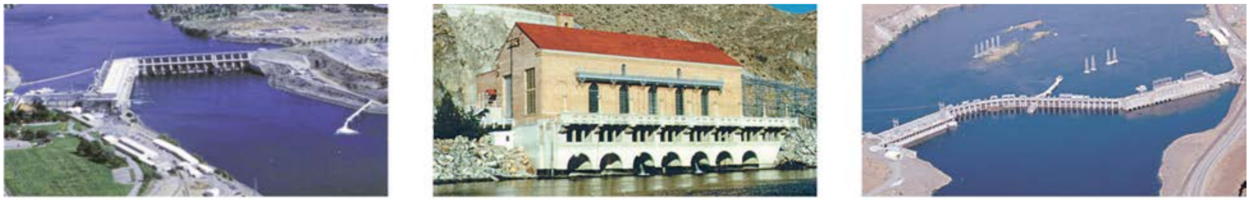

PUBLIC UTILITY DISTRICT NO. 1 of CHELAN COUNTY
P.O. Box 1231, Wenatchee, WA 98807-1231 • 327 N. Wenatchee Ave., Wenatchee, WA 98801
(509) 663-8121 • Toll free 1-888-663-8121 • www.chelanpud.org

April 9, 2021

VIA ELECTRONIC FILING

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Re: **Rocky Reach Hydroelectric Project No. 2145**
Article 10 – Annual Report of Activities under the Anadromous Fish Agreement and Habitat Conservation Plan for Calendar Year 2020

Dear Secretary Bose:

The Public Utility District No. 1 of Chelan County hereby submits the attached annual progress report regarding activities under the Anadromous Fish Agreement and Habitat Conservation Plan (HCP). The Rocky Reach HCP requires preparation of an annual progress report that describes progress toward achieving the performance standard of No Net Impact (NNI) for each Plan Species. The NNI standard consists of two components: 1) providing a minimum of 91% combined adult and juvenile project survival; and 2) up to 9% compensation for unavoidable project mortality provided through hatchery and tributary programs.

The progress report fulfills Article 10 of Appendix B of the License[1] and Section 4.8 of the HCP by describing results of studies, agreements and decision made in 2020 for both components of NNI. A copy of this report is also being submitted to the National Marine Fisheries Service.

If you have any questions or requests for additional information, please contact Lance Keller at (509) 661-4299, or me.

Sincerely,

Jeffrey G. Osborn
Senior License Compliance Specialist
jeff.osborn@chelanpud.org
(509) 661-4176

[1] *Public Utility District No. 1 of Chelan County*, 126 FERC ¶ 61,138 (Feb. 19, 2009) (Order on Offer of Settlement and Issuing New License).

cc: Lance Keller, Chelan PUD
Erich Gaedeke, FERC
Scott Carlon, NMFS
HCP Coordinating Committee
HCP Hatchery Committee
HCP Tributary Committee

Attachments Annual Report, Calendar Year 2020, of Activities under the Anadromous Fish Agreement and Habitat Conservation Plan


Photograph courtesy of Chelan PUD

April 2021
Rocky Reach Hydroelectric Project FERC License No. 2145

Annual Report Calendar Year 2020 Activities Under the Anadromous Fish Agreement and Habitat Conservation Plan

Prepared for Federal Energy Regulatory Commission

April 2021
Rocky Reach Hydroelectric Project FERC License No. 2145

Annual Report Calendar Year 2020 Activities Under the Anadromous Fish Agreement and Habitat Conservation Plan

Prepared for
Federal Energy Regulatory Commission
888 First Street Northeast
Washington, DC 20426

Prepared by
Anchor QEA, LLC
1201 3rd Avenue, Suite 2600
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Project Number: 200034-01.01
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ABBREVIATIONS

BiOp	Biological Opinion
BY	brood year
CCD	Cascadia Conservation District
CCNRD	Chelan County Natural Resources Department
CCT	Colville Confederated Tribes
CF	Cascade Fisheries
cfs	cubic feet per second
Chelan PUD	Public Utility District No. 1 of Chelan County
COVID-19	coronavirus disease 2019
CRITFC	Columbia River Inter-Tribal Fish Commission
CWT	coded wire tag
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FH	fish hatchery
gpm	gallons per minute
GSHP	General Salmon Habitat Program
GSI	gonadosomatic index
HxH	hatchery-by-hatchery
HCP	Habitat Conservation Plan
M&E	monitoring and evaluation
MSRF	Methow Salmon Recovery Foundation
NMFS	National Marine Fisheries Service
NNI	No Net Impact
ONA	Okanagan Nation Alliance
PIT	passive integrated transponder
Plan Species	species addressed in the Habitat Conservation Plan
PNI	proportionate natural influence
PRCC	Priest Rapids Coordinating Committee
QC	quality control
RI	Rock Island
RM	river mile
RR	Rocky Reach
RRJFBS	Rocky Reach Juvenile Fish Bypass System
RRS	relative reproductive success
SOA	statement of agreement
SRFB	Salmon Recovery Funding Board

TU	Trout Unlimited
UCR	Upper Columbia River
UCSRB	Upper Columbia Salmon Recovery Board
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
W	Wells Plan Species Account
WDFW	Washington Department of Fish and Wildlife
YN	Yakama Nation

1 Introduction

On June 21, 2004, the Federal Energy Regulatory Commission (FERC) approved an Anadromous Fish Agreement and Habitat Conservation Plan (HCP) for the Rocky Reach Hydroelectric Project (Rocky Reach – FERC License No. 2145) on the Columbia River in Washington State, operated by Public Utility District No. 1 of Chelan County (Chelan PUD). The HCP provides a comprehensive and long-term adaptive management plan for meeting a No Net Impact (NNI) goal for species addressed in the Habitat Conservation Plan (Plan Species) and their habitat. This document fulfills Article 10 of Appendix B and Section 9.8 of Appendix E of the FERC License issued on February 19, 2009[1], and Section 4.8 of the HCP, which requires annual reporting of progress toward achieving the NNI goal. Responsibilities toward achieving the NNI goal are described in Section 3 of the HCP, and in a 10-year Comprehensive Report assessing overall status of NNI (HCP Coordinating Committees 2013),[2] as well as successive 10-year intervals, in common understandings based upon completed studies, including those conducted as research and development for NNI progress or those not considered valid due to extenuating circumstances (Section 5.2.3 of the HCP).

The signatories of the Mid-Columbia HCPs (HCPs for the Wells, Rocky Reach, and Rock Island hydroelectric projects) meet as combined Coordinating Committees, Hatchery Committees, and Tributary Committees to expedite the process of overseeing and guiding HCP implementation. Minutes from the 2020 monthly meetings are compiled in Appendix A (HCP Coordinating Committees), Appendix B (HCP Hatchery Committees), and Appendix C (HCP Tributary Committees). The HCP Policy Committees provide a forum for discussing issues and resolving disputes that are either elevated to or arise in the HCP Coordinating Committees and remain unresolved. In 2020, the HCP Policy Committees convened to discuss Columbia River Inter-Tribal Fish Commission's (CRITFC's) annual request to tag Sockeye Salmon at Wells Dam, as further described in Section 3.2 and Appendix D. Appendix E lists members of the Rocky Reach HCP Committees. The Rocky Reach HCP Coordinating Committee oversaw the preparation of this 17th Annual Report, which covers the period from January 1 to December 31, 2020. (The 1st through 16th Annual Reports covered the periods January 1 to December 31, 2004, through 2019, respectively.)

[1] 126 FERC, paragraph 61,138 (2009)

[2] Public Utility District No. 1 of Chelan County – Natural Resources Department, 2013. *Rock Island and Rocky Reach Anadromous Fish Agreements and Habitat Conservation Plans 2013 Comprehensive Progress Report*. February 2013.

2 Progress Toward Meeting No Net Impact

The Rocky Reach HCP requires preparation of an Annual Report that describes progress toward achieving the performance standard of NNI for each Plan Species. The NNI standard consists of two components: 1) 91% combined adult and juvenile project survival, as achieved by project-improvement measures implemented within the geographic area of the project; and 2) up to 9% compensation for unavoidable project mortality provided through hatchery and tributary programs, with up to 7% compensation provided through hatchery programs and 2% through tributary programs (Section 3.1 of the HCP).

In 2020, Chelan PUD met or exceeded all requirements for NNI under the Rocky Reach HCP for spring migrant HCP Plan Species (spring Chinook Salmon [*Oncorhynchus tshawytscha*], steelhead [*O. mykiss*], Sockeye Salmon [*O. nerka*], and Coho Salmon [*O. kisutch*]). Project survival standards have been exceeded for steelhead, yearling Chinook Salmon, Sockeye Salmon, and Coho Salmon; all of which are currently designated Phase III (Standards Achieved). For subyearling summer/fall Chinook Salmon (a summer migrant and non-Endangered Species Act [ESA]-listed Plan Species), considerable life history variability and limited technology constrain the ability to meaningfully estimate project survival (Section 2.1.1). As a result, subyearling summer Chinook Salmon are designated as Phase III (Additional Juvenile Studies[3]) and will continue to be compensated through the Tributary Conservation and Hatchery Compensation Plans at levels consistent with the guidance provided in the HCP. As established in Section 3.1 of the HCP, the inability to estimate survival due to limitations of technology shall not be construed as a success or a failure to achieve NNI.

Chelan PUD provided funding and hatchery facility capacity to meet the hatchery compensation component of NNI. Recalculated NNI production levels for all Plan Species were agreed on in 2011 within the HCP Hatchery Committees, and implementation began with the 2014 release year and will continue for the next 10 years (release years 2014 through 2023). Additionally, Chelan PUD funded the Tributary Conservation Plan's Plan Species Account at the level established in the HCP ($229,800 in 1998 dollars; see Table 1 and Section 2.3).

[3] The current phase designation will be re-evaluated in 2022.

Table 1
Rocky Reach Habitat Conservation Plan No Net Impact Progress for Plan Species (2020)

HCP Plan Species (ESA Status)	Survival Standard Met	Hatchery Compensation Provided	Tributary Conservation Plan Funded	NNI
Spring Chinook Salmon Yearlings (ESA-listed)	Yes – Combined Adult and Juvenile	Yes	Yes	Yes
Steelhead (ESA-listed)	Yes – Combined Adult and Juvenile	Yes	Yes	Yes
Sockeye Salmon (Not Listed)	Yes – Combined Adult and Juvenile	Yes	Yes	Yes
Summer/Fall Chinook Salmon (Not Listed)	Phase III (Additional Studies)	Yes	Yes	Yes – NNI compensation provided, but additional studies required
Coho Salmon (Not Listed)	Phase III (Standards Achieved)	Yes	Yes	Yes

Throughout 2020, the HCP Coordinating, Hatchery, and Tributary Committees reached agreement on numerous issues during meetings in support of achieving the NNI goals, all of which were documented in the meeting minutes or were described in stand-alone statements of agreement (SOAs; Appendix F and G). In 2020, the HCP Policy Committees also convened to discuss CRITFC's annual request to tag Sockeye Salmon at Wells Dam, but no formal Rocky Reach HCP Agreements or Decisions resulted from these discussions (Section 3.2 and Appendix D). All agreements reached among the HCP Committees along with approvals for funding of habitat projects by the Rocky Reach HCP Tributary Committee are summarized in Table 2 and discussed in the remainder of this report.

Table 2
Summary of 2020 Agreements and Decisions for Rocky Reach Habitat Conservation Plan

Date	Agreement	HCP Committee	Reference
January 15, 2020	Agreed to update the PUD's M&E Plan (2019 Update) by appending the written guidance from the panel of agency geneticists developed in 2018	Hatchery	Appendix B
February 25, 2020	Approved the *2020 Rocky Reach and Rock Island HCP Action Plan*	Coordinating	Appendix A and Appendix I
February 25, 2020	Approved the *2020 Fish Spill Plan, Rock Island and Rocky Reach Dams*, as revised	Coordinating	Appendix A and Appendix K

Date	Agreement	HCP Committee	Reference
February 25, 2020	Agreed on the following approach for the 2021 Rocky Reach HCP Confirmation Survival Study species selection: 1) select yearling Chinook Salmon for the juvenile target species; 2) select spring Chinook Salmon to calculate the adult conversion rate; 3) if feasible given the data, conduct a post-hoc analysis of juvenile survival using study fish data segregated by origin ad-present versus ad-clipped yearling Chinook Salmon; and 4) study fish may include fish that have CWTs but not PIT tags	Coordinating	Appendix A
February 25, 2020	Agreed to add Scott Hopkins, the future Chelan PUD HCP Hatchery Committees Alternate, to the HCP Hatchery Committees email distribution list and provide him with access to the HCP Hatchery Committees extranet site	Coordinating	Appendix A
March 18, 2020	Approved the *HCP HCs and PRCC HSC-approved Upper Columbia River 2020 BY Salmon and 2021 BY Steelhead Hatchery Program Management Plan and Associated Protocols for Broodstock Collection, Rearing/Release, and Management of Adult Returns* (2020 Broodstock Collection Protocols)	Hatchery	Appendix B and Appendix N
March 19, 2020	Approved the *2019 Rock Island HCP Annual Report* and *2019 Rocky Reach HCP Annual Report* after no disapprovals were received prior to the 30-day review period deadline	Coordinating	Appendix A
March 24, 2020	Approved the *2020 Fish Spill Plan, Rock Island and Rocky Reach Dams*, as revised	Coordinating	Appendix A and Appendix K
March 24, 2020	Approved the SOA, *Selection of Yearling Chinook and Adult Spring Chinook for Chelan PUD's 2021 Rocky Reach Confirmation Survival Study*	Coordinating	Appendix A and Appendix F
March 24, 2020	Approved the *2019 Biological Evaluation of the Rocky Reach Juvenile Fish Bypass System Final Report*	Coordinating	Appendix A and Appendix L
March 24, 2020	Approved the *2020 Rocky Reach Juvenile Fish Bypass System Operations Plan*	Coordinating	Appendix A and Appendix J
June 11, 2020	Elected to contribute $54,646 to a GSHP proposal from CCNRD titled *Beaver Creek Barrier #040016 Correction Project*	Tributary	Appendix C
June 11, 2020	Elected to contribute $149,020 to a GSHP proposal from CCNRD titled *Nason Kahler Instream Complexity Project*	Tributary	Appendix C
June 23, 2020	Approved the SOA, *Deferment of the Rocky Reach Project Confirmation Survival Study from 2021 to 2022*, as revised	Coordinating	Appendix A and Appendix F
July 15, 2020	Agreed to add Katy Shelby (WDFW Science Staff) to the HCP Hatchery Committees primary email distribution list and provide her with access to the HCP Hatchery Committees extranet site	Hatchery	Appendix B

Date	Agreement	HCP Committee	Reference
July 28, 2020	Agreed to add Katy Shelby to the HCP Hatchery Committees primary email distribution list and provide her with access to the HCP Hatchery Committees extranet site	Coordinating	Appendix A
September 16, 2020	Approved the *Chelan PUD 2021 Hatchery Monitoring and Evaluation Implementation Plan*	Hatchery	Appendix B and Appendix O
October 27, 2020	Approved the *Chelan PUD Rocky Reach and Rock Island HCPs Draft 2020 Fish Spill Report*, as revised	Coordinating	Appendix A and Appendix M
October 27, 2020	Agreed to Chelan PUD's request to begin the 2020/2021 ladder maintenance outage at Rocky Reach Dam 1 month earlier than usual to allow more time to complete required work. Rather than beginning work during the first week in January (per usual), maintenance work will begin on December 1, 2020	Coordinating	Appendix A
November 12, 2020	Elected to contribute $82,145.47 to a GSHP proposal from CCD titled: *Chumstick Baseflow and Riparian Enhancement Project*	Tributary	Appendix C
December 10, 2020	Approved the portions of Douglas PUD's Wells Complex 2021 M&E Plan pertaining to Chelan PUD programs	Hatchery	Appendix B

The following sections summarize the achievements, actions, and activities taken in 2020 specific to project survival and dam operations, hatchery compensation, and funding of tributary habitat protection and restoration projects.

2.1 Project Survival and Dam Operations

2.1.1 Status of Phase Designations for Current Plan Species

A major feature of the Rocky Reach HCP is what is termed a "phased implementation plan" to achieve the survival standards. This approach includes three phases (Phase I, II, and III) and consists of conducting survival studies over multiple years and evaluating the achievement of survival standards, which is needed to proceed to the next phase. Progress through each phase has been described at length in previous HCP annual reports submitted to FERC.

Current phase designations for all Rocky Reach HCP Plan Species are summarized in Table 3.

Table 3
Current Phase Designations for Rocky Reach Habitat Conservation Plan

Plan Species	Project Survival (%)	Phase Designation	SOA Date
UCR Steelhead	94.77[1]	Phase III (Standards Achieved)	January 25, 2013
Okanogan River Sockeye Salmon	92.58[1]	Phase III (Standards Achieved)	January 25, 2013
UCR Yearling Chinook Salmon	92.28[1]	Phase III (Standards Achieved)	August 30, 2011
UCR Subyearling Summer/Fall Chinook Salmon	To Be Determined	Phase III (Additional Juvenile Studies)	September 26, 2019
Coho Salmon	92.94[2]	Phase III (Standards Achieved)	March 30, 2017

Notes:
1. Combined adult and juvenile survival achieved (HCP standard is 91%)
2. Juvenile project survival achieved using surrogacy analysis of direct-measured yearling Chinook Salmon acoustic tag passage survival

Since 2013, the Rocky Reach HCP Coordinating Committee has routinely evaluated available data, study designs, and tag technology to assess the feasibility of conducting a valid survival study on subyearling Chinook Salmon. These evaluations have resulted in three SOAs maintaining subyearling Chinook Salmon in Phase III (Additional Juvenile Studies) for 3 years (approved by the Rocky Reach HCP Coordinating Committee on June 25, 2013, September 29, 2016, and September 26, 2019, respectively). In 2019, the HCP Coordinating Committees also agreed to convene quarterly subyearling Chinook Salmon check-ins to occur during future HCP Coordinating Committees meetings occurring in February, May, August, and November each year, to continue to evaluate or monitor study design, tag technology, and life history information on a quarterly basis to better understand the feasibility of conducting survival studies on subyearling Chinook Salmon in the future.

In 2020, subyearling Chinook Salmon quarterly check-ins were held during the HCP Coordinating Committees meetings on February 25, May 26, August 25, and November 24, 2020. The HCP Coordinating Committees briefly discussed Pacific Northwest National Laboratory's recent award for advancements in tag technology for their Eel and Lamprey Acoustic Tag (or ELAT), which may mean forward progress on tag size and battery duration (both limiting factors for conducting subyearling studies). The HCP Coordinating Committees also briefly discussed the U.S. Army Corps of Engineers Annual Fish Evaluation Program that was held on December 3, 2019; however, there were no new updates on subyearling studies to share. Quarterly check-ins will continue in 2021, and the phase designation for subyearling Chinook Salmon will be revisited in 2022, per the latest SOA.

2.1.2 Assessment of Project Survival

The Rocky Reach HCP requires that Chelan PUD will work toward a 91% combined adult and juvenile project survival at Rocky Reach Dam, which is achieved by project-improvement measures implemented within the geographic area of the project. Progress toward this objective is described in the following sections.

2.1.2.1 Adult Passage Monitoring

When the Rocky Reach HCP was signed in 2002, it was acknowledged there was no scientifically rigorous method for the Rocky Reach HCP Coordinating Committee to assess adult project passage survival for Plan Species. Existing methods did not differentiate between mortality caused by the project and other sources of mortality (e.g., delayed mortality from injuries resulting from passage at downstream projects, injuries sustained by marine mammals, or harvest activities). Section 5.2 of the Rocky Reach HCP states that given the inability to differentiate between the sources of adult mortality, initial compliance with the combined adult and juvenile salmon and steelhead survival standard would be based on the measurement of 93% juvenile salmon and steelhead project survival or 95% juvenile salmon and steelhead dam passage survival, and an adult survival estimate of 98% to 100%.

Beginning in December 2012, Chelan PUD was able to evaluate adult passage survival through the Rocky Reach Project (dam and reservoir) for steelhead and Sockeye Salmon, even though unknown harvest mortality remained in the survival estimates. Passive integrated transponder (PIT)-tag detections from the PIT Tag Information System database were used to evaluate adult fish migrating upstream in 2010, 2011, and 2012 to estimate project conversion rates. For steelhead, adult fish destined for the Methow and Okanogan river systems were used for the survival evaluation. For Sockeye Salmon, adults returning to the Okanogan River Basin were evaluated. The 3-year arithmetic mean survival rates at Rocky Reach Project for adult steelhead and Sockeye Salmon were 98.93% and 98.92%, respectively (Table 4). A year prior, in 2011, Chelan PUD estimated the 3-year mean survival rates for adult spring Chinook Salmon migrating through the Rocky Reach Project. This survival estimate was 99.90% for migration years 2009 through 2011. Chelan PUD will re-evaluate adult passage survival at Rocky Reach in 10-year intervals, as required per the HCP (Section 2.1.2.3).

Juvenile, adult, and combined (juvenile and adult) survival rates at the Rock Island and Rocky Reach projects are presented in Table 4. Adult conversion rates were calculated from adult passage data for the years 2010 through 2012.[4]

The HCP combined adult and juvenile project survival standard is 91%. The HCP combined adult and juvenile project survival estimates apply to fish actively migrating through the Rock Island and

[4] Buchanan, R. A. and J. R. Skalski, 2012. *Estimation of the Adult Salmon and Steelhead Conversion Rates through Rock Island and Rocky Reach Projects, 2010-2012*. Prepared for Public Utility District No. 1 of Chelan County. December 2012.

Rocky Reach projects in the mainstem Columbia River and do not include mortality occurring in other locations (i.e., they do not include ocean or tributary mortality).

Table 4
Habitat Conservation Plan Juvenile, Adult, and Combined Project Survival Rates at Rock Island and Rocky Reach

Project	Species	Juvenile Survival	Adult Survival	Combined[5]
Rock Island	Steelhead	96.75%	99.31%[2]	96.08%
	Spring Chinook Salmon	93.75%[1]	99.89%[3]	93.65%
	Sockeye Salmon	93.27%	98.37%[2]	91.75%
Rocky Reach	Steelhead	95.79%	98.93%[2]	94.77%
	Spring Chinook Salmon	92.37%[1]	99.90%[3]	92.28%
	Sockeye Salmon	93.59%	98.92%[4]	92.58%

Notes:
1. Includes spring-migrating yearling Chinook Salmon.
2. Estimate does not account for fish losses due to recreational harvest in any years.
3. No recreational harvest occurred.
4. Estimate adjusted for fish losses from recreational harvest in 2010 and 2011 but not for harvest losses in 2012.
5. Combined survival is the product of juvenile and adult survival estimates (e.g., 98% × 93% = 91%).

2.1.2.2 Valid Study Flow Duration Curve Update

Section 13.24 of the Rocky Reach HCP requires that as part of the 2013 Comprehensive Review, and every 10 years thereafter, the Rocky Reach HCP Coordinating Committee will update the spring and summer period Flow Duration Curves used to define valid survival studies. The updated Flow Duration Curves must reflect "Representative Flow Conditions," meaning river flows between the 10th and 90th percentiles on the Flow Duration Curve, as calculated from the Grand Coulee Dam daily average outflow. In 2013, efforts began to update the Flow Duration Curve. The HCP Coordinating Committees agreed to develop the updated Flow Duration Curve with the historical 1929 to 1978 and 1983 to 2001 datasets used previously, to which the new 2002 to 2012 dataset was added. For comparison, Flow Duration Curves were also constructed using only the 1983 to 2012 dataset. The HCP Coordinating Committees also agreed to revise the definition of the summer period to comprise June 1 through August 15, compared to the former July 1 through August 15 period. Updated Flow Duration Curves were expected to become final in early 2014; however, in February 2014, a fracture discovered in Wanapum Dam postponed a number of efforts, including updating the curves, until time allows.

In 2019, Chelan PUD and Douglas PUD provided a joint presentation to the HCP Coordinating Committees, which addressed the questions asked by the HCP Coordinating Committees in 2013. The presentation also described approaches to updating the curves, including the following: 1) switching from the Grand Coulee Flow Duration Curves to project-specific curves for the Wells, Rocky Reach, and Rock Island projects; 2) using a rolling average of the most recent 30 years to calculate the curves, such that 10 years from now, 10 years of new data will be added to the dataset and the older 10 years of data will be removed; and 3) including the month of June in the summer Flow Duration Curves. After discussing these proposed updates at length, notably about whether the proposed time frames were representative of Plan Species run timing and normal river flow conditions, the Rocky Reach HCP Coordinating Committee approved the SOA, *Updated Flow Duration Curves for the Rocky Reach Project for Establishing Representative Flow Conditions* (as appended to the *2019 Rocky Reach HCP Annual Report*), which included all three proposed approaches to updating the curves.

On June 23, 2020, the Rocky Reach Coordinating Committee agreed to defer the 2021 Rocky Reach HCP Survival Confirmation Study for 1 year from 2021 to 2022. Therefore, these updated Flow Duration Curves will be used to establish environmental criteria for the 2022 Rocky Reach Survival Confirmation Study that will begin implementation in April 2022.

2.1.2.3 2020 Survival Studies

No survival studies were conducted at the Rocky Reach Project in 2020; however, throughout 2020, the Rocky Reach HCP Coordinating Committee continued evaluating the feasibility of studying subyearling summer Chinook Salmon survival as stipulated in the SOA. This resulted in an SOA maintaining subyearling summer Chinook Salmon in Phase III (Additional Juvenile Studies) for another 3 years (through September 2022) that was approved on September 26, 2019 (Section 2.1.1).

The Rocky Reach HCP Coordinating Committee also continued planning for the upcoming Rocky Reach Survival Confirmation Study, which in early 2020, was scheduled to be implemented jointly with the 2021 Rock Island Survival Confirmation Study. In January 2020, the Rocky Reach and Rock Island HCP Coordinating Committees discussed the selection of a study species, including the feasibility of studying each Plan Species and risks to the respective stocks; the ability to collect and tag wild-origin fish; and collecting sample size targets to meet precision requirements. The Committees also discussed that fish previously PIT-tagged cannot be used due to additional handling biases. Based on data reviewed on February 25, 2020, the Rocky Reach and Rock Island HCP Coordinating Committees agreed on the following approach for the respective survival confirmation studies species selections: 1) select yearling Chinook Salmon for the juvenile target species; 2) select spring Chinook Salmon to calculate the adult conversion rate; 3) if feasible given the data, conduct a post-hoc analysis of juvenile survival using study fish data segregated by origin (ad-present versus ad-clipped yearling Chinook Salmon); and 4) study fish may include fish that have coded wire tags (CWTs) but not PIT tags. On March 24, 2020, the Rocky Reach and Rock Island HCP Coordinating Committees approved the respective SOAs, *Selection of Yearling Chinook and Adult Spring Chinook for Chelan PUD's 2021 Rocky Reach Confirmation Survival Study* (Appendix F) and *Selection of Yearling Chinook and Adult Spring Chinook for Chelan PUD's 2021 Rock Island Confirmation Survival Study*.

Throughout 2020, Chelan PUD continued providing monthly updates on the ongoing turbine unit maintenance at Rock Island and Rocky Reach dams, which had been prioritized based on having specific units in service for the respective survival confirmation studies planned for each project (Section 2.1.3.2). On May 26, 2020, Chelan PUD notified the Rock Island and Rocky Reach HCP Coordinating Committees that impacts of coronavirus disease 2019 (COVID-19), had delayed unit maintenance (including the return-to-service dates for Turbine Units C3 and C4 at Rocky Reach Dam) such that conditions at the start of the Survival Confirmation Study in April 2021 would not be representative of Rocky Reach Dam operations for the next 10-year period following the evaluation. The Rock Island and Rocky Reach HCP Coordinating Committees began discussing deferment of the 2021 Rocky Reach Survival Confirmation Study to 2022, while keeping the 2021 Rock Island Survival Confirmation Study on schedule for implementation in April 2021. The Committees determined that although combining the projects provides efficiencies from an implementation standpoint, resolution of the data for both the Rock Island and Rocky Reach projects would not change should the studies be conducted together or separately. The Committees discussed that the projects were originally planned to be studied in separate years (Rock Island Project in 2020 and Rocky Reach Project in 2021); however, in 2018, the Rock Island HCP Coordinating Committee approved a 1-year deferment of the Rock Island Survival Confirmation Study (as described in the *2018 Rock Island HCP Annual Report*). Lastly, the ongoing turbine unit maintenance at Rock Island Dam will be in a status to allow for the most optimal testing of that project in 2021. Therefore, on June 23, 2020, the Rocky Reach HCP Coordinating Committee approved the SOA, *Deferment of the Rocky Reach Project Confirmation Survival Study from 2021 to 2022*, as revised (Appendix F), and the Rock Island HCP Coordinating Committee moved forward with planning the 2021 Rock Island Survival Confirmation Study for implementation in April 2021.

2.1.3 Project Operations and Improvements

This section summarizes project operations and progress toward maintaining the juvenile project survival standard at Rocky Reach Dam in 2020. Actions in 2020 were guided by the *2020 Rocky Reach and Rock Island HCP Action Plan* (Appendix I), as approved by the Rocky Reach and Rock Island HCP Coordinating Committees on February 25, 2020 (Appendix A).

2.1.3.1 Operations

2.1.3.1.1 *Juvenile Bypass System and Fish Spill Operations*[5]

At Rocky Reach Dam, juvenile fish spill operations are guided by two documents. The Rocky Reach and Rock Island HCP Coordinating Committees approved both the *2020 Rocky Reach Juvenile Fish Bypass System Operations Plan* (Appendix J) and the *2020 Fish Spill Plan, Rock Island and Rocky Reach Dams*, as revised (Appendix K) on March 24, 2020. The Rocky Reach Juvenile Fish Bypass System (RRJFBS) operated continuously from April 1 through August 31, 2020, which covered the normal bypass operating period for the out-migration of juvenile salmon and steelhead at Rocky Reach Dam.

The *2019 Rocky Reach Juvenile Fish Bypass System Report* (Appendix L), which summarizes activities at the RRJFBS in 2019, was approved by the Rocky Reach HCP Coordinating Committee on March 24, 2020.

Spill for summer-migrating subyearling Chinook Salmon at Rocky Reach Dam began on May 23, 2020, at 0001 hours and continued uninterrupted for 95 days through 2400 hours on August 25, 2020. The target spill level for the duration of the summer spill period in 2020 was 9% of the estimated daily average river flow, as specified and approved in the *2020 Fish Spill Plan, Rock Island and Rocky Reach Dams*, as revised (Appendix K). Spill volume for the 95-day summer period averaged 24.19% of the total river flow and comprised 8.93% fish spill and an additional 15.26% unavoidable hydraulic spill. The Columbia River flow rate past Rocky Reach Dam during the spill period averaged 163,054 cubic feet per second (cfs), and the daily average spill rate was 39,436 cfs. Following completion of the bypass operations on August 31, 2020, it was estimated that spill was provided for 98.7% of the subyearling Chinook Salmon out-migration passing Rocky Reach Dam.

Complete Rocky Reach Dam 2020 fish spill operations results are summarized in the *Chelan PUD Rocky Reach and Rock Island HCPs Final 2020 Fish Spill Report*, as revised (Appendix M), which was approved by the Rocky Reach and Rock Island HCP Coordinating Committees on October 27, 2020.

2.1.3.1.2 *Pikeminnow Predator Control*

Chelan PUD has implemented a Northern Pikeminnow (*Ptychocheilus oregonensis*) predator-control program in the Rocky Reach Project since 1994. Since 1996, the Chelan PUD has contracted annually with the U.S. Department of Agriculture (USDA) to carry out this program. Chelan PUD also provides funding for the annual Pikeminnow Derby sponsored by the East Wenatchee Rotary Club.

Complete results from the 2019 removal effort were summarized in the *2019 Rock Island HCP Annual Report* and are described in the *2019 Rock Island and Rocky Reach Pikeminnow Control Program Summary Report*, which is expected sometime in early 2021. The 2020 USDA hook-and-line angling

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[5] 129 FERC ¶ 62,183 (issued December 8, 2009). Order Modifying and Approving Operations Plan Pursuant to License Article 402.

program commenced during the peak of the juvenile salmonid migration. The total combined harvest of Northern Pikeminnow in 2020 from Rocky Reach and Rock Island reservoirs was 77,851 fish. Harvest numbers from the various control efforts in 2020 were as follows: USDA hook-and-line angling, 54,526 fish; Columbia Research long-line angling, 19,520 fish; East Wenatchee Rotary Club Pikeminnow Derby, 2,887 fish; and removal by Chelan PUD Fish and Wildlife personnel, 918 fish.

In 2020, Chelan PUD continued implementing the Northern Pikeminnow removal program with Columbia Research long-line angling during the pre-migration period to target large pikeminnow that stage in deep reservoir areas and are difficult to capture with other gear types. A report summarizing results of the 2020 removal effort is expected sometime in early 2021.

2.1.3.1.3 *Rocky Reach Dam Large Unit Temporary Blade Configuration*

In 2013, Rocky Reach Dam Turbine Units C8, C9, C10, and C11 were modified from their normal Kaplan configuration to a temporary, fixed blade configuration as an interim measure while permanent repairs are fabricated and installed on these four large units (Section 2.1.3.2.2). An interim operating angle of 31 degrees was selected because it is the most hydraulically efficient angle at full turbine discharge of 23,000 cfs. The 31-degree angle is the safest angle for fish passage (due to it being hydraulically efficient), and it represents the safest position of the blades because at this angle cavitation is minimized and the risk of a turbine runaway is lowest. In 2020, maintenance continued on the large units with return-to-service dates targeted for the first quarter of 2023.

2.1.3.1.4 *Rocky Reach Dam Turbine Unit C1 Outage*

In 2018, Rocky Reach Dam Turbine Unit C1 was taken offline to investigate an oil leak and mechanics discovered a loss of oil from the unit hub via the trunnion seals. Turbine Unit C1 remained offline through 2019 while Rocky Reach Dam mechanics worked on repairing the unit, including waiting on receipt of parts from vendors that were needed to repair the unit (Section 2.1.3.2.3).

In early 2020, the remaining parts needed to repair Turbine Unit C1 were received, the unit was watered up and tested, and on March 16, 2020, Turbine Unit C1 was returned to service for operation.

2.1.3.1.5 *Rocky Reach Dam Turbine Unit C2 Outage*

In late 2019, Rocky Reach Dam Turbine Unit C2 was taken offline due to a possible failure of the internal servo rod seal. However, due to concurrent maintenance activities, mechanics were unable to investigate this issue and Turbine Unit C2 remained offline for the remainder of 2019 (Section 2.1.3.2.5).

In 2020, maintenance work on Turbine Unit C2 was delayed due to impacts of COVID-19; however, repairs were made, recommissioning of the unit was underway by December 2020, and the unit was returned to service on December 23, 2020.

2.1.3.1.6 *Rocky Reach Dam Turbine Unit C3 Outage*

In 2019, Rocky Reach Dam Turbine Unit C3 was taken offline due to leaking trunnion seals. The Rocky Reach HCP Coordinating Committee discussed changes in attraction flow in the cul-de-sac area of the Rocky Reach Dam forebay with both Turbine Units C1 and C3 offline and potential impacts to juvenile and adult yearling Chinook Salmon survival performance at Rocky Reach Dam. The Rocky Reach HCP Coordinating Committee reviewed an analysis conducted by Drs. John Skalski and Richard Townsend (Columbia Basin Research) that reviewed juvenile survival data under three scenarios. The purpose of the analysis was to demonstrate how reallocating juvenile yearling Chinook Salmon passage and route-specific survival from the surface collector and the juvenile intake screens to turbine passage routes might translate into changes in juvenile project survival estimates and the 91% combined juvenile/adult survival metric for Plan Species outlined in the Rocky Reach HCP. This analysis found a slight reduction in collection efficiency, but the project would still meet the survival standard for Plan Species.

Throughout 2019 and 2020, maintenance and repair activities continued on Turbine Unit C3, including removing and returning the unit from and to service for routine inspections (Section 2.13.2.5). The current return-to-service date for Turbine Unit C3 is scheduled for May 2021.

2.1.3.1.7 *Rocky Reach Dam Turbine Unit C7 Outage*

In 2020, Rocky Reach Dam Turbine Unit C7 was taken offline for repairs as scheduled; however, impacts of COVID-19 delayed the return-to-service date from September 2020 to mid-November 2020. In addition, damage to the Kaplan tube during its removal further delayed the return-to-service date of Turbine Unit C7 to March 2021.

2.1.3.1.8 *Juvenile Fish Bypass System Pre-Season Marked Fish Releases*

The RRJFBS is used for monitoring the physical condition of fish and species composition. Chelan PUD also uses the facility to evaluate seasonal run timing for target species. Each year, Chelan PUD conducts pre-season marked fish releases at the RRJFBS to test the system for possible descaling, injury, or mortalities prior to the start of the bypass season, which begins on April 1 at 0000 hours. Test fish are fin-clipped to differentiate between release locations, released into the system, recovered at the sampling facility, and visually inspected, and the results are tallied.

On March 19, 2020, Chelan PUD conducted pre-season marked fish releases in the RRJFBS and juvenile intake screen system deployed in Rocky Reach Dam Turbine Unit C1. A total of 100 fish were released into the north and south entrances each, and 99 fish were recovered from each release.

A release of marked fish into Unit C1 was also conducted under higher-velocity conditions, and 98 of the 100 fish released were recovered. No signs of descaling or injury were observed during any of the releases. Additionally, in 2020 Chelan PUD, Douglas PUD, and Biomark conducted a joint study of the detection efficiency of PIT-tag arrays installed at the RRJFBS in 2010 in the surface collection structure using PIT-tagged fish. Detection efficiency associated with these tests was equal to or greater than 92%. A complete report summarizing 2020 activities at the RRJFBS is expected in 2021.

2.1.3.2 Improvements and Maintenance

Facility improvements and maintenance at the Rocky Reach Project in 2020 that had the potential to affect Plan Species are described in this section.

2.1.3.2.1 *2019/2020 Rocky Reach Adult Fish Ladder Winter Maintenance*

The upper adult fishway at Rocky Reach Dam was taken offline for annual winter maintenance on December 16, 2019, and the lower adult fishway was taken offline on January 9, 2020. The entire adult fish ladder was returned to service on February 18, 2020. Activities beyond general maintenance included the installation of larger fish viewing windows in the upper portion of the adult fish ladder.

Following the fish rescues associated with the 2018/2019 winter maintenance outage, Washington Department of Fish and Wildlife (WDFW) expressed interest in collecting any unique species encountered during the fish rescues to determine the source. During the 2019/2020 winter maintenance outage, there were no unique species encountered or collected during fish salvage activities at Rocky Reach Dam. Chelan PUD and WDFW will coordinate, as needed, prior to conducting fish rescues at Rocky Reach Dam in future years.

2.1.3.2.2 *Rocky Reach Dam Large Unit Repair*

In 2013, while repairing internal hydraulic issues in Rocky Reach Dam Turbine Unit C10, mechanic crews discovered a deep hairline crack in a stainless-steel rod that delivers oil to the servo motor. Rocky Reach Dam Turbine Units C8, C9, and C11 all have the same stainless-steel rod design as part of the servo motors. During the 2013/2014 winter maintenance outage, interim fixes were installed on Units C8, C9, C10, and C11 (Section 2.1.3.1.2). In 2015, permanent fixes were initiated on Turbine Unit C10. Repairs were anticipated to require 6 months per unit and were projected to be completed by 2019, pending any additional unforeseen delays. In 2016, head-cover issues were identified in Unit C8, and cracks were identified in the wheels of the bridge crane required to hoist the turbines for repair. In December 2017, Turbine Unit C8 was repaired and returned to service in February 2018. In 2019, due to delays in recommissioning Turbine Unit C1 (Section 2.1.3.2.3), the return-to-service date for Turbine Unit C9 was postponed from fall 2019 to February 2020.

In January 2020, recommissioning of Turbine Unit C9 was completed earlier than anticipated and the unit was returned to service. In February 2020, due to the development of trunnion seal issues in the small units at Rocky Reach Dam, Chelan PUD decided to change the turbine unit repair schedule. Rather than addressing one small unit and one large unit simultaneously, the small units will be recommissioned first to be completed prior to and in time for the 2021 survival confirmation study. This new plan maintains Turbine Units C10 and C11 in operation until Turbine C10 is addressed in December 2021 and Turbine Unit C11 is addressed in February 2022, with both units scheduled to be returned to service by the first quarter of 2023.

2.1.3.2.3 *Rocky Reach Dam Turbine Unit C1 Repair*

In 2018, Rocky Reach Dam Turbine Unit C1 was taken offline to investigate an oil leak (Section 2.1.3.1.4). Mechanics discovered a loss of oil from the unit hub via the trunnion seals. New replacement stock trunnion seals were received, installed, and tested; however, the new stock seals failed to stop oil from leaking from the unit hub. Chelan PUD investigated hydraulically locking the blades into place; however, engineers were not confident that operating in a hydraulically locked configuration would not result in an oil leak with a failed trunnion seal. Chelan PUD Board of Commissioners approved entering into a sole-source contract to design and manufacture engineered trunnion seals for Turbine Unit C1 at Rocky Reach Dam. The engineered trunnion seals were installed and tested; however, they failed to stop oil from leaking from the unit hub. This led Rocky Reach Dam mechanics to believe the issue may be leaky trunnion seals due to trunnion bushing wear. In 2019, disassembly of Turbine Unit C1 began to replace the trunnion bushing; however, repairs were postponed due to delayed delivery of necessary components for repair from the vendors.

In early 2020, the wicket gate servo control unit needed for Turbine Unit C1 was finally received from the vendor and the unit was watered up for testing in mid-February 2020. On March 16, 2020, Turbine Unit C1 was returned to service for operation.

2.1.3.2.4 *Rocky Reach Dam Turbine Unit C2 Repair*

In late 2019, Rocky Reach Dam Turbine Unit C2 was taken offline to investigate small traces of oil observed in the tailrace. Mechanics believed the issue was a failure of the internal servo rod seal causing over-pressurization of the turbine hub; however, an assessment of the issue was delayed because crews and equipment (headgates) were addressing Turbine Units C1 (repairs), C3 (seals), C7 (vibration issues), and C9 (repairs).

In January 2020, Rocky Reach Dam mechanics began assessing the status of the servo rod seals in Turbine Unit C2; however, impacts of COVID-19 resulted in multiple schedule delays for all turbine unit maintenance activities at Rocky Reach Dam. Throughout 2020, crews replaced servo rod seals, trunnion bushings, and trunnion seals, as well as performed a general unit overhaul. In

September 2020, crews were able to start the final stages of preparing the unit for commissioning, and by December 2020, the commissioning of Turbine Unit C2 was underway. Turbine Unit C2 was returned to service on December 23, 2020.

2.1.3.2.5 *Rocky Reach Dam Turbine Unit C3 Repair*

In early 2019, Rocky Reach Dam Turbine Unit C3 was taken offline for an inspection, and mechanics discovered more than 5 gallons of water inside the hub. The engineered seals designed for Rocky Reach Dam Turbine Unit C1 were installed in Turbine Unit C3, the unit was pressurized, and the seals did not work. Mechanics implemented the same evaluation process as was done for Turbine Unit C1, including considering hydraulically locking the blades into place, manufacturing new trunnion seals, and possibly using a compound that is injected into the hub to improve the seal and allow the blades to continue to operate in a Kaplan configuration. New engineered Chesterton seals and a second set of trunnion seals were installed and tested in Turbine Unit C3, and inspections showed that the second set of new trunnion seals performed best. Therefore, Turbine Unit C3 was returned to service operating with the second set of new trunnion seals.

In late 2019, Turbine Unit C3 was taken offline for inspection, and mechanical crews detected a weeping seal where oil was observed on the blade. In early 2020, in consultation with Italian engineers, Chelan PUD began moving forward with hydraulically locking the blades into place, including developing new blade angles and the information needed for unit testing. In February 2020, Turbine Unit C3 was returned to service with the blades in the hydraulically locked configuration and using the governor system to maintain blade angle. Throughout 2020, Turbine Unit C3 was on a 3-week inspection schedule to ensure oil from the governor system was not escaping from the hub or that river water was not migrating into the governor oil system. In September 2020, crews began the overhaul of Turbine Unit C3, including it receiving a trunnion bushings replacement. The current return-to-service date for Turbine Unit C3 is scheduled for May 2021.

2.1.3.2.6 *Rocky Reach Dam Turbine Unit C7 Repair*

In 2020, crews began overhauling Turbine Unit C7, including trunnion bushing replacement as scheduled; however, progress was delayed due to impacts of COVID-19. The repair schedule was further delayed due to damages to the Kaplan tube during its removal and the procurement process for a replacement part. The return-to-service date for Turbine Unit C7 is now March 2021.

2.1.3.2.7 *Rocky Reach Dam Visitor's Center Renovation*

During the 2019/2020 winter maintenance outage at Rocky Reach Dam, contractors broke ground on the remodel of the Rocky Reach Dam Visitor's Center, beginning with the installation of new windows in the fish viewing area. Renovations that include a new exhibit center continued throughout 2020. Completion of the Visitor's Center renovation is tentatively set for June 2021.

2.1.3.2.8 *2020/2021 Rocky Reach Adult Fish Ladder Winter Maintenance*

On October 27, 2020, the Rocky Reach HCP Coordinating Committee agreed to Chelan PUD's request to begin the 2020/2021 ladder maintenance outage at Rocky Reach Dam 1 month earlier than usual to allow more time to complete the required work. This includes replacing a large dewatering pump for the lower section of the fishway and completing the routine preventative maintenance that is required each year. On December 1, 2020, the adult fish ladder at Rocky Reach Dam was taken offline for annual winter maintenance. The ladder will be back to service by February 28, 2021.

A fish rescue was performed in the upper portion of the adult fish ladder on December 1, 2020, and in the lower portion of the adult fish ladder on December 9, 2020, prior to maintenance activities in the respective areas. All fish rescued were alive and released in the Rocky Reach Dam forebay.

2.2 Hatchery Compensation

Section 8.1 of the Rocky Reach HCP describes a Hatchery Compensation Plan with two primary objectives: 1) to provide compensation for Plan Species and 2) to implement specific elements of the hatchery program consistent with the overall objectives of rebuilding natural populations and achieving NNI. In 2020, Chelan PUD continued to provide funding and capacity for hatchery production consistent with meeting NNI. Recalculated hatchery production values required to meet NNI through release year 2023 were approved by the Rocky Reach HCP Hatchery Committee on December 14, 2011, and represented in *Chelan PUD's No Net Impact and Inundation Obligations for Release Years 2014–2023*. Hatchery compensation for the Rocky Reach Project in 2020 included the release of 1,268,513 juvenile salmonids (combined Rocky Reach and Rock Island hatchery compensation; Table 5).

In June 2015, the HCP Hatchery Committees agreed to convene joint sessions of the HCP Hatchery Committees and Priest Rapids Coordinating Committee (PRCC) Hatchery Sub-Committee when discussing agenda items applicable to and requiring participation from both Committees. These practices benefit the HCP Hatchery Committees through increased coordination and sharing of expertise. The Grant PUD representatives have no voting authority under the HCPs; however, because these joint discussions influence similar and sometimes overlapping hatchery programs, those discussions are documented and included here, accordingly. The HCP Hatchery Committees and PRCC Hatchery Sub-Committee continued holding joint sections of meetings in 2020 when agenda items pertained to both sets of Committees. In May 2019, the HCP Hatchery Committees and PRCC Hatchery Subcommittee agreed to a common set of meeting protocols; shared support and facilitation staff; and a single set of email lists for distributing meeting materials to further improve efficiency among the Committees—a process that continued in 2020. This coordination and joint process will continue in 2021.

2.2.1 Hatchery Production Summary

Table 5 summarizes and compares HCP hatchery production objectives and actual 2020 smolt releases.

Table 5
2020 Production Level Objectives and Smolt Releases for Rocky Reach Habitat Conservation Plan Hatchery Programs

Species[1]	Program	Final Rearing Site	Rocky Reach Production Level Objectives (2014 to 2023)[2,3]	Total Releases for Rocky Reach in 2020 (Number of Fish)
Spring Chinook Salmon	Methow	Chewuch Acclimation Facility	60,516	65,581 smolts
Summer Chinook Salmon	Chelan Falls	Chelan Falls Acclimation Facility	576,000	620,280 smolts
Steelhead	Wenatchee	Chiwawa Acclimation Facility	247,300[4]	218,307 smolts
Sockeye Salmon	Okanogan	kł cp̓əlk̓ stim̓ Hatchery	591,050[5] (34% of kł cp̓əlk̓ stim̓ Hatchery production)	218,002 fry
Spring Chinook Salmon	Okanogan	Chief Joseph Hatchery	115,000 (12.81% of Chief Joseph Hatchery production)	15,374 smolts[6]
Summer Chinook Salmon	Okanogan	Chief Joseph Hatchery /Omak Pond	94,570 (13.51% of Chief Joseph Hatchery production)	76,436 subyearlings
Summer Chinook Salmon	Okanogan	Similkameen Acclimation Facility	166,569 (12.81% of Chief Joseph Hatchery production)	54,533 yearlings

Notes:

1. Coho Salmon mitigation met by the funding agreement with the YN.
2. As specified in the Rocky Reach and Rock Island HCP Hatchery Committees SOA Chelan PUD Hatchery Compensation, Release Years 2014 to 2023, approved December 14, 2011.
3. Chelan PUD is responsible for providing the capacity and funding to meet the Rocky Reach and Rock Island HCPs hatchery compensation requirements.
4. Steelhead production at Chiwawa Acclimation Facility includes Rock Island and Rocky Reach obligations.
5. Combined with the Rocky Reach HCP, the Okanogan Sockeye Salmon production requirement totals 591,050 smolts (production is allocated between the two HCPs); the table includes the number of fry released. By agreement of the HCP Hatchery Committees, this production requirement is satisfied for Okanogan Sockeye Salmon by funding of the Skaha and Lake Sockeye Salmon reintroduction program through release year 2021.
6. A catastrophic infrastructure failure at Chief Joseph Hatchery resulted in reduced smolt production for BY 2018; the failed infrastructure has subsequently been remedied.

2.2.2 Hatchery Planning and Implementation

This section details the actions taken in 2020 that are relevant to planning for hatchery operations that support the HCP.

2.2.2.1 2020 Broodstock Collection Protocols

In late 2019 and early 2020, the HCP Hatchery Committees engaged in early discussion and editing of the 2020 Broodstock Collection Protocols (Appendix N) to address programmatic changes not dependent on run size predictions in advance of the initial annual draft protocols for review. The Committees also shared authorship among permit holders, which includes WDFW and the PUDs.

In February 2020, the HCP Hatchery Committees began their review of the Draft 2020 Broodstock Collection Protocols for Chinook Salmon and steelhead. The revised draft protocols were unanimously approved by WDFW, Chelan PUD, Douglas PUD, National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), the Colville Confederated Tribes (CCT), and the Yakama Nation (YN) on March 18, 2020. The final 2020 Broodstock Collection Protocols were distributed to the HCP Hatchery Committees on March 19, 2020, and implemented at program hatcheries throughout 2020. As in previous years, the 2020 Broodstock Collection Protocols guide the collection of salmon and steelhead broodstock in the Methow River, Wenatchee River, Chelan River, and Columbia River. The protocols are consistent with previously defined program objectives such as program operational intent (i.e., conservation or harvest augmentation) and mitigation production levels (i.e., HCPs), and they comply with ESA permit provisions.

Similarly, beginning in September 2020, a list of Broodstock Collection Protocols Discussion Topics for 2021 was developed that identified lead authors for given topics and specified meeting dates for those topics to be discussed (Appendix B).

2.2.2.1.1 *Alternative Broodstock Composition and Mating Strategies*

During the development of the 2019 Broodstock Collection Protocols in early 2019, the potential consequences of not including jacks (age-3 fish) in broodstock was raised as a topic of concern, especially when low numbers of age-4 and older fish are available for broodstock collection. The purpose of conservation programs is to conserve and rebuild populations, minimize negative ecological impacts, conserve diversity, and minimize negative genetic impacts. However, ideal conditions are rarely met, and artificial selection is inevitable in hatchery propagation and due to selectivity of fisheries. Douglas PUD developed a literature review on alternative methods for broodstock mating regimes for consideration by the HCP Hatchery Committees. It was suggested that the current mating approach should be modified by including jacks at a predetermined rate based on natural occurrence and contributions to spawning and to pair mates based on size. Douglas PUD suggested implementing some elements of the new approaches in the Methow Fish Hatchery (FH) program to test the feasibility in the field and inform hatchery managers of the desire to improve practices. Discussions will continue in 2021 as methods are further developed.

2.2.2.1.2 *Calculating Broodstock Collection Targets*

During the development of the 2019 Broodstock Collection Protocols, the idea of providing ranges around broodstock collection targets, rather than providing a single numerical target, was proposed. In 2019, Douglas PUD presented an approach for modeling production targets using basic broodstock calculation that includes several factors such as pre-spawn survival and fecundity. Briefly, a stochastic model was presented that identifies the factors driving the selection for the number of females in a given year (e.g., fecundity) and estimates the required number of broodstock to meet program targets with ranges of uncertainty. The model allows for the estimation of the number of females needed, but also the likelihood of achieving program targets to prevent collecting too many or too few fish. The utility of the method is to formally provide estimates of uncertainty in identifying broodstock collection targets so that managers can make more informed decisions in the probability of meeting targets. It also allows managers to make in-season adjustments with greater confidence. In 2020, Douglas PUD worked with WDFW to implement the method with a focus on preparing content for the 2021 Broodstock Collection Protocols.

In 2020, the HCP Hatchery Committees used the geometric mean instead of the arithmetic mean when calculating broodstock collection targets in order to minimize the effect of outliers in datasets. It was acknowledged that this approach is only valid when all values are positive; that is, when zeros occur in a dataset, the calculation must be adjusted, and any adjustments to the calculation should be noted.

2.2.2.1.3 *Differentiating Natural-Origin Okanogan River Spring Chinook Salmon from Natural-Origin Methow Basin Spring Chinook Salmon*

During the development of the 2019 Broodstock Collection Protocols, it was determined that a method for differentiating natural-origin Okanogan River spring Chinook Salmon during the collection of Methow FH broodstock at Wells Dam will be needed beginning in 2021, the first year that 4-year-old fish originating from the new Okanogan program would return over Wells Dam. The CCT would like to prevent fish from the Okanogan River from becoming incidentally collected for Methow FH broodstock at Wells Dam, though some would be able to ascend Wells Dam if trapping is not in operation every day at both ladders. Currently, spring Chinook Salmon collected for broodstock at Wells Dam are screened genetically to identify fish of Methow River or Twisp River origin. However, the program to reintroduce spring Chinook Salmon to the Okanogan River Basin uses fish from the Methow River Basin. Therefore, there is likely to be little genetic differentiation. Possible methods for differentiating between the two stocks were discussed, focusing specifically on the use of elemental signature analysis on scales in an expedient manner while holding broodstock. A need was identified to begin collecting scales from wild yearling smolts known to originate from the Okanogan River Basin during PIT-tagging or snorkel surveys to establish a baseline for the elemental signature of the Okanogan River compared to the Methow River. It is unknown whether there are natural differences in the isotopic signal between the Methow and Okanogan rivers that could be distinguished from analysis of the scales; however, results are encouraging from otolith studies used to differentiate Similkameen/Okanogan summer Chinook Salmon from mainstem Columbia River summer/fall Chinook Salmon. The CCT are currently exploring whether there are sufficient differences in water chemistry among spring Chinook Salmon rearing tributaries. It was confirmed with Tim Lindley (Pacific Northwest National Laboratories) that scales could be analyzed within season; however, this approach may be cost prohibitive.

In 2020, the CCT agreed to develop a probabilistic model of encountering Okanogan spring Chinook Salmon at Wells Dam to inform the decision process, recognizing that there is lower resolution of spawner estimates and in-basin production compared to the Methow River due to survey limitations. The CCT also agreed to develop a protocol and cost estimate for scale elemental analysis for spring Chinook Salmon collected at Wells Dam, to be presented to the HCP Hatchery Committees in 2021.

2.2.2.1.4 *Wenatchee River Steelhead and Salmon*

In past years, Broodstock Collection Protocols were written to ensure broodstock were collected throughout the return year. In 2020, run forecasts to the Wenatchee Basin were low, and it was suggested that opportunities to collect broodstock be maximized by collecting on all days and at all sites available and a high proportion of early returning fish be retained in a manner that would not be normally advocated but would be a prudent action to avoid under-collecting later in the season. Revisions to the Broodstock Collection Protocols were retained from 2019 to state that, in the Wenatchee Basin, trapping at Dryden Dam Traps and Tumwater Dam could be carried out simultaneously for summer Chinook Salmon, summer steelhead, and Coho Salmon.

2.2.2.1.5 *Chelan Falls Summer Chinook Salmon*

In the 2019 Broodstock Collection Protocols, the Wells Dam Volunteer Trap and instream collection via temporary picket weir and beach seining in the Chelan River Habitat Channel were identified as sources for summer Chinook Salmon brood used in the Chelan Falls summer Chinook Salmon program. Due to safety concerns, the Chelan River Canal Trap previously used to collect broodstock was deemed infeasible to operate without major modifications. Chelan PUD alternatively prioritized collection at the Wells Dam Volunteer Trap in 2019 while simultaneously piloting collection within the Chelan River Habitat Chanel using a temporary weir and beach seining in the Chelan Falls spawning channel. In January 2020, Chelan PUD summarized the results of this effort for the HCP Hatchery Committees. Collection efforts in the Chelan River using a temporary weir were successful in 2019, and the collection target of 200 fish from the Chelan River was met with comparable fecundity and bacterial kidney disease status to the 380 fish collected at Wells FH. Comparisons of fry quality between the two groups were monitored into early 2020. One ongoing concern is the timing of fish collected at Wells FH is several weeks earlier than in the Chelan River because weir operation is not permitted to begin until July 15.

Based on positive early results of the pilot trapping, Chelan PUD and WDFW prepared an approach for 2020 (that was approved by the HCP Hatchery Committees) to collect 186 adults at Wells FH and 200 adults in the Chelan River. In addition, language was added to the 2020 Broodstock Collection

Protocols to equitably and flexibly manage the allocation of Wells FH surplus fish in-season, so they are allocated earlier in the season when fish are of higher quality for spawning or consumption, while also allowing for collection of broodstock for the Chelan Falls program later in the run to better match the timing of collection in the Chelan River.

However, in July of 2020, it was determined that due to delays in fabrication of a new temporary weir and trap box associated with COVID-19 restrictions, the Chelan River Weir would not be operational until the third week of July; therefore, Chelan PUD entered into an Interlocal Agreement with Douglas PUD to collect all of the broodstock needed for the Chelan Falls program (386 fish) from the Wells Dam Volunteer Trap in 2020. The trap was not piloted in 2020 because enough brood were collected from the Wells Dam Volunteer Trap and installing the trap presented a risk due to COVID-19. The long-term objective for the Chelan Falls program remains to collect broodstock within the Chelan River, and collection at Wells Dam is considered a short-term backstop.

2.2.2.1.6 *Yakima Summer Chinook Salmon Program*

In 2020, Chelan PUD and the YN entered into a service agreement that allowed the YN to use space at Chelan PUD's Eastbank Hatchery to hold and spawn surplus summer/fall Chinook Salmon collected at Wells Dam or Chelan River and to transfer green eggs to the YN facilities in the Yakima River basin in Prosser, Washington. Questions were raised about whether temperature of the water pumped from the local aquifer would be appropriately cold for holding broodstock at Eastbank Hatchery during this time of the year because this had been a concern in the past. Chelan PUD reported that Eastbank Hatchery has been recharging the Eastbank Aquifer with cold water in February and March over the past 3 years with 5,000 gallons per minute (gpm) of extra water to counterbalance high water temperatures in late summer and fall, and this has proven effective. In addition, adequate water supply is available; switching to circular re-use tanks and reducing flow rates to an appropriate flow index for holding Chinook Salmon allows for the use of 300 gpm, or only 1% of Eastbank Hatchery's water right.

2.2.2.1.1 *Methow Spring Chinook Salmon Broodstock Collection*

In 2019, projected run sizes for Upper Columbia River spring Chinook Salmon were near historical lows, and managers shared concerns that broodstock collection targets may not be met. The HCP Hatchery Committees approved proposals to collect broodstock from multiple locations where adult fish may be encountered in order to take advantage of fish in hand. It was agreed that wild adult spring Chinook Salmon encountered at Wells Dam Volunteer Trap would be retained, identified genetically to the tributary of origin, and transported to Methow River FH for broodstock, based on the assumptions that they are likely to be returning to the Methow River and may not be recaptured in the Methow if returned to the mainstem river.

The retention of wild spring Chinook Salmon was again implemented in 2020 because the run size projections were again very low, nearly identical to 2019. Managers trapped aggressively at Wells Dam in 2020 in order to meet broodstock targets, while remaining below the 33% retention limit for Methow River natural-origin spring Chinook Salmon.

Adequate numbers of adult spring Chinook Salmon were obtained at Methow FH for the Methow and Chewuch programs in 2020, using mostly natural-origin fish, with small numbers of hatchery-origin fish incorporated to meet targets. One female fish from the Methow-Chewuch program was incorporated into the Twisp River program to achieve the target of eight pairs of natural-origin spawners.

2.2.2.2 2020 Rearing and Release Strategies

2.2.2.2.1 *Wenatchee Steelhead Release Plan 2018–2020*

The permit for the Wenatchee steelhead programs includes a special condition to minimize residualism and maximize downstream survival, so Chelan PUD and WDFW drafted a 3-year release plan with the following objectives: 1) evaluate survival based on size at release to optimize hatchery practices; 2) evaluate rearing vessels; 3) minimize confounding variables; and 4) use data to assess monitoring and evaluation (M&E) objectives. In March 2018, the HCP Hatchery Committees approved the *Wenatchee Steelhead Release Plan (Brood Years 2017 to 2019)*. The plan is a 3-year study beginning with the 2018 release year (brood year [BY] 2017).

In early 2018 (Section 2.2.2.2.1.1), as part of the 3-year release plan, Chelan PUD prepared a study that used PIT tags to evaluate residualism. In order to reduce the number of covariates and PIT tag enough steelhead to evaluate residualism, Chelan PUD requested approval to not transfer a proportion of the steelhead overwintered at Chiwawa Acclimation Facility to Blackbird Pond for final acclimation in January 2018, before the final plan was developed. The HCP Hatchery Committees discussed the draft plan and the proposed transfer and approved Chelan PUD's request to move approximately 25,000 hatchery-by-hatchery (HxH) steelhead, destined for final acclimation at Blackbird Pond, from the enzyme-linked immunosorbent assay pond to Raceway 2 at the Chiwawa Acclimation Facility and forego final acclimation at Blackbird Pond in 2018 to 2020. Results from the 3-year release plan will be provided in 2021.

2.2.2.2.1.1 Establishing Baseline Residualism Conditions in the Wenatchee Steelhead Program

The Wenatchee steelhead permit also requires Chelan PUD and WDFW to minimize residualism and maximize downstream migration of steelhead. Because NMFS does not direct the permit holders on how to determine baseline conditions for residualism or downstream migration, Chelan PUD developed the draft *Methodology for Establishing Baseline Conditions in the Wenatchee Steelhead Program* that the HCP Hatchery Committees reviewed in March 2018. Options to measure residualism included a PIT-tag evaluation, post-release sampling, and an electrofishing and angling study. The HCP Hatchery Committees discussed the options and methods for estimating rates of residualism, as well as sampling ideas and statistical approaches. The Hatchery Evaluation Technical Team met to discuss the draft plan in addition to the Hatchery Committees. Based on feedback from the HCP Hatchery Committees and the Hatchery Evaluation Technical Team, Chelan PUD indicated they intend to complete a PIT-tag evaluation and use gonadosomatic index (GSI) sampling to assess maturation. Only the lethal, post-release, GSI sampling required approval from the HCP Hatchery Committees, which was provided in April 2018. The PIT-tag study and GSI sampling occurred in 2018, 2019, and 2020 as described in the draft *Methodology for Establishing Baseline Conditions in the Wenatchee Steelhead Programs* plan. Results will be provided in 2021.

2.2.2.2.1.2 Wenatchee Steelhead Surplus and Precocial Maturation Study

In November 2018, WDFW and Chelan PUD notified the HCP Hatchery Committees that there was an overage in the Wenatchee steelhead program of approximately 21,000 excess HxH BY 2018 steelhead, which were destined for isolated ponds along Rock Island Reservoir. Chelan PUD developed a plan to study the effects of temperature regime on early maturation using 1,500 of the excess fish. Discussions with steelhead experts at National Oceanic and Atmospheric Administration yielded a recommendation to apply different temperature regimes to overwintering fish to evaluate whether transferring fish to the Chiwawa Acclimation Facility and rearing steelhead on colder water in November may be contributing to early maturation. Chelan PUD decided to rear 500 steelhead in each of three different locations (Eastbank Hatchery, Chiwawa Acclimation Facility, and Chelan Hatchery) with different temperature regimes at similar densities through early March, then transfer all 1,500 fish to the Chiwawa Acclimation Facility where final rearing occurs. The fish were lethally sampled in June 2019 to evaluate the effects of temperature regimes on precocial maturation using GSI sampling. The HCP Hatchery Committees discussed the overage and provided feedback on the study plan, particularly regarding what other data will be collected in addition to GSI sampling. Results will be provided in 2021.

2.2.2.3 Hatchery Monitoring and Evaluation Plan Implementation

2.2.2.3.1 *Hatchery Monitoring and Evaluation Plan – 2019 Update*

Chelan PUD hatchery M&E programs are operated in accordance with the *Monitoring and Evaluation Plan for PUD Programs.* The HCP Hatchery Committees revised the population genetics component of the plan (Objective 7) in 2019, as described in the 2019 Rocky Reach HCP Annual Report. A previous major revision was conducted in 2017 (to the *Monitoring and Evaluation Plan for PUD Programs – 2013 Update)*, as described in the 2017 Rocky Reach HCP Annual Report. The 2020 Hatchery M&E Implementation Plan (Section 2.2.2.3.3) was based on the Hatchery M&E Plan – 019 Update.

2.2.2.3.2 *Hatchery Monitoring and Evaluation Implementation Plan*

The *Chelan County PUD Hatchery Monitoring and Evaluation Implementation Plan* is prepared annually to describe the M&E activities for the next calendar year. In August 2020, the HCP Hatchery Committees were provided a draft Annual M&E Implementation Plan for review. Changes from the previous version included clarifying electrofishing methods for sampling Chiwawa spring Chinook Salmon parr in the fall and permit requirements for precocial maturation sampling for the summer Chinook Salmon programs. The Rock Island and Rocky Reach HCP Hatchery Committees approved the *Chelan PUD 2021 Hatchery M&E Implementation Plan* (Appendix O) on September 16, 2020, following a 30-day HCP Hatchery Committees review period. The Rocky Reach HCP Hatchery Committee also approved the portions of Douglas PUD's Wells Complex 2021 M&E Plan pertaining to Chelan PUD programs on December 10, 2020 (Appendix B).

The 2020 Hatchery M&E Implementation Plan was previously approved in September 2019 and was implemented in 2020.

2.2.2.3.3 *Hatchery Monitoring and Evaluation Plan Reporting*

In September 2020, the Chelan PUD 2019 Hatchery M&E Plan Report, titled *Monitoring and Evaluation of the Chelan and Grant County PUDs Hatchery Programs 2019 Annual Report,* which documented M&E activities in 2019 (Appendix P), was finalized following a 30-day HCP Hatchery Committees review period.

In addition, Chelan PUD began working with the HCP Hatchery Committees in 2016 to develop a long-term scheduling plan to logically orchestrate HCP requirements and M&E reporting, including annual and 5-year statistical reports, and the 10-year Comprehensive Review (Rocky Reach HCP: Section 8.7). The *Final M&E Reporting Schedule for the PUD Hatchery Programs,* finalized in March 2017, describes the content and function of each report and development and due dates through 2052.

Per the reporting schedule, the first draft of the 10-Year Comprehensive M&E Report was initially scheduled to be completed by December 31, 2020. Chelan PUD has been working with Douglas PUD, Grant PUD, and other entities since 2018 to assemble data to inform the analyses required for the Comprehensive Report. In April 2020, Chelan PUD, Douglas PUD, and Grant PUD provided an update to the HCP Hatchery Committees and PRCC Hatchery Sub-Committee on the status of the 10-Year Comprehensive M&E Report. The approach to developing the report is to assign a lead to each chapter, who then assembles and analyzes data and works with local experts and co-authors to review the results. Some of the chapters may be prepared as journal articles. Once the draft chapters are prepared, they will be assembled into reports for each species and provided to the Committees for review. Due to staffing limitations related to COVID-19, the WDFW genetics laboratory was not able to complete genetic sampling as scheduled; thus, drafts including genetic analyses were not completed in 2020. Further delays related to COVID-19 and staffing constraints meant that it took longer than planned to obtain reference data. In October 2020, Chelan PUD, Douglas PUD, and Grant PUD communicated to the Committees that the Draft 10-Year Comprehensive M&E Report will be provided for review by July 1, 2021.

2.2.2.3.4 *Independent Scientific Advisory Board Recommendations*

In 2017 and 2018, the Independent Scientific Advisory Board reviewed habitat assessment, research and monitoring, and prioritization and coordination of recovery actions for spring Chinook Salmon in the Wenatchee, Entiat, and Methow basins. Their final report, *Review of Spring Chinook Salmon in the Upper Columbia River*,[6] includes several recommendations pertaining to the Hatchery M&E Plan and its appendices. In February 2018, the HCP Hatchery Committees discussed the report and requested that Dr. Tracy Hillman (Chair of the HCP Hatchery Committees) begin updating the M&E Plan and its appendices and analyses as needed.

Dr. Hillman worked on this task throughout 2018 and 2019, reporting back to the Committees regularly with updates. To date, his review has focused on the statistical analyses in Appendix H of the M&E Plan to compare the productivity of paired treatment streams with hatchery supplementation programs and control streams without hatchery supplementation programs. Improved statistical modeling of the treatment and control comparisons was performed and the methods were reviewed externally by Dr. Barb Downes (University of Melbourne) and Dr. Carl Schwartz (Simon Fraser University, retired). Updates to the plan and its appendices will continue in 2021 after the 10-year Comprehensive Review is completed.

2.2.2.3.5 *Genetic Analyses for Habitat Conservation Plan Program Species*

The M&E Plan specifies genetic analyses, which should occur at 10-year intervals in order to examine the potential for changes in genetic diversity of natural populations as a result of hatchery programs. In 2016, the HCP Hatchery Committees recognized the need to reconsider the genetic sampling intervals and scheduling for HCP program species. From 2016 through 2020, the HCP Hatchery Committees explored approaches for this genetic analysis.

In 2018, a review was prepared including a draft timeline for sample collection, analyses, and reporting to meet all monitoring objectives, and potential approaches to updating sampling intervals. The HCP Hatchery Committees also recognized the need to identify a baseline genetic period for each program, because hatchery programs change over time, especially broodstock.

The HCP Hatchery Committees sought input from a panel of geneticists from multiple agencies to ensure that genetic analyses and reporting completed as part of hatchery M&E answer appropriate genetic questions for each program. The panel responded with consensus answers to the

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6 Independent Scientific Advisory Board, 2018. Review of Spring Chinook Salmon in the Upper Columbia River. ISAB 2018-1. February 9, 2018. Available at: https://www.nwcouncil.org/sites/default/files/ISAB%202018-1UpColSpringChinookReview10AprilUPDATE.pdf.

HCP Hatchery Committees' questions about genetics M&E in the memorandum, *Response to questions posed by the HCP Hatchery Committees regarding the PUD M&E Plan*.

In 2019, after reviewing the recommendations and conclusions of the panel, the HCP Hatchery Committees added analysis of linkage disequilibrium to the Hatchery M&E Plan as a metric of genetic status. The genetic monitoring objectives were also revised to incorporate testing of statistical hypotheses for natural-origin baseline samples and natural-origin contemporary samples every 10 years. They also revised the hypotheses in the plan to compare contemporary natural-origin fish to contemporary hatchery-origin fish and the natural-origin fish baseline. Hypotheses were added to the genetic monitoring objectives for equivalence testing approaches in addition to the standard null-hypothesis testing approaches based on suggestions from the Independent Scientific Advisory Board and M&E Plan authors. Revisions emphasized the importance of putting the significance of genetic analysis results in context of a biologically meaningful effect size, and that hypotheses for sampling hatchery-origin fish should be program-specific based on aspects of a program (such as genetics, stray rate, and productivity) that affect how the hatchery population affects the natural population. After completion of the 10-year Comprehensive Review, more information will be available to refine the hypotheses.

The HCP Hatchery Committees updated the Hatchery M&E Plan (referred to as the 2019 Update) with revisions to Objective 7 on December 24, 2019. In January 2020, the HCP Hatchery Committees agreed to append the *Response to questions posed by the HCP Hatchery Committees regarding the PUD M&E Plan* from geneticists to the M&E Plan-2019 Update. The genetic analyses and statistical and equivalence testing described in the revisions will be implemented for samples collected in 2020 and future years.

2.2.2.3.6 *Improving Homing in the Methow Basin: Adult Outplanting Plan*

In 2016, the HCP Hatchery Committees designed a pilot management plan to address Objective 5 (regarding homing and straying of hatchery fish) of the Hatchery M&E Plan. The intent of the plan is to augment the number of adults spawning naturally by translocating hatchery-origin fish to areas adjacent to juvenile acclimation sites in upstream tributaries, and to ultimately determine the efficacy of outplanting adults by comparing the number of returns resulting from outplanted adults to those resulting from acclimation of juveniles. The HCP Hatchery Committees approved the Final Outplanting Adults Plan in April 2017 and intended to implement the study in 2017. However, the translocation study did not occur in 2017, 2018, or 2019 because the spring Chinook Salmon runs were small and no surplus hatchery-origin adults were available for translocation. In 2019, the HCP Hatchery Committees reconsidered the intent of translocating adult fish in years of low abundance. Given that runs may continue to be too small to implement the plan as written, alternative perspectives were discussed for prioritizing the productivity of natural spawning with outplanted fish over filling hatchery broodstock with natural-origin spawners, and to consider habitat capacity and improving productivity in reaches with low spawner densities by outplanting fish. Outplanting surplus eggs in artificially constructed redds in areas of low spawner densities was also suggested. The approaches would be treated as experimental until methods can be proven feasible and repeatable in the future. In March of 2020, WDFW prepared a retrospective analysis of the years in which an adequate number of fish returned to be able to implement the outplanting plan, while still maintaining proportionate natural influence (PNI) targets in hatchery broodstock, as stipulated by hatchery program permits. It was determined that the return size would have been large enough only in 1995 and 1996. The HCP Hatchery Committees discussed the implications of relaxing PNI targets to allow for more fish to be translocated to spawn naturally, yet it was determined this would require reconsultation with NMFS to evaluate these actions, as they were not assessed in their Biological Opinion (BiOp). They discussed that the PNI target is intended to be met by a 5-year average; however, if the hatchery program experiences a high proportion of hatchery-origin spawners in only 1 or 2 years, they would still risk falling below the program's PNI target. The HCP Hatchery Committees agreed to remove references to a specific plan from the 2020 Broodstock Collection Protocols. As in the previous 3 years, no surplus Methow Composite spring Chinook Salmon were available for outplanting in 2020. A revised outplanting plan will be presented by WDFW in early 2021 for further discussion.

2.2.2.3.7 *Marking and Tagging Pre-Release Assessment*

In April 2020, Chelan PUD, Douglas PUD, and Grant PUD identified issues during monthly in-hatchery sampling at the Carlton Acclimation Facility, with adipose fin marking and CWT tagging done by the WDFW Marking Division at Eastbank Hatchery in 2019. Fish that were supposed to be ad-clipped had "bad clips," which is defined as a fish retaining 25% or more of the adipose fin after clipping. Chelan PUD's Fish and Wildlife staff followed WDFW's quality control (QC) protocol to conduct a QC assessment on all programs marked at Eastbank Hatchery in 2019 to estimate a bad clip rate during the annual pre-release sampling. Pre-release assessments to estimate the bad clip rate were conducted for the Wenatchee steelhead (safety net), Nason spring Chinook Salmon (safety net), Wenatchee summer Chinook Salmon, Chelan Falls summer Chinook Salmon, and Methow summer Chinook Salmon programs. The bad clip rate ranged from 13.6% for the Chelan Falls summer Chinook Salmon program to 27.8% for the Wenatchee summer Chinook Salmon program. The Committees discussed potential issues arising from a high bad clip rate. Due to the presence of CWTs in hatchery-origin fish, broodstock collection is unlikely to be impacted by a high bad clip rate. One potential issue is the inclusion of safety net fish in conservation programs when intending to include HxH fish, depending on the run size. The Committees also discussed the QC protocols for clipping. WDFW staff indicated that more QC steps are being added to identify problems with enough time to address them before clipping is complete.

2.2.2.4 Okanogan Sockeye Salmon Mitigation

In 2020, Chelan PUD provided a 15th year of funding for a portion of the Okanagan Nation Alliance's (ONA's) Skaha and Okanagan Lake Sockeye Salmon Reintroduction Program (the current hatchery production obligation for Okanogan Sockeye Salmon mitigation is a combined 591,050 smolts for Rocky Reach and Rock Island HCPs). Chelan PUD funding contributed to the construction of the kł cp̓əlk̓ stim̓ Sockeye Salmon Hatchery in Penticton, British Columbia, which was completed in September 2014. Per the 2010 SOA, Chelan PUD funding contributes to operation and maintenance of the hatchery and to the M&E program through the release of the 2020 brood. In June 2015, the hatchery held its first official fish release of roughly 1.7 million fry, mostly in Shingle Creek, and some in Okanagan Lake as part of a ceremonial ONA release. The hatchery was designed to support up to an 8-million-egg program; however, the plumbing system initially installed supported a production capacity of 5 million eggs. The egg-take goal of 5 million eggs was achieved for the first time in 2016. In spring 2020, the hatchery released roughly 641,182 fry (Chelan PUD's proportion was 218,002 fry) into Skaha Lake.

2.2.2.4.1 *Annual Skaha and Okanagan Lake Sockeye Salmon Reintroduction Updates*

The HCP Hatchery Committees and PRCC Hatchery Sub-Committee are updated annually on the status of the Skaha and Okanagan Lake Sockeye Salmon Reintroduction Program. The 2020 annual update was provided during the January 2021 Hatchery Committees meeting.

2.2.2.4.2 *Comprehensive Program Review*

In 2020, Chelan PUD initiated discussions with the HCP Hatchery Committees about the future of Chelan PUD's mitigation obligation for the Skaha and Okanagan Lake Sockeye Salmon Reintroduction Program. In 2010, the HCP Hatchery Committees agreed that Chelan PUD would cofund (along with Grant PUD) the Skaha and Okanagan Lake Sockeye Salmon Reintroduction Program, operated by the ONA, in order to meet the PUDs' mitigation goals. The 2010 SOA terminates with the release of the 2020 brood, prompting Chelan PUD to review the success of the program and consider its future. In June 2020, Chelan PUD provided a draft SOA, *SOA Regarding Chelan PUD's Okanagan Sockeye Obligation and Status of the Reintroduction Program* (Appendix B) that requested the following: 1) approval that the Reintroduction Program had been successful; 2) agreement that the mitigation goal is to continue to establish natural production and significant new habitats; 3) Chelan PUD and Grant PUD will fund and support the M&E program and the hatchery operations; and 4) the Committees agree the PUDs' funding and implementation of the Reintroduction Program from 2020 to 2031 meets the PUDs' NNI Sockeye Salmon obligation. The Committees discussed the draft SOA in June and August 2020, and upon further coordination determined that two SOAs would be more appropriate. The first SOA would establish the success of the Reintroduction Program after a comprehensive review of existing data. The second SOA would determine any mitigation for the programs moving forward. In November 2020, Chelan PUD and

Grant PUD provided a library of documents related to the Skaha Lake and Okanagan Lake Reintroduction Programs for the Committees to review in preparation for the program review. In December 2020, Chelan PUD, Grant PUD, and the ONA provided a summary of the comprehensive program review of the Skaha and Okanagan Lakes Sockeye Salmon Reintroduction Program. The program review will be conducted in early 2021 and both SOAs are anticipated in early 2021 as well.

2.2.2.5 ESA Consultation and Permitting

There are current ESA Section 10 permits for the Rocky Reach HCP Hatchery programs.

2.2.2.5.1 *Wenatchee Steelhead*

On October 30, 2015, NMFS issued a BiOp on the Wenatchee River Summer Steelhead Hatchery Program. On November 27, 2017, USFWS, in coordination with NMFS, issued a BiOp for the impact of Wenatchee River programs on Bull Trout, including the Chiwawa spring Chinook Salmon, Wenatchee steelhead, and Wenatchee summer Chinook Salmon programs on November 27, 2017. NMFS issued Section 10 (a)(1)(A) Permit No. 18583 to WDFW, Chelan PUD, and the YN (as an authorized agent of Chelan PUD) on December 26, 2017. The permit expires on December 31, 2027.

2.2.2.5.2 *Methow Spring Chinook Salmon*

NMFS issued the final permits for the combined Methow spring Chinook Salmon programs, including Permit 20533 for Chelan PUD, in February 2017, and they will expire in December 2027.

2.2.2.5.3 *Chelan Falls Summer Chinook Salmon*

The final environmental assessment and Section 10 ESA permits for the Chelan PUD summer Chinook Salmon programs were finalized and signed in September 2019 and will expire in 2030.

2.2.2.6 Wenatchee Steelhead Relative Reproductive Success Study

The Rocky Reach HCP, Section 8.5.3, requires that Chelan PUD fund and implement a steelhead relative reproductive success (RRS) study. The Wenatchee steelhead RRS Study began in 2008 and incorporated data from each subsequent BY to 2011. The study objective was to measure the RRS of hatchery-origin steelhead in the natural environment and determine the degree to which any differences in reproductive success between hatchery- and natural-origin steelhead can be explained by measurable biological characteristics.

In September 2015, WDFW and NMFS presented to the HCP Hatchery Committees the results of the Wenatchee steelhead RRS Study. In summary, many differences in life history traits were detected between hatchery and natural fish; however, there were no apparent differences in spawn timing. Additionally, spawning distribution was similar. HxH broodstock male and female fish had the lowest RRS. Hatchery-by-wild broodstock male and female fish had an RRS between those of HxH broodstock and wild-by-wild broodstock. Wild-by-wild male and female fish had almost indistinguishable RRS from wild fish, though the RRS had greater variance between years. Size and season also contributed to variation in RRS among individuals. An SOA documenting the completion of the steelhead RRS study will be brought to the HCP Hatchery Committee in 2021.

2.2.2.7 Multispecies/Expanded Acclimation

In the interest of developing a long-term, multispecies/acclimation plan for Upper Columbia River (UCR) Salmon mitigation programs, in January 2013, the Joint Fisheries Parties developed a plan outlining multispecies acclimation options for UCR Salmon and steelhead mitigation programs. Methow spring Chinook Salmon and Coho Salmon are acclimated at the Goat Wall Acclimation Site and Chewuch Pond.

2.2.2.8 Adult Prophylactic Disease Management Plan for Eastbank Fish Hatchery Complex Spring and Summer Chinook Salmon Programs (2018 to 2020)

In 2018, WDFW distributed an Adult Prophylactic Management Plan for Eastbank FH Complex spring and summer Chinook Salmon programs in 2018-2020 to the HCP Hatchery Committees. The WDFW reviewed the plan, which includes a trend away from using antibiotics in prophylactic treatments. The HCP Hatchery Committees discussed which aspects of fish health are the purview of the Committees and the importance of communication between fish health staff at different hatcheries and agencies. The initial plan was approved by the HCP Hatchery Committees and implemented in 2018. It was also proposed that the plan be incorporated as an appendix to the Broodstock Collection Protocols in future years.

In 2019, Chelan PUD and WDFW staff revised the plan and included it as Appendix I of the 2019 Broodstock Collection Protocols (Appendix N to this report), *2018-2020 Brood year Adult Prophylactic Disease Management Plan for Eastbank Fish Hatchery Complex Spring and Summer Chinook Hatchery Programs*. The HCP Hatchery Committees approved the plan during approval of the Broodstock Collection Protocols in 2019 and in 2020. The goals of the plan are to ensure integrated or recovery programs make the most efficient use of natural-origin broodstock and maximizing natural-origin spawners while minimizing handling and unnecessary activities. The plan describes the proposed methods, including the timing and approach for prophylactic treatment, PIT-tagging strategies, and the program-specific plans for the current BY.

In 2021, WDFW and Chelan PUD will evaluate results to determine if modifications are needed for BY 2021 and will revise the plan.

2.2.2.9 Marking Surplus Fish

During discussions about the development of the 2021 Broodstock Collection Protocols, the HCP Hatchery Committees began discussing whether fish in excess of production needs should be marked before being released into non-anadromous waters. The Committees will continue discussing the marking strategy for surplus fish in 2021.

2.2.2.10 Meeting Logistics

The HCP Hatchery Committees and PRCC Hatchery Sub-Committee continued holding joint sections of meetings in 2020 when agenda items pertain to both sets of Committees. Both Committee groups continued to operate under shared meeting facilitation and support services with shared distribution lists, meeting protocols, and meeting minutes in 2020.

2.2.2.11 Effects of COVID-19 on Hatchery Planning and Production

The COVID-19 pandemic posed unanticipated challenges to successful implementation of Chelan PUD hatchery programs in 2020. Activities at Chelan PUD facilities were conducted according to local, state, and federal guidance to protect the safety of staff on site. Policies implemented limited the number of staff that could be on site and restricted access to facilities.

State and federal COVID-19 restrictions had some effects on timing and logistics of HCP activities. The WDFW Molecular Genetics Laboratory experienced a delay in processing genetic samples, which affected the timing of the 10-Year Comprehensive M&E Report (Section 2.2.2.3.6). It was also difficult for Chelan PUD, Douglas PUD, and Grant PUD to solicit reference data for use in the 10-Year Comprehensive M&E Report, which affected the analysis and draft timeline.

Manufacturing delays related to COVID-19 delayed the installation of the temporary weir in the Chelan River in 2020 for broodstock collection. It was ultimately not installed due to brood being successfully collected at the Wells Dam Volunteer Trap and risks related to COVID-19 during installation.

Operations at the lower Wenatchee River traps were halted in March and April 2020 for approximately 3 weeks due to safety concerns related to the COVID-19 pandemic. The stoppage will be a data gap in smolt trapping data, but the gap did not occur during the peak out-migration. This may affect the precision of out-migration estimates in 2020 and will be discussed in the 2020 Hatchery M&E Annual Report.

Spawning surveys in the Wenatchee River for steelhead were not able to be conducted in 2020 due to the COVID-19 pandemic. A combination of radio-telemetry data and PIT-tag data will be used to estimate the number of spawners in the mainstem Wenatchee River.

Chelan PUD contractors require access to the Priest Rapids off-ladder adult fish trap to conduct PIT-tagging of adult steelhead. Due to the COVID-19 pandemic, access to the off-ladder adult fish trap was occasionally denied in October 2020, resulting in 8 missed days of steelhead PIT-tagging in the middle of the season. The PIT-tagging effort also ended early due to concerns about COVID-19.

2.2.3 Maintenance and Improvements

2.2.3.1 Chelan Fish Hatchery Rehabilitation Design

In 2015, a rehabilitation feasibility study began for the Chelan FH Building, which is more than 60 years old. Rehabilitation is planned for the existing hatchery building, including the offices, incubation, early rearing, and ancillary functions. No program changes are proposed at this time. The feasibility study continued in 2016 and will be finalized in 2021.

2.2.3.2 Blackbird Pond

In 2020, Chelan PUD sold the infrastructure at Blackbird Pond, in Leavenworth, Washington, to the City of Leavenworth. Blackbird Pond was previously used as a final acclimation site for Wenatchee steelhead but was no longer needed after in-basin acclimation began at the Chiwawa Acclimation Facility. In November 2020, Chelan PUD notified the HCP Hatchery Committees of the sale and provided a summary of steelhead acclimation activities in the Wenatchee Basin since the construction of Blackbird Pond in 2001 to present. The pond would have required costly improvements to the intake and riverbank armoring to continue to use it for in-basin acclimation. The biological benefit of these improvements was determined to be low because Chiwawa Acclimation Facility is effective for acclimating juvenile steelhead.

2.3 Habitat Conservation Plan Tributary Committees and Plan Species Accounts

As outlined in the Rocky Reach HCP, the signatory parties each designated one member to serve on the HCP Tributary Committee. The Rock Island, Rocky Reach, and Wells HCP Tributary Committees meet on a regularly scheduled basis as a collective group to enhance coordination and minimize meeting dates and schedules. Subject items requiring decisions are voted on in accordance with the terms outlined in the specific HCPs. During 2020, the Rocky Reach HCP Tributary Committee met on nine occasions.

An initial task of the HCP Tributary Committees in 2020 was to review and, if necessary, update their operating procedures that provide a mechanism for decision making. These were initially developed in 2005 and were included in that year's annual report (Anchor Environmental 2005).[7] The HCP Tributary Committees also developed Policies and Procedures for soliciting, reviewing, and approving project proposals (Anchor Environmental 2005). The Policies and Procedures provide formal guidance to project sponsors on submission of proposals for projects to protect and restore habitat of Plan Species within the geographic scope of the HCP. The HCP Tributary Committees

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[7] Anchor Environmental, L.L.C. 2005. Annual Report, Calendar Year 2005, of Activities under the Anadromous Fish Agreement and Habitat Conservation Plan. Rocky Reach Hydroelectric Project, FERC License No. 2145. Prepared for FERC by Anchor Environmental L.L.C. and Public Utility District No. 1 of Chelan County.

established two complementary funding programs, the General Salmon Habitat Program (GSHP) and the Small Projects Program. The HCP Tributary Committees made no revisions to their Policy and Procedures document or their operating procedures in 2020.

The HCP Tributary Committees continued the process of identifying high priority, targeted, habitat projects within each of the Wenatchee, Entiat, Methow, and Okanogan subbasins. Based on the HCP Tributary Committees' extensive knowledge of the subbasins, limiting habitat factors, threats, and limiting life stages, they have been identifying enhancement or protection actions within each subbasin and may call for proposals to implement those actions. They will work closely with the Upper Columbia Regional Technical Team on identifying high priority habitat actions. This is similar to the Bonneville Power Administration Targeted Solicitation Process. Although the HCP Tributary Committees will continue to accept project applications from sponsors anytime during the year, they plan to take a more active role in identifying and funding targeted projects within each subbasin. The HCP Tributary Committees are currently working with project sponsors on developing large floodplain restoration projects in the Methow and Chiwawa rivers, and in Peshastin Creek, a tributary to the Wenatchee River. They are also working with project sponsors to develop a conceptual plan to remove Enloe Dam on the Similkameen River in the Okanogan subbasin.

Dr. Tracy Hillman continued as the Chairperson for the Rocky Reach HCP Tributary Committee. In 2019, the HCP Tributary Committees conducted a formal evaluation of the Chairperson and agreed unanimously to retain Dr. Hillman as the Chairperson for the next 3-year period (2020 through 2022). Dr. Hillman is an Ecological Society of America board-certified senior ecologist and chief executive officer of BioAnalysts, Inc. He has more than 30 years of experience as an ecologist and has chaired the Rocky Reach HCP Tributary Committee since 2007.

2.3.1 Regional Coordination

To improve coordination and communication, the Rocky Reach, Rock Island, and Wells HCPs Tributary Committees hold joint meetings and conference calls. In addition, a representative from Grant PUD and the facilitator of the PRCC Habitat Subcommittee are invited to the HCP Tributary Committees monthly meetings. These representatives received meeting announcements, draft agendas, and meeting minutes. This benefits the HCP Tributary Committees through increased coordination and the sharing of expertise. The Grant PUD representative and PRCC Habitat Subcommittee facilitator have no voting authority within the HCP Tributary Committees.

The HCP Tributary Committees also coordinate with the Upper Columbia Salmon Recovery Board (UCSRB). Coordination is typically between the Chairperson of the HCP Tributary Committees and the Executive Director or the Natural Resource Program Manager of the UCSRB. In addition, some members of the HCP Tributary Committees typically attend UCSRB meetings to foster coordination in developing and selecting projects for funding. Some members of the HCP Tributary Committees are also members of the UCSRB's Regional Technical Team, which increases coordination in selecting projects for funding. Many of the Policies and Procedures of the Salmon Recovery Funding Board (SRFB) and HCP Tributary Committees are complementary, and annual funding rounds by these funding entities have been coordinated since 2005.

In addition to coordinating with the SRFB process and the PRCC Habitat Sub-Committee, the Rocky Reach HCP Tributary Committee coordinates funding of GSHP proposals with Bonneville Power Administration and the U.S. Bureau of Reclamation. The purpose of this coordination, according to Section 2 of the Tributary Fund Policies and Procedures for Funding Projects, is to collaborate with regional, local, state, tribal, and national organizations that fund salmon habitat projects. The efforts resulted in identification of possible cost-shares for suitable habitat restoration and protection projects.

2.3.2 Fiscal Management of Plan Species Accounts

The HCP Tributary Committees set up methods for the long-term management of the Plan Species accounts for each HCP. The Rocky Reach HCP Tributary Committee appointed the accounting firm Clifton Larson Allen to perform the necessary tasks for fiscal management of the Rocky Reach Plan Species Account. These tasks include the following: 1) develop a long-term approach to maintain the funds and to carry out tax calculations and reporting; 2) conduct the daily management of activities (such as processing of invoices); and 3) provide technical expertise on financial matters to the Committees. The beginning balance of the Rocky Reach Plan Species Account on January 1, 2020, was $3,263,072.60. Chelan PUD's annual contribution was $380,923. Interest received during 2020 was $17,020.82. Funds disbursed for projects in 2020 totaled $99,045.53. In addition, $3,566.58 was paid to Clifton Larson Allen and Chelan PUD for account administration, $2,000 was paid to Cordell, Neher & Company for an external financial review, and $3.00 was paid in bank fees. The ending balance on December 31, 2020, was $3,556,401.31. The 2020 Annual Financial Report for this Plan Species Account is provided in Appendix Q.

In 2020, the Rocky Reach HCP Tributary Committee hired the accounting firm Cordell, Neher & Company, PLLC, to conduct an external financial review of the Plan Species Account. The external review is to be conducted every 5 years. The accounting firm submitted their results to the Committee in December 2020. The Rocky Reach Tributary Committee reviewed the results and concluded that there are no issues with the handling of incoming funds, the budgeting process, or the allocation and approval of funds. The Rocky Reach Tributary Committee was satisfied with the financial performance and position of the financial accounts manager for the Rocky Reach Plan Species Account. The Rocky Reach Tributary Committee will request another external financial review of the Plan Species Account in 2025.

The Rocky Reach HCP Tributary Committee delegated signatory authority to the Chairperson for processing of payments for invoices approved by the HCP Tributary Committee, with the

HCP Coordinating Committee Chairperson serving as the alternate. Chelan PUD recognizes the uniqueness of the Rocky Reach HCP Tributary Committee decision-making process and delegation of signatory authority to the Chairperson, and the Chelan PUD subsequently has provided funding necessary to assign reasonable liability insurance to the Tributary Chairperson.

2.3.3 Criteria for Making Funding Decisions

Criteria for making funding decisions are outlined in Section 5 of the HCP Tributary Committees Policies and Procedures document. In addition, in 2019, the HCP Policy Committees provided the following guidance specific to the HCP Tributary Committees:

- HCP Tributary Committees will base funding decisions on technical merit, biological benefit, durability, feasibility, and cost effectiveness (using the specific evaluation criteria in Section 5 of the Policies and Procedures document) and will notify respective HCP Coordinating and Policy Committees' representatives of any potential policy issues needing to be addressed in those forums.
- The HCP Tributary Committees should consider abstention in lieu of disapproval to preserve respective policy positions.

2.3.4 General Salmon Habitat Program

The HCP Tributary Committees established the GSHP as the principal mechanism for funding projects. The goal of the program is to fund projects for the protection and restoration of Plan Species habitat. An important aspect of this program is to assist project sponsors in developing practical and effective applications for relatively large projects. Many habitat projects are increasingly complex in nature and infeasible without extensive design, permitting, and public participation. Often, a reach-level project involves many authorities and addresses more than one habitat factor. Because of this trend, the GSHP was designed to fund relatively long-term projects. There is no maximum financial request in the GSHP; the minimum request is $100,000, although the HCP Tributary Committees may approve lesser amounts during a phased project.

The HCP Tributary Committees accept GSHP applications at any time during the year. They also accept SRFB applications for projects where Plan Species Account Funds are included as cost-shares in SRFB proposals.

In an effort to coordinate with ongoing funding and implementation programs within the region, the HCP Tributary Committees used the previously established technical framework and review process for this geographic area and worked with the other funding programs to identify cost-sharing procedures (Section 2.3.1).

2.3.4.1 2020 General Salmon Habitat Projects

The SRFB announced its 2020 funding cycle in March, with draft proposals due on April 17, 2020, and final proposals due on May 29, 2020. The HCP Tributary Committees received and reviewed 10 draft SRFB proposals. The HCP Tributary Committees identified seven projects they believed warranted full proposals and dismissed three projects because they were inconsistent with the intent of the Tributary Fund, did not have strong technical merit, or were not cost effective.

In May, the HCP Tributary Committees received eight full SRFB proposals to the GSHP. All were cost-shares with the SRFB or other funding entities. The HCP Tributary Committees approved funding for six projects. In addition, the HCP Tributary Committees received three full proposals to the GSHP that were outside the SRFB process. Table 6 identifies the projects, sponsors, total cost of each project, amount requested from Tributary Funds, and, if funded, which Plan Species Account supported the project.

Table 6
General Salmon Habitat Program Projects Reviewed by the Habitat Conservation Plan Tributary Committees in 2020

Project Name	Sponsor	Total Cost	Request from Tributary Committee	Plan Species Account
SRFB Applications				
Upper Beaver Creek Final Design and Restoration	MSRF	$395,342	$59,307	W: $59,307
Beaver Creek #040016 Correction Project	CCNRD	$251,110	$54,646	RR: $54,646
Chiwawa Floodplain Reconnection & Enhancement	CCNRD	$166,395	$24,960	RI: $24,960
Icicle Confluence Side Channel Improvement	CCNRD	$335,320	$50,298	Not funded
Big Meadow Creek Fish Passage Restoration	CF	$475,000	$207,500	RI: $207,500
Nason Kahler Instream Complexity	CCNRD	$662,865	$149,020	RR: $149,020
Chewuch RM 4.2 Fish Enhancement	YN	$659,351	$137,866	Not funded
Alder Creek Floodplain Restoration	YN	$691,700	$149,967	W: $149,967
GSHP Applications				
City of Leavenworth Fish Screen	TU	$900,100	$475,100	RI: $475,100
Enloe Dam Removal Concept Plan	CCT	$464,075	$117,612	W: $117,612
Chumstick Baseflow and Riparian Enhancement	CCD	$237,727	$82,145	RR: $82,145

In 2020, the Rocky Reach HCP Tributary Committee agreed to fund the following GSHP project:

- **Beaver Creek Barrier #040016 Correction Project** for the amount of $54,646 (with cost-share, the total cost of the project was $251,110). This project will replace a partial fish passage barrier at river mile (RM) 0.5 on Beaver Creek, a tributary to the Wenatchee River. This project will restore fish access to approximately 6.2 miles of habitat for salmonids.

- **Nason Kahler Instream Complexity Project** for the amount of $149,020 (with cost-share, the total cost of the project was $662,865). This project will improve adult Chinook Salmon and steelhead holding habitat and increase winter rearing habitat for juvenile salmonids by increasing instream complexity and peripheral off-channel habitat at RM 6.0-7.4 on Nason Creek, a tributary to the Wenatchee River.
- **Chumstick Baseflow and Riparian Enhancement Project** for the amount of $82,145 (with cost-share, the total cost of the project was $237,727). This project will improve water quality, water quantity, and riparian habitat along 0.26 mile of Chumstick Creek by installing beaver dam analogs and post-assisted log structures at four different locations in Chumstick Creek, a tributary to the Wenatchee River. Enhancement structures will create pools, sort and store sediments, store water, prolong stream flows, improve water quality, and improve riparian conditions.

2.3.4.2 Modifications to General Salmon Habitat Program Contracts

In 2020, the Rocky Reach HCP Tributary Committee received no requests from sponsors asking for modifications to GSHP projects funded by the Committee.

2.3.5 Small Projects Program

The Small Projects Program has an application and review process that increases the likelihood of participation by private stakeholders that typically do not have the resources or expertise to go through an extensive application process. The HCP Tributary Committees encourage small-scale projects by community groups, in cooperation with landowners, to support Plan Species recovery on private property. Project sponsors may apply for funding at any time and, in most cases, will receive a funding decision within 3 months. The maximum contract allowed under the Small Projects Program is $100,000.

2.3.5.1 2020 Small Projects

In 2020, the HCP Tributary Committees received three requests for funding under the Small Projects Program. Table 7 identifies the projects, sponsors, total cost for each project, amount requested from Tributary Funds, and which Plan Species Account supported the projects.

Table 7
Projects Reviewed by the Habitat Conservation Plan Tributary Committees under the Small Projects Program in 2020

Project Name	Sponsor	Total Cost	Request from Tributary Committee	Plan Species Account
Goodwin Side Channel Assessment	CF	$21,157	$17,067	RI: $17,067
Sugar Reach Habitat Enhancement	MSRF	$19,932	$15,621	W: $15,621
Methow River – Vandervort Property Appraisal	MSRF	$9,250	$9,250	W: $9,250

In 2020, the Rocky Reach HCP Tributary Committee did not fund any Small Projects.

2.3.5.2 Modifications to Small Project Contracts

In 2020, the Rocky Reach HCP Tributary Committee received the following requests from sponsors asking for modifications to Small Projects funded by the Committee:

- In January, Cascade Fisheries asked the Rocky Reach HCP Tributary Committee for a scope change and budget amendment on the *Napeequa Side Channel Connection Project*. Because of regulatory issues and high costs, constructing a pedestrian bridge over the Napeequa River is not feasible at this time. Therefore, the sponsor asked if they could use the $25,000, which was to be used to construct the pedestrian bridge, to purchase a vehicle and a water filtration system. The Rocky Reach Tributary Committee denied the request because it represents a significant change in the project.

2.3.6 Tributary Assessment Program

The Rocky Reach HCP established the Tributary Assessment Program (separate from the Rocky Reach Plan Species Account) to fund M&E of the relative performance of projects funded by the initial contribution to the Plan Species Account. The Tributary Assessment Program comprised a fixed, onetime contribution of $200,000, not subject to inflation adjustment. The Rocky Reach HCP Tributary Committee began funding monitoring projects from the Tributary Assessment Program in 2014, with the funding of the ONA proposal to monitor the effects of spawning platforms as adaptive management for designing and construction of more platforms. This work focused on quantifying spawners (redd surveys), egg retention (carcass surveys), egg-to-fry success, and habitat conditions (e.g., gravel stability, thalweg slope, fine sediment deposition, and gravel composition) within treated and untreated areas. Monitoring occurred throughout a 5-year period (2014 through 2018).

In 2020, the HCP Tributary Committees received a monitoring application from ONA titled, ORRI Effectiveness Monitoring and Restoration Prioritization (2020–2024) Project. The purpose of the project was to monitor the effectiveness of enhancement actions placed within Penticton Channel, Oliver, and Okanagan Falls restoration sites. Results from this work will direct the future enhancement of spawning areas for Sockeye Salmon and Chinook Salmon in other sections of the river and Okanagan tributaries; determine priority enhancement sites; assess the long-term sustainability and function of constructed restoration structures and identify adaptive management options; support stock management decisions; and provide leverage to secure Canadian funding. The cost of the monitoring project over a 5-year period was $99,000. The Rocky Reach HCP Tributary Committee elected to fund (1) assessment of spatial distribution of fall spawners and redds using drones; (2) evaluation of relationships between spawners/redd distribution, flow levels, and fry recruitment; and (3) effectiveness monitoring using drones for $65,000.

To date, Chelan PUD has spent $53,738.14 of the original $200,000.00 total for the Rocky Reach HCP Tributary Assessment Program. The remaining balance of $146,261.86 in the Rocky Reach HCP Tributary Assessment Program is unallocated.

3 Habitat Conservation Plan Administration

This section lists events of note that occurred in 2020 related to the administration of the HCPs and provides a list of reports published in 2020 that relate to the HCPs.

3.1 Mid-Columbia Habitat Conservation Plan Forums

In 2005 and 2006, Mid-Columbia Forums were held as a means of communicating and coordinating with the non-signatories and other interested parties regarding the implementation of the HCPs. Non-signatory parties at the time of the 2006 meeting included the Confederated Tribes of the Umatilla Indian Reservation and American Rivers. As in 2006 through 2019, these parties were invited by letter in 2020 to participate in a meeting with members of the HCP Coordinating, Hatchery, and Tributary Committees, in conformity with the 2005 FERC Order on Rehearing 109 FERC 61208 and in accordance with the offer to non-signatory parties of non-voting membership in HCP Hatchery and Tributary Committees processes. The non-signatory parties again indicated no interest in attending a meeting with the HCP Committees in 2020.

3.2 HCP Policy Committees

Following policy-level discussions in 2019, the HCP Policy Committees agreed that convening regularly scheduled HCP Policy Committee meetings in addition to any dispute resolution meetings would benefit the Committees by building and maintaining a good rapport among members and would help facilitate addressing time-sensitive issues, should one arise. As such, an HCP Policy Committees meeting was scheduled to convene in person on May 5, 2020, for members to touch base and review the past year of HCP implementation. However, due to COVID-19, this in-person meeting was postponed until further notice.

In 2020, the HCP Policy Committees convened by conference call on two occasions to discuss CRITFC's annual request to tag Sockeye Salmon at Wells Dam, with the goal of developing guidance to provide to the Wells HCP Coordinating Committee for implementation in future years (Appendix D). Chelan PUD participated in one of two conference calls (on September 1, 2020); however, Chelan PUD did not attend the second conference call (on October 6, 2020) because the discussion applied only to the Wells HCP.

3.3 COVID-19 and Implementation of the Rocky Reach and Rock Island HCPs

In 2020, Chelan PUD and the HCP Committees continued the successful implementation of the Rocky Reach and Rock Island HCPs, despite impacts of the COVID-19 pandemic. State and federal COVID-19 restrictions had some effects on timing and logistics of HCP activities; however, additional planning and coordination by Chelan PUD and the HCP Committees prevented any major delays or non-compliance with Chelan PUD's FERC license and the Rocky Reach and Rock Island HCPs.

3.4 Habitat Conservation Plan Related Reports and Miscellaneous Documents Published in Calendar Year 2020

The following is a list of reports released in 2020 that are related to the implementation of the Rocky Reach HCP:

- Anchor QEA (Anchor QEA, LLC) and Chelan PUD (Public Utility District No. 1 of Chelan County), 2020. *Annual Report Calendar Year 2019 of Activities Under the Anadromous Fish Agreement and Habitat Conservation Plan*. Rocky Reach Hydroelectric Project FERC License No. 943. Prepared for Federal Energy Regulatory Commission. April 2020.
- Chelan PUD, 2020. *2020 Rocky Reach and Rock Island HCP Action Plan – Final*. March 2020.
- Chelan PUD, 2020. *Rocky Reach and Rock Island HCPs Final 2020 Fish Spill Report*. September 2, 2020.
- Chelan PUD, 2020. *2021 Hatchery Monitoring and Evaluation Implementation Plan*. Distributed in February 2021.
- Hillman, T., M. Miller, C. Willard, S. Hopkins, M. Hughes, C. Moran, J. Williams, M. Tonseth, J. Caisman, T. Pearsons, and P. Graf, 2020. *Monitoring and Evaluation of the Chelan and Grant County PUDs Hatchery Programs: 2019 Annual Report.* Report to the HCP and PRCC Hatchery Committees. September 15, 2020.
- Hopkins, S.A., 2020. *2019 Biological Evaluation of the Rocky Reach Juvenile Fish Bypass System Final Report*. Prepared for Public Utility District No. 1 of Chelan County. March 2020.
- Keller, L. and S. Hopkins, 2020. *2020 Rocky Reach Juvenile Fish Bypass System Operations Plan – Final Plan*. Prepared for Public Utility District No. 1 of Chelan County. March 2020.
- Mosey, T., 2020. *2020 Fish Spill Plan – Rock Island and Rocky Reach Dams*. Prepared for Public Utility District No. 1 of Chelan County. March 24, 2020.
- Tonseth, M., 2020. *HCP HCs and PRCC HSC-approved Upper Columbia River 2020 BY Salmon and 2021 BY Steelhead Hatchery Program Management Plan and Associated Protocols for Broodstock Collection, Rearing/Release, and Management of Adult Returns*. Prepared for National Marine Fisheries Service, and the HCP and PRCC Hatchery Committees. March 18, 2020.

Appendix A
Habitat Conservation Plan Coordinating Committees 2020 Meeting Minutes and Conference Call Minutes

FINAL

1201 3rd Avenue, Suite 2600
Seattle, Washington 98101
206.287.9130

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: March 3, 2020

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris

Re: Final Minutes of the January 28, 2020 HCP Coordinating Committees Meeting

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met at the Grant PUD office in Wenatchee, Washington, on Tuesday, January 28, 2020, from 10:00 a.m. to 1:15 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

- Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).
- Anchor QEA, LLC (Anchor QEA) will distribute the redline version of the draft *2020 Total Dissolved Gas Abatement Plan* (and appended *Wells Bypass Operating Plan*) to the HCP Coordinating Committees for review, and will notify Washington Department of Fish and Wildlife (WDFW) and the Colville Confederated Tribes (CCT), who were not in attendance at this meeting, to contact Douglas PUD with questions (Item III-B). *(Note: Kristi Geris distributed the redline version and notified WDFW and the CCT, as discussed, following the meeting on January 28, 2020.)*
- Chelan PUD will investigate how loss of fish from recreational harvest was calculated and incorporated into adult survival estimates in past Rock Island and Rocky Reach survival studies (Item IV-D).
- The Yakama Nation (YN) will confirm whether the additional coho salmon released during the YN Coho Salmon Reintroduction Program 3-Year Natural Production phase will receive passive integrated transponder (PIT) tags (Item IV-D).
- Chelan PUD will update WDFW and the CCT about the Rock Island and Rocky Reach 2021 Confirmation Survival Study species selection discussion in preparation for a possible decision during the HCP Coordinating Committees meeting on February 25, 2020 (Item IV-D).
- Chelan PUD will determine the minimum sample size required to calculate combined adult survival (Item IV-D).
- The HCP Coordinating Committees will prepare prioritized suggestions for a Rock Island and Rocky Reach 2021 Confirmation Survival Study species selection for discussion and possible decision during the HCP Coordinating Committees meeting on February 25, 2020, and will

email Committees members with thoughts on selecting one species over others prior to the meeting, if warranted (Item IV-D).

- Chelan PUD will consider preparing a pros and cons list for a Rock Island and Rocky Reach 2021 Confirmation Survival Study species selection for discussion and possible decision during the HCP Coordinating Committees meeting on February 25, 2020 (Item IV-D).
- The HCP Coordinating Committees will continue considering whether to request additional information from Jeff Fryer regarding Columbia River Inter-Tribal Fish Commission's (CRITFC's) annual request to tag sockeye salmon at Wells Dam, to be further discussed during the HCP Coordinating Committees meeting on January 28, 2020 (Item V-B).
- Anchor QEA will add David Blodgett, III (YN HCP Policy Committees Representative) to the HCP Coordinating Committees and HCP Hatchery Committees secondary email distribution lists (Item V-C). *(Note: Kristi Geris added Blodgett to these lists and notified the YN, Tracy Hillman [HCP Hatchery Committees Chairman], and Larissa Rohrbach [HCP Hatchery Committees Support Staff] of this addition.)*
- The HCP Coordinating Committees will prepare to discuss study design, tag technology, and life history information to better understand future subyearling Chinook salmon survival study feasibility by 2022, during the first subyearling Chinook salmon quarterly check-in at the next HCP Coordinating Committees meeting on February 25, 2020 (Item V-D).
- The HCP Coordinating Committees meeting on February 25, 2020, will be held at 9:00 a.m., in-person at the Grant PUD Wenatchee office in Wenatchee, Washington (Item V-D). *(Note: this will be the first concurrent meeting with the PRCC, with the HCP Coordinating Committees convening from 9:00 a.m. to 12:00 p.m. and the PRCC convening from 1:00 to 4:00 p.m., as distributed to the HCP Coordinating Committees by Kristi Geris on January 31, 2020.)*

Decision Summary

- There were no HCP Decisions approved during today's meeting.

Agreements

- There were no HCP Agreements discussed during today's meeting.

Review Items

- The *Wells Project Subyearling Chinook Life-History Study 2011-2013 Draft Final Report* was distributed to the HCP Coordinating Committees by Kristi Geris on May 24, 2019.
- The draft *2020 Total Dissolved Gas Abatement Plan* (and appended *Wells Bypass Operating Plan*) was distributed to the HCP Coordinating Committees by Kristi Geris on January 20, 2020, and is available for review, with edits and comments due to Andrew Gingerich by

Tuesday, February 18, 2020; Douglas PUD will request approval of the draft plan during the HCP Coordinating Committees meeting on February 25, 2020 (Item III-B).

- The *Draft 2020 Wells HCP Action Plan* was distributed to the HCP Coordinating Committees by Kristi Geris on January 20, 2020, and is available for a 30-day review, with edits and comments due to Tom Kahler by Wednesday, February 19, 2020; Douglas PUD will request approval of the draft plan during the HCP Coordinating Committees meeting on February 25, 2020 (Item III-C).
- The draft *2020 Rocky Reach and Rock Island HCP Action Plan* was distributed to the HCP Coordinating Committees by Kristi Geris on January 28, 2020, and is available for a 30-day review, with edits and comments due to Lance Keller by Thursday, February 27, 2020; if appropriate, Chelan PUD will request approval of the draft plan during the HCP Coordinating Committees meeting on February 25, 2020 (Item IV-E).
- The draft *2020 Fish Spill Plan, Rock Island and Rocky Reach Dams, Public Utility District No. 1 of Chelan County* (2020 Rock Island and Rocky Reach Fish Spill Plan) was distributed to the HCP Coordinating Committees by Kristi Geris on January 28, 2020, and is available for a 30-day review, with edits and comments due to Lance Keller by Thursday, February 27, 2020; if appropriate, Chelan PUD will request approval of the draft plan during the HCP Coordinating Committees meeting on February 25, 2020 (Item IV-F).
- CRITFC's annual request to tag sockeye salmon at Wells Dam in 2020 was distributed to the HCP Coordinating Committees by Kristi Geris on February 4, 2020 (Item V-B).
- The draft *2019 Wells HCP Annual Report* was distributed to the HCP Coordinating Committees by Kristi Geris on February 6, 2020, and is available for a 30-day review with edits and comments due to Geris by March 6, 2020.
- The draft *2019 Rock Island Dam Smolt Monitoring Program and Gas Bubble Trauma Evaluation Draft Report* (2019 Rock Island Smolt and Gas Bubble Trauma Evaluation Report) was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and is available for a 30-day review, with edits and comments due to Lance Keller by Monday, March 16, 2020.
- The draft *2019 Biological Evaluation of the Rocky Reach Juvenile Fish Bypass System Draft Report* (2019 Rocky Reach Juvenile Fish Bypass System Report) was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and is available for a 30-day review, with edits and comments due to Lance Keller by Monday, March 16, 2020.
- The draft *Rock Island Dam Smolt Monitoring and Gas Bubble Trauma Evaluation Plan 2020* (2020 Rock Island Bypass Monitoring Plan) was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and is available for a 30-day review, with edits and comments due to Lance Keller by Monday, March 16, 2020.

- The draft *2020 Rocky Reach Juvenile Fish Bypass System Operations Plan* was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and is available for a 30-day review, with edits and comments due to Lance Keller by Monday, March 16, 2020.
- The draft *2019 Rock Island HCP Annual Report* and draft *2019 Rocky Reach HCP Annual Report* were distributed to the HCP Coordinating Committees by Kristi Geris on February 18, 2020, and are available for a 30-day review with edits and comments due to Geris by March 19, 2020.

Finalized Documents

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. The following revisions were requested:

- Lance Keller added: 1) *2020 Rocky Reach and Rock Island HCP Action Plan*; and 2) 2020 Rock Island and Rocky Reach Fish Spill Plan
- Ferguson added: 1) YN HCP Policy Committees Representative; and 2) HCP annual report review schedule reminders (to discuss during the respective action plan agenda items)

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft December 17, 2019 meeting minutes. Kristi Geris said all comments and revisions received from members of the Committees were incorporated into the revised minutes. Geris said she also added the two recently distributed review items (draft *2020 Total Dissolved Gas Abatement Plan* [and appended *Wells Bypass Operating Plan*] and *Draft 2020 Wells HCP Action Plan*) to the Review Items section of the revised minutes. HCP Coordinating Committees members present approved the December 17, 2019 meeting minutes, as revised. *(Note: Chad Jackson provided WDFW approval of the revised minutes via email on January 21, 2020.)*

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on December 17, 2019, and follow-up discussions, were as follows. *(Note: Italicized text corresponds to agenda items from the meeting on December 17, 2019):*

- *Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).*
  This will be discussed during today's meeting and will also be carried forward.
- *Chelan PUD will correct the summer time frame as reported along the y-axis and title of Attachment B in both Statements of Agreement (SOAs), Updated Flow Duration Curves for the Rock Island Project for Establishing Representative Flow Conditions and Updated Flow Duration Curves for the Rocky Reach Project for Establishing Representative Flow Conditions (Item III-A).*
  These corrections were made in the final SOAs, as discussed.
- *Douglas PUD will add a period to the final sentence in the Statement section of the SOA, Regarding the Updated Flow-Duration Curves for the Wells Hydroelectric Project for Establishing Representative Environmental Conditions (Item IV-A).*
  This correction was made in the final SOA, as discussed.
- *Douglas PUD will correct the year shown in the 2019 data column for sockeye salmon in Table 2 of the Passage-Dates Analysis, from 2018 to 2019 (Appendix A to the 2019 Wells Dam Post-Season Bypass Report; Item IV-B).*
  This correction was made in the final report, as discussed.
- *HCP Coordinating Committees representatives who are also representatives on the Priest Rapids Coordinating Committee (PRCC) will discuss with the PRCC meeting logistics in 2020, including potentially coordinating meeting dates and locations with the HCP Coordinating Committees, to be further discussed during the HCP Coordinating Committees meeting on January 28, 2020 (Item V-A).*
  This will be discussed during today's meeting.
- *Anchor QEA, LLC, will request the Grant PUD Wenatchee office for the regular HCP Coordinating Committees meeting dates and times in 2020 but will let Grant PUD know the HCP Coordinating Committees and PRCC are discussing possible adjustments to these arrangements (Item V-A).*
  Kristi Geris contacted Grant PUD following the HCP Coordinating Committees meeting on December 17, 2019, and received approval of this request on December 18, 2019.
- *The HCP Coordinating Committees will continue considering whether to request additional information from Jeff Fryer regarding CRITFC's annual request to tag sockeye salmon at Wells Dam, to be further discussed during the HCP Coordinating Committees meeting on January 28, 2020 (Item V-C).*
  This will be discussed during today's meeting.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees meeting on January 9, 2020:

- *Review of Tributary Committees' Policies and Procedures*: The HCP Tributary Committees reviewed their Policies and Procedures document and their Operating Procedures. No edits or changes were made to the documents.
- *Napeequa Side Channel Connection Project*: The Rocky Reach HCP Tributary Committee received a scope change/budget amendment request from Cascade Columbia Fisheries Enhancement Group (CCFEG) on the Napeequa Side Channel Connection Project. As part of the original reconnection project, the sponsor asked for $25,000 to construct a pedestrian bridge over the Napeequa River. Hillman explained for background, there is a side channel to the Napeequa River that is mostly blocked or disconnected due to a road that is used by a church camp to get to either side of the channel. Hillman said part of the project is to remove the road to help restore riparian habitat and reconnect the side channel to flow into the Napeequa River. He said the sponsor requested to build a pedestrian bridge so the church can get back and forth across the channel. However, due to regulatory issues and cost, the sponsor indicated that construction of the pedestrian bridge is not feasible. Therefore, rather than use the $25,000 to install a pedestrian bridge, the sponsor asked to use the $25,000 to purchase a vehicle for the church to use to get around the channel, and a water filtration system. After evaluating the request, the Rocky Reach HCP Tributary Committee concluded that the allocated funds for the pedestrian bridge cannot be used to purchase a vehicle or a water filtration system because equipment or assets purchased with Plan Species Account Funds would have to belong to the Committee. In this case, the Rocky Reach HCP Tributary Committee did not want to own a vehicle. John Ferguson asked about the location of the Napeequa River, and Hillman said it is a tributary to the White River, which flows into Lake Wenatchee. Keely Murdoch asked if the project is still moving forward with reconnecting the side channel. Hillman said the HCP Tributary Committees have not heard back from CCFEG. Murdoch asked what regulatory issues prevent a pedestrian bridge on private land for private use? Hillman said he is unsure who the regulatory agency is or what the issues are; rather, CCFEG just indicated it is not feasible at this time. He said he can talk to Jason Lundgren (CCFEG Contact) and will share what he finds. *(Note: Hillman provided an update from CCFEG to Kristi Geris on January 30, 2020, which Geris distributed to the HCP Coordinating Committees that same day.)*

- *Cottonwood Flats Floodplain Restoration Project*: Chelan County Natural Resources Department (CCNRD) and Chelan Douglas Land Trust (CDLT) met with the Rocky Reach HCP Tributary Committee to discuss the most recent modeling results from analyzing the original design and the pilot-channel design for the Cottonwood Flat Floodplain Restoration Project. Hillman recalled that CCNRD is the project sponsor and CDLT is the landowner of the Cottonwood Flats Floodplain on the Entiat River. Hillman said the original design was to carve out a channel in the floodplain and the Rocky Reach HCP Tributary Committee recommended a pilot-channel design to let the river create its own flow path through the floodplain. In short, the project sponsor completed modeling and indicated that the original design provides more certainty of success compared to the pilot design. Additionally, although the original design is more expensive to implement than the pilot design, if the pilot design does not work and crews have to reenter the floodplain to fix the pilot design, the pilot design becomes more expensive than the original design. After discussion with CCNRD and CDLT, the Rocky Reach HCP Tributary Committee recommended extending the pilot channel further into the floodplain. This will reduce project uncertainty and will still allow the river to develop flow paths across the floodplain. In addition, the Rocky Reach HCP Tributary Committee recommended that CCNRD avoid developing large, trapezoidal channels; rather, it was recommended that a smaller channel that protects existing riparian vegetation be constructed. Hillman said CCNRD will look into this recommendation.
- *Beaver Fever: Restoring Ecosystem Function Project*: Trout Unlimited (TU) provided a presentation titled, "BDA Project Update." Hillman recalled that "BDA" stands for "beaver dam analog." TU provided an overview of the project including their coordination with the U.S. Forest Service (USFS). TU and USFS have identified about 30 treatment sites on Potato and Roaring creeks in the Entiat Basin to install BDAs. TU and USFS also asked the Rock Island HCP Tributary Committee about monitoring the effectiveness of BDAs. The Rock Island HCP Tributary Committee offered monitoring recommendations and encouraged TU to submit an application for monitoring. Jim Craig asked if monitoring will largely include cameras. Hillman said the recommendation included two methods: 1) use of drones with remote sensing capability to document changes over time in floodplain and channel development; and 2) sampling fish responses using techniques such as mark-recapture studies. Hillman said the Rock Island HCP Tributary Committee wants to know if fish grow and survive better in treated areas.
- *Plan Species Account Deposits*: Hillman said this was discussed after the HCP Tributary Committees meeting on January 9, 2020. Chelan PUD deposited $804,280 into the Rock Island Plan Species Account and $380,923 into the Rocky Reach Account. Douglas PUD deposited $292,037 into the Wells Account. Currently, the unallocated balances within each account are $4,920,769 in the Rock Island Account, $2,286,937 in the Rocky Reach Account, and

$2,130,796 in the Wells Account. Among the three accounts, there is about $9,338,502 available for restoration and protection work. Hillman noted that last year, there was almost $12,000,000 available among the three accounts. He said quite a bit of funds from the Rock Island Account were spent last year in part due to there being more restoration and protection opportunities under the Rock Island Project compared to the Wells Project.

- *Next Meeting*: There is no planned meeting for the HCP Tributary Committees in February 2020. HCP Tributary Committees members will attend project presentations with the Regional Technical Team on March 11 and 12, 2020.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees meeting on January 15, 2020 (*note: joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *Collection Site for Chiwawa Spring Chinook Salmon Broodstock (joint):* Chelan PUD provided a presentation describing the collection of Chiwawa spring Chinook salmon broodstock. Currently, the Chiwawa Weir is the location for collecting natural-origin Chiwawa spring Chinook salmon broodstock; however, because large numbers of bull trout are encountered at the weir and only a certain number of bull trout can be handled at the weir, trapping at the weir in recent years has been terminated before adequate numbers of spring Chinook salmon broodstock for the Chiwawa Program were collected. To backfill the shortfall, the program collects hatchery-origin spring Chinook salmon at Tumwater Dam. As a result, percent natural-origin broodstock (pNOB) and proportionate natural influence (PNI) goals are not achieved. Chelan PUD asked if all Chiwawa spring Chinook salmon broodstock can be collected at Tumwater Dam. Only spring Chinook salmon that are genetically identified as Chiwawa spring Chinook salmon (with 90% or greater certainty) would be retained as broodstock for the Chiwawa program. This approach would help achieve pNOB and PNI goals. The Committees discussed the balance of meeting pNOB and PNI goals with allowing local adaptation of spawning aggregates. The Committees will continue to discuss this during the next few meetings.
- *Broodstock Collection Protocols (joint):* The Committees continue to update the broodstock collection protocols. Most of the appendices to the protocols have been updated. The first draft of the broodstock collection protocols will be available for Committees' review 10 days before the HCP Hatchery Committees meeting on February 19, 2020.
- *Hatchery Monitoring and Evaluation (M&E) Plan (joint):* The Committees discussed the need to attach the memorandum from the Genetics Panel to the Hatchery M&E Plan. Recall that the memorandum provides responses to the Committees' questions regarding monitoring the

effects of hatchery programs on population genetics. All members present agreed to attach the memorandum to the Hatchery M&E Plan.

- *2019 Chelan Falls Summer/Fall Chinook Broodstock Collection Summary (Rock Island/Rocky Reach):* Chelan PUD provided a presentation describing the collection of summer Chinook salmon broodstock for the Chelan Falls Summer Chinook Salmon Program. Currently, broodstock are collected at Wells Dam and within the Chelan River. Different collection methods have been tested in the Chelan River. A weir and trap were tested recently and with adjustments this should be a good method for collecting broodstock in the Chelan River. The Rock Island and Rocky Reach HCP Hatchery Committees agreed to collect broodstock at both Wells Dam and within the Chelan River for another year. This will allow further testing of the weir and trap approach for collecting broodstock within the Chelan River. Ferguson asked about the location of the trap in the Chelan River. Hillman said the trap is located at the upper end of the habitat channel and the weir is between the large pool and habitat channel. Bill Towey (Chelan PUD) agreed and said it is a picket weir.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on February 19, 2020.

III. Douglas PUD

A. Wells Dam 2019/2020 Winter Maintenance Outages (Tom Kahler)

Tom Kahler said the east fishway at Wells Dam was taken out of service for annual winter maintenance on January 7, 2020, and a fish salvage memorandum was distributed (by Kristi Geris on January 17, 2020). Kahler said typically, the upper ladder is dewatered, then mechanics set bulkheads in the fishway entrance to close off supplemental flow, and then the collection gallery is dewatered the next day. He said this year, there was an issue with setting the bulkheads in the auxiliary water supply slots. He said the issue was resolved and the collection gallery was finally dewatered on January 13, 2020. He said while mechanics worked to resolve the issue, fish were basically holding in a huge chamber of water with fresh water flowing into the area, as well. He said the east fishway should be back in service by January 30, 2020, and the west fishway will be dewatered next week with fish salvage occurring from February 4 to 5, 2020. He said the west fishway will have a lengthier outage and will include fixing the two large pumps that supply attraction flow.

B. Draft 2020 Total Dissolved Gas Abatement Plan (and appended Wells Bypass Operating Plan) (Andrew Gingerich)

Andrew Gingerich said for years, Douglas PUD has annually drafted a Total Dissolved Gas Abatement Plan in coordination with the Aquatic Settlement Work Group (SWG). He said Douglas PUD's Clean Water Act Section 401 Water Quality Certification stipulates that the Total Dissolved Gas Abatement

Plan and Bypass Operating Plan be vetted with both the Aquatic SWG and Wells HCP Coordinating Committee. He said typically, this review is straightforward; however, this year, there are more changes to the document with the expectation that the total dissolved gas (TDG) standards will change. He said for the Wells Project, this starts on April 1, 2020, the start of the HCP juvenile migration period. He recalled last year distributing a redline version of the plan; however, this year, he said only a clean draft *2020 Total Dissolved Gas Abatement Plan* (and appended *Wells Bypass Operating Plan*) was distributed (by Kristi Geris on January 20, 2020). Gingerich projected a redline version on the screen for the Wells HCP Coordinating Committee and walked the Committee through the changes. He said this version can also be distributed for review, and he had not yet distributed the redline version because there were so many changes this year. He said today, he wants to point out changes in the TDG standards that Washington State Department of Ecology (Ecology) has adopted and are now under Environmental Protection Agency (EPA) review for approval. John Ferguson asked about the timeline for EPA approval. Gingerich said the rule package was submitted to EPA on December 30, 2019, and a decision must be made in time to implement the changes by April 1, 2020. Geris said Breean Zimmerman (Ecology Aquatic SWG Representative) indicated EPA has 60 days to approve or 90 days to deny the rule package.

Gingerich said the new TDG rule allows for a modification of the TDG standards in a project's tailrace and in the forebay of the downstream project. He said a project can spill more water to benefit fish passage, but that spill may raise TDG values above the existing TDG standards. He said the thought is, this TDG adjustment will provide for TDG compliance during periods when hydroprojects spill specifically to increase fish passage survival. He said formerly, modifications by Ecology to the 110% TDG standard during the fish bypass season for Wells Dam included: 1) no hourly value in the Wells Dam tailrace of 125% or more; 2) no 120% value in the Wells Dam tailrace using a rolling highest 12-hour average, which can span two days; and 3) no values above 115% in the Rocky Reach Dam forebay, also calculated as the rolling highest 12-hour average (or 12-C high calculation). Gingerich said Ecology has largely preserved these rules as Option A for 2020, with a few changes to how TDG values are calculated. He said the new rule removes "consecutive hourly readings" and only considers the 12 highest values of the day, regardless of when they occur (this truncates the rule to 1 day). He said or, operators can apply for Option B, which is a simplified TDG standard and is also where the major changes occur. He said Option B removes the next downstream forebay standard and the 120% 12-C high standard in the tailrace, and adds a new 126% and 125% standard in the tailrace of the project. Ferguson said a 126% standard was not included in the initial proposed rule change. Gingerich said this is correct, that the original rule change only included a 125% standard as measured as the two highest values of the day. He said this original proposed rule went out for comment and during the review period, Ecology added the 126% value in the final rule. Gingerich said the draft *2020 Total Dissolved Gas Abatement Plan* reflects the final rule Ecology proposed to EPA. He said Douglas PUD could not wait for formal EPA approval of the rule change because the final *2020 Total Dissolved Gas Abatement Plan* is due to the Federal Energy Regulatory Commission (FERC) by February 28, 2020.

Gingerich said Douglas PUD will likely apply for Option B. He said this option applies only to the spring spill season, which Ecology defines as April to June. He said this means that in July when the Wells Project is still in bypass season, TDG standards will switch back to Option A. Ferguson asked how this rule change affects incoming TDG levels in the Rocky Reach Dam forebay or what is the effect of the higher gas cap in the Wells Dam tailrace? Gingerich said in theory, what Rocky Reach Dam receives from the Wells Project will not be different. He said in this document, there is language about how the Wells Project performed in terms of TDG compliance in 2019. He said there was one value of 115.2% in the Rocky Reach Dam forebay as measured as the 12-C high calculation. He said this translated into a violation in 2019; however, with the new rule in place this is not a violation. As such, he said in theory, compliance will improve. He added that Douglas PUD has collected a lot of biological data, and the Fish Passage Center has as well, which indicate that the TDG criteria as written has been conservative. He said Douglas PUD has confidence that Option B will not have a detrimental effect on migrating fish.

Jim Craig asked if Grand Coulee Dam can apply for Option B. Gingerich said, no. He said Ecology drafted the rule such that only projects that provide anadromous fish passage can apply for the adjustment. He said he is unaware of any other rule or Washington Administrative Code that would allow Grand Coulee Dam to apply for an adjustment. He said federal projects that do provide anadromous fish passage can and likely will apply for Option B.

Gingerich continued briefly summarizing the redline edits in the document. He said there is a background section that explains why Ecology proposed the rule change, and he noted that Ecology first vetted this idea with the PUDs. He said Ecology received pressure to make a change and the department did a good job of reaching out to each PUD to make sure the utilities stayed informed and in order to provide technical input. He said the document also provides an overview of the new rule, including details about an implementation plan and resident fish monitoring that will be required starting in 2021. He said gas bubble trauma (GBT) data are collected for salmonids and indicate that up to 125% TDG will not impact salmonids; however, no GBT data are collected for resident fish. He said therefore, Ecology is requiring agencies to collect these data as part of Option B. He said this may be challenging because it is unclear where to locate resident fish to meet this requirement. He said historically, resident fish have not been encountered at the Rocky Reach Dam bypass sample facility in numbers that would meet sampling requirements; therefore, as outlined in this document, Douglas PUD plans to conduct pilot testing in 2020 towards meeting the resident fish monitoring requirement in 2021. Craig asked if the requirement is to sample 50 fish of any native resident fish species. Gingerich said the requirement is to sample resident fish once per week. He said the Douglas PUD sample location can be anywhere from the McNary Dam forebay to the Chief Joseph Dam tailrace. He said sampling can be coordinated between the PUDs. He said the Implementation Plan associated with the rule stipulates that at least 10 fish be sampled of three different native resident fish species, and the other 20 fish can be any native fish collected. He said the challenge is not only where to locate these fish, but also how many salmonids will be encountered and permitting-related issues. Ferguson asked if these GBT data will be reported in an annual report. Gingerich said the data will be made available online.

Ferguson asked if the Wells HCP Coordinating Committee approves this document on February 25, 2020, can Douglas PUD still make the FERC submittal by February 28, 2020? Gingerich said this will be fine; however, he requested that substantial edits and comments be submitted to him by Tuesday, February 18, 2020. Wells HCP Coordinating Committee members asked if the redline version can also be distributed. Geris said she can do this and also notify WDFW and the CCT, who were not in attendance at this meeting, to contact Douglas PUD with questions. *(Note: Geris distributed the redline version and notified WDFW and the CCT, as discussed, following the meeting on January 28, 2020.)*

Gingerich reminded the Wells HCP Coordinating Committee to also review Appendix 1 (*Wells Hydroelectric Project Spill Playbook*) and Appendix 2 (*Wells Bypass Operating Plan*) of the draft *2020 Total Dissolved Gas Abatement Plan* for approval of the comprehensive package during the HCP Coordinating Committees meeting on February 25, 2020.

C. Draft 2020 Wells HCP Action Plan (Tom Kahler)

Tom Kahler said the *Draft 2020 Wells HCP Action Plan* was distributed to the HCP Coordinating Committees by Kristi Geris on January 20, 2020, and is available for a 30-day review, with edits and comments due to Kahler by Wednesday, February 19, 2020. Kahler said Douglas PUD produces this plan each year but it is not a requirement of the HCP. He said the plan includes various activities Douglas PUD plans to complete throughout the year, including start and end dates. He asked that the Wells HCP Coordinating Committee review the plan for missing or lacking details. He said this plan provides an opportunity for the HCP Coordinating Committees to see what Douglas PUD plans to accomplish in the upcoming year toward maintaining compliance with the HCP. He said the other HCP Committees will also review their respective sections.

John Ferguson noted that the draft *2019 Wells HCP Annual Report* will be distributed on February 6, 2020, for a 30-day review by the Wells HCP Coordinating Committee review, with edits and comments due by March 6, 2020. Kahler also noted that the 2018 and 2019 pikeminnow reports will likely be distributed together for review and will consist of short memorandums with results. He said a more comprehensive report with analysis of data from multiple years will be distributed periodically. He also noted that the HCP Hatchery Committees will provide the draft *2020 Broodstock*

Collection Protocols for review in February 2020, in time for Wells HCP Coordinating Committee review and approval by March 2020, and submittal to the National Marine Fisheries Service by April 15, 2020.

Ferguson asked if there are any updates on the 2020 Survival Verification Study? Andrew Gingerich said everything is moving along, and most importantly the study fish are doing well with no issues. Kahler said fish were PIT-tagged in November 2019. Gingerich said contractors are in place for the various pieces, barges are rented, and tanks have been rehabilitated. He said there are a few more logistical items to finish but everything is on schedule.

Ferguson said Douglas PUD will request approval of the *Draft 2020 Wells HCP Action Plan* during the HCP Coordinating Committees meeting on February 25, 2020.

IV. Chelan PUD

A. Rocky Reach Dam Turbine Units Maintenance Update (Lance Keller)

Lance Keller said Turbine Unit C9 is now watered up. He recalled that mechanical crews were working on Turbine Unit C9 and Turbine Unit C1 simultaneously. He said with Turbine Unit C9 watered up, those headgates can now be used to dewater Turbine Unit C2 to assess the status of the servo rod in that unit. He said Turbine Unit C1 is on track to return-to-service in the first week of March 2020, which is a date that needs to be maintained or met earlier in order to conduct testing of the juvenile bypass system prior to the start of the bypass season on April 1, 2020. He said resources being used on Turbine Unit C3 were moved to Turbine Unit C1 to maintain this schedule. He said divers are in the water today, installing headgates on Turbine Unit C2 and intake screens on Turbine Unit C1.

Keller said regarding the resources that were moved from Turbine Unit C3, he recalled that this unit was taken offline in late 2019 for a trunnion seal inspection. He said mechanical crews did detect a weeping seal where oil was observed on the blade. He said Chelan PUD is now moving forward with hydraulically locking the blades into place. He said two Italian engineers were on site last week to consult with Rocky Reach Dam staff regarding the hydraulic locking process. He said while this is moving forward, it is now paused because resources were moved to Turbine Unit C1.

Keller said regarding the overall maintenance schedule for the Rocky Reach Dam powerhouse, considering the new status and knowledge about the trunnion seal issues in the small units, the initial plan to perform large unit maintenance (addressing hairline cracks in the servo motor rods) simultaneously with small unit maintenance, has been put on hold. He said maintenance efforts are now focused only on the small units while Chelan PUD assesses this situation. He said he should have more resolution on the schedule by the next meeting.

B. Rock Island Dam Powerhouse 1 Maintenance Update (Lance Keller)

Lance Keller said mechanical crews are currently working on Turbine Unit B4, with a return-to-service date of May 2020. He said work on the discharge liner has been completed and the contractor is working on the stay ring for the turbine unit, conduits for the hydraulic power unit system, and the rotor. He said once work is complete on Turbine Unit B4, work will begin on Turbine Unit B3, and then will continue towards the east shoreline in Powerhouse 1.

C. Rocky Reach and Rock Island Adult Fishway Maintenance Update (Lance Keller)

Lance Keller reviewed adult fishway maintenance updates at Rocky Reach Dam and Rock Island Dam, as follows:

Rocky Reach Dam

Keller said, as reported during the HCP Coordinating Committees meeting on December 17, 2019, the upper fishway was dewatered on December 16, 2019. He recalled this earlier outage was approved by the Rocky Reach HCP Coordinating Committee (on August 27, 2019) to help facilitate completion of maintenance and repairs in the ladder and fish viewing window areas in time to return the fishway to service by the end of February 2020. He said the lower fishway was dewatered on January 9, 2020. He explained that headgates are first installed in the upper fishway exits and the ladder slowly dewaters to the same elevation as the tailwater, and then the entrance gates remain opened so fish can volitionally leave. He said on the day the lower fishway is dewatered, the entrance gates are then closed, and fish and wildlife staff conduct a fish rescue once the lower fishway is dewatered. He said the fish rescue in the lower fishway encountered fewer fish this year, which might be due to the longer than normal duration between dewatering the upper and lower fishways. He said one bull trout was encountered in the lower fishway. He said the bull trout was about 7 inches in length, in healthy condition, and was released to forebay. He said all maintenance is expected to be complete by the week of February 10, 2020. He said the new fish viewing windows are on schedule to be installed and sealed by February 18, 2020. He said the plan is to water up the fishway on February 18, 2020, to test the seal on the new windows. He said this leaves the remainder of February to address issues in case that is needed to finalize installation of the windows. He noted that the contractor specializes in fishway window and aquarium installations and has completed 120 prior installations with only two leaks. Keller also added that the new windows will not be open to the public until 2021, when the Visitor Center remodel is complete.

Rock Island Dam

Keller said the upper portion of the right fish ladder was dewatered on January 6, 2020. He noted a fish rescue also occurred on the same day, and of interest, 18 adult Pacific lamprey were rescued. He said the lower portion of the right fish ladder was dewatered on January 10, 2020. He said a fish rescue was conducted the same day with fairly low numbers of fish encountered. He said the left fish ladder was returned to service on January 14, 2020. He said crews are currently conducting a fish rescue in the middle fish ladder. He summarized that the right and middle fish ladders are currently out-of-service and the left fish ladder is in service. He said the right fish ladder will be returned to service very shortly.

D. 2021 Confirmation Survival Study Species Selection Discussion (Lance Keller)

Lance Keller shared a presentation titled, *2021 RR and RI Confirmation Survival Study Species Selection Discussion* (Attachment B), which was distributed to the HCP Coordinating Committees by Kristi Geris following the HCP Coordinating Committees meeting on January 28, 2020.

<u>Slide 2 of Attachment B</u>

Keller read language from Section 5.3.3 of the Rocky Reach and Rock Island HCPs. He said per the HCPs, Chelan PUD must re-evaluate survival under the applicable standard. He said, historically, both the Rocky Reach and Rock Island projects have measured survival against the 91% Combined Adult and Juvenile Survival Standard, which is the direction Chelan PUD plans to take for the 2021 Confirmation Survival Study. He said results from the 2021 study for the species selected will be incorporated into the combined average that currently exists for that species.

Keely Murdoch said she understands juvenile survival is measured using acoustic tags, and she asked how adult survival is incorporated into the results. Keller explained that adult survival is calculated through returning adults that are PIT-tagged and destined for the upper Columbia River. Murdoch asked if these are adults that were tagged as juveniles, hatchery fish, PIT-tagged at Priest Rapids Dam, or other? Keller said this includes any adult that is PIT-tagged regardless of origin, so long as it is destined for the upper Columbia River. Murdoch asked if “upper Columbia River” means destined to the Methow or Okanogan rivers, upstream of the turn-offs to the Entiat or Wenatchee rivers. Keller said this is correct. He said Dr. John Skalski queries PTAGIS to calculate project passage and account for harvest. Keller said that in order to measure conversion rates for the Rocky Reach Project, PIT-tag detections at Rock Island Dam are compared to detections at Wells Dam; and for the Rock Island Project, detections at Priest Rapids Dam are compared to detections at Rocky Reach Dam. He said the calculations are species specific and the two survivals (juvenile and adult) are multiplied together. Tom Kahler said there is no PIT detection at Wanapum Dam. Keller said Skalski calculates project survival as the fourth root of survival through four projects. Murdoch noted that this assumes species survive equally though each project. *(Note: Keller later clarified, after further review of Skalski’s notes, that the calculated project survival did incorporate survival metrics outside of the project boundary and should be considered minimal survival values. [i.e., did not assume equal survival through each project]. For example, if a harvest estimate was available for a project, survival was adjusted conservatively for this through that project. If a harvest estimate was not available [i.e., sockeye salmon harvest estimate* *below Wanapum Dam] then project survival could not be corrected for recreational harvest, thus producing a minimum estimate of adult conversion/survival on a project scale.)*

Murdoch noted that studying steelhead could be tricky because of the wide range of time when steelhead adults return. Keller agreed and added, for example, that the timeframe for steelhead is wider than for springers. John Ferguson said the HCPs stipulate 1 year of study and one species being studied for each project. He said the species selection for each project does not need to be the same. Keller agreed and said the Rocky Reach and Rock Island HCPs are independent and are two separate evaluations; so theoretically, there can be two different species. He said, however, it is worth noting there are benefits to studying one species across two projects.

Slide 3 of Attachment B

Keller said this slide illustrates where each project stands and what has been evaluated for spring migrating species. He said these are the previous juvenile studies conducted for the Rock Island and Rocky Reach projects. He noted that for the Rock Island Project, juvenile survival for steelhead was calculated using only 2 years of survival data because after 2008 and 2010, the average survival was already so high that the Rock Island HCP Coordinating Committee approved using just the 2 years of data. He also noted that for the Rock Island Project, while studying juvenile spring Chinook salmon and steelhead, tag failure issues were encountered resulting in aborting the study in mid-May 2009; the same year, a sockeye salmon evaluation was also conducted and was not affected by the tag issues due to the use of different tags. Keller said lastly, for the Rocky Reach Project, he noted that juvenile survival for spring Chinook salmon is less than 93%; however, the combined adult and juvenile survival meets the 91% standard, as shown on the next slide.

Slide 4 of Attachment B

Keller said this slide shows combined adult and juvenile survival for the Rock Island and Rocky Reach projects. He noted that for the Rocky Reach Project, sockeye salmon, the adult survival estimate was adjusted for loss of fish from recreational harvest in 2010 and 2011, but not for harvest losses in 2012. Jim Craig asked how loss of fish from recreational harvest is calculated. Keller said he is not sure how Skalski does this, but he will investigate how loss of fish from recreational harvest was calculated and incorporated into adult survival estimates in past Rock Island and Rocky Reach survival studies.

Slide 5 of Attachment B

Keller said in summary, these confirmation survival studies aim to verify Phase III Standards Achieved. He said the new survival studies for each project will be conducted to confirm the 91% Combined Adult and Juvenile Survival Standard continues to be met. He said that while the survival studies will be conducted in 2021, the Requests for Proposals (RFPs) are anticipated by spring 2020, which is why

Chelan PUD is bringing this topic to the HCP Coordinating Committees at this time. He said contractors will need to know which species needs to be studied and form their proposal appropriately.

<u>Discussion</u>

Craig asked where the test fish will be collected, and Keller said at the Rocky Reach Dam bypass sampling facility. Ferguson asked if there might be any logistical issues at the Rocky Reach bypass facility, such as obtaining adequate numbers, timing, or other issues? Keller said regarding timing, he believes it might be difficult to collect enough coho salmon to conduct a juvenile study, and he said there is variation in the duration and length of the juvenile coho salmon outmigration. He said a key consideration is being able to collect enough study fish for a 30-day survival study. He said typically, study fish are released across 30 days, in replicates, for 15 releases. He said there are about 25 to 35 fish per replicate. He said in order to conduct a study in its entirety, once initiated, there needs to be a high level of confidence that Chelan PUD will be able to continue collecting and tagging the species for the duration of the study. Ferguson asked about the total sample size, and Keller said the previous study for the Rock Island Project used 500 test fish and 500 control fish. He said for the Rocky Reach Project, the study evaluated day and night survival and diel passage of yearling spring Chinook salmon. He said there were 500 "day" test fish, 500 "night" test fish, 500 "day" control fish, and 500 "night" control fish, as well as 350 "day" test fish released into the juvenile bypass system to calculate route-specific survival. He said control fish were released at the outfall of the bypass system and survival was calculated across the bypass system itself. He estimated that approximately 400 test fish passing through the bypass system at Rocky Reach Dam were evaluated. Ferguson said this means that a total sample size of about 2,400 fish is needed. Keller said yes, at a bare minimum. He added that this estimate is based on previous survival values and detection probabilities for those species studied in the past.

Ferguson asked if Chelan PUD has recommendations for a study species. Keller said no, that Chelan PUD is open to suggestions, but pointed out that this is limited to species that have previously been evaluated, due to the nature of confirming a previous survival estimate. He said other considerations include run-timing and meeting sample size requirements, and adequate returns of PIT-tagged adults.

Murdoch said the YN Coho Salmon Reintroduction Program is starting a 3-Year Natural Production phase where instead of releasing the typical 500,000 PIT-tagged coho salmon, a total of 1,000,000 will be released in the Methow River Basin. She said she believes this phase is beginning in 2021. Craig asked if the additional fish will receive PIT tags. Murdoch said she believes so but will confirm this. Craig asked if these are volitional releases and Murdoch said most are. Murdoch added that volitionally released coho salmon tend to move when the water gets high and movement typically occurs later than springers. She said she is not sure why this is. Keller agreed and said coho salmon also seem to move later than sockeye salmon. He said he is unsure how long it takes coho salmon to travel through the Rocky Reach Project, but he plans to look into this further.

Murdoch noted the lower combined survival value for springers in the Rocky Reach Project and said it might be beneficial to study springers to verify this value. She also suggested testing steelhead because the juvenile survival for the Rock Island Project is based only on 2 years of data. She noted that these values factor into hatchery recalculations and hatchery mitigation, which are typically based on 3 years of data.

Murdoch asked if these confirmation studies are required every 10 years. Keller said yes and if the standards are met, another confirmation study is not required for another 10 years; however, if the standards are not met, a retest is required the following year.

Keller said ideally, Chelan PUD would like to reach a decision during the HCP Coordinating Committees meeting on February 25, 2020, to issue the RFPs shortly thereafter. He said he will update WDFW and the CCT about this discussion in preparation for a possible decision during the next meeting. Ferguson asked if Chelan PUD plans to develop a proposal or list of pros and cons for HCP Coordinating Committees review ahead of the next meeting. Keller said he thought about a pros and cons document similar to what Douglas PUD produced; however, Douglas PUD was faced with capacity issues and Chelan PUD does not have those same constraints because study fish will be run-of-the-river fish. Craig asked about a minimum sample size required to calculate combined adult survival. Keller said he will find out about this.

Craig suggested that HCP Coordinating Committees members prepare prioritized suggestions for a Rock Island and Rocky Reach 2021 Confirmation Survival Study species selection for discussion and possible decision during the HCP Coordinating Committees meeting on February 25, 2020. Ferguson also suggested that members email the Committees with thoughts on selecting one species over others prior to the meeting, if warranted. Chelan PUD will also consider preparing a pros and cons list.

E. 2020 Rocky Reach and Rock Island HCP Action Plan (Lance Keller)

Lance Keller said the draft *2020 Rocky Reach and Rock Island HCP Action Plan* was distributed to the HCP Coordinating Committees by Kristi Geris prior to the HCP Coordinating Committees meeting on January 28, 2020. Keller said the action plan is not a requirement of the HCPs, but Chelan PUD likes to produce the document to show what activities will be occurring in the coming year. He said the HCP Coordinating Committees portion has virtually remained unchanged from 2019, except for the top three items: 1) 2021 Confirmation Survival Study species selection; 2) 2021 Confirmation Survival Study plan; and 3) 2020 HCP Policy Committees meeting. He noted the upcoming delivery of four documents for review, which he hopes to distribute by Friday, January 31, 2020. John Ferguson noted that the draft *2019 Rock Island and Rocky Reach HCP Annual Reports* will be distributed for a 30-day review by the Rock Island and Rocky Reach HCP Coordinating Committees on February 19, 2020, with edits and comments due by March 19, 2020.

Ferguson said if appropriate,[1] Chelan PUD will request approval of the draft *2020 Rocky Reach and Rock Island HCP Action Plan* during the HCP Coordinating Committees meeting on February 25, 2020.

F. 2020 Rock Island and Rocky Reach Fish Spill Plan (Lance Keller)

Lance Keller said the draft 2020 Rock Island and Rocky Reach Fish Spill Plan was distributed to the HCP Coordinating Committees by Kristi Geris prior to the HCP Coordinating Committees meeting on January 28, 2020. Keller said the main change to the plan is on page 7. He recalled in previous years, converting notch gates 18 and 26 to full gate capacity to provide Rock Island Dam with more immediate spillway capacity during heavy spring river flow events. He said this year, however, the plan is to convert notch gates 18 and 26 as full gates for the entire spill season at Rock Island Dam, due to a crack detected in spillway pier 1. He said the crack is not to the same degree as the Wanapum Dam incident. He said Chelan PUD contacted the Washington State Department of Transportation to utilize their equipment used to inspect bridges to inspect and install monitoring equipment on the crack, and plans are in place to address the crack. He said in the meantime, Rock Island Dam operators do not want to implement a full gate option in spillways 1 and 2 (located on each side of the pier with the crack) and notch gates 18 and 26 (located away from spillways 1 and 2) will remain in full gate capacity.

Keller said otherwise, the plan is identical to the 2019 document. He said the plan is available for a 30-day review. He recalled that Thad Mosey (Chelan PUD), who oversees spill implementation for the Rock Island and Rocky Reach projects, produces this document. Keller asked that edits and comments be sent to him and he will relay these to Mosey. John Ferguson said if appropriate,[1] Chelan PUD will request approval of the draft plan during the HCP Coordinating Committees meeting on February 25, 2020.

V. HCP Administration

A. HCP Coordinating Committees and PRCC Meeting Logistics in 2020 (John Ferguson)

John Ferguson recalled discussing last month the idea of convening the HCP Coordinating Committees and PRCC monthly meetings on the same day. He asked Scott Carlon, Jim Craig, and Keely Murdoch if there were any updates on this topic as discussed within the PRCC. Murdoch said the concept was discussed within the PRCC. She said the PRCC understands the idea is supported by

[1] The 30-day review period technically ends on February 27, 2020.

the HCP Parties. She said she does not recall good or bad responses; rather, there was a neutral agreement to further discuss the topic. Craig said there was general agreement on the principle. He said there may be some meetings with larger agendas where the meetings will need to be held on separate days. Carlon agreed with Craig and Murdoch. Carlon said convening on the same day might be a problem for Tom Skiles (CRITFC PRCC Representative), but Skiles also indicated he could make it work.

Ferguson said Denny Rohr (PRCC Facilitator) called him and indicated there has not yet been a decision. Ferguson said he asked Rohr about Grant PUD's preference to convene the meetings at Wanapum Dam and he asked about issues for Carlon traveling from Portland, Oregon. Ferguson said according to Rohr, Grant PUD would consider convening the meetings in Wenatchee, Washington, with the HCP in the morning and the PRCC in the afternoon, and then maybe switching arrangements periodically. Ferguson said Rohr also mentioned possibly convening an occasional meeting in western Washington. Ferguson said different start and end times were also discussed and these times could be flexible depending on the agendas.

Craig said one downside is if there are busy agendas it can be a lot to take in. Tom Kahler asked what the purpose is for a westside meeting. Ferguson said he is unsure; it was just a comment that came up. Murdoch said the PRCC used to meet at SeaTac, Washington, and Ferguson said the HCP Coordinating Committees also formerly met at the Radisson in SeaTac, Washington. Craig suggested the Chairmen coordinate ahead of each meeting and if the agendas are light, convene both meetings on the same day. Ferguson agreed in concept but pointed out, if agendas require that the meetings be conducted on separate days, Committee members would have planned for a 1-day meeting and it is likely their schedules on the following day would be filled with other meetings or activities. Carlon said he would likely travel the night before the meetings and travel home after the second meeting. He said for the next three months, however, he will likely conference into the meeting. Murdoch said this topic can be walked onto the next PRCC agenda, too. *(Note: the next HCP Coordinating Committees meeting on February 25, 2020, will be the first concurrent meeting with the PRCC, with the HCP Coordinating Committees convening from 9:00 a.m. to 12:00 p.m. and the PRCC convening from 1:00 to 4:00 p.m., as distributed to the HCP Coordinating Committees by Kristi Geris on January 31, 2020.)*

B. CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam (John Ferguson)

John Ferguson recalled the action item to continue considering whether to request additional information from Jeff Fryer regarding CRITFC's annual request to tag sockeye salmon at Wells Dam. This action item was created based on comments from Kirk Truscott, who is not in attendance; therefore, this action item will be carried forward.

CRITFC's annual request to tag sockeye salmon at Wells Dam in 2020 arrived following the meeting and was distributed to the HCP Coordinating Committees by Kristi Geris on February 4, 2020.

C. YN HCP Policy Committees Representative – David Blodgett, III (John Ferguson)

John Ferguson said David Blodgett, III, has been designated the new YN HCP Policy Committees Representative, as distributed to the HCP Coordinating Committees by Kristi Geris on January 27, 2020. Keely Murdoch said Blodget was hired to the YN Fisheries Department to be the replacement for Steve Parker (YN HCP Policy Committees Representative, retired). Murdoch said Blodgett comes from the YN Wildlife Department. Murdoch asked that Blodgett be added to the HCP Hatchery and Coordinating Committees secondary email distribution lists. Murdoch said Blodget may also attend a future HCP Coordinating Committees meeting.

Anchor QEA will add Blodgett to the HCP Coordinating Committees and HCP Hatchery Committees secondary email distribution lists. *(Note: Kristi Geris added Blodgett to these lists and notified the YN, Tracy Hillman, and Larissa Rohrbach of this addition.)*

D. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on February 25, 2020, to be held at 9:00 a.m., in-person at the Grant PUD Wenatchee office in Wenatchee, Washington. *(Note: this will be the first concurrent meeting with the PRCC, with the HCP Coordinating Committees convening from 9:00 a.m. to 12:00 p.m. and the PRCC convening from 1:00 to 4:00 p.m., as distributed to the HCP Coordinating Committees by Kristi Geris on January 31, 2020.)*

John Ferguson reminded the HCP Coordinating Committees that the first subyearling Chinook salmon quarterly check-in is scheduled for the next meeting. He suggested that the HCP Coordinating Committees be prepared to discuss study design, tag technology, and life history information to better understand future subyearling Chinook salmon survival study feasibility by 2022, during the next HCP Coordinating Committees meeting on February 25, 2020.

The March 24 and April 28, 2020 meetings will be held by conference call or in-person at the Grant PUD Wenatchee Office in Wenatchee, Washington, as is yet to be determined.

VI. List of Attachments

Attachment A List of Attendees
Attachment B *2021 RR and RI Confirmation Survival Study Species Selection Discussion*

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman††	BioAnalysts
Lance Keller*	Chelan PUD
Bill Towey	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
Scott Carlon*†	National Marine Fisheries Service
Jim Craig*	U.S. Fish and Wildlife Service
Keely Murdoch*	Yakama Nation

Notes:

* Denotes HCP Coordinating Committees member or alternate

† Joined by phone

†† Joined by phone for HCP Hatchery and Tributary Committees Update

2021 RR and RI Confirmation Survival Study Species Selection Discussion

January 28, 2020

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HCP Language

- RR and RI HCP's – 5.3.3
  - **Phase III Standard Achieved**
    - "The District Shall proceed to Phase III (Standard Achieved) following measurement and evaluation that indicate that either the 91% Combined Adult and Juvenile Survival Standard or 93% Juvenile Project Survival is being achieved. **In this case, the District shall re-evaluate survival under the applicable standard every 10 years.** Representative species shall be picked by the Coordinating Committee. This re-evaluation will occur over one year and be included in the pertinent average for that particular species."

Previous Juvenile Studies

Project	Species	Juvenile Survival	HCP Study Years [3]
Rock Island	Steelhead	96.75%	2008, 2010 (n = 2)[1]
	Spring Chinook [1, 2]	93.75%	2007-2010 (n = 3)[1]
	Sockeye	93.27%	2007-2009 (n = 3)[1]
Rocky Reach	Steelhead	95.79%	2004-2006 (n = 3)
	Spring Chinook [2]	92.37%	2004-2005, 2010-2011 (n = 4)
	Sockeye	93.59%	2006-2009 (n = 3)

[1] Juvenile survival standards tested at the Rock Island Project under a 10% project spill level.
[2] Spring-migrating, yearling Chinook salmon.
[3] Study years used to calculate Juvenile Survival for Phase Designation evaluation. A total of 30 juvenile acoustic survival studies have been conducted at RR and RI between 2003-2011.

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Combined Adult & Juvenile Survival

Project	Species	Juvenile Survival	Adult Survival	Combined[6]
Rock Island	Steelhead	96.75%	99.31% [2]	**96.08%**
	Spring Chinook	93.75% [1]	99.89% [3]	**93.65%**
	Sockeye	93.27%	98.37% [2]	**91.75%**
Rocky Reach	Steelhead	95.79%	98.93% [2]	**94.77%**
	Spring Chinook	92.37% [1]	99.90% [3, 4]	**92.28%**
	Sockeye	93.59%	98.92% [5]	**92.58%**

[1] Spring-migrating, yearling Chinook salmon.

[2] Estimate does not account for fish losses due to recreational harvest in any years

[3] No recreational harvest occurred for adult spring Chinook

[4] Adult conversion rate and Combined Project Survival approved for Rocky Reach Project on August 30, 2011 using 2009-2011 adult spring Chinook passage data.

[5] Estimate adjusted for loss of fish from recreational harvest in 2010 and 2011, but not for harvest losses in 2012.

[6] Combined survival is the product of juvenile and adult survival estimates (e.g., 98% × 93% = 91%)

Species Selection-Main Points

- Confirmation Survival Studies aim to verify “Phase III Standard Achieved”.[1]
  - Comprised of the 91% Adult and Juvenile survival standard.
- New survival studies for each project will to be conducted to confirm the 91% Combined Adult and Juvenile Survival Standard.
- Results to be included in the pertinent average for selected species.
- Survival studies to be conducted in 2021, RFP anticipated in spring of 2020.

[1] Verification of previously conducted studies including yearling Chinook, steelhead, and sockeye

Discussion

FINAL

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206.287.9130

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: March 24, 2020

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris

Re: Final Minutes of the February 25, 2020 HCP Coordinating Committees Meeting

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met at the Grant PUD office in Wenatchee, Washington, on Tuesday, February 25, 2020, from 9:00 a.m. to 12:15 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

- Anchor QEA, LLC (Anchor QEA) will provide an updated revised draft HCP Coordinating Committees January 28, 2020 meeting minutes to Chelan PUD for review and approval that will include clarification from Chelan PUD regarding the 2021 Confirmation Survival Study species selection agenda topic, as discussed during today's meeting; the final minutes will then be distributed to the HCP Coordinating Committees (Item I-B). *(Note: this was completed, as discussed, and the final HCP Coordinating Committees January 28, 2020 meeting minutes were distributed to the HCP Coordinating Committees by Kristi Geris on March 3, 2020.)*
- Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).
- Chelan PUD will distribute draft Statements of Agreement (SOAs) for the 2021 Confirmation Survival Study species selections for the Rock Island and Rocky Reach projects, which will include the approach discussed and agreed upon during today's meeting, for decision during the HCP Coordinating Committees meeting on March 24, 2020 (Item III-A). *(Note: these SOAs were distributed to the HCP Coordinating Committees by Kristi Geris on March 20, 2020.)*
- Chelan PUD will adjust the positions of spill gates 18 and 26 in the spill gate sequence, as discussed in the *2020 Fish Spill Plan, Rock Island and Rocky Reach Dams, Public Utility District No. 1 of Chelan County* (2020 Rock Island and Rocky Reach Fish Spill Plan); the final plan will then be distributed to the HCP Coordinating Committees (Item III-E).
- Chelan PUD will distribute Rock Island Dam spillway gate opening depths to the HCP Coordinating Committees (Item III-E).
- Anchor QEA will set a reminder for December 2020 to consider scheduling an HCP Coordinating Committees in-person meeting at Rocky Reach Dam following completion of the Visitor's Center renovation (tentatively set for July 2021; Item III-J). *(Note: Kristi Geris set this reminder, as discussed.)*

- Douglas PUD will update Jeff Fryer (Columbia River Inter-Tribal Fish Commission [CRITFC]) on Wells HCP Coordinating Committee discussions regarding CRITFC's annual request to tag sockeye salmon at Wells Dam (Item IV-C).
- Wells HCP Coordinating Committee representatives will discuss internally CRITFC's annual request to tag sockeye salmon at Wells Dam, for a possible decision during the HCP Coordinating Committees meeting on March 24, 2020 (Item IV-C).
- Douglas PUD will distribute a corrected Wells Dam west fishway fish salvage memorandum to the HCP Coordinating Committees (Item IV-D). *(Note: Tom Kahler provided a corrected memorandum following the meeting on February 25, 2020, which Kristi Geris distributed to the HCP Coordinating Committees that same day.)*
- Anchor QEA will coordinate to add Scott Hopkins (Chelan PUD) to the HCP Hatchery Committees email distribution list and provide Hopkins with HCP Hatchery Committees extranet site access, as approved by the HCP Coordinating Committees (Item VII-B). *(Note: Kristi Geris notified Catherine Willard [Chelan PUD HCP Hatchery Committees Representative], Tracy Hillman [HCP Hatchery Committees Chairman], and Larissa Rohrbach [HCP Hatchery Committees Support Staff] of this approval; and Geris contacted Julene McGregor [Douglas PUD Information Services Staff] to request extranet access for Hopkins, as discussed.)*
- The HCP Coordinating Committees meeting on March 24, 2020, will be held at 9:00 a.m., in-person at the Grant PUD Wenatchee office in Wenatchee, Washington (Item VII-C). *(Note: this meeting has been changed to be held by conference call.)*

Decision Summary

- Rock Island and Rocky Reach HCP Coordinating Committees representatives present approved the *2020 Rocky Reach and Rock Island HCP Action Plan* (Item III-D).
- Rock Island and Rocky Reach HCP Coordinating Committees representatives present approved the 2020 Rock Island and Rocky Reach Fish Spill Plan (Item III-E).
- Wells HCP Coordinating Committee representatives present approved the *Draft 2020 Wells HCP Action Plan*, as revised (Item IV-A).
- Wells HCP Coordinating Committee representatives present approved the *2020 Total Dissolved Gas Abatement Plan* (and appended *Wells Bypass Operating Plan*; Item IV-B).
- The *2019 Wells HCP Annual Report* was approved by the Wells HCP Coordinating Committee on March 6, 2020, after no disapprovals were received prior to the 30-day review period deadline (Item IV-E).

Agreements

- Rock Island HCP Coordinating Committees representatives present agreed on the following approach for the 2021 Rock Island HCP Confirmation Survival Study species selection: 1) select yearling Chinook salmon for the juvenile target species; 2) select spring Chinook salmon to calculate the adult conversion rate; 3) if feasible given the data, conduct a post-hoc analysis of juvenile survival using study fish data segregated by origin (adipose [ad]-present versus ad-clipped yearling Chinook salmon); and 4) study fish may include fish that have coded wire tags but not passive integrated transponder (PIT) tags (Item III-A).

- Rocky Reach HCP Coordinating Committees representatives present agreed on the following approach for the 2021 Rocky Reach HCP Confirmation Survival Study species selection: 1) select yearling Chinook salmon for the juvenile target species; 2) select spring Chinook salmon to calculate the adult conversion rate; 3) if feasible given the data, conduct a post-hoc analysis of juvenile survival using study fish data segregated by origin ad-present versus ad-clipped yearling Chinook salmon; and 4) study fish may include fish that have coded wire tags but not PIT tags (Item III-A).
- HCP Coordinating Committees representatives present agreed to add Scott Hopkins, the future Chelan PUD HCP Hatchery Committees Alternate, to the HCP Hatchery Committees email distribution list and provide Hopkins with access to the HCP Hatchery Committees extranet site (Item VII-B).

Review Items

- The *Wells Project Subyearling Chinook Life-History Study 2011-2013 Draft Final Report* was distributed to the HCP Coordinating Committees by Kristi Geris on May 24, 2019.
- CRITFC’s annual request to tag sockeye salmon at Wells Dam in 2020 was distributed to the HCP Coordinating Committees by Kristi Geris on February 4, 2020 (Item IV-C).
- The draft *2019 Rock Island Dam Smolt Monitoring Program and Gas Bubble Trauma Evaluation Draft Report* (2019 Rock Island Smolt and Gas Bubble Trauma Evaluation Report) was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and is available for a 30-day review, with edits and comments due to Lance Keller by Monday, March 16, 2020 (Item III-F).
- The draft *2019 Biological Evaluation of the Rocky Reach Juvenile Fish Bypass System Draft Report* (2019 Rocky Reach Juvenile Fish Bypass System Report) was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and is available for a 30-day review, with edits and comments due to Lance Keller by Monday, March 16, 2020 (Item III-G).
- The draft *Rock Island Dam Smolt Monitoring and Gas Bubble Trauma Evaluation Plan 2020* (2020 Rock Island Bypass Monitoring Plan) was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and is available for a 30-day review, with edits and comments due to Lance Keller by Monday, March 16, 2020 (Item III-H).
- The draft *2020 Rocky Reach Juvenile Fish Bypass System Operations Plan* was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and is available for a

30-day review, with edits and comments due to Lance Keller by Monday, March 16, 2020 (Item III-I).

- The draft *2019 Rock Island HCP Annual Report* and draft *2019 Rocky Reach HCP Annual Report* were distributed to the HCP Coordinating Committees by Kristi Geris on February 18, 2020, and are available for a 30-day review with edits and comments due to Geris by March 19, 2020.
- The 2020 Broodstock Collection Protocols were distributed to the Wells HCP Coordinating Committee by Kristi Geris on March 19, 2020; Douglas PUD will request approval of the protocols during the HCP Coordinating Committees conference call on March 24, 2020.
- The draft SOA, *Selection of Yearling Chinook and Adult Spring Chinook for Chelan PUD's 2021 Rock Island Confirmation Survival Study*, was distributed to the HCP Coordinating Committees by Kristi Geris on March 20, 2020 (Item III-A).
- The draft SOA, *Selection of Yearling Chinook and Adult Spring Chinook for Chelan PUD's 2021 Rocky Reach Confirmation Survival Study*, was distributed to the HCP Coordinating Committees by Kristi Geris on March 20, 2020 (Item III-A).

Finalized Documents

- The final *2020 Wells HCP Action Plan* was distributed to the HCP Coordinating Committees by Kristi Geris on February 25, 2020 (Item IV-A).

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. The following revisions were requested:

- Jim Craig added an update on the Leavenworth Fisheries Complex Manager position
- Tom Kahler added an update on the draft *Wells HCP Annual Report*
- Ferguson added a request to add Scott Hopkins to the HCP Hatchery Committees email distribution list and enable extranet access

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft January 28, 2020 meeting minutes. Kristi Geris said all comments and revisions received from members of the Committees were incorporated into the revised minutes and there is one outstanding comment to be addressed regarding the 2021 Confirmation Survival Study species selection agenda topic. Lance Keller said he wanted to clarify that after further review of Dr. John Skalski's (Columbia Basin Research) notes, the calculated project survival (as the fourth root of survival through four projects) did incorporate survival metrics outside of the project boundary and should be considered minimal survival values (i.e., did not assume equal survival through each project). Keller said, for example, if a harvest estimate was available for a project, survival was adjusted conservatively for this through that project. He said if a harvest estimate was not available (i.e., sockeye salmon harvest estimate below Wanapum Dam) then project survival could not be corrected for recreational harvest, thus producing a minimum estimate of adult conversion/survival on a project scale. Geris said Anchor QEA will provide an updated revised draft HCP Coordinating Committees January 28, 2020 meeting minutes, which will include this clarification, to Chelan PUD for review and approval prior to finalizing the minutes. Geris said she also added the distribution of the draft *2019 Rock Island HCP Annual Report* and draft *2019 Rocky Reach HCP Annual Report* for a 30-day review to the Review Items section of the revised minutes. *(Note: the final HCP Coordinating Committees January 28, 2020 meeting minutes were distributed to the HCP Coordinating Committees by Geris on March 3, 2020.)*

HCP Coordinating Committees members present approved the January 28, 2020 meeting minutes, as revised. The Colville Confederated Tribes (CCT) and Washington Department of Fish and Wildlife (WDFW) abstained because representatives of theirs were not present during the January 28, 2020 meeting.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on January 28, 2020, and follow-up discussions, were as follows. *(Note: Italicized text corresponds to agenda items from the meeting on January 28, 2020):*

- *Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).*
  This will be discussed during today's meeting and will also be carried forward.
- *Anchor QEA, LLC (Anchor QEA) will distribute the redline version of the draft 2020 Total Dissolved Gas Abatement Plan (and appended Wells Bypass Operating Plan) to the HCP Coordinating Committees for review, and will notify WDFW and the CCT, who were not in attendance at this meeting, to contact Douglas PUD with questions (Item III-B).*
  Kristi Geris distributed the redline version and notified WDFW and the CCT, as discussed, following the meeting on January 28, 2020.
- *Chelan PUD will investigate how loss of fish from recreational harvest was calculated and incorporated into adult survival estimates in past Rock Island and Rocky Reach survival studies (Item IV-D).*
  This will be discussed during today's meeting.
- *The Yakama Nation (YN) will confirm whether the additional coho salmon released during the YN Coho Salmon Reintroduction Program 3-Year Natural Production phase will receive PIT tags (Item IV-D).*

Keely Murdoch clarified that the 3-year phase of increased release numbers is ongoing right now, and 2020 is the final year for releasing 1 million fish each of three years. She said in 2021, release numbers will go back to 700,000 fish, per usual. She said this year, 27,000 PIT-tagged fish will be released and come back as adults starting in 2021.

- *Chelan PUD will update WDFW and the CCT about the Rock Island and Rocky Reach 2021 Confirmation Survival Study species selection discussion in preparation for a possible decision during the HCP Coordinating Committees meeting on February 25, 2020 (Item IV-D).*
  Lance Keller said this was done.
- *Chelan PUD will determine the minimum sample size required to calculate combined adult survival (Item IV-D).*
  This will be discussed during today's meeting.
- *The HCP Coordinating Committees will prepare prioritized suggestions for a Rock Island and Rocky Reach 2021 Confirmation Survival Study species selection for discussion and possible decision during the HCP Coordinating Committees meeting on February 25, 2020, and will email Committees members with thoughts on selecting one species over others prior to the meeting, if warranted (Item IV-D).*
  This will be discussed during today's meeting.
- *Chelan PUD will consider preparing a pros and cons list for a Rock Island and Rocky Reach 2021 Confirmation Survival Study species selection for discussion and possible decision during the HCP Coordinating Committees meeting on February 25, 2020 (Item IV-D).*
  This will be discussed during today's meeting.
- *The HCP Coordinating Committees will continue considering whether to request additional information from Jeff Fryer regarding Columbia River Inter-Tribal Fish Commission's (CRITFC's) annual request to tag sockeye salmon at Wells Dam, to be further discussed during the HCP Coordinating Committees meeting on January 28, 2020 (Item V-B).*
  This will be discussed during today's meeting.
- *Anchor QEA will add David Blodgett, III (YN HCP Policy Committees Representative) to the HCP Coordinating Committees and HCP Hatchery Committees secondary email distribution lists (Item V-C).*
  Kristi Geris added Blodgett to these lists and notified the YN, Tracy Hillman, and Larissa Rohrbach of this addition.
- *The HCP Coordinating Committees will prepare to discuss study design, tag technology, and life history information to better understand future subyearling Chinook salmon survival study feasibility by 2022, during the first subyearling Chinook salmon quarterly check-in at the next HCP Coordinating Committees meeting on February 25, 2020 (Item V-D).*
  This will be discussed during today's meeting.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman said the HCP Tributary Committees did not meet in February 2020; however, the Committees did receive a General Salmon Habitat Program Application:

- *City of Leavenworth Fish Screen Project*: This proposal was from Trout Unlimited. The purpose of the project is to bring the existing failing screen into compliance to protect all fish species and life stages from injury, entrainment, and mortality. The screen is located at river mile 5.8 on Icicle Creek. This project will complement the Icicle Boulder Field Project. The total cost of the project was $900,100. The sponsor requested $475,100 from HCP Plan Species Account Funds. The Rock Island HCP Tributary Committee elected to contribute $475,100 to the project. Jim Craig asked if the City of Leavenworth plans to contribute the remaining cost of the project. Hillman said there is a cost share in place; however, he is unsure exactly how much the City will contribute. Andrew Gingerich asked how many fish screens are included in this cost, and Hillman said one.
- *Next Meeting*: The HCP Tributary Committees will not officially meet in March; however, Committee representatives will attend project presentations with the Regional Technical Team on March 11 and 12, 2020.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees meeting on February 19, 2020 (*note: joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *2020 Broodstock Collection Protocols (joint):* The HCP Hatchery Committees are reviewing the updated protocols. Comments are due March 4, 2020, with vote to approve during the next HCP Hatchery Committees meeting on March 18, 2020. Hillman said once approved, the protocols will be sent to the Wells HCP Coordinating Committee for review and approval. John Ferguson said this will be a decision item during the HCP Coordinating Committees meeting on March 24, 2020, and he asked if there is anything needing discussion today? Tom Kahler said the Wells HCP Coordinating Committee interest in the protocols is regarding the trapping schedule. He said the proposed trapping schedule has not changed at Wells Dam or Wells Fish Hatchery (FH), except: 1) there will no longer be a fall collection of steelhead broodstock; 2) summer Chinook salmon incidentally encountered while trapping for spring Chinook salmon can now be retained as qualified broodstock (formerly unable to retain until July 1); and 3) coho salmon collection, which starts in the third week in September, will no longer occur concurrent with steelhead trapping (see exception 1). Ferguson asked about the trapping days and hours at Wells Dam. Kahler said the most recent Section 10 permit does not specify trapping constraints (deferring to the Wells HCP Coordinating Committee), but what is proposed is 16 hours per day of trapping, unless there is a need for additional collection then trapping for spring Chinook salmon can occur all day, 7 days per week.

- *Collection Site for Chiwawa Spring Chinook Salmon Broodstock (joint):* In January 2020, Chelan PUD described the issues of collecting natural-origin Chiwawa spring Chinook salmon broodstock at the Chiwawa Weir. Recall, Chelan PUD was unable to collect the necessary number of natural-origin broodstock at the weir because of the large number of bull trout encountered there. Thus, in January, Chelan PUD proposed to collect natural-origin spring Chinook salmon that are genetically identified as Chiwawa-origin (with 95% certainty) at Tumwater Dam. In February 2020, Chelan PUD proposed to modify broodstock collection efforts at the Chiwawa Weir; rather than trap 24 hours every other day at the weir (i.e., weir would be up and fishing for 24 hours and then down for 24 hours), Chelan PUD proposed trapping only during daylight hours (weir is up only during daylight hours). Thus, the weir would be down during nighttime when bull trout are moving. This approach has been used successfully at the Twisp Weir. The HCP Hatchery Committees agreed to test this approach during 2020. If the approach works, there will be no need, or less need, to collect broodstock for the Chiwawa spring Chinook salmon program at Tumwater Dam. This should help the program achieve percent natural-origin broodstock and proportionate natural influence goals.
- *WDFW Hatchery Reform in Washington (joint):* WDFW provided a summary on their review of hatchery reform science in Washington State. The review identified overarching themes, Hatchery Scientific Review Group recommendations, and knowledge gaps and major assumptions of current hatchery management. WDFW also noted that the hatchery policy review report will be available soon.
- *YN Summer Chinook Salmon Program* (Rock Island/Rocky Reach): Chelan PUD reported that the YN will pay an annual fee for space at Eastbank FH to hold 620 adult summer Chinook salmon. The YN will spawn these fish and transfer green eggs to their hatchery facility on the Yakima River. The holding of these fish will not affect HCP hatchery production at Eastbank FH.
- *2020 Rock Island and Rocky Reach HCP Action Plan* (Rock Island/Rocky Reach): The Rock Island and Rocky Reach HCP Hatchery Committees reviewed the action plan. There were no edits or concerns with the plan.
- *2020 Wells HCP Action Plan* (Wells): The Wells HCP Hatchery Committee reviewed the action plan. There were no edits or concerns with the plan.

- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on March 18, 2020. Due to a conflict with the American Fisheries Society meeting in April 2020, the HCP Hatchery Committees meeting on April 15 was moved to April 21, 2020.

III. Chelan PUD

A. DECISION: 2021 Confirmation Survival Study Species Selection Discussion (Lance Keller)

Lance Keller said, acknowledging that the full Rock Island and Rocky Reach HCP Coordinating Committees were not present during the last HCP Coordinating Committees meeting, Chelan PUD is open to extending this decision into next month, if needed. He said, per Chelan PUD's action items, he discussed this topic with Kirk Truscott and Chad Jackson after the last meeting.

Keller said he and Truscott discussed the possibility of studying spring Chinook salmon (springers), as able, including the ability to collect and tag adipose fin (ad)-present yearlings at the Rocky Reach Juvenile Fish Bypass System (RRJFBS) to target a higher probability of collecting study fish that are true springers. Truscott said the yearling summer Chinook salmon (summers) hatchery production above Priest Rapids Dam is 100% ad-clipped. He said in reviewing stock status, springers are struggling the most in the Mid-Columbia River Basin, and it is important to consider as best as possible springers as study subjects in the upcoming survival study to make sure the HCPs are mitigating most appropriately for struggling species. He said if ad-present spring migrants are collected at the RRJFBS, these will mostly be springers or wild yearling summers. Truscott said he and Keller also discussed risks associated with selecting springers as the study fish—what if Chelan PUD cannot meet collection targets? Truscott said Keller reviewed run data and it seems it might be difficult to collect adequate numbers of fish. Keller said he reviewed the daily ad-clipped percentage and total number of fish run comparison. He said these matched closely; however, in 2018 and 2019, after the initial peak, ad-present yearling numbers ranged from 100 to below 50 fish daily. He said confidence to collect these ad-present fish for replicates might be compromised. Keller said he discussed this with Todd West (Chelan PUD Fish and Wildlife Superintendent) whose foreman operated the RRJFBS in 2010 and 2011. Keller said during that timeframe, the RRJFBS was operated every day, at the top of each hour for 20 minutes, which includes sampling outside the normal index sample hours. He said even with samples being collected throughout each day and including collection of both ad-present and ad-clipped fish, it was still difficult to collect sample size targets. He explained that certain standards need to be met for a fish to be considered as a study fish in a replicate, including fish length, fish condition based on tag weight or burden, and fish condition based on limited injury and descaling. He said also, if a fish has been previously PIT-tagged, this fish cannot be used due to additional handling biases and this might also compromise any programs the fish is already a part of for research. He said these standards eliminate biases in the survival estimate but also narrow the number of fish available for study. He said Chelan PUD's goal is to collect 45 to 50 fish for each replicate to meet a target sample size for each replicate of 25 to 35 fish that can be tagged. He said further, data indicate more ad-present and ad-clipped fish abundance in 2010 and 2011 compared to 2018 and 2019 in the index sample data. Keller said he and Truscott also discussed extended sampling to obtain study fish; however, no additional extended sampling has been conducted other than what was implemented in 2010 and 2011 so there are no additional data to consider. Keller said there will be some overlap in species migrations while collecting study fish, which could result in collecting thousands of fish (e.g., sockeye salmon) in a short timeframe (45 seconds). He said when this occurs, it takes additional time to handle all of these fish, move the fish out of the facility, and get ready to handle the next sample. He said using run-of-the-river fish as test species is great because this measures what is migrating; however, due to high fish traffic through the facility it can be difficult to target specific species for collection. Truscott said he and Keller also discussed how to collect fish for replicates in a manner that tracks the actual run timing; however, because there needs to be a consistent number of fish collected for each replicate and true run timing is not known until the juvenile outmigration is fully complete, this makes it tougher to collect the numbers needed on the tail ends of the outmigration. Truscott said in summary, he would like to study the most struggling species (springers); however, it does not seem feasible.

Keller said he updated Jackson on discussions with the HCP Coordinating Committees and Truscott, including reviewing the presentation he shared during the last meeting. Jackson said similar to Truscott, he would like to see an evaluation on springers; however, he understands the difficulties associated with doing this. Jackson suggested that Chelan PUD modify the study design where possible, similar to how Douglas PUD agreed to modify the study design for their 2020 Survival Verification Study, to at least collect some data on springers. Keller said historically, the goal of the study has been to reflect run-of-the-river yearling Chinook salmon that are available to tag migrating through the Rock Island and Rocky Reach projects. He said another goal has also been to keep consistent with the HCPs where there is no preference regarding origin of species, i.e., tagging what is available and represent the run as a whole. Jim Craig asked if it would be feasible to run survival on both ad-present and ad-clipped and if there are enough unmarked wild Chinook salmon, then develop the survival estimates for this population. Keller said it is hard to say without knowing the numbers, but based on the 2010 and 2011 study, it was difficult to meet tagging criteria.
John Ferguson further outlined what Craig was suggesting, which is to select a mixed tagged history where the prioritization is for ad-present fish throughout the season and shortfalls would be made up by ad-clipped fish along the way. Keller said this could introduce a bias into the survival estimate and suggested, instead, that collecting fish be done similar to the 2010 to 2011 studies: tag fish that meet the tagging criteria, and conduct an analysis on the backside. Craig asked if in 2010 and 2011, did Chelan PUD use summers regardless of origin? Keller said yes that fish with coded wire tags were acceptable to use as study fish. Ferguson summarized that Keller is suggesting tagging the run as it

comes in and conducting a post-hoc analysis of the data if feasible to analyze the survival of juvenile spring Chinook salmon. Truscott said numbers of ad-present fish will be so small compared to ad-clipped because hatchery fish dominate the composition of yearling spring migrants. Keller said attempting to match up proportions on test and control sides might be even more difficult.

Keller recalled Craig talking briefly on harvest calculations during the last meeting. Keller said when available from WDFW, John Skalski does apply harvest rates. Keller said these data are available for some species in specific reaches of the hydro system. He said for example, there are harvest data for sockeye salmon in the Rocky Reach Project but not for Rock Island, i.e., the adult conversion calculated for the Rock Island Project included a harvest component that was not corrected, but this was corrected for Rocky Reach. He said to calculate this for springers, PTAGIS could be queried for fish passing Rock Island Dam to account for travel time to, for example, Wells Dam before the summer Chinook salmon fishery opens.

Keller recalled Keely Murdoch asking a question about minimum sample size for adults during the last meeting. Keller said Dr. Rebecca Buchanan (Columbia Basin Research) indicated this is species-specific, but he believes generally, the minimum sample size for adult conversion rates is 40 to 60 adults on an annual basis. Keller said detection efficiency and survival are also included in this calculation, which collectively includes 3 years of data. Ferguson asked if there were issues in 2010 and 2011 with having enough data to perform the adult conversion calculations. Keller said to his recollection, no, because the calculation considers adult survival over 3 years and combines them so there were plenty of data points.

Keller recalled an action item from the last meeting for Chelan PUD to consider developing a pros and cons list for a species selection. He said Chelan PUD is still working on this list internally and if after today's discussion the HCP Coordinating Committees still feel the list is warranted, Chelan PUD can deliver the list to the HCP Coordinating Committees in the next week. He said based on data reviewed, from a juvenile perspective, he believes yearling Chinook salmon or steelhead are possible choices. He said based on collection numbers, sockeye salmon might meet replicate requirements and be possible to study, as well. He said coho salmon could be a struggle in some years. He said the coho salmon juvenile outmigration shows variability in duration and numbers at the RRJFBS. He said in the past 10 years, the coho salmon run has been truncated and compacted, even more so than the sockeye salmon run. He said this may pose challenges from a juvenile perspective regarding meeting model assumptions. He asked the HCP Coordinating Committees to share thoughts on species selections.

Craig said he likes the yearling Chinook salmon option regardless of origin. He said it would be nice to get a better handle on wild fish; however, he does not believe the sample size is available.

Truscott said he is trying to reconcile if the study was weighted for run timing, would studying springers be doable. He also asked if there would be implications associated with weighting the study for run timing versus years the study was not weighted. He said he is still concerned about adequately mitigating for springer impacts.

Murdoch said she is still leaning towards yearling spring Chinook salmon, mainly because recovery of the species seems tricky. She said currently, there are some lower measurements for the species using adult and juvenile survival and it would be beneficial to have another data point. She agreed it would be ideal to design the study to reflect wild springers to the extent possible, understanding that a study using run-of-the-river fish is limiting in that if the wild springer run timing is earlier it is not possible to study the earlier part of the run. She said she also sees the value in studying steelhead because there are only 2 years of data rather than 3 years for the Rock Island Project. She said she understands there would need to be a significant outcome to affect the species; however, another year of data will help inform hatchery mitigation.

Scott Carlon said he supports studying yearling Chinook salmon.

Keller said he thinks weighting the study for run timing would be difficult because run timing is not known until after the run is complete, resulting in an educated guess on the size of individual replicates to be released. Would this mean releasing replicates of 2 to 5 fish at the beginning and end of the juvenile outmigration? He said this would also limit the ability to review the data on a replicate basis due to small sample sizes of replicates released during assumed early and late points of the juvenile outmigration.

Jackson said if yearling Chinook salmon are selected as the study species, what are the next steps? He asked if Chelan PUD will then develop a study design that the HCP Coordinating Committees can provide comments on regarding collection period, size criteria and timing, and other adjustments to try and incorporate data on springers. Keller said this is correct. He said Chelan PUD will release a Request for Proposals and the selected contractor will be involved in the study design process that will hopefully be ready for HCP Coordinating Committees review by Q4 2020 or Q1 2021.

Truscott said he can support using yearling Chinook salmon as the target component for this study. He said, however, springers are doing really poorly and there is sentiment that the problem is upriver. He said there will be a benefit to everyone in the Mid-Columbia River Basin to target springers as a study species, which is why he is pushing for this. Keller said he understands, and Chelan PUD has also heard and responded to these sentiments.

Truscott said 2011 was a high-water year, and he asked how sampling and collection efficiency at the RRJFBS might differ during a low flow year. Keller said in 2010, the RRJFBS had 53.6% collection efficiency and in 2011, the RRJFBS had 49.1% collection efficiency—so, similar in both water years.

Ferguson asked the HCP Coordinating Committees if members are ready to agree on a study species. Keller noted that a study species will need to be approved for each project (i.e., Rock Island and Rocky Reach projects).

Rock Island HCP Coordinating Committees representatives present agreed on the following approach for the 2021 Rock Island HCP Confirmation Survival Study species selection: 1) select yearling Chinook salmon for the juvenile target species; 2) select spring Chinook salmon to calculate the adult conversion rate; 3) if feasible given the data, conduct a post-hoc analysis of juvenile survival using study fish data segregated by origin ad-present versus ad-clipped yearling Chinook salmon; and 4) study fish may include fish that have coded wire tags but not PIT tags.

Rocky Reach HCP Coordinating Committees representatives present agreed on the following approach for the 2021 Rocky Reach HCP Confirmation Survival Study species selection: 1) select yearling Chinook salmon for the juvenile target species; 2) select spring Chinook salmon to calculate the adult conversion rate; 3) if feasible given the data, conduct a post-hoc analysis of juvenile survival using study fish data segregated by origin ad-present versus ad-clipped yearling Chinook salmon; and 4) study fish may include fish that have coded wire tags but not PIT tags.

Keller said Chelan PUD will distribute draft SOAs for the 2021 Confirmation Survival Study species selections for the Rock Island and Rocky Reach projects, which will include the approach discussed and agreed upon during today's meeting, for decision during the HCP Coordinating Committees meeting on March 24, 2020. *(Note: these SOAs were distributed to the HCP Coordinating Committees by Kristi Geris on March 20, 2020.)*

B. Rocky Reach Dam Turbine Units Maintenance Update (Lance Keller)

Lance Keller said Turbine Unit C1 is ahead of schedule and was watered up last week. He said crews are conducting tests on the unit now and there is an early March 2020 return-to-service date, with a marked fish release planned for intake screen system in the RRJFBS prior to the start of the bypass season.

Keller said regarding Turbine Unit C3, Rocky Reach Dam staff, in consultation with Italian engineers, continue to move forward with hydraulically locking the blades into place. Keller said this includes developing new blade angles and populating the proper code for testing.

Keller recalled that Chelan PUD was considering changing the overall maintenance schedule for the Rocky Reach Dam powerhouse, in light of the development of the trunnion seal issues in the small units. He recalled the initial plan was to address one small unit and one large unit simultaneously; however, the new plan is to address the small units first and postpone addressing the large units (which have hairline cracks in the servo rod pipes). He said this approach focuses on repairing the small units ahead of the check-in study in 2021, and addresses Turbine C10 in December 2021 and Turbine Unit C11 in February 2022, with both units back online by Q1 2023. He said Turbine Units C10 and C11 will remain operational until Turbine Unit C10 is taken out of service in December 2021.

Kirk Truscott asked if two small units will be out-of-service at the same time, and Keller said yes. Truscott said in 2022, how will having two large units out-of-service at the same time impact the spill plan relative to which bays are spilling or operating? He said the spill configuration is important while conducting survival studies. Keller said from a spill perspective, there should be no change in the ability to spill in the same fashion as usual. He said the spillway is separate from the turbine units so there should be no impacts to the spill gates. He said additionally, studies are conducted with targeted no spill operations. He said if anything, when repairs start on the large units there may be involuntarily spill for headwater control if there is a large freshet.. Truscott said he just wanted to be sure there would be no altered spill configuration, and Keller said not at all.

C. Rock Island Dam Powerhouse 1 Maintenance Update (Lance Keller)

Lance Keller said mechanical crews continue to work on Turbine Unit B4, with a return-to-service date of May 2020. He said work is being done on the conduits for the hydraulic power unit system, programming, and the rotor. He said crews are out of the turbine pit and are moving up the unit. He recalled this is the first look into an original unit at Rock Island Dam and what it takes to rehab the whole unit. He said next, work will begin on Turbine Unit B3 and will hopefully be more efficient by utilizing lessons learned from Turbine Unit B4.

D. DECISION: 2020 Rocky Reach and Rock Island HCP Action Plan (Lance Keller)

Lance Keller said the draft *2020 Rocky Reach and Rock Island HCP Action Plan* was distributed to the HCP Coordinating Committees by Kristi Geris on January 28, 2020. Keller said no comments were received from the HCP Coordinating or Hatchery Committees. Geris asked if the HCP Tributary Committees reviewed the tributary portion of the plan. Tom Kahler said the HCP Tributary Committees reviewed all action plans. Keller said no comments were received from Catherine Willard (Chelan PUD HCP Tributary Committees representative).

Rock Island and Rocky Reach HCP Coordinating Committees representatives present approved the *2020 Rocky Reach and Rock Island HCP Action Plan*.

E. DECISION: 2020 Rock Island and Rocky Reach Fish Spill Plan (Lance Keller)

Lance Keller said the draft 2020 Rock Island and Rocky Reach Fish Spill Plan was distributed to the HCP Coordinating Committees by Kristi Geris on January 28, 2020. Keller said no comments were received on the draft plan; however, he and Kirk Truscott discussed changes to notch gates 26 and 18 to full gates for the duration of the spring spill season in 2020. Keller explained that the current spill plan has gate 26 as number 5 and gate 18 as number 7 in the gate sequence. He said when these gates are converted to full gates during the spill season, if the gate sequence is not altered, these gates will then be operated before the other notch gates; therefore, he proposed moving gates 26 and 18 in the gate sequence so they are the first full gates to be operated, ensuring all of the over/under and notch gates are utilized before full gate operations. Truscott said he just wants to be sure spill is provided in important fish passage locations. Keller said gates 26 and 18 will still be located on the spillway 2 side where the bulk of fish passage occurs. John Ferguson said the proposed move prioritizes fish passage slot spill bays over deep spill bays, which is ideal. Keller said in theory, the sequence will reach the full gates sooner because there will be reduced spill capacity available via the over/under and notched gates, causing operators to then rely on full gate operations to meet daily spill targets. Keller recalled that a crack was detected in spillway pier 1, which ultimately influenced the decision to convert gates 26 and 18 to full gates for the entire spring spill season. He said he is unsure about the timeline for fixing the crack, but it involves rerouting electrical conduits across the entire spillway. Scott Carlon asked how deep the crack is. Keller said he is unsure; however, there are no concerns with operating notch gates at this location, but there are concerns with full gate operations.

Truscott asked if converting gates 26 and 18 are the same operations implemented in past years, and Keller said these have been standard practice since 2018 due to a malfunction with the spill gates. Truscott asked if this will result in less notch gate spill in the spillway. Keller said yes, there will be more full gate spill and this sequence is intended to address total dissolved gas in certain locations while still providing fish passage. He said converting gates 26 and 18 will result in more flow through these gates compared to in the notch gate configuration.

Truscott asked if the check-in study in 2021 will be conducted under the normal spill configuration. Keller said yes and Chelan PUD is supporting an expedited process to address this. Truscott asked about estimating survival under the two different spill configurations, where in one configuration during 2021 testing the spill pattern and gate configuration would reflect the 2018 to 2020 period, while another would reflect the standard pattern and configuration. Keller said having gates 26 and 18 in full gate configuration is not how Rock Island Dam will be operated moving forward; rather, having gates 26 and 18 as notch gates is the preferred configuration. He added that the depths are not significantly different. He said he will distribute Rock Island Dam spillway gate opening depths to the HCP Coordinating Committees.

Rock Island and Rocky Reach HCP Coordinating Committees representatives present approved the 2020 Rock Island and Rocky Reach Fish Spill Plan. Keller said Chelan PUD will adjust the positions of spill gates 18 and 26 in the spill gate sequence in the spill plan, as discussed, and the final plan will then be distributed to the HCP Coordinating Committees.

F. 2019 Rock Island Smolt and Gas Bubble Trauma Evaluation Report (Lance Keller)

Lance Keller said the draft 2019 Rock Island Smolt and Gas Bubble Trauma Evaluation Report was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and is available for a 30-day review, with edits and comments due to Keller by Monday, March 16, 2020. Keller said there is nothing unusual in the report. John Ferguson noted that Chelan PUD will request approval of this report during the HCP Coordinating Committees meeting on March 24, 2020.

G. 2019 Rocky Reach Juvenile Fish Bypass System Report (Lance Keller)

Lance Keller said the draft 2019 Rocky Reach Juvenile Fish Bypass System Report was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and is available for a 30-day review, with edits and comments due to Keller by Monday, March 16, 2020. Keller said he will pass edits and comments along to Scott Hopkins (Chelan PUD). John Ferguson noted that Chelan PUD will request approval of this report during the HCP Coordinating Committees meeting on March 24, 2020.

H. 2020 Rock Island Bypass Monitoring Plan (Lance Keller)

Lance Keller said the draft 2020 Rock Island Bypass Monitoring Plan was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and is available for a 30-day review, with edits and comments due to Keller by Monday, March 16, 2020. Keller said the plan is unchanged from 2019, except there will be additional PIT-tagging of steelhead as part of a Priest Rapids Coordinating Committee (PRCC) and Real Time Research avian predation study. John Ferguson noted that Chelan PUD will request approval of this plan during the HCP Coordinating Committees meeting on March 24, 2020.

I. 2020 Rocky Reach Juvenile Fish Bypass System Operations Plan (Lance Keller)

Lance Keller said the draft 2020 Rocky Reach Juvenile Fish Bypass System Operations Plan was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and is available for a 30-day review, with edits and comments due to Keller by Monday, March 16, 2020. Keller said the plan is unchanged from 2019, except the alternate operations language formerly under Turbine Unit C1 has moved to Turbine Unit C2. He recalled this language describes adjusting the soft-limit set point to allow additional flow. John Ferguson noted that Chelan PUD will request approval of this plan during the HCP Coordinating Committees meeting on March 24, 2020.

J. Rocky Reach and Rock Island Adult Fishway Maintenance Update (Lance Keller)

Lance Keller reviewed adult fishway maintenance updates at Rock Island Dam and Rocky Reach Dam, as follows:

Rock Island Dam

Keller said the middle ladder was returned to service on February 12, 2020, and all three fish ladders are now operational. *(Note: the right ladder was returned to service on February 8, 2020.)*

Rocky Reach Dam

Keller said the ladder was watered up on February 18, 2020, to test the seals on the new fish viewing windows and also allow contingency should a leak be detected. He said no leaks were detected and the ladder remained watered up and was returned to service that same day.

Keller said the new windows are great and run from floor to ceiling. He said the area will not be open to the public until next year due to the renovation of the entire Visitors Center. Bill Towey (Chelan PUD) said the target completion date for the renovation is July 2021. Keller noted that the remodeled Visitors Center eliminates the security checkpoint at that location. John Ferguson suggested convening an in-person meeting at Rocky Reach Dam once the renovation is complete. Keller agreed this is a good idea and noted that there may be additional things to see regarding the check-in study. Kristi Geris said she will set a reminder for December 2020 to consider scheduling an HCP Coordinating Committees in-person meeting at Rocky Reach Dam following completion of the Visitor's Center renovation (tentatively set for July 2021). *(Note: Geris set this reminder, as discussed.)*

IV. Douglas PUD

A. DECISION: Draft 2020 Wells HCP Action Plan (Tom Kahler)

Tom Kahler said the *Draft 2020 Wells HCP Action Plan* was distributed to the HCP Coordinating Committees by Kristi Geris on January 20, 2020. Kahler said no comments were received from the Wells HCP Hatchery Committee and the Wells HCP Tributary Committee approves. He said the plan is unchanged, except he added the HCP Policy Committees meeting in May 2020.

Wells HCP Coordinating Committee representatives present approved the *Draft 2020 Wells HCP Action Plan*, as revised. The final *2020 Wells HCP Action Plan* was distributed to the HCP Coordinating Committees by Geris on February 25, 2020.

B. DECISION: Draft 2020 Total Dissolved Gas Abatement Plan (and appended Wells Bypass Operating Plan) (Tom Kahler and Andrew Gingerich)

Tom Kahler said the draft *2020 Total Dissolved Gas Abatement Plan* (and appended *Wells Bypass Operating Plan*) was distributed to the HCP Coordinating Committees by Kristi Geris on January 20, 2020. Kahler recalled that Andrew Gingerich reviewed this document during the last meeting. Gingerich said the Aquatic Settlement Work Group (SWG) approved the document on February 12, 2020, including Washington State Department of Ecology (Ecology), and Breean Zimmerman

(Ecology Aquatic SWG Representative) also provided a separate email approval from Ecology on February 14, 2020. Gingerich recalled that the Bypass Operating Plan is consistent with past years and the Gas Abatement Plan includes updated total dissolved gas standards based on Ecology's proposed revision to the rule. He said no comments were received from the Wells HCP Coordinating Committee, and Douglas PUD is requesting approval of the document in order to submit a final package to the Federal Energy Regulatory Commission by February 28, 2020.

Wells HCP Coordinating Committee representatives present approved the *2020 Total Dissolved Gas Abatement Plan* (and appended *Wells Bypass Operating Plan*).

C. CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam (Tom Kahler)

Tom Kahler said CRITFC's annual request to tag sockeye salmon at Wells Dam in 2020 was distributed to the HCP Coordinating Committees by Kristi Geris on February 4, 2020. Kahler said Jeff Fryer is proposing to collect, sample (for scales and genetic material) and PIT tag 800 adults; no acoustic tagging is proposed this year. Kahler recalled that the Wells HCP Coordinating Committee had an action item to consider the use of these data. He said he reached out to Department of Fisheries and Oceans (DFO) but has not yet heard back. He said he will be attending a meeting with Fryer, DFO, and Okanagan Nation Alliance (ONA) on February 27, 2020, and he can ask about the purpose of the data and how critical it is to continue tagging. Kahler said tagging is not proposed until late June 2020, so a decision can be deferred as late as the HCP Coordinating Committees meeting on May 26, 2020.

Kirk Truscott said he discussed this internally with the CCT and there is opposition to agreeing to CRITFC tagging sockeye salmon at Wells Dam. He said this is in part because this is a long-standing activity in conjunction with additional tagging at Bonneville Dam that has already produced a lot of data and analyses to inform sockeye salmon migration, behavior, and survival, and correlations to water temperature. He asked, how much more data are needed, and does it really need to be collected annually? He said the CCT do not believe it does. He said there are already a lot of data to make management decisions. He said additionally, there is reluctance to remove 800 fish from available harvest. He said this effort uses Aqui-S, and per the U.S. Food and Drug Administration, use of Aqui-S for research purposes requires the assumption that study fish will not be available for consumption for 3 days, and this is not the case. He said if others believe these data need to be collected on an annual basis, the CCT would propose tagging at Priest Rapids Dam during Cle Elum sockeye salmon collection. He said this will remove the issue of excluding harvestable fish for the CCT.

Jim Craig asked if tagging was moved to Priest Rapids Dam, would this require genetic analyses to separate the stocks? Truscott said his understanding is this effort is ongoing in conjunction with tagging at Bonneville Dam, which includes both stocks.

Keely Murdoch asked if there are any other precedents where a research project request to trap at Wells Dam has been denied? Kahler said he cannot think of any, but this does not mean it has not happened. He said since 2006, there have not been many research proposals that were not internal.

John Ferguson asked how many years of data does Fryer have? Kahler said he believes he has annual data since about 2005. Ferguson suggested that Kahler relay these concerns to Fryer to figure out how to get to a decision. Truscott said lastly, the CCT do not support the YN conducting operations in CCT territory. Kahler asked if this has been communicated to ONA, and Truscott said no.

Ferguson said there seems to be three issues: 1) whether enough data have been collected already; 2) use of Aqui-S on fish that could be consumed; and 3) the policy issue on the YN conducting operations in the CCT territory. He said this includes both technical- and policy-level discussions, and he asked if this needs to be elevated to another level.

Truscott said if the data need is strong, he believes tagging at Priest Rapids Dam is a reasonable consideration. Murdoch said tagging at Priest Rapids Dam will require increasing the sample size quite a bit and she is unsure if this will sit well with the Cle Elum managers. Ferguson asked if the migration timing is comingled, and Truscott said pretty much. Murdoch said the Wenatchee River and Osoyoos River stocks might be differentiated based on fish size, but this may not be absolute. Ferguson said Fryer is clearly targeting Okanagan River Basin stocks, and Murdoch said this is correct, which is why if Wenatchee River stock are included a larger collection effort will be needed to meet the target sample sizes. Truscott said the projections at the mouth of the Columbia River are roughly 246,000 returns, 200,000 of which are anticipated to be Okanagan stock. Craig said based on these numbers, maybe increasing the sample size to 1,000 fish will be adequate. Kahler agreed this might work.

Kahler said he can talk with Fryer and others about how critical these data are. Chad Jackson said discussing the data will not resolve the issue; rather, he believes there needs to be a recommendation to Fryer to propose sampling at Priest Rapids Dam and the PRCC vote in that forum. Ferguson said if the tagging is proposed at Priest Rapids Dam then the action is no longer affecting operations at Wells Dam; however, the action would be affecting stocks in the Chelan PUD project. Lance Keller agreed that Chelan PUD would need to consider what this means for the overall Lake Wenatchee adult run.

Douglas PUD will update Fryer on Wells HCP Coordinating Committee discussions regarding CRITFC's annual request to tag sockeye salmon at Wells Dam. Wells HCP Coordinating Committee representatives will discuss internally CRITFC's annual request to tag sockeye salmon at Wells Dam, for a possible decision during the HCP Coordinating Committees meeting on March 24, 2020.

Andrew Gingerich asked if there needs to be a vote in this forum. Kahler said the request is addressed to Douglas PUD, and Douglas PUD brings the request to the Wells HCP Coordinating Committee because the proposed activity could affect fish passage at Wells Dam. Murdoch asked if the HCP Coordinating Committees nexus is to vote that the activity will not impact passage? Ferguson said this request is similar to the broodstock collection protocols, where the Wells HCP Coordinating Committee approves that trapping at Wells Dam will not impact fish passage. Kahler noted that the broodstock collection protocols do not dictate that CRITFC tagging will occur.

Ferguson suggested that this topic be discussed within the PRCC and Truscott said he can do this. Ferguson also pointed out that the request to collect and tag sockeye salmon at Wells Dam has no nexus with the Wells HCP. It is being conducted for sockeye salmon management purposes and is not a requirement of the HCP. Therefore, the policy issue discussed today is between the two tribes and should not be elevated to the Wells HCP Policy Committee for resolution.

D. Wells Dam 2019/2020 Winter Maintenance Outages (Tom Kahler)

Tom Kahler said the east fish ladder was returned to service in early February 2020, and the west fish ladder was taken out-of-service shortly after and is still out. He said major maintenance is planned for the west fish ladder including repairs and upgrades to the drain system in the fish pumps. He said he expects this work to continue for another couple of weeks.

Kahler said the Aquatic SWG identified errors in the Pacific Lamprey numbers as reported in the fish salvage memorandum for the west fish ladder. He said he will distribute a corrected Wells Dam west fishway fish salvage memorandum to the HCP Coordinating Committees. *(Note: Kahler provided a corrected memorandum following the meeting on February 25, 2020, which Kristi Geris distributed to the HCP Coordinating Committees that same day.)*

E. 2019 Wells HCP Annual Report (Tom Kahler)

Tom Kahler said the draft *2019 Wells HCP Annual Report* is currently available for review with edits and comments due by March 6, 2020. Kahler said since the report has been out for review, he has updated Table 3 with corrected conversion rates for steelhead and summer Chinook salmon. He said for steelhead, there were three fish detected at Rocky Reach Dam that were not detected at Wells Dam but were detected at the Lower Methow and Lower Okanogan arrays, and one fish that was not detected upstream of Wells Dam. He said what happened is, the primary computer for the PIT-tag detection system that sends data to Biomark and PTAGIS was failing and missed tag detections. He said Biomark repopulated PTAGIS using the data from the backup computer, but this was done after he had run the queries for the annual report. He said the missing steelhead was detected at Wells Dam on August 30, 2019, which increased the conversion rate from 98.4% to 100%. He said additional detections of summer Chinook salmon were also located, which increased the conversion rate from 95.5% to 96.4%. He said spawning of summer Chinook salmon in the Wells Dam tailrace affects apparent conversion rates. Douglas PUD conducts drone flights over the Wells Dam tailrace seeking to quantify the redds; however, there have been difficulties stitching the pictures together, so buoys have been deployed this year to help with this. He said redd counts are still pending. He said harvest is also not accounted for in the conversion-rate calculations.

The *2019 Wells HCP Annual Report* was approved by the Wells HCP Coordinating Committee on March 6, 2020, after no disapprovals were received prior to the 30-day review period deadline.

V. Chelan PUD / Douglas PUD

A. Subyearling Chinook Studies – Quarterly Check-In (Lance Keller and Tom Kahler)

John Ferguson recalled that the HCP Coordinating Committees agreed to revisit this topic once per quarter. He said this month is the first check-in. He said no topics are planned; rather, this is just an opportunity for discussion.

Kirk Truscott noted that the Pacific Northwest National Laboratory recently won an award for advancements in tag technology. Tom Kahler said this was for their Eel and Lamprey Acoustic Tag (or ELAT). Truscott said this might mean forward progress on tag size and battery duration, which are both limiting factors for conducting subyearling studies. He said other things to continue discussing include study plans, approach, and statistical analyses.

Lance Keller recalled another reason behind the February timing for a check-in is to follow the U.S. Army Corps of Engineers Annual Fish Evaluation Program. He said he was unable to attend last year. Tom Kahler and Ferguson said they both attended but did not have any updates to share from the conference. Keller said Chelan PUD plans to focus more on this topic during the development of the survival check-in study plans, as it relates to study assumptions.

VI. U.S. Fish and Wildlife Service

A. Leavenworth Fisheries Complex Manager (Jim Craig)

Jim Craig announced that he was selected as the new Manager of the Leavenworth Fisheries Complex, which consists of the Leavenworth, Entiat, and Winthrop National Fish Hatcheries and the Mid-Columbia Fish and Wildlife Conservation Office. He said this new role will not change the existing U.S. Fish and Wildlife Service HCP representation designations on the HCP Coordinating and Policy Committees.

VII. HCP Administration

A. HCP Coordinating Committees and PRCC Meeting Logistics in 2020 (John Ferguson)

John Ferguson said the plan is to continue convening both meetings in one day for about 6 months to see how this works for everyone. Ferguson said he and Denny Rohr (PRCC Facilitator) will coordinate with each other prior to each meeting on expected time requirements for their respective meetings and understand how to best manage the agendas for each meeting.

B. HCP Hatchery Committees Email Distribution and Extranet Access – Scott Hopkins (Lance Keller)

Lance Keller said Scott Hopkins is a Biologist for Chelan PUD and will soon be the Chelan PUD HCP Hatchery Committees Alternate to support Catherine Willard. Keller said Hopkins is already attending the HCP Hatchery Committees meetings. John Ferguson asked that Alene Underwood (Chelan PUD Fish and Wildlife Manager) provide a representation designation letter once the designation is official.

HCP Coordinating Committees representatives present agreed to add Hopkins, the future Chelan PUD HCP Hatchery Committees Alternate, to the HCP Hatchery Committees email distribution list and provide Hopkins with access to the HCP Hatchery Committees extranet site. Anchor QEA will coordinate to add Hopkins to the HCP Hatchery Committees email distribution list and provide Hopkins with HCP Hatchery Committees extranet site access, as approved by the HCP Coordinating Committees. *(Note: Kristi Geris notified Willard, Tracy Hillman, and Larissa Rohrbach of this approval; and Geris contacted Julene McGregor to request extranet access for Hopkins, as discussed.)*

C. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on March 24, 2020, to be held at 9:00 a.m., in-person at the Grant PUD Wenatchee office in Wenatchee, Washington. *(Note: this meeting has been changed to be held by conference call.)*

The April 28 and May 26, 2020 meetings will be held by conference call or in-person at the Grant PUD Wenatchee Office in Wenatchee, Washington, as is yet to be determined.

VIII. List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman††	BioAnalysts
Lance Keller*	Chelan PUD
Bill Towey	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
Scott Carlon*†	National Marine Fisheries Service
Jim Craig*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
Keely Murdoch*†	Yakama Nation
Kirk Truscott*	Colville Confederated Tribes

Notes:
- * Denotes HCP Coordinating Committees member or alternate
- † Joined by phone
- †† Joined by phone for HCP Hatchery and Tributary Committees Update

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: April 28, 2020

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris

Re: Final Minutes of the March 24, 2020 HCP Coordinating Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Tuesday, March 24, 2020, from 9:00 a.m. to 11:40 a.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

- Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).
- The Yakama Nation (YN) will provide the National Oceanic and Atmospheric Administration (NOAA) scientific research permit issued to Columbia River Inter-Tribal Fish Commission (CRITFC) to tag sockeye salmon at Wells Dam in 2020, along with the scientific research permit application, which contains additional information about the study (Item III-A). *(Note: Keely Murdoch provided these documents to Kristi Geris during the HCP Coordinating Committees conference call on March 24, 2020, which Geris distributed to the HCP Coordinating Committees that same day.)*
- The Wells HCP Coordinating Committee will consider the following language for concurrence during the HCP Coordinating Committees conference call on April 28, 2020: *Wells HCP Coordinating Committee representatives present have reviewed the CRITFC request to tag sockeye salmon at Wells Dam in 2020, and given the provisions contained within the Wells HCP, are voting on whether there are no fish passage impacts or acceptable fish passage impacts to Plan Species associated with the proposed data collection* (Item III-B).
- The Wells HCP Coordinating Committee will be prepared to convene by conference call to discuss a path forward for implementing the Douglas PUD 2020 Survival Verification Study, in the event the study cannot begin by the scheduled start date of April 13, 2020 (due to impacts of COVID-19; Item III-D).
- The HCP Coordinating Committees meeting on April 28, 2020, will be held at 9:00 a.m., by conference call (Item V-B).

Decision Summary

- The *2019 Rock Island HCP Annual Report* and *2019 Rocky Reach HCP Annual Report* were approved by the Rock Island and Rocky Reach HCP Coordinating Committees on March 19, 2020, after no disapprovals were received prior to the 30-day review period deadline.
- Wells HCP Coordinating Committee representatives present approved the 2020 Broodstock Collection Protocols, consistent with the provisions of the Wells HCP (Item III-A).
- Rock Island and Rocky Reach HCP Coordinating Committees representatives present approved the revisions to the 2020 Rock Island and Rocky Reach Fish Spill Plan (Item IV-C).
- Rock Island HCP Coordinating Committee representatives present approved the Statement of Agreement (SOA), *Selection of Yearling Chinook and Adult Spring Chinook for Chelan PUD's 2021 Rock Island Confirmation Survival Study* (Item IV-D).
- Rocky Reach HCP Coordinating Committee representatives present approved the SOA, *Selection of Yearling Chinook and Adult Spring Chinook for Chelan PUD's 2021 Rocky Reach Confirmation Survival Study* (Item IV-D).
- Rock Island HCP Coordinating Committee representatives present approved the *2019 Rock Island Dam Smolt Monitoring Program and Gas Bubble Trauma Evaluation Draft Report* (2019 Rock Island Smolt and Gas Bubble Trauma Evaluation Report) (Item IV-E).
- Rocky Reach HCP Coordinating Committee representatives present approved the *2019 Biological Evaluation of the Rocky Reach Juvenile Fish Bypass System Draft Report* (2019 Rocky Reach Juvenile Fish Bypass System Report) (Item IV-F).
- Rock Island HCP Coordinating Committee representatives present approved the *Rock Island Dam Smolt Monitoring and Gas Bubble Trauma Evaluation Plan 2020* (2020 Rock Island Bypass Monitoring Plan) (Item IV-G).
- Rocky Reach HCP Coordinating Committee representatives present approved the *2020 Rocky Reach Juvenile Fish Bypass System Operations Plan* (Item IV-H).

Agreements

- There were no HCP Agreements discussed during today's conference call.

Review Items

- The *Wells Project Subyearling Chinook Life-History Study 2011-2013 Draft Final Report* was distributed to the HCP Coordinating Committees by Kristi Geris on May 24, 2019.
- CRITFC's annual request to tag sockeye salmon at Wells Dam in 2020 was distributed to the HCP Coordinating Committees by Kristi Geris on February 4, 2020 (Item III-B).

Finalized Documents

- The final 2020 Broodstock Collection Protocols (dated March 24, 2020) were distributed to the HCP Coordinating Committees by Kristi Geris on April 3, 2020 (Item III-A).
- The final *2019 Wells HCP Annual Report*, which was approved by the Wells HCP Coordinating Committee on March 6, 2020, after no disapprovals were received prior to the 30-day review period deadline, was distributed to the HCP Coordinating Committees by Kristi Geris on March 26, 2020 (Item III-E).
- The final *2020 Rocky Reach and Rock Island HCP Action Plan*, which was approved by the Rocky Reach and Rock Island HCP Coordinating Committees on February 25, 2020, was distributed to the HCP Coordinating Committees by Kristi Geris on March 31, 2020.
- The final 2020 Rock Island and Rocky Reach Fish Spill Plan was distributed to the HCP Coordinating Committees by Kristi Geris on March 31, 2020 (Item IV-C).
- The final SOA, *Selection of Yearling Chinook and Adult Spring Chinook for Chelan PUD's 2021 Rock Island Confirmation Survival Study*, was distributed to the HCP Coordinating Committees by Kristi Geris on March 31, 2020 (Item IV-D).
- The final SOA, *Selection of Yearling Chinook and Adult Spring Chinook for Chelan PUD's 2021 Rocky Reach Confirmation Survival Study* was distributed to the HCP Coordinating Committees by Kristi Geris on March 31, 2020 (Item IV-D).
- The final 2019 Rock Island Smolt and Gas Bubble Trauma Evaluation Report was distributed to the HCP Coordinating Committees by Kristi Geris on March 31, 2020 (Item IV-E).
- The final 2019 Rocky Reach Juvenile Fish Bypass System Report was distributed to the HCP Coordinating Committees by Kristi Geris on March 31, 2020 (Item IV-F).
- The final 2020 Rock Island Bypass Monitoring Plan was distributed to the HCP Coordinating Committees by Kristi Geris on March 31, 2020 (Item IV-G).
- The final *2020 Rocky Reach Juvenile Fish Bypass System Operations Plan* was distributed to the HCP Coordinating Committees by Kristi Geris on March 31, 2020 (Item IV-H).
- The final *2019 Rock Island HCP Annual Report* and *2019 Rocky Reach HCP Annual Report* were distributed to the HCP Coordinating Committees by Kristi Geris on April 10, 2020.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. The following revisions were requested:

- Ferguson requested that: 1) Douglas PUD provide an update on any COVID-19 impacts to the Douglas PUD 2020 Survival Verification Study; and 2) Chelan PUD, Douglas PUD, and

Tracy Hillman provide an update on any COVID-19 impacts to HCP bypass and hatchery operations

- Lance Keller added an update on COVID-19 impacts to the Chelan PUD Fish and Wildlife Department
- Tom Kahler added an update on the final *2019 Wells HCP Annual Report*

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft February 25, 2020 meeting minutes. Kristi Geris said all comments and revisions received from members of the Committees were incorporated into the revised minutes and there are two outstanding items remaining to be discussed. *(Note: Italicized text corresponds to agenda items from the meeting on February 25, 2020):*

- *HCP Hatchery Committees Update*: Lance Keller clarified under the YN Summer Chinook Salmon Program agenda item, the YN will pay an annual fee (not "rent") for space at Eastbank Fish Hatchery.
- *2021 Confirmation Survival Study Species Selection Discussion*: Keller confirmed Todd West (Chelan PUD Fish and Wildlife Superintendent) managed a foreman (not "was the foreman") who operated the Rocky Reach Juvenile Fish Bypass System in 2010 and 2011.

Geris said she also closed out one action item and added two review items in the revised minutes. HCP Coordinating Committees members present approved the February 25, 2020 meeting minutes, as revised.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on February 25, 2020, and follow-up discussions, were as follows. *(Note: Italicized text corresponds to agenda items from the meeting on February 25, 2020):*

- *Anchor QEA, LLC (Anchor QEA) will provide an updated revised draft HCP Coordinating Committees January 28, 2020 meeting minutes to Chelan PUD for review and approval that will include clarification from Chelan PUD regarding the 2021 Confirmation Survival Study species selection agenda topic, as discussed during today's meeting; the final minutes will then be distributed to the HCP Coordinating Committees (Item I-B).*
  This was completed, as discussed, and the final HCP Coordinating Committees January 28, 2020 meeting minutes were distributed to the HCP Coordinating Committees by Kristi Geris on March 3, 2020.
- *Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).*
  This action item will be carried forward.

- *Chelan PUD will distribute draft SOAs for the 2021 Confirmation Survival Study species selections for the Rock Island and Rocky Reach projects, which will include the approach discussed and agreed upon during today's meeting, for decision during the HCP Coordinating Committees meeting on March 24, 2020 (Item III-A).*
  These SOAs were distributed to the HCP Coordinating Committees by Kristi Geris on March 20, 2020.
- *Chelan PUD will adjust the positions of spill gates 18 and 26 in the spill gate sequence, as discussed in the 2020 Fish Spill Plan, Rock Island and Rocky Reach Dams, Public Utility District No. 1 of Chelan County (2020 Rock Island and Rocky Reach Fish Spill Plan); the final plan will then be distributed to the HCP Coordinating Committees (Item III-E).*
  This will be discussed during today's conference call.
- *Chelan PUD will distribute Rock Island Dam spillway gate opening depths to the HCP Coordinating Committees (Item III-E).*
  This will be discussed during today's conference call.
- *Anchor QEA will set a reminder for December 2020 to consider scheduling an HCP Coordinating Committees in-person meeting at Rocky Reach Dam following completion of the Visitor's Center renovation (tentatively set for July 2021; Item III-J).*
  Kristi Geris set this reminder, as discussed.
- *Douglas PUD will update Jeff Fryer (CRITFC) on Wells HCP Coordinating Committee discussions regarding CRITFC's annual request to tag sockeye salmon at Wells Dam (Item IV-C).*
  This will be discussed during today's conference call.
- *Wells HCP Coordinating Committee representatives will discuss internally CRITFC's annual request to tag sockeye salmon at Wells Dam, for a possible decision during the HCP Coordinating Committees meeting on March 24, 2020 (Item IV-C).*
  This will be discussed during today's conference call.
- *Douglas PUD will distribute a corrected Wells Dam west fishway fish salvage memorandum to the HCP Coordinating Committees (Item IV-D).*
  Tom Kahler provided a corrected memorandum following the meeting on February 25, 2020, which Kristi Geris distributed to the HCP Coordinating Committees that same day.
- *Anchor QEA will coordinate to add Scott Hopkins (Chelan PUD) to the HCP Hatchery Committees email distribution list and provide Hopkins with HCP Hatchery Committees extranet site access, as approved by the HCP Coordinating Committees (Item VII-B).*
  Kristi Geris notified Catherine Willard (Chelan PUD HCP Hatchery Committees Representative), Tracy Hillman (HCP Hatchery Committees Chairman), and Larissa Rohrbach (HCP Hatchery Committees Support Staff) of this approval; and Geris contacted Julene McGregor (Douglas PUD Information Services Staff) to request extranet access for Hopkins, as discussed.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman said the HCP Tributary Committees did not meet in March 2020; however, the Committees did attend presentations provided by the project sponsors to the Regional Technical Team (RTT) and HCP Tributary Committees:

- *RTT Presentations*: The purpose of the presentations was to describe possible projects that may be submitted through the Salmon Recovery Funding Board (SRFB) process. Of the 26 proposed projects presented, 17 identified a possible HCP Tributary Committees cost share. Along with the RTT, HCP Tributary Committees members provided feedback to project sponsors during the presentations. Under the SRFB process, draft applications are due on April 17, 2020. Site visits will occur from May 11 to 13, 2020. The HCP Tributary Committees will then evaluate draft applications on May 14, 2020. At that time, the Committees will identify which proposed projects are fundable and which are not. For those projects that are fundable, the Committees will request final applications, which will be evaluated on June 11, 2020.
- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on April 9, 2020.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees meeting on March 18, 2020 (*note: joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *2020 Broodstock Collection Protocols (joint):* The HCP Hatchery Committees reviewed, edited, and approved the 2020 Broodstock Collection Protocols. The protocols were sent to the Wells HCP Coordinating Committee for review and approval. Once approved, the protocols will be submitted to the National Marine Fisheries Service (NMFS).
- *Marking and Tagging of Hatchery Fish (joint):* Some hatchery programs are currently moving forward with marking and tagging juvenile hatchery fish; however, this may not be feasible due to the impacts of COVID-19. This is being evaluated on a day-to-day basis. Hillman said he believes the PUDs have already marked several fish stocks, but U.S. Fish and Wildlife Service (USFWS) is facing potential issues with social distancing within typical tagging trailers.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on April 21, 2020. Hillman recalled this meeting is now on a Tuesday (rescheduled around an American Fisheries Society meeting) and will be held by conference call.

B. COVID-19: HCP Bypass and Hatchery Operations (Chelan PUD, Douglas PUD, Tracy Hillman)

John Ferguson asked Chelan PUD, Douglas PUD, and Tracy Hillman to provide an update on how social distancing due to COVID-19 and Governor Jay Inslee's March 23, 2020 Statewide Stay-At-Home Order has impacted the respective HCP bypass and hatchery operations.

Lance Keller said Chelan PUD has identified critical operations for both Rock Island Dam and Rocky Reach Dam and both juvenile fish bypass systems rank high on this list. Keller said these systems are operated by seasonal crews, who are already on site. He said staff are practicing social distancing within each crew and each crew is also being isolated from other crews. He said the plan is to operate each bypass system, per usual, starting April 1, 2020. He said as everyone knows, this topic is developing and changing rapidly, and Chelan PUD is evaluating procedures on a daily basis. He said as of now, Chelan PUD is moving forward with as minimal staff at the hydroelectric projects as possible.

Tom Kahler said Douglas PUD employees have been advised to practice social distancing and there have been no new updates from the Douglas PUD Commissioner since Governor Inslee's Stay-At-Home Order. Kahler said most hatchery activities do not require gathering in a crowd except for spawning, which is coming up; and he is unsure how this will be performed. Andrew Gingerich said Douglas PUD has closed several facilities available to the public (e.g., visitor centers). He said he anticipates the bypass will operate per usual; the bypass barriers are scheduled to be in place by April 1, 2020, ready to start bypass operation on April 9, 2020. He said all normal functions are scheduled to continue to meet requirements. He said hatchery releases are on schedule and marking is almost complete. Kahler said all Douglas PUD programs were already tagged except the subyearlings for release in May 2020. He said the subyearlings will have coded wire tags because this tagging and adipose-clipping is already underway. He said also, USFWS typically tags a portion of these subyearlings as part of an ongoing Comparative Survival Study marked group but he is unsure whether this will happen. He said this usually happens in late April. Jim Craig said as of now, the contractors who conduct marking for USFWS have been called off. Craig said this is being evaluated on a daily basis.

Hillman said the HCP Hatchery Committees have not discussed impacts of COVID-19 aside from continuing monthly meetings by conference call rather than in-person until it is cleared to do so. Kirk Truscott said the HCP Hatchery Committees did briefly discuss non-PUD-funded hatcheries. He said Chief Joseph Fish Hatchery is still operating with provisions. He said fish will be coded-wire-tagged and adipose (ad)-clipped. He said passive integrated transponder (PIT)-tagging by Biomark likely will not happen due to the Colville Confederated Tribes (CCT) partial shutdown.

III. Douglas PUD

A. DECISION: 2020 Broodstock Collection Protocols (Tom Kahler)

Tom Kahler recalled that each year, the HCP Hatchery Committees develop the Broodstock Collection Protocols and the Wells HCP includes a requirement for Wells HCP Coordinating Committee approval of the protocols. Kahler said the basis for this requirement has to do with trapping at the Wells Dam fish ladders. He said proposed trapping operations at Wells Dam are outlined in Appendix D of the protocols (which were distributed to the Wells HCP Coordinating Committee by Kristi Geris on March 19, 2020), and are essentially the same as those approved last year with a few exceptions, as discussed during the last HCP Coordinating Committees meeting. He said CRITFC trapping of sockeye salmon is still included in the protocols; although, this is not an activity for PUD mitigation programs. He said in light of the concerns raised by the CCT regarding this activity, the HCP Hatchery Committees modified this language to indicate CRITFC trapping of sockeye salmon may occur if approved by the Wells HCP Coordinating Committee.

Keely Murdoch said the YN has been discussing this internally and is not certain the Wells HCP Coordinating Committee has purview in this situation. She asked, what is the Wells HCP Coordinating Committee approving or not approving? She said this issue has not been fully resolved. She said the YN does not want to limit available options if it is decided that the Wells HCP Coordinating Committee has no purview. She asked if the Broodstock Collection Protocols are a binding document. Kahler said no, the protocols are a living document. He recalled in past years, sometimes the protocols were not even finalized until December. He said the document is intended to be adjusted, as needed. Murdoch asked, just because the protocols indicate Wells HCP Coordinating Committee approval is needed for the proposed CRITFC trapping, does this lock the YN into this process (i.e., does approving the Broodstock Collection Protocols bind the Parties to language included in the protocols)? Kahler said no, he does not view the protocols as binding in this decision (note: however, the Wells HCP Coordinating Committee decision on a tagging activity at Wells Dam would be necessary regardless of the language in the protocols). Murdoch said she just wants to be sure approving the protocols does not mean the YN agrees to, or is locked into, this process.

John Ferguson said the CRITFC request for trapping sockeye salmon at Wells Dam is a request by fisheries managers to collect information at Wells Dam and is not related to the Wells HCP. He said what is related to the Wells HCP, is that the proposed CRITFC activities have the potential to affect fish passage at Wells Dam. Murdoch said she is not disagreeing with this. She said her supervisors have questions about what authority the Wells HCP Coordinating Committee has here. She said she has reviewed the Wells HCP and cannot locate language giving the Wells HCP Coordinating Committee authority to decide what data are valuable or what (incidental) take is acceptable. She said the technical merit of this project has already been reviewed and approved, and funded by the

Bonneville Power Administration, and the project already has its own permit for allowable take. She said further, if the Wells HCP Coordinating Committee does have authority, the purview is related to HCP activities.

Kahler said Appendix A of the Wells HCP is the *Wells Hydroelectric Project, Adult Fish Passage Plan* (Fish Passage Plan). He said Douglas PUD interprets this plan as the Wells HCP Coordinating Committee nexus for approving activities that might affect fish passage through the Wells Dam fishways. He read the following excerpts from the Fish Passage Plan:

> *Changes in operating criteria require unanimous support of the Coordinating Committee including approval by NMFS Hydro Program. –page 71*

> *Brood stock collection protocols are developed by the Washington Department of Fish and Wildlife and are annually submitted to the Wells Coordinating Committee and NMFS Hydro Program for annual approval prior to trapping at the Dam. –page 72*

> *Modification to the ladder operating criteria can only take place following approval by the Wells Coordinating Committee. –page 73*

Murdoch said it looks like the Fish Passage Plan already approves the sockeye salmon work, and she read the following excerpt from the Fish Passage Plan:

> *In addition to brood stock collection, the adult fish traps are occasionally used to collected information from CWT tagged steelhead, collect sockeye scales for stock identification and age analysis and collect adult bull trout, chinook, sockeye and steelhead for radio-tagging. –page 72*

Murdoch said this CRITFC work started in the early 1990s and predates the HCPs, which might be why this language was included, because the activities were already happening at the time of the development of the HCPs. She reiterated that the YN is not questioning Wells HCP Coordinating Committee approval of the Broodstock Collection Protocols; rather, the question is if the Wells HCP Coordinating Committee can approve or not approve whether CRITFC can trap at Wells Dam.

Kahler said he interpreted the excerpt that Murdoch read as activities that occasionally happen at Wells Dam. Kahler said Douglas PUD routinely has third parties trap at Wells Dam. He said historically, Wells Dam was the last trap on the Columbia River as fish migrate upstream. He said now there is trapping at the Chief Joseph Dam fish ladder, as well. He said there have been situations in the past when proposed activities at the Wells Dam fish ladders would interfere with an ongoing Douglas PUD study, and as the Project Operators, Douglas PUD has had the opportunity to ask the Wells HCP Coordinating Committee whether the Committee agrees that the proposed activity might interfere with HCP activities. He said, for example, the Douglas PUD Aquatic Settlement Work Group (SWG) wanted to conduct a Pacific Lamprey study in the Wells Dam fish ladders and the Wells HCP Coordinating Committee determined the proposed study would impede fishway entrance by Plan Species. He said the Aquatic SWG had to modify the study, per recommendations from the Wells HCP Coordinating Committee so as to not affect fishway attraction. He said the Wells HCP Coordinating Committee needs to make decisions about any activity proposed for the Wells Dam fish ladders that might affect passage for Plan Species. He said this is per the Douglas PUD Federal Energy Regulatory Commission (FERC) license.

Murdoch said it makes sense that the Wells HCP Coordinating Committee purview is related to HCP activities; however, for the CCT to not approve the activity because the CCT do not believe the data are useful does not seem to be within the Wells HCP Coordinating Committee purview.

Ferguson asked Douglas PUD to review the specific trapping operations that are expected for the Wells Dam fish ladders during the sockeye salmon migration in 2020. Kahler said CRITFC has been conducting this effort for years and has always coordinated with other trapping activities to the extent possible. He said typically, this coordination has occurred with the steelhead broodstock collection and stock assessment trapping conducted by the Washington Department of Fish and Wildlife (WDFW), and summer Chinook salmon stock-assessment and broodstock trapping conducted by WDFW and Douglas PUD, respectively. He said WDFW or Douglas PUD operates the traps, and when sockeye salmon are encountered, fish are handed over to CRITFC for tagging. He said this year, however, the steelhead stock assessment is occurring at the Priest Rapids Dam Off-Ladder Adult Fish Trap, and broodstock collection for steelhead occurs in the spring. He said trapping of summer Chinook salmon (summers) at Wells Dam for the Carlton Program and for stock-assessment sampling will only occur at the east fish ladder, and Douglas PUD collection of spring Chinook salmon (springers) will occur at both ladders, but will conclude by June 28, 2020 before most of the sockeye salmon trapping would occur. He said, for the Carlton summers, the trap will be operated by the Douglas PUD hatchery crew, a maximum of 3 days per week. He said oftentimes, all broodstock for a given week is collected within 1 day. He said in the past, when WDFW and Douglas PUD trapping operations were fulfilled, CRITFC would continue operating the trap if more sockeye salmon were needed.

Ferguson said this is something for the Wells HCP Coordinating Committee to consider, that there may be days where the trap is operated only for sockeye salmon collection to meet CRITFC tagging needs. Murdoch said during this timeframe there are few Endangered Species Act-list species migrating. She said late June to early July is the end of the springer run and the steelhead migration will not quite be started yet.

Kirk Truscott said his recollection is that the NOAA scientific research permit issued to CRITFC to tag sockeye salmon at Wells Dam in 2020 and/or the Broodstock Collection Protocols state that the proposed activity must be performed concurrent with other trapping. He said the CCT's position is there would be additional passage impacts to all anadromous species if trapping is not performed concurrently with other trapping activities. Murdoch said Jeff Fryer recently provided the YN with the NOAA scientific research permit and permit application held by CRITFC, where the YN is listed as co-investigators, and in neither document does she see anything about the action needing to be performed concurrent with another trapping activity. Murdoch said CRITFC's permit includes a take allowance for springers and steelhead, and she noted that similar to the YN coho salmon trapping effort, when trapping occurs concurrently with another program, this does not result in additional take. The Wells HCP Coordinating Committee requested copies of the research permit and Murdoch said she will distribute the permit and permit application, which contains additional information about the study. She noted that the permit and application do include other activities in addition to the sockeye salmon tagging at Wells Dam. *(Note: Murdoch provided these documents to Geris during the HCP Coordinating Committees conference call on March 24, 2020, which Geris distributed to the HCP Coordinating Committees that same day.)*

Ferguson recalled another concern expressed by the CCT was about anesthetic and affects to the tribal fishery; however, this concern is outside the HCP and does not affect fish passage at the dam. Murdoch said Fryer contacted Aqui-S regarding the 3-day holding period and the representative said for wild fish there is no withdrawal period. Murdoch said the 3-day holding period for hatchery fish is based on the assumption there will be repeated exposure to the anesthetic. Truscott asked if CRITFC holds an Investigational New Animal Drug (INAD) exemption for Aqui-S. He said he found another INAD for Aqui-S and his interpretation is the fish cannot be released for 72 hours if entering authorized fisheries. Murdoch said this is not what the representative from Aqui-S said. Truscott said this is why he would like to review CRITFC's INAD. He also agreed with Ferguson that this is not an HCP issue; rather, this is a regulatory compliance issue that Douglas PUD may need to consider.

Ferguson asked about next steps if the Wells HCP Coordinating Committee cannot agree on this topic. Murdoch said it needs to be clear on what the Wells HCP Coordinating Committee is voting on. Kahler said from Douglas PUD's perspective, the Wells HCP Coordinating Committee is the entity that decides whether a change in operations of the Wells Dam fishways and trapping facilities is or is not affecting safe, effective, and timely fish passage. He said every entity using the facilities must pass a facility screening. He said the YN already has an agreement in place. He said every entity also must have and comply with a permit for the proposed activities. He said regardless, Douglas PUD has a requirement to submit to NMFS the Broodstock Collection Protocols approved by the Wells HCP Coordinating Committee. He asked if language in Appendix D can be modified so the Committee can approve this document. Ferguson read the following excerpt from Appendix D of the protocols:

The CRITFC may also trap sockeye at Wells Dam for tagging and stock assessment. Their request for trapping in 2020 did not specify trapping details other than timing (late June through early August), but their preference in past years has been to use the East ladder. Although this work has been done in the past, this action will need approval in 2020 by the Wells HCP Coordinating Committee. –page 50 of the version distributed on March 19, 2020

Ferguson asked, given this language and needing to move forward and understanding this is a living document, is this language sufficient to vote on now? The Wells HCP Coordinating Committee clarified this decision on the protocols is based on impacts to HCP activities.

Wells HCP Coordinating Committee representatives present approved the 2020 Broodstock Collection Protocols, consistent with the provisions of the Wells HCP.

The final protocols were distributed to the HCP Coordinating Committees by Geris on March 24, 2020.

B. CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam (Tom Kahler)

John Ferguson said it seems more discussion is needed on this item before a decision is made and a vote taken, and he asked the Wells HCP Coordinating Committees for comments. Keely Murdoch said the YN is ready to vote right now or can wait 1 month if Committee members need additional time or information. Kirk Truscott suggested discussing how this request and activity affects safe and efficient passage of Plan Species. He said sampling takes place Monday through Friday in late June to early August. He said the only ongoing trapping will be for the Carlton Program. He said the CCT's position is that any trapping outside concurrent trapping for the Carlton Program has additional impacts to Plan Species passing via the fish ladder and the CCT do not approve this. Murdoch said this action has almost always been conducted concurrently with other trapping and if the target quota has not been achieved by the time others are done trapping, CRITFC has a permit that allows for take. She said this has been determined by NOAA Fisheries. Truscott said the action takes place on a PUD facility where signatories to the HCP approve whether the action provides safe and efficient passage—period. He said he believes this action is at an impasse. Murdoch suggested developing criteria in order to reach concurrence.

Tom Kahler said trapping for the Carlton Program may occur 3 days per week, 16 hours per day. Murdoch said, however, the trapping effort may not take this long. Kahler said this depends on how quickly brood are collected. He said trapping for the Carlton Program is planned from July 1 to September 15, 2020, and during trapping for springers prior to this time, if summers are encountered these fish are retained for the Carlton Program.

Truscott said the CCT can vote to concur that this action has or does not have passage impact; however, the CCT cannot vote to approve CRITFC trapping and tagging of sockeye salmon at Wells Dam in 2020. Murdoch asked how to frame the question for decision. Truscott suggested framing the question to be consistent with the provisions in the Wells HCP.

Truscott said this is similar to the issue that occurred within the HCP Tributary Committees. He said the Wells HCP Coordinating Committee needs to consider this from a technical standpoint. The Wells HCP Coordinating Committee developed the following language to consider for concurrence:

> *Wells HCP Coordinating Committee representatives present have reviewed the CRITFC request to tag sockeye salmon at Wells Dam in 2020, and given the provisions contained within the Wells HCP, are voting on whether there are no fish passage impacts or acceptable fish passage impacts to Plan Species associated with the proposed data collection.*

Truscott said he will discuss this language internally with the CCT, but he believes this issue may be elevated to the policy level. He said this language will help policy staff understand what the Wells HCP Coordinating Committee is doing and how it is consistent with HCP provisions. Ferguson said this is also consistent with the guidance from the HCP Policy Committees last year.

Kahler asked what the CCT can approve at this time. Truscott said the CCT agree these activities (CRITFC trapping and tagging of sockeye salmon) will not result in additional negative passage impacts if concurrent with trapping for the Carlton Program. He said he is unsure what the policy level will say, but he believes the Wells HCP Coordinating Committee has done its due diligence as HCP Signatories to evaluate the action as it might affect Plan Species and approved a Broodstock Collection Protocols that allows HCP programs to collect broodstock.

The Wells HCP Coordinating Committee will be prepared to vote on the language developed to consider for concurrence (the italicized language directly above) during the HCP Coordinating Committees conference call on April 28, 2020.

C. Wells Dam 2019/2020 Winter Maintenance Outages (Tom Kahler)

Tom Kahler said the west fish ladder at Wells Dam has been out of service for major maintenance on the fish pumps. He said this maintenance is complete and the collection gallery is watered up; however, the gates are not yet open because of a staff shortage due to COVID-19. He said the plan is to remove the gates so the technicians can calibrate the pumps, which is a couple-day process. He said the priority is to get Turbine Unit 1 back online for a nine-unit plant before bypass operations begin and then to return the west fishway to service. He said in the interest of maintaining total dissolved gas compliance, there needs to be as many units online as possible. He said the plan is to complete all of this in the next couple of weeks.

Kirk Truscott asked if the west fish ladder will be back online in time for springer trapping. Kahler said that is the intention.

D. COVID-19: Douglas PUD 2020 Survival Verification Study (Andrew Gingerich)

Andrew Gingerich said as of today, the expectation is to move forward as scheduled with the Survival Verification Study. He said as mentioned earlier, there has been no further direction from the Douglas PUD Commissioners since Governor Inslee's Stay-At-Home Order. Gingerich said according to sources online, employees of the energy sector are considered "essential," which will allow Douglas PUD to move forward with the study. He said he does not know how contractors supporting this effort will be impacted but hopes this will be clearer in the coming days. He said things are fairly fluid and a little reactionary at this time. He said there are 108,000 study fish on station for a needed sample size of 100,000 fish. He said the fish are tagged, feeding well, and are healthy. He said the release barges are in the water, contractors are hired, agreements are executed, the Physiology Plan is in place, and other preparatory items are ongoing.

John Ferguson asked about the first release date and Gingerich said it is scheduled for April 13, 2020. Gingerich said 15 replicates are planned for release, with the last release on May 12, 2020. He said there may be flexibility to push the study back 1 week; however, as of now, he is optimistic the study will stay on schedule. He said a dry run is planned for April 8 and 9, 2020, which will involve transporting the tanks with no fish inside.

Scott Carlon asked, if the contractors are not allowed to work due to COVID-19, will Douglas PUD convene a conference call with the Wells HCP Coordinating Committee to discuss how to proceed? Ferguson said if Douglas PUD cannot execute the study this year due to COVID-19, he is unsure what the Wells HCP Coordinating Committee can do about this. He said Douglas PUD may just need to notify the Committee the study was terminated and begin planning for a study in 2021 during the next HCP Coordinating Committees meeting. Gingerich agreed but asked, what if the Stay-At-Home Order jeopardizes the start date of April 13, but the study can start on April 20, 2020? He asked if this would still be a representative study of spring migrating fish? He asked, how much of a delay is acceptable where Douglas PUD's obligation and the Wells HCP Coordinating Committee's needs are still met? He said another thing to consider is, not only does terminating the study result in a loss of funds expended and time already invested into the study but delaying and then carrying out the study has additional costs, including time and energy. He asked, what if Douglas PUD carries out the study 1 to 2 weeks late without the direction of the Wells HCP Coordinating Committee? He asked if the Committee would accept the results even though the study was delayed? Ferguson agreed these are all good points. He added that the updated flow duration curves also come into this. Tom Kahler also agreed these are good points and said he plans to review the data used to establish the release dates so he will be prepared to have a more informed conversation if the study timing needs to shift.

The Wells HCP Coordinating Committee will be prepared to convene by conference call to discuss a path forward for implementing the Douglas PUD 2020 Survival Verification Study, in the event the study cannot begin by the scheduled start date of April 13, 2020 (due to impacts of COVID-19).

Gingerich said Douglas PUD really wants to conduct this study in 2020. He said half of the work is already complete. He said, however, if it cannot be done there is really nothing anyone can do.

E. 2019 Wells HCP Annual Report (Tom Kahler)

Tom Kahler said no comments were received on the draft *2019 Wells HCP Annual Report*, and Douglas PUD plans to submit the final report to FERC today or tomorrow.

The final *2019 Wells HCP Annual Report*, which was approved by the Wells HCP Coordinating Committee on March 6, 2020, after no disapprovals were received prior to the 30-day review period deadline, was distributed to the HCP Coordinating Committees by Kristi Geris on March 26, 2020.

IV. Chelan PUD

A. Rock Island Dam Powerhouse 1 Maintenance Update (Lance Keller)

Lance Keller said maintenance continues on Turbine Unit B4 and the return-to-service date of May 2020 is still on schedule. He said, however, impacts of COVID-19 are already affecting the contractor workforce dedicated to Turbine Unit B4, which may result in delays in the schedule. He said he will keep the Rock Island HCP Coordinating Committee updated as news becomes available.

B. Rocky Reach Dam Turbine Units Maintenance Update (Lance Keller)

Lance Keller said on March 16, 2020, Turbine Unit C1 was returned to service for operation. He said intake screens were installed and on March 19, 2020, a marked fish release was conducted in the intake structure. He said almost all fish released were recollected at the bypass system and were free of injury and descaling, and there were no mortalities. He said additionally, in the surface collection structure, there was a joint effort with Douglas PUD and Biomark using PIT-tagged fish to test detection efficiency at the Rocky Reach Juvenile Fish Bypass System. He said PIT-tag arrays installed in 2010 were tested and detection efficiency was equal to or greater than 92%. He said Biomark believes additional tuning will increase this detection efficiency.

Keller said disassembly of Turbine Unit C2 is continuing. He said the rotor is out, but he has not yet heard about the diagnosis or condition of the servo rod seals.

Keller recalled during the last HCP Coordinating Committees meeting, indicating that Turbine Unit C3 was returned to service in the hydraulically locked configuration. He said this unit was recently taken offline for inspection and oil was observed in the hub. He said no oil was released to the river. He said engineering staff knew it was possible that oil might escape from the governor control system and are now evaluating different options. He said the return-to-service date is unknown largely due to COVID-19 and limited staff and social distancing requirements.

C. DECISION: 2020 Rock Island and Rocky Reach Fish Spill Plan (Lance Keller)

Lance Keller recalled that the Rock Island and Rocky Reach HCP Coordinating committees approved the 2020 Rock Island and Rocky Reach Fish Spill Plan during last month's meeting. He said, however, since this approval there has been additional discussion with Rock Island Dam staff about how the notch gates that have been converted to full gates will integrate into the spill gate sequence at the beginning of the full gate sequence. He said there is a specific frame to allow a notch gate to move up and down (open or close). He said removing this frame just leaves a gate slot and to move the spill gate requires a gantry crane and a full mechanic crew, which could lead to possible delays in adjusting spill volume on an hourly basis. He said there were concerns about the ability to adjust the daily spill shape or if there is a new river forecast, especially outside of normal business hours, and whether staff would be available to be called out to the dam on late notice to adjust spill gates. He said staff discussed remedies to encompass the need for a full gate configuration while maintaining responsiveness. He said the remedy is outlined in the revised draft 2020 Rock Island and Rocky Reach Fish Spill Plan (v2) that was distributed to the HCP Coordinating Committees by Kristi Geris on March 20, 2020.

Keller said the changes are highlighted on pages 7 and 8 (the same language applies to both spring and summer periods). He said gates 18 and 26 will convert back to full-gate function to increase spill capacity but will be removed from the spill gate sequence and be replaced by adjacent gates 19 and 27. He said this shifts the pattern one gate towards Powerhouse 2 and allows use of automatic gates. He said gates 19 and 27 have an auto-hoist system so operators can control the gates instantaneously from the powerhouse control room. He said this allows spill to stay close to Powerhouse 2 and provides more control over the gates.

John Ferguson noted that Rock Island Dam has a small capacity for storing water in the reservoir, thus the need to utilize automated gates. Keller said this is correct. He said there is only 4 feet of storage in the reservoir, which can be depleted in a short amount of time. He said there needs to be a strategic and timely way to open and close the spill bays to adjust spill volumes.

Kirk Truscott said there is no anticipated effect on fish passage because most spill is still associated with the same powerhouse, and Keller said this is correct. Keller said this configuration keeps spill closer to Powerhouse 2 versus Powerhouse 1 or the middle of the spillway. He said acoustic telemetry data indicate the majority of fish pass Rock Island Dam via Powerhouse 2 and spillway 2. Truscott asked where gates 18 and 26 fall in the sequence, and noted these gates are no longer shown in the revised spill plan. Keller explained that gates 18 and 26 were replaced by gates 19 and 27, and now gates 18 and 26 will only be used at the mechanics' discretion at the end of the sequence outlined in the schedule. Truscott asked if this means that gates 18 and 26 will only be used if the other gates are not able to handle the hydraulic flow. Keller said this is correct.

Keller recalled Truscott asking about the elevation difference between notch and full gate operation. Keller said in a shallow bay (e.g., spillbay 18), there is less than 2 feet elevation difference between the bottom of a full gate versus a notch gate. He said in a deep bay (e.g., spillbay 26), the difference is about 20 feet. Truscott asked if these gates can be only partially opened. Keller said yes and he believes there is a minimum opening of about 2 feet. Truscott said that fish passage effectiveness of the spill may be reduced when a full gate replaces a notched gate in the spill sequence due to juvenile salmonids being surface-oriented, but since this is a safety issue, he can approve these changes.

Rock Island and Rocky Reach HCP Coordinating Committees representatives present approved the revisions to the 2020 Rock Island and Rocky Reach Fish Spill Plan.

The final plan was distributed to the HCP Coordinating Committees by Geris on March 31, 2020.

D. DECISION: 2021 Confirmation Survival Study Species Selection SOAs (Lance Keller)

Lance Keller said the draft SOAs, *Selection of Yearling Chinook and Adult Spring Chinook for Chelan PUD's 2021 Rock Island Confirmation Survival Study* and *Selection of Yearling Chinook and Adult Spring Chinook for Chelan PUD's 2021 Rocky Reach Confirmation Survival Study*, were distributed to the HCP Coordinating Committees by Kristi Geris on March 20, 2020. Keller said if the Rock Island and Rocky Reach HCP Coordinating Committees need more time with the SOAs, Chelan PUD can delay a decision until the HCP Coordinating Committees meeting on April 28, 2020. He said the SOAs are straightforward, identifying yearling Chinook salmon for the juvenile component and returning adult springers for the adult component. He said the SOAs also describe that juveniles will be run-of-the-river fish collected at the Rocky Reach Juvenile Fish Bypass System and adult springers will be evaluated using returning PIT-tagged adults.

Rock Island HCP Coordinating Committee representatives present approved the SOA, *Selection of Yearling Chinook and Adult Spring Chinook for Chelan PUD's 2021 Rock Island Confirmation Survival Study*. Rocky Reach HCP Coordinating Committee representatives present approved the SOA, *Selection of Yearling Chinook and Adult Spring Chinook for Chelan PUD's 2021 Rocky Reach Confirmation Survival Study*.

The final SOAs were distributed to the HCP Coordinating Committees by Geris on March 31, 2020.

E. DECISION: 2019 Rock Island Smolt and Gas Bubble Trauma Evaluation Report (Lance Keller)

The draft 2019 Rock Island Smolt and Gas Bubble Trauma Evaluation Report was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and was available for a 30-day review, with edits and comments due to Lance Keller by Monday, March 16, 2020.

Keller said no edits, comments, or questions were received on the report, which was drafted by Scott Hopkins (Chelan PUD). Keller noted that one unique result from 2019 was the mortality issue identified at the Rock Island Juvenile Sampling Facility caused by a partially open drainage plug, which was ultimately fixed, resolving the issue.

Rock Island HCP Coordinating Committee representatives present approved the 2019 Rock Island Smolt and Gas Bubble Trauma Evaluation Report.

The final report was distributed to the HCP Coordinating Committees by Geris on March 31, 2020.

F. DECISION: 2019 Rocky Reach Juvenile Fish Bypass System Report (Lance Keller)

The draft 2019 Rocky Reach Juvenile Fish Bypass System Report was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and was available for a 30-day review, with edits and comments due to Lance Keller by Monday, March 16, 2020.

Keller said no edits, comments, or questions were received on the report, which was also compiled by Scott Hopkins. Keller said there were only routine operations to report.

Rocky Reach HCP Coordinating Committee representatives present approved the 2019 Rocky Reach Juvenile Fish Bypass System Report.

The final report was distributed to the HCP Coordinating Committees by Geris on March 31, 2020.

G. DECISION: 2020 Rock Island Bypass Monitoring Plan (Lance Keller)

The draft 2020 Rock Island Bypass Monitoring Plan was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and was available for a 30-day review, with edits and comments due to Lance Keller by Monday, March 16, 2020.

Keller said no edits, comments, or questions were received on the plan. He said routine operations are planned for 2020. He said, however, one thing to note is there will be a partnership between Chelan PUD and Real Time Research to conduct additional steelhead tagging for the Priest Rapids

Coordinating Committee, which will be a part of previous efforts by Real Time Research for avian predation in the Columbia River system.

Rock Island HCP Coordinating Committee representatives present approved the 2020 Rock Island Bypass Monitoring Plan.

The final plan was distributed to the HCP Coordinating Committees by Geris on March 31, 2020.

H. DECISION: 2020 Rocky Reach Juvenile Fish Bypass System Operations Plan (Lance Keller)

The draft *2020 Rocky Reach Juvenile Fish Bypass System Operations Plan* was distributed to the HCP Coordinating Committees by Kristi Geris on February 14, 2020, and was available for a 30-day review, with edits and comments due to Lance Keller by Monday, March 16, 2020.

Keller said no edits, comments, or questions were received on the plan. He said the plan outlines routine operations, as expected. He said one noted change is the proposed alternate operations language formerly under Turbine Unit C1 has moved to Turbine Unit C2. He recalled this language describes adjusting the soft-limit set point to allow additional flow. He said these operations are expected to occur through the duration of the 2020 bypass season.

Rocky Reach HCP Coordinating Committee representatives present approved the *2020 Rocky Reach Juvenile Fish Bypass System Operations Plan*.

The final plan was distributed to the HCP Coordinating Committees by Geris on March 31, 2020.

I. COVID-19: Chelan PUD Fish and Wildlife Department (Lance Keller)

Lance Keller said Chelan PUD is practicing social isolation and the majority of the Fish and Wildlife staff are working remotely; however, staff are still working. He said if anyone has questions or comments in all three HCP Committees, please continue to reach out to those respective representatives for Chelan PUD.

V. HCP Administration

A. COVID-19: Meeting Logistics (John Ferguson)

John Ferguson said he appreciates the flexibility of HCP Coordinating Committees representatives to meet by conference call, and he will keep in touch with everyone as updates become available.

B. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on April 28, 2020, to be held by conference call.

John Ferguson reminded the Wells HCP Coordinating Committee about a possible conference call before the next regularly scheduled monthly call to discuss the Douglas PUD 2020 Survival Verification Study.

The May 26 and June 23, 2020 meetings will be held by conference call or in-person at the Grant PUD Wenatchee Office in Wenatchee, Washington, as is yet to be determined.

VI. List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman†	BioAnalysts
Lance Keller*	Chelan PUD
Bill Towey	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Jim Craig*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
Patrick Verhey*	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation
Kirk Truscott*	Colville Confederated Tribes

Notes:
- * Denotes HCP Coordinating Committees member or alternate
- † Joined for the HCP Hatchery and Tributary Committees Update

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: May 26, 2020

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris

Re: Final Minutes of the April 28, 2020 HCP Coordinating Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Tuesday, April 28, 2020, from 9:00 a.m. to 10:50 a.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

- Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).
- Chad Jackson will update Washington Department of Fish and Wildlife (WDFW) and Keely Murdoch will update the Yakama Nation (YN) and Columbia River Inter-Tribal Fish Commission (CRITFC) about Douglas PUD's ongoing internal discussions and considerations about how to implement salmon and steelhead trapping activities at Wells Dam fish ladders in 2020, while complying with the evolving COVID-19 restrictions and concerns (Item IV-C).
- The YN will further discuss and consider the option of implementing CRITFC's sockeye salmon trapping and tagging concurrent with the Carlton Program trapping at Wells Dam in 2020, versus no CRITFC sockeye salmon trapping and tagging at all (Item IV-C).
- Keely Murdoch will discuss with Kraig Mott (YN Fisheries Biologist and Crew Leader for CRITFC sockeye salmon trapping) and Jeff Fryer (CRITFC) about the feasibility of conducting CRITFC sockeye salmon trapping at both east and west fish ladders at Wells Dam in 2020, to possibly meet sample size requirements (Item IV-C).
- Anchor QEA, LLC (Anchor QEA) will schedule HCP Policy Committees conference calls to follow the HCP Coordinating Committees conference calls in May and June 2020, in the event the Wells HCP Coordinating Committee cannot reach consensus on whether there are no impacts or acceptable impacts to Plan Species associated with CRITFC's request to conduct sockeye salmon trapping and tagging at Wells Dam in 2020 and the issue is elevated to the policy level and needs resolution in a timely manner. The calls will be canceled if not necessary (Item IV-C). *(Note: Following the meeting, Douglas PUD revised researcher access regulations to Wells Dam to address COVID-19 concerns, which made this discussion a moot point; therefore, there is no need to convene the HCP Policy Committees as discussed.)*
- The HCP Coordinating Committees meeting on May 26, 2020, will be held at 9:00 a.m., by conference call (Item V-E).

Decision Summary

- There were no HCP Decisions approved during today's conference call.

Agreements

- There were no HCP Agreements discussed during today's conference call.

Review Items

- The *Wells Project Subyearling Chinook Life-History Study 2011-2013 Draft Final Report* was distributed to the HCP Coordinating Committees by Kristi Geris on May 24, 2019.
- CRITFC's annual request to tag sockeye salmon at Wells Dam in 2020 was distributed to the HCP Coordinating Committees by Kristi Geris on February 4, 2020 (Item IV-C).
- A draft Federal Energy Regulatory Commission (FERC) notification letter regarding the maintenance rehabilitation of Rock Island Dam Powerhouse 2 was distributed to the Rock Island HCP Coordinating Committee by Kristi Geris on April 27, 2020, and is available for a 30-day review with edits and comments due to Lance Keller or Jeff Osborn (Chelan PUD License Compliance Specialist) by May 27, 2020 (Item III-D).

Finalized Documents

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. The following revisions were requested:

- Lance Keller added: 1) initiation of spring spill at Rock Island Dam; and 2) draft FERC notification letter regarding the maintenance rehabilitation of Rock Island Dam Powerhouse 2.
- Ferguson rearranged select agenda items in the following order: 1) Chelan PUD updates; 2) Douglas PUD updates; and 3) CRITFC decision.
- Ferguson added: 1) notification that an alligator gar was caught in the lower Yakima River; and 2) a subyearling Chinook salmon check-in reminder.

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft March 24, 2020 conference call minutes. Kristi Geris said all comments and revisions received from members of the Committees were incorporated into the revised minutes and there is one outstanding item remaining to be discussed under the 2020 Broodstock Collection Protocols discussion. Geris said Tom Kahler provided clarification to a statement he made in response to a comment made by Keely Murdoch during the meeting. Geris said she edited the minutes to incorporate Kahler's clarifications and asked if the edits were adequate. Kahler and Murdoch approved the edits. Kirk Truscott also requested edits under the CRITFC agenda item clarifying a statement he made during the meeting and these edits were incorporated. HCP Coordinating Committees members present approved the March 24, 2020 conference call minutes, as revised.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on March 24, 2020, and follow-up discussions, were as follows. *(Note: Italicized text corresponds to agenda items from the meeting on March 24, 2020):*

- *Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).*
  This action item will be discussed during today's conference call and will also be carried forward.
- *The YN will provide the National Oceanic and Atmospheric Administration (NOAA) scientific research permit issued to CRITFC to tag sockeye salmon at Wells Dam in 2020, along with the scientific research permit application, which contains additional information about the study (Item III-A).*
  Keely Murdoch provided these documents to Kristi Geris during the HCP Coordinating Committees conference call on March 24, 2020, which Geris distributed to the HCP Coordinating Committees that same day.
- *The Wells HCP Coordinating Committee will consider the following language for concurrence during the HCP Coordinating Committees conference call on April 28, 2020: Wells HCP Coordinating Committee representatives present have reviewed the CRITFC request to tag sockeye salmon at Wells Dam in 2020, and given the provisions contained within the Wells HCP, are voting on whether there are no fish passage impacts or acceptable fish passage impacts to Plan Species associated with the proposed data collection (Item III-B).*
  This action item will be discussed during today's conference call.
- *The Wells HCP Coordinating Committee will be prepared to convene by conference call to discuss a path forward for implementing the Douglas PUD 2020 Survival Verification Study, in the event the study cannot begin by the scheduled start date of April 13, 2020 (due to impacts of COVID-19; Item III-D).*
  This action item will be discussed during today's conference call.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees conference call on April 9, 2020:

- *Goodwin Side Channel Assessment Project*: The HCP Tributary Committees received a Small Projects Program proposal from Cascade Fisheries titled, *Goodwin Side Channel Assessment Project*. The purpose of the project is to conduct a groundwater study and topographic survey to determine inflow of groundwater to a partially disconnected side channel located between river mile (RM) 11.7 and 12.1 on the Wenatchee River. Results from the study will be used to assess the suitability of a habitat enhancement project designed to increase year-round juvenile salmonid rearing habitat, hyporheic exchange, and floodplain inundation. The total cost of the project is $21,157.02. The sponsor requested $17,067.02 from HCP Plan Species Account Funds. The Rock Island HCP Tributary Committee elected to contribute.
- *Sugar Reach Habitat Enhancement Early Implementation Project*: The HCP Tributary Committees received a Small Projects Program proposal from the Methow Salmon Recovery Foundation titled, *Sugar Reach Habitat Enhancement Early Implementation Project*. The purpose of the project is to reconnect a partially disconnected side channel located at RM 42.25 on the Methow River. Reconnection will be accomplished by constructing an inlet channel through fill material. The total cost of the project is $19,931.95. The sponsor requested $15,621.30 from HCP Plan Species Account Funds. The Wells HCP Tributary Committee elected to contribute.
- *Budget Amendment*: The Rock Island HCP Tributary Committee received a budget amendment request from Cascade Fisheries on the Chiwawa Nutrient Enhancement Project. The sponsor would like to reallocate existing funds among the budget line items. New line items include the use of a helicopter to distribute analogs along the Chiwawa River and a 10% indirect expense line item. The reallocation of existing funds would not affect the overall budget amount of $267,650. Before the Rock Island HCP Tributary Committee can approve the amendment, the Committee needs proof that the use of a helicopter to distribute analogs within the Chiwawa River is covered under existing permits. Therefore, the Committee asked the sponsor to check with the appropriate regulatory agencies and provide confirmation that the use of a helicopter is covered under their existing permits. Once the Committee has this information, the Rock Island HCP Tributary Committee will make a decision on the budget amendment.
- *Salmon Recovery Funding Board and HCP Tributary Committee Schedule for 2020*: The HCP Tributary Committees will receive draft Salmon Recovery Funding Board applications with

HCP Tributary Committees cost shares on April 17, 2020. Virtual tours will occur from April 11 to 13, 2020. The HCP Tributary Committees will review the draft applications on April 14, 2020, and determine which applications are fundable and which ones are not. Those that are fundable, the Committees will ask the project sponsors for final applications.

- *External Financial Review*: Every 5 years the Rock Island and Rocky Reach HCP Tributary Committees request an external financial review of all financial transactions made by the two Committees. The Committees selected the accounting firm Cordell, Neher & Co. to conduct the review this year. Results from the review will be available after the tax season. Funds to pay for the review come from the Rock Island and Rocky Reach Administrative Accounts. Hillman said the Wells HCP Tributary Committee does not do a 5-year review. Rather, the Wells account is reviewed on an annual basis.
- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on May 14, 2020. Virtual site visits will occur from May 11 to May 13, 2020.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees meeting on April 21, 2020 (*note: joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *2021 Broodstock Collection Protocols Discussion Schedule (joint):* The HCP Hatchery Committees recently completed the 2020 Broodstock Collection Protocols and are now identifying topics that will need to be discussed before completing the 2021 Broodstock Collection Protocols. These discussions will occur from May through December this year.
- *Comprehensive Hatchery Monitoring and Evaluation (M&E) Report (joint):* The PUDs provided an update on the status of comprehensive reporting. The comprehensive reports, which are due at the end of this year, evaluate the performance of the HCP hatchery programs by addressing each of the hatchery M&E objectives in the Hatchery M&E Plan. The PUDs are currently compiling and analyzing data and writing reports for each HCP hatchery program. At this time, it looks like all reports, except the genetics report, will be completed by the end of the year. The genetics lab will not be able to meet the deadline because of issues related to COVID-19. The genetics report should be available during early 2021.
- *COVID-19 and Hatchery M&E Activities:* Each member of the HCP Hatchery Committees discussed the effects of COVID-19 on their respective M&E activities. M&E activities most affected by COVID-19 have been smolt trapping operations, steelhead spawning ground surveys, and precocial spring Chinook salmon sampling. Most of these activities have resumed or will resume shortly as entities identify ways to protect fieldworkers from exposure to COVID-19. Precocial sampling has been canceled this year. In-hatchery M&E activities have

occurred with little to no interruptions. In addition, most marking and tagging activities have occurred or will occur. Passive integrated transponder (PIT)-tagging of fall Chinook salmon may not occur this year. In addition, COVID-19 has not affected fish counting at dams. These data have not yet been uploaded to the Columbia River Data Access in Real Time (DART) website, likely because of COVID-19; however, these data are available on the PUD websites.

- *Marking and Tagging Pre-Release Assessment:* Recent sampling of marked and tagged fish indicates that several hatchery fish from several programs were not correctly adipose (ad) fin clipped. That is, several fish that were supposed to be ad-clipped retained 50% or more of their adipose fin. Among the programs evaluated, from 14% to 28% of the fish sampled had "bad" ad-clips. However, coded wire tag retention was high (greater than 95%) in those fish. There were a few reasons for the poor clippings that occurred this year, including not replacing replaceable marking/tagging parts in the tagging trailers and poor quality assurance/quality control following tagging. These issues have been resolved and will not affect marking and tagging in the future. The results of the poor ad-clips this year will have some effects on harvest and perhaps monitoring programs. It should not affect broodstock collections.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on May 20, 2020. Hillman said he hopes this meeting will convene in-person; however, it may be convened by conference call if necessary.

III. Chelan PUD

A. Rock Island Dam Powerhouse 1 Maintenance Update (Lance Keller)

Lance Keller said there has been little to no work completed in Powerhouse 1 due to COVID-19. He said the Rock Island Dam Superintendent is trying to determine how to continue work as restrictions ease but still require social distancing and appropriate personal protective equipment.

Keller added that Turbine Unit B4 will no longer be returned to service in May 2020, as previously scheduled before COVID-19, which will result in a reduction of powerhouse capacity and more spill than the 10% daily target.

B. Rocky Reach Dam Turbine Units Maintenance Update (Lance Keller)

Lance Keller said similar to Rock Island Dam, the Rocky Reach Dam Superintendent is trying to meet social distancing requirements and continue work on Turbine Units C2 and C3. Keller said work was ahead of schedule on Turbine Unit C2 when the Stay-At-Home Order was issued, so he hopes there will not be too much of a delay in the overall schedule.

John Ferguson asked if a delay or change in the maintenance schedule will have an effect on spill patterns, spill operations, or powerhouse capacity during the 2020 fish passage season. Keller said there should be no negative impacts to fish passage.

C. Initiation of Spring Spill at Rock Island Dam (Lance Keller)

Lance Keller said 10% spring fish spill at Rock Island Dam was initiated on April 17, 2020, at 0000 hours. Keller said Thad Mosey (Chelan PUD Senior Fish Biologist) oversees the fish spill program and monitored daily bypass trap counts of juvenile spring migrating species to determine if there was any indication to initiate spring spill earlier to provide spill for 95% of the spring species outmigration. Keller said the counts were low through April 16, 2020; therefore, per the Rock Island HCP, spring spill was initiated no later than April 17, 2020, at 0000 hours. He said in reviewing data on DART through April 16, 2020, as of April 28, 2020, the passage percentages for yearling Chinook salmon, steelhead, and sockeye salmon were well below 5% to meet 95% coverage at Rock Island Dam. Keller said Mosey interpreted these data well and made the right call. Keller said Rock Island Dam will spill 10% of the estimated daily average river flow, and when subyearlings arrive, daily average spill will instantaneously increase to 20%.

D. Draft FERC Notification Letter Regarding the Maintenance Rehabilitation of Rock Island Dam Powerhouse 2 (Lance Keller)

Lance Keller said a draft FERC notification letter regarding the maintenance rehabilitation of Rock Island Dam Powerhouse 2 was distributed to the Rock Island HCP Coordinating Committee by Kristi Geris on April 27, 2020, and is available for a 30-day comment period. Keller said the letter outlines the rehabilitation effort for eight bulb-turbine type units planned to start in fall 2021, after the 2021 survival check-in study. He said the schedule calls for rehabilitating one unit per year, which results in the maintenance being completed by 2029 and ahead of the next scheduled survival check-in study. He said this work is deemed maintenance, similar to Powerhouse 1 Turbine Units B1 to B4, and does not involve changes to the generator nameplate, turbine horsepower, or authorized Project hydraulic capacity; rather, parts will be refurbished or replaced and will be identical or comparable to the original components, which will bring their specifications back into tighter operating tolerances. He said, therefore, these activities do not require prior approval by FERC; however, Chelan PUD will continue to coordinate with FERC as these activities progress. He said the rehabilitation will replace the generator stator core and windings and turbine discharge liner, and the internal hub components will be re-built to decrease friction. He said the units will continue operating with variable-pitch blades, which are the same conditions tested earlier when the HCP juvenile salmonid passage survival standard was achieved. He said Rock Island Dam Powerhouse 2 Units U1 to U8 have been operated since 1979 and are reaching the end of their mechanical life. He said this rehabilitation work should lead to an additional 40 years of operation for the bulb units in

Powerhouse 2. He said there will be no changes to any civil works, for example, there will be no changes to the diameter of the intake or height of wicket gates. He said this draft FERC notification letter is available for review through May 27, 2020. Keller said to contact him or Jeff Osborn with questions or comments.

John Ferguson asked if Rock Island HCP Coordinating Committee members can provide verbal comments during the HCP Coordinating Committees conference call on May 26, 2020, or if Chelan PUD prefers receiving comments in writing. Keller requested that edits and comments on the draft letter be provided in writing with changes tracked. He said all comments received will be included in a consultation matrix, along with Chelan PUD responses, and appended to the final letter. He said, however, if verbal comments work best for Rock Island HCP Coordinating Committee members, Chelan PUD can accommodate these as well.

Ferguson said Keller summarized key activities very well. Ferguson added that this letter also identifies the sequence of each unit going out of service. He said in terms of fish passage, there does not seem to be any changes. Keller said this is correct. He said the rehabilitation is an all mechanical maintenance approach. He said if anything, Chelan PUD expects additional efficiency from these units after the maintenance, which could benefit fish passage. He said Chelan PUD Fish and Wildlife Staff clearly explained to the engineers that HCP survival standards were met under the current bulb unit design and it is important to keep the refurbished units as similar to the original units as possible. Keller also noted that Rock Island Dam Powerhouse 2 Units U1 to U8 are horizontal-axis bulb units, which are more difficult to refurbish compared to vertical-axis units; however, the goal is to have no changes to how these units operate.

IV. Douglas PUD

A. Douglas PUD 2020 Survival Verification Study (Tom Kahler)

Tom Kahler said by the end of today, Douglas PUD will have reached the middle-point of the study by concluding the release of replicate 8. He said the weather has posed some challenges, but crews have been able to continue their work and accomplish the releases as intended. He said so far, detections have been good, with about 2,600 detections at the Rocky Reach Juvenile Fish Bypass System. He said in the lower river, however, there have not been good detections and he hopes this is an issue of travel time. He said additionally, with more spill in the lower river in 2020 compared to 2010 during the last survival verification study, Douglas PUD is expecting detection rates in bypass systems at lower Columbia River dams to be lower compared to 2010, which was one reason behind increasing the sample size for this study. He said Douglas PUD crews have figured out how to accomplish various components while social distancing to keep everyone safe. He said all components of the study are outside except the physiology sampling, which is completed in a mobile laboratory in the back of a van. He said Douglas PUD expects the study to continue and be completed as intended.

John Ferguson asked what weather has posed challenges and Kahler said the wind. Kahler said high winds have impacted towing the barges carrying the release tanks. He said the cranes also have a long reach from the shore to load the tanks, and the high winds have shortened how far cranes can reach due to safety concerns. He said so far, all operations have been completed successfully.

B. Wells Dam 2020 Bypass Operations (Tom Kahler)

Tom Kahler said bypass operations at Wells Dam began on April 9, 2020, at 0000 hours. He said Douglas PUD is now equipped with new tools for monitoring bypass compliance remotely from a computer. He said the new tools include a graphical interface that displays turbine operations and spill gate openings. He said to date, bypass operations are going well.

John Ferguson asked if the PIT-tag detection system is operational in Spillway 2. Kahler said yes; however, there has not been high detections at this location because adjacent Turbine Units 1 and 3 are not operating. He said one unit is offline for rebuild and the other is offline for annual maintenance. He said fish are passing the project more toward river-left, away from river-right, where Spillway 2 is located. He said Turbine Unit 1 is scheduled to be back in service in 1 week; however, the survival study will be two-thirds complete by this time. He said still, the data should show the effect of bringing Turbine Unit 1 back to service and what this does to detection efficiency in Spillway 2.

C. DECISION: CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam (Tom Kahler)

John Ferguson recalled about 1 year ago, Kirk Truscott started questioning the need for these data. Ferguson said since then, this topic has been discussed over the course of several HCP Coordinating Committees meetings. He recalled during the last meeting, Keely Murdoch helped the Wells HCP Coordinating Committee focus on key issues to work through, including whether statements regarding the CRITFC sockeye salmon trapping in the Broodstock Collection Protocols are binding, which the Wells HCP Coordinating Committee agreed they are not. Ferguson also recalled that Murdoch questioned whether the Wells HCP Coordinating Committee has the purview to weigh in on tagging operations at Wells Dam, and the Wells HCP Coordinating Committee seemed to agree that they do to the extent the operations could affect passage of Plan Species. Ferguson said the Wells HCP Coordinating Committee agreed not to weigh in on whether the data are valuable or who conducts the sampling; rather, they will review the request from the perspective of impacts to fish passage. He recalled reviewing and discussing the CRITFC permit for incidental take, sampling concurrent with and not in addition to sampling for the Carlton Program, the use of Aqui-S, and whether CRITFC holds an Investigational New Animal Drug (INAD) exemption for the proposed sampling. Ferguson recalled that the CRITFC request is to sample up to 800 fish. He said considering the past 25 years of passage timing, the proposed summer Chinook salmon sampling for the Carlton Program from July 1 to September 15 falls in the middle 80th percentile of the sockeye salmon migration. He recalled that the Wells HCP Coordinating Committee crafted a statement to discuss with respective HCP Policy Committees representatives and consider for concurrence, as follows:

> *Wells HCP Coordinating Committee representatives present have reviewed the CRITFC request to tag sockeye salmon at Wells Dam in 2020, and given the provisions contained within the Wells HCP, are voting on whether there are no fish passage impacts or acceptable fish passage impacts to Plan Species associated with the proposed data collection.*

Ferguson said this statement addresses the technical aspects of the CRITFC request, consistent with HCP Policy Committees guidance from 2019. He said the CRITFC request is a decision item today, but it can be postponed 1 more month, if needed.

Murdoch said she has been talking a lot with people to obtain more information. She said she understands the Wells HCP Coordinating Committee is not making a decision on whether the data are useful or not; however, she believes the importance of the data can help inform whether the impacts of the proposed activity are acceptable. She said she had a conversation with Okanagan Nation Alliance (ONA) staff about how these PIT-tag data are used and the importance of these data. She said it sounds like these data are very important for in-season escapement management, spawner distribution, and M&E for the sockeye salmon Skaha Lake reintroduction program in the Okanagan River Basin. She said all parties except for Douglas PUD have helped fund this project (with the exception of efforts related to the Fish and Water Management Tool). She noted the email from Kim Hyatt (Department of Fisheries and Oceans Canada [DFO]) to Tom Kahler that was distributed to the Wells HCP Coordinating Committee by Kristi Geris on April 27, 2020, which indicates these data are clearly very important. Murdoch said a modeling effort is underway to support discussions for the renewal of the Columbia River Treaty (Treaty), and DFO and ONA are relying on these data for the model being developed to support analyses associated with renewing the Treaty. Murdoch said further, she had a conversation with Jeff Fryer who indicated there has been a lot of restrictions on sampling at the Bonneville Dam Adult Fish Facility (Bonneville AFF) this year due to social distancing requirements associated with COVID-19 and Fryer may not be able to reach the target sample numbers at the Bonneville AFF, which makes reaching sampling targets at Wells Dam really important. Murdoch said this issue at the Bonneville AFF and the impacts to the data are so important that it will be on the agenda for discussion at the next Canadian Okanagan Basin Technical Working Group (COBTWG) meeting scheduled for June 2020. She said additionally, regarding sampling only in space and time concurrent with the Carlton Program at Wells Dam, after talking with Kraig Mott, YN Fisheries Biologist and Crew Leader for CRITFC sockeye salmon trapping, Mott said if trapping is limited only to when trapping is operating for the collection of summer Chinook salmon broodstock for the Carlton Program, Mott will not be able to reach the target sample size for CRITFC. Murdoch said further, Mott is unsure the trapping efforts can be conducted concurrently while maintaining social distancing. Murdoch said, therefore, she suggests that the YN conduct the sockeye salmon sampling independent of the Carlton Program for the reasons just discussed. She said CRITFC's sockeye salmon trapping and tagging is a collaborative effort with DFO, ONA, and the YN, and it would be a shame to not be able to collect these data this year.

Murdoch asked Truscott how implementing CRITFC's request would impact the sockeye salmon population. Murdoch asked if data exist that show a negative impact. Truscott asked if data exist that show there is no negative impact to sockeye salmon or any Plan Species. He said he is erring on the side of caution. Murdoch asked if the Colville Confederated Tribes (CCT) are an ONA tribe and Truscott said they are. Murdoch asked if the CCT have discussed this topic with ONA. Truscott said he had not known the rationale of these data until he received Hyatt's email yesterday. Truscott asked why a retrospective analysis of the last 16 years of PIT-tag data would not be sufficient to meet the needs for this evaluation? Murdoch said Hyatt's email indicates he needs these PIT-tags to validate the data from a 3-year Treaty modeling project, and Murdoch read the last paragraph of Hyatt's email, as follows:

> *My DFO Research Group is currently reviewing the past several years of pit tagging, migration, and survival work to complete the adult freshwater migration portion of what we intend to eventually use in a cumulative impacts life history model for sockeye [salmon] and then for Chinook [salmon]. The ongoing information from tagging sockeye [salmon] at Wells [Dam] is viewed as having especially high value to our ability to verify model performance over the three-year funding window in which this work is to be completed. I am hopeful that the tagging and biological sampling that has been undertaken in recent years at Wells [Dam] may continue in support of this new three-year research initiative.*

Truscott said he is not privy to the specifics of this 3-year initiative and he cannot really provide an answer on whether he or others agree this is correct that additional data are needed. Murdoch reiterated that ONA also indicated these data are used for real-time management of escapement, spawner distribution, and M&E, and this cannot be done with a retrospective analysis.

Truscott said the Wells HCP Coordinating Committee had a path forward and this discussion is a different path. He suggested Murdoch contact ONA and have Howie Wright (ONA Fisheries Manager) call Randy Friedlander (CCT Fish and Wildlife Program Director and HCP Policy Committees

Representative). Truscott said currently, his path remains unchanged. He said if CRITFC sampling is conducted concurrent with the Carlton Program there would be no additional impacts. He said this is still where he stands. Murdoch said Tom Scribner (YN HCP Hatchery Committees Representative) already spoke with Wright and it was Wright's idea to bring this issue to the COBTWG to discuss the technical implications of not reaching the target sample sizes. Murdoch said this is likely why Wright has not yet called Friedlander, because the topic will be discussed at the next COBTWG meeting in June 2020.

Ferguson asked if and how the run size forecast plays into Mott's conclusion that sockeye salmon trapping would need to go beyond the concurrent trapping window to meet sample size requirements. Murdoch said Mott's comments are based on his experience from conducting this sampling for several years. Murdoch said in the past, sockeye salmon trapping has occurred on the east fish ladder and brood collection has occurred on the west fish ladder. *(Note: Kahler later clarified that broodstock for the Carlton Program are collected on both ladders, with preference for the east ladder, and M&E run-comp trapping has typically occurred at the east ladder.)*

Murdoch said she thinks one limiting factor is sockeye salmon trapping would need to align with the brood collection schedule, which typically occurs early in the week. Kahler explained further that Fryer prefers trapping at the east fish ladder because when sockeye salmon are collected at the west fish ladder these fish are conveyed to Pond 6 and are processed along with the summer Chinook salmon the next day (compared to trapping at the east fish ladder and processing the fish the same day separate from the summer Chinook salmon).

Kahler said this year, brood collection for the Carlton Program will occur at both fish ladders. He said over the last 2 years, Chinook salmon have been favoring the east fish ladder and sockeye salmon have been favoring the west fish ladder. He said if trapping is concurrent on both fish ladders, he wonders if there might be a greater chance of reaching the quota.

Kahler said regarding COVID-19, Douglas PUD is still trying to figure out how to complete planned activities while maintaining social distancing. He said the hatchery buildings at Wells Dam are siloed off. He said he can access the old building but not the new building at Wells Fish Hatchery. He said he cannot go into Wells Dam but he can drive over the dam. He said there are a lot of older employees in hydromechanics and as dam operators, and Douglas PUD is trying to protect these staff. He said he cannot access Methow Fish Hatchery either and Methow Fish Hatchery staff are not allowed access to Wells Fish Hatchery. He said M&E and steelhead spawning staff are limited on when and where staff can be at different locations. He said now the major brood collection season has started, with spring Chinook salmon collection starting today and running through the end of June, and summers and sockeye salmon collection starting soon after. He said that surplusing of summer Chinook salmon is also quickly approaching. He said this is all very complicated, and

Douglas PUD staff plan to convene this afternoon to discuss how to address COVID-19 while allowing all these different uses of the project. He said this is a multi-party consideration that Douglas PUD is trying to sort through, and it is still unknown how things will change in June and July. He said it is good to discuss ideals; however, he hopes everyone can appreciate that everything is in flux. He said it may be that Douglas PUD needs to trap and tag sockeye salmon. He said this is not ideal for Douglas PUD, the YN, or CRITFC, but this may be the only option. He said lastly, he appreciates the utility of the data and for the modeling exercise to support discussions on the Treaty, and the real time aspect of managing the resources. He said he also appreciates the need for long-term datasets.

Ferguson suggested that Chad Jackson update WDFW and Murdoch update the YN and CRITFC about Douglas PUD's ongoing internal discussions and considerations about how to implement salmon and steelhead trapping activities at Wells Dam fish ladders in 2020, while complying with the evolving COVID-19 restrictions and concerns.

Ferguson reminded the Wells HCP Coordinating Committee, as discussed during the last meeting, the purview of the HCP Coordinating Committees is the safe and efficient passage of Plan Species as a technical decision point. He said it is important to keep this in mind. He said if there is a formal vote right now, the CCT and the YN have been clear there is not consensus. He said this means the proposed sockeye salmon trapping and tagging at Wells Dam in 2020 will not go forward. Ferguson said this topic can be elevated to the policy level and addressed by conference call; however, he is unsure whether the outcome will be any different with the Wells HCP Policy Committee. He said Truscott expressed he is still firm in his view, so it comes down to whether the YN wants to collect as many fish as possible during concurrent sampling or get no fish at all.

Jim Craig said it seems the Wells HCP Coordinating Committee is at an impasse. Ferguson asked if Craig is proposing a vote now versus postponing a decision for 1 month. Craig said he is unsure what will change in 1 month but is also supportive of waiting another month if this is preferred. Murdoch said, considering that Douglas PUD plans to meet today to discuss COVID-19 mitigation measures and the COBTWG is convening in June, she thinks discussions from these two meetings might clarify a decision or path forward before the proposed sampling start date in late June. Ferguson said there will also be two more meetings of the HCP Coordinating Committees, on May 26 and June 23, 2020, to further discuss this topic, if needed. Murdoch said the YN is supportive of postponing a decision today. She said, however, if there is no way the CCT will approve this activity, she believes an HCP Policy Committees meeting will be needed. Truscott agreed.

Ferguson said the decision will be deferred for now to allow more time for COVID-19 and COBTWG discussions. He suggested that the YN also further discuss and consider the option of implementing CRITFC's sockeye salmon trapping and tagging concurrent with the Carlton Program trapping at

Wells Dam in 2020, versus no CRITFC sockeye salmon trapping and tagging at all. Murdoch said she can discuss this with Fryer; however, with the low sample size at the Bonneville AFF it is really important to reach the sample size at Wells Dam. Kahler also suggested that Murdoch discuss with Mott and Fryer the feasibility of conducting CRITFC sockeye salmon trapping at both east and west fish ladders at Wells Dam in 2020, to possibly meet sample size requirements. Murdoch said she can discuss this with Mott and Fryer; however, Mott already indicated he does not believe numbers will be close to reaching the sample target while sampling concurrently.

Ferguson said it is worth noting that the longer the Wells HCP Coordinating Committee postpones a decision, the more difficult it will be to convene the HCP Policy Committees in a timely way to meet the needs of sampling. Jackson suggested scheduling HCP Policy Committees conference calls now to take place after each of the next HCP Coordinating Committees meetings in May and June, in case these are needed. He said canceling the meetings will be easier than trying to schedule last minute. Murdoch agreed. Ferguson said that Anchor QEA will schedule HCP Policy Committees conference calls to follow the HCP Coordinating Committees conference calls in May and June 2020, in the event the Wells HCP Coordinating Committee cannot reach consensus on whether there are no impacts or acceptable impacts to Plan Species associated with CRITFC's request to conduct sockeye salmon trapping and tagging at Wells Dam in 2020 and the issue is elevated to the policy level and needs resolution in a timely manner. He said the calls will be canceled if not necessary. *(Note: Following the meeting, Douglas PUD revised researcher access regulations to Wells Dam to address COVID-19 concerns, which made this discussion a moot point; therefore, there is no need to convene the HCP Policy Committees as discussed.)*

V. HCP Administration

A. COVID-19 and Meeting Logistics (John Ferguson)

John Ferguson asked each HCP Coordinating Committees representative to provide updates on COVID-19 restrictions for their respective Parties, if any.

Lance Keller said most Chelan PUD staff are still continuing to work from home.

Tom Kahler said the same is true for Douglas PUD. He said there are very few staff still working at headquarters in East Wenatchee, Washington, which is now closed to the public. He said most, but not all, office phones are transferring calls directly to employee's mobile phones. He said the Douglas PUD Natural Resources Department should all be available via teleworking from home. He said currently, there is no timeframe established for ending this arrangement.

Keely Murdoch said she provided a similar update to the HCP Hatchery Committees. She said generally, the YN is reduced to activities required to keep fish alive. She said the YN also obtained authorization for limited time-sensitive activities. She said, for example, last week, staff installed smolt traps that are now operational, and staff are now also collecting kelts at Rock Island Dam with help from Chelan PUD. She said staff are practicing social distancing during all activities.

Kirk Truscott said he also discussed most impacts of COVID-19 for the CCT with the HCP Hatchery Committees. He said briefly, the CCT are only conducting essential activities with essential staff, which changes weekly. He said Chief Joseph Hatchery is closed to the public. He said similar to Douglas PUD, the CCT are limiting internal staff visits to the hatchery.

Chad Jackson said for hatcheries, any activity required to keep fish alive is considered essential. He said WDFW staff are working from home except for smolt trapping and steelhead monitoring. He said WDFW is currently working on obtaining approval to expand what is allowed as essential work.

Jim Craig said most of the conservation office is teleworking. He said there are skeleton crews working at the three federal hatcheries, while social distancing. He said fish releases occurred last week and staff were equipped with personal protective equipment while cleaning ponds and moving fry out to the ponds. He said everything proceeded as planned and everyone is healthy. Ferguson asked if tagging at federal hatcheries stopped. Craig said the marking trailer is on hold but is ready to mobilize. He said all fish released were previously marked.

Ferguson said he and Kristi Geris are teleworking and are available, per usual.

B. HCP Policy Committee In-Person Meeting Postponed (John Ferguson)

John Ferguson recalled that the HCP Policy Committees had planned to convene an in-person meeting on May 5, 2020; however, this meeting is postponed due to COVID-19. He said the meeting is tentatively planned for late summer or early fall 2020. He said the purpose of this meeting will be to review the past year of HCP implementation, and maybe now to also discuss sockeye salmon.

C. Alligator Gar in the Yakima River (John Ferguson)

John Ferguson said a video was recently circulated to several fish and wildlife staff in the region showing an alligator gar collected in a carp trap in the Lower Yakima River. Ferguson asked Chad Jackson to provide a summary and update on this encounter.

Jackson said on April 14 or 15, 2020, Paul Hoffarth (WDFW District 4 Fish Biologist) received an email containing a Snapchat video from a permitted carp fisherman who annually fishes the Yakima River Delta. Jackson explained that a commercial carp permit allows take of carp only and bycatch, alive or dead, must be returned to the river. He said this carp trap is checked routinely and most bycatch is sport fish, and commercial gear cannot be used to capture sport fish. He said two fish identified as alligator gar (and later confirmed by an expert in Texas), both about 28 to 30 inches in length, were captured in this carp trap. He said because of the permit requirement, the commercial fisherman returned both fish to the river, not knowing the extent of this. He said this fisherman plans to return to the Yakima River Delta to fish for carp as he would normally and will set nets in the same area where he caught the gar originally. Jackson said WDFW has modified this commercial carp fisherman's permit to allow retention of gar and northern pike. Jackson said U.S. Geological Survey and the YN have also attempted to recapture the fish with no success. He said WDFW has not been able to obtain an "essential work" permit to send out personnel to try to recapture these fish. He said based on research and information provided by the professor in Texas, these are immature fish and alligator gar typically take 10 to 12 years to reach sexual maturity. He said their best guess is that someone released these fish from an aquarium. He said these fish are available to purchase online for $30 to $50, with "platinum" alligator gar selling for $2,000 each. He said fish and wildlife enforcement staff are investigating this case. He said he can keep the HCP Coordinating Committees updated as more develops. He said WDFW is currently waiting for permission to send out electroshocking boats.

Kirk Truscott asked what possibility is there for these fish to survive to sexual maturity? Jackson said WDFW believes there is a good possibility of these fish surviving to maturity. He said reaching maturity may be slower compared to when these fish are in their native range (warmer temperatures). He said so far, no evidence of spawning has been observed. He said there is no panic yet, and he hopes these fish are recaptured or both fish are males or females. He said based on the size and condition of the fish captured, it appears the fish survived a winter in the Columbia River; however, this is all speculation. Truscott asked about the chances of these fish successfully bringing up brood in this region. Jackson said he is unsure. He said spawning requirements for alligator gar include water temperatures as low as 68°F but more ideally toward lower- to mid-70°F. Ferguson asked about reproduction ecology. Jackson said alligator gar spawn similar to sturgeon, by broadcast spawning and sticky eggs that can hatch in days. He said alligator gar do not spawn in big water like sturgeon do but the fish spawn in the same manner.

D. Subyearling Chinook Salmon Check-In Reminder (John Ferguson)

John Ferguson reminded the HCP Coordinating Committees that the next subyearling Chinook salmon check-in will be on the agenda for the next HCP Coordinating Committees meeting on May 26, 2020.

E. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on May 26, 2020, to be held by conference call.

The June 23 and July 28, 2020 meetings will be held by conference call or in-person at the Grant PUD Wenatchee Office in Wenatchee, Washington, as is yet to be determined.

VI. List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman†	BioAnalysts
Lance Keller*	Chelan PUD
Bill Towey	Chelan PUD
Tom Kahler*	Douglas PUD
Jim Craig*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation
Kirk Truscott*	Colville Confederated Tribes

Notes:
* Denotes HCP Coordinating Committees member or alternate
† Joined for the HCP Hatchery and Tributary Committees Update

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: June 23, 2020

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris

Re: Final Minutes of the May 26, 2020 HCP Coordinating Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Tuesday, May 26, 2020, from 9:00 a.m. to 11:00 a.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

- Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).
- Chelan PUD will: 1) share with Washington Department of Fish and Wildlife (WDFW) and National Marine Fisheries Service (NMFS) what the Rock Island and Rocky Reach HCP Coordinating Committees discussed about deferring the 2021 Rocky Reach Confirmation Survival Study to 2022 and conducting the 2020 Rock Island Confirmation Survival Study in 2021 as already approved by the Rock Island HCP Coordinating Committee (on December 4, 2018); 2) ask that WDFW and NMFS provide any comments on these topics to Kristi Geris for distribution to the HCP Coordinating Committees; and 3) develop a draft Statement of Agreement (SOA) to defer the 2021 Rocky Reach Confirmation Survival Study to 2022 (Item IV-D). *(Note: Scott Carlon indicated NMFS support via email on June 5, 2020 and Chad Jackson indicated WDFW support via email on June 10, 2020, of Chelan PUD's proposal to defer the 2021 Rocky Reach Confirmation Survival Study to 2022, which Geris distributed to the HCP Coordinating Committees those same days. A draft SOA to defer the 2021 Rocky Reach Confirmation Survival Study to 2022 was distributed to the Rocky Reach HCP Coordinating Committee by Geris on June 9, 2020.)*
- The HCP Coordinating Committees meeting on June 23, 2020, will be held at 9:00 a.m., by conference call (Item VI-C).

Decision Summary

- There were no HCP Decisions approved during today’s conference call.

Agreements

- The Wells HCP Coordinating Committee agreed that Douglas PUD shall immediately notify the Committee of any deviations to the Bypass Operating Plan for Wells Dam, should a deviation occur, and provide monthly updates on bypass operations during Wells HCP Coordinating Committee meetings, in lieu of providing written monthly bypass operation reports as described in the *Summary of Wells Dam Bypass Operations in April 2019* (distributed to the HCP Coordinating Committees by Kristi Geris on May 10, 2019, and discussed during the HCP Coordinating Committees meeting on May 28, 2019; Item III-C).

Review Items

- The *Wells Project Subyearling Chinook Life-History Study 2011-2013 Draft Final Report* was distributed to the HCP Coordinating Committees by Kristi Geris on May 24, 2019 (Item V-A).
- Columbia River Inter-Tribal Fish Commission's (CRITFC's) annual request to tag sockeye salmon at Wells Dam in 2020 was distributed to the HCP Coordinating Committees by Kristi Geris on February 4, 2020 (Item III-A).
- A draft Federal Energy Regulatory Commission (FERC) notification letter regarding the maintenance rehabilitation of Rock Island Dam Powerhouse 2 was distributed to the Rock Island HCP Coordinating Committee by Kristi Geris on April 27, 2020, and is available for a 30-day review with edits and comments due to Lance Keller or Jeff Osborn (Chelan PUD License Compliance Specialist) by May 27, 2020 (Item IV-A).
- A Wells Project Land-Use Permit Application for #LUP 4-06 was distributed to the HCP Coordinating Committees by Kristi Geris on June 3, 2020. This application is available for a 30-day review with comments or indication of no comments due to Tom Kahler no later than Friday, July 3, 2020.
- The draft SOA, *Deferment of the Rocky Reach Project Confirmation Survival Study from 2021 to 2022*, was distributed to the Rocky Reach HCP Coordinating Committee by Kristi Geris on June 9, 2020 (Item IV-D).

Finalized Documents

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. Lance Keller added a notification of the initiation of summer fish spill at Rock Island and Rocky Reach dams.

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft April 28, 2020 conference call minutes. Kristi Geris said all comments and revisions received from members of the Committees were incorporated into the revised minutes. HCP Coordinating Committees members present approved the April 28, 2020 conference call minutes, as revised.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees conference call on April 28, 2020, and follow-up discussions, were as follows. *(Note: Italicized text corresponds to agenda items from the conference call on April 28, 2020):*

- *Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).*
  This will be discussed during today's conference call and will also be carried forward.
- *Chad Jackson will update Washington Department of Fish and Wildlife (WDFW) and Keely Murdoch will update the Yakama Nation (YN) and Columbia River Inter-Tribal Fish Commission (CRITFC) about Douglas PUD's ongoing internal discussions and considerations about how to implement salmon and steelhead trapping activities at Wells Dam fish ladders in 2020, while complying with the evolving COVID-19 restrictions and concerns (Item IV-C).*
  This will be discussed during today's conference call.
- *The YN will further discuss and consider the option of implementing CRITFC's sockeye salmon trapping and tagging concurrent with the Carlton Program trapping at Wells Dam in 2020, versus no CRITFC sockeye salmon trapping and tagging at all (Item IV-C).*
  This will be discussed during today's conference call.
- *Keely Murdoch will discuss with Kraig Mott (YN Fisheries Biologist and Crew Leader for CRITFC sockeye salmon trapping) and Jeff Fryer (CRITFC) about the feasibility of conducting CRITFC sockeye salmon trapping at both east and west fish ladders at Wells Dam in 2020, to possibly meet sample size requirements (Item IV-C).*
  This will be discussed during today's conference call.
- *Anchor QEA, LLC (Anchor QEA) will schedule HCP Policy Committees conference calls to follow the HCP Coordinating Committees conference calls in May and June 2020, in the event the*

Wells HCP Coordinating Committee cannot reach consensus on whether there are no impacts or acceptable impacts to Plan Species associated with CRITFC's request to conduct sockeye salmon trapping and tagging at Wells Dam in 2020 and the issue is elevated to the policy level and needs resolution in a timely manner. The calls will be canceled if not necessary (Item IV-C). Following the meeting, Douglas PUD revised researcher access regulations to Wells Dam to address COVID-19 concerns, which made this discussion a moot point; therefore, there is no need to convene the HCP Policy Committees as discussed.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees conference call on May 14, 2020:

- *Upper Burns and Angle Point Areas Habitat Enhancement Project*: The Rock Island HCP Tributary Committee received a budget amendment request from the YN on the Upper Burns and Angle Point Areas Habitat Enhancement Project. The YN requested an additional $187,550, which would increase the Committee's contribution to a total of $376,550. The YN requested additional funding from the Rock Island HCP Tributary Committee because the project did not receive funding from the Salmon Recovery Funding Board last year. The Rock Island HCP Tributary Committee declined to contribute more than the $189,000 already approved for the project. The Committee identified concerns with the overall cost of the project, placement of one of the large wood structures, and the amount of excavation work proposed. As the Rock Island HCP Tributary Committee recommended last year, the Committee would like to see a project at this site that minimizes disturbance of existing riparian vegetation.
- *General Salmon Habitat Program Draft Proposals*: The HCP Tributary Committees received 10 General Salmon Habitat Program draft proposals. These are cost-share proposals with the Salmon Recovery Funding Board. The Committees identified three projects that did not warrant a full proposal, because these did not have strong technical or biological merit or were not cost effective (low benefits per cost). The Committees solicited full proposals from seven projects, which are due on May 29, 2020. The proposed projects are located in the Wenatchee and Methow River basins.
- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on June 11, 2020, when the Committees will review the final General Salmon Habitat Program applications.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees conference call on May 20, 2020 (*note: joint HCP*

Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"):

- *Re-evaluation of Conservation Program Size (joint):* The HCP Hatchery Committees and PRCC Hatchery Subcommittee are looking at revising the size of the Wenatchee spring Chinook salmon conservation programs. Importantly, total hatchery production will not change; only the allocation of production between the conservation and safety-net programs may change. The Committees reviewed the spreadsheet model that was used during No Net Impact recalculation and are looking to update input parameters to the model. Updated inputs will include spawner escapements, smolt-to-adult recruit ratios, broodstock needs, pre-spawn losses, and updated stock-recruitment estimates. Discussion on this topic will continue over the next few months.
- *COVID-19 and Hatchery Monitoring and Evaluation (M&E) Activities (joint):* Each member of the HCP Hatchery Committees and PRCC Hatchery Subcommittee discussed the effects of COVID-19 on their respective M&E activities. Overall, very little has changed since last month. Monitoring is occurring within the hatcheries and crews are operating smolt traps. Steelhead spawning ground surveys remain on hold. U.S. Fish and Wildlife Service (USFWS) has restarted marking and tagging programs, but other fieldwork is not yet allowed.
- *Chiwawa Spring Chinook Salmon Marking Strategy (Rock Island/Rocky Reach):* Chelan PUD provided an update on the Chiwawa spring Chinook salmon marking strategy that was approved by the HCP Hatchery Committees in March 2019. Chelan PUD noted that about 1% of the brood year 2018 Chiwawa hatchery-by-hatchery spring Chinook salmon, which received a coded wire tag in the snout and a blank wire tag (BWT) in the caudal, had deformed spines. The deformity was likely due to the insertion of the BWT into the spine. The Committees talked about the possibility of reducing the incidence of deformities by modifying the angle at which the BWT is inserted into the caudal peduncle.
- *Subyearling Summer Chinook Salmon for Orcas (Wells):* Douglas PUD reported receipt of a Section 4(d) permit from NMFS for the orca subyearling summer Chinook salmon program produced by Douglas PUD at Wells Fish Hatchery on behalf of WDFW. Douglas PUD also noted that during the marking of these fish by WDFW, about 25% of the fish were cut too deep during adipose fin removal. This could have an effect on the survival of the fish. John Ferguson asked if signs of disease are already being observed that might be indicative of survival issues? Hillman said signs of disease have been observed, including saprolegnia and secondary signs of disease. Tom Kahler said other diseases associated with deep cuts had been observed; however, these fish are now stabilized, and releases are starting today.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on June 17, 2020.

III. Douglas PUD

A. CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam (Tom Kahler)

Tom Kahler said Douglas PUD convened an internal meeting on May 28, 2020. He said Wells Dam gets a lot of use, including surplusing of hatchery fish, sockeye salmon tagging, and all the programs relying on collection at the hatchery and dam. He said Douglas PUD needed to arrive at a policy for how to deal with COVID-19 and protect staff at the dam and hatchery. He said as a result, Douglas PUD decided to only allow Wells Fish Hatchery staff and a limited number of Charlie Snow's (WDFW) crew access to the Adult Handling Facility at the hatchery. Kahler said this entails a total of four designated people who can cycle through, two at a time, to process fish for broodstock and collect surplus fish. He said similarly, only four people in total will be allowed access to the fish ladder traps, particularly at the east ladder trap because the west ladder trap sends fish to the Adult Handling Facility. He said this includes three people at a maximum from Snow's crew and one Douglas PUD staff from the Methow Fish Hatchery. Kahler said no other entities will be allowed access, which effectively eliminates the CRITFC crew from trapping. Kahler said Douglas PUD recommended to Jeff Fryer that he coordinate with Snow to determine whether his crew has the ability to tag sockeye salmon for CRITFC. Kahler said Fryer and Snow worked something out to be able to collect and tag sockeye salmon concurrent with other planned trapping activities without prolonging trapping.

John Ferguson recalled that the YN and the Colville Confederated Tribes (CCT) both had action items to discuss this internally at the policy level, and he asked both tribal representatives to share comments from those discussions.

Keely Murdoch said at this point, there is not a whole lot anyone can do because there is no access to the ladder traps. She said the YN is supportive of Snow's crew tagging as many sockeye salmon as possible; however, based on conversations with Snow, he is uncertain how many he can do because it depends on how busy he is with processing trapped Chinook salmon. Murdoch said the YN and CRITFC are seeking authorization from Grant PUD to conduct supplemental tagging of sockeye salmon at Priest Rapids Dam. She said, while these are the plans for this year, the YN believes this issue needs to be resolved for future years because the preference is to continue the CRITFC tagging at Wells Dam because it is more practical than at Priest Rapids Dam. She said the same request will come next year and suggested adding this topic to the next HCP Policy Committees meeting scheduled for fall 2020. She said the Canadian Okanagan Basin Technical Working Group (COBTWG) also plans to discuss this topic at their upcoming meeting in June 2020. Ferguson asked that Murdoch keep the HCP Coordinating Committees updated on tagging at the Priest Rapids Dam Off-Ladder Adult Fish Trap and said that this topic will be added to the next HCP Policy Committees meeting agenda.

Kirk Truscott said the CCT are in agreement that this topic needs to be addressed during the next HCP Policy Committees meeting. He urged folks who want to implement this action to coordinate more closely with the CCT. He said the CCT and Okanagan Nation Alliance (ONA) are close; however, there has not been much interaction between the two regarding the importance of this activity in managing Okanagan River sockeye salmon. He said it would be a worthwhile endeavor for ONA, Fryer, or Kim Hyatt (Department of Fisheries and Oceans Canada) to engage with the CCT on the management needs for these data and activities. Truscott said there is an opportunity here to have some dialogue and a better understanding of the potential costs and benefits of this activity being conducted at Wells Dam.

Murdoch asked if the CCT attend the COBTWG meetings. Truscott said not generally. Murdoch said she thought the purpose of discussing this issue at the next COBTWG meeting, in part, was to have this dialogue with the CCT. She said she still does not know the exact date in June because the YN is not a part of COBTWG, but she knows the meeting is still planned via a virtual conference.

Ferguson thanked the YN and the CCT for the comments and agreed this topic needs additional input from the tribes, ONA, CRITFC, and the HCP Policy Committees.

B. Douglas PUD 2020 Survival Verification Study (Tom Kahler)

Tom Kahler reported that Douglas PUD has completed the 2020 Survival Verification Study. He said the last releases occurred the week of May 10, 2020. He said all study fish are now in the water and about one-third have been detected downstream. He said most passage occurs from April to June; however, during the 2010 Survival Verification Study, the last detection was around August 8, 2010. He said Douglas PUD will continue monitoring until it seems there has been as many detections as practical, and at that point Dr. John Skalski (Columbia Basin Research) and his team will begin running analyses. Kahler guessed this would not happen before July 2020. He said there were challenges this year associated with releasing fish during windy conditions, which made it difficult at times to load the barges. He said also, normally about the entire Natural Resources and Lands departments, a line crew, and a mechanic crew are involved in the study; however, due to COVID-19 restrictions, staff to assist with the study were greatly reduced. He said nearly everyone involved worked 30 days straight. Despite these challenges, everything went well. He said he will have another update during the HCP Coordinating Committees meeting on June 23, 2020.

Kahler also noted that NMFS typically operates an estuary trawl detection site below Bonneville Dam, which provides a detection probability estimate to allow survival to be estimated to Bonneville Dam; however, this year NMFS is not operating the estuary trawl due to COVID-19 restrictions. He said this means there will not be a survival estimate to Bonneville Dam, but there will be estimates to John Day, McNary, and Rocky Reach dams; therefore, this does not affect the survival estimate Douglas PUD is primarily relying upon. John Ferguson said he contacted NMFS and discovered that due to

COVID-19, all field work has been terminated in 2020, including operating the estuary trawl detection site. He clarified that detections at Bonneville Dam are still coming from the passive integrated transponder (PIT) detectors located within the dam, but survival to Bonneville Dam cannot be calculated without an estimate of the probability of detection at Bonneville Dam provided by a detection point downstream from Bonneville Dam.

Kirk Truscott said there is still monitoring at McNary Dam, correct? Kahler said yes, and he noted that detections are lower than last year. He said detections at John Day Dam are really good for some reason; there are way more detections at Bonneville Dam compared to John Day or McNary dams, and there are more detections at John Day Dam compared to McNary Dam. He also said there have been over 30,000 detections at Rocky Reach Dam.

C. Wells Dam 2020 Bypass Operations (Tom Kahler)

Tom Kahler recalled reporting during the last HCP Coordinating Committees meeting on April 28, 2020, that bypass operations at Wells Dam began on April 9, 2020, as specified in the Bypass Operating Plan for Wells Dam. He said the bypass has been running since and there has not been a need to pull any barriers for emergency action or total dissolved gas (TDG) compliance. He said at one point, mechanics were ready to pull the barrier at bypass bay 6; however, after further review of the forecast, operators determined this would not be necessary. He said the bypass system is operating normally.

Kahler recalled last year, there were abnormal compliance issues with bypass operations at Wells Dam during April 2019. He said as an outcome of these issues, Douglas PUD investigated and developed a better way to verify that bypass operations are compliant, by working with technicians and operators at the dam and with Information Services to establish the ability to monitor bypass compliance from a desk. He said the system updates every 30 seconds and shows which bypass bays are operating through the entire spillway, which has been very helpful. He said the memorandum[1] that summarized what happened during April 2019 included how Douglas PUD intended to monitor and ensure compliance moving forward. He said in the memorandum, Douglas PUD indicated their plans to provide the Wells HCP Coordinating Committee with monthly bypass reports; however, it was never discussed what these reports would look like. He said Douglas PUD is unsure what the Committee wants to see other than monitoring is ongoing, and operations are in compliance. He asked if the Committee wants a written report, a memorandum indicating that all systems are working as specified, or just a verbal report during each meeting?

[1] *Summary of Wells Dam Bypass Operations in April 2019* distributed to the HCP Coordinating Committees by Kristi Geris on May 10, 2019 and discussed during the HCP Coordinating Committees meeting on May 28, 2019.

Kirk Truscott suggested providing an update if something is out of the norm or deviates from the plan. He said an in-depth monthly summary is not necessary because this type of thing will be included in the annual report. John Ferguson also proposed that Douglas PUD provide a verbal update during each meeting.

The Wells HCP Coordinating Committee agreed that should a deviation occur Douglas PUD shall immediately notify the Committee of any deviations to the Bypass Operating Plan for Wells Dam, and provide monthly updates on bypass operations during Wells HCP Coordinating Committee meetings in lieu of providing written monthly bypass operation reports as described in the *Summary of Wells Dam Bypass Operations in April 2019* (distributed to the HCP Coordinating Committees by Kristi Geris on May 10, 2019, and discussed during the HCP Coordinating Committees meeting on May 28, 2019).

IV. Chelan PUD

A. Draft FERC Notification Letter Regarding the Maintenance Rehabilitation of Rock Island Dam Powerhouse 2 (Lance Keller)

Lance Keller said this item is on the agenda to provide Rock Island HCP Coordinating Committee members an opportunity to ask questions, if there are any. Keller said he also wanted to notify the Committee that he received comments from Jim Craig on May 18, 2020. Keller said the recommendation from USFWS is for Chelan PUD to conduct fish salvage protocols as each turbine unit is dewatered, including ancillary work and during the rehabilitation. Keller said this recommendation will be added to a comment/response matrix, which will be included in the FERC consultation packet. He said the response is that Chelan PUD will conduct fish salvages and if bull trout are encountered Chelan PUD will notify USFWS.

Keller said Chelan PUD is requesting comments on this draft FERC notification letter by close-of-business on May 28, 2020. He asked if the Rock Island HCP Coordinating Committee has any questions. No questions were raised. Keller said Chelan PUD greatly appreciates review of this letter, all comments received will be included in the consultation record, and a final letter will be distributed following the review period.

B. Rock Island Dam Powerhouse 1 Maintenance Update (Lance Keller)

Lance Keller said limited work is restarting in Rock Island Dam Powerhouse 1. He said this includes work that can be completed while maintaining and achieving social distancing requirements for COVID-19. He said Chelan PUD is continually looking into what is needed to provide employees and contractors the ability to move forward with work while achieving social distancing standards. He said working on these turbine units involves confined spaces where there needs to be a couple of people in a small area at the same time. He recalled that Turbine Unit B4 is currently offline and the return to service schedule has now slipped past the May 2020 timeframe. He said there may be more delays and it is not clear where the final return to service date will land. He guessed maybe September 2020. He said he will continue to keep the Rock Island HCP Coordinating Committee updated as things change or solidify.

C. Rocky Reach Dam Turbine Units Maintenance Update (Lance Keller)

Lance Keller said at Rocky Reach Dam, crews are currently working on Turbine Units C2 and C7. He said similar to Rock Island Dam, all work had stopped due to COVID-19 and now limited work is restarting with social distancing.

Keller said Turbine Unit C3 was returned to service on May 15, 2020. He recalled that this unit was operating in a hydraulically blade block configuration using the governor system to maintain the blade angle. He said crews took Turbine Unit C3 out of service for inspection and found oil leaking from the governor system into the hub, and crews were able to recover and measure all of the leaked oil and it matched what was lost from the governor system. He reiterated that all oil was contained and did not leak past the trunnion seals, and he said the unit was returned to service that same day. He said Turbine Unit C3 will be removed from service again on June 8, 2020, for an additional inspection of the oil level and water in the hub. He said if crews see something that suggests oil levels are changing more rapidly, the unit will be taken out of service prior to June 8, 2020. He recalled that Turbine Unit C3 is the first unit to operate in a hydraulically blade block configuration. He said this leaking oil is an issue engineers and mechanics were worried would happen and that crews will continue monitoring the unit.

Keller said limited work has also restarted on Turbine Units C2 and C7; however, there are schedule delays associated with these units due to COVID-19. He said the return to service for Turbine Unit C2 is now mid-October 2020 and for Turbine Unit C7 is now mid-November 2020. He said previously, the estimated return to service for Turbine Unit C2 was mid-August 2020 and for Turbine Unit C7 was the end of September 2020.

D. Deferment of 2021 Rocky Reach Confirmation Survival Study to 2022 (Lance Keller)

Lance Keller said in the last months, Chelan PUD has provided maintenance updates on the Rocky Reach Dam turbine units and he thinks Committee members can understand the impacts to unit maintenance due to COVID-19. He said Chelan PUD planned to have all maintenance addressed in Turbine Units C2, C3, C4, and C7 prior to starting the 2021 Rocky Reach Confirmation Survival Study in mid-April 2021; however, this has been delayed due to COVID-19. He recalled the reasons for addressing the maintenance issues in these units, including: 1) trunnion seal and bushing issues observed in Turbine Units C1 and C3, which may also exist in the other small units; 2) mechanical and operational challenges with Turbine Unit C3 operating in a hydraulically blade block configuration; 3) servo rod seal issue with Turbine Unit C2, which may be present in the other units but has not yet been tested due to COVID-19 restrictions; 4) Chelan PUD changed the maintenance strategy from simultaneously working on one small unit (Turbine Units C1 to C7) and one large unit (Turbine Units C8 to C11) to simultaneously working on two small units to increase the reliability of the small units, as well as the overall Rocky Reach Dam powerhouse capacity, prior to the confirmation study in 2021; and 5) Turbine Units C10 and C11 are currently mechanically blade blocked due to servo rod cracks.

Keller said it is also worth highlighting that the maintenance required at Rocky Reach Dam is for a different reason than the maintenance required at Rock Island Dam. He said at Rock Island Dam, the maintenance needed on Turbine Units B1 to B4 is due to deferred maintenance during the 2008 to 2010 time period (i.e., maintenance is behind on these units and the units are unsafe to operate). He said at Rocky Reach Dam, the wear on the trunnion bushings is not consistent with the life expectancy of these parts (i.e., the parts are wearing faster than expected). He added that the wearing in Turbine Units C1 and C3 resulted in oil releases, which Chelan PUD takes very seriously.

Keller said the return to service dates for Turbine Units C2 and C7 have been delayed due to COVID-19, which also delays the outage schedule for Turbine Units C3 and C4. He said with the current return to service dates for Turbine Units C2 and C7 in October and November 2020, respectively, this pushes the Turbine Units C3 and C4 outages into mid-April to May 2021, which is when Chelan PUD plans to conduct the juvenile survival study at Rocky Reach Dam. He said Chelan PUD believes with the Turbine Unit C3 and C4 outages, this will not be a representative evaluation of Rocky Reach Dam operations for the following 10 years; therefore, there is good merit to defer the 2021 Rocky Reach Confirmation Survival Study to 2022. He said this will allow Chelan PUD to address maintenance in Turbine Units C2 and C7 and return the blades to operate in a Kaplan configuration. He said additionally, this will allow time to install new trunnion seals and servo rod seals in Turbine Units C3 and C4. He said completing these maintenance activities will increase the reliability of the small units and the overall reliability and capacity of the Rocky Reach Dam powerhouse.

Keller recognized that representatives from WDFW and NMFS are not present; however, at this time, he said Chelan PUD would like to hear what the other Rocky Reach HCP Coordinating Committee members think about deferring the study and answer any questions. He said understanding if there is general agreement to defer the study will allow Chelan PUD to adjust and release a modified Request for Proposals that excludes the Rocky Reach Confirmation Survival Study and only includes the Rock Island Confirmation Survival Study for 2021.

Keely Murdoch asked if Keller could describe the advantages and disadvantages of studying the two projects together, and she asked if separating the projects will lose any reach-based analyses? Keller explained that combining the projects provides efficiencies from an implementation standpoint; however, regarding the data, the resolution for both the Rock Island and Rocky Reach projects would not change should the studies be conducted together or separately. He said this is due to the nature of an acoustic telemetry survival study approach.

Murdoch said these data factor into hatchery recalculations and hatchery mitigation and she is not sure what it means to only have updated data for one project and not the other. She said mitigation for populations upstream of the Rocky Reach Project are based on survival data from both Rock Island and Rocky Reach projects. She said she does not expect a huge change because one data point will not significantly skew the average; rather, her question is more about process. She said she is not sure if it is desirable to recalculate hatchery mitigation until all data are updated. She said she thinks the last new numbers went into effect in 2012. She said the HCP Hatchery Committees will need to think about this, as it might be a disadvantage.

Keller said this is a good point; however, at the same time, he thinks more information is considered during recalculation than just the survival component. Murdoch said yes and no; and explained that part of deciding on recalculation methodologies originally outlined in the Biological Assessment and Management Plan (BAMP) involved other data such as smolt to adult return ratios. She said, however, in 2012, recalculation methodologies were simplified so that the BAMP method applied only to wild fish and not to the hatchery component. Keller recalled discussing this specific topic when considering deferring the 2020 Rock Island Confirmation Survival Study to 2021, and he thought the hatchery program recalculations could move forward and once additional data were available recalculation could be reinitiated. He said, however, he needs to review the meeting minutes to confirm this. Murdoch said she cannot recall what was discussed either but suggested it might be advantageous to delay both studies and recalculation.

Keller said regarding Murdoch's suggestion to delay both studies to 2022, as of now, the Rock Island Confirmation Survival Study is on schedule to be conducted in 2021. Keller said deferring the study an additional year will be 12 years between confirmation studies, since this study has already been deferred from 2020 to 2021. He said Chelan PUD would advocate conducting the Rock Island Confirmation Survival Study in 2021 and only deferring the Rocky Reach Confirmation Survival Study to 2022.

John Ferguson said he reviewed the SOA, *Deferment of the Rock Island Project Confirmation Survival Study from 2020 to 2021*, which was approved by the Rock Island HCP Coordinating Committee on December 4, 2018, and there is no discussion about hatchery recalculation included in the SOA. Keller said he located the hatchery recalculation discussion in the HCP Coordinating Committees meeting on October 23, 2018. He said the discussion was about maintenance on Rock Island Dam Turbine Units B1 to B4 and deferring the 2020 Rock Island Confirmation Survival Study to 2021. He said Murdoch posed a question about how a shift from 2020 to 2021 would affect recalculation of the HCP hatchery programs. Keller said he responded as recorded in the meeting minutes, as follows:

> *Keller said he spoke with Alene Underwood and Catherine Willard (Chelan PUD HCP Hatchery Committees Representative) and reviewed the Rock Island HCP. Keller said the timelines for the check-in studies and hatchery recalculations are not connected. He said the HCP stipulates that recalculation will occur in 2013 and in 10-year intervals, and the confirmation timeline is based on when Phase III Standards Achieved is reached, which was in 2010 for Rock Island Dam. He said, therefore, these are not connected in terms of a formal timeline; however, the check-in results do inform recalculation. Murdoch said it would be helpful to have the latest data opposed to the same data from 10 years prior, because this would essentially mean recalculating hatchery programs with the same data for 20 years. She asked if there are no new data is recalculation performed anyway? Keller said there will still be updated smolt-to-adult ratios and other hatchery performance data.*

Keller said the HCP itself never envisioned a timeline tie-in between confirmation studies and every 10-year recalculation. He said he recalls thinking there was a connection, but it was just a coincidence the two activities aligned.

Kirk Truscott asked if both projects were studied at the same time during previous confirmation studies. Keller said yes and no. He said, for example, the last confirmation study for the Rock Island Project was in 2010 and for the Rocky Reach Project was in 2011. He said when studies were conducted at both projects at the same time, sometimes the same species were studied at each project and sometimes not. He also recalled that studying yearling Chinook salmon at the Rocky Reach Project was put on hold until 2009, and during this time yearling Chinook salmon were studied at the Rock Island Project under the 20% and 10% spill operations.

Truscott asked, regarding a Rock Island Confirmation Survival Study in 2021, will study fish be collected at the Rocky Reach Juvenile Fish Bypass System (RRJFBS) and where are the release locations? Keller said this is correct and study fish will be released at the 1,000-foot mark downstream of Rocky Reach Dam and at the 1,000-foot mark downstream of Rock Island Dam to evaluate Rock Island Project survival. Truscott asked, regarding a Rocky Reach Confirmation Survival Study in 2022, will study fish be collected at the RRJFBS and be released at the 1,000-foot mark downstream of Wells Dam and at the 1,000-foot mark downstream of Rocky Reach Dam? Keller said this is correct. He added that typically in past years, to evaluate route-specific survival there has been an additional release into the surface collector of the RRJFBS in conjunction with the Rocky Reach Dam tailrace release. Truscott asked if both projects are studied in the same year is the study design the same? Keller said yes and explained that fish released in the Rocky Reach Dam tailrace would be the Rocky Reach Project study control release and also serve as the test fish for the Rock Island Project study. He said separating the studies loses this efficiency.

Ferguson asked about sample size. He asked if there is a biological effect if the studies are combined in that there will not be a need to double-up on Rocky Reach Dam tailrace releases. Keller said if the studies are combined, this saves money on tags when the same species is simultaneously evaluated at both Projects. He said he believes each study requires 1,000 fish. He said in 2011, he believes there were 500-day and 500-night releases. He said each project will need to be wired up independent of one another to evaluate passage survival at each site, so there are no losses there.

Truscott said he is trying to determine if the studies are conducted in the same year, will there be any differences in the study plans? He also noted that Mid-Columbia River studies have been criticized for not studying cumulative impacts. He said if both projects were studied in the same year maybe this could be addressed (i.e., larger release in the upper project area and use these fish for both projects). Keller said because the Rock Island and Rocky Reach HCPs are independent of each other, if the studies were conducted in the same year, evaluation of fish released in the Wells Dam tailrace would stop at the boat restriction zone at Rock Island Dam, which is the second detection array downstream of Rocky Reach Dam. He said this detection would calculate survival through the Rocky Reach Project. He said when both projects have been studied together, there has never been a survival evaluation from the Wells Dam tailrace through the Rock Island Project because this is not a requirement of either HCP. Truscott said he understands and was just looking for opportunities to quiet the rhetoric of these studies. Keller said Chelan PUD has a lot of good data, past studies have been very rigorous with high levels of precision, and there are strong statistical analyses to stand on. He said to address Truscott's question, the study designs for the Rock Island and Rocky Reach projects will not change if conducted in the same or different years. He said conducting the studies separately will just lose a little efficiency. Ferguson said there are also cost savings if the studies are conducted in the same year. Keller agreed but said this is not the driver. He said having Turbine Units C3 and C4 out of service is not how Chelan PUD intends to operate the Rocky Reach Project for the next 10 years, and the District is willing to forgo the cost savings to make sure the results from the confirmation study are a representative evaluation of project operations.

Truscott said, as far as delaying the 2021 Rocky Reach Confirmation Survival Study to 2022, if the decision is no, the Committee would be saying conduct the study under "not normal" operations. He said for the CCT, delaying the study is a no-brainer. He said, however, the Committee may want to think about delaying the Rock Island Confirmation Survival Study to 2022, as well.

Murdoch said she agrees with Truscott regarding delaying the 2021 Rocky Reach Confirmation Survival Study to 2022, because she is not sure what else can be done.

Jim Craig said USFWS also supports Chelan PUD's proposal.

Keller said regarding delaying the Rock Island Confirmation Survival Study to 2022, Chelan PUD feels that Rock Island Dam will be in a status to allow for the most optimal testing in 2021. He said as previously outlined with the HCP Coordinating Committees, the ongoing maintenance in Powerhouse 1 is not anticipated to affect survival, and if anything, survival will likely increase as Powerhouse 1 is brought back into tighter operating tolerances, and Turbine Unit B4 will be operational during the confirmation survival study in 2021. He said as noted earlier in Chelan PUD's agenda, maintenance rehabilitation work will commence in Powerhouse 2 in the fall of 2021, further making 2021 the best year to conduct an evaluation at Rock Island Dam. Truscott asked if Keller is saying that delaying the Rock Island Confirmation Survival Study to 2022 may result in a Powerhouse 2 that is less than normal operations compared to 2021? Keller said this is correct, that a survival study in 2021 will have a full Powerhouse 2 (i.e., all units available). He said by fall 2021, the schedule is to start rehabilitating Powerhouse 2, as outlined in the FERC notification letter that is currently under Rocky Reach HCP Coordinating Committee review (see Agenda Item IV-A). He said additionally, units will still be out of service in Powerhouse 1 resulting in a decrease in overall capacity at Rock Island Dam in 2022. Truscott asked about changes resulting from rehabilitating Powerhouse 2. Ferguson said in terms of fish passage, there will be no change. Keller added that the work does not involve changes to the generator nameplate, turbine horsepower, or authorized Project hydraulic capacity. He said this work will just replace parts to bring specifications back into tighter operating tolerances, which should extend their mechanical lifetime for an additional 40 years of operation. He said if there is any change in fish passage, it will likely be an increase in benefit to fish by bringing operations back into tolerances.

Truscott said, provided what was just shared, the CCT support conducting the Rock Island Confirmation Survival Study in 2021. He said previously, the Rock Island Confirmation Survival Study would have been conducted in 2020, and the Rocky Reach Confirmation Survival Study in 2021, so originally the studies were not planned to occur in the same year. Keller said this is correct.

Murdoch said the YN has no additional comments and supports staggering the studies if this is the only option.

Craig said USFWS supports the schedule, as proposed.

Chad Jackson said he joined the conference call late and has no opinion at this time but will follow-up with Keller after the meeting.

Keller said Chelan PUD will: 1) share with WDFW and NMFS what the Rock Island and Rocky Reach HCP Coordinating Committees discussed about deferring the 2021 Rocky Reach Confirmation Survival Study to 2022 and conducting the 2020 Rock Island Confirmation Survival Study in 2021 as already approved by the Rock Island HCP Coordinating Committee (on December 4, 2018); 2) ask that WDFW and NMFS provide any comments on these topics to Kristi Geris for distribution to the HCP Coordinating Committees; and 3) develop a draft SOA to defer the 2021 Rocky Reach Confirmation Survival Study to 2022. *(Note: Scott Carlon indicated NMFS support of Chelan PUD's proposal to defer the 2021 Rocky Reach Confirmation Survival Study to 2022, via email to Geris on June 5, 2020, which Geris distributed to the HCP Coordinating Committees that same day.)*

E. Initiation of Summer Fish Spill at Rock Island and Rocky Reach Dams (Lance Keller)

Lance Keller provided notification that Chelan PUD initiated summer fish spill at Rock Island and Rocky Reach dams on May 23, 2020, at 0000. Keller said on May 22, 2020, subyearlings started showing up at Rocky Reach Dam due to early hatchery releases. He said the last estimate Thad Mosey (Chelan PUD) received from Program RealTime estimated that 0.74% of the subyearling Chinook salmon outmigration had passed Rocky Reach Dam. He said understanding the variability in the subyearling run, Mosey decided to be conservative and initiate summer spill. Keller said this means spilling 9% of the daily average river flow at Rocky Reach Dam and 20% of the daily average river flow at Rock Island Dam.

John Ferguson asked if starting summer spill is early this year? Keller said it is a bit early due to hatchery releases upstream of Rocky Reach Dam occurring earlier than anticipated. He said as of May 22, 2020, a total of 152 subyearlings had passed Rocky Reach Dam.

V. Chelan PUD and Douglas PUD

A. Subyearling Chinook Salmon Studies – Quarterly Check-In (John Ferguson)

John Ferguson asked if Chelan PUD or Douglas PUD have updates on Subyearling Chinook Salmon Studies.

Lance Keller said Chelan PUD has nothing additional to share since the last check-in.

Tom Kahler said, regarding the *Wells Project Subyearling Chinook Life-History Study 2011-2013 Draft Final Report*, the CCT provided comments last fall 2019. Kahler said he discussed these comments with John Rohrbach (CCT) and prepared responses for Andrew Gingerich to review; however, Gingerich has been busy with the Douglas PUD 2020 Survival Verification Study and has not yet had time to review the responses. Kahler said Gingerich indicated plans to get to this soon.

VI. HCP Administration

A. COVID-19 and Meeting Logistics (John Ferguson)

John Ferguson asked if there are any new updates HCP Coordinating Committees members have to share. Chad Jackson said in terms of field work, WDFW has returned to business-as-usual. He said there are a few pieces that are not allowed, but most is progressing as normal.

B. HCP Policy Committee In-Person Meeting (John Ferguson)

John Ferguson recalled attempting to convene the HCP Policy Committees in early May 2020; however, this was canceled due to COVID-19. Ferguson said the purpose of this meeting was to meet in-person to discuss implementation of the HCPs over the past year and into the next year. He said a discussion about the CRITFC request was also planned. He said this HCP Policy Committees in-person meeting is now rescheduled for September 1, 2020 in the afternoon.

C. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on June 23, 2020, to be held by conference call.

The July 28 and August 25, 2020 meetings will be held by conference call or in-person at the Grant PUD Wenatchee Office in Wenatchee, Washington, as is yet to be determined.

VII. List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman†	BioAnalysts
Lance Keller*	Chelan PUD
Tom Kahler*	Douglas PUD
Jim Craig*	U.S. Fish and Wildlife Service
Chad Jackson*††	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation
Kirk Truscott*	Colville Confederated Tribes

Notes:
- * Denotes HCP Coordinating Committees member or alternate
- † Joined for the HCP Hatchery and Tributary Committees Update
- †† Joined during Agenda Item IV-D

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: July 28, 2020

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris

Re: Final Minutes of the June 23, 2020 HCP Coordinating Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Tuesday, June 23, 2020, from 9:00 a.m. to 10:20 a.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

- Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).
- Chelan PUD will notify the Rock Island HCP Coordinating Committee when Chelan PUD submits the Federal Energy Regulatory Commission (FERC) notification letter regarding the maintenance rehabilitation of Rock Island Dam Powerhouse 2 (Item III-D).
- Douglas PUD will inquire internally regarding the pedestrian access described in the Wells Project Land-Use Permit Application for No. LUP 4-06 (Item IV-B). *(Note: Tom Kahler provided clarification to Kristi Geris following the HCP Coordinating Committees conference call on June 23, 2020, which Geris distributed to the HCP Coordinating Committees that same day.)*
- The HCP Coordinating Committees meeting on July 28, 2020, will be held at 9:00 a.m., by conference call (Item V-B).

Decision Summary

- Rocky Reach HCP Coordinating Committee representatives present approved the Statement of Agreement (SOA), *Deferment of the Rocky Reach Project Confirmation Survival Study from 2021 to 2022*, as revised (Item III-A).

Agreements

- Wells HCP Coordinating Committee representatives present agreed to an informal review (opposed to a formal HCP review process) of the *Okanagan Fish and Water Management Tools (FWMT)* annual reports that are prepared by the Okanagan Nation Alliance Fisheries Department, Westbank, B.C., for the FWMT Steering Committee and Douglas PUD (Item IV-C).

Review Items

- The *Wells Project Subyearling Chinook Life-History Study 2011-2013 Draft Final Report* was distributed to the HCP Coordinating Committees by Kristi Geris on May 24, 2019.
- A Wells Project Land-Use Permit Application for #LUP 143-01 was distributed to the HCP Coordinating Committees by Kristi Geris on July 15, 2020. This application is available for a 30-day review with comments or indication of no comments due to Tom Kahler no later than Friday, August 14, 2020.

Finalized Documents

- The final SOA, *Deferment of the Rocky Reach Project Confirmation Survival Study from 2021 to 2022*, was distributed to the Rocky Reach HCP Coordinating Committee by Kristi Geris on July 10, 2020 (Item III-A).

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. The following revisions were requested:

- Lance Keller added: 1) 2021 Rock Island Confirmation Survival Study Request for Proposals (RFP); and 2) FERC notification letter regarding the maintenance rehabilitation of Rock Island Dam Powerhouse 2
- Andrew Gingerich added: 1) 2020 Survival Verification Study update

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft May 26, 2020 conference call minutes. Kristi Geris said all comments and revisions received from members of the Committees were incorporated into the revised minutes. HCP Coordinating Committees members present approved the May 26, 2020 conference call minutes, as revised. National Marine Fisheries Service (NMFS) abstained because a representative was not present during the May 26, 2020 conference call, and Washington Department of Fish and Wildlife (WDFW) abstained because the representative was present for only the last quarter of the May 26, 2020 conference call.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on May 26, 2020, and follow-up discussions, were as follows. *(Note: Italicized text corresponds to agenda items from the meeting on May 26, 2020):*

- *Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).*
  This action item will be discussed during today's conference call and will also be carried forward.
- *Chelan PUD will: 1) share with WDFW and NMFS what the Rock Island and Rocky Reach HCP Coordinating Committees discussed about deferring the 2021 Rocky Reach Confirmation Survival Study to 2022 and conducting the 2020 Rock Island Confirmation Survival Study in 2021 as already approved by the Rock Island HCP Coordinating Committee (on December 4, 2018); 2) ask that WDFW and NMFS provide any comments on these topics to Kristi Geris for distribution to the HCP Coordinating Committees; and 3) develop a draft SOA to defer the 2021 Rocky Reach Confirmation Survival Study to 2022 (Item IV-D).*
  Scott Carlon indicated NMFS support via email on June 5, 2020, and Chad Jackson indicated WDFW support via email on June 10, 2020, of Chelan PUD's proposal to defer the 2021 Rocky Reach Confirmation Survival Study to 2022, which Geris distributed to the HCP Coordinating Committees those same days. A draft SOA to defer the 2021 Rocky Reach Confirmation Survival Study to 2022 was distributed to the Rocky Reach HCP Coordinating Committee by Geris on June 9, 2020.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees conference call on June 11, 2020:

- *Small Projects Program Proposal*: The HCP Tributary Committees received a Small Projects Program Proposal titled, *Methow River – Vandervort Property Appraisal*. The purpose of the project is to fund an appraisal to determine the value of the property at the upper end of the Silver Side Channel Project area, located on the Methow River near river mile 35.5. The acquisition of this property would potentially allow the removal of a levee that currently isolates flow into the upper end of the Silver Side Channel. The total cost of the project was $9,250. The sponsor requested $9,250 from HCP Plan Species Account Funds. The HCP Tributary Committees declined the opportunity to fund this project because at this time, there are too many uncertainties and unknowns associated with the Silver Side Channel, including the potential effect of beavers moving into the lower portion of the side channel and impacts to the landowners located in the middle of the side channel. The HCP Tributary Committees want to better understand these uncertainties; therefore, the Committees invited the project sponsor to a future meeting to discuss the project with the Committees.

- *General Salmon Habitat Program Proposals*: The HCP Tributary Committees received eight General Salmon Habitat Program (GSHP) proposals that were cost shares with the Salmon Recovery Funding Board (SRFB). In addition, the Committees received an application from the Colville Confederated Tribes (CCT) that was not a cost share with the SRFB. Members with conflicts of interest recused themselves from discussing and voting on specific proposals. Of the nine GSHP proposals reviewed, the Committees elected to fund four of them. Those that were not selected for funding had low biological benefit, needed more information, included too much excavation work, did not take advantage of the full restoration potential of a site, or had low benefits per cost. The four projects funded occur within the Wenatchee River basin and were supported by the Rock Island or Rocky Reach Plan Species Account Funds.
- *Workshops*: In coordination with the Upper Columbia Regional Technical Team and the PRCC Habitat Subcommittee, the HCP Tributary Committees are considering hosting two workshops. The first workshop would focus on the use of beavers in restoration. Although beavers are an important part of the ecosystem and are important agents of stream restoration, beavers can also harm recently completed enhancement projects. Thus, this workshop would address when and how to use beavers in restoration. The second workshop would focus on appropriate methods for reconnecting floodplain habitat. Although floodplain reconnection is an important action and has biological benefits, there are differing opinions on how to reconnect floodplains. Thus, this workshop will identify conditions favoring different approaches. Depending on logistics, the two workshops may be combined into one on the same day. John Ferguson asked about a timeframe for these workshops. Hillman said the Committees would like to convene the workshops this year, ideally in person to facilitate more participation. He said, however, given the current situation with COVID-19, convening the workshops this year may need to be via conference call.
- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on July 9, 2020.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees conference call on June 17, 2020 (*note: joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *Re-evaluation of Conservation Program Size (joint):* The Committees continued their discussion on revising the size of the Wenatchee spring Chinook salmon conservation programs. The intent is to reevaluate the allocation of production between the conservation and safety net programs; total hatchery production will not change. The Committees reviewed updated information on carrying capacity based on stock-recruitment modeling. They also discussed preliminary pre-spawn survival estimates and will ask WDFW to present the findings at a meeting this summer or early fall.

- *COVID-19 and Hatchery Monitoring and Evaluation Activities (joint):* Each member of the HCP Hatchery Committees discussed the effects of COVID-19 on their respective monitoring and evaluation (M&E) activities. Overall, very little has changed since last month. Monitoring is occurring within the hatcheries and crews are operating smolt traps. Steelhead spawning ground surveys remain on hold; however, researchers are evaluating the use of passive integrated transponder (PIT) tags to estimate spawning escapements in places where redd surveys were to be conducted. U.S. Fish and Wildlife Service (USFWS) has started some low-risk fieldwork and are planning to conduct redd surveys this year.
- *Draft SOA Regarding Chelan and Grant PUD's Okanogan Sockeye Salmon Obligation and Reintroduction Program (Rock Island/Rocky Reach):* Chelan PUD submitted a draft SOA to the Rock Island and Rocky Reach HCP Hatchery Committees for review. The draft SOA describes the success of the sockeye salmon reintroduction program based on Chelan PUD's fulfillment of its funding commitments, the continuation of the mitigation goal of establishing natural sockeye salmon production in Skaha and Okanagan lakes, Chelan PUD's commitment to continue funding the hatchery and M&E program through 2030, and the support by the Rock Island and Rocky Reach HCP Hatchery Committees for Chelan PUD to continue funding the implementation of the reintroduction program through 2031 in order to meet Chelan PUD's No Net Impact sockeye salmon obligation. Comments on the draft SOA are due to Chelan PUD by July 1, 2020. The Committees will vote on the SOA during HCP Hatchery Committees meeting on July 15, 2020.
- *Methow Hatchery Spring Chinook Salmon Broodstock (Wells):* Douglas PUD reported that because the spring Chinook salmon run is small this year, Douglas PUD is closely monitoring the trapping activities at Wells Dam to make sure not to extract more than 33% of the natural-origin return, as defined in their permits. Douglas PUD is currently at 28% and based on forecast modeling, they should be able to collect all the broodstock needed for their Methow program. It is likely Douglas PUD will need to include some hatchery fish in their broodstock this year.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on July 15, 2020.

III. Chelan PUD

A. DECISION: SOA for Deferment of 2021 Rocky Reach Confirmation Survival Study to 2022 (Lance Keller)

Lance Keller said the draft SOA, *Deferment of the Rocky Reach Project Confirmation Survival Study from 2021 to 2022*, was distributed to the Rocky Reach HCP Coordinating Committee by Kristi Geris on June 9, 2020. Keller said this SOA is structured similarly to the final SOA, *Deferment of the Rock Island Project Confirmation Survival Study from 2020 to 2021*, that was approved by the Rock Island HCP Coordinating Committee on December 4, 2018. Keller read the *Agreement Statement* of the draft SOA. He said the *Background* of the draft SOA explains the timeline of schedule changes, including the COVID-19 response. He recalled an action item to reach out to both Scott Carlon and Chad Jackson, which Keller said he did, as discussed under the review of last meeting's action items. Keller asked for any additional thoughts or questions, and if not, then suggested proceeding to vote.

Kirk Truscott said the CCT is in agreement to defer; however, he suggested adding language to the *Agreement Statement* explaining that this deferment will allow the project to be under representative operations during the survival study confirmation. Keller said Chelan PUD can accommodate this request, and the Rocky Reach HCP Coordinating Committee crafted language to insert into the draft SOA.

Rocky Reach HCP Coordinating Committee representatives present approved the SOA, *Deferment of the Rocky Reach Project Confirmation Survival Study from 2021 to 2022*, as revised.

The final SOA was distributed to the Rocky Reach HCP Coordinating Committee by Geris on July 10, 2020.

B. 2021 Rock Island Confirmation Survival Study RFP (Lance Keller)

Lance Keller notified the HCP Coordinating Committees that Chelan PUD released the RFP for the 2021 Rock Island Confirmation Survival Study. Keller said the RFP was released for bid on June 17, 2020, and closes on July 17, 2020, at 2:30 p.m. He said Chelan PUD hopes to solicit proposals, conduct a thorough evaluation and interview process to identify a suitable contractor, and have a contract in place by mid- to late August 2020, so the team can start looking at study design decisions with Dr. John Skalski (Columbia Basin Research). Keller said Chelan PUD developed this somewhat aggressive schedule to try and minimize any impacts or delays due to COVID-19. He said once a contract is in place, he will notify the HCP Coordinating Committees.

John Ferguson asked if the RFP is for the 2021 Rock Island Confirmation Survival Study only or if the 2022 Rocky Reach Confirmation Survival Study is also bundled into the same contract. Keller said at this point, the RFP only includes the 2021 Rock Island Confirmation Survival Study. He said, however, Chelan PUD will evaluate contractor performance in determining a contractor for the 2022 Rocky Reach Confirmation Survival Study. He said Chelan PUD is not required to release an RFP; rather, the District wanted to release an RFP to get an assessment of available tag technology and see about options for additional services (e.g., tagging of fish). He said Chelan PUD could perform some of these tasks in-house; however, the District has not conducted a survival study since 2011 and has lost certain critical staff since. He said this RFP seemed like a good route to determine who can provide these services to best evaluate survival in 2021.

C. Rock Island Dam Powerhouse 1 Maintenance Update (Lance Keller)

Lance Keller said maintenance activities are getting closer to being back to normal. He said crews still need to adhere to social distancing and personal protective equipment requirements; however, additional activities are beginning to be conducted. He said some work has focused on Turbine Unit B4, but it is not quite back to a pre-COVID-19 workload. He said the return to service date is still not solid enough to announce, but all signs indicate there is high likelihood that Turbine Unit B4 will be returned to service before the 2021 Rock Island Confirmation Survival Study, which was a key reason for deferring the study from 2020 to 2021. He said he will notify the HCP Coordinating Committees as he learns more about the return to service date.

D. FERC Notification Letter Regarding the Maintenance Rehabilitation of Rock Island Dam Powerhouse 2 (Lance Keller)

Lance Keller recalled that a draft FERC notification letter regarding the maintenance rehabilitation of Rock Island Dam Powerhouse 2 was distributed to the Rock Island HCP Coordinating Committee by Kristi Geris on April 27, 2020, and was available for a 30-day review with edits and comments due to Keller or Jeff Osborn (Chelan PUD License Compliance Specialist) by May 27, 2020. Keller said Chelan PUD received comments from Jim Craig, which will be included in a comment matrix along with Chelan PUD's response. Keller said Chelan PUD has not yet submitted the final letter to FERC; however, he said Chelan PUD will notify the Rock Island HCP Coordinating Committee when the letter is submitted.

E. Rocky Reach Dam Turbine Units Maintenance Update (Lance Keller)

Lance Keller said similar to Rock Island Dam, some maintenance activities are returning at Rocky Reach Dam. He said some work is starting on Turbine Units C2 and C7, but the work is not yet at the capacity of pre-COVID-19. He said there have been continued inspections on Turbine Unit C3, the unit that is operating in a hydraulic blade blocked condition. He said on June 8, 2020, the unit was dewatered and the hub was drained. He said crews inspected the hub to ensure oil from the governor system was not escaping from the hub or that river water was not migrating into the governor oil. He said neither was observed and the unit was returned to service. He said the unit is on a 3-week inspection schedule and will be taken out of service again next week for inspection. He said if anything out of the ordinary is observed, he will notify the HCP Coordinating Committees.

IV. Douglas PUD

A. 2020 Survival Verification Study Update (Andrew Gingerich)

Andrew Gingerich said Douglas PUD released the study fish for the 2020 Survival Verification Study starting in mid-April 2020 and ending in May 2020. He said there was also a few weeks of planning prior to starting the releases in mid-April 2020. He said in the field, everything went well, crews completed all releases, and Biomark performed the scanning of the fish for PIT tags prior to release. He recalled that study fish were released at the mouth of the Okanogan and Methow rivers, as well as in the Wells Dam tailrace. He said by now, the bulk of the fish have migrated through the system, but Douglas PUD was continuing to get detections every day. He said in the last couple of days, about 15 fish have been detected at Rocky Reach Dam. He said on average, of the 100,000 to 105,000 fish released, there has been about a 33% detection rate at Rocky Reach Dam, which is encouraging. He said this will help with the confidence bounds when running the statistics and estimating survival. He said Douglas PUD is working with Drs. Richard Townsend and John Skalski (University of Washington) to put together the statistical analyses. Gingerich said in the field, there were no days where crews could not complete a release, despite challenges with the weather. He said high winds affected crane and towing barge operations, which were further complicated by high river flows. Gingerich said Tom Kahler reviewed the flow duration curves and the early indication is that everything lines up well and test conditions will fall within expected ranges. Gingerich said flows started low but increased rapidly. He said at the start of releases, river flow was 60,000 to 80,000 cubic feet per second (60 to 80 kcfs) and then increased to 185 kcfs. He said he believes this will fall nicely within the flow duration curve requirement. Gingerich said Kahler is also tracking PIT-tag detections and arrival timing in the lower river at McNary and Bonneville dams. Gingerich said one important goal of the study was to release fish in a staggered fashion. He said this was intended so that releases in the Okanogan River come down and meet with releases in the Methow River, which then meet up with the releases in the Wells Dam tailrace, and then the three combined releases arrive at Rocky Reach Dam in similar distributions so the fish are traveling and experiencing similar environmental and operational conditions. Gingerich said Kahler has been able to track some of this, and the early indication is that the early release groups match up well, while the later release groups match up not quite as well due to the higher river flow, but are still very similar. Gingerich said of the early statistical data survival looks relatively good, but Douglas PUD will wait for the analytical analysis from Townsend and Skalski before providing a more comprehensive survival report. Gingerich guessed this might be in October 2020. He added, regarding physiological statistics, the plasma glucose and fat indices look comparable while cortisol and gill ATPase comparisons between treatment and control groups will be performed by the lab. He said the final lab results are expected back from Betsy Bamberger (Douglas PUD Fish Health Specialist) in early September 2020. Gingerich said Douglas PUD can provide an update once these results are available, which are delayed due to COVID-19.

B. Wells Project Land-use Permit No. LUP 4-06 (Tom Kahler)

Tom Kahler said a Wells Project Land-Use Permit Application for No. LUP 4-06 was distributed to the Wells HCP Coordinating Committee for review by Kristi Geris on June 3, 2020. Kahler said this application is for existing unpermitted actions implemented over time by the owners of adjacent private property, but conditions for permitting those actions were already negotiated between Douglas PUD and the property owner. He said the application is just a formality of the negotiated settlement, and Douglas PUD provides the Wells HCP Coordinating Committee an opportunity to review land-use permit applications. He said Jim Craig already provided USFWS's indication of no comments (via email on June 3, 2020), and no other comments have been received to date.

Keely Murdoch asked what type of actions are the property owners doing without a permit? Kahler said the actions are events, structures, and roads that were built on Douglas PUD land years ago. He said these include residential landscaping, an access road, a pump house, and a pedestrian path that was used as a boat launch back in the 2000s. He said the only new proposed action is a 10-foot-wide pedestrian path that Douglas PUD plans to permit, but it will not be used as a boat launch.

Murdoch asked if the property owners had followed the normal process, would Douglas PUD have permitted these actions? Kahler said yes, it is customary to permit these types of actions to a property owner on Douglas PUD land. He said the actions were for a water intake for an orchard.

Kirk Truscott asked where this property is located on the Wells Reservoir, and Kahler said it is located upstream of Starr Boat Launch. Geris projected Exhibit C of the land-use permit application, which is an aerial photograph of the property. Truscott said it would be helpful if parcel numbers were provided. He added that it seems odd for a property owner to make improvements without a permit, then apply for a permit, and Douglas PUD issues one. He asked if there are penalties for not obtaining a permit in the first place? Kahler said mitigation measures associated with these actions were negotiated as part of a settlement. He said Douglas PUD acquired property needed for their FERC license from this negotiation. Truscott asked if the property owner did not obtain permits to use Douglas PUD property, is it known whether the owner obtained the appropriate water permits from the state? Kahler said he is unsure of this but assumes the owner must have because Douglas PUD would not issue a permit without other permits in place. Truscott asked if the 10-foot-wide pedestrian path is existing. Kahler said yes, it used to be used as a boat launch. Truscott asked how anyone will know if the owner uses the path as a boat launch? Kahler said he believes there is something there that interferes with getting a boat through the path. He said Douglas PUD also conducts routine reservoir inspections. Truscott noted the disturbance to the substrate downstream from where the path is located (from the aerial photograph). Kahler said he is unsure if that area was excavated but can find out.

John Ferguson said on Google Earth, the path looks like it is now covered with shrubs. Truscott asked if the area is vegetated, what is the purpose of a pedestrian path? He said if it is to walk to the water, there are plenty of access points along the entire property line. He said if the area is overgrown with vegetation, he does not want it to be reestablished as a pedestrian path. Kahler said he is unsure about how the area is managed.

Murdoch asked, regarding Truscott's concern that the path will be used as a boat launch, is it possible to require installation of some kind of barrier so a vehicle cannot access the path? Kahler said he can find out about measures that might be employed to prevent using the path as a boat launch. Murdoch said this will be helpful, and she noted that providing a 10-foot-wide path to the river invites it to be used as a boat launch, whether it be this property owner or a future owner. She asked when the review period closes, and Geris said Friday, July 3, 2020. *(Note: Kahler later clarified comments are needed by Tuesday, June 30, 2020.)*

Kahler said it is not apparent from the aerial photographs, but the bank through this area is fairly high and the location of the proposed path may be a low spot. He explained that the area between the pedestrian path and the big tree to the south had an eroding bank, and as part of an activity necessary at this property, Douglas PUD installed bioengineered bank stabilization. He said this bank is about 4 feet above the beach. He said the area around the tree located at the point was stabilized, too. He said the bank around the pump house is also very steep with cobble substrate, about 4 to 5 feet above the ordinary high water mark. He said he believes the idea behind the pedestrian access path is to provide a location with a low angle of slope to access the river.

Andrew Gingerich noted that there is language in Section 10 of the permit application that allows for termination if the landowner sells the subject property. Gingerich said there are also other clauses to allow for termination with 60 days written notice if the owner does not adhere to permit conditions and documents. He said using a pedestrian path as a boat launch would, in theory, be terms for termination. He said he agrees a 10-foot-wide path is an attractive nuisance to use as a boat launch; however, the elevation difference or slope of the site may not support launching boats in this location.

Douglas PUD will inquire internally regarding the pedestrian access described in the Wells Project Land-Use Permit Application for No. LUP 4-06. *(Note: Kahler provided clarification to Geris following the HCP Coordinating Committees conference call on June 23, 2020, which Geris distributed to the HCP Coordinating Committees that same day. On June 30, 2020, Truscott indicated via email that based on* *the discussion during the HCP Coordinating Committees conference call on June 23, 2020, and the additional information provided by Kahler, the CCT have no additional comments. Craig also indicated no further comments from USFWS, Scott Carlon indicated no comments from NMFS, and Chad Jackson indicated no comments from WDFW that same day.)*

C. Final FWMT Annual Reports (Tom Kahler)

The final FWMT annual reports for water years 2013-2014, 2014-2015, 2015-2016, and 2018-2019 were distributed to the HCP Coordinating Committees by Kristi Geris on June 3, 2020.

Tom Kahler said historically, there has been a B.C. administrative task force that includes a number of water managers such as the Okanagan Nation Alliance, Fisheries and Oceans Canada, and the B.C. Ministry of Environment, who work together to make water use decisions throughout the water year, which is October to September. He said following each year of implementation of the FWMT, this group issues what used to be called a Record of Decision. He said recently, the group decided to combine the Record of Decision with descriptions of activities included in FWMT implementation such as, all spawner surveys, water quality monitoring, lake level gauges, and other data, into an annual report; and now the group is going back retroactively to update prior year reports into this new format. He said these newly formatted annual reports are what were distributed to the HCP Coordinating Committees.

Kahler said the Wells HCP Committees have a responsibility to review all reports generated under the implementation of the Wells HCP. He said in the past, the Wells HCP Committees have elected not to review certain reports for activities that originated outside of the respective Committees activities. He said Douglas PUD has asked the Wells HCP Coordinating Committee if the Committee wanted to review these reports (in the previous format), and the Committee deferred review of these reports to the Canadian water managers. Kahler explained that the Canadian water managers first began producing these reports so that if there was a legal issue about how the water was managed there would be this Record of Decision, which shows that the managers followed a deliberative decision-making process and gave the managers defensibility regarding their decisions. Kahler noted that this turned out to be useful in 2017 when there was flooding around Okanagan Lake that caused flood damage and the Province or federal government reviewed the Record of Decision and found there was no fault of the water managers.

Kahler said there will be more of these updated annual reports issued and he asked if the Wells HCP Coordinating Committee prefers a formal review process or prefers to continue considering the reports as a record from the Canadian water managers to have as a reference, with no formal review process. Wells HCP Coordinating Committee representatives present agreed to an informal review (opposed to a formal HCP review process) of the *Okanagan Fish and Water Management Tools*

(FWMT) annual reports that are prepared by the Okanagan Nation Alliance Fisheries Department, Westbank, B.C., for the FWMT Steering Committee and Douglas PUD.

D. Wells Dam 2020 Bypass Operations Update (Andrew Gingerich and Tom Kahler)

Andrew Gingerich said bypass operations at Wells Dam have been going generally as planned, notably compared to last year when there were compliance issues at Bypass Bay 2. Tom Kahler added that this year, the bypass barriers in Spillbay 6 were pulled on May 28, 2020, and were reinstalled last week on June 16, 2020. He said pulling bypass barriers is based on Emergency Action Plan requirements, which are outlined in a table in the Bypass Operating Plan, where barriers are pulled from at least one bypass bay when flow is sustained above 200 kcfs to provide sufficient auto-hoist gate capacity to handle a load rejection without flooding the dam. He said this happened on the afternoon of May 28, 2020, after which the forecasted inflow returned back below 200 kcfs by the weekend. He said June 14, 2020, was the first day the extended flow forecast was below 200 kcfs, and a decision was made on Monday, June 15, 2020, to reinstall the barriers, which were installed in the afternoon of Tuesday, June 16, 2020. He said as Gingerich noted, everything is going well.

John Ferguson asked if there were any other variances, and Kahler said there was a little issue with interpretation of the Spill Playbook when operators pulled the barriers in Spillway 6. Kahler said time was spent with the operators to help their understanding of the spill distribution under a scenario with bypass barriers pulled (i.e., to allocate spill to the correct spillways).

V. HCP Administration

A. COVID-19 and Meeting Logistics (John Ferguson)

John Ferguson asked if there are any new updates HCP Coordinating Committees members have to share. No updates were shared.

B. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on July 28, 2020, to be held by conference call.

The August 25 and September 22, 2020 meetings will be held by conference call or in-person at the Grant PUD Wenatchee Office in Wenatchee, Washington, as is yet to be determined.

VI. List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman†	BioAnalysts
Lance Keller*	Chelan PUD
Bill Towey	Chelan PUD
Tom Kahler*††	Douglas PUD
Andrew Gingerich*	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Jim Craig*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation
Kirk Truscott*	Colville Confederated Tribes

Notes:
* Denotes HCP Coordinating Committees member or alternate
† Joined for the HCP Hatchery and Tributary Committees Update
†† Joined for the Douglas PUD items

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: September 7, 2020

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris

Re: Final Minutes of the July 28, 2020, HCP Coordinating Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Tuesday, July 28, 2020, from 9:00 a.m. to 10:00 a.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

- Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).
- Douglas PUD will provide a link to the Hallauer Act, or Revised Code of Washington (RCW) 54.16.220, to Kristi Geris for distribution to the HCP Coordinating Committees (Item III-B). *(Note: Tom Kahler provided this link during the conference call on July 28, 2020, which Geris distributed to the HCP Coordinating Committees following the conference call that same day.)*
- Douglas PUD will inquire internally regarding the Colville Confederated Tribes' (CCT's) comment on Wells Project Land-Use Permit Application for #LUP 143-01, about requesting that the property owner move operations farther upland in order to provide a wider riparian buffer similar in width to the opposite shoreline of the Okanagan River (Item III-B).
- Anchor QEA will coordinate to add Katy Shelby (Washington Department of Fish and Wildlife [WDFW] Technical Support) to the HCP Hatchery Committees primary email distribution list and provide Shelby with HCP Hatchery Committees extranet site access, as approved by the HCP Coordinating Committees (Item V-A). *(Note: Kristi Geris notified Mike Tonseth and Chad Jackson [WDFW HCP Hatchery Committees Representative and Alternate, respectively], Tracy Hillman [HCP Hatchery Committees Chairman], and Sarah Montgomery [HCP Hatchery Committees Support Staff] of this approval following the conference call on July 28, 2020; and Geris contacted Julene McGregor [Douglas PUD Information Services Staff] to request extranet access for Shelby that same day, as discussed.)*
- The HCP Coordinating Committees meeting on August 25, 2020, will be held at 9:00 a.m., by conference call (Item V-D).

Decision Summary

- There were no HCP Decisions approved during today's conference call.

Agreements

- HCP Coordinating Committees representatives present agreed to add Katy Shelby to the HCP Hatchery Committees primary email distribution list and provide Shelby with access to the HCP Hatchery Committees extranet site (Item V-A).

Review Items

- The *Wells Project Subyearling Chinook Life-History Study 2011–2013 Draft Final Report* was distributed to the HCP Coordinating Committees by Kristi Geris on May 24, 2019.
- A Wells Project Land-Use Permit Application for #LUP 143-01 was distributed to the HCP Coordinating Committees by Kristi Geris on July 15, 2020. This application is available for a 30-day review with comments or indication of no comments due to Tom Kahler no later than Friday, August 14, 2020 (Item III-B).

Finalized Documents

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. No additions or changes were requested.

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft June 23, 2020 conference call minutes. Kristi Geris said all comments and revisions received from members of the Committees were incorporated into the revised minutes. HCP Coordinating Committees members present approved the June 23, 2020 conference call minutes, as revised.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on June 23, 2020, and follow-up discussions, were as follows. *(Note: Italicized text corresponds to agenda items from the meeting on June 23, 2020):*

- *Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).*
  This will be discussed during today's conference call and will also be carried forward.

- *Chelan PUD will notify the Rock Island HCP Coordinating Committee when Chelan PUD submits the Federal Energy Regulatory Commission (FERC) notification letter regarding the maintenance rehabilitation of Rock Island Dam Powerhouse 2 (Item III-D).*
  Lance Keller said Chelan PUD filed the letter and comment/response matrix with FERC on July 2, 2020.
- *Douglas PUD will inquire internally regarding the pedestrian access described in the Wells Project Land-Use Permit Application for No. LUP 4-06 (Item IV-B).*
  Tom Kahler provided clarification to Kristi Geris following the HCP Coordinating Committees conference call on June 23, 2020, which Geris distributed to the HCP Coordinating Committees that same day.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees conference call on July 9, 2020:

- *Monitoring Proposal*: The HCP Tributary Committees received a monitoring proposal from the Okanagan Nation Alliance titled *ORRI Effectiveness Monitoring and Restoration Prioritization (2020–2024) Project*. The purpose of the project is to monitor the effectiveness of enhancement actions within three project sites: Penticton Channel, Oliver Site, and Okanagan Falls. The cost of the monitoring project over a five-year period is $99,000. After review and discussion, the HCP Tributary Committees indicated an interest in possibly funding some components of the project. However, before the Committees can support these monitoring components, the Committees need additional information from the project sponsor. Once the sponsor responds with additional information, the Committees will make a funding decision.
- *Project Presentations*: The HCP Tributary Committees heard presentations from both Chelan County Natural Resources Department and the Methow Salmon Recovery Foundation. The Chelan County Natural Resources Department described six different projects to the Committees, while the Methow Salmon Recovery Foundation outlined design concepts on the Sugar Levee Project, which is an HCP Tributary Committees targeted project located on the Methow River. The Committees provided feedback and recommendations to the project sponsors. Next month, the Yakama Nation will discuss 12 potential projects with the HCP Tributary Committees. This is in response to the Committees' request to be included in early discussions during the development of conceptual, preliminary, and final designs.
- *Chiwawa Nutrient Enhancement Project*: Cascade Fisheries (CF) reported to the HCP Tributary Committees that it does not appear CF will receive cost-free carcass analogs this year. He recalled that CF is adding carcass analogs to the middle segment of the Chiwawa River. The

Rock Island Plan Species Account supports a portion of the monitoring of this project. The company that makes the analogs (AmCan) had to lay off staff due to the COVID-19 pandemic. In order to continue the third year of nutrient enhancement work, CF would need about $90,000 to purchase 40,000 pounds of analogs from a different vendor this year. If CF is unable to secure free analogs in the future, CF will need about $270,000 for analogs over the next 3 years. The CF asked the HCP Tributary Committees if the Committees would be willing to fund the purchase of the analogs this year and possibly over the 3-year period. Although the Committees see some value in the project, the Committees are not willing to provide any additional funding for this project.

- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on August 13, 2020.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees conference call on July 15, 2020 (*note: joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *Re-evaluation of Conservation Program Size (joint):* The Committees continued their discussion on revising the size of the Wenatchee spring Chinook salmon conservation programs. The intent is to reevaluate the allocation of production between the conservation and safety net programs; total hatchery production will not change. With help from the National Oceanic and Atmospheric Administration's Northwest Fisheries Science Center, the Committees are evaluating density dependence and carrying capacity within spring Chinook salmon spawning aggregates.
- *Differentiating Natural-Origin Okanogan and Methow Spring Chinook Salmon (joint):* The CCT are working on methods to differentiate natural-origin Okanogan spring Chinook salmon from natural-origin Methow spring Chinook salmon at Wells Dam. This work is needed to prevent the collection and incorporation of natural-origin Okanogan spring Chinook salmon into Methow Hatchery programs. The CCT are currently looking at elemental signature analyses as a means to differentiate natural-origin spring Chinook salmon. John Ferguson asked if this elemental signature analysis is being used elsewhere and how does it work? He asked what tissues are analyzed and that otoliths cannot be used for this, correct?
  Kirk Truscott said an otolith analysis would not provide the desired results. He said the CCT have used otolith elemental analysis to differentiate summer Chinook salmon in the Okanogan River Basin from the mainstem Columbia River summer Chinook salmon. He said in the Okanogan River, the CCT have also used this analysis for resident fish. Ferguson asked about a timeframe to obtain results. Truscott said it can be as short as one week, similar to other genetic analyses. He said the CCT are also currently analyzing whether there is enough

differentiation between subbasins in the Okanogan and Methow rivers to differentiate between spring Chinook salmon. He said the CCT are looking at what information exists on the elemental constituents in the two major river basins. Ferguson asked, for the purpose of developing a baseline? Truscott said this is correct.

- *COVID-19 and Hatchery Monitoring and Evaluation (M&E) Activities (joint):* Each member of the HCP Hatchery Committees discussed the effects of COVID-19 on their respective M&E activities. Overall, very little has changed since last month. Monitoring is occurring within the hatcheries and crews are operating smolt traps. Broodstock collections are proceeding as planned and monitoring crews are planning to conduct spring Chinook salmon spawning surveys this year.
- *Chiwawa Spring Chinook Salmon Broodstock Collection (Rock Island/Rocky Reach):* Chelan PUD reported that trapping began for spring Chinook salmon broodstock at the Chiwawa Weir on July 6, 2020. Trapping at the weir was delayed this year because of high flows in the Chiwawa River. The goal is to collect 84 natural-origin spring Chinook salmon at the weir.
- *Chelan Falls Summer Chinook Salmon Broodstock Collection (Rock Island/Rocky Reach):* Chelan PUD reported that because of the COVID-19 pandemic, Chelan PUD was unable to install the adult summer Chinook salmon trap in the Chelan River habitat channel in time to collect broodstock for the Chelan Falls program. Therefore, broodstock for the program will be collected at the Wells Fish Hatchery volunteer trap. Chelan PUD intends to install the Chelan River trap this month and test it. Any fish collected during testing will be surplused (i.e., the fish will not be incorporated into broodstock).
- *Methow Hatchery Spring Chinook Salmon Broodstock Collection (Wells):* Douglas PUD reported that enough spring Chinook salmon broodstock were collected for the Methow Hatchery Program. Given the COVID-19 pandemic and the low number of returning spring Chinook salmon, that there was a concern broodstock targets might not be met.
- *Requested Change in Distribution List (Administration):* WDFW requested that McLain Johnson (former WDFW Fish Biologist) be replaced by Katy Shelby (new WDFW Fish Biologist) on the HCP Hatchery Committees primary email distribution list. Shelby will provide technical support to the Committees. The HCP Hatchery Committees approved the request and are requesting approval from the HCP Coordinating Committees.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on August 19, 2020.

III. Douglas PUD

A. Wells Dam 2020 Bypass Operations Update (Tom Kahler)

Tom Kahler said bypass operations at Wells Dam have been consistent with the Bypass Operating Plan and there are no anomalies to report.

B. Wells Project Land-use Permit No. LUP 143-01 (Tom Kahler)

Tom Kahler said a Wells Project Land-Use Permit Application for #LUP 143-01 was distributed to the HCP Coordinating Committees by Kristi Geris on July 15, 2020. This application is available for a 30-day review (with comments or indication of no comments) due to Kahler no later than Friday, August 14, 2020.

Kahler said it might be useful to describe some of the history behind these Wells Project land-use permit applications, particularly for those located way upstream in the Okanogan River. He explained that at the time of the development of the Wells Project boundary, Douglas PUD was required by FERC to acquire all lands within a footprint of what would be a worst-case scenario backwater effect. He said that Douglas PUD had a short window of time between when Douglas PUD received the order to proceed with the project from FERC and the deadline for obtaining all affected properties within the project boundary. He said Douglas PUD chose to coordinate directly with the landowners with a goal of establishing positive relationships with the residents around the Wells Project rather than relying on the imminent domain process to acquire properties. He said there was a huge effort to obtain these properties, and also in the middle of this process a law was passed by the Washington State Legislature (referred to as the Hallauer Act). Kahler said the name under the RCW is *Columbia River Hydroelectric Projects - Grant Back Of Easements To Former Owners*, but Senator Hallauer of Omak, Washington promoted this law. Kahler said the Hallauer Act applies to all Columbia River PUDs and requires that for all privately owned lands acquired for the purpose of a hydroelectric project reservoir, the PUD has to grant an easement to the former owners for use of the land, with provisions. Kahler said he can provide a link to the Hallauer Act, or RCW 54.16.220, to Geris for distribution to the HCP Coordinating Committees. *(Note: Kahler provided this link during the conference call on July 28, 2020, which Geris distributed to the HCP Coordinating Committees following the conference call that same day.)*

Kahler said there was a process that property owners had to go through, per the Hallauer Act, and some did this. He said the idea was that the State Legislature did not want the PUDs depriving property owners of the use of land that those people already had, even though the PUDs also wanted these property owners to continue to have the same opportunity to use the land as long as this use did not interfere with the purpose of the project (as required under the FERC license). He said the Hallauer Act set the tone of what the local government wanted (i.e., the PUDs needed to obtain land but not deprive property owners of the use of the lands, which had been primarily agricultural along the Okanogan River and in the Wells Reservoir proper). He said, in summary, Douglas PUD went through a major process of trying to obtain lands from landowners by agreement, rather than taking the land from the owners through eminent domain and incurring the animus associated with this process. He said this sometimes was in the form of a longstanding and often verbal agreement between the Douglas PUD and the landowner, where the intent was to solidify these agreements as actual permits over time as there were opportunities to do so.

Kahler said this Wells Project Land-Use Permit Application for #LUP 143-01 is one of these properties. He said from before Douglas PUD obtained the property until the present, the landowners used the property as a farm and grew vegetables. Kahler said Douglas PUD granted the landowners continued use of this property even though Douglas PUD now owns it. He said the mother recently turned the property over to a son, which presented a good opportunity to solidify this usage with a formal permit. He said this property is located along the Okanogan River well above any area that is influenced by normal project operations; however, Douglas PUD had to own the land because in an extreme flood event the location is within the mandated inundation zone.

Kahler said changing how the land under these agreements and permits is used has been discussed; however, changing how the land is used is not in the spirit of the original agreements. He said, additionally, it would be a complicated process to go back into these land files to determine what exactly these landowners were given, and sometimes this would not be clear due to the verbal agreements. He said, in the meantime, Douglas PUD is not lax on enforcing regulations on project lands. He said Douglas PUD tours the entire reservoir twice per month and if residents are violating the terms of their permit or agreement, Douglas PUD will notify the landowner to correct the infraction and take legal action if needed.

Scott Carlon asked if most of these residents obtain water via pumps off the Columbia River or from groundwater wells. Kahler said most water is obtained from pumps off the river, and in the 2004 to 2011 timeframe, Douglas PUD went through a process with guidance from Bryan Nordlund (National Marine Fisheries Service [NMFS], retired) and per the FERC license, to require everyone to install a NMFS-compliant screen system on their pump intakes. Carlon asked if this is also part of the permitting process (to require that pumps are screened properly). Kahler said yes, as far as he knows (this is only required for what FERC considered major withdrawals)..

Kirk Truscott said he and Kahler discussed this application and he asked Kahler if Douglas PUD could condition the permit on moving operations farther upland in order to provide a wider riparian buffer similar in width to the opposite shoreline of the Okanagan River. Kahler said he will inquire internally about this request.

IV. Chelan PUD

A. Rock Island Dam Powerhouse 1 Maintenance Update (Lance Keller)

Lance Keller said work is continuing on Turbine Unit B4; however, Chelan PUD is not yet confident about releasing a return-to-service date for the unit at this time. Keller recalled that Turbine Unit B4 is the first of the small units at the powerhouse to be rehabilitated, so there is a bit of a learning curve associated with rehabilitating this first unit, and crews should be more efficient with regard to the timelines for rehabilitating Turbine Units B1 to B3. He said Chelan PUD is confident the return-to-service date for Turbine Unit B4 will be well in advance of the 2021 Rock Island survival check-in study. He said he hopes to provide a firmer return-to-service date for Turbine Unit B4 during the HCP Coordinating Committees meeting on August 25, 2020.

B. Rocky Reach Dam Turbine Units Maintenance Update (Lance Keller)

Lance Keller said work continues on Turbine Unit C2 and the return-to-service date remains at the end of October 2020. He said the Turbine Unit C7 return-to-service date has slipped because as he understands, when the Kaplan tube was extracted it was bound up tightly and the tube was damaged. He said the procurement process for a replacement part has taken additional time and the earlier estimated return-to-service date of November 2020 has shifted back to the end of 2020. However, this date depends on when the new Kaplan tube arrives onsite. He recalled that Turbine Unit C3 is the unit operating in a hydraulic blade blocked configuration. He said due to previous observations of water and oil in the hub, the unit is now taken out of service every 3 weeks to drain the hub and assess how much water is coming in from outside, and to confirm the integrity of the trunnion seal and bushing to ensure there are no releases of oil to the river. He said crews conducted a service outage in early July 2020, drained the water/oil mixture off, and did not observe any oil loss or water intrusion into the governor system. He said crews returned the unit to service and the next scheduled service for Turbine Unit C3 is scheduled to occur on August 3, 2020. He said he will share the results of the August 3, 2020 servicing during the HCP Coordinating Committees meeting on August 25, 2020.

V. HCP Administration

A. HCP Hatchery Committees Primary Email Distribution List – Katy Shelby, WDFW Technical Support (John Ferguson)

John Ferguson said the HCP Hatchery Committees requested to add Katy Shelby to the primary email distribution list and provide Shelby with access to the extranet site. Ferguson recalled that Shelby will replace Mclain Johnson. Chad Jackson said he has nothing further to add.

HCP Coordinating Committees representatives present agreed to add Shelby to the HCP Hatchery Committees primary email distribution list and provide Shelby with access to the HCP Hatchery Committees extranet site. Anchor QEA will coordinate to add Shelby to the HCP Hatchery Committees primary email distribution list and provide Shelby with HCP Hatchery Committees extranet site access, as approved by the HCP Coordinating Committees. *(Note: Kristi Geris notified Mike Tonseth and Jackson, Tracy Hillman, and Sarah Montgomery of this approval following the* *conference call on July 28, 2020, and Geris contacted Julene McGregor to request extranet access for Shelby that same day, as discussed.)*

B. COVID-19 and Meeting Logistics (John Ferguson)

John Ferguson asked if there are any new updates HCP Coordinating Committees members have to share.

Lance Keller said over the last month, Chelan PUD offices have been open to staff as long as staff wear masks. Keller said now Chelan PUD is encouraging all non-essential staff to work from home through the remainder of 2020, which includes all biological staff. He said everyone is still available via email and cell phone.

Chad Jackson said WDFW is close to reopening all laboratories and returning staff to offices, including scale readers, coded wire tag operations, and fish health laboratories. He said WDFW and other State agencies have also been furloughed for the past four Fridays in July and will be furloughed once per month through the end of 2020. He said this may potentially delay some services and some services may not be available. Ferguson noted that he understands the 1-day furlough will vary among State agencies, so not all State employees will be furloughed on the same day from August through December 2020.

Kirk Truscott said the CCT extended the partial government shutdown to the end of September 2020. He said certain actions, many policy-related, may take longer to get through the process. Ferguson asked if some policy staff are not working, and Truscott said this is correct.

Scott Carlon said the NMFS offices remain closed. He said staff receive regular updates about how to reopen but no timeline on when offices will reopen. He said he is doubtful offices will reopen before the end of 2020; however, business is as usual with staff working remotely from home.

Ferguson said the HCP Policy Committees had intended to convene in-person back on May 5, 2020; however, due to COVID-19, this meeting was rescheduled to September 1, 2020. He said recently, there have been emails circulating to determine whether members of the Committees still want to convene this meeting on September 1, 2020, which looks like it will need to be via WebEx. He said these discussions are revolving around either delaying the meeting again because of the benefit of meeting in-person (especially because there are two to three new members to the Committees), or convening a meeting via WebEx to address one or more pressing topics. He said there will be more to come on this once a decision is made.

No other updates were shared by the HCP Coordinating Committees.

C. Subyearling Chinook Salmon Studies – Next Quarterly Check-In (John Ferguson)

John Ferguson said this is a reminder that the next subyearling Chinook salmon studies quarterly check-in will be during the HCP Coordinating Committees meeting on August 25, 2020.

Tom Kahler said Douglas PUD reviewed the CCT comments on the *Wells Project Subyearling Chinook Life-History Study 2011–2013 Draft Final Report* and provided responses back to the CCT asking whether additional dialogue is needed or if the report is ready to present to the Wells HCP Coordinating Committee. Kirk Truscott said he plans to work offline with Kahler on this.

D. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on August 25, 2020, to be held by conference call.

The September 22 and October 27, 2020 meetings will be held by conference call or in-person at the Grant PUD Wenatchee Office in Wenatchee, Washington, as is yet to be determined.

VI. List of Attachments

Attachment A   List of Attendees

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman†	BioAnalysts
Lance Keller*	Chelan PUD
Bill Towey	Chelan PUD
Tom Kahler*	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Jim Craig*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation
Kirk Truscott*	Colville Confederated Tribes

Notes:
* Denotes HCP Coordinating Committees member or alternate
† Joined for the HCP Hatchery and Tributary Committees Update

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Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: September 22, 2020

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Sarah Montgomery, Kristi Geris

Re: Final Minutes of the August 25, 2020, HCP Coordinating Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Tuesday, August 25, 2020, from 9:00 a.m. to 10:00 a.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

- Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).
- The HCP Coordinating Committees meeting on September 22, 2020, will be held at 9:00 a.m., by conference call (Item VI-C).

Decision Summary

- There were no HCP Decisions approved during today's conference call.

Agreements

- There were no HCP Agreements discussed during today's conference call.

Review Items

- The *Wells Project Subyearling Chinook Life-History Study 2011–2013 Draft Final Report* was distributed to the HCP Coordinating Committees by Kristi Geris on May 24, 2019.
- The *Chelan PUD Rocky Reach and Rock Island HCPs Draft 2020 Fish Spill Report* was distributed to the HCP Coordinating Committees by Kristi Geris on September 19, 2020 and is available for a 30-day review with edits and comments due to Lance Keller by October 19, 2020.

Finalized Documents

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. The following revisions were requested:

- Scott Carlon asked for an update about Rock Island Dam relicensing. Lance Keller said he can provide an update, and Ferguson added this as an item for Chelan PUD.

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft July 28, 2020, conference call minutes. Sarah Montgomery said all comments and revisions received from members of the Committees were incorporated into the revised minutes. HCP Coordinating Committees members present approved the July 28, 2020, conference call minutes, as revised.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on July 28, 2020, and follow-up discussions, were as follows. *(Note: Italicized text corresponds to agenda items from the meeting on July 28, 2020):*

- *Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).*
  This will be discussed during today's conference call and will be carried forward.
- *Douglas PUD will provide a link to the Hallauer Act, or Revised Code of Washington (RCW) 54.16.220, to Kristi Geris for distribution to the HCP Coordinating Committees (Item III-B).*
  Tom Kahler provided this link during the conference call on July 28, 2020, which Geris distributed to the HCP Coordinating Committees following the conference call that same day.
- *Douglas PUD will inquire internally regarding the Colville Confederated Tribes' (CCT's) comment on Wells Project Land-Use Permit Application for #LUP 143-01, about requesting that the property owner move operations farther upland in order to provide a wider riparian buffer similar in width to the opposite shoreline of the Okanagan River (Item III-B).*
  Tom Kahler said he discussed this item with the Douglas PUD lands department. The department will not make changes to the original agreement unless there is a Federal Energy Regulatory Commission obligation to do so. Kahler said if there was an obligation, Douglas PUD would modify the permit; otherwise, they will not make unilateral changes to these types of agreements. Kirk Truscott thanked Kahler for looking into this item and said he understands the constraints. He said he was looking for a cooperative process to provide additional riparian buffer. Kahler said the issue is that there is a road along the bank so it would be difficult to move, and this was not a discussion topic as part of the initial permitting process.

- *Anchor QEA will coordinate to add Katy Shelby (Washington Department of Fish and Wildlife [WDFW] Technical Support) to the HCP Hatchery Committees primary email distribution list and provide Shelby with HCP Hatchery Committees extranet site access, as approved by the HCP Coordinating Committees (Item V-A).*
  Kristi Geris notified Mike Tonseth and Chad Jackson (WDFW HCP Hatchery Committees Representative and Alternate, respectively), Tracy Hillman (HCP Hatchery Committees Chairman), and Sarah Montgomery (HCP Hatchery Committees Support Staff) of this approval following the conference call on July 28, 2020; and Geris contacted Julene McGregor (Douglas PUD Information Services Staff) to request extranet access for Shelby that same day, as discussed.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees conference call on August 13, 2020:

- *Vandervort Appraisal Discussion:* In June 2020, the HCP Tributary Committees reviewed a Small Projects Application from the Methow Salmon Recovery Foundation titled, "Methow River – Vandervort Property Appraisal Project." The purpose of the project was to fund an appraisal to determine the value of the Vandervort property at the upper end of the Silver Side Channel Project area, located on the Methow River near RM 35.5. The acquisition of this property would potentially allow the removal of a levee that currently isolates flow into the upper end of the Silver Side Channel. The sponsor requested $9,250 from HCP Plan Species Account Funds. The HCP Tributary Committees declined the opportunity to fund the project at that time because of several unknowns and uncertainties. The Committees invited the sponsor to a future meeting to discuss the Committees' concerns. Chris Johnson (Methow Salmon Recovery Foundation) joined the conference call and responded to the Committees' questions and concerns. Following the discussion, the Wells HCP Tributary Committee agreed to contribute $9,250 to fund the appraisal, which will be conducted by the Committees' approved appraiser.
- *Yakama Nation Project Presentations:* The HCP Tributary Committees convened with the PRCC Habitat Subcommittee to hear presentations from the Yakama Nation (YN) on nine potential habitat enhancement projects located in the Wenatchee, Entiat, and Methow subbasins. These projects are in various stages of development. The YN gave the presentations in response to the HCP Tributary Committees' request to be included in early discussions during the development of conceptual, preliminary, and final designs. The HCP Tributary Committees

provided feedback and recommendations to the YN. The HCP Tributary Committees asked to be included in future discussions on these projects.

- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on September 10, 2020.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees conference call on August 19, 2020 (*note: joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *Re-evaluation of Conservation Program Size (joint)*: The HCP Hatchery Committees and PRCC HSC continued their discussion on revising the size of the Wenatchee spring Chinook conservation programs. The intent is to reevaluate the allocation of production between the conservation and safety net programs. Total hatchery production will not change. With help from the National Oceanic and Atmospheric Administration (NOAA) Northwest Fisheries Science Center, the Committees are evaluating density dependence and carrying capacity within spring Chinook salmon spawning aggregates. John Ferguson asked how the modeling analysis is written up. Hillman said there will be a report on the subject at some point. He said one model is NOAA's life cycle model (an effort led by NOAA employee Rich Zabel), another model is being built by Mark Sorel (a NOAA contractor who is developing the model as part of his PhD dissertation at the University of Washington), and the third is a tool that Keely Murdoch and WDFW staff put together during the last recalculation, which is being updated with more recent information.
- *COVID-19 and M&E Activities (joint)*: Each member of the HCP Hatchery Committees discussed the effects of COVID-19 on their respective M&E activities. Overall, very little has changed since last month. Monitoring is occurring within the hatcheries and crews are operating smolt traps. Broodstock collections are proceeding as planned and monitoring crews are conducting spring Chinook spawning surveys.
- *Chiwawa Spring Chinook Salmon Broodstock Collection (Rock Island/Rocky Reach)*: WDFW began trapping spring Chinook salmon broodstock at the Chiwawa Weir on July 6, 2020. Trapping at the weir was delayed this year because of high flows in the Chiwawa River. WDFW was able to collect 70 natural-origin spring Chinook salmon at the weir, and the overall target is 84 fish for the Chiwawa program. An additional 18 spring Chinook salmon were collected at Tumwater Dam. During tapping at the weir, 70 bull trout were encountered (the encounter limit at the weir is 123 bull trout).
- *Okanagan Sockeye Salmon Draft Statement of Agreement (Rock Island/Rocky Reach)*: Chelan PUD responded to comments they received on their draft Okanogan Sockeye Salmon

Obligation and Reintroduction Program Statement of Agreement (SOA). Based on comments received, Chelan PUD decided to submit two separate SOAs; one will address the success of the sockeye salmon program and the other will address future obligations. Chelan PUD will prepare a whitepaper describing the success of the program. Chelan PUD will also give a presentation to the Committees during the September meeting regarding the sockeye program. The SOAs will be submitted to the Committees following the September meeting.

- *Predation at Eastbank Fish Hatchery (Rock Island/Rocky Reach)*: Chelan PUD reported that birds have consumed several thousand juvenile spring Chinook salmon at Eastbank Fish Hatchery (roughly 12,000 Nason Creek conservation fish, 23,000 Nason Creek safety-net fish, and 15,000 Chiwawa fish). To reduce predation, the lethal removal of birds by the U.S. Department of Agriculture has begun and Chelan PUD is in the process of installing netting over the rearing raceways. Jim Craig asked if this was an issue in previous years. Hillman said he is not sure. Lance Keller said he is also not sure about previous years, but added that in 2020, an extensive effort utilizing trail cameras was able to determine that crows and herons are the primary predators.
- *2021 Hatchery M&E Implementation Plan (Rock Island/Rocky Reach)*: Chelan PUD submitted their draft 2021 Hatchery Monitoring and Evaluation Implementation Plan for review. Comments from the Committees are due on September 4, 2020.
- *Methow Hatchery Spring Chinook Broodstock Collection (Wells)*: Douglas PUD reported that collection of spring Chinook salmon at the Twisp weir fell one female short of the target of eight female spring Chinook salmon for the Twisp program. Douglas PUD was able to make up the deficit by adding production to the Methow-Chewuch spring Chinook salmon program.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on September 16, 2020.

III. Chelan PUD

A. Rock Island Dam Powerhouse 1 Maintenance Update (Lance Keller)

Lance Keller said during the last HCP Coordinating Committees meeting, he provided an update that the maintenance schedule for Turbine Unit B4 was continuing to shift. He said though the schedule could still change again due to COVID-19, the tentative return to service date for B4 is December 2020. He said Chelan PUD is happy with this timeline because it is well in advance of the Rock Island juvenile survival study planned for 2021. He said he will continue providing updates on maintenance in Powerhouse 1 at future meetings.

B. Rocky Reach Dam Turbine Units Maintenance Update (Lance Keller)

Lance Keller said Chelan PUD continues work to bring Turbine Unit C2 back into service, with an estimate return to service date of November 2020.

He said maintenance work on Turbine Unit C3 also continues. He said the turbine hub was drained in early August 2020, to assess if water from the river in the hub had entered the governor oil system. Then, there was an assessment to determine whether any oil from the governor was getting into the hub and escaping into the river. He said inspection of the drained hub shows that this is not the case, and that water and oil are both being properly contained within the hub. He said C3 was scheduled to return to service in late August or early September 2020, but with the progress being made on C2, it makes more sense to start the overhaul on C3 while also addressing the turbine bushing issue. He said C3 will most likely not return to service between the HCP Coordinating Committees meeting and September 4, 2020. He said by the HCP Coordinating Committees meeting in September 2020, he hopes to have an estimate for the timeline for the overhaul of C3.

He said maintenance on Turbine Unit C7 also continues. He said the Kaplan pipe was damaged when the unit was disassembled, and Chelan PUD is working to procure a new pipe. The return to service date for C7 is currently estimated as February 2021.

C. 2020 Rocky Reach and Rock Island Summer Fish Spill (Lance Keller)

Lance Keller said he provided an update on summer fish spill for Rocky Reach and Rock Island dams to the HCP Coordinating Committees on August 18, 2020. He said at Rock Island Dam as of August 17, 2020, all three of the criteria to end summer fish spill had been met. He said the current model estimates showed that 95% of the subyearling run had migrated pass Rock Island Dam by August 5, 2020, and based on the start date of May 23, 2020, for summer fish spill, the model estimated that we achieved spill coverage for 95% of the outmigration on August 5, 2020, as well. He said in looking at the 5 prior days of index counts, three out of the 5 counts were below 0.3% of the cumulative index count, averaging 0.25% during the August 14 to August 18, 2020, period. This criterion was achieved on August 17, 2020, but Chelan PUD continued summer fish spill for an additional day to ensure that index counts continued to trend lower. Given that all three of the required criteria to end summer spill had been met at Rock Island Dam, and daily index counts continued to trend downward, Chelan PUD ended summer fish spill at Rock Island Dam on August 18, 2020, at 2400 hours.

He said his email on August 18, 2020, also provided an update on Rocky Reach summer fish spill. As of August 18, 2020, two of the three criteria to end summer fish spill had been met. He said the current model estimates showed that 95% of the subyearling run had migrated pass Rocky Reach Dam by August 15, 2020, and based on the start date of May 23, 2020, for summer spill, the model estimated that we achieved spill coverage for 95% of the outmigration on August 15, 2020. He said over the 5 days prior to August 18, 2020, however, all of the daily index counts were greater than 0.3% of the cumulative index count, averaging 1.06% during the August 14 to August 18, 2020, period. Due to daily index counts remaining higher than the 0.3% criteria, summer spill at Rocky Reach Dam will continue until the daily index counts fall below 0.3% of the cumulative index count. He said now that it has been an additional week, over the last 5 days daily index counts are averaging right around 0.3% of the cumulative index count, with the last two days falling under the threshold. He said Chelan PUD will be watching today's index count to assess whether to end summer spill tonight or extend it another day. He noted that 58 smolts passed on August 23, 2020, and 25 smolts passed on August 24, 2020, which is 0.10% of the cumulative index count. Keller said once today's data are available, Chelan PUD will assess whether the criteria to end summer spill have been met. He said he will provide an email update to the committees today on the decision to end summer fish spill. He said ending summer fish spill with only six days remaining in August 2020 leaves little chance that an exceedance could occur. He said he also plans to draft a summary of the summer fish spill program for discussion at the HCP Coordinating Committees meeting in September 2020.

D. Rock Island Confirmation Survival Study Request for Proposal Update (Lance Keller)

Lance Keller said as he described last month, Chelan PUD released an RFP for the Rock Island Confirmation Survival Study. He said Chelan PUD received four complete proposals and an internal team of six staff reviewed them and selected a contractor. He said contract negotiations are ongoing and he will provide another update in September once the contract is awarded. He said the four proposals were all very good and he looks forward to working with the selected contractor, Chelan PUD staff, and John Skalski (University of Washington) to draft the study design, which will be provided to the Rocky Reach HCP Coordinating Committee for review this winter. He said there will be a lot of activity in the Committee related to this topic between now and April 2021.

E. Rock Island Relicensing Update (Lance Keller)

Lance Keller said Chelan PUD is beginning to prepare for Rock Island relicensing (note: Rock Island relicensing is due by the end of 2028). He said one of the first steps is working internally to define the stakeholder group. He said one question was whether to include NOAA in the list of stakeholders, based on the fact that NOAA did not sign the Rocky Reach license, but are a signatory to the Rocky Reach HCP. It was decided in discussions with Jeff Osborn (Chelan PUD) that NOAA would be included on the stakeholder list. He said outreach to the stakeholder group will begin in September or October, at which point Chelan PUD will provide a general timeline for the relicensing process and contact information. He said Chelan PUD has designated Janel Ulrich (Chelan PUD

Manager of Hydro Licensing) to lead the Rock Island relicensing effort. He said Ulrich was involved in the Rocky Reach relicensing process and brings a unique skillset to this task, which will be her focus moving forward. Scott Carlon thanked Keller for the update.

IV. Douglas PUD

A. Wells Dam 2020 Bypass Operations Update (Tom Kahler)

Tom Kahler said Douglas PUD ended bypass operations at Wells Dam shortly after midnight on August 19, 2020. He said the bypass has been operated according to the plan since the last meeting. He noted that debris was removed from the units 9 and 10 in the forebay; when those units were off, the bypass bay for unit 10 was also closed. He said spillway 10 has a flap gate that was also closed whenever the contractor was working on debris, and units 9 and 10 were off according to the bypass operating plan. He said Douglas PUD adjusted some of the data due to default settings for the flap gate sensor, which were registering the flap gate as open whenever the lockout-tagout procedure shut off the main power to the sensor. He summarized that there were no deviations from the plan and summer spill was terminated accordingly.

V. Chelan PUD / Douglas PUD

A. Subyearling Chinook Salmon Studies – Quarterly Check-In (John Ferguson)

Tom Kahler said Douglas PUD received comments from the CCT in September 2019 on the report, *Wells Project Subyearling Chinook Life-History Study 2011–2013 Draft Final Report*, to which Douglas PUD responded around late June 2020. Kirk Truscott said the CCT are still reviewing Douglas PUD's responses to comments and he will provide an update when the review is complete.

VI. HCP Administration

A. COVID-19 and Meeting Logistics (John Ferguson)

John Ferguson asked if there are any new updates HCP Coordinating Committees members have to share. There were none.

B. WDFW HCP Policy Committees Representation (John Ferguson)

John Ferguson said he received an email from Chad Jackson explaining that Michael Livingston (WDFW, Yakima, Washington office) will be attending the HCP Policy Committees meeting on September 1, 2020, and will act as the representative when Jackson is not available. Ferguson said James Brown's (former WDFW HCP Policy Representative) position is vacant, so his duties are being assigned to staff from other offices. Ferguson said he will introduce himself to Livingston and other new HCP Policy Committees representatives before the call, which will focus on issues related to sockeye salmon sampling at Wells Dam.

C. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on September 22, 2020, to be held by conference call.

The October 27 and November 24, 2020, meetings will be held by conference call or in-person at the Grant PUD Wenatchee Office in Wenatchee, Washington, as is yet to be determined.

VII. List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Sarah Montgomery	Anchor QEA, LLC
Tracy Hillman†	BioAnalysts
Lance Keller*	Chelan PUD
Bill Towey	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Jim Craig*	U.S. Fish and Wildlife Service
Keely Murdoch*	Yakama Nation
Kirk Truscott*	Colville Confederated Tribes

Notes:
* Denotes HCP Coordinating Committees member or alternate
† Joined for the HCP Hatchery and Tributary Committees Update

FINAL

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ANCHOR QEA

Memorandum

To:	Wells, Rocky Reach, and Rock Island HCP Coordinating Committees	Date: November 24, 2020
From:	John Ferguson, HCP Coordinating Committees Chairman	
cc:	Kristi Geris	
Re:	**Final Minutes of the October 27, 2020, HCP Coordinating Committees Conference Call**	

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Tuesday, October 27, 2020, from 9:00 a.m. to 11:00 a.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

- Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).
- Anchor QEA, LLC (Anchor QEA) will distribute to the HCP Coordinating Committees the presentation, *Wells Project Passage Survival Study, 2020*, that was presented by Drs. John Skalski and Richard Townsend (University of Washington, Columbia Basin Research) (Item II-A). *(Note: Kristi Geris distributed this presentation following the HCP Coordinating Committees conference call on October 27, 2020.)*
- Douglas PUD will distribute a draft Statement of Agreement (SOA) approving the results of the *Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study)*, for approval during the HCP Coordinating Committees conference call on November 24, 2020 (Item II-B). *(Note: Tom Kahler provided a draft SOA to Kristi Geris on November 13, 2020, which Geris distributed to the HCP Coordinating Committees that same day.)*
- Wells HCP Coordinating Committee representatives will review and provide edits and comments on the draft *Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study)* to Tom Kahler and Andrew Gingerich by November 23, 2020, and be prepared to vote to approve the report during the HCP Coordinating Committees conference call on November 24, 2020, or possibly the HCP Coordinating Committees conference call on December 15, 2020 (Item II-B).
- The Colville Confederated Tribes (CCT) will distribute to the HCP Coordinating Committees the presentation, *Reintroduction of Salmon Upstream of Chief Joseph and Grand Coulee Dams*, that the CCT presented during the HCP Hatchery Committees conference call on October 21, 2020 (Item III-A). *(Note: Kirk Truscott provided this presentation to Kristi Geris following the HCP Coordinating Committees conference call on October 27, 2020, which Geris distributed to the HCP Coordinating Committees that same day.)*

- Anchor QEA will coordinate with the CCT to arrange a presentation of, *Reintroduction of Salmon Upstream of Chief Joseph and Grand Coulee Dams*, during a future HCP Coordinating Committees conference call (Item III-A).
- Douglas PUD will inquire internally regarding the CCT's question on Wells Project Land-Use Permit Application No. LUP 730-01, about whether the proposed activities are subject to cultural resource requirements (Item IV-A). *(Note: Tom Kahler provided a response to Kirk Truscott's question to Kristi Geris following the HCP Coordinating Committees conference call on October 27, 2020, which Geris distributed to the HCP Coordinating Committees that same day.)*
- Douglas PUD will communicate to the Columbia River Inter-Tribal Fish Commission (CRITFC) the discussions regarding Jeff Fryer's (CRITFC) annual request to tag sockeye salmon at Wells Dam that took place during the HCP Policy Committees conference call on October 6, 2020 (i.e., not conducting additional sampling for sockeye salmon until a thermal barrier has set up in the Okanagan River) and during the HCP Coordinating Committees conference call on October 27, 2020 (i.e., stipulate in the next request letter, a request that sockeye salmon sampling periods are concurrent with both spring *and* summer Chinook salmon trapping operations) (Item VI-B).
- The HCP Coordinating Committees meeting on November 24, 2020, will be held at 9:00 a.m., by conference call (Item VI-C).

Decision Summary

- Rocky Reach and Rock Island HCP Coordinating Committees representatives present approved the *Chelan PUD Rocky Reach and Rock Island HCPs Draft 2020 Fish Spill Report*, as revised (Item V-A).

Agreements

- Rocky Reach HCP Coordinating Committee representatives present agreed to Chelan PUD's request to begin the 2020/2021 ladder maintenance outage at Rocky Reach Dam 1 month earlier than usual to allow more time to complete required work. Rather than beginning work during the first week in January (per usual), maintenance work will begin on December 1, 2020 (Item V-D).

Review Items

- The draft *Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study)* was distributed to the Wells HCP Coordinating Committee by Kristi Geris on October 22, 2020. This draft report is available for a 30-day review with edits and comments due to Tom Kahler and Andrew Gingerich by November 23, 2020 (Item II-B).

- Wells Project Land-Use Permit Application No. LUP 730-01 was distributed to the HCP Coordinating Committees by Kristi Geris on October 26, 2020. This application is available for a 30-day review with comments or indication of no comments due to Tom Kahler by November 25, 2020 (IV-A).
- The draft SOA, *Approval of the Results of the 2020 Wells Project Survival Verification Study, Phase III (Standard Achieved)*, was distributed to the HCP Coordinating Committees by Kristi Geris on November 13, 2020. Douglas PUD will request approval of the draft SOA during the HCP Coordinating Committees conference call on November 24, 2020 (Item II-B).
- The draft 2020 Wells Post-Season Bypass Report and Passage-Dates Analysis was distributed to the HCP Coordinating Committee by Kristi Geris on November 23, 2020. This draft report is available for a 30-day review with edits and comments due to Tom Kahler by December 23, 2020.

Finalized Documents

- The *Wells Project Subyearling Chinook Life-History Study 2011-2013 Final Report* and comment/response matrix were distributed to the HCP Coordinating Committees by Kristi Geris on November 13, 2020.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson said Wells Project Land-Use Permit Application No. LUP 730-01 was added under the Douglas PUD items. Tom Kahler noted that Drs. John Skalski and Richard Townsend have already provided Douglas PUD with the draft Passage-Dates Analysis document (a component of the 2020 Wells Dam Post-Season Bypass Report); however, Kahler has not yet had time to review the document. Kahler said he plans to distribute the draft analysis to the Wells HCP Coordinating Committee for review soon. Ferguson asked for any other additions or changes to the agenda. No other additions or changes were requested.

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft September 22, 2020, conference call minutes. Kristi Geris said all comments and revisions received from members of the Committees were incorporated into the revised minutes. Geris said she also added Douglas PUD's survival verification study report and land-use permit application under Review Items. HCP Coordinating Committees members present approved the September 22, 2020, conference call minutes, as revised. The

National Marine Fisheries Service (NMFS) abstained because a NMFS representative was not present during the September 22, 2020, conference call.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on September 22, 2020, and follow-up discussions, were as follows. *(Note: Italicized text corresponds to agenda items from the meeting on September 22, 2020):*

- *Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).*
  This will be discussed during today's conference call and will be carried forward.
- *HCP Coordinating Committees members will discuss within the Priest Rapids Coordinating Committee (PRCC) rescheduling the December 2020 meeting 1 week earlier to accommodate the holiday, for further discussion during the HCP Coordinating Committees meeting on October 27, 2020 (Item IV-C).*
  Denny Rohr (PRCC Facilitator) notified Kristi Geris and John Ferguson that the PRCC agreed to reschedule the PRCC meeting to the afternoon of December 15, 2020, to follow the HCP Coordinating Committees meeting.

II. Douglas PUD/University of Washington

A. PRESENTATION: Wells Project Passage Survival Study, 2020 (Drs. John Skalski and Richard Townsend)

Dr. Richard Townsend projected a presentation titled, *Wells Project Passage Survival Study, 2020* (Attachment B), which was distributed to the HCP Coordinating Committees by Kristi Geris following the HCP Coordinating Committees conference call on October 27, 2020. Dr. John Skalski provided the presentation, as follows:

<u>Slide 1 of Attachment B</u>

Skalski said the 2020 study is the third in a series of studies for the Wells Project. He said the first study (actually three separate studies conducted from 1998–2000) that assessed survival through the Wells Project met (juvenile project) survival standards of 93% ($\hat{S}_{Dam} \geq 0.93$) with a standard error of less than 2.5% ($\widehat{SE}(\hat{S}) \leq 0.025$; as required by the Wells HCP). He said the 2010 check-in study also met these standards. He said this presentation focuses on the 2020 study. *(Note: To clarify, the 2020 study is the sixth separate survival study conducted for the Wells Project. The three studies conducted in 1998, 1999, and 2000, completed the three years of valid studies of Juvenile Project Survival required in Phase I of the Passage Survival Plan of the Wells HCP, resulting in advancement to Phase III (Standard Achieved) for yearling Chinook salmon and steelhead prior to the signing of the HCP in 2002.)*

Slide 2 of Attachment B

Skalski reviewed the study objectives, as bulleted on this slide.

Slide 3 of Attachment B

Skalski said this slide shows a map of the study area. He said there were multiple releases at the mouths of the Okanogan and Methow rivers, which were the treatment groups. He said the control group consisted of releases 1,000 feet downstream of Wells Dam in the tailrace. He said one study objective was then to estimate survival from the confluences of the Okanogan and Methow rivers to the Wells Dam tailrace.

Slide 4 of Attachment B

Skalski said for the Methow releases, the actual release number was 34,874 fish, and the Okanogan releases included 17,672 fish. He said the release ratio was 66.4% (Methow) versus 33.6% (Okanogan), which was close to the target ratio. He said these releases were then pooled and treated as a composite group moving downstream equaling 52,546 fish. He said, in total, there were about 105,000 passive integrated transponder (PIT)-tagged fish released for this study, which included 52,786 control fish released to the Wells Dam tailrace. He said detection rates were calculated for detection locations at Rocky Reach, McNary, John Day, and Bonneville dams. He said the full model allows evaluation of each release independent of survival through each reach and detection rate; or, depending on results of analysis of the homogeneity of detections and survival processes at and below Rocky Reach Dam, the model can be simplified. If detections and survival are homogenous below Rocky Reach Dam, Wells Project survival is estimated as the survival of releases at Okanogan and Pateros to Rocky Reach Dam, divided by the survival of Wells Dam tailrace released fish to Rocky Reach Dam.

Slide 5 of Attachment B

Skalski said there were triple releases every 2 days, and releases were staggered to facilitate downstream mixing. He said there would be an Okanogan release at 2:00 p.m. on Day 1, and then a Methow release at 10:00 a.m. and a Wells Dam tailrace release at 2:00 p.m. on Day 2. He said these represented a single replicate, and there were 16 of these replicates over the course of the study, from April 13 to May 14, 2020.

Slide 6 of Attachment B

Skalski said the next few slides summarize general observations.

Slide 7 of Attachment B

Skalski said the total release number equaled 105,332 fish. He reviewed the downstream detection numbers as bulleted on this slide, noting that the majority of the detections were at Rocky Reach Dam.

Slide 8 of Attachment B

Skalski said detection probability is the likelihood that a given fish arriving at the dam will be detected. He said the precision is based on detections at Rocky Reach, McNary, and John Day dams, which are usually in the mid- to upper teens. He said the lower values reflect the effects of the spill program, i.e., more water passing through the spillways and less fish going through the bypass systems. He said the detection rate at Bonneville Dam is the joint probability of survival from John Day Dam to Bonneville Dam and the probability of being detected at Bonneville Dam or the National Oceanic and Atmospheric Administration barge downstream of Bonneville Dam.

Slide 9 of Attachment B

Skalski said this slide shows the 16 replicates across the study for both upstream and downstream releases, specifically survival of upstream releases down to Rocky Reach Dam and survival of Wells Dam tailrace releases to Rocky Reach Dam. He said the point of this slide is: 1) there is no seasonal trend for yearling Chinook salmon estimated survival, which is consistent with previous evaluations; and 2) the 95% confidence intervals for each replicate are overlapping, indicating that there is no difference in survival between replicates. He said almost all datasets cross the center line of average survival (blue dashed line). He said there are no trends, and the data are consistent across replicates. He said the confidence intervals are shown by the vertical bars and are consistent release to release, and sample size is consistent among replicates.

Slide 10 of Attachment B

Skalski said the next slides review the mark-recapture methods to test survival.

Slide 11 of Attachment B

Skalski said one consideration of the model is to assume both release groups—upstream and downstream—once below Wells Dam, have the same survival to Rocky Reach Dam. He said the model uses the ratio of survival between upstream and downstream release points to produce mixing plots, which can be found in the appendix of the report. He said there are 16 releases and four detection locations—Rocky Reach, McNary, John Day, and Bonneville dams. He said this slide shows one plot of releases from the first replicate with the distribution of detections at Rocky Reach Dam. He said the three lines represent Okanogan, Methow, and Wells Dam tailrace releases. He said there is consistent overlap in the patterns as fish move downriver, which is what one hopes to see.

He said the sample sizes at Rocky Reach Dam are higher than downstream detection locations, so there is more definition in these plots. He said often times there will be a single peak; however, here there are a lot of submodes, and all release groups showed the same patterns, which is partly accredited to the study design and how the releases were staggered in time to facilitate fish from reach release passing the project at similar times.

Slide 12 of Attachment B

Skalski said another consideration of the model is to assume upstream detections have no effect on downstream survival and detection. He said to test this, there are a series of Burnham tests[1] and results can be pooled to evaluate the number of detections and level of detection rates. He said only four of the 160 individual tests were significant at the 10% level ($\alpha = 0.10$), when by random chance one would expect 16 significant tests out of 160 tests at the 10% level. He said zero of the 32 pooled tests were significant at the 10% level ($\alpha = 0.10$). Since these results are less than what one would expect to occur randomly, these findings mean there is no evidence of any effect of fish detection at Rocky Reach Dam on downstream processes (survival) and their being detected downstream.

Slide 13 of Attachment B

Skalski said another part of this evaluation is making sure the release groups are comparable. He said this means all three release groups and each single replicate share the same fish source so there is no difference in upstream and downstream releases to bias the test. He said this also means balanced loading, as shown in the table on this slide. He said this fish loading schedule[2] for the 16 replicates was developed in advance to make sure there was a balancing of all fish pulled from a raceway. He said additionally, transport times were standardized. He said, for example, trucking times from loading to release were standardized for all release locations, and barge times were also standardized so all fish in each release had the same amount of handling.

Slide 14 of Attachment B

Skalski said that their assessment of the size distribution of smolts indicated comparable-sized fish were used across release groups.

Slide 15 of Attachment B

Skalski reviewed the schematic shown on slide 4 and said this is considered the full model. He said upstream and downstream releases can be a separate evaluation at each reach, along with separate capture rates. He said back to slide 15, when detections and survival processes are equal, the most parsimonious model is selected that uses fewer parameters, which boosts precision.

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[1] Burnham et al. 1989 and Burnham et al. 1987
[2] M=Methow, O=Okanogan, W=Wells Dam tailrace

Slide 16 of Attachment B

Skalski said the slides to this point were the preamble showing results of their assessment of the data and testing of assumptions that inform how to proceed with the analysis, and the next slides summarize the results.

Slide 17 of Attachment B

Skalski said this slide shows the survival estimates for each of the 16 replicates, with the standard error shown in parentheses. He said survival can be more than 100%. He said 13 of 16 replicates used the simple model and the other replicates used the full model. He said the overall project survival was 95.17%, with a standard error of 0.0142. He said these results meet the HCP juvenile project survival standard of ≥93% and precision standard of ≤2.5%.

Slide 18 of Attachment B

Skalski said this slide shows the 16 replicates over the course of the season. He said a couple things to note: 1) all data are overlapping, which means there is no difference between individual replicate estimates; and 2) all estimates cross over the mean value (blue dashed line) and confidence intervals around the mean (blue shaded area). He said this means there was no seasonal trend observed with the upstream and downstream releases. He said basically, from April 13 to May 14, 2020, survival estimates were very constant, with a best estimate of 95.17% survival.

Slide 19 of Attachment B

Skalski said this slide compares the first 3-year average from the initial 1998–2000 studies to the 2020 study, which shows no significant difference in survival. He said this slide also compares the 1998–2000 studies and 2010 check-in study to the 2020 study, which again, shows no significant difference. He said this means there is equal survival across the course of over a 20-year period when survival was studied.

Slide 20 of Attachment B

Skalski said the next goal was to calculate a new 5-year average. He noted for each of the five averages over the past 20 years, all individual estimates (shown in the middle column) exceeded the 93% project minimum survival standard, and the standard errors were less than the standard error requirement of 2.5%. He said each annual study met the HCP requirements, and the average now is 96.04% and the estimated standard error is less than 1%. He noted that survival has been fairly constant over the past 4 to 5 studies and the standard error has been very constant.

Kirk Truscott asked if the 5-year arithmetic average standard error of 0.0098 is correct. Skalski said yes, and explained that the 5-year estimate in the middle column is coupled with empirical variance and the variance is divided by the sample size; therefore, the average becomes more and more precise over time as more annual values are incorporated (i.e., the mean becomes more precise than what the individual estimates contribute). Truscott said he wanted to confirm that this value is not the sum of the 5 years divided by the number of years. Skalski said the mean is, but the standard error is the square root divided by the sample of five, or the variance of the mean, which gets smaller and smaller as more years are added. He said in 2030, he expects the standard error to go down even more.

Slide 21 of Attachment B

Skalski said he was also asked to address delayed effects; therefore, a Ricker relative survival estimate was calculated to evaluate the proportion of fish released upstream and downstream and the recovery rates. He said the first equation evaluates survival of Okanogan and Methow releases to Bonneville Dam and survival of Wells Dam tailrace releases to Bonneville Dam. He said comparing these ratios equals 93.37% survival with a standard error of less than 2.5%. He said one might expect survival to Bonneville Dam to be lower than to Rocky Reach Dam because there is more time for synergistic effects to play out. He said a paired-survival estimate showed no significant difference despite the tight standard error. He said this means there is no evidence or signs of delayed effects for fish migrating through the Wells Project, which is consistent with previous evaluations.

Summary and Discussion

Skalski said in summary, this was a fairly clean study with good downstream mixing and no problems with the test of assumptions. He said everything was consistent with how fish were handled. He said 13 of 16 replicates used the simplest model once fish reached a common point at Rocky Reach Dam. He said the estimate of survival met the 93% requirement with a standard error of less than 2.5%. He said in terms of delayed effects, there was little to no evidence of delayed effects downstream to Bonneville Dam.

John Ferguson said he does not believe he has ever seen a survival study of this magnitude turn out as clean and consistent among replicates and treatments as seen here. He said "hats off" to the design and execution, and he asked if his perception is accurate. Skalski said this is correct, that part of this is due to well-conducted logistics. He said there was very little man-induced variability. He said he thinks Douglas PUD has the logistics down pat, so this variable is taken out of the analyses. He said partly this pattern is also due to the fish stock used in the study. He said it is more likely to see these types of results with spring releases, and there would be a drop in survival if the study was conducted with summer migrants, e.g., from June 1 to July 1.

Ferguson asked about the representativeness of the study in terms of environmental conditions that treatment fish were exposed to this year. Tom Kahler said he reviewed how conditions fit against the flow duration curves and operations were normal. He said there were no weird set of operational circumstances and river flows were well within the normal flow duration curve for the Wells Project that the Wells HCP Coordinating Committee approved in December 2019; therefore, operational and environmental criteria were met for the study.

Andrew Gingerich said he would like to extend his gratitude to Skalski, Townsend, Betsy Bamberger (Douglas PUD Fish Health Specialist), and Kahler. Gingerich said he appreciated having support to conduct this study, which was not a small effort. He thanked Skalski and Townsend for the great presentation and help with the statistics, and Bamberger for help with the field work.

B. Draft Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study) (Andrew Gingerich and Tom Kahler)

John Ferguson said the draft *Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study)* was distributed to the Wells HCP Coordinating Committee for review by Kristi Geris on October 22, 2020. Ferguson said today, Anchor QEA will distribute to the HCP Coordinating Committees the presentation, *Wells Project Passage Survival Study, 2020*, that was presented by Drs. John Skalski and Richard Townsend. *(Note: Geris distributed this presentation following the HCP Coordinating Committees conference call on October 27, 2020.)*

Ferguson said in discussions with Tom Kahler, he understands that Douglas PUD would like to wrap up the study and obtain approval of the study report in this calendar year, in terms of compliance with the Federal Energy Regulatory Commission. Ferguson said with this in mind, he proposed the report be available for a 30-day review with comments due November 23, 2020, a discussion during the HCP Coordinating Committees meeting on November 24, 2020, and a vote to approve during the HCP Coordinating Committees meeting on December 15, 2020. He said given the study results, this seems doable. Kahler said in the past, Douglas PUD has also produced an SOA approving the study results for Wells HCP Coordinating Committee approval. He said Douglas PUD wants to provide the Wells HCP Coordinating Committee the opportunity to review and comment on the report. He said if comments are received and focus more on the report and not the results, then Douglas PUD could request approval of the SOA in November and if needed, postpone requesting approval of the report until December. Wells HCP Coordinating Committee representatives agreed with this approach.

Douglas PUD will distribute a draft SOA approving the results of the *Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study)*, for approval during the HCP Coordinating Committees conference call on November 24, 2020. *(Note: Kahler provided a draft SOA to Kristi Geris on November 13, 2020, which Geris distributed to the HCP Coordinating Committees that same day.)*

Wells HCP Coordinating Committee representatives will review and provide edits and comments on the draft *Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study)* to Kahler and Andrew Gingerich by November 23, 2020, and be prepared to vote to approve the report during the HCP Coordinating Committees conference call on November 24, 2020, or possibly the HCP Coordinating Committees conference call on December 15, 2020.

III. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees conference call on October 8, 2020:

- *Methow Salmon Recovery Foundation Projects*: The Methow Salmon Recovery Foundation discussed three projects with the HCP Tributary Committees. These projects included the Upper Beaver Creek Final Design and Restoration Project, Sugar Levee Project, and Vandervort Property Appraisal Project, all of which have some level of funding from the Committees. The purpose of the discussions was to update the HCP Tributary Committees on the status of the projects, solicit feedback from the Committees, and continue coordination and communication with the Committees. This discussion was in response to the Committees' requirement to be engaged in the development of these projects. The HCP Tributary Committees provided feedback and input on the projects and asked the sponsor to keep the Committees updated on progress. The HCP Tributary Committees will also review draft designs when these are available.
- *Lower Chiwawa River Project*: The U.S. Bureau of Reclamation (Reclamation) met with the Rock Island HCP Tributary Committee to discuss the Lower Chiwawa River Floodplain Reconnection and Instream Enhancement Project. This project was supported by the Rock Island HCP Tributary Committee but did not receive funding from the Salmon Recovery Funding Board. Reclamation has about $100,000 to use to help design projects in the Lower Chiwawa River, and Reclamation would like to work with the Rock Island HCP Tributary Committee on developing a reach-based restoration approach. The Rock Island HCP Tributary Committee agreed to work with Reclamation on this project; however, the Committee recommended waiting until results are available from the Upper Columbia Regional Technical Team's prioritization process. The prioritization process will identify impaired habitat conditions and limiting factors within the Lower Chiwawa River. Once the prioritization process is complete, the Rock Island HCP Tributary Committee and Reclamation can move forward with developing a reach-based approach. This will likely happen in December 2020 or January 2021.
- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on November 12, 2020.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees conference call on October 21, 2020 (*note: joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *Reintroduction of Endemic Anadromous Fish Upstream from Chief Joseph Dam (joint)*: The CCT provided a presentation titled, *Reintroduction of Salmon Upstream of Chief Joseph and Grand Coulee Dams*. The presentation included a description of the project location, forums involved in the work, and the four-phased approach to reintroduction. Phase 1 work included identifying donor stocks, risk assessment, habitat assessments, review of fish passage technologies, life-cycle modeling, and recommended future studies. Phase 1 is now complete, and it demonstrates that the CCT should move into Phase 2 of the study. Phase 2 deals with coordination, planning, and preparing a strategic implementation plan. In parallel with the Phase 2 work, the CCT are conducting "Cultural and Educational" releases of fish. Interestingly, of 753 yearling Chinook salmon that were PIT-tagged and released well upstream of Grand Coulee Dam (1,092 km from the ocean), a few have returned to the Columbia River (i.e., the fish left Lake Roosevelt and passed Grand Coulee Dam, migrated to the ocean, and one has returned to Chief Joseph Hatchery). The HCP Hatchery Committees were grateful for the presentation. Hillman said this was a very interesting presentation and the HCP Coordinating Committees may also be interested in hearing it. John Ferguson asked Kirk Truscott if he would be interested in presenting this to the HCP Coordinating Committees. Truscott said he thinks Casey Baldwin (CCT) would be interested in presenting this, but he will need to ask him. HCP Coordinating Committees representatives expressed interest in hearing the presentation. Truscott said he can distribute the presentation to the HCP Coordinating Committees and Ferguson said Anchor QEA will coordinate with the CCT to arrange a presentation during a future HCP Coordinating Committees conference call. *(Note: Truscott provided this presentation to Kristi Geris following the HCP Coordinating Committees conference call on October 27, 2020, which Geris distributed to the HCP Coordinating Committees that same day.)*
- *Broodstock Collection Protocols (joint)*: The HCP Hatchery Committees are in the early process of updating the broodstock collection protocols. The Committees have identified important issues to cover in the 2021 broodstock collection protocols and identified who will lead the writeup of certain sections of the protocols.
- *COVID-19 and Monitoring and Evaluation (M&E) Activities (joint)*: Each member of the HCP Hatchery Committees discussed the effects of COVID-19 on their respective M&E activities. Virtually nothing has changed since last month. Monitoring is occurring within the hatcheries

and crews are operating rotary screw traps. Broodstock collections are proceeding as planned and monitoring crews are conducting summer Chinook salmon spawning surveys.

- *Update on 10-year Comprehensive M&E Report (joint)*: The PUDs reported that because of the COVID-19 pandemic, the enormous amount of data to compile, process, and analyze, and the difficulty in securing reference-population data, the draft comprehensive report will be submitted to the HCP Hatchery Committees on July 1, 2021.
- *2021 Hatchery M&E Implementation Plan (Wells)*: Douglas PUD submitted a draft 2021 Hatchery M&E Implementation Plan for review. Members will review the draft plan and provide comments to Douglas PUD by November 16, 2020.
- *2019 Wells Complex M&E Annual Report (Wells)*: Douglas PUD received a few comments on the draft 2019 Wells Complex M&E Annual Report. These comments have been addressed and Douglas PUD will submit the edited report to the Wells HCP Hatchery Committee for approval.
- *NMFS Representation on the HCP Hatchery Committees (Administration)*: NMFS has officially identified Emi Melton as the alternate on the three HCP Hatchery Committees. She replaces Charlene Hurst, who no longer works for NMFS. Brett Farman will continue as the designated representative on the Committees.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on November 18, 2020.

IV. Douglas PUD

A. Wells Project Land-Use Permit Application No. LUP 730-01 (Tom Kahler)

Tom Kahler said Wells Project Land-Use Permit Application No. LUP 730-01 (Attachment C) was distributed to the HCP Coordinating Committees by Kristi Geris on October 26, 2020. Kahler said this application is for an existing property owner who removed trees from the property with the intent to turn the land into alfalfa production. He said this application is similar to the last land-use permit application[3] for a property owner located in the Okanogan River Basin, in that the Douglas PUD Lands Department is taking this opportunity to formalize the property owner's use of Wells Project lands for agricultural purposes by issuing the landowner a permit to do what the property owner has already been doing. He said the property owner also has a well and a pump on the property for irrigation purposes.

Kirk Truscott asked if the action is converting the land from an orchard to alfalfa production, and Kahler said this is correct. Truscott said he assumes there is some level of tilling involved, and Kahler said he does not know. Truscott said he would assume if the action is converting orchard grass to

[3] Wells Project Land-Use Permit Application for No. LUP 143-01 (distributed to the HCP Coordinating Committees by Kristi Geris on July 15, 2020).

alfalfa, this requires tilling and seeding, and he is wondering if there are cultural resource requirements associated with a ground disturbance. Kahler corrected himself that the orchard will be converted to hay production (not alfalfa), and he said he will inquire internally regarding Truscott's question about whether the proposed activities are subject to cultural resource requirements. *(Note: Kahler provided a response to Truscott's question to Geris following the HCP Coordinating Committees conference call on October 27, 2020, which Geris distributed to the HCP Coordinating Committees that same day.)*

John Ferguson said this application is available for comment, and Geris confirmed the application is available for a 30-day review with comments or indication of no comments due to Kahler no later than Wednesday, November 25, 2020.

V. Chelan PUD

A. DECISION: 2020 Rocky Reach and Rock Island Fish Spill Report (Lance Keller)

Lance Keller said the *Chelan PUD Rocky Reach and Rock Island HCPs Draft 2020 Fish Spill Report* was distributed to the HCP Coordinating Committees by Kristi Geris on September 19, 2020. Keller recalled during the initial review, there was a comment to update the axis on some graphs, which he did, and a revised draft spill report was distributed on September 23, 2020. The revised draft report was available for a 30-day review with edits and comments due to Keller by October 19, 2020. Keller said no additional comments were received from the Rocky Reach and Rock Island HCP Coordinating Committees.

Rocky Reach and Rock Island HCP Coordinating Committees representatives present approved the *Chelan PUD Rocky Reach and Rock Island HCPs Draft 2020 Fish Spill Report*, as revised.

B. Rock Island Dam Powerhouse 1 Maintenance Update (Lance Keller)

Lance Keller said work on Turbine Unit B4 continues. He recalled reporting last month that the return-to-service date for Turbine Unit B4 was towards the end of December 2020 but could go into January 2021. He said this schedule still holds true.

C. Rocky Reach Dam Turbine Units Maintenance Update (Lance Keller)

Lance Keller said work continues on Turbine Unit C2 and Turbine Unit C7 in the Rocky Reach Dam powerhouse. He said it does appear that the Turbine Unit C2 outage could extend into December 2020. He recalled reporting last month, maintenance crews thought this work could be completed by November 2020. He said the return-to-service schedule for Turbine Unit C7 of March 2021 is still holding. He said Turbine Unit C3 remains out of service until crews complete work in the dry on Turbine Unit C2. He said once complete, crews will pull the headgates to water up the unit for the watered-up portion of the maintenance effort, and then these headgates can be moved to dewater Turbine Unit C3.

D. 2020/2021 Rock Island and Rocky Reach Adult Fishway Winter Maintenance (Lance Keller)

Lance Keller reviewed adult fishway maintenance updates at Rock Island Dam and Rocky Reach Dam, as follows:

Rock Island Dam

Keller said the winter adult fishway maintenance period is rapidly approaching, with outages at Rock Island Dam occurring from December through February. He said typically, one to two ladders are out of service for inspection and maintenance at a time. He said Rock Island Dam has three fish ladders, which means at least one ladder is watered up at all times. He said currently, maintenance work planned for Rock Island Dam is all routine. He said he does not yet know which ladders will be out of service first, but he will pass along this information once he knows.

Rocky Reach Dam

Keller said based on the anticipated workload, Chelan PUD would like to request an early outage for the Rocky Reach Dam adult fishway. He said one of the biggest projects driving this request is the need to replace a large dewatering pump for the lower section of the fishway. He said this pump failed during dewatering last year, which caused a 1-week delay in dewatering the fishway. He said once the fishway was dewatered, crews assessed the pump and determined the pump is not repairable. He said after dewatering the fishway this year, crews will need to extract the pump for replacement, which is estimated to be approximately 500 hours of extra work on top of the already planned work on the rest of the adult fishway, as well as Turbine Unit C2 and Turbine Unit C7 to keep these units on schedule. He said Chelan PUD is proposing to begin the outage on Tuesday, December 1, 2020, to allow time to dewater the entire fishway in the first week of December, and the following week, start extracting the pump, replace it back in the fishway, and make sure the pump is functioning properly. He said there is also actuator work that is needed, which will require additional time to complete. He said collectively, all of this work for the Rocky Reach Dam adult fishway 2020/2021 maintenance period is the driver for requesting an earlier than normal outage. He said typically, the winter outage at Rocky Reach Dam is January 1 through February 28. He said as Chelan PUD has noted with previous early outage requests, should crews complete all work prior to February 28, crews will return the Rocky Reach Dam adult fishway back to service as soon as possible.

John Ferguson asked if Chelan PUD needs Rocky Reach HCP Coordinating Committee approval today, for planning purposes? Keller said ideally, yes, if the Committee is comfortable with voting today. He said if the Committee needs more days to think about this, Chelan PUD could possibly accommodate a vote via email shortly after today. He said there are a lot of moving parts and pieces to pull together regarding conducting a fish rescue, inside a designated confined space, among other things.

Rocky Reach HCP Coordinating Committee representatives present agreed to Chelan PUD's request to begin the 2020/2021 ladder maintenance outage at Rocky Reach Dam 1 month earlier than usual to allow more time to complete required work. Rather than beginning work during the first week in January (per usual), maintenance work will begin on December 1, 2020.

Keller said Chelan PUD appreciates the Committee approving this outage today, which will be very helpful.

VI. HCP Administration

A. COVID-19 Updates (John Ferguson)

John Ferguson asked if there are any updates HCP Coordinating Committees members would like to share regarding impacts of COVID-19 on HCP activities. No updates were shared.

B. HCP Policy Committees October 6, 2020, Conference Call (John Ferguson)

John Ferguson said the HCP Policy Committees convened by conference call on October 6, 2020, which followed the HCP Policy Committees conference call on September 1, 2020. Ferguson recalled last month, characterizing the September 1, 2020, conference call as positive. He said the HCP Policy Committees discussed how to collect and tag sockeye salmon at Wells Dam or the Priest Rapids Dam Off-Ladder Adult Fish Trap (OLAFT) for research purposes. He said this positive tone continued into the October 6, 2020, conference call. He said the Wells HCP Policy Committee reviewed five alternatives, including four having to do with the Wells Dam east ladder and one with the OLAFT. He said the Committee did some research, talked through the alternatives, and agreed to proceed with collecting additional fish on days in addition to Carlton collection dates, if needed, only during the time period when the thermal block has set up in the Okanagan River. He said this allows sockeye salmon to get up to the Okanogan River as soon as possible and operating the trap for additional days will not impart additional delays. He said the Wells HCP Policy Committee recognizes the value of these data and the goal to PIT tag up to 800 fish; and in some years, this may require additional sampling. He said there is an outstanding action item to touch base with the Okanagan Nation Alliance to discuss the continued need for these data. He said the Wells HCP Policy Committee also did not formalize exactly how to recognize a thermal block, but there was general agreement that Tom Kahler (and possibly others) will monitor temperatures and Kahler will distribute an email to Wells HCP Coordinating and Policy Committees representatives. Ferguson asked if others who attended the HCP Policy Committees conference call had additional comments to share.

Keely Murdoch said she contacted Jeff Fryer after the conference call to discuss what was resolved, and Fryer raised a concern that had not been raised before. Murdoch said the HCP Policy Committees only discussed concurrent trapping with the Carlton Program, and Fryer brought up a concern about the earlier part of the run before trapping for the Carlton Program starts up. Murdoch said usually, trapping for sockeye salmon starts about 2 weeks before the Carlton Program, concurrent with trapping for spring Chinook salmon (springers). She said the HCP Policy Committees did not discuss this and Fryer was concerned about missing the first part of the run. Ferguson agreed this was not mentioned before. Murdoch said she did mention this at first, but then the focus shifted to trapping for summer Chinook salmon (summers). Kahler said trapping for springers occurs through June 28, and crews retain wild summers that are encountered during that period. Murdoch said according to the broodstock collection protocols that the HCP Hatchery Committees put together, trapping at Wells Dam for springers technically is scheduled through the end of June and trapping for summers starts on July 1. She said she thinks the concept is still valid (i.e., as long as trapping for sockeye salmon is concurrent with trapping for whichever species). Kahler said he cannot speak for the entire Wells HCP Policy Committee, but he agrees this seems to be the intent.

Ferguson thanked Murdoch for bringing this forward and suggested that Douglas PUD communicate to CRITFC the discussions regarding Fryer's annual request to tag sockeye salmon at Wells Dam that took place during the HCP Policy Committees conference call on October 6, 2020 (i.e., not conducting additional sampling for sockeye salmon until a thermal barrier has set up in the Okanagan River) and during the HCP Coordinating Committees conference call on October 27, 2020 (i.e., stipulate in the next request letter, a request that sockeye salmon sampling periods are concurrent with both spring *and* summer Chinook salmon trapping operations).

C. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on November 24, 2020, to be held by conference call.

The December 15, 2020, and January 26, 2021, meetings will be held by conference call.

VII. List of Attachments

Attachment A	List of Attendees
Attachment B	Presentation, *Wells Project Passage Survival Study, 2020*
Attachment C	Wells Project Land-Use Permit Application No. LUP 730-01

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman†	BioAnalysts
Dr. John Skalski††	University of Washington, Columbia Basin Research
Dr. Richard Townsend††	University of Washington, Columbia Basin Research
Lance Keller*	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
Betsy Bamberger	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Jim Craig*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation
Kirk Truscott*	Colville Confederated Tribes

Notes:

* Denotes HCP Coordinating Committees member or alternate

† Joined for the HCP Hatchery and Tributary Committees Update

†† Joined for the presentation: 2020 Survival Verification Study Report and Results

Wells Project Passage Survival Study, 2020

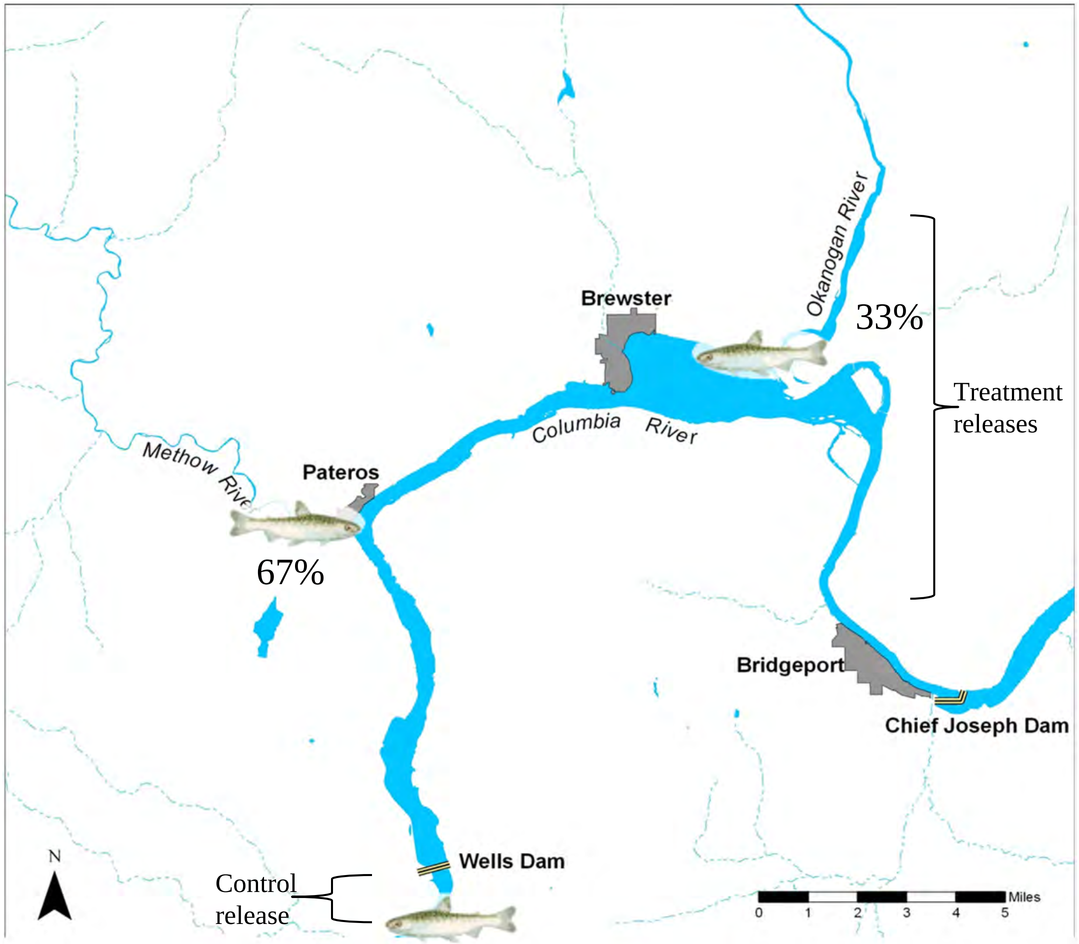
John Skalski
Richard Townsend
Michael Clawson

Columbia Basin Research
School of Aquatic and Fishery Sciences
University of Washington

Study Objectives

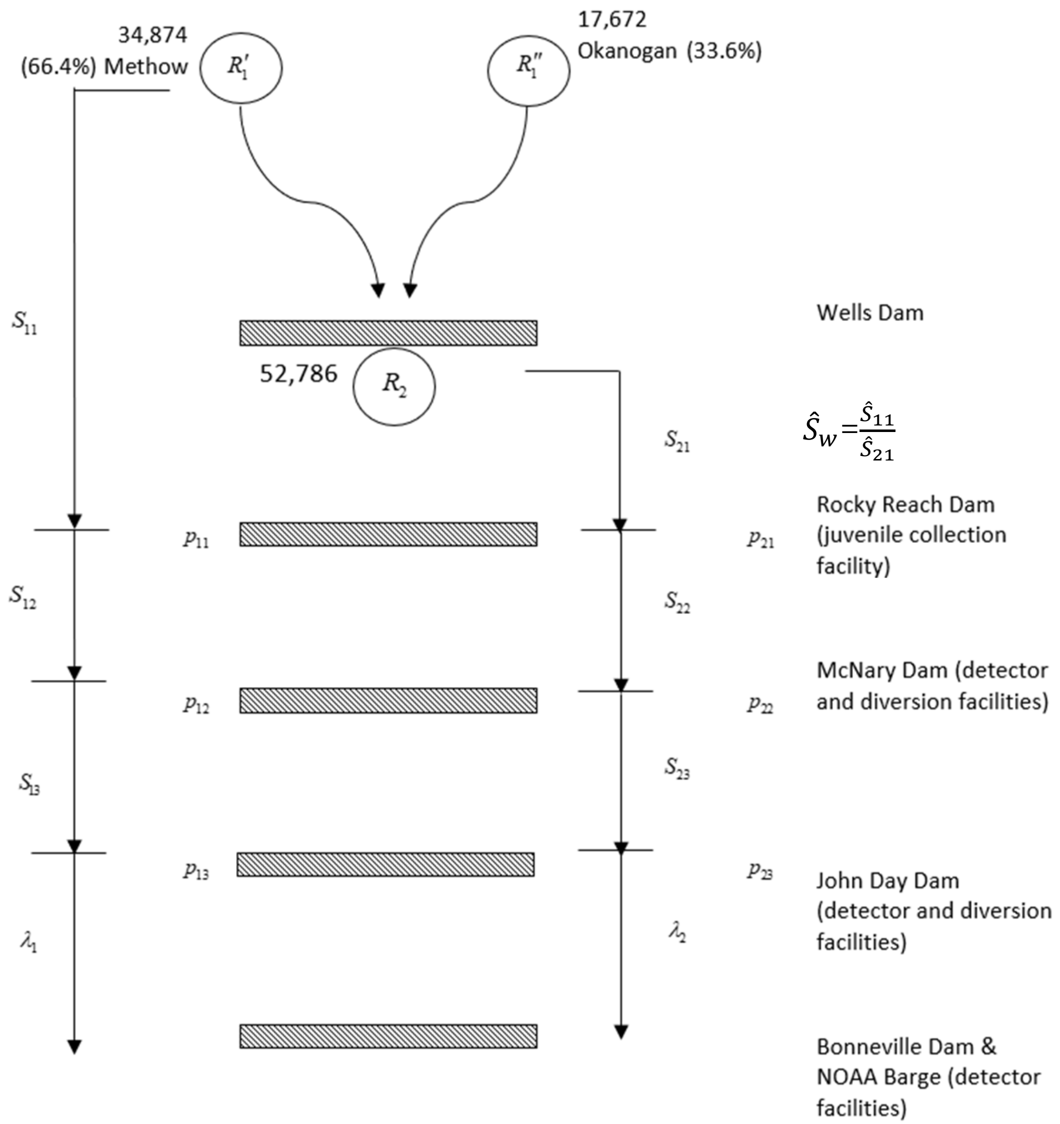
- Estimate survival for yearling Chinook passing the Wells Project
- Compare 2020 estimates to previous estimates, 1998-2000 and 2010
- Estimate new 5-year average
- Examine delayed effects

Study Area



- Release locations (fish symbols) of the two treatment groups at Methow and Okanogan rivers and the control group at Wells Dam tailrace for the 2020 study.

Model Schematic



Slide 4

TK1 "Rocky Reach Dam (juvenile collection facility)" is not the detection site, but rather the juvenile bypass facility. I don't know how difficult this is to change, but at least clarify in the presentation. I just made this edit in the draft report, also, so it should be easy to replace this with the modified figure from the report.

Tom Kahler, 10/12/2020

Approach

- Triple release every two days
- Releases staggered to facilitate downstream mixing
  - Okanogan 2:00 pm day 1
  - Methow 10:00 am day 2
  - Wells tailrace 2:00 pm day 2
- Sixteen replicate release groups
  - 13 April – 14 May
- Methow/Okanogan released at 2:1 ratio

General Observations

Downstream Detection Numbers

- Total Release: 105,332
  - Rocky Reach: 34,014
  - McNary: 1,895
  - John Day 3,013
  - Bonneville 5,669 (+NOAA barge)

Slide 7

AG3 When I divide 34,014/105,332 I get 32.3% detection rate. But the p on the next slide is 39.30% is this because it is accounting for fish that were missed by Rocky reach but known to have traveled past Reach since they were detected below? We need to walk the CC through this important difference if so.

Andrew Gingerich, 10/9/2020

Detection Rates

- Rocky Reach $\hat{\hat{p}} = 0.3930$
- McNary $\hat{\hat{p}} = 0.0253$
- John Day $\hat{\hat{p}} = 0.0501$
- Bonneville $\hat{\hat{\lambda}} = 0.0954$

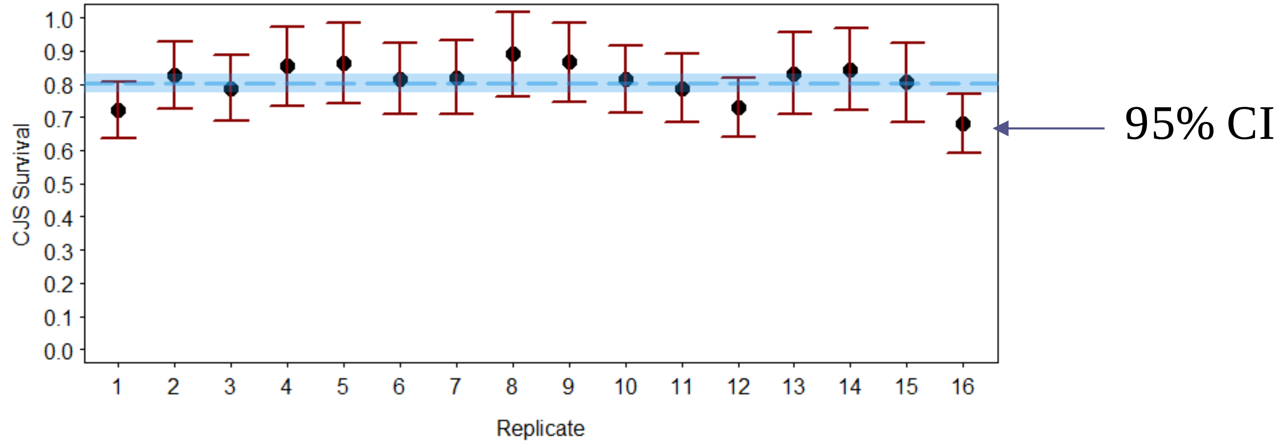
very low in 2020

Slide 8

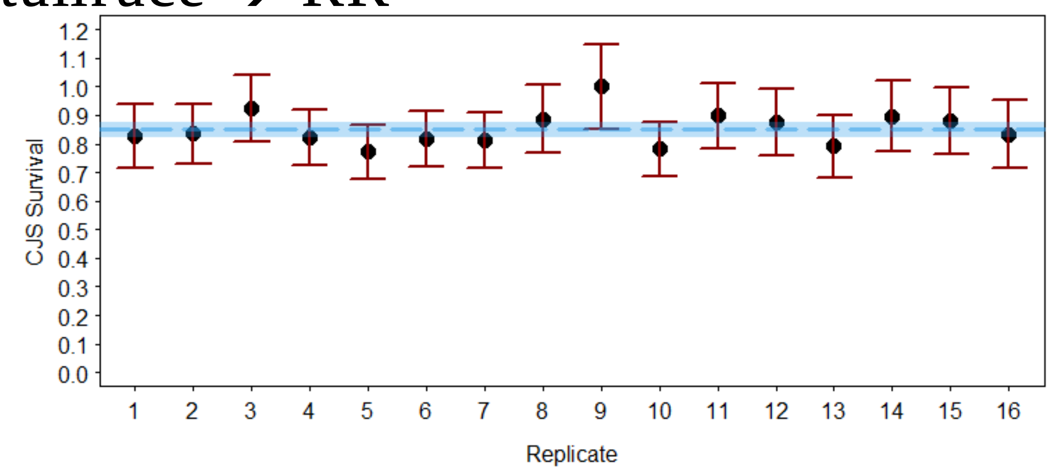
TK2 The presenter should explain the difference between the detection rates shown here and what one would calculate from the numbers of detections on the previous slide. These are the average detection probabilities of the 32 release groups at each detection site, whereas a calculation of detection rate from the numbers on the last slide would simply be the proportion of total fish detected.
Tom Kahler, 10/12/2020

Reach Survival ($\hat{S}$) Trends

a. Okanogan/Methow → RR



b. Wells tailrace → RR

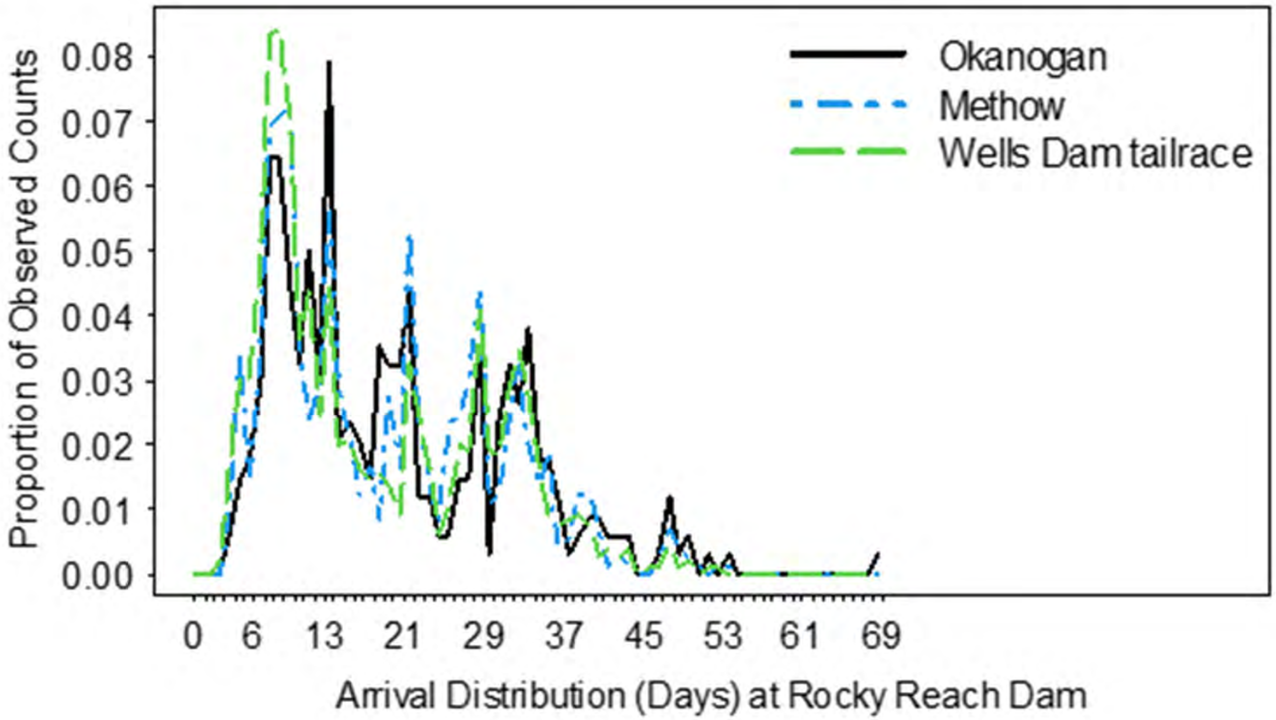


Conclusion: No Seasonal Trend

Assumption Evaluations

Assumption Evaluations

1. Release groups share common downstream survival process
   - Approach: Evaluate downstream mixing (16 x 4 mixing plots)
   - Example: First rep @ RR



Conclusion: Good visual mixing

Assumptions Evaluation (Continued)

2. Upstream detections do not effect downstream survival and detection

Approach:

- Two Burnham et al. (1989) tests 2
- Three Burnham et al (1987) tests 3
- Pool test results within release

$\left.\right\}$ 160 tests

$\left.\right\}$ 32 tests

Results:

- 4/160 tests (2.5%) significant at $\alpha = 0.10$
- 0/32 tests significant at $\alpha = 0.10$

Conclusion: No indication of problem

Assumptions Evaluation (Continued)

3. Release groups with comparable fish and handling

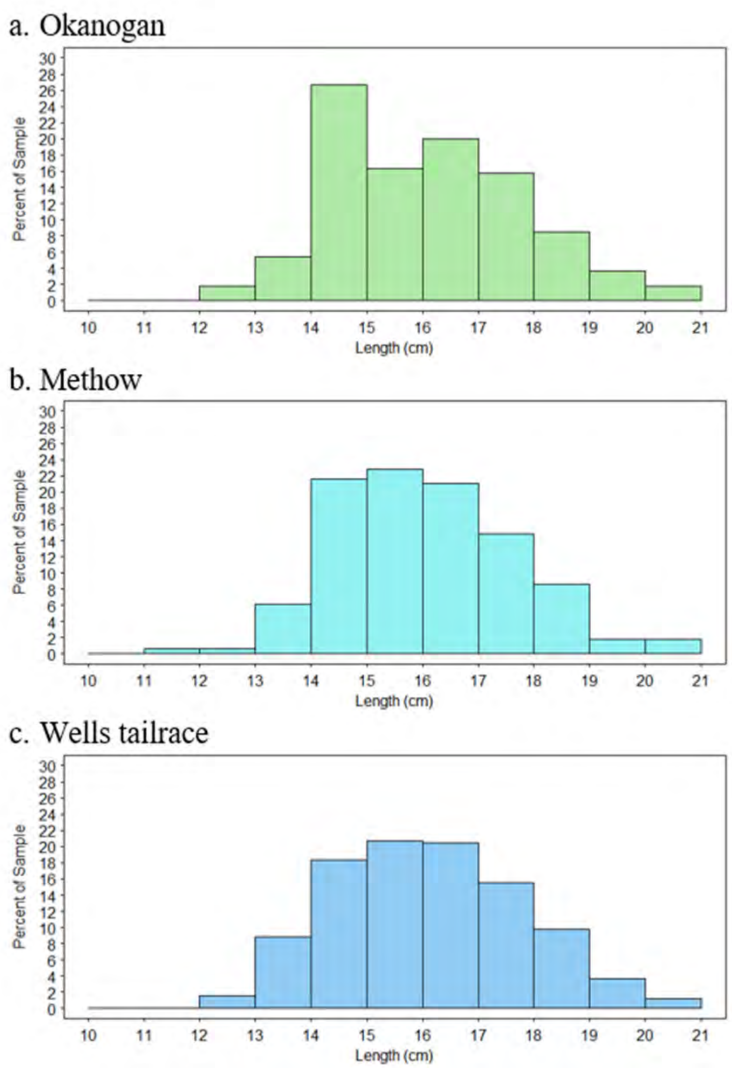
Field Approach:

- Release groups within rep from common raceway
- Balanced loading of fish tanks from a raceway
- Transport times standardized

	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Rep 11	Rep 12	Rep 13	Rep 14	Rep 15	Rep 16
Tank 1	M	M	O	M	W	W	O	O	O	W	W	W	W	M	W	M
Tank 2	O	O	W	O	O	M	W	W	W	O	O	W	M	W	M	O
Tank 3	W	W	M	W	M	O	M	W	W	M	M	M	W	O	O	W
Tank 4	W	W	W	W	W	W	W	M	M	W	W	O	O	W	W	W
Tank 5	O	W	W	W	O	M	W	M	W	M	M	W	M	W	W	O
Tank 6	W	W	O	W	W	W	W	O	M	O	W	M	W	W	W	W
Tank 7	M	O	W	O	W	W	M	W	W	W	O	W	W	O	O	M
Tank 8	W	M	M	M	M	O	O	W	O	W	W	O	O	M	M	W
Tank 9	M	W	W	M	M	M	W	W	M	M	M	W	W	M	W	M
Tank 10	W	W	W	W	W	M	W	M	M	W	W	M	M	W	M	W
Tank 11	W	M	M	M	W	W	M	M	W	W	M	W	M	W	W	W
Tank 12	M	M	M	W	M	W	M	W	W	M	W	M	W	M	M	M

Assumptions Evaluation (Continued)

Comparison of size (FL) distributions of release groups



Assumptions Evaluation (Continued)

4. Parsimonious model selection
   - 13 of 16 replicate releases, detections, and survival processes homogenous at and below Rocky Reach Dam

Survival Results

Wells Project Survival Estimates by Replicate and Overall

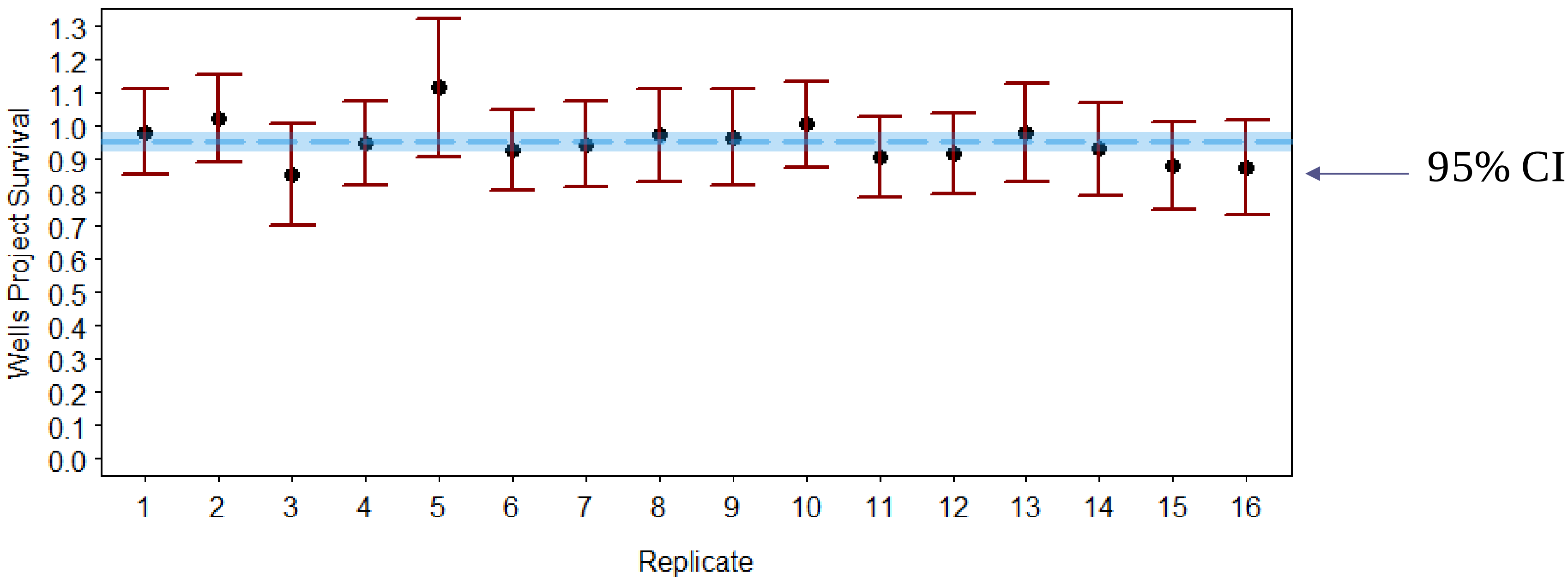
Release Groups	$(\hat{S}_W)$
op1/w1	0.9808 (0.0661)
op2/w2	1.0226 (0.0676)
op3/w3	0.8521 (0.0773)
op4/w4	0.9484 (0.0652)
op5/w5	1.1164 (0.1060)
op6/w6	0.9284 (0.0624)
op7/w7	0.9453 (0.0648)
op8/w8	0.9735 (0.0710)
op9/w9	0.9660 (0.0731)
op10/w10	1.0044 (0.0663)
op11/w11	0.9060 (0.0626)
op12/w12	0.9153 (0.0620)
op13/w13	0.9801 (0.0750)
op14/w14	0.9304 (0.0707)
op15/w15	0.8804 (0.0662)
op16/w16	0.8734 (0.0726)
Weighted Average	0.9517 (0.0142)

2020 Result

Conclusion: Meets HCP Juvenile Project Survival Standard ($\hat{S} \geq 0.93$) and precision standard ($\hat{S}E \leq 0.025$)

Project Survival Trends

Wells Survival Estimates



Conclusion: No Seasonal Trend

Cross-year Comparisons

1998-2000	2020	P-value	
0.9620 (0.089)	0.9517 (0.0142)	0.5383	No difference
1998-2000, 2010	**2020**	**P-value**	
0.9625 (0.0074)	0.9517 (0.0142)	0.4943	No difference

New Five-year Average

Year	Estimate ($\hat{s}_w$)	$\widehat{SE}$
1998	0.997	0.015
1999	0.943	0.016
2000	0.946	0.015
2010	0.964	0.013
2020	0.952	0.014
Five-year arithmetic average	0.9604	0.0098

Delayed Effects 2020

- Ricker survival to Bonneville

$$\hat{S} = \left(\frac{2721}{52535}\right) \Big/ \left(\frac{2928}{52786}\right) = \frac{0.0518}{0.0555}$$

$$= 0.9337\ (\widehat{SE} = 0.0242)$$

- Paired-survival to Rocky Reach

$$\widehat{S_w} = 0.9517\ (\widehat{SE} = 0.0142)$$

Conclusion: No evidence of delayed effects to BON

P(Ƶ < -0.6415) = 0.2606

From: Kristi Geris
To: Jackson, Chad S (DFW); Jim Craig (jim_l_craig@fws.gov); John Ferguson; Keely Murdoch (murk@yakamafish-nsn.gov); Keller, Lance; kirk.truscott@colvilletribes.com; Kristi Geris; Scott Carlon; "Tom Kahler (tkahler@dcpud.org)"
Cc: Aaron Beavers; Alene.Underwood@chelanpud.org; Amber Nealy; Andrew Gingerich (andrewg@dcpud.org); Brandon Rogers; Casey Baldwin; Catherine Willard; Dale Bambrick; David Blodgett, III; Gallaher, Becky; Justin Yeager; michael.livingston@dfw.wa.gov; Mike Tonseth; Ritchie Graves; Shane Bickford (sbickford@dcpud.org); Steve Hemstrom (steven.hemstrom@chelanpud.org); Tom Scribner (scrt@yakamafish-nsn.gov); Towey, Bill <bill.towey@chelanpud.org>; Verhey, Patrick M (DFW); "william_gale@fws.gov"
Subject: FW: Land-use permit application for existing irrigation withdrawal and commercial agriculture in Wells Tract 730
Date: Monday, October 26, 2020 10:02:58 AM

Hi Wells-HCP-CC: please see the email below from Tom regarding Wells Project Land-use Permit #LUP 730-01, which is available for a 30-day review with comments or indication of no comments due to Tom no later than **Wednesday, November 25, 2020**. Thanks! – kristi

Kristi Geris

ANCHOR QEA, LLC
kgeris@anchorqea.com
C 360.220.3988

From: Tom Kahler <tomk@dcpud.org>
Sent: Monday, October 26, 2020 09:45
To: Kristi Geris <kgeris@anchorqea.com>
Cc: Andrew Gingerich <andrewg@dcpud.org>; John Ferguson <jferguson@anchorqea.com>
Subject: Land-use permit application for existing irrigation withdrawal and commercial agriculture in Wells Tract 730

Hi Kristi,

Here's another land-use permit application for CC review; please pass this along to them.

By issuing this permit, DPUD will bring historically allowed existing agricultural use of Project lands under Land Use Permit. This action was triggered by removal of the commercial orchard trees by the applicant who wishes to convert use to hay production. The permit area is the existing agricultural use area on Project lands (the red polygon in the figure below), which also includes the applicant's well and irrigation pump. Existing riparian habitat and shoreline will remain protected.

The location is Project Land in Douglas County adjacent to the applicant's ownership in Douglas County Tax Parcel No. 30242230001, 150 Crane Orchard Road. The orchard seen in the included figure has been removed.

There are no attachments.

Thanks,

Tom Kahler
Fisheries Biologist

PUD No. 1 of Douglas County
East Wenatchee, WA 98802
509-881-2322 Work
509-679-1232 Cell

1201 3rd Avenue, Suite 2600
Seattle, Washington 98101
206.287.9130

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: October 28, 2020

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris

Re: Final Minutes of the September 22, 2020, HCP Coordinating Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Tuesday, September 22, 2020, from 9:00 a.m. to 10:00 a.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

- Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).
- HCP Coordinating Committees members will discuss within the Priest Rapids Coordinating Committee (PRCC) rescheduling the December 2020 meeting 1 week earlier to accommodate the holiday, for further discussion during the HCP Coordinating Committees meeting on October 27, 2020 (Item IV-C). *(Note: Denny Rohr [PRCC Facilitator] notified Kristi Geris and John Ferguson that the PRCC agreed to reschedule the PRCC meeting to the afternoon of December 15, 2020, to follow the HCP Coordinating Committees meeting.)*
- The HCP Coordinating Committees meeting on October 27, 2020, will be held at 9:00 a.m., by conference call (Item IV-C).

Decision Summary

- There were no HCP Decisions approved during today’s conference call.

Agreements

- There were no HCP Agreements discussed during today’s conference call.

Review Items

- The *Wells Project Subyearling Chinook Life-History Study 2011–2013 Draft Final Report* was distributed to the HCP Coordinating Committees by Kristi Geris on May 24, 2019.
- The *Chelan PUD Rocky Reach and Rock Island HCPs Draft 2020 Fish Spill Report* was distributed to the HCP Coordinating Committees by Kristi Geris on September 19, 2020, and a revised draft spill report was distributed on September 23, 2020. The revised draft report is

available for a 30-day review with edits and comments due to Lance Keller by October 19, 2020 (Item III-C).

- The draft *Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study)* was distributed to the Wells HCP Coordinating Committee by Kristi Geris on October 22, 2020. This draft report is available for a 30-day review with edits and comments due to Tom Kahler and Andrew Gingerich by November 23, 2020.
- Wells Project Land-Use Permit Application #LUP 730-01 was distributed to the HCP Coordinating Committees by Kristi Geris on October 26, 2020. This application is available for a 30-day review with comments or indication of no comments due to Tom Kahler by November 25, 2020.

Finalized Documents

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. No additions or changes were requested.

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft August 25, 2020, conference call minutes. Kristi Geris said she added the *Chelan PUD Rocky Reach and Rock Island HCPs Draft 2020 Fish Spill Report* under Review Items. She said U.S. Fish and Wildlife Service also provided a few comments after the revised minutes were distributed, as follows:

- *HCP Tributary Committees Update, Vandervort Appraisal Discussion*: Jim Craig suggested rewording the last sentence under this bullet to be clearer. The sentence was edited for clarification and Tracy Hillman and Craig approved the revision.
- *HCP Hatchery Committees Update, Predation at Eastbank Fish Hatchery*: Craig provided suggested punctuation edits to the last sentence under this bullet; however, Tracy Hillman had also already provided edits to this sentence, which Craig approved.
- *Chelan PUD, Rock Island Relicensing Update*: Craig suggested adding a note that the relicensing of Rock Island Dam is due to be completed by the end of 2028. This edit was incorporated, and Lance Keller and Craig approved the revision.

Geris said all other comments and revisions received from members of the Committees were incorporated into the revised minutes. HCP Coordinating Committees members present approved the August 25, 2020, conference call minutes, as revised. *(Note: Scott Carlon provided National Marine Fisheries Service approval of the August 25, 2020, conference call minutes via email prior to the HCP Coordinating Committees conference call on September 22, 2020.)*

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on August 25, 2020, and follow-up discussions, were as follows. *(Note: Italicized text corresponds to agenda items from the meeting on August 25, 2020):*

- *Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).*
  This will be discussed during today's conference call and will be carried forward.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman said the HCP Tributary Committees did not meet in September 2020. The next meeting of the HCP Tributary Committees will be on October 8, 2020, when the Committees will hear presentations from the Yakama Nation and Methow Salmon Recovery Foundation.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees conference call on September 16, 2020 (*note: joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *Broodstock Collection Protocols (joint)*: Consistent with the approved 2019 Statement of Agreement[1], the HCP Hatchery Committees began the process of updating the broodstock collection protocols. The Committees are currently identifying important issues to cover in the broodstock collection protocols and identifying who will lead the writeup of certain sections of the protocols.
- *COVID-19 and Monitoring and Evaluation (M&E) Activities (joint)*: Each member of the HCP Hatchery Committees discussed the effects of COVID-19 on their respective M&E activities. Overall, very little has changed since last month. Monitoring is occurring within the hatcheries

[1] *Wells HCP Hatchery Committee Final Statement of Agreement Annual Broodstock Collection Protocols* and *Rock Island and Rocky Reach HCP Hatchery Committee Final Statement of Agreement Annual Broodstock Collection Protocols*, both approved on September 18, 2019.

and crews are operating smolt traps. Broodstock collections are proceeding as planned and monitoring crews are conducting spring Chinook salmon spawning surveys. The Colville Confederated Tribes (CCT) reported that the fire in the Okanogan Basin has destroyed some of the CCT outbuildings and fish sampling equipment. Other members of the Committees have offered equipment from their respective agencies to help the CCT with monitoring efforts this year and next. Kirk Truscott said the offer for assistance is appreciated by the CCT.

- *2021 Hatchery M&E Implementation Plan (Rock Island/Rocky Reach)*: The Rocky Reach and Rock Island HCP Hatchery Committees reviewed and approved Chelan PUD's 2021 Hatchery M&E Implementation Plan.
- *2021 Hatchery M&E Implementation Plan (Wells)*: Douglas PUD will submit their draft 2021 Hatchery M&E Implementation Plan for review soon. Members will have 30 days to review the plan.
- *Washington Department of Fish and Wildlife (WDFW) Cyberattack (HCP Administration)*: WDFW recently experienced a cyberattack, which has limited email communication with WDFW representatives. Currently, WDFW staff cannot receive or send emails with attachments. Attachments can be sent to WDFW representatives through the Anchor QEA ftp site, Dropbox, or the HCP Hatchery Committees extranet site. John Ferguson said this morning he has been sending and receiving emails with attachments from the WDFW offices in Olympia, Washington, and he asked Chad Jackson if there are more recent updates on the cyberattack since the last HCP Hatchery Committees meeting on September 16, 2020. Jackson said the situation is now mostly contained; however, it is not quite 100% resolved. He said the attackers are finding different ways to trick people into opening attachments or links. He said WDFW staff can now send emails; however, if attachments need to be sent or received special clearance must be obtained from WDFW Information Technology (IT) services. He said generally, every external email with attachments gets scrubbed. Hillman cautioned Ferguson to be extra careful if he receives emails from WDFW with attachments, because he has also received a few emails about familiar projects that had zip file attachments and he was advised not to open them. Jackson agreed and said a key tip-off that an email may be fraudulent is if the email is about a subject that was dealt with a few weeks prior but now has resurfaced. Ferguson said the files he has opened were PDFs of publications but said he will be more vigilant and thanked Hillman and Jackson for this information. Ferguson asked if the WDFW cyberattack is a case of ransomware. Jackson said it seems to involve three components: 1) initial phishing to seek a way in; 2) effects on computers; and 3) ransomware. He said he understands that a total of 16 Washington State agencies experienced similar cyberattacks.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on October 21, 2020.

III. Chelan PUD

A. Rock Island Dam Powerhouse 1 Maintenance Update (Lance Keller)

Lance Keller said regarding Turbine Unit B4 in Powerhouse 1, he previously reported a return-to-service date of December 2020. He said this date still seems possible, but there is a slight chance the outage could last into the first 1 or 2 weeks in January 2021. He said staff are continuing work on the unit while meeting COVID-19 restrictions, repairs are still fairly on schedule, and the expectation is the unit will be returned to service in plenty of time before the start of the 2021 survival check-in study.

B. Rocky Reach Dam Turbine Units Maintenance Update (Lance Keller)

Lance Keller said he previously reported that Turbine Unit C2 will return to service by November 2020, and this date is still holding true. He said he understands crews are starting the final stages of preparing the unit for commissioning.

Keller said regarding Turbine Unit C7, he previously reported a return-to-service date of February 2021. He said this schedule has moved into March 2021, mainly due to the Kaplan tube damage incurred during removal of the pipe.

Keller recalled reporting during the HCP Coordinating Committees conference call on August 25, 2020, removing Turbine Unit C3 from service and draining the hub to inspect for oil and water. He said now the unit is out of service to begin the overhaul of the unit and address the trunnion bushing issue. He said the return-to-service date is scheduled for May 2021.

C. 2020 Rocky Reach and Rock Island Fish Spill Report (Lance Keller)

Lance Keller said the *Chelan PUD Rocky Reach and Rock Island HCPs Draft 2020 Fish Spill Report* was distributed to the HCP Coordinating Committees by Kristi Geris on September 19, 2020 and is available for a 30-day review with edits and comments due to him by October 19, 2020. Keller recalled that each year this report is drafted by Thad Mosey (Chelan PUD), and Keller reviewed the report, as follows.

Rocky Reach Dam – Summer Spill

Keller said the target species is subyearling Chinook salmon and the spill target is 9% of the daily average river flow. He said Chelan PUD initiated summer spill operations at Rocky Reach Dam on May 23, 2020, and ended spill on August 25, 2020. He said Program RealTime and the Columbia River Data Access in Real Time database (DART) estimated that 95% of the subyearling outmigration had passed Rocky Reach Dam on August 16, 2020. He said now that data are finalized with no additional adjustments to run timing from DART, the data indicate that spill passage was provided for 98.7% of the subyearling outmigration passing Rocky Reach Dam. He said the cumulative index count at the Rocky Reach Juvenile Fish Bypass (RRJFB) was just shy of 26,000 subyearlings (i.e., 25,925 subyearling Chinook salmon). He said the actual summer spill percentage was 24.91%, which included 8.93% fish spill and 15.26% forced spill. Keller noted that the fish spill number is based on Mosey's requests for fish spill and forced spill is hydraulic spill exceeding the hydraulic capacity at Rocky Reach Dam. Keller recalled there were two high flow events in the Mid-Columbia River this spill season sustaining higher flows into July 2020, which were also expressed in spill. He said average river flow at Rocky Reach Dam was 163,054 cubic feet per second (160 kcfs), and average spill was almost 40 kcfs (i.e., 39,436 cfs) across 95 spill days. He said the first graph in the draft spill report is similar to past spill reports. He said the blue line represents subyearlings and the purple line represents percent spill provided at Rocky Reach Dam. He noted the variability in the subyearling outmigration and also the amount of hydraulic spill above the 9% spill target into the first week of August 2020. He said the second graph shows adipose (ad)-present subyearlings observed daily at RRJFB from May 19 to August 31, 2020. He said similar to previous years, there are very few ad-present fish observed at the beginning of the outmigration, then ad-present fish numbers gradually increase into July, and by the end of July and early August, most fish collected in the RRJFB are ad-present.

Kirk Truscott noted on the first graph that the scale for the percent spill axis does not seem correct. Keller said the scale should be in increments of 10% and he will revise this in the version for approval.

John Ferguson asked on the second graph where the presence of ad-present fish increases, is this timing consistent with other years? Keller said the overall trendline and curve is generally similar to other years, i.e., mostly ad-clipped and very little ad-present fish during the beginning of the outmigration (or May), then a mix of ad-clipped and ad-present in the middle of the outmigration (or mid-June and early July), and then mostly ad-present by the end of the outmigration (or July into August).

Rock Island Dam – Spring Spill

Keller said the target species include yearling Chinook salmon, steelhead, and sockeye salmon, and the spill target is 10% of the daily average river flow. He said Chelan PUD started spring spill operations at Rock Island Dam on April 17, 2020, and ended on May 22, 2020, at which point there was an instantaneous increase to the 20% summer spill target. He said spill was provided for 99.3% of the yearling Chinook salmon run, 99.6% of the steelhead run, and 98.7% of the sockeye salmon run. Keller noted that this includes a combination of spring and summer fish spill coverage. He explained that the spring target is 10% spill but when this transitions to 20% spill for summer, spill coverage is still being provided for spring with the instantaneous transition from that point on. He said over 24,000 yearling Chinook salmon (i.e., 24,278 fish), about 12,000 steelhead (i.e., 11,708 fish), and more than 42,000 sockeye salmon (i.e., 42,498 fish) were counted in the sampling facility at Rock Island Dam. He said the spring spill percentage was 19.07%, including 9.86% that Mosey requested for fish spill and 9.21% of forced spill beyond the hydraulic capacity of the plant. Keller said average river flow at Rock Island Dam averaged roughly 148 kcfs (i.e., 147,944 cfs) and average spill over 36 days was averaged about 28 kcfs (i.e., 28,214 cfs). He said the third graph in the spill report shows daily index counts at the Rock Island Juvenile Fish Bypass (RIJFB) trap for yearling Chinook salmon, steelhead, coho salmon, and sockeye salmon. He said percent spill is shown by the purple line. He said during the time period from April 1 to April 16, 2020, there were very few spring species counted at the trap. He said Chelan PUD initiated spring fish spill on April 17, 2020, and then there was an increase in daily index counts for spring species. Keller said this was a good judgement call by Mosey to start spring fish spill when he did. Keller noted on the purple line there is a purple diamond that shows when spring spill transitioned to summer spill. He also noted that at this time, water and river flow exceeded both spill targets. He said this graph also illustrates the large number of coho salmon counted at the trap in May and early June 2020. He said he will correct the scale for the percent spill axis on this graph, as well. *(Note: A revised draft spill report with corrected graphs was distributed to the HCP Coordinating Committees by Geris on September 23, 2020.)*

Rock Island Dam – Summer Spill

Keller said the target species is subyearling Chinook salmon and the spill target is 20% of the daily average river flow. He said Chelan PUD initiated summer spill operations at Rock Island Dam on May 23, 2020, and ended spill on August 18, 2020. He said Program RealTime and DART estimated that 95% of the subyearling outmigration had passed Rock Island Dam on August 6, 2020. He said with the data finalized and no additional adjustments to run timing from DART, the data indicate that spill passage was provided for 99.2% of the subyearling outmigration passing Rock Island Dam. He said 18,115 subyearling Chinook salmon were counted at RIJFB. He said the summer spill percentage was 32.84% of the daily average river flow, which included 19.87% fish spill requested by Mosey and 12.97% hydraulic spill beyond powerhouse capacity. He said average river flow at Rock Island Dam was about 171 kcfs (i.e., 171,280 cfs), and average spill was over 56 kcfs (i.e., 56,280 cfs) across 88 spill days. He said in the fourth graph in the draft spill report, the teal line represents index counts of subyearlings and the purple line shows the daily spill percentage at Rock Island Dam. He said once again, the diamond on the graph represents the transition from 10% to 20% spill and noted that although summer spill operations were initiated on May 23, 2020, additional spill coverage was provided for the early part of the subyearling run prior to that date. He said then, although the target was 20% spill, due to hydraulic capacity, total daily spill at Rock Island Dam was above the 20% target, which lasted into the second week of August 2020. He said the last graph in the draft report shows a mix of ad-present subyearlings in the early counts, but the RIJFB daily counts were definitely dominated by ad-clipped fish until mid-June 2020 when there is a peak. He said by the tail end of July 2020, the majority of fish handled at the RIJFB were ad-present.

Rocky Reach Dam and Rock Island Dam Juvenile Index Counts

Keller said Tables 1 and 2 show the daily and total counts at Rocky Reach and Rock Island dams for Plan species. He reviewed counts from 2020 compared to previous years at both Rocky Reach and Rock Island dams. He noted that the sampling procedures are different at the two facilities. He said at Rocky Reach Dam, there are four separate 30-minute instantaneous samples of fish at the RRJFB. He said at Rock Island Dam, the sample is collected via a gatewell collection system at Powerhouse 2, over a 24-hour period, and an expansion is applied based on representative flows through that powerhouse compared to the entire project. He said these are slightly different ways to arrive at index counts based on different sampling protocols; however, he believes the numbers are comparable at each individual site from year-to-year.

Ferguson said comments on the draft report are due to Chelan PUD by October 19, 2020, and he asked if Chelan PUD plans to request approval of the report during the HCP Coordinating Committees meeting on October 27, 2020. Keller said this is the intent, and he asked that Rocky Reach and Rock Island HCP Coordinating Committees members reach out to him with questions and comments.

D. Rock Island Confirmation Survival Study Request for Proposal Update (Lance Keller)

Lance Keller said the Chelan PUD Board of Commissioners approved the recommended contract award that was developed based on responses to their Request for Proposals. Blue Leaf Environmental, Inc. (Blue Leaf) was selected to conduct the work. Keller said Chelan PUD received four complete proposals, which were reviewed and evaluated by a 6-person internal team. He said Chelan PUD was pleased with the proposals received, and he said each was a competitive proposal. He said Blue Leaf was selected and there is now a standing contract between Chelan PUD and Blue Leaf for the 2021 survival study. Keller said Chelan PUD has a good working relationship with Blue Leaf, who currently conducts all M&E activities for the Rocky Reach White Sturgeon Management Plan. Keller said Blue Leaf expressed great interest in the study, is experienced in handling large datasets, and also conducted the last survival study for the Priest Rapids Project. Keller said Blue Leaf also has some of the most recent experience with acoustic tag studies in the region. He said Blue Leaf will now begin the process of developing a study plan, in consultation with Chelan PUD and Dr. John Skalski (University of Washington, Columbia Basin Research), which will be available for Rock Island HCP Coordinating Committee review.

John Ferguson asked about the timing of the draft study plan for Rock Island HCP Coordinating Committee review. Keller said the draft plan will likely be ready by the end of Q4 2020 (December). He noted that in the Request for Proposals, Chelan PUD already requested a draft study plan for this survival study, but a separate study plan will be drafted in consultation with Chelan PUD. He said it will essentially be very similar to what was implemented for the Phase Designation studies for the Rock Island Project, i.e., a paired release study design with release locations at the 1,000-foot mark downstream of Rocky Reach Dam and at the 1000-foot mark downstream of Rock Island Dam, and using similar downstream detection arrays. He said there should not be any surprises to the Rock Island HCP Coordinating Committee during review of the study plan, which will be comparable to the previous effort for the Rock Island Project.

Ferguson recalled that Douglas PUD planned to have a draft 2020 Survival Verification Study report available for review this fall, and now Chelan PUD will have a draft 2021 Confirmation Survival Study plan available for review in Q4 2020.

IV. HCP Administration

A. COVID-19 and Wildfire Updates (John Ferguson)

John Ferguson asked if there are any updates HCP Coordinating Committees members would like to share regarding impacts of COVID-19 or local wildfires on HCP activities.

Chad Jackson said as of yesterday, WDFW staff have been advised to telework to the greatest extent possible through next June 2021.

Kirk Truscott said the CCT Tribal Council is currently assessing the shutdown and a decision will be made at the end of the month. He said the CCT Reservation is no longer on fire and no personnel were injured due to the fires.

No other updates were shared.

B. HCP Policy Committees September 1, 2020 Conference Call (John Ferguson)

John Ferguson said the HCP Policy Committees convened by conference call on September 1, 2020. He said all HCP Parties were present, there was really good participation, and discussions went well. He said each Party presented views from their respective agencies and organizations, and through the course of a couple of hours, unanimous support was reached to collect and tag sockeye salmon, as done in the past (for Jeff Fryer's [Columbia River Inter-Tribal Fish Commission] program), using the east fish ladder at Wells Dam, concurrent with trapping activities for the Carlton summer Chinook salmon collection program. Ferguson said the discussions revolved around what could be done, or alternatives, for trapping beyond 1 to 3 days per week to meet target sample size needs for Fryer.

Ferguson said the HCP Policy Committees developed five alternatives, including four alternatives at Wells Dam and one alternative at the Priest Rapids Dam Off-Ladder Fish Trap, which HCP Policy Committees members are now researching to prepare for further discussion at the next HCP Policy Committees call on October 6, 2020. Ferguson said a draft agenda for the HCP Policy Committees conference call on October 6, 2020 was distributed for review on September 18, 2020, along with a request for additional agenda items. Ferguson said he has started reaching out to HCP Policy and Coordinating Committees representatives who attended the HCP Policy Committees conference call on September 1, 2020, to touch base before the conference call on October 6, 2020. He said he is unsure if the HCP Policy Committees will be ready to move forward with a decision at that point, but he hopes so. He said there is still a lot of time between now and May 2021, when a decision is needed. He said this has been a good effort with a lot of good ideas, and he asked if HCP Coordinating Committees representatives present during the last HCP Policy Committees conference call had any other additional thoughts to share. Kirk Truscott, Keely Murdoch, Chad Jackson, and Tom Kahler said they have nothing additional to add.

C. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on October 27, 2020, to be held by conference call.

Kristi Geris asked if HCP Coordinating Committees members wanted to start discussing alternative meeting dates for November and December 2020 to accommodate the holidays. Andrew Gingerich said he and Tom Kahler were hoping to invite Drs. John Skalski and Richard Townsend (University of Washington, Columbia Basin Research) to attend a future meeting to present on the Douglas PUD 2020 Survival Verification Study results, so it would be helpful to discuss future meeting dates sooner rather than later. Gingerich said Douglas PUD also hopes to have a draft report available for review before Skalski and Townsend present on the data.

The HCP Coordinating Committees reviewed the November 2020 calendar. The HCP Coordinating Committees meeting on November 24, 2020, is 2 days before the holiday. Kirk Truscott said he is available November 17, 2020, and is on leave the week of November 23, 2020, but can work in advance on items needing addressed. Keely Murdoch said she is on leave November 16 to 17, 2020, but can also work in advance, as needed. Chad Jackson said he is out of office the week of November 16, 2020. John Ferguson suggested keeping the HCP Coordinating Committees meeting on November 24, 2020.

The HCP Coordinating Committees reviewed the December 2020 calendar. The HCP Coordinating Committees meeting on December 22, 2020, is 3 days before the holiday. Ferguson suggested that HCP Coordinating Committees members discuss within the PRCC rescheduling the December 2020 meeting 1 week earlier to accommodate the holiday, for further discussion during the HCP

Coordinating Committees meeting on October 27, 2020. *(Note: Denny Rohr notified Geris and Ferguson that the PRCC agreed to reschedule the PRCC meeting to the afternoon of December 15, 2020, to follow the HCP Coordinating Committees meeting.)*

The November 24 and December 15, 2020, meetings will be held by conference call.

V. List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman†	BioAnalysts
Lance Keller*	Chelan PUD
Bill Towey	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
Jim Craig*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation
Kirk Truscott*	Colville Confederated Tribes

Notes:
* Denotes HCP Coordinating Committees member or alternate
† Joined for the HCP Hatchery and Tributary Committees Update

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: January 6, 2021

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris

Re: **Final Minutes of the November 24, 2020, HCP Coordinating Committees Conference Call**

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Tuesday, November 24, 2020, from 9:00 a.m. to 10:15 a.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

- Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).
- Anchor QEA, LLC (Anchor QEA) will coordinate with the Colville Confederated Tribes (CCT) to arrange a presentation of *Reintroduction of Salmon Upstream of Chief Joseph and Grand Coulee Dams*, during a future HCP Coordinating Committees conference call (Item I-C). *(Note: Kristi Geris emailed Kirk Truscott and Casey Baldwin [CCT] about this on November 24, 2020 and will report back to the HCP Coordinating Committee once a response is received.)*
- Douglas PUD will communicate to the Columbia River Inter-Tribal Fish Commission (CRITFC) the discussions regarding Jeff Fryer's (CRITFC) annual request to tag sockeye salmon at Wells Dam that took place during the HCP Policy Committees conference call on October 6, 2020 (i.e., not conducting additional sampling for sockeye salmon until a thermal barrier has set up in the Okanagan River), and during the HCP Coordinating Committees conference call on October 27, 2020 (i.e., stipulate in the next request letter, a request that sockeye salmon sampling periods are concurrent with both spring and summer Chinook salmon trapping operations) (Item I-C).
- Douglas PUD and the Yakama Nation (YN) will further discuss the language included in the draft Statement of Agreement (SOA), *Approval of the Results of the 2020 Wells Project Survival Verification Study, Phase III (Standard Achieved)*, and will report back to Anchor QEA by the week of December 7, 2020 (Item III-A).
- The HCP Coordinating Committees meeting on December 15, 2020, will be held at 9:00 a.m., by conference call (Item V-E).

Decision Summary

- Wells HCP Coordinating Committee representatives present approved the report, *Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study)* (Item III-B). (Note: Jim Craig provided U.S. Fish and Wildlife Service [USFWS] approval of the report via phone call on November 17, 2020; Scott Carlon provided National Marine Fisheries Service [NMFS] approval of the report via email on November 20, 2020; and Kirk Truscott provided CCT approval of the report via email on November 23, 2020.)

Agreements

- There were no HCP Agreements discussed during today's conference call.

Review Items

- Wells Project Land-Use Permit Application No. LUP 730-01 was distributed to the HCP Coordinating Committees by Kristi Geris on October 26, 2020. This application is available for a 30-day review with comments or indication of no comments due to Tom Kahler by November 25, 2020 (Item I-A).
- The draft 2020 Wells Post-Season Bypass Report and Passage-Dates Analysis was distributed to the HCP Coordinating Committee by Kristi Geris on November 23, 2020. This draft report is available for a 30-day review with edits and comments due to Tom Kahler by December 23, 2020 (Item III-C).

Finalized Documents

- The final report, *Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study)*, was distributed to the HCP Coordinating Committees by Kristi Geris following the HCP Coordinating Committees conference call on November 24, 2020 (Item III-B).

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. The following revisions were requested:

- Tom Kahler added 2020/2021 Wells Dam Winter Maintenance. He also noted that the review period for Wells Project Land-Use Permit Application No. LUP 730-01 concludes today and no comments have been received to date; therefore, Douglas PUD intends to proceed with processing. Ferguson said Kirk Truscott indicated via email on November 23, 2020, that Douglas PUD's response to the action item answered Truscott's question, and he has no further comments on LUP 730-01.

- Lance Keller added 2021 Rock Island Survival Check-In Study Plan.
- Ferguson added subyearling Chinook salmon studies quarterly check-in.

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft October 27, 2020, conference call minutes. Kristi Geris said all comments and revisions received from members of the Committees were incorporated into the revised minutes. Geris said she also added Douglas PUD's draft *2020 Wells Post-Season Bypass Report* and *Passage-Dates Analysis* under Review Items. Lastly, she notified the HCP Coordinating Committees that Scott Carlon and Jim Craig provided NMFS and USFWS approvals of the minutes, respectively, via email on November 17, 2020, and Kirk Truscott provided CCT approval of the minutes via email on November 23, 2020.

HCP Coordinating Committees members present approved the October 27, 2020, conference call minutes, as revised.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on October 27, 2020, and follow-up discussions, were as follows. *(Note: Italicized text corresponds to agenda items from the meeting on October 27, 2020):*

- *Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).*
  This action item will be carried forward.
- *Anchor QEA will distribute to the HCP Coordinating Committees the presentation, Wells Project Passage Survival Study, 2020, that was presented by Drs. John Skalski and Richard Townsend (University of Washington, Columbia Basin Research) (Item II-A).*
  Kristi Geris distributed this presentation following the HCP Coordinating Committees conference call on October 27, 2020.
- *Douglas PUD will distribute a draft SOA approving the results of the Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study), for approval during the HCP Coordinating Committees conference call on November 24, 2020 (Item II-B).*
  Tom Kahler provided a draft SOA to Kristi Geris on November 13, 2020, which Geris distributed to the HCP Coordinating Committees that same day.

- *Wells HCP Coordinating Committee representatives will review and provide edits and comments on the draft Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study) to Tom Kahler and Andrew Gingerich by November 23, 2020, and be prepared to vote to approve the report during the HCP Coordinating Committees conference call on November 24, 2020, or possibly the HCP Coordinating Committees conference call on December 15, 2020 (Item II-B).*
  This will be discussed during today's conference call.
- *The CCT will distribute to the HCP Coordinating Committees the presentation, Reintroduction of Salmon Upstream of Chief Joseph and Grand Coulee Dams, that the CCT presented during the HCP Hatchery Committees conference call on October 21, 2020 (Item III-A).*
  Kirk Truscott provided this presentation to Kristi Geris following the HCP Coordinating Committees conference call on October 27, 2020, which Geris distributed to the HCP Coordinating Committees that same day.
- *Anchor QEA will coordinate with the CCT to arrange a presentation of Reintroduction of Salmon Upstream of Chief Joseph and Grand Coulee Dams, during a future HCP Coordinating Committees conference call (Item III-A).*
  This action item will be carried forward.
- *Douglas PUD will inquire internally regarding the CCT's question on Wells Project Land-Use Permit Application No. LUP 730-01, about whether the proposed activities are subject to cultural resource requirements (Item IV-A).*
  Tom Kahler provided a response to Kirk Truscott's question to Kristi Geris following the HCP Coordinating Committees conference call on October 27, 2020, which Geris distributed to the HCP Coordinating Committees that same day. Truscott indicated via email on November 23, 2020, that Douglas PUD's response answered his question, and he has no further comments on LUP 730-01.
- *Douglas PUD will communicate to the CRITFC the discussions regarding Jeff Fryer's (CRITFC) annual request to tag sockeye salmon at Wells Dam that took place during the HCP Policy Committees conference call on October 6, 2020 (i.e., not conducting additional sampling for sockeye salmon until a thermal barrier has set up in the Okanagan River), and during the HCP Coordinating Committees conference call on October 27, 2020 (i.e., stipulate in the next request letter, a request that sockeye salmon sampling periods are concurrent with both spring and summer Chinook salmon trapping operations) (Item VI-B).*
  This action item will be carried forward.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees conference call on November 12, 2020:

- *General Salmon Habitat Program Application*: The Rocky Reach HCP Tributary Committee received a General Salmon Habitat Program proposal from Cascadia Conservation District titled, *Chumstick Baseflow and Riparian Enhancement Project*. The purpose of the project is to improve water quality, water quantity, and riparian habitat along 0.26 mile of Chumstick Creek by installing beaver dam analogs and post-assisted log structures at four different locations in Chumstick Creek. Enhancement structures will create pools, sort and store sediments, store water, prolong stream flows, improve water quality, and improve riparian conditions. The total cost of the project was $237,727.48. The sponsor requested $82,145.47 from HCP Plan Species Account Funds. The Rocky Reach HCP Tributary Committee elected to contribute $82,145.47 to the project.
- *Methow Salmon Recovery Foundation (MSRF) Projects Discussion*: The MSRF discussed three, site-specific projects that make up part of the larger Sugar Project on the Methow River. Those site-specific projects included the Sugar Levee, Sugar Left, and Twisp Confluence projects. The purpose of the discussion was to update the Committees on current design concepts, seek feedback from the HCP Tributary Committees, and to gauge the Committees' interest in moving forward with design development. This discussion was in response to the Committees' requirement to be engaged in the development of these projects. The HCP Tributary Committees are currently studying the conceptual designs and will provide feedback to MSRF on December 1, 2020. MSRF will use feedback from the Committees to develop preliminary designs.
- *YN Projects Discussion*: Earlier this year, the YN submitted the Alder Creek Floodplain Restoration Project and the Chewuch River Mile 4.2 Fish Enhancement Project to the HCP Tributary Committees for funding. In July 2020, the Committees declined the opportunity to fund these projects as designed, but indicated the Committees were open to discussing the projects further with the YN. In response to the Committees' concerns with the projects, the YN provided written responses to the Committees' concerns in September 2020. The purpose of this discussion was to review the projects and describe how the YN addressed the Committees' concerns. Importantly, the YN has secured cost shares from the Salmon Recovery Funding Board (SRFB) and Bonneville Power Administration (BPA) Accords on both projects. Following the discussion, and after the YN left the call, the HCP Tributary Committees discussed each project. Based on the information provided by the YN and responses to the Committees' concerns, the Wells HCP Tributary Committee elected to contribute $149,967 to

the Alder Creek Floodplain Restoration Project. With the SRFB and BPA cost shares, this project is now fully funded (total cost = $691,700). The HCP Tributary Committees were unable to make a funding decision on the Chewuch River Mile 4.2 Fish Enhancement Project. A decision on this project is tabled until the Committees can have a discussion with the Washington State Department of Ecology (Ecology) regarding wetland regulations and policy. The Chewuch project site has a wetland, which, if connected, could provide a large benefit to HCP Plan Species. However, because of Ecology's mitigation requirements, the YN is not able to reconnect natural floodplain features. Thus, the HCP Tributary Committees see a potential conflict between floodplain reconnection projects that will benefit HCP Plan Species and Ecology wetland regulations. The HCP Tributary Committees invited Ecology and U.S. Army Corps of Engineers to the HCP Tributary Committees meeting on December 10, 2020.

- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on December 10, 2020, largely to discuss the Chewuch River Mile 4.2 Fish Enhancement Project with Ecology.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees conference call on November 18, 2020 (*note: joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *Broodstock Collection Protocols (joint)*: The HCP Hatchery Committees are in the process of updating the broodstock collection protocols. The Committees have identified important issues to cover in the 2021 broodstock collection protocols and identified who will lead the writeup of certain sections of the protocols. The Committees also had a discussion on what should be included in communications to Committees members when there is a surplus of hatchery fish on station.
- *COVID-19 and Monitoring and Evaluation (M&E) Activities (joint)*: Each member of the HCP Hatchery Committees discussed the effects of COVID-19 on each member's respective M&E activities. Little has changed since last month. However, with the increase in COVID-19 infection rates, entities are taking additional measures to minimize the spread of the virus (e.g., social distancing, allowing only one person per vehicle, etc.).
- *Skaha and Okanagan Sockeye Reintroduction Program Comprehensive Review (Rock Island/Rocky Reach)*: Chelan PUD reported that all reports associated with the Skaha and Okanagan sockeye salmon reintroduction program have been uploaded to the HCP Hatchery Committees Extranet Site. Chelan PUD will provide a summary of the reports to the HCP Hatchery Committees by late November 2020, and will discuss the summary during the meeting in December 2020.

- *Blackbird Pond Update (Rock Island/Rocky Reach)*: Chelan PUD reported no plans to use Blackbird Pond as an acclimation site for hatchery-by-hatchery steelhead in the future. Chelan PUD described the history of the pond and that it was used for acclimation before steelhead could be acclimated at the Chiwawa Acclimation Facility. Because steelhead are now acclimated at the Chiwawa Acclimation Facility, Chelan PUD will no longer use Blackbird Pond for steelhead acclimation. The City of Leavenworth owns the pond and infrastructure there. Blackbird Pond is located on Blackbird Island near Leavenworth, Washington.
- *2021 Hatchery M&E Implementation Plan (Wells)*: The Wells HCP Hatchery Committee approved the 2021 Hatchery M&E Implementation Plan.
- *2019 Wells Complex M&E Annual Report (Wells)*: Douglas PUD is working with Washington Department of Fish and Wildlife (WDFW) and USFWS on addressing comments on the draft *2019 Wells Complex M&E Annual Report*. Douglas PUD will submit a final report once all comments are addressed.
- *Chelan PUD Representation on the HCP Hatchery Committees (Administration)*: Chelan PUD officially identified Scott Hopkins as the Rock Island and Rocky Reach HCP Hatchery Committees Alternate. Catherine Willard will continue as the designated Rock Island and Rocky Reach HCP Hatchery Committees Representative.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on December 16, 2020.

III. Douglas PUD

A. DECISION: Draft SOA, Approval of the Results of the 2020 Wells Project Survival Verification Study, Phase III (Standard Achieved) (Tom Kahler)

Tom Kahler said the draft SOA, *Approval of the Results of the 2020 Wells Project Survival Verification Study, Phase III (Standard Achieved)*, distributed to the HCP Coordinating Committees by Kristi Geris on November 13, 2020, describes the results of the survival verification study and how these fit within the current hatchery compensation plan. Kahler said this SOA is essentially the same SOA that was approved for the 2010 Wells Project Survival Verification Study except updated with a fifth year of data. He said he also deleted some of the Background portion of the SOA that introduced the concept of a survival verification study. He said the addition of this fifth year of data resulted in a slight increase in hatchery production commitments for each species, adjusted up from 3.7% to 3.96%, per the HCP. He said approvals of the SOA were already received from USFWS, NMFS, and the CCT (i.e., Jim Craig provided USFWS approval of the SOA via phone call on November 17, 2020; Scott Carlon provided NMFS approval of the SOA via email on November 20, 2020; and Kirk Truscott provided CCT approval of the SOA, with minor clarifying edits, via email on November 23, 2020). Kahler said Truscott's suggested edits clarify that the CCT raise both yearling summer Chinook and spring Chinook salmon at Chief Joseph Hatchery for Douglas PUD, and that summer steelhead are for release to the Twisp River. Kahler said he also added clarifying edits that summer steelhead for release at the Twisp River are raised at Wells Fish Hatchery, yearling Chinook salmon are raised at Methow Fish Hatchery, and the Methow River coho salmon are raised at Wells Fish Hatchery for release to the Twisp River.

Keely Murdoch read an excerpt from the Statement portion of the SOA, as follows:

> *The Juvenile Project Survival measured in 2020 (95.17%, SE = 0.0142) will now be included with the results of previous survival studies (99.7%, 94.3%, 94.6%, 96.4%) in a new 5-year average Juvenile Project Survival of 96.04% for yearling Chinook Salmon, Coho Salmon, and steelhead.*

Murdoch recalled that the Wells HCP Coordinating Committee chose yearling Chinook salmon as the study species. She said she understands that coho salmon are linked as a surrogate to the yearling Chinook salmon value, but she is confused about the inclusion of steelhead. She then read an excerpt from Section 4.2.5.1 Phase III (Standards Achieved) of the Wells HCP, as follows:

> *…only one species will be utilized to represent spring migrants and one species for summer migrants. This re-evaluation will occur over one year and be included in the pertinent average for that particular species.*

Murdoch said she is not aware that a Chinook salmon value can be used for steelhead, and if this is not intended in the SOA, she thinks the language is not worded correctly.

Kahler explained that the evaluation is for all species under Phase III (Standards Achieved) (i.e., whichever species the Wells HCP Coordinating Committee selects would become the surrogate for all species under Phase III [Standards Achieved]). He said there is no separate survival value for steelhead and yearling Chinook salmon; rather, it is a combined value. He recalled the first 3 years of survival studies, prior to signing of the Wells HCP, the Mid-Columbia Coordinating Committee agreed these first 3 years of studies demonstrated that the Wells Project had achieved standards for Phase III for yearling Chinook salmon and steelhead. He said these species then became effectively linked unless it could be demonstrated that one species did not meet the survival target, then that species would fall out of Phase III (Standards Achieved). He added that, under Section 4.2.5.1, if one species fails (after the third attempt to verify achievement of survival standards), this calls into question the other species, as well.

Murdoch said because there are different survival rates for steelhead and Chinook salmon, it is still not clear to her that this is the correct way to interpret the data. She suggested that she and Kahler discuss this further offline, because it seems to her that this study should only affect the survival rate of the species that was studied, not all species. Murdoch clarified that she is not questioning the survival verification study results; rather, she is just questioning how to interpret the results for the purposes of hatchery compensation.

John Ferguson asked if editing the language in the SOA might address Murdoch's concern. Murdoch said an edit may not be enough because she thinks this has to do with the math behind the results. Ferguson suggested separating the value from the representativeness. Murdoch said the way the SOA is currently written changes the survival for steelhead based on a yearling Chinook salmon survival value, and this is the part of the SOA she is not comfortable with. She said if the SOA indicated this survival value represents only yearling Chinook salmon and only adjusts yearling Chinook and coho salmon survival values, she would have no issues with the SOA.

Kahler said these values have never been separated. Murdoch said separate tests have been conducted for Chinook salmon and steelhead, which produced separate values for Chinook salmon and steelhead. Kahler read an excerpt from Section 8.4.4 Adjustment of Hatchery Compensation - Survival Studies of the Wells HCP, as follows:

> *…compensation for spring chinook, yearling summer chinook and steelhead shall be reduced to 3.8%...*

Kahler said that all those Plan Species had the same hatchery-compensation rate because that rate was established during the negotiation of the HCP based on the three years of valid survival studies conducted from 1998 to 2000 on yearling Chinook salmon and steelhead (referencing Wells HCP Section 4.2.1). Kahler said then, when coho salmon and Okanogan Basin spring Chinook salmon were added, compensation was also set at 3.8% for these fish because this was the approved yearling survival value (see Sections 8.4.5.1 and 8.4.5.2 of the Wells HCP). Murdoch said she thought compensation was based on the median value for Chinook salmon and steelhead. Kahler said it was recognized in the analysis that coho salmon survival falls between these two species, but there has never been a separate compensation level for steelhead and one for yearling coho salmon and Okanogan Basin spring Chinook salmon.

Ferguson asked if Douglas PUD is still proposing all three species be adjusted up to 3.96%, based on the approach. Kahler said yes, which is consistent with the language in the Wells HCP and the way the HCP has been interpreted over the 16 years of implementation. He said before this is done differently, the Wells HCP Coordinating Committee needs to step back and evaluate whether this other approach was contemplated and what it should look like. He said this would mean Douglas PUD has been mitigating incorrectly since 2002. Murdoch said this just sounds like new news to her and it is not the way she remembers dealing with this in the past.

Kahler asked Murdoch to let him know if she wants to discuss this offline. Murdoch thanked Kahler and said she might need help finding additional information or survival rates. Kahler said Douglas PUD does hope to finalize the survival study report and SOA as a 2020 action for compliance with the Federal Energy Regulatory Commission (FERC), and he asked Murdoch about how much time she might need for further review. Murdoch suggested touching base next week by December 1 or 2, 2020. Kahler and Murdoch said Douglas PUD and the YN will further discuss the language included in the draft SOA, *Approval of the Results of the 2020 Wells Project Survival Verification Study, Phase III (Standard Achieved)*, and will report back to Anchor QEA by the week of December 7, 2020.

Ferguson asked Chad Jackson if WDFW has any concerns with the SOA. Jackson said no, but he is interested to hear what Murdoch finds out.

Andrew Gingerich asked if the concern is about how the survival estimate presented in the SOA would influence steelhead mitigation or production? Murdoch said the concern is about how the math is being done. She said she thought yearling Chinook salmon and steelhead have different survival values and are mitigated based on different survival rates, and results of this survival study should only affect yearling Chinook salmon and not steelhead. She said she does not believe there is precedence to combine survival rates for these species. She said she may be remembering incorrectly, but she wants to be sure. Gingerich asked if Murdoch's interpretation is correct that steelhead have a separate survival estimate, would this influence just steelhead mitigation or production numbers? Murdoch said in her mind, the next hatchery recalculation will include a new value for yearling Chinook and coho salmon, and there will not be a new value for steelhead until a survival study is conducted for steelhead. Gingerich said in reviewing survival estimate numbers over the past five studies, spring Chinook salmon and steelhead numbers have remained within a certain range with the current study falling in the middle of the survival estimates calculated to date. He said he wonders if the group who signed the Wells HCP came to the understanding that because these survival studies are large efforts, once standards are achieved these studies are only required every 10 years. He said these studies include a lot of moving parts that are not just species-specific, but also include a number of varying environmental conditions in each study year. He said maybe there was recognition that it is not feasible to study every species, every year, in every environmental condition, which may be the rationalization behind using an overall average. He said maybe these differences in historical survival numbers are less species-specific and more due to environmental conditions that changed when each study was conducted. Murdoch said she thinks it is both.

Murdoch recalled back when the Wells HCP Coordinating Committee was discussing study methodologies, a lot of time was spent trying to match hatchery yearling Chinook salmon conditions with wild yearling Chinook salmon conditions. She recalled discussing fish size and adjusting run-timing to match wild spring Chinook salmon, and there was never discussion or concern about trying to match steelhead conditions. She said the entire time, the discussion was about this being the only check-in study for the yearling species for the next 10 years, and she did not think this would affect the survival values for steelhead or sockeye salmon.

Kahler said he just assumed everyone understood this, which is why Douglas PUD never considered discussing how the study results would affect hatchery and mitigation rates. He apologized for this oversight. He also recalled how in the discussion over which species to use and the timing of the 2020 study, the Wells HCP Coordinating Committee struggled with the challenge of representing all yearling spring migrants in Phase III (Standard Achieved), particularly steelhead and coho salmon, if the start date of the study was moved to earlier, because those species tended to emigrate later than wild spring Chinook salmon. In this discussion, Douglas PUD provided data and graphics of yearling summer Chinook salmon, spring Chinook salmon, coho salmon, and steelhead to inform the decision. Murdoch asked if 2020 was the first survival check-in study. Kahler said this was the second, that the first check-in study was in 2010. He said the 2010 study also studied yearling Chinook salmon and, as a result, the hatchery compensation rate was adjusted for all yearling species. He said sockeye salmon and subyearling Chinook salmon are not included in these adjustments but are both mitigated at 7%. He said these species are not under Phase III (Standard Achieved).

Ferguson said depending on how these discussions go, this may be beyond the HCP Coordinating Committee level and there may be a need to consult the HCP Policy Committee. He said if the discussion is about the original intent or changing the intent of the HCP, this is a policy decision. He suggested keeping this in mind.

B. DECISION: Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study) (Tom Kahler)

Tom Kahler said no comments were received on the draft report, *Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study)*, which was distributed to the Wells HCP Coordinating Committee by Kristi Geris on October 22, 2020. Kahler said approvals were already received from USFWS, NMFS, and the CCT.

Wells HCP Coordinating Committee representatives present approved the report, *Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study)*. *(Note: Jim Craig provided USFWS approval of the report via phone call on November 17, 2020; Scott Carlon provided NMFS approval of the report via email on November 20, 2020; and Kirk Truscott provided CCT approval of the report via email on November 23, 2020.)*

The final report was distributed to the HCP Coordinating Committees by Geris following the HCP Coordinating Committees conference call on November 24, 2020.

C. Draft 2020 Wells Post-Season Bypass Report and Passage-Dates Analysis (Tom Kahler)

Tom Kahler said the draft 2020 Wells Post-Season Bypass Report and Passage-Dates Analysis was distributed to the HCP Coordinating Committee by Kristi Geris on November 23, 2020. Kahler said the first page of the document (post-season bypass report) is a summary of Wells Dam bypass operations in 2020, and the rest of the document (passage-dates analysis) are the results that Drs. John Skalski and Richard Townsend produce about Plan species migrations affected by Wells Dam bypass operations. Kahler recalled that the first passage-dates analysis was developed in 2011, when Douglas PUD was determining how to evaluate bypass timing. He said there is a requirement in the Wells HCP to evaluate bypass timing every 10 years, which meant the first evaluation needed to take place in 2012. He said, therefore, Drs. Skalski and Townsend developed the first passage-dates analysis in 2011 and has added to this analysis every year since. Kahler said typically, Douglas PUD distributes this post-season bypass report and passage-dates analysis for Wells HCP Coordinating Committee review in October; however, this year, Douglas PUD and Drs. Skalski and Townsend were busy finalizing the survival verification study results. Kahler said additionally, Dr. Townsend needs to run queries in the Passive Integrated Transponder Tag Information System to complete the passage-dates analysis, and there were data entry mistakes in the tag fields that resulted in certain fish being excluded from the analysis. Kahler said Dr. Townsend eventually figured out what was causing the incomplete queries and was able to complete the draft document. Kahler said these are the reasons the post-season bypass report and passage-dates analysis is being distributed later than normal.

Kahler encouraged the Wells HCP Coordinating Committee to review the document and provide comments and questions. He said Douglas PUD hopes to have the full Committee present during the HCP Coordinating Committees conference call on December 15, 2020, to address any comments and questions at that time. He said he can also address questions now if there are any at this time. He said one thing to note, the Wells Dam bypass operating period for 2020 did very well, providing bypass passage to 100% of nearly 100% of all migrations of the various Plan species. He said additionally, several years ago, the Wells HCP Coordinating Committee requested to see what bypass passage was provided for the wild-only portion of the yearling and subyearling Chinook salmon migration; therefore, these data have been included in the passage dates analysis since 2012. He said similar to past years, the data indicate that wild yearling Chinook salmon started migrating earlier than the combined run at large in 2020. He said that while bypass timing was appropriate for the combined population at large, timing was a little late for the wild-only population. He recalled that the Wells HCP does not have a separate standard for wild-origin fish, but the Wells HCP Coordinating Committee expressed concern about protecting the wild population.

John Ferguson said this document was distributed yesterday, November 23, 2020, and is available for a 30-day review with edits and comments due to Kahler by December 23, 2020; however, Douglas PUD may request approval of the document during the HCP Coordinating Committees conference call on December 15, 2020. Kahler said this is correct, that Douglas PUD would like to request approval on December 15, 2020, if the Wells HCP Coordinating Committee is ready to vote; however, Douglas PUD will provide the full 30-day review, if needed, and can request approval via email at the close of review period.

D. 2020/2021 Wells Dam Winter Maintenance (Tom Kahler)

Tom Kahler said the Wells Project Superintendent indicated that the 2020/2021 Wells Dam winter maintenance will begin the week of December 28, 2020. Kahler said the first ladder will be taken out of service that week; however, he is unsure if this will be the east or west fish ladder. He said he will have another update to share during the HCP Coordinating Committees conference call on December 15, 2020.

IV. Chelan PUD

A. Rock Island Dam Powerhouse 1 Maintenance Update (Lance Keller)

Lance Keller said, as reported last month, work on Turbine Unit B4 continues and is progressing well. He recalled reporting that the return-to-service date for Turbine Unit B4 was December 2020, but this might stretch into January 2021. He said at this point, the outage is expected to stretch into the first 10 days in January 2021. He said this return-to-service date will be well before the initiation of the 2021 survival check-in study scheduled for April 2021.

B. Rocky Reach Dam Turbine Units Maintenance Update (Lance Keller)

Lance Keller said this week, maintenance crews have initiated the commissioning process on Turbine Unit C2. He said this includes watering up Turbine Unit C2, which means removal of the headgates that can now be used to dewater Turbine Unit C3 to begin the overhaul process in that unit. He recalled that Turbine Unit C3 will receive a trunnion bushings replacement, and the current return-to-service date for this unit of May 2021, is still holding. He said progress is also continuing on Turbine Unit C7, and the return-to-service date of March 2021, for this unit is also holding.

C. 2020/2021 Rock Island and Rocky Reach Adult Fishway Winter Maintenance (Lance Keller)

Lance Keller reviewed adult fishway maintenance updates at Rock Island Dam and Rocky Reach Dam, as follows:

Rocky Reach Dam

Keller thanked the Rocky Reach HCP Coordinating Committee for approving the early outage at Rocky Reach Dam. He said crews will begin dewatering the adult fishway on December 1, 2020, beginning with the upper portion of the adult ladder while maintaining water in the lower portion of the ladder equal to the tailwater elevation. He said crews will conduct a fish rescue in the upper fishway that same day. He said crews plan to dewater and conduct a fish rescue in the lower fishway on December 8, 2020.

Rock Island Dam

Keller said the right fish ladder will be taken out of service first. He said dewatering and a fish rescue in the upper portion of the fishway are scheduled for December 9, 2020. He said dewatering and a fish rescue in the lower section of the right ladder is scheduled for December 10, 2020. He noted that the dewatering and fish rescue schedules at Rocky Reach and Rock Island dams need to be coordinated because the same fish and wildlife staff conduct the fish rescues at both projects.

D. 2021 Rock Island Survival Check-In Study Plan (Lance Keller)

Lance Keller said a draft 2021 Rock Island Survival Check-In Study Plan will be available for review soon. He said Chelan PUD has already submitted a placeholder order into Advanced Telemetry Systems (ATS) for about 1,000 acoustic tags based on a sample size analysis conducted by Drs. John Skalski and Richard Townsend. Keller said the analysis is based on detection probabilities from previous studies and estimates the sample size needed to meet the precision requirements outlined in the Rock Island HCP. He said this tag order does not lock Chelan PUD into a specific number; rather, it is a placeholder so that Chelan PUD's tag requirements are in the manufacturing cue and ATS can procure long lead-time components such as batteries.

John Ferguson asked if Chelan PUD used ATS for the last survival check-in. Keller said last time, Chelan PUD used Hydroacoustic Technology Inc (HTI). He said HTI's manufacturing process was more hands-on compared to ATS, whereas ATS is more automated but the results include more QA/QC. He said for this large of a tag order, Chelan PUD needed to submit a placeholder with ATS to start a battery order, especially with potential delays due to COVID-19 restrictions.

V. HCP Administration

A. COVID-19 Updates (John Ferguson)

John Ferguson asked if there are any updates HCP Coordinating Committees members would like to share regarding impacts of COVID-19 on HCP activities. No updates were shared.

B. Chelan PUD HCP Representation Designation Update (John Ferguson)

John Ferguson recalled that Tracy Hillman announced that Chelan PUD officially identified Scott Hopkins as the Rock Island and Rocky Reach HCP Hatchery Committees Alternate, and Catherine Willard will continue as the designated Rock Island and Rocky Reach HCP Hatchery Committees Representative.

Ferguson said additionally, Chelan PUD officially identified Justin Erickson (Managing Director, District Services) as the Rock Island and Rocky Reach HCP Policy Committees Alternate, and Alene Underwood will continue as the designated Rock Island and Rocky Reach HCP Policy Committees Representative.

C. 2020 HCP Annual Reports (John Ferguson)

John Ferguson asked Kristi Geris to share an update on the 2020 HCP annual reports. Geris said Anchor QEA is beginning to draft these annual reports. She said deadlines of interest to the HCP Coordinating Committees include:

- *2020 Wells HCP Annual Report* (final report due to FERC by March 31, 2021): draft due to Douglas PUD for 14-day review on January 12, 2021, and draft due to the Wells HCP Coordinating Committee for 30-day review on February 5, 2021
- *2020 Rock Island and Rocky Reach HCP Annual Reports* (final reports due to FERC by April 15, 2021): draft due to Chelan PUD for 14-day review on January 20, 2021, and draft due to Rock Island and Rocky Reach HCP Coordinating Committees for 30-day review on February 18, 2021

D. Subyearling Chinook Salmon Studies – Quarterly Check-In (John Ferguson)

John Ferguson asked if Chelan PUD or Douglas PUD have updates on subyearling Chinook salmon studies.

Tom Kahler recalled that the *Wells Project Subyearling Chinook Life-History Study 2011-2013 Final Report* and comment/response matrix were distributed to the HCP Coordinating Committees by Kristi Geris on November 13, 2020. Kahler encouraged the HCP Coordinating Committees to review the documents. Ferguson asked if anything further is needed regarding finalizing the document. Kahler said no, the document was just distributed to complete the administrative record.

No other updates were shared.

E. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on December 15, 2020, to be held by conference call.

The January 26 and February 23, 2021, meetings will be held by conference call or in-person at the Grant PUD Wenatchee Office in Wenatchee, Washington, as is yet to be determined.

VI. List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman†	BioAnalysts
Lance Keller*	Chelan PUD
Bill Towey	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
Chad Jackson*	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation

Notes:

* Denotes HCP Coordinating Committees member or alternate

† Joined for the HCP Hatchery and Tributary Committees Update

FINAL

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206.287.9130

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: December 15, 2020

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris

Re: Final Action Items of the December 15, 2020 HCP Coordinating Committees Conference Call

This memorandum provides a summary of action items, decisions, agreements, and documents for review as discussed during the Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees meeting, which met by conference call on Tuesday, December 15, 2020, from 9:00 a.m. to 10:45 a.m. Attendees are listed in Attachment A to this memorandum.

Action Item Summary

- Chelan PUD will continue providing Rocky Reach Dam and Rock Island Dam turbine unit maintenance updates as information becomes available (Item I-C).
- Anchor QEA, LLC (Anchor QEA) will coordinate with the Colville Confederated Tribes (CCT) to arrange a presentation of *Reintroduction of Salmon Upstream of Chief Joseph and Grand Coulee Dams*, during the HCP Coordinating Committees conference call on January 26, 2021, and will notify the Yakama Nation (YN) once these plans are confirmed (Item I-C). *(Note: Kristi Geris emailed the CCT with the proposed date and time for this presentation, Casey Baldwin [CCT] confirmed this plan works for his schedule, and Geris notified the YN that these plans are confirmed.)*
- Douglas PUD will communicate to the Columbia River Inter-Tribal Fish Commission (CRITFC) the discussions regarding Jeff Fryer's (CRITFC) annual request to tag sockeye salmon at Wells Dam that took place during the HCP Policy Committees conference call on October 6, 2020 (i.e., not conducting additional sampling for sockeye salmon until a thermal barrier has set up in the Okanagan River) and during the HCP Coordinating Committees conference call on October 27, 2020 (i.e., stipulate in the next request letter, a request that sockeye salmon sampling periods are concurrent with both spring and summer Chinook salmon trapping operations) (Item I-C).
- Chelan PUD will update the Rock Island Dam overview figure that was shared during the HCP Coordinating Committees conference call on December 15, 2020, to include more details such as turbine unit and spillway gate labels, as well as a legend (Item III-A).
- Anchor QEA will set a reminder for June 2021 to consider scheduling an HCP Coordinating Committees in-person meeting at Rocky Reach Dam following completion of the Visitor's

Center renovation (tentatively set for June 2021; Item IV-D). *(Note: Kristi Geris set this reminder, as discussed.)*

- U.S. Fish and Wildlife Service (USFWS) will provide a vote via email on the 2020 Wells Post-Season Bypass Report and Passage-Dates Analysis no later than Friday, December 18, 2020 (Item IV-B). *(Note: USFWS approved the document via email following the HCP Coordinating Committees conference call on December 15, 2020.)*
- The HCP Coordinating Committees meeting on January 26, 2021, will be held at 9:00 a.m., by conference call (Item V-B).

Decision Summary

- Wells HCP Coordinating Committee representatives present approved the Statement of Agreement (SOA), *Approval of the Results of the 2020 Wells Project Survival Verification Study, Phase III (Standard Achieved)* (Item IV-A).
- Wells HCP Coordinating Committee representatives approved the 2020 Wells Post-Season Bypass Report and Passage-Dates Analysis, as follows: National Marine Fisheries Service (NMFS) approved via phone call prior to the HCP Coordinating Committees conference call on December 15, 2020; Douglas PUD, Washington Department of Fish and Wildlife (WDFW), the YN, and the CCT approved during the HCP Coordinating Committees conference call on December 15, 2020; and USFWS approved via email following the HCP Coordinating Committees conference call on December 15, 2020 (Item IV-B).

Agreements

- There were no HCP Agreements discussed during today's conference call.

Review Items

- There are no items that are currently available for review.

Finalized Documents

- The final SOA, *Approval of the Results of the 2020 Wells Project Survival Verification Study, Phase III (Standard Achieved)*, was distributed to the HCP Coordinating Committees by Kristi Geris following the HCP Coordinating Committees conference call on December 15, 2020 (Item IV-A).

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman†	BioAnalysts
Lance Keller*	Chelan PUD
Bill Towey	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
Jim Craig*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
Kirk Truscott*	Colville Confederated Tribes
Keely Murdoch*	Yakama Nation

Notes:
* Denotes HCP Coordinating Committees member or alternate
† Joined for the HCP Hatchery and Tributary Committees Update

Appendix B
Habitat Conservation Plan Hatchery Committees 2020 Meeting Minutes and Conference Call Minutes

FINAL

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509.888.2070

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Date: February 19, 2020

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Larissa Rohrbach, Anchor QEA, LLC

Re: Final Minutes of the January 15, 2019 HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees (HCs) and Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) meetings were held in Wenatchee, Washington, on Wednesday, January 15, 2020, from 10:00 a.m. to 3:00 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Joint HCP-HCs and PRCC HSC

- Mike Tonseth will coordinate with Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) to present pre-spawn mortality modeling results for spring Chinook salmon at an upcoming HCP-HC meeting (Item I-B). *(Note: this item is ongoing.)*
- Kirk Truscott will discuss with Colville Confederated Tribes (CCT) biologists whether elemental signature analysis could differentiate natural-origin Okanogan spring Chinook salmon from other natural-origin Chinook salmon during broodstock collection at Wells Hatchery for Methow Fish Hatchery programs (Item I-B). *(Note: this item is ongoing.)*
- Brett Farman will discuss with Charlene Hurst and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-B). *(Note: this item is ongoing.)*
- Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-B). (*Note this item is ongoing.*)
- Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-B). (*Note this item is ongoing.*)
- Mike Tonseth will confirm the completion date for an updated plan for Outplanting Surplus Methow Composite Spring Chinook (Item I-B). (*Note this item is ongoing.*)

- Greg Mackey and Mike Tonseth will provide edits to the draft 2020 Broodstock Collection Protocols to Larissa Rohrbach by Friday, January 31, 2020, for compilation and distribution to the HCP-HCs and PRCC HSC no later than Friday, February 7, 2020 (Item III-B).
- Keely Murdoch will provide Appendix K to the 2020 Broodstock Collection Protocols to Larissa Rohrbach for compilation when it is complete (Item III-B).
- Tracy Hillman will append the 2018 guidance from the panel of agency geneticists to the PUDs' Monitoring and Evaluation (M&E) Plan (2019 Update) for distribution (Item III-C).

Rock Island and Rocky Reach HCs

- Mike Tonseth and Catherine Willard will update the Broodstock Collection Protocols with the proposed plan for collecting Chiwawa spring Chinook salmon broodstock at Tumwater Dam and the Chiwawa Weir in 2020 (Item III-A).
- Mike Tonseth and Catherine Willard will update the Broodstock Collection Protocols with the proposed plan for collecting Chelan Falls summer/fall Chinook salmon broodstock at Wells Hatchery and in the Chelan River in 2020 (Item IV-A).

PRCC HSC

- Craig Busack (National Marine Fisheries Service [NMFS]) will provide written responses to the PRCC HSC's questions on White River spring Chinook salmon hatchery production (Item II-B).

Decision Summary

- The Wells HC approved Douglas County PUD's *Implementation of Comprehensive Monitoring and Evaluation of Wells Hatchery Complex Programs in 2020* via email and phone on December 24, 2019.

Agreements

- The HCP-HCs and PRCC HSC agreed to update the PUDs' M&E Plan (2019 Update) by appending the written guidance from the panel of agency geneticists developed in 2018.

Review Items

- There are no items available for review.

Finalized Documents

- The Wells Complex summer steelhead Section 10(a)(1)(A) permit and the PUDs' unlisted summer/fall and fall Chinook salmon bundle Section 10(a)(1)(B) permits were finalized and signed by all parties in September and October 2019, expiring December 31, 2029.

- The Wells HC-approved *Implementation of Comprehensive Monitoring and Evaluation of Wells Hatchery Complex Programs in 2020* was distributed by Larissa Rohrbach via email to the HCP-HCs and PRCC HSC on Monday January 1, 2020.

I. Welcome

A. Routine Safety Briefing

Grant PUD staff provided a routine safety briefing on emergency procedures for the meeting location.

B. Review Agenda, Announcements, Approve the November 20, 2019 Meeting Minutes, Review Last Meeting Action Items

Tracy Hillman welcomed the HCP-HCs and PRCC HSC to the meeting. Hillman reviewed the agenda and asked for any additions or changes to the agenda.

Hillman moved the PRCC HSC discussion on White River spring Chinook salmon to the top of the agenda allowing guest attendee Craig Busack to answer members' questions on NMFS' view of hatchery supplementation in the subbasin. The HCP-HCs and PRCC HSC members approved the revised agenda.

Several announcements were made.

- Keely Murdoch announced that David Blodgett III will replace Steve Parker, who has retired, as the Yakama Nation's (YN's) representative to the Policy Committee.
- Hillman announced that an assessment of survival estimates that are based on wild, passive integrated transponder (PIT)-tagged fish has been written for Upper Columbia populations as a chapter in the annual Comparative Survival Study report.[1] Hillman will distribute the relevant chapter to the HCP-HCs and PRCC HSC.
- Hillman shared highlights from a presentation by Laurie Weitkamp on recent ocean conditions and National Oceanic and Atmospheric Administration (NOAA) Fisheries' most recent report on "Ocean ecosystem indicators of salmon marine survival in the Northern California Current."[2] Conditions continued to be poor for salmon survival in 2019. Relatively warm ocean conditions have occurred since 2014; the biological responses have been huge and are likely to continue

[1] Fish Passage Center 2019. Comparative Survival Study of PIT-tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye. 2019 Annual Report. Prepared by the Comparative Survival Study Oversight Committee and Fish Passage Center. December 2019. Available at: http://www.fpc.org/documents/CSS.html.

[2] NOAA Fisheries. Outlook of adult returns for coho and Chinook Salmon. Available at: https://www.nwfsc.noaa.gov/research/divisions/fe/estuarine/oeip/g-forecast.cfm#TableSF-02.

for several years. Hillman said the presentation will be given at the Upper Columbia Science Conference taking place next week, January 22 and 23, 2019.

The HCP-HCs and PRCC HSC representatives reviewed the revised November 20, 2019 meeting minutes. The HCP-HCs and PRCC HSC members approved the meeting minutes as revised.

Action items from the HCP-HCs and PRCC HSC meeting on November 20, 2019, were reviewed, and follow-up discussions were addressed *(note that italicized text below corresponds to agenda items from the meetings on November 20, 2019)*:

Joint HCP-HCs and PRCC HSC

- *Mike Tonseth will coordinate with Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) to present pre-spawn mortality modeling results for spring Chinook salmon at an upcoming HCP-HC meeting (Item I-A).*
  Tonseth said pre-spawn mortality values will be available soon. This information will inform the Wenatchee Spring Chinook Management Plan and the sliding scale currently used to determine the size of the Nason and Chiwawa conservation programs. This item is ongoing.
- *Kirk Truscott will discuss with Colville Confederated Tribes (CCT) biologists whether elemental signature analysis could differentiate natural-origin Okanogan spring Chinook salmon from other natural-origin Chinook salmon during broodstock collection at Wells Hatchery for Methow Fish Hatchery programs (Item I-A).*
  Truscott said he is making progress and may have something available for distribution over email within the month. This item is ongoing *(Item I-A).*
- *Brett Farman will discuss with Charlene Hurst and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A).*
  Tonseth said he needs to provide Farman with the necessary data. This item is ongoing.
- *Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A).*
  Mackey said this item is ongoing.
- *Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A).*
  Mackey said he has written a plan for Wells summer Chinook salmon and Methow spring Chinook salmon. A response was provided on the spring Chinook salmon plan from Charlie Snow's office and Mackey is awaiting a response on the summer Chinook salmon plan. This item is ongoing.

- *Mike Tonseth will confirm the completion date for an updated plan for Outplanting Surplus Methow Composite Spring Chinook salmon (Item II-A).*
  Tonseth said he is currently reviewing a draft and that he is conferring with NMFS about additional questions that arose. Tonseth said he has no completion date yet. This item is ongoing.

Wells Hatchery Committee

- Keely Murdoch will contact Melinda Goudy (YN) to determine if there is capacity to transfer surplus summer/fall Chinook salmon eggs to the Yakima Basin programs (Item III-A).
  Murdoch said there was no capacity to accept eggs in the Yakima Basin. No eggs were transferred. This item is complete.

PRCC HSC

- Todd Pearsons will revise the 2020 Broodstock Collection Protocols to pilot test collecting natural-origin Priest Rapids Hatchery fall Chinook salmon in the Angler Broodstock Collection fishery.
  This item is complete.

II. PRCC HSC

A. Approve the November 20, 2019 Meeting Minutes, Committee Updates, and Meeting Summary Review (Todd Pearsons)

The PRCC HSC representatives approved the November 20, 2019 meeting minutes as revised.

Tracy Hillman reviewed the agenda. He explained that the intent of the agenda item on White River spring Chinook salmon recovery was to identify questions for Craig Busack. Busack was formerly the NMFS representative on the PRCC HSC and was involved in early discussions regarding White River spring Chinook salmon supplementation. Busack's responses to the questions will support decision-making on a White River spring Chinook salmon hatchery program.

B. White River Spring Chinook Salmon

Tracy Hillman welcomed Craig Busack who joined the meeting by phone with Brett Farman. Busack said he and Farman had conferred on the questions that were posed by the PRCC HSC and emailed to Busack on December 9, 2019. Busack said he flagged some of the questions for discussion with higher levels of authority and confirmed some answers with Mike Ford (NMFS). Hillman asked Busack to discuss his answers with the PRCC HSC in today's meeting and to provide his written responses via email following the meeting for clarity. The following are minutes of the discussion that occurred during the meeting.

1. Is the White River spawning aggregate necessary to the Wenatchee spring Chinook salmon population in regards to meeting viable salmon population (VSP) criteria?

Busack said the short answer is no, but it would help. Busack said, the long answer requires more research on past discussions and written statements involving NMFS. WDFW considered the White River spring Chinook salmon a separate population in the past, then NMFS reconsidered its importance to diversity. Busack said meeting the VSP criteria (abundance, productivity, spatial structure, and diversity), depends on considering each in context with all the others. Meeting the diversity criteria is not absolutely necessary if other criteria are met, but meeting the diversity criteria would be a good thing. Busack relayed a statement by Ford who said if the environment is distinctive enough to create a locally adapted aggregate in the White River, it will probably arise again if conditions are correct.

Kirk Truscott asked if the loss of White River spring Chinook salmon would reduce diversity and spatial structure that would need to be replaced by another spawning aggregate. Busack said he reviewed the Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan (UCSRB 2007; Recovery Plan),[3] which states that natural spring Chinook salmon spawning will occur in four out of five major spawning areas (MSAs) and in one minor spawning area (mSA). By these criteria, the White River aggregate is not essential for recovery. Busack said the standard that has to be met for production is relatively low. According to the Recovery Plan, the minimum number of naturally produced spring Chinook salmon redds within each MSA will be either 5% of the total number of redds within the Wenatchee subbasin or at least 20 redds within each major area, whichever is greater. Todd Pearsons said some people think the Upper Wenatchee River is not a viable MSA because it appears to be more of a sink than a sustainable spawning population. If the Upper Wenatchee River MSA is lost, should the Recovery Plan drop down to maintaining three of four MSAs, or some other revision, and how hard is it to revise that approach and the Recovery Plan? Busack cautioned that the Recovery Plan is not a regulatory document, it is an advisory document, intended to guide actions toward meeting recovery criteria. Busack said he is unsure what the Recovery Plan revisions and discussions would require and that the NMFS personnel that helped craft the plan have retired. Busack said if the question is whether maintaining four of five MSAs is wrong because the Upper Wenatchee River is not a real MSA, then this is a larger discussion. Bill Gale said there is no magic number directing how many spawning areas a basin needs to have. When the plan was developed, five MSAs were identified in discussions; however, in other basins like the Entiat,

[3] Upper Columbia Salmon Recovery Board (UCSRB) 2007. Upper Columbia Salmon and Steelhead Recovery Plan. August 2007. Available at: https://www.ucsrb.org/mdocuments-library/plans/.

only one was identified. Gale said it should not be surprising that information from 10 years ago would prove to be different now.

Busack said if managers cannot meet this criterion, he is unable to comment on whether the White River MSA is necessary for recovery. Farman said if it is a bigger question, as in, if that population no longer exists or is not valuable, then it is not a question that can be answered in this forum and requires a broader forum with the Upper Columbia Salmon Recovery Board (UCSRB).

Busack said, for example, the Lower Columbia River/Upper Willamette River recovery standards divided the Lower Columbia ESU into three strata and separate criteria were developed for all three. The Lower Columbia Salmon Recovery Board said the criteria were infeasible for the Gorge stratum and did not necessarily agree that there was historically that level of diversity. The Lower Columbia Salmon Recovery Board came up with their own criteria that was adopted in the recovery plan for that domain, but it was a long discussion [among all stakeholders].

Busack said [reexamining the importance of the White River] changing recovery criteria would likely require a Recovery Plan revision. Busack said even though the Recovery Plan is advisory and not regulatory, when NMFS reviews a Hatchery and Genetic Monitoring Plan, they must ensure it is consistent with the Recovery Plan. Hillman said it would be difficult to initiate a process to revise the Recovery Plan. Keely Murdoch said, with proper data that indicates that goals are unobtainable or incorrect, the discussion may be feasible. Hillman said the Counties may have difficulty with reinitiating these discussions.

Peter Graf asked, to maintain a spawning aggregate, is it necessary to maintain its diversity or abundance or both? Murdoch said it is both. Graf asked if the criteria could be met with fish distributed elsewhere that carry the White River genetic signal? Hillman showed the difference between diversity and spatial structure criteria in the Recovery Plan for maintaining a spawning aggregate. Graf said the question under discussion is, "is the White River aggregate necessary?" Hillman repeated Busack's answer, "no, but it would be good."

2. What is the NOAA's Northwest Fisheries Science Center's most recent view on the importance of the White River spawning aggregate?

Busack said he spoke to Ford who referenced the most recent FST data (a measure of genetic distance) that shows a difference in FST values of 0.0025 between Nason and Chiwawa aggregates, and 0.0025 between natural and hatchery fish throughout the [Wenatchee] Basin.

The difference in Chiwawa and White River aggregate FST values is 0.00409, which is twice as large as that between other aggregates. Ford cautions these are very, very small numbers such that the difference could be the result of genetic drift and reflect genes from other historic programs [rather than local adaptation]. Busack said though this metric shows the White River aggregate is distinct, it should be interpreted with caution. Ford wrote if habitat in the White River is distinctive, adaptation should develop there. Management decisions may be based on balancing short-term needs with long-term needs. Busack said the aggregates are genetically different but not hugely different and the analysis was done some time ago. Busack said that Ford, Shawn Narum (Columbia River Inter-Tribal Fish Commission [CRITFC] geneticist), and Ken Warheit (WDFW geneticist) were looking for outliers to show some selection signal and could not find it. Busack said the importance of the genetic diversity in the White River is uncertain.

Looking at the FST numbers, Truscott asked, should we conclude that there is no difference between hatchery-origin (HOR) and natural-origin (NOR) returns, and so the recovery should be based on total returns not just NOR? Busack said no, genetic distance that is based on neutral markers just indicates that HOR and NOR are interbreeding, but they should not be considered equivalent. Truscott said the same could be said between the Chiwawa and White aggregates that are known to interbreed and he would have expected closer FST values. Busack said genetic signature of White River aggregate will bounce around year to year due to the small number of spawners. Chiwawa and Nason aggregates are larger groups so the values of this metric would be more stable.

Busack said, as a geneticist, he avoids looking at FST values. Gale asked if the difference between Chiwawa and Nason is a negligible number. Busack said as an author of regulatory documents, he avoids using the word negligible, but there is not strong evidence for biologically meaningful differentiation here. Pearsons said he wondered if the numbers Ford was using to show differences were based on numbers collected since the last geneticist panel discussion.

Hillman asked what size FST would be considered biologically significant or meaningful. Busack said approximately 0.1, for example, based on other populations. Busack said he typically does not use FST values, but 0 indicates no difference and 1 indicates complete genetic/reproductive isolation. Gale said, for context it would be good to know the FST differences between, for instance, Chiwawa and Methow spring Chinook salmon. Busack read from a table from Todd Seamons showing that different winter steelhead in the Puget Sound have FSTs of 0.5. Farman said it is not helpful to go down the path of identifying specific FST criteria for what identifies a spawning aggregate because it may not be a target we can define. Farman said his sense is the most recent data indicate the White River MSA is still a distinct spawning aggregate and these data support what is currently in the Recovery Plan. Farman said there is not going to be an FST value chosen that would indicate that no action would be required.

Tom Scribner said he has been involved in the White River program since the inception and observed the resources spent on a major and expensive captive broodstock program. He asked if the perspective has changed today relative to the past when it was considered so important to initiate a captive broodstock program. Busack regrets the money spent on the White River in the past. With many years of observations, more data, and shift in general views toward salmon recovery, NMFS has backed off from their original position a few years ago. Busack said given the overall challenges salmon recovery faces it is uncertain how much the status of a small spawning aggregate should be emphasized. Busack said to his knowledge, there is no other place where there has been so much focus on one population subcomponent, especially for Chinook salmon. Busack said the Upper Columbia Evolutionarily Significant Unit (ESU) is different too; there are only three extant populations to work with, which is different compared to, for instance, the Salmon River with around 25 populations to work with. Busack said ideas have evolved.

3. If the White River and Little Wenatchee spawning aggregates are important to recovery and both suffer from the same limiting factors, how will NOAA address recovery without one or both aggregates?
   a. Can both aggregates be considered one aggregate?
   b. Is there a need to revise the existing Recovery Plan?

Busack said It would be good to review the Recovery Plan to discern what is stated about diversity versus demography, but that he recollects that the material on diversity was not as comprehensive, thorough, and demanding as he thought it would be. There is not a discussion on what the decision would be if maintaining diversity is not working. Hillman said there is a draft of an adaptive management plan associated with the Recovery Plan that may be informative.

4. How important is the White River aggregate to the overall genetic diversity of Wenatchee spring Chinook salmon?
   a. How much within-population genetic variation is needed for recovery?
   b. Given the degree of escapement by other within-basin aggregates into the White River, is there evidence to suggest that the White River aggregate is still genetically distinct?

Hillman said the answers to this question are likely consistent with question 1. Busack said people assume there is a formula for reviewing the VSP metrics to measure how close an ESU is to recovery. Busack said there is no standard formula for evaluating recovery; everything has to be reviewed in the context of everything else. Busack said no ESU has been delisted yet. During delisting discussions, the first metric considered is usually natural-origin abundance. Diversity has yet to be considered as a key factor in terms of delisting.

5. If the White River genetic signature is lost, can recovery still be achieved?

Busack said yes.

   a. If so, how do we achieve recovery without the White River genetic signature?

Busack said it needs to be assured that in the Recovery Plan there are heightened levels of diversity elsewhere. Pearsons asked, hypothetically, in a worst-case scenario where White River aggregate dies out and recolonization by Chiwawa or Nason aggregates occur, how would recovery be met? If other criteria are met for recovery based on abundance, spatial structure, etc., how do you show you have met the criteria for genetic diversity?

Busack said it would be desirable to observe diversity among the spawning aggregates. Even though the White River would be recolonized, it would be desirable for enough time to pass to see genetic differences develop between aggregates. Pearsons asked what if gene flow continues as it occurs now? Busack said an aggregate does not have to be free of gene flow, but there has to be some measure of genetic divergence greater than that caused by simple genetic drift. Busack said no one has ever brought these issues to NMFS before. If an aggregate is meeting other criteria such as productivity and abundance, diversity is likely to develop on its own. Mike Tonseth said an argument could be made, if recolonization is natural over a long enough period of time and the White River environment is unique, that the diversity criteria are being met. Busack said local adaptation is hard to prove and is typically assumed. Busack said delisting is a larger process than hatchery management and outside his area of emphasis. Pearsons said its helpful to have a target in order to design programs. Busack said the target should be natural sustainability.

6. Would NOAA support a composite broodstock hatchery program for the White River?

Busack said he and Farman do not like to use the term "support" to describe their role. NMFS' role on ruling on Hatchery and Genetic Management Plans (HGMPs) is to ensure they are consistent with recovery. As long as compositing is consistent with, and not limiting recovery, NMFS would probably approve the actions, but would not be enthusiastic about it. Busack acknowledged that a broodstock program may not be possible without compositing because there are not enough White River fish to support a hatchery program there. Busack said perhaps the population is too small right now for selective forces to act on it. Busack said it is important to ask how useful compositing would be for recovery and whether it would help the program.

7. If White River spring Chinook salmon are not genetically distinct from other Wenatchee spring Chinook salmon aggregates, what would be NOAA's view on White River supplementation?

Busack said if the question is, if there is no genetic concern, then the answer is similar to question 6. Busack said, from what you have told us about the White River, it is important to ask if supplementation is really the answer.

8. If HORs do not contribute to NORs, would adding another supplementation program in the Wenatchee contribute to recovery?

Busack said we (NMFS) would like to know that the underlying population would sustain itself. Adding HORs to the spawning population temporarily creates more NOR recruits. A small population may have high genetic drift and may be inbred. Adding HORs can help by contributing to supplementation to allow selective forces to work on a population.

Pearsons asked if NMFS would assess whether that natural population is sustainable with HORs in the population, or does recovery require demonstrating that natural populations could sustain themselves without the hatcheries?

Busack said this is currently a major issue under broader discussion. That is, if HORs are successful, they are contributing to NORs but the level of their contribution is unknown. This has been an issue with Snake River fall Chinook salmon. Productivity of those fish has been better than expected, but this is in context of many hatchery fish being released. Busack said potential statistical techniques that could parse this out may be informative.

Pearsons asked, is it the interpretation that the standard for recovery would not be that all hatchery production is stopped to observe whether a population is naturally sustaining? Busack said messaging from NMFS on this topic has not been good. There is a widespread assumption that recovery cannot be achieved without turning off all the hatcheries. Busack said knowing if natural productivity has been achieved is very difficult in the context of hatchery production. Busack said NMFS would be open minded to shutting off hatchery production in some locations to make this observation if it were acceptable with stakeholders.

Pearsons asked, if there is a hatchery program that does not increase NORs, would that constitute something that would not contribute to recovery? Farman said the answer to the first part of the question is to confirm that the hatchery program is not contributing to recovery. The hatchery program may still contribute or prop up the population even if NORs do not increase.

Pearsons asked whether every permitted program action has to contribute to recovery? Busack said actions have to be consistent with the Recovery Plan but does not have to be contributing measurably to recovery, but asked if this question was about permitting or delisting? Pearsons said permitting.

Tonseth said the assumption that the hatchery is not producing NORs may be an oversimplification. Just because you do not observe the uptick in NORs does not mean the hatchery is not contributing. There could be outside forces like poor ocean conditions affecting productivity. Pearsons said if increases in NORs are not observed in other Wenatchee River watersheds, why assume it would work in the White River? Murdoch said the other element not considered here is whether there are other factors that limit natural production. It is not clear what is limiting productivity whether in freshwater, estuary, ocean, etc. Murdoch said the hatchery fish would be subject to the same limiting factors.

Murdoch said the hatchery program buys time and is helping to preserve genetic components and numbers while other limiting factors are being addressed.

Pearsons asked, if no increase in natural productivity metrics is observed, how can the value of the hatchery be assessed? Murdoch said the value is that the hatchery provides a cushion against catastrophic population failure. Pearsons said he understands that a hatchery program can buy a population time, but asked if natural productivity is not consistently found to be working across many subbasins, how can the value of hatchery programs be measured? Murdoch said this depends on definition of success of the programs. Murdoch said a hatchery program is working if it reduces risk of extinction. If whether a hatchery program is working to supplement natural productivity alone is in question, this depends on addressing the other limiting factors.

Hillman asked how would NMFS evaluate a proposed hatchery program in the White River? It seems they would determine whether it precludes recovery and is consistent with the Recovery Plan. Farman said he agrees that it would provide a buffer to failure. Hillman summarized that a hatchery program may be acceptable to NMFS if it does not preclude recovery.

Busack said the general approach to supplementation hatcheries in the Upper Columbia is a risk-aversion measure. There is some risk that they are eroding diversity through domestication though there are no hard numbers to indicate how much they do that. Right now, extinction risk is not going down due to ocean conditions.

9. If survival data indicate the bottleneck for White River spring Chinook salmon is predation (e.g., bull trout) within Lake Wenatchee, how do the federal regulatory agencies interact to resolve the issue?

Busack said he is aware of one example in the Clackamas River where work was done to increase bull trout range and the question was whether bull trout would eat Chinook salmon. Busack said the approach to working with U.S. Fish and Wildlife Service (USFWS) ranges widely depending on personnel working on the issue. His personal experience has been with bull trout consultations working with three different state offices and the approach has been different in all three. Busack said the issue is also arising when considering the relative risk of increasing hatchery fish production relative to orca extinction risk. Gale said agencies can work together on this, but the difficult discussion is to choose between two imperiled species, which is not easy. Farman said in the absence of a concrete proposal and assumptions about bull trout predation in Lake Wenatchee, it is hard to know what to consult on with USFWS. Farman said that the project proponents, and not NMFS, would need to develop a proposed action. Busack said it would be better to co-develop the action rather than for one party to propose something the other has to consult on.

Scribner thanked Busack for joining the meeting, answering questions, and for providing honest responses. Scribner said the YN Tribal Council has been very interested to hear the responses given today and he will be reporting back to them. Scribner said he is hearing a lot of vagueness and uncertainty that there is no backup plan or set path forward for recovery. Scribner said he would like to bring this back to the Tribal Council with a better path forward and with more certainty about the sideboards around the path forward. Scribner asked, how do we get to resolving some of the uncertainty around how to interpret recovery? Scribner said, for example, YN fisheries are restricted and he needs to show that there is a path forward.

Focusing on productivity in the White River, Busack said NMFS would not rule out a White River supplementation program. Scribner said it is not just the White River. He needs to understand how spawning aggregates relate to the overall recovery of the ESU. Scribner said he needs a clearer picture of what it will take to achieve a sustainable population that meets the ESU criteria.

Busack said this is a big question and advised starting a dialogue with Michael Tehan about this. Tehan is in charge of the interior Columbia basin office and questions of recovery, such as potential revisions to the Recovery Plan, should be directed to him. Busack suggested starting by talking to Dale Bambrick, who reports to Tehan. Busack said the difference between hatchery consultations and recovery has been an issue for some time. Farman said the difficult position is that NMFS is not an action agency. Farman said he is trying not to be indifferent but would not take the role of an advocate for a specific program. Farman said NMFS takes a middle role to review permits but does not advocate for certain programs. (Note that additional clarifying comments were provided by Busack via email on January 21, 2020, provided in Attachment B, and written responses to the questions provided by Busack on February 10, 2020 are provided in Attachment C. Busack noted that if any discrepancy exists between these meeting minutes, and his formal written responses, the formal responses should be considered the authoritative version.)

Busack thanked the PRCC HSC and left the meeting.

Hillman asked if there were any follow-up questions or discussion from the PRCC HSC members. Hillman summarized that Busack's responses were somewhat expected and that his answers would refer back to the Recovery Plan.

Murdoch said, as Busack described it, there is flexibility in the Recovery Plan, whether the region is willing to revisit it or not. Tonseth said he suggests initiating a discussion with the UCSRB to identify how flexible the plan really is, whether it can be updated with recent data. Murdoch said she also now realizes there may be more flexibility in how to operate a hatchery program as directed by the PRCC HSC, and NMFS would approve if consistent with the recovery plan. Gale said NMFS decides whether a population should be listed. The Board's plan is advisory because they are not the decision-makers, and it depends on whether hatchery program actions meet Recovery Plan goals. Gale said NMFS is a regulatory agency, but that NMFS may advocate certain positions as an HCP member. Murdoch said that during HGMP development, Chris Peterson (formerly the NMFS representative on the HCP-HC and PRCC HSC) abstained from approving the Proposed Action in the HCP meetings because NMFS would later be consulting on it. Tonseth said if what is proposed is inconsistent with the Recovery Plan, the action may not be approved by NMFS because it opens up the risk of litigation. Tonseth noted NMFS did contribute to and review the content of the HGMPs.

III. Joint HCP-HCs and PRCC HSC

A. Collection Site for Chiwawa Spring Chinook Salmon Broodstock

Catherine Willard gave a presentation entitled, "*Chiwawa Brood Collection*" (Slide 1) showing a history of broodstock collection for the Chiwawa spring Chinook Hatchery Program and recent observations since the amended permit in 2014 with collection at the Chiwawa Weir. Willard said Mike Tonseth and Chris Moran (WDFW) assisted with gathering the data shown. Willard's presentation is included as Attachment D.

Slide 2: Historic brood collection summary table. Data shown included the collection locations, years in operation, and brood and smolt targets. Collection locations were combinations of Chiwawa Weir, Tumwater Dam, and Chiwawa River via snagging. The period 2008 to 2010 preceded recalculation. During recalculation, parties agreed to reduce broodstock collection to 298 (because permitted levels were not being met) and allow overwinter acclimation at Chiwawa. Thus, broodstock collections dropped in 2013 with recalculation.

Tonseth said 2013 was a proof of concept year for parentage-based tagging as an alternative brood stock collection method utilizing fish collected at the off-ladder adult fish trap (OLAFT) and assigning fish recollected at Tumwater to a subbasin. Tonseth said there was no way to differentiate White River spring Chinook salmon effectively and this was not a successful approach.

Willard noted that from 2014 to present, the primary broodstock collection location is the Chiwawa Weir. Additionally, previously PIT-tagged natural-origin smolts originating from the Chiwawa River that are recaptured at Tumwater as adults are incorporated into the brood. Hatchery-origin fish are also collected at Tumwater Dam to backfill conservation program short-falls.

Slide 3: Brood origin summary table by year. Data summarized for the past 5 years include the number of NOR brood collected at the weir, number of HORs used to backfill, and the number of the NORs that were PIT-tagged as juveniles and were recaptured.

Slide 4: Summary table of Chiwawa Weir trapping days and bull trout encounters by year. Challenges to collecting NORs at the weir include low numbers of NORs captured and trapping limitations due to bull trout encounters. This has resulted in the need to backfill the Chiwawa Hatchery program with HORs, with a negative effect on proportion of natural-origin broodstock (pNOB) (and PNI). Annual limits to bull trout encounters are based on the average bull trout spawning population over the past 5 years. WDFW calculates bull trout population size from spawner surveys conducted in index reaches in the Chiwawa River basin.

Slide 5: Summary table of PNI by year. As runs have declined and bull trout encounters have increased, PNI has declined. Only in 2015 was a pNOB of 1 achieved.

Slide 6: Summary table of PNI by year, with PNI if pNOB had been 1.

Slide 7: Genetics. Summary of the microsatellite based genetic assignments of fish collected at the Chiwawa Weir by year. WDFW analyzed microsatellite genetic markers since 2014 (excluding 2018, which were being analyzed by CRITFC at the time for PBT). Assignments were made by using a 90% genetic assignment threshold for highly likely to assign to the Chiwawa basin and below 90% as positive but possibly ambiguous. The threshold for positive assignments is 60% or greater. Many fish in the subsample are unassigned because they assign to two different baseline populations.

Slide 8: Genetics. Summary of the genetic assignments compared between Chiwawa Weir and Tumwater Dam. Genetic analysis was done on fish at Tumwater Dam in order to exclude White River fish from being included in broodstock. Keely Murdoch noted that the genetic composition of spring Chinook salmon sampled at Tumwater Dam and at the Chiwawa Weir looks surprisingly similar, except for the percent of the trapped population that assign to the White River. Bill Gale said the difference may be an effect of numbers being trapped that are different between the two sites but agrees they are surprisingly similar. Murdoch also cautioned that there is a lot of uncertainty around the genetic assignments based on microsatellites. Kirk Truscott said it would be interesting to know if the precision of assignments was similar at Chiwawa Weir versus Tumwater Dam. Gale asked if the most likely identity of the unassigned fish are crosses between aggregate spawning groups (Nason-Chiwawa crosses, Chiwawa-White crosses, etc.). Willard, reading from the geneticist's report, stated that the majority of unassigned fish were likely Chiwawa-Wenatchee and Chiwawa-Nason crosses. Tonseth said samples are from broodstock that were collected for the Chiwawa program and do not necessarily reflect the run at large at Tumwater Dam.

Slide 9: Tradeoffs between collection sites. Willard summarized advantages and disadvantages of using Tumwater Dam compared to Chiwawa Weir for collecting broodstock. Willard said she is offering the details on both options because the program is currently not meeting PNI targets stated in the permit. Truscott asked whether the sliding scale is being used to meet PNI requirements.

Willard said yes, PNI goals are based on a sliding scale. Additionally, the permit states that in addition to the sliding scale, the mean PNI over five years is expected to be no less than of 0.67 and actions should be reevaluated if not meeting that target. Murdoch agreed and said that the PNI sliding scale tool may also require reevaluation with more years of data. Gale said regarding bull trout, spring Chinook salmon broodstock collection at Tumwater Dam affects primarily the Chiwaukum bull trout population, whereas collection at Chiwawa Weir affects the Chiwawa bull trout population. A disadvantage of using the Chiwawa Weir to capture spring Chinook salmon broodstock is the double handling of bull trout (i.e., bull trout captured at both Tumwater Dam and the Chiwawa Weir). Murdoch said those impacts of double handling could also be an impact on other native fish.

Tracy Hillman noted that a decision should be made prior to completion of the 2020 Broodstock Collection Protocols. Willard proposed adding a placeholder to the protocols and finishing the decision in the next meeting.

Tonseth said collecting broodstock at Tumwater Dam would be compositing the Chiwawa population, which has not been supported by the state. Reluctantly, WDFW moved in that direction with Nason Creek in order to implement that program. The genetic data do not tell where the parents of these fish spawned. Tonseth said the Relative Reproductive Success Study shows that offspring are highly likely to return to that tributary to spawn. Tonseth said the state is interested in allowing for local adaptation to continue. He said there is not a biological or abundance issue here; it is an operational issue. Tumwater Dam is able to accommodate the numbers required for the programs. Tonseth said constraints are currently in the hatchery programs' USFWS Biological Opinion (BiOp) regarding bull trout take at the Chiwawa Weir and there was negotiation over an action plan to be able to achieve broodstock for the Chiwawa program and minimize impacts to bull trout.[4] Tonseth said at that time, concerns were expressed that the sideboards in the BiOp for the protection of bull trout may be too constraining. Gale said USFWS entered into that negotiation with the perspective that the collection plan would be affecting multiple populations of bull trout and although it was not ideal, they allowed the operations to go forward and parties moved toward the center on the negotiation. Tonseth said discussions should occur again before whole-heartedly abandoning the Chiwawa Weir and compositing the Chiwawa brood from Tumwater Dam. Gale said these populations have already been composited and the populations are not distinguishable anymore. Tonseth said there are differences in the individual fish depending on where the parents of that individual spawn. Tonseth said these differences are important to maintain for the most important spawning aggregates for recovery of the Wenatchee population. The compositing that occurred in the past was not directed in the same way. Murdoch said, based on the genetic data

[4] United States Fish and Wildlife Service (USFWS) 2017. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion Consultation for the Wenatchee River Spring Chinook Salmon, Summer Chinook Salmon, and Steelhead Hatchery Programs. November 27, 2017.

collected, compositing is already happening at the Chiwawa Weir too. There is no way to know if fish collected at the Chiwawa Weir are from that river or are ducking into the river temporarily before moving to another tributary.

Willard said, out of 133 samples collected at the Chiwawa Weir (lacking data from 2018), 25% assigned with 95% or greater certainty to the Chiwawa River, 36% at 90% or greater, and 39% at less than 90% certainty. Truscott said he thought that would have been higher.

Murdoch said a decision before the committee is whether increasing PNI by collecting more NOR at Tumwater Dam is more important or whether it is more important to use fish that were trapped in the Chiwawa River.

Tonseth said when permits were approved to collect at the Chiwawa Weir, it was recognized that some fish from other spawning aggregates would be captured at the Chiwawa Weir. Tonseth questioned whether to run genetics on fish collected at the Chiwawa Weir or assume all fish collected at the Weir originated in the Chiwawa.

David Clark (WDFW) said the bull trout encounter threshold was met very early in the season in 2019, and it will be an ongoing problem constraining them to only trapping during the early part of the run.

Gale said, ideally, to allow the two spawning aggregates to separate, the current approach is not a good fit because it involves compositing for the Nason program, which will make the Nason program more similar to the Chiwawa, and then attempting to keep the Chiwawa aggregate separate from all other aggregates.

Truscott said the system is not set up that way. The original goal was not only to put more fish on spawning grounds in the Chiwawa River but to manage for local adaptation. Why not use the Chiwawa Weir to try to maintain local adaptation? Tonseth said in the past it was necessary to do adult management at Tumwater to reduce the stray rate of Chiwawa fish, but it seems to have been brought under control in recent years. It is unknown whether or not you could see the same effect by doing adult management at the Chiwawa Weir.

Peter Graf asked if fish are differentially marked depending on whether they are progeny of fish collected at Tumwater versus Chiwawa Weir. Graf said essentially there is a Tumwater composite that is going to the Chiwawa program, assuming that will continue if it is necessary in the future to continue backfilling the program. Matt Cooper asked if juvenile fish that are PIT-tagged in the Chiwawa River are genotyped and asked if they genotype back to the Chiwawa aggregate. Willard said juvenile fish are collected with electrofishing gear and PIT-tagged in the Chiwawa River, but they are not typically genotyped. Willard said one Chiwawa sample was accidentally genotyped due to a mix up of samples and it was found to have a different genetic assignment: 64% Chiwawa with a mix of Nason, White, and Leavenworth markers. Graf noted that the composition appears really similar to the population composition at Tumwater and perhaps reflected compositing that had occurred historically.

Tonseth said, regardless of the genetic composition of the fish, if the parents of an individual spawned in the Chiwawa River, it is likely that fish will return to the Chiwawa River. Tonseth said trapping adults lower in the system takes the program farther away from maintaining local adaptation.

Willard said by using the Chiwawa Weir, PNI would not be met; although, total adult collection and smolt production targets have been met every year except for 2019.

Murdoch said retaining more NORs to achieve 100% NOR broodstock means a few more HORs would be spawning on the spawning ground, but natural-origin productivity would be increased due to the hatchery production. Murdoch said her preference would be to achieve the NOR broodstock goal (pNOB = 1) and allow more HORs onto the spawning grounds.

Tonseth said in 2018 and 2019, very few PIT-tagged NORs (PIT-tagged as juveniles) returned to Tumwater Dam and that trend is not likely to change due to poor ocean conditions, so the question of where to capture broodstock is now an operational problem.

Brett Farman said NMFS is in concurrence with WDFW to collect primarily at the Chiwawa Weir to maintain some level of local adaptation. Farman said acknowledging that compositing has taken place in the past is different than developing a management plan that directs compositing to occur in the future. Farman said he would like to work with the USFWS to define impacts differently. That is, encounters at the Chiwawa Weir do not necessarily constitute lethal take.

Tonseth said the permit allows for a maximum number of days operating the Chiwawa Weir and a cap on bull trout encounters. He added they have never reached the maximum number of days because they reach the bull trout cap before they reach the maximum allowed trapping days. Tonseth suggested discussing which limit is most appropriate.

Gale said if the HCP-HCs want to develop a proposal, Sierra Franks and Cindy Raekes (USFWS Ecological Services) can consider them in Consultation discussions. Gale said his answer is going to be that if the program is collecting the same fish from either location, why would we decide to increase the impacts on bull trout by collecting at both sites. Gale said they cannot be differentiated genetically. They have been mixed up completely in the past.

Truscott said if operating these programs to sustain local adaptation in the long term is not the goal, they need to rethink their direction completely.

Gale said it is not that the population in the Chiwawa has changed, it is that the Nason aggregate was made more like the Chiwawa. The Chiwawa fish were already locally adapted. Gale said what is needed is for the Nason aggregate to become locally adapted to Nason Creek, but that will not happen because they are being composited.

Truscott said using a higher genetic assignment rate than 60% would be better. Willard said they would use a genetic assignment rate of 90% or more.

Tonseth said he would not be satisfied because you could have a fish that assigned to the Chiwawa River, spawns in Nason Creek, so its offspring would return to Nason Creek, but if removed at Tumwater Dam it would not be allowed to return to Nason Creek.

Murdoch asked what level of micromanagement of spawning aggregates is necessary to maintain diversity when we are talking about three very similar tributaries and aggregates? Truscott said salmon have adapted to return to their native spawning ground and have site fidelity even within a reach. This is an adaptation that has allowed them to survive for thousands of years and should be sustained.

Gale said the Nason aggregate became like the Chiwawa aggregate when Chiwawa fish made up a large portion of the Nason broodstock composition over multiple brood years. Gale said programs should worry about local adaptation when there are abundances of fish that allow for management at the level of the spawning aggregate.

Hillman said if we have conversations with USFWS Ecological Services regarding increasing the number of bull trout that can be handled at the Chiwawa Weir, and hypothetically they allow the handling of up to 20 or 25% of the 5-year mean population size at the Chiwawa Weir, would all HCP-HC members agree to continue to use the weir for broodstock collection, or would this result in the handling of too many bull trout more than once?

Murdoch said their priority is to meet hatchery production goals primarily with NORs. Murdoch said she is interested in whether there are any data on unintended consequences of operating the Chiwawa Weir, such as fish straying as they encounter the weir. Hillman said there are observations on percent of brood that have strayed into other aggregates. For example, in 2010 to 2013 when the Chiwawa Weir was down, there was less straying. Hillman said the stray rate data suggest a correlation. Murdoch said it would be interesting to see the data by return year rather than by brood year.

Tonseth said there is currently a permit that spells out how fish will be collected to achieve brood for the program. A parallel path could explore the options for collection at different sites (e.g., use of one site only, collecting some component at Tumwater). Tonseth suggested following the program plan until there is a proposal to bring to the USFWS for consideration. Gale said depending on the proposal, there may be a range of reactions, for instance, ranging from describing in a letter how far programs would be deviating from the permits to reinitiating consultation. Tonseth said reinitiating consultation would not change the ongoing permitted operations. Gale reminded everyone that this BiOp was written for all Wenatchee programs. Tonseth said reinitiating consultation in the past (in 2014) moved the program under Section 10 of the Endangered Species Act and allowed WDFW to reconsult on a portion of the BiOp and not the entire BiOp. Gale said when the USFWS considered the Chiwawa Weir operation, the proposal was to operate 24 hours up and 24 hours down, which extended the overall trapping period. Gale said there are days that flows impact weir operations and suggested changing the criteria on operations.

Hillman asked if adult bull trout collected at the Chiwawa Weir are PIT-tagged. Willard said yes. Hillman said if fish are re-encountered and the data show high survival rates, the impact of the weir on bull trout could be better assessed. Chris Moran (WDFW) said there may not be enough redetections post-release to make an assessment. Hillman said if fish could be detected going upstream and again going downstream, you could say something about survival. Willard said, because trapping is only happening for up to 6 days, it is difficult to assign impact to the encounter with the weir and not with other impacts.

Hillman asked the HCP-HCs if the program is going forward with the existing protocols. Willard said something needs to change because they will still be limited by bull trout encounters, will still scramble to convene meetings with USFWS in-season, and will ultimately have to resort to collecting hatchery-by-hatchery brood at Tumwater Dam.

Gale said perhaps in this era of low returns, now is the time to reset approaches to collect all Chiwawa brood at Tumwater Dam, and then address how to improve on local adaptation in the future.

Tonseth suggested that he and Willard work together on a proposed approach to be recorded in the 2020 Broodstock Collection Protocols.

B. Broodstock Collection Protocols Progress Update

Tracy Hillman said the draft of the 2020 Broodstock Collection Protocols are not quite ready for internal review. Grant PUD has made their revisions but contributions from Douglas PUD and WDFW/Chelan PUD are still needed. The HCP-HCs and PRCC HSC have time to compile information and edit the protocols before the deadline of 10 days prior to the February meeting.

Mike Tonseth said the adult management section needs work in the main body of the Broodstock Collection Protocols for spring Chinook salmon. He is still waiting on ocean survival information.

Keely Murdoch will provide Appendix K on the YN's coho salmon program as soon as information is available.

Larissa Rohrbach will compile edits into one draft document and will distribute it no later than Friday, February 7, 2020, which is 10 days prior to the February meeting. Rohrbach will require edits by the end of January for compilation.

C. M&E Plan – Geneticist Guidance Attachment to the M&E Plan

Tracy Hillman reminded the committees that early in 2019 it was suggested that the written guidance provided by the panel of geneticists consulted in 2018 be appended to the PUD's M&E Plan (2019 Update). All members agreed to update the M&E Plan by appending the guidance from geneticists.

IV. Rock Island/Rocky Reach HCs

A. 2019 Chelan Falls Summer/Fall Chinook Broodstock Collection Summary

Catherine Willard gave a presentation entitled "2019 Chelan Falls Brood Collection Summary" (Slide 1). Willard's presentation is included as Attachment D.

Slide 2: Willard summarized activities in 2019. The weir was installed on July 11 with help from the CCT. For the pilot year, weir pieces and a trap box were borrowed from WDFW. The trap box turned out to be too small to trap at night (which would have required fish to be held at high densities longer than the biologists were comfortable with). Trapping occurred from July 17 to August 14. The trap was opened in the morning as early as possible and hours of operation were limited due to high temperatures and to avoid filling the trap to capacity. A WDFW Hydraulic Project Approval (HPA) permit was issued for the installation and operation of the weir. It was determined that a U.S. Army Corps of Engineers permit was not needed by using bags filled with gravel instead of sand bags, then opening the bags at the end of the activity to deposit the gravel as part of the ongoing gravel augmentation project in the Chelan River.

Slides 3 and 4: Lessons were learned in the pilot year. Willard said approximately 200 fish nosed up under the weir and escaped into the pool at the outlet of the water conveyance canal. Chinook salmon were removed from the pool by seine. Some summer Chinook carcasses were recovered from fish that died upstream of the weir. They resolved the challenge with the weir by zip-tying the pickets together. After the pickets were zip-tied, no more summer Chinook breached the weir. Willard said a bonus to operating the weir, was the added benefit of Northern pikeminnow removal, which is a tool within the HCP to achieve survival studies.

Slide 5: Willard made comparisons of hatchery spawning metrics between broodstock collected at Wells Hatchery and within the Chelan River. Willard said fecundity was similar and bacterial kidney disease (BKD) ELISA values were slightly higher in the Wells group. The number of fish collected were 380 from Wells Hatchery and 200 from the Chelan River. Willard said age structure information will be available in the future. Mike Tonseth said the hatchery staff were likely more selective collecting fish at Wells Hatchery because there were more fish available, whereas at Chelan Falls all fish were retained (no opportunity for selectivity). Tonseth said BKD ELISA levels in the Wells collected group were similar to Wenatchee summer Chinook salmon broodstock. He also said fish for the Chelan Falls program collected at Wells Hatchery were collected in the early part of the run over a short period (2 weeks) even though it was after the collection for Wells Fish Hatchery program and perhaps they had a larger body size at the earlier part of the run.

Slide 6: Redd counts in the Chelan River were actually higher than the past, despite trapping for broodstock and a large fishery. Redds occurred in the habitat pool upstream of the weir after trapping was complete.

Tonseth said in 2019 the primary collection location for the program was Wells Hatchery (for collecting 100% of brood) because it was unknown whether fish could be collected in the Chelan River and there were uncertainties about the effects of high water temperatures in the Chelan River on broodstock viability. Tonseth said the risk of disease appears to be low and it is unlikely that culling will need to occur. In addition, fecundity of fish collected in Chelan River appears normal. Tonseth said there still is some uncertainty about fry quality. Fish from broodstock collected at Wells Hatchery and from the Chelan River are incubated separately to be able determine if there are any differences in fry quality between the two sources of broodstock. Willard said they have not seen any difference in the past.

Tonseth proposed continuing the collection of summer/fall Chinook salmon for the Chelan Falls program at Wells Hatchery in 2020 because there remain uncertainties based on only 1 year of trapping in the Chelan River. Tonseth also suggested planning better for distributing surplus adults from collection at both sites, or to bring in fish trapped in the Wells Volunteer Trap later. Tonseth said there are parallel discussions on use of surplus fish for the Yakima River summer/fall Chinook salmon program and holding surplus adult fish at Eastbank Fish Hatchery. Tonseth said he would like to avoid producing too many surplus eggs that would ultimately be destroyed. Tonseth said he proposes that less than 100% of the broodstock target be collected at Wells Hatchery, for instance, 200 fish from Wells Hatchery, and they will develop a target for collection in the Chelan River to achieve the broodstock target. Tonseth said it is not anticipated that fewer adults will be available in 2020 than in 2019, but probably not more.

Willard said Chelan PUD will build a new trap box that will allow trapping at night if the HCP-HC supports the continuation of trapping in the Chelan River. Willard noted that the permit limits use of the weir to after July 1 and use of the weir is season-dependent; fish were not observed until mid-late July and flows limit use of the weir earlier in the season.

Kirk Truscott agreed that fish should be collected at Wells Hatchery for another year because making changes to the weir could have unintended effects, like the fish holding below the weir instead of passing through it into the holding box. Keely Murdoch said she supports collection in the Chelan River and at Wells Hatchery for one more year as long as production targets continue to be met.

HCP-HC members agreed there is no strong reason not to trap in the Chelan River versus at Wells Hatchery. Tonseth and Willard will add language to the Broodstock Collection Protocols for the HCs to review and approve proposing collection at Chelan River and Wells Hatchery to meet collection targets and minimize surplus adults and production of surplus eggs.

V. Administration

A. Next Meetings

The next HCP-HCs and PRCC HSC meetings will be February 19, 2020, March 18, 2020, and April 15, 2020, at Grant PUD in Wenatchee, Washington.

VI. List of Attachments

Attachment A	List of Attendees
Attachment B	Clarifying comments from Craig Busack (NMFS), January 21, 2020, regarding role in evaluating hatchery program actions versus Recovery Plan development
Attachment C	Formal written responses from Craig Busack (NMFS) on White River Spring Chinook Salmon
Attachment D	“Chiwawa Brood Collection” and “2019 Chelan Falls Brood Collection Summary”

Attachment A
Meeting Attendees

Name	Organization
Tracy Hillman	BioAnalysts, Inc.
Larissa Rohrbach	Anchor QEA, LLC
Ian Adams	Chelan PUD
Scott Hopkins	Chelan PUD
Catherine Willard*	Chelan PUD
Kirk Truscott*‡	Colville Confederated Tribes
Tom Kahler*	Douglas PUD
Greg Mackey*	Douglas PUD
Peter Graf‡	Grant PUD
Todd Pearsons‡	Grant PUD
Deanne Pavlik-Kunkel°	Grant PUD
Craig Busack°	National Marine Fisheries Service
Brett Farman*‡°	National Marine Fisheries Service
Matt Cooper*‡	U.S. Fish and Wildlife Service
Bill Gale*‡	U.S. Fish and Wildlife Service
Alf Haukenes	Washington Department of Fish and Wildlife
David Clark°	Washington Department of Fish and Wildlife
McLain Johnson°	Washington Department of Fish and Wildlife
Chris Moran°	Washington Department of Fish and Wildlife
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Keely Murdoch*‡	Yakama Nation
Tom Scribner*‡°	Yakama Nation

Notes:
* Denotes HCP-HC member or alternate
‡ Denotes PRCC HSC member or alternate
° Joined by phone

From: Craig Busack - NOAA Federal <craig.busack@noaa.gov>
Sent: Tuesday, January 21, 2020 3:11 PM
To: Tracy Hillman <tracy.hillman@bioanalysts.net>
Subject: Message for committee members

Tracy, please send this out to the HC and HSC committee members. Thanks
****

Dear Committee Members:

I enjoyed talking with you last week, and hope I provided you with some useful perspectives. Unfortunately, I should have provided some context for my perspectives, especially as we got into broader areas of salmon recovery, but the importance of this did not occur to me until Tom Scribner mentioned reporting back to his YN superiors.

In thinking about my answers to your questions, it is important to remember that 99% of what Brett Farman and I do is evaluating actions (hatchery programs and inland fisheries) in terms of NEPA, Magnuson-Stevens, and the ESA from a technical/scientific perspective. We may be asked our opinions or even participate on teams working on policy issues such as listings, viability criteria development, or recovery planning, but that is outside our ordinary purview and range of authority. On issues related to recovery planning and recovery, the appropriate path for discussion is through Scott Carlon, NOAA's rep on the coordinating committees, then his boss Dale Bambrick, Columbia Basin Branch Chief, then Dale's boss Michael Tehan, Assistant Regional Administrator, Interior Columbia Basin Office.

Craig

Craig Busack, Ph.D.

Anadromous Production and Inland Fisheries Program
Sustainable Fisheries Division
NOAA Fisheries
West Coast Regional Office
1201 NE Lloyd Blvd., Suite 1100
Portland, OR 97232
503-230-5412

Questions for Craig Busack:

Craig Busack

January 27, 2020

Here are responses to the questions that were posed to me at the 1/15 committee meeting. These answers will undoubtedly differ somewhat from what I said at the meeting, as per the email message I sent to the committee last week. Long story short, I can offer opinions/perspectives on all these, but decision-making authority on many lies within the Interior Columbia Branch Office (ICBO), the local head of which is Dale Bambrick, not with the Sustainable Fisheries Division, of which Brett and I are members.

1. Is the White River spawning aggregate necessary to the Wenatchee spring Chinook population in regards to meeting VSP criteria? ***This has been discussed many times within the agency, including Mike Ford and Tom Cooney. The short answer is no, but it will help achieve the 4 of 5 spawning aggregate goal.***
2. What is the NOAA Science Center's most recent view on the importance of the White River spawning aggregate? ***I contacted Mike Ford for the most recent information. He said his most recent information was Chiwawa-White Fst=.0049, Chiwawa-Nason Fst=.0025, and wild-hatchery in that area Fst=.0025. So White is more different than the general baseline level of Fst, but these are very small Fst levels. To the extent that the distinctiveness of White River is due to adaptation to the environment it occupies, this distinctiveness could be regained if it were to be lost***.

   I'd like to also point out that the genetic distinctiveness (or lack thereof) of the White River spring Chinook spawning aggregate has been discussed many times within the PRCC HSC, including at least one panel discussion by geneticists from CRITFC, NOAA, and WDFW. I recommend the committee refer to the records of these past discussions in the minutes
3. If the White River and Little Wenatchee spawning aggregates are important to recovery and both suffer from the same limiting factors, how will NOAA address recovery without one or both aggregates? ***I'm not going to answer this directly because the ensuing discussion focused more on the issue of the Wenatchee River spawning aggregate not really existing. If this were the case, the current spatial distribution specs in the recovery plan now seem much more onerous (i.e., is it now that all 4 real spawning aggregates are needed?) How to deal with this, including the possibility of a revision to the recovery plan, is something you should take up with Dale.***
4. How important is the White River aggregate to the overall genetic diversity of Wenatchee spring Chinook?
   a. How much within-population genetic variation is needed for recovery? I know of no set *quantitative standards for diversity for any ESU or DPS.* ***My experience in recovery discussions, including assessing population VSP levels is that everything has to be evaluated in the context of everything else (i.e. it is relational, not absolute). However, this question is more appropriate for Dale, assisted by NWFSC geneticists.***
   b. Given the degree of escapement by other within basin aggregates into the White River, is there evidence to suggest that the White River aggregate is still genetically distinct?

See answers to earlier questions (particularly question #2) above also refer back to minutes from previous discussions.

5. If the White River genetic signature is lost, can recovery still be achieved? ***As I said earlier, recent discussions at NOAA have concluded yes.***
    a. If so, how do we achieve recovery without the White River genetic signature? ***Again, this is technically outside my lane, so again, it would be wise to contact Dale. However, I also recommend looking at the recovery plan. I have not studied it in detail, but there is lack of emphasis on White River specifically.***
6. Would NOAA support a composite broodstock hatchery program for the White River? ***Depends on the details of that program, but at this point it is not clear what the benefits would be. While it can be argued that a larger spawning population is a good thing in that it reduces genetic drift, allowing natural selection to be more efficient, compositing would likely erase the White River genetic signature. It also seems that given the low production potential of the White River basin, the value of the program is open to question.***

7. If White River spring Chinook are not genetically distinct from other Wenatchee spring Chinook aggregates, what would be NOAA's view on White River supplementation? ***Same as #6, but genetic concerns would be less. The White River spawning aggregate is distinct; the question is how high a value to place on this low level of distinctness.***

8. If HORs do not contribute to NORs, would adding another supplementation program in the Wenatchee contribute to recovery? ***Maybe, maybe not. Key to recovery is sustainability of natural production, not how many NORs you can create by augmenting spawning grounds with hatchery fish. Exactly how the hatchery programs contribute to recovery is a question best asked of the ICBO. We would expect to be in on that discussion, but in a supporting role.***

    In the ensuing discussion, it became clear that a larger issue is the general recovery benefits of supplementation programs, other than as a buffer against extinction. My own opinion is that supplementation programs only really solve problems when populations are critically low; you can't permanently get more natural production out of a system without increasing the productivity and capacity of that system.

Attachment D
“Chiwawa Brood Collection” and “2019 Chelan Falls Brood Collection Summary”

Chiwawa Brood Collection

January 15th, 2020 HC

History

Brood Years	Location	Brood Target	Smolt Target
1989-1991	Chiwawa River via snagging	380	672,000
1992-2007	Chiwawa Weir (NO) and Tumwater (HO)	380 (both HO and NO)[1]	672,000
2008-2010	Chiwawa Weir (NO) and Tumwater (HO)	178 (both HO and NO)[1]	298,000
2011	Chiwawa Weir	178 (both HO and NO)[1]	298,000
2012	Chiwawa Weir	114 (both HO and NO)[2]	204,452
2013	Tumwater	74[3]	144,026
2014-2019	Chiwawa Weir	78[4,5]	144,026

[1]Up to 33% of the estimated NO return but no less than 33% NO fish in broodstock. Broodstock collection did not occur for the 1995 and 1999 broods.

[2]Includes NNI recalculated Chiwawa obligation of 144,026 + 60,516 Methow SPC obligation under a one-time agreement.

[3] NO adults collected at Tumwater Dam as proof of concept year for PBT. HO adults collected at Tumwater as backup.

[4] HO adults collected at Tumwater + NO adults previously PIT tagged as juveniles in the Chiwawa River collected at Tumwater Dam + NO adults collected at Chiwawa Weir.

[5] In 2019, NO fish collected at Tumwater for the Nason program were balanced accordingly with only those adults assigning to the Chiwawa with a probability >95% being used for the Chiwawa program.

Brood Origin Summary

Brood Year	Broodstock		Previously PIT-tagged as smolts (recaps)
	NOB (brood target= up to 78)	HOB	
2014	61	12	15
2015	72	0	21
2016	62	37	16
2017	50	18	20
2018	37	69	6
2019	28[1]	32	7

[1]Of the 28 natural-origin brood, 7 were collected at the Chiwawa weir, 7 were recaps, and 14 were collected at Tumwater and retained for the Chiwawa brood based on genetic assignment to the Chiwawa at 95% or greater.

Trap Days/Bull Trout Encounters

Year	Dates Operated	Trapping Days	Bull Trout Encounters	NOB Collected at the Weir	Recaps
2014	6/26 to 8/15	21	56	46	15
2015	6/10 to 7/24	15	67	51	21
2016	6/22 to 7/22	15	101	46	16
2017	7/11 to 7/31	12	56	30	20
2018	6/27 to 7/7	6	99	31	6
2019	6/14 to 7/3	6	119	7[1]	7

[1]Of the 28 natural-origin brood, 7 were collected at the Chiwawa weir, 7 were recaps, and 14 were collected at Tumwater and retained for the Chiwawa brood based on genetic assignment to the Chiwawa at 95% or greater.

PNI

Brood Year	Spawners			Broodstock			PNI
	NOS	HOS	pHOS	NOB	HOB	pNOB	
2014	538	461	0.61	61	12	0.84	0.65
2015	337	630	0.69	72	0	1.00	0.61
2016	407	164	0.46	62	37	0.63	0.70
2017	171	288	0.65	50	18	0.74	0.55
2018	166	456	0.73	37	69	0.35	0.34
2019	TBD	TBD	TBD	28	32	0.47	TBD

PNI

Brood Year	Spawners			Broodstock			PNI	PNI with pNOB = 1.0
	NOS	HOS	pHOS	NOB	HOB	pNOB		
2014	538	461	0.61	61	12	0.84	0.65	0.69
2015	337	630	0.69	72	0	1.00	0.61	0.61
2016	407	164	0.46	62	37	0.63	0.70	0.78
2017	171	288	0.65	50	18	0.74	0.55	0.62
2018	166	456	0.73	37	69	0.35	0.34	0.59
2019	TBD	TBD	TBD	28	32	0.47	TBD	NA

Genetics

Table1. Summary of Chiwawa broodstock population assignments to Spring Chinook salmon baseline. Unassigned fish were nearly equally likely to have come from two or more populations.

		Assignments at >60% relative likelihood						
year	WDFW code	Chiwawa	Entiat	Nason	WenatcheeSpr	White	unassign	Grand Total
2014	14RL	19		3	1	1	2	26
2015	15IM	24		6	2	2	13	47
2016	16IN	15	1	2	4	2	4	28
2017	17GI	15		3	1		6	25
2019	19IA	6			1			7
	Grand Total	79	1	14	9	5	25	133

We set 90% as a threshold for highly likely assignments and considered values below that as positive but possibly ambiguous assignments. We report the assignments above 60% as positive assignments and below 60% the fish were considered unassigned (Small et al.).

Genetics

Population Assignment	Weir (BY 14-17 and 19)	TUM (BY 15-19)
Chiwawa	64.69%	67.25%
Nason	8.69%	7.80%
Wenatchee Spring Chinook	8.13%	2.32%
White	3.05%	7.43%
Entiat	0.71%	1.51%
Unassigned	14.73%	9.57%
Leavenworth	0.0%	2.16%
Summer Chinook	0.0%	1.53%

Genetic Samples (n)	
400	Total samples analyzed between BY15-19 at TUM
269 (67.25%)	Assigned to Chiwawa at 60% or greater
173 (43.25%)	Assigned to Chiwawa at 90% or greater
146 (36.50%)	Assigned to Chiwawa at 95% or greater

Trade-offs

	Advantages	Disadvantages
Tumwater	• More likely to collect NO brood and meet PNI goals • Fish not handled twice (TUM and Chiwawa Weir) • Select broodstock based on genetic assignment	• Collected brood held at EB for genetic analyses
Chiwawa Weir	• Local adaptation	• Bull trout encounters • Potential delay spring Chinook and bull trout

2019 Chelan Falls Brood Collection Summary

January 15th, 2020 HC

2019 Chelan River Weir

- Permitting
- Operation
  - Installed July 11th
  - Trapped July 17th to August 14th

2019 Chelan River Weir

2019 Chelan River Weir

- Trapping summary
  - 184 brood seined
  - 29 trapped
  - 13 Chinook carcasses
  - 766 pikeminnow

2019 Chelan River Weir

- Hatchery Spawn Summary

Collection Location	Fecundity	% Loss	ELISA		
			Low	Mod	High
Chelan River	3,947	6.86	0	0	0
Wells	4,426	6.45	10	6	19

2019 Chelan River Weir

- Chelan River Summer Chinook Surveys

Survey Year	Total Redd Count
2015	448
2016	448
2017	421
2018	420
2019	509

2019 Chelan River Weir

- Chelan River Summer Chinook Surveys

Survey Year	Total Redd Count
2015	448
2016	448
2017	421
2018	420
2019	509

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Date: March 18, 2020

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Larissa Rohrbach, Anchor QEA, LLC

Re: Final Minutes of the February 19, 2020 HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees (HCs) and Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) meetings were held in Wenatchee, Washington, on Wednesday, February 19, 2020, from 10:00 a.m. to 2:30 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Joint HCP-HCs and PRCC HSC

- Mike Tonseth will coordinate with Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) to present pre-spawn mortality modeling results for spring Chinook salmon at an upcoming HCP-HC meeting (Item I-A). *(Note: this item is ongoing)*
- Brett Farman will discuss with Charlene Hurst and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A). *(Note: this item is ongoing.)*
- Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A). (*Note this item is ongoing.*)
- Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth will confirm the completion date for an updated plan for Outplanting Surplus Methow Composite Spring Chinook (Item I-A). (*Note this item is ongoing.*)
- Matt Cooper will provide Winthrop National Fish Hatchery spring Chinook salmon return forecasts to Mike Tonseth to update Appendix J of the draft 2020 Broodstock Collection Protocols (BCPs; Item II-A).

- All HCP-HC and PRCC HSC members will submit final edits to the draft 2020 BCPs to Larissa Rohrbach by March 4, 2020, for compilation and distribution by March 8, 2020, in preparation for the March 18, 2020 meeting (Item II-A).
- Mike Tonseth will organize a meeting with WDFW, Chelan PUD, and U.S. Fish and Wildlife Service (USFWS) Ecological Services to share the proposed Chiwawa Weir operations plan for 2020 (Item II-B).

Rock Island and Rocky Reach HCs

- Catherine Willard will send data showing the change in Eastbank Hatchery's water temperature profile due to aquifer recharging actions to Kirk Truscott.

PRCC HSC

- Tracy Hillman will forward the written responses from Craig Busack (National Marine Fisheries Service [NMFS]) on White River Spring Chinook Salmon to Dale Bambrick (NMFS) to ask for additional responses related to NMFS policy (Item V-B). *Update: Hillman emailed Bambrick on Friday, February 21, 2020*.

Decision Summary

- No decisions were made in today's meeting.

Agreements

- No agreements were made in today's meeting.

Review Items

- An updated version of *Draft 2020 Broodstock Collection Protocols*, with Appendices, were distributed via email by Larissa Rohrbach on February 19, 2020, following the meeting for review by HCP-HCs and PRCC HSC members through March 4, 2020.
- The Wells HCP Action Plan was distributed via email by Sarah Montgomery on February 12, 2020, for review through February 25, 2020.
- The RI/RR HCP Action Plan was distributed via email by Sarah Montgomery on February 13, 2020 for review.
- The Grant County PUD 2020-21 Priest Rapids Hatchery Monitoring and Evaluation Implementation Plan was distributed via email by Larissa Rohrbach on March 2, 2020, for review by PRCC HSC members through April 1, 2020.

Finalized Documents

- No documents were recently finalized.

I. Welcome

A. Review Agenda, Announcements, Approve Past Meeting Minutes, Review Last Meeting Action Items

Tracy Hillman welcomed the HCP-HCs and PRCC HSC to the meeting and all attendees introduced themselves. Hillman provided a routine safety briefing on emergency procedures for the meeting location in the Grant PUD offices. Hillman reviewed the agenda and asked for any additions or changes to the agenda. Douglas PUD added the draft 2020 Wells HCP Action Plan to the agenda.

The HCP-HCs and PRCC HSC representatives reviewed the revised January 15, 2020 meeting minutes and approved the meeting minutes as revised.

Action items from the HCP-HCs and PRCC HSC meeting on January 15, 2020, were reviewed, and follow-up discussions were addressed *(note that italicized text below corresponds to action items from the previous meeting)*:

Joint HCP-HCs and PRCC HSC

- *Mike Tonseth will coordinate with Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) to present pre-spawn mortality modeling results for spring Chinook salmon at an upcoming HCP-HC meeting (Item I-A).*
  Tonseth said this item is ongoing.
- *Kirk Truscott will discuss with Colville Confederated Tribes (CCT) biologists whether elemental signature analysis could differentiate natural-origin Okanogan spring Chinook salmon from other natural-origin Chinook salmon during broodstock collection at Wells Hatchery for Methow Fish Hatchery programs (Item I-A).*
  Truscott said he spoke with key individuals and will present a memorandum to the HCP-HCs and PRCC HSC. This item is complete.
- *Brett Farman will discuss with Charlene Hurst and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A).*
  Tonseth said he will provide Farman with necessary data. This item is ongoing.
- *Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A).*

Mackey said he will not push to include a modeling approach in the draft 2020 BCPs and will provide updates periodically in 2020 as the approach is further developed. This item is ongoing.

- *Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A).*
  Mackey said he will not push to include an approach in the draft 2020 BCPs and will provide updates periodically in 2020 as the approach is further developed. This item is ongoing.
- *Mike Tonseth will confirm the completion date for an updated plan for Outplanting Surplus Methow Composite Spring Chinook salmon (Item II-A).*
  Tonseth said this item is ongoing.
- *Greg Mackey and Mike Tonseth will provide edits to the draft 2020 Broodstock Collection Protocols to Larissa Rohrbach by Friday, January 31, 2020, for compilation and distribution to the HCP-HCs and PRCC HSC no later than Friday, February 7, 2020 (Item III-B).*
  Rohrbach distributed the most recent draft 2020 BCPs to the HCP-HCs and PRCC HSC by email following the meeting on Wednesday, February 19, 2020. This item is complete.
- *Keely Murdoch will provide Appendix K to the 2020 Broodstock Collection Protocols to Larissa Rohrbach for compilation when it is complete (Item III-B).*
  Murdoch provided Appendix K on Monday, February 10, 2020. This item is complete.
- *Tracy Hillman will append the 2018 guidance from the panel of agency geneticists to the PUDs' Monitoring and Evaluation (M&E) Plan (2019 Update) for distribution (Item III-C).*
  Hillman provided the updated M&E Plan and it was distributed by Larissa Rohrbach on Wednesday, February 5, 2020. This item is complete.

Rock Island and Rocky Reach HCs

- *Mike Tonseth and Catherine Willard will update the Broodstock Collection Protocols with the proposed plan for collecting Chiwawa spring Chinook salmon broodstock at Tumwater Dam and the Chiwawa Weir in 2020 (Item III-A).*
  These edits were included in the draft 2020 BCPs and the draft protocols were distributed by Larissa Rohrbach to the HCP-HC and PRCC HSC on Wednesday, February 19, 2020. This item is complete.
- *Mike Tonseth and Catherine Willard will update the Broodstock Collection Protocols with the proposed plan for collecting Chelan Falls summer/fall Chinook salmon broodstock at Wells Hatchery and in the Chelan River in 2020 (Item IV-A).*
  These edits were included in the draft 2020 BCPs and the draft protocols were distributed by Larissa Rohrbach to the HCP-HC and PRCC HSC on Wednesday, February 19, 2020. This item is complete.

PRCC HSC

- *Craig Busack (National Marine Fisheries Service [NMFS]) will provide written responses to the PRCC HSC's questions on White River spring Chinook salmon hatchery production (Item II-B).* Busack provided written responses that were distributed to the HCP-HC and PRCC HSC by Larissa Rohrbach on Friday, February 14, 2020. The written responses were appended to the final January 15, 2020 meeting minutes. This item is complete.

II. Joint HCP-HCs and PRCC HSC

A. 2020 Broodstock Collection Protocols Progress Update

Tracy Hillman informed the HCP-HCs and PRCC HSC that a draft of the 2020 BCPs including edits to date has been assembled and was distributed by Larissa Rohrbach to members for review. The schedule for developing a final version was discussed. All agreed to submit final edits and comments to Rohrbach by March 4, 2020. Rohrbach will compile and distribute the protocols to the HCP-HCs and PRCC HSC by March 8, 2020, as a decision item for the March 18, 2020 meeting.

Mike Tonseth noted that the schedule could be adjusted, and an extra conference call could occur between meetings if there are items that require further discussion.

Catherine Willard said two parts of the BCPs that were updated and will be discussed in today's meeting are the collection plan for Chiwawa River spring Chinook salmon and holding summer Chinook salmon broodstock for the Yakama Nation's (YN's) Yakima River summer Chinook salmon program.

Todd Pearsons said Peter Graf has been working to update numbers for Appendix A that would then change numbers in other tables in the body of the BCPs. Pearsons said one way to handle these edits in a timely manner is to use the same numbers as last year because run projections are similar. Pearsons said, for instance, the Carlton Pond program has used the previous years' fecundity numbers to estimate geometric means for the upcoming year. Pearsons said the request from Carlton pond staff was to keep the brood numbers the same this year as last year. Greg Mackey confirmed the calculation results for DPUD-operated programs were very similar to last year. Tonseth agreed he would not anticipate a need for more brood at Carlton Pond as they have had adequate numbers in 2018 and 2019.

Pearsons said Wenatchee River summer Chinook could be updated based on new numbers obtained from WDFW. Pearsons said he and Graf will make the effort to review and update numbers in Appendix A. Pearsons said he updated Appendix I. Pearsons said he met with WDFW last week to make updates based on pilot releases ongoing at Priest Rapids Hatchery and approximate dates they will be released. Rohrbach has incorporated those edits. Tonseth agreed this update shows the variance from how procedures were done in the past.

Tonseth reminded Pearsons to use geometric means (GM) as have been used in recent years. Tonseth asked co-authors to indicate in footnotes if they use a statistic other than a geometric mean. Provided all values are positive, the GM will be calculated as follows:

$$GM_y = \sqrt[n]{\prod_{i=1}^{n} Y_i}$$

Tonseth said there are additional updated numbers in Appendices A, C, and J sent on Saturday February 15, 2020, that had not been incorporated. Rohrbach agreed that she would update these tables and redistribute the BCPs with Appendices in one document to members immediately after today's meeting.

Tonseth said he is still waiting for spring Chinook salmon forecasts from Winthrop National Fish Hatchery to estimate age-at-return for Tables 1 and 2 and Appendix J.

Mackey asked if smolt estimates were used in Tables 1 and 2. Mackey said the estimates are not accurate because they are based on spurious screw trap estimates (where the Twisp River estimate is as large as the estimate for the entire Methow River basin for both years). Tonseth said he will re-evaluate numbers in Tables 1 and 2 to update them with more defensible numbers. Mackey asked that Tonseth update the text accordingly as well.

Willard said she updated the time period for closing the Tumwater Dam fishway trap for lamprey passage at night starting from September 1 and ending September 30 (previously ending December 31). Willard said there is no need to close the trap at night to facilitate lamprey passage after September 30 based on lamprey observations in recent years.

Mackey asked, regarding the process for submittal, were the BCPs submitted with a cover letter to a specific individual at NMFS in the past, or via the HC/HSC reps? Mackey also asked who would submit the BCPs to NMFS this year. Hillman said he and Rohrbach can distribute the BCPS to NMFS and the HC/HSC at the same time. Brett Farman confirmed that he and Charlene Hurst are the correct NMFS contacts to receive the BCPs. Tonseth confirmed that the document letterhead should be edited to reflect the PUDs and WDFW as the permittees.

No other edits or procedures were discussed for completion of the 2020 BCPs.

B. Collection Site for Chiwawa Spring Chinook Salmon Broodstock

Catherine Willard said Chelan PUD and WDFW have edited the BCPs to propose trapping operations that are similar to those implemented at the Twisp Weir where bull trout encounters also limited trapping in the past. Willard said they would try trapping only during daylight hours to avoid bull trout encounters and lower the weir at night when bull trout are most active. Mike Tonseth said the approach is being proposed as a pilot method that will be re-evaluated after the trapping season.

Matt Cooper asked if the number of trapping days will exceed the number of days allocated in the past. Tonseth said they have proposed trapping for 20 days as in previous years and operating within the take of 10% of the estimated bull trout spawning abundance.

Keely Murdoch asked if 20 days can be distilled down to number of hours. For instance, does 12 hours with the weir up count as a half day or full day? Murdoch suggested asking USFWS for their interpretation. Tonseth said, based on the biological opinion for the Section 7(a) consultation, USFWS recommended a schedule of 24 hours with the weir up and 24 hours with the weir down to allow for a 24-hour bull trout passage period, and trapping would not be allowed on back-to-back days. Tonseth said this pilot proposal proposes back-to-back trapping days with the weir up from 6 a.m. to 9 p.m., allowing 10 hours with the weir down. Cooper said he will share the language with USFWS Ecological Services staff to find out if allowing for 10 hours with the weir down is suitable to allow for bull trout passage and to show that this method may reduce encounter rate. Tonseth suggested convening a short meeting within the next week with USFWS Ecological Services, WDFW, and Chelan PUD to discuss the proposed operations plan and ensure all are in agreement on what is recorded in the 2020 BCPs.

Kirk Truscott asked how moving weirs up and down during dawn and dusk would affect trapping efficiency for spring Chinook salmon. Tonseth said he does not think there are any data to examine for a potential effect because the weir was operated on a 24-hour period and not checked more frequently than once per day.

Murdoch asked if this approach is working for the Twisp Weir. Mackey said the weir does not work well anyway because it is overrun by high water in the spring, so most broodstock are collected at Wells Dam and their identity is confirmed by genetic analysis. Mackey confirmed that the bull trout movements are observed using passive integrated transponder (PIT) tags, showing movement occurs mostly at night.

Murdoch asked what will happen if bull trout encounters are reduced at the Chiwawa Weir, but spring Chinook salmon collection is still too low. Willard said they are proposing concurrent collection at Tumwater Dam for this pilot year to ensure enough broodstock are collected in 2020.

Tonseth said, at Tumwater Dam, the collection target includes previously PIT-tagged natural-origin fish (estimated as 24 fish), and surplus Chiwawa natural-origin fish collected for the Nason conservation program that genetically identify to the Chiwawa at 95% or greater likelihood would be moved into to the Chiwawa program. Tonseth said the goal is full natural-origin brood but would be backfilled with hatchery-origin brood if the program is unable to meet targets. Willard said if the PNI objectives are not met with broodstock collection at the Chiwawa Weir, trapping location discussions will need to be re-visited.

Todd Pearsons asked Tonseth whether additional natural-origin spring Chinook salmon would be collected beyond those needed for the Nason program. That is, if there are more offspring that are needed in either program, fish can be moved into the other program if they type to the other program, but no excess are intentionally collected. Tonseth confirmed that females and males are tracked at spawning and excess eggs that type to another group can be moved into the other conservation program. Tonseth confirmed that excess fish for broodstock are not collected intentionally, but fecundity can be higher than expected, creating excess offspring in some years.

Murdoch said if this does not work, she would like to revisit this topic as soon as possible after the trapping season. Tonseth said he agrees that this topic can be revisited in time for next year according to the previously approved BCP development timeline. Tonseth said trapping is flow-dependent and may not start until July. Willard said they began trapping in June the past 2 years.

This pilot approach is written into the draft 2020 BCPs and will be modified or approved in the March 18, 2020 meeting.

C. Upper Columbia Science Conference Notes

The Upper Columbia Science Conference occurred on January 22 and 23, 2020. Presentations can be found online at https://uc2020.org/detailed-schedule/.

Tracy Hillman said this conference typically brings state-of-the-science to the Upper Columbia. Hillman said the purpose of the discussion here is to allow time to identify presentations that would inform these committees. Hillman said, for example, the WDFW presentation on amount of bias in spawning escapements was informative and should be considered in the 10-year Comprehensive Review. It is unclear at this time how bias corrections can be applied to reference streams, which are used in Before-After-Control-Impact analyses.

Catherine Willard noted that ocean conditions really affect population status. Hillman agreed that ocean conditions are often a larger driver than our efforts to improve hatchery and habitat conditions.

Todd Pearsons said a recent paper showed a relationship between Chinook salmon size and recovery of the Northern Resident population of killer whales (Ohlberger et al. 2019)[1]. Pearsons said the hypothesis in the paper was that size-selective predation by orca could be an even greater effect than size-selective harvest (e.g., gillnetting). Willard asked haven't orca always selected for the largest Chinook salmon, and weren't Chinook salmon much larger in the past? Greg Mackey said yes, but the relative abundance of very large fish is much smaller today than in the past. Mike Tonseth said it is difficult to ascribe the impact on Chinook salmon size to marine mammals compared to the millions of metric tons taken in ocean fisheries. Keely Murdoch said the species have existed together for millennia. Pearsons said the Chasco et al. paper (2017)[2] showed the take by marine mammals is very high. Tonseth agreed that given the reduction in numbers of salmon, it is interesting to contemplate the size of the effect of mammal predators.

Matt Cooper said Stan Gregory's presentation on predation was interesting, showing that as one predator is removed another will replace it.

Hillman concluded the discussion on the Upper Columbia Science Conference.

D. WDFW's Hatchery Science and Policy Review Report

Larissa Rohrbach forwarded a notice via email on February 7, 2019, about a workshop held by the Washington Fish and Wildlife Commission (Commission) to hear highlights of a recently finalized hatchery reform science report. During today's meeting, Rohrbach distributed the document entitled "A review of hatchery reform science in Washington State," the summary presentation given by WDFW to the Commission, and a link to the recorded presentation via email to the HCP-HCs and PRCC HSC.

Tracy Hillman asked Alf Haukenes (WDFW) to provide a general overview because he was a co-author of the report. Haukenes described the purpose and timeline of report development.

Haukenes said WDFW was tasked with the mission to revisit hatchery reform over 2 years ago. Two parallel paths were identified to respond to contrasting points of view on increasing production in the face of emerging hatchery reform science. This document is a renewed review of the hatchery reform documentation. Joe Anderson (WDFW) and Ken Warheit (WDFW) did most of the work on the document.

The second of two documents should be available in March to respond to the State's interest in how the agency is performing in terms of adapting to hatchery reform policy. Andrew Murdoch (WDFW)

[1] Ohlberger, J., Schindler, D.E., Ward., E.J., Walsworth, T.E., and Essington, T.E. 2019. Resurgence of an apex marine predator and the decline in prey body size. *PNAS 116*, 26682. www.pnas.org/cgi/doi/10.1073/pnas.1910930116.

[2] Chasco, B.E., Kaplan, I.C., Thomas, A.C. et al. 2017. Competing tradeoffs between increasing marine mammal predation and fisheries harvest of Chinook salmon. *Sci Rep 7*, 15439. https://doi.org/10.1038/s41598-017-14984-8.

is working with Gary Marston (WDFW) in defining how our programs have adapted to these policy recommendations. Andrew Murdoch has been working to finish the policy reform document to be presented to Commissioners on March 4 in the Tri Cities area. Andrew Murdoch should be asked to discuss the details of the policy reform document with the HCP-HCs and PRCC HSC.

The science review report was submitted to the Washington Academy of Sciences for review and all authors and academy members were brought together to decide upon a good approach to assembling the final version of the document. The draft document was submitted to WDFW leadership last fall and the final language was refined. The authors want to provide a fair update to hatchery operations.

On February 5, 2020, a workshop was held with the Commissioners that lasted 4 hours. The Commission was impressed with the effort in the document. The Commissioners now have the same information as WDFW does in terms of recent science.

At this time, 10 years after adopting a reform policy, there are data available and there also continue to be data gaps on assessing risk and benefits. The scientific foundations on hatchery reform policies are seen as sound science. The document has reached the end of agency development to educate the Commissioners. It is likely to go out to peer review at a later time.

The HCP-HC and PRCC HSC may wish to review material written by Warheit on domestication selection, proportion of hatchery-origin spawners (pHOS), and related topics. Haukenes said some information seems like old news, but some of the details on how programs are adapting state-wide may be new. Haukenes concluded by saying that Anderson would be a good resource to meet in Wenatchee or by video conference if a longer conversation was desired.

Hillman said the overarching themes of the science review, Hatchery Science Review Group (HSRG) assumptions, and knowledge gaps are provided in the abstract of the document.

Kirk Truscott asked what the next step is if the report and policy document are well-accepted by the Commissioners. Haukenes said these two documents have initiated conversations on the meaning for long-standing policy, and a next step will be working with co-managers to determine what this means for boots-on-the-ground management with a basin-level approach. Haukenes said the steps toward that are not clear at this point and need to be defined. Haukenes said this effort was about due diligence to educate our Commissioners with the best available information. Ultimately, there should be policy direction by the Commissioners on whether to prioritize hatchery reform.

Truscott said science review and recommendations have been prepared in the past without enough funding or a plan to implement the recommendations and he would like to see a strategic plan that comes from this. Haukenes said their approach to this has been received with a great level of respect by the agencies and Commissioners and has been taken seriously with some level of debate. Haukenes said it was always a concern of the authors that the document would be left out on an island. Haukenes said leadership has been using this document to strengthen their position on what they have been doing and what they will continue to do.

Hillman asked how the increased production of salmon for orca prey fits with this document. Haukenes said the orca prey production prompted this document from the beginning as the State discovered that the proposal to increase production was in some ways counter to policy developed in 2009.

Haukenes said assembling the science document and the policy level document will complete the picture. Haukenes said the policy document will be made available once it is available for the Commission.

III. Wells HC

A. 2020 Wells HCP Action Plan

The Wells HC Action Plan was distributed via email by Sarah Montgomery on February 12, 2020. Tracy Hillman projected the draft Wells 2020 Action Plan in the meeting and asked the Wells HC if they have any comments. The Wells HCP Coordinating Committee (HCP-CC) will be asked to approve the Action Plan on Tuesday, February 25, 2020.

Tom Kahler said it is showing hatchery activities in the same format as in past years. He said there are the following differences this year:

- 10-year Comprehensive Review Report will be delivered by December 2020.
- Assessment of precocial maturation will be carried out per permit conditions; now using a visual assessment of smoltification for steelhead.
- Electrofishing for the Twisp population study will occur, but it is unclear at this time exactly how it will be implemented.

Greg Mackey said they are trying to figure out why the juvenile population estimate (based on electrofishing surveys) in the Twisp is lower than the screw trap estimate. They went out to survey some habitat in person to verify the area and length in a segment of the Twisp basin and found much more side channel habitat than shown in GIS center line coverages and aerial photos, but have not figured out how to apply that area to modeling the population size. Mackey said it is complicated to determine how that side channel habitat could be used in a tractable population estimate. Mackey said they have halted field work for sampling fish while evaluating how the population estimates are generated. In 2017 and 2018, mark-recapture was done instead of depletion surveys, and in 2019 the habitat survey was carried out, including drone flights with high resolution photography, but they were still unable to see as much of the habitat area as on foot due to overhanging vegetation. Mackey said there is a plan to restart work to determine a population estimate, but this has been taking a long time to resolve.

Kahler reviewed the rest of the elements in the Action Plan. Kahler asked others to comment if there were any activities that were not captured here.

Hillman asked about the deadline for approval of the BCP by the Wells HCP-CC. Kahler said review by the HCP-CC allows them to comment on trapping at Wells Dam, and he will update the relevant tables, but generally the HCP-CC defers to the HCP-HC in developing the BCP activities.

Kirk Truscott asked, regarding the Okanogan Water Management Tool, will spawning surveys and other related activities continue to be funded by Douglas PUD? Kahler said yes, with funding from other collaborators such as Department of Fisheries and Oceans Canada and the Province of British Columbia. Kahler said the Okanagan Nation Alliance is doing most of the field work for spawning surveys, fry estimates, etc. and that Chelan PUD and Grant PUD also fund parts of it.
Catherine Willard confirmed that Chelan PUD's support occurs via hatchery operations and M&E funding.

Hillman recommended that edits on the Action Plan be sent to Kahler prior to the February 25, 2020 HCP-CC meeting.

IV. Rock Island/Rocky Reach HCs

A. Yakama Nation's Yakima Summer Chinook Salmon Program

Catherine Willard said Chelan PUD wants to notify the RI and RR HCP-HCs that space will be encumbered to hold broodstock for the YN's Yakima River summer Chinook salmon program at Eastbank Hatchery in 2020. Fish will be spawned by the YN staff at Eastbank Hatchery. Green eggs will be transferred to the YN facilities (at Prosser, Washington) as they have been in the past. Chelan PUD cannot allow use of their space for free because they are funded by the public, so a fee will be charged to the YN. Up to 620 adults will be held to meet their target of 1 million smolts.

Keely Murdoch said last year there were challenges to holding and spawning fish at Wells Fish Hatchery. The YN reached out to all the hatchery operators to prepare a plan. Murdoch said surplus adults would be collected at Wells Fish Hatchery, but then YN needed a place to hold and spawn the adults.

Kirk Truscott said at one point in time there was a concern with the temperature regime of the groundwater at Eastbank Hatchery, prompting the circular re-use experiment to alleviate use of the groundwater from the local aquifer. Truscott asked if the water saved using re-use is similar to the demand created by this new adult holding plan? Willard said the other reason for re-use was to reduce demand to 620-700 gallons per minute (gpm) of extra water. Dave Clark has been looking at the flow index for Methow and Wenatchee summer Chinook salmon and found they are too high and would be reduced to 300 gpm, approximately 1% of Eastbank Hatchery's water right. Willard said, regarding the effect on temperature that Truscott is referring to, Eastbank Hatchery has been recharging the Eastbank aquifer in February and March over the past 3 years with 5,000 gpm of extra water to counterbalance high water temperatures in late summer/fall and has proven effective. There is a 1- to 2-month lag time from when colder water is added to the aquifer and when temperatures are reduced. Mackey said at Wells Hatchery the well-water is around 54°F, but the river can be around 35°F, so that could be a large difference in water temperatures. Truscott said he would like to see the temperature data if available. Truscott said the warmest water occurs in October from the groundwater source. Willard agreed to send those data to Truscott.

Todd Pearsons asked where the water goes that is pulled into the hatchery. Willard confirmed it is discharged to the Columbia River.

Willard said a remaining question is how Chelan Falls summer Chinook salmon broodstock collection is going to appropriately coincide with a declaration of surplus at Wells Dam. Mike Tonseth said for the Chelan Falls program last year, the BCPs proposed collecting the full program at Wells Dam. Tonseth said this year's target is 386 fish and the number to be collected at Wells Dam is 200. Tonseth said this year's return forecast is similar to 2019 and the program should also be able to obtain approximately 200 fish from the Chelan River weir. Tonseth said in the future the expectation would be to obtain all broodstock at the weir, meaning that any excess fish collected at Wells Dam could be rolled into the YN program. Tonseth said the conflict would be that this prioritizes allocation of excess summer Chinook salmon to the YN program. Tonseth recommended tracking the Chelan Falls collection on a weekly basis. That is, collect for 2 weeks, and if collection is on track, do not collect any fish at Wells Dam for the Chelan Falls program. If collection falls behind, continue trapping at Wells Dam. Tonseth said by collecting at Wells Dam they are less likely to obtain 400 fish that are only Chelan Falls summer Chinook salmon, but this approach allows the program to pilot the scenario without relying on collecting the full 386 in the Chelan River, and provides up to 200 fish to the Yakima program at Wells Dam.

Tonseth said the 200 fish for the Yakima program would be collected at Wells Dam before fish would be collected in the Chelan River because the weir cannot begin operating until July 15. Willard said she thought they discussed delaying collection at Wells Dam to coincide with trapping in the Chelan River. Tonseth said that would delay the declaration of surplus at Wells Dam but that would reduce the quality of surplussed fish.

Murdoch proposed moving fish into surplus as soon as targets are met in season; the management would be a bit complicated, but the math could be done. Truscott said he wants to ensure there are equitable allocations of surplus fish. Tonseth agreed that allocation to surplus could be managed in season regardless of how complicated the logistics and communication may be. Truscott suggested that as soon as excess fish are identified, all parties could be invited to collect surplus, including the 200 for the Yakima program. Truscott will provide language in the BCPs to the effect that surplus allocation will be equitable to all parties. Mackey agreed that the potential for a surplus should be obvious by mid-season. Tonseth suggested that he could write out the surplus allocation strategy to support co-manager discussions on determining surplus (not to be included in the BCPs).

Willard and Tonseth will also include seining as a collection method in the Chelan River in the BCPs.

Hillman summarized that a total of 400 adults will be collected for broodstock, 200 at Wells Dam and 200 from Chelan River, and if more than 200 are collected in the Chelan River, fewer fish would be needed from Wells and more would be made available for other non-HCP programs. Tonseth added they want to ensure the target of 200 are collected for the Chelan PUD program at Wells Dam first, because those fish will return before collection in the Chelan River begins.

Tonseth said he anticipates collecting at Wells Dam by mid-June to better capture the beginning of the return. Tonseth said last year fish were already there and were being recycled at the dam. Truscott said fish arriving in June will not leave to go elsewhere, so collecting brood in July will capture a composite that includes early arriving fish.

Tonseth asked if the Wells Dam Volunteer Trap is being run for spring Chinook salmon. Mackey said yes, it is another avenue for collecting wild spring Chinook salmon to take advantage of fish in hand rather than returning them to the river to recapture them in the Methow River. Mackey said the other objective is to remove hatchery steelhead for gene flow management. Tonseth said part of the reason for last year's decision to collect fish from multiple sites was due to the low run forecast and to take advantage of fish in hand.

B. 2020 RI/RR HCP Action Plan

The 2020 RI/RR HCP Action Plan was distributed via email by Sarah Montgomery on February 13, 2020. Tracy Hillman projected the Action Plan for consideration by the HC. Catherine Willard said there are no substantive changes to the Action Plan, and it represents a continuation of previous years' work. Generator installation at Eastbank Hatchery was removed from the 2020 Action Plan because the project was completed. Willard said additions include the following:

- 10-year Comprehensive Review Report delivery by December 2020.
- Implementation of year 3 of 3 of the steelhead release plan.

- Continuing Chelan Hatchery rehabilitation engineering feasibility. This hatchery needs several safety upgrades as well as modifications for the steelhead program.
- The Chiwawa weir needs reinforcement of the abutments and some in-river work to strengthen the substrate. Chelan PUD is working on permits for that work.

Mike Tonseth asked which genetic analyses are anticipated for this year (and asks the same question regarding Douglas PUD's Action Plan)? Willard said those samples are identified in the 10-year Comprehensive Review. Kirk Truscott noted that is also an action in the 2020 Implementation Plans.

V. PRCC HSC

A. Review Agenda, Announcements, Approve Past Meeting Minutes

The PRCC HSC representatives approved the January 15, 2020 meeting minutes as revised.

B. White River Spring Chinook – Next Steps

Tracy Hillman noted that Craig Busack (NMFS) responded in writing to the Subcommittees questions on the importance of White River spring Chinook (distributed by Larissa Rohrbach on February 14, 2020, and attached to the January 15, 2020 meeting minutes). Hillman said he shared Busack's responses with PRCC facilitator Denny Rohr to keep him informed. Hillman asked how the PRCC HSC wants to move forward?

Todd Pearsons asked if the HSC is satisfied with NMFS' responses. Pearsons said one of the key issues is that we may not have access to Busack in the future. Busack's answers may be sufficient, but if not, there may be a need for follow-up questions. Hillman noted Busack will be on-call for at least a year.

Keely Murdoch noted the written responses were quite a bit shorter than the verbal responses. Murdoch (in coordination with Tom Scribner) suggested sending the questions to Dale Bambrick (NMFS Columbia Basin Branch Chief), but would want to coordinate with Busack so their answers are not in conflict, the approach is tactful, and does not have the appearance that the PRCC HSC is seeking different answers.

Mike Tonseth suggested framing this as an ask for additional information. Pearsons said it is likely that Bambrick would reach out to Busack and this may be a vehicle for a coordinated NMFS response. Hillman said Brett Farman and Busack made clear their ability to respond to policy questions and they recommended reaching out to Bambrick or Michael Tehan (NMFS Assistant West Coast Regional Administrator). Pearsons asked Farman's opinion. Farman supported the approach for Hillman to send the written responses directly to Bambrick. Farman said he would provide Bambrick notice that he would be receiving this material.

Pearsons asked if Tehan should be Cc'd to obtain a broader NMFS perspective. Farman recommended sending only to Bambrick, assuming Tehan would rely on Bambrick to respond, and Bambrick would ask Tehan for policy guidance if he needs it.

Hillman will forward Busack's written responses regarding the importance of White River spring Chinook salmon to Bambrick with an email soliciting additional feedback.

VI. Meeting Administration

Todd Pearsons said the Washington/British Columbia and Western Division American Fisheries Society (AFS) meeting is in Vancouver, BC, April 12 through 16 in the same week as the April HCP-HC and PRCC HSC meeting. Grant PUD and Chelan PUD will be participating in the AFS meeting. Keely Murdoch said the new combination of HCP-CCs and PRCC meetings frees up April 21, 2020, for the HCs and HSC meetings. The HCP-CCs meeting will occur on the morning of April 28, 2020, and the PRCC meeting will occur in the afternoon.

The PUDs, CCT, NMFS, WDFW, and YN agreed to move the April HCP-HCs and PRCC HSC meeting to Tuesday April 21, 2020. Matt Cooper will confirm this meeting date change with Bill Gale.

Kirk Truscott asked Brett Farman when the next 5-year Status Review would be coming out from NMFS. Farman said he did not know exactly though it is planned for completion in 2020 or 2021. Tracy Hillman suggested asking Bambrick. Hillman suggested they may want to use analyses developed in the 10-year Comprehensive Review in 2020.

VII. Next Meetings

The next HCP-HCs and PRCC HSC meetings will be March 18, 2020, April 21, 2020 (*note date change*), and May 20, 2020, at Grant PUD in Wenatchee, Washington.

VIII. List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
Tracy Hillman	BioAnalysts, Inc.
Larissa Rohrbach	Anchor QEA, LLC
Scott Hopkins	Chelan PUD
Catherine Willard*	Chelan PUD
Kirk Truscott*‡	Colville Confederated Tribes
Tom Kahler*	Douglas PUD
Greg Mackey*	Douglas PUD
Todd Pearsons‡	Grant PUD
Deanne Pavlik-Kunkel	Grant PUD
Brett Farman*‡º	National Marine Fisheries Service
Matt Cooper*‡	U.S. Fish and Wildlife Service
Alf Haukenesº	Washington Department of Fish and Wildlife
David Clarkº	Washington Department of Fish and Wildlife
Chris Moranº	Washington Department of Fish and Wildlife
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Keely Murdoch*‡	Yakama Nation

Notes:
* Denotes HCP-HC member or alternate
‡ Denotes PRCC HSC member or alternate
º Joined by phone

FINAL

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ANCHOR QEA

Memorandum

To:	Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee	Date: April 21, 2020
From:	Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator	
cc:	Larissa Rohrbach, Anchor QEA, LLC	
Re:	**Final Minutes of the March 18, 2020 HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings**	

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees (HCs) and Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) meetings were held by conference call and webshare on Wednesday, March 18, 2020, from 10:00 a.m. to 2:45 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Joint HCP-HCs and PRCC HSC

- Mike Tonseth will coordinate with Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) to present pre-spawn mortality modeling results for spring Chinook salmon at an upcoming HCP-HC meeting (Item I-A). (Note: this item is ongoing.)
- Brett Farman will discuss with Charlene Hurst and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A). (Note: this item is ongoing.)
- Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A). (Note this item is ongoing.)
- Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A). (Note this item is ongoing.)
- Bill Gale will ask Rod Engle (U.S. Fish and Wildlife Service [USFWS]) for information on weir operation in the Imnaha River allowing for bull trout passage (Item II-A).
- Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historic run-size data (Item II-B).
- All parties will provide updates on changes to marking and tagging plans due to the impacts of COVID-19 on operations as updates become available (Item II-C).

PRCC HSC

- Tracy Hillman will discuss updating the Upper Columbia Salmon and Steelhead Recovery Plan with Melody Kreimes (Upper Columbia Salmon Recovery Board [UCSRB]; Item III-B).

Decision Summary

- The *Upper Columbia River 2020 BY Salmon and 2021 BY Steelhead Broodstock Collection Protocols* were unanimously approved by the HCP-HCs and PRCC HSC (Item II-A).

Agreements

- No agreements were made in today's meeting.

Review Items

- Grant County PUD's 2020-21 Priest Rapids Hatchery (PRH) Monitoring and Evaluation Implementation Plan was distributed via email by Larissa Rohrbach on March 2, 2020, for review by PRCC HSC members through April 1, 2020.

Finalized Documents

- The HCP-HCs and PRCC HSC-approved *Upper Columbia River 2020 BY Salmon and 2021 BY Steelhead Broodstock Collection Protocols* were distributed by Larissa Rohrbach to members, including Wells Coordinating Committee Chair, cc the PRCC facilitator, on March 19, 2020, for approval by the Wells HCP-Coordinating Committee.

I. Welcome

A. Review Agenda, Announcements, Approve Past Meeting Minutes, Review Last Meeting Action Items

Tracy Hillman welcomed the HCP-HCs and PRCC HSC to the meeting and read the list of attendees signed into the meeting. The meeting was held via conference call and webshare because of travel and group meeting restrictions resulting from the COVID-19 pandemic. Hillman reviewed the agenda and asked for any additions or changes to the agenda. Hillman noted three topics to add to the agenda for brief discussion:

- USFWS has asked to discuss effects of COVID-19 restrictions on hatchery and fish tagging operations.

- Responses from Dale Bambrick to the PRCC HSC regarding the White River spring Chinook salmon program were received on March 17, 2020, one day prior to this meeting, and will be reserved for discussion next month.
- Schedule for the April meeting with cancelation of the Western Division American Fisheries Society meeting due to COVID-19 restrictions.

All members approved the agenda with these additions.

The HCP-HCs and PRCC HSC representatives reviewed the revised February 19, 2020 meeting minutes.

The use of geometric means (GMs) in place of arithmetic means in the broodstock collection protocols (BCPs) was discussed. Hillman reviewed the typical method for calculating the GM, which is to calculate the natural log (ln) of all values, calculate the arithmetic mean of the ln values, then calculate the antilog of that mean. This method does not work (returns an error) if the data set contains zeros; this method only works with positive values. There are several methods for compensating for zeros in the dataset, including:

- Add one to all values, calculate the GM, then subtract one from the mean.
- Drop the zero values; however, this returns a very different mean.
- Make the zero a very small number (compared to the rest of the values).

Hillman asked why GM is preferred for calculations in the BCPs instead of the arithmetic mean. Mike Tonseth said he has used the GM for several years in Appendix A and uses the command in Excel. He said the GM tends to return conservative numbers of brood needed. For instance, a few steelhead with high fecundity can skew the target number of brood downward. He said in some cases where there are zero values in a dataset, the GM of the 2- or 3-year dataset was calculated instead of a 5-year dataset.

Greg Mackey said he encountered this problem when calculating the smolt-to-adult returns used for run projections, where zeros can occur. Tonseth said he doesn't mind changing the methodology but suggested testing the various methods and comparing to past broodstock needs first to ensure we are not grossly over estimating or underestimating brood targets.

Todd Pearsons said Grant PUD asked WDFW to calculate the GM for various tables in the BCPs; the numbers for Grant PUD programs have not changed dramatically among methods and he would not want to make changes in the protocols at this time. Pearsons said he agrees with using the Excel GM calculation unless numbers look dramatically different from past years. Peter Graf agreed and suggested the authors of the BCPs use professional judgement when looking at a mean of five numbers; one formula may not fit for all metrics.

Hillman concluded the discussion and inserted the typical GM formula in the February 19, 2020 minutes with a statement that it is appropriate when all values are positive.

The HCP-HCs and PRCC HSC approved the February 19, 2020 meeting minutes as revised.

Action items from the HCP-HCs and PRCC HSC meeting on February 19, 2020, were reviewed, and follow-up discussions were addressed *(note that italicized text below corresponds to action items from the previous meeting)*:

Joint HCP-HCs and PRCC HSC

- *Mike Tonseth will coordinate with Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) to present pre-spawn mortality modeling results for spring Chinook salmon at an upcoming HCP-HC meeting (Item I-A).*
  Tonseth said this item is ongoing.
- *Brett Farman will discuss with Charlene Hurst and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A).*
  Tonseth said he will provide Farman with necessary data. This item is ongoing.
- *Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A).*
  Mackey said this item is ongoing.
- *Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A).*
  Mackey said this item is ongoing.
- *Mike Tonseth will confirm the completion date for an updated plan for Outplanting Surplus Methow Composite Spring Chinook salmon (Item II-A).*
  Tonseth said this item will be discussed in today's meeting and this action item should be removed from this list.
- *Matt Cooper will provide Winthrop National Fish Hatchery spring Chinook salmon return forecasts to Mike Tonseth to update Appendix J of the draft 2020 Broodstock Collection Protocols (BCPs; Item II-A).*
  Tonseth said this item is complete.
- *All HCP-HC and PRCC HSC members will submit final edits to the draft 2020 BCPs to Larissa Rohrbach by March 4, 2020, for compilation and distribution by March 8, 2020, in preparation for the March 18, 2020 meeting (Item II-A).*

Rohrbach said previously reviewed edits were accepted and comments and questions in the document were answered by the authors. Rohrbach sent an updated version of the draft 2020 BCPs to the HCP-HCs and PRCC HSC via email on March 11, 2020. This item is complete.

- *Matt Cooper will organize a meeting with WDFW, Chelan PUD, and U.S. Fish and Wildlife Service (USFWS) Ecological Services to share the proposed Chiwawa Weir operations plan for 2020 (Item II-B).*
  Mike Tonseth said the method proposed in last month's meeting was modified only slightly. Keely Murdoch asked that this section of the BCPs be reviewed carefully during this meeting. This item is complete.
- *Mike Tonseth will prepare a written strategy for distribution of surplus Wells Hatchery Summer Chinook in 2020, to be shared with co-managers (Item IV-A).*
  Tonseth said this item will be tracked outside of the HCP-HCs meetings.

Rock Island and Rocky Reach HCs

- *Catherine Willard will send data showing the change in Eastbank Hatchery's water temperature profile due to aquifer recharging actions to Kirk Truscott.*
  Willard said this item is complete.

PRCC HSC

- *Tracy Hillman will forward the written responses from Craig Busack (National Marine Fisheries Service [NMFS]) on White River Spring Chinook Salmon to Dale Bambrick (NMFS) to ask for additional responses related to NMFS policy (Item V-B).*
  Hillman sent an email to Bambrick on Friday, February 21, 2020. Bambrick replied and Larissa Rohrbach distributed his responses to the PRCC HSC via email on March 17, 2020. This item is complete.

II. Joint HCP-HCs and PRCC HSC

A. DECISION: 2020 Broodstock Collection Protocols

Tracy Hillman shared the revised 2020 BCPs via the webshare portion of the meeting. Hillman read each set of unresolved comments to review the changes and comments, suggest a resolution or open the topic for discussion, and allow representatives to respond. Hillman made revisions in the document during the meeting. The following minutes reflect the discussion of comments and questions:

- Summary of notable activities in this year's protocols: To date, no spring Chinook salmon originating from Chief Joseph Hatchery (CJH) have been observed returning to Winthrop National Fish Hatchery. Mike Tonseth said the BCPs state any fish that is identified to be CJH shall be returned to CJH. Kirk Truscott said some of the CJH fish are passive integrated transponder (PIT) tagged, so if PIT-tagged fish are recovered in the broodstock, we would like to have those fish returned to CJH. Truscott said he does not know whether Methow hatcheries have been reading coded wire tags (CWTs) yet prior to spawning. Greg Mackey said at the Methow Fish Hatchery (MFH), CWTs are read prior to spawning so if a fish was identified for the CJH program the eggs could be made available. Bill Gale said the comments are confusing because MFH is not spawning ad-clipped fish. Mackey said Michael Humling had written a comment to align the BCP text with what is happening at Winthrop National Fish Hatchery (WNFH). Truscott said this is a moot issue if CWTs are not read prior to spawning at WNFW. Gale confirmed that CWTs would not be read until eye-up and culling of eggs. Gale said a CJH fish has not been observed in the hatchery yet. Humling's comment is that this is not something that has been seen and is asking whether it is worth pursuing. Truscott said the bulleted text can be stricken for this year but the programs should keep monitoring for CJH fish to ensure that the presence of CJH fish in MFH or WNFH does not increase over time as the CJH returns increase, and Committees should assess the need to revise that protocol in the future. Gale agreed and reiterated that if PIT-tagged CJH fish are found at WNFH, USFWS will make an effort to transfer them to CJH.

- Table 1, Spring Chinook salmon age-at-return projections: A correction was made to the number of age-4 fish in the brood from one year to the next.
- Trapping at Twisp Weir: Tonseth said the text is fine as revised to reference the agreed-upon plan. Tom Kahler said activities during steelhead trapping are consistent with Appendix D. Kahler provided language in the BCPs that is consistent with Appendix D (e.g., trapping occurs 7 days per week, up to 16 hours per day for spring Chinook salmon). Truscott asked what the permit provisions are for trapping at Twisp Weir and whether what is written in the BCPs is less aggressive than what is in the permit language. Tonseth said the permit is very general and refers to a future plan to be developed between Douglas PUD and USFWS, which is the plan provided in Appendix D.
- Methow Spring Chinook Salmon Adult Outplanting strategy: Tonseth said this should be discussed to determine a path forward with the outplanting plan. The 2017 outplanting plan was developed as a study to test the outplanting method, but raised the question whether, as is, the plan could even be implemented and if there would be permit coverage to do so. Implementation of outplanting with current run sizes would involve relaxing the proportion of hatchery origin spawners (pHOS) and PNI conditions of the permits and revising methods that were detailed in the 2017 outplanting plan. Tonseth said a retrospective analysis was done, and if the 2017 outplanting plan had been in place in the past, 1995 and 1996 would have been the only brood years (BYs) in which this could have been implemented while still meeting pHOS targets identified by permits. Implementation in other years, and in 2020,

would require exceeding PNI and pHOS. Tonseth said he contacted Brett Farman and Charlene Hurst to ask NMFS' position on relaxation of the PNI and pHOS sideboards in permit conditions to be able to test this methodology. Prior to this meeting, Farman told Tonseth that relaxing the PNI targets would require re-consultation under the biological opinion[1] (BiOp) because the effect of outplanting on PNI was not considered as part of the proposed action. This would also be the case for outplanting eyed eggs. Tonseth said, based on historical observations, the 2017 outplanting plan is not likely to be implementable, nor would a modification of the plan that eases pHOS/PNI requirements during the life of the permit. Keely Murdoch said one of the discussions held when developing this plan was that there would be flexibility during the first 5 years of implementing the permit. Murdoch said the criterion is to meet the 5-year average for PNI, so 1 year of low PNI should not preclude implementing the plan. Tonseth said it will require at least 2 or 3 years to determine feasibility because it is based on a sliding scale for PNI, and taking the perspective of implementing it for 1 year with low PNI, the program would still need to maintain pHOS at low levels for the other 4 years. Tonseth said in order to consider that action, the effects of that action will need to be consulted on and that will take some time. Farman agreed and said changing the year to year goals, with the assumption that that goals will be met at some time in the future, puts the program in a bad situation. Murdoch said when the 2017 outplanting plan was developed, it was not anticipated that the program would change the PNI goals. Catherine Willard said the 2017 outplanting plan reads that it will be consistent with the number of adults needed for the hatchery programs, and implementation scenarios were written depending on different abundances. Willard asked Tonseth to share the historical analysis that was done with the HCP-HCs. Murdoch said the idea was that the plan would not be implemented until the conditions could be met but that the plan should be tested during the first 5 years, the grace period, of the permit. Murdoch said the idea of outplanting was to have more control of a wider distribution of returning adults, so the alternative would be to use more juvenile acclimation sites. Hillman summarized that Tonseth is proposing to replace the existing language in the BCPs with Tonseth's suggested language, which is more general in nature regarding distribution of surplus Methow spring Chinook salmon and does not refer to the outplanting plan specifically. All agreed with the proposed revision. Willard said this conversation should continue in future meetings and asked that the analysis based on historical run sizes be provided for the HCP-HCs to review. Tonseth agreed to share the analysis. Tonseth said the outplanting Plan of 2017 should not be included as an appendix but

[1] National Marine Fisheries Service (NMFS), 2016. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation for the Issuance of Four Section 10(a)(1)(A) Permits for Spring Chinook Salmon Hatchery Programs in the Methow Subbasin. NMFS Consultation Number WCR-2015-3845.

suggests keeping references to it as a placeholder until a decision is made whether to make changes to the plan.

- Reconditioned kelts encountered during Methow steelhead broodstock collection: Language has been added to indicate that reconditioned kelts collected at the Twisp weir should not be taken for broodstock and should be returned to river and allowed to spawn naturally, per the goal of the kelt reconditioning project. It was noted that reconditioned kelts encountered during angling should similarly be excluded from broodstock collection. Mackey agreed, but said this section is already complicated; every detail for every potential scenario should not have to be written in the BCPs and recommends leaving language as is. Mackey suggested adding a blanket statement that reconditioned kelts would not be retained. Murdoch agreed. Tonseth suggested revising the text to refer to any encounter of reconditioned kelts. Gale said USFWS would not know whether it is a returning kelt until it has been transported to the hatchery. Logistically, should it then be returned to the capture site, or the river at the hatchery, some other site like Miller's hole, etc.? Gale recommended leaving the logistics up to Charlie Snow (WDFW), Humling, and Matt Abrahamse (Yakama Nation [YN]) to determine how to return fish to the river.

  Murdoch said additional handling and moving of kelts to the hatchery is stressful and should be minimized. Murdoch asked that PIT tags be read in the field with portable detectors to identify reconditioned kelts prior to loading them into the fish transport trucks. Gale said carrying portable readers in the field may not be feasible and asked if a list of fish that have ascended a mainstem ladder can be used to identify fish that may be in the area. Murdoch said many fish are not encountered in ladders because they may have overwintered upstream of dams. Murdoch said perhaps PIT-tag readers cannot be carried in the field but maybe they could be read at the transport trucks prior to being loaded. Gale suggested the people in the field refine the logistical approach. Murdoch agreed and said she would ask Matt Abrahamse to look up a list of potential PIT-tags of reconditioned kelts to inform the field work.
- Methow steelhead collection by hook and line: Corrections were made during the meeting to show the target number as 24 fish (12 male and 12 female) in text and Tables 5 and 6. The discrepancies in the footnotes to Tables 5 and 6 were resolved in the meeting.
- Steelhead juvenile releases: Truscott said there is redundancy in paragraphs meant to summarize juvenile releases by program, but the bulk of the paragraph is about broodstock that has already been addressed in other areas of the document and suggested making this section more succinct. Mackey said originally this part of the protocol was much simpler but has become more complex as the programs have continued to become more complex. Additions to this section have changed it over time, especially the collection at the weir and angling. Mackey said he does not like the redundancy; however, this section isolates all the information for a single program in a slightly different format, so he does not mind keeping it

this way for this year but agrees is should be rewritten to make it more usable and succinct. Tonseth agreed and suggested combining juvenile release methods with the broodstock collection methods that follow in one section. Mackey said another idea is to move the broodstock collection methods to an appendix so that this section is only about where and what number of fish are collected, and the appendix describes the details of the collection methods. Hillman asked if there was opposition to retaining the language as is and then making revisions next year. Truscott said his comments were made as an observation and revisions can be made next year.

- Table 4, 2021 Steelhead Wells and upstream: The numeric target for one of the programs was deleted to be consistent with the contents of the table.
- Wells Hatchery-Columbia River Steelhead Program: Tonseth revised the BCPs to include this program description that was missing from the previous version.
- Okanogan Steelhead Conservation Program (Grant PUD/Colville Confederated Tribes [CCT]): Truscott asked what Okanagan steelhead collections are being contemplated. Tonseth said the collections described in the 2019 BCPs are the same as described in these draft 2020 BCPs; nothing new unless there are suggestions on other options for collection. Truscott said he may have misinterpreted the language that there was now a proposal to collect at the Wells Dam ladder for the Okanagan program or any other program. Tonseth said this was not currently a proposal, but the BCPs do not preclude the option to do so if the run forecast is low enough that the brood targets cannot be met. Tonseth said parties *may* opt to collect from the East and West ladders at Wells Dam in the spring, and maybe in the fall, if there is reason to believe the targets will not be met, but currently these activities are not planned. Truscott summarized that this language provides the option to adjust the broodstock programs as detailed previously in the document. Truscott said he agrees with the narrative as written and suggests no changes.
- Methow Spring Chinook Salmon Conservation Program: Mackey confirmed permit language for summer steelhead specified the collection of up to 33% is specific to natural-origin fish because, under adult management, up to 100% of hatchery-origin fish could also be removed. If the run size is low enough, the entire hatchery-origin run and up to 33% of the natural-origin run could be removed. Mackey said if it came to this type of decision, the programs would defer to the permits rather than the BCPs for making decisions.
- Steelhead trapping in fall: Tonseth emphasized retaining the option in the BCPs for allowing programs to collect in the fall if run projections are very low without the need to discuss in the HCP-HCs and PRCC HSC again. Truscott said he agrees with the language, but if necessary, this issue should be brought to the HCP-HCs and PRCC HSC to acknowledge the need and ensure all still approve. Tonseth agreed to provide notice to the HCP-HCs and PRCC HSC; however, permits already allow for the activity to occur during that time period. Truscott

noted the HCP-HCs and PRCC HSC have gone to great lengths to avoid overcollection, but approves of the existing language, assuming the committees would be informed if fall collection is undertaken. Hillman retained the existing language with no revisions.

- Natural-origin summer Chinook salmon collection at Wells Dam: Target was 124 in 2019, changed to 122 this year based on using a GM. Todd Pearsons said the method used reflects discussions with hatchery staff regarding fecundity. Hillman retained the 122 fish (61 females) based on use of GMs of past values to forecast 2020 needs.
- Allocation of surplus summer Chinook salmon to the YN's Yakima River summer Chinook salmon program: Several authors made edits, which Tonseth merged into one parsimonious revision. Hillman inquired among the members to ensure all agree with the revisions. Truscott agreed to accept the revisions as written. Tonseth had revised numbers to show 186 fish would be collected from the Chelan River and 200 from Wells Dam to sum to a total of 386 brood. Any additional fish collected in the Chelan River would be in excess of program needs. Table 8 was revised to reflect this change.
- Chiwawa Weir operations for collection of spring Chinook salmon: Revisions were made to reflect the status of the coordination and concurrence with USFWS for 2020. Tonseth adjusted language to respond to Matt Cooper's comments that the BCPs clarify they are lowering the weir instead of just opening the traps to allow passage. Murdoch asked to continue the discussion initiated in the last meeting regarding spring Chinook salmon trapping efficiency with a new approach to lower the weir at night for protecting bull trout. Murdoch requested that the Rock Island HCP-HC check in mid-season rather than at the end of the trapping season. The program may need to change operations mid-season if, for instance, Chinook salmon are not effectively captured by only trapping during the day. Willard and Tonseth agreed this was a good idea. Tonseth proposed a week-by-week comparison of spring Chinook salmon movement over the lower Chiwawa River PIT-tag array compared to spring Chinook salmon trapping observations and encounters with bull trout. Murdoch suggested communicating weekly over email, memorandum, or phone conference rather than in HCP-HC meetings. Tonseth agreed. An email update is preferable; a phone conference can be requested if any one party feels it is needed. Murdoch asked if contingency language is needed in the BCPs in case the trapping does not work. Tonseth said it is not necessary because the BCPs are considered a living document. As long as due diligence is taken during the season to evaluate trapping effectiveness, and parties recognize the need to change course, a change can be implemented and it is not necessary to take up space in the document with unknown scenarios. Gale said Rod Engle (USFWS) has been working with ODFW on the Imnaha Weir with similar challenges. At Imnaha they were successful by raising the lower panel of the weir to allow bull trout to pass but still retained Chinook salmon that did not tend to move below the weir panel with the exception of a few jacks that were able to

navigate through the opening. Gale said it is unclear whether this happened because of the size of the opening or some other species-specific behaviors. Gale offered to ask Engle for more information. Tonseth agreed it would be helpful to discuss this further and to compare their weir with the Chiwawa Weir. Willard said they are able to raise a portion of the panels or remove some pickets at the Chiwawa Weir. Tonseth asked if the lower part of a panel could be trimmed up or notched to create a similar effect. Gale said he would talk to Engle to provide information to WDFW and Chelan PUD committee.

- Appendix B, uses of BY versus release year: The BY and release year columns were revised where they were out of alignment for S1 versus S2 programs. Recent revisions to release year resolved the comments made on the table. Gale said there is confusion because there are 24,000 S1 smolts being released by Douglas PUD into the Twisp River; 24,000 S2 smolts from WNFH on Douglas PUD's behalf into the Twisp River; and 24,000 S1 smolts from WNFH released into the Methow River at WNFH. Tonseth said this could be clarified by removing Douglas PUD's name from the MetComp Conservation line. Humling had commented that a footnote should be added to identity fish that are part of USFWS' 200,000 production requirements from WNFH regardless of release location. A footnote was added during the meeting to resolve this detail. All lines of the table were made consistent to refer to rearing location rather than release location.
  - The following note was removed pertaining to Okanogan River release locations: "TBD in fall of 2020."
  - Willard asked that the additional mark for BY 2019 be a continued discussion item. Willard said if 100% natural-origin brood are collected for the Chiwawa program, there is no need for an additional mark. However, in BY 2019, hatchery fish will be used to backfill the program due to low expected returns, and the RI/RR HCP-HCs needs to decide whether to continue with the body tagging method used in the past. Willard said Chelan PUD staff noticed deformities in body-tagged fish this year.
- Table 6 in Appendix C: Tonseth responded to a question about refining Methow Spring Chinook salmon adult management forecasts to smaller groups, noting that it is time consuming and of little value because the forecasts are not very accurate and splitting into smaller groups would increase inaccuracies.
- Columbia River Inter-Tribal Fish Commission (CRITFC) program for sockeye trapping at Wells Dam East and West ladder traps: Truscott removed the provision noting it is not supported by the CCT. Tonseth asked Truscott why the CCT would oppose this. Truscott said the CRITFC have 17 years of sockeye tagging data as it relates to release timing and water temperature. Truscott said there is enough information collected already and is not aware of substantive management decisions that have been made based on these data, and the CCT do not want to preclude any sockeye from harvest opportunity. Murdoch said it was premature to remove

this provision from the BCPs because this has not yet been decided in HCP-Coordinating Committee (HCP-CC) meetings. Murdoch said this is being discussed and may be voted on in the Wells HCP-CC, but likely to be discussed for an additional month prior to making a decision. Murdoch said she is willing to modify the language to provide some wiggle room. Truscott said he does not support leaving this in the document and asked if there is anything that would preclude this from being added to the document later this year. Murdoch suggested revising the text to state that historically this activity has been carried out and would require approval by the Wells HCP-CC in 2020. Truscott accepted this revision. Tonseth said he is concerned that approval of the BCPs by the Wells HCP-CC next week could indirectly authorize this activity before the conversations are concluded in the Wells-CC. Murdoch disagreed and said with the revisions, approval of the BCPs is not approval of CRITFC sockeye sampling. Tonseth agreed.

- Coho trapping: Murdoch provided revisions that coincide with the provisions of the permit (also outlined in Appendix J).
- Appendix D, trapping operation plans: Fall steelhead trapping operations at Wells Dam and Methow Hatchery outfall trapping information was added back into Tables 4 and 5, respectively (to retain the potential to trap during this time). Murdoch said coho trapping and PIT-tagging at the PRD Off Ladder Adult Fish Trap (OLAFT) will probably occur this year and was added to Table 6 (concurrent with Viable Salmonid Population monitoring to estimate coho escapement), but no broodstock collection would occur at the OLAFT.
- Formerly Appendix H, alternative plan for Methow Sub-Basin Conservation Steelhead Programs: Several comments suggested formalizing this draft plan that has now been implemented over 3 years. Tonseth said this was maintained as draft because of uncertainty around feasibility of spring broodstock collection only, and collection by angling. Tonseth said he now supports formalizing this plan as the status quo because these actions have been successful and this appears to be how the program will be operating in the future. Tonseth suggested eliminating this Appendix because the program is fully described in text of the BCPs. All parties agreed as long as all this information is in other parts of the document. This appendix was eliminated and Appendix callouts were updated throughout the document.
- Wenatchee summer steelhead rearing and release plan element: This was removed from Appendix H of the BCPs because the last year of this rearing and release plan was implemented in 2019.
- Appendix J, Methow basin coho program: Kahler revised the target release number to 25,900 smolts. Murdoch was not sure this was correct that the number should be adjusted for Douglas PUDs production. Kahler said Douglas PUD’s production is tied to the YN production target for each brood year, based on a statement of agreement from 2015 approved by the HC. Murdoch reviewed the statement of agreement and agreed to the edits made by Kahler.

Hillman asked for a vote to approve of the Draft Upper Columbia River 2020 BY Salmon and 2021 BY Steelhead Broodstock Collection Protocols. All members of the HCP-HCs and PRCC HSC approved.

Larissa Rohrbach will update the document header and other edits to appendix and table callouts, then will distribute the HCP-HCs and PRCC HSC-approved version for HCP-CC approval.

Hillman asked if there were any items that should be discussed in the near term in preparation for next year's broodstock collection activities. Willard said that the marking of backfill hatchery-origin Chiwawa spring Chinook salmon should be discussed soon. Pearsons said further progress on sizing of hatchery programs (allocation of fish between safety-net versus conservation programs) needs to move forward. Tonseth said differentiation of naturally produced Okanogan spring Chinook salmon from Methow River fish will be necessary (involves the use of elemental signature analysis).

B. Outplanting Adult Methow Spring Chinook Salmon

This item was discussed as part of revising and approving the annual BCPs during the previous agenda item.

C. Impacts of Agency Responses to COVID-19 on Hatchery Operations

Bill Gale said the USFWS is evaluating marking and tagging activities that are occurring right now while trying to implement social distancing measures, which is difficult to do in tagging trailers where people are confined in close proximity for 8 hours at a time. USFWS is evaluating whether program fish can be marked and tagged this release year and how a change in schedule could cascade to affect marking and tagging later in the year. Gale said it is likely that future tagging events will be canceled. Gale asked if any other programs have started to think about these issues.

Catherine Willard said Chelan PUD is PIT-tagging Wenatchee steelhead at Chiwawa, which does not require working in a trailer, and will re-evaluate upcoming activities on a case-by-case basis. Willard said Chelan PUD is evaluating on a case-by-case basis whether contractors should be allowed on site (e.g., at hatchery facilities).

Todd Pearsons said Grant PUD has closed facilities to the public and is taking all other precautions that other agencies are taking. Pearsons said it is unclear how marking will be handled because these activities are contracted out.

Kirk Truscott said for subyearlings, the CCT uses an automated clipping trailer, which would not require people to work in close proximity.

Gale asked if all ad-clipping and CWT marking is complete for this year. Gale said he may have to provide USFWS with a program-by-program update. Willard said yes for Chelan PUD's programs. Pearsons said not yet for Grant PUD's PRH program. Truscott said the CCT's subyearling releases have already been clipped or tagged. Tom Kahler said he thinks Douglas PUD's fish have all been tagged with the exception of subyearlings scheduled for PIT tagging by USFWS starting April 13, so that may not occur. Mike Tonseth said he would look into WDFW programs to provide a better update.

Brett Farman said these discussions are occurring in US v. Oregon Agreement meetings. NMFS has not had the chance to discuss their position on this rapidly emerging issue internally but will have an internal discussion about potentially developing a priority list of programs for determining whether tagging can occur.

Gale said this has been helpful and provided helpful information for his need. Tracy Hillman asked each party to provide updates to tagging and marking activities to the HCP-HCs and PRCC HSC as they become available this spring.

III. PRCC HSC

A. Review Agenda, Announcements, Approve Past Meeting Minutes

The PRCC HSC representatives approved the February 19, 2020 meeting minutes as revised.

B. White River Spring Chinook Salmon: Next Steps

Tracy Hillman informed the PRCC HSC that Dale Bambrick provided responses to questions about the White River spring Chinook salmon program, distributed via email by Larissa Rohrbach yesterday.

Todd Pearsons said a lot of this depends upon whether the recovery plan[2] can be modified or not. Pearsons asked what is the process for modifying the recovery plan? Hillman said because the UCSRB was instrumental in developing the recovery plan under the direction by NMFS, the Subcommittee may need to go back to the UCSRB. Brett Farman agreed and said he did not have more information on a specific process for updating the recovery plan.

Pearsons said a specific example of new information since the original plan was produced would be data that indicates the [viability] of the Wenatchee River spring Chinook salmon spawning aggregate is now in question. Pearsons asked how the recovery plan could be modified to incorporate this new information.

Hillman will ask Melody Kreimes (UCSRB Executive Director) for her response to what it would take to open the recovery plan up for revision.

[2] UCSRB 2007. Upper Columbia Salmon and Steelhead Recovery Plan. Available from: https://www.ucsrb.org/mdocuments-library/plans/

Discussion of Bambrick's responses was tabled until the April meeting to allow members more time to review.

IV. Meeting Administration

Todd Pearsons said the Washington/British Columbia and Western Division American Fisheries Society meeting that was scheduled to occur in the same week as the April HCP-HC and PRCC HSC meeting (April 15) has been cancelled due to COVID-19 concerns (organizers considered holding a virtual meeting but ultimately chose to cancel completely). Tracy Hillman said the next meeting date of April 21 will be maintained for consistency and held as a conference call unless changes in health department guidance allow for an in-person meeting.

V. Next Meetings

The next HCP-HCs and PRCC HSC meetings will be Tuesday, April 21, 2020, by conference call and webshare; Wednesday, May 20, 2020; and Wednesday, June 17, 2020, at Grant PUD in Wenatchee, Washington.

VI. List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
Tracy Hillmanº	BioAnalysts, Inc.
Larissa Rohrbachº	Anchor QEA, LLC
Catherine Willard*º	Chelan PUD
Kirk Truscott*‡º	Colville Confederated Tribes
Tom Kahler*º	Douglas PUD
Greg Mackey*º	Douglas PUD
Peter Graf‡º	Grant PUD
Todd Pearsons‡º	Grant PUD
Brett Farman*‡º	National Marine Fisheries Service
Bill Gale*‡º	U.S. Fish and Wildlife Service
Mike Tonseth*‡º	Washington Department of Fish and Wildlife
David Blodgettº	Yakama Nation
Keely Murdoch*‡º	Yakama Nation

Notes:
* Denotes HCP-HC member or alternate
‡ Denotes PRCC HSC member or alternate
º Joined by phone

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Date: May 20, 2020

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Larissa Rohrbach, Anchor QEA, LLC

Re: Final Minutes of the April 21, 2020 HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) meetings were held by conference call and web-share on Tuesday, April 21, 2020, from 10:00 a.m. to 2:45 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Joint HCP-HCs and PRCC HSC

- Mike Tonseth will coordinate with Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) to present pre-spawn mortality modeling results for spring Chinook salmon at an upcoming HCP-HCs meeting (Item I-A). *(Note: this item is ongoing.)*
- Brett Farman will discuss with Charlene Hurst and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A). *(Note: this item is ongoing.)*
- Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A). (*Note this item is ongoing.*)
- Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historic run-size data (Item II-A). (*Note this item is ongoing.*)
- All parties will provide updates on changes to marking and tagging plans due to the impacts of COVID-19 on operations as updates become available (Item II-D). (*Note this item is ongoing.*)
- Kirk Truscott will determine the number of scales that should be collected from spring Chinook salmon at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook salmon from Methow River spring Chinook salmon (Item II-A).
- Keely Murdoch will prepare an updated retrospective analysis of conservation program size to present in the next meeting (Item II-A).

PRCC HSC

- Tracy Hillman will communicate with Denny Rohr, PRCC Chair, regarding the responses from the National Marine Fisheries Service (NMFS) on a potential White River spring Chinook salmon hatchery program and request from the PRCC to provide further direction to the PRCC HSC on this topic (Item IV-C).
- Brett Farman will inquire within NMFS whether the Upper Columbia River Spring Chinook 5-year status review would evaluate the existing recovery criteria and whether any other salmon or steelhead recovery plans have been updated since their original development (Item IV-C).

Decision Summary

- The PRCC HSC approved Grant County PUD's *2020-21 Priest Rapids Hatchery (PRH) Monitoring and Evaluation Implementation Plan* in today's meeting (Item IV-B).

Agreements

- No agreements were made in today's meeting.

Review Items

- A draft infographic prepared by Grant PUD depicting No Net Impact (NNI) is available for limited review by PRCC HSC representatives, with comments due to Todd Pearsons by Wednesday, May 13, 2020 (Item IV-D).

Finalized Documents

- Grant County PUD's final *2020-21 Priest Rapids Hatchery (PRH) Monitoring and Evaluation Implementation Plan* was distributed via email by Larissa Rohrbach on April 24, 2020 (Item IV-B).

I. Welcome

A. Review Agenda, Announcements, Approve Past Meeting Minutes, Review Last Meeting Action Items

Tracy Hillman welcomed the HCP-HCs and PRCC HSC to the meeting and read the list of attendees signed into the meeting. The meeting was held via conference call and web-share because of travel and group meeting restrictions resulting from the COVID-19 pandemic. Hillman reviewed the agenda and asked for any additions or changes to the agenda.

The following topics were added to the agenda for brief discussion:

- Mike Tonseth requested that the PUDs provide an update on whether COVID-19 social distancing measures are going to create delays in reporting the adult fish passage numbers at their hydro-projects. This will be addressed during the discussion of effects of COVID-19 on monitoring and evaluation (M&E) activities (Item II-C).
- Kirk Truscott will update the PRCC HSC on a juvenile steelhead mortality event in the Okanogan River Basin.

All members approved the agenda with these additions.

The HCP-HCs and PRCC HSC representatives reviewed the revised March 18, 2020 meeting minutes. Minor revisions were resolved in the meeting. The HCP-HCs and PRCC HSC approved the March 18, 2020 meeting minutes as revised.

Action items from the HCP-HCs and PRCC HSC meeting on March 18, 2020, were reviewed, and follow-up discussions were addressed *(note that italicized text below corresponds to action items from the previous meeting)*:

Joint HCP-HCs and PRCC HSC

- *Mike Tonseth will coordinate with Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) to present pre-spawn mortality modeling results for spring Chinook salmon at an upcoming HCP-HCs meeting (Item I-A).*
  Tonseth said this item is ongoing. Tonseth informed the attendees that Andrew Murdoch has recently moved into the role of temporary North Central Washington Regional Director for WDFW.
- *Brett Farman will discuss with Charlene Hurst and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A).*
  Farman said this item is ongoing.
- *Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A).*
  Mackey said this item is ongoing.
- *Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A).*
  Mackey said this item is ongoing.
- *Bill Gale with ask Rod Engle (USFWS) for information on weir operation in the Imnaha River allowing for bull trout passage (Item III-E).*

Gale said he had a meeting with Engle, Catherine Willard, Ian Adams (Chelan PUD), and Mike Tonseth last week and discussed how operations of the Imnaha River weir may or may not apply to Chiwawa River weir. Willard will provide an update on this item in today's meeting. This item is complete.

- *Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historic run-size data (Item I-A).*
  Tonseth said this item is ongoing.
- *All parties will provide updates on changes to marking and tagging plans due to the impacts of COVID-19 on operations as updates become available (Item II-C).*
  This item will be discussed in today's meeting.

PRCC HSC

- *Tracy Hillman will discuss updating the Upper Columbia Salmon and Steelhead Recovery Plan with Melody Kreimes (Upper Columbia Salmon Recovery Board; Item IV-C).*
  Hillman said Kreimes sent a response email and they also communicated via phone call. This item will be discussed in today's meeting.

II. Joint HCP-HCs and PRCC HSC

A. Major Discussions Schedule for the Broodstock Collection Protocols

Tracy Hillman projected the summary table of broodstock collection protocols (BCPs) topics for HCP-HCs and PRCC HSC discussion in 2020 (Appendix B). Hillman asked representatives for feedback on the timing of discussions and required actions.

1. Chiwawa spring Chinook salmon marking strategy: Catherine Willard said that another group of hatchery by hatchery (HxH) fish will backfill the wild by wild (WxW) broodstock and will be differentially marked this summer. Last year, uniquely coded wire tags (CWTs) were injected into the caudal peduncle to identify the HxH group. Technicians noticed some scoliosis this year that may be attributable to the CWT injections and there is a need to determine whether that strategy should be pursued again. This discussion should be planned for next month. Mike Tonseth said the brood year 2019 juveniles are not marked yet.

2. Differentiating natural-origin Okanogan spring Chinook salmon using elemental signature analysis: Kirk Truscott said he is still working on this topic and may not be ready to discuss it before June. He is developing a pilot plan for sampling for elemental signature analysis by sampling scales rather than fin rays, because in the past, fish sampled for fin rays in the Wenatchee Basin did not survive well. Truscott said all natural-origin returns (NOR) encountered at Wells Dam are already scale-sampled, so this is a matter of determining

whether or not the elemental signature analysis is feasible. Tonseth said it should be discussed whether or not additional scales should be collected for elemental signature analysis. Tonseth was uncertain how many scales are needed for laser ablation to obtain sufficient information for aging the fish and to determine origins. Truscott said he would inquire with laboratory personnel about how many scales would be needed to obtain both types of information. Tonseth said he thought the mortality seen from the effort in the Wenatchee Basin was a result of holding those fish on surface water at the Chiwawa Acclimation Facility and they contracted fungus. Truscott said there was a test and control group (fin-ray sampled and not sampled) that were both held on surface water and mortality was high in both groups; there was no control for fish held on groundwater. Tonseth said he wonders if there is a way to test the method differently. Truscott said he would not recommend testing with a listed stock fish, but he has been discussing testing this approach with a surrogate stock like summer Chinook salmon. Tonseth said he thinks it would be a good idea to pursue some methods using fin rays because he wonders whether the scales will return enough material.

Truscott said he is struggling to figure out how to collect broodstock without adding additional work. He added that there was difficulty differentiating fish from different subbasins within the Wenatchee Basin using elemental signature analysis. In this case, however, they are trying to differentiate among basins, which should be easier because of the broader geographic scale.

3. Outplanting surplus Methow composite spring Chinook salmon adults: Tonseth said there has been no revision to the previous run escapement analysis. He said the run over Bonneville Dam is looking more encouraging, but it is too early to tell what the run size will be. Perhaps the run is slightly early this year. Tonseth said if run sizes are what they were projected to be, implementing the 2017 outplanting plan will not be possible.

4. Wenatchee spring Chinook salmon pre-spawn survival estimates: Andrew Murdoch's new duty as North Central Washington Region's temporary Director may limit his ability to participate. Tonseth suggested moving his presentation to later this year.

5. Sizing of upper Columbia River (UCR) spring Chinook salmon conservation programs: Hillman reminded the attendees that the program was awaiting some data to be able to re-analyze program size, such as data from the Wenatchee spring Chinook salmon Relative Reproductive Success Study. Tonseth said two pieces of information are needed: pre-spawn survival estimates and updated spawner-recruit curves that are a product of the 10-year comprehensive review. Keely Murdoch said she had done a retrospective analysis that was similar to the original program size analysis with additional years of data. She said the pre-

spawn mortality estimates are a key factor that would allow her to update the original analysis. Keely Murdoch said they were also waiting for a component of the Relative Reproductive Success Study that would allow for a different and parallel program size analysis. Tonseth said he recollected there was an interest in waiting on some information from the life-cycle analysis. Keely Murdoch said she could add more years to the retrospective analysis while waiting for the additional information. Hillman said he has updated most of the stock-recruitment relationships for the 10-year Comprehensive Review. Hillman suggested discussing this topic in May to review the status of the analysis and decide what additional information is needed. Todd Pearsons said there are some elements that could be updated including capacity and some discussion about the reliability of those estimates – both of which are presented annually in the committee approved M&E report. A second is pre-spawn mortality, which is important to allow enough fish to escape above Tumwater Dam so that enough of them survive to spawn. The third is the risk level for bad survival years. Pearsons said Keely Murdoch has mentioned a number of times that reducing the size of the conservation program requires an acknowledgement by the HCP-HCs and PRCC HSC that more safety-net fish may be allowed on the spawning grounds. Pearsons said the problem with that approach is that it was designed to work in low survival years which means that in many years natural-origin fish are taken into the hatchery instead of leaving them on the spawning grounds. Pearsons asked if the topic of leaving more fish on the spawning grounds than in the past could be discussed. Keely Murdoch agreed there is an element to this discussion that is a risk assessment around the use of hatchery-origin fish and at what frequency, not just on spawning grounds, because the retrospective analysis showed that reducing the hatchery program size allows for more fish on the spawning ground while still meeting PNI goals. Keely Murdoch said the risk is that within the hatchery program there may be a need to use safety-net fish more often because there would not be that many conservation-program fish coming back. Keely Murdoch said there is a tradeoff by selecting a conservation-program size based on the retrospective analysis that would make use of safety-net fish very infrequently. Keely Murdoch said the Yakama Nation (YN) would be comfortable with allowing a greater escapement of safety-net fish to the spawning grounds but different parties may have different comfort levels with using safety-net fish in the conservation programs. Keely Murdoch agreed to update the conservation-program size analysis for next month's meeting to review what it informs and what information is still needed.

6. Revising protocols for the transfer of adult Chief Joseph Hatchery (CJH) fish from Methow River facilities: Truscott agreed to the timeline provided in the table, which is to discuss the protocols in the fall. He noted that if CJH fish are not prevalent in the river, modifying these protocols becomes a lower priority than other updates to the BCPs.

7. Requests for surplus adults for research purposes or other non-program requests: Hillman asked if there are any known research uses. Tonseth said this topic is most relevant at Wells Fish Hatchery because that is where most of the requests for surplus are made. Tonseth said once all production program needs have been met, any other research needs directed at improving an HCP program would be allocated toward that use prior to declaring surplus. Bill Gale said it not clear whether prioritization of surplus should be included or not in the BCPs and would like a consistent and uniform practice. Gale said he agrees to prioritizing fish for HCP-related research; fish are only designated as surplus once the HCPs' and PRCC's needs are met. Tonseth said this is correct; however, fish have been considered surplus if in excess of production goals. Gale said he agrees but calling it surplus is confusing. Tonseth said this is a way to show need for retaining adults in the BCPs for approval whereas in the past requests have been made after BCP approval. Tonseth said he would not advocate for a change in how approvals have been done in the past; however, the earlier a request can be outlined the better likelihood that that request can be met and the easier it will be to ensure the allocation is truly made with fish that are surplus to production.

8. Major BCP section rewrites: Greg Mackey said he would start rewriting the steelhead section in question to streamline some of the material Douglas PUD had added in previous years.

9. Preparing for BCP authorship and tech editing: author tasks will be assigned and Larissa Rohrbach will support the best approaches for co-authoring and technical editing the BCPs.

B. Comprehensive M&E Report Status Update

Todd Pearsons shared slides that described the progress and the plan for completion of the 10-year Comprehensive Report (Attachment C).

Slide 1 – Title: Hatchery Comprehensive Report (aka Program Review): Hatchery Committees Update

Slide 2 – There was an effort to restructure the reporting schedule to match with other obligations like recalculation. This content of the report was not a prescribed in the HCPs or Agreements, but was a response to the direction in the HCPs and Agreements.

Slide 3 – Types of reporting products. The annual reports are prepared in all years, 5-year statistical reports include the results of the statistical tests for each program, and a program review is developed every 10 years to integrate all information, not just by program but also to compare to other programs inside and potentially outside of the UCR basin. The 10-year Comprehensive Report (aka Program Review) will try to address the objectives that are in the M&E Plan.

Slide 4 – The approved schedule for reporting. A draft Program Review is to be completed at the end of 2020. It is a large effort to assemble all the information. The PUDs have been working for 1 to 2 years to assemble all the information available.

Slide 5 – A separate report will be provided for each species.

Slide 6 – Hatchery M&E objectives. The goal is to address the M&E objectives in the report to the best of our ability.

Slide 7 – A rough outline for how the different objectives could be encapsulated within a general topic, given as titles for individual chapters. For example, the first chapter topic, "The effects of hatchery supplementation on abundance…" combines a number of objectives that fit together well.

Slide 8 – The general approach to document development has been to assign a lead for each chapter to assemble data, relying on Tracy Hillman, WDFW, and others. The results should not be surprising because these data are mostly available in the annual reports. Hillman has been preparing a large portion of the data analysis. In many cases, the chapters could be complete before December 31, 2020, allowing for Committees to review prior to the release of the complete draft report. In some cases, chapters will be sent to the local experts, co-authors, and those who collected the data for review. In addition, interesting topics could be prepared as journal articles. By December 31, some chapters will be well reviewed, and some will not have been reviewed at all. The idea would be to bring all chapters together into single species reports.

Slide 9 – The genetics monitoring chapters will not be finalized by the end of 2020 due to staffing limitations related to COVID-19. Essential services have been prioritized in the WDFW genetics lab. A placeholder chapter may be provided in the comprehensive report to complete the genetics monitoring chapter at a later date.

Slide 10 – One chapter has undergone peer review already. It was important to have a baseline understanding of stray rates for comparison (Pearsons and O'Connor 2020[1]). The authors prepared a publication on natural-origin stray rates in the UCR basin that was reviewed by local technical experts, peer-reviewed, and published. Another article submitted to the journal *Fisheries* is now in press describing the partnerships at Priest Rapids Hatchery.

Kirk Truscott asked when chapters will go through technical reviews and whether there will be a summary of those reviews and responses that Committee members could view. He said it would be informative to see what the reviewers were recommending and to see the technical back-and-forth. Pearsons said he understands the question and request; however, one of the challenges is a limited

[1] Pearsons, T. N., and R. R. O'Connor, 2020. "Stray Rates of Natural-Origin Chinook Salmon and Steelhead in the Upper Columbia River Watershed." *Transactions of the American Fisheries Society*. 149:147-158.

amount of time to turn drafts around and he is concerned about slowing down the process. Pearsons said additional review loops are not feasible, though providing the journal peer reviews would be possible because there is more time for those efforts. Truscott said he would like to know what technical issues were considered and how the end product was determined. Pearsons said, for example, the fall Chinook salmon chapter is being co-authored by Grant PUD and WDFW. There has been a lot of back-and-forth that is difficult to track. Pearsons will consider some other ideas for tracking how the end product was decided without slowing the process. Truscott said he would want to know any major decisions related to why the analyses were performed a certain way. Pearsons said that several chapters will not be ready until December; only those chapters for publication that are finished early would have been previously reviewed and revised.

C. Effect of COVID-19 Pandemic on M&E Activities

Tracy Hillman asked each Committee member to provide an update on impacts of the COVID-19 pandemic on M&E activities.

Mike Tonseth said M&E staff recently had a meeting to re-define which activities are essential. Alf Haukenes (WDFW) said last week the list of tasks WDFW has been given permission to carry out was expanded, including smolt trap operations and data collection for Endangered Species Act (ESA) issues, especially in the Methow, and the list always included spawning ground surveys and hatchery operations including broodstock collection and other activities. Haukenes said preparing the list was difficult. There was some resistance to some items from the Governor's office. Haukenes said they are hoping that this small expansion of activities will allow for greater capacity to add even more activities. Haukenes said items were identified that, if not carried out now, major ESA commitments like Biological Assessments would not be met, but public safety and social distancing was a major consideration as to whether these were activities that could be carried out safely. Todd Pearsons asked how long the screw traps were not operating and what programs will be able to report with the data collected when they are in operation again. In other words, are data being collected just because there is a contract to run the traps or will there be useful data gained this year. Haukenes said it is probably too soon to address that question completely but there will probably be value in this year's activities. Haukenes said, anecdotally, some of the traps are coming on-line that are extremely valuable but he was unsure if that applies to all traps in operation. Catherine Willard said operation of the Chiwawa River and lower Wenatchee River traps stopped on March 25 and operations started again last week, but peak outmigration had not occurred yet and although there will be a gap in this year's smolt trapping data, it is not a loss. Keely Murdoch added that a larger amount of data are missing than can be extrapolated as is done for briefer outages; however, operators did not miss the entire spring outmigration, which can still be compared to previous years. Murdoch said the population estimate may not be as precise in 2020 as in other years, but there is some information to be gleaned about the size of the outmigration compared to previous years.

Pearsons asked Murdoch if the YN schedule for smolt trap operations was the same as WDFW's. Murdoch said it was similar but not exactly the same. In the beginning, YN technicians were given strict guidelines by the YN to undertake only activities to keep fish alive with a limited number of people. Murdoch said they are generally still under an order to maintain minimum operations to keep fish alive, but with written memoranda ensuring social distancing will be maintained; they have been able to restart some other activities. Murdoch said technicians have more recently been given more authority to carry out activities that are time sensitive and that deal with ESA-listed species; for example, collecting kelts at Rock Island Dam. Murdoch said the YN was able this week to obtain authorization to restart smolt traps, and traps are being placed in the water today.

Mackey said some staff were having difficulty acquiring personal protective equipment (PPE). Haukenes said the definition of PPE varies depending on the activity, but WDFW is following the new CDC guidelines, which includes wearing a cloth mask that is washed daily and bringing hand sanitizer to the field. WDFW staff are using construction masks or homemade masks.

Brett Farman said NMFS is taking a stance that safety is more important than strict adherence to written permits and biological opinions. Farman said NMFS is working on ways to deal with reporting obligations that would trigger re-initiation of consultation to avoid re-initiation.

Pearsons asked if re-initiation would be triggered in situations where M&E data cannot be collected this year? Farman said yes, for example, marking that may not occur and may preclude the ability to report on certain metrics. Farman said NMFS is currently working on prioritizing marking activities and is working on ideas from co-managers for other ways to analyze and collect those data. Farman said right now, it is mainly the effect of marking activities that NMFS is concerned with.

Bill Gale said there is not much new to add to the emails sent out last month regarding the hold on marking and tagging through the end of the shelter-in-place order (forwarded by Larissa Rohrbach on March 26, 2020). Gale said the U.S. Fish and Wildlife Service (USFWS) is looking at how this affects each program; however, UCR programs have already been marked and tagged. Gale said there will be fall Chinook salmon in the lower CR Spring Creek and Little White Salmon River stocks that will not be marked. Gale said all activities are largely still on hold in the UCR with very limited hatchery sampling associated with releases that has been curtailed to an absolute minimum out of concern of the risk to existing hatchery staff. Gale said they are maintaining the fewest number of people on station at a time. Matt Cooper said some pre-release sampling has been done for some projects. The timing for some projects has been remarkably good; for instance, sampling lamprey in the Entiat River is about a month away and hopefully those activities will be able to be carried out.

Kirk Truscott said within-hatchery monitoring activities have continued including activation of passive integrated transponder (PIT)-tag detection systems for spring releases, all operating as normal.

Truscott said the largest impact has been to juvenile emigration activities. All screw trapping has been curtailed in the Okanogan River basin and is unlikely to start until there is a significant change in the status of the COVID-19 pandemic. It was not feasible to run the screw traps and maintain safety, remembering that use of PPE, like cloth masks, is not a barrier to COVID-19 for the wearer. Truscott said work at weirs in the Okanogan basin is progressing with some laborious efforts to maintain social distancing such as driving to sites in individual vehicles.

Marking and tagging at CJH has proceeded. Steelhead spawning ground surveys in the Okanogan are ongoing but restricted to the mainstem river because most tributaries are accessed from private lands and the Colville Confederated Tribes wanted to give private land-owners due respect given this situation.

Willard said adult counts are ongoing at Rocky Reach and Rock Island dams and are available on the Chelan PUD website[2] but there is currently an issue with the counts being posted to DART[3] (Columbia River Data Access in Real Time); Chelan PUD is working to resolve the issue. Tonseth said none of the PUDs' projects' numbers are being reported on DART. Willard said the juvenile bypass is being operated with proper social distancing and PPE. Willard said pre-release sampling was performed safely over the past couple of weeks for all of Chelan PUD and Grant PUD programs. Willard said no activities were curtailed at this point.

Greg Mackey said the 10-year survival study is ongoing with adjustments for safe social distancing, and pre-release sampling has been proceeding. Mackey said there has been a fish marking issue. Tagging of subyearling summer Chinook salmon by USFWS may be canceled and Douglas PUD has made provisions with Biomark to carry out marking if USFWS cannot do it. Mackey said WDFW carries out the M&E so that aspect has been covered by Haukenes. Tom Kahler said Douglas PUD does not typically post any adult counts to DART until May 1 and fish counters stop work after November following the U.S. Army Corps of Engineers fish counting season. Kahler said the fish counting facility is large enough to accommodate social distancing with two to three people, which will allow fish counts to be collected as usual. Kahler said the only exception is if the sizable sockeye run materializes that has been predicted, the fish counter schedule may need to be modified to accommodate counting the large numbers of fish. Mackey said the pre-release precocity sampling of spring Chinook salmon was canceled at the Methow Fish Hatchery. He said NMFS was notified before this was canceled and a visual assessment for parr will be done.

Pearsons said the Priest Rapids Hatchery (PRH) pre-release sampling is not typically done until mid-May; they are hoping restrictions are lifted by then. Pearsons said otherwise at PRH, there are

[2] Available at: https://www.chelanpud.org/environment/fish-and-wildlife/fish-counts
[3] Available at: http://www.cbr.washington.edu/dart/query/adult_graph_text

3,000 fish normally PIT tagged by USFWS that will not be tagged this year and 40,000 fish normally PIT tagged by Biomark that will not be tagged this year.

Peter Graf said Priest Rapids Dam and Wanapum fish counters are working now with video dating back to April 15, which is the normal start date.

Willard said the first spring Chinook salmon ascended Rocky Island on April 4 and another on April 18, 2020.

D. Marking and Tagging Pre-release Assessment

Catherine Willard said that during monthly size sampling in March and April at Carlton Pond, Douglas PUD staff estimated about 20% of the fish that were supposed to be 100% adipose fin-clipped had “bad clips.” Marking occurs at Eastbank Hatchery. She said the WDFW marking staff were notified and a meeting was set up with Chelan PUD, Jason Norton (WDFW marking crew lead), Grant PUD, and Mike Tonseth to discuss reasons why there were so many bad clips. Willard reported that Joe Coutu (WDFW), went to Carlton to sample the fish himself and also identified a high rate of miss-clips. Willard also reported that Coutu indicated that among the marking trailers used by WDFW, there were some parts needing replacement and those were not replaced on the first fleet and replacement was not done until later. Willard said the question discussed during the meeting was if WDFW does a quality check (QC) scan at the time of clipping, why did they report a 100% clipping-rate? She said there were some problems identified with QC and ideas were discussed for mitigating this in the future. Willard said the bad clips cannot be corrected, but this will be mitigated in the future. Willard said this has implications for other programs. Chelan PUD conducted pre-release sampling to figure out what the bad clip rate is for all programs, in addition for checking CWT retention. Willard shared a table, distributed by Larissa Rohrbach following the meeting, showing results of the sampling (Attachment D). Bad clips were prevalent in the summer Chinook salmon programs and ranged from 13.8% to 27.8%. Willard said Chelan PUD crews that conducted the additional QC during pre-release sample followed the methodology used by Regional Mark Information System (RMIS) for QC and WDFW is going to update RMIS to reflect the updated bad clip rates. Willard said CWT retention rates were not much different from the QC check 20 days after tagging and the original reporting was accurate.

Kirk Truscott asked what constitutes a bad clip? Willard said this was discussed with the PUDs, the WDFW Methow crew, and Norton to ensure all agreed to what was called a “bad clip.” All agreed a bad clip is defined as a fish retaining 25% or more of the adipose fin following clipping.
Todd Pearsons said three samples came up with similar estimates of bad clip rates at Carlton.
Truscott asked because their fishing regulations require release of all fish that have an adipose fin that has not been completely removed and there are a good number of Carlton fish that are

encountered in the Okanogan River. Truscott said he is wondering about the definition to avoid a situation where anglers are releasing a hatchery-origin fish that could have been retained.

Pearsons said he recalled that about half of the fish in the bad-clip category at Carlton were actually "no clips." Greg Mackey said Douglas PUD has been monitoring the Wells Hatchery program fish and noted the Methow summer Chinook salmon yearlings had a bad clip rate of 13.8%. He said they have not assessed the subyearlings yet. Mackey said he has worked with Charlie Snow and Charles Frady (WDFW) to increase the sample sizes to better estimate the numbers that were badly marked.

Tracy Hillman asked if there are other problems that need to be considered by these Committees as a result of bad clips. Truscott said for broodstock collection, selection of hatchery-origin returns (HOR) or NOR could be made based on presence or absence of CWT. Truscott said HOR are selectively collected at CJH for segregated program fish. Depending on how bad the clips are, technicians may have to scan for CWTs. Bill Gale said it seems like the complication will be the potential inclusion of safety-net fish in conservation programs when intending to include HxH fish depending on the run size. Tonseth said the CWTs will serve as backup. Gale said the options are to scan for CWTs ahead of time or to back-calculate the effect after the fact. Gale said there could be some effectiveness of passing adult fish upstream.

Truscott asked, going forward, what is the protocol for QC during clipping. Tonseth said there are two QC steps when WDFW does the tagging. One occurs within a few days after completion of CWT tagging and adipose-clipping and the second occurs at least 28 days after tagging is finished. Tonseth said the initial QC was not catching those bad clips and the first line of detection needs to occur because there is no ability to go back and clip fish later. Tonseth said some initial QC steps are being added immediately after tagging and clipping to identify problems with the marking equipment in time to course-correct.

III. Rock Island/Rocky Reach HC

A. Chiwawa Weir Operations Update

Catherine Willard said Rod Engle provided an overview of the weir installation and operation on the Imnaha River. Passage of bull trout was allowed by gaps under the weir near the riverbed. Willard stated that Ian Adams (Chelan PUD) indicated the Chiwawa Weir could not be operated that way without extensive modification, and especially not this year. Mike Tonseth said they began to look at what modification could be feasible in the future to the weir; however, at this time there is no change for the proposed operations from the recently approved BCPs. Tonseth said the modification made to the Imnaha Weir was a fortunate accident that allowed resident fish passage; the gap occurred along the deepest part of the channel during low flow conditions. Resident fish passage ports were installed in the weir and monitoring showed bull trout were using these resident fish passage ports.

Biologists later ensured the ports were cleaned regularly to maintain passage. Tracy Hillman asked the size of the ports. Tonseth said they are approximately 3 to 4 inches high. He said large bull trout would lay on their side and squeeze through. Larger Chinook salmon could not pass through the ports. Bill Gale estimated openings were approximately 4 inches high and 12 inches wide. Gale said he hoped some modifications to the Chiwawa Weir could be made in the future to avoid bull trout handling issues and still meet broodstock collection goals. Gale said the Imnaha consultation was more onerous, requiring modifications and monitoring. Gale said Sierra Franks (USFWS Ecological Services) was also on the call and Franks found the discussion interesting and thought this was important and useful information for the Chiwawa Weir. Willard asked to share some of the materials provided by USFWS and Gale agreed to distribute them following the meeting (Attachment E).

Tonseth said to keep in mind the Imnaha Weir was completely redesigned and replaced while maintaining the concrete base because weir impacts were resulting in quite a few mortalities. Gale said mortalities were related to handling issues under the standard operating procedures that were also resolved. Tonseth said it was the latent effects of the anesthesia that was causing fish to become impinged on the weir.

Gale asked if Adams is looking at how the weir can be modified. Willard said yes; however, he thinks it would be a big project, but he is thinking of ways it could be modified.

IV. PRCC HSC

A. Review Agenda, Announcements, Approve Past Meeting Minutes

The PRCC HSC representatives approved the March 18, 2020 meeting minutes as revised.

B. DECISION ITEM: Priest Rapids Hatchery M&E Plan

Tracy Hillman called for a vote to approve Grant PUD's *Implementation Plan ,2020-21 Priest Rapids Hatchery Monitoring and Evaluation*. All members of the PRCC HSC approved except for Kirk Truscott, who did not review the plan and abstained.

C. White River Spring Chinook Salmon: Next Steps

Tracy Hillman reminded the PRCC HSC that Dale Bambrick (NMFS Columbia Basin Branch Chief) provided responses to questions about the White River spring Chinook salmon program, distributed via email by Larissa Rohrbach on March 17, 2020 (Attachment F).

Hillman said Bambrick's responses seemed consistent with Craig Busack's (former NMFS representative to the PRCC HSC) responses. Hillman asked the group how they want to proceed. Todd Pearsons said he had some observations, as follows:

- Reponses from NMFS did not preclude a hatchery program but did not see much of a benefit to the White River minor spawning aggregate (mSA) that would bring the evolutionarily significant unit closer to recovery, particularly from a composited hatchery.
- The role of the spawning aggregate seemed to be less important to recovery than was previously thought.
- Their responses suggested the possibility for updating the recovery plan.

Brett Farman said Pearsons's overview seems consistent with Busack's and Bambrick's intent. That is, not precluding a hatchery program but not taking a position that it was necessary or would actually benefit the stock. Farman said from NMFS' perspective, they are open to discussing a change in the baseline assumptions from the original drafted recovery plan.

Keely Murdoch said she is trying to circle back to the original reason of engaging Busack to solidify the purpose of the memorandum for the PRCC and to respond to the data needs. Murdoch said the dialog with Busack and Bambrick provides helpful insight into NMFS' current perspectives. Farman said although data needs were being discussed, it was in the context of whether the hatchery program would be restarted for ESA recovery in order to determine what would be needed to restart the program. Murdoch said the PRCC HSC was tasked with identifying questions and data that would go before an expert panel that would decide whether a hatchery program was needed. Hillman said he recalls asking the PRCC to direct the PRCC HSC how to move forward, and in the meantime, the PRCC HSC solicited perspectives from Busack on whether a hatchery program would be supported by NMFS. Hillman summarized that NMFS staff identified some adverse impacts of a hatchery, but did not say that a hatchery would be a bad thing for recovery. Hillman said Denny Rohr (facilitator of the PRCC) is aware of the responses from Busack and Bambrick and the PRCC HSC is still waiting for guidance from the PRCC. Kirk Truscott said questions 1 through 5 asked of Busack and Bambrick are about how important the White River spawning aggregate is to recovery, questions 6 through 8 are about their position on a hatchery program. Truscott said to move forward, leaving this with the PRCC is the correct action now and re-engaging with the PRCC HSC if the PRCC sends it back, or if there is reason to do so after the pending 5-year status review. Truscott and Murdoch confirmed that NMFS responses have not been discussed in the PRCC yet. Hillman will discuss these responses with Rohr to convey the need for the PRCC to consider the next steps.

Hillman said he discussed updating the Upper Columbia Salmon and Steelhead Recovery Plan with Melody Kreimes, Upper Columbia Salmon Recovery Board (UCSRB) Executive Director, about the possibility of updating the recovery plan with updated information. Kreimes said it would be worth an initial conservation with NMFS, as the Upper Columbia plan was fully adopted by NMFS compared to others that were appendices to a NMFS plan (the full response from Kreimes was distributed via email by Rohrbach on March 25, 2020).

Hillman summarized the main points of his phone conversation with Kreimes as follows:

- To open up the plan for revision would be to open up the entire plan including harvest, hatchery, habitat, and hydropower sections, not just one component of the plan. Based on what it took to approve, it would be a large process, but it can be done. It would be a public process including all stakeholders. Kreimes would need to know relatively soon so she can inform all stakeholders.
- The UCSRB would ask the Regional Technical Team, Implementation Team, and Watershed Action Teams to review the updated information and provide a recommendation to the UCSRB and NMFS as to whether the recovery plan should be updated. If the issue is to reduce the number of spring Chinook salmon spawning aggregates in the Wenatchee River basin based on relative reproductive studies, the science teams would review the information and make a recommendation. If the upper Wenatchee River spawning area is removed, the recommendation could be that natural-origin spring Chinook salmon have to occupy all four of the remaining spawning areas in the upper Wenatchee basin. The current criteria indicate that spring Chinook salmon have to occupy four of the five spawning areas in the upper Wenatchee basin.
- Kreimes does not see how reopening the plan would help inform whether or not a hatchery program would be needed on the White River. If scientific information has changed, but it would not change the recovery criteria, the plan does not need to be reopened. However, if there is new information that indicates the current recovery criteria are inadequate or precluding recovery, or the criteria are unable to be met, that would be a reason for opening the plan.

Pearsons said if the information in the recovery plan is incorrect or incomplete, the authority on that document would want to revise it to make it as correct as possible. Pearsons said that is not necessarily a PRCC HSC task but an interested party could bring it to the UCSRB or NMFS so they can determine whether they want to do something about it. Farman said there may be new information, but whether this means the plan is incorrect, NMFS may not agree. Farman said the plans are a snapshot in time and do need updating when new information comes available; however, NMFS weighs the update needs and the severity of the discrepancies before launching into a large process, knowing there will always be information that is already out of date by the time the document is published. Farman said, in his personal opinion, NMFS would probably be reluctant to revise the plan and would want more mounting evidence that the whole plan requires revision. Hillman said based on what was shared so far, Kreimes did not think there was enough reason to reopen the plan. On the other hand, if recent science indicates that current recovery criteria are precluding recovery, that would be a reason to reopen the plan. Farman said that makes sense.

Bill Gale said he questions whether it makes sense or not to update the plan and he is unaware of any mechanism to review or update the plan. Hillman said Bambrick responded by saying if there are issues with the plan, there is language that allows for the plan to be updated. Gale said he questions the idea that you would write a recovery plan with no review of whether the plan is adequate. Gale added that the "all or nothing" idea of opening up the plan for all elements to be reconsidered should be questioned, there should be an intermediate measure for revising aspects of it as good adaptive management. Mike Tonseth agreed with Gale. Tonseth said a lot of those criteria were developed using the most current information at that time, which were data from before 2000. Tonseth said that now there is over two decades worth of information. Tonseth asked how can they make statements that they are not willing to open it up unless it changes the criteria, when in fact you have to reopen it to rerun those analyses to find out if those criteria make sense. Hillman said it is not that it cannot be reopened, Kreimes is saying if the PRCC HSC requests the plan be opened, then the available information needs to show that the current recovery criteria are inappropriate. In addition, one does not have to open the recovery plan to rerun analyses to find out if the criteria are inappropriate. One would do those analyses to demonstrate that the plan needs to be reopened. Hillman asked if the analyses in NMFS' 5-year review include an evaluation of the reasonableness of current recovery criteria in the plan. Farman said he has not been deeply involved in either process, but agrees that is probably correct; the 5-year review could be the trigger for reopening the recovery plan.

Tonseth said his understanding is that it is a comparison of the most recent 5 years of recovery data to compare to whether they are meeting criteria. Reviewing the reasonableness of criteria would be a much more lengthy process. Hillman asked if the PRCC HSC or co-managers should request that NMFS review the reasonableness of the criteria as part of their 5-year evaluation. Tonseth said it would be helpful to know what all is evaluated in the 5-year status review to get a clear outline on whether they are evaluating whether the criteria are suitable or if it is simply a comparison among time periods. Farman said he is not aware of a statutory link between recovery plan and status review, so it is not automatically a trigger for reviewing the plan but he will ask about whether this type of information is considered in the 5-year status review and he will also ask if other recovery plans have been updated. Hillman said the Upper Columbia plan followed recommendations from the Interior Columbia Basin Technical Recovery Team. That team dissolved but the National Oceanic and Atmospheric Administration established the Recovery Implementation Science Team (RIST), which was set up to review recovery plans. Hillman suggested that the PRCC HSC could ask RIST, if it still exists, to review recovery criteria based on new information. He suggested that Farman contact Michelle McClure (NMFS) to see if the RIST could review the criteria. Hillman and Rohrbach will add header information to the responses from Busack and Bambrick and will redistribute them following the meeting.

D. No Net Impact Infographic

Todd Pearsons shared a draft of an infographic for PRCC HSC review only, explaining what NNI is in terms of fish mitigation for the mainstem dams operated by Grant PUD. Pearsons said this is a product he has been contributing to within Grant PUD for some time. Pearsons said the infographic is intended to be circulated within the county to give people an overview of what Grant PUD does and what they strive to achieve. Pearsons asked the PRCC HSC to point out any fatal flaws with this document before it goes to a broader audience. He said the intent is to share it with the PRCC, PRCC Habitat Subcommittee, and the Fish Forum. Pearsons asked that it not be distributed more widely at this time. Pearsons said the hope is that it is a one-stop document that brings people (for instance, new committee members or county commissioners) up to speed rather quickly.

Keely Murdoch asked if it could be shared with supervisors or others within the YN. She said she wants people within her own organization to be able to review this before it goes public because it does include the YN logo and logos of other organizations. Deanne Pavlik-Kunkel said it could be shared within the agencies but to ask that she request that it not be distribute outside the organization. Brett Farman and others will ask for up-to-date logos.

Pearsons asked for feedback by the next HSC meeting.

Bill Gale asked, on the mitigation side, what about improvements to project survival such as improvements at the dams. He said on the loss side, survival through the project is affected also by mainstem habitat alteration that has changed the rivers to reservoirs, resulting in fish loss because, intuitively, survival is worse through the reservoir compared to migration through a free-flowing river. Gale suggested adding habitat alteration to the loss side of the balance.

Kirk Truscott said the eye-popping dollar amounts are emphasized and it would be fair to show the benefits in terms of producing power to be able to weigh dollar amounts of power produced and communities served, for instance, in terms of homes powered. Truscott said that would show the money spent balanced by the money made by the power producer. Truscott said there needs some context for why this amount of money is being spent on fish and habitat. That is, it is being spent because fish are killed by the dams, but also to generate power to serve specific purposes and markets including Seattle City Light and Puget Sound Energy. Truscott said, without this spending, the benefits from hydropower would not be had. Pearsons said this was intended to summarize the environmental side of the work because the hydropower production side is already pretty well-known. Pearsons said he will think about how to incorporate this feedback, noting they did cite the report that includes that type of information.

Gale said that within the hatchery section, a sentence could be added about the economic benefit of hatchery production. For instance, fishery opportunities in the ocean, lower Columbia River, and in the Hanford Reach. Mike Tonseth said he does not agree with that perspective, mitigation replaces what otherwise would have been lost without having the mitigation. Gale said he agrees, but without the NNI that economic benefit would be completely lost.

Pearsons asked if this would be a beneficial communication tool within different organizations or if it is useful only within Grant PUD. Gale said it could be beneficial if the other PUDs also provided similar information, but it is not quite as useful with information from just one PUD.

Murdoch said it is clear that the overall emphasis is on dollars spent and this stokes some anger about money spent without emphasizing the benefits. Murdoch said the number of projects and fish are written in small font and sentences that do not stand out. She said the focus on the action for fish mitigation seems like it would be more important to highlight than money that has been spent. Pearsons said the main message is the NNI up front and center, and he understands the opinion on emphasis on money. He said this is intended to be informational for people who are thinking about the financial numbers.

Tonseth said he suggests double checking the 10.9 million fish number. Pearsons said it includes PRH, sockeye, and coho salmon. Tonseth said it looks like the U.S. Army Corps of Engineers program reared at PRH may have been added into that number, and to check whether other resident fish (sturgeon, lamprey) were included.

Pearsons asked PRCC HSC members to share the document internally and return comments to him 1 week before the next PRCC HSC meeting (by May 13, 2020), allowing him time to seek answers within Grant PUD prior to the next Grant PUD meeting.

E. Carlton Pond Back-Up Well

Todd Pearsons said summer Chinook salmon acclimated at Carlton Pond were released last night based on fish readiness and environmental conditions. Brandon Kilmer (Douglas PUD Methow Hatchery Supervisor, responsible for operation of the Carlton Pond) said this was the best group of fish he had seen. He said flows in the Methow River were increasing. Pearsons said there is no news on how the release went.

Pearsons said the site operates with a 2,000 gallons per minute (gpm) permitted well with no back-up well at this time. Pearsons said they are in the process of putting in a back-up well that will be 3,200 gpm and a separate domestic well will be used to minimize stress on the pumps of bigger wells. Pearsons said the domestic well will serve the facility, for example, the eyewash station, bathroom, and outdoor spigot. Pearsons said they are planning on having this done before the fish arrive on station this fall, providing backup capacity to the well that is already there.

Mike Tonseth said last fall there were discussions regarding the intake for the Carlton facility, and asked if there were other ideas explored like an infiltration gallery for the intake in surface water. Pearsons said the methods for accessing surface water were difficult, may not be permittable, and the reliability is uncertain and that they were not being pursued at this time. Pearsons said currently, the main channel is migrating away from the intake and they have not come up with any great ways to create a redundant surface water intake.

Tonseth asked Pearsons to confirm that both wells were not designed to be run concurrently. Pearsons said correct, only one can be run at a time.

F. Omak Creek Steelhead Mortality Event Update

Kirk Truscott said, at the Saint Mary's acclimation pond on Easter weekend, a power failure occurred and approximately 5,000 juveniles were lost, representing 50% of 10,000 that were rearing at the facility. Truscott said the release target for Omak Creek was 30,000, so this represents about 17% of the release for Omak Creek and roughly 5% for the total Okanogan Basin. Truscott said the remaining 20,000 fish were releases from Wells Fish Hatchery into Omak Creek. Truscott said the overall production out of Wells Fish Hatchery was 105% of 100,000, so they were still able to meet 100% of the release target for the Okanogan Basin as a whole. Truscott said the remaining fish were released on April 12 and 13. He said some fish were released at the time that problems were observed, which was within days of the target release date.

Truscott said the problem occurred because back-up generation started and provided power but when the utility power came back on, this signaled for the generators to switch off, but the facility did not switch back over to utility power as it should have. He said the problem was the ground to the solenoid to switch back to utility power was disconnected. He said the system has been repaired, checked, replaced, and switched into operation mode. Truscott said he prepared an incident report that will be reviewed internally and could be sent out to the PUDs and the PRCC HSC later if asked. Truscott said the issue has been in the press.

Mike Tonseth asked what proportion of the WxW fish from brood year 2019 were lost? Truscott said these were WxW progeny, but he was not certain what proportion of all WxW production for the Okanogan River the loss represented.

Pearsons asked if the affected fish that were released were so compromised that they would have poor survival. Truscott said in the rush to save fish, they were not counted. He said one pond was not released so they could observe latent mortality and there were about 500 mortalities the first day and 1,700 the following day. Truscott said this proportion that suffered latent mortality was factored into the estimate of the total mortality.

G. Nason Spring Chinook Salmon Release Update

Todd Pearsons said they typically look for fish readiness and environmental conditions before force-releasing fish from the Nason Creek Acclimation Facility. Pearsons said the fish are still small at the acclimation facility, therefore, they have decided to hold fish a bit longer and will release them when there is a spike in flows. Mike Tonseth asked what the final date is for releasing them.

Keely Murdoch said because the Nason Creek smolt trap is now operating, she asked that Grant PUD please contact Jeff Caisman (YN) before the fish at the acclimation facility are released. Murdoch said this communication usually occurs; however, there are additional concerns to maintain safe social distancing if a large number of fish pass the trapping location. In addition, the traps have not been manned 24 hours a day. Pearsons said releases will occur at night.

V. Next Meetings

The next HCP-HCs and PRCC HSC meetings will be Wednesday, May 20, 2020, Wednesday, June 17, 2020, and Wednesday, July 15, 2020, held by conference call and web-share until further notice.

VI. List of Attachments

Attachment A	List of Attendees
Attachment B	2020 Major Discussion Topics
Attachment C	Hatchery Comprehensive Report (aka Program Review): Hatchery Committees Update
Attachment D	2020 Pre-release Sampling Mark and CWT summary
Attachment E	Imnaha Weir Performance Information
Attachment F	Role of the White River Spring Chinook Spawning Aggregate in Recovery

Attachment A
List of Attendees

Name	Organization
Larissa Rohrbachº	Anchor QEA, LLC
Tracy Hillmanº	BioAnalysts, Inc.
Scott Hopkinsº	Chelan PUD
Catherine Willard*º	Chelan PUD
Kirk Truscott*‡º	Colville Confederated Tribes
Tom Kahler*º	Douglas PUD
Greg Mackey*º	Douglas PUD
Peter Graf‡º	Grant PUD
Deanne Pavlik-Kunkelº	Grant PUD
Todd Pearsons‡º	Grant PUD
Brett Farman*‡º	National Marine Fisheries Service
Matt Cooper*‡º	U.S. Fish and Wildlife Service
Bill Gale*‡º	U.S. Fish and Wildlife Service
Alf Haukenesº	Washington Department of Fish and Wildlife
Chris Moranº	Washington Department of Fish and Wildlife
Mike Tonseth*‡º	Washington Department of Fish and Wildlife
Keely Murdoch*‡º	Yakama Nation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate
º Joined by phone

Table 1. Topics for HCP-HC and PRCC HSC Discussion in 2020

Topic	Discussion Lead	Meeting Dates for Discussion	Required Action and Date
Chiwawa spring Chinook salmon marking strategy (BY2019, BY2020 body tag for hatchery fish)	Catherine Willard	May	Incorporate marking plan into 2021 BCPs
Differentiating natural-origin Okanogan spring Chinook salmon from other natural-origin Chinook salmon during broodstock collection at Wells Dam for Methow Fish Hatchery programs – consider elemental signature analysis	Kirk Truscott	April – June	Incorporate sampling into 2021 BCPs
Outplanting surplus Methow Composite Spring Chinook Salmon Adults	Mike Tonseth	June	Update plan; linkages to BCPs
Wenatchee spring Chinook pre-spawn survival estimates	Mike Tonseth/ Andrew Murdoch	June or later based on Andrew's Murdoch's availability	Present method and results to HCs/HSC; inform program sizing discussions
Sizing of upper Columbia River conservation programs	All	May	Depends upon pre-spawn survival estimates, updated S/R curves, capacity estimates, and risk (max natural-origin fish on spawning grounds)
Revise protocols for identifying/transferring Chief Joseph Hatchery fish from Methow Fish Hatchery and Winthrop National Fish Hatchery during broodstock collection	Kirk Truscott	Sept - Nov	Include in draft BCPs for internal permit holders by January 10
Request for HCP surplus adults for research or other requests	All	Sept – Feb (2021)	Include in draft BCPs for internal permit holders by January 10 (needs to be surplus to production goals)

Topic	Discussion Lead	Meeting Dates for Discussion	Required Action and Date
Review of the Broodstock Collection Protocols (BCPs) to identify major rewrites needed and assign co-authors • Address redundancy in Methow Steelhead juvenile release methods and broodstocking methods • Consistent descriptions of allocation of surplus	Tracy Hillman	Sept-Nov	Assign BCP author responsibilities in Sept meeting
BCP document production: options for co-authoring and technical editing	Larissa Rohrbach	Nov-Dec	Establish BCP drafting protocol by mid-December; Prepare draft BCPs for internal permit holders by January 10

Hatchery Comprehensive Report (aka Program Review)

Hatchery Committees Update

April 21, 2020

HSC/HCP agreement (March 13, 2017)

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- Sockeye

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Objective 10: Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest augmentation programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.

General chapter topics and M&E Objectives

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FEATURED PAPER

Stray Rates of Natural-Origin Chinook Salmon and Steelhead in the Upper Columbia River Watershed

Todd N. Pearsons* and Rolland R. O'Connor
Grant County Public Utility District, Post Office Box 878, Ephrata, Washington 98823, USA

Abstract
Despite the importance of straying in understanding the ecology of Pacific salmon *Oncorhynchus* spp. and steelhead *O. mykiss*, most of what is known about salmon and steelhead straying comes from tagged hatchery fish. We provide estimates of donor straying by natural-origin spring, summer, and fall Chinook Salmon *O. tshawytscha* and summer steelhead at three spatial scales in the upper Columbia River watershed by using PIT tags. In total, 823,770

Revision 3 submission 3_23_2020.pdf - Adobe Acrobat Pro DC
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Expanding Partnerships and Innovations to Implement Reform of a Large Columbia River Hatchery Program

Journal:	*Fisheries*
Manuscript ID	FSH-2019-0095.R3
Manuscript Type:	Feature
Date Submitted by the Author:	n/a
Complete List of Authors:	Pearsons, Todd; Grant Public Utility District, Haukenes, Alf; Washington Department of Fish and Wildlife Hoffarth, Paul; Washington Department of Fish and Wildlife Richards, Steven; Washington Department of Fish and Wildlife
Keywords:	Hatchery reform, PNI, Domestication, Chinook Salmon, Management, Columbia River, Genetics

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4/16/2020

CWT retention rates and "bad clip" rates for 2020 hatchery release groups (fish sampled during pre-release sampling).

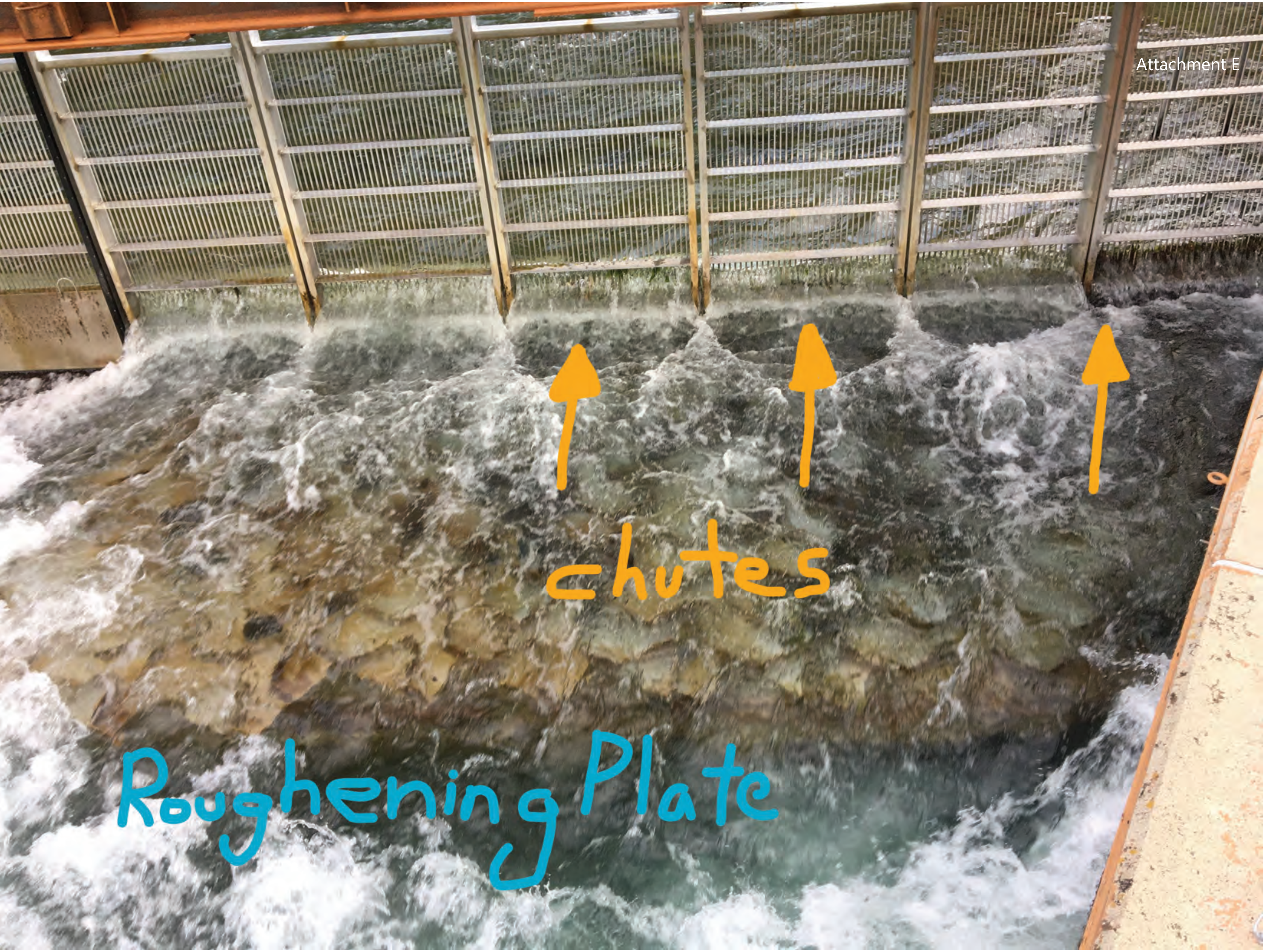
Date Sampled	Group	Production Type	Vessel/RCY	AD Clip Sampled	AD Bad Clip	AD Bad Clip Rate %	CWT Sampled	CWT Detected	CWT Retention Rate %
4/14/2020	Wenatchee Steelhead Indoor	WxW	Circ-1/3	NA	NA	NA	400	386	96.5
4/15/2020-4/17/2020	Wenatchee Steelhead Outdoor	WxW	RCY-2	NA	NA	NA	200	196	98.0
	Wenatchee Steelhead Outdoor	HxH	RCY-2	1,111	175	15.8	200	191	95.5
4/10/2020	Wenatchee-Dryden Summer Chinook	WxW	DRYP	1,000	278[a]	27.8	1,000	990	99.0
4/06/2020	Chiwawa River Spring Chinook	WxW	RCY-1	NA	NA	NA	200	199	99.5
4/06/2020	Nason Creek Spring Chinook	HxH	Circ 1-4	400	82	20.5	400	389	97.2
4/07/2020	Nason Creek Spring Chinook	WxW	Circ 4-5	400	NA	NA	400	395	98.8
4/13/2020	Chewuch River Spring Chinook	WxW	CHEWUP	NA	NA	NA	1,000	964	96.4
4/09/2020	Carlton Summer Chinook	WxW	Circ 1-8	1,000	255	25.5	1,000	997	99.7
4/08/2020	Chelan Falls Summer Chinook	HxH	Circ 1-4	1,000	136	13.6	1,000	999	99.9

[a]The 278 bad clips includes 13 no clips (1.3% no ad-clip).

Attachment E


Attachment E

Attachment E


Attachment E
chutes
Roughening Plate

Attachment E Imnaha Weir Performance Information (continued)

- 2020_04_21 USFWS - Imnaha Bull Trout Weir interaction photos video_bull trout upstream.asf
- 2020_04_21 USFWS - Imnaha Bull Trout Weir interaction photos video_bull trout upstream 2.asf

Distributed to the HCP-HCs and PRCC HSC by Larissa Rohrbach on April 21, 2020, and available for download from the HCP-HCs Extranet under Draft Documents > All by Mtg Date > 4/21/2020

Role of the White River Spring Chinook Spawning Aggregate in Recovery

Questions were prepared by the PRCC Hatchery SubCommittee (HSC) in January 2020 for Craig Busack, former NMFS representative to the PRCC HSC and Dale Bambrick, current NMFS Columbia Basin Branch Chief. Busack provided his responses over email on February 10, 2020 (black bold italics) and Bambrick added to those responses via email on March 17, 2020 (red bold italics).

Here are responses to the questions that were posed to me at the 1/15 committee meeting. These answers will undoubtedly differ somewhat from what I said at the meeting, as per the email message I sent to the committee last week. Long story short, I can offer opinions/perspectives on all these, but decision-making authority on many lies within the Interior Columbia Branch Office (ICBO), the local head of which is Dale Bambrick, not with the Sustainable Fisheries Division, of which Brett and I are members.

1. Is the White River spawning aggregate necessary to the Wenatchee spring Chinook population in regards to meeting VSP criteria? ***This has been discussed many times within the agency, including Mike Ford and Tom Cooney. The short answer is no, but it will help achieve the 4 of 5 spawning aggregate goal. And the goal is just that. The recovery plan presented the best thinking on the matter at the time. If, over time, it appears that some of the goals are unachievable, or achieving them poses greater risk to the species than achieving them, goals can be adjusted,***

2. What is the NOAA Science Center's most recent view on the importance of the White River spawning aggregate? ***I contacted Mike Ford for the most recent information. He said his most recent information was Chiwawa-White Fst=.0049, Chiwawa-Nason Fst=.0025, and wild-hatchery in that area Fst=.0025. So White is more different than the general baseline level of Fst, but these are very small Fst levels. To the extent that the distinctiveness of White River is due to adaptation to the environment it occupies, this distinctiveness could be regained if it were to be lost.***

   I'd like to also point out that the genetic distinctiveness (or lack thereof) of the White River spring Chinook spawning aggregate has been discussed many times within the PRCC HSC, including at least one panel discussion by geneticists from CRITFC, NOAA, and WDFW. I recommend the committee refer to the records of these past discussions in the minutes

3. If the White River and Little Wenatchee spawning aggregates are important to recovery and both suffer from the same limiting factors, how will NOAA address recovery without one or both aggregates? ***I'm not going to answer this directly because the ensuing discussion focused more on the issue of the Wenatchee River spawning aggregate not really existing. If this were the case, the current spatial distribution specs in the recovery plan now seem much more onerous (i.e., is it now that all 4 real spawning aggregates are needed?) How to deal with this, including the possibility of a revision to the recovery plan, is something you should take up with Dale. See answer to # 1 above. In addition, I think the question is better worded as "how MIGHT NOAA address recovery….." We are a long haul away from recovery for UCR spring-run Chinook salmon. It is nevertheless hard to imagine that we would not consider delisting if all three populations are meeting abundance and productivity goals and most major spawning***

areas meet recovery criteria. We do not at this time know how productive the White and Little Wenatchee major spawning areas might eventually be. Measures to improve local habitats and reduce mortality within the migration corridor continue and may eventually contribute significantly to the abundance and productivity within these MSA.

4. How important is the White River aggregate to the overall genetic diversity of Wenatchee spring Chinook?

    a. How much within-population genetic variation is needed for recovery? I know of no set *quantitative standards for diversity for any ESU or DPS.* ***My experience in recovery discussions, including assessing population VSP levels is that everything has to be evaluated in the context of everything else (i.e. it is relational, not absolute). However, this question is more appropriate for Dale, assisted by NWFSC geneticists.*** *Agreed. See earlier comments.*

    b. Given the degree of escapement by other within basin aggregates into the White River, is there evidence to suggest that the White River aggregate is still genetically distinct? ***See answers to earlier questions (particularly question #2) above also refer back to minutes from previous discussions.***

5. If the White River genetic signature is lost, can recovery still be achieved? ***As I said earlier, recent discussions at NOAA have concluded yes.***

    a. If so, how do we achieve recovery without the White River genetic signature? ***Again, this is technically outside my lane, so again, it would be wise to contact Dale. However, I also recommend looking at the recovery plan. I have not studied it in detail, but I think there is lack of emphasis on White River specifically. It is unclear that there is at present much of a White River signature. We believe it is more likely that such a signature would become more pronounced if this MSA is not supplemented with hatchery fish. As for how we might achieve recovery, I think this has more to do with distribution of spawning than a genetic signature, but see answers 1 and 3.***

6. Would NOAA support a composite broodstock hatchery program for the White River? ***Depends on the details of that program, but at this point it is not clear what the benefits would be. While it can be argued that a larger spawning population is a good thing in that it reduces genetic drift, allowing natural selection to be more efficient, compositing would likely erase the White River genetic signature. It also seems that given the low production potential of the White River basin, the value of the program is open to question. At this time, we do not think a supplementation program would benefit the MSA or move us any closer to recovery.***

7. If White River spring Chinook are not genetically distinct from other Wenatchee spring Chinook aggregates, what would be NOAA's view on White River supplementation? ***Same as #6, but genetic concerns would be less. The White River spawning aggregate is distinct; the question is how high a value to place on this low level of distinctness.***

8. If HORs do not contribute to NORs, would adding another supplementation program in the Wenatchee contribute to recovery? ***Maybe, maybe not. Key to recovery is sustainability of natural production, not how many NORs you can create by augmenting spawning grounds***

with hatchery fish. Exactly how the hatchery programs contribute to recovery is a question best asked of the ICBO. We would expect to be in on that discussion, but in a supporting role.

In the ensuing discussion, it became clear that a larger issue is the general recovery benefits of supplementation programs, other than as a buffer against extinction. My own opinion is that supplementation programs only really solve problems when populations are critically low; you can't permanently get more natural production out of a system without increasing the productivity and capacity of that system. I concur. I'd rather conquer, but I'll settle for concur.

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Page 4 of 5 1362 words

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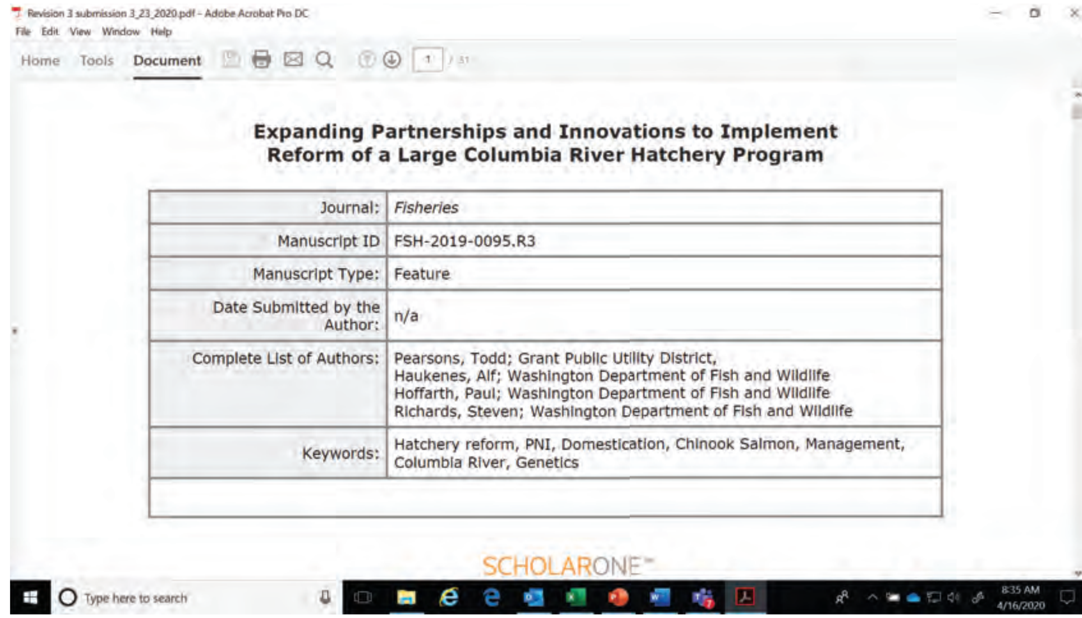
Stray Rates of Natural-Origin Chinook Salmon and Steelhead in the Upper Columbia River Watershed

Todd N. Pearsons* and Rolland R. O'Connor
Grant County Public Utility District, Post Office Box 878, Ephrata, Washington 98823, USA

Abstract
Despite the importance of straying in understanding the ecology of Pacific salmon *Oncorhynchus* spp. and steelhead *O. mykiss*, most of what is known about salmon and steelhead straying comes from tagged hatchery fish. We provide estimates of donor straying by natural-origin spring, summer, and fall Chinook Salmon *O. tshawytscha* and summer steelhead at three spatial scales in the upper Columbia River watershed by using PIT tags. In total, 823,770



Expanding Partnerships and Innovations to Implement Reform of a Large Columbia River Hatchery Program

Journal:	*Fisheries*
Manuscript ID	FSH-2019-0095.R3
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Keywords:	Hatchery reform, PNI, Domestication, Chinook Salmon, Management, Columbia River, Genetics

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Attachment D

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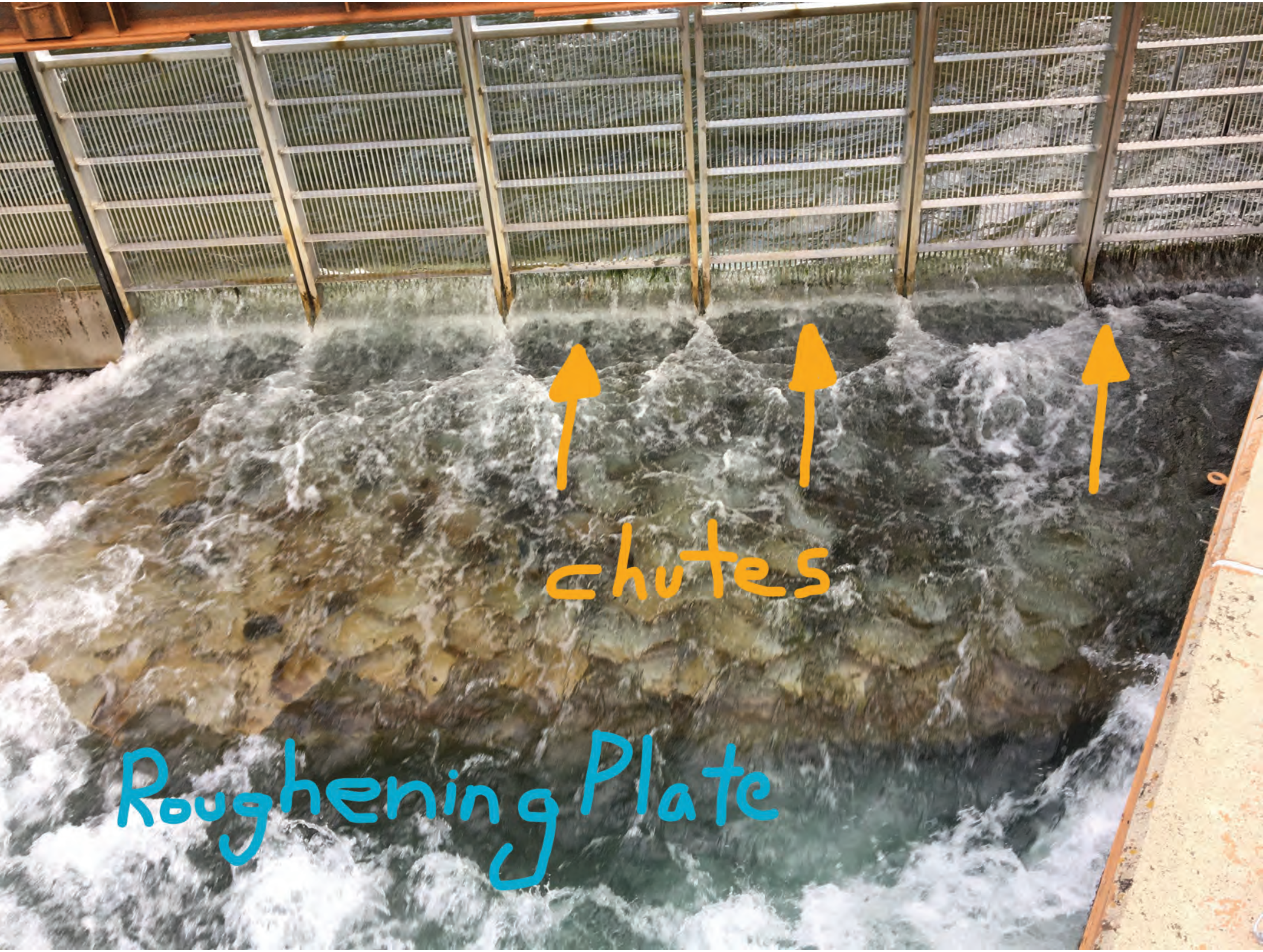
4/16/2020

CWT retention rates and "bad clip" rates for 2020 hatchery release groups (fish sampled during pre-release sampling).

Date Sampled	Group	Production Type	Vessel/RCY	AD Clip Sampled	AD Bad Clip	AD Bad Clip Rate %	CWT Sampled	CWT Detected	CWT Retention Rate %
4/14/2020	Wenatchee Steelhead Indoor	WxW	Circ-1/3	NA	NA	NA	400	386	96.5
4/15/2020-4/17/2020	Wenatchee Steelhead Outdoor	WxW	RCY-2	NA	NA	NA	200	196	98.0
	Wenatchee Steelhead Outdoor	HxH	RCY-2	1,111	175	15.8	200	191	95.5
4/10/2020	Wenatchee-Dryden Summer Chinook	WxW	DRYP	1,000	278[a]	27.8	1,000	990	99.0
4/06/2020	Chiwawa River Spring Chinook	WxW	RCY-1	NA	NA	NA	200	199	99.5
4/06/2020	Nason Creek Spring Chinook	HxH	Circ 1-4	400	82	20.5	400	389	97.2
4/07/2020	Nason Creek Spring Chinook	WxW	Circ 4-5	400	NA	NA	400	395	98.8
4/13/2020	Chewuch River Spring Chinook	WxW	CHEWUP	NA	NA	NA	1,000	964	96.4
4/09/2020	Carlton Summer Chinook	WxW	Circ 1-8	1,000	255	25.5	1,000	997	99.7
4/08/2020	Chelan Falls Summer Chinook	HxH	Circ 1-4	1,000	136	13.6	1,000	999	99.9

[a]The 278 bad clips includes 13 no clips (1.3% no ad-clip).


passage chutes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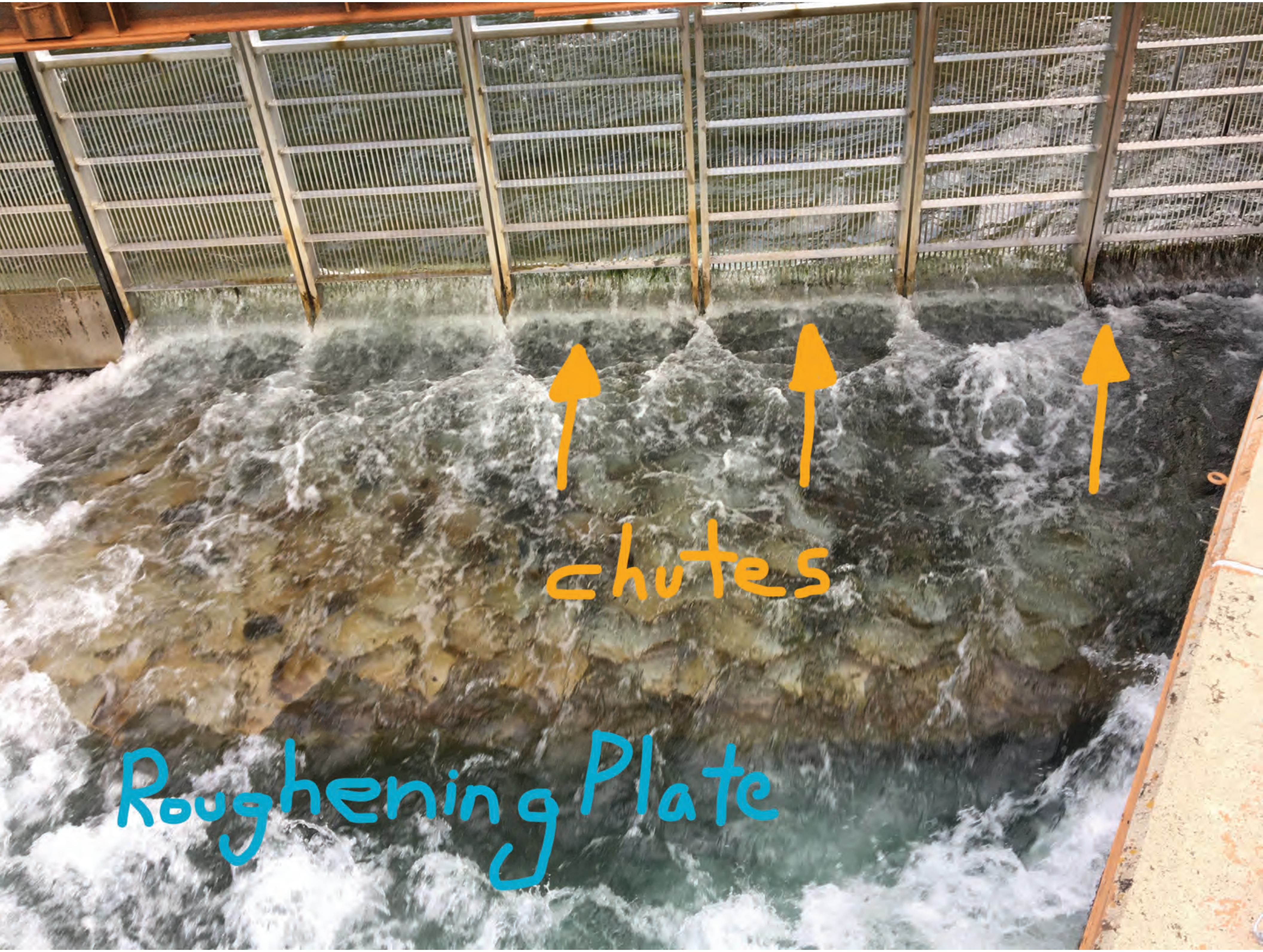
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Roughening Plate

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Date: June 17, 2020

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Kristi Geris, Anchor QEA, LLC

Re: Final Minutes of the May 20, 2020 HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) meetings were held by conference call and web-share on Wednesday, May 20, 2020, from 10:00 a.m. to 11:45 a.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Joint HCP-HCs and PRCC HSC

- Mike Tonseth will coordinate with Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) to present pre-spawn mortality modeling results for spring Chinook salmon at an upcoming HCP-HC meeting (Item I-A). *(Note: this item is ongoing.)*
- Brett Farman will discuss with Charlene Hurst and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A). *(Note: this item is ongoing.)*
- Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A). *(Note this item is ongoing.)*
- Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A). *(Note this item is ongoing.)*
- Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historic run-size data (Item I-A). *(Note this item is ongoing.)*
- All parties will provide updates on changes to marking and tagging plans due to the impacts of COVID-19 on operations as updates become available (Item I-A). *(Note this item is ongoing.)*
- Kirk Truscott will determine the number of scales that should be collected from spring Chinook salmon at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook salmon from Methow River spring Chinook salmon (Item I-A). *(Note this item is ongoing.)*

- Tracy Hillman will develop additional estimates of carrying capacity for Wenatchee River Basin spring Chinook salmon spawning aggregates (Item II-A).

PRCC HSC

- None.

Decision Summary

- No decisions were approved during today's meeting.

Agreements

- No agreements were discussed during today's meeting.

Review Items

- The *Monitoring and Evaluation of the Chelan and Grant County PUDs Hatchery Programs Draft 2019 Annual Report* and appendices, which were provided by Tracy Hillman and were distributed to the HCP-HCs and PRCC HSC by Kristi Geris on June 16, 2020, are available for a 30-day review with edits and comments due to Hillman on July 16, 2020.
- The draft Statement of Agreement, *Regarding Chelan PUD's Okanagan Sockeye Obligation and Status of the Reintroduction Program,* was provided to the Rocky Reach and Rock Island HCP-HCs by Kristi Geris on June 13, 2020, and is available for review with edits and comments due to Catherine Willard on July 1, 2020.

Finalized Documents

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda, Announcements, Approve Past Meeting Minutes, Review Last Meeting Action Items

Tracy Hillman welcomed the HCP-HCs and PRCC HSC to the meeting and read the list of attendees signed into the meeting. The meeting was held via conference call and web-share because of travel and group meeting restrictions resulting from the COVID-19 pandemic. Hillman reviewed the agenda and asked for any additions or changes to the agenda. Greg Mackey added a brief update on subyearling summer Chinook salmon for orcas. All members approved the agenda with these additions.

The HCP-HCs and PRCC HSC representatives reviewed the revised April 21, 2020 meeting minutes. Minor revisions were resolved in the meeting. The HCP-HCs and PRCC HSC approved the April 21, 2020 meeting minutes, as revised.

Action items from the HCP-HCs and PRCC HSC meeting on April 21, 2020, were reviewed, and follow-up discussions were addressed *(note that italicized text below corresponds to action items from the previous meeting)*:

Joint HCP-HCs and PRCC HSC

- *Mike Tonseth will coordinate with Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) to present pre-spawn mortality modeling results for spring Chinook salmon at an upcoming HCP-HCs meeting (Item I-A).*
  Tracy Hillman said this item is ongoing.
- *Brett Farman will discuss with Charlene Hurst and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A).*
  Farman said this item is ongoing.
- *Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A).*
  Mackey said this item is ongoing.
- *Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A).*
  Mackey said this item is ongoing.
- *Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historic run-size data (Item II-A).*
  Tracy Hillman said this item is ongoing.
- *All parties will provide updates on changes to marking and tagging plans due to the impacts of COVID-19 on operations as updates become available (Item II-D).*
  This item will be discussed in today's meeting and will be ongoing.
- *Kirk Truscott will determine the number of scales that should be collected from spring Chinook salmon at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook salmon from Methow River spring Chinook salmon (Item II-A).*
  Tracy Hillman said this item is ongoing.
- *Keely Murdoch will prepare an updated retrospective analysis of conservation program size to present in the next meeting (Item II-A).*
  This item will be discussed in today's meeting.

PRCC HSC

- *Tracy Hillman will communicate with Denny Rohr, PRCC Chair, regarding the responses from the National Marine Fisheries Service (NMFS) on a potential White River spring Chinook salmon hatchery program and request from the PRCC to provide further direction to the PRCC HSC on this topic (Item IV-C).*
  Hillman said he spoke with Rohr before the PRCC meeting and understands that Rohr shared this information with the PRCC; however, the PRCC had no specific direction to give the PRCC HSC at this time. Hillman recalled that this action item aligned with the discussion about the possibility of updating the Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan; and during the last update, he reported discussing the possibility of updating the plan with the director of the Upper Columbia River Salmon Recovery Board. He recalled that the Recovery Implementation Science Team (RIST) replaced the Interior Columbia Basin Technical Recovery Team, and he said he contacted Ken Currens (Northwest Indian Fisheries Commission) about whether the RIST is still functioning. Hillman said Currens indicated the RIST last convened in 2011 and he has not heard from the group since, but Currens agreed the RIST would be the appropriate group to review the criteria within the recovery plan. Hillman asked Brett Farman if he knows about the status of the RIST, and Farman said he also agrees the RIST seems like the proper group to review the plan, but he is unsure about the status of the group.
- *Brett Farman will inquire within NMFS whether the Upper Columbia River Spring Chinook 5-year status review would evaluate the existing recovery criteria and whether any other salmon or steelhead recovery plans have been updated since their original development (Item IV-C).*
  Farman said yes, the 5-year status review uses the existing recovery criteria. He said he is in the process now of drafting a response to the group to clarify the steps of the process. Todd Pearsons asked Farman to clarify what he is asking the group. Farman said he understands the group uses the existing criteria in the review, but he wants to be clear about how the group uses the criteria and incorporates this back into updating the plan. Pearsons asked if the question is whether the group is evaluating the status against the existing criteria. Farman clarified that the group considers the criteria within the recovery plan in the status review to determine whether these criteria still make sense. He said what he needs to follow up on is, if the criteria do not make sense, how does this loop back to updating the recovery plan. Pearsons asked if the group determines that the recovery criteria are no longer suitable, do they include that in their 5-year review? Farman said he understands the group does consider these criteria in their evaluation.

II. Joint HCP-HCs and PRCC HSC

A. Updated Retrospective Analysis of Wenatchee Spring Chinook Salmon Conservation Program Size

Keely Murdoch shared the presentation, *Updated Retrospective Analysis* (Attachment B), which was distributed to the HCP-HCs and PRCC HSC by Kristi Geris following the meeting on May 20, 2020. Murdoch said there is one piece of data from WDFW (recent pre-spawn mortality data) that was not published in the 2018 Hatchery Monitoring and Evaluation (M&E) Annual Report.[1] She said she requested these data from Mike Tonseth (WDFW); however, she only made the request two days ago and the data will not be ready until tomorrow. Murdoch said she does have data through the 2017 return. She said Hughes indicated he can provide 2018 data, but he is unsure whether 2019 data are ready. Murdoch noted that an extra year of data will not significantly change the results. For today, she suggested reviewing what was done last time and how the model works.

Murdoch reviewed slide 2 of Attachment B. She recalled that a retrospective analysis was first performed in 2009 to help develop a plan for the Nason Creek safety-net and conservation program split. She said this slide describes the information inputs in the model. She said estimates of natural-origin recruit (NOR) spring Chinook salmon at Tumwater Dam by spawning location was determined by back-calculating based on spawning ground surveys and assigning a portion of the NORs at Tumwater Dam to each major spawning aggregate. She said this is the dataset WDFW is updating. She said draft escapement goals were developed while drafting the Wenatchee Spring Chinook Management Plan.[2] She said these goals were based on a Beverton-Holt Curve and should be updated, but she does not believe she is the best person to do this. She said the analysis used a sliding scale of PNI, per the Wenatchee Spring Chinook Management Plan and permit. She said the analysis used average Chiwawa River spring Chinook salmon smolt-to-adult return rates (Chiwawa SARs) because there were no Nason Creek data available, and she noted that the updated analysis still uses Chiwawa SARs. She said as the analysis modeled different scenarios, the idea was to develop a solution that balanced maximizing PNI, escapement, and recruits, and minimizing using safety-net fish too often.

Murdoch reviewed slide 3 of Attachment B. She said the retrospective analysis was updated in 2018. She said the SARs were updated from the 2009 analysis to the most recent 10 years, still using Chiwawa data. She said NORs at Tumwater Dam were updated for all years, and she noted that the 2018 update did not just add new years; rather, WDFW researched and reanalyzed all of the data. She said the broodstock needs were updated and new safety-net splits were run for Nason Creek spring Chinook salmon only. She said now that the safety-net program was also using potential

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[1] *Monitoring and Evaluation of the Chelan and Grant County PUDs Hatchery Programs, 2018 Annual Report*. September 15, 2019.
[2] *Wenatchee Basin Spring Chinook Management Plan*. November 4, 2010.

Chiwawa NORs in the broodstock, there was an attempt to model a Nason-Chiwawa composite. She said there were a lot of problems with this, which will be discussed later in this presentation.

Murdoch reviewed slide 4 of Attachment B. She said the 2018 update did not use a new pre-spawn mortality level. She said she believes the pre-spawn mortality data currently in this analysis is probably too low, which will also affect the escapement goals. She said if there is a higher pre-spawn curve, this will translate into a higher escapement goal to compensate. She said the 2018 update also did not use a new stock-recruit model. She said all of these things that were lacking in 2018 are still lacking at this point.

Murdoch reviewed slide 5 of Attachment B. She said this is the spreadsheet WDFW produces to estimate wild spawners in major spawning aggregates. She said this spreadsheet includes data up to 2017, but will very soon have 2018, and possibly 2019.

Murdoch reviewed slide 6 of Attachment B. She said she has been trying to think about how to present these data graphically. She said the idea here is to start with the estimated NORs at Nason Creek, which were back calculated from the spawning ground to Tumwater Dam, and there is a target extraction rate. She said this shows how many NORs end up in the broodstock and how many hatchery broodstock are needed to meet those goals. She said this model assumes there are always enough hatchery-origin recruits (HORs) and therefore there is no shortage in HORs. She said the model assumes if there are not enough conservation fish, the program will use safety-net fish. She said the model calculates theoretical escapement goals aimed at hitting a PNI target based on a sliding scale. She said in the end, the model calculates how many HORs are needed from the conservation program to meet both broodstock and escapement needs. She noted the summary in the upper right corner of the slide, which shows the mean HOR run size for the conservation component only. She said this is based on a conversation program of 125,000 fish and considers SARs in an average year to get 608 fish back. She said the SARs can probably be updated with a year or two of data but might not change the outcome a whole lot. She said the data also show, in an average year, the mean HOR needed. She said a mean HOR run size of 608 fish and a mean HOR needed of 429 fish says, in an average year, there are more conservation program fish coming back than what is needed for spawning escapement and broodstock targets. She said this means probably removing conservation program HORs at Tumwater Dam in an average year. She said in a poor return year with a HOR run of 384 fish, hatchery fish would be needed to help meet broodstock targets. She said in a low run size year, there is still a need for safety-net fish on the spawning grounds. She said she is unsure about how often this occurs and that it would be interesting to model. She said for the 125,000-fish program, the mean total escapement is 503 fish, the mean total recruits is 366 fish, and the mean PNI is 0.44. She said this is based on an adult-to-adult curve that Bob Pfeifer (WDFW) put together. She said it would be nice to have an updated curve, but this is not super relevant to the model. She said if there is more escapement there will be more recruits to the spawning grounds.

Murdoch reviewed slide 7 of Attachment B. She said this slide shows a reduced conservation program size (100,000 fish) and increased safety-net. She said an average year has a mean HOR run size of 486 fish and mean HOR needed of 422 fish. She said this indicates, because these values are so close, in most below average years, there is a shortage of conservation program fish and a need for safety-net fish to meet goals. She said in an above average year, there are excess conservation fish, generally higher escapement, a little more total recruitment, and a little higher mean PNI. She said the tradeoff is, in a below average year, safety-net fish are needed for the program or on the spawning grounds.

Murdoch reviewed slide 8 of Attachment B. She said this slide shows an even more reduced conservation program size (85,000 fish). She said a mean HOR run size of 413 fish equals a mean HOR needed to meet broodstock and escapement goals of 444 fish. She said this means in an average year, help is needed from safety-net fish. She said at some point in an above average year, there will be excess fish. She said with a conservation program and safety-net split, if too many safety-net fish are needed, in her personal opinion, the balance of gene flow is too far in the wrong direction (becoming dominated by hatchery gene flow).

Murdoch reviewed slide 9 of Attachment B. She said this slide shows an attempt to model a combined program. She said the problem is, this only models Chiwawa fish returning to Nason Creek and does not account for returns to the Chiwawa River. She said this is a limitation with this combined model. She said this combined conservation program includes 125,000 fish from Nason Creek and 144,000 fish from the Chiwawa River, with a Nason Creek safety net program of 98,670 fish. She said a mean HOR run size of 1,308 fish equals a mean HOR needed to meet broodstock and escapement goals of 613 fish. She said there is definitely excess conservation fish; however, there is no way to direct Chiwawa River fish to Nason Creek.

Murdoch reviewed slides 10 and 11 of Attachment B. She said these slides each show a slight reduction in the combined program size (compared to slide 9). She said the decrease in HORs needed does not change substantially, partly because this does not model a reduction in the Chiwawa River component of the combined program. She said even a decrease in Nason Creek fish to 85,000 (slide 11) does not result in a significant difference, again, she believes because the Chiwawa River component stays the same (144,000 fish). She said ultimately, it is difficult to interpret these models (for a combined program) because there is no parsing out of HORs returning (to the Chiwawa River versus Nason Creek).

Murdoch reviewed slide 12 of Attachment B. She said in summary, reducing the program can result in more fish on the spawning grounds. She said she would like to see how adjusting the escapement goal will impact decisions on reducing the program size. She said the fourth bullet on slide 12 essentially applies to all scenarios ranging from the middle down to 100,000-fish programs. She said she needs to discuss the last bullet on slide 12 with the Yakama Nation (YN) HCP Policy Committees representative because this person has recently changed. She said the YN has always supported using safety-net fish in broodstock and on spawning grounds because this is what safety-net fish are for when used in a conservation program; however, she is unsure if this will change with more conservation fish. She lastly noted that the biggest changes to these numbers will be the addition of recent pre-spawn mortality and escapement data.

Todd Pearsons recalled discussing during previous meetings using the capacity estimate that Tracy Hillman provides each year in the Hatchery M&E Annual Report, but these estimates are based on adult-to-juvenile survival and not adult-to-adult. Pearsons said his understanding of estimates based on adult-to-adult survival is they (capacity estimates) are not as clear. He said the R squared (R^2) is lower than 0.20. He said there are already good capacity and escapement estimates in the Hatchery M&E Annual Report. Murdoch said yes, the capacity estimate (from the 2018 Hatchery M&E Annual Report) is used in this analysis and the total escapement goals come from the Wenatchee Spring Chinook Management Plan based off of an adult-to-juvenile Beverton-Holt Curve and are not based on adult-to-adult survival. She said, however, these need to be updated but she does not feel equipped to do so. She said she agrees with Pearsons that a new analysis will include stock-recruitment data that will adjust the curves. Murdoch clarified that where adult-to-adult survival is used in this analysis it is useless. She said, to her, the last column in slides 6 to 11 is irrelevant and can be assumed to be not very accurate. She said all these data show are correlations between total escapement and how many adults return, in theory. She said she is okay with focusing on how often the program is reaching the escapement goals.

Pearsons asked on slide 6 of Attachment B, if the Nason Creek escapement goal of 542 fish is the estimate of number of adults versus the number of juveniles in 2009 or has this number been updated since then? Murdoch said this is not an updated number. She said this number was used in the Wenatchee Spring Chinook Management Plan and was modeled at the time the plan was written. Pearsons said he thinks the Beverton-Holt or hockey stick models were used to create these estimates in the Hatchery M&E Annual Report, and the report includes number of years and how these estimates changed over time. He said he thinks this information is readily available. Hillman said this is correct and added that the draft 2019 Hatchery M&E Annual Report will be available by mid-June 2020. He said escapements needed to achieve maximum smolt capacity are available from the Hatchery M&E Annual Report and the report shows how the escapement numbers vary over time as more stock-recruitment data are added. He said the 2019 report will include updated data for the Chiwawa River, Nason Creek, and the White River.

Murdoch said the new data can be modeled; however, 542 fish is the number everyone agreed to, as included in the Wenatchee Spring Chinook Management Plan. She said the HCP-HCs and PRCC HSC need to review the new data and agree as a group to new escapement goals, if deemed appropriate. Hillman agreed the HCP-HCs and PRCC HSC need to all agree to this. Pearsons asked if this number was generated in a WDFW and YN document. Murdoch said the document started as a WDFW and YN publication, then National Oceanic and Atmospheric Administration's Northwest Fisheries Science Center became involved and attended meetings, and then the rest of the HCP-HCs reviewed and approved the final document. She said the document includes all of these agency's logos. She said she believes the PRCC HSC was also involved but would need to verify.

Hillman said he reviewed the final 2018 Hatchery M&E Annual Report and the escapement estimates, which are based on smolts produced per spawner, are about half the number shown in Attachment B. He said the annual report numbers range in the 200s compared to 542 fish in Attachment B, which makes it seem that the values in Attachment B might be based on adult-to-adult and not adult-to-smolt. Murdoch said she thinks the escapement goals in the Wenatchee Spring Chinook Management Plan include estimates of pre-spawn mortality at Tumwater Dam, and the higher the pre-spawn mortality the more fish that are needed. She suggested reviewing the Beverton-Holt Curve to determine how many fish are needed to achieve escapement goals with estimates of pre-spawn mortality. Hillman said this makes sense and noted that his work does not include pre-spawn mortality; rather, his work only looks at smolts in Nason Creek based on spawners in Nason Creek, which may be why the number in Attachment B is greater.

Murdoch said she thinks including updated information from the Relative Reproductive Study with new pre-spawn mortality will be important. She said this may not necessarily be the same for HORs and NORs and this may also change the composition of the conservation program. She said Attachment B is just a concept and a fairly simplistic model. She said she thinks this topic is more complicated than this, but the model provides an idea of HOR needs, what is coming back, and whether there is a big or little need for safety-net fish. She said it would be interesting to develop a curve graphically showing run sizes and how often to use safety-net fish.

Pearsons said a main reason for this exercise is because NORs are used in the Nason Creek Program and when returning progeny from these fish are not needed, the fish are removed at Tumwater Dam. He said when this is done routinely, it does not seem like the best use of NORs. He said if there is concern, then it needs to be clear what tradeoff will be involved by reducing this risk. He said in some ways, there is reducing risk by killing fish at Tumwater Dam versus the risk of having not the most optimal fish in the broodstock and on the spawning grounds. He said this is a tradeoff issue and it is not clear how to work through this. He asked, what is an acceptable tradeoff? Murdoch agreed and said she hates to see NORs used for broodstock and then their progeny removed at Tumwater Dam. She said this issue comes down to comfort levels. She said reduced conservation and more safety-net fish results in gene flow running the wrong direction. She said she is personally intrigued by the middle model but needs to discuss this with YN policy staff.

Hillman said he will develop additional estimates of carrying capacity for Wenatchee River Basin spring Chinook salmon spawning aggregates and Murdoch said she will obtain recent pre-spawn mortality data from WDFW to incorporate into an updated Retrospective Analysis of Conservation Program Size.

Hillman shared Table 6.19 from the final 2018 Hatchery M&E Annual Report, as follows:

Table 6.19. Estimated parameters and statistics associated with fitting the Ricker model to spawning escapement and smolt data. Smolts represent numbers of smolts produced entirely within the Nason Creek watershed. A = alpha parameter; B = beta parameter; SE = standard error (estimated from 5,000 bootstrap samples); and r^2 = coefficient of determination. Spawners represent the stock size needed to achieve population capacity.

Years of data	Parameter				Population capacity	Intrinsic productivity	Spawners	r^2
	A	A SE	B	B SE				
5	90.60	87.13	0.0046	0.0015	7,293	91	219	0.453
6	90.02	5618.57	0.0045	0.0014	7,360	90	222	0.442
7	92.67	1696.44	0.0046	0.0009	7,395	93	217	0.517
8	107.07	1208.15	0.0052	0.0012	7,575	107	192	0.454
9	99.89	1125.42	0.0051	0.0012	7,149	100	195	0.409
10	90.35	50.04	0.0049	0.0008	6,825	90	205	0.470
11	72.26	34.50	0.0043	0.0009	6,240	72	235	0.308
12	76.76	31.24	0.0043	0.0008	6,522	77	231	0.337
13	35.98	32.48	0.0030	0.0013	4,412	36	333	0.049
14	47.48	29.79	0.0035	0.0011	4,962	47	284	0.038
15	49.93	24.34	0.0036	0.0009	5,088	50	277	0.042

Hillman said this table is updated with new data every year. He said the table starts with 5 years of data to estimate population capacity, using the Ricker Model. He said as years of data are added, the capacity and spawner estimates change. He said currently, based on 15 years of data, the model indicates that 277 adults are needed to fully seed the Nason Creek subbasin, which produces 5,088 smolts. He said the relationship looks like Figure 6.6, as follows:

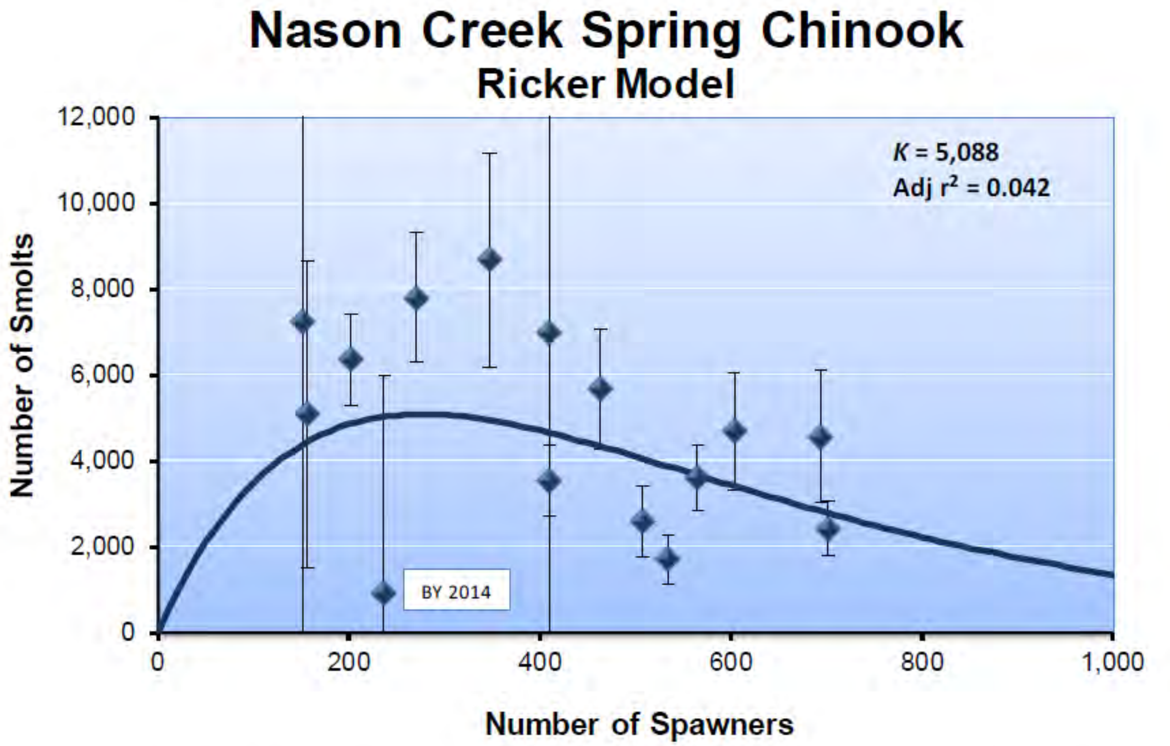

Figure 6.6. Relationship between spawners and number of yearling smolts produced in the Nason Creek watershed. Population carrying capacity (*K*) was estimated using the Ricker model. Vertical bars represent 95% confidence intervals on smolt estimates.

Hillman said an increase in spawners beyond about 300 fish results in a relatively strong density-dependent effect. He said brood year (BY) 2014 has a strong effect on the results. He said this BY produced very few smolts and pulls the curve down. He said if this data point was not here, the capacity would be much higher. Hillman said what Murdoch is suggesting is to include pre-spawn mortality, which would increase maximum spawner estimates.

Greg Mackey said in Figure 6.6, even with the 2014 point removed, the maximum number of spawners would not change much. He said considering the 95th percentile (using quantile regression techniques) would give a higher smolt capacity estimate but the number of spawners to achieve those smolts would not change a lot. Hillman said this is a good point, noting that the Ricker Curve could be fit to the upper 95% distribution of the data but the hump on the curve would still occur between 200 and 300 spawners. He said the Ricker Curve is currently estimating the average population condition, which is not the same as habitat capacity. Fitting the curve to the upper 95% distribution would provide a closer estimate of habitat capacity.

B. Effect of COVID-19 Pandemic on M&E Activities

Tracy Hillman asked each Committee member to provide an update on impacts of the COVID-19 pandemic on M&E activities. Hillman said Kirk Truscott indicated that nothing has changed for the Colville Confederated Tribes since last month. Hillman said Truscott's time is being consumed by writing COVID plans and M&E activities are currently ongoing.

Alf Haukenes said WDFW is in the same position, that the update last month is consistent with where WDFW is now. Hillman noted as described in the monthly report,[3] WDFW was unable to conduct steelhead spawning surveys, and he asked if WDFW crews are now conducting these surveys. Haukenes said some steelhead surveys are being conducted in Washington State; however, the ones referred to in the report are not.

Brett Farman said NMFS has no new updates. He said there are ongoing discussions but nothing new. He said the general guidance is to consider human safety first and address ramifications of data gaps, as necessary.

Bill Gale said U.S. Fish and Wildlife Service (USFWS) restarted the marking and tagging program. He said this started initially as day trips from Vancouver, Washington, to the Gorge, Little White Salmon, and Carson National Fish Hatcheries (NFHs). He said he thinks crews are nearing completion at these locations and USFWS now has authorization for overnight travel for the tagging program. He said crews will move to Winthrop NFH to tag there in a few weeks. He said in terms of field work, almost all work is on hold. He said USFWS is conducting in-hatchery monitoring. He said USFWS is working on obtaining approval for activities that do not require travel and where social distancing requirements can be met. He said he anticipates USFWS will receive approval in the next week or so. He said activities such as electrofishing will be on hold for a while because there is no way to socially distance; however, redd surveys and trap and haul activities may move forward soon.

Keely Murdoch said originally, the general guidance allowed only essential employees for essential activities (i.e., keeping fish alive). She said on a case-by-case basis, the YN is now obtaining authorization to perform other activities as long as the activities can be conducted while socially distancing, and the activities are time-sensitive and inclusive of Endangered Species Act-listed species. She said the YN has restarted the smolt traps and kelt collection at Rock Island Dam. She said fortunately for coho salmon, YN staff were able to complete acclimation and release the fish before restrictions were in place due to COVID-19, and it will be a while before adults return.

Catherine Willard said everything is on par for Chelan PUD and staff are able to do everything with social distancing. Hillman asked if the University of Washington database[4] is uploading Chelan PUD

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[3] *Chelan and Grant PUD Hatchery Programs Monitoring and Evaluation Progress Report, April 2020*

[4] Columbia River Data Access in Real Time (DART), available at: http://www.cbr.washington.edu/dart/query/adult_graph_text

data yet and recalled last month that Willard indicated there were issues with dam counts being posted to the site. Willard said the issue is now fixed and data are updated.

Greg Mackey said field work was successfully completed for the Douglas PUD 2020 Survival Verification Study. He said at the hatchery facilities and for trapping activities, personnel are limited to Douglas PUD and Charlie Snow's WDFW Twisp Office crews. He said Douglas PUD is trying to limit different individuals working on site, so there are not a lot of people cycling though.

Todd Pearsons said Grant PUD has pre-release sampling for Priest Rapids Dam scheduled this week. He said a new process regarding M&E contractors is that the contractors need to conform to Grant PUD COVID-19 risk policies. He said Grant PUD anticipates obtaining all data normally collected for pre-release sampling. He said the Nason Creek fish release occurred at the end of April 2020, and fish looked good. Haukenes asked in terms of COVID-19 risk policies for Priest Rapids Dam, is this information on the Grant PUD website? Pearsons said Steve Richards (WDFW) has this information, which was signed by both Grant PUD and WDFW to be compliant with these policies.

III. Rock Island/Rocky Reach HCP-HCs

A. Brood Year 2019 Chiwawa Spring Chinook Salmon Marking Strategy

Catherine Willard said background information for determining the BY2019 Chiwawa spring Chinook salmon marking strategy (Attachment C) was distributed to the HCP-HCs by Kristi Geris on May 19, 2020.

Willard said this year, marking and tagging for the BY2019 Chiwawa Conservation Program will begin in a couple of months. She said like last year, there are a lot of hatchery-by-hatchery (HxH) fish to backfill the conservation program, and again like last year, Chelan PUD needs to determine how to mark and tag these fish. She said as a reminder, the second table in Attachment C shows how many HxH fish were used to backfill the conservation program for BY2018, along with the tagging scheme that was approved by the HCP-HCs last March 2019. She said HxH fish will be adipose (ad)-present, coded-wire-tagged (CWT) in the snout, and blank-wire-tagged (BWT) in the caudal fin. She said Chelan PUD wants to be sure the HCP-HCs are aware that when BWT tagging BY2018 fish, among the Chiwawa Program HxH fish that received CWTs in the snout and BWTs in the caudal fin, 1% of these fish developed deformities in the spine from inserting the caudal BWT. She said Chelan PUD and the WDFW marking crew discussed how to avoid this in the future. She said the same deformities were observed in Nason Creek Conservation Program fish when using caudal tags. She said crews moved to CWTs in the dorsal fin for the Nason Creek wild-by-wild (WxW) fish, and HxH fish, that were ad-present received BWTs in the caudal fin. She said again, Chelan PUD wanted to notify the HCP-HCs this was happening, and that Chelan PUD will need to decide quickly how to mark HxH fish this year because there are a lot of fish to mark. She said Chelan PUD can continue with the same marking strategy if this is still the preference of the HCP-HCs.

Keely Murdoch said the crooked spine is disappointing; however, the YN is not supportive of ad-clipping these fish because these are still conservation program fish. She said the YN is open to other suggestions. She said the YN has had these same discussions regarding coho salmon. She said she believes WDFW methodologies and techniques might differ from other crews and she suggested that these crews share information about how to perform body tagging better (e.g., modifying the angle). She said she spoke with Cory Kamphaus (YN) about this and he provided information back when this was first discussed regarding Nason Creek fish. Murdoch said she can look for this information again.

Tracy Hillman summarized that Chelan PUD is proposing to move forward with the same tagging scheme for the BY2019 Chiwawa Program HxH backfill fish, and maybe these crews can discuss how to minimize effects.

IV. Wells HCP-HC

A. Subyearling Summer Chinook Salmon for Orcas

Greg Mackey said Douglas PUD and WDFW received the Section 4(d) permit from NMFS for the subyearling summer Chinook salmon program for orcas. He noted that there were issues during marking and about 25% of these fish were ad-clipped too deeply.

V. PRCC HSC

A. Review Agenda, Announcements, Approve Past Meeting Minutes

The PRCC HSC representatives approved the April 21, 2020 meeting minutes as revised.

B. No Net Impact Infographic

Todd Pearsons recalled that last month, he presented an infographic, which Pearsons clarified is a Grant PUD document and not a PRCC HSC document. He said this will be inserted into a financial report that Grant PUD produces, which is part of the reasoning behind the financial numbers included in the infographic. He said he received good comments and a number of these comments were incorporated into a revised version of the infographic. He reviewed the revisions, including updating the hydropower development/operation icon in the upper left corner, per comments received from Bill Gale. Pearsons said he did not have time to obtain permissions for using all agency logos; therefore, the agency names were inserted instead. He said the infographic was changed to highlight the number of hatchery programs. He said the hatchery production number was changed from 10 million to 8.8 million, to include only Grant PUD fish. He said some of the symbols under habitat preservation that were dollar signs were changed to checkmarks to make the graphic more about the projects instead of money. He said he appreciates everybody's feedback and it helped make improvements to the infographic.

VI. Next Meetings

Tracy Hillman said the draft 2019 Hatchery M&E Annual Report will be distributed for review before the next meeting. He said some sections will be missing because the scale-reading lab at WDFW shut down due to COVID-19 and Wenatchee summer Chinook salmon scales have not been analyzed. He said he hopes to have these sections completed before the final report is due. He said the draft report will be available for a 30- or 60-day review period. He said he and others are also working on the draft 10-year Comprehensive Report.

The next HCP-HCs and PRCC HSC meetings will be Wednesday, June 17, 2020, Wednesday, July 15, 2020, and Wednesday, August 19, 2020, held by conference call and web-share until further notice.

VII. List of Attachments

Attachment A	List of Attendees
Attachment B	Updated Retrospective Analysis PowerPoint
Attachment C	Background Information for Determining the BY2019 Spring Chinook Salmon Marking Strategy

Attachment A
List of Attendees

Name	Organization
Kristi Geris	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Scott Hopkins	Chelan PUD
Catherine Willard*	Chelan PUD
Tom Kahler*	Douglas PUD
Greg Mackey*	Douglas PUD
Peter Graf‡	Grant PUD
Deanne Pavlik-Kunkel	Grant PUD
Todd Pearsons‡	Grant PUD
Brett Farman*‡	National Marine Fisheries Service
Bill Gale*‡	U.S. Fish and Wildlife Service
Alf Haukenes	Washington Department of Fish and Wildlife
Chad Jackson*‡	Washington Department of Fish and Wildlife
Keely Murdoch*‡	Yakama Nation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate

Updated Retrospective Analysis

Nason Creek Conservation + Safety Net Program and current management plan

Retrospective Analysis 2009

- A look back at ‘what might have been’ based on the draft management plan
  - Estimates of NOR spring Chinook at Tumwater by spawning location
  - Draft Escapement goal (Beverton Holt Curve)
  - Sliding Scale of PNI (as per Wentachee Spring Chinook Management Plan
  - Chiwawa SARs (10 year: mean, min, max)
  - Conservation and Safety Net program sized to:
    - Maximize PNI
    - Maximize Escapement
    - Maximize Recruits
    - Minimize use of Safety Net fish on the spawning grounds and in the broodstock

2018 Update

- Updated SARS with most recent 10 years (still Chiwawa)
- Updated NORs at Tumwater – all years
- Updated Broodstock needs
- Re-ran analysis with new safety net splits
  - Nason Only
  - Nason Chiwawa Composite

2018 Update

- Did not use a new prespawn mortality level
- Did not use a new escapement goal (as a result of new prespawn mortality information)
- Did not use new stock-recruit models
- <u>To make the update complete new prespawn mortality rates and resulting escapement goals need to be updated!</u>

		Wild Spawners in Individual Major Spawning Areas												
Brood	Wilds	NASON		CHIWAWA		WHITE		LI'L WENATCHEE		WENATCHEE MS		Total wild	% Wild spawners	Nason+ Ch
Year	at TWD	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	spawners	to Tumwater Total	Combined
1999	173	22	12.8%	88	50.6%	3	1.6%	8	4.8%	0	0.0%	121	0.698	110
2000	651	223	34.3%	263	40.3%	27	4.1%	22	3.3%	31	4.8%	566	0.869	486
2001	2073	294	14.2%	497	24.0%	126	6.1%	95	4.6%	49	2.4%	1,061	0.512	791
2002	1033	347	33.6%	281	27.2%	80	7.7%	96	9.3%	66	6.4%	870	0.842	628
2003	919	193	21.0%	205	22.3%	38	4.1%	26	2.8%	21	2.3%	482	0.525	398
2004	898	297	33.1%	573	63.8%	54	6.0%	39	4.3%	46	5.1%	1,009	1.124	870
2005	594	83	13.9%	140	23.5%	119	20.1%	38	6.4%	9	1.5%	388	0.653	222
2006	573	118	20.6%	116	20.2%	41	7.1%	26	4.5%	6	1.1%	307	0.536	234
2007	324	82	25.2%	157	48.4%	62	19.2%	79	24.3%	9	2.7%	388	1.199	239
2008	631	139	22.1%	196	31.1%	20	3.1%	13	2.1%	0	0.0%	368	0.583	335
2009	777	164	21.1%	305	39.3%	81	10.5%	43	5.6%	0	0.0%	594	0.764	469
2010	880	59	6.8%	416	47.3%	26	3.0%	31	3.5%	3	0.3%	535	0.608	476
2011	1225	252	20.5%	795	64.9%	26	2.2%	71	5.8%	8	0.7%	1,152	0.941	1047
2012	1470	222	15.1%	575	39.1%	89	6.1%	44	3.0%	4	0.2%	934	0.635	797
2013	938	72	7.6%	414	44.2%	45	4.8%	79	8.4%	0	0.0%	610	0.650	486
2014	991	199	20.1%	545	55.0%	48	4.9%	68	6.8%	9	0.9%	869	0.877	744
2015	1177	145	12.4%	404	34.3%	105	8.9%	62	5.3%	28	2.4%	745	0.633	549
2016	927	143	15.4%	410	44.2%	74	7.9%	61	6.6%	4	0.4%	691	0.746	553
2017	499	90	18.1%	191	38.3%	20	4.0%	33	6.6%	12	2.5%	347	0.695	282

Current Program back-cast. Theoretical Nason Creek backcast (1999-2008) of broodstock, escapement, and PNI objectives.

NOR Brood Goal (Conservation Programs Only - Safety Net Excluded)	74			
Nason Creek Escapement Goal	542			
NOR Target Extraction Rate	33%			
Conservation Program Size			125,000	56%
Safety Net Program Size			98,670	44%
			223,670	

Conservation Program:	SAR (BY2002-2011)		SAR (89-11)	
Mean HOR run size:	608	0.004864	581	0.00465
Minimum HOR runs size:	384	0.003076	45	0.00036
Maximum HOR run size:	792	0.006334	1953	0.01562
	10 year	All		
Mean HO R Needed	429	376		
Minimum HOR Needed	139	116		
Maximum HOR Needed	557	594		
Mean / Total Escapement	503	5033	469	8744
Mean/ Total Recruits	366	3795	365.51	6945
Mean PNI*	0.44		0.46	

***PNI Calcuated for the whole basin may be higher**

Year	Estimated Nason NOR Run Size at TWD	Target Extraction Rate	NOB	HOB	pNOB	Theoretical Escapement NOS	Theoretical Escapement HOS	Total HOR Needed	Total Esc'nt	pHOS	PNITarget	PNI	Est. No. Adult NOR Recruits	2.96E-01 / 2.00E-03
1999	22	0.333	7	67	0.10	15	527	594	542	0.97	Any	0.09	393	
2000	223	0.333	74	0	0.99	149	393	466	542	0.72	0.50	0.58	393	
2001	294	0.333	74	0	1.00	220	220	294	440	0.50	0.67	0.67	375	
2002	347	0.333	74	0	1.00	273	257	257	530	0.48	0.67	0.67	391	
2003	193	0.333	64	10	0.86	129	413	423	542	0.76	0.50	0.53	393	
2004	297	0.333	74	0	1.00	223	222	222	445	0.50	0.67	0.67	376	
2005	83	0.333	28	46	0.37	55	70	116	125	0.56	0.40	0.40	229	
2006	118	0.333	39	35	0.53	79	341	376	420	0.81	0.40	0.40	370	
2007	82	0.333	27	47	0.37	55	70	117	125	0.56	0.40	0.40	229	
2008	139	0.333	46	28	0.63	93	449	477	542	0.83	0.40	0.43	393	
2009	164	0.333	55	19	0.74	109	433	452	542	0.80	0.40	0.48	393	
2010	59	0.333	20	54	0.27	39	503	557	542	0.93	Any	0.22	393	
2011	252	0.333	74	0	1.00	178	364	364	542	0.67	0.50	0.60	393	
2012	222	0.333	74	0	1.00	148	394	394	542	0.73	0.50	0.58	393	
2013	72	0.333	24	50	0.32	48	494	544	542	0.91	Any	0.26	393	
2014	199	0.333	66	8	0.90	133	409	417	542	0.76	0.50	0.54	393	
2015	145	0.333	48	26	0.65	97	445	471	542	0.82	0.40	0.44	393	
2016	143	0.333	48	26	0.64	95	447	473	542	0.82	0.40	0.44	393	
2017	90	0.333	30	44	0.41	60	95	139	155	0.61	0.40	0.40	256	
Mean	**165**		**50**	**23**	**0.69**	**116**	**347**	**376**	**469**	**0.72**		**0.46**	**365.51**	Average All (1999
10-Year Mean	**149**		**48**	**26**	**0.65**	**100**	**403**	**429**	**503**	**0.79**		**0.44**	**366**	Average Last 10 ye

Summary of Option 1: This option has the potential to produces the lowest PNI, lowest Escapement, and lowest total Recruits. Hatchery returns are in excess of what is needed in most.

Reduced Conservation Program and increased Safety-Net

Brood Goal	59		
Nason Creek Escapement Goal	542		
Target Extraction Rate	33%		
Conservation Program Size		100,000	45%
Safety Net Program Size		123,670	55%
		223,670	

Conservation Program:	SAR (BY2002-2011)		SAR (89-11)	
Mean HOR run size:	**486**	0.004864	**465**	0.00465
Minimum HOR runs size:	**308**	0.003076	**36**	0.00036
Maximum HOR run size:	**633**	0.006334	**1562**	0.01562
	10 year	**All**		
Mean HO R Needed	**422**	**380**		
Minimum HOR Needed	**209**	**166**		
Maximum HOR Needed	**542**	**579**		
Mean / Total Escapement	**512**	5118	**487**	**9118**
Mean/ Total Recruits	**375**	3849	**375.17**	**7128**
Mean PNI*	**0.48**		**0.49**	

***PNI Calcuated for the whole basin may be higher**

Year	Estimated Nason NOR Run Size at TWD	Target Extraction Rate	NOB	HOB	pNOB	Theoretical NOS	Theoretical HOS	Total	Total Esc'nt	pHOS	PNITarget	PNI	Est. No. Adult NOR Recruits	2.96E-01 2.00E-03
1999	22	0.333	7	52	0.12	15	527	579	542	0.97	Any	0.11	393	
2000	223	0.333	59	0	1.00	164	378	437	542	0.70	0.50	0.59	393	
2001	294	0.333	59	0	1.00	235	225	284	460	0.49	0.67	0.67	379	
2002	347	0.333	59	0	1.00	288	254	254	542	0.47	0.67	0.68	393	
2003	193	0.333	59	0	1.00	134	408	408	542	0.75	0.50	0.57	393	
2004	297	0.333	59	0	1.00	238	222	222	460	0.48	0.67	0.67	379	
2005	83	0.333	28	31	0.47	55	135	166	190	0.71	0.40	0.40	281	
2006	118	0.333	39	20	0.67	79	463	483	542	0.85	0.40	0.44	393	
2007	82	0.333	27	32	0.46	55	125	157	180	0.70	0.40	0.40	275	
2008	139	0.333	46	13	0.78	93	449	462	542	0.83	0.40	0.49	393	
2009	164	0.333	55	4	0.93	109	433	437	542	0.80	0.40	0.54	393	
2010	59	0.333	20	39	0.33	39	503	542	542	0.93	Any	0.26	393	
2011	252	0.333	59	0	1.00	193	349	349	542	0.64	0.50	0.61	393	
2012	222	0.333	59	0	1.00	163	379	379	542	0.70	0.50	0.59	393	
2013	72	0.333	24	35	0.41	48	494	529	542	0.91	Any	0.31	393	
2014	199	0.333	59	0	1.00	140	402	402	542	0.74	0.50	0.57	393	
2015	145	0.333	48	11	0.82	97	445	456	542	0.82	0.40	0.50	393	
2016	143	0.333	48	11	0.81	95	447	458	542	0.82	0.40	0.49	393	
2017	90	0.333	30	29	0.51	60	180	209	240	0.75	0.40	0.40	310	
Mean	**165**		**44**	**15**	**0.77**	**121**	**359**	**380**	**487**	**0.73**		**0.49**	**375.17**	Average All (1999 Included)
10-Year Mean	**149**		**45**	**14**	**0.76**	**104**	**408**	**422**	**512**	**0.79**		**0.48**	**375**	Average Last 10 years

Summar 2: Increased PNI, Increased escapement, Increased recruitment. In below average years will need to use safety net fish in broodstock and/or spawning grounds (may not be a bad thing).

Reduced Conservation Program and increased Safety-Net

Brood Goal	50		**Conservation Program:**	SAR (BY2002-2011)		SAR (89-11)	
Nason Creek Escapement Goal	542		**Mean HOR run size:**	**413**	0.004864	**395**	0.00465
Target Extraction Rate	33%		**Minimum HOR runs size:**	**261**	0.003076	**31**	0.00036
Conservation Program Size	**85,000**	**38%**	**Maximum HOR run size:**	**538**	0.006334	**1328**	0.01562
Safety Net Program Size	**138,670**	**0%**		**10 year**	**All**		
	223,670		**Mean HO R Needed**	**444**	**426**		
			Minimum HOR Needed	**502**	**509**		
			Maximum HOR Needed	**533**	**570**		
			Mean / Total Escapement	**542**	5420	**535**	**10179**
			Mean/ Total Recruits	**393**	3933	**392.19**	**7452**
			Mean PNI*	**0.50**		**0.52**	

***PNI Calcuated for the whole basin may be higher**

Year	Estimated Nason NOR Run Size at TWD	Target Extraction Rate	NOB	HOB	pNOB	Theoretical Escapement NOS	Theoretical Escapement HOS	Total HOR Needed From Conservation Program	Total Esc'nt	pHOS	PNITarget	PNI	Est. No. Adult NOR Recruits	2.96E-01 / 2.00E-03
1999	22	0.333	7	43	0.15	15	527	570	542	0.97	Any	0.13	393	
2000	223	0.333	50	0	1.00	173	369	419	542	0.68	0.50	0.59	393	
2001	294	0.333	50	0	1.00	244	241	291	485	0.50	0.67	0.67	384	
2002	347	0.333	50	0	1.00	297	245	245	542	0.45	0.67	0.69	393	
2003	193	0.333	50	0	1.00	143	399	399	542	0.74	0.50	0.58	393	
2004	297	0.333	50	0	1.00	247	233	233	480	0.49	0.67	0.67	383	
2005	83	0.333	50	0	1.00	33	509	509	542	0.94	0.40	0.52	393	
2006	118	0.333	50	0	1.00	68	474	474	542	0.87	0.40	0.53	393	
2007	82	0.333	50	0	1.00	32	510	510	542	0.94	0.40	0.52	393	
2008	139	0.333	46	4	0.93	93	449	453	542	0.83	0.40	0.53	393	
2009	164	0.333	50	0	1.00	114	428	428	542	0.79	0.40	0.56	393	
2010	59	0.333	20	30	0.39	39	503	533	542	0.93	Any	0.30	393	
2011	252	0.333	50	0	1.00	202	340	340	542	0.63	0.50	0.61	393	
2012	222	0.333	50	0	1.00	172	370	370	542	0.68	0.50	0.59	393	
2013	72	0.333	24	26	0.48	48	494	520	542	0.91	Any	0.34	393	
2014	199	0.333	50	0	1.00	149	393	393	542	0.73	0.50	0.58	393	
2015	145	0.333	48	2	0.97	97	445	447	542	0.82	0.40	0.54	393	
2016	143	0.333	48	2	0.95	95	447	449	542	0.82	0.40	0.54	393	
2017	90	0.333	30	20	0.60	60	482	502	542	0.89	0.40	0.40	393	
Mean	**165**		**43**	**5**	**0.92**	**122**	**405**	**426**	**535**	**0.75**		**0.52**	**392.19**	Average All (1999 Included)
10-Year Mean	**149**		**42**	**8**	**0.83**	**107**	**435**	**444**	**542**	**0.80**		**0.50**	**393**	Average Last 10 years

Current Program back-cast. Theoretical Nason Creek backcast (1999-2008) of broodstock, escapement, and PNI objectives.

NOR Brood Goal (Conservation Programs Only - Safety Net Excluded)	150	(76 Chiwawa, 74 Nason)		
Nason/Chiwawa Escapement Goal	1129			
NOR Target Extraction Rate	33%			
Combined Conservation Program Size (125K Nason, 144K Chi			**269,000**	**73%**
Nason Safety Net Program Size			**98,670**	**27%**
			367,670	

Conservation Program:	SAR (BY2002-2011)		SAR (89-11)	
Mean HOR run size:	**1308**	0.004864	**1251**	0.00465
Minimum HOR runs size:	**827**	0.003076	**97**	0.00036
Maximum HOR run size:	**1704**	0.006334	**4202**	0.01562
	10 year	**All**		
Mean HO R Needed	**613**	**702**		
Minimum HOR Needed	**397**	**397**		
Maximum HOR Needed	**997**	**1169**		
Mean / Total Escapement	**1036**	10363	**1074**	**19907**
Mean/ Total Recruits	**1258**	12536	**1260.93**	**23958**
Mean PNI*	**0.63**		**0.58**	

***PNI Calcuated for the whole basin may be higher**

Year	Estimated NOR Run Size at TWD - whole basin	Target Extraction Rate	NOB	HOB	pNOB	Theoretical Escapement NOS	Theoretical Escapement HOS	Total HOR Needed	Total Esc'nt	pHOS	PNITarget	PNI	Est. No. Adult NOR Recruits	3.45E-01 4.61E-04
1999	110	0.333	37	113	0.24	73	1056	1169	1129	0.94	Any	0.21	1305	
2000	486	0.333	150	0	1.00	336	793	943	1129	0.70	0.50	0.59	1305	
2001	791	0.333	150	0	1.00	641	209	359	850	0.25	0.80	0.80	1154	
2002	628	0.333	150	0	1.00	478	472	472	950	0.50	0.67	0.67	1214	
2003	398	0.333	133	17	0.88	265	864	881	1129	0.76	0.50	0.54	1305	
2004	870	0.333	150	0	1.00	720	250	250	970	0.26	0.80	0.80	1225	
2005	222	0.333	74	76	0.49	148	981	1057	1129	0.87	Any	0.36	1305	
2006	234	0.333	78	72	0.52	156	973	1045	1129	0.86	Any	0.38	1305	
2007	239	0.333	80	70	0.53	159	970	1040	1129	0.86	Any	0.38	1305	
2008	335	0.333	112	38	0.74	223	906	944	1129	0.80	0.40	0.48	1305	
2009	469	0.333	150	0	1.00	319	810	810	1129	0.72	0.50	0.58	1305	
2010	476	0.333	150	0	1.00	326	803	803	1129	0.71	0.50	0.58	1305	
2011	1047	0.333	150	0	1.00	897	232	232	1129	0.21	0.80	0.83	1305	
2012	797	0.333	150	0	1.00	647	213	213	860	0.25	0.80	0.80	1160	
2013	486	0.333	150	0	1.00	336	793	793	1129	0.70	0.50	0.59	1305	
2014	744	0.333	150	0	1.00	594	535	535	1129	0.47	0.67	0.68	1305	
2015	549	0.333	150	0	1.00	399	401	401	800	0.50	0.67	0.67	1121	
2016	553	0.333	150	0	1.00	403	397	397	800	0.50	0.67	0.67	1121	
2017	282	0.333	94	56	0.63	188	941	997	1129	0.83	0.40	0.43	1305	
Mean	**511**		**127**	**39**	**0.76**	**385**	**679**	**702**	**1074**	**0.62**		**0.58**	**1260.93**	Average All (1999 Included)
10-Year Mean	**574**		**141**	**9**	**0.94**	**433**	**603**	**613**	**1036**	**0.57**		**0.63**	**1258**	Average Last 10 years

Summary of Option 1: This option has the potential to produces the lowest PNI, lowest Escapement, and lowest total Recruits. Hatchery returns are in excess of what is needed in all years.

Current Program back-cast. Theoretical Nason Creek backcast (1999-2008) of broodstock, escapement, and PNI objectives.

NOR Brood Goal	135 (76 Chiwawa, 59 Nason)		
Nason Creek Escapement Goal	1129		
NOR Target Extraction Rate	33%		
Combined Conservation Program Size (100K Nason, 144K Chiwawa)		**244,000**	**66%**
Nason Safety Net Program Size		**123,670**	**34%**
		367,670	

Conservation Program:	SAR (BY2002-2011)		SAR (89-11)	
Mean HOR run size:	**1187**	0.004864	**1135**	0.00465
Minimum HOR runs size:	**750**	0.003076	**88**	0.00036
Maximum HOR run size:	**1545**	0.006334	**3811**	0.01562
	10 year	**All**		
Mean HO R Needed	**603**	**691**		
Minimum HOR Needed	**258**	**1042**		
Maximum HOR Needed	**982**	**1154**		
Mean / Total Escapement	**1042**	10418	**1077**	**20007**
Mean/ Total Recruits	**1262**	12572	**1264.21**	**24020**
Mean PNI*	**0.64**		**0.59**	

						Theoretical Escapement		Total HOR Needed From						3.45E-01
Year	**Estimated NOR Run Size at TWD - whole basin**	**Target Extraction Rate**	**NOB**	**HOB**	**pNOB**	**NOS**	**HOS**		**Total Esc'nt**	**pHOS**	PNITarget	**PNI**	Est. No. Adult NOR Recruits	4.61E-04
1999	110	0.333	37	98	0.27	73	1056	1154	1129	0.94	Any	0.22	1305	
2000	486	0.333	135	0	1.00	351	778	913	1129	0.69	0.50	0.59	1305	
2001	791	0.333	135	0	1.00	656	214	349	870	0.25	0.80	0.80	1166	
2002	628	0.333	135	0	1.00	493	482	482	975	0.49	0.67	0.67	1228	
2003	398	0.333	133	2	0.98	265	864	866	1129	0.76	0.50	0.56	1305	
2004	870	0.333	135	0	1.00	735	235	235	970	0.24	0.80	0.80	1225	
2005	222	0.333	74	61	0.55	148	981	1042	1129	0.87	Any	0.39	1305	
2006	234	0.333	78	57	0.58	156	973	1030	1129	0.86	Any	0.40	1305	
2007	239	0.333	80	55	0.59	159	970	1025	1129	0.86	Any	0.41	1305	
2008	335	0.333	112	23	0.83	223	906	929	1129	0.80	0.40	0.51	1305	
2009	469	0.333	135	0	1.00	334	795	795	1129	0.70	0.50	0.59	1305	
2010	476	0.333	135	0	1.00	341	788	788	1129	0.70	0.50	0.59	1305	
2011	1047	0.333	135	0	1.00	912	217	217	1129	0.19	0.80	0.84	1305	
2012	797	0.333	135	0	1.00	662	213	213	875	0.24	0.80	0.80	1169	
2013	486	0.333	135	0	1.00	351	778	778	1129	0.69	0.50	0.59	1305	
2014	744	0.333	135	0	1.00	609	520	520	1129	0.46	0.67	0.68	1305	
2015	549	0.333	135	0	1.00	414	386	386	800	0.48	0.67	0.67	1121	
2016	553	0.333	135	0	1.00	418	422	422	840	0.50	0.67	0.67	1147	
2017	282	0.333	94	41	0.70	188	941	982	1129	0.83	0.40	0.45	1305	
Mean	**511**		**117**	**30**	**0.80**	**394**	**673**	**691**	**1077**	**0.61**		**0.59**	**1264.21**	Average All (1999 Included)
10-Year Mean	**574**		**129**	**6**	**0.95**	**445**	**597**	**603**	**1042**	**0.56**		**0.64**	**1262**	Average Last 10 years
Summary of 2:		increased PNI, increased escapment, increased recruitment												

Current Program back-cast. Theoretical Nason Creek backcast (1999-2008) of broodstock, escapement, and PNI objectives.

NOR Brood Goal	126	(76 Chiwawa, 50 Nason)		
Nason Creek Escapement Goal	1129			
NOR Target Extraction Rate	33%			
Combined Conservation Program Size (85K Nason, 144K Chiwawa)			**229,000**	**62%**
Nason Safety Net Program Size			**138,670**	**38%**
			367,670	

Conservation Program:	SAR (BY2002-2011)		SAR (89-11)	
Mean HOR run size:	**1114**	0.004864	**1065**	0.00465
Minimum HOR runs size:	**704**	0.003076	**82**	0.00036
Maximum HOR run size:	**1450**	0.006334	**3577**	0.01562
	10 year	**All**		
Mean HO R Needed	**602**	**687**		
Minimum HOR Needed	**413**	**1033**		
Maximum HOR Needed	**973**	**1145**		
Mean / Total Escapement	**1049**	10493	**1082**	**20132**
Mean/ Total Recruits	**1266**	12620	**1268.23**	**24096**
Mean PNI*	**0.64**		**0.60**	

***PNI Calcuated for the whole basin may be higher**

Year	Estimated NOR Run Size at TWD - whole basin	Target Extraction Rate	NOB	HOB	pNOB	Theoretical Escapement NOS	Theoretical Escapement HOS	Total HOR Needed From Conservation Program	Total Esc'nt	pHOS	PNITarget	PNI	Est. No. Adult NOR Recruits	3.45E-01 4.61E-04
1999	110	0.333	37	89	0.29	73	1056	1145	1129	0.94	Any	0.24	1305	
2000	486	0.333	126	0	1.00	360	769	895	1129	0.68	0.50	0.59	1305	
2001	791	0.333	126	0	1.00	665	225	351	890	0.25	0.80	0.80	1179	
2002	628	0.333	126	0	1.00	502	473	473	975	0.49	0.67	0.67	1228	
2003	398	0.333	126	0	1.00	272	857	857	1129	0.76	0.50	0.57	1305	
2004	870	0.333	126	0	1.00	744	256	256	1000	0.26	0.80	0.80	1241	
2005	222	0.333	74	52	0.59	148	981	1033	1129	0.87	Any	0.40	1305	
2006	234	0.333	78	48	0.62	156	973	1021	1129	0.86	Any	0.42	1305	
2007	239	0.333	80	46	0.63	159	970	1016	1129	0.86	Any	0.42	1305	
2008	335	0.333	112	14	0.89	223	906	920	1129	0.80	0.40	0.52	1305	
2009	469	0.333	126	0	1.00	343	786	786	1129	0.70	0.50	0.59	1305	
2010	476	0.333	126	0	1.00	350	779	779	1129	0.69	0.50	0.59	1305	
2011	1047	0.333	126	0	1.00	921	208	208	1129	0.18	0.80	0.84	1305	
2012	797	0.333	126	0	1.00	671	229	229	900	0.25	0.80	0.80	1185	
2013	486	0.333	126	0	1.00	360	769	769	1129	0.68	0.50	0.59	1305	
2014	744	0.333	126	0	1.00	618	511	511	1129	0.45	0.67	0.69	1305	
2015	549	0.333	126	0	1.00	423	427	427	850	0.50	0.67	0.67	1154	
2016	553	0.333	126	0	1.00	427	413	413	840	0.49	0.67	0.67	1147	
2017	282	0.333	94	32	0.75	188	941	973	1129	0.83	0.40	0.47	1305	
Mean	**511**		**111**	**25**	**0.82**	**400**	**672**	**687**	**1082**	**0.61**		**0.60**	**1268.23**	Average All (1999 I
10-Year Mean	**574**		**121**	**5**	**0.96**	**452**	**597**	**602**	**1049**	**0.56**		**0.64**	**1266**	Average Last 10 ye

Summary

- Reducing the program can result in more fish on the spawning grounds (marginally)
- Adjust the escapement goal has greater potential to increase escapement and recruitment – this should be done at the same time or in conjunction with adjustments to the conservation program size
- Need updated prespawn mortality data and habitat capacity info to update the escapement goals
- Composite broodstock was not modeled in 2009 but appears to give us better flexibility in adjusting the conservation program size, however because Chiwawa program hatchery fish and NORs cannot reliably be used for Nason Creek spawning escapement the Nason only model may be more appropriate.
- All parties would need to support potentially regular use of safety net fish in broodstock and on spawning grounds.

Background information for determining the Brood Year 2019 marking strategy:

Brood year 2019:

Program	Origin	Number per origin as of April 2020
Chiwawa Conservation	WxW	55,172
	HxH	70,973

The following tagging scheme was decided during the March 2019 HC meeting for Brood Year 2018 Nason and Chiwawa conservation and safety-net programs:

Program	Number as of March 2019	Origin	Adipose Mark	Snout Mark	Body Mark
Chiwawa Conservation	49,927	WxW	Ad +	CWT	None
	124,297	HxH	Ad +	CWT	Caudal BWT
Nason Conservation	110,327	WxW	Ad +	None	Dorsal CWT[a]
	14,600	HxH	Ad +	CWT	Caudal BWT
Nason Safety-Net	115,637	HxH	Ad -	CWT	None

Note:

a. Prior to 2016, Nason Conservation Program WxW fish were marked with a snout CWT and a caudal CWT.

A brood year 2018 caudal BWT marked fish (picture taken during PIT-tagging March of 2020).

Updated Retrospective Analysis

Nason Creek Conservation + Safety Net Program and current management plan

Retrospective Analysis 2009

- A look back at 'what might have been' based on the draft management plan
  - Estimates of NOR spring Chinook at Tumwater by spawning location
  - Draft Escapement goal (Beverton Holt Curve)
  - Sliding Scale of PNI (as per Wentachee Spring Chinook Management Plan
  - Chiwawa SARs (10 year: mean, min, max)
  - Conservation and Safety Net program sized to:
    - Maximize PNI
    - Maximize Escapement
    - Maximize Recruits
    - Minimize use of Safety Net fish on the spawning grounds and in the broodstock

2018 Update

- Updated SARS with most recent 10 years (still Chiwawa)
- Updated NORs at Tumwater – all years
- Updated Broodstock needs
- Re-ran analysis with new safety net splits
  - Nason Only
  - Nason Chiwawa Composite

2018 Update

- Did not use a new prespawn mortality level
- Did not use a new escapement goal (as a result of new prespawn mortality information)
- Did not use new stock-recruit models
- <u>To make the update complete new prespawn mortality rates and resulting escapement goals need to be updated!</u>

		Wild Spawners in Individual Major Spawning Areas												
Brood	Wilds	NASON		CHIWAWA		WHITE		LI'L WENATCHEE		WENATCHEE MS		Total wild	% Wild spawners	Nason+ Ch
Year	at TWD	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	spawners	to Tumwater Total	Combined
1999	173	22	12.8%	88	50.6%	3	1.6%	8	4.8%	0	0.0%	121	0.698	110
2000	651	223	34.3%	263	40.3%	27	4.1%	22	3.3%	31	4.8%	566	0.869	486
2001	2073	294	14.2%	497	24.0%	126	6.1%	95	4.6%	49	2.4%	1,061	0.512	791
2002	1033	347	33.6%	281	27.2%	80	7.7%	96	9.3%	66	6.4%	870	0.842	628
2003	919	193	21.0%	205	22.3%	38	4.1%	26	2.8%	21	2.3%	482	0.525	398
2004	898	297	33.1%	573	63.8%	54	6.0%	39	4.3%	46	5.1%	1,009	1.124	870
2005	594	83	13.9%	140	23.5%	119	20.1%	38	6.4%	9	1.5%	388	0.653	222
2006	573	118	20.6%	116	20.2%	41	7.1%	26	4.5%	6	1.1%	307	0.536	234
2007	324	82	25.2%	157	48.4%	62	19.2%	79	24.3%	9	2.7%	388	1.199	239
2008	631	139	22.1%	196	31.1%	20	3.1%	13	2.1%	0	0.0%	368	0.583	335
2009	777	164	21.1%	305	39.3%	81	10.5%	43	5.6%	0	0.0%	594	0.764	469
2010	880	59	6.8%	416	47.3%	26	3.0%	31	3.5%	3	0.3%	535	0.608	476
2011	1225	252	20.5%	795	64.9%	26	2.2%	71	5.8%	8	0.7%	1,152	0.941	1047
2012	1470	222	15.1%	575	39.1%	89	6.1%	44	3.0%	4	0.2%	934	0.635	797
2013	938	72	7.6%	414	44.2%	45	4.8%	79	8.4%	0	0.0%	610	0.650	486
2014	991	199	20.1%	545	55.0%	48	4.9%	68	6.8%	9	0.9%	869	0.877	744
2015	1177	145	12.4%	404	34.3%	105	8.9%	62	5.3%	28	2.4%	745	0.633	549
2016	927	143	15.4%	410	44.2%	74	7.9%	61	6.6%	4	0.4%	691	0.746	553
2017	499	90	18.1%	191	38.3%	20	4.0%	33	6.6%	12	2.5%	347	0.695	282

Current Program back-cast. Theoretical Nason Creek backcast (1999-2008) of broodstock, escapement, and PNI objectives.

NOR Brood Goal (Conservation Programs Only - Safety Net Excluded)	74			Conservation Program:	SAR (BY2002-2011)		SAR (89-11)	
Nason Creek Escapement Goal	542			**Mean HOR run size:**	**608**	0.004864	**581**	0.00465
NOR Target Extraction Rate	33%			**Minimum HOR runs size:**	**384**	0.003076	**45**	0.00036
Conservation Program Size		**125,000**	**56%**	**Maximum HOR run size:**	**792**	0.006334	**1953**	0.01562
Safety Net Program Size		**98,670**	**44%**		**10 year**	**All**		
		223,670		**Mean HO R Needed**	**429**	**376**		
				Minimum HOR Needed	**139**	**116**		
				Maximum HOR Needed	**557**	**594**		
				Mean / Total Escapement	**503**	5033	**469**	**8744**
				Mean/ Total Recruits	**366**	3795	**365.51**	**6945**
				Mean PNI*	**0.44**		**0.46**	
				***PNI Calcuated for the whole basin may be higher**				

Year	Estimated Nason NOR Run Size at TWD	Target Extraction Rate	NOB	HOB	pNOB	Theoretical Escapement NOS	Theoretical Escapement HOS	Total HOR Needed	Total Esc'nt	pHOS	PNITarget	PNI	Est. No. Adult NOR Recruits	2.96E-01 2.00E-03
1999	22	0.333	7	67	0.10	15	527	594	542	0.97	Any	0.09	393	
2000	223	0.333	74	0	0.99	149	393	466	542	0.72	0.50	0.58	393	
2001	294	0.333	74	0	1.00	220	220	294	440	0.50	0.67	0.67	375	
2002	347	0.333	74	0	1.00	273	257	257	530	0.48	0.67	0.67	391	
2003	193	0.333	64	10	0.86	129	413	423	542	0.76	0.50	0.53	393	
2004	297	0.333	74	0	1.00	223	222	222	445	0.50	0.67	0.67	376	
2005	83	0.333	28	46	0.37	55	70	116	125	0.56	0.40	0.40	229	
2006	118	0.333	39	35	0.53	79	341	376	420	0.81	0.40	0.40	370	
2007	82	0.333	27	47	0.37	55	70	117	125	0.56	0.40	0.40	229	
2008	139	0.333	46	28	0.63	93	449	477	542	0.83	0.40	0.43	393	
2009	164	0.333	55	19	0.74	109	433	452	542	0.80	0.40	0.48	393	
2010	59	0.333	20	54	0.27	39	503	557	542	0.93	Any	0.22	393	
2011	252	0.333	74	0	1.00	178	364	364	542	0.67	0.50	0.60	393	
2012	222	0.333	74	0	1.00	148	394	394	542	0.73	0.50	0.58	393	
2013	72	0.333	24	50	0.32	48	494	544	542	0.91	Any	0.26	393	
2014	199	0.333	66	8	0.90	133	409	417	542	0.76	0.50	0.54	393	
2015	145	0.333	48	26	0.65	97	445	471	542	0.82	0.40	0.44	393	
2016	143	0.333	48	26	0.64	95	447	473	542	0.82	0.40	0.44	393	
2017	90	0.333	30	44	0.41	60	95	139	155	0.61	0.40	0.40	256	
Mean	**165**		**50**	**23**	**0.69**	**116**	**347**	**376**	**469**	**0.72**		**0.46**	**365.51**	Average All (1999 l
10-Year Mean	**149**		**48**	**26**	**0.65**	**100**	**403**	**429**	**503**	**0.79**		**0.44**	**366**	Average Last 10 ye

Summary of Option 1: This option has the potential to produces the lowest PNI, lowest Escapement, and lowest total Recruits. Hatchery returns are in excess of what is needed in most.

Reduced Conservation Program and increased Safety-Net

Brood Goal	59		
Nason Creek Escapement Goal	542		
Target Extraction Rate	33%		
Conservation Program Size		100,000	45%
Safety Net Program Size		123,670	55%
		223,670	

Conservation Program:	SAR (BY2002-2011)		SAR (89-11)	
Mean HOR run size:	**486**	0.004864	**465**	0.00465
Minimum HOR runs size:	**308**	0.003076	**36**	0.00036
Maximum HOR run size:	**633**	0.006334	**1562**	0.01562
	10 year	**All**		
Mean HO R Needed	**422**	**380**		
Minimum HOR Needed	**209**	**166**		
Maximum HOR Needed	**542**	**579**		
Mean / Total Escapement	**512**	5118	**487**	**9118**
Mean/ Total Recruits	**375**	3849	**375.17**	**7128**
Mean PNI*	**0.48**		**0.49**	

***PNI Calcuated for the whole basin may be higher**

Year	Estimated Nason NOR Run Size at TWD	Target Extraction Rate	NOB	HOB	pNOB	Theoretical NOS	HOS	Total	Total Esc'nt	pHOS	PNITarget	PNI	Est. No. Adult NOR Recruits	2.96E-01 2.00E-03
1999	22	0.333	7	52	0.12	15	527	579	542	0.97	Any	0.11	393	
2000	223	0.333	59	0	1.00	164	378	437	542	0.70	0.50	0.59	393	
2001	294	0.333	59	0	1.00	235	225	284	460	0.49	0.67	0.67	379	
2002	347	0.333	59	0	1.00	288	254	254	542	0.47	0.67	0.68	393	
2003	193	0.333	59	0	1.00	134	408	408	542	0.75	0.50	0.57	393	
2004	297	0.333	59	0	1.00	238	222	222	460	0.48	0.67	0.67	379	
2005	83	0.333	28	31	0.47	55	135	166	190	0.71	0.40	0.40	281	
2006	118	0.333	39	20	0.67	79	463	483	542	0.85	0.40	0.44	393	
2007	82	0.333	27	32	0.46	55	125	157	180	0.70	0.40	0.40	275	
2008	139	0.333	46	13	0.78	93	449	462	542	0.83	0.40	0.49	393	
2009	164	0.333	55	4	0.93	109	433	437	542	0.80	0.40	0.54	393	
2010	59	0.333	20	39	0.33	39	503	542	542	0.93	Any	0.26	393	
2011	252	0.333	59	0	1.00	193	349	349	542	0.64	0.50	0.61	393	
2012	222	0.333	59	0	1.00	163	379	379	542	0.70	0.50	0.59	393	
2013	72	0.333	24	35	0.41	48	494	529	542	0.91	Any	0.31	393	
2014	199	0.333	59	0	1.00	140	402	402	542	0.74	0.50	0.57	393	
2015	145	0.333	48	11	0.82	97	445	456	542	0.82	0.40	0.50	393	
2016	143	0.333	48	11	0.81	95	447	458	542	0.82	0.40	0.49	393	
2017	90	0.333	30	29	0.51	60	180	209	240	0.75	0.40	0.40	310	
Mean	**165**		**44**	**15**	**0.77**	**121**	**359**	**380**	**487**	**0.73**		**0.49**	**375.17**	Average All (1999 Included)
10-Year Mean	**149**		**45**	**14**	**0.76**	**104**	**408**	**422**	**512**	**0.79**		**0.48**	**375**	Average Last 10 years

Summar 2: Increased PNI, Increased escapement, Increased recruitment. In below average years will need to use safety net fish in broodstock and/or spawning grounds (may not be a bad thing).

Reduced Conservation Program and increased Safety-Net			
Brood Goal	50		
Nason Creek Escapement Goal	542		
Target Extraction Rate	33%		
Conservation Program Size		85,000	38%
Safety Net Program Size		138,670	0%
		223,670	

Conservation Program:	SAR (BY2002-2011)		SAR (89-11)	
Mean HOR run size:	413	0.004864	395	0.00465
Minimum HOR runs size:	261	0.003076	31	0.00036
Maximum HOR run size:	538	0.006334	1328	0.01562
	10 year	All		
Mean HO R Needed	444	426		
Minimum HOR Needed	502	509		
Maximum HOR Needed	533	570		
Mean / Total Escapement	542	5420	535	10179
Mean/ Total Recruits	393	3933	392.19	7452
Mean PNI*	0.50		0.52	

*PNI Calcuated for the whole basin may be higher

Year	Estimated Nason NOR Run Size at TWD	Target Extraction Rate	NOB	HOB	pNOB	Theoretical Escapement NOS	Theoretical Escapement HOS	Total HOR Needed From Conservation Program	Total Esc'nt	pHOS	PNITarget	PNI	Est. No. Adult NOR Recruits	2.96E-01 2.00E-03
1999	22	0.333	7	43	0.15	15	527	570	542	0.97	Any	0.13	393	
2000	223	0.333	50	0	1.00	173	369	419	542	0.68	0.50	0.59	393	
2001	294	0.333	50	0	1.00	244	241	291	485	0.50	0.67	0.67	384	
2002	347	0.333	50	0	1.00	297	245	245	542	0.45	0.67	0.69	393	
2003	193	0.333	50	0	1.00	143	399	399	542	0.74	0.50	0.58	393	
2004	297	0.333	50	0	1.00	247	233	233	480	0.49	0.67	0.67	383	
2005	83	0.333	50	0	1.00	33	509	509	542	0.94	0.40	0.52	393	
2006	118	0.333	50	0	1.00	68	474	474	542	0.87	0.40	0.53	393	
2007	82	0.333	50	0	1.00	32	510	510	542	0.94	0.40	0.52	393	
2008	139	0.333	46	4	0.93	93	449	453	542	0.83	0.40	0.53	393	
2009	164	0.333	50	0	1.00	114	428	428	542	0.79	0.40	0.56	393	
2010	59	0.333	20	30	0.39	39	503	533	542	0.93	Any	0.30	393	
2011	252	0.333	50	0	1.00	202	340	340	542	0.63	0.50	0.61	393	
2012	222	0.333	50	0	1.00	172	370	370	542	0.68	0.50	0.59	393	
2013	72	0.333	24	26	0.48	48	494	520	542	0.91	Any	0.34	393	
2014	199	0.333	50	0	1.00	149	393	393	542	0.73	0.50	0.58	393	
2015	145	0.333	48	2	0.97	97	445	447	542	0.82	0.40	0.54	393	
2016	143	0.333	48	2	0.95	95	447	449	542	0.82	0.40	0.54	393	
2017	90	0.333	30	20	0.60	60	482	502	542	0.89	0.40	0.40	393	
Mean	**165**		**43**	**5**	**0.92**	**122**	**405**	**426**	**535**	**0.75**		**0.52**	**392.19**	Average All (1999 Included)
10-Year Mean	**149**		**42**	**8**	**0.83**	**107**	**435**	**444**	**542**	**0.80**		**0.50**	**393**	Average Last 10 years

Current Program back-cast. Theoretical Nason Creek backcast (1999-2008) of broodstock, escapement, and PNI objectives.

NOR Brood Goal (Conservation Programs Only - Safety Net Excluded)	150	(76 Chiwawa, 74 Nason)			**Conservation Program:**	SAR (BY2002-2011)		SAR (89-11)	
Nason/Chiwawa Escapement Goal	1129				**Mean HOR run size:**	**1308**	0.004864	**1251**	0.00465
NOR Target Extraction Rate	33%				**Minimum HOR runs size:**	**827**	0.003076	**97**	0.00036
Combined Conservation Program Size (125K Nason, 144K Chi			**269,000**	**73%**	**Maximum HOR run size:**	**1704**	0.006334	**4202**	0.01562
Nason Safety Net Program Size			**98,670**	**27%**		**10 year**	**All**		
			367,670		**Mean HO R Needed**	**613**	**702**		
					Minimum HOR Needed	**397**	**397**		
					Maximum HOR Needed	**997**	**1169**		
					Mean / Total Escapement	**1036**	10363	**1074**	**19907**
					Mean/ Total Recruits	**1258**	12536	**1260.93**	**23958**
					Mean PNI*	**0.63**		**0.58**	
					***PNI Calcuated for the whole basin may be higher**				

Year	Estimated NOR Run Size at TWD - whole basin	Target Extraction Rate	NOB	HOB	pNOB	Theoretical Escapement NOS	Theoretical Escapement HOS	Total HOR Needed	Total Esc'nt	pHOS	PNITarget	PNI	Est. No. Adult NOR Recruits	3.45E-01 4.61E-04
1999	110	0.333	37	113	0.24	73	1056	1169	1129	0.94	Any	0.21	1305	
2000	486	0.333	150	0	1.00	336	793	943	1129	0.70	0.50	0.59	1305	
2001	791	0.333	150	0	1.00	641	209	359	850	0.25	0.80	0.80	1154	
2002	628	0.333	150	0	1.00	478	472	472	950	0.50	0.67	0.67	1214	
2003	398	0.333	133	17	0.88	265	864	881	1129	0.76	0.50	0.54	1305	
2004	870	0.333	150	0	1.00	720	250	250	970	0.26	0.80	0.80	1225	
2005	222	0.333	74	76	0.49	148	981	1057	1129	0.87	Any	0.36	1305	
2006	234	0.333	78	72	0.52	156	973	1045	1129	0.86	Any	0.38	1305	
2007	239	0.333	80	70	0.53	159	970	1040	1129	0.86	Any	0.38	1305	
2008	335	0.333	112	38	0.74	223	906	944	1129	0.80	0.40	0.48	1305	
2009	469	0.333	150	0	1.00	319	810	810	1129	0.72	0.50	0.58	1305	
2010	476	0.333	150	0	1.00	326	803	803	1129	0.71	0.50	0.58	1305	
2011	1047	0.333	150	0	1.00	897	232	232	1129	0.21	0.80	0.83	1305	
2012	797	0.333	150	0	1.00	647	213	213	860	0.25	0.80	0.80	1160	
2013	486	0.333	150	0	1.00	336	793	793	1129	0.70	0.50	0.59	1305	
2014	744	0.333	150	0	1.00	594	535	535	1129	0.47	0.67	0.68	1305	
2015	549	0.333	150	0	1.00	399	401	401	800	0.50	0.67	0.67	1121	
2016	553	0.333	150	0	1.00	403	397	397	800	0.50	0.67	0.67	1121	
2017	282	0.333	94	56	0.63	188	941	997	1129	0.83	0.40	0.43	1305	
Mean	**511**		**127**	**39**	**0.76**	**385**	**679**	**702**	**1074**	**0.62**		**0.58**	**1260.93**	Average All (1999 Included)
10-Year Mean	**574**		**141**	**9**	**0.94**	**433**	**603**	**613**	**1036**	**0.57**		**0.63**	**1258**	Average Last 10 years

Summary of Option 1: This option has the potential to produces the lowest PNI, lowest Escapement, and lowest total Recruits. Hatchery returns are in excess of what is needed in all years.

Current Program back-cast. Theoretical Nason Creek backcast (1999-2008) of broodstock, escapement, and PNI objectives.

NOR Brood Goal	135	(76 Chiwawa, 59 Nason)	
Nason Creek Escapement Goal	1129		
NOR Target Extraction Rate	33%		
Combined Conservation Program Size (100K Nason, 144K Chiwawa)		**244,000**	**66%**
Nason Safety Net Program Size		**123,670**	**34%**
		367,670	

Conservation Program:	SAR (BY2002-2011)		SAR (89-11)	
Mean HOR run size:	**1187**	0.004864	**1135**	0.00465
Minimum HOR runs size:	**750**	0.003076	**88**	0.00036
Maximum HOR run size:	**1545**	0.006334	**3811**	0.01562
	10 year	**All**		
Mean HO R Needed	**603**	**691**		
Minimum HOR Needed	**258**	**1042**		
Maximum HOR Needed	**982**	**1154**		
Mean / Total Escapement	**1042**	10418	**1077**	**20007**
Mean/ Total Recruits	**1262**	12572	**1264.21**	**24020**
Mean PNI*	**0.64**		**0.59**	

Year	Estimated NOR Run Size at TWD - whole basin	Target Extraction Rate	NOB	HOB	pNOB	Theoretical Escapement		Total HOR Needed From	Total Esc'nt	pHOS	PNITarget	PNI	Est. No. Adult NOR Recruits	3.45E-01
						NOS	HOS							4.61E-04
1999	110	0.333	37	98	0.27	73	1056	1154	1129	0.94	Any	0.22	1305	
2000	486	0.333	135	0	1.00	351	778	913	1129	0.69	0.50	0.59	1305	
2001	791	0.333	135	0	1.00	656	214	349	870	0.25	0.80	0.80	1166	
2002	628	0.333	135	0	1.00	493	482	482	975	0.49	0.67	0.67	1228	
2003	398	0.333	133	2	0.98	265	864	866	1129	0.76	0.50	0.56	1305	
2004	870	0.333	135	0	1.00	735	235	235	970	0.24	0.80	0.80	1225	
2005	222	0.333	74	61	0.55	148	981	1042	1129	0.87	Any	0.39	1305	
2006	234	0.333	78	57	0.58	156	973	1030	1129	0.86	Any	0.40	1305	
2007	239	0.333	80	55	0.59	159	970	1025	1129	0.86	Any	0.41	1305	
2008	335	0.333	112	23	0.83	223	906	929	1129	0.80	0.40	0.51	1305	
2009	469	0.333	135	0	1.00	334	795	795	1129	0.70	0.50	0.59	1305	
2010	476	0.333	135	0	1.00	341	788	788	1129	0.70	0.50	0.59	1305	
2011	1047	0.333	135	0	1.00	912	217	217	1129	0.19	0.80	0.84	1305	
2012	797	0.333	135	0	1.00	662	213	213	875	0.24	0.80	0.80	1169	
2013	486	0.333	135	0	1.00	351	778	778	1129	0.69	0.50	0.59	1305	
2014	744	0.333	135	0	1.00	609	520	520	1129	0.46	0.67	0.68	1305	
2015	549	0.333	135	0	1.00	414	386	386	800	0.48	0.67	0.67	1121	
2016	553	0.333	135	0	1.00	418	422	422	840	0.50	0.67	0.67	1147	
2017	282	0.333	94	41	0.70	188	941	982	1129	0.83	0.40	0.45	1305	
Mean	**511**		**117**	**30**	**0.80**	**394**	**673**	**691**	**1077**	**0.61**		**0.59**	**1264.21**	Average All (1999 Included)
10-Year Mean	**574**		**129**	**6**	**0.95**	**445**	**597**	**603**	**1042**	**0.56**		**0.64**	**1262**	Average Last 10 years

Summary of 2: increased PNI, increased escapment, increased recruitment

Current Program back-cast. Theoretical Nason Creek backcast (1999-2008) of broodstock, escapement, and PNI objectives.

NOR Brood Goal	126 (76 Chiwawa, 50 Nason)			**Conservation Program:**	SAR (BY2002-2011)		SAR (89-11)	
Nason Creek Escapement Goal	1129			**Mean HOR run size:**	**1114**	0.004864	**1065**	0.00465
NOR Target Extraction Rate	33%			**Minimum HOR runs size:**	**704**	0.003076	**82**	0.00036
Combined Conservation Program Size (85K Nason, 144K Chiwawa)		**229,000**	**62%**	**Maximum HOR run size:**	**1450**	0.006334	**3577**	0.01562
Nason Safety Net Program Size		**138,670**	**38%**		**10 year**	**All**		
		367,670		**Mean HO R Needed**	**602**	**687**		
				Minimum HOR Needed	**413**	**1033**		
				Maximum HOR Needed	**973**	**1145**		
				Mean / Total Escapement	**1049**	10493	**1082**	**20132**
				Mean/ Total Recruits	**1266**	12620	**1268.23**	**24096**
				Mean PNI*	**0.64**		**0.60**	
				***PNI Calcuated for the whole basin may be higher**				

Year	Estimated NOR Run Size at TWD - whole basin	Target Extraction Rate	NOB	HOB	pNOB	Theoretical Escapement		Total HOR Needed From Conservation Program	Total Esc'nt	pHOS	PNITarget	PNI	Est. No. Adult NOR Recruits	3.45E-01 4.61E-04
						NOS	HOS							
1999	110	0.333	37	89	0.29	73	1056	1145	1129	0.94	Any	0.24	1305	
2000	486	0.333	126	0	1.00	360	769	895	1129	0.68	0.50	0.59	1305	
2001	791	0.333	126	0	1.00	665	225	351	890	0.25	0.80	0.80	1179	
2002	628	0.333	126	0	1.00	502	473	473	975	0.49	0.67	0.67	1228	
2003	398	0.333	126	0	1.00	272	857	857	1129	0.76	0.50	0.57	1305	
2004	870	0.333	126	0	1.00	744	256	256	1000	0.26	0.80	0.80	1241	
2005	222	0.333	74	52	0.59	148	981	1033	1129	0.87	Any	0.40	1305	
2006	234	0.333	78	48	0.62	156	973	1021	1129	0.86	Any	0.42	1305	
2007	239	0.333	80	46	0.63	159	970	1016	1129	0.86	Any	0.42	1305	
2008	335	0.333	112	14	0.89	223	906	920	1129	0.80	0.40	0.52	1305	
2009	469	0.333	126	0	1.00	343	786	786	1129	0.70	0.50	0.59	1305	
2010	476	0.333	126	0	1.00	350	779	779	1129	0.69	0.50	0.59	1305	
2011	1047	0.333	126	0	1.00	921	208	208	1129	0.18	0.80	0.84	1305	
2012	797	0.333	126	0	1.00	671	229	229	900	0.25	0.80	0.80	1185	
2013	486	0.333	126	0	1.00	360	769	769	1129	0.68	0.50	0.59	1305	
2014	744	0.333	126	0	1.00	618	511	511	1129	0.45	0.67	0.69	1305	
2015	549	0.333	126	0	1.00	423	427	427	850	0.50	0.67	0.67	1154	
2016	553	0.333	126	0	1.00	427	413	413	840	0.49	0.67	0.67	1147	
2017	282	0.333	94	32	0.75	188	941	973	1129	0.83	0.40	0.47	1305	
Mean	**511**		**111**	**25**	**0.82**	**400**	**672**	**687**	**1082**	**0.61**		**0.60**	**1268.23**	Average All (1999 I
10-Year Mean	**574**		**121**	**5**	**0.96**	**452**	**597**	**602**	**1049**	**0.56**		**0.64**	**1266**	Average Last 10 ye

Summary

- Reducing the program can result in more fish on the spawning grounds (marginally)
- Adjust the escapement goal has greater potential to increase escapement and recruitment – this should be done at the same time or in conjunction with adjustments to the conservation program size
- Need updated prespawn mortality data and habitat capacity info to update the escapement goals
- Composite broodstock was not modeled in 2009 but appears to give us better flexibility in adjusting the conservation program size, however because Chiwawa program hatchery fish and NORs cannot reliably be used for Nason Creek spawning escapement the Nason only model may be more appropriate.
- All parties would need to support potentially regular use of safety net fish in broodstock and on spawning grounds.

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Date: July 20, 2020

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Kristi Geris, Anchor QEA, LLC

Re: Final Minutes of the June 17, 2020 HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) meetings were held by conference call and web-share on Wednesday, June 17, 2020, from 10:00 a.m. to 11:45 a.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Joint HCP-HCs and PRCC HSC

- Brett Farman will discuss with Charlene Hurst and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A). *(Note: this item is ongoing.)*
- Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A). (*Note this item is ongoing.*)
- Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historic run-size data (Item I-A). (*Note this item is ongoing.*)
- All parties will provide updates on changes to marking and tagging plans due to the impacts COVID-19 on operations as updates become available (Item I-A). (*Note this item is ongoing.*)
- Kirk Truscott will determine the number of scales that should be collected from spring Chinook salmon at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook from Methow River spring Chinook salmon (Item I-A). (*Note this item is ongoing.*)
- Todd Pearsons, along with representatives from Chelan PUD and Douglas PUD, will provide direction to Tracy Hillman on next steps for estimating carrying capacity (Item II-A).
- Mike Tonseth will check with Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) on presenting pre-spawn mortality data to the HCP-HCs and PRCC HSC at an

upcoming meeting and will discuss with him the potential for using estimates of female pre-spawn mortality to calculate escapement goals (Item II-B).

- Mike Tonseth will ask Mike Hughes (WDFW) about visual assessments of males vs. females at Tumwater Dam (Item II-B).
- Keely Murdoch will provide an update on the operation of the Nason Creek and White River screw traps (Item II-C).

Joint RI/RR HCP-HC and PRCC HSC

- Catherine Willard will discuss the draft Statement of Agreement (SOA), *Regarding Chelan PUD's Okanagan Sockeye Obligation and Status of the Reintroduction Program,* with Kirk Truscott (Item IV-A).

Wells HCP-HC

- Greg Mackey will work with Charles Frady (WDFW) to update the run forecast for hatchery spring Chinook salmon escapement to the Winthrop National Fish Hatchery (NFH) and provide it to Bill Gale and Matt Cooper (Item III-A).

PRCC HSC

- None.

Decision Summary

- No decisions were approved during today's meeting.

Agreements

- No agreements were discussed during today's meeting.

Review Items

- The *Monitoring and Evaluation of the Chelan and Grant County PUDs Hatchery Programs Draft 2019 Annual Report* and appendices, which were provided by Tracy Hillman and were distributed to the HCP-HCs and PRCC HSC by Kristi Geris on June 16, 2020, are available for a 30-day review with edits and comments due to Hillman on July 16, 2020.
- The *Grant County PUD Hatchery Monitoring and Evaluation Implementation Plan for Spring and Summer Chinook in the Wenatchee Basin and Summer Chinook in the Methow Basin 2021*, which was provided by Todd Pearsons and was distributed to the PRCC HSC by Kristi Geris on July 8, 2020, is available for a 30-day review with edits and comments due to Pearsons on August 7, 2020.

Finalized Documents

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda, Announcements, Approve Past Meeting Minutes, Review Last Meeting Action Items

Tracy Hillman welcomed the HCP-HCs and PRCC HSC to the meeting and read the list of attendees signed into the meeting. The meeting was held via conference call and web-share because of travel and group meeting restrictions resulting from the COVID-19 pandemic. Hillman reviewed the agenda and asked for any additions or changes to the agenda. Mike Tonseth removed the update on outplanting surplus Methow composite spring Chinook salmon. All representatives present approved the agenda with this change.

The HCP-HCs and PRCC HSC representatives reviewed the revised May 20, 2020 meeting minutes. Minor revisions were resolved in the meeting. The HCP-HCs and PRCC HSC approved the May 20, 2020 meeting minutes, as revised. WDFW abstained because Mike Tonseth was not present during the May 20, 2020 meeting.

Action items from the HCP-HCs and PRCC HSC meeting on May 20, 2020, were reviewed, and follow-up discussions were addressed *(note that italicized text below corresponds to action items from the previous meeting)*:

Joint HCP-HCs and PRCC HSC

- *Mike Tonseth will coordinate with Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) to present pre-spawn mortality modeling results for spring Chinook salmon at an upcoming HCP-HCs meeting (Item I-A).*
  Tonseth said this item is ongoing and will be discussed briefly today.
- *Brett Farman will discuss with Charlene Hurst and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A).*
  Farman said this item is ongoing.
- *Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A).*
  Mackey said this item is ongoing.
- *Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A).*

Mackey said this item is ongoing.

- *Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historic run-size data (Item II-A).*
  Tonseth said this item is ongoing; he was able to get the data and is working to process it.
- *All parties will provide updates on changes to marking and tagging plans due to the impacts of COVID-19 on operations as updates become available (Item II-D).*
  This item will be discussed in today's meeting and will be ongoing.
- *Kirk Truscott will determine the number of scales that should be collected from spring Chinook salmon at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook salmon from Methow River spring Chinook salmon (Item II-A).*
  Tracy Hillman said this item is ongoing and Truscott is reviewing a draft plan for elemental signature analysis. Hillman said Truscott will likely provide an update on this topic to the committees in July or August.
- *Tracy Hillman will develop additional estimates of carrying capacity for Wenatchee River Basin spring Chinook salmon spawning aggregates, and Mike Tonseth will obtain recent pre-spawn mortality data from WDFW to incorporate into an updated Retrospective Analysis of Conservation Program Size (Item II-A).*
  Hillman said he completed his part of this action item. The second part of the item is redundant with the first action item (see above).

PRCC HSC

- None.

II. Joint HCP-HCs and PRCC HSC

A. Updated Retrospective Analysis of Wenatchee Spring Chinook Salmon Conservation Program Size

Keely Murdoch said one piece of this discussion revolves around stock-recruitment analyses. She said Mike Tonseth and Mike Hughes (WDFW) provided data that allowed her to update the retrospective analysis with the latest 2 years of data. She said the analysis now provides an estimate of the number of natural-origin returns from Nason Creek at Tumwater Dam. She said the updated analysis has similar results as to what was discussed last month because it reports 10-year averages. She said at one end of the release sizes modeled, there are excess hatchery-origin fish in most years, and at the other end, there are probably not enough conservation program fish in most years. She said the retrospective analysis indicates there is a middle release where these concerns can be balanced. She said the most significant changes in incorporating the more recent data are the updated pre-spawn mortality rates and the updated stock-recruitment curve. She pointed out Figure 9.2 of the Wenatchee Spring Chinook Management Plan, which shows the Nason Creek spring

Chinook salmon spawner-recruitment relationship, and Table 6 of the same plan, which shows the interim Wenatchee basin escapement targets. She said the escapement goal in the Management Plan is incorrect because of a mathematical error. She said the escapement goal at the time (352 fish) was based off of this curve, but last month the committees discussed a goal of approximately 300 fish, which seems significantly different. She said, comparing this to the retrospective analysis, a value of 542 fish was used instead of 500, additionally indicating a mathematical error at some stage in the analysis. She said the retrospective analysis relates to the Nason Creek spring Chinook stock-recruitment model that Tracy Hillman has been working on.

Murdoch said the current stock-recruitment model identifies a spawner goal of around 300 adult Chinook or slightly lower. She said the stock-recruitment curve shows the relationship between spawners and yearling smolts produced in the Nason Creek watershed. However, she said approximately 80% of the fish emigrating from Nason Creek are subyearlings. She identified subyearlings as likely very important to adult production in Nason Creek. She suggested subyearling migrants should be incorporated in the model because they may contribute to adult production in Nason Creek. Murdoch said downstream rearing (fall migrants) contributed the most to adult production in the Idaho study (89.5% of production)[1], which means fall migrants are an important life history contribution. She said this high contribution may or may not be consistent in the upper Columbia River but should be considered. Additionally, she noted that Andrew Murdoch presented information at an American Fisheries Society conference regarding the normalization of overwinter survival, showing that the survival of fall migrants was higher than other life history strategies. Murdoch suggested running the model to capture the production of fall migrants in order to more fully show the relationship between the number of spawners and total number of emigrants, especially before adjusting targets for spawner escapement.

Todd Pearsons asked if the suggestion is to make a new model (and figure) using total emigrants as opposed to just yearling smolts in order to assess carrying capacity. Keely Murdoch replied yes, because the relationship between spawners and total emigrants is important in determining carrying capacity. She said this could be complicated, however, if adjustments for overwinter survival need to be incorporated. Hillman agreed and said the stock-recruitment relationships are based on yearling smolts produced in Nason Creek and in the Chiwawa River, but there are data showing large numbers of emigrants leave the tributaries in the fall especially in Nason Creek. He said to determine total smolt production, these fish or some of these fish would need to be incorporated in the model. Knowing the overwinter survival rate of fall migrants allows the model to be corrected for migrants that leave and survive to smolt. He said for the Chiwawa River, there are estimates of parr, fall subyearling migrants, and smolts. Modeling these data allows us to evaluate the number of spawners

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[1] Copeland, T., D. A. Venditti, and B. R. Barnett. 2014. The importance of juvenile migration tactics to adult recruitment in stream-type Chinook salmon populations. Transactions of the American Fisheries Society 143:1460-1475, DOI: 10.1080/00028487.2014.949011

needed to maximize production. Focusing only on parr would likely provide the best estimate of the number of spawners needed to maximize production. For Nason Creek, parr data are not available, so it is more difficult to estimate maximum stock size. He said there may be a relationship between yearling production in the Chiwawa River and in Nason Creek, and a relationship between smolt and parr production in the Chiwawa River, which could inform a crosswalk model to estimate parr in Nason Creek. Alternatively, he said fall migrants could be added to the smolts produced within Nason Creek, and that sum could be modeled to estimate maximum stock size in Nason Creek. A better approach would be to apply an overwinter survival rate to the fall migrants, add those survivors to the yearling estimates, and then run the model to estimate maximum stock size in Nason Creek. He noted also that for Nason Creek, the Beverton-Holt curve only applies to fish produced within the basin and not those that leave.

Keely Murdoch said she would like to see these models updated. Historically, she said the thought was that fall migrants did not contribute significantly to productivity. She said the growing body of evidence shows that fall migrants may actually be a more successful life history strategy. She said especially in the Wenatchee basin, most tributaries are cold and at high elevations, so fish that stay within the tributaries may not be particularly successful compared to those that leave to warmer water in the mainstem Wenatchee River where there is likely more food. She said the dataset is not complete enough to answer all of these questions, but the data indicate that fall migrants are important components of spring Chinook salmon productivity in natal tributaries.

Pearsons said he thinks this issue and the model could become quite complicated, for example, if a correction for subyearling migrants is provided that does not account for density-dependence in Nason Creek, then carrying capacity will be overestimated. He asked whether the issue of fall-winter migrants could be bypassed by estimating capacity at the lower Wenatchee River screw trap. He said if capacity estimates for the whole basin area are available, tributary estimates could be checked by whether they add up to the total estimate for the Wenatchee basin. Hillman said not all Chinook-producing tributaries have smolt traps; therefore, it would be difficult to compare the sum of smolts produced in tributaries to the overall Wenatchee estimates. However, he said he can use the lower Wenatchee River trap to estimate total smolt production and then estimate number of smolts per intrinsic potential for the entire Wenatchee basin. This ratio would then be multiplied by the intrinsic potential within each tributary to determine carrying capacity in each tributary. He said there are many ways to run these analyses and update the models, so he would need additional input from the committees before moving forward.

Keely Murdoch said the committees can still move forward with the retrospective analysis in the meantime and use the existing agreed-upon escapement goal for Nason Creek while adjusting for the new pre-spawn mortality rate, but before the escapement goal is changed, the committees should evaluate subyearling production. She said Andrew Murdoch may have passive integrated transponder (PIT)-tag data that additionally inform this evaluation, which she will follow up on. Hillman responded that the survival of PIT-tagged Chiwawa Chinook that remain in the Chiwawa versus those that migrate has been analyzed, but he is not sure whether that has been done for Nason Creek.

Pearsons said he would like to think about the next steps for this item before moving forward. He said there are implications for different ways of estimating carrying capacity that should be considered before deciding which analyses to complete. He said he will discuss this more with the Chelan PUD and Douglas PUD representatives and provide more direction to Hillman on next steps for this analysis.

B. Wenatchee Spring Chinook Salmon Pre-Spawn Survival Estimates

Mike Tonseth said he discussed the Wenatchee spring Chinook salmon pre-spawn survival estimates with Andrew Murdoch and has an update. He said WDFW staff have found there is a reasonably good pre-spawn mortality estimate for females in the Wenatchee basin, but males are more complicated. He said they found the pre-spawn mortality model (a sub-model of the life-cycle model) works best when applied in the Chiwawa River, and not as well in other tributaries to the Wenatchee River. He said staff are still working on this topic, especially trying to determine whether the issues are with the model or with the low sample size of carcass data that the model uses. Tonseth estimated the pre-spawn mortality estimates would be completed in fall 2020, and said with the field season underway, they are not currently making much progress on the model.

Tracy Hillman asked whether the good estimates of pre-spawn mortality for females applies to all spawning aggregates. Tonseth said so far, the model works well for females in the Chiwawa River and reasonably well for females in other tributaries, but more analysis is needed. He added that the model does not work well for males in spawning aggregates outside of the Chiwawa River.

Keely Murdoch said she wonders if there is a difference in the pre-spawn mortality rates between males and females, and noted that, in a previous analysis, a flat rate of 35% pre-spawn mortality had been applied for all tributaries. She said there was hesitation to commit to a higher estimate of pre-spawn mortality without evidence, but at the time, many thought the estimate to be low. Tonseth replied the previous analysis focused more on differences in pre-spawn mortality between hatchery and wild fish instead of between males and females. He pondered that knowing the pre-spawn mortality estimate of females may be more biologically meaningful because females dictate the number of eggs; though males will spawn with multiple females, the number of females may be more influential to the capacity estimate. He wondered about setting targets for the number of female hatchery-origin spawners in a tributary with a lower target for the number of hatchery-origin males in order to manipulate the PNI. He said this has been taken into consideration during spring

Chinook salmon adult management activities at Tumwater Dam, but was not incorporated in the Wenatchee Basin Spring Chinook Management Plan. Tonseth said using females as a metric to try to meet escapement targets may be a more appropriate management direction than the current strategy. He suggested maybe the model should be reworked to focus on female pre-spawn mortality, especially considering the issues with low sample size. Keely Murdoch asked whether Andrew Murdoch could present his findings to the committees in July. Tonseth said he will discuss this with Andrew Murdoch.

Hillman asked whether the model assumes one female per redd. If so, he said this would be a straightforward analysis, and changes to management strategies would depend on confidence in these pre-spawn mortality estimates for females in each spawning aggregate.

Pearsons asked how accurate are the visual sex determination methods used during adult management at Tumwater Dam? Tonseth replied that the methods are relatively good, but ultrasound would be needed for more certainty. He said he will ask Mike Hughes for more information on the accuracy of visual assessment methods. Pearsons said he likes the theory of manipulating PNI by allowing more female than male hatchery-origin spawners, but questions the implications for handling, anesthetizing, and passing fish upstream at Tumwater Dam. Tonseth said unclipped hatchery fish are already present at Tumwater Dam during adult management, so handling is already occurring. He said he does not know how much more sampling would be needed to implement this strategy, as fish would need to be anesthetized to use ultrasound. In addition, this would depend on adult management occurring. Catherine Willard added that fish are already anesthetized, and because of the relative reproductive success study, they are PIT-tagged. She said this could also change in the future and should be considered when thinking about management activities at Tumwater Dam.

C. Effect of COVID-19 Pandemic on Monitoring and Evaluation Activities

Tracy Hillman asked each committee member to provide an update on impacts of the COVID-19 pandemic on monitoring and evaluation activities. Alf Haukenes (WDFW) reported no significant updates from WDFW. He said WDFW has opened up more activities but much in this region has not changed. He noted that steelhead surveys are still on hold; Mike Tonseth said even if the restrictions that apply to these surveys were lifted, the window of opportunity to complete these surveys is quickly passing. Tonseth added that WDFW has a return-to-work plan, but even if the agency moves into new phases of allowable activities, many staff are still restricted based on the counties they work or reside in. Hillman asked if drone operation is an allowable activity. Haukenes said WDFW was working with a graduate student who was doing drone surveys in 2019, and the agency is still working on this topic. He said WDFW has purchased another drone that Jeremy Cram (WDFW) may use for mapping and other activities, but he does not think this activity is underway currently. He said he thinks the staff who performed summer Chinook salmon surveys via drone last year will do more work this summer. Hillman asked whether a drone could be used in the Wenatchee River to conduct steelhead surveys. He said not having these surveys in 2020 would be a relatively large data gap. Catherine Willard said Chelan PUD is working on a method to use PIT tags to determine number of spawners in the mainstem Wenatchee River. Tonseth added that drones would have limited utility in surveying the Wenatchee River because of the high water and propensity for steelhead to spawn in margins. He said steelhead surveys via helicopter have been attempted previously and these were unsuccessful even with the ability to hover and look for redds, so he is not certain that drones would be any more effective.

Brett Farman said the National Marine Fisheries Service does not have any updates. He said he will likely be teleworking until a vaccine is available.

Bill Gale said he has been busy navigating the COVID-19 guidance for USFWS. He said the Fish and Wildlife Conservation offices are returning to field work but are limited to day trips and not overnight travel. He said only activities that are considered low or negligible risk are being allowed through his office. He said USFWS is following a phased approach along with each county, and activities will increase as counties progress to future phases. He said redd surveys will likely be completed, and most of the in-hatchery monitoring work has been allowed to move forward under limited contact and increased distancing. He said other upcoming work includes eDNA sampling and trap-and-haul work for bull trout in the Yakima basin. These activities can largely be completed with minimal risk and will likely move forward unless counties move backwards in phases. He said the Yakima region especially is concerning and USFWS has staff in that area.

Keely Murdoch said there have been no new changes for the Yakama Nation. She said staff are still mostly working from home and field work or other essential duties can move forward if authorized with a social distancing plan. Todd Pearsons asked about the status of the Nason and White River screw traps. Keely Murdoch said when the traps were installed this year, it was anticipated that they could be checked with two people safely while using social distancing. However, the White River trap is not possible to check at high flows because a small boat is used to access the trap. This trap was pulled temporarily during high flows. She said the trap in the Nason River has been easier to keep running, and at certain high flows, the traps are taken out anyway. She estimated that the traps have likely been pulled in a more conservative or frequent manner this year due to social distancing, and she said she will check on the status of the traps.

Willard said Chelan PUD field staff continue with all activities using precautions. She said gonadosomatic index (GSI) sampling will be conducted at the Chiwawa Acclimation Facility next week for the third and final year. She said spring Chinook salmon surveys will move forward, and office staff continue to work from home when possible.

Greg Mackey reported no significant updates for Douglas PUD. He said facilities are still restricted to Douglas PUD staff and activities are moving forward following standard social distancing guidance.

Pearsons reported no significant updates for Grant PUD. He said pre-release sampling for fall Chinook salmon will likely be completed this week.

III. Wells HCP-HC

A. Methow Hatchery Spring Chinook Salmon Broodstock

Greg Mackey provided an update on the broodstock collection for spring Chinook salmon at the Methow Hatchery. He said early in the run and up to a few weeks ago, the run was small. He said staff have been trapping wild broodstock at Wells Dam, which need to be genotyped before they can be assigned to broodstock. He said it is difficult to acquire broodstock at Wells Dam even when runs are larger, so it was not looking like the full wild broodstock would be collected this year. He said Charles Frady (WDFW), who performs the stock assessment and provides updates on fish composition based on trapping and retaining, was concerned initially that Douglas PUD would exceed the 33% retention rate of the natural-origin return for broodstock. Mackey said he also performed run projection modeling and estimated that the whole allotment of broodstock could be collected while staying under the 33% retention rate. He said Frady also projected similar values using a different approach. Having done these analyses, Mackey said Douglas PUD decided to continue trapping aggressively to meet broodstock targets. He said as of the latest projections, the program is close to meeting the broodstock target at an extraction rate of around 28% of the natural-origin return. He said some hatchery fish will likely be used as broodstock, which is not uncommon, and there are 89 confirmed broodstock being held at Methow Hatchery (including both the Twisp and Met-Comp programs). There are additional fish being held at Wells Fish Hatchery that will likely add 10 to 15 to the broodstock after genetic testing. He added that some hatchery fish are starting to volunteer into the Methow Hatchery trap, and these are being retained. Some ad-clipped fish have been transferred to the Winthrop NFH as well. He said Winthrop NFH has also reported some ad-present fish, which may be transferred to Methow Hatchery; however, this may not be needed because they are also swimming into the volunteer trap at Methow Hatchery. He said he provides this update to the committee specifically because it was looking like the program may need Winthrop NFH to transfer Methow Hatchery-origin returning fish to Methow Hatchery to fulfill the conservation program, but now this is looking less likely, or would be few fish. He summarized that broodstock collection has overall gone well, a few hatchery fish may be used in the brood, and trapping will cease soon because the spring Chinook salmon run is decreasing and summer Chinook salmon are starting to arrive.

Matt Cooper asked what the forecast was for hatchery fish returning to the Methow Hatchery. Mackey said the projection for wild fish was a few hundred and he is not sure of the hatchery fish projection. Bill Gale asked if that projection could be completed. He said staff at Winthrop NFH estimated there are 500 to 550 spring Chinook salmon in the pond at Winthrop NFH, with a visual estimate of at least 5% (or around 25 fish) being ad-present, indicating they originate from Methow Hatchery. He said with the three-population PNI model in mind, it is beneficial to spawn as many Methow Hatchery-origin fish as possible at Winthrop NFH. He said a forecast of hatchery fish returning to Methow Hatchery would allow Winthrop NFH to keep as many Methow Hatchery-origin fish as possible, and perhaps even receive fish in excess of broodstock needs from Methow Hatchery. Gale said Winthrop NFH will be sorting these fish on Wednesday, June 24, so any updates before then would be helpful. Mackey said he will check with Frady on the expected returns of hatchery fish to Methow Hatchery and provide an update to Gale and Cooper.

IV. Joint Rock Island/Rocky Reach HCP-HCs and PRCC HSC

A. Draft SOAs Regarding Chelan and Grant PUDs' Okanagan Sockeye Salmon Obligation and Status of Reintroduction Program

Catherine Willard shared the draft, "SOA Regarding Chelan PUD's Okanagan Sockeye Obligation and Status of the Reintroduction Program," which was distributed by Kristi Geris on June 13, 2020. She said the Okanogan sockeye program is co-funded by Chelan and Grant PUDs. This SOA is written for the Rocky Reach and Rock Island HCP-HCs; a similar one will be drafted for the PRCC HSC.

Willard provided background on the Okanogan sockeye program. She said in 2010, the HCP-HCs and PRCC HSC agreed that Chelan and Grant PUDs will co-fund the Skaha Lake and Okanagan Lake Reintroduction Program, operated by the Okanagan Nation Alliance (ONA), in order to meet the Districts' mitigation goals. Under this agreement, she said Chelan PUD receives mitigation credit for naturally produced smolts at Skaha and Okanagan lakes and hatchery produced smolts from Penticton Hatchery. She said the term of the SOA ends with the release of the 2020 brood, so the committees should consider a new SOA. The draft SOA (1) requests approval that the reintroduction program has been successful. She said the success is supported by annual updates by the Okanagan Nation Alliance to the HCP-HCs and PRCC HSC on the reintroduction program; funding of the construction of the hatchery; annual funding of the hatchery operations which provided hatchery releases starting in 2015; and funding of the M&E program used to adaptively manage the reintroduction program. She said during this time, reintroduction has accounted for 21.3% of the production in the basin. The next piece of the SOA (2) requests agreement that the mitigation goal is to continue to establish natural production and significant new habitats; (3) that the Districts will fund and support the monitoring and evaluation program and the hatchery operations; and (4) the

HCP-HCs agree to support the District's funding and implementation of the Reintroduction Program, from 2020 through 2031 in order to meet the District's NNI sockeye obligation.

She said her plan today is to present the draft SOA to the committees for their review and answer any immediate questions. She requested comments and questions by July 1 so that it can be revised and distributed for approval at the July meeting.

Keely Murdoch said she will review the SOA internally and she asked a few initial questions. First, she asked if there is a way to quantify the goal around natural production and spawning and rearing. For context, she said most mitigation programs have a goal expressed in number of fish. Willard said Todd Pearsons may have more information, but sockeye production from a hatchery was an unknown quantity when the 2010 SOA was written. Murdoch said that would make sense in the beginning of a reintroduction program, especially because the hatchery was not yet built when the SOA was being negotiated. However, now that more is known about the number of fish and variability in production, she said she would think that the district could estimate what is produced and what proportion of it is being funded. She said the SOA does not make clear what portions of the program are being funded by the Districts. Willard clarified that between Chelan PUD and Grant PUD, the districts fund 100% of the hatchery operations plus the monitoring and evaluation program. She said they are reluctant to describe that in the SOA, but language regarding the extent of the funding may be appropriate in the background sections. Pearsons said one reason the funding arrangement is not described fully in the SOA is because it would be possible for ONA to decide to do something out of scope with the original program, in which case the Districts would not want to be obligated to fund the entire program. Pearsons added that the mitigation goal of this program has been to reintroduce sockeye salmon into historically occupied lakes. The big prize has been to open up blocked areas and to jump-start natural production in these areas. Natural production is occurring in Skaha Lake and the next phase is to get production in Okanagan Lake.

Willard asked for comments and edits back by July 1, 2020, so that she can revise the SOA for approval at the July meeting. She said she will also follow up with Kirk Truscott to inform him of this draft SOA and discussion.

V. PRCC HSC

A. Review Agenda, Announcements, Approve Past Meeting Minutes

The PRCC HSC representatives approved the May 20, 2020 meeting minutes as revised.

VI. Next Meetings

The next HCP-HCs and PRCC HSC meetings will be Wednesday, July 15, 2020; Wednesday, August 19, 2020; and Wednesday, September 16, 2020, held by conference call and web-share until further notice. Note that the July and August meetings will begin at 9 am.

VII. List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
Sarah Montgomery	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Scott Hopkins	Chelan PUD
Catherine Willard*	Chelan PUD
Tom Kahler*	Douglas PUD
Greg Mackey*	Douglas PUD
Peter Graf‡	Grant PUD
Deanne Pavlik-Kunkel	Grant PUD
Todd Pearsons‡	Grant PUD
Brett Farman*‡	National Marine Fisheries Service
Bill Gale*‡	U.S. Fish and Wildlife Service
Matt Cooper*‡	U.S. Fish and Wildlife Service
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Charlie Snow	Washington Department of Fish and Wildlife
Alf Haukenes	Washington Department of Fish and Wildlife
Keely Murdoch*‡	Yakama Nation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees, and Priest Rapids Coordinating Committee Hatchery Subcommittee

Date: August 24, 2020

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Sarah Montgomery, Anchor QEA, LLC

Re: Final Minutes of the July 15, 2020, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) meetings were held by conference call and web-share on Wednesday, July 15, 2020, from 9:00 a.m. to 10:30 a.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Joint HCP-HCs and PRCC HSC

- Brett Farman will discuss with Charlene Hurst (NMFS) and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A). *(Note: this item is ongoing.)*
- Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A). (*Note this item is ongoing.*)
- Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook salmon Outplanting plan based on historic run-size data (Item I-A). (*Note this item is ongoing.*)
- All parties will provide updates on changes to marking and tagging plans due to the impacts of COVID-19 on operations as updates become available (Item I-A). (*Note this item is ongoing.*)
- Kirk Truscott will determine whether scales collected from spring Chinook salmon at Wells Dam for elemental signature analysis can be used to discern Okanogan River spring Chinook salmon from Methow River spring Chinook salmon (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth will check with Andrew Murdoch (WDFW) on presenting pre-spawn mortality data to the HCP-HCs and PRCC HSC at an upcoming meeting (tentatively planned for fall 2020) and will discuss with him the potential for using estimates of female pre-spawn mortality to calculate escapement goals (Item I-A). (*Note this item is ongoing.*)

- Mike Tonseth will ask Mike Hughes (WDFW) about visual assessments of males vs. females at Tumwater Dam (Item I-A). (*Note this item is ongoing.*)
- Todd Pearsons will continue coordinating with Mark Sorel (University of Washington) regarding his work on life cycle models for Wenatchee spring Chinook salmon and invite him to an upcoming meeting (tentatively planned for winter 2020/2021; Item II-A).
- Mike Tonseth will discuss collecting extra scales from broodstock at Methow Hatchery with WDFW staff at the facility (Item II-B).
- Kirk Truscott will work with CCT staff to develop a model that addresses the probability of encountering natural-origin Okanogan spring Chinook salmon at Wells Dam (Item II-B).
- Kirk Truscott will work with Casey Baldwin (CCT) to prepare a presentation about reintroduction of spring Chinook salmon upstream from Chief Joseph Dam (Item II-B).
- Bill Gale will share with Keely Murdoch the U.S. Fish and Wildlife Service (USFWS) hazard analysis for hatchery work considering COVID-19 (Item II-C).

Joint RI/RR HCP-HC and PRCC HSC

- Catherine Willard will discuss the draft Statement of Agreement (SOA), *Regarding Chelan PUD's Okanagan Sockeye Obligation and Status of the Reintroduction Program,* with Kirk Truscott (Item I-A). (*Note this item is ongoing.*)

PRCC HSC

- None.

Decision Summary

- No decisions were approved during today's meeting.

Agreements

- The HCP Hatchery Committees and Priest Rapids Coordinating Committees representatives present approved the addition of Katy Shelby (WDFW) to their respective distribution lists (Item VI-B). *(Note: Tracy Hillman will coordinate the final approval of Shelby's addition to the HCP distribution lists through the HCP Coordinating Committees).*

Review Items

- The *Grant County PUD Hatchery Monitoring and Evaluation Implementation Plan for Spring and Summer Chinook in the Wenatchee Basin and Summer Chinook in the Methow Basin 2021*, which was provided by Todd Pearsons and was distributed to the PRCC HSC by Kristi Geris on

July 8, 2020, is available for a 30-day review, with edits and comments due to Pearsons on August 7, 2020.

Finalized Documents

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda, Announcements, Approve Past Meeting Minutes, Review Last Meeting Action Items

Tracy Hillman welcomed the HCP-HCs and PRCC HSC to the meeting and read the list of attendees signed into the meeting. The meeting was held via conference call and web-share because of travel and group meeting restrictions resulting from the COVID-19 pandemic. Hillman reviewed the agenda and asked for any additions or changes to the agenda. Mike Tonseth removed the update on outplanting surplus Methow composite spring Chinook salmon and the update on Wenatchee spring Chinook salmon pre-spawn survival estimates. Catherine Willard added an update on Chelan Falls broodstock collection and noted that she moved the decision about SOAs regarding Chelan and Grant PUD's Okanagan Sockeye Obligation and Status of Reintroduction Program to next month.

All representatives present approved the agenda with these changes.

The HCP-HCs and PRCC HSC representatives reviewed the revised June 17, 2020, meeting minutes. Minor revisions were resolved in the meeting. The HCP-HCs and PRCC HSC approved the June 17, 2020, meeting minutes, as revised. The CCT abstained because they were not represented at the June meeting.

Action items from the HCP-HCs and PRCC HSC meeting on June 17, 2020, were reviewed, and follow-up discussions were addressed *(note that italicized text below corresponds to action items from the previous meeting)*:

Joint HCP-HCs and PRCC HSC

- *Brett Farman will discuss with Charlene Hurst and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A).*
  Farman said this item is ongoing.
- *Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A).*

Mackey said this item is ongoing.

- *Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A).*
  Mackey said this item is ongoing. He said one new paper on this topic recently came out. Tracy Hillman recognized the title and offered to send Mackey a copy.
- *Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook salmon Outplanting plan based on historic run-size data (Item I-A).*
  Tonseth said this item is ongoing.
- *All parties will provide updates on changes to marking and tagging plans due to the impacts of COVID-19 on operations as updates become available (Item I-A).*
  Tracy Hillman said this item is ongoing.
- Kirk Truscott will determine whether scales collected from spring Chinook salmon at Wells Dam for elemental signature analysis can be used to discern Okanogan River spring Chinook salmon from Methow River spring Chinook salmon *(Item I-A).*
  Truscott said he will provide an update on this today.
- *Todd Pearsons, along with representatives from Chelan PUD and Douglas PUD, will provide direction to Tracy Hillman on next steps for estimating carrying capacity (Item II-A).*
  Pearsons said he will provide an update on this during II-A.
- *Mike Tonseth will check with Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) on presenting pre-spawn mortality data to the HCP-HCs and PRCC HSC at an upcoming meeting and will discuss with him the potential for using estimates of female pre-spawn mortality to calculate escapement goals (Item II-B).*
  Tonseth said this item is ongoing.
- *Mike Tonseth will ask Mike Hughes (WDFW) about visual assessments of males vs. females at Tumwater Dam (Item II-B).*
  Tonseth said this item is ongoing.
- *Keely Murdoch will provide an update on the operation of the Nason Creek and White River screw traps (Item II-C).*
  Murdoch reported the trap details as follows: both the Nason Creek and White River screw traps have been active since March. She said the Nason Creek and White River traps ran from March 1 to March 23. The Nason Creek trap resumed operation on June 9 and has been operating since then. The White River trap has not yet restarted. They are waiting for the flows to decrease. It should restart soon as the flows are beginning to drop in the White River.

Joint RI/RR HCP-HC and PRCC HSC

- *Catherine Willard will discuss the draft Statement of Agreement (SOA), regarding Chelan PUD's Okanagan Sockeye Obligation and Status of the Reintroduction Program, with Kirk Truscott (Item IV-A).*

  Willard said this action item is ongoing and one reason why the topic was delayed.

Wells HCP-HC

- *Greg Mackey will work with Charles Frady (WDFW) to update the run forecast for hatchery spring Chinook salmon escapement to the Winthrop National Fish Hatchery (NFH) and provide it to Bill Gale and Matt Cooper (Item III-A).*

  Mackey said this item is complete.

PRCC HSC

- None.

II. Joint HCP-HCs and PRCC HSC

A. Updated Retrospective Analysis of Wenatchee Spring Chinook Salmon Conservation Program Size

Todd Pearsons said he has an update on discussions about sizing the conservation programs. He said he reviewed an American Fisheries Society talk from 2019, by Mark Sorel (University of Washington), which Andrew Murdoch (WDFW) also contributed to. The research related spawning escapements to different life stages of emigrants from the screw traps. Pearsons said Sorel is now working on a life cycle model for Wenatchee spring Chinook salmon that would likely inform discussions about the size of conservation programs. Pearsons added that one aspect of Sorel's dissertation will focus on the effects of density dependence on predicting adult abundance. Another important piece to his work is incorporating management scenarios into the model. He also plans to incorporate each life stage that migrates out of the Nason, Chiwawa, and White rivers, and will try to account for growth, size, and survival rates in the model.

Tracy Hillman asked if the committees would like to invite Sorel to a meeting to discuss his work. Pearsons said winter would be a good time to invite Sorel because he is just in the beginning stages of his model. Pearsons said he will continue discussing this with Sorel and invite him to a meeting this winter.

Hillman asked whether the retrospective analysis is on hold until the committees have results from Sorel's model. Pearsons said he does not think it needs to wait because a lot of new information is available to inform the analysis that is better than what was used to size the program originally.

Murdoch said she is not comfortable changing escapement targets until the stock-recruit curve includes fall migrants and pre-spawn mortality. She said pre-spawn mortality will make a big difference in estimates of spawning escapement, too.

B. Differentiating Natural-Origin Okanogan Spring Chinook Salmon from Other Natural-Origin Chinook Salmon during Broodstock Collection at Wells Dam for Methow Hatchery Programs

Kirk Truscott said collection of natural-origin return (NOR) spring Chinook salmon is occurring at Wells Dam. With the return of NOR spring Chinook salmon there is concern that these fish may be collected and used in the Methow program rather than returning to the Okanogan for natural production. He said CCT is working on methods to identify Okanogan spring Chinook salmon so those fish can be excluded from the Methow program brood collection. One potential method is scale elemental analysis, which appears to be valid when using otoliths from juveniles to distinguish Similkameen/Okanogan summer Chinook salmon from mainstem Columbia River summer/fall Chinook salmon. Presently, it is unknown whether or not elemental "scale" analysis could be used to reliably distinguish these two summer Chinook natal origins; however, the otolith results are encouraging. This method relies on differences in water chemistry between rearing sites. Water chemistry information for tributaries in the Okanogan and Methow Basins is necessary to assess if sufficient differences in water chemistry exists among tributaries such that elemental scale analysis could translate to differences in scale samples for identifying Okanogan River spring Chinook from Methow River spring Chinook. He said the CCT is looking into the available data to determine if there are sufficient differences in water chemistry among spring Chinook rearing tributaries such that it would translate to differences in elemental analysis as a method for identifying Methow spring Chinook from Okanogan spring Chinook. Greg Mackey asked how quick of a turnaround a laboratory could provide for these scale samples? Truscott said a laboratory could return results in as short as one week; however, the tests are quite expensive. He said he has been getting some guidance from Tim Lindley (Pacific Northwest National Laboratory) on this analysis, such as how many scales would need to be run to confidently assign a fish to its basin of origin.

Mike Tonseth asked if 2021 is the first year when 4-year-old returns can be expected from production in the Okanogan basin. Truscott said the first juvenile release was in 2015, so 2020 will be a full cohort. Tonseth noted that WDFW has scale samples from 2019 that were used to assign spring Chinook salmon to the Methow basin, and additional scale samples could be taken again in 2020 even if the analyses will not be undertaken until later. Truscott asked, how many scales are typically taken? Tonseth said four to five scales per fish, and he will talk to WDFW staff at Methow Hatchery to see if this can be increased.

Bill Gale asked whether grandparent and parent analysis could be used to identify natural-origin fish that were produced from releases out of Riverside Pond, because the parentage of the Riverside Pond releases are known from parentage-based-tagging efforts at Winthrop NFH. Truscott said he recalls previous work in the Wenatchee basin that showed grandparentage analysis and more removed analyses are not particularly reliable for determining assignment probabilities. Tonseth agreed and said using grandparentage analysis would require sampling all spring Chinook salmon passing Wells Dam and would depend on the manager's level of comfort with the assignment probabilities.

Todd Pearsons asked if Truscott has performed any rough modeling to estimate the number of spring Chinook that may be returning to the Okanogan basin. He suggested a scenario-based model that would provide a probability of Okanogan spring Chinook salmon being collected. Truscott said the passive-integrated transponder (PIT)-tag data from adult tagging activities might help inform a model like this. He said there are a surprisingly large number of fish that cross the PIT array in the lower Okanogan River, but spawning ground surveys show few redds. He said one problem is a lack of access to spawning habitat on private lands. This limits the scope of redd surveys in the basin. He said it is unclear how many spawners there are in the basin because the estimate would be different depending on which data source is used—last detections of the PIT reader or redd observations. He added taking the estimate of spawners then becomes even more complicated because an assumption about egg to smolt survival is needed to expand it to basin production. He said this would produce a large range of potential encounters at Wells Dam. He said the probabilistic model of encountering Okanogan fish at Wells Dam, given what is known about spawning in the Okanogan River, would still be helpful to informing these potential analyses, and that he will work with his staff to develop one. He said CCT will also work to develop a protocol and estimate costs for scale elemental analysis to determine basin of origin for spring Chinook collected at Wells Dam.

Truscott said he will continue providing updates on this item at future meetings.

C. Effect of COVID-19 Pandemic on Monitoring and Evaluation Activities

Tracy Hillman asked each committee member to provide an update on impacts of the COVID-19 pandemic on monitoring and evaluation activities.

Mike Tonseth reported no changes from the previous meeting.

Brett Farman also reported no changes.

Bill Gale reported no changes. He said USFWS has resumed field work except for electrofishing and other activities where social distancing is not feasible. He asked Tonseth what would happen if Chelan County reverted to Phase 1. Tonseth said there is always the possibility of more restrictions, but keep in mind that before Phase 1.5 started, WFDFW staff had started M&E activities with exemptions from COVID-19 restrictions. Gale asked Tonseth to continue providing updates on WDFW policy so that activities can be consistent.

Keely Murdoch said the Yakama Nation are looking ahead to coho salmon broodstock collection and spawning in about 6 weeks. She said Yakama Nation staff are working on plans to implement collection and spawning with social distancing. She said she may ask staff at Tumwater or Dryden dams and Leavenworth NFH to compare how staff are setting up spawning areas and trapping while maintaining distance. Gale offered to send USFWS' hazard analyses to Murdoch to help with this effort.

Catherine Willard said when the time for coho salmon collection at Tumwater and Dryden nears, she will also be in contact with Murdoch to review procedures. Murdoch said one concern at Dryden is that the access to the trap is cramped. Willard also noted that Chelan PUD is planning to start spring Chinook salmon surveys at the end of July.

Kirk Truscott reported that CCT's M&E staff are seining and tagging juvenile summer Chinook salmon at the confluence of the Okanogan River. Next, they will install the weir on the Okanogan River when flows decline. He said staff are also collecting summer Chinook salmon broodstock with a purse seine at the Okanogan River mouth. He said a developing thermal barrier at the mouth of the Okanogan should improve collections for this effort. Truscott added that CCT staff will be working from home until at least September 30 due to the CCT partial government shutdown that has been extended.

Todd Pearsons reported no changes to impacts from COVID-19 on Grant PUD programs since the prior meeting. He said broodstock collection for fall Chinook salmon in September will pose a challenge though.

Greg Mackey reported no changes since the previous meeting.

III. Wells HCP-HC

A. Methow Hatchery Spring Chinook Salmon Broodstock

Greg Mackey provided an update on broodstock collection for the spring Chinook salmon program at Methow Hatchery. He said broodstock collection is almost complete. For the Twisp program, he said there are 7 pairs of wild fish with a target of 8 pairs. He said the Twisp program may not reach its goal for 2020, especially if fecundities are less than expected. He said if this program does not meet its broodstock targets, an extra fish spawned in the Methow-Chewuch program will be incorporated, as described in the Hatchery and Genetic Management Plan.

For the Methow programs (Methow and Chewuch), he said there are 61 females—53 wild females and 8 hatchery females. For males, there are fewer than the target—35 wild, 10 hatchery, and 2 jacks. Douglas PUD continues to trap at the hatchery outfall trap and will likely collect a few more males. He said this means there are enough fish to spawn and get the full program; however, some males may be reused. Considering how low the run was this year and challenges with broodstock collection, he said the program is in relatively good shape and that he will provide another update in August.

IV. RI/RR HCP-HC

A. Brood Year 2020 Chiwawa Broodstock Collection

Catherine Willard provided an update on the collection of brood year 2020 Chiwawa spring Chinook salmon. She said the target is 84 NOR fish, and so far, 28 NOR and 53 hatchery-origin return (HOR) fish have been collected. At Tumwater Dam, 16 NOR fish, previously PIT-tagged as smolts, were collected. She said trapping efforts at the Chiwawa Weir began on July 6, once flows were low enough to operate the trap. Staff initially tried trapping during the day from 6 am to 9 pm for four days but found that to be unsuccessful in collecting NOR Chinook salmon (but a few HOR Chinook salmon and bull trout were each collected). Willard said Chelan PUD discussed the progress with the USFWS and requested using the 2019 protocol (24 hours trapping, then 24 hours off). Once this was confirmed and implemented, collections of NOR spring Chinook salmon increased. She said the current bull trout encounter tally is at 28 fish out of an allowable 123. Trapping is ongoing at the 24-hour on/off schedule rate until either 20 days of trapping have occurred or the bull trout limit is reached. She said she will also provide an email summary of this update.

Kirk Truscott asked if there are reliable PIT-tag data that could inform when spring Chinook salmon are entering the Chiwawa River. Willard said she is not sure, but based on counts at Tumwater Dam, there was a pulse of fish and now there are fewer. Truscott asked about the likelihood of meeting brood given that peak passage has occurred. Willard agreed that it is unlikely that the Chiwawa spring Chinook salmon program will meet its full complement of NOR brood in 2020 but will be able to backfill with hatchery-origin brood to meet its smolt production target.

B. Chelan Falls Broodstock Collection

Catherine Willard said the adult summer Chinook trap for collecting broodstock in the Chelan River habitat channel for the Chelan Falls program was planned to be installed and operational by July 16, 2020; however, due to delays associated with COVID-19, the trap will not be ready until the fourth week of July. She said this is close to the timeframe when it would be beneficial to trap for broodstock in the Chelan River but not close enough to plan on collecting the full brood She said Chelan PUD has an Interlocal Agreement with Douglas PUD to collect all of the needed brood for the

Chelan Falls program at the Wells Dam Volunteer Trap in 2020. She said the adult summer Chinook trap will still be installed in the Chelan River in late July as a pilot to test collection for future years. The fish collected through this effort will be surplus, per discussion with Mike Tonseth, and may be held at Eastbank Hatchery. Tonseth added the surplus fish will be set aside to satisfy production needs for either the CCT or YN production programs, or as food fish.

Keely Murdoch asked for confirmation about whether the trap will be operated in 2020. Willard said yes but not for brood collection—brood will be sourced from Wells Dam Volunteer Trap. Willard also confirmed the trap was not installed due to delays from COVID-19.

V. PRCC HSC

A. Review Agenda, Announcements, Approve Past Meeting Minutes

The PRCC HSC representatives approved the June 17, 2020, meeting minutes as revised.

B. Grant County PUD Hatchery Monitoring and Evaluation Implementation Plan for Spring and Summer Chinook in the Wenatchee Basin and Summer Chinook in the Methow Basin 2021

Todd Pearsons said Grant PUD's Hatchery Monitoring and Evaluation Implementation Plan for Spring and Summer Chinook Salmon in the Wenatchee Basin and Summer Chinook Salmon in the Methow Basin 2021 is available for a 30-day review, with edits and comments due by August 7. Pearsons said the main difference between this version and the previous version is new text associated with the new Section 10 permit for summer and fall Chinook salmon in the appendices.

C. Carlton Acclimation Facility Construction Updates

Todd Pearsons said he has another update on construction at the Carlton Acclimation Facility. He said installation of the backup well has been postponed to next year. He said Grant PUD had originally planned to have it running before fish are on station. He said, on the other hand, the domestic well, which provides water for showers, eyewash stations, etc., will be completed before fish are on station.

Truscott asked what caused the delay. Deanne Pavlik-Kunkel said there were supply chain issues related to COVID-19. She said the bid was also higher than anticipated for this work, making it challenging to get full funding for the work in 2020. She said the plan is to have everything in place by spring or early summer in 2021.

VI. Administrative Items

A. Anchor QEA Support Through 2020

Tracy Hillman and Sarah Montgomery notified representatives present that Montgomery will be providing support to the committees through the end of 2020.

B. WDFW Requests Change to Distribution Lists

Tracy Hillman said he received a request from Mike Tonseth to add Katy Shelby (WDFW) to the primary distribution list for the HCP Hatchery Committees and PRCC HSC. Alf Haukenes (WDFW) said Shelby is a recent hire with WDFW and she will be providing technical support to the committees. Hillman asked representatives present if they approve the addition of Shelby to the distribution list for the HCP Hatchery Committees and all present approved. Hillman said the next step for adding Shelby to the distribution list is to get approval from the HCP Coordinating Committees.

Regarding the PRCC HSC distribution list, Todd Pearsons said the PRCC HSC can also add Shelby to the list and inform Denny Rohr (facilitator of the PRCC). Hillman said he will inform the PRCC that Shelby will be added to the distribution list.

VII. Next Meetings

Keely Murdoch requested that the CCT provide a presentation or update about the phased approach for reintroduction of spring Chinook salmon to blocked areas in the upper Columbia River. Kirk Truscott said he will work with Casey Baldwin to provide this update sometime this fall. Murdoch thanked Truscott and noted that the program is not tied to the HCP Hatchery Committees or PRCC HSC but that it would be interesting to the committees.

The next HCP-HCs and PRCC HSC meetings will be Wednesday, August 19, 2020; Wednesday, September 16, 2020, and Wednesday, October 21, 2020; held by conference call and web-share until further notice. Note that the August meeting will begin at 9 am.

VIII. List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
Sarah Montgomery	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Scott Hopkins	Chelan PUD
Catherine Willard*	Chelan PUD
Kirk Truscott*	Colville Confederated Tribes
Tom Kahler*	Douglas PUD
Greg Mackey*	Douglas PUD
Peter Graf‡	Grant PUD
Deanne Pavlik-Kunkel	Grant PUD
Todd Pearsons‡	Grant PUD
Brett Farman*‡	National Marine Fisheries Service
Bill Gale*‡	U.S. Fish and Wildlife Service
Matt Cooper*‡	U.S. Fish and Wildlife Service
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Charlie Snow	Washington Department of Fish and Wildlife
Alf Haukenes	Washington Department of Fish and Wildlife
Keely Murdoch*‡	Yakama Nation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees, and Priest Rapids Coordinating Committee Hatchery Subcommittee

Date: September 21, 2020

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Sarah Montgomery, Anchor QEA, LLC

Re: Final Minutes of the August 19, 2020, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) meetings were held by conference call and web-share on Wednesday, August 19, 2020, from 9:00 a.m. to 10:30 a.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Joint HCP-HCs and PRCC HSC

- Brett Farman will discuss with Charlene Hurst (National Marine Fisheries Service [NMFS]) and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A). *(Note: this item is ongoing.)*
- Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A). (*Note this item is ongoing.*)
- Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth will distribute the analysis showing feasibility of the *Methow Spring Chinook salmon Outplanting plan* based on historic run-size data (Item I-A). (*Note this item is ongoing.*)
- All parties will provide updates on changes to marking and tagging plans due to the impacts of COVID-19 on operations as updates become available (Item I-A). (*Note this item is ongoing.*)
- Kirk Truscott (Colville Confederated Tribes [CCT]) will determine the number of scales that should be collected from spring Chinook at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook from Methow River spring Chinook (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth will check with Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) on presenting pre-spawn mortality data to the HCP-HCs and PRCC HSC at an upcoming meeting (tentatively planned for fall 2020; Item I-A). (*Note this item is ongoing.*)

- Mike Tonseth will distribute information from Mike Hughes (WDFW) about visual assessments of males vs. females at Tumwater Dam (Item I-A). (*Note: Montgomery provided Tonseth's email with this information to the committees following the meeting on August 19, 2020.)*
- Todd Pearsons will continue coordinating with Mark Sorel (University of Washington) regarding his work on life cycle models for Wenatchee spring Chinook salmon and invite him to an upcoming meeting (tentatively planned for winter 2020/2021; Item I-A). (*Note this item is ongoing.*)
- Kirk Truscott will work with CCT staff to develop a model that addresses the probability of encountering natural-origin Okanogan spring Chinook at Wells Dam (Item I-A). (*Note this item is ongoing.*)
- Kirk Truscott will work with Casey Baldwin (CCT) to prepare a presentation about reintroduction of endemic anadromous fish upstream from Chief Joseph Dam (Item I-A). (*Note this item is ongoing and tentatively planned for the October HCP Hatchery Committees meeting.*)
- Keely Murdoch and Mike Tonseth will update the retrospective analysis for Wenatchee spring Chinook salmon using estimates of female pre-spawn mortality (Item II-A).
- Sarah Montgomery will update and distribute the document *Discussion Topics for 2020* to prepare for discussions about changes to the broodstock collection protocols for 2021 (Item VIII).

PRCC HSC

- None

Decision Summary

- The PRCC HSC approved the *Grant County PUD Hatchery Monitoring and Evaluation Implementation Plan for Spring and Summer Chinook in the Wenatchee Basin and Summer Chinook in the Methow Basin 2021* as follows: the CCT approved (via email) on August 12 and Grant PUD, the Yakama Nation (YN), WDFW, NMFS, and U.S. Fish and Wildlife Service (USFWS) approved during the meeting on August 19, 2020.

Agreements

- No agreements were approved during today's meeting.

Review Items

- The *Chelan PUD 2021 Hatchery Monitoring and Evaluation Implementation Plan,* which was provided by Catherine Willard and was distributed to the Rocky Reach and Rock Island HCP Hatchery Committees by Sarah Montgomery on August 19, 2020, is available for a 30-day review with edits and comments due to Willard by September 18, 2020. (*Note that Chelan PUD has requested comments by September 4, 2020, to facilitate early approval at the September 16, 2020, Hatchery Committees meeting.)*

- The Douglas PUD *2019 Wells Complex M&E Annual Report*, which was provided by Greg Mackey and was distributed to the Wells HCP Hatchery Committee by Sarah Montgomery on August 28, 2020, is available for a 30-day review with edits and comments due to Mackey by September 28, 2020.

Finalized Documents

- The approved plan, *Grant County PUD Hatchery Monitoring and Evaluation Implementation Plan for Spring and Summer Chinook in the Wenatchee Basin and Summer Chinook in the Methow Basin 2021,* was distributed by Sarah Montgomery to the PRCC HSC on September 3, 2020.
- The final report, Monitoring and Evaluation of the Chelan and Grant PUDs Hatchery Programs 2019 Annual Report was distributed by Kristi Geris to the Rocky Reach and Rock Island HCP Hatchery Committees and PRCC HSC on September 11, 2020.

I. Welcome

A. Review Agenda, Announcements, Approve Past Meeting Minutes, Review Last Meeting Action Items

Tracy Hillman welcomed the HCP-HCs and PRCC HSC to the meeting and read the list of attendees signed into the meeting. The meeting was held via conference call and web-share because of travel and group meeting restrictions resulting from the COVID-19 pandemic. Hillman reviewed the agenda and asked for any additions or changes to the agenda. Catherine Willard added an item for the *Draft Chelan PUD 2021 Hatchery M&E Implementation Plan* and an item for predation at Eastbank Hatchery.

All representatives present approved the agenda with these changes.

The HCP-HCs and PRCC HSC representatives reviewed the revised July 15, 2020, meeting minutes. Minor revisions were resolved in the meeting. The HCP-HCs and PRCC HSC approved the July 15, 2020, meeting minutes, as revised.

Action items from the HCP-HCs and PRCC HSC meeting on July 15, 2020, were reviewed, and follow-up discussions were addressed *(note that italicized text below corresponds to action items from the previous meeting)*:

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  Farman said this item is ongoing.
- *Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A).*
  Mackey said this item is ongoing.
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  Tonseth said this item is ongoing.
- *All parties will provide updates on changes to marking and tagging plans due to the impacts of COVID-19 on operations as updates become available (Item I-A).*
  This item is ongoing.
- *Kirk Truscott will determine whether scales collected from spring Chinook salmon at Wells Dam for elemental signature analysis can be used to discern Okanogan River spring Chinook salmon from Methow River spring Chinook salmon (Item I-A).*
  This item is ongoing.
- *Mike Tonseth will check with Andrew Murdoch (WDFW) on presenting pre-spawn mortality data to the HCP-HCs and PRCC HSC at an upcoming meeting (tentatively planned for fall 2020) and will discuss with him the potential for using estimates of female pre-spawn mortality to calculate escapement goals (Item I-A).*
  Tonseth said the second part of this item is complete and he will provide those data to Keely Murdoch soon.
- *Mike Tonseth will ask Mike Hughes (WDFW) about visual assessments of males vs. females at Tumwater Dam (Item I-A).*
  Tonseth said he discussed this with Hughes, who pointed him to gender assessment work at Tumwater Dam that was completed from 2004 to 2007 as part of a relative reproductive success study. *(Note: Tonseth provided an email update of this discussion to the committees on August 19, 2020, following the meeting.)*
- *Todd Pearsons will continue coordinating with Mark Sorel (University of Washington) regarding his work on life cycle models for Wenatchee spring Chinook salmon and invite him to an upcoming meeting (tentatively planned for winter 2020/2021; Item II-A).*

Pearsons said he discussed this with Sorel, and it will be discussed today.

- *Mike Tonseth will discuss collecting extra scales from broodstock at Methow Hatchery with WDFW staff at the facility (Item II-B).*
  Tonseth said WDFW staff at Methow Hatchery are collecting additional scales for a potential study by the CCT and this item is complete.
- *Kirk Truscott will work with CCT staff to develop a model that addresses the probability of encountering natural-origin Okanogan spring Chinook salmon at Wells Dam (Item II-B).*
  This item is ongoing.
- *Kirk Truscott will work with Casey Baldwin (CCT) to prepare a presentation about reintroduction of spring Chinook salmon upstream from Chief Joseph Dam (Item II-B).*
  Hillman said this item is ongoing and Truscott had communicated to him that Baldwin will likely give this presentation in October.
- *Bill Gale will share with Keely Murdoch the U.S. Fish and Wildlife Service (USFWS) hazard analysis for hatchery work considering COVID-19 (Item II-C).*
  Murdoch said she received the hazard analysis and this item is complete.

Joint RI/RR HCP-HC and PRCC HSC

- *Catherine Willard will discuss the draft Statement of Agreement (SOA), regarding Chelan PUD's Okanagan Sockeye Obligation and Status of the Reintroduction Program, with Kirk Truscott (Item IV-A).*
  Willard said this item is complete and will be discussed today.

PRCC HSC

- None

II. Joint HCP-HCs and PRCC HSC

A. Updated Retrospective Analysis of Wenatchee Spring Chinook Salmon Conservation Program Size

Todd Pearsons said he discussed this topic with Mark Sorel and his advisor to get a better understanding of Sorel's model. He said Sorel's model will integrate data from the screw traps in the Wenatchee basin (Chiwawa River, Nason Creek, and White River screw traps) and will model density dependence with regards to migration and survival through adulthood. Pearsons said he was surprised that Sorel's model will be a life cycle model but is not a component of the National Oceanic and Atmospheric Administration's existing life cycle model for spring Chinook. Pearsons said Sorel told him that he intends for the model to be useful for managers and is looking forward to getting input and suggestions from the committees. Pearsons said he will continue following up with Sorel and asked if representatives present have any questions.

Tracy Hillman asked if this item should remain on the agenda or if it should be taken off until further updates are available. Keely Murdoch suggested that it remain on the agenda as a reminder to keep the program sizing discussion moving forward. She said the committees will also need to decide whether to make any decisions about the size of the conservation program with currently available information. Hillman said the committees have been exploring the currently available data that can be added to the existing retrospective model, but Sorel's model presents a different potential decision-making tool. Murdoch agreed and said there were initially two paths forward for this discussion – first, the committees intended to update the retrospective model (and this has been done to the point that it can be, without additional information about pre-spawn mortality or escapement goals); second, the committees intended to use the life cycle model to gain a better understanding of an appropriate size for a conservation hatchery program. She said this second piece has not progressed much. Mike Tonseth agreed and said the purpose of the second path was to use the life cycle model to determine outputs for spawner escapement that could be compared to the retrospective analysis. He said Andrew Murdoch may be working on this at some point, and now Sorel's model presents a third path that could also provide estimates of spawner escapement. Tonseth suggested eventually comparing all three, but for right now, he noted that the retrospective analysis has been advanced as far as possible except for incorporating pre-spawn survival data for females only. He said, in July, the committees discussed revising the retrospective analysis to incorporate the pre-spawn survival data for females. He said with this update, the number of females on spawning grounds would determine whether the seeding goal has been met instead of the number of total fish on spawning grounds. With this in mind, he suggested making this update to the model. Keely Murdoch said she will work on making this update.

Hillman said this item will remain on the agenda so monthly updates can be provided as needed. Tonseth said Andrew Murdoch will present his research on pre-spawn mortality as well, likely in the fall.

B. Effect of COVID-19 Pandemic on Monitoring and Evaluation Activities

Tracy Hillman asked each committee member to provide an update on impacts of the COVID-19 pandemic on monitoring and evaluation activities.

Catherine Willard said Chelan PUD's only update is that the Chelan Falls trap will not be piloted in 2020 because enough brood had already been collected at Wells Fish Hatchery and installing the trap presented a risk due to COVID-19. She said spring Chinook redd surveys are ongoing as of last week using COVID-19 safety protocols.

Greg Mackey said Douglas PUD has no changes to report since the previous meeting.

Matt Cooper said the USFWS has no additional updates. He said field and hatchery activities are continuing with the same protections and checklists that were developed for COVID-19 earlier in the year.

Keely Murdoch said the YN is preparing for Coho collection and spawning efforts. She said YN will staff the effort internally and not hire temporary workers due to COVID-19 risks associated with traveling and housing. Because of the limited crew, she said spawning protocols may differ from previous years; for example, there may be twice weekly spawning efforts instead of weekly. She said the YN is also still working to figure out trapping at Dryden and Tumwater dams and coordination with WDFW. Willard said Chelan PUD owns the trapping facilities and therefore also has staff at those facilities so please coordinate accordingly. Murdoch replied that she will mention this to Cory Kamphaus (YN), who is coordinating the effort.

Katy Shelby said WDFW has no major changes to report from previous meetings. She said staff are adapting to the slightly loosened carpooling restrictions—they are now allowed to carpool using PPE and social distancing. Mike Tonseth added WDFW has released new guidance regarding carpooling and reporting exposures to COVID-19.

Brett Farman reported no changes from the National Oceanic and Atmospheric Administration.

Todd Pearsons said Grant PUD is conducting summer Chinook surveys in the Methow River, and there are no major changes to how that work is being conducted. He said instead of renting a house for staff, staff will be staying individually in hotel rooms to minimize risk. He said broodstock and M&E work for fall Chinook will begin in September. He said there are many staff for this effort, so one protocol being considered is compartmentalizing the crews so that if isolation becomes necessary, only part of the crew would be exposed and need to isolate.

III. Wells HCP-HC

A. Methow Hatchery Spring Chinook Salmon Broodstock

Greg Mackey provided an update on broodstock collection for the spring Chinook salmon program at Methow Hatchery. He said the Twisp program will be short one female (there are seven and the goal is eight). He said Douglas PUD increased the Methow composite/Methow-Chewuch program accordingly to compensate for the reduction in the Twisp program to make up the overall production, in accordance with the Hatchery Genetic Management Plan (HGMP). He said spawning has been going on for three weeks and is going well so far.

IV. RI/RR HCP-HCs

A. Brood Year 2020 Chiwawa Broodstock Collection

Catherine Willard provided an update on the collection of brood year 2020 Chiwawa spring Chinook salmon, which was also distributed via email prior to the meeting. Willard said the target for broodstock collected is 84 adults, and through recaptures at Tumwater Dam and trapping at the Chiwawa Weir, 70 natural-origin returns (NORs) and 18 hatchery-origin returns (HORs) have been collected. She said after reviewing scale analysis results, 3 HOR females and 3 NOR males were removed from the broodstock. She also noted that one female that was recaptured at Tumwater Dam had DNA with a 90% assignment to Leavenworth National Fish Hatchery and was surplused (the sample was accidentally included in the Nason Creek weekly DNA samples). She said HOR fish were also retained as backup. Regarding collection at the Chiwawa Weir, Willard said earlier in the season the weir was operated only during the day between the hours of 6:00 a.m. and 8:00 p.m. to evaluate minimizing the capture of bull trout while collecting spring Chinook salmon brood. However, minimal spring Chinook salmon were being trapped and it was decided to operate the weir on a 24-hour cycle (24 hours up then 24 hours down) consistent with the 2019 broodstock collection protocol Chiwawa weir operating plan. Trapping at the weir was initiated on July 7, and most of the brood has been collected with only 70 bull trout encounters, which is below the permit limit for 2020 (123 bull trout encounters).

Keely Murdoch asked whether the decision to trap for Chiwawa fish at Tumwater Dam to get more NOR fish needs to be revisited now that operating the Chiwawa Weir and encountering bull trout appears to be less of an issue in collecting NOR broodstock? She asked what Willard is thinking the plan for 2021 might be. Willard replied that the 2021 plan can be decided by the committees with consideration that in 2019, the weir was operated earlier in the year and they encountered the full bull trout permit allowance within three days. She said it is not clear whether there was less of an issue with bull trout encounters in 2020 due to trapping later in the season or due to other conditions, but one thought is that bull trout are migrating earlier in the season and are therefore more likely to be encountered. She added that flows in 2020 were too high to trap earlier in the season as well. Murdoch suggested revisiting this topic in the fall when broodstock collection protocols are discussed. She said one goal is to collect broodstock throughout the run, so only operating the weir later in the season may be a concern if the first part of the run is missed due to high flows or trying to avoid bull trout encounters. Willard agreed and said this will be on the agenda in September and available for discussion throughout the fall as broodstock collection protocols are developed.

B. Hatchery M&E Implementation Plan 2021

Catherine Willard said Chelan PUD's *Hatchery M&E Implementation Plan* for 2021 will be distributed today for review. She said there are few changes in the document—dates have been updated, electrofishing methods have been clarified, and permit requirements for precocial maturation sampling for the summer chinook programs have been added. She said Chelan PUD will ask for approval of this plan at the September committees meeting.

V. Joint RI/RR HCP-HCs and PRCC HSC

A. SOAs Regarding Chelan and Grant PUD's Okanagan Sockeye Obligation and Status of Reintroduction Program: Update and Next Steps

Catherine Willard said after further discussions with WDFW and the YN, Chelan PUD and Grant PUD have decided to separate the draft *Statement of Agreement (SOA) Regarding Chelan and Grant PUDs' Okanagan Sockeye Obligation and Status of Reintroduction Program* into two SOAs. She said the first SOA would establish the success of the Okanagan sockeye reintroduction program after a comprehensive review of existing data. She said the second SOA would determine any mitigation for the program moving forward. She said the plan for the comprehensive review is to provide the hatchery committees with documents including annual reports, any reports relevant to the program, and relevant publications. She said pertinent data will be summarized in a white paper that will also be provided to the committees. During the September committees meeting, Willard will review the results in the white paper and initiate a discussion regarding results of the program to date. After this, she said the committees can review the data and draft an SOA, and lastly, determine mitigation for the program in the future.

B. Predation at Eastbank Hatchery

Catherine Willard said after fish were marked at Eastbank Fish Hatchery in June and July, staff determined that there had been a more significant issue with predation in 2020 than initially thought. She said staff determined there were shortages in the following programs:

- 12,000 fish from the Nason spring Chinook conservation program
- 23,700 fish from the Nason spring Chinook safety-net program
- 15,000 fish from the Chiwawa spring Chinook program

She said hatchery staff thought the shortages were due to avian predation and this was confirmed via video surveillance conducted by a U.S. Department of Agriculture contractor. She said the primary predators have been crows and herons. She said Chelan PUD is addressing this issue by removing some of the crows and herons and covering the raceways with netting to protect fish from further predation. Tracy Hillman asked if the birds are being harassed to reduce predation. Willard said the predators are being lethally removed according to permits with the U.S. Department of Agriculture. Mike Tonseth asked when the exclusion netting will be in place, and whether staff are expecting similar predation losses in summer Chinook and steelhead ponds. Willard said the netting will be installed by the end of August, and because summer Chinook and steelhead have not been marked yet, shortages in the programs due to predation have not been determined. She said video evidence suggests most of the predation has been on spring Chinook. Tonseth asked if Chelan PUD plans to place netting over all of the ponds at the hatchery, suggesting that the predators may pursue fish from other ponds once the spring Chinook ponds are covered. Willard said the summer Chinook are in a super raceway so it would be more difficult to install netting over those. She said the focus currently is on spring Chinook but covering other raceways will be considered as more information about predation becomes available.

VI. PRCC HSC

A. Review Agenda, Announcements, Approve Past Meeting Minutes

The PRCC HSC representatives approved the July 15, 2020, meeting minutes as revised.

B. Angler Broodstock Collection Fishery and COVID-19 – Alternative Broodstock Collection?

Todd Pearsons said the 2020 Broodstock Collection Protocols did not include collection of fish at the off-ladder adult fish trap (OLAFT) at Priest Rapids Dam, with the plan instead to collect broodstock from the Angler Broodstock Collection (ABC) fishery. Pearsons said WDFW and Grant PUD has worked with the Coastal Conservation Association to organize and implement the fishery, and the WDFW, Grant PUD, and Coastal Conservation Association has been working to plan the fishery with appropriate COVID-19 protocols to reduce risk. Despite these planning efforts, he said it is possible that the fishery will be cancelled and Grant PUD will need to collect more of its broodstock from the Priest Rapids volunteer channel, which include more hatchery-origin fish and therefore reduce the proportion of natural-origin brood (pNOB) of the program in 2020. A low pNOB in 2020 would also translate to a low PNI, which would decrease the 5-year average and potentially affect the program's ability to meet PNI targets. Pearsons asked representatives present for their opinions on Grant PUD's options for broodstock collection in 2020.

Mike Tonseth said the impacts from COVID-19 were not anticipated when the Broodstock Collection Protocols were approved, and even 2021 protocols will be uncertain. He said if the ABC fishery does not occur, he also anticipates a dip in PNI. Moving forward to 2021, he said it would be pragmatic to develop a contingency plan, such as collecting broodstock from the OLAFT, especially if the pandemic continues. Pearsons agreed and said it could be written as a tiered approach, such as if by a certain date, if there is a high risk that the ABC fishery does not occur, the program defaults to collection at the OLAFT. Tonseth said in July 2021, there will be a better sense of which activities will occur so it will be easier to plan broodstock collection as long as the approach is described in the protocols.

Keely Murdoch thanked Pearsons for bringing this up and said that his plan sounds like a good one for 2021. She said the ABC fishery has provided enough natural-origin broodstock so that a dip in PNI in 2020 is not too much of a concern. She agreed that in 2021, a tiered approach to broodstock collection is a good approach. Pearsons said he will write the tiered protocol (of backfilling broodstock collection with fish collected at the OLAFT) into the draft broodstock collection protocols for 2021, and summarized that if the ABC fishery does not occur in 2020, a dip in PNI is probably okay for the program but it would be bad to have two low years of PNI in a row. Tracy Hillman asked when the ABC fishery is scheduled. Pearsons replied October 30, 31, and November 1.

C. Grant County PUD Hatchery Monitoring and Evaluation Implementation Plan for Spring and Summer Chinook in the Wenatchee Basin and Summer Chinook in the Methow Basin 2021

Tracy Hillman said Grant PUD's *Hatchery Monitoring and Evaluation Implementation Plan for Spring and Summer Chinook Salmon in the Wenatchee Basin and Summer Chinook Salmon in the Methow Basin 2021* was available for a 30-day review, with edits and comments due by August 7, 2020. Todd Pearsons said no comments were received so he accepted the redlines from the previous year for the final version. Hillman asked for votes on the plan and noted that Kirk Truscott approved it via email on August 12, 2020. The USFWS, YN, WDFW, NMFS, and Grant PUD representatives approved the plan during the meeting on August 19, 2020.

VII. Administrative Items

A. AFS Meeting and September Meeting Schedule

Tracy Hillman said there is a virtual American Fisheries Society meeting scheduled on September 16, 2020, which may present a conflict with the September HCP-HC and PRCC HSC meeting if representatives wanted to attend the AFS meeting. He asked the representatives present what their preferences were. Todd Pearsons had previously provided input via email that he would be interested in moving the HCP-HC and PRCC HSC meeting. Catherine Willard, Greg Mackey, Matt Cooper, Keely Murdoch, Mike Tonseth, and Brett Farman stated that they prefer to maintain the original meeting date. Hillman also noted that he believes September 16 works for Kirk Truscott who is not present today. No changes were made to the September HCP-HC and PRCC HSC meeting date.

Sarah Montgomery asked Hillman and the representatives present if the September meeting should start at 9 am or 10 am due to school calendars. Murdoch said the 10 am start times during the school year were scheduled to accommodate Wednesday late starts, which are not currently planned during COVID-19. Representatives present agreed to continue with 9 am start times for the meetings until a change is warranted.

VIII. Next Meetings

The next HCP-HCs and PRCC HSC meetings will be Wednesday, September 16, 2020; Wednesday, October 21, 2020; and Wednesday November 18, 2020; held by conference call and web-share until further notice.

IX. List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
Sarah Montgomery	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Scott Hopkins	Chelan PUD
Catherine Willard*	Chelan PUD
Tom Kahler*	Douglas PUD
Greg Mackey*	Douglas PUD
Peter Graf‡	Grant PUD
Deanne Pavlik-Kunkel	Grant PUD
Todd Pearsons‡	Grant PUD
Brett Farman*‡	National Marine Fisheries Service
Matt Cooper*‡	U.S. Fish and Wildlife Service
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Katy Shelby	Washington Department of Fish and Wildlife
Keely Murdoch*‡	Yakama Nation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees, and Priest Rapids Coordinating Committee Hatchery Subcommittee

Date: November 23, 2020

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Sarah Montgomery, Anchor QEA, LLC

Re: Final Minutes of the September 16, 2020, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) meetings were held by conference call and web-share on Wednesday, September 16, 2020, from 9:00 a.m. to 10:45 a.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Joint HCP-HCs and PRCC HSC

- Brett Farman will discuss with NOAA staff and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A). *(Note: this item is ongoing.)*
- Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A). (*Note this item is ongoing.*)
- Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historic run-size data (Item I-A). (*Note this item is ongoing.*)
- All parties will provide updates on changes to marking and tagging plans due to the impacts of COVID-19 on operations as updates become available (Item I-A). (*Note this item is ongoing.*)
- Kirk Truscott will determine the number of scales that should be collected from spring Chinook at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook from Methow River spring Chinook (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth will check with Andrew Murdoch (WDFW) on presenting pre-spawn mortality data to the HCP-HCs and PRCC HSC at an upcoming meeting (tentatively planned for fall 2020; Item I-A). (*Note this item is ongoing.*)

- Todd Pearsons will continue coordinating with Mark Sorel (University of Washington) regarding his work on life cycle models for Wenatchee spring Chinook salmon and invite him to an upcoming meeting (tentatively planned for winter 2020/2021; Item I-A). (*Note this item is ongoing.*)
- Kirk Truscott will work with CCT staff to develop a model that addresses the probability of encountering natural-origin Okanogan spring Chinook at Wells Dam (Item I-A). (*Note this item is ongoing.*)
- Kirk Truscott will work with Casey Baldwin (CCT) to prepare a presentation about reintroduction of endemic anadromous fish upstream from Chief Joseph Dam (Item I-A). (*Note this item is ongoing and tentatively planned for the October HCP Hatchery Committees meeting.*)
- Keely Murdoch and Mike Tonseth will update the retrospective analysis for Wenatchee spring Chinook salmon using estimates of female pre-spawn mortality (Item II-A).
- Greg Mackey will ask Betsy Bamberger (Douglas PUD) if any surplus fish are needed for research projects in 2021, which would need to be included in the Broodstock Collection Protocols (Item II-B).

PRCC HSC

- None

Decision Summary

- The Rocky Reach and Rock Island HCP Hatchery Committees approved the *Chelan PUD 2021 Hatchery Monitoring and Evaluation Implementation Plan,* as follows: Chelan PUD, the YN, the CCT, WDFW, NMFS, and USFWS approved during the meeting on September 16, 2020.

Agreements

- No agreements were approved during today's meeting.

Review Items

- The Douglas PUD *2019 Wells Complex M&E Annual Report*, which was provided by Greg Mackey and was distributed to the Wells HCP Hatchery Committee by Sarah Montgomery on August 28, 2020, is available for a 30-day review with edits and comments due to Mackey by September 28, 2020.

Finalized Documents

- The final report, *Monitoring and Evaluation of the Chelan and Grant PUDs Hatchery Programs 2019 Annual Report*, was distributed by Kristi Geris to the Rocky Reach and Rock Island HCP Hatchery Committees and PRCC HSC on September 11, 2020.

I. Welcome

A. Review Agenda, Announcements, Approve Past Meeting Minutes, Review Last Meeting Action Items

Tracy Hillman welcomed the HCP-HCs and PRCC HSC to the meeting and read the list of attendees signed into the meeting. The meeting was held via conference call and web-share because of travel and group meeting restrictions resulting from the COVID-19 pandemic. Hillman reviewed the agenda and asked for any additions or changes to the agenda. Brett Farman added an update on NOAA representation. Todd Pearsons said he will provide an update on the ABC fishery at a later meeting. All representatives present approved the agenda with these changes.

The HCP-HCs and PRCC HSC representatives reviewed the revised August 19, 2020, meeting minutes. Minor revisions were resolved in the meeting. The HCP-HCs and PRCC HSC approved the August 19, 2020, meeting minutes, as revised. Kirk Truscott noted that he was not in attendance. Bill Gale noted that Matt Cooper should also confirm edits in the minutes (this was provided via email after the meeting).

Action items from the HCP-HCs and PRCC HSC meeting on August 19, 2020, were reviewed, and follow-up discussions were addressed *(note that italicized text below corresponds to action items from the previous meeting)*:

Joint HCP-HCs and PRCC HSC

- *Brett Farman will discuss with NOAA staff and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A).*
  Farman said this item is ongoing; however, Charlene Hurst no longer works at NOAA so he will be discussing this item with other NOAA staff.
- *Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A).*
  Mackey said this item is ongoing and will be a focus for him as discussions about the Broodstock Collection Protocols develop.

- *Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A).*
  Mackey said this item is ongoing. He has been working on it, but not ready to share yet.
- *Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook salmon Outplanting plan based on historic run-size data (Item I-A).*
  Tonseth said this item is ongoing.
- *All parties will provide updates on changes to marking and tagging plans due to the impacts of COVID-19 on operations as updates become available (Item I-A).*
  This item is ongoing.
- *Kirk Truscott will determine the number of scales that should be collected from spring Chinook at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook from Methow River spring Chinook salmon (Item I-A).*
  This item is ongoing.
- *Mike Tonseth will check with Andrew Murdoch on presenting pre-spawn mortality data to the HCP-HCs and PRCC HSC at an upcoming meeting (tentatively planned for fall 2020; Item I-A).*
  Tonseth said this item is ongoing.
- *Mike Tonseth will distribute information from Mike Hughes (WDFW) about visual assessments of males vs. females at Tumwater Dam (Item I-A).*
  This item is complete. Montgomery provided Tonseth's email with this information to the committees following the meeting on August 19, 2020.
- *Todd Pearsons will continue coordinating with Mark Sorel (University of Washington) regarding his work on life cycle models for Wenatchee spring Chinook salmon and invite him to an upcoming meeting (tentatively planned for winter 2020/2021; Item I-A).*
  This item is ongoing. Pearsons said he and Sorel will work to pick a time to present to the committees, which will depend on Sorel's progress.
- *Kirk Truscott will work with CCT staff to develop a model that addresses the probability of encountering natural-origin Okanogan spring Chinook at Wells Dam (Item I-A).*
  This item is ongoing.
- *Kirk Truscott will work with Casey Baldwin to prepare a presentation about reintroduction of endemic anadromous fish upstream from Chief Joseph Dam (Item I-A).*
  This item is ongoing and will be first on the agenda for the October HCP Hatchery Committees meeting.
- *Keely Murdoch and Mike Tonseth will update the retrospective analysis for Wenatchee spring Chinook salmon using estimates of female pre-spawn mortality (Item II-A).*
  Keely Murdoch said this item will be discussed today. She said she has not had a chance to get together with Tonseth on this yet.

- *Sarah Montgomery will update and distribute the document Discussion Topics for 2020 to prepare for discussions about changes to the broodstock collection protocols for 2021 (Item VIII).* This item is complete. The revised document was distributed on September 10, 2020 by Kristi Geris.

PRCC HSC

- None

II. Joint HCP-HCs and PRCC HSC

A. Updated Retrospective Analysis of Wenatchee Spring Chinook Salmon Conservation Program Size

Keely Murdoch said there is no update at this time.

B. Broodstock Collection Protocols

Tracy Hillman shared the revised document, *Topics for HCP-HC and PRCC HSC Discussion in 2020*, which was distributed to the HCP Hatchery Committees and PRCC HSC on September 10, 2020. He summarized that the committees have a number of items to discuss related to the drafting the 2021 Broodstock Collection Protocols, as follows:

- Chiwawa spring Chinook marking strategy
  - Catherine Willard said this item should be revisited to make sure folks are aware of how things went in 2020 and the committees can discuss whether to move forward with the same strategy for 2021. She said this should be discussed again in January 2021.
- Differentiating natural-origin Okanogan and Methow spring Chinook salmon
  - Kirk Truscott said the CCT is working on developing these protocols. He said this discussion should continue in 2021, as the CCT will likely not be prepared to implement any studies or actions in 2021 to begin this process. He said this process has become more complicated than he originally thought. He identified that one option for 2021 could be to collect additional scales and archive them; this could inform a retrospective analysis of whether Okanogan-origin spring Chinook were encountered at Wells Dam. Hillman said one task for Truscott was to analyze how many fish could potentially be returning to Wells Dam. Truscott said this discussion should be brought up again in January 2021.
- Outplanting surplus Methow-composite spring Chinook salmon adults

- Mike Tonseth said he will distribute this analysis when it is prepared. The committees can then discuss it in October or November 2020.

- Wenatchee pre-spawn survival estimates
    - Tonseth said this item will be presented to the committees in October or November 2020.
- Sizing of conservation programs
    - Hillman said it appears this item will not change for 2021 based on recent conversations. Todd Pearsons agreed and said the committees will discuss marking protocols in winter 2021, so it would be unlikely that a change would be made for 2021. Keely Murdoch agreed. Hillman said he will leave this one on the agenda for upcoming discussions.
- Revising protocols for identifying and transferring Chief Joseph Hatchery fish from Winthrop National Fish Hatchery
    - Kirk Truscott said this item could be discussed briefly now. He said the only way currently to identify Chief Joseph Hatchery-origin fish is to read the coded wire tags during spawning. Bill Gale asked how this process of transferring fish would work. He asked about the logistics of not spawning these fish, then transferring green eggs.
    - Truscott said notification for green eggs would require having males available at Chief Joseph Hatchery to make the cross, which would require same-day spawning. He said this is logistically very unlikely to work. Gale identified another concern: spawning adults that have shown a propensity to stray elsewhere may not be desirable for the CJH program. Truscott agreed and said the term "stray" may not be accurate, however, because these fish are trapped. Gale also noted that the Broodstock Collection Protocols are specific to the HCPs, and this discussion is outside of the HCP. He said it can still be included in the protocols, but representatives should be aware of that point.
    - Tonseth asked how many fish this protocol would apply to. During the call Bill Gale contacted Michael Humling (USFWS), he reported that there have been zero fish from CJH trapped at Winthrop NFH in recent history. He said they appear on spawning grounds but do not ascend the ladder to the trap. Gale said this information from Humling means there would be zero transferrable fish, so no protocol is needed.
- Request for HCP surplus adults for research

- Mike Tonseth clarified that this item is in relation to requests for adult surplus fish that would directly benefit or inform HCP programs. Hillman noted that the research conducted by Douglas PUD to control saprolegnia also falls under this item. Tonseth said additional examples would be egg to fry survival studies or passage survival studies.

- Greg Mackey said he will check with Betsy Bamberger on any potential requests for surplus adults.

- Hillman asked whether Chelan PUD will be requesting any fish for their survival studies. Willard said Chelan PUD uses run-of-the-river fish for survival studies, not fish from production.

- Review Broodstock Collection Protocols and assign responsibilities to HC members
  - Address redundancies in Methow steelhead juvenile release methods and broodstock methods (re-write the Wells/Methow steelhead section)
    - Greg Mackey volunteered for this task.
  - Consistent descriptions of allocation of surplus
    - Kirk Truscott asked whether this item relates to describing the allocations or describing how allocations are determined? Tonseth said this section relates to describing that allocations are available. Truscott noted that not all members of the committees are involved in allocating surplus.
    - Tonseth said he will revise this section.
  - Chiwawa broodstock collection protocols: trapping for natural-origin fish at Tumwater Dam
    - Catherine Willard volunteered to update this section
  - ABC (Angler Broodstock Collection) Fishery contingency plan
    - Todd Pearsons said he will know by November 2020 if the ABC Fishery will occur this year. If the committee is comfortable in having one low year of PNI, this item can be postponed until November. If the ABC Fishery does not occur in 2020, he said the committees may want to write a tiered approach to broodstock collection, with a fallback plan of collecting fish at the OLAFT.

    - Tonseth said he is comfortable with waiting until November. He asked about the participation level for the ABC Fishery in 2020. Pearsons said the number of boats is capped at 75, compared to 100 in 2019. He said he does not anticipate any issues with meeting the broodstock goal if the fishery occurs.
    - No representatives present expressed concern with waiting until November to decide whether a contingency plan should be added to the protocols.
- Broodstock Collection Protocols coauthoring
    - Sarah Montgomery said she can coordinate any necessary co-authoring.

C. Effect of COVID-19 Pandemic on Monitoring and Evaluation Activities

Tracy Hillman asked each committee member to provide an update on impacts of the COVID-19 pandemic on monitoring and evaluation activities.

Brett Farman reported no changes from NOAA.

Keely Murdoch reported no changes from YN.

Mike Tonseth reported no changes from WDFW. Katy Shelby agreed and said the smolt trap was shut down in early August due to high river temperatures.

Kirk Truscott reported no changes from COVID-19. He added that the CCT's hatchery programs have been heavily impacted by recent fires. He said the Chief Joseph Hatchery M&E Program lost outbuildings, boats, and other equipment. This may affect upcoming summer/fall Chinook salmon surveys. He said staff have not been able to fully assess losses and damages yet so this may be an incomplete summary of impacts.

Bill Gale said the USFWS has no additional updates. He offered that the USFWS may have rafts, boats, or other equipment to loan to the CCT if needed for their upcoming surveys.

Catherine Willard reported no changes from Chelan PUD. She also offered that Chelan PUD may similarly be able to loan M&E equipment to the CCT.

Greg Mackey said Douglas PUD has no changes to report since the previous meeting. He also offered that Douglas PUD may similarly be able to loan M&E equipment to the CCT.

Todd Pearsons said Grant PUD has no changes to report related to COVID-19. He said smoke has been an issue recently for M&E activities, and they have implemented containment measures to reduce staff exposure to smoke. He also offered that Grant PUD may similarly be able to loan M&E equipment to the CCT.

Truscott thanked the representatives for their offers of support.

III. Wells HCP-HC

A. Draft 2021 Hatchery M&E Implementation Plan

Greg Mackey said Douglas PUD's Draft 2021 Hatchery M&E Implementation Plan will be ready for review soon. He summarized the changes from 2021, as follows:

- Mackey said there was a section about alternative assessment techniques (e.g., electrofishing) in the juvenile fish assessment section, which has been removed. He said this was removed because the plan describes rotary screw trapping and no changes to implementation of juvenile fish assessment are anticipated.
- Mackey said in the steelhead section, he added language about applying the redd observer efficiency model retrospectively.
- Mackey said the genetics sections have been updated to reflect the work to be done for the 10-year M&E report.

Mackey said he will provide the plan for review soon.

IV. RI/RR HCP-HCs

A. Hatchery M&E Implementation Plan 2021

Tracy Hillman said Chelan PUD's *Hatchery M&E Implementation Plan* for 2021 has been available for review, and Catherine said she received comments last week. She said there were two minor revisions in the final plan, as follows:

- Willard said on page 9, she updated language about electrofishing to PIT-tag parr. She corrected the language to reflect that the random sampling of 10% occurs throughout the annual period (not each time a fish is PIT-tagged).
- Willard said on page 15, she updated language about spring Chinook surveys regarding "all redds and all carcasses," which is what Chelan PUD has been doing but it was previously recorded as "all redds and all female carcasses" in the plan.

Kirk Truscott asked whether the aggregate sampling for PIT-tagging is a 10% random sample, and if that is used to make an assessment of the abundance of migrants during non-trapping periods. Willard said the random sample is collected to evaluate tag loss and delayed mortality.

Representatives present approved the plan as follows: NMFS, CCT, YN, WDFW, USFWS, and Chelan PUD approved the plan during the meeting on September 16, 2020.

V. PRCC HSC

A. Review Agenda, Announcements, Approve Past Meeting Minutes

The PRCC HSC representatives approved the August 19, 2020, meeting minutes as revised.

VI. Administrative Items

A. NOAA Representation

Brett Farman said Charlene Hurst is no longer working at NOAA, so NOAA is working to appoint a new alternate for the HCP Hatchery Committees and PRCC HSC.

B. WDFW Cybersecurity

Mike Tonseth said WDFW is experiencing a cybersecurity attack and it has been affecting staff email use. He said WDFW staff may be unable to send email attachments or open received attachments in the meantime. Montgomery said she will coordinate with Tonseth on any necessary delivery of committee materials to WDFW during this time.

VII. Next Meetings

The next HCP-HCs and PRCC HSC meetings will be Wednesday, October 21, 2020; Wednesday November 18, 2020; and Wednesday, December 16, 2020; held by conference call and web-share until further notice.

VIII. List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
Sarah Montgomery	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Catherine Willard*	Chelan PUD
Kirk Truscott*‡	Colville Confederated Tribes
Greg Mackey*	Douglas PUD
Peter Graf‡	Grant PUD
Deanne Pavlik-Kunkel	Grant PUD
Todd Pearsons‡	Grant PUD
Brett Farman*‡	National Marine Fisheries Service
Bill Gale*‡	U.S. Fish and Wildlife Service
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Katy Shelby	Washington Department of Fish and Wildlife
Keely Murdoch*‡	Yakama Nation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate

FINAL

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ANCHOR QEA

Memorandum

To:	Wells, Rocky Reach, and Rock Island HCP Hatchery Committees, and Priest Rapids Coordinating Committee Hatchery Subcommittee	Date:	November 23, 2020

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Sarah Montgomery, Anchor QEA, LLC

Re: Final Minutes of the October 21, 2020, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) meetings were held by conference call and web-share on Wednesday, October 21, 2020, from 9:00 a.m. to 10:45 a.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Joint HCP-HCs and PRCC HSC

- Brett Farman will discuss with NOAA staff and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A). *(Note: this item is ongoing.)*
- Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A). (*Note this item is ongoing.*)
- Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historic run-size data (Item I-A). (*Note this item is ongoing.*)
- All parties will provide updates on changes to monitoring and evaluation plans due to the impacts of COVID-19 on operations as updates become available (Item I-A). (*Note this item is ongoing.*)
- Kirk Truscott will determine the number of scales that should be collected from spring Chinook at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook from Methow River spring Chinook (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth will check with Andrew Murdoch (WDFW) on presenting pre-spawn mortality data to the HCP-HCs and PRCC HSC at an upcoming meeting (tentatively planned for February 2021; Item I-A). (*Note this item is ongoing.*)

- Kirk Truscott will work with CCT staff to develop a model that addresses the probability of encountering natural-origin Okanogan spring Chinook at Wells Dam (Item I-A). (*Note this item is ongoing.*)
- Keely Murdoch and Mike Tonseth will update the retrospective analysis for Wenatchee spring Chinook salmon using estimates of female pre-spawn mortality (Item II-A). (*Note this item is ongoing.*)
- Tracy Hillman will review the HCP-HCs and PRCC HSC's previous discussions and agreements about using geometric means to calculate broodstock needs and provide a summary to the committees (Item II-C). (*Note: Mike Tonseth provided this information, which was distributed to the committees on October 22, 2020.*)
- Todd Pearsons will provide an update on the Angler Broodstock Collection (ABC) Fishery at the November 18, 2020 meeting (Item II-C).
- Greg Mackey will provide a final draft of Douglas PUD's *2019 Wells Complex M&E Annual Report*, for Wells HCP-HC review (Item III-B).
- Sarah Montgomery will add Emi Melton to the HCP-HCs and PRCC HSC distribution lists and coordinate access to Extranet and SharePoint (Item V-A). *(Note: this item was completed on October 22, 2020).*
- Brett Farman will provide a summary of NOAA points-of-contact for programs and permits related to the HCP-HCs and PRCC HSC (Item V-A).

PRCC HSC

- Todd Pearsons will provide a summary of growth and temperature profiles for the Carlton Acclimation Facility to the PRCC HSC (Item IV-A).
- Todd Pearsons will check on the operational feasibility of using different water sources (groundwater vs. surface water) in different recirculating aquaculture systems (circular rearing vessels) at Carlton Acclimation Facility (Item IV-A).
- Todd Pearsons will include maturation monitoring in the pre-release sampling (Item IV-A).
- Todd Pearsons and Deanne Pavlik-Kunkel will review prior assessments of groundwater and surface water connectivity for the Carlton Acclimation Facility and provide to the PRCC HSC (Item IV-A).
- Mike Tonseth will review prior assessments of groundwater and surface water connectivity in the Methow sub-basin and provide any relevant information to the PRCC HSC (Item IV-A).

Decision Summary

- No decisions were approved during today's meeting.

Agreements

- No agreements were approved during today's meeting.

Review Items

- The Final Draft Douglas PUD *2019 Wells Complex M&E Annual Report*, which was provided by Greg Mackey and was distributed to the Wells HCP Hatchery Committee by Sarah Montgomery on October 23, 2020, is available for further review with a yet to be determined deadline for approval.

Finalized Documents

- No documents have been finalized recently.

I. Welcome

A. Review Agenda, Announcements, Approve Past Meeting Minutes, Review Last Meeting Action Items

Tracy Hillman welcomed the HCP-HCs and PRCC HSC to the meeting and read the list of attendees signed into the meeting. The meeting was held via conference call and web-share because of travel and group meeting restrictions resulting from the COVID-19 pandemic. Hillman reviewed the agenda and asked for any additions or changes to the agenda. There were no changes.

Montgomery said due to a delay in distributing the draft meeting minutes, the revised September 16, 2020 meeting minutes are still available for review. She asked for email approval of the revised minutes by November 2, 2020.

Action items from the HCP-HCs and PRCC HSC meeting on September 16, 2020, were reviewed, and follow-up discussions were addressed *(note that italicized text below corresponds to action items from the previous meeting)*:

Joint HCP-HCs and PRCC HSC

- *Brett Farman will discuss with NOAA staff and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A).*
  Farman said this item is ongoing.
- *Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A).*

Mackey said this item is ongoing.

- *Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A).*

  Mackey said this item is ongoing.
- *Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historic run-size data (Item I-A).*

  Tonseth said this item is ongoing.
- *All parties will provide updates on changes to marking and tagging plans due to the impacts of COVID-19 on operations as updates become available (Item I-A).*

  This item is ongoing.
- *Kirk Truscott will determine the number of scales that should be collected from spring Chinook at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook from Methow River spring Chinook (Item I-A).*

  Truscott said this item is ongoing.
- *Mike Tonseth will check with Andrew Murdoch (WDFW) on presenting pre-spawn mortality data to the HCP-HCs and PRCC HSC at an upcoming meeting (tentatively planned for fall 2020; Item I-A).*

  Tonseth said this item is ongoing.
- *Todd Pearsons will continue coordinating with Mark Sorel (University of Washington) regarding his work on life cycle models for Wenatchee spring Chinook salmon and invite him to an upcoming meeting (tentatively planned for winter 2020/2021; Item I-A).*

  Pearsons said this item is ongoing but can be taken off the list for now; he will provide an update when one is available.
- *Kirk Truscott will work with CCT staff to develop a model that addresses the probability of encountering natural-origin Okanogan spring Chinook at Wells Dam (Item I-A).*

  Truscott said this item is ongoing.
- *Kirk Truscott will work with Casey Baldwin (CCT) to prepare a presentation about reintroduction of endemic anadromous fish upstream from Chief Joseph Dam (Item I-A).*

  Truscott said this item is complete and will be discussed today.
- *Keely Murdoch and Mike Tonseth will update the retrospective analysis for Wenatchee spring Chinook salmon using estimates of female pre-spawn mortality (Item II-A).*

  This item is ongoing.
- *Greg Mackey will ask Betsy Bamberger (Douglas PUD) if any surplus fish are needed for research projects in 2021, which would need to be included in the Broodstock Collection Protocols (Item II-B).*

  Mackey said Douglas PUD does not anticipate needing additional fish outside of normal production for research purposes in 2021.

PRCC HSC

- None

II. Joint HCP-HCs and PRCC HSC

A. Reintroduction of Salmon Upstream of Chief Joseph and Grand Coulee Dams

Tracy Hillman welcomed Casey Baldwin to the meeting and thanked him for being available to present to the committees. Baldwin shared a presentation with the committees titled, "Reintroduction of Salmon Upstream of Chief Joseph and Grand Coulee Dams," which was distributed to the committees following the meeting (Attachment B). Baldwin said the CCT works closely with stakeholders as part of the reintroduction programs, and he recognized Conor Giorgi (Spokane Tribe) and Tom Biladeau (Coeur d'Alene Tribe) as coauthors on this work. A very brief summary is included below, with more detail available on the slides. Questions and comments followed Baldwin's presentation.

Baldwin introduced the program and the phased approach to reintroduction. He said the program is currently in Phase 2, which includes experimental, pilot-scale reintroductions and interim passage facilities. He described the modeling approaches that were used to determine quantities of available spawning habitat, and how it was determined that high potential exists for summer/fall Chinook salmon.

Baldwin described some of the options for fish passage and how Phase 2 will also include more coordination and planning, such as with dam owners and operations. Finishing the Strategic Implementation Plan is also a key next step in Phase 2.

Baldwin described the cultural and educational releases, which are a parallel path to the phased approach. He said the objectives of the cultural and educational releases are different but are consistent with and a rewarding addition to the scientific foundation of the phased approach.

Baldwin identified the significant number of partners and programs that the reintroduction program works with and thanked the committees for their interest in the program, especially the cultural and social components.

Representatives present thanked Baldwin for his presentation.

Pearsons asked what are some of the challenges to implementing the reintroduction program? Baldwin said political and funding challenges are the most significant. He said focusing on small simple steps helps to gain political traction. Baldwin said funding seems like the most logical concern about the program. Truscott added that there are some concerns that reintroduction could undermine or change federal authorizations or purposes, so this may also be contributing to political opposition.

Keely Murdoch asked when fish were first transported upstream during Phase 2. Baldwin clarified that the program differentiates between releases as part of the phased approach, and cultural or educational releases. Baldwin said 242 fish were transported in 2019 and 150 in 2020. He said the Spokane Tribe and CDA Tribe have also been releasing fish, including juveniles. He said he is working to compile these data in a summary table.

Murdoch asked if the CCT report will be comprehensive and include the Spokane Tribe and CDA Tribe releases, or will it only summarize the CCT releases. Baldwin said he will be providing individual scientific reports for the tagged fish releases, but the cultural and education releases are not intended to be sources of scientific data. He said while these fish are PIT-tagged, the purpose is not necessarily to monitor them (though any data that are collected are taken into account as proof of concept). Murdoch agreed that the anecdotal data from cultural and educational releases are helpful and also surprising. She asked how long Phase 2 is intended to last. Baldwin said the CCT is outlining a series of studies that have a 10 to 15-year horizon. He said this timeline will start when there is enough funding or support to start the studies. Successful implementation of these studies would follow, and fish returns would need another few generations in order to obtain enough data. He said Phase 2 also includes evaluating interim passage facilities.

Murdoch said the presentation noted that donor species and stocks have been identified. She asked which stocks were chosen and where the broodstock would be sourced. Baldwin said the exact stocks are yet to be determined, and it would depend on opportunities for collecting adults (currently, these are sourced from Wells FH surplus). He said the donor stock evaluation included an evaluation of 40 stocks and 5 species. While Wells FH stock was not the highest ranked, others were not available. However, it was clear from the evaluation that the focus should be on unlisted summer Chinook and sockeye. Baldwin said another concern might be bringing ESA-listed fish to blocked areas, particularly in Phase 2 during testing. Murdoch asked how much broodstock the CCT anticipates needing during Phase 2. Baldwin responded not much broodstock will be needed for research activities in Phase 2. He said because acoustic tracking is being used, only small groups are needed to generate enough returning adults to track dozens of adults. Murdoch asked what Phase 3 might entail. Baldwin said he is not sure yet, because the point of Phase 2 is to determine the feasibility of moving forward with Phase 3. He said interim passage facilities are a big component of Phase 2 and understanding fish behavior in and around dams. This requires working with dam owners, operators and engineers on potential options. All of these components would guide what Phase 3 will entail.

Murdoch asked about the harvest framework modeling that Baldwin mentioned, and how this would affect Zone 6 fisheries. Baldwin said he anticipates that the program would add more fish to the Zone 6 fisheries. Baldwin said the idea of reintroduction is to generate additional juvenile releases through the expansion of hatchery programs, and ultimately generate more wild fish in habitats upstream of Chief Joseph and Grand Coulee dams. Murdoch asked if Baldwin anticipates any restrictions on downstream fisheries to ensure enough fish return to the upper river. Baldwin said he does not anticipate restrictions on fisheries. Murdoch asked if there is a timeline for his report. Baldwin said he will be summarizing individual studies as results are made available, and some of those summaries will be available this winter. He said he is not sure when the implementation plan will be finalized. Murdoch thanked him for the presentation and for answering her questions.

B. Updated Retrospective Analysis of Wenatchee Spring Chinook Salmon Conservation Program Size

Keely Murdoch said she has no update today, but this item can remain on the agenda for future meetings.

C. Broodstock Collection Protocols

Tracy Hillman shared the revised document, *Topics for HCP-HC and PRCC HSC Discussion in 2020*, and reviewed the topics in the document.

Regarding Chiwawa spring Chinook marking, Catherine Willard said she is working to draft revisions to this section of the protocols.

Regarding the options for differentiating natural-origin spring Chinook salmon from other natural-origin Chinook salmon during broodstock collection, Truscott said this item will likely not be ready to implement in 2021.

Regarding options for outplanting surplus Methow Composite spring Chinook salmon adults, Mike Tonseth said this item will probably be drafted and ready for discussion in November 2020.

Regarding Wenatchee spring Chinook pre-spawn survival estimates, Tonseth said this item will likely be discussed in November or December 2020.

Regarding the sizing of upper Columbia River conservation programs, there was no update.

Regarding requests for HCP adults or juveniles for HCP-specific research or other requests (surplus to HCP broodstock needs), Tonseth clarified that this item pertains only to requests for surplus fish for research studies that are directed at furthering the HCP programs. Hillman edited the document to clarify this item.

Regarding authorship of sections needing to be revised, Greg Mackey is working on addressing redundancies in the Methow Steelhead juvenile release methods and broodstocking methods sections; Tonseth is working on the sections that describe how surplus is declared; Willard is working on the section about broodstock collection for the Chiwawa spring Chinook program; and Todd Pearsons may add a tiered approach including back-up collection plans if the ABC Fishery is not successful in collecting brood (which Pearsons will provide an update on at the next meeting).

Pearsons brought up an additional discussion item: methods to calculate means that are used to generate broodstock collection needs. He said in 2020, a geometric mean was used to calculate broodstock collection needs and he asked the committees whether this will be the approach for 2021. He recalled that the arithmetic mean provided similar results to the geometric mean, and the committees had discussed the pros and cons of the different calculations. Tonseth said he believes language was added to the protocols specifying that geometric means should be used in calculating broodstock needs. He recommended maintaining this approach because with a wide variance in fecundities for steelhead, the geometric mean particularly improves the accuracy for estimating steelhead egg take. Tracy Hillman volunteered to review the committees' discussion about geometric mean and provide a summary to the group of what was agreed upon in 2020.

D. Effect of COVID-19 Pandemic on Monitoring and Evaluation Activities

Tracy Hillman asked each committee member to provide an update on impacts of the COVID-19 pandemic on monitoring and evaluation activities.

Brett Farman reported no changes from NOAA related to COVID-19. He said Allyson Purcell will be taking a 6-month leave of absence, so an acting supervisor will be appointed in the next four to six weeks. Todd Pearsons asked Farman if it would be possible for NOAA to provide a chart or list of NOAA staff points-of-contact for the various HCP and PRCC programs and permits. This would be in response to the many recent staffing changes at NOAA. Farman said he will provide this after he receives more direction from the branch office.

Kirk Truscott said he has no updates related to COVID-19. Regarding the impacts from the fires that were discussed during the September meeting, he said he passed along the committees' offers of assistance to his staff. He said the CCT were able conduct their programs with no adverse impacts, and spawning ground and carcass surveys are ongoing in the Okanogan River. He thanked the committee members again for their offers of help.

Keely Murdoch reported no changes from YN. She said broodstock collection and spawning has started, and these activities are being conducted with smaller crew sizes due to COVID-19. She said spawning ground surveys are also occurring but are reduced this year. She said this reduction is offset by increased PIT-tagging and detections at Priest Rapids Dam, so the surveys are more efficient.

Mike Tonseth reported no changes from WDFW. Katy Shelby agreed.

Catherine Willard reported no changes from Chelan PUD. She said Chelan PUD is currently contracting with BioAnalysts to conduct adult steelhead PIT tagging at the OLAFT. She said this work was not conducted the week of October 9 because access to the OLAFT was denied due to COVID-19. This resulted in one week and one day where steelhead PIT tagging did not occur.

Greg Mackey said Douglas PUD has no changes to report since the previous meeting. He said summer Chinook spawning finishes today.

Todd Pearsons said Grant PUD has no changes to report related to COVID-19. He said general precautions are being followed, especially for the ABC Fishery, which is upcoming this weekend.

E. Update on 10-Year M&E Comprehensive Report

Catherine Willard said Chelan, Grant, and Douglas PUDs have been working with BioAnalysts to obtain, compile, and analyze data to inform the 10-Year M&E Comprehensive Report. Due to challenges from COVID-19 and in obtaining data from reference populations, and the total amount of data that needs to be analyzed, the deadline for the Draft 10-Year M&E Report has been moved to July 1, 2021. Hillman said he received reference data just last week, and it has been a challenging year to access and compile data due to how busy staff are.

III. Wells HCP-HC

A. Draft 2021 Hatchery M&E Implementation Plan

Greg Mackey said Douglas PUD's Draft 2021 Hatchery M&E Implementation Plan is available for review with comments due on November 16, 2020.

B. Approve 2019 Wells Complex M&E Annual Report

Greg Mackey said Douglas PUD received comments on the Draft 2019 Wells Complex M&E Annual Report from Michael Humling, which have since been addressed by Charlie and himself. He asked the Wells HCP-HC whether they would like to review the final version with comments addressed, or if they would like to approve the version they have reviewed, understanding that minor changes have been made since their review. Representatives present asked to review a revised draft. Mackey said he will provide a final draft for the Wells HCP-HC to review, with approval requested via email within two weeks.

IV. PRCC HSC

A. Carlton Fish Health/Culture Recommendation

Todd Pearsons shared a presentation titled, *Carlton Acclimation Facility Rearing Plan* (Appendix C). He reviewed mortality trends for the Carlton Acclimation Facility from 2014 to 2020 based on the type of water the facility was sourcing for fish. He pointed out differences in years when surface water was used entirely, compared to years when groundwater was used for part of the rearing cycle. He described a trend that there was less mortality in years when groundwater was used, and fish were put on surface water before being released. Greg Mackey and Matt Cooper said at Methow Fish Hatchery and Winthrop National Fish Hatchery, fish are reared on groundwater until December, and then put on surface water before release.

Pearsons summarized that extending the period of groundwater rearing at Carlton Acclimation Facility appears to reduce mortality, possibly due to pathogen reduction and reductions in poor water quality (e.g., turbidity). He said fish health and fish culture staff have recommended that fish be reared on groundwater until February 1, and then transitioned 25% volume per week for a month, and then 100% surface water until their release date. He asked the committees for feedback on this approach.

Keely Murdoch said she understands why this would be a preferable approach from a fish health standpoint. She asked, what are the differences in smolting or survival that result from rearing for longer periods on groundwater? She said this approach may defeat the purpose of overwintering fish on surface water. She asked whether there is information available about growth and temperature profiles from 2019 that might inform these questions. Pearsons agreed with Murdoch's concerns and said he will ask the fish health staff for this information. He said one consideration is that the Methow River is very cold in some months, which is not very good for fish. He said fish health staff anecdotally reported that the fish looked very healthy in 2019 when they were reared on groundwater for the longest period, compared to other years. Pearsons said an additional concern is straying. Given that fish health and hatchery staff have been successful at rearing fish to their target size, and the stray rates for fish that have been overwinter acclimated were higher on average, he said he has some confidence that homing would not be significantly worse with this rearing strategy.

Murdoch said that reaching the target size is not the only concern. She said when growth occurs is important, and it may not be preferable to rear fish on warmer water throughout the winter and then put them on cold surface water before they smolt. She said the rearing strategy overall, not just the size of the smolt, may affect survival and homing. She also suggested considering an earlier transition to surface water, since February 1 seems quite late.

Pearsons said he will ask fish health staff for more information on growth and temperature profiles to address this concern. He said there is also information about survival and travel time available in annual reports.

Kirk Truscott asked if there are any precocity data available for these release years to compare rearing strategies. Pearsons said there are precocity data for some of the surface-water-rearing years; however, he said there are probably not enough data to make a robust comparison. Truscott said water source and temperature has the potential to have dramatic effects on precocity and jack rates and suggested reviewing the available information to better understand the long-term consequences for adult returns with this rearing strategy. Pearsons said it may be possible to estimate precocity or jacking rates in spring 2021, and he said he will look into adding this component to the pre-release sampling.

Truscott also pointed out that addressing mortality events in late October through early December would make a significant change for the program. Pearsons agreed and said one challenge with the Carlton Acclimation Facility is that mortality continues into the spring, so there are risks of releasing diseased fish and result in lower post-release survival. He said extending the groundwater rearing period could limit disease issues in the last three months of acclimation. Truscott asked what rearing vessels are used at Carlton Acclimation Facility. Pearsons said circular rearing vessels are used. Truscott suggested that different rearing strategies could be used in different vessels, with the majority of the vessels being used for the proposed strategy. Pearsons said he is not sure if that is possible operationally, but he said he will incorporate maturation monitoring during pre-release sampling to evaluate if the recommended plan has undesirable influences on precocity.

Mackey said some of the mortality was attributed to transfer stress, but additional mortality spikes could be due to poor quality surface water (e.g., periods of high turbidity). He said once fish are stressed, it is difficult to keep them healthy. He suggested keeping in mind that mortality data do not provide a full picture of fish health.

Tracy Hillman reminded the committees that annual reports include size at release data and survival data for fish that are PIT-tagged.

Tonseth echoed Murdoch and Truscott's concerns. He said he understands the fish health challenges and disease management, but questions whether there would be long-term negative effects due to shortening the acclimation window. He asked whether any work has been done to examine the connectivity of surface water and groundwater reservoirs at Carlton Acclimation Facility. He said if there is significant connectivity between the water sources, there may be less cause for concern about effects on homing or acclimation. Pearsons asked the committees whether maturation sampling of adults would address their concerns, though results would not be known for a few years after the releases. Tonseth said he believes maturation sampling would be necessary if this rearing strategy were chosen. He also recommended moving the transition earlier, as Murdoch as suggested. Pearsons said it is clear that more discussion is needed on this strategy. He said the fish are on groundwater right now, so the committees have approximately one month to decide whether to switch to surface water if the previous rearing strategy is favored.

Regarding the connectivity between surface water and groundwater, Deanne Pavlik-Kunkel said an assessment of the water rights was performed when the facility was designed. She said the water right links groundwater and surface water, which means the two are connected. She said there may be additional details regarding water chemistry in that assessment, and she will provide it to the committees. Tonseth said the Methow Valley Irrigation District has also recently switched from surface water to groundwater wells, so there may be additional information available about surface and groundwater connectivity in the Methow basin. He said he will share that information with the committees as well.

Tonseth said regarding Truscott's idea to have separate rearing groups for surface and groundwater, one component of the program that would not fit this strategy is the tagging strategy. Currently, these fish all are given the same CWT code, so post-release differentiation would not be possible. This would not, however, preclude within-facility studies. Truscott added that in an analysis of travel time and survival, it is also important to consider the high variability of flow regimes, especially in the years of data that are currently available for releases from Carlton Acclimation Facility.

Catherine Willard said during the pre-release sampling for the 2020 release group, precocial maturation was estimated following the methodology in the NMFS Section 10 permit for the program, which includes checking for running milt and identifying whether fish were parr, transitional, or smolts. In 2020, she said zero fish were determined to be precocially mature using these methods. Truscott asked if earlier work included gonadosomatic index (GSI) sampling. Pearsons said yes. Truscott said he would recommend using the GSI methodology in future years.

Pearsons summarized that fish health and fish culture staff have recommended rearing fish on groundwater for a longer period, to February 1, but the committees will further discuss this due to concerns raised today.

B. Review Agenda, Announcements, Approve Past Meeting Minutes

The PRCC HSC representatives will review the September 16, 2020 meeting minutes and provide approval by November 2, 2020.

V. Administrative Items

A. NOAA Representation

Brett Farman said he provided a letter to Tracy Hillman that designates Emi Kondo as the new alternate for NOAA on the HCP Hatchery Committees and PRCC HSC (Attachment C). Hillman said he will provide the letter to John Ferguson (Chair of the HCP Coordinating Committees). Montgomery said she will coordinate with Kondo on email and Extranet/Sharepoint access.

VI. Next Meetings

Tracy Hillman notified the committees that Todd Pearsons and coauthors recently published a paper in *Fisheries* titled, "Expanding Partnerships and Innovations to Implement Reform of a Large Columbia River Hatchery Program," which was distributed to the committees on October 16, 2020. Pearsons added that the article describes how hatchery reform has been implemented at Priest Rapids Dam in accordance with recommendations by the Hatchery Scientific Review Group. Pearsons said there is a second article in the same issue that discusses the history of hatcheries, which he recommended to the committees.

The next HCP-HCs and PRCC HSC meetings will be Wednesday November 18, 2020; Wednesday, December 16, 2020; and Wednesday January 20, 2020, held by conference call and web-share until further notice.

VII. List of Attachments

Attachment A	List of Attendees
Attachment B	Reintroduction of Salmon Upstream of Chief Joseph and Grand Coulee Dams
Attachment C	Carlton Acclimation Facility Rearing Plan
Attachment D	NOAA Committee Designation Letter

Attachment A
List of Attendees

Name	Organization
Sarah Montgomery	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Catherine Willard*	Chelan PUD
Scott Hopkins	Chelan PUD
Kirk Truscott*‡	Colville Confederated Tribes
Casey Baldwin*‡	Colville Confederated Tribes
Greg Mackey*	Douglas PUD
Deanne Pavlik-Kunkel	Grant PUD
Todd Pearsons‡	Grant PUD
Brett Farman*‡	National Marine Fisheries Service
Bill Gale*‡	U.S. Fish and Wildlife Service
Matt Cooper*‡	U.S. Fish and Wildlife Service
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Katy Shelby	Washington Department of Fish and Wildlife
Keely Murdoch*‡	Yakama Nation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate

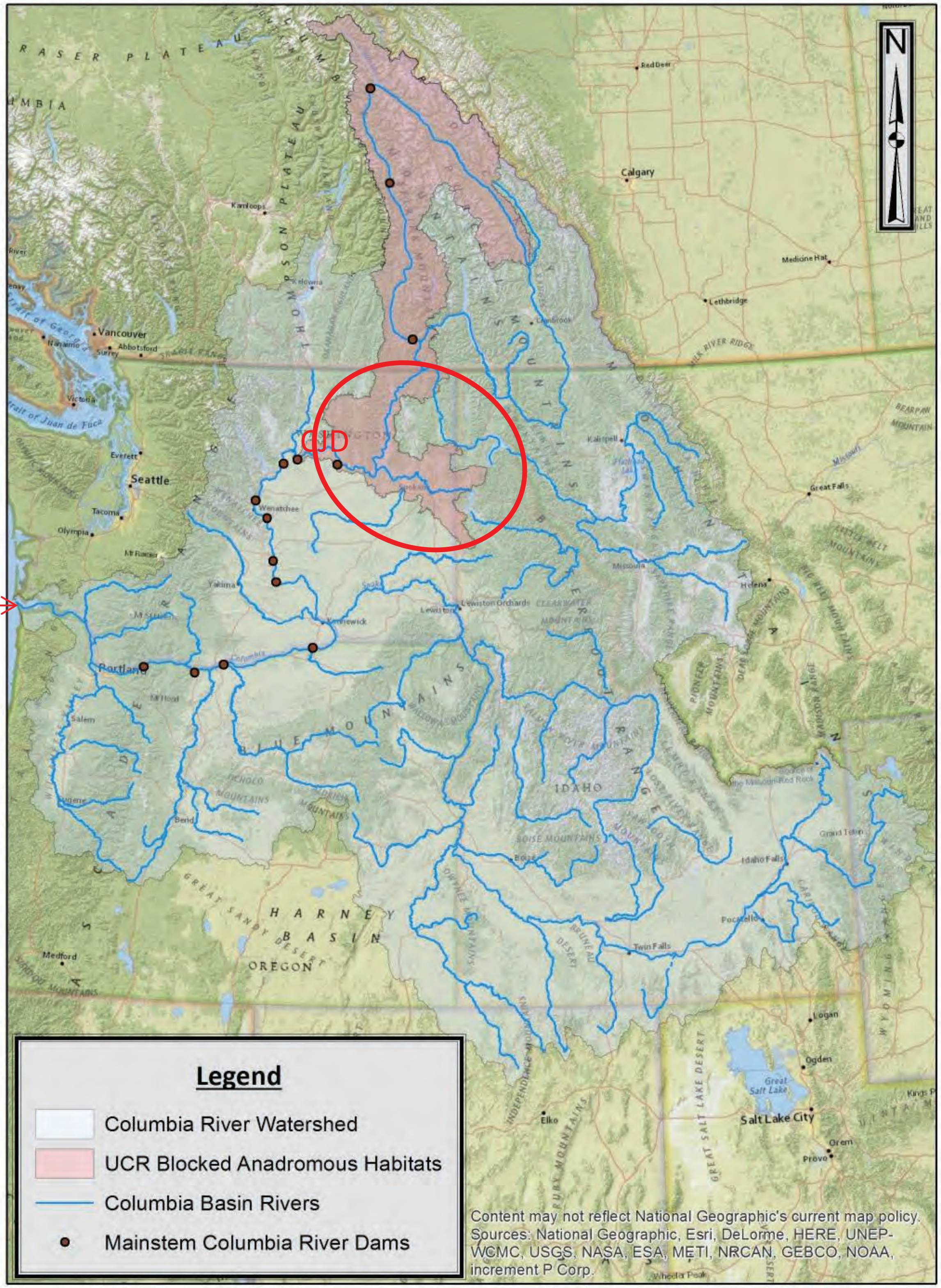
Reintroduction of Salmon Upstream of Chief Joseph and Grand Coulee Dams.

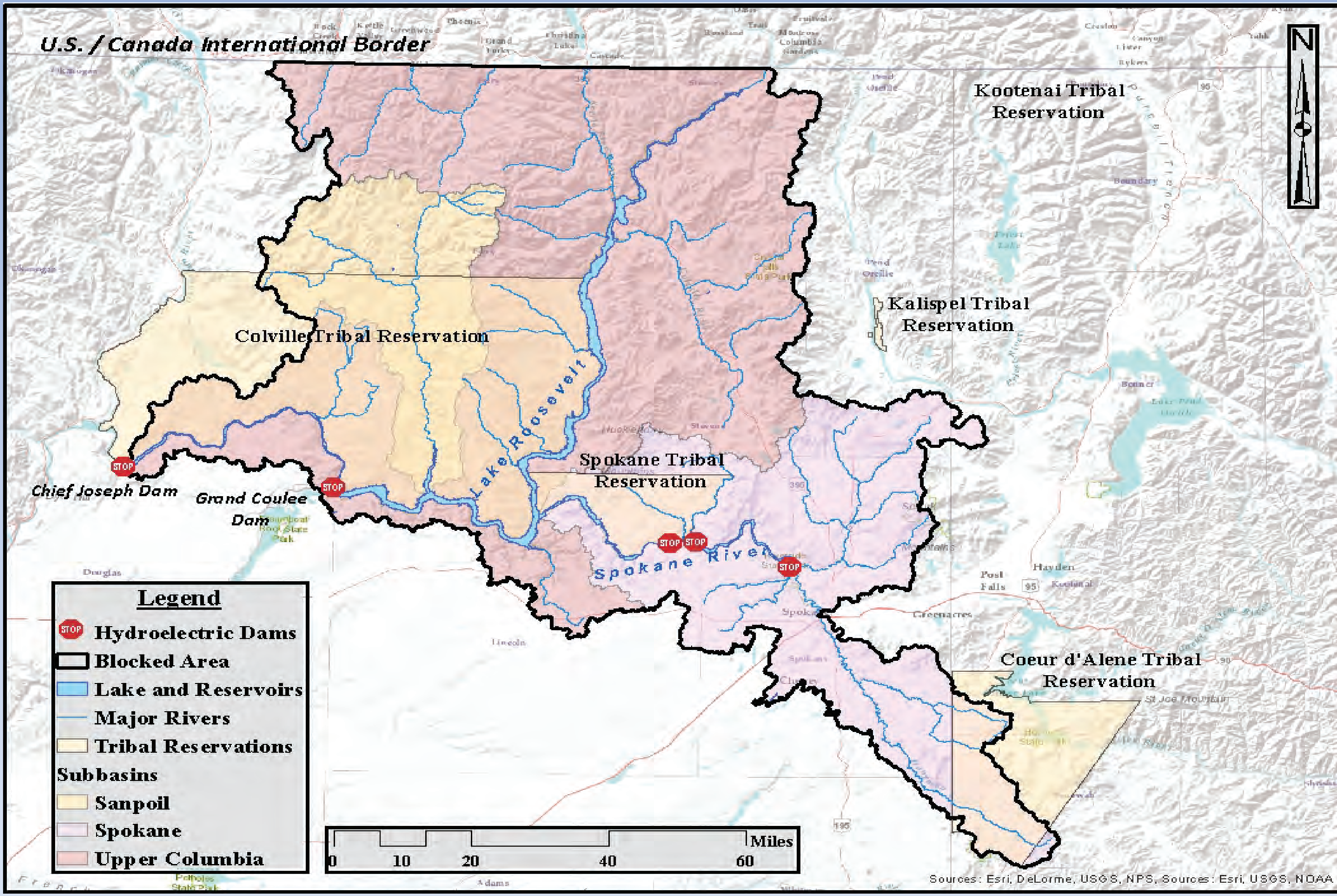
Casey Baldwin, Colville Tribes Research Scientist
Kirk Truscott, Colville Tribes Anadromous Program Mngr.
Conor Giorgi, Anadromous Prog. Mngr. Spokane Tribe
Tom Biladeau, Coeur d' Alene Tribe

Mid-C PUD Hatchery Committees
October 21, 2020

Input & participation:
UCUT (5 tribes)
WDFW
ONA
USGS, PNNL, ICFI
DWA (Kevin Malone)
Steve Smith Consulting
BPA, USBR, USFWS,
DPUD

Mouth of Columbia





Over 4 million acres of traditional lands in the U.S. portion of the blocked area

FISH PASSAGE AND REINTRODUCTION

3 forums

- Columbia River Treaty
  6 dams (4 in Canada)
- NPCC Fish & Wildlife Program
  2 dams (U.S. only)
- Tribal Initiatives

Arrow Lakes Reservoir. Photo courtesy of West Kootenay Parks

Phased approach

Phase I: Pre-assessment planning for reintroduction and fish passage.

Ongoing

Phase II: Experimental, pilot-scale salmon reintroductions and interim passage facilities.

Phase III: Construct permanent juvenile and adult passage facilities and supporting propagation facilities. Implement priority habitat improvements.

Phase IV: Monitoring, evaluation, and adaptive management. Continue needed habitat improvements.

Phase 1 Outline

-Donor Stock Assessment (*Which species and stocks are most appropriate)*

-Risk Assessment (*What are the risks to resident fish and downstream anadromous pops?)*

-Habitat Assessments (*Can the habitat support fish production?)*

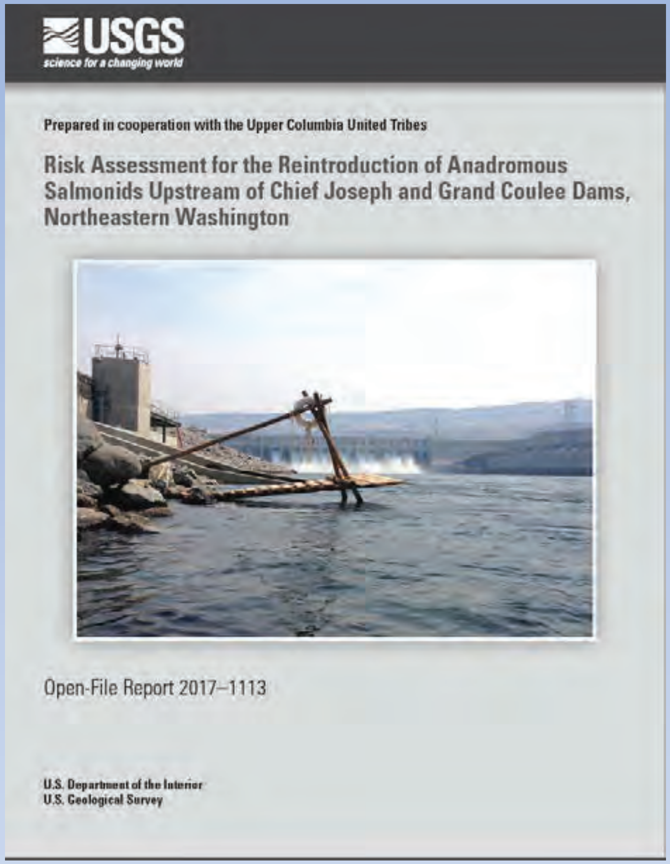
-Review of Fish Passage Technologies
Is it possible to pass fish above CJD & GCD?

-Life Cycle Modeling *(What are possible outcomes, is there potential for objectives to be met?*

- **Future studies/recommendations**
What comes next?

Donor Stock and Risk Assessment

- **Species (40 stocks/populations)**
  - Sockeye (7)
  - Summer/fall Chinook (10)
  - Spring Chinook (10)
  - Steelhead (7)
  - Coho (6)
- **Scored and ranked based on 6 criteria**



USGS
science for a changing world

Prepared in cooperation with the Upper Columbia United Tribes

Risk Assessment for the Reintroduction of Anadromous Salmonids Upstream of Chief Joseph and Grand Coulee Dams, Northeastern Washington

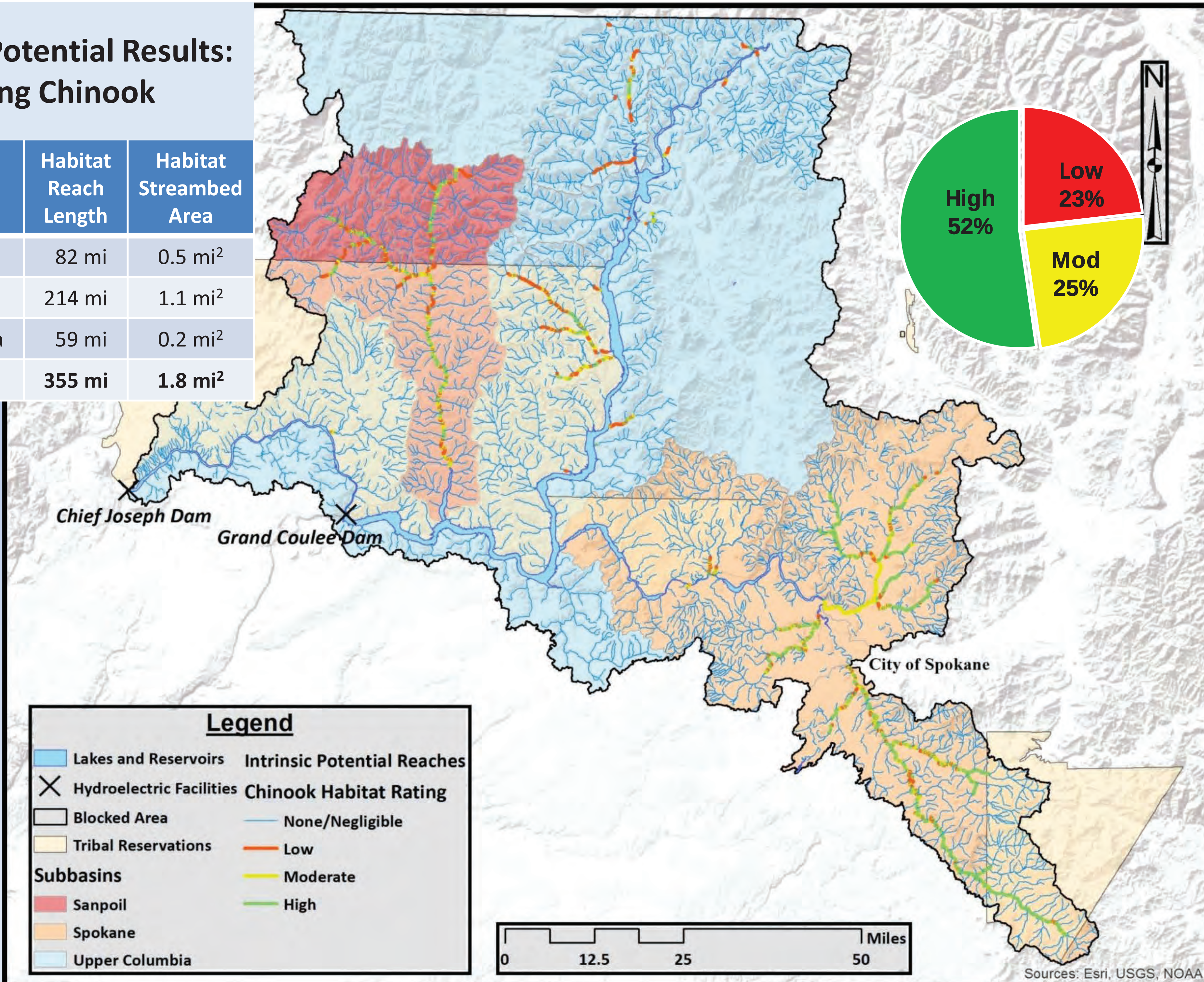
Open-File Report 2017–1113

U.S. Department of the Interior
U.S. Geological Survey

Feasibility testing in Phase 2 will begin with summer/fall Chinook and sockeye because they are un-listed, productive, readily available and lowest risk to downstream and upstream populations.

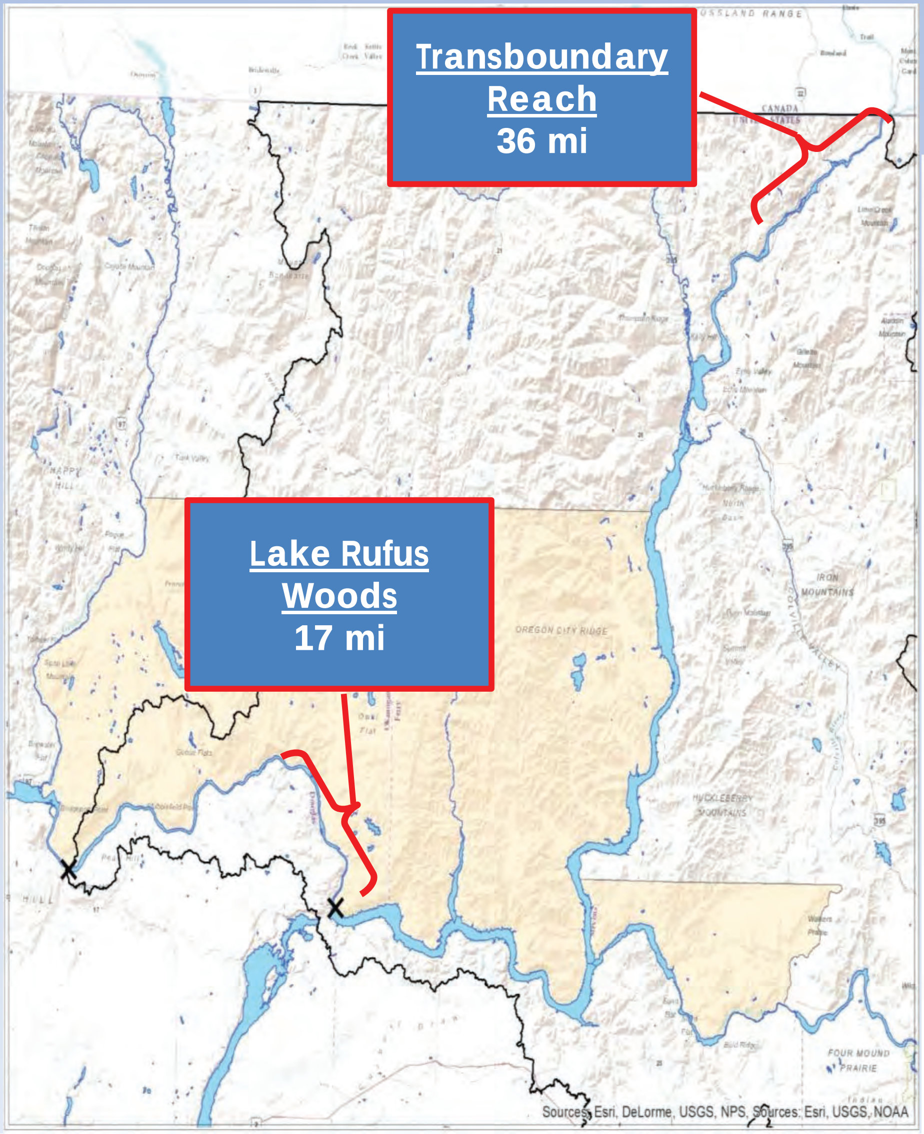
Intrinsic Potential Results: Spring Chinook

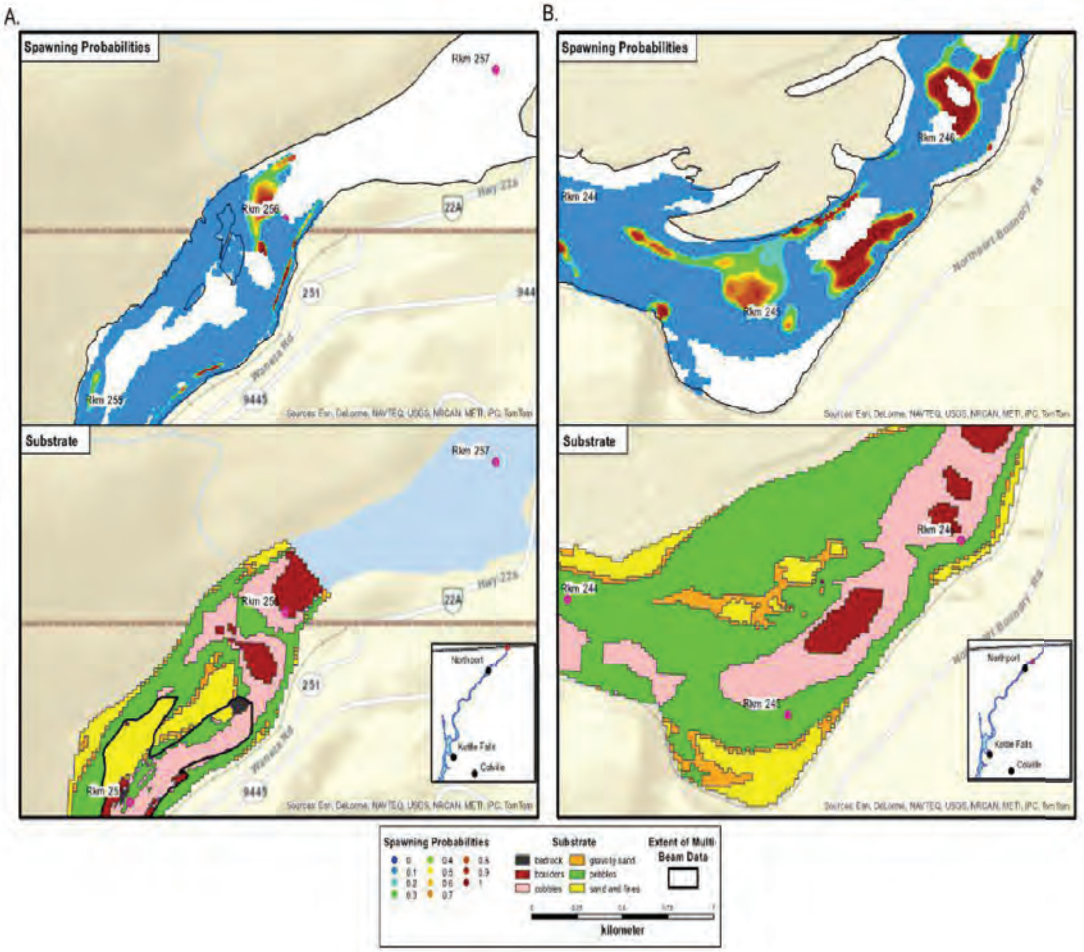
Subbasin	Habitat Reach Length	Habitat Streambed Area
Sanpoil	82 mi	0.5 mi^2
Spokane	214 mi	1.1 mi^2
Upper Columbia	59 mi	0.2 mi^2
Total	**355 mi**	**1.8 mi^2**



Mainstem Chinook Spawning Habitats

- 2-D hydraulic model: depth, velocity, substrate, channel-bed slope
  - Habitat preferences informed by Hanford Reach
  - Extrapolated habitat area → spawner capacity





Suitable Habitats are Available

- **Potential Habitats: >1,200 miles in U.S.**
  - 1,161 tributary miles for Steelhead
  - 355 tributary miles for spring Chinook
  - 53 miles mainstem summer/fall Chinook
- **Current Spawner Capacity Estimates:**

Species	Low Capacity	High Capacity
Spring Chinook	900	1,200
Summer/Fall Chinook	13,000	76,800
Sockeye	34,100	756,300
Steelhead	3,100	4,200
Total	**51,100**	**838,500**

Photo Credit: Michael Visintainer, Silver Bow Fly Shop

- **Lake Roosevelt Rearing Capacity:** 12 million – 48.5 million Sockeye

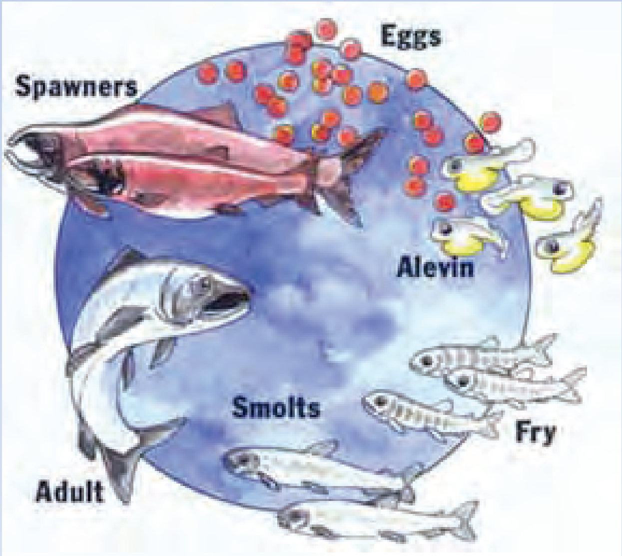
Life Cycle Modeling Summer/Fall Chinook

Baseline Management Scenario:

- 1.5 million hatchery smolts
- 3,000 additional surplus hatchery fish translocated
- Passage/bypass facilities at CJ and GC dams

Baseline Results

Modeled Population	Pre-Harvest Adults	# Harvested Adults	Adult Escapement
Rufus Woods	16,000	9,400	6,200
Sanpoil	3,000	2,000	400
Mainstem	22,000	12,600	7,400
Total	**41,000**	**24,000**	**14,000**



Harvest assumptions

- Used existing harvest frameworks and rates
- Added some additional harvest for new terminal area fishing (15% HOR ; 1% NOR)
- ~58% ER for UCR summer Chinook
- The project is successful by adding new fish, so everyone gets more harvest.

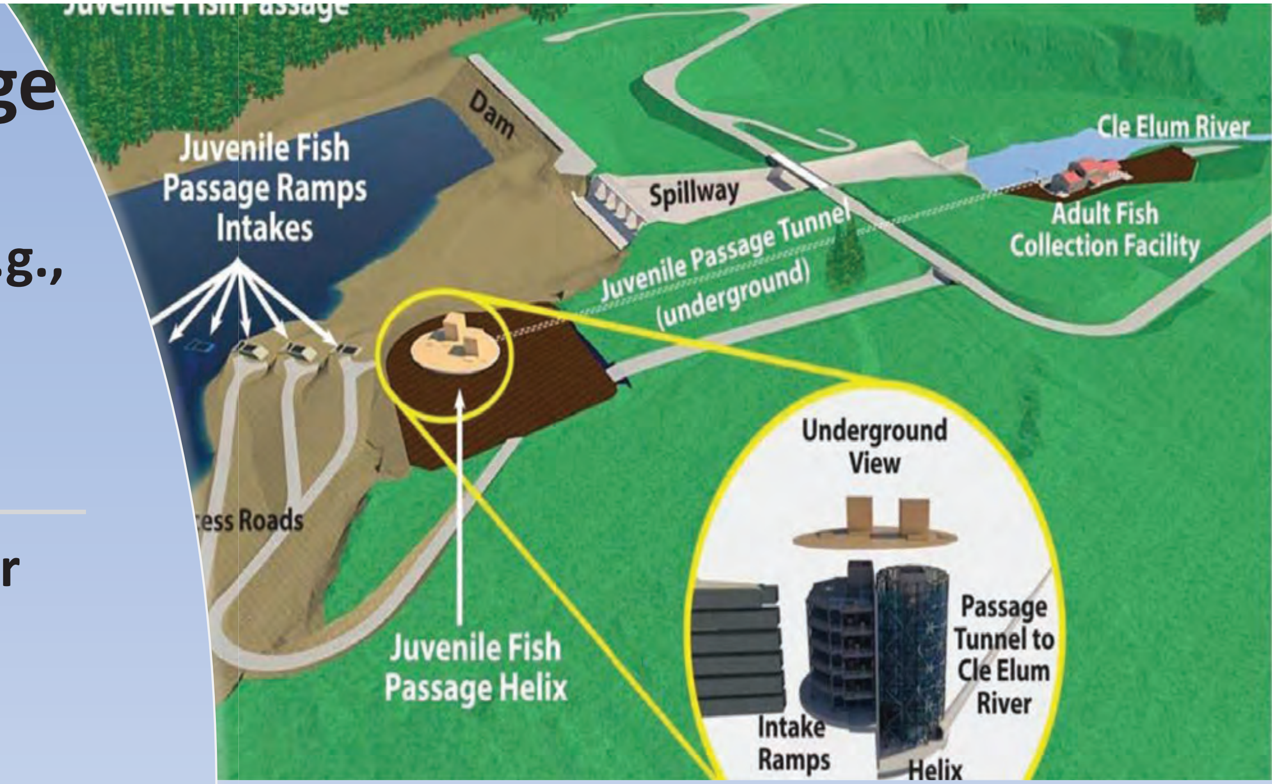
Examples of Fish Passage

Juvenile Passage Concepts:

- Floating Surface Collectors (e.g., Baker Lake)
- "The Helix" (e.g., Cle Elum)
- Others - project specific (e.g. Rocky Reach juvenile collector bypass)

Adult Passage:

- Trap & Haul
- Elevator & Locks
- Whooshh Salmon Cannon



Phase 1 Study Conclusions

- There are good options for donor stocks
- We understand the disease risks and they are manageable
- There are large quantities of habitat in the U.S. that are available and suitable (and even more in Canada not addressed in this report)
- Passage technology exists and is being used at other high head dams
- Life Cycle Models show promising results
- Returning salmon to the blocked area will deliver cultural and economic benefits for all

Phase 1 work affirms we should move forward into Phase 2

What's Next in Phase 2 Actions and Studies?

Coordination/Planning

- Coordination with dam owners and operators
- Coordination with Canada
- Seek funding
- Continue to foster support and build on momentum
- Finish Strategic Implementation Plan

Implementation

- Survival at various life stages and habitat types
- Migration timing
- Fish passage pathways and survival
- Fish passage design/planning
- Continue to implement cultural and educational releases

‘Cultural and Educational’ Releases

A parallel path to the Phased approach

- To reconnect the people with the fish and the fish with the habitat
- To have ceremonies and keep the salmon culture alive and well
- In some cases, to provide a harvest opportunity in areas that have not had anadromous fish for 60-110 years
- To educate and involve the tribal membership, youth, the general public, and other partners and stakeholders in the process of salmon reintroduction to the blocked area
- To scope reintroduction strategies and generate baseline information

Cultural and Educational Releases 2017-2020

Colville Tribes Cultural Releases 2019

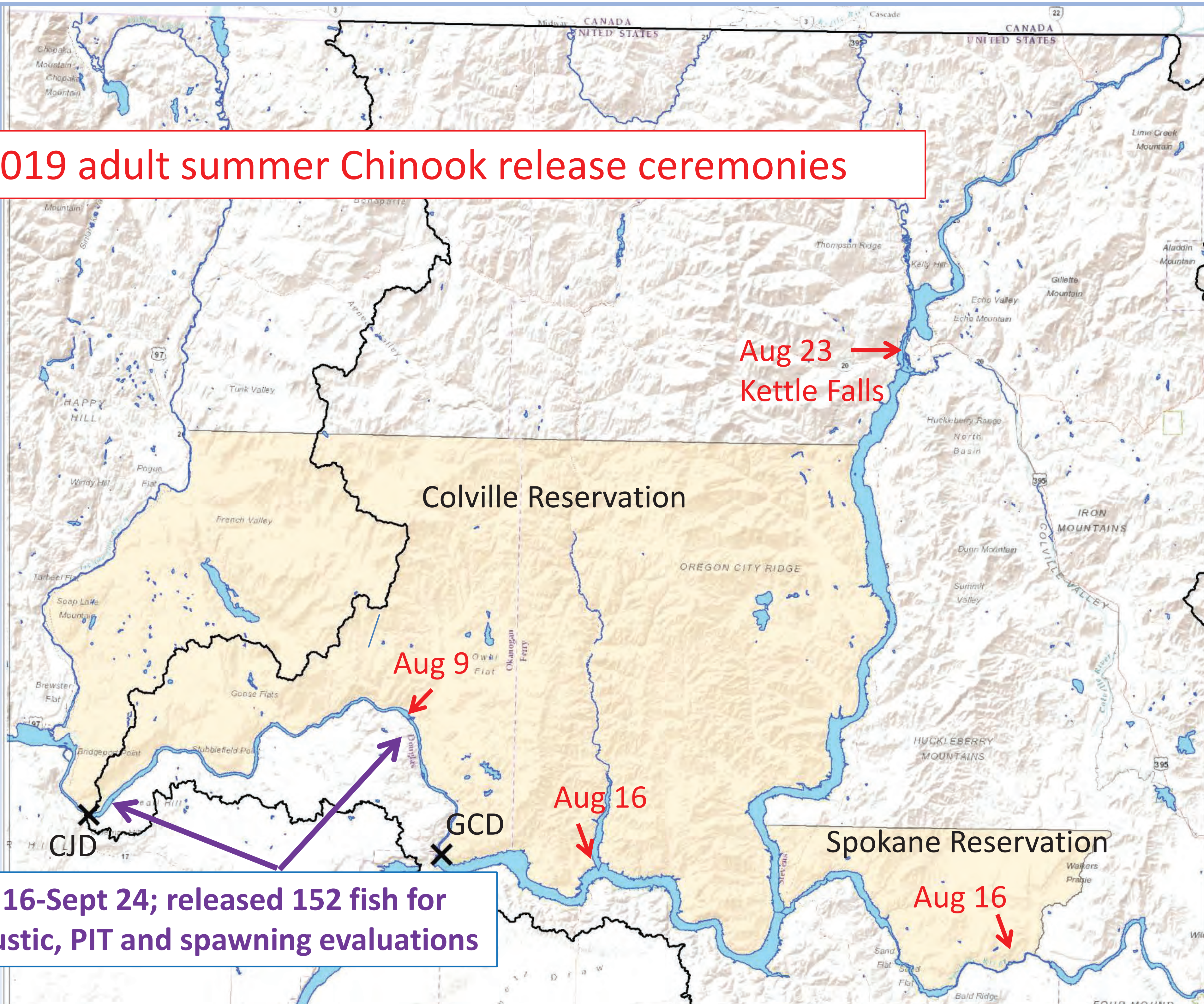
CCT Cultural Releases 2019

Colville Tribes Cultural Releases 2019

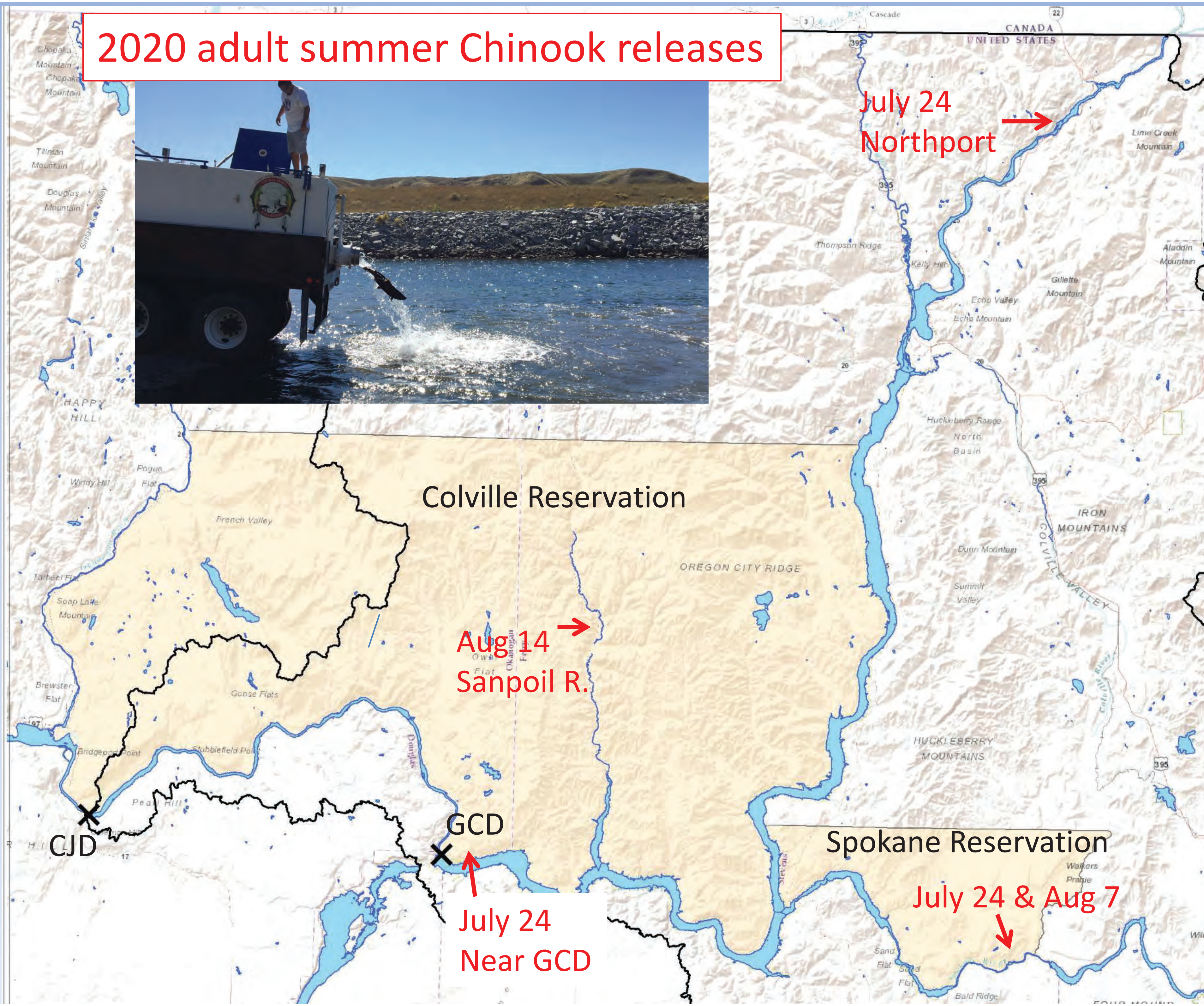
Colville Tribes Cultural Releases 2019

Colville Tribes Cultural Releases 2019

2019 adult summer Chinook release ceremonies



Aug 16-Sept 24; released 152 fish for acoustic, PIT and spawning evaluations


2020 adult summer Chinook releases
July 24
Northport
Colville Reservation
Aug 14
Sanpoil R.
GCD
CJD
July 24
Near GCD
Spokane Reservation
July 24 & Aug 7
CANADA
UNITED STATES
HAPPY HILL
OREGON CITY RIDGE
IRON MOUNTAINS
COLVILLE VALLEY
HUCKLEBERRY MOUNTAINS

Spokane Tribe Cultural and Educational Releases

In 2017, 753 yearling Chinook were released into Tshimikain Creek, 1092 km and 12 dams from the Ocean

Observation Location	# Unique Fish Detected
Juveniles released in 2017	753
Juvenile Fish Bypass Facilities	75
Estuary Trawl Net	3
Avian Colonies	3
Adult Fishways	9
Total	90

She who retraces her steps

- 2019 – One adult from the 2017 release returns to Chief Joseph Hatchery.
- 2020 – Three adults from the 2017 release return to the Columbia

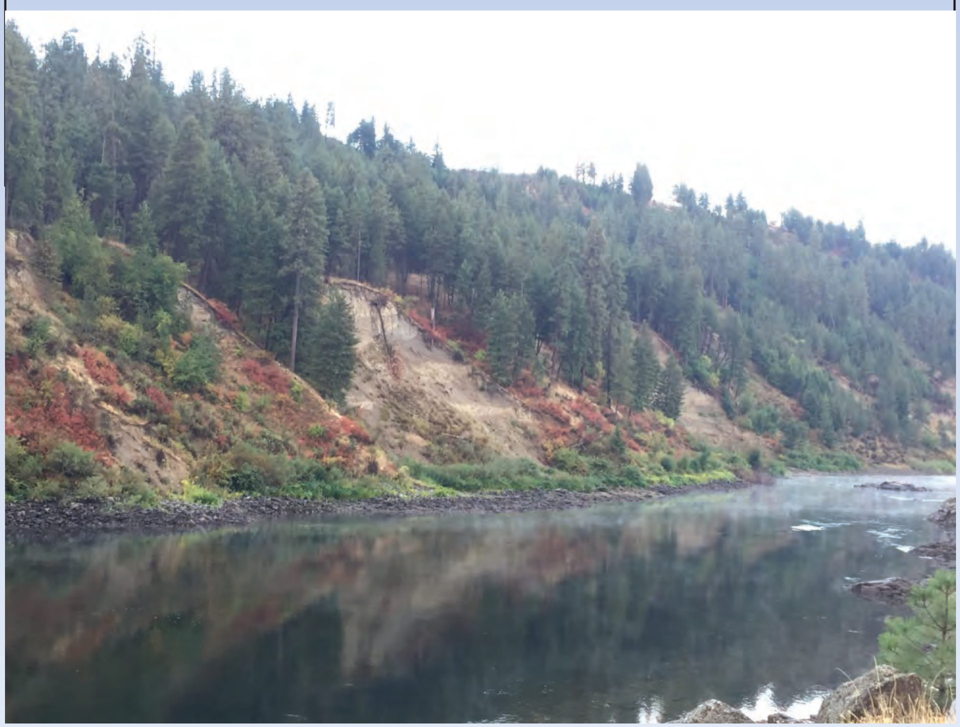
Spokane Tribe Cultural and Educational Releases

- 2019 Spokane Tribe released 50 adult summer Chinook in Tshimikain Ck for a fishery *(most were caught by kids with spears, nets and one even used his bare hands!)*

Spokane Tribe Cultural and Educational Releases

March 2020 Juvenile Chinook Releases

- 750 at base of Little Falls Dam
- ~90 detected so far...



July 2020 Adult Chinook Releases

- 50 adults released to Tshimikain Creek
- 50 adults released to Spokane River adjacent to the Reservation

Coeur d' Alene Tribe Ceremonial Releases

- 2019 released several hundred Chinook juveniles, some were raised by kids in the classroom, all were released by kids

Coeur d’ Alene Tribe Ceremonial Releases

Chinook salmon are swimming in Hangman Creek on the Coeur d’Alene Reservation for the first time in over a century

Community Salmon Celebration, Coeur d’Alene Indian Reservation, Hangman Creek.

Coeur d’ Alene Tribe Ceremonial Releases

2020 Juvenile Chinook Release

~1,400 in upper Hangman Creek

~68 detected at downstream dams

2020 Adult Chinook Release

- 75 in upper Hangman Creek
- Tribal members harvest salmon on the reservation for the first time in 110 years

Current Partners and Support

- 14 Tribes Coalition (Col. River Treaty)
- Regional recommendation by the U.S. entity for the Col. R. Treaty
- NPCC F&W program (2014 amendment and 2020 addendum)
- Gov. Inslee's Southern Resident Orca Task Force
- Tribal/State/Federal 'Fish Management Initiative'
- Columbia Basin Partnership (MAFAC Task Force)
- WDFW, USGS, PNNL, ONA, BPA, USBR, USFWS, DPUD

Thank you

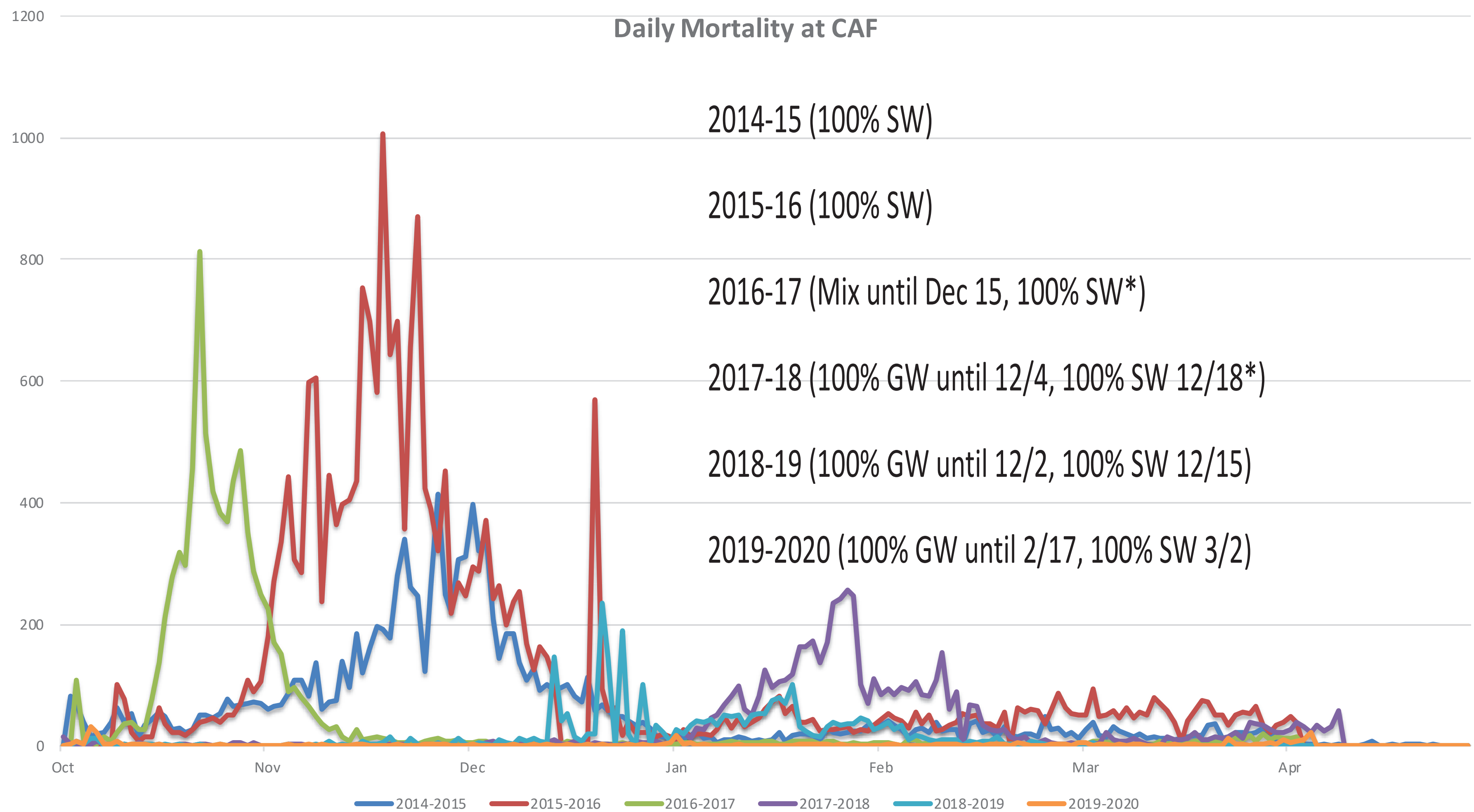
For more information visit: https://ucut.org/

"…after experiencing, in my life…days of our cultural darkness, now we are coming into our cultural light. Where our traditions, our ceremonies, are just shining down on everybody, and making everybody happy. And this is what we need. So let our light shine on, and let our children and our grandchildren feel that light."

- Francis White, Coeur d' Alene tribal elder

Carlton Acclimation Facility Rearing Plan

HSC October 2020


Daily Mortality at CAF
2014-15 (100% SW)
2015-16 (100% SW)
2016-17 (Mix until Dec 15, 100% SW*)
2017-18 (100% GW until 12/4, 100% SW 12/18*)
2018-19 (100% GW until 12/2, 100% SW 12/15)
2019-2020 (100% GW until 2/17, 100% SW 3/2)
1200
1000
800
600
400
200
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
2014-2015
2015-2016
2016-2017
2017-2018
2018-2019
2019-2020

Fish health recommendation

- Use 100% groundwater until February 1 and transition (25%/week) completely to 100% surface water by March 1 prior to release

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

October 19, 2020

Dr. Tracy Hillman
BioAnalysts, Inc.
4725 N. Cloverdale Rd, Suite 102
Boise, ID 83713

Subject: Notification of Change of Alternate for NMFS Representation to the HCP Hatchery Committee and PRCC Hatchery Subcommittee

Dear Dr. Hillman:

Mr. Brett Farman will continue be our designated representative to the HCP Hatchery Committee and PRCC Hatchery Subcommittee, and effective October 21, 2020, Emi Melton will serve as alternate for both groups. Their contact information is as follows:

Mr. Brett Farman
brett.farman @noaa. gov
(503) 231-6222

Ms. Emi Melton
emi.melton@noaa. gov
503-736-4739

If you have any questions concerning this matter, please feel free to contact me at (503) 736-4736.

Sincerely,

Allyson Purcell
Branch Chief
Anadromous Production and Inland Fisheries

FINAL

23 S. Wenatchee Avenue, Suite 220
Wenatchee, Washington 98801
509.888.2070

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees, and Priest Rapids Coordinating Committee Hatchery Subcommittee

Date: January 12, 2021

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Sarah Montgomery, Anchor QEA, LLC

Re: Final Minutes of the November 18, 2020, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) meetings were held by conference call and web-share on Wednesday, November 18, 2020, from 9:00 a.m. to 12:15 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Joint HCP-HCs and PRCC HSC

- Brett Farman will discuss with NOAA staff and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A). *(Note: this item is ongoing.)*
- Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A). (*Note this item is ongoing.*)
- Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historic run-size data (Item I-A). (*Note this item is ongoing.*)
- All parties will provide updates on changes to monitoring and evaluation plans due to the impacts of COVID-19 on operations as updates become available (Item I-A). (*Note this item is ongoing.*)
- Kirk Truscott will determine the number of scales that should be collected from spring Chinook at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook from Methow River spring Chinook (Item I-A). (*Note this item is ongoing.*)
- Andrew Murdoch (WDFW) will present pre-spawn mortality data during the February 2021 HCP-HC and PRCC HSC meeting (Item I-A). (*Note this item is ongoing.*)

- Kirk Truscott will work with CCT staff to develop a model that addresses the probability of encountering natural-origin Okanogan spring Chinook at Wells Dam (Item I-A). (*Note this item is ongoing.*)
- Keely Murdoch and Mike Tonseth will update the retrospective analysis for Wenatchee spring Chinook salmon using estimates of female pre-spawn mortality (Item I-A). (*Note this item is ongoing.*)
- Brett Farman will provide a listing of NOAA points-of-contact for programs and permits related to the HCP-HCs and PRCC HSC, and update the HCP-HCs and PRCC HSC on who is covering Allyson Purcell's duties while she is on leave (Item I-A). (*Note this item is ongoing.*)
- HCP Hatchery Committees and PRCC HSC Representatives will consider desired outputs of Mark Sorel's (University of Washington) model (Item II-A).
- Mike Tonseth will check on the WDFW policy for releasing unmarked surplus fish (Item II-B).
- Catherine Willard will check on previous guidance or agreements about which entity pays the costs for ad-clipping surplus fish (Item II-B).
- HCP Hatchery Committees and PRCC HSC Representatives will consider Mike Tonseth's discussion points for Appendix G of the Broodstock Collection Protocols, which will be included in the meeting minutes (Item II-B).
- Greg Mackey, Mike Tonseth, and Brett Farman will review conditions regarding surplus in the NMFS permit for the Wells HCP programs for discussion in December 2020 (Item II-B).

PRCC HSC

- Mike Tonseth will review prior assessments of groundwater and surface water connectivity in the Methow sub-basin and provide any relevant information to the PRCC HSC (Item IV-A).
- Todd Pearsons will send his presentation from the meeting about the Carlton Acclimation Facility and the water chemistry report he referenced to the PRCC HSC (Item IV-A). *(Note: Sarah Montgomery distributed these items to the PRCC HSC via email on November 23, 2020.)*

Decision Summary

- The Wells HCP Hatchery Committee approved Douglas PUD's *Wells 2021 Hatchery M&E Implementation Plan* during the meeting on November 18, 2020.
- The Wells HCP Hatchery Committee approved Douglas PUD's Wells Complex 2021 M&E Plan via email on December 10, 2020. The Rocky Reach HCP Hatchery Committee and the PRCC HSC approved the portions of the plan pertaining to Chelan PUD and Grant PUD programs.

Agreements

- The PRCC HSC agreed that Grant PUD can implement a fish health recommendation for brood year 2020 fish reared at Carlton Acclimation Facility as follows: rear fish on 100%

groundwater until February 1, transition completely to surface water by March 1 (25% per week), and rear fish on 100% surface water from March 1 until release; Grant PUD will provide updates on the performance of these fish.

Review Items

- There are not items currently available for review.

Finalized Documents

- Douglas PUD's *Final 2021 Wells Complex M&E Implementation Plan* was distributed via email by Sarah Montgomery on December 11, 2020.
- Douglas PUD's final report, Monitoring and Evaluation of the Wells Hatchery and Methow Hatchery Programs – 2019 Annual Report was distributed via email by Sarah Montgomery on December 11, 2020.

I. Welcome

A. Review Agenda, Announcements, Approve Past Meeting Minutes, Review Last Meeting Action Items

Tracy Hillman welcomed the HCP-HCs and PRCC HSC to the meeting and read the list of attendees signed into the meeting. The meeting was held via conference call and web-share because of travel and group meeting restrictions resulting from the COVID-19 pandemic. Hillman reviewed the agenda and asked for any additions or changes to the agenda. There were no changes and all representatives present approved the agenda.

The HCP-HCs and PRCC HSC representatives reviewed the revised September 16, 2020, meeting minutes and the revised October 21, 2020 meeting minutes. Minor revisions were resolved in the meeting. The HCP-HCs and PRCC HSC approved the September 16, 2020, and October 21, 2020, meeting minutes, as revised.

Action items from the HCP-HCs and PRCC HSC meeting on October 21, 2020, were reviewed, and follow-up discussions were addressed *(note that italicized text below corresponds to action items from the previous meeting)*:

Joint HCP-HCs and PRCC HSC

- *Brett Farman will discuss with NOAA staff and Mike Tonseth the potential use of a multi-population model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A).*
  Farman said this item is ongoing.

- *Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A).*
  Mackey said he has been working on this and will talk with Tonseth soon.
- *Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A).*
  Mackey said this item is ongoing.
- *Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historic run-size data (Item I-A).*
  Tonseth said this item is ongoing.
- *All parties will provide updates on changes to marking and tagging plans due to the impacts of COVID-19 on operations as updates become available (Item I-A).*
  This item is ongoing.
- *Kirk Truscott will determine the number of scales that should be collected from spring Chinook at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook from Methow River spring Chinook (Item I-A).*
  Truscott said this item is ongoing.
- *Mike Tonseth will check with Andrew Murdoch (WDFW) on presenting pre-spawn mortality data to the HCP-HCs and PRCC HSC at an upcoming meeting (tentatively planned for February 2021; Item I-A).*
  Tonseth said this item is complete and will be discussed in February.
- *Kirk Truscott will work with CCT staff to develop a model that addresses the probability of encountering natural-origin Okanogan spring Chinook at Wells Dam (Item I-A).*
  Truscott said this item is ongoing. He and Casey Baldwin have been discussing model concepts and are reviewing available data.
- *Keely Murdoch and Mike Tonseth will update the retrospective analysis for Wenatchee spring Chinook salmon using estimates of female pre-spawn mortality (Item II-A).*
  Murdoch said she and Tonseth have discussed this analysis and this item is ongoing.
- *Tracy Hillman will review the HCP-HCs and PRCC HSC's previous discussions and agreements about using geometric means to calculate broodstock needs and provide a summary to the committees (Item II-C).*
  Tonseth provided this information, which was distributed to the committees on October 22, 2020.
- *Todd Pearsons will provide an update on the Angler Broodstock Collection (ABC) Fishery at the November 18, 2020 meeting (Item II-C).*
  This item will be discussed today.

- *Greg Mackey will provide a final draft of Douglas PUD's 2019 Wells Complex M&E Annual Report, for Wells HCP-HC review (Item III-B).*
  This item is complete. Hillman said this was distributed on October 23, 2020, and Mackey is working to continue addressing comments. This will be discussed today. Gale said USFWS is helping to work through comments.
- *Sarah Montgomery will add Emi Melton to the HCP-HCs and PRCC HSC distribution lists and coordinate access to Extranet and SharePoint (Item V-A).*
  Hillman said this item is complete.
- *Brett Farman will provide a listing of NOAA points-of-contact for programs and permits related to the HCP-HCs and PRCC HSC, and update the HCP-HCs and PRCC HSC on who is covering Allyson Purcell's duties while she is on leave (Item V-A).*
  Farman said this is ongoing. He said in the interim, he can be the contact person for any questions. Pearsons asked who is acting in Allyson Purcell's position while she is on leave. Farman said he will also provide this information, and it was added to the action item.

PRCC HSC

- *Todd Pearsons will provide a summary of growth and temperature profiles for the Carlton Acclimation Facility to the PRCC HSC (Item IV-A).*
  Pearsons said he will provide an update on this today.
- *Todd Pearsons will check on the operational feasibility of using different water sources (groundwater vs. surface water) in different recirculating aquaculture systems (circular rearing vessels) at Carlton Acclimation Facility (Item IV-A).*
  Pearsons said he will provide an update on this today.
- *Todd Pearsons will include maturation monitoring in pre-release sampling (Item IV-A).*
  Pearsons said he will provide an update on this today.
- *Todd Pearsons and Deanne Pavlik-Kunkel will review prior assessments of groundwater and surface water connectivity for the Carlton Acclimation Facility and provide to the PRCC HSC (Item IV-A).*
  Pearsons said he will provide an update on this today.
- *Mike Tonseth will review prior assessments of groundwater and surface water connectivity in the Methow sub-basin and provide any relevant information to the PRCC HSC (Item IV-A).*
  Tonseth said this item is ongoing.

II. Joint HCP-HCs and PRCC HSC

A. Updated Retrospective Analysis of Wenatchee Spring Chinook Salmon Conservation Program Size

Keely Murdoch said she does not have an update on this topic. She said she and Mike Tonseth are working to incorporate pre-spawn mortality estimates into the model.

Todd Pearsons said he contacted Mark Sorel (University of Washington) to determine when would be a good time for him to meet with the committees and discuss his model. Pearsons said they decided that the January meeting would be a good time for this discussion, and Pearsons asked the committees to be prepared to provide input to Sorel about inputs and outputs of the model that would be useful for management purposes. Pearsons said Sorel's model focuses on aspects of the program such as supplementation and density dependence, so it may help inform decisions about program size for hatcheries.

B. Broodstock Collection Protocols

Tracy Hillman shared the revised document, *Topics for HCP-HC and PRCC HSC Discussion in 2020*, and reviewed the topics in the document.

Regarding Chiwawa spring Chinook marking, Catherine Willard said she is working to draft revisions to this section of the protocols and will be ready to discuss this topic in January 2021.

Regarding the options for differentiating natural-origin spring Chinook salmon from other natural-origin Chinook salmon during broodstock collection, Truscott said he is continuing to work on this item.

Regarding options for outplanting surplus Methow Composite spring Chinook salmon adults, Mike Tonseth said this item will probably be drafted and ready for discussion in December 2020 or January 2021.

Regarding Wenatchee spring Chinook pre-spawn survival estimates, Tonseth said this item will be discussed in February 2021.

Regarding the sizing of upper Columbia River conservation programs, see Item II-A, above. Tonseth added that this will likely also involve discussions with Mark Sorel.

Regarding requests for HCP adults or juveniles for HCP-specific research or other requests (surplus to HCP broodstock needs), Greg Mackey said Douglas PUD has no requests. Representatives present did not have additional input on other requests that would occur in 2021.

Regarding authorship of sections needing to be revised, Mackey said he rewrote the section for steelhead in the Methow basin. He said he kept the section that describes the logical flow of broodstock collection, but he shortened the section overall and eliminated repetition.

Regarding consistent declaration of surplus, Tonseth said he is working on the draft language for this section, which addresses excess adults at the Wells Dam volunteer trap. He said the committees should also discuss updating or adding language about how notifications of surplus declaration are provided to the committees. He said, for example, there was a recent notification about a surplus in the Okanogan steelhead program. He said Appendix G of the Broodstock Collection Protocols provides the instructions for what should be included in a notification. From his perspective as a committees' representative and a co-manager, he suggested adding more information, as follows:

- Brood year/stock-program/age class (egg/juvenile/adult).
- Target release number/number currently on hand/number being retained for the program (needs to be accurate count – not estimate).
- Number identified as surplus (after tagging there should be an accurate count so round numbers like 12K should not be provided – unless that is the true count).
- Target destination of surplus.
- Confirmation that surplus has been adipose clipped and approximate size at transfer.
- Summary of conversations with other program operators that surplus is not needed for other programs.
- Explanation as to why the surplus occurred (could be as simple as better-than-expected in-hatchery survival, higher fecundities, etc.).

He suggested that the committees review this list and discuss whether anything should be added to it or removed. Then, he said Appendix G can be updated.

Todd Pearsons asked for Mackey's input about whether fish that are going to be released in non-anadromous waters should be adipose-clipped. Mackey said Douglas PUD has been marking enough of their steelhead program to ensure that the mitigation target is met, and additional fish above the target are not marked and are kept separate from the marked fish. He said Douglas PUD is prepared to provide information on how many fish are marked and how, and their approximate size, but would prefer to avoid unnecessary marking of fish that are not part of the mitigation program.

Tonseth said he thinks there is a WDFW policy that any juvenile surplus anadromous fish should have an external mark no matter what water body it is released into, and he said he will check on this policy and report back to the committees. Mackey said Douglas PUD has not incorporated that policy into their program, but he is interested in hearing more about it.

Pearsons said this may be a gray area but it seems like once the fish are determined to be surplus, they are the responsibility of the co-managers. Tonseth agreed and said once the fish are surplus, the co-managers are responsible for determining how the fish are used, but not for accommodating the marking needs of the fish. Pearsons said that may be a difference in interpretation, and suggested further conversations may be helpful to determine whether surplus fish should be marked. Tonseth said his interpretation is that the surplus is the result of program implementation. If protocols have been followed and a surplus exists, rearing and marking of the fish is still the responsibility of the PUDs. Mackey said he does not believe the trout program fish are marked when released to non-anadromous waters. Tonseth said even though this surplus is treated as trout, the fish are still steelhead and would be considered steelhead under WDFW policy. Matt Cooper said from the USFWS perspective, juvenile steelhead are marked with an adipose-fin clip when released into non-anadromous waters.

Willard said Alene Underwood (Chelan PUD) made her aware of an internal Chelan PUD policy that if there is an excess of fish for surplus, and the co-managers want the fish ad-clipped, Chelan PUD does not cover the cost of the clipping of any production over 110%. She said she will look into this policy and provide more information about it.

Tonseth said he will continue working on Appendix G. He asked for input from the committees over the next month for things to add to the list and on the best way to be consistent across programs.

Kirk Truscott said the projected release number would be a good addition to Tonseth's list. This would help the recipients of the notification evaluate whether enough fish are being retained to meet the target release number. He also suggested that representatives consider the language in Appendix G, which currently states that up to 100% of production should be marked.

Brett Farman said a more detailed discussion on this is needed. He said, within the permits, 110% is listed as a buffer but it should never be interpreted as the program target. Truscott agreed and said 110% is not the target release number; however, with variability in survival from year to year, it makes sense to mark 110% of the program if the fish are available, knowing that there will be some mortality between final marking and the release period. Tonseth agreed with Truscott. He said when the Broodstock Collection Protocols are developed, they are structured to achieve 100% of the production goal, and the permits allow for release of up to 110% of the target to allow for annual variation in fecundities and survival. He said the program managers have periodic check-ins during rearing where there are opportunities to cull the program back down to 110%. Mackey said it would not be within the intent of the permit to knowingly mark 110% of the program, because they should not be purposely targeting a release in excess of the program target. He said the fish are marked in accordance with the mitigation target. Tonseth said the co-managers should have a say in whether the extra 10% are released as part of the program or put into a landlocked lake. Mackey said what does not make sense to him is that the program managers have means to control the overage, but it sounds like Tonseth is saying they should not.

Hillman summarized the discussion and noted that Farman may need to provide more guidance from NMFS on this topic. He said the target release is 100% of the mitigation goal, and Truscott is saying that if there are additional fish, those addition fish up to 110% of the program should be marked. Truscott added that the biological metrics that set the stage for broodstock collection and protocols should be reviewed if there is a consistent overage in any program. Farman said there is significant gray area to this topic and there are many constraints to how fish are released into anadromous and non-anadromous waters. He said NMFS is concerned with calculations of juvenile mortality, fecundity estimates, and other biological metrics that will allow the managers to more closely hit the 100% target. He said if the program releases are consistently high, reinitiating consultation may be necessary to adjust program targets. Tonseth asked if NMFS' position is to manage a program back to 100% at various life stages (such as eyed egg and at marking), or to manage a program to 110%. Farman said estimates of mortality between marking and release should be incorporated too, but the end release should be at or below 110%. He said there is no clear trigger to reinitiate consultation, but it is important to make sure the analysis adequately covers what the program is doing.

Tonseth said the committees should continue to discuss this item. He said he interprets some of his past discussions with NMFS differently. Truscott said the committees should also consider the status of the most recent returns from the steelhead program. He said if production is going to be limited to 100%, but there is allowable excess of up to 110%, the full picture including survival should be taken into account. Pearsons said it would be helpful to have clear guidance from NMFS on this topic. Bill Gale said he is not sure this topic is as complicated as it may seem. He said when NMFS did the effects analysis for the permits, they analyzed the worst-case scenario for effects (i.e., 110% release). So, he said releasing 110% is within the considered action. Farman agreed but said that the language in the permits and BiOp suggests that 110% should be a rare occurrence, not annual. He said some flexibility is needed, but consistent overproduction is an issue for the effects analysis. Gale said this conversation also pertains to US v OR. He said he would not be comfortable agreeing to guidance from NMFS in one program that could be in conflict with conversations occurring for other programs. Farman agreed, and indicated that a broad policy from NMFS on exact interpretation is unlikely since the program specifics and history are important for each individual situation.

Hillman summarized that Farman's understanding of NMFS' guidance to date is that the goal is to meet the release target plus or minus 10%. Farman agreed but said the 10% below the target is less of an issue for ESA impacts, but a regular 10% overage could be an issue. Hillman said the next part of the guidance pertains to how many of those fish should be marked, which is a separate discussion.

Gale added that as long as the program is within 10% of the production target, the program goal is met. From an ESA impacts perspective, whether the program is over or under ideally balances out over the long term.

Mackey said his main question is whether the operator should knowingly take an action that would result in more fish being released than the target as stated in the ESA permit, or should the operator always target the release number if they have the ability to do so. Tonseth said this comes down to a difference of opinion in interpreting the permit, and the committees should continue to discuss it.

There were no further updates on topics related to the broodstock collection protocols, including Chiwawa broodstock collection and document production. The topic related to a contingency plan for the ABC Fishery is discussed under Section VI-B.

C. Effect of COVID-19 Pandemic on Monitoring and Evaluation Activities

Tracy Hillman asked each committee member to provide an update on impacts of the COVID-19 pandemic on monitoring and evaluation activities.

Brett Farman reported no changes from NOAA related to COVID-19.

Keely Murdoch reported no changes from YN.

Kirk Truscott said he has no updates related to COVID-19.

Bill Gale said he has no updates.

Mike Tonseth reported that there have been some minor modifications to WDFW's COVID-19 policies related to reducing working group sizes (now groups should be less than 5, even if working outside). He said staff are to avoid agency facilities unless required. Katy Shelby agreed with Tonseth and added that staff are now going back to single occupancy in vehicles as much as possible.

Catherine Willard reported that Chelan PUD ended steelhead PIT-tagging at the OLAFT a week early, on October 23, 2020, due to COVID-19 concerns.

Greg Mackey said Douglas PUD has no changes to report since the previous meeting.

Todd Pearsons said Grant PUD has no changes to report related to COVID-19.

III. Joint RI/RR HCP-HCs and PRCC HSC

A. Distribution of Information for the Skaha and Okanagan Reintroduction Program, Comprehensive Program Review

Catherine Willard said she provided a library of documents related to the Skaha and Okanagan Reintroduction Program to Sarah Montgomery for uploading to the SharePoint sites. Willard said these documents will be provided to the committees to review and if anyone would like more information, to please contact her. She said during the January or February committees meeting, Ryan Benson (Okanagan Nation Alliance) will provide the 2020 annual review and will be available for answering questions about the documents and the program in general.

IV. RI/RR HCP-HC

A. Blackbird Pond Update

Catherine Willard said Blackbird Pond was first constructed in 2001 by the Icicle Chapter of Trout Unlimited (TU) to provide children's fishing opportunities. Later, it was not used due to low oxygen levels. She said TU approached Chelan PUD to improve the pond and provide acclimation for steelhead. Historically, Willard said steelhead were reared at Turtle Rock Island, then truck-planted into the Wenatchee River. In order to final acclimate up to 50,000 steelhead at Blackbird Pond and improve homing rates, Chelan PUD funded the improvements including intake structures and volitional release capabilities. She said steelhead were acclimated at Blackbird Pond for the first time in 2010. Annually since 2010, up to 50,000 hatchery-by-wild or hatchery-by-hatchery steelhead were transferred from Turtle Rock to Blackbird Pond, which WDFW operated. She said the goal was to get fish to Blackbird Pond in early March, but the transfer sometimes happened in April due to river conditions. Willard said after July 1, fish remaining in the pond were assumed to be residual, and cutthroat trout were also stocked to provide a fishery.

Willard said the Chiwawa Acclimation Facility was constructed and steelhead were overwinter acclimated starting in 2012. During that time, she said the RI/RR HCP Hatchery Committees decided that final acclimation should still occur at Blackbird Pond. Approximately 25,000 hatchery-by-hatchery steelhead were acclimated at Blackbird Pond beginning in 2012. Willard said no steelhead were transferred into Blackbird Pond from 2018 to 2020 to minimize variables involved in evaluation of the steelhead program. During 2018-2020, Chelan PUD continued to place infrastructure in the pond during high water to allow for the children's fishery with cutthroat trout. She said considering the evaluation of the program has concluded and steelhead are now being acclimated at the Chiwawa Acclimation Facility, she wanted to provide an update to the committees about the status of Blackbird Pond.

Willard said the original purpose of Blackbird Pond was to provide acclimation in the Wenatchee River. Now that fish are acclimated at Chiwawa AF, Blackbird Pond is not needed. She said the pond requires costly improvements to the intake and riverbank armoring is also needed. She said the intake backwash is needed to keep the intake clean. With turbid and high water, it can be difficult to get a crane to the intake screen to clean it. She said the intake screen not being cleaned almost resulted in loss or early released fish (which is a concern for ESA-listed steelhead). She said Chelan PUD evaluated the costs of performing these upgrades and the biological data from the pond. She said juvenile outmigration was compared for fish released in the upper Wenatchee River to fish released from Blackbird Pond. She said survival was higher for fish released in the upper Wenatchee in most years but was not statistically different. She said earlier transfer to Blackbird Pond also resulted in lower survival (likely due to predation). She said for these reasons, Chelan PUD determined that there was a high cost to make Blackbird Pond safe to final acclimate steelhead compared to the biological benefit. She said Chelan PUD has surplussed the infrastructure at Blackbird Pond to the City of Leavenworth, who plans to maintain the pond. Trout Unlimited plans to operate the pond when fish are present for a fishery. She said there is no need to perform the costly improvements if the pond is only being used for the children's fishery for cutthroat trout in the summer.

Kirk Truscott asked if the juvenile survival comparisons were of fish from the same parental origin. Willard said no, the fish released from Blackbird Pond were hatchery-by-hatchery fish and the fish released from the upper Wenatchee River were a mix of wild-by-wild and wild-by-hatchery. Truscott asked if they were of similar size and growth regimes. He said the survival estimates may not be comparable. Willard said the growth regimes were similar, but the fish were not of the same origin. She said the closest comparison possible was chosen for the analysis. Truscott said one initial reason Blackbird Pond was chosen as an acclimation site was to limit potential negative ecological interactions (such as those resulting from residualized hatchery fish). He said he would be reluctant to make decisions that would be counter to the objective of limiting post-release negative ecological interactions. Willard said the raceway at Chiwawa AF is mixed with HxH and WxW, so both are released in the upper basin. She said there are other options for minimizing ecological interactions, like screening fish. She said one option is to release fish that do not volitionally move from one raceway to another farther down in the mainstem Wenatchee River. She agreed that Blackbird Pond was beneficial for minimizing ecological interactions and said that there are other ways to do that currently without investing in costly updates to Blackbird Pond, especially given the evidence that Blackbird Pond may not be as effective at acclimating fish as Chiwawa AF. She said with the use of Chiwawa AF, the steelhead that would be acclimated at Blackbird Pond even if it were updated would not be a big proportion of the program.

Bill Gale asked if the survival estimates used in the analysis were measured from emigration from the pond to McNary Dam or from stocking at the pond to McNary Dam. Willard said the estimates were from the time fish were stocked. Gale suggested that the survival estimate from Blackbird Pond could be lower due to predation at the pond than due to actual in-river survival differences. Willard agreed that survival in Blackbird Pond is lower than the other sites, but her point was to demonstrate the overall lower survival from Blackbird Pond compared to truck plants in the upper Wenatchee basin. Gale said the comparison does not account for mortality during rearing for the fish that are released from the truck plants. Tonseth agreed that comparing differential survival between Blackbird Pond at truck plants in the upper Wenatchee basin is difficult. He said fish that were released using truck plants in the upper basin were just a small group of fish, about 50,000, out of the 180,000-release group. He said within-hatchery rearing data are therefore difficult to add to this dataset. He added that at Blackbird Pond, it is difficult to get fish to emigrate from the pond due to the way the pond responds to the river elevation (there is backflow into the pond through the discharge end). He said these emigration issues results in fewer PIT-tag detections for juvenile steelhead leaving Blackbird Pond. He said there may not be a clear way to compare the survival between these two groups; however, Blackbird Pond is not an ideal location and emigration has not been to desired levels. He said now that in-basin acclimation exists with the Chiwawa AF, which has been upgraded to accommodate 100% of the program, Blackbird Pond is not the best option for acclimating steelhead. Tonseth asked if Chelan PUD is retaining ownership of the infrastructure. Willard said Chelan PUD sold the infrastructure to the City of Leavenworth who also owns the property, so Chelan PUD has no ownership whatsoever of Blackbird Pond.

V. Wells HCP-HC

B. Approve 2021 Hatchery M&E Implementation Plan

Greg Mackey said Douglas PUD's Draft 2021 Hatchery M&E Implementation Plan was available for review with comments due on November 16, 2020. He received no comments or edits on the plan. The Wells HCP Hatchery Committees approved the plan as follows: NMFS, YN, CCT, USFWS, WDFW, and Douglas PUD voted yes during the meeting.

C. Update on Revisions to 2019 Wells Complex M&E Annual Report

Greg Mackey said Douglas PUD has been working with USFWS and WDFW staff to resolve comments on the 2019 Wells Complex M&E Annual Report. He said he and Bill Gale have been reviewing the updates provided by Charlie Snow and Michael Humling, which mostly include calculations for tables and similar content. He said Douglas PUD will provide a final version for approval by the committees when the revisions are complete.

VI. PRCC HSC

A. Carlton Fish Health/Culture Recommendation

Todd Pearsons shared a revised version of the Carlton Fish Health Recommendation presentation that he shared with the PRCC HSC during the September 16, 2020, meeting (Attachment B). He reviewed the mortality data at Carlton Acclimation Facility (Slide 2) and summarized that the mortality at Carlton AF is associated with surface water. He said during the previous discussion, PRCC HSC members noted concerns about precocial maturation related to water temperatures, growth rates, and size at release. Questions also included whether tanks at Carlton AF could be isolated, the connectivity of surface and groundwater, and the timing of the switch between water sources.

To address concerns about water temperatures, Pearsons showed data for groundwater and surface water temperatures at Carlton AF since 2016. He said groundwater is warmer than surface water in the winter, but it is still relatively cold especially in comparison to Eastbank Hatchery, where these fish used to be reared in the spring. Carlton AF is generally in the 40s and below 45 degrees Fahrenheit in February.

To address concerns about growth profiles, Pearsons showed data comparing the growth patterns from different years, with 2019-2020 representing a year when fish were reared longer on groundwater. He said the fish have a similar growth profile when reared on groundwater and were released relatively small (16 fish per pound) and within the target range.

To address concerns about precocious maturation, Pearsons shared data from visual assessments of precocity and milt presence in 2020. He said there is no evidence that precocious maturation was a problem.

To address the question about connectivity between surface water and groundwater, Pearsons said he will distribute an analysis that was conducted at Carlton AF, which shows the constituents of the groundwater and surface water.

Regarding questions about straying, Pearsons showed data for donor straying from the Methow River. He said these data show that more straying occurs when fish are overwinter acclimated. While this comes as a surprise, he emphasized that the results are not statistically significant. He surmised that instances of disease and chemical treatments may reduce the ability of fish to imprint and home. He said it is possible that water chemistry changes or being sick could affect a fish's ability to imprint and to home. Kirk Truscott asked which fish the homing data are from. Pearsons said the data are from the spring acclimation of Carlton AF fish, with three years of data (2010, 2011, 2014), and the years of overwinter acclimation at Carlton AF (2015 to 2017). Bill Gale asked how Pearsons defined "stray" for this analysis. Pearsons said strays are those fish who have PIT-tag detections in other subbasins, such as the Okanogan, Entiat, and Wenatchee. Gale said this does not mean that the fish spawn in those other subbasins, and Pearsons agreed. Pearsons said he believes the analysis removed any fish that were detected in-basin after their out-of-basin detections, but this does not confirm their spawning location. Gale said it would be interesting to compare CWT recovery data in the Entiat River compared to the Carlton AF program.

Regarding questions about the flexibility to have different tanks with different water sources at the same time at Carlton AF, Pearsons said the original water right was focused on surface water. Later, due to drought conditions, the water right was amended so that the water source for the facility could be toggled between surface and groundwater. However, the surface water intake pumps are either on or off, so running both at the same time could cause an issue with exceeding the water right. Kirk Truscott thanked Pearsons for looking into this question.

Regarding the choice between February 1 and January 1 as the date for switching to surface water, Pearsons said one of the main reasons to use February 1 is to delay the introduction of surface water as long as possible without affecting the fish's ability to imprint. One goal is to reduce bacterial kidney disease. He said there are also issues with drug clearance timing. Betsy Bamberger added that the less time fish are exposed to surface water, the fewer disease problems, and specifically gill disease problems, they are likely to have. She said the preferred chemicals to treat gill disease, such as Diquat, has a 30-day hold time, so it is difficult to treat the fish and hold them for 30 days towards the end of the rearing period. She said while other chemicals without a 30-day hold time could be used, Diquat is the most effective.

Kirk Truscott asked how the growth rate in 2019 to 2020 compares to previous years. Pearsons said the 2018 to 2019 growth rate was similar when fish were also on groundwater. Truscott noted that the size at release remains approximately the same throughout the years shown by Pearsons, but when they are on groundwater they arrive as smaller fish so they have to grow more to reach the same target. He said conducting GSI monitoring provides him more comfort with proceeding with the rearing plan because his concerns about growth rate are tied to concerns about precocity.

Tonseth asked Pearsons how the tanks are filled with surface water incrementally (25%) by week. Pearsons said the issue with turning the pumps on and off is more related to the duration they are on. A one-month transitional period can be reasonably accommodated within the water right, but extending the transitional period longer makes it harder to be consistent with the water right.

Deanne Pavlik-Kunkel noted that the groundwater at the facility is more easily manipulated than the surface water. She said running some of the ponds on groundwater and others on surface water is not possible given the constraints of the facility and the water right.

Hillman asked if the PRCC HSC should vote on this recommendation. Pearsons said he is not sure whether a vote is needed to implement a fish health recommendation. Hillman said he thinks it would be appropriate to document concurrence with the proposed action.

Pearsons summarized that the recommendation is listed in the presentation and would also include pre-release morphological sampling.

The PRCC HSC agreed to implement the fish health recommendation for brood year 2020-2021. Brett Farman voted yes and noted that it would be preferable to transition to surface water earlier. He said it will be important to revisit the decision to check-in on how the fish perform. He suggested monitoring growth rates and survival to McNary Dam. Kirk Truscott, Keely Murdoch, Bill Gale, and Todd Pearsons voted yes. Mike Tonseth voted yes and also noted that an annual check on fish performance will be important.

Mike Tonseth asked if the recommendation would change any proposed size targets when the fish are transferred from Eastbank FH. Pearsons said no, the current size requests will be maintained.

Hillman asked if the M&E Plan needs to be updated with the morphological sampling. Pearsons said the pre-release sampling is already included, so the meeting notes will suffice for documenting the additional need for GSI sampling.

B. ABC Fishery Update

Todd Pearsons said the Angler Broodstock Collection Fishery was very successful, with 1,175 fall Chinook collected (648 males). He said even with the reduced number of anglers due to COVID-19, over 1,000 fish were collected, which means the PNI goal will be met.

Mike Tonseth asked what was the relative quality of the fish? Pearsons said he has not heard about any quality issues with the fish. He said spawning is ongoing, and he has not heard of any mortality issues yet. He said Steve Richards would have more information if Tonseth has more questions.

Pearsons said due to the successful fishery, he will not be adding a tiered approach to broodstock collection to the 2021 Broodstock Collection Protocols, and this item can be removed from the tracking list.

C. Review Agenda, Announcements, Approve Past Meeting Minutes

The PRCC HSC representatives approved the September 16, 2020, and October 21, 2020, meeting minutes, as revised.

VII. Administrative Items

A. Chelan PUD Alternate Designation

Tracy Hillman said he received a letter from Chelan PUD designating Scott Hopkins as the new alternate for Chelan PUD on the HCP Hatchery Committees (Attachment C). Montgomery said she is coordinating with Hopkins on email and Extranet/SharePoint access.

VIII. Next Meetings

The next HCP-HCs and PRCC HSC meetings will be Wednesday, December 16, 2020; Wednesday January 20, 2021; and Wednesday February 17, 2021, held by conference call and web-share until further notice.

IX. List of Attachments

Attachment A	List of Attendees
Attachment B	Carlton Acclimation Facility Rearing Plan
Attachment C	Chelan PUD Committee Designation Letter

Name	Organization
Sarah Montgomery	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Catherine Willard*	Chelan PUD
Scott Hopkins*	Chelan PUD
Kirk Truscott*‡	Colville Confederated Tribes
Greg Mackey*	Douglas PUD
Tom Kahler*	Douglas PUD
Deanne Pavlik-Kunkel	Grant PUD
Todd Pearsons‡	Grant PUD
Peter Graf‡	Grant PUD
Brett Farman*‡	National Marine Fisheries Service
Bill Gale*‡	U.S. Fish and Wildlife Service
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Katy Shelby	Washington Department of Fish and Wildlife
Keely Murdoch*‡	Yakama Nation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate

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ANCHOR QEA

Memorandum

To:	Wells, Rocky Reach, and Rock Island HCP Hatchery Committees, and Priest Rapids Coordinating Committee Hatchery Subcommittee	Date:	January 20, 2021
From:	Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator		
cc:	Sarah Montgomery and Larissa Rohrbach, Anchor QEA, LLC		
Re:	**Final Minutes of the December 16, 2020, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings**		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) meetings were held by conference call and web-share on Wednesday, December 16, 2020, from 9:00 a.m. to 10:15 a.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Joint HCP-HCs and PRCC HSC

- Brett Farman will discuss with National Oceanic and Atmospheric Administration (NOAA) staff and Mike Tonseth the potential use of a multipopulation model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A). *(Note: this item is ongoing.)*
- Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A). (*Note this item is ongoing.*)
- Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historic run-size data (Item I-A). (*Note this item is ongoing.*)
- All parties will provide updates on changes to monitoring and evaluation plans due to the impacts of COVID-19 on operations as updates become available (Item I-A). (*Note this item is ongoing.*)
- Kirk Truscott will determine the number of scales that should be collected from spring Chinook at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook from Methow River spring Chinook (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth will check whether the scales from spring Chinook salmon sampled at Wells Dam are archived, and if so, whether any contamination from the acetate impression process could affect elemental signature analysis (Item I-A).

- Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) will present pre-spawn mortality data during the February 2021 HCP-HC and PRCC HSC meeting (Item I-A). (*Note: this item is ongoing.*)
- Kirk Truscott will work with Colville Confederated Tribes (CCT) staff to develop a model that addresses the probability of encountering natural-origin Okanogan spring Chinook at Wells Dam (Item I-A). (*Note: this item is ongoing.*)
- Keely Murdoch and Mike Tonseth will update the retrospective analysis for Wenatchee spring Chinook salmon using estimates of female pre-spawn mortality (Item I-A). (*Note: this item is ongoing.*)
- Brett Farman will provide a listing of NOAA points-of-contact for programs and permits related to the HCP-HCs and PRCC HSC, and update the HCP-HCs and PRCC HSC on who is covering Allyson Purcell's (NOAA) duties while she is on leave (Item I-A). (*Note: Farman distributed this information on December 18, 2020).*
- HCP Hatchery Committees and PRCC HSC Representatives will consider desired outputs of Mark Sorel's (University of Washington) model (Item I-A). (*Note: this item is ongoing.*)
- Mike Tonseth will check on the WDFW policy for releasing unmarked surplus fish (Item I-A). (*Note: this item is ongoing.*)
- Mike Tonseth and Greg Mackey will solicit input from hatchery managers on the methods used to quantify surplus fish (Item II-B).
- Representatives will review the NOAA research summary and Hatchery and Genetic Management Plans (HGMPs) presentation distributed by Tracy Hillman and consider whether to request the authors attend a future committee meeting to discuss their research (Item IV-B).

PRCC HSC

- None.

Decision Summary

- None.

Agreements

- None.

Review Items

- There are no items currently available for review.

Finalized Documents

- Douglas PUD's *Final 2021 Wells Complex M&E Implementation Plan* was distributed via email by Sarah Montgomery on December 11, 2020.
- Douglas PUD's final report, *Monitoring and Evaluation of the Wells Hatchery and Methow Hatchery Programs – 2019 Annual Report,* was distributed via email by Sarah Montgomery on December 11, 2020.

I. Welcome

A. Review Agenda, Announcements, Approve Past Meeting Minutes, Review Last Meeting Action Items

Tracy Hillman welcomed the HCP-HCs and PRCC HSC to the meeting and read the list of attendees signed into the meeting. The meeting was held via conference call and web-share because of travel and group meeting restrictions resulting from the COVID-19 pandemic. Hillman reviewed the agenda and asked for any additions or changes to the agenda. Hillman added an agenda item regarding an update on research conducted by NOAA that was recently presented to the Northwest Power and Conservation Council. Representatives present approved the agenda.

Sarah Montgomery said due to a delay in providing the November 18, 2020, meeting minutes for review, the review period will continue through Friday, December 18, 2020. The revised minutes will be available for approval via email the following week. Montgomery asked for feedback from representatives present on the best way to phrase committees' approval of Douglas PUD's Wells 2021 Hatchery Monitoring and Evaluation (M&E) Implementation Plan. She noted that aspects of the implementation plan apply to Chelan PUD and Grant PUD programs; however, historically Chelan PUD and Grant PUD have not formalized approval of Douglas PUD's plan. She asked whether this is necessary. Greg Mackey said that programs are more complicated now than previously, and in many cases programs that are particular to a given PUD may have different programmatic attributes than other programs. He said it would be important that in the potential instance where one committee does not approve the plan, the ability for the other PUD(s) to move forward with contracting or program implementation not be restricted. He said this would not be appropriate because the approval of each committee should apply only to programs within that committee's purview and not necessarily to an entire plan where details for other programs are included. He said in the instance that Douglas PUD's plan includes something that a committee other than the Wells HCP Hatchery Committee does not approve, it would be important to work through a compromise so that there are no delays in program implementation. Tracy Hillman noted that the annual reports for each HCP should also reflect approval of plans and reports that are pertinent to their programs. Representatives present reworded the agreement to show that the Rocky Reach HCP Hatchery

Committee and the PRCC HSC approved the portions of the plan pertaining to Chelan PUD and Grant PUD programs.

Catherine Willard reminded representatives to review the Okanagan Nation Alliance's comprehensive evaluation summaries and documents. She said these items will be discussed at both the January and February meetings.

Action items from the HCP-HCs and PRCC HSC meeting on November 18, 2020, were reviewed, and follow-up discussions were addressed *(note that italicized text below corresponds to action items from the previous meeting)*:

Joint HCP-HCs and PRCC HSC

- *Brett Farman will discuss with NOAA staff and Mike Tonseth the potential use of a multipopulation model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A).*
  Farman said he and Tonseth plan to meet next week to discuss this item.
- *Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A).*
  Mackey said he hopes to share this approach with Tonseth this week and is making progress.
- *Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A).*
  Mackey said this item is ongoing.
- *Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historic run-size data (Item I-A).*
  Tonseth said this item is ongoing.
- *All parties will provide updates on changes to monitoring and evaluation plans due to the impacts of COVID-19 on operations as updates become available (Item I-A).*
  This item will be discussed today.
- *Kirk Truscott will determine the number of scales that should be collected from spring Chinook at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook from Methow River spring Chinook (Item I-A).*
  Truscott said this item is ongoing. He said he would not want to remove more scales than necessary. He asked Mike Tonseth what the lab does with scales from spring Chinook (sampled at Wells Dam) after their origin is determined. Tonseth said in the past, scale cards have been archived. He said typically, an acetate impression of the scale is used to read the scale. He said he will check with the lab on the archiving and sampling procedures. Truscott said if the scales are archived, it may be possible to perform the elemental signature analysis without collecting

additional scales. Tonseth said he will also check with the lab whether any part of the acetate impression process would contaminate the scales such that they could not be used for elemental signature analysis.

- *Andrew Murdoch (WDFW) will present pre-spawn mortality data during the February 2021 HCP-HC and PRCC HSC meeting (Item I-A).*
  This item is ongoing. Sarah Montgomery said the February meeting already has at least a 2-hour period set aside for discussions about the Okanagan Lake and Skaha programs, so she will coordinate with Murdoch to find a time for his discussion.
- *Kirk Truscott will work with CCT staff to develop a model that addresses the probability of encountering natural-origin Okanogan spring Chinook at Wells Dam (Item I-A).*
  Truscott said this item is ongoing. He said he has been discussing this item with Casey Baldwin. They are getting input on the best methods to conduct a probability analysis and will resume this task in 2021.
- *Keely Murdoch and Mike Tonseth will update the retrospective analysis for Wenatchee spring Chinook salmon using estimates of female pre-spawn mortality (Item I-A).*
  Murdoch said this item is ongoing. Tonseth said Andrew Murdoch's presentation in February may help update the analysis.
- *Brett Farman will provide a listing of NOAA points-of-contact for programs and permits related to the HCP-HCs and PRCC HSC, and update the HCP-HCs and PRCC HSC on who is covering Allyson Purcell's duties while she is on leave (Item I-A).*
  Farman said he is putting this information together and will distribute it when complete. He said Lance Kruzic (NOAA) is acting in Purcell's place until March 2021, at which time Emi Melton will take over duties until June 2021.
- *HCP Hatchery Committees and PRCC HSC Representatives will consider desired outputs of Mark Sorel's (University of Washington) model (Item II-A).*
  Tracy Hillman said this item will be discussed in January. He asked representatives present whether they have any input on this topic. Todd Pearsons said Sorel's model is oriented towards making management decisions and takes into account different life history strategies. Hillman asked how Sorel's model compares or relates to Jeff Jorgensen's (NOAA) life cycle model for Wenatchee spring Chinook. Pearsons said Sorel's model is a standalone model. He said because there are multiple models available for Wenatchee spring Chinook, with a variety of inputs and outputs, it would be interesting to compare models that have the same outputs (e.g., predicted number of spawners).
- *Mike Tonseth will check on the WDFW policy for releasing unmarked surplus fish (Item II-B).*
  Tonseth said he is still working internally to respond to this discussion item. He said there is a section of the Revised Code of Washington (RCW) addressing tagging requirements for fish for which there could be multiple interpretations. He said WDFW may need to get input from the

Attorney General's (AG) office on the intent of the RCW. He said because the language governing the release of unmarked fish is encompassed in an RCW, if there is a question of how to interpret it, WDFW may not be able to make that determination without input from the AG's office.

- *Catherine Willard will check on previous guidance or agreements about which entity pays the costs for ad-clipping surplus fish (Item II-B).*
  Willard said she found a letter from Chelan PUD to WDFW documenting an agreement between Chelan PUD and WDFW that all production fish will be marked, but any production over 110% of the program target will be marked at the expense of the state. Hillman said this partially addresses Kirk Truscott's previous inquiry about whether fish up to the 110% threshold need to be marked.
- *HCP Hatchery Committees and PRCC HSC Representatives will consider Mike Tonseth's discussion points for Appendix G of the Broodstock Collection Protocols, which will be included in the meeting minutes (Item II-B).*
  Tracy Hillman said this item will be discussed today.
- *Greg Mackey, Mike Tonseth, and Brett Farman will review conditions regarding surplus in the NMFS permit for the Wells HCP programs for discussion in December 2020 (Item II-B).*
  Tracy Hillman said this will be discussed today.

PRCC HSC

- *Mike Tonseth will review prior assessments of groundwater and surface water connectivity in the Methow sub-basin and provide any relevant information to the PRCC HSC (Item IV-A).*
  Tonseth said he's been researching this and has not found anything relevant to the committees' question. He said because the rearing strategy for the current brood is already determined, he recommended removing this action item; Tracy Hillman agreed.
- *Todd Pearsons will send his presentation from the meeting about the Carlton Acclimation Facility and the water chemistry report he referenced to the PRCC HSC (Item IV-A).*
  Sarah Montgomery distributed these items to the PRCC HSC via email on November 23, 2020.

II. Joint HCP-HCs and PRCC HSC

A. Updated Retrospective Analysis of Wenatchee Spring Chinook Salmon Conservation Program Size

Keely Murdoch said she has no updates on this item and it can be carried forward.

B. Broodstock Collection Protocols

Tracy Hillman shared the revised document, *Topics for HCP-HC and PRCC HSC Discussion in 2020*, and reviewed the topics in the document.

Regarding Chiwawa spring Chinook, Hillman said this topic will be discussed in January 2021.

Regarding the options for differentiating natural-origin spring Chinook salmon from other natural-origin Chinook salmon during broodstock collection, Kirk Truscott said no additional discussion is needed on this item currently (but see Action Item Summary), and he will provide an update when one is available.

Regarding options for outplanting surplus Methow Composite spring Chinook salmon adults, Mike Tonseth said this item will probably be drafted and ready for discussion in January 2021. He said he is currently working on it.

Regarding Wenatchee spring Chinook pre-spawn survival estimates, Tonseth said this item will be discussed in February 2021 with Andrew Murdoch's presentation.

Regarding the sizing of upper Columbia River conservation programs, see Item II-A, above.

Regarding requests for HCP adults or juveniles for HCP-specific research or other requests (surplus to HCP broodstock needs), representatives present did not have additional input on other requests that would occur in 2021, so this discussion is complete.

Regarding authorship of sections needing to be revised, Greg Mackey said he rewrote the section for steelhead release methods in the Methow basin. He shortened the section but maintained the logical flow of broodstock collection, so this discussion is also complete.

Regarding the Angler Broodstock Collection Fishery, Todd Pearsons said this discussion is complete for 2020.

Regarding consistent declarations of surplus (contained in Appendix G), representatives continued their discussion from the November 18, 2020 meeting. Hillman shared the bulleted items that Tonseth listed for the committees to consider as items to include in a notification of surplus:

- Brood year/stock-program/age class (egg/juvenile/adult)
- Target release number/number currently on hand/number being retained for the program (needs to be accurate count – not estimate)
- Number identified as surplus (after tagging there should be an accurate count so round numbers like 12K should not be provided – unless that is the true count)
- Target destination of surplus
- Confirmation that surplus has been adipose clipped and provide approximate size at transfer
- Summary of conversations with other program operators that surplus is not needed for other programs

- Explanation as to why the surplus occurred (could be as simple as better-than-expected in-hatchery survival, higher fecundities, etc.)

Hillman said Tonseth will update Appendix G of the Broodstock Collection Protocols with the language that the committees agree to.

Mackey said the point of the notification is that the committees should have a full understanding of what the surplus is and what is happening with the surplus. He said the explanation does not have to be long.

Pearsons said the two items still up for discussion include the fifth bullet "confirmation that surplus has been adipose clipped," and the third bullet, "number identified as surplus (after tagging there should be an accurate count so round numbers like 12K should not be provided – unless that is the true count)," which he said fish culturalists could provide more input on. Regarding the accurate quantification of the surplus, Mackey said hatchery staff can provide this number.

Tonseth said if all of the fish are not being marked, he would be looking for an agreed upon method for how the number of unmarked fish is determined. He said fish can be counted at the eyed-egg stage but there is a lot of variability between that number and the number at marking. He said if the unmarked fish are not going to be run through the marking trailer and marked, there should be an agreed upon method for how to inventory those fish.

Hillman asked Tonseth whether he has a standardized methodology in mind for counting the unmarked fish. Tonseth said he is open to approaches recommended by fish culturalists. He said estimating by weight or displacement are both options, and he would seek feedback from hatchery operators on the best methods. Mackey said at Wells Fish Hatchery, the number of viable eyed eggs are counted and then a running tally of mortalities is kept. He said this is Douglas PUD's standard for knowing how many fish are in each pond. Tonseth said large rearing vessels may have mortalities that are not counted (e.g., losses due to predation). He said counting the surplus fish is also important because receiving waterbodies have carrying capacities that should not be exceeded by overplanting.

Tonseth said he will reach out to hatchery staff for input on methods for determining the number of surplus fish available that are not marked and he asked Mackey to do the same.

Tonseth said these two bullets can be further discussed when the committees review the draft 2021 Broodstock Collection Protocols.

C. Effect of COVID-19 Pandemic on Monitoring and Evaluation Activities

Tracy Hillman asked each committee member to provide an update on impacts of the COVID-19 pandemic on monitoring and evaluation activities.

Brett Farman reported no changes from NOAA related to COVID-19.

Keely Murdoch reported no changes from Yakama Nation.

Kirk Truscott said he has no updates related to COVID-19.

Matt Cooper said he has no updates.

Mike Tonseth reported no changes.

Catherine Willard reported no changes.

Greg Mackey said Douglas PUD has no changes to report since the previous meeting.

Todd Pearsons said Grant PUD has no changes to report related to COVID-19 but provided an update on M&E work in general. He said field work in the Hanford Reach is nearly complete and he thanked the contractors and staff who worked on this project for their diligence and safe practices, noting that it was a challenge to collect so much data while dealing with the pandemic.

III. PRCC HSC

A. Review Agenda, Announcements, Approve Past Meeting Minutes

The PRCC HSC representatives are still reviewing the November 18, 2020, meeting minutes.

IV. Administrative Items

A. Anchor QEA Support Staff

Sarah Montgomery said Larissa Rohrbach is returning from leave and will return to supporting the committees starting in January 2021. Tracy Hillman and representatives present thanked Montgomery for her support of the committees in 2020.

B. NOAA Research Presentations

Tracy Hillman said scientists from the Northwest Fisheries Science Center recently presented updates on three Bonneville Power Administration-funded projects related to hatchery science and management to the Northwest Power and Conservation Council. Hillman said he listened to the presentations and thought they would be of interest to the committees. He said the presentations are summarized in a document, *BPA sponsored research informing hatchery activities in the Columbia*

River Basin: Projects 1999-056-00, 2002-031-00, and 1989-056-00 (Attachment B), which he distributed to the committees following the meeting on December 16, 2020. As stated in the document, the three projects can be summarized as follows:

- Chris Tatara's research: Advance Hatchery Reform Research (Project 1993-056-00)

  This project is designed to provide information on whether hatchery culture coupled with natural steelhead growth patterns, behavior, and physiology, can limit domestication effects. Importantly too, the project will help elucidate the mechanisms responsible for domestication and provide insights into how or whether inadvertent domestication can be alleviated when steelhead are artificially reared.

- Don Larsen and Brian Beckman's research: Growth Modulation in Salmon Supplementation (Project 2002-031-00)

  This is a highly relevant and practical research project that addresses key uncertainties involving survival and maturation rates of hatchery Chinook salmon and the potential effects of hatchery supplementation on natural and hatchery production. Results from this project may be used to help develop hatchery rearing regimes that minimize early male maturation rates and improve hatchery smolt-to-adult survival rates (SARs) while minimizing negative impacts to protected natural stocks, including resident fishes. Based on the findings of this project, all Chinook salmon hatcheries in the Columbia Basin should test for and estimate the production of minijacks.

- Ewann Berntson's research: Genetic Monitoring and Evaluation (M&E) Program for Salmon and Steelhead (Project 1989-056-00)

  This is a well-developed and well-designed proposal to increase our understanding of the effects of artificial propagation on salmonid populations. The project is credited with pioneering many of the genetic monitoring tools now widely used by salmon researchers. It has consistently provided valuable information to regional managers and helped others within and outside of the Basin to address issues raised in Federal Columbia River Power System Biological Opinion Reasonable and Prudent Alternatives and the Fish and Wildlife Program.

Hillman said he thought the presentations were very interesting, although short, and asked whether representatives would like to review the research summaries. Representatives present said they will review the summaries and consider their pertinence to HCP and PRCC HSC programs. Hillman offered to coordinate a request to any of the researchers to attend a committees' meeting to discuss aspects of their research that representatives find interesting. Todd Pearsons said he looks forward to reviewing the research summaries and said because early 2021 looks to be very busy, the middle of the year might be a better time to consider these topics. Hillman agreed and said the committees can revisit this discussion after the Broodstock Collection Protocols are finalized.

Hillman said he also recently attended a presentation by Lance Kruzic, titled *Hatchery and Genetic Management Plans: NOAA's Update* (Attachment C, which was distributed to the committees following the meeting on December 16, 2020). Hillman said the presentation discussed the history of HGMPs and the evolution of how HGMPs have become more accepted by managers over time. He said the presentation gave him some perspective about the challenges that hatchery managers face. Representatives present said they will also review this presentation and consider its relevancy to HCP and PRCC HSC programs. Hillman said he would also be happy to coordinate with Kruzic to request that he discuss his findings with the committees if the committees find it useful.

V. Next Meetings

The next HCP-HCs and PRCC HSC meetings will be Wednesday January 20, 2021; Wednesday February 17, 2021; and Wednesday March 17, 2021, held by conference call and web-share until further notice.

VI. List of Attachments

Attachment A	List of Attendees
Attachment B	BPA sponsored research informing hatchery activities in the Columbia River Basin: Projects 1999-056-00, 2002-031-00, and 1989-056-00
Attachment C	Hatchery and Genetic Management Plans: NOAA's Update

Attachment A
List of Attendees

Name	Organization
Sarah Montgomery	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Catherine Willard*	Chelan PUD
Kirk Truscott*‡	Colville Confederated Tribes
Greg Mackey*	Douglas PUD
Deanne Pavlik-Kunkel	Grant PUD
Todd Pearsons‡	Grant PUD
Brett Farman*‡	National Marine Fisheries Service
Matt Cooper*‡	U.S. Fish and Wildlife Service
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Katy Shelby	Washington Department of Fish and Wildlife
Keely Murdoch*‡	Yakama Nation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate

Attachment B
BPA sponsored research informing hatchery activities in the Columbia River Basin:
Projects 1999-056-00, 2002-031-00, and 1989-056-00

BPA sponsored research informing hatchery activities in the Columbia River Basin: Projects 1993-056-00, 2002-031-00, and 1989-056-00

Prepared by:
Christopher P. Tatara, P.I. Project 1993-056-00, Advance Hatchery Reform Research
National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest Fisheries Science Center, Environmental and Fisheries Sciences Division, Manchester Research Station, 7305 Beach Drive East, Port Orchard, WA 98366

Don Larsen and Brian Beckman P.I.s Project 2002-031-00, Growth Modulation in Salmon Supplementation
National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest Fisheries Science Center, Environmental and Fisheries Sciences Division, 2725 Montlake Boulevard East, Seattle, WA 98112

Ewann Berntson, P.I. Project 1989-056-00, Genetic Monitoring and Evaluation (M&E) Program for Salmon and Steelhead
National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest Fisheries Science Center, Conservation Biology Division, Manchester Research Station, 7305 Beach Drive East, Port Orchard, WA 98366

Steelhead
Onchorhynchus irideus

Chinook Salmon
Onchorhynchus tshawytscha

Executive Summary

This report was prepared by NOAA Fisheries, Northwest Fisheries Science Center (NWFSC) project Principal Investigators in response to a request by Northwest Power and Conservation Council (NWPCC) staff.

In this report we briefly review three separate, on-going Bonneville Power Administration (BPA) sponsored research projects that examine issues related to hatchery rearing and supplementation of Chinook salmon and steelhead in the Columbia and Snake River Basins. Two projects focus on the effects of hatchery rearing environments on resulting phenotypes of both smolts and returning adults. The third project is concerned with evaluating the nature and extent of genetic impacts on out planted hatchery stocks to both targeted and non-targeted natural stocks.

The first two projects have clearly demonstrated that choices made about hatchery rearing conditions have profound effects on smolt performance, adult phenotypes, and may potentially reduce the effects of domestication selection. The 2019 ISRP review (https://www.nwcouncil.org/reports/isrp2019-2) recognized the implications of project results on Columbia River Basin Hatchery Programs.

199305600 - Advance Hatchery Reform Research

"This project is designed to provide information on whether hatchery culture coupled with natural steelhead growth patterns, behavior, and physiology, can limit domestication effects. Importantly too, the project will help elucidate the mechanisms responsible for domestication and provide insights into how or whether inadvertent domestication can be alleviated when steelhead are artificially reared."

200203100 - Growth Modulation in Salmon Supplementation

"This is a highly relevant and practical research project that addresses key uncertainties involving survival and maturation rates of hatchery Chinook salmon and the potential effects of hatchery supplementation on natural and hatchery production. Results from this project may be used to help develop hatchery rearing regimes that minimize early male maturation rates and improve hatchery smolt-to-adult survival rates (SARs) while minimizing negative impacts to protected natural stocks, including resident fishes. Based on the findings of this project, all Chinook salmon hatcheries in the Columbia Basin should test for and estimate the production of minijacks."

The third project continues to document intended and unintended effects of outplanting hatchery-reared fish into targeted and nontargeted (wild) populations in the Snake River Basin. Annual genetic monitoring of juveniles from reference sites combined with an intensive investigation of relative reproductive success (RRS) of hatchery and natural fish in three river systems makes it an essential part of hatchery reform and provides information that is critical when using widespread hatchery propagation for recovery of natural populations. Remarks in the 2019 ISRP review reflect the essential and innovative nature of this project's investigations (https://www.nwcouncil.org/reports/isrp2019-2):

198909600 - Genetic Monitoring and Evaluation (M&E) Program for Salmon and Steelhead

"This is a well-developed and well-designed proposal to increase our understanding of the effects of artificial propagation on salmonid populations. The project is credited with pioneering many of the genetic monitoring tools now widely used by salmon researchers. It has consistently provided valuable information to regional managers and helped others within and outside of the Basin to address issues raised in FCRPS BiOp RPAs and the Fish and Wildlife Program."

Among the three NWFSC projects, hatchery managers receive comprehensive information directly relevant to both "nature" and "nurture" aspects of artificial propagation in general and supplementation of threatened populations in particular. These studies continue to respond to specific management problems with the most advanced molecular and bioanalytical methods available. Many results have been actionable, but even when managers were unable to act on new information, BPA-funded supplementation research at the NWFSC has transformed understanding of Columbia and Snake River Basin Chinook and steelhead. We know a great deal more about these animals, and we have infinitely more powerful tools to measure the results of management action.

The broad application of the results described for these projects could be focused by a better understanding and categorization of hatchery rearing programs and environments in the Columbia and Snake River Basins. At the end of this report, we make direct recommendations regarding what information is needed to initiate this effort.

Background

The Northwest Power and Conservation Council (NWPCC) and Bonneville Power Administration (BPA) programs support numerous supplementation programs to assist in recovery of Chinook salmon and steelhead trout listed as threatened or endangered under the Federal Endangered Species Act (ESA). In an effort to release fish that are ecologically, genetically, and phenotypically similar to their wild cohorts a number of rearing guidelines for supplementation programs have been made by the Hatchery Scientific Review Group (HSRG) (http://www.hatcheryreform.us/hrp/reports/system/welcome_show.action). Hatchery Reform Efforts in the Columbia River Basin have focused on two central themes

- Genetic management of broodstocks and escapement of natural spawners (i.e., the proportions of hatchery- and natural-origin fish)
- Hatchery culture practices.

Whereas the genetic composition of hatchery brood stocks can have a significant effect on fitness and performance, it is undeniable that husbandry practices and the hatchery environment also play an important role, and that the genetic and environmental factors ultimately interact to determine the outcomes and performance of hatchery programs. Research conducted at the NOAA Fisheries, Northwest Fisheries Science Center, Seattle, WA directly address these two major themes in hatchery steelhead and Chinook salmon. Project # 198909600 "Genetic Monitoring and Evaluation (M&E) Program for Salmon and Steelhead" is focused on brood stock management and interactions among spawning individuals on natural spawning grounds.

Project #200203100 "Growth Modulation in Salmon Supplementation" and Project #199305600 "Advance Hatchery Reform Science" focus on hatchery culture practices for Chinook salmon and steelhead, respectively. It is important to note that Chinook salmon and steelhead have very unique and complex life history differences including, but not limited to the following:

- Chinook salmon are semelparous and steelhead trout are iteroparous
- Freshwater residency – Chinook salmon (moderate and only males) vs. steelhead trout (extensive and both males and females)
- Chinook salmon resident life-histories provide a modest source of genetic variability. Steelhead residents may provide a significant source of genetic variability.
- Spawn timing of Chinook (Summer-Fall) vs. steelhead (Winter-Spring)
- Anthropogenic alterations (hatchery culture, dams, climate change) could have very unique and complex life history and environmental differences

These life history differences demand the need for independent research tracks for these two species, but extensive collaboration among projects across hatchery facilities in the Columbia River Basin and at the NWFSC provides a unique economy of scale with regard to facilities, diagnostic tools and expertise.

Project #199305600 "Advance Hatchery Reform Science"

Project #199305600 "Advance Hatchery Reform Science" focuses on Basin-wide efforts to improve the management and performance of hatchery programs for steelhead trout and the methods used to improve conservation hatchery operations. Research is conducted at hatchery (Winthrop National Fish Hatchery) and laboratory scales (NWFSC, Manchester Research Station) using the Methow River summer steelhead population (ESA-listed Threatened). Rearing methods were developed and tested with conservation hatcheries and natural-origin broodstock in mind, but apply to hatchery steelhead populations across the Columbia and Snake River Basins to support harvest and recovery

This project focuses on understanding the mechanisms of fitness loss in hatchery-reared steelhead, and using this information to manipulate hatchery rearing practices to reduce domestication selection and improve fitness. The project aims to provide hatchery rearing solutions that provide for sustainable fisheries and align with ESA recovery efforts including:

- Improve smoltification rates
- Improve post-release survival
- Increase migration speed
- Reduce precocious male maturation
- Reduce residualism rates
- Reduce potential for ecological interactions
- Minimize fitness loss
- Reduce domestication
- Maintain life history diversity
- Improve smolt-to-adult return

Primary Research Hypotheses:

(1) The mismatch between hatchery-imposed life history and natural life history of steelhead contributes toward domestication selection for rapid growth resulting in fitness loss.

(2) Hatcheries with a fixed age-at-smoltification (age-1 or age-2) reduce the natural life history diversity required for conservation and recovery of ESA-listed populations.

(3) Simple modifications to existing hatchery practices for steelhead can reduce selective pressure of the hatchery environment and improve fitness of hatchery-reared steelhead.

Hatchery steelhead are almost exclusively raised as 1-year-old smolts (S1), rather than the more typical 2-and 3-year-old (S2 and S3) natural smolt life history patterns (Berejikian et al. 2012). How steelhead are raised in hatcheries alters the proportions of smolts, parr, and precocious males at release (Figure 1). High growth rates associated with accelerated hatchery rearing to a 1-year-old smolt life history may contribute to maladaptive behavioral traits and reduced post-release survival and may constitute a primary mechanism leading to reduced fitness in hatchery steelhead (Berejikian et al. 2017, Tatara et al., accepted). The project has also focused on how and when to extend hatchery rearing to produce S2 smolts. S2 rearing can provide the following benefits when compared to S1 rearing (Berejikian et al. 2012, 2019; Tatara et al. 2017, 2019):

- Increased use of natural origin broodstock
- Maintenance of natural spawn timing
- Reduced selection for rapid growth
- More uniform size distribution [lower coefficient of variation (CV)]
- Increased smoltification
- Greater or equivalent survival
- Faster migration
- Similar residualism rates
- Similar reproductive success of females spawning naturally

Figure 1: Developmental state of hatchery steelhead prior to release. Four classes of steelhead are typical of hatchery rearing (parr, transitional, smolt, and mature male) and the proportions vary with rearing methodology and broodstock source. It is desirable to produce a high proportion of smolts and transitional steelhead, as parr and mature males residualize with consequences for limiting ecological interactions and genetic management of integrated populations. (Photo credit, Michael Humling, USFWS)

Further refinements that tailor hatchery environments to juvenile growth rate hold promise for improving smoltification and reducing precocious maturation. Instead of using a fixed age-at-release for all steelhead (S1 or S2), the new method sorts steelhead fry within 9 weeks of ponding. The growth of larger fry is accelerated to produce S1 smolts, while growth is restrained during extended rearing for the remaining fry to produce S2 smolts. The proportion to allocate to S1 and S2 rearing depends on the spawning date of the broodstock and the thermal profile of the hatchery rearing water, which vary considerably among hatchery programs. We are currently developing high throughput automated sorting procedures and proportional allocation guidance according to these two variables for application of the method across Columbia Basin steelhead hatcheries (see deliverable 6).

Table 1. Current research timelines for deliverables of proposed research for Project 1993-056-00. Details regarding each deliverable are available in the 2019 proposal (link to full proposal provided below). Note all timelines were derived prior to the COVID-19 pandemic and may need to be revised.

Deliverable	**Description**	**Timeline**
1	Assess how growth in culture under a split rearing regime (BY18-21) affects life history pathways and smolt quality.	Initiated April 2018, Complete 2023
2	Determine effects of a split-rearing regime on post-release behavior and survival, and selection on body size.	Initiated April 2018, Complete 2023
3	Determine effects of age-at-release on the fecundity of returning anadromous females.	Initiate 2021, Complete 2023
4	Determine effects of a split-rearing regime on survival throughout the migratory lifecycle.	Initiate 2023, Complete 2025
5	Identify behavioral and physiological traits under selection through laboratory-scale research.	Initiate 2021, Complete 2023
6	A tool for hatcheries to optimize smolt production using natural-origin steelhead broodstock.	Initiated 2019, Complete 2022

Most recent proposal: NPCC19-1993-056-00 – Advance Hatchery Reform Research (1993-56-00)

https://www.cbfish.org/Proposal.mvc/Summary/NPCC19-1993-056-00

2018 Annual Report: Advance Hatchery Reform Research (1993-056-00)

https://www.cbfish.org/Document.mvc/Viewer/P163756D

2019 Annual Report: Advance Hatchery Reform Research (1993-056-00)

https://www.cbfish.org/Document.mvc/Viewer/P170272D

Proposed research beyond 2023

The 2020 Biological Opinion for operations of the Columbia River System (NMFS 2020) addresses Conservation and Safety Net hatchery programs for steelhead and Chinook salmon. The Winthrop Steelhead Program is the only steelhead program specifically mentioned in the 2020 Biological Opinion for the Columbia River System. It is managed as an Integrated Conservation program and it is the research focus of project 1993-056-00. The Conservation hatchery program has a unique relationship to the Safety Net hatchery program for Methow River steelhead and to the Harvest hatchery program for steelhead at the Wells Dam Hatchery. The broodstocks used in these programs are derived from a common population but are separated by a minimum of two generations of hatchery influence. The Conservation program uses natural-origin broodstock (minimal hatchery influence), the Safety Net program uses broodstock that are the progeny from the Conservation program (one generation removed), and the Harvest program uses hatchery-origin broodstock (minimum of 2 hatchery generations removed from natural-origin broodstock). Future research efforts (beyond 2023) will focus on the differences in fitness related traits of steelhead produced in the three types of hatchery programs (Conservation, Safety Net, and Harvest) all derived from the ESA-threatened Upper Columbia River steelhead DPS. Impacts of domestication selection and fitness loss are hypothesized to become progressively stronger with each generation of hatchery influence experienced by the broodstock. Experimental designs measuring fitness, performance, and genetic parameters for the three programs will be developed and pursued. Comparisons among the three hatchery program types would provide information to guide hatchery operations, recovery efforts, and address critical uncertainties across the spectrum of artificial propagation activities for steelhead in the Columbia and Snake River systems.

Project 200203100 "Growth Modulation in Salmon Supplementation"

The title "Growth Modulation in Salmon Supplementation" acknowledges that growth is a central driver of life-history 'decisions' in salmonid fishes and that hatchery rearing induced variation in growth may result in either advantageous or deleterious life history variation in smolts released from hatcheries. The project highlights the importance of understanding how hatchery rearing protocols may alter seasonal growth and size of juvenile fish and the subsequent smolt quality and life history variation of the fish

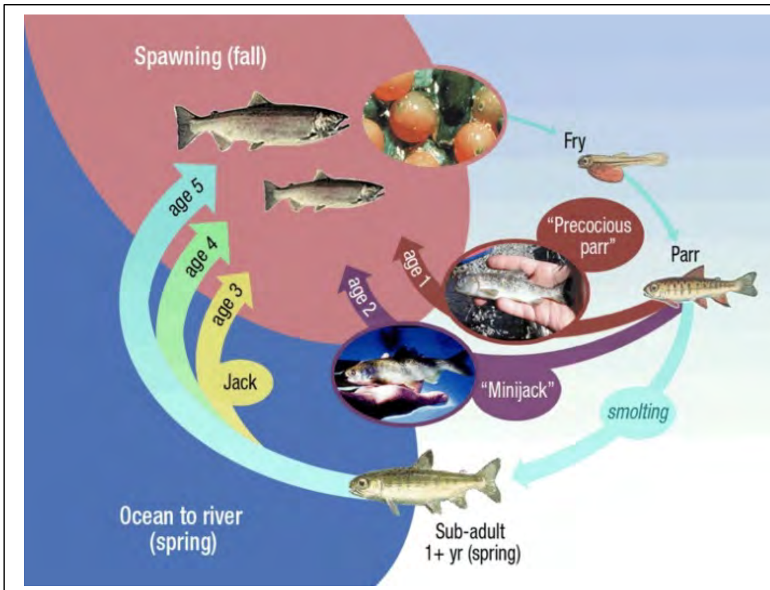

Figure 2. Life-history of Spring Chinook Salmon

hatcheries release. This project has a significant historical base in the Yakima River basin (Beckman and Larsen 2005; Larsen et al. 2004, 2006, 2010, 2014, 2019), but has broad scope and application in Chinook salmon hatchery reform throughout the Columbia and Snake River Basins (Harstad et al. 2013, 2018 Spangenberg et al. 2014; 2015, Beckman et al. 2017).

Guidelines for rearing of local broodstocks in supplementation programs have recommend that "naturally selected populations should provide the model for successful artificially reared populations, in regard to population structure, mating protocol, behavior, growth, morphology, nutrient cycling, and other biological characteristics (Columbia River Basin Fish & Wildlife Program Nov. 14, 2000)" In this project we refer to this guiding principle as the "Wild Fish Template (Beckman et al. 2000) " and include focus on the following:

- Seasonal growth rate, size and dietary lipid composition should match wild fish
- Mismatches in these factors may result in life-history differences including altered smolt migration timing, residualism, early age/small size at maturation, and reduced SARs.

Salmon hatcheries often rear fish with unnatural growth regimes and high lipid diets that can result in earlier age at maturity, most notably in males. We have documented that hundreds of thousands of age-2 minijacks are released each year from Chinook salmon hatchery programs throughout the Columbia and Snake River basins (range 7.9-71.4% of males depending on the program; Larsen et al. 2004, 2015; Harstad et al. 2014; Spangenberg et al. 2014; 2015; Beckman et al. 2017; Harstad et al. 2018). Minijack rates of hatchery fish have been estimated to be approximately 10x that of wild fish (Larsen et al. 2013).

The release of minijacks results in:

- Potential domestication of hatchery broodlines
- Significant loss in anadromous adult production
- Increased error in SAR estimates used for hatchery and hydroelectric project evaluations as these fish are not smolts (although they are enumerated as such)
- Increased residualism and interbreeding (via a 'sneaker strategy') with wild fish
- Contribute to low relative reproductive success in supplementation programs that produce high minijack rates (Ford et al. 2012)
- Competition with native fish for food and habitat.
- Wasted hatchery resources.
- Impediments to recovery via reduction in SARs.

Project Objectives

- Assess proportion of precociously maturing males produced in supplementation and conservation hatcheries for Chinook salmon in the Columbia River Basin
- Conduct both basic and applied research to determine causative affecting life-history
- Devise rearing protocols to enhance smolt development, reduce domestication selection.
- Produce fish with similar physiological, morphological and behavioral attributes as their wild cohorts.

Overarching Hypothesis: The use of the “Wild Fish Template” to guide hatchery reform efforts will.

- Reduce unnaturally high rates of early male maturation
- Limit domestication of hatchery broodstocks
- Decrease opportunity for unwanted hatchery/wild genetic introgression and ecological interactions
- Improve smolt development and increase SARs for hatchery Chinook salmon.

Links to most recent proposal

Proposal NPCC19-2002-031-00 - Growth Modulation in Salmon Supplementation (2002-031-00)

https://www.cbfish.org/FileResource.mvc/GetImageFile/8282ae03-e2e3-4926-b5b3-7c18b9d973e2

Links to last 2 annual reports

Growth Modulation in Salmon Supplementation (2002-031-00) Annual Report 2018
https://www.cbfish.org/Document.mvc/Viewer/P163602

Growth Modulation in Salmon Supplementation (2002-031-00) Annual Report 2019
https://www.cbfish.org/Document.mvc/Viewer/P170639

The research outlined in the current proposal has eight deliverables (Table 2).

Table 2. Current research timelines for deliverables of proposed research for Project 2002-031-00. Details regarding each deliverable are available in the 2019 proposal (link to full proposal provided below). Note all timelines were derived prior to the COVID-19 pandemic and may need to be revised.

Deliverable	Description	Timeline
1	Complete manuscript describing multi-brood year Growth Modulation Expt. With URB Umatilla R. Fall Chinook salmon	Initiated April 2011, Complete 2023
2	Complete manuscript exploring effects of alterations in emergence time on life-history of URB Fall Chinook salmon	Initiated April 2011, Complete 2021
3	Survey integrated and segregated Idaho hatchery Chinook salmon stocks for minijack maturation	Initiate 2015, Complete 2023
4	Analysis of relationship between minijack and jack maturation in Idaho hatchery Chinook salmon	Initiate 2015, Complete 2023

5	Complete manuscript describing interactive effects of stock and environment on minijack rates in McCall Chinook salmon	Initiate 2015, Complete 2021
6	Complete manuscript examining genetic variation in minijack rates and threshold for early male maturation in Chinook salmon	Initiated 2014, Complete 2020
7	Experiment – The interaction of genetic and environmental effects on minijack and jack production in hatchery spring Chinook salmon	Initiated 2018, Completed 2023
8	Production scale PRAS Growth Modulation Experiment, Leavenworth Nation Fish Hat.	Initiate 2021, Completed 2029

Proposed Research beyond 2023

How do we apply the principals of the "wild fish template" to Partial Recycling Aquaculture Systems (PRAS)?

BPA, USFWS and PUD sponsored hatchery facilities throughout the Columbia River Basin are implementing use of partial recycling aquaculture systems (PRAS) for yearling Chinook salmon. However, few controlled studies with salmonids have been conducted, thus, there is need to monitor and evaluate their effects on the quality of smolts released and their subsequent effects on adult age structure and SAR's. Our proposed research will design, monitor and evaluate a newly implemented PRAS systems being implemented at the Leavenworth National Fish Hatchery, Leavenworth WA over the next 2-4 years. This program provides an ideal opportunity to conduct these studies due to the following 1) the Chinook salmon are not ESA listed 2) they have a robust M&E program for monitoring downstream migration and survival, 3) the proposed system is sufficiently sized for controlled experiments with over 200K smolts in 4 rearing vessels, 4) PRAS and raceway stocks can be compared.

Project # 198905600 “Genetic Monitoring and Evaluation (M&E) Program for Salmon and Steelhead”

This genetic monitoring program was designed to evaluate the effects of outplanting hatchery reared fish on natural and wild populations of spring/summer Chinook salmon and steelhead in the Snake River Basin. The two major goals of this project are to 1) evaluate the nature and extent of genetic changes in outplanted hatchery stocks, and 2) quantify the genetic impact of out planting on targeted and non-targeted natural stocks. This study was designed as a two-tiered approach: genetic monitoring through annual sampling of juveniles at a number of reference sites in the Snake/Salmon River sub basins (Tier 2), and an intensive investigation of relative reproductive success (RRS) of hatchery and natural fish in three river systems through sampling of juveniles, residents (for steelhead) and returning adults (Tier 3). We have three ongoing reproductive success projects: Little Sheep Creek (Imnaha Basin) for steelhead, and Catherine Creek and Lostine River (Grande Ronde basin) for Chinook salmon. The reproductive success work has been pursued since 2000, while the gene frequency monitoring has been a central component since the study’s inception in 1989.

The greatest strength of this genetic monitoring program lies in the breadth and depth of its sampling design; we have collections for both steelhead and Chinook across multiple river basins, multiple life stages, and multiple life histories, every year since 1989. We've employed historical samples predating supplementation, and we've leveraged our resources by relying heavily on the annual efforts of other field crews. Whether annual samples are genotyped right away or are stored for future use, we have produced an invaluable resource for understanding subtle effects of hatchery propagation throughout the basin. We've made those samples available to other BPA-funded labs, and each year we prioritized (in part) genotyping and analysis in response to specific co-manager directives.

This project continues to implement cutting-edge ecological genetic and genomic tools to accommodate new challenges and exploit new opportunities (see below). New DNA sequencing technologies offer significant power to address old problems in artificial propagation, such as domestication and the genetic/environmental determinants of morphological traits such as size and age at maturity, reproductive behavior, and juvenile migration. Advances in technology and biological understanding in the areas of genetics, physiology, and behavior are all converging to offer unprecedented opportunities in artificial propagation in general and supplementation of threatened populations in particular.

Project Objectives

Qualitative Objectives

This genetic monitoring program has extensively evaluated the effects of outplanting hatchery reared fish on natural and wild populations of spring/summer Chinook salmon and steelhead in the Snake River Basin.

The two primary qualitative objectives are the following:

1) Evaluate the nature and extent of genetic changes in hatchery stocks to be used for outplanting, and
2) Quantify the genetic impact of outplanting on targeted natural stocks and non-targeted wild stocks.

The information obtained from this study directly addresses a critical remaining knowledge gap identified by comanagers: under what conditions does hatchery supplementation provide a sustained contribution to natural production? Our previous results disproved many misconceptions and alleviated some concerns about hatchery propagation (e.g., Van Doornik et al. 2011; Van Doornik et al. 2013); however, we also identified potential for substantial improvement in some programs and opportunities to avoid problems in others (e.g., Berntson et al. 2011). Our goal has always been to provide practical support for management in evaluating effectiveness of propagation improvements toward achieving supplementation goals. Without this continued monitoring, there would be no measure of on-going efforts to increase relative reproductive success (and sustained productivity) of naturally-spawning hatchery fish.

Quantitative Objectives

Our analyses of Tier 2 and Tier 3 data relate to the following quantitative objectives:

1) Characterize population genetic relationships within and among populations of Chinook and steelhead in the Snake River basin.

2) Use allele frequency changes over time, genetic linkage disequilibrium, and population pedigrees to estimate effective population sizes and rates of inbreeding and introgression in Chinook and steelhead populations in the Snake River Basin.

3) Estimate the relative reproductive success (RRS) of hatchery fish spawning in the wild using genetic pedigrees. Currently we have three rivers with ongoing RRS projects: Little Sheep Creek, Imnaha Basin (steelhead), and Catherine Creek and Lostine River, Grande Ronde basin (Chinook).

4) Measure associations of physical and behavioral characteristics associated with RS.

Results

This study has made numerous contributions to management and research in the Snake River basin over the past 3 decades, highlighting a few:

- Provided data pertaining to population genetic structure and geographic distribution of genetic variation for Chinook and steelhead NMFS status reviews, as well as to the US v. Oregon dispute resolution.
- Examined genetic effects in hatchery and natural systems over the 20+ year span of this project (Van Doornik et al. 2011, Van Doornik et al. 2013). We provided evidence of populations where hatchery fish appear to have contributed to natural production, and others where genetic effects of the hatchery supplementation are less apparent.
- Continues to provide best available estimates in Snake Basin salmon populations for important genetic parameters, Nm, Ne, and Nb to N ratios. The studies above produced Nb estimates for Salmon River Chinook populations over the span of 3-5 generations, and found that in most populations Ne didn't fall low enough to reduce heterozygosity or allelic richness over that time span. The geometric mean of Nb/N was significantly higher in non-supplemented populations (0.3) compared to supplemented populations (0.23) compared to hatchery populations (0.15).
- Produced individual-specific, full life-cycle reproductive success estimates in steelhead and Chinook salmon over multiple brood years. Documented low RRS in hatchery steelhead (~0.4) and variable but overall nearly equal RRS in Chinook (~1.0), and suggested the low acclimation site and high hatchery spawner densities contributed to the low RS in Little Sheep Creek.
- Provided quantitative genetic analysis of a mixed hatchery and natural steelhead population
- Documented reproductive contributions of kelts, resident rainbow trout, and residualized hatchery fish in Little Sheep Creek steelhead, and precocious male parr in Catherine Creek and Lostine River Chinook).

The most recent Biological Opinion (NMFS 2020) listed the Snake River spring/summer Chinook populations almost entirely as "high risk," and noted that 2017-2019 saw the lowest returns since 1999, and that estimates of total spawners in Snake River populations were experiencing a similar downward trend. The report suggested the driving force behind these declines may be tied to declining ocean conditions and ocean productivity during this time period. Our continued annual monitoring will keep co-managers apprised of life-stage-specific changes in relative survival and reproductive success of hatchery and natural fish.

Table 3. Current research timelines for deliverables of proposed research for Project 1989-096-00. Details regarding each deliverable are available in the 2019 proposal (link to full proposal provided below). Note all timelines were derived prior to the COVID-19 pandemic and may need to be revised.

Deliverable	Description	Timeline
1	Collect Chinook and steelhead genetic samples from multiple locations within Snake River Basin	Initiated 1989, Ongoing
2	Genotype Chinook and steelhead samples for current CRITFC/IDFG SNP panels for Tier-2 monitoring (conventional monitoring)	Initiated 2014, Ongoing
3	Genotype Chinook and steelhead samples for current CRITFC/IDFG SNP panels for Tier-3 studies (relative reproductive success)	Initiated 2014, Ongoing
4	Test for changes in diversity and gene flow at Tier-2 study sites since our last major publications	Initiated 2020, Complete 2023
5	Analyze data and interpret results for Tier-3 sampling	Initiated 2020, Complete 2023
6	Evaluate ability of eDNA sampling to replace electrofishing	Initiated 2020, Complete 2022
7	Identify potential microhaplotypes contained in the current GT-Seq SNP panels	Initiated 2020, Complete 2020
8	Screen parent and offspring data for microhaplotype information	Initiate 2021, Complete 2023
9	Analyze eDNA samples for allele frequencies of Chinook and steelhead populations	Initiate 2023, Complete 2024

Proposed research beyond 2023

We are initiating a project during the current 2020 contract in conjunction with BPA Project #2003-039-00 (Monitor and Evaluate (M&E) Reproductive Success and Survival in Wenatchee River) to use Whole-Genome Sequencing (WGS) to compare natural-origin Chinook (and potentially steelhead) with their hatchery-origin counterparts, as well as fish from differing hatchery programs (e.g., captive broodstock vs. conventional programs).

High water temperatures have kept us from sampling one of our Tier-2 sites for the past 2 years. We anticipate increasing limitations on handling fish for traditional genetic sampling, e.g. electrofishing, seine netting, or trapping. Our most recent proposal included evaluating the utility of eDNA filtered from river water or extracted from sediments as a substitute for electrofishing and direct tissue sampling (Deliverable #6 and 9 above). The first goal is to estimate allele frequencies in natural populations from eDNA. This will give at least some limited information for populations that can't be sampled because of temperature limitations. However, complete population genetic monitoring requires genotypes for individual fish, which is a much greater challenge to obtain from eDNA analysis. Despite, significant molecular and bioinformatic barriers, we are optimistic about current collaboration among cetacean and salmon geneticists with similar interests and study organisms that are not easily sampled directly. Technology is advancing rapidly and even since our last proposal we are more hopeful about obtaining genotypes for individual fish (whales) from eDNA samples, whether filtrates, sediments or feces. It now appears that for this project, with proper field collection and laboratory preparation, a combination of currently available commercial services and reagent kits might be used to genotype individual Chinook and steelhead from complex eDNA samples. Genotyping is not only relevant to obtaining full population information for Tier-2 conventional monitoring. If we succeed in implementing this exciting new method, our Tier-3 pedigree studies could also be conducted, at least in part if not eventually in total, from eDNA. Combined with our genomics research on age at maturity, and deep linkage disequilibrium, we look forward to a time when hatchery origin, life-history type and many aspects of phenotype can be associated with reproductive success and multi-generational productivity in the wild and in the hatchery without ever actually touching fish.

Link to most recent proposal:

Proposal NPCC19-1989-096-00- Genetic Monitoring and Evaluation (M&E) Program for Salmon and Steelhead (1989-096-00)
https://www.cbfish.org/Proposal.mvc/SummaryAsPdf/NPCC19-1989-096-00

Links to the past two annual reports:

Monitor and Evaluate the Genetic Characteristics of Supplemented Salmon and Steelhead (1989-096-00) Annual report 2018
https://www.cbfish.org/Document.mvc/Viewer/P164684

Monitor and Evaluate the Genetic Characteristics of Supplemented Salmon and Steelhead (1989-096-00) Annual report 2019
https://www.cbfish.org/Document.mvc/DocumentViewer/P171338/46273-165-1.pdf

Information needs to further inform hatchery operations in the Columbia and Snake Basins

While the research results reported by these three projects currently inform hatchery operations across the states of Washington, Idaho, and Oregon, the principal investigators, ISRP, and NWPCC envision greater application to additional hatchery programs operating in the Columbia and Snake Basin hatchery systems. Unfortunately, this effort is hampered by the availability of aggregated data regarding environmental, broodstock management, and life history metrics for Chinook and steelhead hatchery programs funded through the BPA (Table 4). The authors recognize that some of these data are available in the Hatchery Genetic Management Plans (HGMP) developed for individual hatchery programs. However, these data lack standardization across programs, are not updated annually, and are not aggregated into a centralized accessible source (i.e., spreadsheet or database). The *2020-2021 Habitat and Hatchery Program Review* process provides an opportunity for the NWPCC to work with hatchery operators to collect this basic data and aggregate it as a resource. Doing so would provide greater opportunity for the research results of the three NWFSC-sponsored projects to inform tailored rearing strategies to optimize hatchery performance and benefit recovery of salmon and steelhead populations within the Columbia and Snake Basins (Table 5). The three projects are well positioned and look forward to continued interaction with program staff as a resource to inform and improve BPA sponsored hatchery programs throughout the region.

Table 4. Recommended environmental, broodstock management, and life history metrics useful for extrapolating research results to inform and optimize hatchery operations in the Columbia and Snake River Basins by hatchery program and species.

Reported metric category			
Program	**Environmental**	**Broodstock management**	**Life history**
Species	Water source	Broodstock origin (natural, hatchery, or mixture)	Age-at-release (in months from spawning)
Production target (# smolts released)	Monthly average water temperature (incubation to release)	Spawning dates (first, last, peak)	Ponding date
Five-year average production (# smolts)		Spawning matrix design	
Target release size (choose unit still)			
Five-year average release size (unit?)			
Number of returns			

Table 5. Potential uses of hatchery metrics to inform performance of steelhead and Chinook salmon hatcheries in the Columbia and Snake River Basins.

Steelhead	Chinook salmon
Facilitate use of natural-origin broodstock	Design and develop seasonal growth rate profile • Minimize minijack rate
Determine age-at-release • Age-1 • Age-2 • Split-rearing age (and proportions)	Maximize smoltification and survival
Improve survival and migration speed	Optimize age structure of adults
Minimize residualism • Immature parr (failure to smolt) • Precociously mature males	Increase size-at-age of adults
Improve RS of hatchery-origin fish spawning in natural environments for supplementation hatcheries	Improve (or maintain) RS of hatchery-origin fish spawning in natural environments for supplementation hatcheries

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Attachment B
Hatchery and Genetic Management Plans: NOAA's Update

NOAA FISHERIES

Hatchery and Genetic Management Plans: NOAA's Update

Lance Kruzic
Hatcheries & Inland Fisheries Branch

For Today

- History of Hatchery and Genetic Management Plans (HGMPs).
- Highlight Some of the Region’s Accomplishments Through HGMPs.

What is a Hatchery and Genetic Management Plan (HGMP)?

- Document describing all aspects of a particular hatchery program:
- Program Objectives & Standards
- Hatchery Operations
- Adult Management (fisheries, spawning)
- Research, Monitoring, Evaluation
- Coordinated Among the Co-managers
- Adaptive

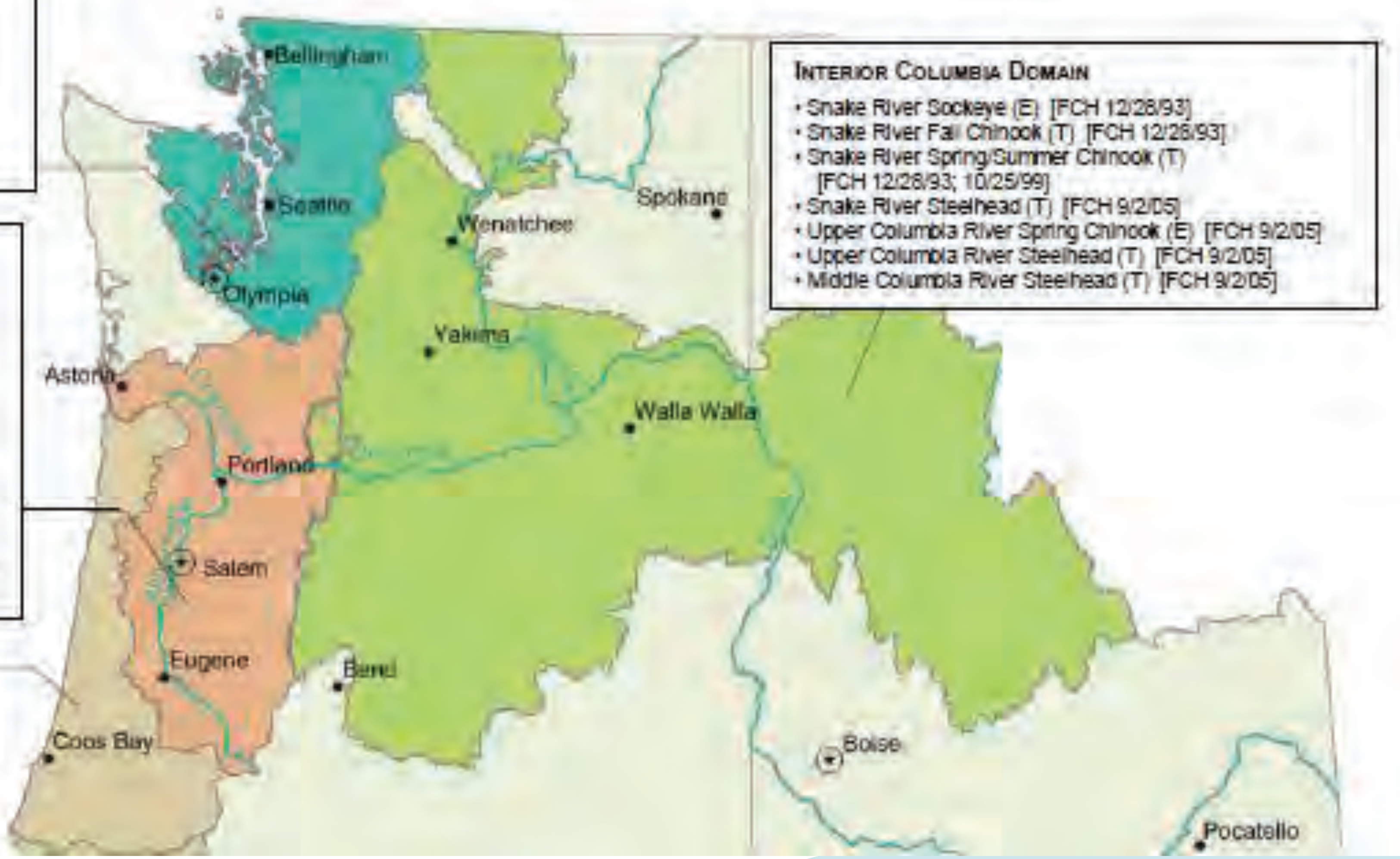
Status of ESA Listings & Critical Habitat Designations for West Coast Salmon & Steelhead

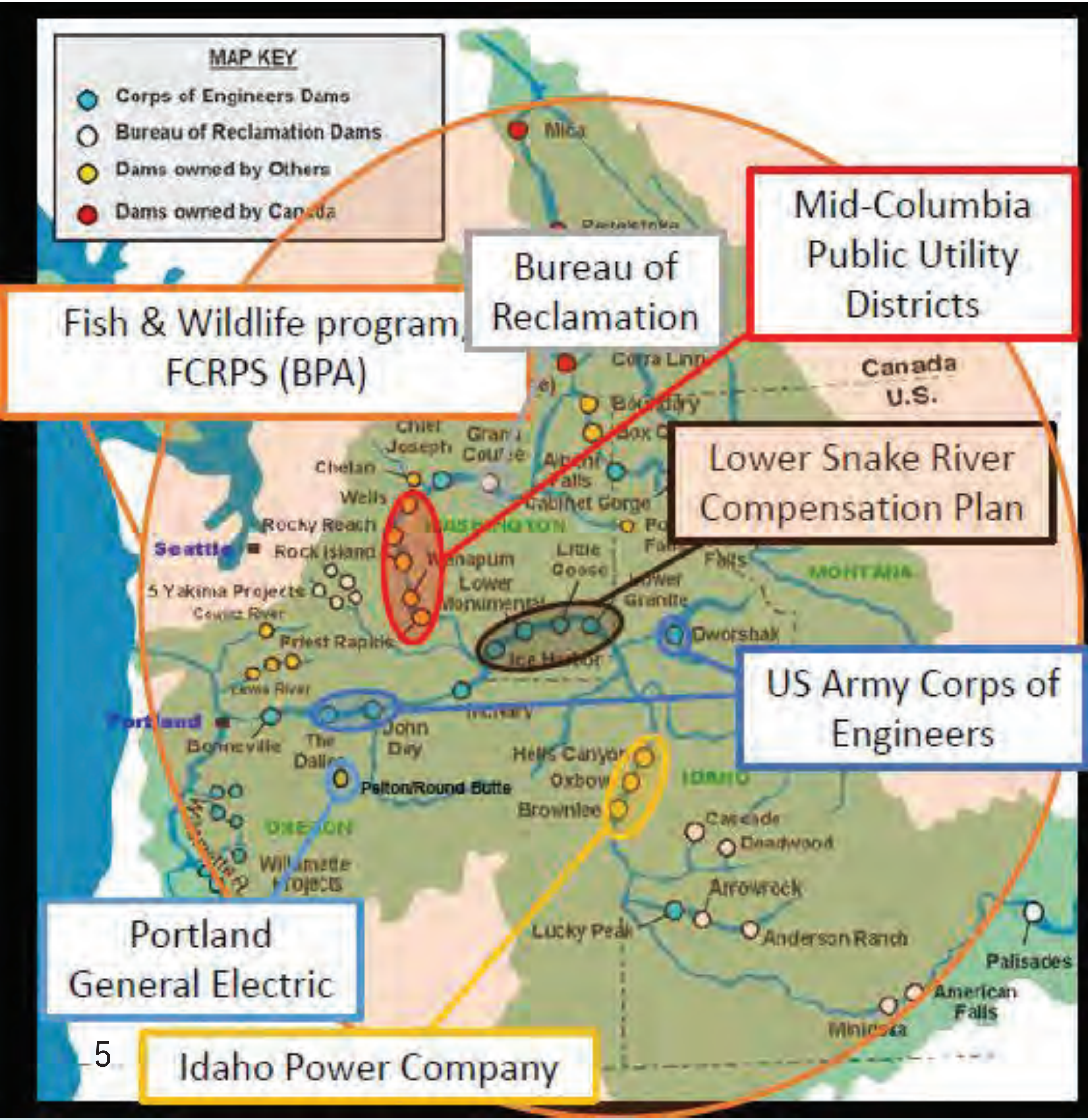
Puget Sound Domain
- Puget Sound Chinook (T) [FCH 9/2/05]
- Hood Canal Summer Chum (T) [FCH 9/2/05]
- Ozette Lake Sockeye (T) [FCH 9/2/05]
- Puget Sound Steelhead (T) [CH under dev.; ANPR 1/10/11]

Willamette/Lower Columbia Domain
- Columbia River Chum (T) [FCH 9/2/05]
- Lower Columbia River Coho (T) [CH Under dev.; ANPR 1/10/11]
- Lower Columbia River Chinook (T) [FCH 9/2/05]
- Lower Columbia River Steelhead (T) [FCH 9/2/05]
- Upper Willamette River Chinook (T) [FCH 9/2/05]
- Upper Willamette River Steelhead (T) [FCH 9/2/05]

Oregon Coast Domain
- Oregon Coast Coho (T) [FCH 2/11/08]

Interior Columbia Domain
- Snake River Sockeye (E) [FCH 12/28/93]
- Snake River Fall Chinook (T) [FCH 12/28/93]
- Snake River Spring/Summer Chinook (T) [FCH 12/28/93; 10/25/99]
- Snake River Steelhead (T) [FCH 9/2/05]
- Upper Columbia River Spring Chinook (E) [FCH 9/2/05]
- Upper Columbia River Steelhead (T) [FCH 9/2/05]
- Middle Columbia River Steelhead (T) [FCH 9/2/05]





191 Hatchery Programs Columbia Basin !

And other hatchery programs funded by:

- Oregon, Washington, Idaho
- Mitchell Act
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Graphic from Becky Johnson, Nez Perce Tribe, 2020.

History of HGMPs

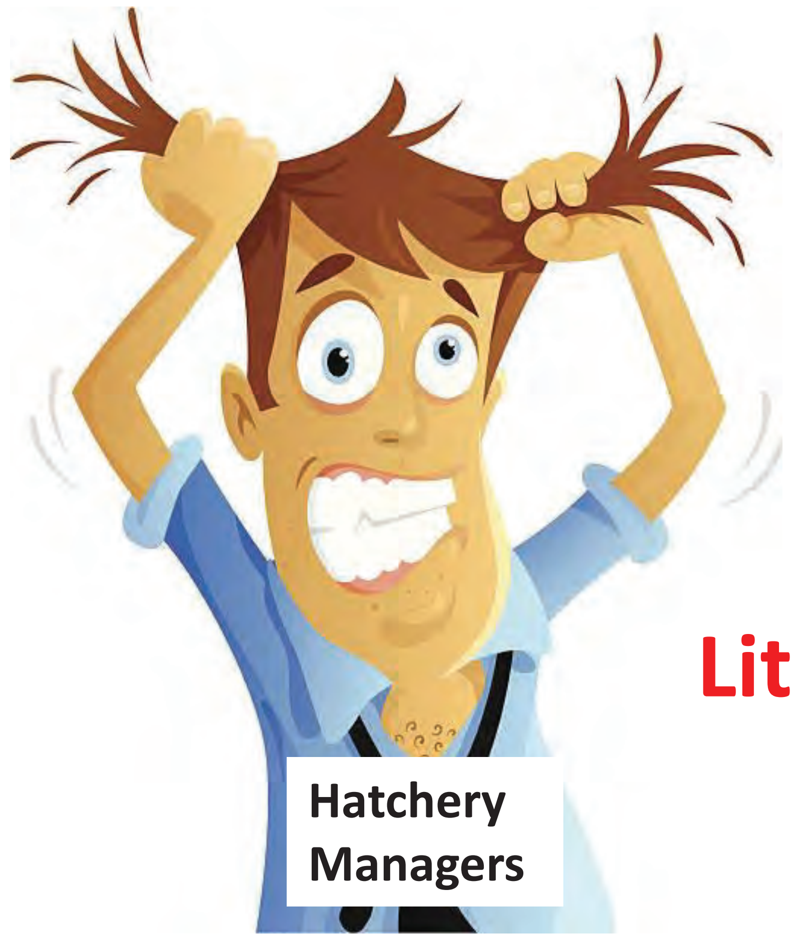
- Effects analysis required.
- Coordination Among the Co-Managers.
- Accountability.
- Adaptive Management.

Not Enough Fish

Too Many Fish

ESA

NEPA



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- 90%+ hatchery programs have (or have had) ESA authorization
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Region's Accomplishments: Coordination Among the Co-Managers

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- Funding Reviews
- Great coordination & collaboration

Region's Accomplishments: Avoiding Extinction

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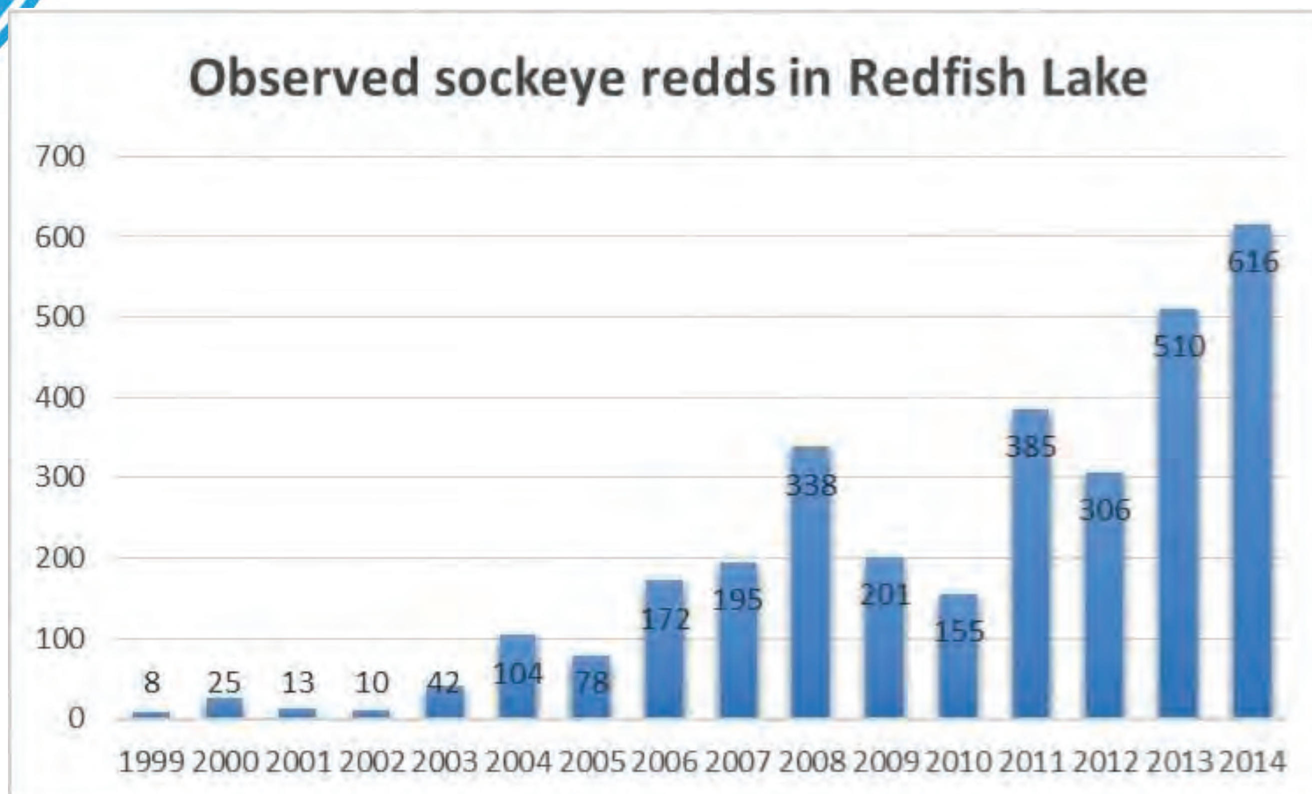

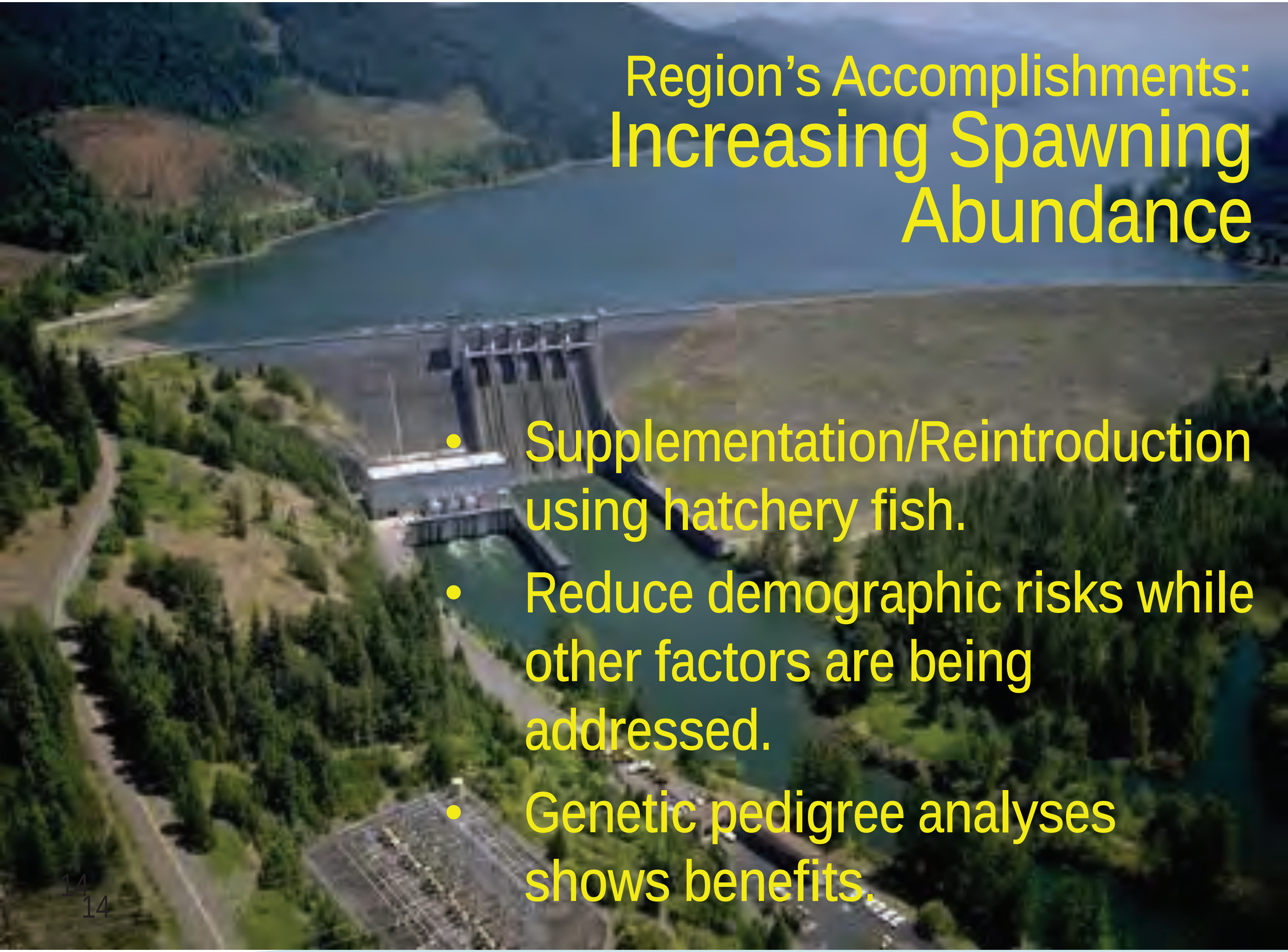

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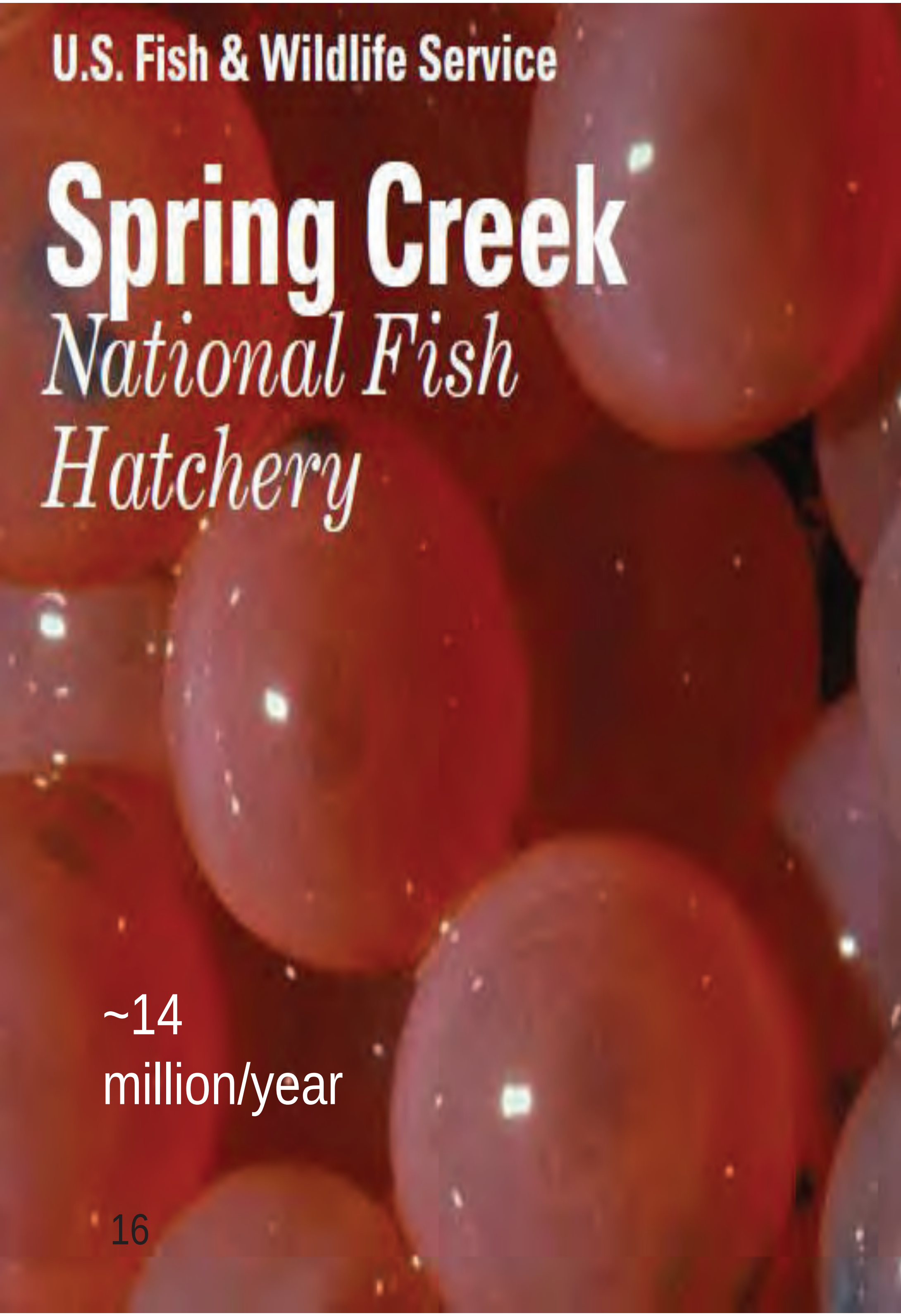

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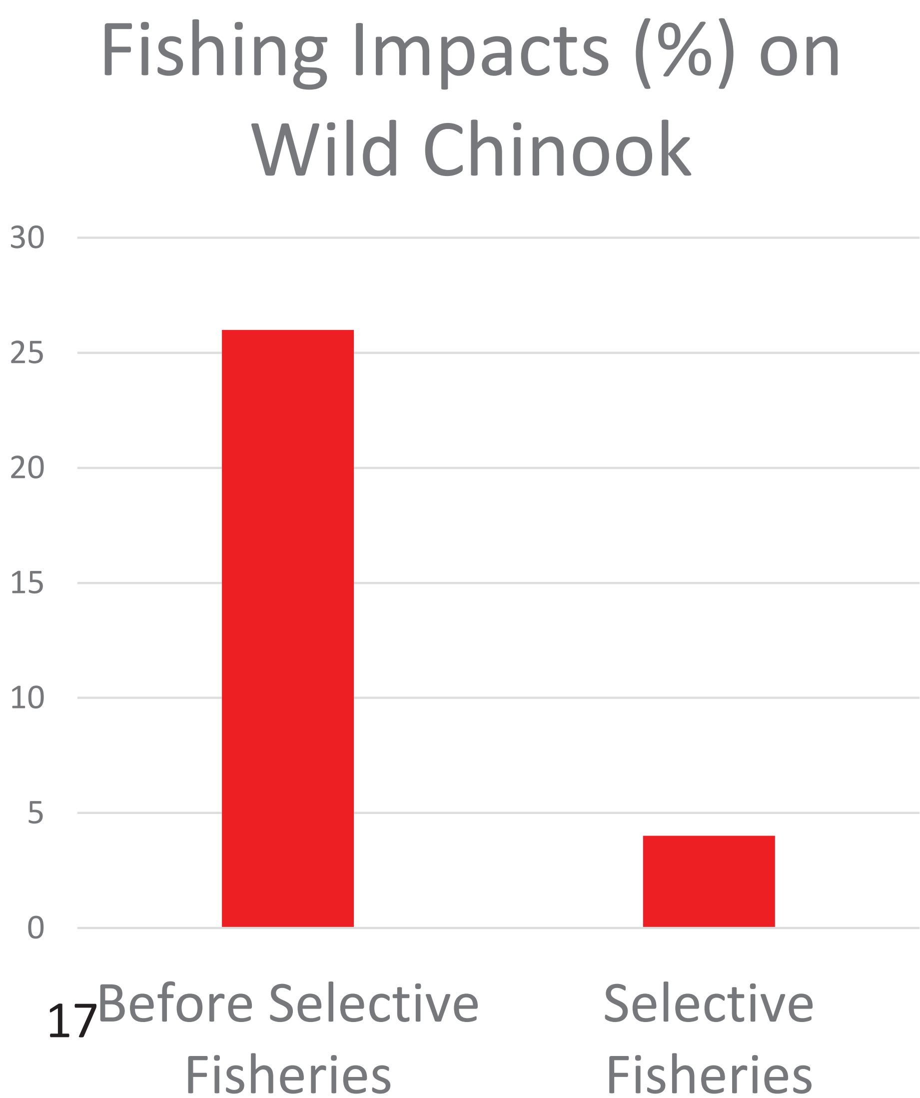
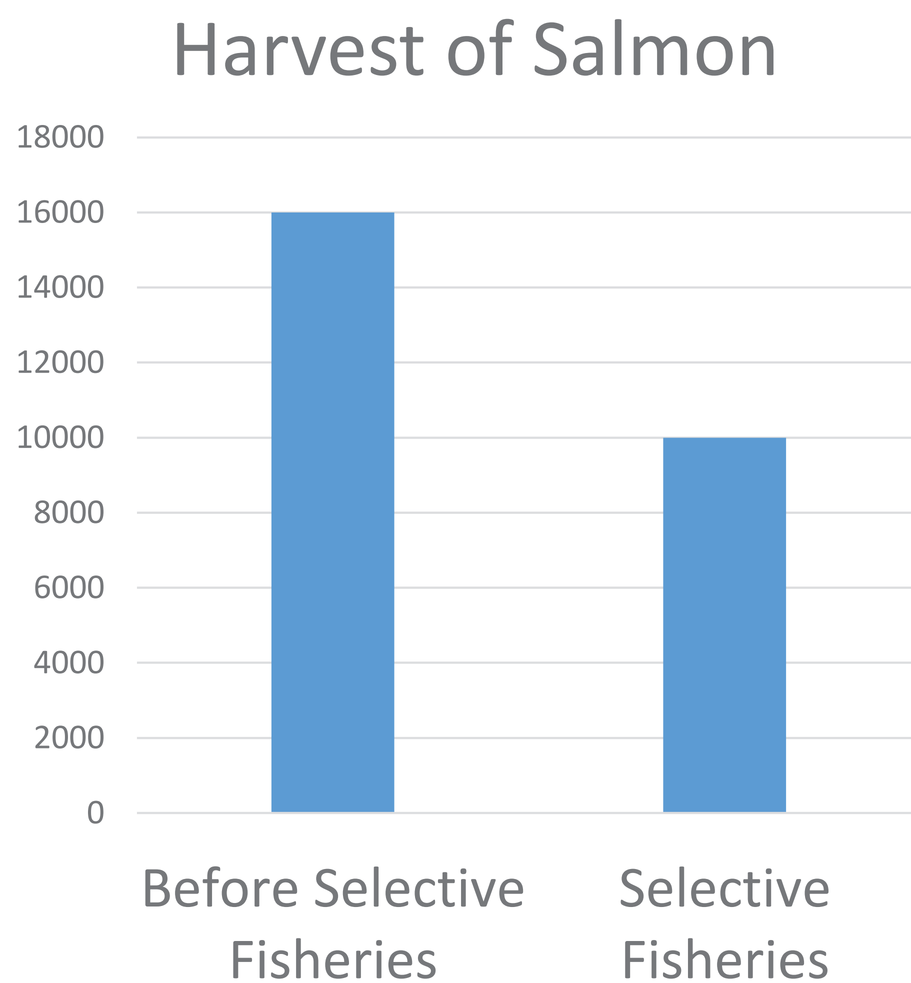
Lower Willamette Spring Chinook Fishery





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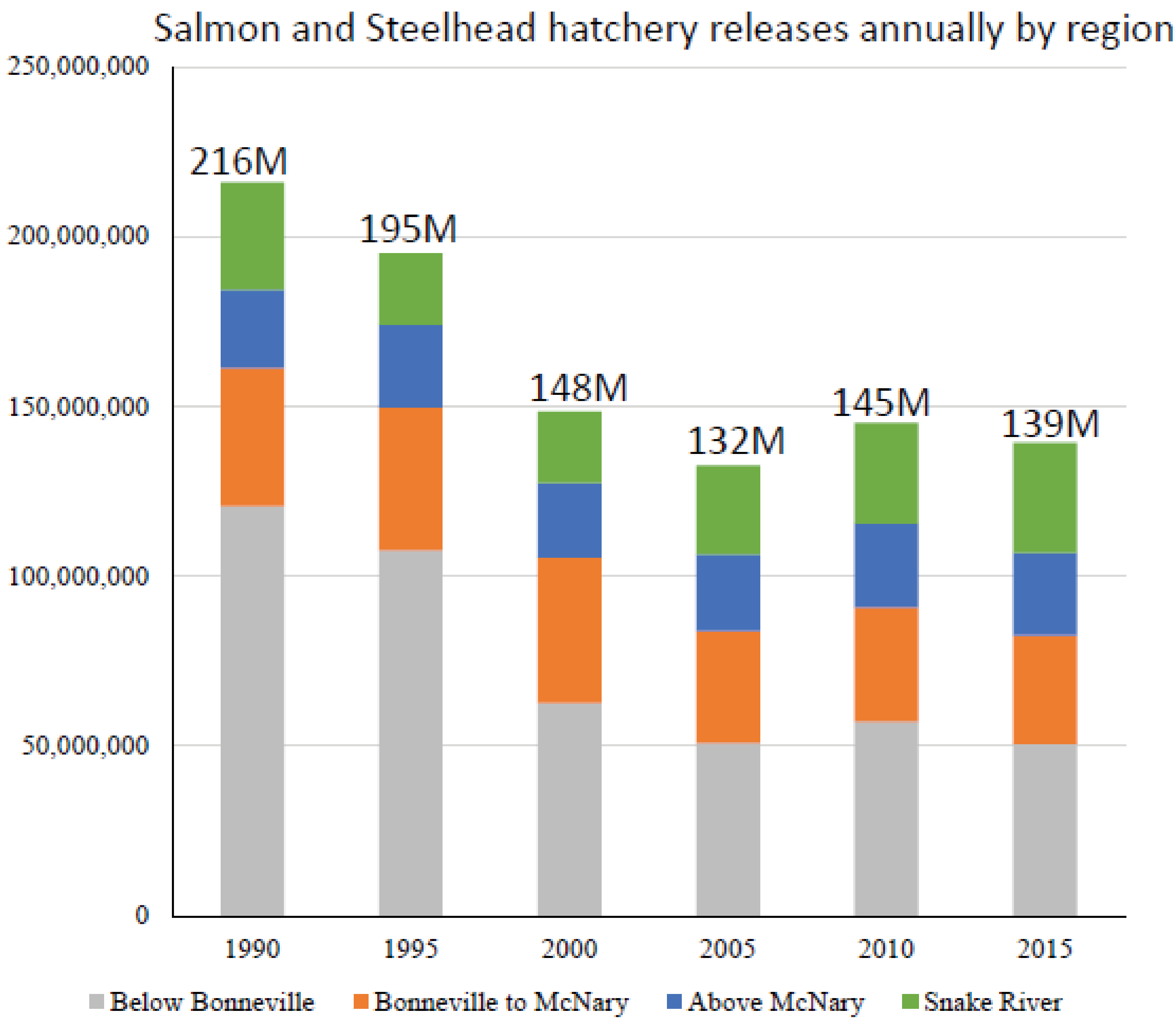
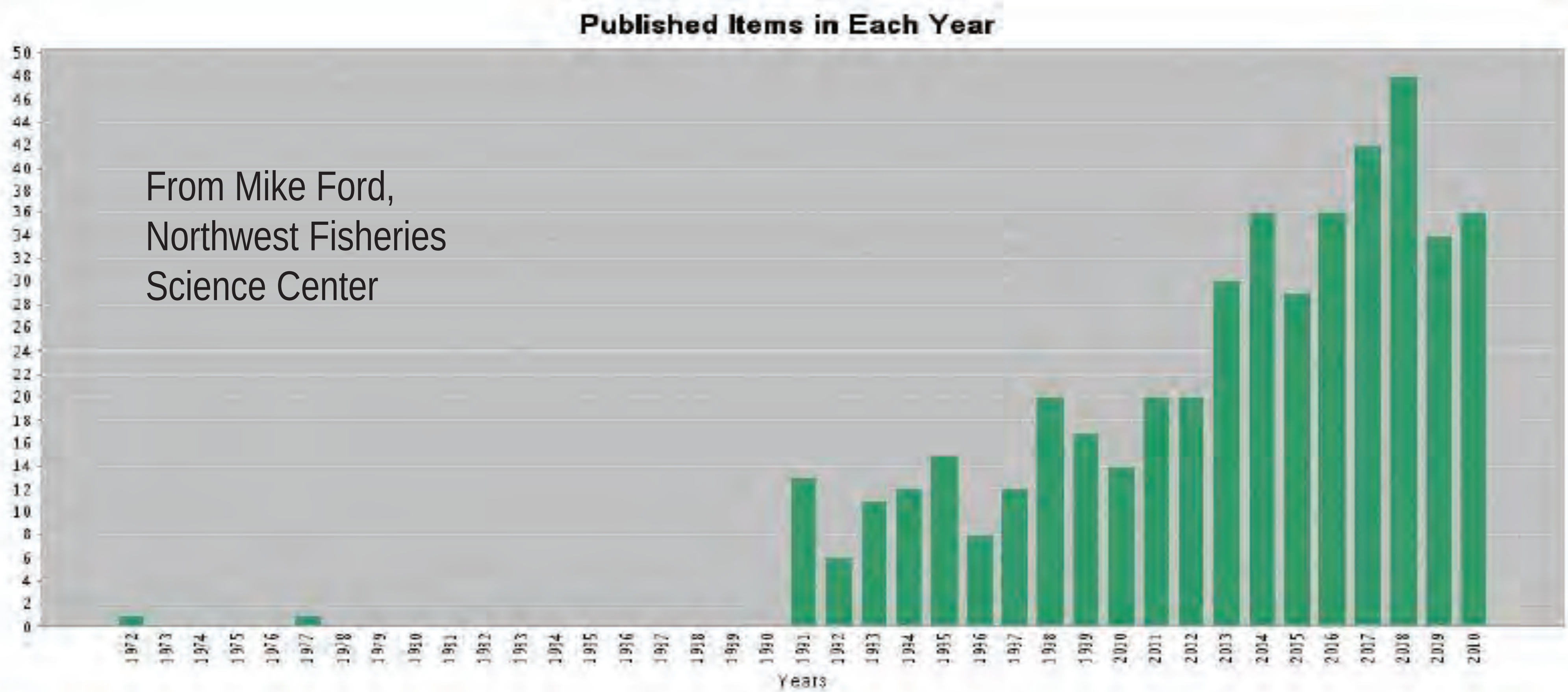


From Becky Johnson, Nez Perce Tribe

Region's Accomplishments:
Facility Upgrades

Region's Accomplishments:

Research, Monitoring, Evaluation



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Thanks For Your Time

Credit USFWS

Hatchery and Genetic Management Plans: NOAA's Update

Lance Kruzic
Hatcheries & Inland Fisheries Branch

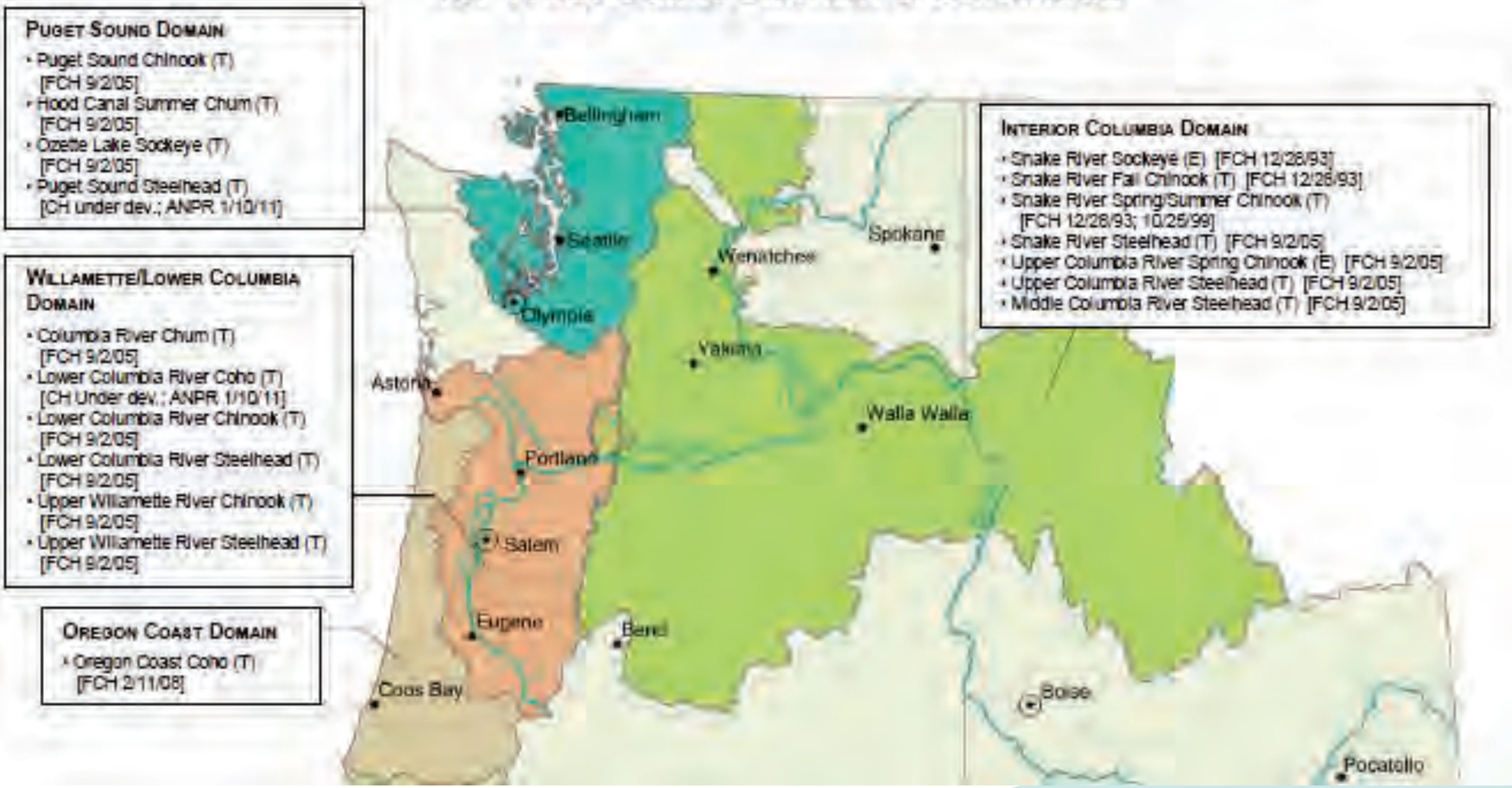
For Today

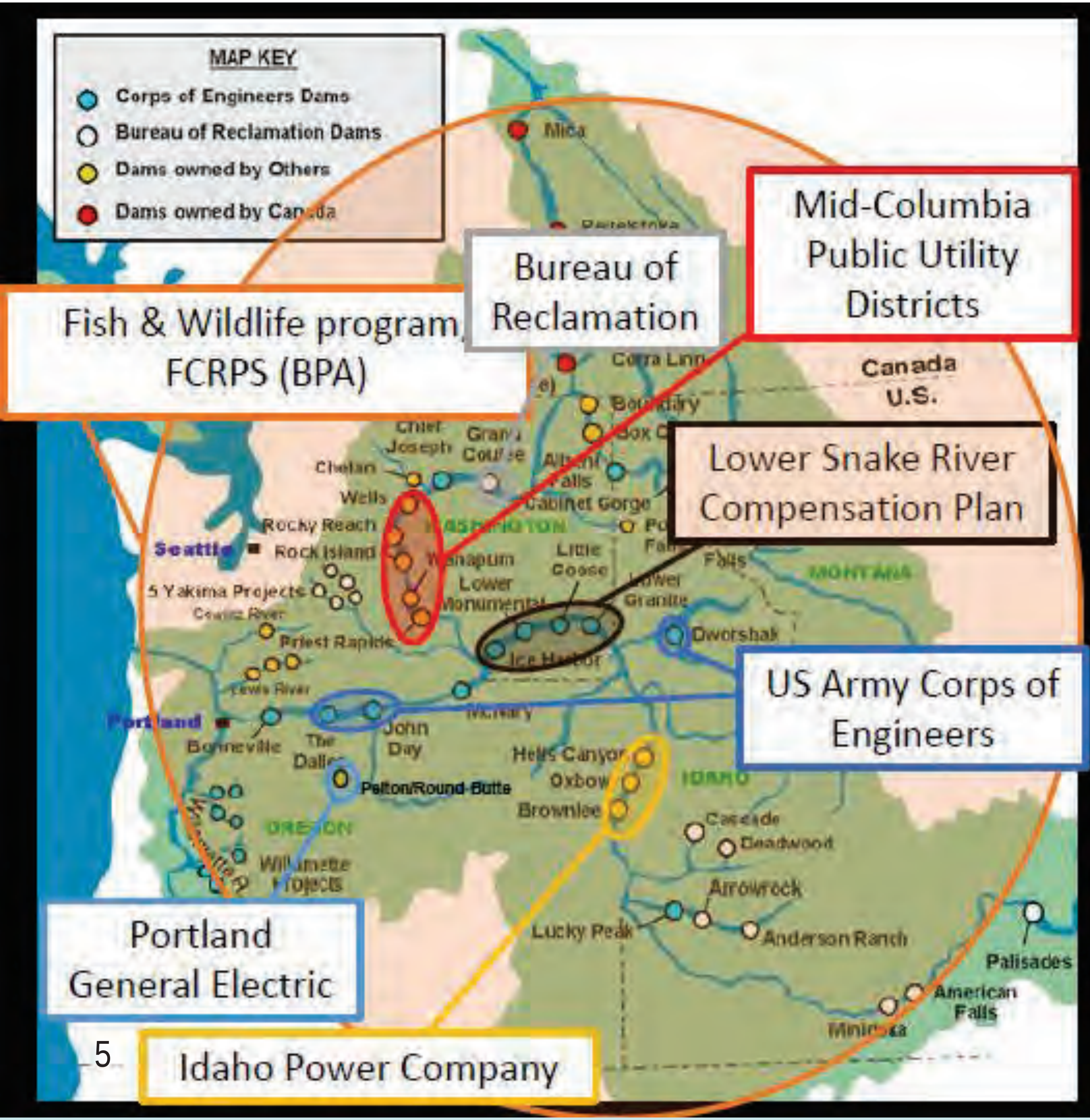
- History of Hatchery and Genetic Management Plans (HGMPs).
- Highlight Some of the Region’s Accomplishments Through HGMPs.

What is a Hatchery and Genetic Management Plan (HGMP)?

- Document describing all aspects of a particular hatchery program:
- Program Objectives & Standards
- Hatchery Operations
- Adult Management (fisheries, spawning)
- Research, Monitoring, Evaluation
- Coordinated Among the Co-managers
- Adaptive

Status of ESA Listings & Critical Habitat Designations for West Coast Salmon & Steelhead





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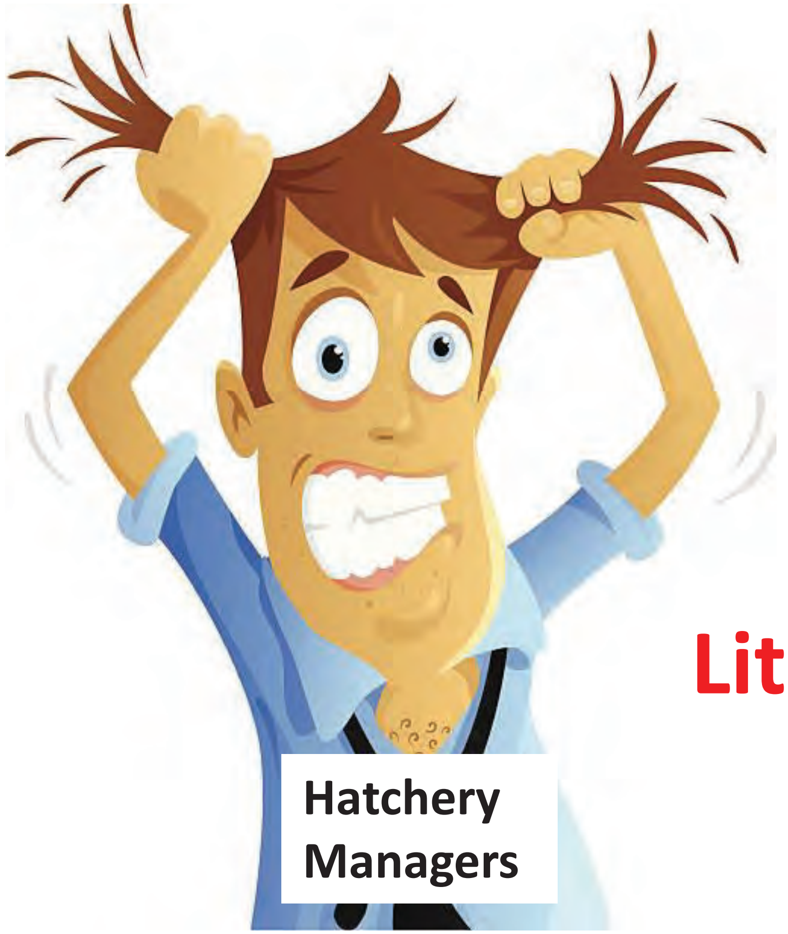

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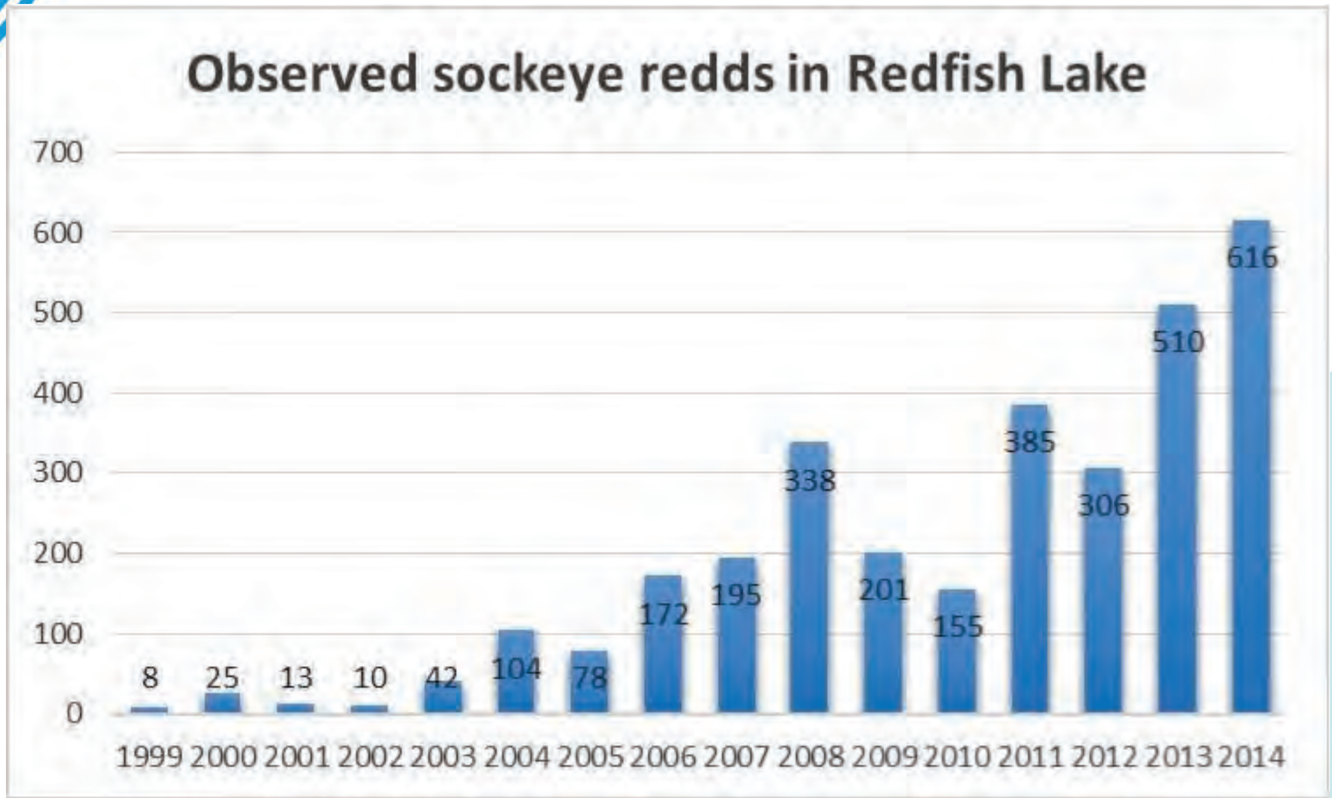

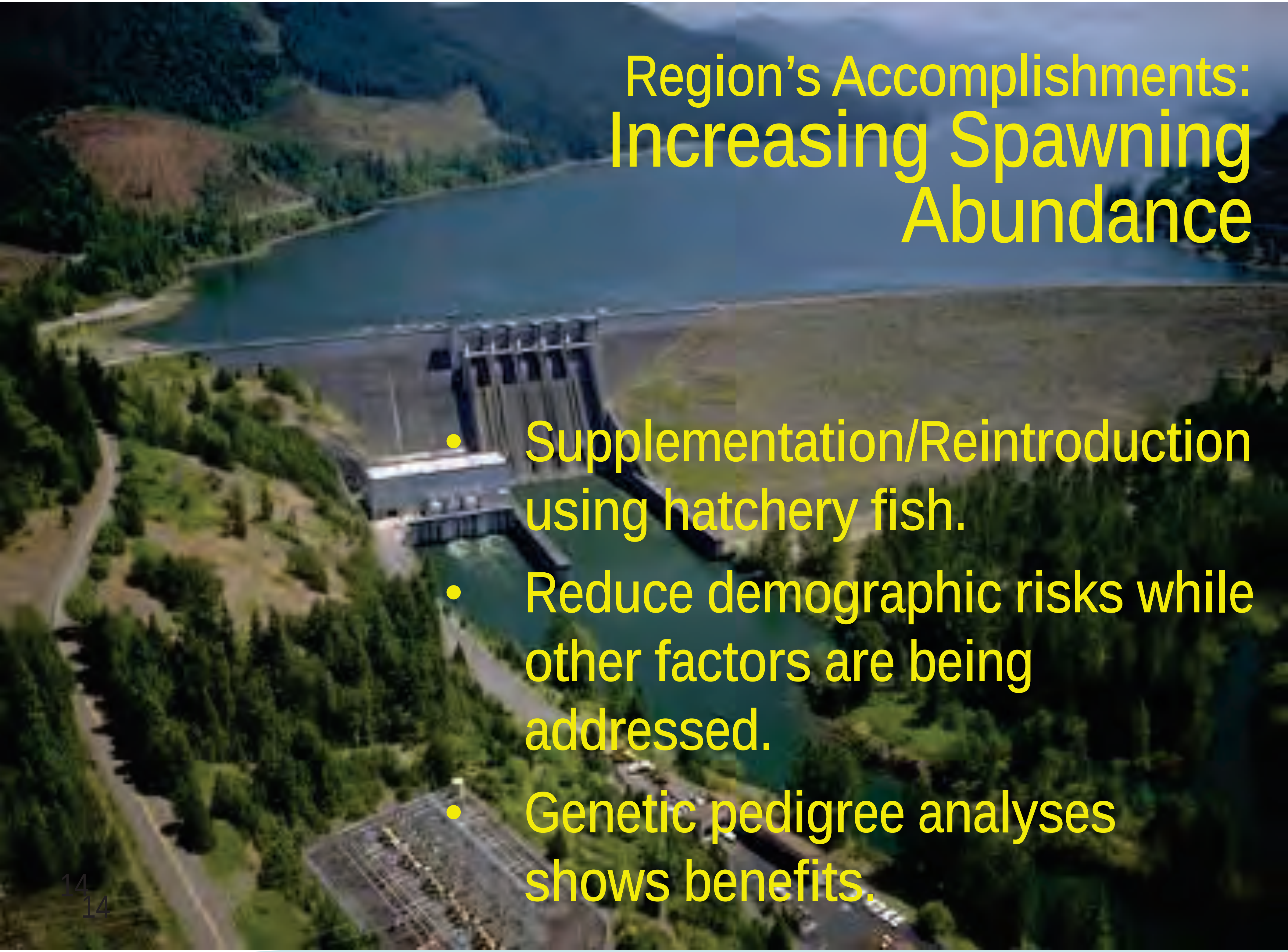

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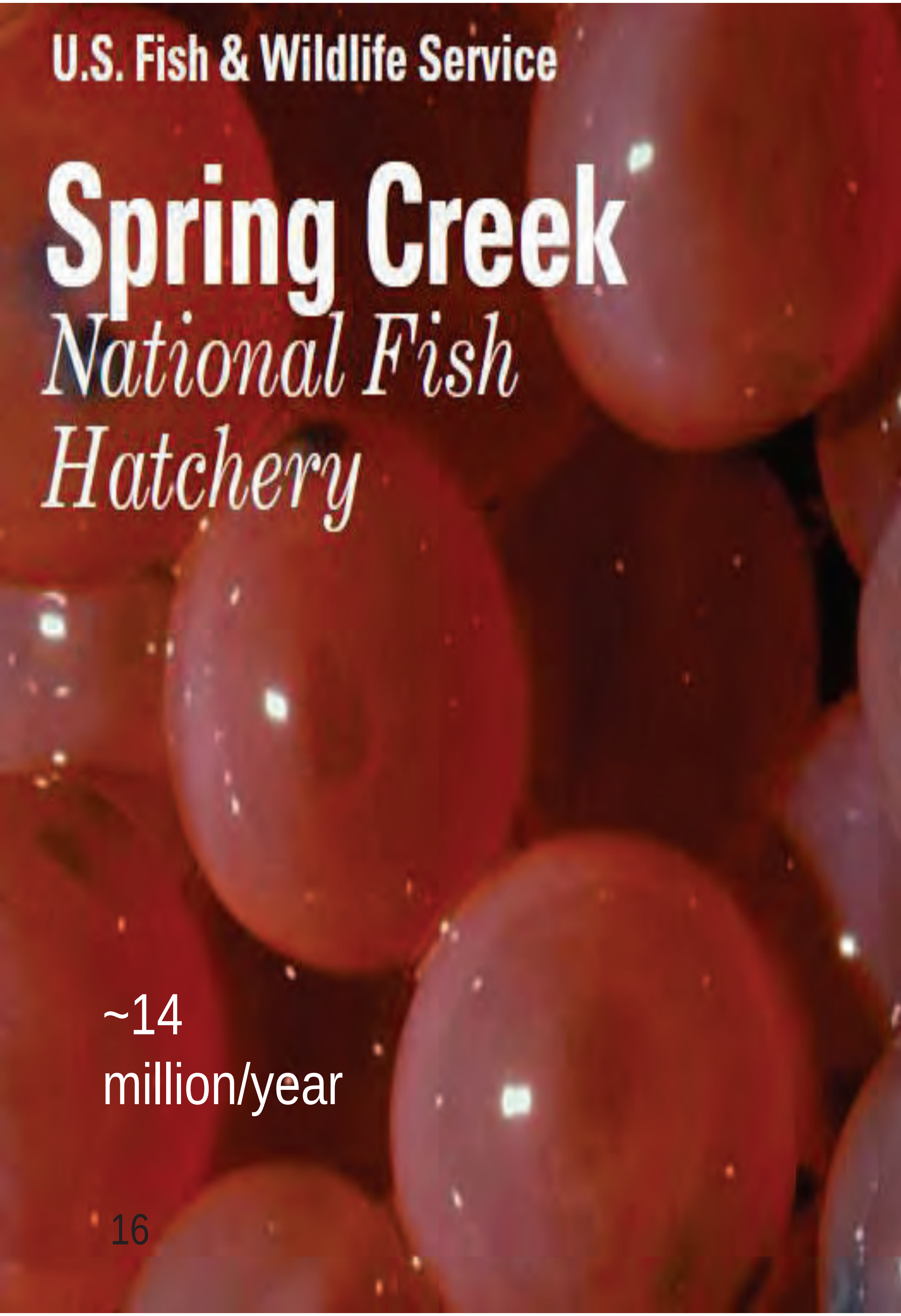

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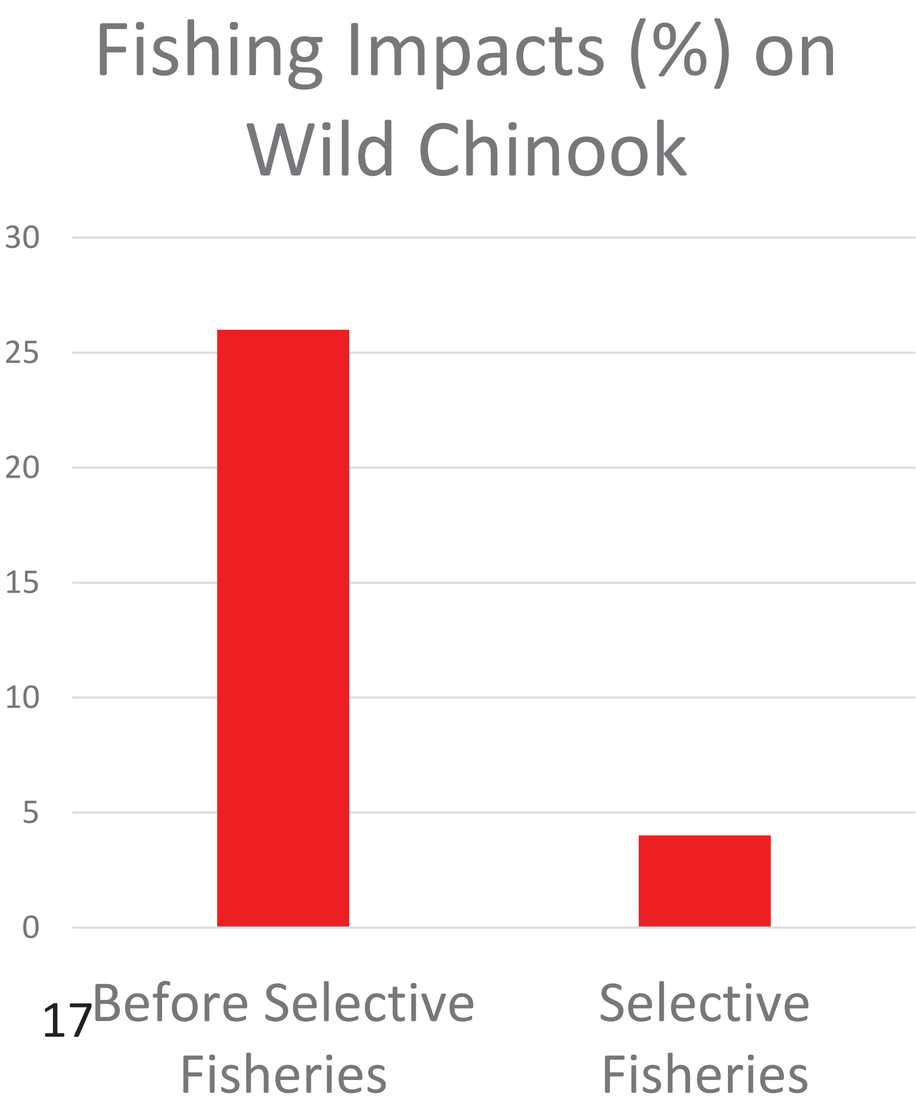

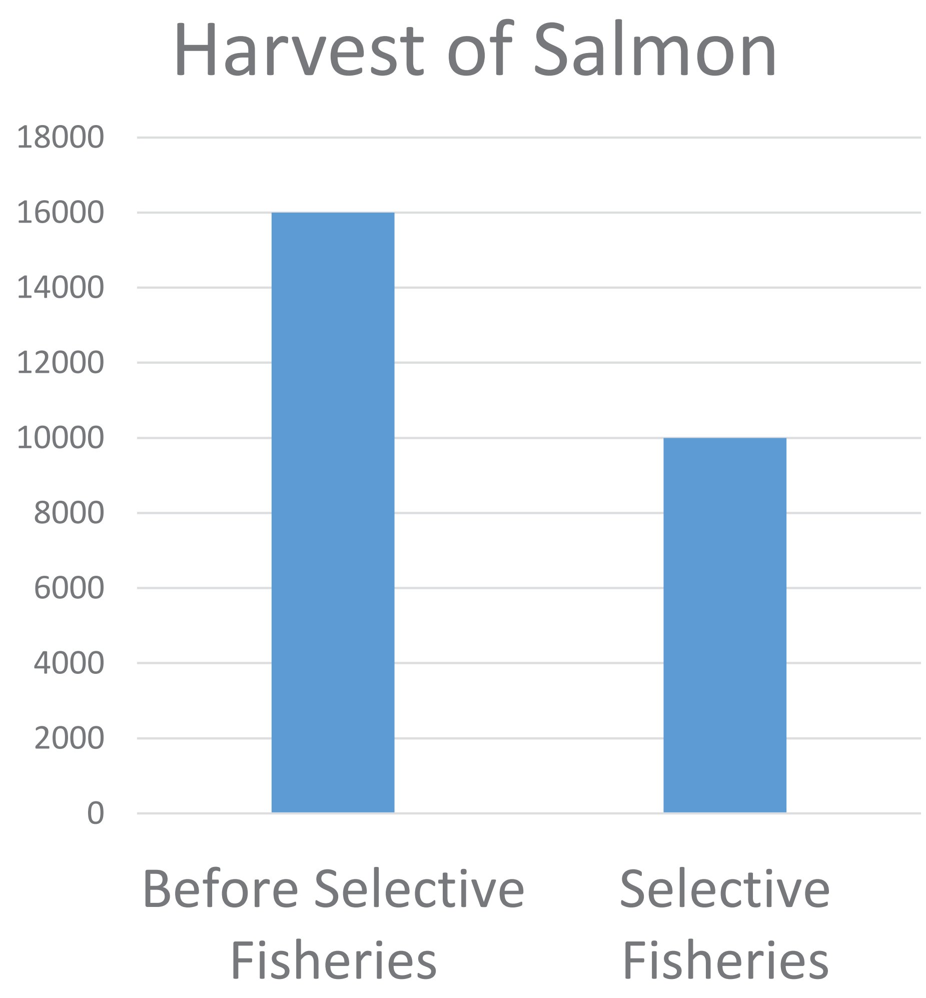

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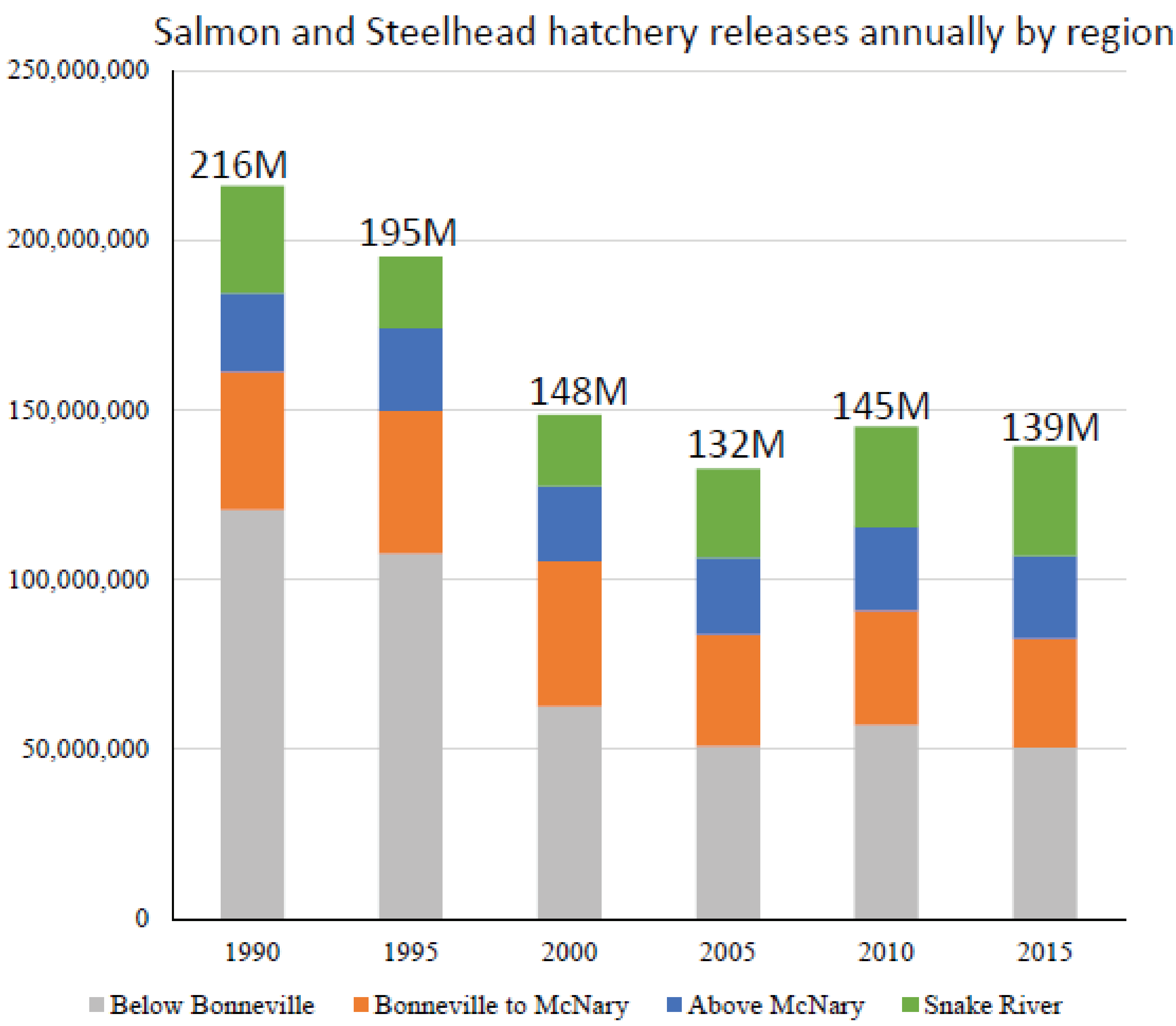
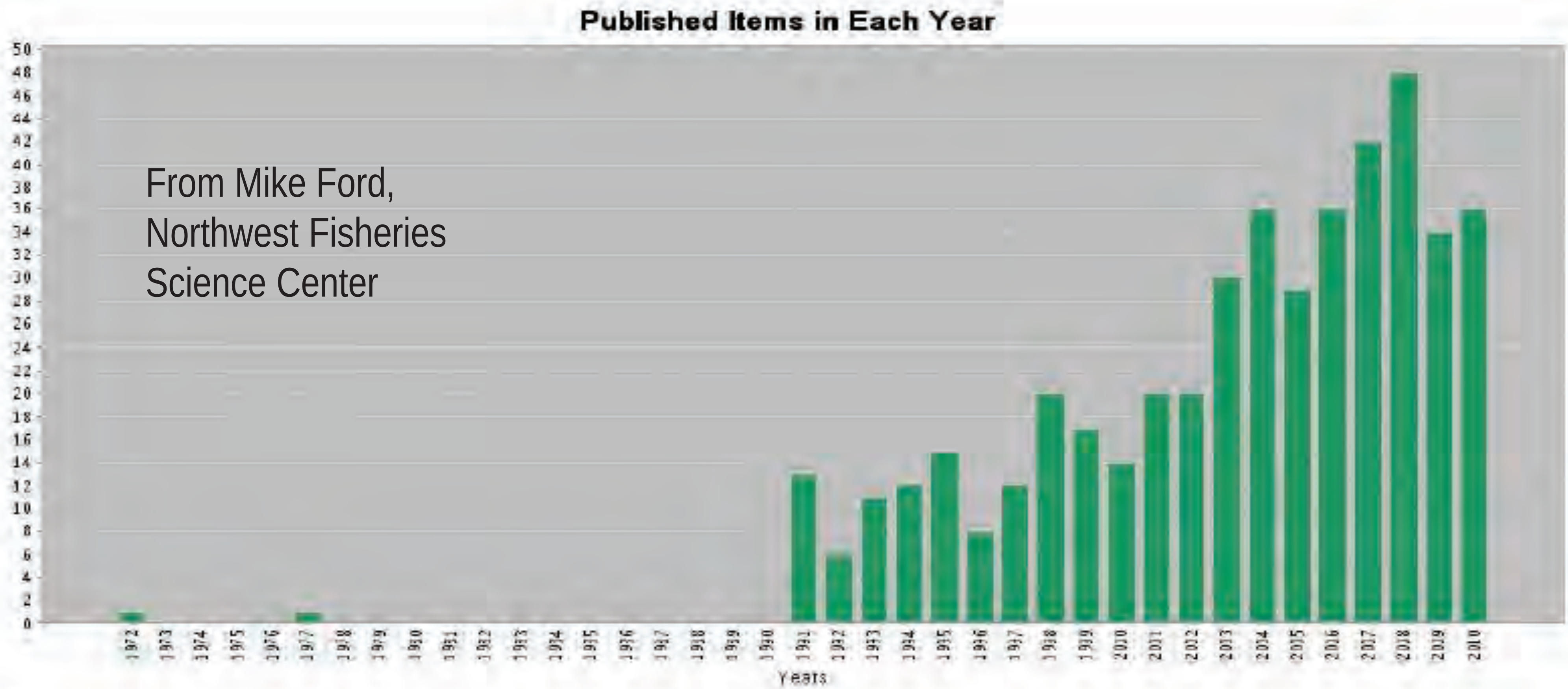


From Becky Johnson, Nez Perce Tribe

Region's Accomplishments: Facility Upgrades

Region's Accomplishments: Research, Monitoring, Evaluation

From Mike Ford, Northwest Fisheries Science Center



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Credit USFWS

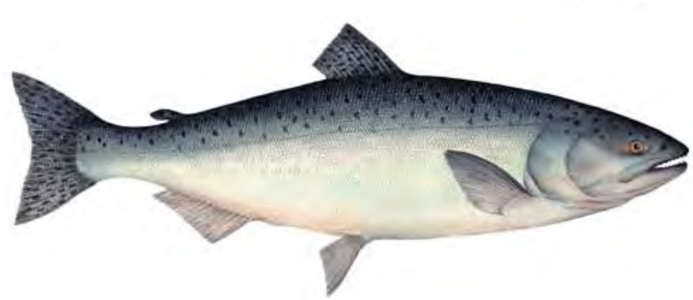
BPA sponsored research informing hatchery activities in the Columbia River Basin: Projects 1993-056-00, 2002-031-00, and 1989-056-00

Prepared by:
Christopher P. Tatara, P.I. Project 1993-056-00, Advance Hatchery Reform Research
National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest Fisheries Science Center, Environmental and Fisheries Sciences Division, Manchester Research Station, 7305 Beach Drive East, Port Orchard, WA 98366

Don Larsen and Brian Beckman P.I.s Project 2002-031-00, Growth Modulation in Salmon Supplementation
National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest Fisheries Science Center, Environmental and Fisheries Sciences Division, 2725 Montlake Boulevard East, Seattle, WA 98112

Ewann Berntson, P.I. Project 1989-056-00, Genetic Monitoring and Evaluation (M&E) Program for Salmon and Steelhead
National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest Fisheries Science Center, Conservation Biology Division, Manchester Research Station, 7305 Beach Drive East, Port Orchard, WA 98366

Steelhead
Onchorhynchus irideus



Chinook Salmon
Onchorhynchus tshawytscha

Executive Summary

This report was prepared by NOAA Fisheries, Northwest Fisheries Science Center (NWFSC) project Principal Investigators in response to a request by Northwest Power and Conservation Council (NWPCC) staff.

In this report we briefly review three separate, on-going Bonneville Power Administration (BPA) sponsored research projects that examine issues related to hatchery rearing and supplementation of Chinook salmon and steelhead in the Columbia and Snake River Basins. Two projects focus on the effects of hatchery rearing environments on resulting phenotypes of both smolts and returning adults. The third project is concerned with evaluating the nature and extent of genetic impacts on out planted hatchery stocks to both targeted and non-targeted natural stocks.

The first two projects have clearly demonstrated that choices made about hatchery rearing conditions have profound effects on smolt performance, adult phenotypes, and may potentially reduce the effects of domestication selection. The 2019 ISRP review (https://www.nwcouncil.org/reports/isrp2019-2) recognized the implications of project results on Columbia River Basin Hatchery Programs.

199305600 - Advance Hatchery Reform Research

"This project is designed to provide information on whether hatchery culture coupled with natural steelhead growth patterns, behavior, and physiology, can limit domestication effects. Importantly too, the project will help elucidate the mechanisms responsible for domestication and provide insights into how or whether inadvertent domestication can be alleviated when steelhead are artificially reared."

200203100 - Growth Modulation in Salmon Supplementation

"This is a highly relevant and practical research project that addresses key uncertainties involving survival and maturation rates of hatchery Chinook salmon and the potential effects of hatchery supplementation on natural and hatchery production. Results from this project may be used to help develop hatchery rearing regimes that minimize early male maturation rates and improve hatchery smolt-to-adult survival rates (SARs) while minimizing negative impacts to protected natural stocks, including resident fishes. Based on the findings of this project, all Chinook salmon hatcheries in the Columbia Basin should test for and estimate the production of minijacks."

The third project continues to document intended and unintended effects of outplanting hatchery-reared fish into targeted and nontargeted (wild) populations in the Snake River Basin. Annual genetic monitoring of juveniles from reference sites combined with an intensive investigation of relative reproductive success (RRS) of hatchery and natural fish in three river systems makes it an essential part of hatchery reform and provides information that is critical when using widespread hatchery propagation for recovery of natural populations. Remarks in the 2019 ISRP review reflect the essential and innovative nature of this project's investigations (https://www.nwcouncil.org/reports/isrp2019-2):

198909600 - Genetic Monitoring and Evaluation (M&E) Program for Salmon and Steelhead

"This is a well-developed and well-designed proposal to increase our understanding of the effects of artificial propagation on salmonid populations. The project is credited with pioneering many of the genetic monitoring tools now widely used by salmon researchers. It has consistently provided valuable information to regional managers and helped others within and outside of the Basin to address issues raised in FCRPS BiOp RPAs and the Fish and Wildlife Program."

Among the three NWFSC projects, hatchery managers receive comprehensive information directly relevant to both "nature" and "nurture" aspects of artificial propagation in general and supplementation of threatened populations in particular. These studies continue to respond to specific management problems with the most advanced molecular and bioanalytical methods available. Many results have been actionable, but even when managers were unable to act on new information, BPA-funded supplementation research at the NWFSC has transformed understanding of Columbia and Snake River Basin Chinook and steelhead. We know a great deal more about these animals, and we have infinitely more powerful tools to measure the results of management action.

The broad application of the results described for these projects could be focused by a better understanding and categorization of hatchery rearing programs and environments in the Columbia and Snake River Basins. At the end of this report, we make direct recommendations regarding what information is needed to initiate this effort.

Background

The Northwest Power and Conservation Council (NWPCC) and Bonneville Power Administration (BPA) programs support numerous supplementation programs to assist in recovery of Chinook salmon and steelhead trout listed as threatened or endangered under the Federal Endangered Species Act (ESA). In an effort to release fish that are ecologically, genetically, and phenotypically similar to their wild cohorts a number of rearing guidelines for supplementation programs have been made by the Hatchery Scientific Review Group (HSRG) (http://www.hatcheryreform.us/hrp/reports/system/welcome_show.action). Hatchery Reform Efforts in the Columbia River Basin have focused on two central themes

- Genetic management of broodstocks and escapement of natural spawners (i.e., the proportions of hatchery- and natural-origin fish)
- Hatchery culture practices.

Whereas the genetic composition of hatchery brood stocks can have a significant effect on fitness and performance, it is undeniable that husbandry practices and the hatchery environment also play an important role, and that the genetic and environmental factors ultimately interact to determine the outcomes and performance of hatchery programs. Research conducted at the NOAA Fisheries, Northwest Fisheries Science Center, Seattle, WA directly address these two major themes in hatchery steelhead and Chinook salmon. Project # 198909600 "Genetic Monitoring and Evaluation (M&E) Program for Salmon and Steelhead" is focused on brood stock management and interactions among spawning individuals on natural spawning grounds.

Project #200203100 "Growth Modulation in Salmon Supplementation" and Project #199305600 “Advance Hatchery Reform Science” focus on hatchery culture practices for Chinook salmon and steelhead, respectively. It is important to note that Chinook salmon and steelhead have very unique and complex life history differences including, but not limited to the following:

- Chinook salmon are semelparous and steelhead trout are iteroparous
- Freshwater residency – Chinook salmon (moderate and only males) vs. steelhead trout (extensive and both males and females)
- Chinook salmon resident life-histories provide a modest source of genetic variability. Steelhead residents may provide a significant source of genetic variability.
- Spawn timing of Chinook (Summer-Fall) vs. steelhead (Winter-Spring)
- Anthropogenic alterations (hatchery culture, dams, climate change) could have very unique and complex life history and environmental differences

These life history differences demand the need for independent research tracks for these two species, but extensive collaboration among projects across hatchery facilities in the Columbia River Basin and at the NWFSC provides a unique economy of scale with regard to facilities, diagnostic tools and expertise.

Project #199305600 “Advance Hatchery Reform Science”

Project #199305600 “Advance Hatchery Reform Science” focuses on Basin-wide efforts to improve the management and performance of hatchery programs for steelhead trout and the methods used to improve conservation hatchery operations. Research is conducted at hatchery (Winthrop National Fish Hatchery) and laboratory scales (NWFSC, Manchester Research Station) using the Methow River summer steelhead population (ESA-listed Threatened). Rearing methods were developed and tested with conservation hatcheries and natural-origin broodstock in mind, but apply to hatchery steelhead populations across the Columbia and Snake River Basins to support harvest and recovery

This project focuses on understanding the mechanisms of fitness loss in hatchery-reared steelhead, and using this information to manipulate hatchery rearing practices to reduce domestication selection and improve fitness. The project aims to provide hatchery rearing solutions that provide for sustainable fisheries and align with ESA recovery efforts including:

- Improve smoltification rates
- Improve post-release survival
- Increase migration speed
- Reduce precocious male maturation
- Reduce residualism rates
- Reduce potential for ecological interactions
- Minimize fitness loss
- Reduce domestication
- Maintain life history diversity
- Improve smolt-to-adult return

Primary Research Hypotheses:

(1) The mismatch between hatchery-imposed life history and natural life history of steelhead contributes toward domestication selection for rapid growth resulting in fitness loss.

(2) Hatcheries with a fixed age-at-smoltification (age-1 or age-2) reduce the natural life history diversity required for conservation and recovery of ESA-listed populations.

(3) Simple modifications to existing hatchery practices for steelhead can reduce selective pressure of the hatchery environment and improve fitness of hatchery-reared steelhead.

Hatchery steelhead are almost exclusively raised as 1-year-old smolts (S1), rather than the more typical 2-and 3-year-old (S2 and S3) natural smolt life history patterns (Berejikian et al. 2012). How steelhead are raised in hatcheries alters the proportions of smolts, parr, and precocious males at release (Figure 1). High growth rates associated with accelerated hatchery rearing to a 1-year-old smolt life history may contribute to maladaptive behavioral traits and reduced post-release survival and may constitute a primary mechanism leading to reduced fitness in hatchery steelhead (Berejikian et al. 2017, Tatara et al., accepted). The project has also focused on how and when to extend hatchery rearing to produce S2 smolts. S2 rearing can provide the following benefits when compared to S1 rearing (Berejikian et al. 2012, 2019; Tatara et al. 2017, 2019):

- Increased use of natural origin broodstock
- Maintenance of natural spawn timing
- Reduced selection for rapid growth
- More uniform size distribution [lower coefficient of variation (CV)]
- Increased smoltification
- Greater or equivalent survival
- Faster migration
- Similar residualism rates
- Similar reproductive success of females spawning naturally

Figure 1: Developmental state of hatchery steelhead prior to release. Four classes of steelhead are typical of hatchery rearing (parr, transitional, smolt, and mature male) and the proportions vary with rearing methodology and broodstock source. It is desirable to produce a high proportion of smolts and transitional steelhead, as parr and mature males residualize with consequences for limiting ecological interactions and genetic management of integrated populations. (Photo credit, Michael Humling, USFWS)

Further refinements that tailor hatchery environments to juvenile growth rate hold promise for improving smoltification and reducing precocious maturation. Instead of using a fixed age-at-release for all steelhead (S1 or S2), the new method sorts steelhead fry within 9 weeks of ponding. The growth of larger fry is accelerated to produce S1 smolts, while growth is restrained during extended rearing for the remaining fry to produce S2 smolts. The proportion to allocate to S1 and S2 rearing depends on the spawning date of the broodstock and the thermal profile of the hatchery rearing water, which vary considerably among hatchery programs. We are currently developing high throughput automated sorting procedures and proportional allocation guidance according to these two variables for application of the method across Columbia Basin steelhead hatcheries (see deliverable 6).

Table 1. Current research timelines for deliverables of proposed research for Project 1993-056-00. Details regarding each deliverable are available in the 2019 proposal (link to full proposal provided below). Note all timelines were derived prior to the COVID-19 pandemic and may need to be revised.

Deliverable	**Description**	**Timeline**
1	Assess how growth in culture under a split rearing regime (BY18-21) affects life history pathways and smolt quality.	Initiated April 2018, Complete 2023
2	Determine effects of a split-rearing regime on post-release behavior and survival, and selection on body size.	Initiated April 2018, Complete 2023
3	Determine effects of age-at-release on the fecundity of returning anadromous females.	Initiate 2021, Complete 2023
4	Determine effects of a split-rearing regime on survival throughout the migratory lifecycle.	Initiate 2023, Complete 2025
5	Identify behavioral and physiological traits under selection through laboratory-scale research.	Initiate 2021, Complete 2023
6	A tool for hatcheries to optimize smolt production using natural-origin steelhead broodstock.	Initiated 2019, Complete 2022

Most recent proposal: NPCC19-1993-056-00 – Advance Hatchery Reform Research (1993-56-00)

https://www.cbfish.org/Proposal.mvc/Summary/NPCC19-1993-056-00

2018 Annual Report: Advance Hatchery Reform Research (1993-056-00)

https://www.cbfish.org/Document.mvc/Viewer/P163756D

2019 Annual Report: Advance Hatchery Reform Research (1993-056-00)

https://www.cbfish.org/Document.mvc/Viewer/P170272D

Proposed research beyond 2023

The 2020 Biological Opinion for operations of the Columbia River System (NMFS 2020) addresses Conservation and Safety Net hatchery programs for steelhead and Chinook salmon. The Winthrop Steelhead Program is the only steelhead program specifically mentioned in the 2020 Biological Opinion for the Columbia River System. It is managed as an Integrated Conservation program and it is the research focus of project 1993-056-00. The Conservation hatchery program has a unique relationship to the Safety Net hatchery program for Methow River steelhead and to the Harvest hatchery program for steelhead at the Wells Dam Hatchery. The broodstocks used in these programs are derived from a common population but are separated by a minimum of two generations of hatchery influence. The Conservation program uses natural-origin broodstock (minimal hatchery influence), the Safety Net program uses broodstock that are the progeny from the Conservation program (one generation removed), and the Harvest program uses hatchery-origin broodstock (minimum of 2 hatchery generations removed from natural-origin broodstock). Future research efforts (beyond 2023) will focus on the differences in fitness related traits of steelhead produced in the three types of hatchery programs (Conservation, Safety Net, and Harvest) all derived from the ESA-threatened Upper Columbia River steelhead DPS. Impacts of domestication selection and fitness loss are hypothesized to become progressively stronger with each generation of hatchery influence experienced by the broodstock. Experimental designs measuring fitness, performance, and genetic parameters for the three programs will be developed and pursued. Comparisons among the three hatchery program types would provide information to guide hatchery operations, recovery efforts, and address critical uncertainties across the spectrum of artificial propagation activities for steelhead in the Columbia and Snake River systems.

Project 200203100 “Growth Modulation in Salmon Supplementation”

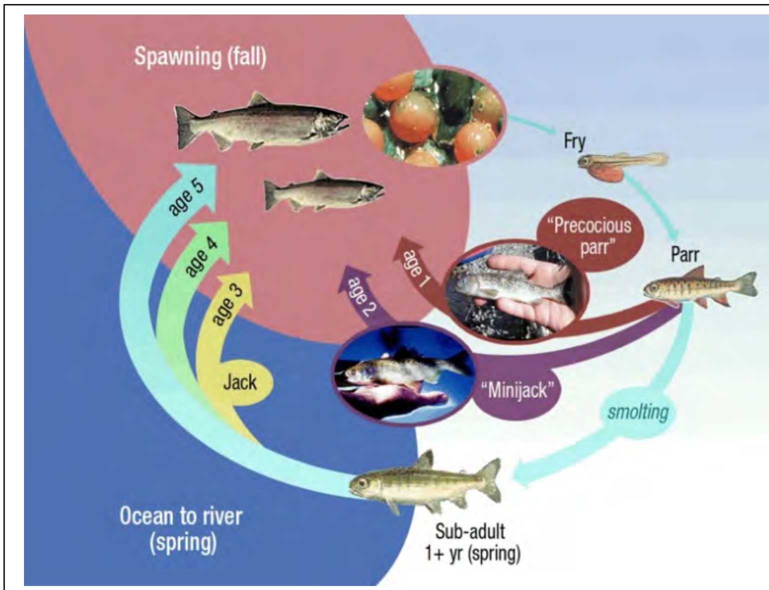


Figure 2. Life-history of Spring Chinook Salmon

The title "Growth Modulation in Salmon Supplementation" acknowledges that growth is a central driver of life-history ‘decisions’ in salmonid fishes and that hatchery rearing induced variation in growth may result in either advantageous or deleterious life history variation in smolts released from hatcheries. The project highlights the importance of understanding how hatchery rearing protocols may alter seasonal growth and size of juvenile fish and the subsequent smolt quality and life history variation of the fish hatcheries release. This project has a significant historical base in the Yakima River basin (Beckman and Larsen 2005; Larsen et al. 2004, 2006, 2010, 2014, 2019), but has broad scope and application in Chinook salmon hatchery reform throughout the Columbia and Snake River Basins (Harstad et al. 2013, 2018 Spangenberg et al. 2014; 2015, Beckman et al. 2017).

Guidelines for rearing of local broodstocks in supplementation programs have recommend that "naturally selected populations should provide the model for successful artificially reared populations, in regard to population structure, mating protocol, behavior, growth, morphology, nutrient cycling, and other biological characteristics (Columbia River Basin Fish & Wildlife Program Nov. 14, 2000)" In this project we refer to this guiding principle as the "Wild Fish Template (Beckman et al. 2000) " and include focus on the following:

- Seasonal growth rate, size and dietary lipid composition should match wild fish
- Mismatches in these factors may result in life-history differences including altered smolt migration timing, residualism, early age/small size at maturation, and reduced SARs.

Salmon hatcheries often rear fish with unnatural growth regimes and high lipid diets that can result in earlier age at maturity, most notably in males. We have documented that hundreds of thousands of age-2 minijacks are released each year from Chinook salmon hatchery programs throughout the Columbia and Snake River basins (range 7.9-71.4% of males depending on the program; Larsen et al. 2004, 2015; Harstad et al. 2014; Spangenberg et al. 2014; 2015; Beckman et al. 2017; Harstad et al. 2018). Minijack rates of hatchery fish have been estimated to be approximately 10x that of wild fish (Larsen et al. 2013).

The release of minijacks results in:

- Potential domestication of hatchery broodlines
- Significant loss in anadromous adult production
- Increased error in SAR estimates used for hatchery and hydroelectric project evaluations as these fish are not smolts (although they are enumerated as such)
- Increased residualism and interbreeding (via a 'sneaker strategy') with wild fish
- Contribute to low relative reproductive success in supplementation programs that produce high minijack rates (Ford et al. 2012)
- Competition with native fish for food and habitat.
- Wasted hatchery resources.
- Impediments to recovery via reduction in SARs.

Project Objectives

- Assess proportion of precociously maturing males produced in supplementation and conservation hatcheries for Chinook salmon in the Columbia River Basin
- Conduct both basic and applied research to determine causative affecting life-history
- Devise rearing protocols to enhance smolt development, reduce domestication selection.
- Produce fish with similar physiological, morphological and behavioral attributes as their wild cohorts.

Overarching Hypothesis: The use of the "Wild Fish Template" to guide hatchery reform efforts will.

- Reduce unnaturally high rates of early male maturation
- Limit domestication of hatchery broodstocks
- Decrease opportunity for unwanted hatchery/wild genetic introgression and ecological interactions
- Improve smolt development and increase SARs for hatchery Chinook salmon.

Links to most recent proposal

Proposal NPCC19-2002-031-00 - Growth Modulation in Salmon Supplementation (2002-031-00)

https://www.cbfish.org/FileResource.mvc/GetImageFile/8282ae03-e2e3-4926-b5b3-7c18b9d973e2

Links to last 2 annual reports

Growth Modulation in Salmon Supplementation (2002-031-00) Annual Report 2018
https://www.cbfish.org/Document.mvc/Viewer/P163602

Growth Modulation in Salmon Supplementation (2002-031-00) Annual Report 2019
https://www.cbfish.org/Document.mvc/Viewer/P170639

The research outlined in the current proposal has eight deliverables (Table 2).

Table 2. Current research timelines for deliverables of proposed research for Project 2002-031-00. Details regarding each deliverable are available in the 2019 proposal (link to full proposal provided below). Note all timelines were derived prior to the COVID-19 pandemic and may need to be revised.

Deliverable	Description	Timeline
1	Complete manuscript describing multi-brood year Growth Modulation Expt. With URB Umatilla R. Fall Chinook salmon	Initiated April 2011, Complete 2023
2	Complete manuscript exploring effects of alterations in emergence time on life-history of URB Fall Chinook salmon	Initiated April 2011, Complete 2021
3	Survey integrated and segregated Idaho hatchery Chinook salmon stocks for minijack maturation	Initiate 2015, Complete 2023
4	Analysis of relationship between minijack and jack maturation in Idaho hatchery Chinook salmon	Initiate 2015, Complete 2023

5	Complete manuscript describing interactive effects of stock and environment on minijack rates in McCall Chinook salmon	Initiate 2015, Complete 2021
6	Complete manuscript examining genetic variation in minijack rates and threshold for early male maturation in Chinook salmon	Initiated 2014, Complete 2020
7	Experiment – The interaction of genetic and environmental effects on minijack and jack production in hatchery spring Chinook salmon	Initiated 2018, Completed 2023
8	Production scale PRAS Growth Modulation Experiment, Leavenworth Nation Fish Hat.	Initiate 2021, Completed 2029

Proposed Research beyond 2023

How do we apply the principals of the "wild fish template" to Partial Recycling Aquaculture Systems (PRAS)?

BPA, USFWS and PUD sponsored hatchery facilities throughout the Columbia River Basin are implementing use of partial recycling aquaculture systems (PRAS) for yearling Chinook salmon. However, few controlled studies with salmonids have been conducted, thus, there is need to monitor and evaluate their effects on the quality of smolts released and their subsequent effects on adult age structure and SAR's. Our proposed research will design, monitor and evaluate a newly implemented PRAS systems being implemented at the Leavenworth National Fish Hatchery, Leavenworth WA over the next 2-4 years. This program provides an ideal opportunity to conduct these studies due to the following 1) the Chinook salmon are not ESA listed 2) they have a robust M&E program for monitoring downstream migration and survival, 3) the proposed system is sufficiently sized for controlled experiments with over 200K smolts in 4 rearing vessels, 4) PRAS and raceway stocks can be compared.

Project # 198905600 “Genetic Monitoring and Evaluation (M&E) Program for Salmon and Steelhead”

This genetic monitoring program was designed to evaluate the effects of outplanting hatchery reared fish on natural and wild populations of spring/summer Chinook salmon and steelhead in the Snake River Basin. The two major goals of this project are to 1) evaluate the nature and extent of genetic changes in outplanted hatchery stocks, and 2) quantify the genetic impact of out planting on targeted and non-targeted natural stocks. This study was designed as a two-tiered approach: genetic monitoring through annual sampling of juveniles at a number of reference sites in the Snake/Salmon River sub basins (Tier 2), and an intensive investigation of relative reproductive success (RRS) of hatchery and natural fish in three river systems through sampling of juveniles, residents (for steelhead) and returning adults (Tier 3). We have three ongoing reproductive success projects: Little Sheep Creek (Imnaha Basin) for steelhead, and Catherine Creek and Lostine River (Grande Ronde basin) for Chinook salmon. The reproductive success work has been pursued since 2000, while the gene frequency monitoring has been a central component since the study’s inception in 1989.

The greatest strength of this genetic monitoring program lies in the breadth and depth of its sampling design; we have collections for both steelhead and Chinook across multiple river basins, multiple life stages, and multiple life histories, every year since 1989. We've employed historical samples predating supplementation, and we've leveraged our resources by relying heavily on the annual efforts of other field crews. Whether annual samples are genotyped right away or are stored for future use, we have produced an invaluable resource for understanding subtle effects of hatchery propagation throughout the basin. We've made those samples available to other BPA-funded labs, and each year we prioritized (in part) genotyping and analysis in response to specific co-manager directives.

This project continues to implement cutting-edge ecological genetic and genomic tools to accommodate new challenges and exploit new opportunities (see below). New DNA sequencing technologies offer significant power to address old problems in artificial propagation, such as domestication and the genetic/environmental determinants of morphological traits such as size and age at maturity, reproductive behavior, and juvenile migration. Advances in technology and biological understanding in the areas of genetics, physiology, and behavior are all converging to offer unprecedented opportunities in artificial propagation in general and supplementation of threatened populations in particular.

Project Objectives

Qualitative Objectives

This genetic monitoring program has extensively evaluated the effects of outplanting hatchery reared fish on natural and wild populations of spring/summer Chinook salmon and steelhead in the Snake River Basin.

The two primary qualitative objectives are the following:

1) Evaluate the nature and extent of genetic changes in hatchery stocks to be used for outplanting, and
2) Quantify the genetic impact of outplanting on targeted natural stocks and non-targeted wild stocks.

The information obtained from this study directly addresses a critical remaining knowledge gap identified by comanagers: under what conditions does hatchery supplementation provide a sustained contribution to natural production? Our previous results disproved many misconceptions and alleviated some concerns about hatchery propagation (e.g., Van Doornik et al. 2011; Van Doornik et al. 2013); however, we also identified potential for substantial improvement in some programs and opportunities to avoid problems in others (e.g., Berntson et al. 2011). Our goal has always been to provide practical support for management in evaluating effectiveness of propagation improvements toward achieving supplementation goals. Without this continued monitoring, there would be no measure of on-going efforts to increase relative reproductive success (and sustained productivity) of naturally-spawning hatchery fish.

Quantitative Objectives

Our analyses of Tier 2 and Tier 3 data relate to the following quantitative objectives:

1) Characterize population genetic relationships within and among populations of Chinook and steelhead in the Snake River basin.

2) Use allele frequency changes over time, genetic linkage disequilibrium, and population pedigrees to estimate effective population sizes and rates of inbreeding and introgression in Chinook and steelhead populations in the Snake River Basin.

3) Estimate the relative reproductive success (RRS) of hatchery fish spawning in the wild using genetic pedigrees. Currently we have three rivers with ongoing RRS projects: Little Sheep Creek, Imnaha Basin (steelhead), and Catherine Creek and Lostine River, Grande Ronde basin (Chinook).

4) Measure associations of physical and behavioral characteristics associated with RS.

Results

This study has made numerous contributions to management and research in the Snake River basin over the past 3 decades, highlighting a few:

- Provided data pertaining to population genetic structure and geographic distribution of genetic variation for Chinook and steelhead NMFS status reviews, as well as to the US v. Oregon dispute resolution.
- Examined genetic effects in hatchery and natural systems over the 20+ year span of this project (Van Doornik et al. 2011, Van Doornik et al. 2013). We provided evidence of populations where hatchery fish appear to have contributed to natural production, and others where genetic effects of the hatchery supplementation are less apparent.
- Continues to provide best available estimates in Snake Basin salmon populations for important genetic parameters, Nm, Ne, and Nb to N ratios. The studies above produced Nb estimates for Salmon River Chinook populations over the span of 3-5 generations, and found that in most populations Ne didn't fall low enough to reduce heterozygosity or allelic richness over that time span. The geometric mean of Nb/N was significantly higher in non-supplemented populations (0.3) compared to supplemented populations (0.23) compared to hatchery populations (0.15).
- Produced individual-specific, full life-cycle reproductive success estimates in steelhead and Chinook salmon over multiple brood years. Documented low RRS in hatchery steelhead (~0.4) and variable but overall nearly equal RRS in Chinook (~1.0), and suggested the low acclimation site and high hatchery spawner densities contributed to the low RS in Little Sheep Creek.
- Provided quantitative genetic analysis of a mixed hatchery and natural steelhead population
- Documented reproductive contributions of kelts, resident rainbow trout, and residualized hatchery fish in Little Sheep Creek steelhead, and precocious male parr in Catherine Creek and Lostine River Chinook).

The most recent Biological Opinion (NMFS 2020) listed the Snake River spring/summer Chinook populations almost entirely as “high risk,” and noted that 2017-2019 saw the lowest returns since 1999, and that estimates of total spawners in Snake River populations were experiencing a similar downward trend. The report suggested the driving force behind these declines may be tied to declining ocean conditions and ocean productivity during this time period. Our continued annual monitoring will keep co-managers apprised of life-stage-specific changes in relative survival and reproductive success of hatchery and natural fish.

Table 3. Current research timelines for deliverables of proposed research for Project 1989-096-00. Details regarding each deliverable are available in the 2019 proposal (link to full proposal provided below). Note all timelines were derived prior to the COVID-19 pandemic and may need to be revised.

Deliverable	Description	Timeline
1	Collect Chinook and steelhead genetic samples from multiple locations within Snake River Basin	Initiated 1989, Ongoing
2	Genotype Chinook and steelhead samples for current CRITFC/IDFG SNP panels for Tier-2 monitoring (conventional monitoring)	Initiated 2014, Ongoing
3	Genotype Chinook and steelhead samples for current CRITFC/IDFG SNP panels for Tier-3 studies (relative reproductive success)	Initiated 2014, Ongoing
4	Test for changes in diversity and gene flow at Tier-2 study sites since our last major publications	Initiated 2020, Complete 2023
5	Analyze data and interpret results for Tier-3 sampling	Initiated 2020, Complete 2023
6	Evaluate ability of eDNA sampling to replace electrofishing	Initiated 2020, Complete 2022
7	Identify potential microhaplotypes contained in the current GT-Seq SNP panels	Initiated 2020, Complete 2020
8	Screen parent and offspring data for microhaplotype information	Initiate 2021, Complete 2023
9	Analyze eDNA samples for allele frequencies of Chinook and steelhead populations	Initiate 2023, Complete 2024

Proposed research beyond 2023

We are initiating a project during the current 2020 contract in conjunction with BPA Project #2003-039-00 (Monitor and Evaluate (M&E) Reproductive Success and Survival in Wenatchee River) to use Whole-Genome Sequencing (WGS) to compare natural-origin Chinook (and potentially steelhead) with their hatchery-origin counterparts, as well as fish from differing hatchery programs (e.g., captive broodstock vs. conventional programs).

High water temperatures have kept us from sampling one of our Tier-2 sites for the past 2 years. We anticipate increasing limitations on handling fish for traditional genetic sampling, e.g. electrofishing, seine netting, or trapping. Our most recent proposal included evaluating the utility of eDNA filtered from river water or extracted from sediments as a substitute for electrofishing and direct tissue sampling (Deliverable #6 and 9 above). The first goal is to estimate allele frequencies in natural populations from eDNA. This will give at least some limited information for populations that can't be sampled because of temperature limitations. However, complete population genetic monitoring requires genotypes for individual fish, which is a much greater challenge to obtain from eDNA analysis. Despite, significant molecular and bioinformatic barriers, we are optimistic about current collaboration among cetacean and salmon geneticists with similar interests and study organisms that are not easily sampled directly. Technology is advancing rapidly and even since our last proposal we are more hopeful about obtaining genotypes for individual fish (whales) from eDNA samples, whether filtrates, sediments or feces. It now appears that for this project, with proper field collection and laboratory preparation, a combination of currently available commercial services and reagent kits might be used to genotype individual Chinook and steelhead from complex eDNA samples. Genotyping is not only relevant to obtaining full population information for Tier-2 conventional monitoring. If we succeed in implementing this exciting new method, our Tier-3 pedigree studies could also be conducted, at least in part if not eventually in total, from eDNA. Combined with our genomics research on age at maturity, and deep linkage disequilibrium, we look forward to a time when hatchery origin, life-history type and many aspects of phenotype can be associated with reproductive success and multi-generational productivity in the wild and in the hatchery without ever actually touching fish.

Link to most recent proposal:

Proposal NPCC19-1989-096-00- Genetic Monitoring and Evaluation (M&E) Program for Salmon and Steelhead (1989-096-00)
https://www.cbfish.org/Proposal.mvc/SummaryAsPdf/NPCC19-1989-096-00

Links to the past two annual reports:

Monitor and Evaluate the Genetic Characteristics of Supplemented Salmon and Steelhead (1989-096-00) Annual report 2018
https://www.cbfish.org/Document.mvc/Viewer/P164684

Monitor and Evaluate the Genetic Characteristics of Supplemented Salmon and Steelhead (1989-096-00) Annual report 2019
https://www.cbfish.org/Document.mvc/DocumentViewer/P171338/46273-165-1.pdf

Information needs to further inform hatchery operations in the Columbia and Snake Basins

While the research results reported by these three projects currently inform hatchery operations across the states of Washington, Idaho, and Oregon, the principal investigators, ISRP, and NWPCC envision greater application to additional hatchery programs operating in the Columbia and Snake Basin hatchery systems. Unfortunately, this effort is hampered by the availability of aggregated data regarding environmental, broodstock management, and life history metrics for Chinook and steelhead hatchery programs funded through the BPA (Table 4). The authors recognize that some of these data are available in the Hatchery Genetic Management Plans (HGMP) developed for individual hatchery programs. However, these data lack standardization across programs, are not updated annually, and are not aggregated into a centralized accessible source (i.e., spreadsheet or database). The *2020-2021 Habitat and Hatchery Program Review* process provides an opportunity for the NWPCC to work with hatchery operators to collect this basic data and aggregate it as a resource. Doing so would provide greater opportunity for the research results of the three NWFSC-sponsored projects to inform tailored rearing strategies to optimize hatchery performance and benefit recovery of salmon and steelhead populations within the Columbia and Snake Basins (Table 5). The three projects are well positioned and look forward to continued interaction with program staff as a resource to inform and improve BPA sponsored hatchery programs throughout the region.

Table 4. Recommended environmental, broodstock management, and life history metrics useful for extrapolating research results to inform and optimize hatchery operations in the Columbia and Snake River Basins by hatchery program and species.

Reported metric category			
Program	**Environmental**	**Broodstock management**	**Life history**
Species	Water source	Broodstock origin (natural, hatchery, or mixture)	Age-at-release (in months from spawning)
Production target (# smolts released)	Monthly average water temperature (incubation to release)	Spawning dates (first, last, peak)	Ponding date
Five-year average production (# smolts)		Spawning matrix design	
Target release size (choose unit still)			
Five-year average release size (unit?)			
Number of returns			

Table 5. Potential uses of hatchery metrics to inform performance of steelhead and Chinook salmon hatcheries in the Columbia and Snake River Basins.

Steelhead	**Chinook salmon**
Facilitate use of natural-origin broodstock	Design and develop seasonal growth rate profile • Minimize minijack rate
Determine age-at-release • Age-1 • Age-2 • Split-rearing age (and proportions)	Maximize smoltification and survival
Improve survival and migration speed	Optimize age structure of adults
Minimize residualism • Immature parr (failure to smolt) • Precociously mature males	Increase size-at-age of adults
Improve RS of hatchery-origin fish spawning in natural environments for supplementation hatcheries	Improve (or maintain) RS of hatchery-origin fish spawning in natural environments for supplementation hatcheries

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Appendix C
Habitat Conservation Plan Tributary Committees 2020 Meeting Minutes

Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 9 January 2020

Members Present: Jeremy Cram (WDFW), Chris Fisher (Colville Tribes), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees Chair).

Others Present: Becky Gallaher (Tributary Project Coordinator) and Lee Carlson (retired Yakama Nation Biologist). Mike Kaputa (Chelan County Natural Resources Department) and Mickey Fleming (Chelan Douglas Land Trust) joined the meeting for the Cottonwood Flats discussion. Cody Gillin (Trout Unlimited) joined the meeting for the Beaver Fever Project discussion.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees met at Grant PUD in Wenatchee, Washington, on Thursday, 9 January 2020 from 9:00 am to 12:30 pm.

I. Review and Adopt Agenda

Tracy Hillman welcomed everyone to the meeting and the Committees adopted the proposed agenda with no additions.

II. Review and Approval of Meeting Minutes

The draft November meeting notes were reviewed and approved by Tributary Committees members in December. Because the Tributary Committees did not meet in December (draft November meeting notes were approved via email), there were no draft notes to review in January.

III. Monthly Update on Ongoing Projects

Becky Gallaher gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Barkley Irrigation – Under Pressure Project – The sponsor (Trout Unlimited; TU) did not provide an update this month.
- Icicle Boulder Field Project – The sponsor (TU) did not provide an update this month.
- Peshastin Creek RM 10.5 PIT-Tag Detection Site Project – This project is complete. The sponsor (Washington Department of Fish and Wildlife; WDFW) provide the 2019 annual report, which has been uploaded to the Extranet site. Jeremy Cram noted that no tagged adults were detected in 2019; however, three tagged juvenile steelhead were detected (one hatchery-origin steelhead and two natural-origin steelhead). He said the low number of detections may be related to stream flows in 2019.

- Beaver Fever Project – The sponsor (TU) did not provide an update this month.
- Methow Basin Barrier Diversion Assessment Project – The sponsor (Cascade Columbia Fisheries Enhancement Group; CCFEG) did not provide an update this month.
- Derby Creek Fish Passage Project – The sponsor (CCFEG) reported that they finalized the design are ready to begin the bid process.
- Chiwawa Nutrient Enhancement Project – The sponsor (CCFEG) reported that there is no new activity this month. They continue to work on the report.
- Monitor Side Channel Design Project – This project is complete and the final report has been uploaded to the Extranet site.
- Entiat Fish Passage and Barrier Assessment Project – The sponsor (CCFEG) reported that there is no new activity on this project.
- Twisp River Floodplain Left Bank Spring-fed Alcove Restoration Project – The sponsor (Methow Salmon Recovery Foundation; MSRF) reported that there is no new activity on this project.
- Johnson Creek Habitat Restoration Project – The sponsor (TU) did not provide an update this month. This work will occur later in 2020.
- Cottonwood Flats Floodplain Restoration Project – The sponsor (CCNRD) reported construction will occur during fall 2020. See additional updates below.
- Upper Kahler Stream and Floodplain Project – The sponsor (Yakama Nation; YN) reported construction is complete and they are writing the final report.
- Stormy Area "A: Stream and Floodplain Enhancement Project – The sponsor (YN) reported construction is complete and they are writing the final report.
- Napeequa Side Channel Connection Project – The sponsor (CCFEG) reported that the pedestrian bridge is not an option and therefore submitted a budget amendment/scope change request (see discussion below).
- Restore Chiwaukum Creek Project – The sponsor (CCFEG) reported that there is no new activity on this project. They are planning a kick-off meeting on 24 January. The sponsor asked that Jeremy Cram and Catherine Willard attend the meeting.
- Sugar Levee Groundwater Evaluation – The sponsor (MSRF) reported that they have identified 13 locations for groundwater monitoring (locations for piezometers). They also installed four staff gauges.

IV. Review of Tributary Committees' Policies and Procedures

Policies and Procedures for Funding Projects

The Committees reviewed their Policies and Procedures document and made no edits or changes to the document.

Tributary Committee Operating Procedures

The Committees reviewed their Operating Procedures and made no edits or changes to the document.

V. Scope Change/Budget Amendment

Napeequa Side Channel Connection Project

The Rocky Reach Tributary Committee received a scope change/budget amendment request from Cascade Columbia Fisheries Enhancement Group (CCFEG) on the Napeequa Side Channel Connection Project. CCFEG reported that because of regulatory issues and high costs, the pedestrian bridge over the Napeequa River is not feasible at this time. Therefore, rather than use the $25,000 to install a pedestrian bridge, they asked to use the $25,000 to purchase a vehicle and a water filtration system. After evaluating the request, the **Rocky Reach Tributary Committee concluded that the allocated funds for the pedestrian bridge cannot be used to purchase a vehicle or a water filtration system**. Equipment or assets purchased with Plan Species Account Funds would belong to the Committee. In this case, the Committee does not want to own a vehicle.

VI. Cottonwood Flats Floodplain Restoration Project

Mike Kapute (CCNRD) and Mickey Fleming (CDLT) provided an update on the Cottonwood Flats Floodplain Restoration Project. Mike shared with the Rocky Reach Tributary Committee the most recent modeling results on both the original design (80% design) and the pilot-channel design. He provided handouts showing modeled depths and velocities at 500 cfs and 1,000 cfs for the two designs. Modeling at 1,000 cfs represents the one-year (annual) high flow. Members asked if larger flows were modeled. Mike said no, because they have no money to pay for additional modeling. Members indicated that higher, channel-forming, flows are needed to carve flow paths under the pilot-channel design.

Mike provided handouts showing the line-item budgets for both designs. In sum, construction costs for both designs were similar ($370,245 for the original design and $323,782 for the pilot-channel design). However, because of uncertainty associated with the pilot-channel design, he included an adaptive management component to the budget. The cost for adaptive management for the pilot-channel design was $252,737. He also provided a budget for monitoring the pilot-channel design, which equated to $232,918. Thus, the total cost to implement and monitor (and adaptively manage) the pilot-channel design is about $809,437. Members thanked Mike for the cost estimates but noted the estimates do not accurately reflect the pilot-channel design proposed by the Committee. The Committee recommended the construction of the pilot channel with additional efforts to knock-down high spots to improve the development of flow paths across the floodplain. The Committee also voiced their concern with the consultant's resistance to evaluate or consider the Committee's full recommendation.

Mickey reported the primary concern of the CDLT is the potential effect of the pilot-channel design on neighboring landowners. She does not want the project to flood or otherwise affect the neighboring landowners. The Committee said the pilot-channel design will not affect adjacent landowners. Mickey said the CDLT is not opposed to the pilot-channel design, they simply want to make sure the project implemented does not negatively affect neighboring landowners.

Mike said the pilot-channel design provides less certainty of success than does the original design. He added that he talked with the Salmon Recovery Funding Board (SRFB) about amending the existing contract to replace the original project with the pilot-channel design (the SRFB is a cost share). He said the SRFB considered the project a significant change in scope and it may require a new application, which would be reviewed by the Upper Columbia Regional Technical Team and Citizen's Advisory Committee.

As a final note, Mike provided a handout describing wetland impacts. In short, if monitoring indicates the pilot-channel design does not work and CCNRD needs to construct a channel similar to the original design, there will be wetland impacts that will need to be mitigated. Mike said this could be expensive and they have no funds to cover the expense. The Committee appreciated the concern but noted the recommendation by the Committee to help develop flow paths by knocking down high points should reduce the need for constructing a channel through the floodplain.

Following the update from CCNRD and CDLT, the Committee reviewed the information and recommended that CCNRD consider extending the pilot channel downgradient to the point marked with the red arrow on the figure below. The blue arrow notes the terminus of the pilot channel originally proposed by the Committee. The extended pilot channel should connect the channel to low points downgradient on the floodplain. It may be necessary to knock down high points to help develop flow paths downstream from the end of the pilot channel. The Committee believes the extended channel will provide CCNRD with more biological certainty and still allow the river to develop flow paths across the lower floodplain. The Committee also recommends that CCNRD avoid developing large, trapezoidal channels that remove and disturb large tracks of riparian vegetation. To the degree possible, CCNRD should construct channels that protect existing vegetation and they should use the existing vegetation to help define the channel.

VII. Beaver Fever: Restoring Ecosystem Function Project

Cody Gillin with Trout Unlimited (TU) gave a presentation titled, "BDA Project Update" (see Attachment 1). Cody talked about the genesis of the project and described the timeline for the project. He noted the pace of the project slowed because of communication and coordination with the Forest Service. However, in 2019, based on discussions and field visits with the Forest Service and WDFW, TU has identified a final list of about 30 treatment sites on Roaring and Potato creeks in the Entiat River basin, with a focus on lower Potato Creek (downstream from the North Fork Potato Creek confluence). The intent is to use beaver dam analogs (BDA) to enhance floodplain activation, ameliorate incision and erosion, induce meanders and braiding, reduce infrastructure impacts, and mitigate head-cuts. Cody showed photos of sites on Potato and Roaring creeks that would benefit from BDA treatments.

Following the discussion on treatment sites and restoration actions, Cody spoke briefly about monitoring the effectiveness of the actions (the last time Cody presented to the Rock Island Tributary Committee, the Committee recommended that TU monitor the effectiveness of the project). Cody identified some of the indicators that could be monitored to determine effectiveness including floodplain reconnection, aggradation, water temperature, riparian vegetation, sediment storage, structural complexity, side channel and wetland development, groundwater storage, stream flows, fish passage, and fish response. The Committee showed interest in monitoring temperature, groundwater dynamics, and fish response (e.g., abundance, size, and growth). The Committee also suggested the use of unmanned aerial vehicles for capturing floodplain, riparian, and channel responses. The Committee encouraged Cody to complete an Effectiveness Monitoring Application and suggested he discuss monitoring with Robes Parrish, Jeremy Cram, and Tracy Hillman.

The Rock Island Tributary Committee thanked Cody for the update on the project.

VIII. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests from November, December, and January:

   Rock Island Plan Species Account:

   - $50.00 to Clifton Larson Allen for Rock Island financial administration in November 2019.
   - $60.00 to Clifton Larson Allen for Rock Island financial administration in December 2019.
   - $995.25 to Chelan PUD for Rock Island project coordination and administration during the fourth quarter of 2019.
   - $178.24 to Cascade Columbia Fisheries Enhancement Group for the Derby Creek Fish Passage Project.
   - $7,485.93 to Cascade Columbia Fisheries Enhancement Group for the Chiwawa Nutrient Enhancement Project (November work).
   - $2,976.63 to Cascade Columbia Fisheries Enhancement Group for the Chiwawa Nutrient Enhancement Project (December work).
   - $117.65 to Cascade Columbia Fisheries Enhancement Group for the Restore Lower Chiwaukum Creek – Phase 1 Project (November work)
   - $3,264.47 to Cascade Columbia Fisheries Enhancement Group for the Restore Lower Chiwaukum Creek – Phase 1 Project (December work).

- $2,933.85 to Chelan County Treasurer for the Monitor Side Channel Design Project.

Rocky Reach Plan Species Account:

- $50.00 to Clifton Larson Allen for Rocky Reach financial administration in November 2019.
- $60.00 to Clifton Larson Allen for Rocky Reach financial administration in December 2019.
- $592.56 to Chelan PUD for Rocky Reach project coordination and administration during the fourth quarter of 2019.
- $784.33 to Cascade Columbia Fisheries Enhancement Group for the Entiat Basin Fish Passage and Screening Assessment Project (November work).
- $1,835.91 to Cascade Columbia Fisheries Enhancement Group for the Entiat Basin Fish Passage and Screening Assessment Project (December work).

Well Plan Species Account:

- $294.36 to Chelan PUD for Wells project coordination and administration during the fourth quarter of 2019.

2. Tracy Hillman reviewed the 2020 Salmon Recovery Funding Board/Tributary Committees proposed schedule for 2020. Important dates are noted below:
    - Project Presentations: 11-12 March 2020
    - Draft Applications Due: 17 April 2020
    - Site Visits: 11-13 May 2020
    - Review Draft Applications: 14 May 2020
    - Final Application Due: 29 May 2020
    - Review Final Applications: 11 June 2020
3. Tracy Hillman reported that he and Becky Gallaher completed Section 2.3 (Tributary Committees and Plan Species Accounts) for the Annual Report of Activities under the Anadromous Fish Agreement and Habitat Conservation Plan for each hydroelectric project. Tracy said he sent the draft reports to Anchor QEA, who is compiling the draft annual reports. The draft reports will be sent to the HCP Coordinating Committees for review. The PUDs will submit the final reports to the Federal Energy Regulatory Commission in April.
4. Tracy Hillman reminded the Committees that the Upper Columbia Science Conference is on 22-23 January in Wenatchee.
5. Kate Terrell gave a brief update on the Sugar Levee Project. She noted that the working groups have developed a project schedule, developed an organization chart, identified the area of analysis, compiled a list of goals and objectives, reviewed existing literature and data collected within the reach, evaluated feasibility of restoration actions on river left at the upper and lower ends of the project area, drafted an outreach plan, drafted a social feasibility map (shows level of landowner interest), and continue conversations with landowners in the reach. She said the group has expanded the length of the reach for investigation by about 1,000 feet.
6. Tracy Hillman and Becky Gallaher informed the Rock Island and Rocky Reach Tributary Committees that the Plan Species Accounts are due for an external financial review. Becky said

she will initiate the process of selecting an accounting firm to conduct the review. Funds to pay for the review come from the Rock Island and Rocky Reach Administrative Accounts.

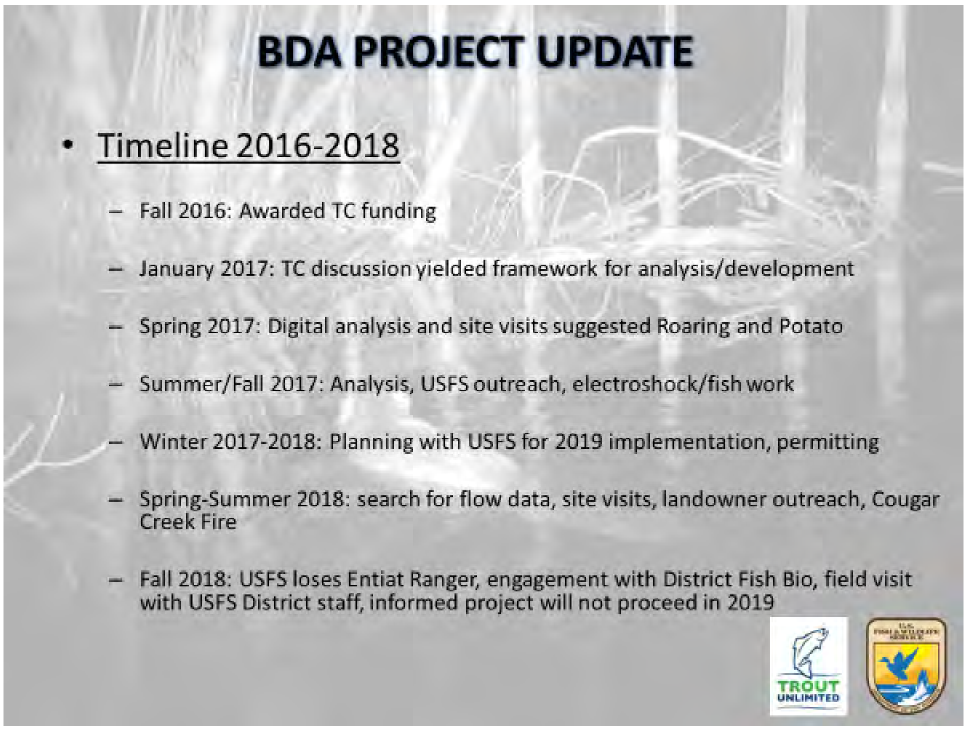
IX. Next Steps

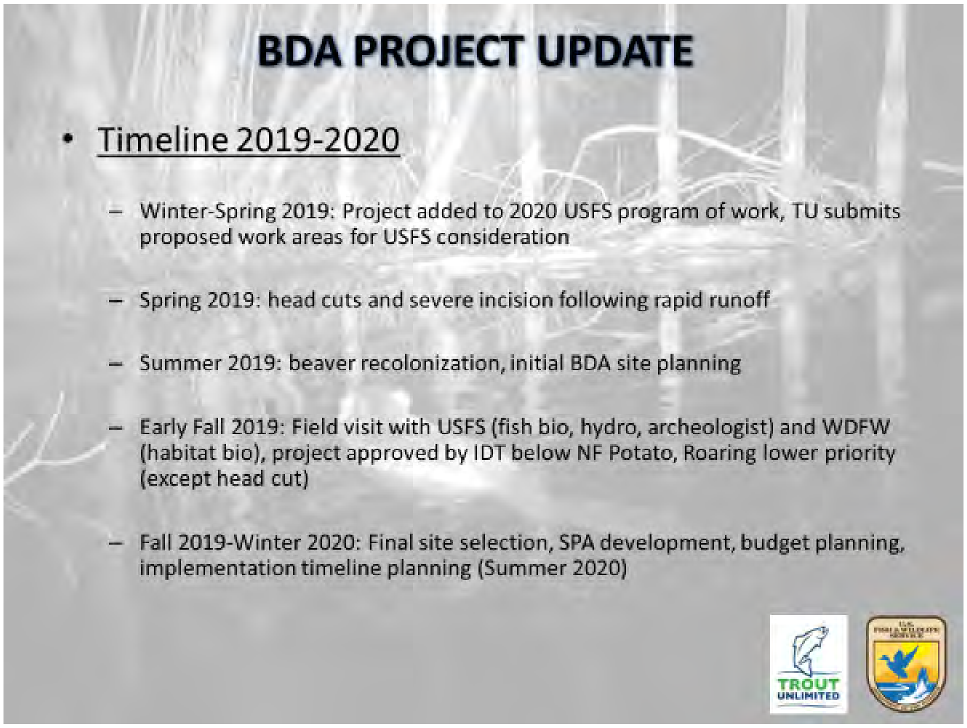
There is no planned meeting for the Tributary Committees in February. Tributary Committees members will attend project presentations with the Regional Technical Team on 11-12 March.

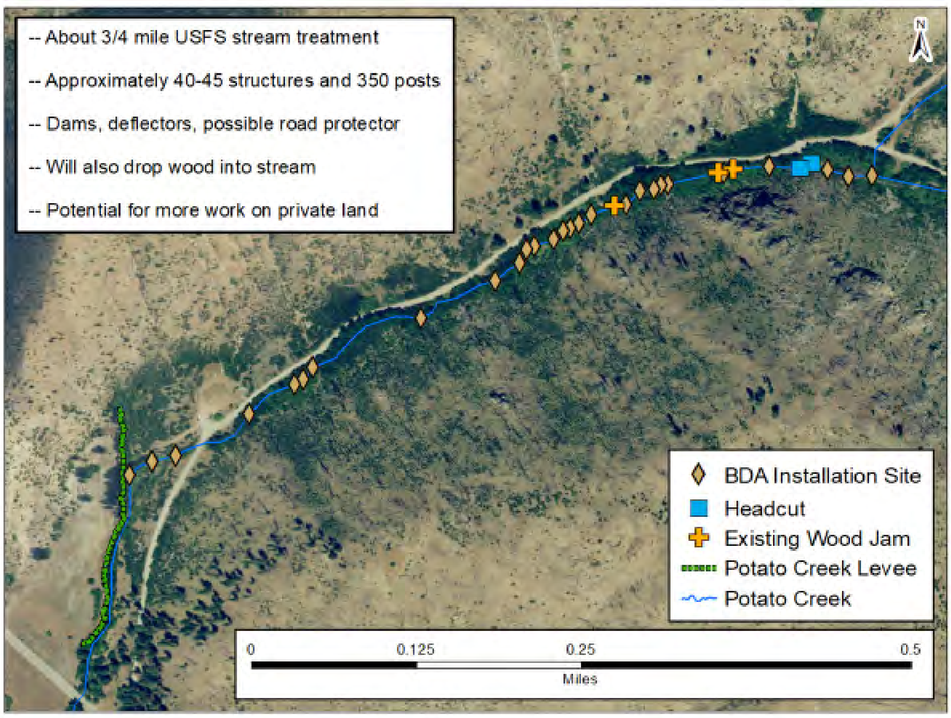
Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Attachment 1

Presentation by Cody Gillin on the Beaver Fever Project




BDA PROJECT UPDATE
• Timeline 2019-2020
– Winter-Spring 2019: Project added to 2020 USFS program of work, TU submits proposed work areas for USFS consideration
– Spring 2019: head cuts and severe incision following rapid runoff
– Summer 2019: beaver recolonization, initial BDA site planning
– Early Fall 2019: Field visit with USFS (fish bio, hydro, archeologist) and WDFW (habitat bio), project approved by IDT below NF Potato, Roaring lower priority (except head cut)
– Fall 2019-Winter 2020: Final site selection, SPA development, budget planning, implementation timeline planning (Summer 2020)
TROUT UNLIMITED

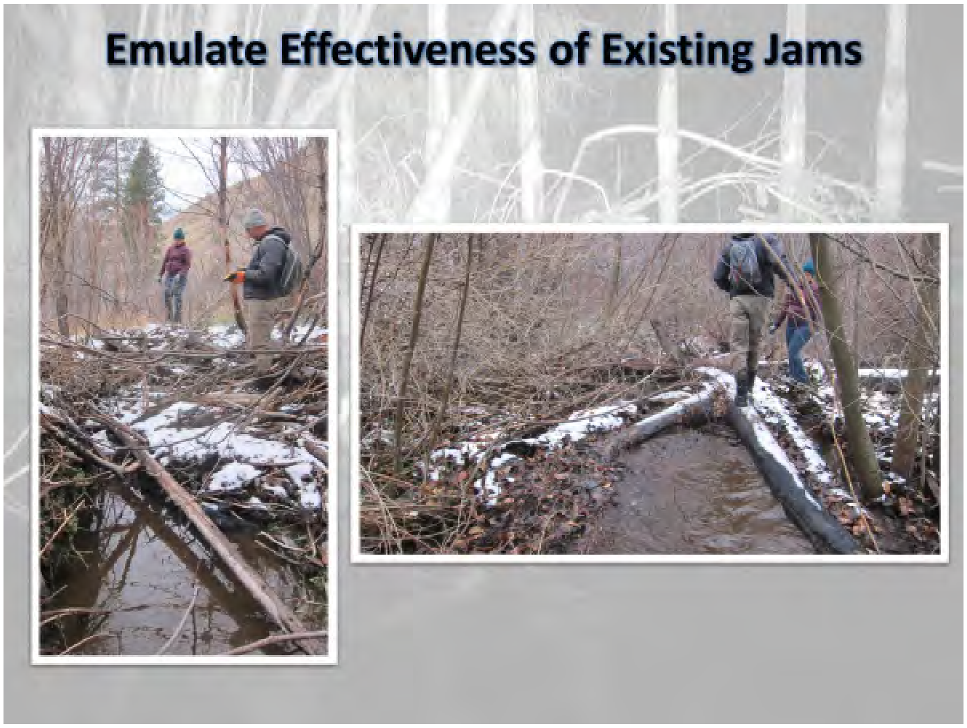

-- About 3/4 mile USFS stream treatment
-- Approximately 40-45 structures and 350 posts
-- Dams, deflectors, possible road protector
-- Will also drop wood into stream
-- Potential for more work on private land
N
BDA Installation Site
Headcut
Existing Wood Jam
Potato Creek Levee
Potato Creek
0
0.125
0.25
0.5
Miles


Enhance Floodplain Activation


Ameliorate Incision/Erosion


Induce Meanders/Braiding


Place Wood and Drop Elevated Spanners


Emulate Effectiveness of Existing Jams


Reduce Infrastructure Impacts?

MONITORING IN ROARING AND POTATO

- Floodplain reconnection: wetted perimeter, wetted width at install sites
- Aggradation: raising bed level of incised reaches
- Stream temperature above, within, and below project area
- Riparian vegetation: expansion, density, species
- Sediment storage/aggradation
- LWD and structural complexity
- Floodplain interaction
- Side channel and wetland development
- Groundwater storage: better estimate using wells/piezometers?
- Intermittent to ephemeral conversion?
- Passage barriers?
- Fish response?

Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 9 April 2020

Members Present: Jeremy Cram (WDFW), Chris Fisher (Colville Tribes), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees Chair).

Others Present: Becky Gallaher (Tributary Project Coordinator) and Scott Hopkins (Chelan PUD Alternate).

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 9 April 2020 from 9:00 am to 11:30 am.

I. Review and Adopt Agenda

Tracy Hillman welcomed everyone to the meeting and the Committees adopted the proposed agenda with no additions.

II. Review and Approval of Meeting Minutes

The draft January meeting notes were reviewed and approved by Tributary Committees members.

III. Monthly Update on Ongoing Projects

Becky Gallaher gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Barkley Irrigation – Under Pressure Project – The sponsor (Trout Unlimited; TU) reported that the Barkley pump station was completed on 31 March and will be ready to deliver water to shareholders by 15 April. The Phase II piping project will also be completed the first week of April. The sponsor continues to work on the easements with DOT and FAA.
- Icicle Boulder Field Project – The sponsor (TU) reported they have finalized the bid package and anticipates receiving several competitive bids. The USFS access agreement for required closure of the Snow Lakes parking area and lane closure is fully executed. This completes the last project permit.
- Peshastin Creek RM 10.5 PIT-Tag Detection Site Project – This project is complete. The sponsor (Washington Department of Fish and Wildlife; WDFW) provided the 2019 annual report, which was uploaded to the Extranet site.
- Beaver Fever Project – The sponsor (TU) reported their main focus has been on permitting. USFWS has completed the ESA consultation and sent the cultural resources request to their regional office for consultation. USFS will handle NEPA through a Categorical Exclusion. They continue to procure materials with the intent of starting work as planned.

- Methow Basin Barrier Diversion Assessment Project – The sponsor (Cascade Columbia Fisheries Enhancement Group; CCFEG) did not provide an update this month.
- Derby Creek Fish Passage Project – The sponsor (CCFEG) reported they received comments from Chelan County Public Works regarding scour calculations. The WDFW engineer is addressing all comments. Once the County approves the edits, the sponsor will finalize the bid package.
- Chiwawa Nutrient Enhancement Project – The sponsor (CCFEG) reported they are preparing for 2020 treatment and coordinating with WDFW on analog availability. They have also been discussing ways to increase effectiveness monitoring with Eastern Washington University faculty and a graduate student.
- Entiat Fish Passage and Barrier Assessment Project – The sponsor (CCFEG) reported they are working on the draft report and it should be available this month.
- Twisp River Floodplain Left Bank Spring-fed Alcove Restoration Project – The sponsor (Methow Salmon Recovery Foundation; MSRF) reported they continue conversations with the landowner of the upstream crossing. They hope to move forward with work as planned.
- Johnson Creek Habitat Restoration Project – The sponsor (TU) did not provide an update this month. This work will occur later in 2020.
- Sugar Levee Groundwater Evaluation Project – The sponsor (MSRF) reported there is no new activity on this project.
- Cottonwood Flats Floodplain Restoration Project – The sponsor (Chelan County Natural Resources Department; CCNRD) provided an update to the Rocky Reach Tributary Committee on 6 April via email. They reported the following:
    - The footprint of the proposed side-channel is designed to protect existing vegetation where possible with the goal of avoiding disturbance of large tracts of riparian vegetation. The side-channel footprint follows the historical fill violation footprint for roughly 1,060 feet of the proposed ~1,300 linear feet of channel. By using this footprint, the project amounts to only 0.09 acres of temporary riparian disturbance outside of the existing road prism that will be offset by 2.21 acres of wetland and riparian re-establishment and re-vegetation efforts as a result of the project.
    - To encourage roughness, diversity, and habitat complexity within the side channel, the sponsor added eight LWM structures into the primary side channel. These structures are located where construction access is feasible with limited vegetation disturbance and will encourage channel complexity. Any vegetation that is removed during side channel construction can be incorporated into these structures to help define the channel.
    - To encourage natural flow pathways, two additional pilot side channels (Side Channel 2 and Side Channel 3) have been added to the designs to key into existing low-lying areas that will allow the river to develop flow pathways across the lower floodplain. The Side Channel 2 pilot will direct higher flows above 500 cfs into the existing wetland habitat along the valley wall. Side Channel 3 is designed to direct flows above 500 cfs into the low-lying wetlands along the valley wall. Collectively, these pilot channels will encourage activation of natural flow pathways across the floodplain under higher flow conditions while concentrating flows into the primary side channel during lower flows (<500 cfs).
    - During this spring, the sponsor held several permitting meetings with the regulatory agencies and are in the final process of securing necessary permits for this project. They

held final meetings with the landowners and have secured all necessary landowner agreements for the project. In order to keep the project on track for 2020 construction, the sponsor put the project out to public bid on 30 March and held a virtual pre-bid walk through with potential bidders on 3 April.

Brandon Rogers noted a potential serious flaw in the design. That is, the gradient of the constructed channel will be about 0.04, which is not steep enough to adequately transport sediment. Thus, he believes the constructed channel will fill with sediment. Brandon said he communicated this issue to the project sponsor and asked that the sponsor address this with their engineer. Brandon will share the sponsor's response with the Committee as soon as he receives it.

- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported they continue to seek additional funding for the project.
- Peshastin RM 3.4 Side Channel Project – The Sponsor/Tributary Committee Agreement has been signed.
- Upper Kahler Stream and Floodplain Project – The sponsor (Yakama Nation; YN) reported construction is complete and the final report has been uploaded the Extranet site.
- Stormy Area "A: Stream and Floodplain Enhancement Project – The sponsor (YN) reported construction is complete and they are writing the final report.
- Napeequa Side Channel Connection Project – The sponsor (CCFEG) reported that Tall Timber Ranch is currently experiencing significant hardships related to COVID-19. The sponsor is still looking for a solution to the loss of the right-of-way and waterline access as a result of this project. The landowner has been unavailable to discuss this project over the past month. The sponsor will restart discussions with the landowner as soon as possible.
- Monitor Side Channel Project – The sponsor (CCNRD) reported that staff met to plan construction sequences and define project roles.
- Restore Chiwaukum Creek Project – The sponsor (CCFEG) reported they have been coordinating with the consultant, RIO ASE regarding spring/summer field work. Rio has also been working on collecting background information and digitizing the campground in CAD.
- City of Leavenworth Fish Screen Project – The Sponsor/Tributary Committee Agreement has been signed.

IV. Small Projects Program Applications

Goodwin Side Channel Assessment Project

The Committees received a Small Projects Program proposal from Cascade Fisheries titled: *Goodwin Side Channel Assessment Project*. The purpose of the project is to conduct a groundwater study and topographic survey to determine perennial inflow of cold groundwater to a partially disconnected 1,200-foot-long side channel located between RM 11.7 and 12.1 on the Wenatchee River. Results from the study will be used to assess the suitability of a habitat enhancement project designed to increase year-round juvenile salmonid rearing habitat, hyporheic exchange, and floodplain inundation. The total cost of the project is $21,157.02. The sponsor requested $17,067.02 from HCP Plan Species Account Funds. ***The Rock Island Tributary Committee elected to contribute $17,067.02 to the project***.

The Committee had a few questions regarding this assessment. First, they asked the sponsor to quantify what they mean by "adequate" perennial inflow of cold groundwater to the project area? That is, how much groundwater inflow is enough to move forward with the enhancement project? If the threshold amount of groundwater is present, what type of channel would be constructed (perennial or season channel)? Would the type of channel constructed depend on the amount of groundwater? Importantly, funding for this assessment is not contingent on the sponsors responses to these questions.[1]

Sugar Reach Habitat Enhancement Early Implementation Project

The Committees received a Small Projects Program proposal from the Methow Salmon Recovery Foundation titled: *Sugar Reach Habitat Enhancement Early Implementation Project*. The purpose of the project is to reconnect a 1,600-foot-long, partially disconnected, side channel located at RM 42.25 on the Methow River. Reconnection will be accomplished by constructing a 250-foot-long inlet channel through fill material. The project will not disturb an existing log jam located near the project site. The inlet will be constructed such that the channel will be activated at flows as low as 600 cfs. This means the channel will be activated for about 148 days per year. The total cost of the project is $19,931.95. The sponsor requested $15,621.30 from HCP Plan Species Account Funds. ***The Wells Tributary Committee elected to contribute $15,621.30 to the project***.

V. Budget Amendment

Chiwawa Nutrient Enhancement Project

The Rock Island Tributary Committee received a budget amendment request from Cascade Fisheries (CF) on the Chiwawa Nutrient Enhancement Project. CF would like to reallocate existing funds among the budget line items. New line items include the use of a helicopter to distribute analogs along the Chiwawa River and a 10% indirect expense line item. The reallocation of existing funds would not affect the overall budget amount of $267,650.

Before the Committee can approve the amendment, they need proof that the use of a helicopter to distribute analogs within the Chiwawa River is covered under existing permits. Therefore, they asked the sponsor to check with the appropriate regulatory agencies (e.g., US Forest Service, US Fish and Wildlife Service, and NOAA Fisheries) and provide confirmation that the use of a helicopter is covered under their existing permits. Once the Committee has this information, they will make a decision on the budget amendment.

VI. Sugar Levee Update

Kate Terrell provided the following updates on the Sugar Levee Project.

- The project goals and objectives were finalized on 18 March.
- The Methow Salmon Recovery Foundation (MSRF) is continuing to do targeted outreach to key individuals (Town of Twisp, Covenant Church, etc.). As potential areas of restoration interest are identified, MSRF will expand their outreach to include additional landowners.
- Inter-Fluve, the technical consultant, is currently reviewing existing data and literature to identify potential areas of restoration interest in the project area.
- Fieldwork originally scheduled for April has been tentatively rescheduled for late June or early July due to issues associated with COVID-19. Development of pre-appraisal concepts does not rely on field data and the postponement of fieldwork is not expected to affect the project schedule.

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[1] Following the meeting, Cascade Fisheries provided the following response to questions. "It is our intent to let the data collected as part of this grant help drive the decision making and design process. We plan to approach this effort without preconceived notions of what the finished project should look like. Once the data is collected, we plan to consult with technical partners, including the Committee, to help answer the question: what is adequate? As with many things, there is likely some gray area and a range of opinions."

- The project is on schedule for the development of pre-appraisal concepts in mid-June.

Kate also shared the following roles and responsibilities associated with potential construction funders (e.g. Tributary Committees).

- Ensure project elements to be considered are designed to align with Tributary Committees' goals and objectives for project funding.
- Designate a representative(s) responsible for maintaining communications between the Tributary Committees and the project.
    - Representative shall keep the Tributary Committees informed about project development.
    - Representative shall clearly communicate feedback on project development from the Tributary Committees to the Project Development Team (PDT).
    - Representative will clearly inform the PDT of any issues or concerns from the Tributary Committees regarding the project.
- Participate on the project Executive Team and PDT as required.
- Review project products within the designated timeline.
- Identify project alternatives suitable to Tributary Committees.
- Participate in selection of the preferred alternatives.
- Keep abreast of major project activities.
- Assist with major issues and problems.

Members agreed with the roles and responsibilities. They noted that it is important that members' potential concerns are shared with the Project Development Team.

VII. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests from February, March, and April:

   Rock Island Plan Species Account:

   - $223.12 to Clifton Larson Allen for Rock Island financial administration in January 2020.
   - $91.87 to Clifton Larson Allen for Rock Island financial administration in February 2020.
   - $52.50 to Clifton Larson Allen for Rock Island financial administration in March 2020.
   - $623.90 to Chelan PUD for Rock Island project coordination and administration during the first quarter of 2020.
   - $98.26 to Cascade Columbia Fisheries Enhancement Group for the Derby Creek Fish Passage – Collins Project (January work).
   - $492.05 to Cascade Columbia Fisheries Enhancement Group for the Derby Creek Fish Passage – Collins Project (February-March work).
   - $2,355.90 to Cascade Columbia Fisheries Enhancement Group for the Chiwawa Nutrient Enhancement Project (January work).

- $15,804.40 to Cascade Columbia Fisheries Enhancement Group for the Chiwawa Nutrient Enhancement Project (February work).
- $3,011.99 to Cascade Columbia Fisheries Enhancement Group for the Chiwawa Nutrient Enhancement Project (March work).
- $1,615.01 to Cascade Columbia Fisheries Enhancement Group for the Restore Lower Chiwaukum Creek – Phase 1 Project (January work)
- $8,246.37 to Cascade Columbia Fisheries Enhancement Group for the Restore Lower Chiwaukum Creek – Phase 1 Project (February work).
- $2,324.11 to Cascade Columbia Fisheries Enhancement Group for the Restore Lower Chiwaukum Creek – Phase 1 Project (March work).
- $412,069.18 to Trout Unlimited for the Barkley Irrigation Company – Under Pressure Project (2019 work).
- $327,754.82 to Trout Unlimited for the Barkley Irrigation Company – Under Pressure Project (January work).
- $127,970.21 to Trout Unlimited for the Barkley Irrigation Company – Under Pressure Project (February work).
- $2,725.31 to Trout Unlimited for the Beaver Fever – Restoring Ecosystem Function Project (January-February work).
- $115,000 to the Yakama Nation for the Upper Kahler Stream and Floodplain Enhancement Project (2019 work).

Rocky Reach Plan Species Account:

- $223.13 to Clifton Larson Allen for Rocky Reach financial administration in January 2020.
- $91.88 to Clifton Larson Allen for Rocky Reach financial administration in February 2020.
- $52.50 to Clifton Larson Allen for Rocky Reach financial administration in March 2020.
- $320.39 to Chelan PUD for Rocky Reach project coordination and administration during the first quarter of 2020.
- $1,231.44 to Cascade Columbia Fisheries Enhancement Group for the Entiat Basin Fish Passage and Screening Assessment Project (January work).
- $259.49 to Cascade Columbia Fisheries Enhancement Group for the Entiat Basin Fish Passage and Screening Assessment Project (February work).
- $2,653.59 to Cascade Columbia Fisheries Enhancement Group for the Entiat Basin Fish Passage and Screening Assessment Project (March work).
- $158.32 to Cascade Columbia Fisheries Enhancement Group for the Napeequa Side Channel Project (January work).
- $131.02 to Cascade Columbia Fisheries Enhancement Group for the Napeequa Side Channel Project (February-March work).

Well Plan Species Account:

- $2,160.00 to Douglas PUD for Wells administration.
- $1,287.58 to the Methow Salmon Recovery Foundation for the Sugar Levee Groundwater Evaluation Project (2019 work).
- $160.61 to Chelan PUD for Wells project coordination and administration during the first quarter of 2020.

2. For the written record, Tracy Hillman reported that on 7 February, the Committees received a General Salmon Habitat Program proposal from Trout Unlimited titled: *City of Leavenworth Fish Screen Project*. The purpose of the project was to bring the existing failing screen into compliance to protect all fish species and life stages from injury, entrainment, and mortality. The screen is located at RM 5.8 on Icicle Creek. This project will complement the Icicle Boulder Field Project. The total cost of the project was $900,100. The sponsor requested $475,100 from HCP Plan Species Account Funds. ***The Rock Island Tributary Committee elected to contribute $475,100 to the project***.
3. For the written record, Tracy Hillman reported that the PUDs deposited funds into each of the Plan Species Accounts. Chelan PUD deposited $804,280 into the Rock Island Plan Species Account and $380,923 into the Rocky Reach Account. Douglas PUD deposited $292,037 into the Wells Account. As of the beginning of February, the unallocated balances within each account were $4,920,769 in the Rock Island Account, $2,286,937 in the Rocky Reach Account, and $2,130,796 in the Wells Account. Thus, among the three accounts, there was about $9,338,502 available.
4. For the written record, Tracy Hillman reported that on 12 February, Douglas PUD submitted the 2020 Wells HCP Action Plan to the Wells Tributary Committee for review. The Wells Tributary Committee had no comments or edits on the 2020 Action Plan. On 13 February, Chelan PUD submitted the 2020 Rock Island and Rocky Reach HCP Action Plans to the two respective committees for review. The Rock Island and Rocky Reach Tributary Committees had no comments or edits on the 2020 Action Plans.
5. Tracy Hillman reviewed the Salmon Recovery Funding Board/Tributary Committees proposed schedule for 2020 (see Attachment 1). Important dates are noted below:
   - Draft Applications Due: 17 April 2020
   - Site Visits: 11-13 May 2020
   - Review Draft Applications: 14 May 2020
   - Final Application Due: 29 May 2020
   - Review Final Applications: 11 June 2020

   Tracy noted that because of issues associated with COVID-19, site visits will likely be virtual tours.
6. Becky Gallaher informed the Rock Island and Rocky Reach Tributary Committees that the two Plan Species Accounts are going through an external financial review. Becky said the accounting firm Cordell, Neher and Company, PLLC, will conduct the review. Funds to pay for the review come from the Rock Island and Rocky Reach Administrative Accounts.

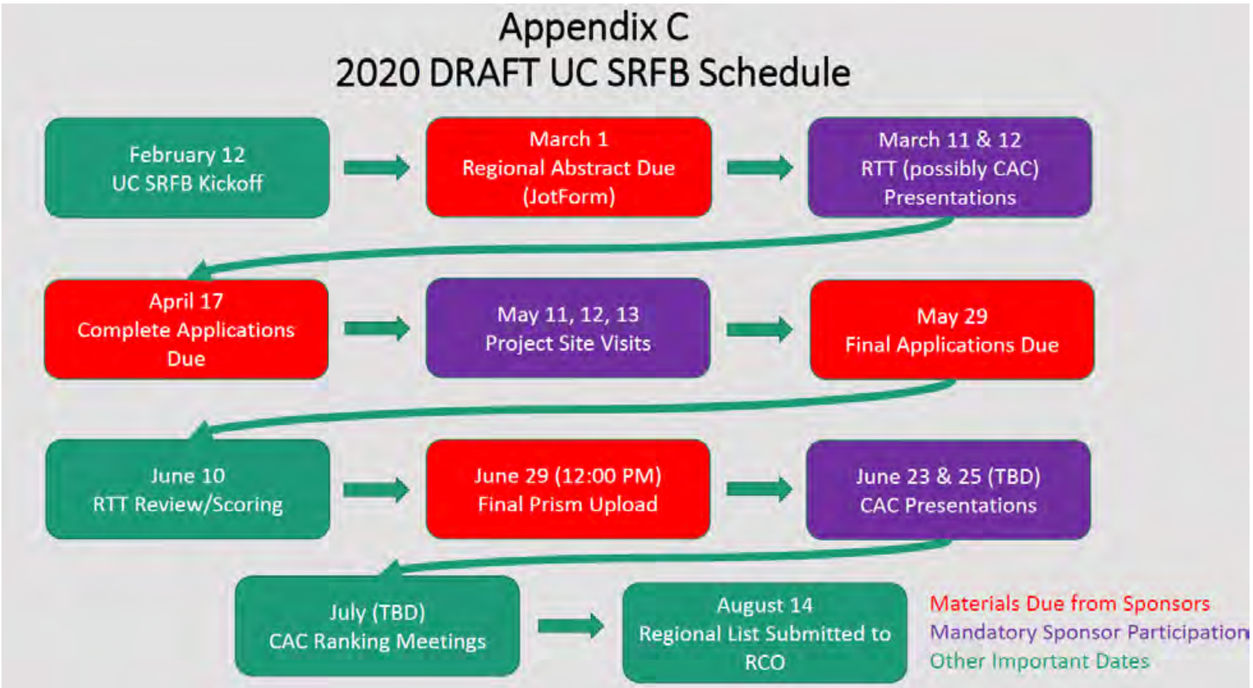
VIII. Next Steps

The next scheduled meeting of the Tributary Committees will be on Thursday, 14 May 2020 at Grant PUD in Wenatchee. Site visits (virtual or in person) will occur on 11-13 May.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Attachment 1

2020 Salmon Recovery Funding Board Process Schedule



Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 14 May 2020

Members Present: Jeremy Cram (WDFW), Chris Fisher (Colville Tribes), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees Chair).

Others Present: Becky Gallaher (Tributary Project Coordinator). Hans Smith (YN Alternate) and Chris Clemons (YN) joined the discussion on the Upper Burns and Angle Point Areas Habitat Enhancement Project.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 14 May 2020 from 9:00 am to 12:00 pm.

I. Review and Adopt Agenda

Tracy Hillman welcomed everyone to the meeting and the Committees adopted the proposed agenda with no additions.

II. Review and Approval of Meeting Minutes

The draft April meeting notes were reviewed and approved by Tributary Committees members.

III. Monthly Update on Ongoing Projects

Becky Gallaher gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Barkley Irrigation – Under Pressure Project – The sponsor (Trout Unlimited; TU) reported all diversion and pump station systems are in operation, including the gravity and pressure delivery lines.
- Icicle Boulder Field Project – The sponsor (TU) reported the project is fully permitted and work should start the first week of May. They plan to start work on the downstream waterline and fish-screen work. The boulder field step-pool passage work will start mid-July, concurrent with the in-water work window.
- Peshastin Creek RM 10.5 PIT-Tag Detection Site Project – This project is complete. The sponsor (Washington Department of Fish and Wildlife; WDFW) provided the 2019 annual report, which was uploaded to the Extranet site.
- Beaver Fever Project – The sponsor (TU) reported there was no new activity this month. They recently hired a new manager for this project.
- Methow Basin Barrier Diversion Assessment Project – The sponsor (Cascade Fisheries; CF) did not provide an update this month.

- Derby Creek Fish Passage Project – The sponsor (CF) reported that the WDFW engineer completed edits to the BODR. The revisions have been submitted to Chelan County Public Works. The sponsor plans to ask for bids later this month.
- Chiwawa Nutrient Enhancement Project – The sponsor (CF) reported they discussed with NOAA, USFWS, WDFW, CPUD, DOE, and USFS the use of a helicopter to distribute analogs. Overall, there were no major issues; however, they will look more closely at the timing and locations of bull trout spawning. USFWS expressed a concern that having a helicopter could possibly harass or maybe harm bull trout. The sponsor plans to discuss this further with USFWS. Kate Terrell noted there also could be issues with spotted owls. The sponsor is waiting for confirmation from WDFW that 40,000 pounds of analogs will be available this fall.
- Entiat Fish Passage and Barrier Assessment Project – The sponsor (CF) reported they are addressing comments on the draft report.
- Twisp River Floodplain Left Bank Spring-fed Alcove Restoration Project – The sponsor (Methow Salmon Recovery Foundation; MSRF) reported there was no new activity on this project.
- Johnson Creek Habitat Restoration Project – The sponsor (TU) did not provide an update this month. This work will occur later in 2020.
- Sugar Levee Groundwater Evaluation Project – The sponsor (MSRF) reported they have been coordinating with Interfluve and YN to obtain past testing results. They intend to compare past results with current efforts. They are also coordinating with landowners for access to the site to evaluate existing groundwater monitoring wells and sites for new monitoring wells.
- Cottonwood Flats Floodplain Restoration Project – The sponsor (Chelan County Natural Resources Department; CCNRD) did not provide an update this month.
- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported the project is moving forward but there is little to report at this time. They had one meeting with Jones Shotwell Ditch Company to discuss project details and another meeting with Washington State Conservation Commission about the consolidated water-right application.
- Peshastin RM 3.4 Side Channel Project – The Sponsor (CCNRD) did not provide an update this month.
- Stormy Area "A: Stream and Floodplain Enhancement Project – The sponsor (YN) reported construction is complete and they are writing the final report.
- Napeequa Side Channel Connection Project – The sponsor (CF) reported there was no new activity on this project.
- Monitor Side Channel Project – The sponsor (CCNRD) did not provide an update this month.
- Restore Chiwaukum Creek Project – The sponsor (CF) reported that their consultant completed a draft Rapid Geomorphic Assessment. Comments from the design team will be incorporated into the final draft. The next phase of the project will be to develop a hydraulic model so they can model high flows to assess areas of the campground that are inundated under existing conditions. Jeremy Cram and Catherine Willard are currently participating on the design/science team. Members directed Tracy Hillman to contact the sponsor and request the addition of Brandon Roger and Kate Terrell to the design/science team.
- City of Leavenworth Fish Screen Project – The Sponsor (TU) did not provide an update this month.

- Goodwin Side Channel Assessment Project – The Sponsor/Tributary Committee Agreement has been signed.

IV. Budget Amendment

Upper Burns and Angle Point Areas Habitat Enhancement Project

The Rock Island Tributary Committee received a budget amendment request from the Yakama Nation on the Upper Burns and Angle Point Areas Habitat Enhancement Project. The Yakama Nation requested an additional $187,550, which would increase the Committee's contribution to a total of $376,550. The Yakama Nation requested additional funding from the Rock Island Tributary Committee because the project did not receive funding from the Salmon Recovery Funding Board last year.

After discussion, the Rock Island Tributary Committee determined that they do not want to contribute more than the $189,000 that they already approved for the project. Members were concerned with the overall cost of the project and with the placement of a large structure (Type 2 Wood Structure on the left bank) in a high-density spawning area. In addition, they believe there is too much excavation work proposed in this area. As the Committee recommended last year, this site may be best approached by modifying the opening of the side channel and letting the river carve the side channel. The Committee would like to see a project at this site that minimizes disturbance of existing riparian vegetation, such as excavating a trench to design elevation and allowing the river to contour the channel banks, rather than grading side slopes to form a trapezoidal channel.

V. General Salmon Habitat Program Draft Applications

The Committees received 10 General Salmon Habitat Program draft proposals. The Committees reviewed each draft proposal and selected those they believe warranted a final proposal. Projects the Committees dismissed were either inconsistent with the intent of the Tributary Fund, did not have strong technical merit, or had low benefits per cost (not cost effective). The Committees assigned draft proposals to one of two categories: Fundable (would like to see a final application) and Not Fundable (would not like to see a final application). It is important to note that these are ratings of draft proposals and do not reflect ratings of final proposals. The Committees directed Tracy Hillman to notify sponsors with appropriate projects to submit a final proposal, with a discussion of the questions/comments identified for each draft proposal listed below. Tracy will also notify sponsors with projects that have no chance or a low likelihood of receiving funding from the Tributary Committees.

Chewuch River Mile 4 Fish Enhancement Project (Not Fundable)

The Committees recommend that this project, sponsored by the Yakama Nation, should not be submitted as a full proposal to the Tributary Committees for the following reasons:

- The Committees believe the project can be accomplished with much less excavation work and disturbance to the forested floodplain by constructing a relatively short pilot channel on the floodplain. This would minimize disturbance to existing riparian habitat and maximize opportunities for the river to carve its own channel or channel features. Another, shorter channel could be constructed at the downstream end of the floodplain to ensure completion of the connection. This approach is not greatly different from the approach the Committees recommended for the Cottonwood Flats Project on the Entiat River.
- The Committees urge project sponsors, who intend to seek funds from Plan Species Accounts, to consult with the Committees during the design phase of a proposed project. This allows the Committees to provide feedback earlier in the process.

Upper Beaver Creek Final Design and Restoration Project (Fundable)

The Committees recommend that the project sponsor (Methow Salmon Recovery Foundation) address the following comment/suggestion as they develop the full proposal:

- Consider removing the surface diversions entirely from the stream. If the sponsor previously evaluated the removal of the diversions, they need to explain why removal is not the preferred alternative.

Alder Creek Floodplain Restoration Project (Fundable)

The Committees recommend that the project sponsor (Yakama Nation) address the following comments/suggestions as they develop the full proposal:

- The Committees question whether it is necessary to construct a perennial channel. The sponsor needs to explore the benefits of constructing a seasonal channel, which should reduce the dilution of groundwater.
- Include an adaptive management plan that describes how recolonization of beavers will be addressed after the proposed project is implemented. The Committees believe recolonization of beavers shortly after completing the project could reduce or destroy restoration efforts.
- Provide information on levels of toxics and heavy metals in sediments on the floodplain. The Alder Creek watershed was actively mined and there are concerns metals have accumulated in the project area and could be mobilized during and after construction.
- As far as floodplain reconnection is concerned, several members of the Committees favor enhancement actions that minimize excavation and let the river do the work and create undercut banks wherever possible. This is especially true for projects that propose to cut through forested floodplains. Several members of the Committees support projects that reconnect existing floodplain features and minimize excavation, while maximizing opportunities for the river to carve its own channel and/or channel features. That said, the Committees are open to the consideration of exceptions where warranted.

Beaver Creek Barrier #040016 Correction Project (Fundable)

The Committees recommend that the project sponsor (Chelan County Natural Resources Department) submit a full proposal. The Committees had no comments on this project.

Lower Chiwawa River Floodplain Reconnection and In-stream Enhancement (RM 1.0-4.25) Project (Fundable)

The Committees recommend that the project sponsor (Chelan County Natural Resources Department) address the following comments/suggestions as they develop the full proposal:

- The Committees are most interested in the floodplain reconnection work. They do not believe an extensive amount of assessment work is needed to evaluate large wood structures in the channel upstream from the floodplain site. In that reach, there are virtually no large wood jams because there are no or few large boulders to retain wood. Therefore, it may not take a lot of effort to assess the upstream reach.
- With regard to floodplain reconnection, several members of the Committees favor enhancement actions that minimize excavation and let the river do the work and create undercut banks wherever possible. This is especially true for projects that propose to cut through forested floodplains. Several members of the Committees tend to support projects that reconnect existing floodplain features and minimize excavation, while maximizing opportunities for the river to carve its own channel and/or channel features. That said, the Committees are open to the consideration of exceptions where warranted.

Lower Nason Creek Floodplain Reconnection (RM 2.5-3.4) Project (Fundable)

The Committees recommend that the project sponsor (Chelan County Natural Resources Department) address the following comments/suggestions as they develop the full proposal:

- The Committees recommend that the sponsor check with the regulatory agencies to see whether a Stage-0 design in this location is supported before investing a significant amount of time on the Stage-0 design.
- The sponsor needs to describe how they intend to protect existing spawning and rearing habitat if a constructed riffle is proposed.
- It is not clear what the $166,000 is buying the restoration community. The final application needs to be more specific in what elements are likely to be included in the design.
- As far as floodplain reconnection is concerned, several members of the Committees favor enhancement actions that minimize excavation and let the river do the work and create undercut banks wherever possible. This is especially true for projects that propose to cut through forested floodplains. Several members of the Committees support projects that reconnect existing floodplain features and minimize excavation, while maximizing opportunities for the river to carve its own channel and/or channel features. That said, the Committees are open to the consideration of exceptions where warranted.

Icicle Confluence Side Channel Habitat Improvement Project (Not Fundable)

The Committees recommend that this project, sponsored by the Chelan County Natural Resources Department, should not be submitted as a full proposal to the Tributary Committees for the following reasons:

- The proposed project will have limited biological benefit and may even increase the incidence of fish stranding.
- Although the addition of deeper pools with wood structures may increase the capacity of the side channel, given the dynamics and condition of the site, those activities will likely improve conditions for coho salmon, which may have a competitive advantage over Chinook salmon and steelhead.
- There could be issues with dissolved oxygen levels if too much organic material is added to the channel.

Merritt Oxbow Reconnection Restoration Project (Not Fundable)

The Committees recommend that this project, sponsored by Cascadia Fisheries, should not be submitted as a full proposal to the Tributary Committees for the following reasons:

- Although the Committees encourage the reconnection of floodplains, especially within the Nason Creek watershed, the Committees are concerned with the stability of the intake structure and the longevity of the project. The sponsor needs to work with the Forest Service (landowner on river right) and fully evaluate the effects of raising the channel bed by constructing a riffle. This should allow floodplain reconnection in a dynamic segment of the stream for a longer period of time.
- Several members of the Committees favor enhancement actions that minimize excavation and let the river do the work and create undercut banks wherever possible. This is especially true for projects that propose to cut through forested floodplains. Several members of the Committees support projects that reconnect existing floodplain features and minimize excavation, while maximizing opportunities for the river to carve its own channel and/or channel features. That said, the Committees are open to the consideration of exceptions where warranted.

Big Meadow Creek Fish Passage Restoration Project (Fundable)

The Committees recommend that the project sponsor (Cascadia Fisheries) address the following comment/suggestion as they develop the full proposal:

- The existing culvert should be replaced with a bridge. The sponsor needs to work with the Forest Service on the installation of a bridge rather than a culvert.

Nason Kahler Instream Complexity Project (Fundable)

The Committees recommend that the project sponsor (Chelan County Natural Resources Department) address the following comments/suggestions as they develop the full proposal:

- The cost of the project appears high for the amount of work to be conducted. The sponsor needs to consider ways to reduce the cost of the project.
- The Committees have concerns with the feasibility of building structures and restoring riparian vegetation under the powerlines. The sponsor needs to provide information that demonstrates BPA supports the proposed actions under the powerlines.
- In general, the Committees are concerned that the proposed approach relies too much on instream structures and places less emphasis on enhancing channel morphology. The Committees would like to see actions that address the large width:depth ratio.

VI. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests from April and May:

   Rock Island Plan Species Account:

   - $162.75 to Clifton Larson Allen for Rock Island financial administration in April 2020.
   - $65.43 to Cascade Fisheries for the Derby Creek Fish Passage – Collins Project (February-March work).
   - $505.49 to Cascade Fisheries for the Restore Lower Chiwaukum Creek – Phase 1 Project (April work)
   - $1,996.89 to Cascade Fisheries for the Chiwawa Nutrient Enhancement Project (April work).

   Rocky Reach Plan Species Account:

   - $162.75 to Clifton Larson Allen for Rocky Reach financial administration in April 2020.
   - $78.51 to Cascade Fisheries for the Entiat Basin Fish Passage and Screening Assessment Project (April work).
   - $153.80 to Cascade Fisheries for the Napeequa Side Channel Project (April work).

2. Becky Gallaher reported the following unallocated balances within each Plan Species Account:

   - Rock Island: $5,532,293
   - Rocky Reach: $2,676,021
   - Wells: $2,131,058

3. Tracy Hillman reviewed the Salmon Recovery Funding Board/Tributary Committees proposed schedule for 2020 (see Attachment 1). Important dates are noted below:

   - Final Applications Due: 29 May 2020
   - Review Final Applications: 11 June 2020

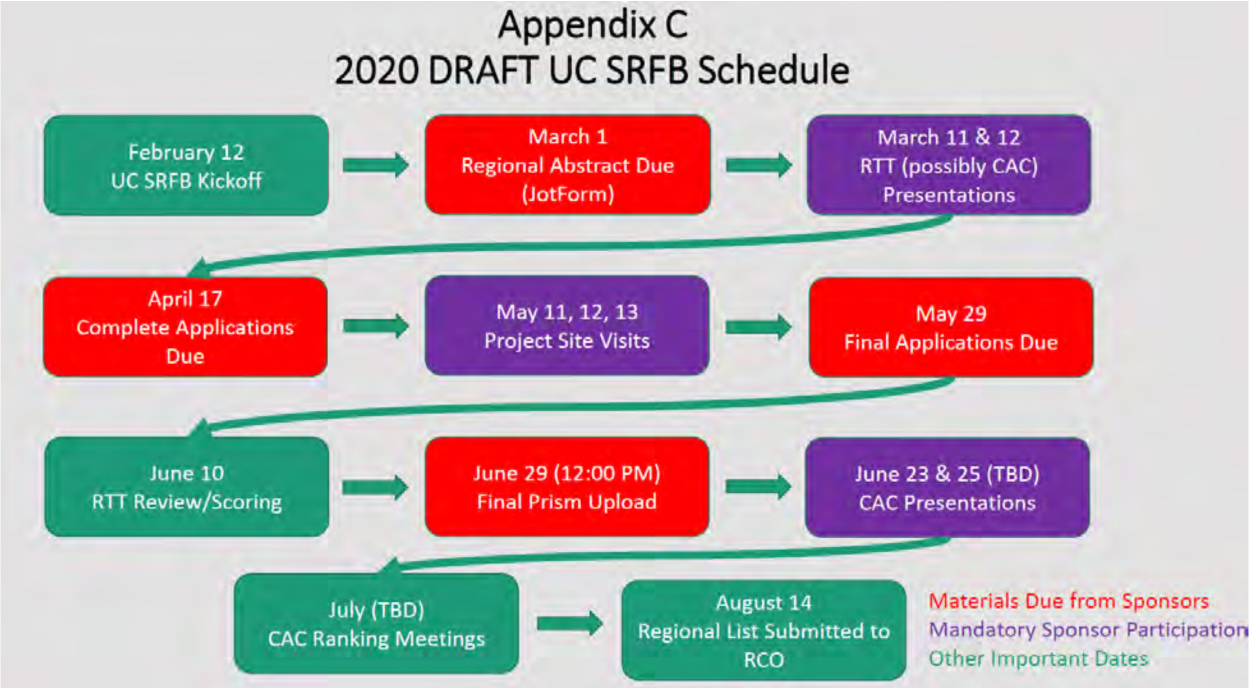
VII. Next Steps

The next scheduled meeting of the Tributary Committees will be on Thursday, 11 June 2020 at Grant PUD in Wenatchee.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Attachment 1

2020 Salmon Recovery Funding Board Process Schedule



Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 11 June 2020

Members Present: Jeremy Cram (WDFW), Chris Fisher (Colville Tribes), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees Chair).

Others Present: Becky Gallaher (Tributary Project Coordinator).

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 11 June 2020 from 9:00 am to 12:00 pm.

I. Review and Adopt Agenda

Tracy Hillman welcomed everyone to the meeting and the Committees adopted the proposed agenda with the addition of a Small Projects Program Application. The Committees also received an Assessment/Monitoring Application but they were unable to review it before the meeting. They will review it and make a funding decision in July.

II. Review and Approval of Meeting Minutes

The draft May meeting notes were reviewed and approved by Tributary Committees members.

III. Monthly Update on Ongoing Projects

Becky Gallaher gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Barkley Irrigation – Under Pressure Project – The sponsor (Trout Unlimited; TU) reported that the pump station is online and running smoothly. The pressure pipeline is also complete. All wells have all been drilled, tested, and commissioned.
- Icicle Boulder Field Project – The sponsor (TU) reported that 400-linear-feet of pipe was installed between the Water Treatment Plant (near the City of Leavenworth) and Snow Lakes parking area. The contractor also spent time breaking and removing boulders between the IPID access and USFS roads.
- Peshastin Creek RM 10.5 PIT-Tag Detection Site Project – This project is complete. The sponsor (Washington Department of Fish and Wildlife; WDFW) provided the 2019 annual report, which was uploaded to the Extranet site.
- Beaver Fever Project – The sponsor (TU) reported there are beaver dam analog projects planned for this summer/fall in Potato and Roaring creeks. The sponsor is currently working on permits.
- Derby Creek Fish Passage Project – The sponsor (CF) reported they completed the bid process and will complete contracting this month.

- Chiwawa Nutrient Enhancement Project – Because of COVID-19, the Sponsor (CF) is still waiting for confirmation from WDFW that 40,000 pounds of analogs will be available for distribution in the Chiwawa River this year. WCC crews are scheduled to distribute the analogs; however, it is unclear at this time how COVID-19 guidelines will affect their availability.
- Entiat Fish Passage and Barrier Assessment Project – The sponsor (CF) reported the final report is expected to be completed by mid-June.
- Twisp River Floodplain Left Bank Spring-fed Alcove Restoration Project – The sponsor (Methow Salmon Recovery Foundation; MSRF) reported they are in contact with the upstream landowners but do not yet have an agreement with them. They will continue to discuss the project with the landowners.
- Johnson Creek Habitat Restoration Project – The sponsor (TU) did not provide an update this month. This work will occur later in 2020.
- Sugar Levee Groundwater Evaluation Project – The sponsor (MSRF) reported that staff gauges have been installed and loggers were installed in historic wells as needed. The sponsor continues to coordinate with landowners regarding access to existing groundwater monitoring wells and sites for new groundwater wells.
- Cottonwood Flats Floodplain Restoration Project – The sponsor (Chelan County Natural Resources Department; CCNRD) did not provide an update this month.
- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported there was no new activity on this project.
- Peshastin RM 3.4 Side Channel Project – The Sponsor (CCNRD) reported they are in the process of contracting for both the cultural resource survey and preliminary design.
- Stormy Area "A: Stream and Floodplain Enhancement Project – The sponsor (YN) reported construction is complete and they are writing the final report.
- Napeequa Side Channel Connection Project – The sponsor (CF) reported there was no new activity on this project.
- Monitor Side Channel Project – The sponsor (CCNRD) did not provide an update this month.
- Restore Chiwaukum Creek Project – The sponsor (CF) reported they recently received additional funding from USFWS to help design the project.
- City of Leavenworth Fish Screen Project – The Sponsor (TU) did not provide an update this month.
- Goodwin Side Channel Assessment Project – The Sponsor (CF) reported there was no new activity on this project.
- Sugar Reach Habitat Enhancement Early Implementation Project – The Sponsor/Tributary Agreement has been signed.

IV. Small Projects Program Application

Methow River – Vandervort Property Appraisal Project

The Methow Salmon Recovery Foundation is the sponsor of the Methow River – Vandervort Property Appraisal Project. The purpose of the project is to fund an appraisal to determine the value of the Vandervolt property at the upper end of the Silver Side Channel Project area, located on the Methow River near RM 35.5. The acquisition of this property would potentially allow the removal of a levee that currently isolates flow into the upper end of the Silver Side Channel. The total cost of the project was $9,250 (does not include the cost of the actual appraisal).[1] The sponsor requested $9,250 from HCP Plan Species Account Funds. The Committees declined the opportunity to fund this project.

The Committees identified several uncertainties and unknowns associated with the Silver Side Channel that they need to better understand. For example, what effects will removal of the levee have on downstream landowners, would downstream landowners agree with levee removal, how will levee removal affect completed enhancement work in the lower portion of the side channel, and are there current or future issues that will prevent the levee from being removed? In addition, the Committees would like to better understand the effectiveness of the implemented enhancement actions in the lower portion of the side channel and the effects of beavers on those actions. To that end, the Committees will invite MSRF to a future meeting to discuss these issues with the Committees. MSRF is welcome to include others (e.g., WDFW and CF) who may be able to respond to these issues.

V. General Salmon Habitat Program Applications

The Committees received eight General Salmon Habitat Program proposals that were cost shares with the Salmon Recovery Funding Board (SRFB). In addition, they received an application from the Colville Confederated Tribes (CCT) that was not a cost share with the SRFB.

Before reviewing the proposals and consistent with the Committees' Operating Procedures, members of the Committees identified potential conflicts of interest. Brandon Rogers recused himself from discussing and voting on the two Yakama Nation proposals. Chris Fisher recused himself from discussing and voting on the CCT proposal.

Becky Gallaher provided the Committees with the unallocated balances within each Plan Species Account. The Wells Account has $2,131,058, the Rocky Reach Account has $2,676,021, and the Rock Island Account has $5,532,293. In sum, among the three accounts, there is $10,339,372 available to fund projects.

Upper Beaver Creek Final Design and Restoration Project

The Methow Salmon Recovery Foundation is the sponsor of the Upper Beaver Creek Final Design and Restoration Project. The purpose of the project is to restore fish passage at two irrigation diversions, increase flood conveyance capacity, and increase fish access to a 1,300-foot-long perennial groundwater-fed wetland channel. This project is located at RM 6.2-6.7 on Beaver Creek, a tributary to the Methow River. The total cost of the project was $395,342. The sponsor requested $59,307 from HCP Plan Species Account Funds. The Committees declined the opportunity to fund this project. Given the effects of the fire and the associated upstream issues, the Committees believe this project will not be sustainable and thus will have little biological benefit. They would like to see the diversions removed from the stream and the groundwater-fed wetland reconnected at both the upstream and downstream ends.

Beaver Creek Barrier #040016 Correction Project

Chelan County Natural Resources Department is the sponsor of the Beaver Creek Barrier #040016 Correction Project. The purpose of the project is to replace a partial fish passage barrier at RM 0.5 on Beaver Creek, a tributary to the Wenatchee River. This project will restore fish access to about 6.2 miles of intrinsic potential for salmonids. The total cost of the project was $251,110. The sponsor requested $54,646 from HCP Plan Species Account Funds. The ***Rocky Reach Tributary Committee elected to contribute $54,646 to the project***. The Committee encourages the sponsor to replace the existing culvert with a bridge; however, the cost of the bridge and its installation should not exceed the existing budget for the project.

[1] The budget request of $9,250 included coordination, administration, and indirect costs.

Lower Chiwawa River Floodplain Reconnection and Instream Enhancement Project

Chelan County Natural Resources Department is the sponsor of the Lower Chiwawa River Floodplain Reconnection and Instream Enhancement Project. The purpose of the project is to evaluate the mainstem Chiwawa River from RM 1.0-4.25, including a 25-acre floodplain wetland complex, to identify and develop enhancement actions that will improve instream habitat conditions and reconnect the floodplain, while avoiding negative effects to residential properties. The total cost of the project was $166,395. The sponsor requested $24,960 from HCP Plan Species Account Funds. The ***Rock Island Tributary Committee elected to contribute $24,960 to the project***. As part of funding for this project, the Committee requires that they can review and approve restoration scenarios and designs.

Icicle Confluence Side Channel Habitat Improvement Project

Chelan County Natural Resources Department is the sponsor of the Icicle Confluence Side Channel Habitat Improvement Project. The purpose of the project is to install wood structures and plantings at strategic locations in the Icicle confluence side channel and along the Wenatchee River margin to encourage pool scour and provide cover for juvenile salmonids. The total cost of the project was $335,320. The sponsor requested $50,298 from HCP Plan Species Account Funds. The Committees declined the opportunity to fund this project.

The Committees believe the proposed project will provide little benefit to juvenile spring Chinook salmon and steelhead. They are concerned the project may actually entrap more fish and depending on the amount of organic matter within the channel, it could create a dissolved oxygen problem during low-flow periods and increase mortality rates. In addition, given the dynamics and condition of the site, the proposed activities will likely improve conditions for coho salmon, which may have a competitive advantage over juvenile Chinook salmon and steelhead.

Big Meadow Creek Fish Passage Restoration Project

Cascade Fisheries is the sponsor of the Big Meadow Creek Fish Passage Restoration Project. The purpose of the project is to replace a partial fish passage barrier at RM 0.25 on Big Meadow Creek, a tributary to the Chiwawa River in the Wenatchee River basin. This project will restore fish access to about 10.7 miles of intrinsic potential for salmonids. The total cost of the project was $475,000. The sponsor requested $207,500 from HCP Plan Species Account Funds. The ***Rock Island Tributary Committee elected to contribute $207,500 to the project***. The Committee encourages the sponsor to replace the existing culvert with a bridge.

Nason Kahler Instream Complexity Project

Chelan County Natural Resources Department is the sponsor of the Nason Kahler Instream Complexity Project. The purpose of the project is to improve adult Chinook and steelhead holding habitat and increase winter rearing habitat for juvenile salmonids by increasing instream complexity and peripheral off-channel habitat at RM 6.0-7.4 on Nason Creek, a tributary to the Wenatchee River. The total cost of the project was $662,865. The sponsor requested $149,020 from HCP Plan Species Account Funds. The ***Rocky Reach Tributary Committee elected to contribute $149,020 to the project***.

Enloe Dam Removal Concept Plan

The Colville Confederated Tribes is the sponsor of the Enloe Dam Removal Concept Plan. The purpose of the project is to develop a conceptual plan to remove Enloe Dam, which is located at RM 8.8 on the Similkameen River in the Okanogan River basin. The plan would include water control, access and staging, sediment management, demolition, and post removal restoration. The plan would identify the sequence with which these elements would be undertaken and the associated cost estimates for each element. The total cost of the project was $117,612. The sponsor requested $117,612 from HCP Plan Species Account Funds. The Committees declined the opportunity to fund this project.

The Committees require that this project include a 15% cost share. In addition, if this project moves forward, the Committees would like to know all the potential funders. The removal of Enloe Dam is not a project the Committees can support financially without significant contributions from other funding sources. After the sponsor includes a cost share and identifies potential future funding sources, they are encouraged to resubmit the application.

Chewuch River Mile 4 Fish Enhancement Project

The Yakama Nation is the sponsor of the Chewuch River Mile 4 Fish Enhancement Project. The purpose of the project is to restore side channel and floodplain connectivity, increase instream complexity, and restore habitat forming processes that will benefit salmonids at RM 4.2-4.6 on the Chewuch River, a tributary to the Methow River. The total cost of the project was $659,351. The sponsor requested $137,866 from HCP Plan Species Account Funds. The Committees declined the opportunity to fund this project.

The Committees believe the project can be accomplished with much less excavation work and disturbance to the forested floodplain by constructing a relatively short pilot channel on the floodplain. This would minimize disturbance to existing riparian habitat and maximize opportunities for the river to carve its own flow paths. Another, shorter channel could be constructed at the downstream end of the floodplain to ensure completion of the connection. In addition, the Committees would prefer the activation of existing features rather than creating new ones. As a final note, the Committees would like to reiterate that if the sponsor intends to seek funds from Plan Species Accounts, the Committees recommend that the sponsor consult with them during the design phase of a proposed project. This will allow the Committees opportunities to provide feedback earlier in the process.

Alder Creek Floodplain Restoration Project

The Yakama Nation is the sponsor of the Alder Creek Floodplain Restoration Project. The purpose of the project is to restore side channel and floodplain connectivity, increase instream complexity, and restore habitat forming processes that will benefit salmonids at RM 34.0-34.5 on the Methow River. The total cost of the project was $691,700. The sponsor requested $149,967 from HCP Plan Species Account Funds. The Committees declined the opportunity to fund this project.

The Committees believe this project relies too heavily on excavation work and can be completed with much less excavation work. In addition, the Committees would need to see a 10-year management plan that addresses potential beaver issues within the site. They believe it is likely that beavers will colonize the site before the enhancement actions have matured to the point to be resistant or resilient to beavers. Finally, they believe their comment on the draft application regarding creation of undercut banks was misunderstood. They were not suggesting the creation of "engineered" undercut banks. Rather, they were suggesting the river be allowed to create undercut banks naturally. That is, allowing the river to cut flow paths across the floodplain or to flow through under-excavated, engineered channels should result in the creation of undercut banks as the water erodes sediments through the forested floodplain.

Summary of Review of 2020 General Salmon Habitat Program Projects

Project Name	Sponsor[1]	Total Cost	Request from T.C.	T.C. Contribution[2]
Upper Beaver Creek Final Design and Restoration	MSRF	$395,342	$59,307	$0
Beaver Creek #040016 Correction Project	CCNRD	$251,110	$54,646	RR: $54,646
Chiwawa Floodplain Reconnection & Enhancement	CCNRD	$166,395	$24,960	RI: $24,960
Icicle Confluence Side Channel Habitat Improvement	CCNRD	$335,320	$50,298	$0
Big Meadow Creek Fish Passage Restoration	CF	$475,000	$207,500	RI: $207,500
Nason Kahler Instream Complexity Project	CCNRD	$662,865	$149,020	RR: $149,020

Project Name	Sponsor[1]	Total Cost	Request from T.C.	T.C. Contribution[2]
Enloe Dam Removal Concept Plan	CCT	$117,612	$117,612	$0
Chewuch River Mile 4 Enhancement Project	YN	$659,351	$137,866	$0
Alder Creek Floodplain Restoration	YN	$691,700	$149,967	$0
Total:		**$3,754,695**	**$951,176**	**$436,126**

[1] CF = Cascade Fisheries; CCNRD = Chelan County Natural Resources Department, CCT = Colville Confederated Tribes, MSRF = Methow Salmon Recovery Foundation, and YN = Yakama Nation.

[2] RI = Rock Island Plan Species Account; RR = Rocky Reach Plan Species Account; W = Wells Plan Species Account.

VI. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests from May and June:

   Rock Island Plan Species Account:

   - $136.50 to Clifton Larson Allen for Rock Island financial administration in May 2020.
   - $30,484.25 to Trout Unlimited for the Barkley Irrigation – Under Pressure Project (March work).
   - $1,584.74 to Cascade Fisheries for the Chiwawa Nutrient Enhancement Project (May work).

   Rocky Reach Plan Species Account:

   - $136.50 to Clifton Larson Allen for Rocky Reach financial administration in May 2020.

2. Tracy Hillman reported that the Upper Columbia Regional Technical Team is proposing to hold a workshop to discuss the use of beavers in restoration work. As there are concerns that beavers can harm recently completed enhancement projects (e.g., Silver Side Channel Project), the workshop would focus on when and how to use beavers in restoration. The Committees indicated that they would like to participate in the workshop.

VII. Next Steps

The next scheduled meeting of the Tributary Committees will be on Thursday, 9 July 2020.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 9 July 2020

Members Present: Jeremy Cram (WDFW), Chris Fisher (Colville Tribes), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees Chair).

Others Present: Becky Gallaher (Tributary Project Coordinator), Hans Smith (YN alternate), and Scott Hopkins (Chelan PUD alternate). Mike Kaputa (CCNRD), Scott Bailey (CCNRD), and Mike Kane (consultant) joined the call for the CCNRD project presentations. Chris Johnson (MSRF), Tara Gregg (MSRF), Steve Kolk (USBOR), and Emily Alcott (Inter-Fluve) joined the call for the Sugar Levee Project update.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 9 July 2020 from 9:00 am to 12:30 pm.

I. Review and Adopt Agenda

Tracy Hillman welcomed everyone to the meeting and the Committees adopted the proposed agenda.

II. Review and Approval of Meeting Minutes

The draft June meeting notes were reviewed and approved by the Tributary Committees.

III. Monthly Update on Ongoing Projects

Becky Gallaher gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Barkley Irrigation – Under Pressure Project – The sponsor (Trout Unlimited; TU) reported they completed the Phase II pressure pipeline project, the individual well project, and a few other miscellaneous items. With several items completed, the project team is concentrating efforts on the easement and working with the contractor on Phase II gravity pipeline construction. They received additional funding and are on track to start construction on the final phase of the project in October 2020.
- Icicle Boulder Field Project – The sponsor (TU) reported they completed installation of the remaining 160 linear feet of pipe near the Water Treatment Plant. The contractor also continued breaking and removing boulders between the IPID access road and USFS roads and installing pipe near the City of Leavenworth Treatment Plant. Construction will resume in late July when stream flows have receded.

- Peshastin Creek RM 10.5 PIT-Tag Detection Site Project – This project is complete. The sponsor (Washington Department of Fish and Wildlife; WDFW) provided the 2019 annual report, which was uploaded to the Extranet site.
- Beaver Fever Project – The sponsor (TU) reported that there was no new activity on this project.
- Derby Creek Fish Passage Project – The sponsor (Cascade Fisheries; CF) reported that there was no new activity on this project.
- Chiwawa Nutrient Enhancement Project – The Sponsor (CF) confirmed that WCC crews will be available for distributing carcass analogs in the Chiwawa River in October; however, the availability of cost-free analogs is still unknown (see Information Updates).
- Entiat Fish Passage and Barrier Assessment Project – The sponsor (CF) reported the project is complete and the final report is expected to be completed soon.
- Twisp River Floodplain Left Bank Spring-fed Alcove Restoration Project – The sponsor (Methow Salmon Recovery Foundation; MSRF) reported they have communicated with the neighboring landowner about cattle trespassing. There is no other new activity.
- Johnson Creek Habitat Restoration Project – The sponsor (TU) did not provide an update this month. This work will occur later in 2020.
- Sugar Levee Groundwater Evaluation Project – The sponsor (MSRF) reported no new activity. The piezometers are recording hourly groundwater readings in the six monitoring wells.
- Cottonwood Flats Floodplain Restoration Project – The sponsor (Chelan County Natural Resources Department; CCNRD) did not provide an update this month.
- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported there was no new activity on this project.
- Peshastin RM 3.4 Side Channel Project – The Sponsor (CCNRD) reported they executed the contract for the cultural-resource survey and are negotiating the scope of work with Inter-Fluve to complete the preliminary design.
- Stormy Area "A: Stream and Floodplain Enhancement Project – The sponsor (Yakama Nation; YN) reported construction is complete and they are writing the final report.
- Napeequa Side Channel Connection Project – The sponsor (CF) reported there was no new activity on this project.
- Monitor Side Channel Project – The sponsor (CCNRD) did not provide an update this month.
- Restore Chiwaukum Creek Project – The sponsor (CF) reported that they held a second design team meeting. Unfortunately, only one USFS employee was there for half the meeting. The sponsor has requested another opportunity to present the Rapid Geomorphic Assessment, initial hydraulic modeling results, and modified concepts to the USFS.
- City of Leavenworth Fish Screen Project – The Sponsor (TU) did not provide an update this month.
- Goodwin Side Channel Assessment Project – The Sponsor (CF) reported that they plan to install piezometers at the project site at the end of July.
- Sugar Reach Habitat Enhancement Early Implementation Project – The Sponsor (MSRF) reported they have initiated pre-project monitoring at the site. Photo points, side channel discharge measurements, side channel staff gauge readings, side channel snorkel surveys, and underwater video were taken to document fish habitat use.

- <u>Enloe Dam Removal Concept Plan Project</u> – The Sponsor/Tributary Committee Agreement is being reviewed and should be signed soon.

IV. Monitoring Application

<u>ORRI Effectiveness Monitoring and Restoration Prioritization (2020-2024) Project</u>

The Okanagan Nation Alliance (ONA) is the sponsor of the ORRI Effectiveness Monitoring and Restoration Prioritization (2020-2024) Project. The purpose of the project is to monitor the effectiveness of enhancement actions within three project sites: Penticton Channel, Oliver Site, and Okanagan Falls. Results from this work will direct the future enhancement of spawning areas for sockeye and Chinook in other sections of the river and Okanagan tributaries, determine priority enhancement sites, assess the long-term sustainability and function of constructed restoration structures and identify adaptive management options, support stock management decisions, and provide leverage to secure Canadian funding. The cost of the monitoring project over a five-year period is $99,000. After review and discussion, the Committees indicated an interest in possibly funding the following components of the project.

1. Penticton Channel
   - Spatial distribution of fall spawners and redds using drones.
   - Relationship between spawners/redd distribution, flow levels, and fry recruitment to the lake.
2. Oliver Site
   - Spatial distribution of fall spawners and redds throughout the entire river using drones.
3. Okanagan Falls
   - Effectiveness monitoring using drones.

Before the Committees can approve funding for these components, they need additional information from the project sponsor. The Committees need more detail on the above specific studies including a description of methodology. The sponsor needs to explain how drone imaging fits in with existing PUD-funded programs for enumerating spawners, and, if the sponsor intends to change methodologies, they need to describe the effort and number of years needed to develop a relationship (crosswalk model) between drone imaging and on-the-ground surveys. Given that drone surveys will be conducted only during peak spawning, the sponsor needs to describe how drone imaging will be used to inform relationships between spawners/redd, flow levels, and fry recruitment. Finally, a short description of how the sponsor estimates fry recruitment would be useful. The Committees request that the sponsor fill out the Tributary Committees Monitoring Application Form and submit it as soon as possible. The Committees will then make a funding decision.

V. CCNRD Projects Presentation

Chelan County Natural Resources Department (Mike Kaputa, Mike Kane, and Scott Bailey) discussed six projects with the Committees. The Committees appreciated the fact that Chelan County Natural Resources Department (CCNRD) is engaging them at an early stage of project development. What follows is a summary of each project and the Committees' initial feedback.

1. **Little Wenatchee Falls Project**

   The purpose of this proposed project is to provide fish passage at the natural falls on the Little Wenatchee River. This project could provide about 9 miles of habitat to spring Chinook upstream from the falls. The Committees see value in expanding the distribution of Chinook salmon and steelhead, even if the expansion is upstream from natural barriers. Such work should potentially increase the carrying capacity of listed species. However, before the Committees would be interested in funding passage at natural barriers, they need to better understand the quantity (primarily) and quality (secondarily) of habitat upstream from the barrier and the feasibility of providing passage at the falls. They would also appreciate a range of costs for providing passage at the falls. This would give the Committees the information they need to evaluate benefits per cost. The Committees encouraged CCNRD to explore further these issues. For example, a rapid assessment of habitat conditions upstream from the falls would be useful. Information from the assessment could be included in the prioritization tool being developed by the RTT. The tool would then help determine the biological benefit of the passage project and prioritize it in the context of other possible actions in the Wenatchee River basin.

2. **Nason Ridge Project**

   CCNRD provided an update on the Nason Ridge Project, which the Rock Island Committee supported with a $500,000 cost share. CCNRD is hoping to receive up to $3 million from the State Legislature. The Committees appreciated the update on the project. The Committees asked CCNRD to keep the Committees updated on the sponsor's success in securing funding for the project.

3. **Icicle/Peshastin Pumpback Project**

   CCNRD provided a brief update on the status of the Icicle/Peshastin Pumpback Project. They have funding from the SRFB to develop preliminary designs and funding from the Icicle Workgroup to evaluate O&M costs. At this time, they are proposing two pumping stations. One near the Town of Peshastin and the other between the Towns of Cashmere and Monitor. The intent of the project is to reduce the amount of water diverted from Icicle Creek and remove the Peshastin Creek diversion. The Committees appreciated the update on the Icicle/Peshastin Pumpback Project. The Committees requested that the sponsor provide an update on results from the feasibility study. The Committees would also like to review the preliminary designs once they are available.

4. **Derby Creek BNSF Crossing Project**

   The purpose of this proposed project is to replace a partial barrier on Derby Creek under the BNSF railroad near the mouth of the stream. CCNRD noted that it is unlikely this project will receive funding from the SRFB. Thus, they would like to know if the Committees would be interested in funding the project knowing that the Committees funded a barrier replacement project further upstream on Derby Creek. The sponsor noted that they have a good working relationship with BNSF and are in a good position to make this project happen. The Committees appreciated the fact that CCNRD has a working relationship with BNSF. These relationships are valuable and are needed to help restore habitat and fish populations. Although the Committees supported a passage project on Derby Creek in the past, they did not have a complete understanding of downstream passage issues and stream flow conditions. Therefore, before the Committees invest further in Derby Creek, they need to better understand limiting conditions in the watershed. For example, they need better information on existing flow conditions, including knowing when and where dewatering occurs. In addition, the Committees would like to know the progress being made to prevent uninterrupted flow in the stream and when interrupted flow condition may exist. Finally, they need a better understanding of habitat conditions throughout the watershed and current threats to those conditions. With this information, the Committees can evaluate whether the biological benefit potentially achieved by enhancing habitat conditions within Derby Creek justifies the cost of enhancement work there. At this time, it does not appear to be cost effective.

5. **Colockum Passage Project**

CCNRD described the diversions on Colockum Creek and their potential effect on steelhead in the stream. They noted that adult steelhead have been detected in Colockum Creek. They also said that there is no minimum flow rule for the stream. The senior water-right holder in the watershed has a legal right to divert 150% of low flow. The water is used for livestock and an orchard. The Committees are pleased that the sponsor is looking at smaller tributaries draining directly into the Columbia River. These small tributaries are included in the spatial structure of steelhead populations and are also known to support juvenile Chinook salmon rearing. Unfortunately, Colockum Creek is outside the geographic distribution of the Habitat Conservation Plans. Plan Species Account funds can only be used in the Columbia River watershed from Rock Island Dam tailrace to Chief Joseph Dam tailrace. Because Colockum Creek drains into the Columbia River downstream from Rock Island Dam, the Committees cannot fund actions in Colockum Creek. The Committees recommended that CCNRD discuss this potential project with the PRCC Habitat Subcommittee.

6. **Beaver Creek Irrigation Diversions Project**

   CCNRD noted that there are two additional diversions on Beaver Creek upstream from those being addressed by TU and CCNRD. These two diversions are 67% passable. CCNRD submitted a funding request to the Open Rivers Fund to cover the cost of preparing designs for both diversions. The request was for $86,600. The sponsor asked whether the Tributary Committees would be interested in funding this project. Although these two irrigation diversions are 67% passable, the Committees would like to see all potential passage barriers in Beaver Creek addressed. This watershed was selected by the RTT, UCSRB, and WDFW as the highest priority watershed in the Upper Columbia for addressing fish passage barriers. The Committees informed CCNRD that if they do not receive funding from the Open Rivers Fund, the Committees would review an application regarding these two diversions.

The Committees thanked CCNRD for discussing these projects with them.

VI. MSRF Update on Sugar Levee Project

The Methow Salmon Recovery Foundation (Tara Gregg and Chris Johnson) provided an update on the Sugar Levee Project on the Methow River (see Attachment 1). The purpose of the update was to review proposed conceptual design elements with the Committees and solicit feedback on the designs. The goal of the Sugar Levee Project is to increase habitat for spring and summer Chinook, steelhead, bull trout, and lamprey. MSRF indicated that they would like to have final conceptual project alternatives identified by the end of October 2020. They are currently evaluating alternatives using a matrix of criteria including biological benefit, restoration of natural processes, risk/impacts, and feasibility. The project reach is divided into five project areas: WDFW, Eagle Rock, Sugar Levee, Sugar South, and Twisp Confluence. Below is a summary of possible actions proposed within each project area.

1. **Sugar Levee Site**

   The goal of enhancing this site is to increase floodplain and off-channel habitat for juvenile Chinook salmon. Land at this site was purchased for habitat enhancement. The amount of floodplain at this site that could be reconnected ranges from 56-88 acres. However, actions implemented at this site will need to protect existing infrastructure. Possible actions at this site include partial levee removal, levee setback, or leave levee in place and consider other ways to provide habitat and fish benefits. The latter will provide much less biological benefit than removing the levee. The Corps of Engineers is aware of the proposed project and must sign-off on any action at this site. MSRF is communicating and coordinating with adjacent landowners. The Yakama Nation is requesting that any channels constructed on the floodplain intercept groundwater. This will provide greater biological benefits to salmonids.

2. **Sugar South Site**

   The goal of enhancing this site is to increase floodplain and off-channel habitat for juvenile Chinook salmon. Land at this site was purchased for habitat enhancement. Possible actions at this site include side channel creation, alcove creation, and large wood structures. The sponsor is considering both perennial and seasonal side channels at this site. Their concern is possible aggradation of reconnected relic channels. This site is also used heavily by recreationalists and there are several adjacent landowners that would need to support the project.

3. **Eagle Rocks Site**

   The goal of enhancing this site is to increase floodplain and off-channel habitat for juvenile Chinook salmon and increase channel margin complexity and cover for fish. A levee and channel incision currently limit floodplain connectivity at this site. This site is owned by several private landowners. Possible actions at this site include aggrading the main channel, addition of large wood structures, and partial or complete levee removal to reconnect side channels and swales. At this site, it is possible to focus enhancement efforts only in the main channel or only on the floodplain. Other enhancement options include realignment of the main channel, side channel creation, and alcove development. Multiple landowners and the low gradient of the floodplain may make floodplain reconnection at this site difficult. Work at this site may require significant excavation.

4. **WDFW Site**

   This site was previously enhanced by removing a levee, adding channel complexity, and installing irrigation improvements. Additional actions at this site would include removing culverts that limit flow to side channels and the floodplain, channel grading and adding large wood structures to address low summer flows in the main channel (the river is trying to convert the side channel into the main channel), and enhancing low-water connectivity to an alcove. The site includes state lands and lands purchased for enhancement.

5. **Twisp Confluence Site**

   The goal of enhancing this site is to increase and improve pool habitat for fish by installing a large wood structure. Lands along this site are owned by multiple landowners including the Town of Twisp. The site is also used heavily by recreationalists; thus, a large wood structure may not be appropriate. In addition, work in this site will need to address the effects of winter icing and damming in the Twisp River.

MSRF asked the Committees to provide feedback on enhancement actions at the five sites by the end of next week (Friday, 17 July). MSRF will send the Committees a comment form to complete. The Committees thanked MSRF for discussing the project with them.

VII. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests from June and July:

   Rock Island Plan Species Account:

   - $63.00 to Clifton Larson Allen for Rock Island financial administration in June 2020.
   - $738.29 to Chelan PUD for Rock Island project coordination and administration during the second quarter of 2020.
   - $4,513.67 to Cascade Fisheries for the Restore Lower Chiwaukum Creek – Phase I Project.

- $839.29 to Cascade Fisheries for the Chiwawa Nutrient Enhancement Project.

Rocky Reach Plan Species Account:

- $63.00 to Clifton Larson Allen for Rocky Reach financial administration in June 2020.
- $476.99 to Chelan PUD for Rocky Reach project coordination and administration during the second quarter of 2020.
- $373.79 to Cascade Fisheries for the Entiat Basin Fish Passage and Screening Assessment Project.

Wells Plan Species Account:

- $410.20 to Chelan PUD for Wells project coordination and administration during the second quarter of 2020.

2. Hans Smith reported that the Yakama Nation would like to discuss about 12 potential projects with the Committees in September. He noted that the Committees have requested that YN bring proposed projects to the Committees before they are fully designed. This will give the Committees an opportunity to review and provide input on proposed projects during the conceptual, preliminary, and final design stages. Hans said he would like a joint meeting with the PRCC Habitat Subcommittee and the HCP Tributary Committees. Tracy said he will coordinate with Denny Rohr (PRCC HSC facilitator) and the YN. Depending on other agenda items and the amount to time to present and discuss each project, some projects may need to be discussed during the September meeting.
3. Tracy Hillman shared an email he received from Jason Lundgren (Cascade Fisheries) regarding the status of the Chiwawa Nutrient Enhancement Project. In short, it does not appear that Cascade Fisheries will receive cost-free carcass analogs this year. The company that makes the analogs (AmCan) has had to lay-off their staff because of the Covid-19 pandemic. In order to continue the third year of project implementation, Cascade Fisheries will need about $90,000 to purchase 40,000 pounds of analogs from Dr. Don's Fish Food in Hoquiam. If Cascade Fisheries is unable to secure free analogs in the future, they will need about $270,000 for analogs over the next three years ($90,000/year x 3 years = $270,000). Cascade Fisheries asked if the HCP Tributary Committees and PRCC Habitat Subcommittee would be willing to fund the purchase of the analogs this year and possibly over the three-years period. Although the Committees see some value in the project, they are not willing to provide any additional funding for this project.
4. For the written record, Tracy Hillman reported that last month the Committees reviewed a General Salmon Habitat Program proposal from the Colville Confederated Tribes (CCT) titled *Enloe Dam Removal Concept Plan*. The purpose of the project was to develop a conceptual plan to remove Enloe Dam, which is located at RM 8.8 on the Similkameen River in the Okanogan River basin. The plan would include water control, access and staging, sediment management, demolition, and post removal restoration. The plan would identify the sequence with which these elements would be undertaken and the associated cost estimates for each element. The total cost of the project was $117,612. During the May meeting, the Committees determined that the sponsor needed to include at least a 15% cost share.

   On 24 June, the Committees received a revised application from CCT that included a cost share. The total cost of the project was $464,075. The sponsor requested $117,612 from HCP Plan Species Account Funds. ***The Wells Tributary Committee elected to contribute $117,612 to the project***.

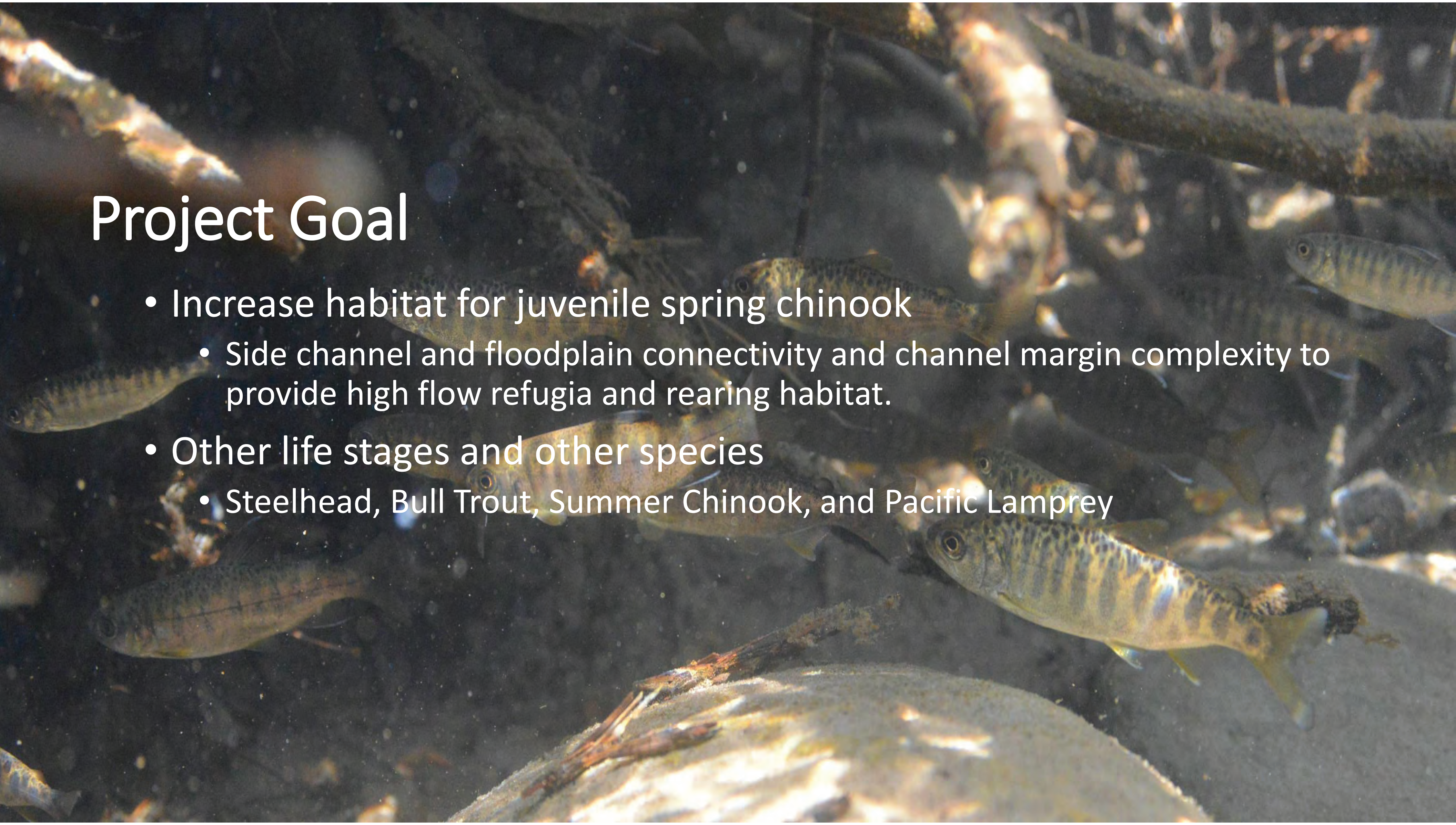
5. Tracy Hillman provided an update on potential future workshops. He said he is working with Upper Columbia Salmon Recovery Board (SRFB) staff on hosting a workshop to discuss methods for reconnecting floodplain habitat. Tracy said this may occur later this year or early next year depending on the Covid-19 pandemic. There has also been a request to hold a workshop to discuss the use of beavers in restoration work. It may be possible to hold both workshops in the same day. Tracy will continue to coordinate with SRFB staff on these workshops.

VIII. Next Steps

The next scheduled meeting of the Tributary Committees will be on Thursday, 13 August 2020.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

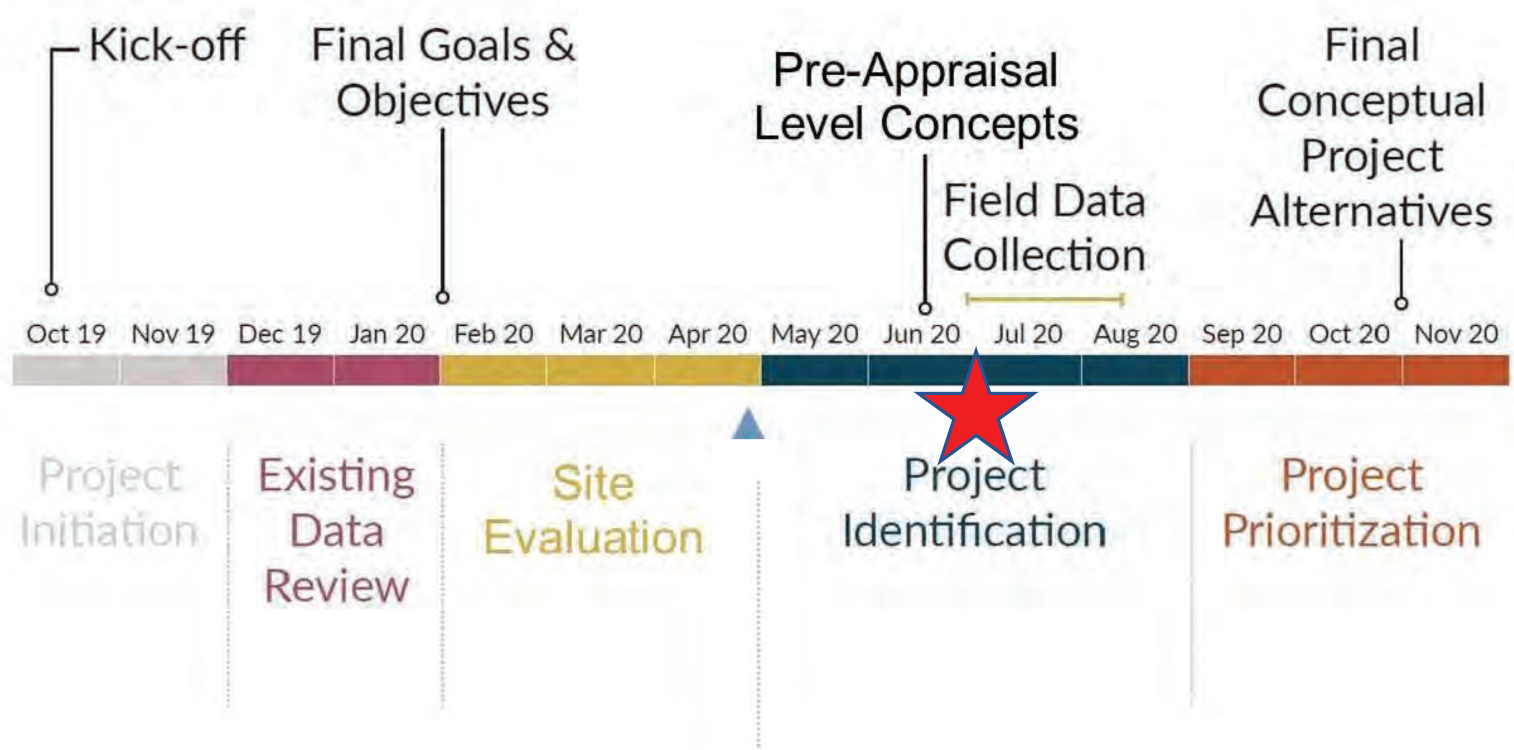

Sugar Project
• Provide an update on the project
• Present pre-appraisal design concepts for feedback
• Understand the level of support for proposed concepts
• Are there project actions that should be added, modified or removed?



Project Goal

- Increase habitat for juvenile spring chinook
  - Side channel and floodplain connectivity and channel margin complexity to provide high flow refugia and rearing habitat.
- Other life stages and other species
  - Steelhead, Bull Trout, Summer Chinook, and Pacific Lamprey

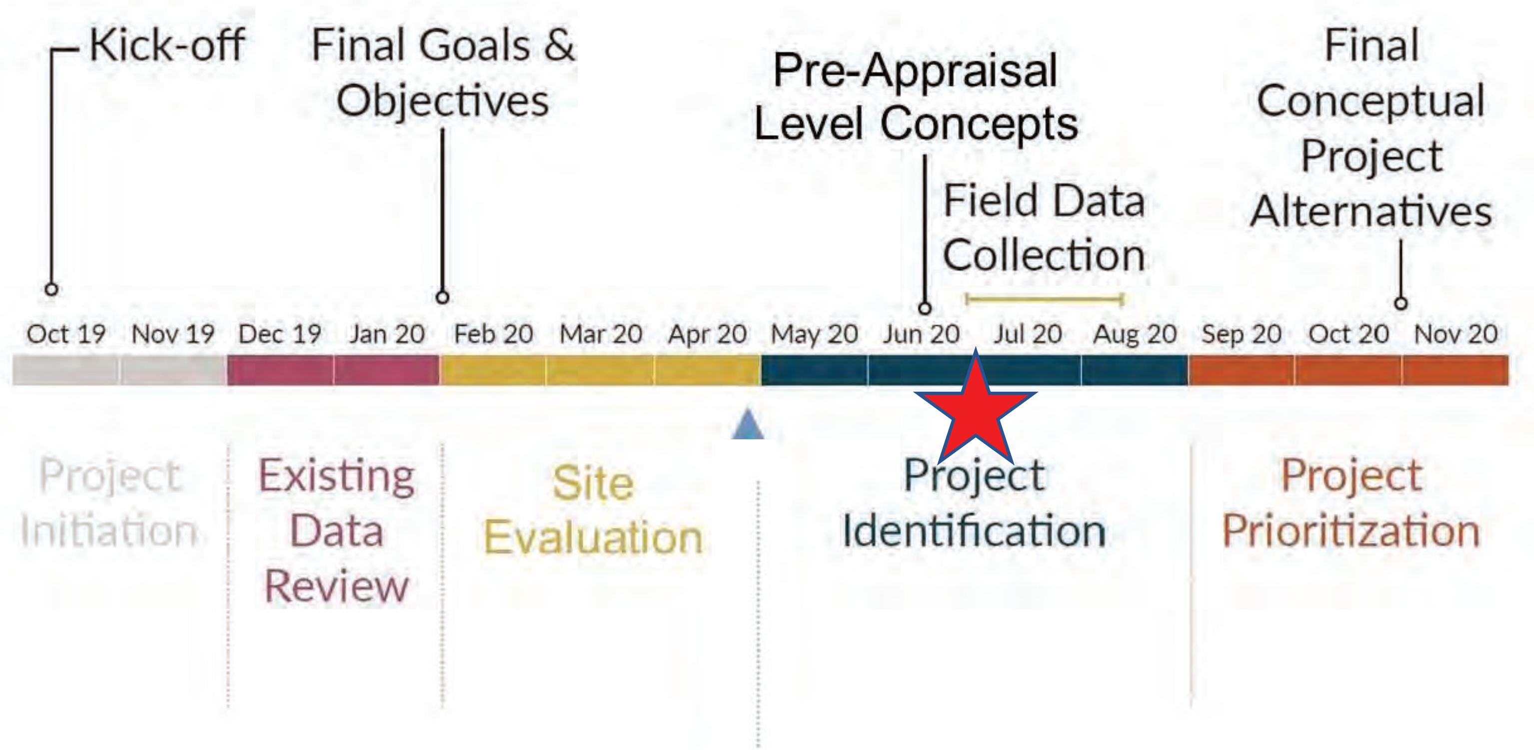
Project Schedule



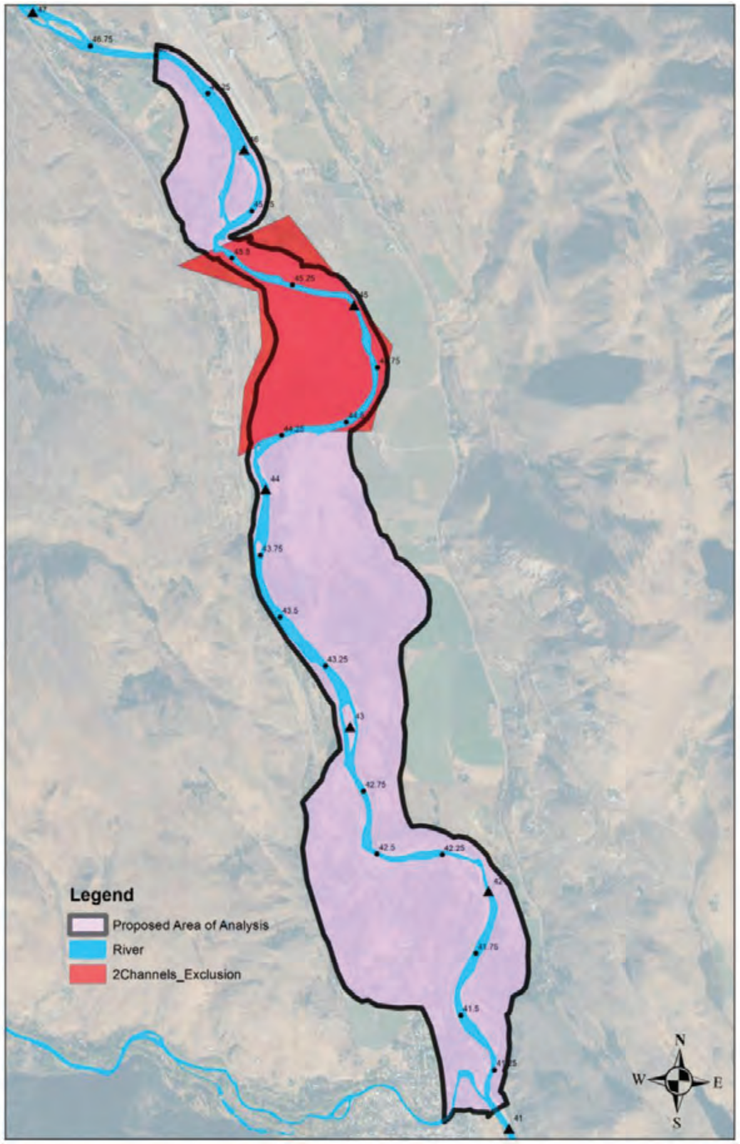
Evaluation Matrix

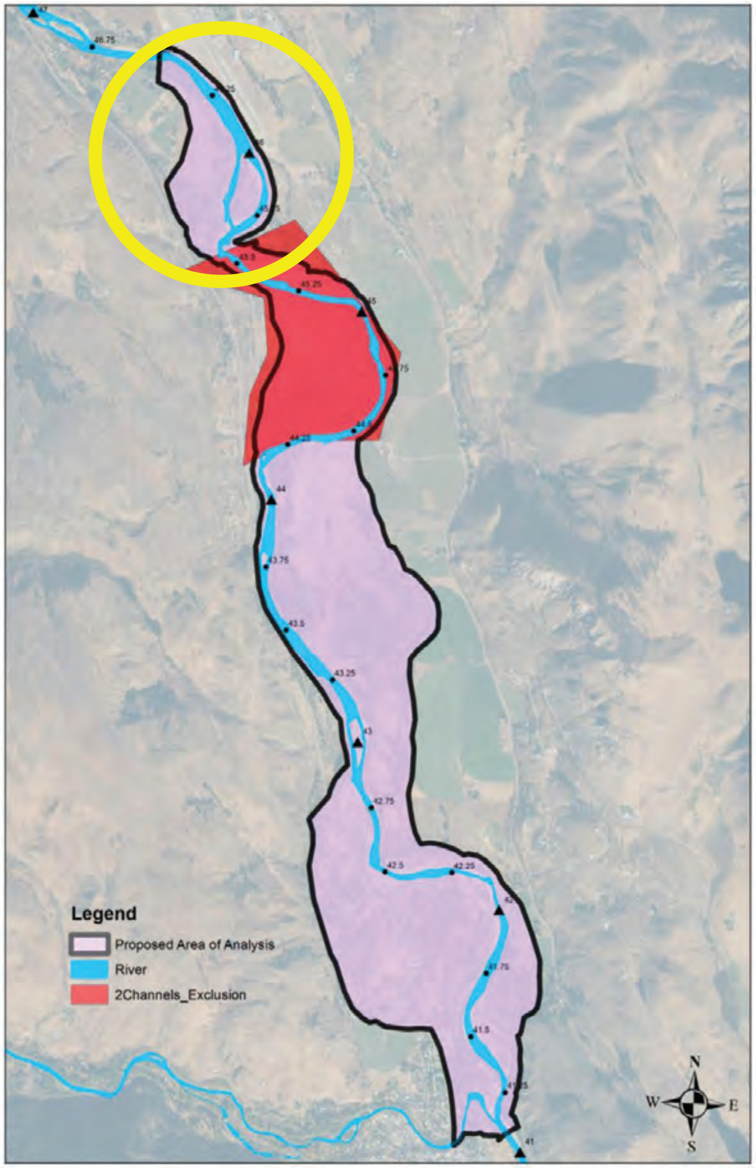
- Biological Benefit
  - Immediate
  - Long term
- Natural Process
- Risk/Impact
- Feasibility

Project Schedule



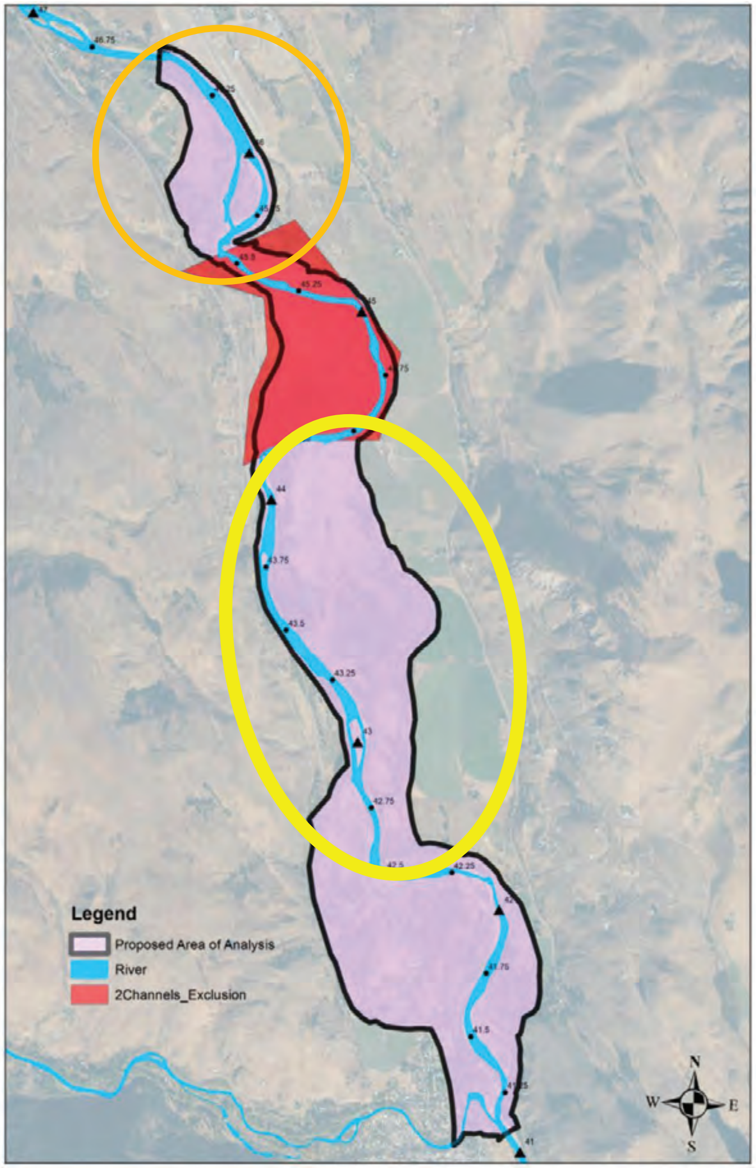
Project Area of Analysis





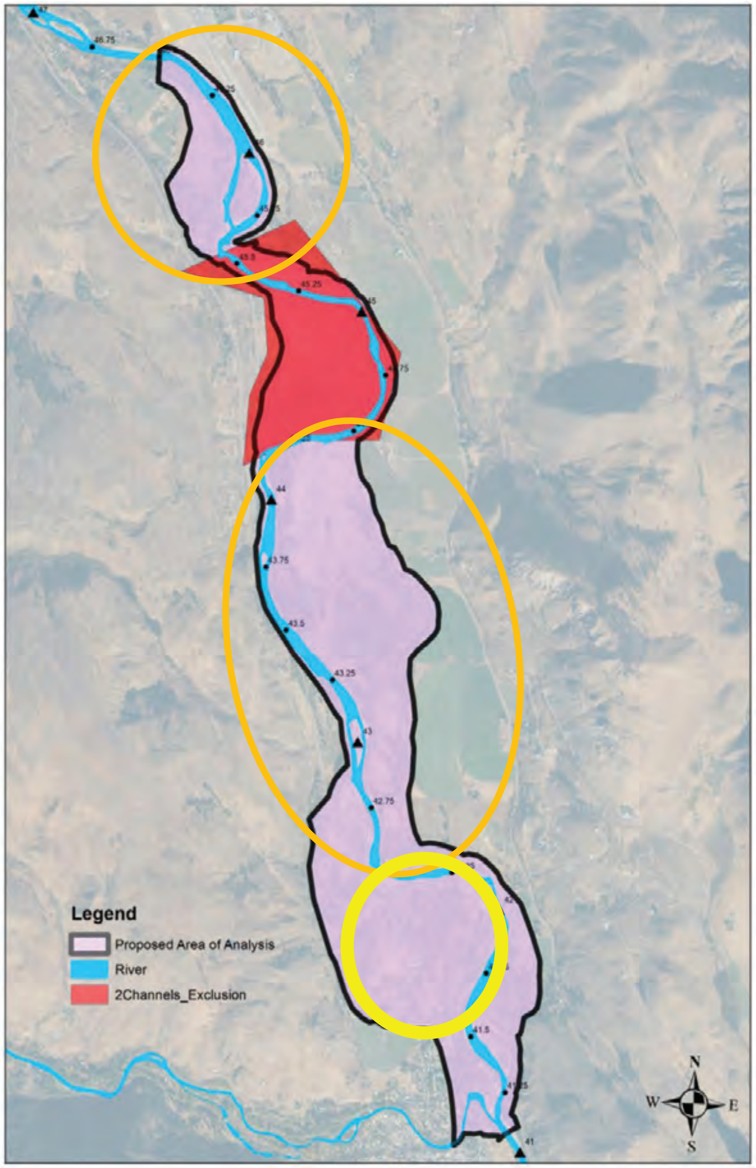
Project Areas

- WDFW



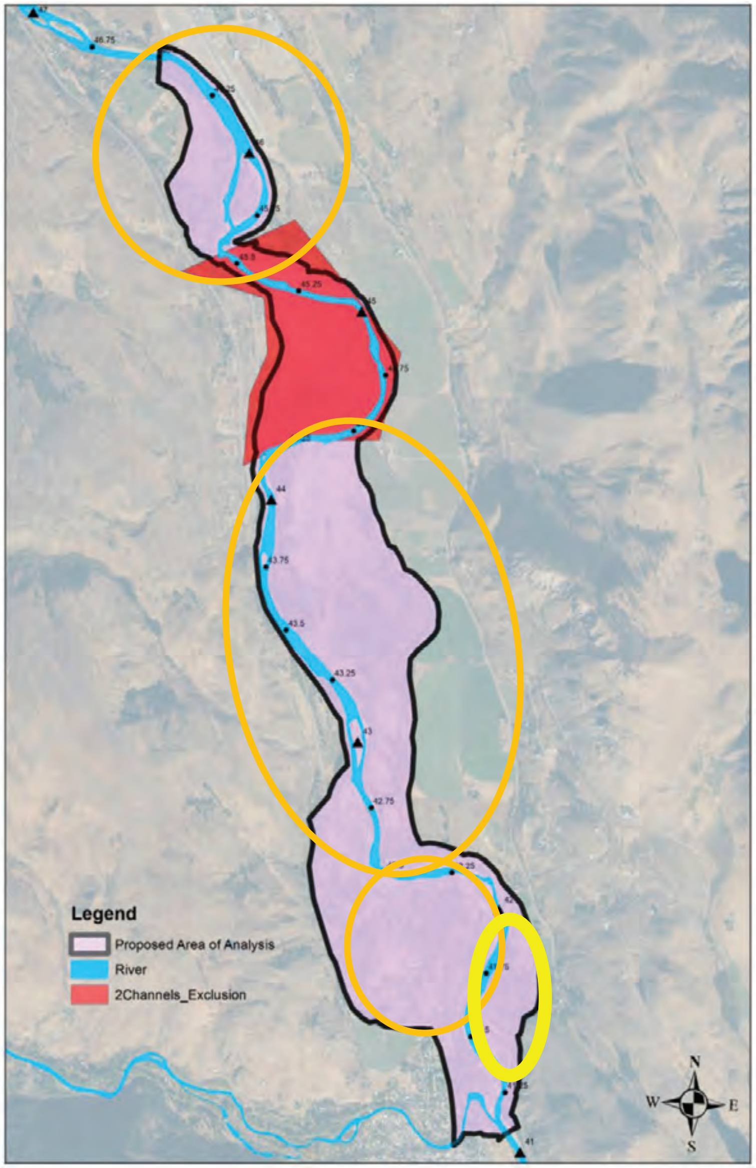
Project Areas

- WDFW
- Eagle Rocks



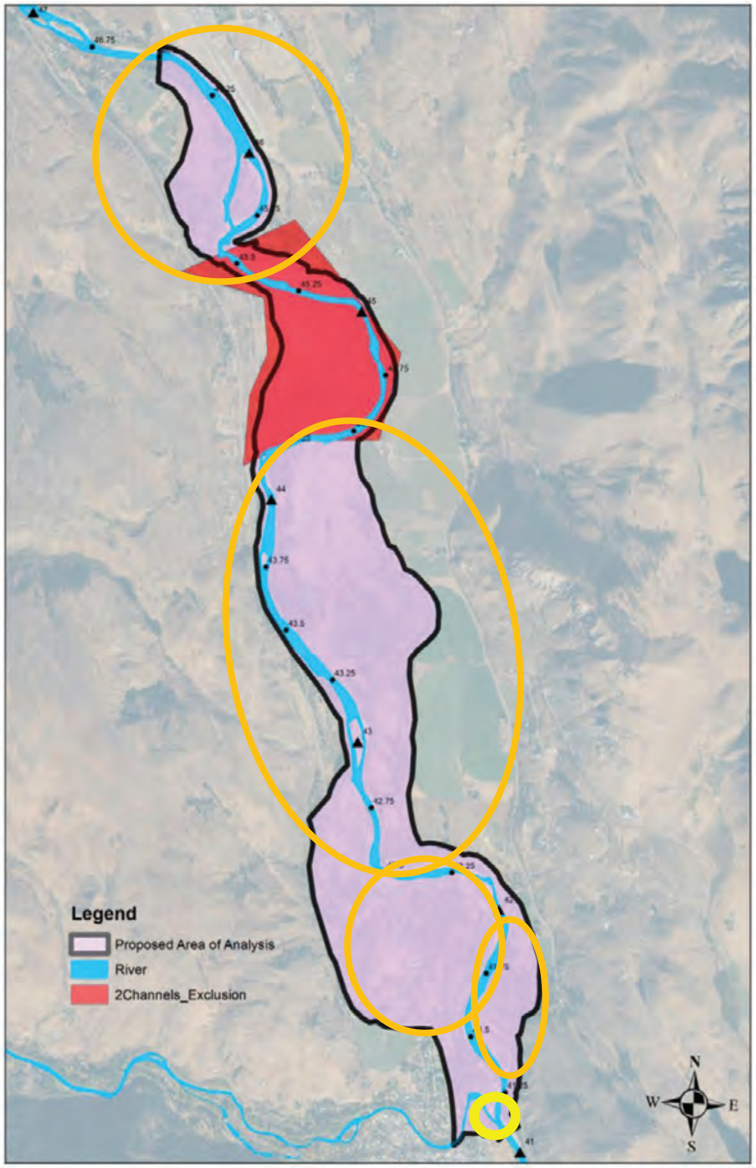
Project Areas

- WDFW
- Eagle Rocks
- Sugar Levee



Project Areas

- WDFW
- Eagle Rocks
- Sugar Levee
- Sugar South



Project Areas

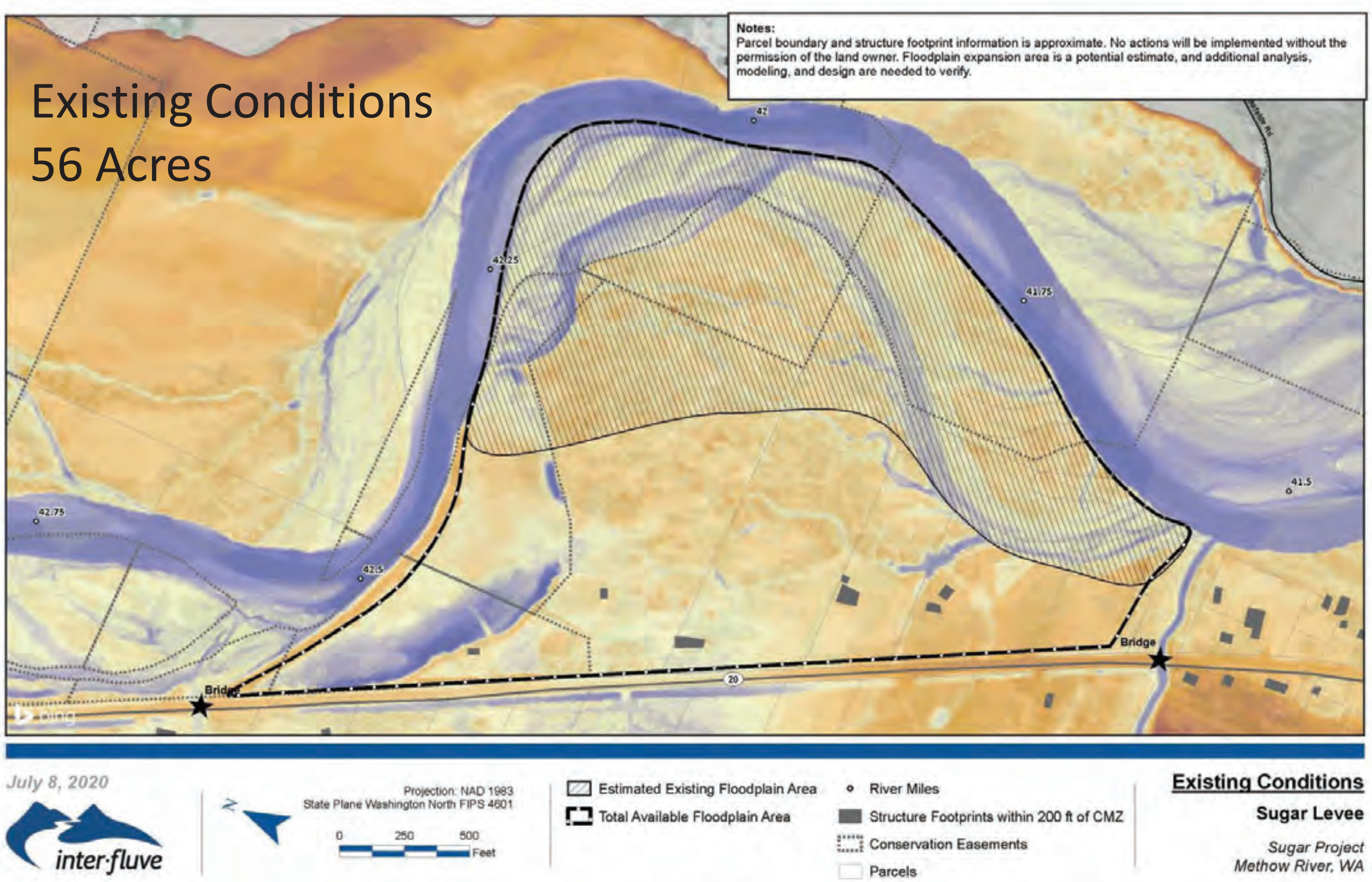
- WDFW
- Eagle Rocks
- Sugar Levee
- Sugar South
- Confluence

Sugar Levee

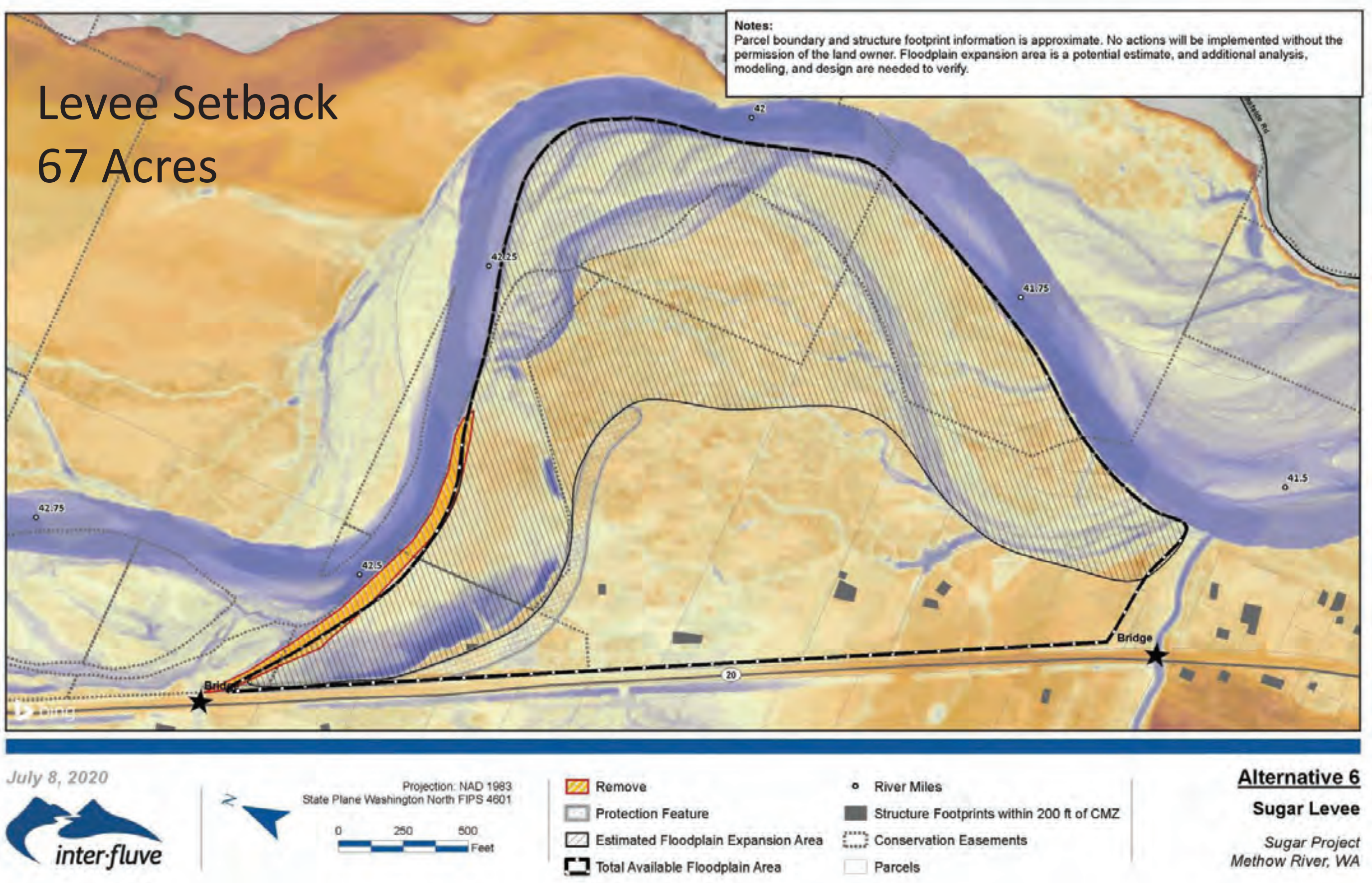
- Floodplain and channel connectivity is currently limited by a levee
- Increase floodplain and off channel habitat for juvenile chinook
  - Immediate
  - Long term
- Land purchased for habitat restoration
- Will need to provide some kind of protection for existing infrastructure

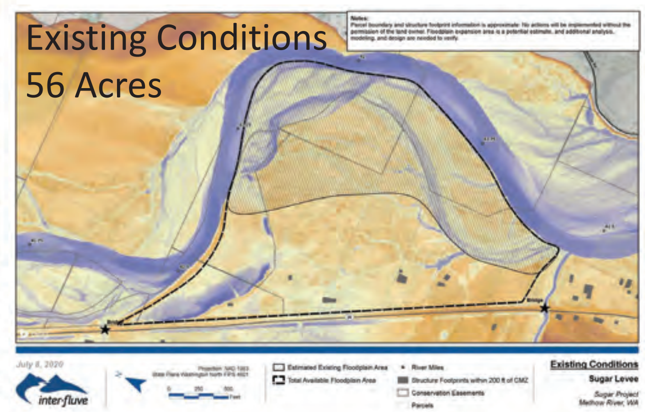
Levee – looking upstream toward Hwy 20

Floodplain Connection

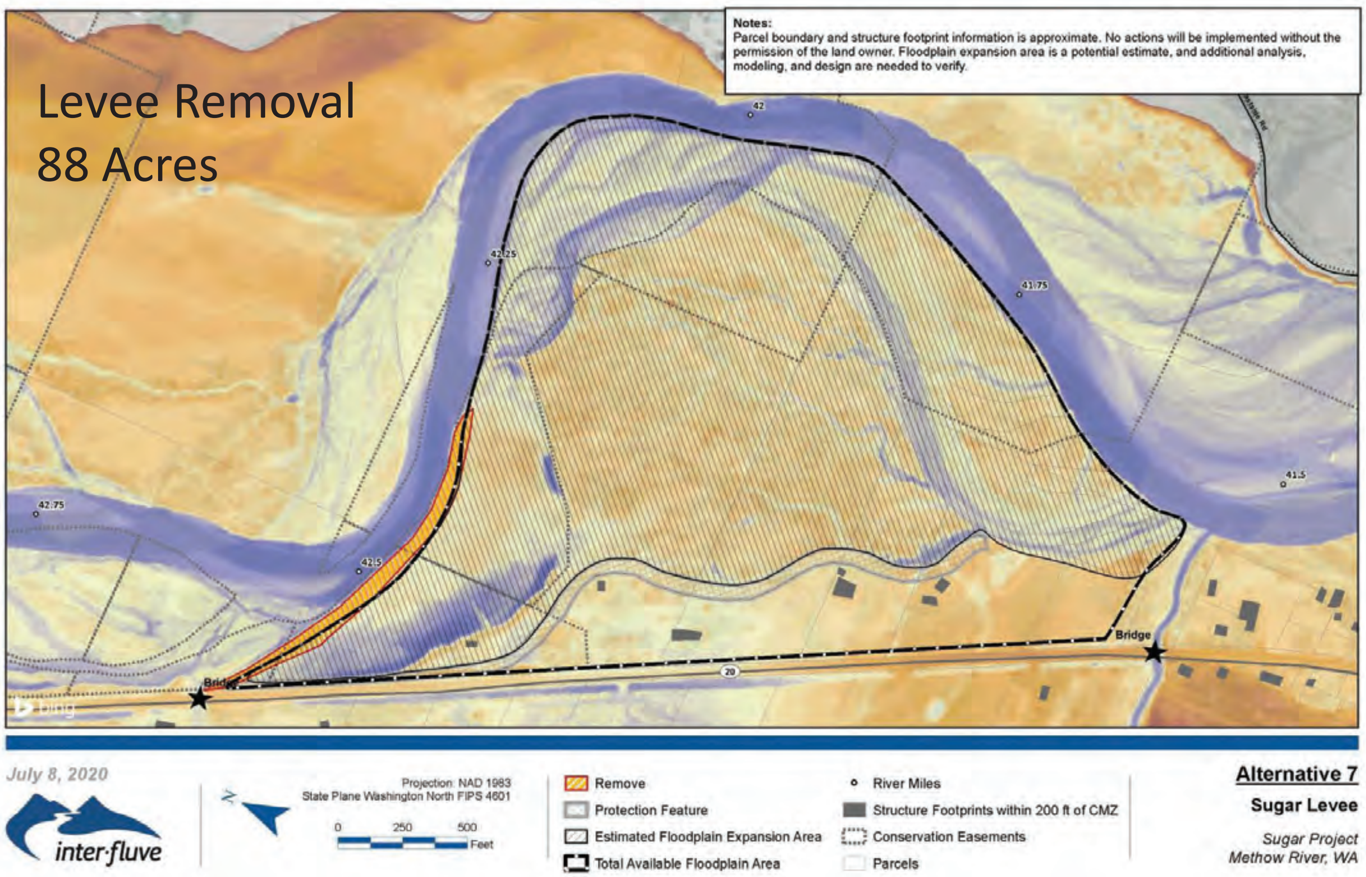


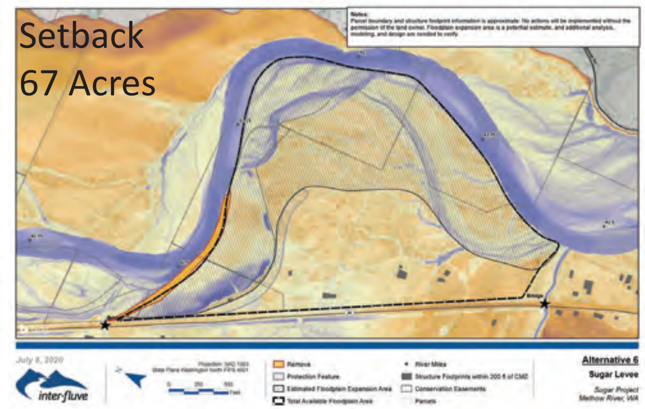
Potential Floodplain Reconnection

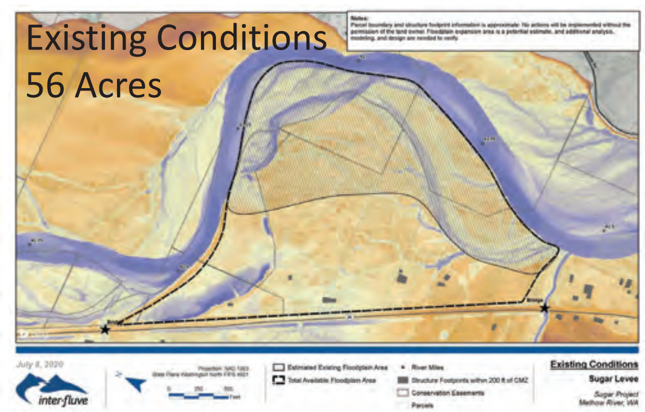


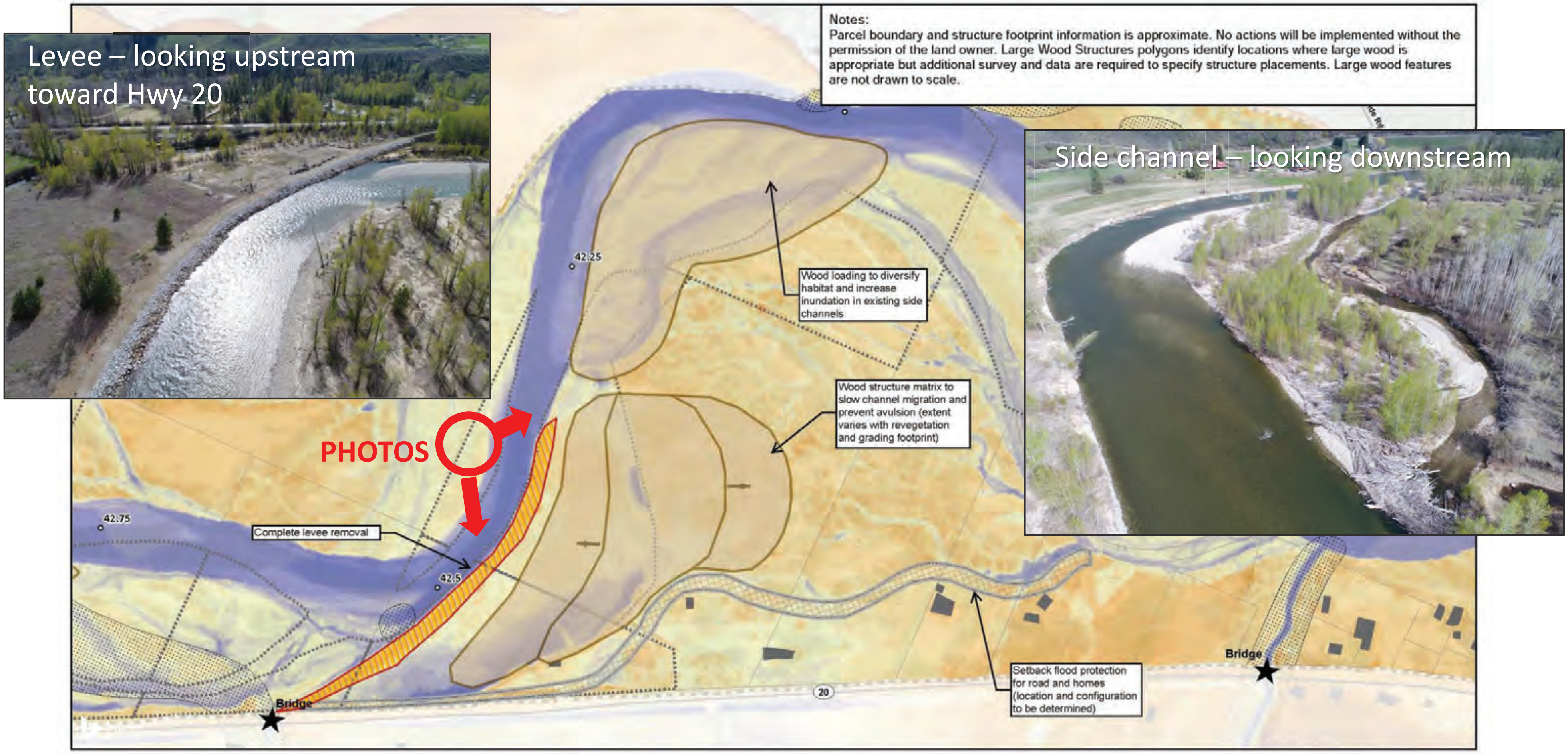


Potential Floodplain Reconnection









June 12, 2020

inter·fluve

Projection: NAD 1983
State Plane Washington North FIPS 4601

N

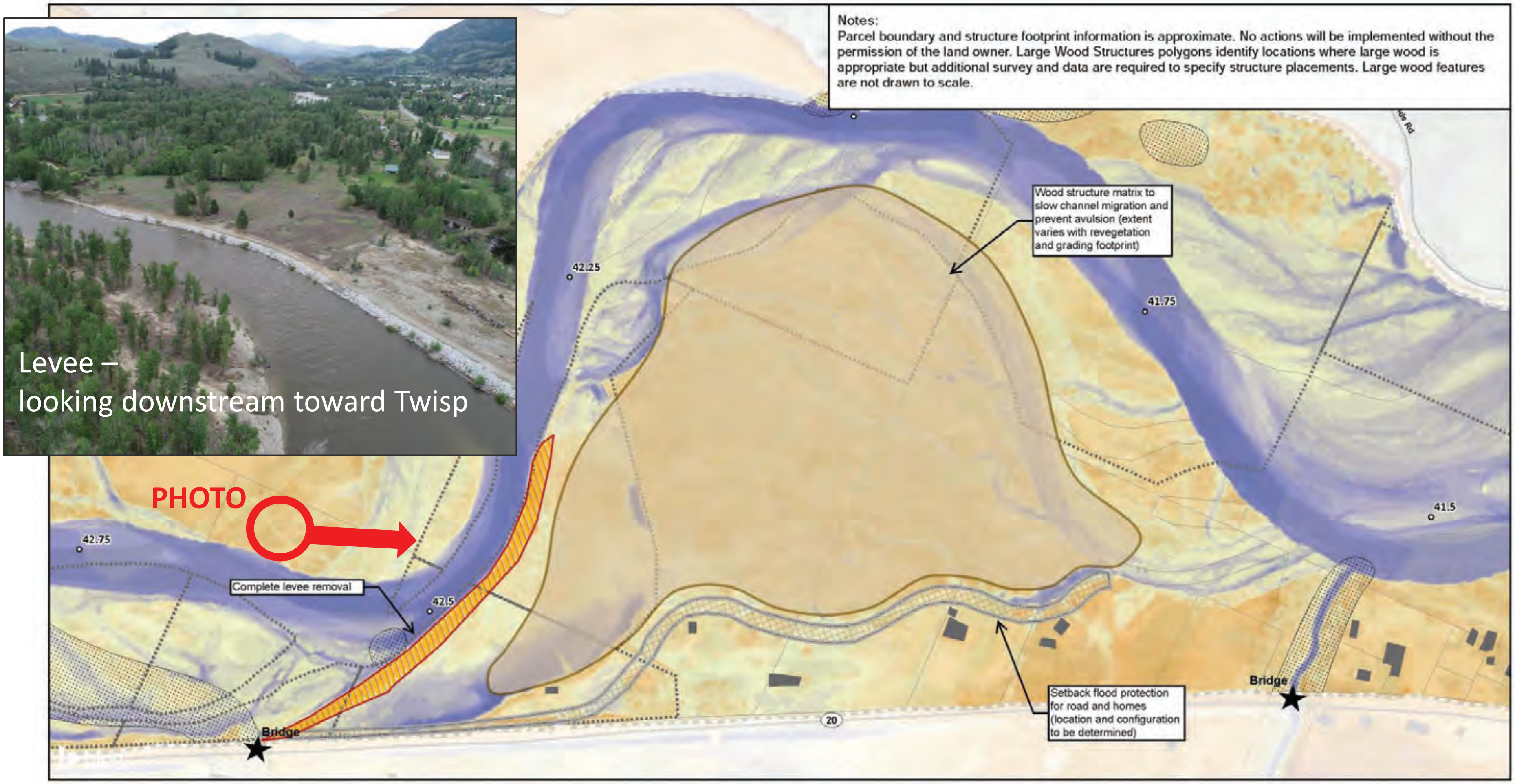
0 250 500
Feet

Large Wood Enhancement	River Miles	Conservation Easements
Remove	Low Geomorphic Surfaces	Parcels
Protection Feature	Structure Footprints within 200 ft of CMZ	Sponsored Habitat Projects

Alternative 4

Sugar Levee

Sugar Project
Methow River, WA



June 12, 2020

inter·fluve

Projection: NAD 1983
State Plane Washington North FIPS 4601

0 250 500
Feet

Large Wood Enhancement
Remove
Protection Feature
River Miles
Low Geomorphic Surfaces
Structure Footprints within 200 ft of CMZ
Conservation Easements
Parcels
Sponsored Habitat Projects

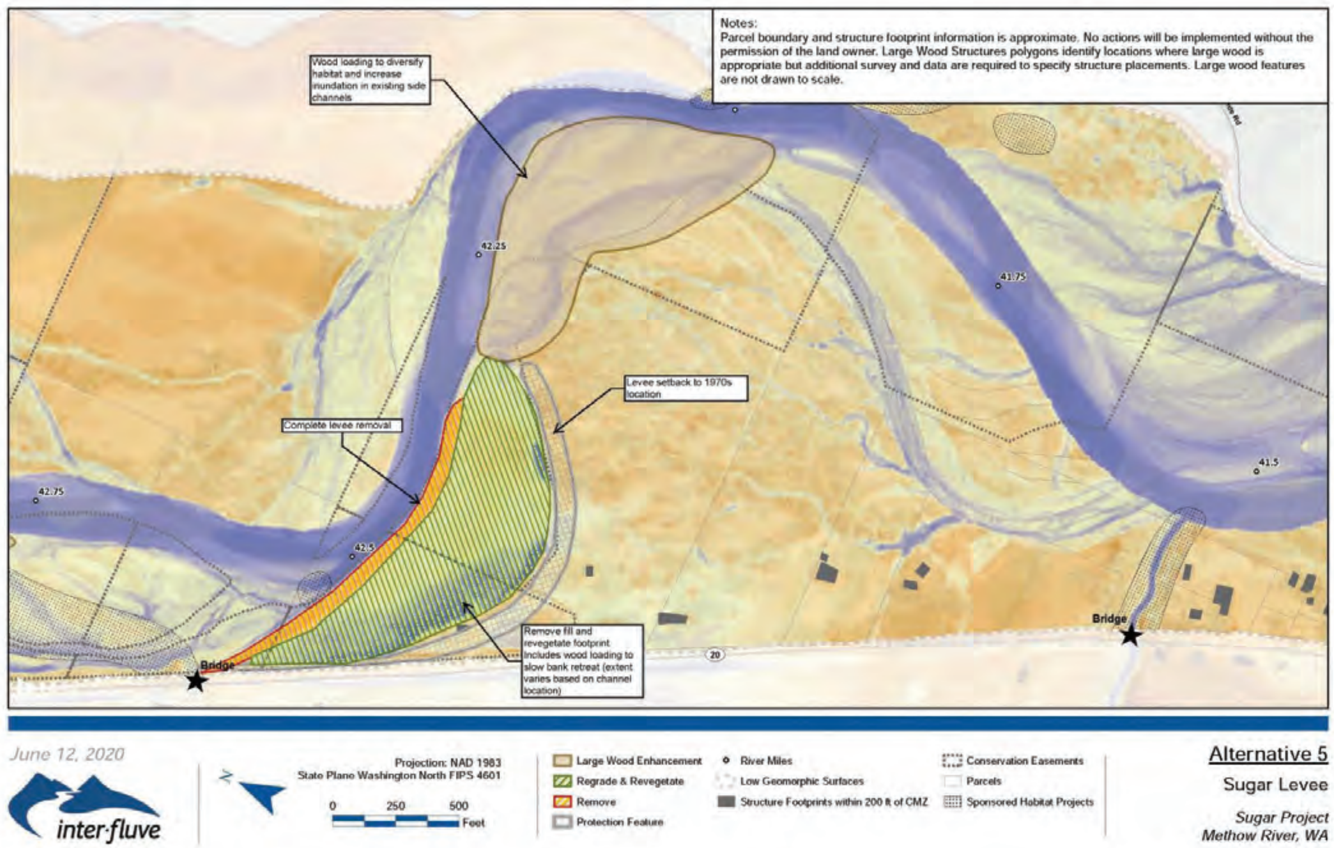
Alternative 7

Sugar Levee

Sugar Project
Methow River, WA

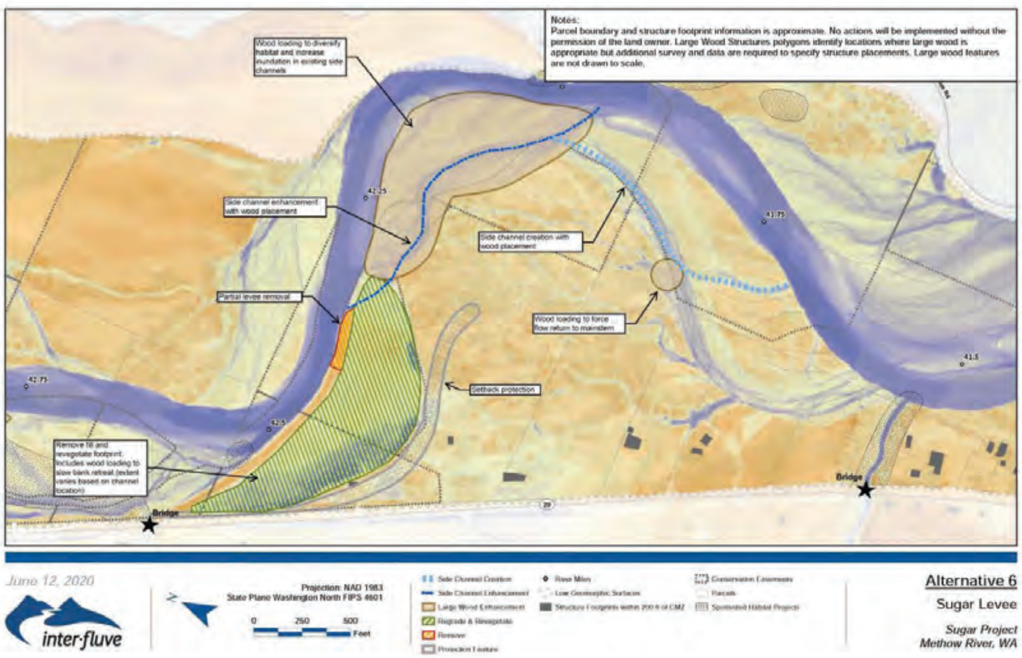
Other Design Considerations

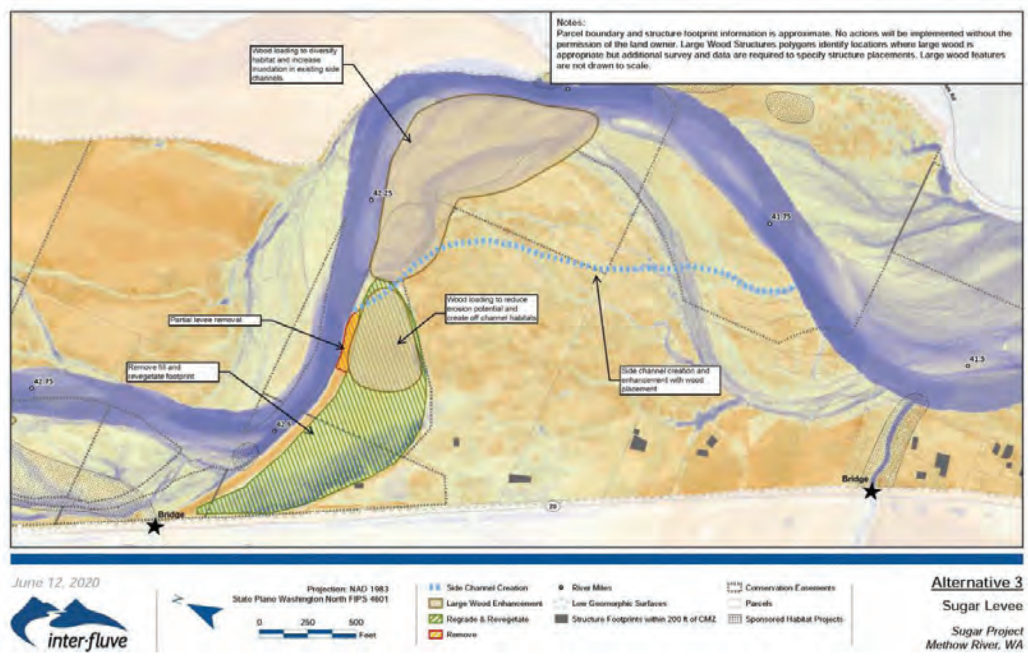
- Levee setback



Other Design Considerations

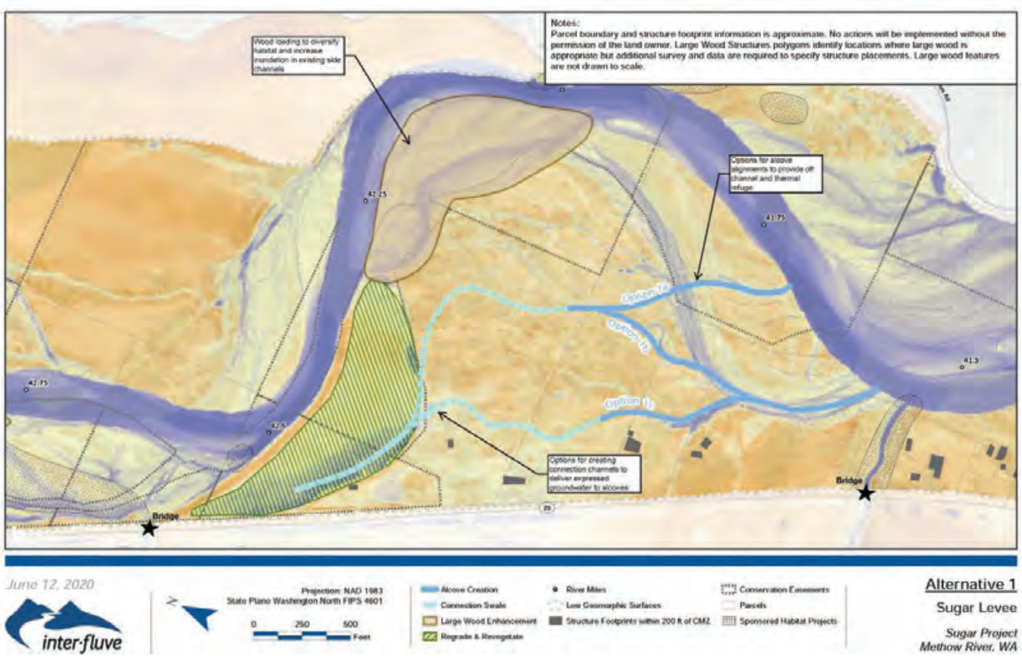
- Partial levee removal

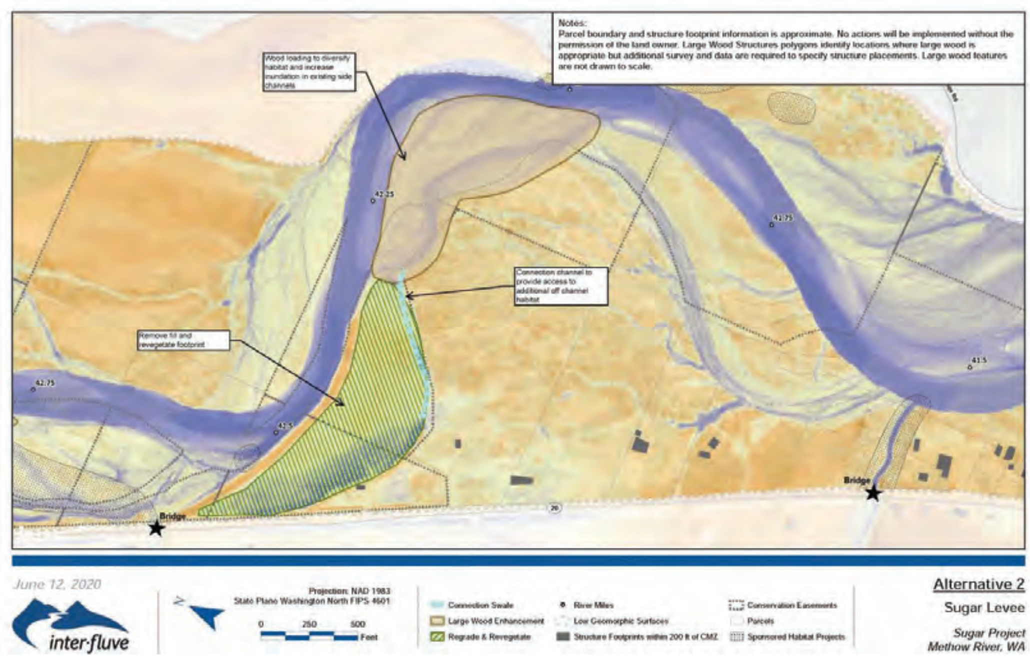




Other Design Considerations

- Levee stays in place and project would review other ways to provide immediate and long term habitat uplift

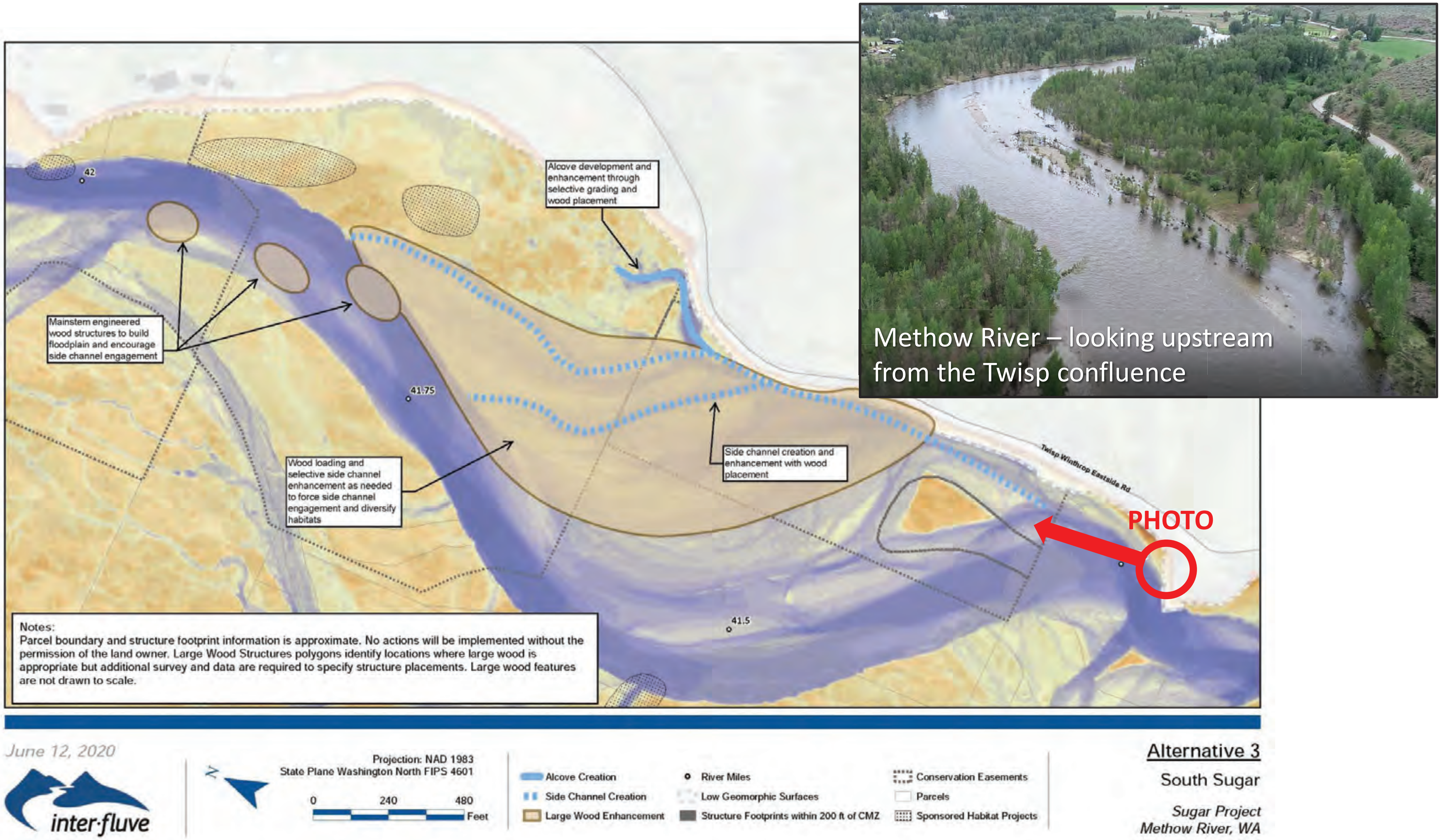




Sugar South

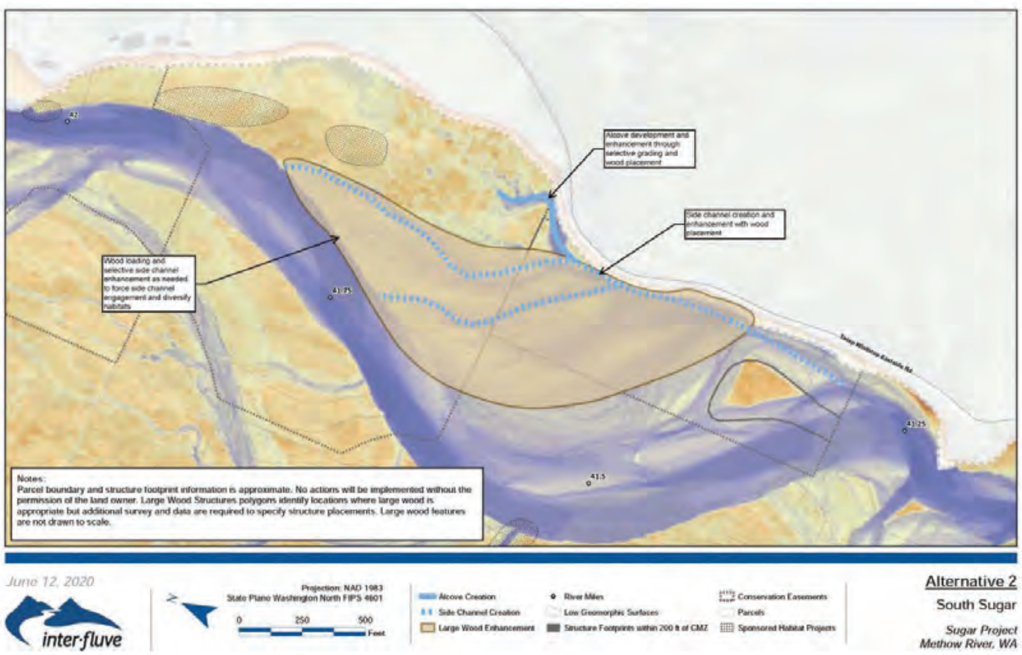
- Floodplain and channel connectivity is currently limited
- Increase floodplain and off channel habitat for juvenile chinook
    - Immediate
    - Long term
- Land purchased for habitat restoration

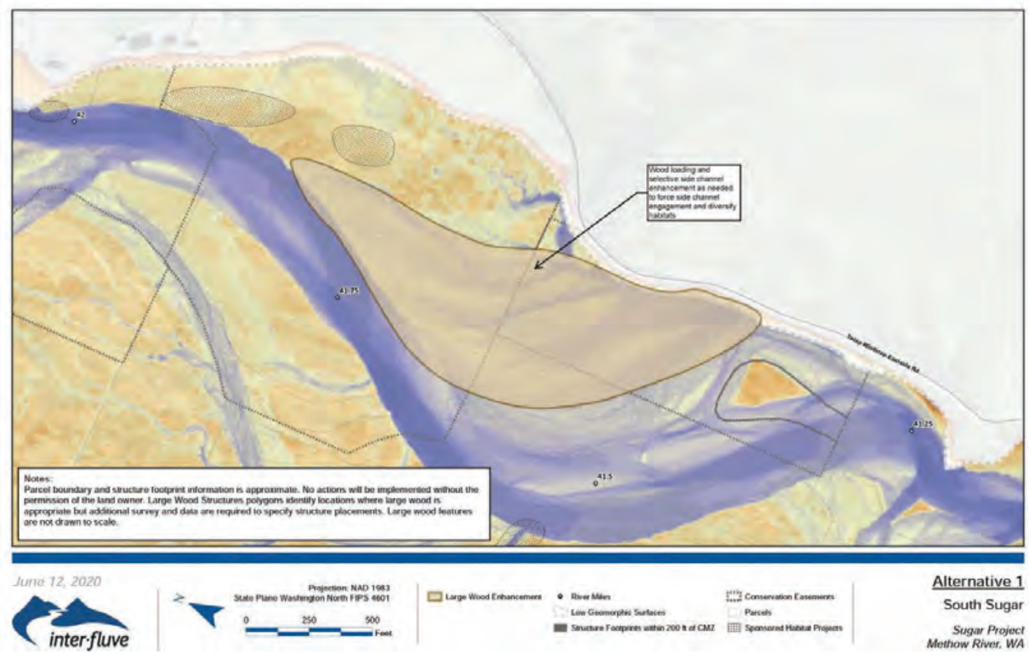

Methow River – looking upstream from the Twisp confluence


Methow River – looking upstream from the Twisp confluence
PHOTO
42
41.75
41.5
Alcove development and enhancement through selective grading and wood placement
Mainstem engineered wood structures to build floodplain and encourage side channel engagement
Wood loading and selective side channel enhancement as needed to force side channel engagement and diversify habitats
Side channel creation and enhancement with wood placement
Twisp Winthrop Eastside Rd
Notes:
Parcel boundary and structure footprint information is approximate. No actions will be implemented without the permission of the land owner. Large Wood Structures polygons identify locations where large wood is appropriate but additional survey and data are required to specify structure placements. Large wood features are not drawn to scale.
June 12, 2020
inter·fluve
N
Projection: NAD 1983
State Plane Washington North FIPS 4601
0
240
480
Feet
Alcove Creation
Side Channel Creation
Large Wood Enhancement
River Miles
Low Geomorphic Surfaces
Structure Footprints within 200 ft of CMZ
Conservation Easements
Parcels
Sponsored Habitat Projects
Alternative 3
South Sugar
Sugar Project
Methow River, WA

Other Design Considerations

- Focus design elements in the floodplain

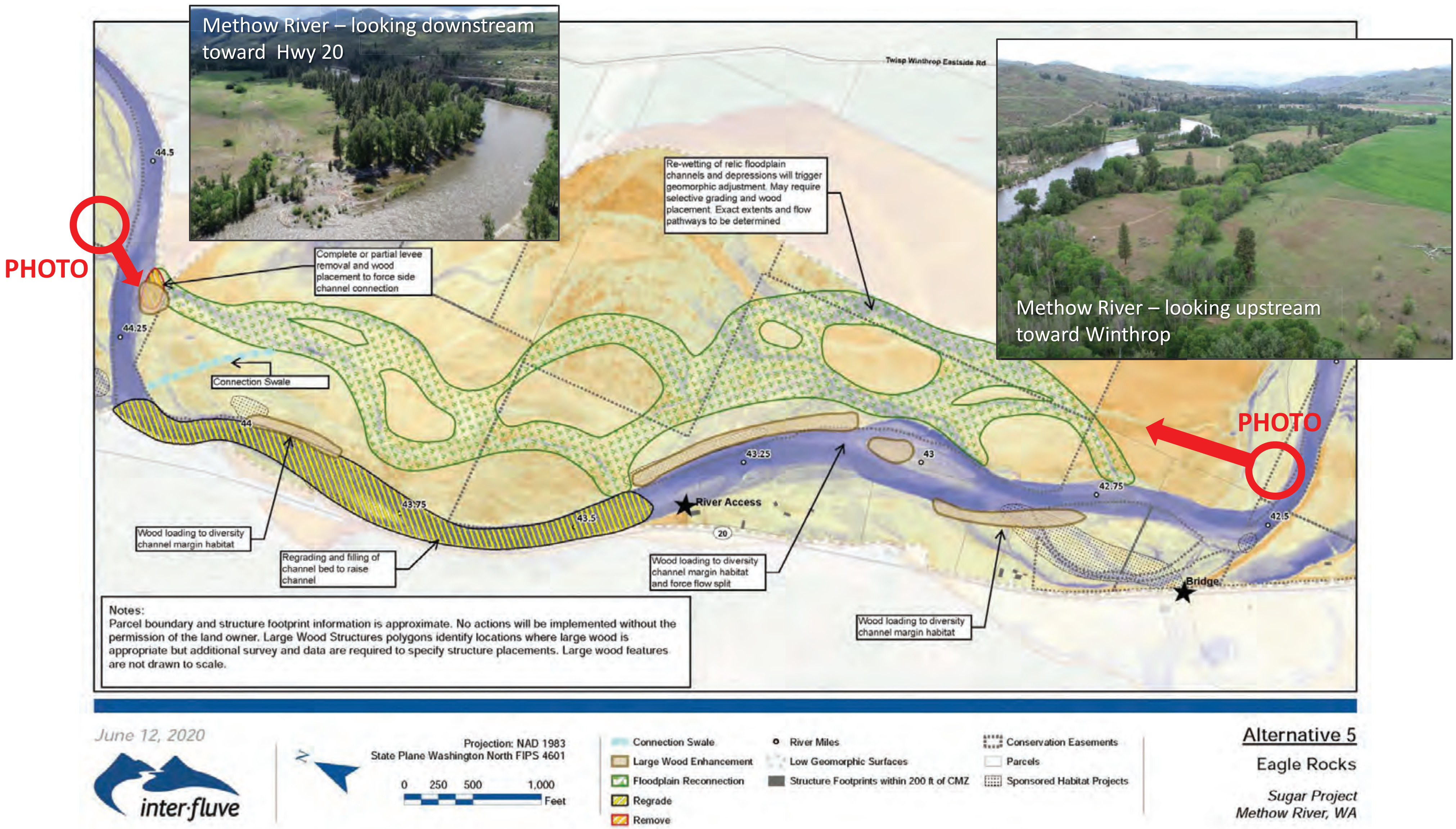




Eagle Rocks

- Floodplain and channel connectivity is currently limited by levee and mainstem incision
- Increase floodplain and off channel habitat for juvenile chinook rearing and overwintering
- Increase channel margin complexity and cover
  - Immediate
  - Long term
- Multiple private land owners

Methow River – looking downstream toward highway 20



Methow River – looking downstream toward Hwy 20
Methow River – looking upstream toward Winthrop
Twisp Winthrop Eastside Rd
PHOTO
PHOTO
44.5
44.25
44
43.75
43.5
43.25
43
42.75
42.5
20
River Access
Bridge
Complete or partial levee removal and wood placement to force side channel connection
Re-wetting of relic floodplain channels and depressions will trigger geomorphic adjustment. May require selective grading and wood placement. Exact extents and flow pathways to be determined
Connection Swale
Wood loading to diversity channel margin habitat
Regrading and filling of channel bed to raise channel
Wood loading to diversity channel margin habitat and force flow split
Wood loading to diversity channel margin habitat
Notes:
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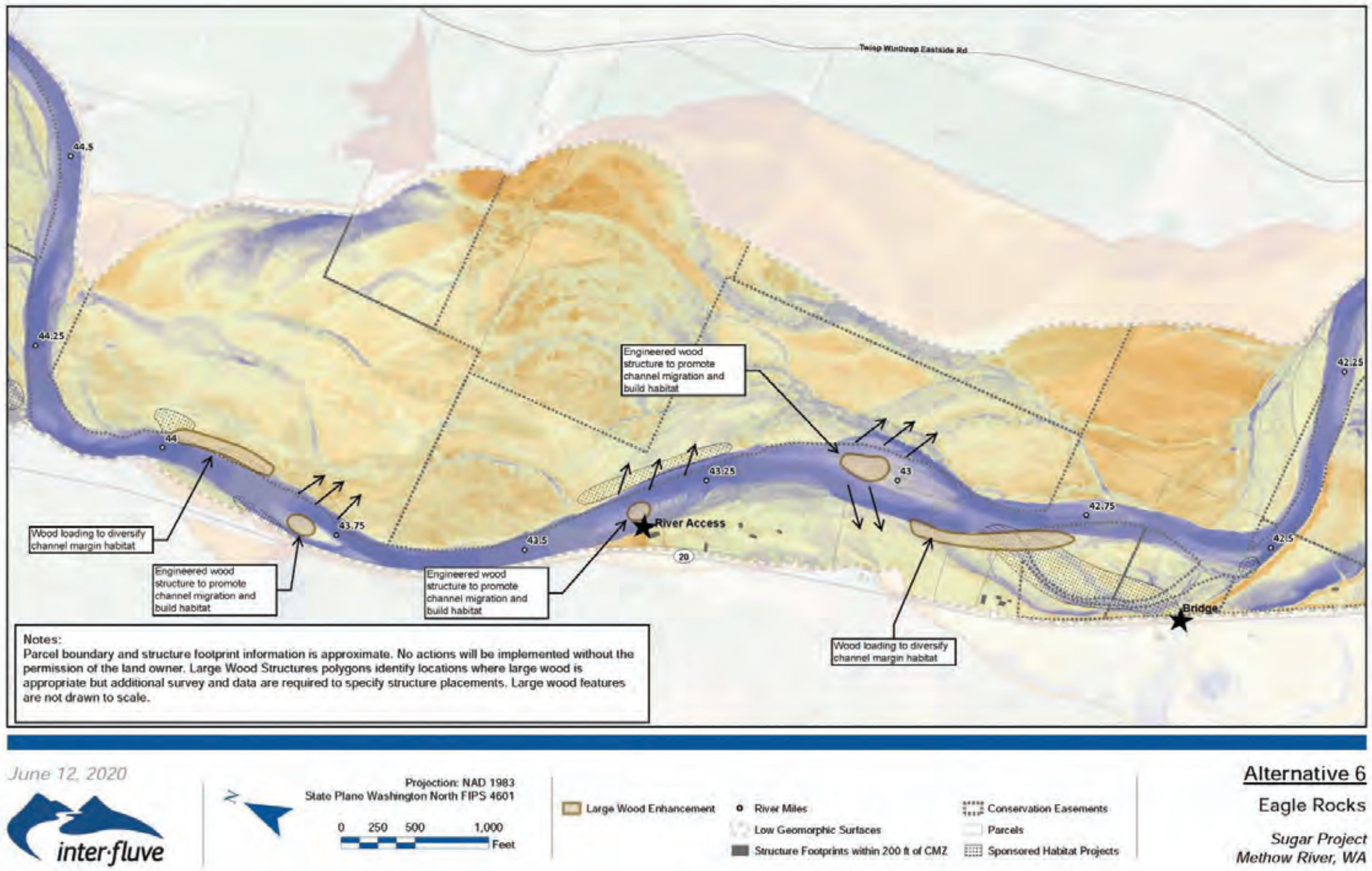
June 12, 2020
inter·fluve
N
Projection: NAD 1983
State Plane Washington North FIPS 4601
0 250 500 1,000 Feet
Connection Swale
Large Wood Enhancement
Floodplain Reconnection
Regrade
Remove
River Miles
Low Geomorphic Surfaces
Structure Footprints within 200 ft of CMZ
Conservation Easements
Parcels
Sponsored Habitat Projects
Alternative 5
Eagle Rocks
Sugar Project
Methow River, WA

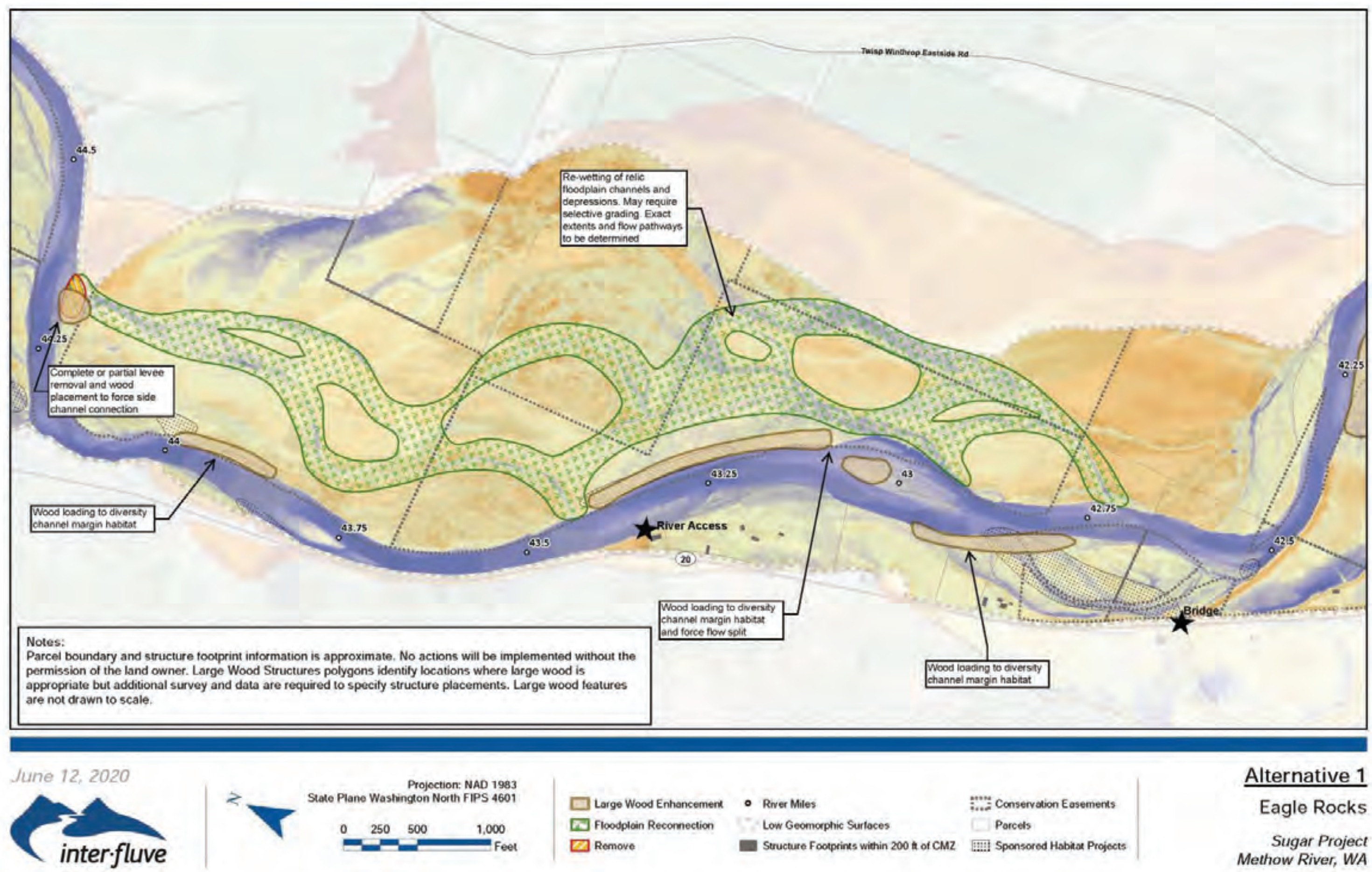
Other Design Considerations

- Focus design elements on main channel



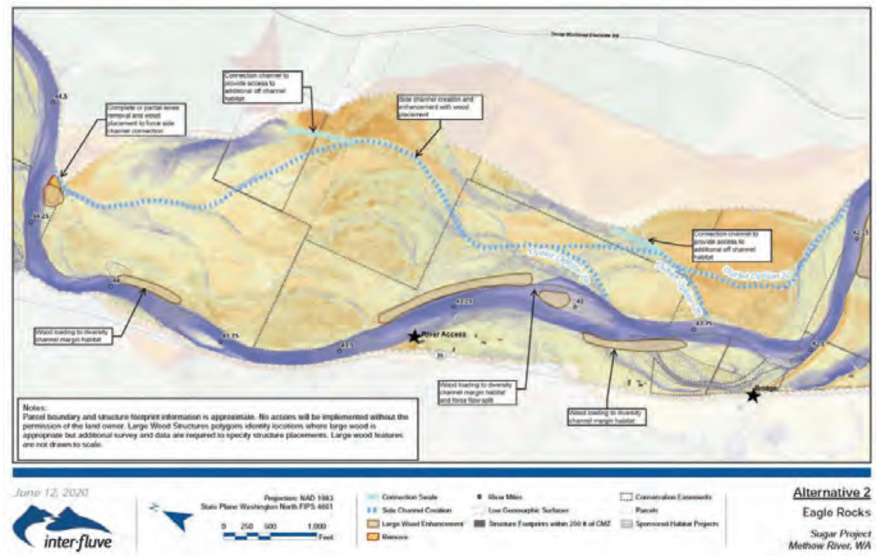
Other Design Considerations

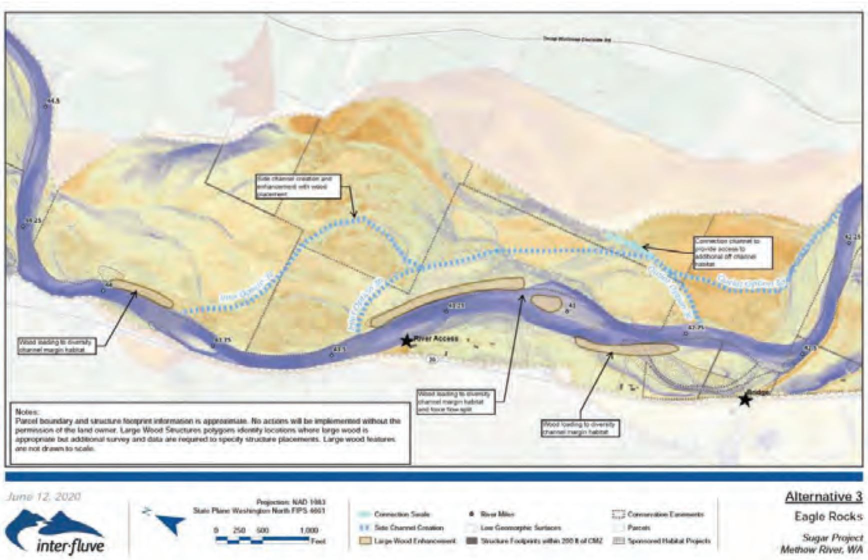
- Focus design elements on floodplain

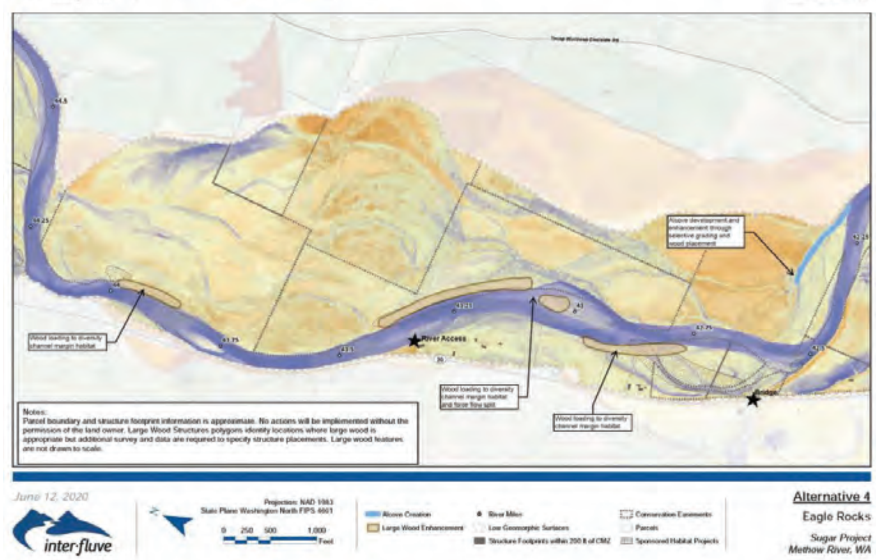


Other Design Considerations

- Side channel
- alcove development

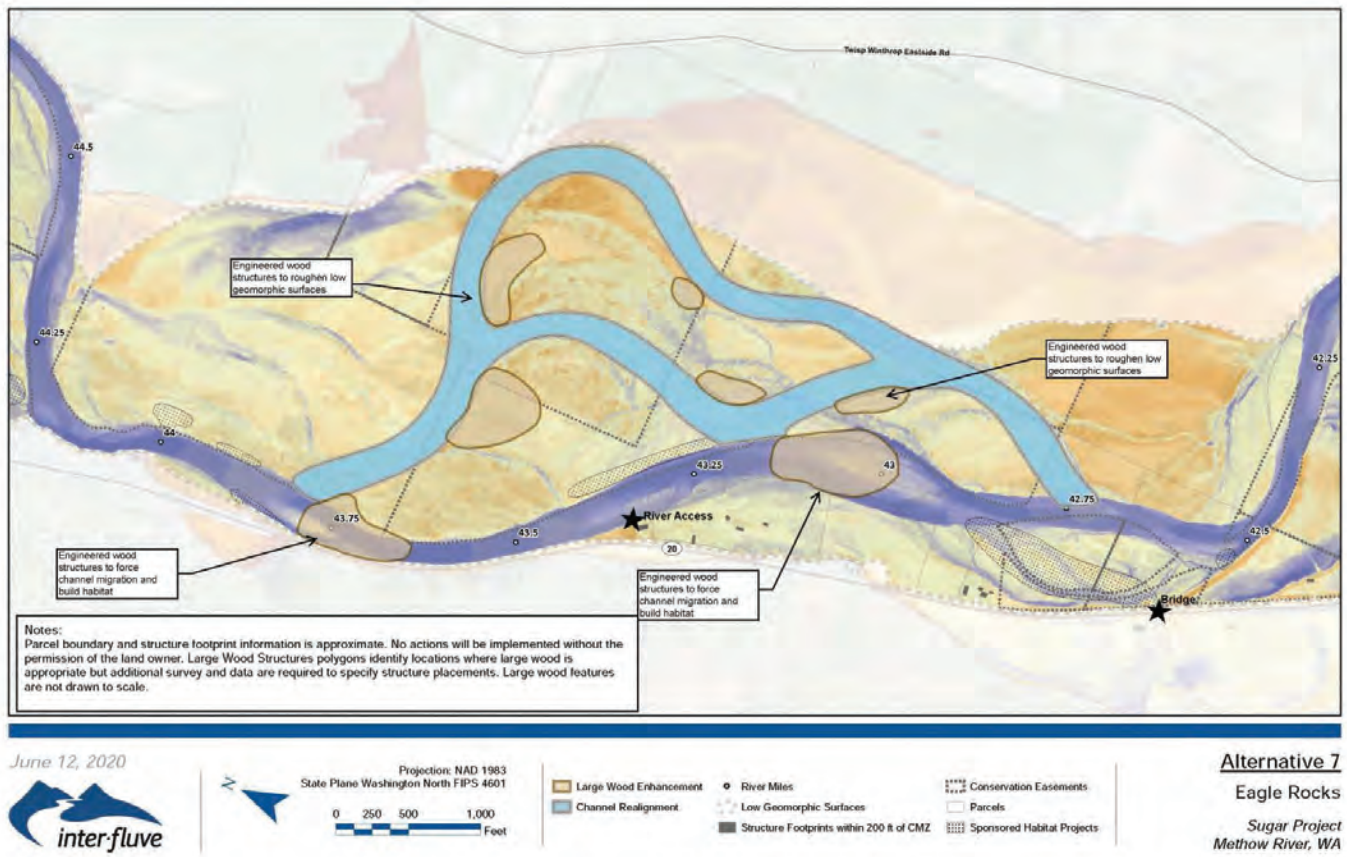






Other Design Considerations

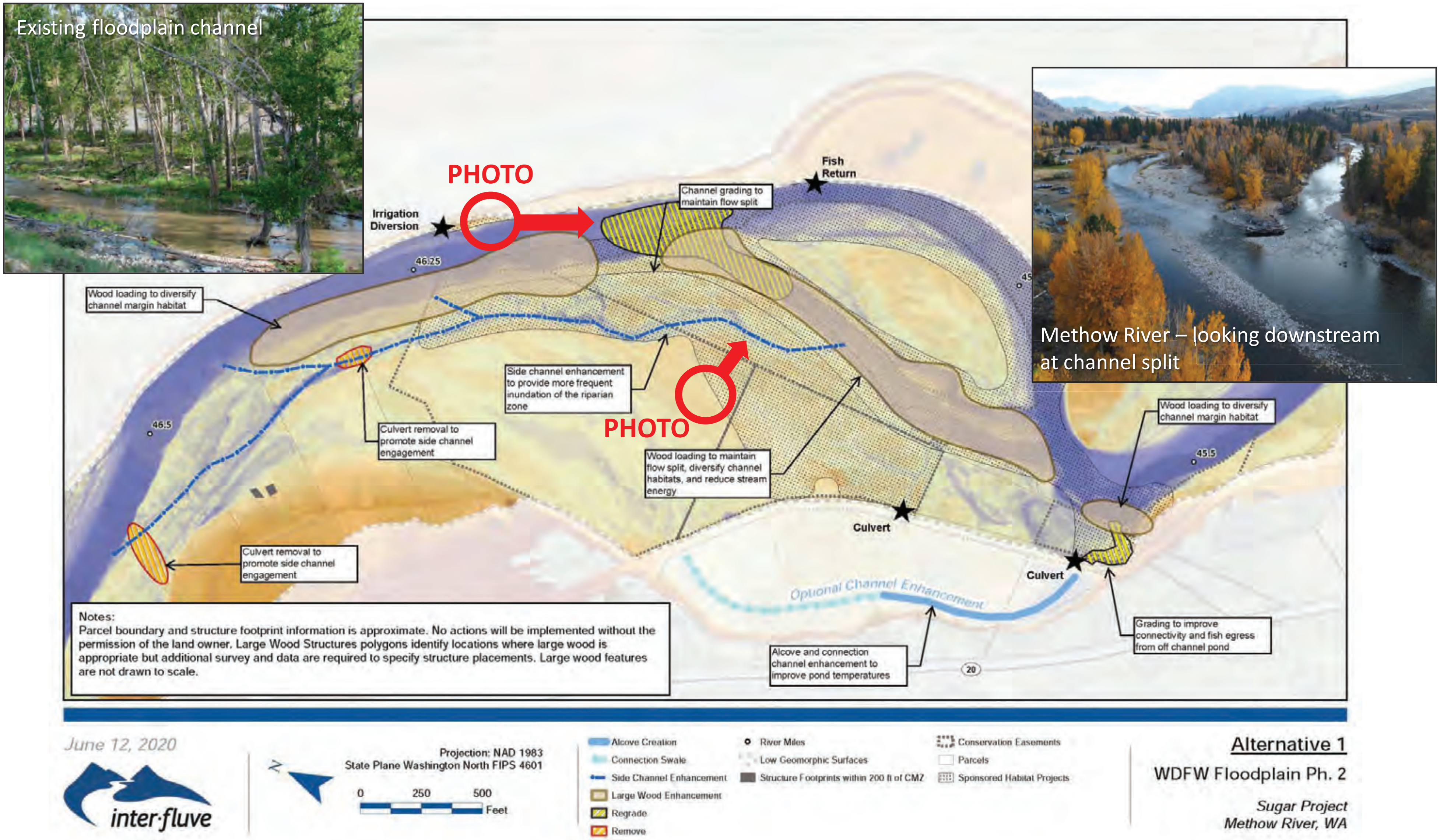
- Channel realignment



WDFW

- Previous project site
  - Removed levee and improved floodplain connectivity
  - Added channel complexity
  - Irrigation improvements
- Culverts limit flow to existing floodplain channel
- Low late summer flow down main channel
- Enhance low water connectivity of existing backwater alcove for juvenile chinook.
- State land and land purchased for restoration

Methow River – looking upstream toward Plummers Pond


Existing floodplain channel
Methow River – looking downstream at channel split
PHOTO
PHOTO
Irrigation Diversion
Fish Return
Channel grading to maintain flow split
46.25
46.5
45.5
Wood loading to diversify channel margin habitat
Side channel enhancement to provide more frequent inundation of the riparian zone
Culvert removal to promote side channel engagement
Wood loading to maintain flow split, diversify channel habitats, and reduce stream energy
Culvert removal to promote side channel engagement
Wood loading to diversify channel margin habitat
Culvert
Culvert
Optional Channel Enhancement
Alcove and connection channel enhancement to improve pond temperatures
Grading to improve connectivity and fish egress from off channel pond
20
Notes:
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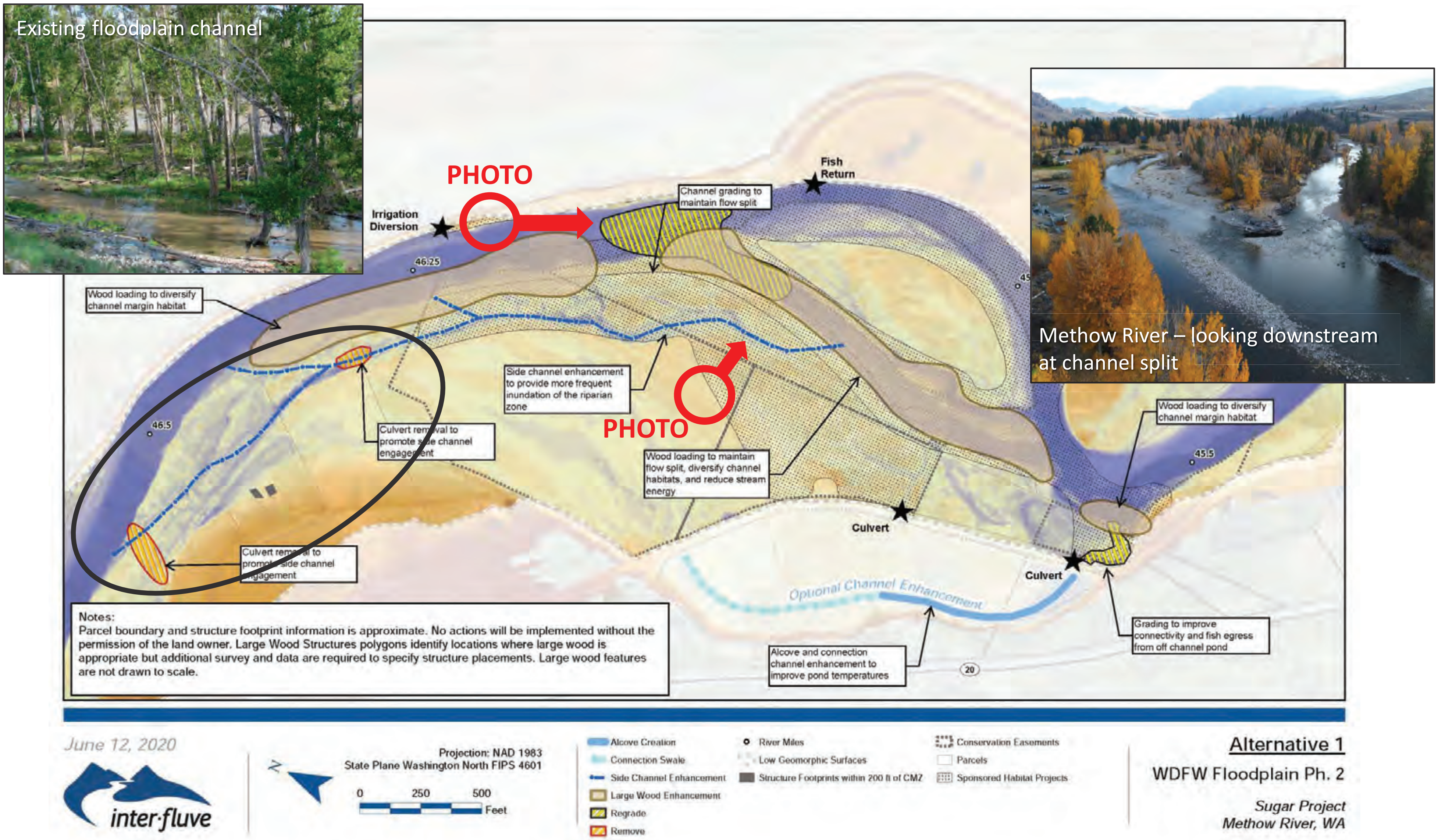
June 12, 2020
inter·fluve
Projection: NAD 1983
State Plane Washington North FIPS 4601
N
0
250
500
Feet
Alcove Creation
Connection Swale
Side Channel Enhancement
Large Wood Enhancement
Regrade
Remove
River Miles
Low Geomorphic Surfaces
Structure Footprints within 200 ft of CMZ
Conservation Easements
Parcels
Sponsored Habitat Projects
Alternative 1
WDFW Floodplain Ph. 2
Sugar Project
Methow River, WA



Existing floodplain channel
Methow River – looking downstream at channel split
PHOTO
PHOTO
Irrigation Diversion
Fish Return
Channel grading to maintain flow split
46.25
46.5
45.5
Wood loading to diversify channel margin habitat
Side channel enhancement to provide more frequent inundation of the riparian zone
Wood loading to maintain flow split, diversify channel habitats, and reduce stream energy
Culvert
Culvert
Wood loading to diversify channel margin habitat
Optional Channel Enhancement
Alcove and connection channel enhancement to improve pond temperatures
Grading to improve connectivity and fish egress from off channel pond
20
Notes:
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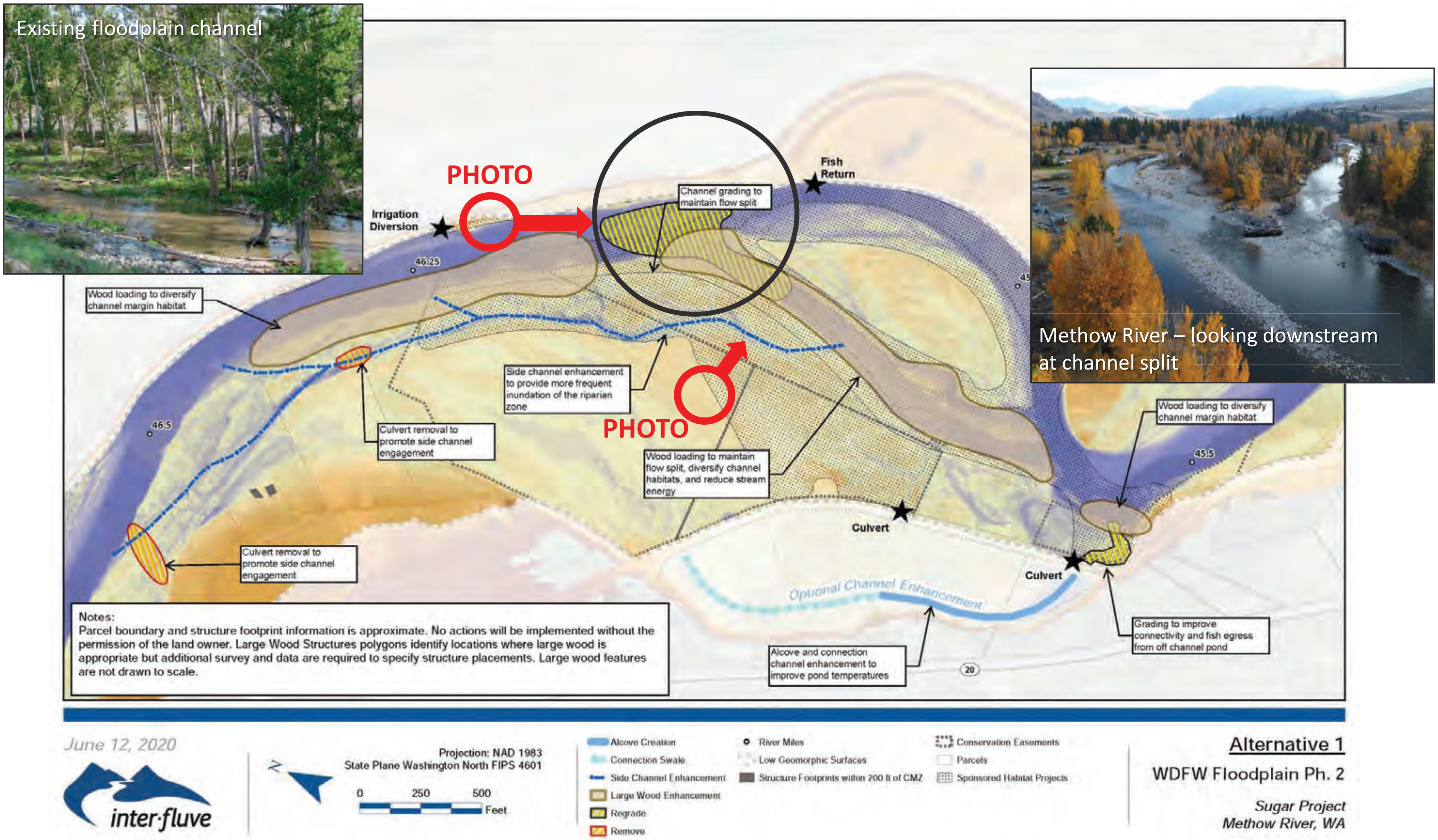
June 12, 2020
inter·fluve
N
Projection: NAD 1983
State Plane Washington North FIPS 4601
0 250 500
Feet
Alcove Creation
Connection Swale
Side Channel Enhancement
Large Wood Enhancement
Regrade
Remove
River Miles
Low Geomorphic Surfaces
Structure Footprints within 200 ft of CMZ
Conservation Easements
Parcels
Sponsored Habitat Projects
Alternative 1
WDFW Floodplain Ph. 2
Sugar Project
Methow River, WA


Existing floodplain channel
PHOTO
Irrigation Diversion
Channel grading to maintain flow split
Fish Return
46.25
Wood loading to diversify channel margin habitat
Side channel enhancement to provide more frequent inundation of the riparian zone
Culvert removal to promote side channel engagement
46.5
PHOTO
Wood loading to maintain flow split, diversify channel habitats, and reduce stream energy
Culvert removal to promote side channel engagement
Culvert
Methow River – looking downstream at channel split
Wood loading to diversify channel margin habitat
45.5
Culvert
Optional Channel Enhancement
Grading to improve connectivity and fish egress from off channel pond
Alcove and connection channel enhancement to improve pond temperatures
20
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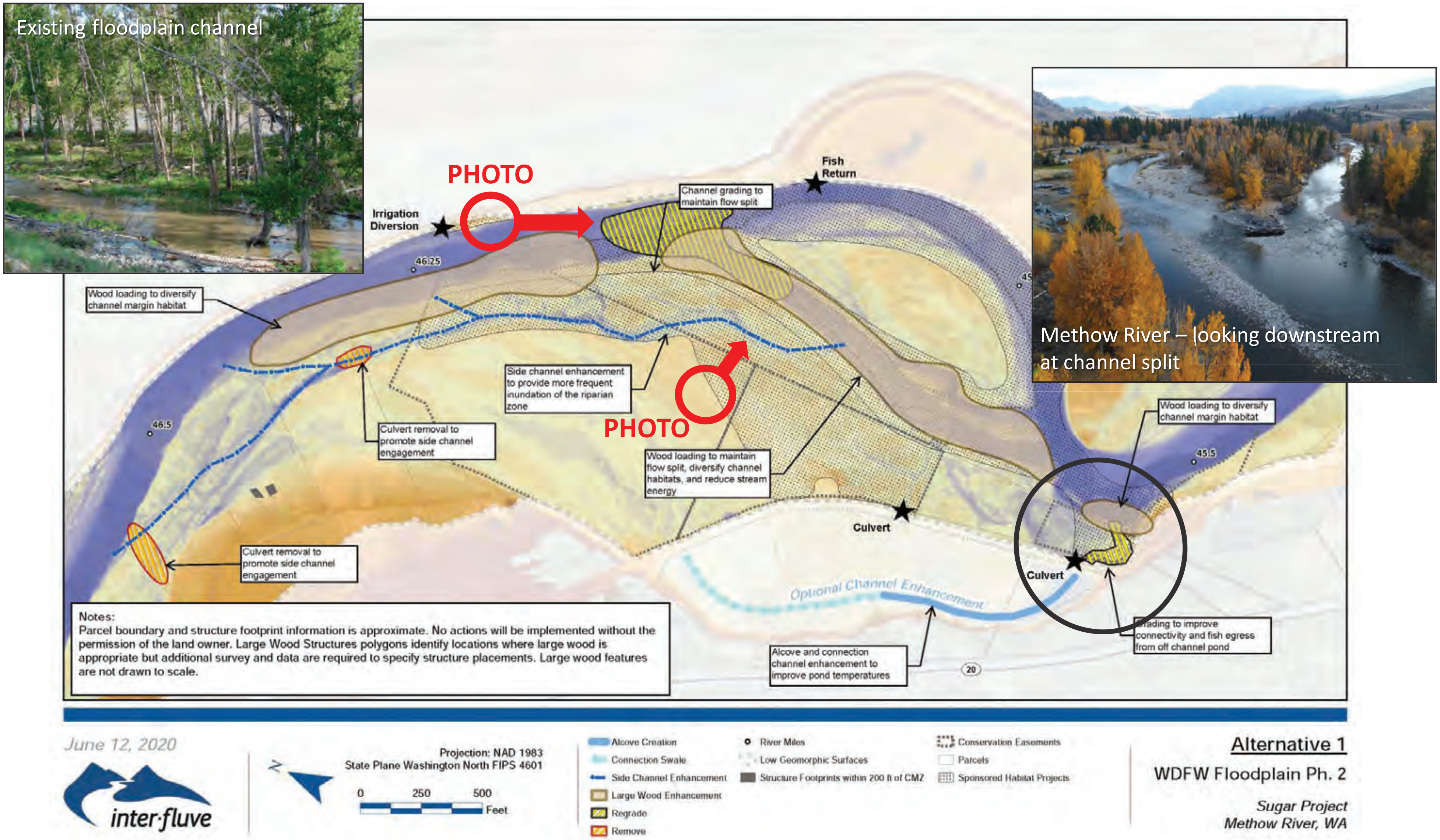
June 12, 2020
inter·fluve
N
Projection: NAD 1983
State Plane Washington North FIPS 4601
0 250 500
Feet
Alcove Creation
Connection Swale
Side Channel Enhancement
Large Wood Enhancement
Regrade
Remove
River Miles
Low Geomorphic Surfaces
Structure Footprints within 200 ft of CMZ
Conservation Easements
Parcels
Sponsored Habitat Projects
Alternative 1
WDFW Floodplain Ph. 2
Sugar Project
Methow River, WA


Existing floodplain channel
PHOTO
Irrigation Diversion
Fish Return
Channel grading to maintain flow split
46.25
Wood loading to diversify channel margin habitat
Side channel enhancement to provide more frequent inundation of the riparian zone
PHOTO
Culvert removal to promote side channel engagement
46.5
Wood loading to maintain flow split, diversify channel habitats, and reduce stream energy
Culvert removal to promote side channel engagement
Culvert
Culvert
Methow River – looking downstream at channel split
Wood loading to diversify channel margin habitat
45.5
Optional Channel Enhancement
Grading to improve connectivity and fish egress from off channel pond
Alcove and connection channel enhancement to improve pond temperatures
20
Notes:
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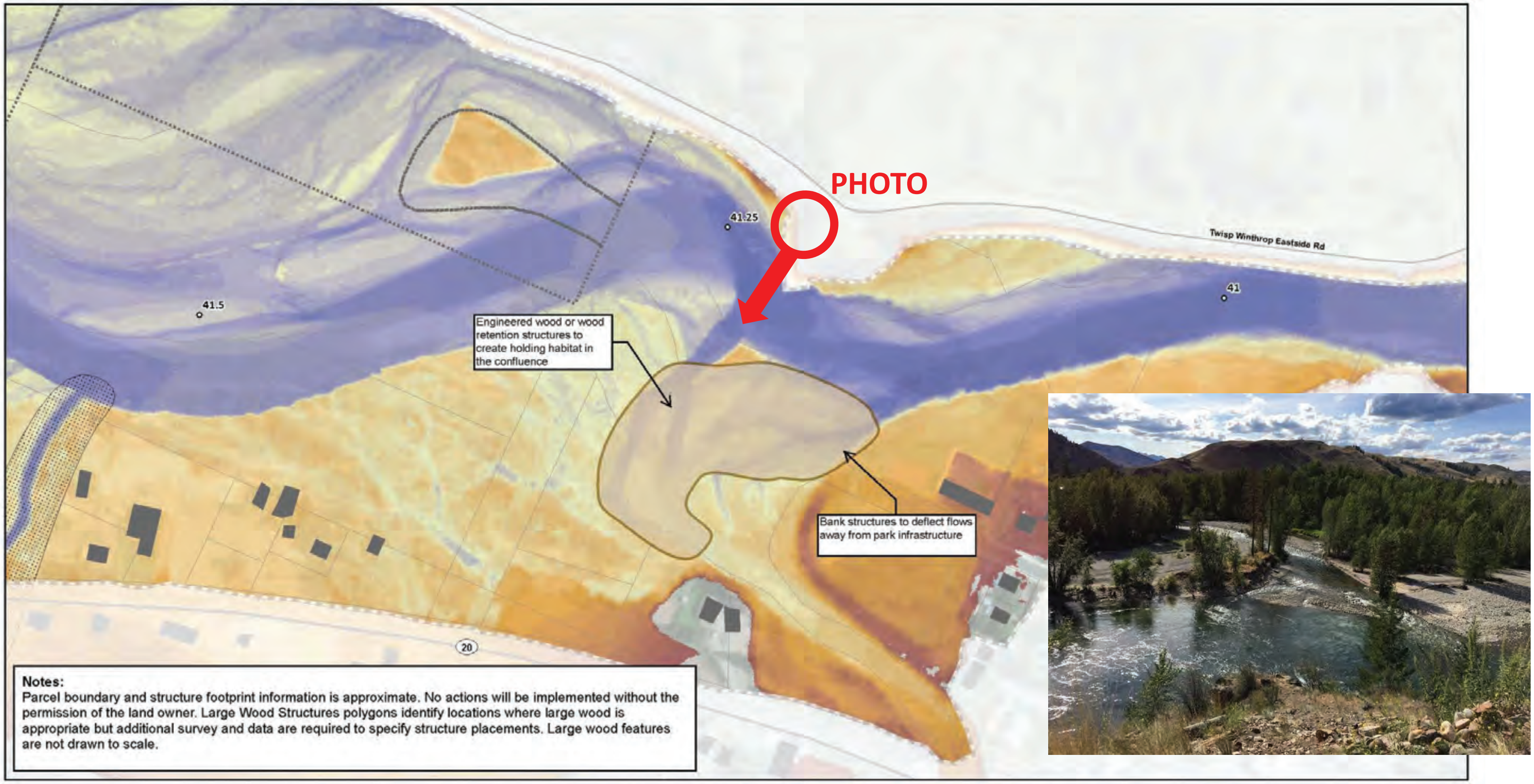
June 12, 2020
inter·fluve
N
Projection: NAD 1983
State Plane Washington North FIPS 4601
0 250 500 Feet
Alcove Creation
Connection Swale
Side Channel Enhancement
Large Wood Enhancement
Regrade
Remove
River Miles
Low Geomorphic Surfaces
Structure Footprints within 200 ft of CMZ
Conservation Easements
Parcels
Sponsored Habitat Projects
Alternative 1
WDFW Floodplain Ph. 2
Sugar Project
Methow River, WA

Confluence

- The confluence is important area for holding
- Increase and improve pool habitat for holding and rearing
- Multiple private landowners
- Town property and park
- Recreational users



June 12, 2020

inter·fluve

N

Projection: NAD 1983
State Plane Washington North FIPS 4601

0 215 430 Feet

Large Wood Enhancement

River Miles

Low Geomorphic Surfaces

Structure Footprints within 200 ft of CMZ

Conservation Easements

Parcels

Sponsored Habitat Projects

Alternative 1

Twisp Confluence

Sugar Project
Methow River, WA

Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 13 August 2020

Members Present: Jeremy Cram (WDFW), Chris Fisher (Colville Tribes), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees Chair).

Others Present: Becky Gallaher (Tributary Project Coordinator) and Hans Smith (YN alternate). Chris Johnson (MSRF) joined the call for the Vandervort Appraisal Discussion. Dave Duvall (Grant PUD), Deanne Pavlik-Kunkel (Grant PUD), and Denny Rohr (PRCC HSC facilitator) joined the call for the YN presentations. Maddie Eckmann, Chris Butler, Jarred Johnson, Chris Clemons, Jason Breidert, Elizabeth Witkowski, Dan Miller, and Mike McAllister (YN and YN consultants) also joined the call for the YN presentations.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 13 August 2020 from 9:00 am to 3:30 pm. The PRCC Habitat Subcommittee joined the call for the Yakama Nation presentations.

I. Review and Adopt Agenda

Tracy Hillman welcomed everyone to the meeting and the Committees adopted the proposed agenda.

II. Review and Approval of Meeting Minutes

The draft 9 July 2020 meeting notes were reviewed and approved by the Tributary Committees.

III. Monthly Update on Ongoing Projects

Becky Gallaher gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Barkley Irrigation – Under Pressure Project – The sponsor (Trout Unlimited; TU) reported they are focusing their efforts on the easement and working with the contractor on Phase II gravity pipeline construction. They are set to start construction on the final phase of the project in October.
- Icicle Boulder Field Project – The sponsor (TU) reported the contractor completed demolition and removal of the screen house, completed about 80% of the excavation work for the new screen house vault, and conducted additional work on the secondary access road. The contractor also began drilling and breaking boulders between the IPID access road and Icicle Creek.
- Peshastin Creek RM 10.5 PIT-Tag Detection Site Project – This project is complete. The sponsor (Washington Department of Fish and Wildlife; WDFW) provided the 2019 annual report, which was uploaded to the Extranet site.

- Beaver Fever Project – The sponsor (TU) reported they received the Hydraulic Project Approval (HPA) permit for Potato Creek beaver dam analog (BDA) work. They are waiting for the HPA for Roaring Creek. They plan to begin BDA work at the end of August or early September.
- Derby Creek Fish Passage Project – The sponsor (Cascade Fisheries; CF) reported they are waiting on the delivery of the box culvert. They plan to begin construction at the end of August.
- Chiwawa Nutrient Enhancement Project – The Sponsor (CF) reported they could not secure additional funding for analogs; therefore, the project is on hold this fall.
- Entiat Fish Passage and Barrier Assessment Project – The sponsor (CF) submitted the final report for this project. The report has been uploaded to the Extranet site.
- Twisp River Floodplain Left Bank Spring-fed Alcove Restoration Project – The sponsor (Methow Salmon Recovery Foundation; MSRF) reported they conducted site visits to evaluate flow channels and vegetation health. Because of a lack of cooperation from the adjacent landowner, cattle trespass continues to be an issue.
- Johnson Creek Habitat Restoration Project – The sponsor (TU) did not provide an update this month. This work will occur later in 2020.
- Sugar Levee Groundwater Evaluation Project – The sponsor (MSRF) reported no new activity. The piezometers are recording groundwater data hourly in the six monitoring wells.
- Cottonwood Flats Floodplain Restoration Project – The sponsor (Chelan County Natural Resources Department; CCNRD) did not provide an update this month.
- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported there was no new activity on this project.
- Peshastin RM 3.4 Side Channel Project – The Sponsor (CCNRD) did not provide an update this month.
- Stormy Area "A: Stream and Floodplain Enhancement Project – The sponsor (Yakama Nation; YN) reported construction is complete and they are preparing the final report.
- Napeequa Side Channel Connection Project – The sponsor (CF) reported there was no new activity on this project.
- Monitor Side Channel Project – The sponsor (CCNRD) did not provide an update this month.
- Restore Chiwaukum Creek Project – The sponsor (CF) reported there was no new activity on this project.
- City of Leavenworth Fish Screen Project – See update on Icicle Boulder Field Project.
- Goodwin Side Channel Assessment Project – The Sponsor (CF) reported that all five piezometers were installed in July and they are collecting data. Data collection includes water depths in the side channel perpendicular to piezometers, water temperatures within the side channel, photo points, and general notes and observations.
- Sugar Reach Habitat Enhancement Early Implementation Project – The Sponsor (MSRF) reported they received confirmation that the project is State Environmental Policy Act (SEPA) exempt. They applied for an HPA permit.
- Enloe Dam Removal Concept Plan Project – Chris Fisher reported that Inter-Fluve will begin work in September.

- Upper Beaver Creek Final Design and Restoration Project – The Sponsor/Tributary Committee Agreement has been signed.

IV. Vandervort Appraisal Discussion

In June, the Tributary Committees reviewed a Small Projects Application from the Methow Salmon Recovery Foundation titled, "Methow River – Vandervort Property Appraisal Project." The purpose of the project was to fund an appraisal to determine the value of the Vandervort property at the upper end of the Silver Side Channel Project area, located on the Methow River near RM 35.5. The acquisition of this property would potentially allow the removal of a levee that currently isolates flow into the upper end of the Silver Side Channel. The total cost of the project was $9,250 (does not include the cost of the actual appraisal).[1] The sponsor requested $9,250 from HCP Plan Species Account Funds. The Committees declined the opportunity to fund the project at that time because of several unknowns and uncertainties. For example, the Committees identified the following questions:

- What effects will removal of the levee have on downstream landowners?
- Would downstream landowners agree with levee removal?
- How will levee removal affect completed enhancement work in the lower portion of the side channel?
- Are there current or future issues that will prevent the levee from being removed?

In June, the Committees invited MSRF to a future meeting to discuss these questions with the Committees.

Chris Johnson, MSRF, joined the call to respond to the questions from the Committees and to provide additional information on the Vandervort property. Chris began the discussion by stating the landowner has received an offer from someone to purchase the property. However, the landowner is currently willing to sell the property to MSRF. Chris then said MSRF needs to identify property boundaries, especially between the Vandervort property and the WDFW and Hill properties. Chris said he has discussed with WDFW the potential benefits of MSRF owning and breaching the levee. He noted that WDFW said establishing perennial flows through the Silver Side Channel will provide large benefits to the site. Chris compared the Silver Side Channel levee with the levee removed on the Twisp River, stating that a portion of the Silver Side Channel levee may need to be retained to serve as a grade control. Chris added that they need to provide enough flow into the side channel to create fish habitat and preclude beaver dam construction. He said WDFW is not in favor of breaching the existing beaver dam on the lower portion of the Silver Side Channel. They (WDFW) are interested in a process-driven system, not a maintenance-driven system. Regarding levee removal, Chris said the Hill's do not need to approve levee removal; however, removal of the levee cannot result in damage to downstream properties (including the Hill property).

To date, WDFW has been unwilling to enforce the conditions of the conservation easement (CE) on the Hill property. Chris said he asked WDFW for a letter indicating that WDFW will enforce the conditions of the CE, especially if MSRF purchases the Vandervort property. WDFW has drafted a letter, which is going through internal review. Chris said he would like to develop a process-based approach, which basically provides a hypothetical situation and identifies what WDFW would do to enforce the CE.

The Committees thanked Chris for taking the time to discuss the project with the Committees. Following the discussion, and after Chris signed off, the Committees voted on the Methow River – Vandervort Property Appraisal Project. The Wells Tributary Committee agreed to fund appraisal support for $9,250 and the appraisal, which will be conducted by the Committees' approved appraiser. The Wells Committee agreed that the property boundaries need to be identified clearly and a letter is needed from WDFW indicating that WDFW will enforce the conditions of the CE. The letter from WDFW is not needed to

[1] The budget request of $9,250 included coordination, administration, and indirect costs.

move forward with the appraisal; however, the letter will be needed before the Committees can support an acquisition.

V. Yakama Nation Projects Presentation

The Yakama Nation (YN) discussed nine potential projects with the Committees. Hans Smith, YN, began the discussion by providing an overview of the YN's Upper Columbia Habitat Restoration Project (UCHRP; see Attachment 1). Hans noted that the UCHRP started in 2008 with a focus on restoring habitat for spring Chinook and steelhead in the Wenatchee, Entiat, and Methow basins. The goal is to restore treaty resources, implement the Upper Columbia Salmon Recovery Plan, and assist Bonneville Power Administration (BPA) in producing mitigation credits under various Biological Opinions. Hans described their habitat restoration and protection approach, which involves working under that framework of the Recovery Plan, assessing habitat conditions (through reach assessments and other information), prioritizing actions, and implementing actions. He then described efforts at the project scale including designing projects based on geomorphology/hydrology, engineering and risk, river safety, and construction impacts. Hans provided an overview of their accomplishments since 2009, identified reach assessments they have completed or funded to date, described their project prioritization guidelines, and summarized their recreation-use assessments to date. He then identified their typical funding strategy by project stage. He concluded by listing projects in various stages of design and noted the year in which they would like to implement the projects.

What follows is a summary of each project and the Committees' initial feedback.

1. **Entiat River Upper Stillwaters USFS Projects**

   The purpose of this proposed project is to address instream structural complexity within a 0.7-mile segment of the Entiat River in the Fox Creek Project Area and a 1.3-mile segment of the Entiat River in the Silver Falls Project Area. The work is proposed between RM 27.6 and 31.5 near the tributary confluences with Fox Creek and Silver Creek. Based on results from the reach assessment and conceptual design work, the proposed action will likely include perennial side channel restoration and strategic large wood placement. YN is partnering with the Forest Service on this project. The proposed implementation date is summer 2022.

   The Committees asked if Fox Creek campsites will be moved as a part of this project. YN noted that at least two sites will need to be moved. When asked why side channels are currently disconnected, YN indicated that channel incision and bank hardening have disconnected the side channels.

   The following additional comments/questions were provided after the meeting:

   - If the levee is removed along the reach of the Fox Creek Project Area, it is presumed the side channel would become activated at a reduced flow of the Entiat River. Would the side channel be perennial if only the levee is removed?
   - Upon review of the Entiat River Reach Based Ecosystem Indicators Rating (Table 1-1), Reach 5, road density is 14 miles/sq. mile. However, in the assessment, sediment scored "all adequate." Which is a more accurate depiction of the sediment conditions in this reach?

   The Committees see value in this project and would like to continue discussions with YN on this project.

2. **Chiwawa Outlet Habitat Project**

   The purpose of this proposed project is to address instream structural complexity, side channel and wetland connections, and floodplain condition within the Upper Wenatchee and Lower

Chiwawa Assessment Units. The project is located in the lower Chiwawa River and at RM 48.5 on the Wenatchee River. The proposed project intends to treat a 3,000-foot segment of the Chiwawa River and 1,600-feet of the Wenatchee River. Proposed treatments include reconnecting perennial side channel habitat, increasing floodplain connectivity, and increasing instream structural complexity. Based on the reach assessment and conceptual design work, actions could include groundwater-fed channel creation, mainstem log jams in the Wenatchee and Chiwawa rivers, and creation and enhancement of floodplain alcoves. The proposed implementation date is summer 2023.

The Committees voiced some concerns with creating the groundwater-fed channels, especially the one connecting the Chiwawa River with the Wenatchee River. It was also pointed out that the location of that channel could confound future monitoring efforts in the Chiwawa River as it is located upstream from the rotary screw trap. YN noted that there is currently no flow in these channels. Some members noted that they have concerns with infiltration galleries and that groundwater monitoring is needed in these channels. There was also concern about potentially disturbing an existing pool with accumulated large wood near the mouth of the Chiwawa River.

The following additional comments/questions were provided after the meeting:

- Conducting restoration work in confluence areas is inherently risky. First, based upon Figure 2, there is evidence of the development of point bars and responding lateral channel migration. Thus, it is possible that constructed habitat types may become something not designed (e.g., alcove becoming the active channel) or becoming isolated as the river channel migrates away from the entrance. Secondly, it is likely the alluvial fan is naturally porous. If so, the goal of activating channels via groundwater may be difficult because (1) there may be insufficient yield from the groundwater source and (2) the porosity of bed material may result in a high infiltration rate and not allow the groundwater to extend throughout the length of the channel.
- Overall, this confluence area, although not pristine, does not appear in disarray. This area displays an active reach where permanent features may be difficult to maintain and continue to benefit fish. There are many areas that could be improved by removing an anthropogenic feature rather than installing habitat features in a reach that appears to be fairly functional.

At least two members have serious concerns with this project and at this time are unlikely to support the project. However, the Committees are willing to continue discussions with YN on this project.

3. Upper Nason Creek Habitat Project

The purpose of this proposed project is to address side channel and wetland connections, bed and channel form, and instream structural complexity within the Nason Creek Assessment Unit. The proposed project intends to treat a 2-mile segment of Nason Creek between RM 14.0 and 16.3 near the Whitepine Creek confluence. Proposed treatments include reconnecting perennial side channel habitat, increasing floodplain connectivity, and increasing instream structural complexity. Based on the recent (2019) reach assessment and conceptual design work, actions could include construction of multiple bar apex log structures within Nason Creek and reconnection of side channels. The proposed implementation date is summer 2023.

YN noted that they are in discussions with the Forest Service and the Church Camp on possible projects within this reach. At this time, YN does not intend to purchase property or conservation easements in this area. Most of the proposed actions are on Forest Service lands. The Committees asked if reactivation of side channels will be perennial or seasonal. YN indicated they would prefer perennial channels. The Committees noted that the Whitepine Road is a significant source of fine sediment and asked if the project could be expanded to address issues with the road. YN said they would look into issues with the road.

The following additional comments/questions were provided after the meeting:

- Based upon large well-established point bars on the plan view (map 2), this project indicates a rich sediment source upstream. The suggested technique to install wood structures to increase bed elevation and activate side channels more frequently and typically a longer duration seems appropriate. Caution is necessary in areas where bankside vegetation appears to be marginal (structure immediately downstream from RM 14.5). This structure will likely accelerate deposition and encourage lateral channel migration along river left. Based upon the image and scale, a road prism is currently 250 feet from the active channel. Because of the existing infrastructure, there may be reason to encourage the river to expend energy on river right and less energy on river left.

The Committees see value in this project and would like to continue discussions with YN on this project.

4. Nason Creek RM 3.4-4.6 Habitat Project

The purpose of this proposed project is to address side channel and wetland connections, bed and channel form, and instream structural complexity within the Lower Nason Creek Assessment Unit. The proposed project intends to treat a 1.2-mile segment of Nason Creek between RM 3.4 and 4.6. The goal is to prevent further habitat degradation caused by Highway 207 flood and erosion control, reconnect perennial side channel habitat, increase floodplain connectivity, and increase instream structural complexity. Based on Reclamation's geomorphic and ecological indicators assessment and conceptual design work, actions could include large wood habitat creation and side channel restoration. YN is working with the Washington Department of Transportation (WDOT) and the Forest Service on this project. The proposed phased implementation date is summer 2022 and summer 2023.

The Committees questioned why there is a focus on this area given the cost to enhance the site and the uncertainty in biological benefit. YN indicated that WDOT has identified this as a Chronic Environmental Deficiency site, which means they have to address the issue in this area. Thus, they (WDOT) will be funding a large percentage of the work. WDOT is partnering with the YN to make sure the work addresses fish.

The following additional comments/questions were provided after the meeting:

- The objective of this project is to reduce the impacts of flood and erosion control practices conducted along Highway 207 on fish habitat in the project reach. First, the highway is not being removed and thus there are limits to a proposed project to benefit fish. Second, based upon Figure 4, there is spawning in this reach by multiple species, primarily spring Chinook. Is there a concern that further modification to this site could actually reduce fish use, i.e., diminish the existing habitat? Because of the existing infrastructure and participants of this proposed project, it is predictable the cost to implement will be inflated and the return on investment low. There would be better value in improving marginal habitat to increase spawning activity rather than augmenting existing habitat under the constraints of multiple entities and a state highway.
- The Committees commend the Yakama Nation for being engaged and would encourage them to continue to influence WDOT as to the best (fish-friendly) technique to meet their departments requirements to protect the highway.

At least two members have serious concerns with this project and are unlikely to support it. They believe enhancement options will be marginalized, expensive, and result in small benefits to fish.

In addition, the impetus here is that WDOT has an issue and they need to support the project financially. The Committees are willing to continue discussions with YN on this project; however, financial support of the project is unlikely at this time.

5. **Eightmile Creek Fish Passage Project**

The purpose of this proposed project is to address anthropogenic barriers within Eightmile Creek, a tributary to the Chewuch River in the Lower Chewuch Assessment Unit. The proposed project intends to address one road-induced velocity barrier along Eightmile Creek at RM 1.7 and one log/boulder-induced vertical drop at RM 0.7. The goal is to reconnect fish passage to about 13 miles of low-gradient, high-quality stream habitat upstream from the barriers. Based on quantitative fish passage assessments and completed construction designs, YN will enhance fish passage at both barrier sites. The proposed implementation date is summer 2021.

YN noted that brook trout exist throughout Eightmile Creek. The Committees asked why there are no steelhead upstream from the falls if the falls are 86% passable. YN responded that the lack of passage is likely due to turbulence. The Committees also had questions about the number of passage structures within a short distance at the Bridge site. YN noted that the structures are needed to reduce turbulence. YN will look into this and report back to the Committees.

The following additional comments/questions were provided after the meeting:

- Three follow-up questions:
    1. Are there any juvenile *O. mykiss* upstream of the Bridge site (suggesting that it may have once been passable but due to the construction of the road became impassable)?
    2. The redd locations are not all shown in Figure 5 of the Basis of Design Report. Nevertheless, there are no redds identified between RM 0.6 and 0.7. Is there certainty that adult steelhead and spring Chinook salmon can currently access Eightmile Creek to RM 0.7?
    3. In lieu of installing structures, was consideration given to demolishing the boulders within the channel that create the non-passable conditions? There are two reasons for this consideration (1) structures could fail over time and (2) engineering structures and installation is expensive. Drilling a few “bad acting” boulders and breaking them would be less expensive. You would have to let the dust settle before one would know the passability of the resulting channel.

The Committees see value in this project and would like to continue discussions with YN on this project.

6. **Upper Methow Large Wood Restoration Project (RM 63.0-64.5)**

The purpose of this proposed project is to address bed and channel form and instream structural complexity within the Upper Methow River Assessment Unit. The proposed project intends to treat a 1.5-mile segment of the Methow River from RM 63.0-64.5 between the tributary confluences of Goat and Fawn creeks. Proposed treatments include increasing instream structural complexity and floodplain connectivity to enhance natural habitat forming processes. Based on the reach assessment and conceptual design work, actions could include strategic placement of main channel bar apex log structures and bank-buried structures as needed. At this time, the plan is to use heavy equipment to construct proposed large wood structures in order to guarantee stability and function, which is needed to address adjacent private lands and infrastructure concerns. The proposed implementation date is summer 2022.

The Committees asked if YN has discussed the removal of the levee with the Army Corp of Engineers (ACOE). YN indicated that before 2018, ACOE was willing to work with YN on this site. Since 2018, ACOE has been less enthusiastic about the site. YN would need both County and ACOE approval to remove or breach the levee.

The following additional comments/questions were provided after the meeting:

- Supportive of the Fawn Creek Project, such that the removal of the levee will provide benefit with limited intrusion.

The Committees see value in this project and would like to continue discussions with YN on this project.

7. Upper Twisp River USFS Projects

The purpose of this proposed project is to address bed and channel form, instream structural complexity, and side channel and wetland connections within the Upper and Lower Twisp River Assessment Units. The proposed project intends to treat a 6-mile segment of the Twisp River between RM 16.0 and 22.2 and a 1-mile segment between RM 1 and 2 on Little Bridge Creek. Proposed treatments include reconnecting perennial side channel habitat, increasing floodplain connectivity, and increasing instream structural complexity. Based on the reach assessment, the habitat and geomorphic assessment, and conceptual design work, actions could include strategic placement of large wood accumulations using heavy-lift helicopters. Excavators may be needed to reorganize large wood in some locations to improve stability and function where access is available and where there is no disturbance to riparian vegetation. The proposed implementation date is summer 2022.

The Committees asked about the source of the wood for placement in the streams. YN indicated that most of the large wood would come from uplands (timber sales). Some, however, would come from the riparian area (e.g., large spruce). Wood stability within the channel would be achieved by using large-sized wood and stacking wood. The Committees acknowledged the lack of wood in this reach of the Twisp River and believe more wood is needed there. Tom Kahler indicated that Douglas PUD has collected fish data in this reach using electrofishing surveys. He asked if YN would like to use those data to inform their enhancement project and post-construction monitoring. YN said yes. Spring Chinook spawning in the upper Twisp also occurs early relative to other spawning locations in the Methow subbasin. YN should consult with Charles Frady (WDFW) on the most appropriate work window for project implementation.

The Committees see value in this project and would like to continue discussions with YN on this project.

8. Twisp Scaffold Camp Habitat Project

The purpose of this proposed project is to address side channel and wetland connections, instream structural complexity, and bed and channel form within the Upper Twisp River Assessment Unit. The proposed project intends to treat a 1,000-foot segment of the Twisp River between RM 15.6 and 15.8. Based on the reach assessment and conceptual design work, actions will likely include perennial side channel enhancement and main channel large wood placement. This work will occur on lands owned by YN. The land was purchased by YN for the purpose of enhancing habitat conditions there. The proposed implementation date is summer 2022.

The Committees had no questions on this project. They noted the lack of wood in this reach of the Twisp River and believe more wood is needed in the Twisp River.

The Committees see value in this project and would like to continue discussions with YN on this project.

9. **Twisp Horseshoe Habitat Project**

   The purpose of this proposed project is to address bed and channel form, side channel and wetland habitat conditions, and instream structural complexity within the Lower Twisp River Assessment Unit. The proposed project intends to treat a 3,500-foot segment of the Twisp River between RM 11.2 and 12.0. Proposed treatments include increasing instream structural complexity. Based on the reach assessment and conceptual design work, actions could include strategic placement of large wood accumulations using heavy-lift helicopters. Excavators will be needed to reorganize large wood to improve stability and function. The proposed implementation date is summer 2022.

   The Committees asked if the oxbows dry seasonally. YN indicated that they are perennial. YN noted that there are a series of beaver dams in this area. The Committees indicated that the reach lacks wood and they support the reconnection of side channels and the floodplain. YN said they intend to make the connections perennial.

   The following additional comments/questions were provided after the meeting:

   - Many side channels are not connected throughout the hydrograph of the main channel. The Committees support the re-activation of the historic side channel but would not support excavating the depth of the side channel to maintain flow throughout the year.

   The Committees see value in this project and would like to continue discussions with YN on this project.

YN indicated that project designs and permit application elements are being funded through the BPA Fish Accords. YN will seek funding from various entities, including the HCP TCs, to implement the projects. At the request of the Committees, YN will continue to consult with the Committees through the design stages of the projects.

The Committees appreciated the fact that YN is engaging them at an early stage of project development. The materials YN provided covered most of the questions the Committees asked, but it was very helpful to have the project managers describe the projects and engage the Committees in their planning process. The Committees appreciated knowing the process YN went through and alternatives considered in the development of the projects, and continued updates/engagement will give the Committees the comfort they need for making funding decisions. The Committees thanked YN for the presentations and supporting materials.

VI. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests from July and August:

   Rock Island Plan Species Account:

   - $147.00 to Clifton Larson Allen for Rock Island financial administration in July 2020.
   - $1,000.00 to Cordell, Neher & Company for the external audit of the Rock Island Plan Species Account.
   - $215.16 to Cascade Fisheries for the Restore Lower Chiwaukum Creek – Phase I Project.
   - $1,024.04 to Cascade Fisheries for the Chiwawa Nutrient Enhancement Project.
   - $1,906.33 to Cascade Fisheries for the Goodwin Side Channel Project.

- $82.07 to Cascade Fisheries for the Derby Creek Fish Passage – Collins Project.
- $364,027.56 to Trout Unlimited for the Icicle Creek Boulder Field Project.
- $2,688.97 to Trout Unlimited for the Beaver Fever – Restoring Ecosystem Function Project.

Rocky Reach Plan Species Account:

- $147.00 to Clifton Larson Allen for Rocky Reach financial administration in July 2020.
- $1,000.00 to Cordell, Neher & Company for the external audit of the Rocky Reach Plan Species Account.
- $1,950.08 to Cascade Fisheries for the Entiat Basin Fish Passage and Screening Assessment Project.
- $109.58 to Cascade Fisheries for the Napeequa Side Channel Project.

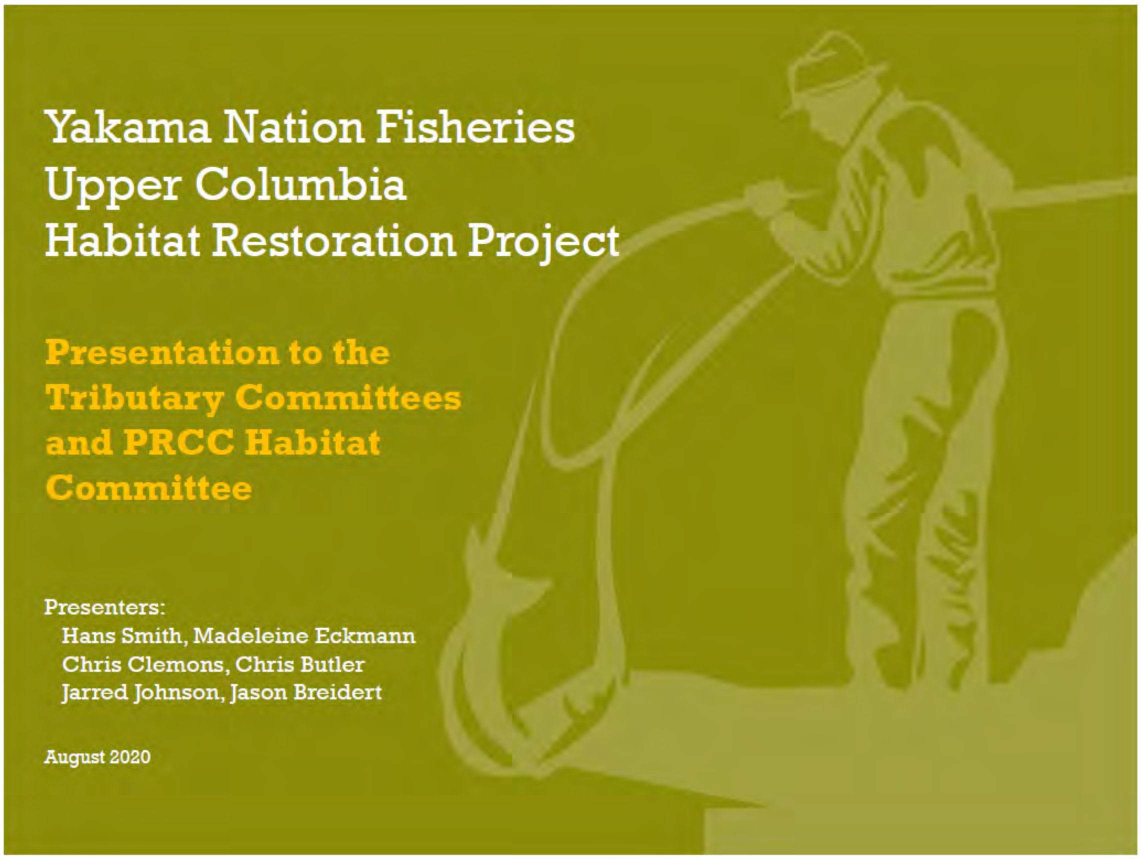
VII. Next Steps

The next scheduled meeting of the Tributary Committees will be on Thursday, 10 September 2020.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Attachment 1

Presentation by Hans Smith on the Yakama Nation's Upper Columbia Habitat Restoration Project

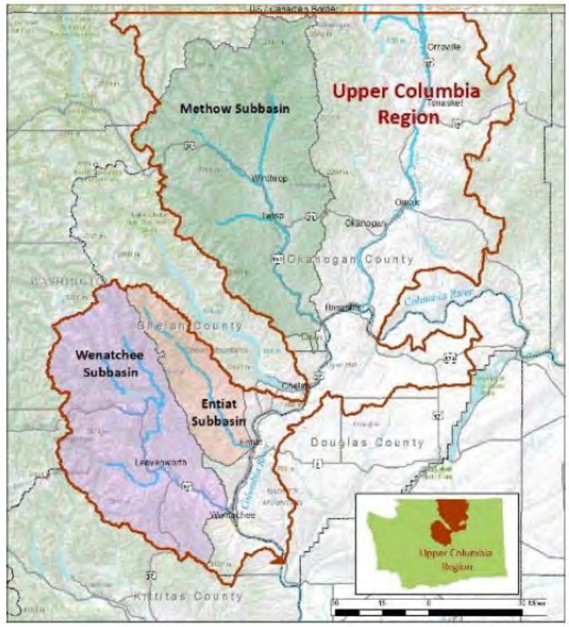


Upper Columbia Habitat Restoration Project *(UCHRP)*

Program Details

- Started in 2008
- Species of focus:
  - UC Spring Chinook
  - UC Steelhead
- Areas of Focus:
  - Methow
  - Entiat
  - Wenatchee

Yakama Nation Fisheries



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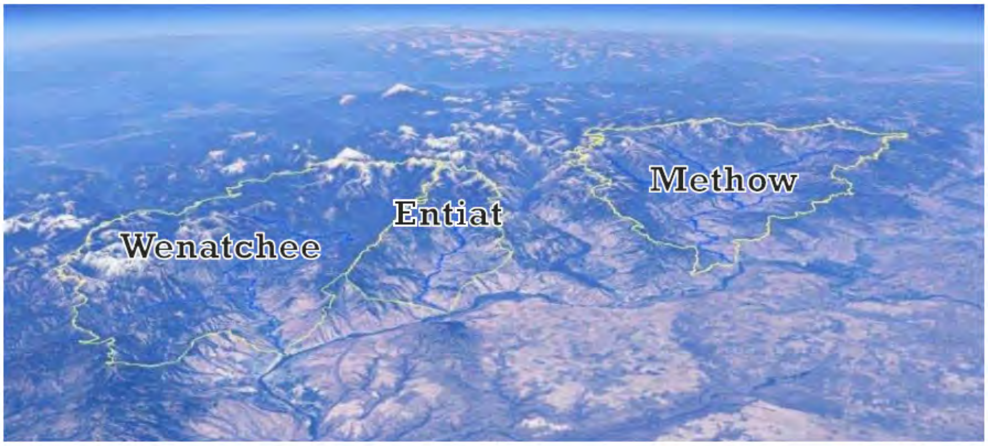
UCHRP Focus Within Yakama Nation Fisheries

Yakama Nation Fisheries



- Restore Treaty Resources
- Implement the Upper Columbia Salmon Recovery Plan
- Assist BPA in producing mitigation credits under the FCRPS BiOP and the Columbia River System (CRS) BiOP

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Project Approach

Yakama Nation Fisheries

- Work under framework of the 2007 Salmon Recovery Plan
- Assess Habitat Conditions
- Prioritize Restoration / Protection Actions
- Develop and Implement Restoration and Protection Projects
    - Side Channel Restoration
    - Large Wood Reintroduction
    - Floodplain Restoration
    - Pool Creation
    - Thermal Refuge Development

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At the Project Scale

Yakama Nation Fisheries

- Typical Design Considerations
  - **Habitat**
  - Geomorphology/Hydrology
  - Engineering and Risk
  - River Safety
  - Construction Impacts

- Increase the quantity and quality of main channel and off-channel spawning and rearing habitat for ESA-listed salmon and steelhead, including:
  - Overhead cover
  - Hydraulic complexity
  - Pool scour
  - Velocity refuge
  - Increased food sources
  - Off-channel rearing
  - Sediment/bedload retention, storing, and sorting
- Design projects that restore or mimic the historical channel structure and complexity that salmonids have adapted to
- Ensure habitat improvements are functioning in the best manner possible during times of greatest stress (low flows, high temperatures, icing, etc…)

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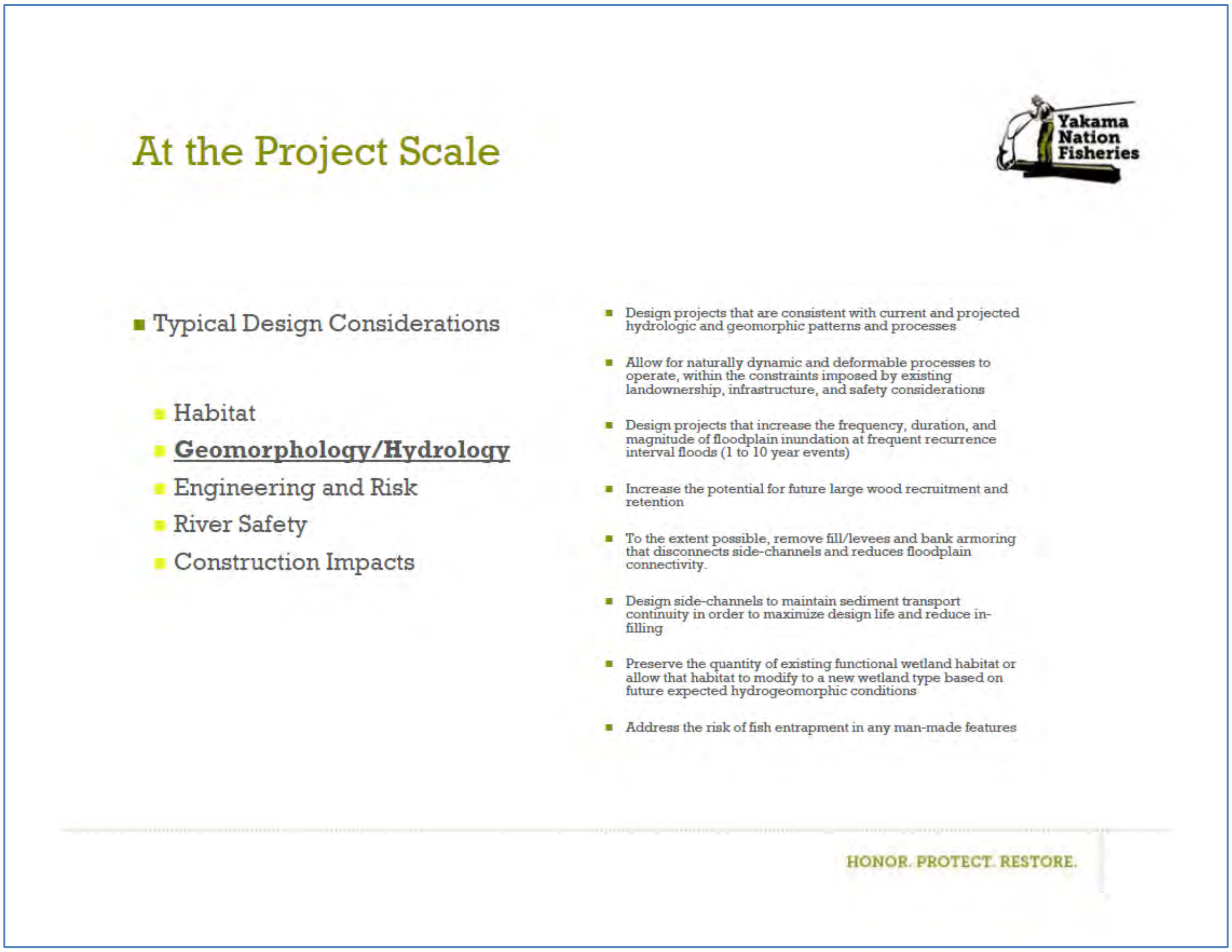
At the Project Scale
Yakama Nation Fisheries
Typical Design Considerations
Habitat
Geomorphology/Hydrology
Engineering and Risk
River Safety
Construction Impacts
Design projects that are consistent with current and projected hydrologic and geomorphic patterns and processes
Allow for naturally dynamic and deformable processes to operate, within the constraints imposed by existing landownership, infrastructure, and safety considerations
Design projects that increase the frequency, duration, and magnitude of floodplain inundation at frequent recurrence interval floods (1 to 10 year events)
Increase the potential for future large wood recruitment and retention
To the extent possible, remove fill/levees and bank armoring that disconnects side-channels and reduces floodplain connectivity.
Design side-channels to maintain sediment transport continuity in order to maximize design life and reduce in-filling
Preserve the quantity of existing functional wetland habitat or allow that habitat to modify to a new wetland type based on future expected hydrogeomorphic conditions
Address the risk of fish entrapment in any man-made features
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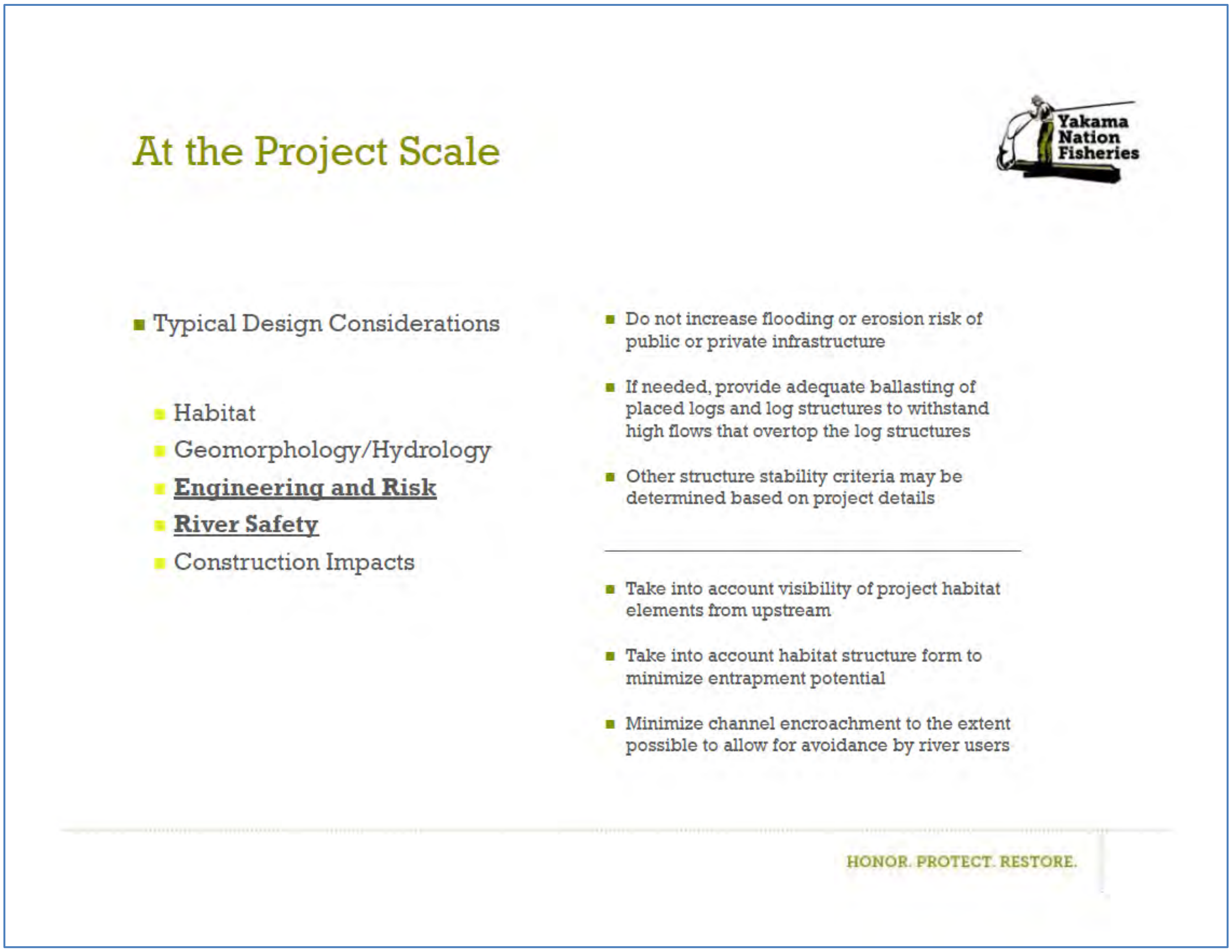
At the Project Scale
Yakama Nation Fisheries
Typical Design Considerations
Habitat
Geomorphology/Hydrology
Engineering and Risk
River Safety
Construction Impacts
Do not increase flooding or erosion risk of public or private infrastructure
If needed, provide adequate ballasting of placed logs and log structures to withstand high flows that overtop the log structures
Other structure stability criteria may be determined based on project details
Take into account visibility of project habitat elements from upstream
Take into account habitat structure form to minimize entrapment potential
Minimize channel encroachment to the extent possible to allow for avoidance by river users
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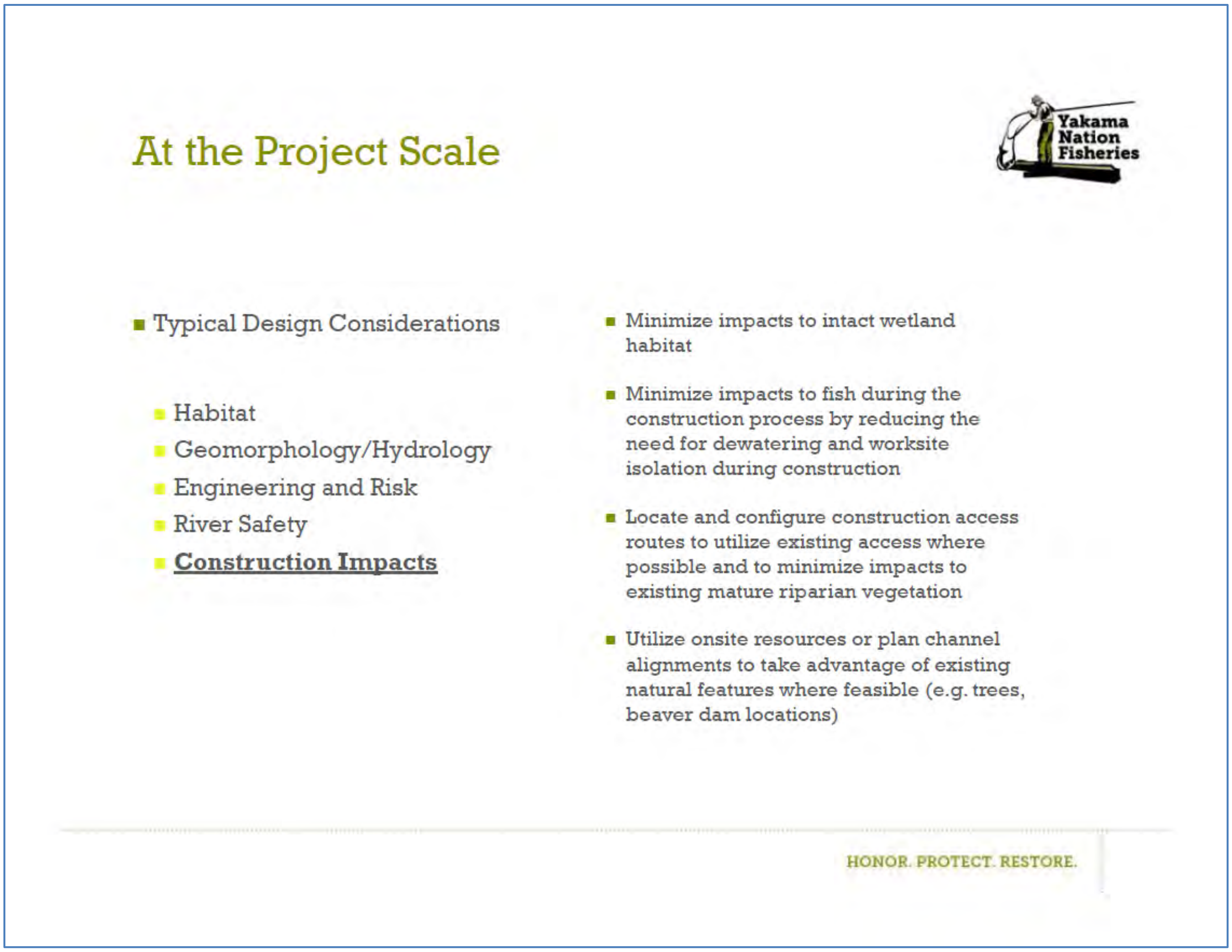
At the Project Scale
Yakama Nation Fisheries
Typical Design Considerations
Habitat
Geomorphology/Hydrology
Engineering and Risk
River Safety
Construction Impacts
Minimize impacts to intact wetland habitat
Minimize impacts to fish during the construction process by reducing the need for dewatering and worksite isolation during construction
Locate and configure construction access routes to utilize existing access where possible and to minimize impacts to existing mature riparian vegetation
Utilize onsite resources or plan channel alignments to take advantage of existing natural features where feasible (e.g. trees, beaver dam locations)
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Projects Completed to Date
Yakama Nation Fisheries
UCHRP Accomplishments (2009 – 2019)
16 miles of mainstem complexity treatments
5.5 miles of side channel treatments
4,600 pieces of wood added as habitat
36 projects implemented
14 habitat assessments conducted
US / Canadian Border
Oroville
Tonasket
Methow Subbasin
Winthrop
Twisp
Omak
Okanogan
Okanogan County
Brewster
Columbia River
Chelan County
Chelan
Wenatchee Subbasin
Entiat Subbasin
Entiat
Leavenworth
Wenatchee
UCHRP Fish Accord Projects
Large Wood Restoration
Side Channel Restoration
Side Channel and Large Wood Restoration
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Reach Assessments Completed to Date

Subbasin	Stream	Reach Assessment	Year
Methow	Twisp	Upper Twisp (and Tribs)	2017
		Middle Twisp	2015
		Lower Twisp	2010
	Chewuch	Upper Chewuch (and Tribs)	2019
		Lower Chewuch	2010
	Methow	Upper Methow	2015
	Beaver	Lower Beaver	2017
	Libby	Lower Libby Creek	2012
Entiat	Entiat	Upper Stillwaters	2013
	Mad	Mad River	2019
Wenatchee	Wenatchee	Upper Wenatchee	2012
		Lower Wenatchee	2017
	Nason	Upper Nason	2019
	Peshastin	Lower Peshastin	2010

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Restoration Project Prioritization

Yakama Nation Fisheries

- **UCHRP Project Prioritization Guidelines**
  - **Step 1: Benefit Score** - Projects are scored according to 4 benefit categories, which include a "recovery gap" category and 3 additional categories. Scores for each category are summed to obtain the ***Benefit Score***.
  - **Step 2: Cost Score** - Projects are given a ***Cost Score***, which reflects the overall *relative cost* for the project based on techniques, access, and construction feasibility issues.
  - **Step 3: Benefit-to-Cost Score** - Total benefit score (sum of all 4 benefit scores) is divided by the cost score to obtain the ***Benefit-to-Cost Score***.
  - **Step 4: Feasibility Designation** - Projects are given a ***Feasibility Designation*** based on the overall likely feasibility of being able to implement the project within a 10-year timeframe.

Project Information						Benefit Score										Cost Score		Cost Benefit	Feasibility Designation	
						Restoration Gap Analysis				Existing and Potential Fish Use		Root Causes								
Tiers	Project Name	Reach	Down-stream RM	Up-stream RM	Total Length (mi)	Existing Condition (1-7)	Achievable Target (1-7)	Final Gap Score (Target - Existing) (0-6)	Rationale/ assumption	Score (1-3)	Rationale/assumption	Score (1-3)	Rationale/ assumption	Total Benefit Score	Cost Score	Rationale/ assumption	Benefit-to-Cost Score	Feasibility Designation	Rationale/ assumption
1	Fawn Creek	2	62.40	63.85	1.45	2	6	4	Low existing function. High potential assuming levees addressed	3	High spawning use. Assumed rearing. Typically remains wetted.	3	Mostly recovery (levee/riprap removals, riparian with some enhancement [assumes levees can be removed]	10	2.5	Removal/set-back of engineered levee/trail. Mod dense main channel jams	4.0	Moderate	Challenging but possible to address levee/trail issues
	Goat Creek	3	65.00	66.25	1.25	3	6	3	Low to moderate existing. High potential assuming levees addressed	2.5	High spawning use. Assumed rearing but seasonally dry conditions may affect usability	2.5	Combination of Recovery (levee removal/modification, riparian work) and Enhancement (log jams)	8	1.5	Mostly push-up levees that can be spoiled on site. Mostly margin log jams	5.3	Moderate	Private lands. Some houses and infrastructure
	Trail Bridge	2	63.85	64.96	1.05	3	6	3	Low to moderate existing. High potential due to low risk to infrastructure	3	High spawning use. Assumed rearing. Typically remains wetted.	2	Mostly enhancement	8	2	Moderately dense mainstem log jams	4.0	Moderate - High	relatively little risk to Mostly inchannel work with
	Weeman	1-2	60.75	62.75	2.00	2	5	3	Low existing function. Moderate potential given existing infrastructure	3	High spawning use. Assumed rearing. Typically remains wetted	2	Mostly enhancement due to existing infrastructure in place	8	2.5	Sparse mainstem log jams. Infrastructure mods at DS end potentially expensive	3.2	Low	Full recovery challenging due to infrastructure limitations (Weeman Bridge and Hwy 20)
	Cedarosa	4	72.25	73.65	1.00	3	6	3	Low to moderate existing. High potential assuming addressing floodplain drainage	2	Moderate spawning use. Assumed rearing but seasonally dry conditions may affect usability	2.5	Combination of Recovery (levee removal/modification, riparian work) and Enhancement (log jams)	7.5	2	Moderately dense mainstem log jams. Levees can be spoiled on-site	3.8	Moderate	Streamside and floodplain residences. Good accessibility
2	Lower Mazama	4	66.15	67.26	1.05	4	6	2	Low to moderate existing. Moderate potential given existing infrastructure	2.5	High spawning use. Assumed rearing but seasonally dry conditions may affect usability	2	Mostly enhancement	6.5	2	Mostly push-up levees that can be spoiled on site. Mostly margin log jams. Offchannel work DS LB could be expensive	3.3	Low - Moderate	Challenging due to streamside residences and private property
	Lost River	5	73.70	75.00	1.30	3	5	2	Low to moderate existing. Moderate potential given Lost River Community impacts	2.5	High spawning use. But seasonally dry conditions may affect usability	2	Mostly enhancement given existing infrastructure affecting underlying processes	6.5	2.5	Mod dense main channel jams. High engineering requirements due to infrastructure. Relatively easy access	2.6	Low - Moderate	Challenging due to streamside residences and private property
	Goat Wall	5	70.25	71.36	1.00	4	6	2	Moderate existing. High potential given lack of significant infrastructure	2	Moderate spawning use. Assumed rearing but seasonally dry conditions may affect usability	2.5	Combination of Recovery (levee removal/modification, riparian work) and Enhancement (log jams)	6.5	2	Moderately dense mainstem log jams. Levees can be spoiled on-site	3.3	Moderate - High	Private lands on river-right but little infrastructure. USFS land road on river-left.

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Recreation Use Assessments to Date

Yakama Nation Fisheries

Subbasin	Stream	Recreation Use Assessment	Year
Methow	Methow	Upper Methow (RM 61 to 75)	2015
		Big Valley (RM 52 to 61)	2014
		Middle Methow (Winthrop to Twisp - RM 41 to 52)	2011
		Middle Methow (Twisp to Carlton - RM 27 to 41)	2018
	Twisp	Upper Twisp (RM 8 to 18)	2016
		Lower Twisp (RM 0 to 8)	2013
	Chewuch	RM 0 to 20	2014
Wenatchee	Wenatchee	Upper Wenatchee (RM 35.5 to 54)	2012
		Lower Wenatchee (RM 0 to 26.5)	2016

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UCHRP Financial Approach to Projects

Yakama Nation Fisheries

Project Stage		Stage Title	Typical Funding Strategy
1	a	Staff and Program Overhead	Fish Accord Funding
2	a	Reach Assessment	Fish Accord Funding
	b	Recreation Assessment	
3	a	Conceptual Design	Fish Accord Funding
	b	Permit Designs	
	c	Final Construction Designs	
4	a	Permitting Costs Including EC	Fish Accord Funding
5	a	Construction Subcontracts	Fish Accord Funding / PUDs / SRFB / Partners
	b	Habitat Restoration Materials Procurement	
	c	Site Stabilization Measures	
6	a	Post Implementation Monitoring	Fish Accord Funding

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August 2020 Project Presentations

Subbasin	Project Name	Year of Implementation	Assessment Unit
Methow	Eightmile Creek Barrier	2021	Lower Chewuch
	Upper Methow Large Wood	2022	Upper Methow
	Twisp USFS Projects	2022	Upper Twisp
	Twisp Scaffold Camp	2022	Upper Twisp
	Twisp Horseshoe Large Wood	2022	Lower Twisp
Entiat	Entiat Fox Creek and Silver Falls	2022	Upper Middle Entiat
Wenatchee	Upper Nason Creek	2023	Nason Creek
	Chiwawa Outlet	2023	Chiwawa
	Nason RM 3.4 to 4.6	2023	Nason Creek

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Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 8 October 2020

Members Present: Jeremy Cram (WDFW), Chris Fisher (Colville Tribes), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees Chair).

Others Present: Becky Gallaher (Tributary Project Coordinator), Hans Smith (Yakama Nation alternate), and Scott Hopkins (Chelan PUD alternate). Chris Johnson (MSRF), Jessica Goldberg (MSRF), and Nick Legg (Wolf Water Resources) joined the call for the Upper Beaver Creek Project, Sugar Levee Project, and Vandervort Appraisal discussions. Steve Kolk (BOR) joined the call for the Lower Chiwawa Project discussion.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 8 October 2020 from 9:00 am to 11:30 am.

I. Review and Adopt Agenda

Tracy Hillman welcomed everyone to the meeting and the Committees adopted the proposed agenda.

II. Review and Approval of Meeting Minutes

The draft 13 August 2020 meeting notes were reviewed and approved by the Tributary Committees.

III. Monthly Update on Ongoing Projects

Becky Gallaher gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Barkley Irrigation – Under Pressure Project – The sponsor (Trout Unlimited; TU) reported they started tree removal and will begin Phase II gravity pipeline construction on 1 October.
- Icicle Boulder Field Project – The sponsor (TU) reported the contractor continued excavation of the step-pool channel, which is now complete and functioning. The biggest accomplishment in September was the placement of the precast screenhouse building. They anticipate substantial completion during the first week of November.
- Peshastin Creek RM 10.5 PIT-Tag Detection Site Project – This project is complete. The sponsor (Washington Department of Fish and Wildlife; WDFW) provided the 2019 annual report, which was uploaded to the Extranet site.
- Beaver Fever Project – The sponsor (TU) reported that they installed 33 beaver dam analogs (BDAs) within a half-mile stretch of Potato Creek. After a rain event late in September, the BDAs were beginning to form pools.

- Derby Creek Fish Passage Project – The sponsor (Cascade Fisheries; CF) reported that all major elements of construction have been completed. In October, they will place asphalt on the driveway and plant riparian vegetation.
- Chiwawa Nutrient Enhancement Project – The Sponsor (CF) reported there was no new activity on this project.
- Twisp River Floodplain Left Bank Spring-fed Alcove Restoration Project – The sponsor (Methow Salmon Recovery Foundation; MSRF) reported they contacted Okanogan Conservation District to discuss fencing options.
- Johnson Creek Habitat Restoration Project – The sponsor (TU) did not provide an update this month. This work will occur later in 2020.
- Sugar Levee Groundwater Evaluation Project – This project is complete. The final report was uploaded to the Extranet site.
- Cottonwood Flats Floodplain Restoration Project – The sponsor (Chelan County Natural Resources Department; CCNRD) did not provide an update this month.
- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported there was no new activity on this project.
- Peshastin RM 3.4 Side Channel Project – The Sponsor (CCNRD) did not provide an update this month.
- Stormy Area "A: Stream and Floodplain Enhancement Project – The sponsor (Yakama Nation; YN) reported construction is complete and they will be submitting the final report soon.
- Napeequa Side Channel Connection Project – The sponsor (CF) reported there was no new activity on this project.
- Monitor Side Channel Project – The sponsor (CCNRD) did not provide an update this month.
- Restore Chiwaukum Creek Project – The sponsor (CF) reported there was no new activity on this project.
- City of Leavenworth Fish Screen Project – See update on Icicle Boulder Field Project.
- Goodwin Side Channel Assessment Project – The Sponsor (CF) reported there was no new activity on this project. The sponsor intends to visit the site and collect data this month.
- Sugar Reach Habitat Enhancement Early Implementation Project – The Sponsor (MSRF) reported there was no new activity on this project.
- Enloe Dam Removal Concept Plan Project – Chris Fisher reported that Inter-Fluve will use LIDAR to help with the analysis. They plan to submit their report in March 2021.
- Upper Beaver Creek Final Design and Restoration Project – The Sponsor (MSRF) discussed coordination with the Wells Tributary Committee on this project during the meeting (see discussion below).
- Vandervort Appraisal Project – Becky Gallaher reported that the appraisal was completed, and it was provided to the Wells Tributary Committee last week. Chris Johnson (MSRF) provided additional updates on this project (see discussion below).

IV. Methow Salmon Recovery Foundation Projects Discussion

Chris Johnson (MSRF), Jessica Goldberg (MSRF), and Nick Legg (Wolf Water Resources) described the status of the Upper Beaver Creek Final Design and Restoration Project with the Committees. In addition, Chris and Jessica updated the Committees on the Sugar Levee and Vandervort Appraisal projects. Chris Johnson said the purpose of the discussions is to update the Committees on the status of the projects, solicit feedback from the Committees, and continue coordination and communication with the Committees.

1. **Upper Beaver Creek Final Design and Restoration Project**

   Chris Johnson and Nick Legg provided a brief presentation on the Upper Beaver Creek Final Design and Restoration Project (see Attachment 1). They provided a brief history of the project noting that the project was initiated in 2008 with the goal of restoring fish passage at the Batie and Marracchi diversions. Chris Johnson said the project has faced many challenges from wildfires and floods. He added that funding has been secured from the Salmon Recovery Funding Board and the Wells Tributary Committee.

   Nick Legg noted that the project design has been revised based on feedback from the Tributary Committees. He described the key project elements of the project, including the redesign of the Batie Diversion and roughened channel, floodplain grading, Anderson Parcel floodplain improvements (near the Marracchi Diversion), and reconnection of the eastern floodplain. The Committee asked if the redesign considers the potential increase in wood loading resulting from recent fires and floods. Both Chris Johnson and Nick Legg said the redesign does address potential increase in wood loading. They added that the Yakama Nation project upstream from the current project is designed to collect most of the wood that would enter the channel from upstream sources. By adding multiple flow paths (lateral dynamism), they believe there should be no concern with the stream washing out the road.

   Nick described the proposed schedule and coordination junctures. He indicated that the 30% (preliminary) design is complete; the 60% design phase will begin this fall. Nick said the "45% design" (design analysis and hydraulic modeling results informing design direction) should be completed by early December. He added that the draft 60% design (permit-ready) will be completed by January 2021 and the draft final design should be completed by June 2021. In-water construction of non-irrigation elements is scheduled to begin in September 2021 and in-water construction of irrigation elements is planned to begin in October 2021.

   Chris Johnson asked the Wells Tributary Committee if they want to be involved in all discussions related to the design of the project, or if they would like to provide input after reviewing the 45% and 60% draft designs. The Committee indicated they would like to provide input after reviewing the 45% and 60% draft designs; however, they see value in some members being engaged in design development. Chris Fisher and Kate Terrell indicated they would like to be involved in design development; although Kate said she may not have time to be fully engaged in the process. Chris Johnson said he will include both Chris Fisher and Kate in design discussions and will ask the Wells Tributary Committee for feedback on the 45%, 60%, and final draft designs.

2. **Sugar Levee Project**

   Chris Johnson described the Sugar Reach – Small Project Action, which was completed this week (see Attachment 1). The goal of the small project was to increase the duration of flow into the historical side channel by excavating material from the mouth of the side channel. Chris provided pictures of the completed project (see Attachment 1). He noted that the project will allow the side channel to be activated annually. Chris said he will discuss the larger Sugar Levee Project with the Committees during their November or December meeting.

3. **Vandervort Appraisal Project**

   Chris Johnson provided an update on the Vandervort property (see Attachment 1). He said the Vandervort property, which includes three parcels, was sold for $665,000. Chris is currently engaging with the new owner to see if the new owner would be willing to sell the conservancy parcel (parcel with the levee that isolates the Silver Side Channel). He said the conservancy parcel was appraised at $100,000. He asked the Tributary Committees how he should proceed. The Committees indicated they will need a letter from WDFW that describes how WDFW intends to enforce the conditions of the conservation easement on the Hill property. The letter will also need to state that WDFW supports restoration and reconnection of the Silver Side Channel. According to Chris Johnson, WDFW supports a process-driven system, not a maintenance-driven system. The Committees are willing to review a proposal seeking funds to purchase the conservancy parcel once WDFW provides the letter.

The Committees thanked Chris, Jessica, and Nick for joining the meeting and updating the Committees on the three projects.

V. Lower Chiwawa River Project Discussion

Steve Kolk (BOR) informed the Committees that although the Rock Island Tributary Committee supported the Lower Chiwawa River Floodplain Reconnection and Instream Enhancement Project, Chelan County Natural Resources Department (project sponsor) did not receive funding from the Salmon Recovery Funding Board for the project. Steve said BOR has about $100,000 they could use to help design projects in the Lower Chiwawa River. He said BOR would like to work with the Rock Island Tributary Committee on developing a reach-based restoration approach. Brandon Rogers said the Yakama Nation considered doing a reach assessment on the Lower Chiwawa River but decided not to because a full-blown reach assessment is probably not needed in this area. Committee members agreed to work with BOR on developing a reach-based restoration approach on the Lower Chiwawa River. However, they said it would be prudent to wait on results from the Upper Columbia Regional Technical Team's (UCRTT) updated prioritization process. The prioritization tool identifies habitat conditions and limiting factors within the Lower Chiwawa River. Once the UCRTT reviews and approves the results from the prioritization process, the Tributary Committee and BOR can move forward with developing a reach-based approach. Tracy Hillman said the UCRTT will be reviewing the prioritization tool and results during October. If there are no fatal flaws, the UCRTT will approve the tool and results during the November meeting. Steve said he will reconnect with the Tributary Committee in December or January.

VI. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests from September and October:

   Rock Island Plan Species Account:

   - $110.25 to Clifton Larson Allen for Rock Island financial administration in August 2020.
   - $841.77 to Cascade Fisheries for the Restore Lower Chiwaukum Creek – Phase I Project (for work in August).
   - $444.59 to Cascade Fisheries for the Chiwawa Nutrient Enhancement Project (for work in August).
   - $357.11 to Cascade Fisheries for the Goodwin Side Channel Project (for work in August).

- $987.54 to Trout Unlimited for the Lower Wenatchee Instream Flow Enhancement – Phase 2 Project (for work in August).
- $239,848.14 to Trout Unlimited for the Icicle Creek Boulder Field Project (for work in July).
- $78.75 to Clifton Larson Allen for Rock Island financial administration in September 2020.
- $961.28 to Chelan PUD for Rock Island project coordination and administration during the third quarter of 2020.
- $579.30 to Cascade Fisheries for the Restore Lower Chiwaukum Creek – Phase I Project (for work in September).
- $372.84 to Cascade Fisheries for the Chiwawa Nutrient Enhancement Project (for work in September).
- $75.28 to Cascade Fisheries for the Goodwin Side Channel Project (for work in September).
- $64.21 to Cascade Fisheries for the Derby Creek Fish Passage – Collins Project (for work in September).
- $6,569.21 to Trout Unlimited for the Beaver Fever – Restoring Ecosystem Function Project (for work in July and August).

Rocky Reach Plan Species Account:

- $110.25 to Clifton Larson Allen for Rocky Reach financial administration in August 2020.
- $78.75 to Clifton Larson Allen for Rocky Reach financial administration in September 2020.
- $754.26 to Chelan PUD for Rocky Reach project coordination and administration during the third quarter of 2020.

Wells Plan Species Account:

- $493.96 to Chelan PUD for Wells project coordination and administration during the third quarter of 2020.
- $4,200.00 to Cascade Chelan Appraisal, Inc. for the Vandervort appraisal.

2. Brandon Rogers said the Committees are requesting that project sponsors work with the Tributary Committees during the design of their projects. He asked whether members of the Tributary Committees, who participate on various design teams with project sponsors, represent the Tributary Committees. Members indicated that those who work with project sponsors do not represent the Committees. Rather, they represent themselves and/or their agencies. This is because there can be divergent opinions among members on restoration designs. Comments and recommendations from the Committees are provided when project sponsors ask the Committees for their review. In this case, the Committees will review preliminary, 30%, 60%, and draft final designs as a group and provide comments to project sponsors. That said, it is important to have members of the Committees participate in design team meetings. Although those members do not represent the Tributary Committees, they can provide important details about projects and designs when the Committees review designs or proposed projects for funding.

VII. Next Steps

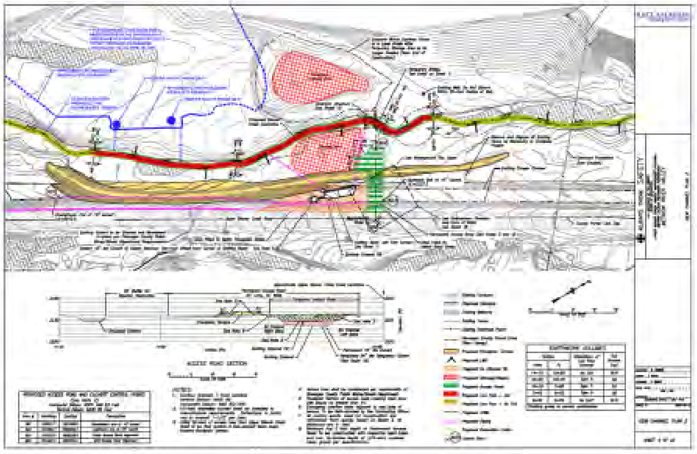
The next scheduled meeting of the Tributary Committees will be on Thursday, 12 November 2020.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Attachment 1

Presentation by Chris Johnson on the Upper Beaver Creek Project, the Sugar Levee Project, and the Vandervort Appraisal

Upper Beaver Creek – Project Update



Nick Legg – W2R
UBC – Project Update

Upper Beaver Creek – Design Status

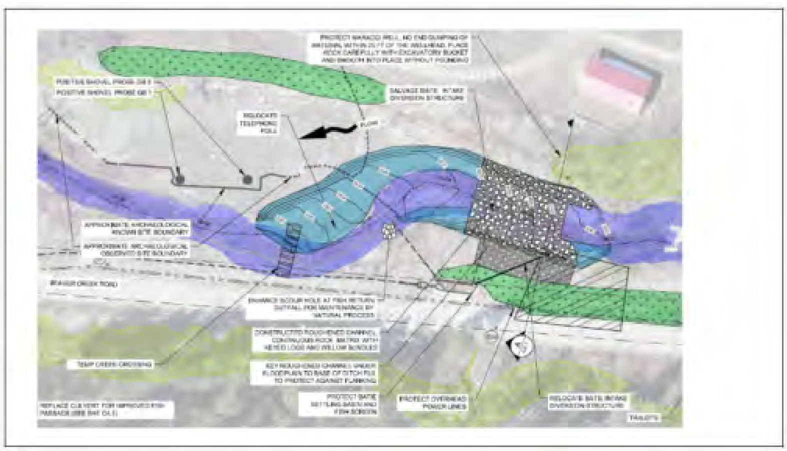
- 30% (preliminary) design is complete
- 60% design phase beginning this fall

Project Element	Status
Batie Diversion and Roughened Channel	• Refined design to improve resilience • Hydraulic modeling on-going
Floodplain grading	• Benefits to stream resilience/floodplain connectivity are clear • Grading zones to be refined (depends on cultural)
Anderson Parcel floodplain improvements (near Marracci diversion)	• Clear benefits to floodplain function and infrastructure (road/diversion) • Detailed design needed
Eastern floodplain connection and culverts	Considering: • Subsurface connections • Surface connections

Schedule and Coordination Junctures

Milestone	Timing	Input from Tributary Committee Members
"45% Design" (design analysis and hydraulic modeling results inform design direction)	Early Dec 2020	Yes
Draft 60% Design (permit-ready)	January 2021	Yes
Draft Final Design	June	If necessary

UBC – Project Update



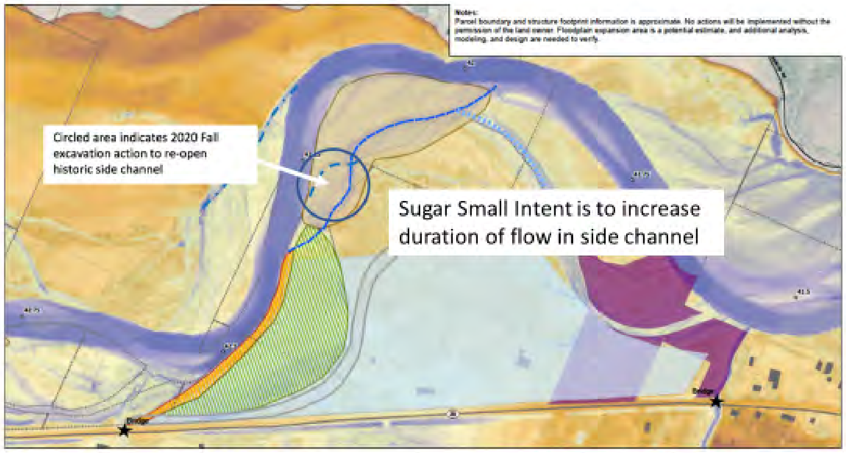
UBC – Project Update

UBC – Project Update

UBC – Project Update

UBC – Project Update

Sugar Reach – Small Project Action



Drone Picture from 10/07/20

Drone Picture from 10/07/20

And, One From Across the River

Vandervort Property Update

The three Vandervort Properties are shown together as a block. There are three parcels that could support two home sites. Total Acres 15.95.

Appraisal Outcome

- Appraised Value of Red Parcel - $100,000 as of Sept 09, 2020

Habitat Value of Acquisition – Levee and Channel

Pulling Back for Context

Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 12 November 2020

Members Present: Jeremy Cram (WDFW), Chris Fisher (Colville Tribes), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees Chair).

Others Present: Becky Gallaher (Tributary Project Coordinator), Hans Smith (Yakama Nation alternate), and Scott Hopkins (Chelan PUD alternate). Chris Johnson (MSRF), Jessica Goldberg (MSRF), Tara Gregg (MSRF), Jen Bountry (BOR), Steve Kolk (BOR), Emily Alcott (Inter-Fluve), Chris Nygarrd (BPA), and Joe Connor (BPA) joined the call for the Sugar Levee discussion. Maddie Eckmann (YN), Chris Butler (YN), and Mike McAllister (Inter-Fluve) joined the call for the Alder Creek and Chewuch RM 4.2 projects discussion.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 12 November 2020 from 9:00 am to 12:40 pm.

I. Review and Adopt November Agenda

Tracy Hillman welcomed everyone to the meeting and the Committees adopted the proposed agenda.

II. Review and Approval of October Meeting Minutes

The draft 8 October 2020 meeting notes were reviewed and approved by the Tributary Committees.

III. Monthly Update on Ongoing Projects

Becky Gallaher gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Barkley Irrigation – Under Pressure Project – The sponsor (Trout Unlimited; TU) reported they completed tree removal and have installed 3,000 feet of pipe within the ditch. In total, they will install 22,385 feet of pipe by the end of May 2021.
- Icicle Boulder Field Project – The sponsor (TU) reported the contractor completed piping from the screen house to the Alpine Lakes parking lot and connected the system to the piping that was installed last May. They will pressure test the system in early November.
- Peshastin Creek RM 10.5 PIT-Tag Detection Site Project – This project is complete. The sponsor (Washington Department of Fish and Wildlife; WDFW) provided the 2019 annual report, which was uploaded to the Extranet site.
- Beaver Fever Project – The sponsor (TU) reported they have been installing beaver dam analogs (BDAs) within Roaring Creek.

- Derby Creek Fish Passage Project – The sponsor (Cascade Fisheries; CF) reported that asphalt was replaced on the driveway; however, the landowner voiced concern that the drainage dip in the driveway between the new culvert and county road is too much of a bump. The contractor will install a patch of asphalt in the spring.
- Chiwawa Nutrient Enhancement Project – The Sponsor (CF) reported there was no new activity on this project.
- Twisp River Floodplain Left Bank Spring-fed Alcove Restoration Project – The sponsor (Methow Salmon Recovery Foundation; MSRF) reported there was no new activity on this project.
- Johnson Creek Habitat Restoration Project – The sponsor (TU) did not provide an update this month. Although this work was supposed to occur this year, it appears the project has been delayed until summer 2021. Becky reported there is no need for a contract extension at this time. The contract will expire in November 2021.
- Cottonwood Flats Floodplain Restoration Project – This project is complete. The sponsor (Chelan County Natural Resources Department; CCNRD) will submit a final report soon.
- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported there was no new activity on this project.
- Peshastin RM 3.4 Side Channel Project – The Sponsor (CCNRD) reported that they continue to collect groundwater data. In addition, the engineering contractor is processing and analyzing data collected in September.
- Stormy Area "A: Stream and Floodplain Enhancement Project – This project is complete. The final report has been uploaded to the Extranet site.
- Napeequa Side Channel Connection Project – The sponsor (CF) reported there was no new activity on this project.
- Monitor Side Channel Project – The sponsor (CCNRD) did not provide an update this month. Becky will check with the sponsor on why they are not submitting updates on this project.
- Restore Chiwaukum Creek Project – The sponsor (CF) reported they are beginning the modeling process.
- City of Leavenworth Fish Screen Project – See update on Icicle Boulder Field Project.
- Goodwin Side Channel Assessment Project – The Sponsor (CF) reported that they visit the site monthly to collect data.
- Sugar Reach Habitat Enhancement Early Implementation Project – The Sponsor (MSRF) reported that excavation of the new side channel inlet is complete. They have also placed game cameras at the site to monitor project evolution.
- Enloe Dam Removal Concept Plan Project – Chris Fisher reported that grab samples have been collected but they have not yet been analyzed. Field crews continue to evaluate techniques for estimating sediment volume behind Enloe Dam. They will test a new technique in December. Inter-Fluve hopes to submit a conceptual plan for dam removal by early April 2021; however, because of delays in information gathering (e.g., volume estimates and chemistry results), Inter-Fluve may request a no-cost time extension.
- Upper Beaver Creek Final Design and Restoration Project – The Sponsor (MSRF) reported that project design is moving forward and is on schedule.

- Vandervort Appraisal Project – This project is complete. The sponsor (MSRF) will submit a final report soon.
- Big Meadow Creek Fish Passage Project – The sponsor (CF) reported they began conversations with the project engineer regarding the installation of a bridge instead of a culvert.

IV. General Salmon Habitat Program Application

Chumstick Baseflow and Riparian Enhancement Project

The Committees received a General Salmon Habitat Program proposal from Cascadia Conservation District (CCD) titled: *Chumstick Baseflow and Riparian Enhancement Project*. The purpose of the project is to improve water quality, water quantity, and riparian habitat along 0.26 miles of Chumstick Creek by installing beaver dam analogs (BDAs) and post-assisted log structures (PALs) at four different locations in Chumstick Creek. Enhancement structures will create pools, sort and store sediments, store water, prolong stream flows, improve water quality, and improve riparian conditions. The total cost of the project is $237,727.48. The sponsor requested $82,145.47 from HCP Plan Species Account Funds. ***The Rocky Reach Tributary Committee elected to contribute $82,145.47 to the project***.

Although the Committee supports the project, they identified potential concerns with effects of actions on nearby infrastructure, potential effects on steelhead redds, and possible elevated water temperatures in pools. The Committee also reserves the right to visit the project within ten years after installation. They will coordinate any site visits with CCD and the landowners. Finally, they encourage CCD to set up photo points at each site to monitor changes over time. This information will be useful to the project sponsor and funding entities.

V. Sugar Project Discussion

Chris Johnson (MSRF), Tara Gregg (MSRF), Jessica Goldberg (MSRF), Jen Bountry (BOR), Steve Kolk (BOR), and Emily Alcott (Inter-Fluve) described the status of the Sugar Project with the Committees. The purpose of the discussion is to update the Committees on current design concepts, seek feedback from the Committees, and to gauge the Committees' interest in moving forward with design develop.

Tara gave a presentation on the status of the Sugar Project (see Attachment 1). She began by describing the goals of the project, which are to allow for naturally dynamic and deformable floodplain process to operate and to increase habitat for juvenile spring Chinook. She then outlined the project schedule and design progression. The development of conceptual designs considered stakeholder feedback (including Committees' comments) and design team expertise. She reminded the Committees that the Sugar Project consists of five restoration areas. Todays discussion will focus on the Sugar Levee, Sugar Left, and the Confluence areas (lower three areas of the Sugar Project).

1. **Sugar Levee**

   Tara remarked that the Sugar Levee is an excellent project for restoring natural processes. Landowners and stakeholders have been engaged with this project. She noted that the river at this site experiences high use by river users (some with impaired judgment). She reviewed feedback received from the Committees and stakeholders, and then described the approach that would address comments and feedback. The approach includes a levee setback (likely to the 1970s streambank alignment) with buried bank structures, strategically placed floodplain roughness elements, cottonwood plantings, and fill removal and regrading. The project is designed to connect with downstream side channels. She noted that there is no significant groundwater input on the floodplain (groundwater is too deep to connect with side channels). However, they do intend to restore ponds that were buried on the floodplain. MSRF is currently working with the landowners on the exact location of the levee setback. They should have that information within a few weeks.

2. **Sugar Left**

   Tara described the location and comments/feedback received on the Sugar Left pre-appraisal concepts. The goal of the project is to reconnect a historical side channel with perennial flow and minimize disturbance to the existing riparian vegetation during construction. Because of the low gradient of the side channel and floodplain, some excavation work would be needed to avoid extensive sediment deposition. Their design team also looked into aggrading the main channel (riffle construction) to minimize excavation in the side channel. This, however, would create a large disturbance area. After further evaluation, the design team recommended a split-flow approach. Thus, the Methow River would split at the top of the site and create a large island. This action was designed in part to reduce any effects on the Yakama Nation's 1890s Channel Project. The Committees had some questions regarding the amount of fill and revegetation required under the split-flow scenario. MSRF noted that some of those details will need to be determined. The Committees also asked about the relationship between the proposed channel alignment (flow split) with the upstream side channel (Sugar Levee Project). *Following the meeting, MSRF provided a figure that shows the relationship between the Sugar Levee Project and the Sugar Left Project (see Attachment 2).*

3. **Confluence**

   Tara identified the location of the Confluence Project area and identified the comments/feedback received on this site. She described the issues associated with the park infrastructure and stated that no bank protection elements are proposed. After considering infrastructure, icing, and river use, the design team is proposing to provide cover for fish along the banks and in the pool. Structures would be placed along the left bank of the Twisp River and along the right bank of the Methow River. They are also looking at providing public access to the swimming hole. They have been in communication with the Town of Twisp on this project.

MSRF asked the Committees to provide feedback on the concepts by 1 December. MSRF will provide the Committees a comment form and the presentation. Tracy Hillman asked members to provide comments to him by 30 November. He will then compile the comments and forward them to MSRF on 1 December.

The Committees thanked MSRF for joining the meeting and updating them on the Sugar Project. The Committees also appreciate the opportunity to provide feedback on the Sugar Project.

VI. Yakama Nation Projects Discussion

Hans Smith (YN), Maddie Eckmann (YN), Chris Butler (YN), and Mike McAllister (Inter-Fluve) described the Alder Creek Floodplain Restoration Project and the Chewuch River Mile 4.2 Fish Enhancement Project with the Committees. Hans stated that the YN submitted these projects to the Tributary Committees earlier this year for funding. In July, the Committees declined the opportunity to fund these projects as designed, but indicated they were open to discussing the projects further with the YN. In response to the Committees' concerns with the projects, the YN provided written responses to the Committees' concerns in September. The purpose of this discussion is to review the projects and describe how the YN addressed the Committees' concerns. Hans stated they secured cost shares from the Salmon Recovery Funding Board and BPA Accords on both projects.

1. **Alder Creek Floodplain Restoration Project**

   Maddie Eckmann (YN) provided a brief presentation on the Alder Creek Floodplain Restoration Project. She provided an overview of the project, including its location, and noted that this project is located in the highest priority reach (according to the Methow River Reach Assessment) and addresses the highest priority ecological concerns (as identified in the Upper Columbia Biological Strategy). She then shared drone footage that showed current conditions on the floodplain and identified locations where enhancement actions would occur. She noted that the upstream portion of the side channel was previously filled in by the landowner and that existing pools strand fish and have low dissolved oxygen levels. She also pointed out that Alder Creek can go subsurface during low water years. She then stated that the proposed action is to excavate 1,200 feet of side channel and reconnect 2,400 feet of side channel. Wood will be added in appropriate places to provide fish cover and aid in development of undercut banks. They will install a bar apex wood structure at the inlet to help capture surface water. The goal is to maintain perennial flow in the side channel and to preclude long-term establishment of beaver dams.

Maddie summarized the concerns the Committees had with the project and showed how the revised plan addresses the comments. Regarding the comment about too much excavation, she and Mike McAllister reported that some excavation will be necessary to prevent fish stranding, to maintain a perennial flow, to flush sediments, and to disrupt beaver dam activity. Mike said although the project is designed to reduce long-term beaver dams, which addresses a concern of the Committees, the project should interact with beavers in a positive way and this should benefit fish. He also noted that the average depth of excavation will be about six feet. Mike reassured the Committees that the project is designed to encourage undercut banks. He said that is not apparent in the design drawings because the software produces trapezoidal-shaped channel cross-sections. As a final point, Mike stated that they will work with the existing vegetation on site. In some areas, where appropriate vegetation is lacking, they will plant riparian vegetation to enhance riparian habitat on the floodplain.

Maddie said the total cost of the project is $691,700. They have secured $182,456 from the Salmon Recovery Funding Board and $359,277 from BPA (Accord funds). They are asking for $149,967 from the Tributary Committees.

2. **Chewuch River Mile 4.2 Fish Enhancement Project**

Chris Butler (YN) provided a brief presentation on the Chewuch River Mile 4.2 Fish Enhancement Project. He began by providing an overview of the project, which is located at RM 4.2-4.6 on the Chewuch River, a tributary to the Methow River. He identified the ecological concerns and showed a landownership map. He also showed video of the project area and described the roughness of the floodplain. He said the goal of the project is to establish a perennial side channel that minimizes disturbance to jurisdictional areas (wetlands), protects large trees, adheres to the requirements of the landowner, and is cost effective. He described the physical features of the site and explained in detail the challenges of reconnecting the wetland, which would require excavation work and therefore would require wetland mitigation with a replacement value of 6:1. He said the biological benefit of reconnecting the wetland would not be cost effective because of the large cost of wetland mitigation. Regarding establishment of the perennial side channel, Chris said the project will require some excavation work because of the roughness of the floodplain (i.e., several high spots) and the need to establish a channel slope that will transport sediment (water velocity of 4-5 feet/second). He added that the project site is upstream of any potential changes in river trajectory; therefore, it is unlikely the side channel will be stranded (plugged) or an avulsion will occur through the site.

Chris summarized the concerns the Committees had with the project and described how the proposed project addresses those concerns. He said the YN appreciates the concern that there is too much excavation, but noted that excavation is needed at this site to avoid impacts to large trees (landowner requirement) and the wetland, to maintain a perennial channel with suitable velocities to transport sediments, and to avoid fish stranding/entrapment. He and Mike McAllister said the construction of an inlet pilot channel is unlikely to be effective at this site. Regarding the Committees' suggestion to activate existing features, Mike and Chris said this would require some excavation, a large channel-spanning structure, and a large flood event. When asked about the inlet plugging, Mike responded that the inlet structure is designed to shed debris away from the inlet; however, it is possible that a large flood could deposit materials at the inlet.

Chris said the total cost of the project is $659,351. They have secured $266,485 from the Salmon Recovery Funding Board and $255,000 from BPA (Accord funds). They are asking for $137,866 from the Tributary Committees.

The Committees thanked Hans, Maddie, Chris, and Mike for joining the meeting and updating the Committees on the two projects. After representatives from the YN left the call (including Brandon Rogers), members of the Committees discussed the projects.

Alder Creek Floodplain Restoration Project—After discussing the project, the ***Wells Tributary Committee elected to contribute $149,967 to the project***. Although they supported the project, they identified concerns with it. Specifically, some believe the effectiveness of the project will be relatively short-term. Given the rapid lateral migration of the Methow River upstream from the project site (about 40 feet per year), some Committee members believe the side channel may fill with sediment and wood, or the side channel may become the main channel. Nevertheless, they believe the project will have benefits to HCP Plan Species within the short term.

Chewuch River Mile 4.2 Fish Enhancement Project—After discussing this project, the Committees were unable to make a funding decision. They would like to have a discussion with the Washington State Department of Ecology (DOE) regarding reconnecting wetlands, wetland disturbance, and wetland mitigation. They see a potential conflict between floodplain reconnection projects that will benefit HCP Plan Species and DOE wetland management. They directed Tracy Hillman to invite Ecology to the Committees next meeting, which will occur on 10 December. The Committees requested that YN staff also attend the meeting. The Committees intend to use the Chewuch River Mile 4.2 project as an example of the potential conflict between floodplain reconnection projects and wetland protection.

VII. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests from October and November:

   Rock Island Plan Species Account:

   - $210.00 to Clifton Larson Allen for Rock Island financial administration in October 2020.
   - $1,000.00 to Cordell, Neher & Company for financial review of the Rock Island Plan Species Account during July through October 2020.
   - $19,316.35 to Cascade Fisheries for the Restore Lower Chiwaukum Creek – Phase I Project.
   - $313.25 to Cascade Fisheries for the Chiwawa Nutrient Enhancement Project.
   - $179.83 to Cascade Fisheries for the Goodwin Side Channel Project.
   - $9,765.41 to Trout Unlimited for the Beaver Fever – Restoring Ecosystem Function Project.

   Rocky Reach Plan Species Account:

   - $210.00 to Clifton Larson Allen for Rocky Reach financial administration in October 2020.
   - $1,000.00 to Cordell, Neher & Company for financial review of the Rocky Reach Plan Species Account during July through October 2020.

- $90,090.00 to Chelan County Treasurer for the Cottonwood Flats Floodplain Restoration Project.

Wells Plan Species Account:

- $11,540.98 to Inter-Fluve for the Enloe Dam Removal Concept Plan Project.

2. Becky Gallaher reported that Cordell, Neher & Company is completing the financial review of the Rock Island and Rocky Reach Plan Species Accounts. A report from the accountant should be available soon.
3. Steve Kolk (BOR) reported that he and others floated the lower Chiwawa River (from Grouse Creek to the mouth) and identified possible habitat impairments. They will use this survey to help inform potential reach-based enhancement actions for the lower Chiwawa River.

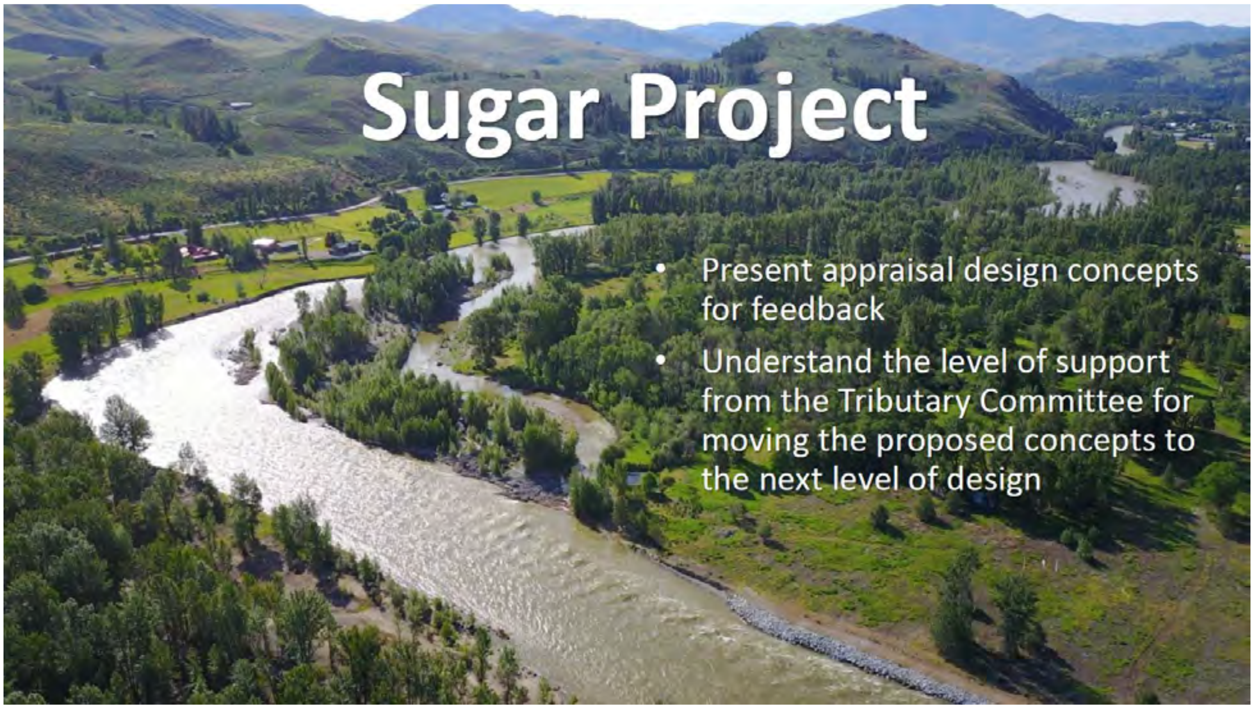
VIII. Next Steps

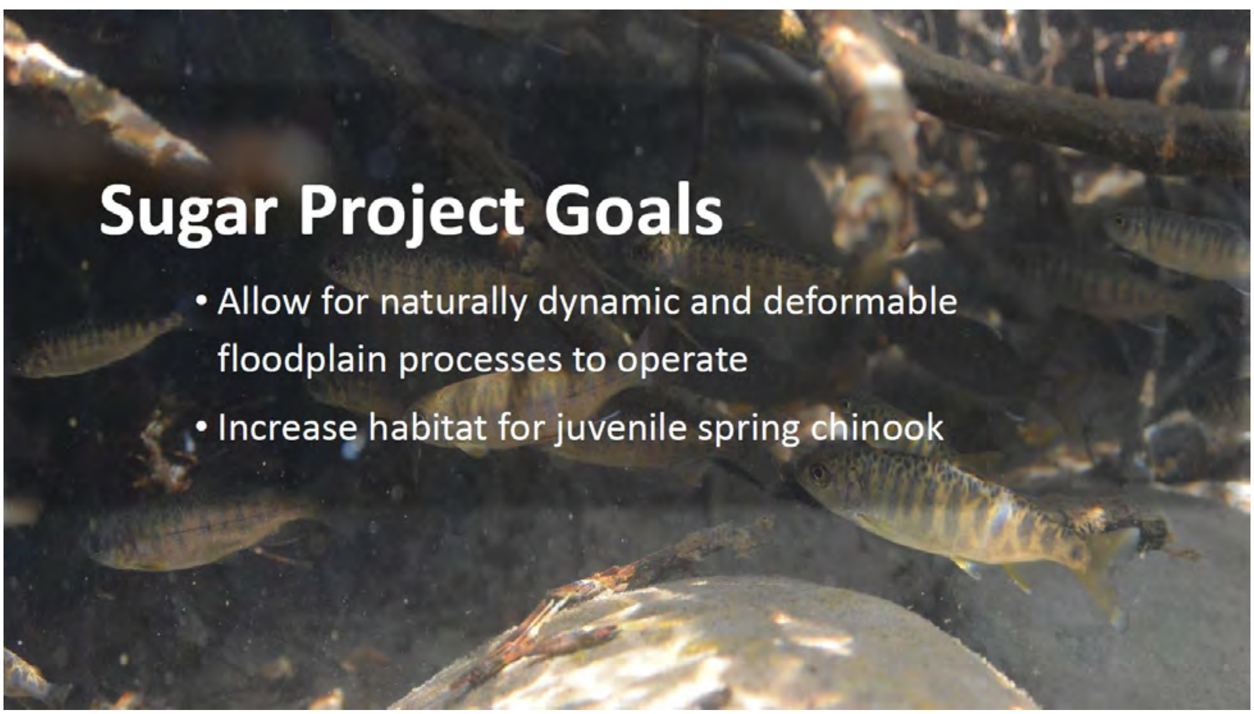
The next scheduled meeting of the Tributary Committees will be on Thursday, 10 December 2020.

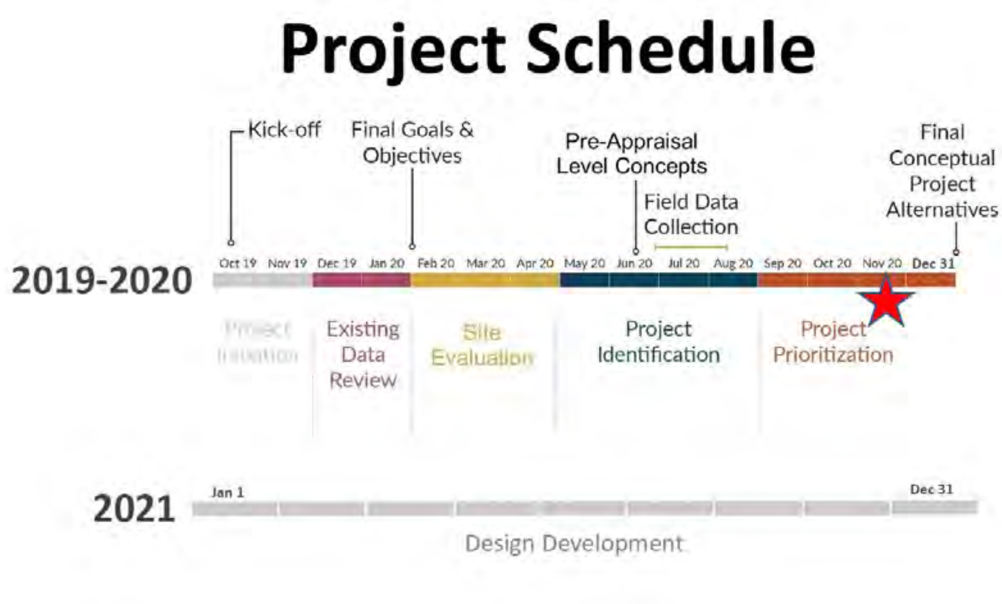
Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

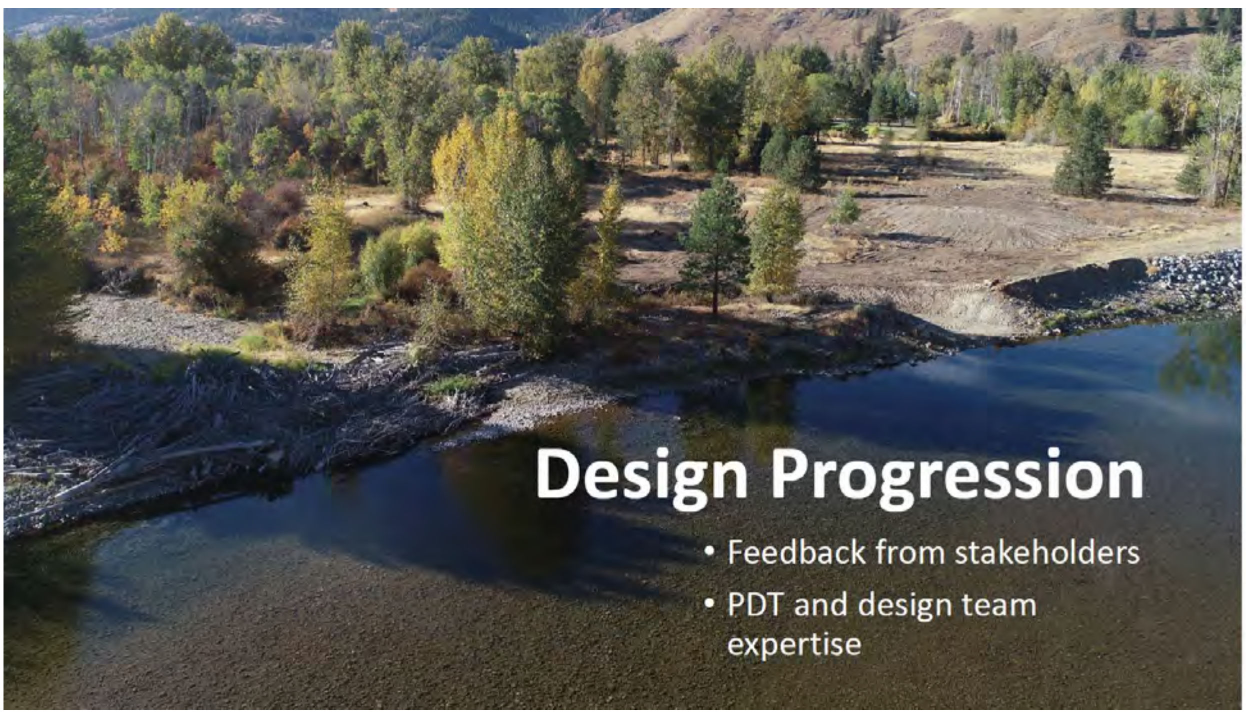
Attachment 1

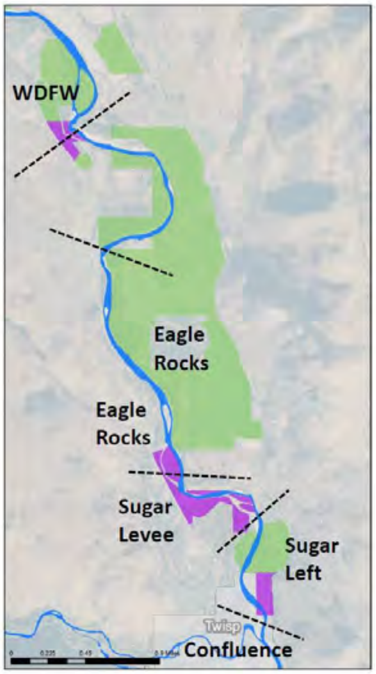
Presentation by Tara Gregg on the Sugar Project






Project Schedule
Kick-off
Final Goals & Objectives
Pre-Appraisal Level Concepts
Field Data Collection
Final Conceptual Project Alternatives
2019-2020
Oct 19 Nov 19 Dec 19 Jan 20 Feb 20 Mar 20 Apr 20 May 20 Jun 20 Jul 20 Aug 20 Sep 20 Oct 20 Nov 20 Dec 31
Existing Data Review
Site Evaluation
Project Identification
Project Prioritization
2021
Jan 1
Dec 31
Design Development

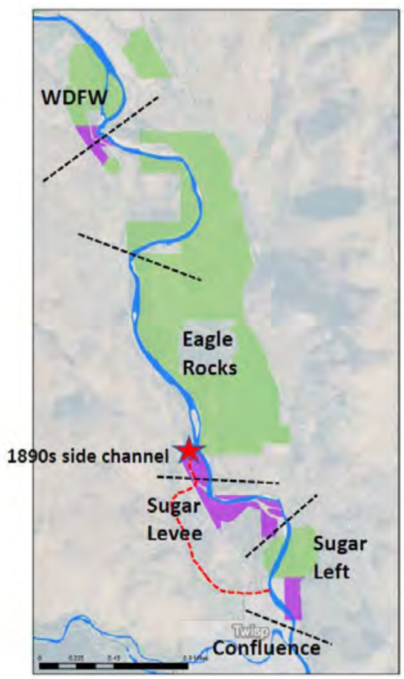

Design Progression
• Feedback from stakeholders
• PDT and design team expertise



Project Areas

- WDFW
- Eagle Rocks
- Sugar Levee
- Sugar Left
- Confluence

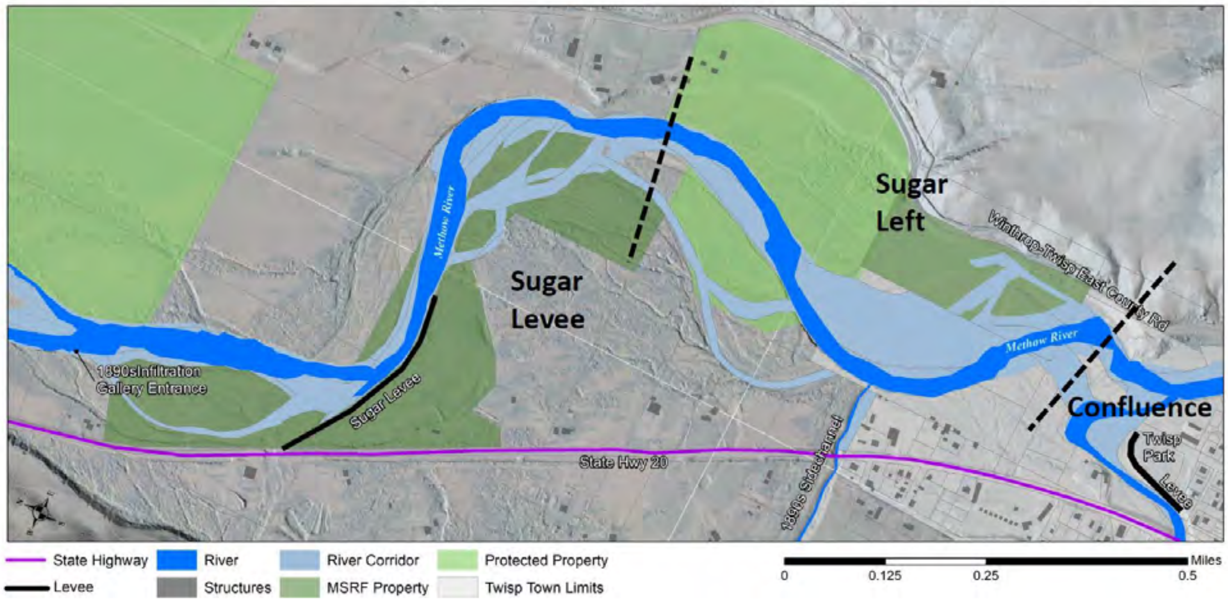
Conservation easements
Property purchased for restoration



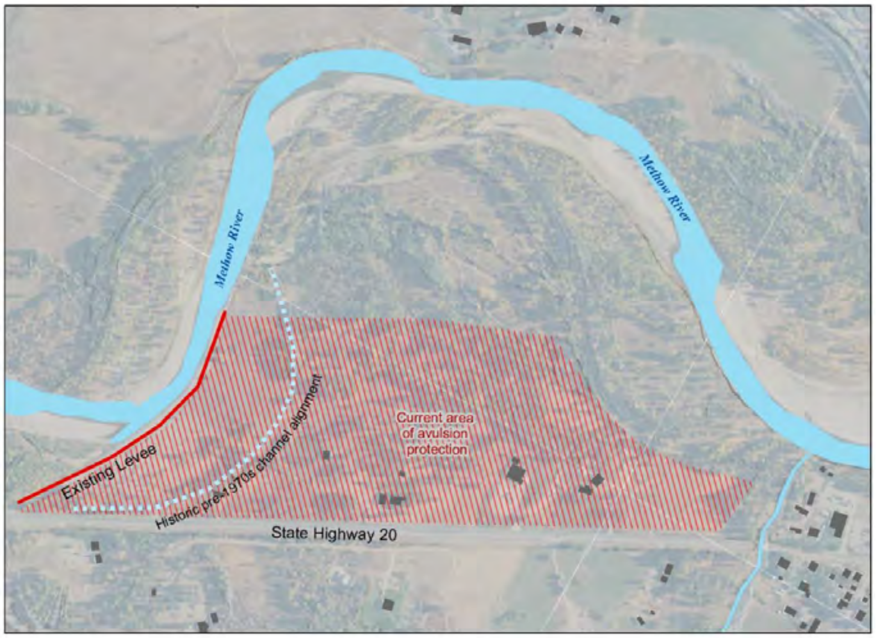
Project Areas

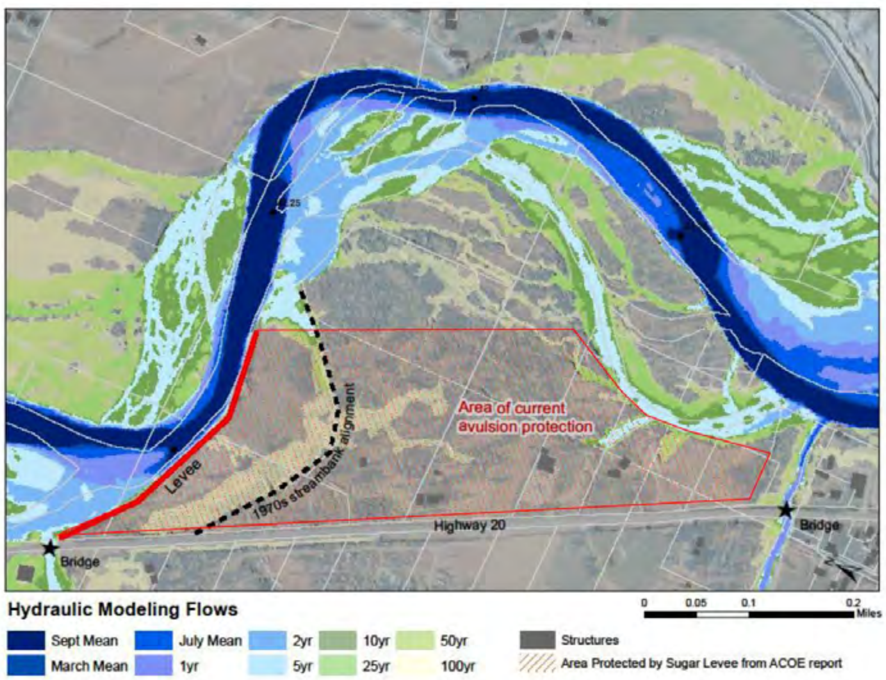
- WDFW – to be presented at a later date
- Eagle Rocks – to be presented at a later date
- Sugar Levee
- Sugar Left
- Confluence

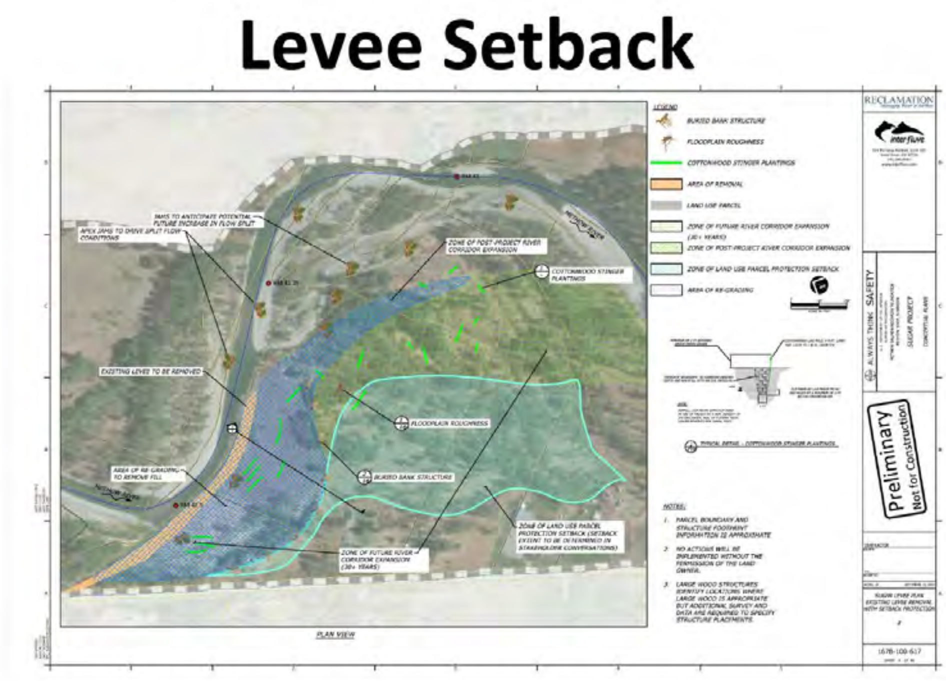
Conservation easements
Property purchased for restoration

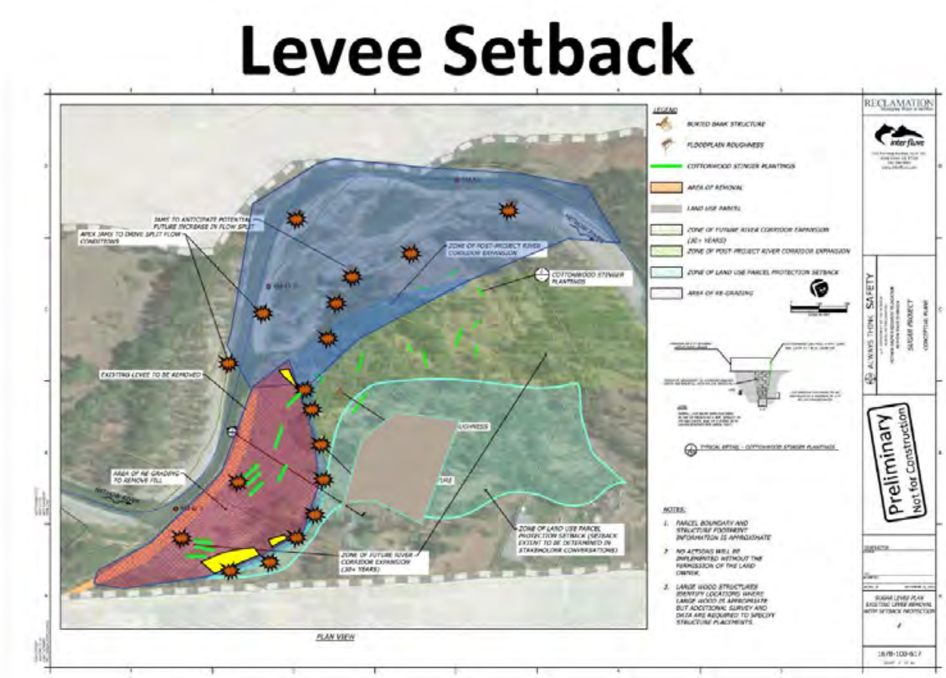


- Consider risk to infrastructure
- Reduce the need for anthropogenic protection features
- Full removal of the levee
- Maintain levee and focus on side channel development
- Reconnect maximum floodplain possible
- When possible, intersect groundwater in side channels
- Perennial flow in side channels
- Minimize large expanses of exposed gravel
- Identify landowner support for changes in the river corridor

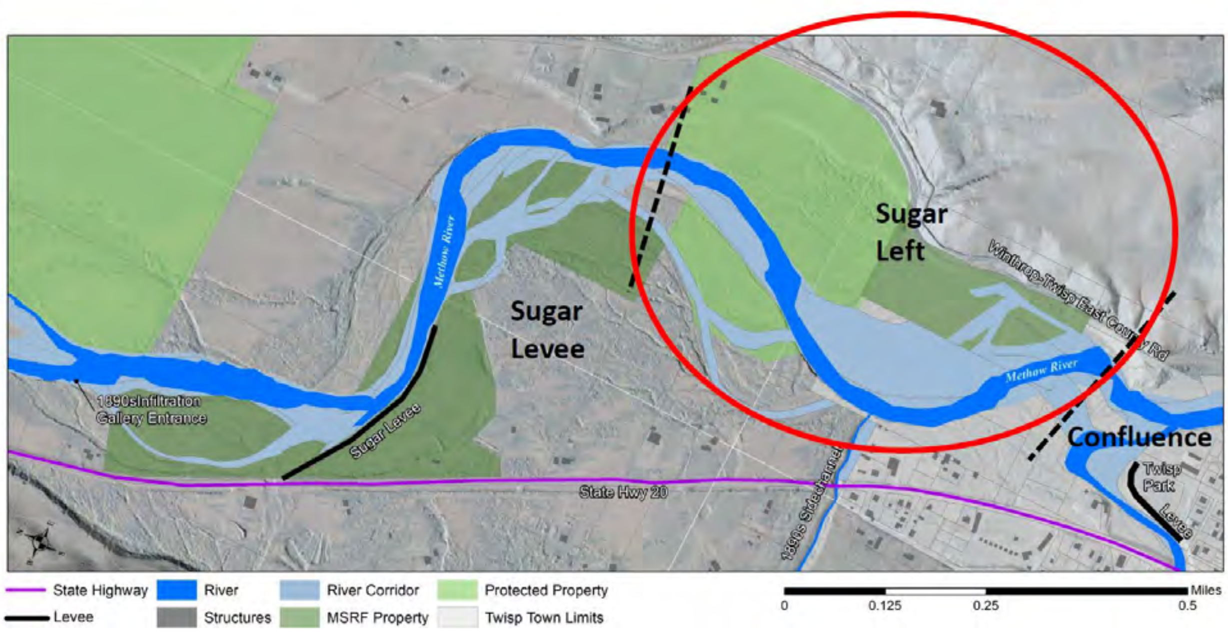

Methow River
Methow River
Existing Levee
Historic pre-1970s channel alignment
Current area of avulsion protection
State Highway 20


Levee
1970s streambank alignment
Area of current avulsion protection
Highway 20
Bridge
Bridge
Hydraulic Modeling Flows
Sept Mean
March Mean
July Mean
1yr
2yr
5yr
10yr
25yr
50yr
100yr
Structures
Area Protected by Sugar Levee from ACOE report
0 0.05 0.1 0.2 Miles


Levee Setback
RECLAMATION
Preliminary
Not for Construction


Levee Setback
RECLAMATION
Preliminary
Not for Construction

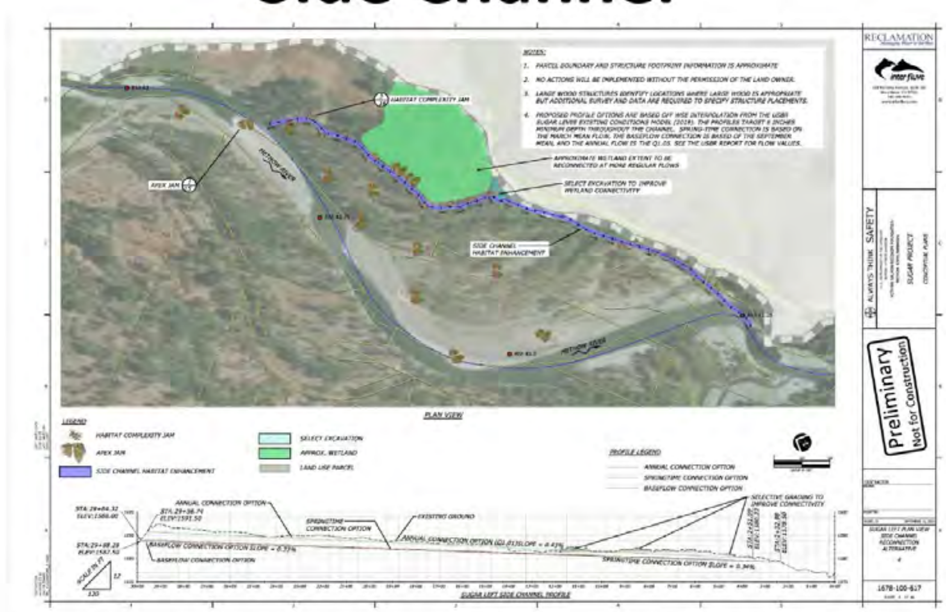

Discussion


Sugar Left
Sugar Levee
Confluence
Methow River
Sugar Levee
1890s Infiltration Gallery Entrance
State Hwy 20
Winthrop-Twisp East County Rd
Twisp Park Levee
State Highway
Levee
River
Structures
River Corridor
MSRF Property
Protected Property
Twisp Town Limits
0 0.125 0.25 0.5 Miles

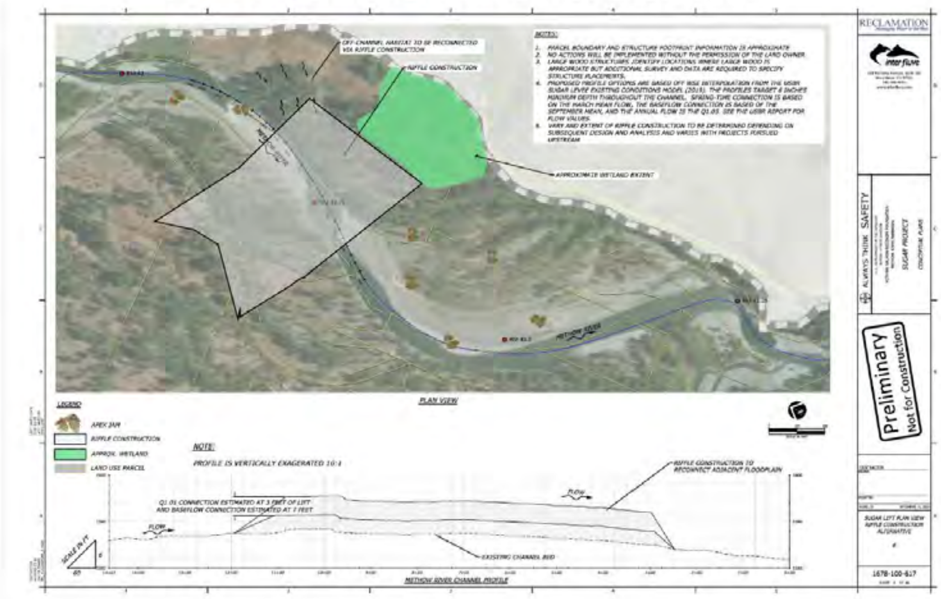
Sugar Left: Feedback on Pre-appraisal concepts

- Perennial flow in side channel
- Account for sediment conveyance
- Consider risk to downstream infrastructure
- Minimize disturbance to existing riparian vegetation
- Avoid over excavation and engineered stability

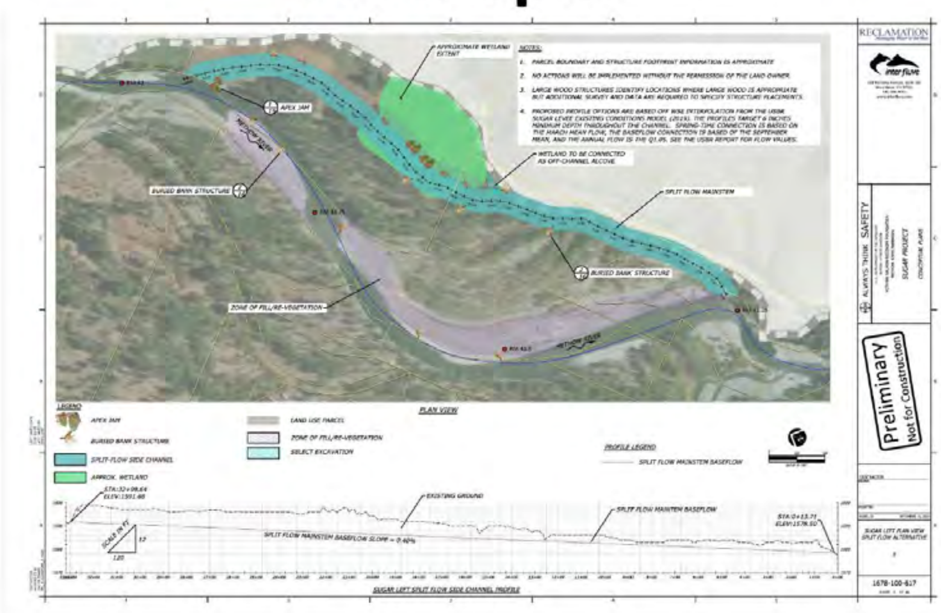
Side Channel



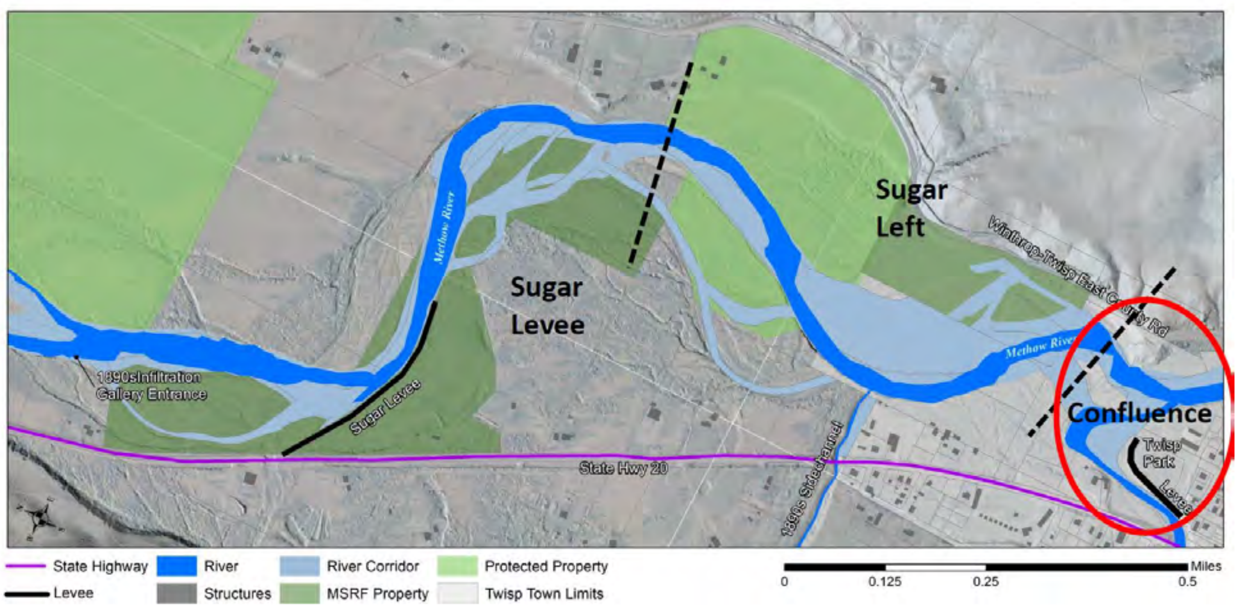
Riffle Construction



Flow Split




Discussion

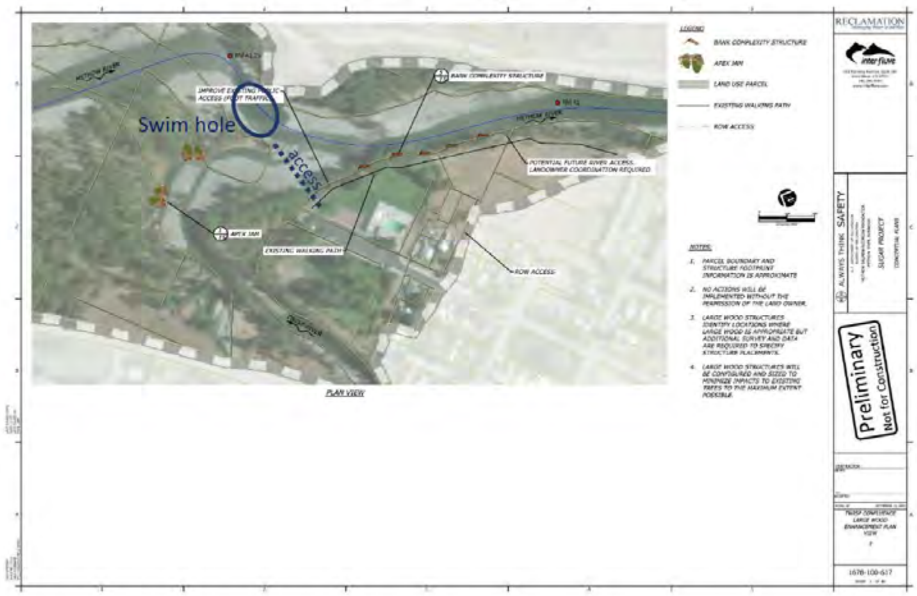

Sugar Left
Sugar Levee
Confluence
Methow River
Winthrop-Twisp East County Rd
1890s Infiltration Gallery Entrance
Sugar Levee
State Hwy 20
Twisp Park
Levee
State Highway
Levee
River
Structures
River Corridor
MSRF Property
Protected Property
Twisp Town Limits
0
0.125
0.25
0.5
Miles

Confluence: Feedback on Pre-appraisal concepts

- Review opportunities for buffer or a setback floodplain area at park
- Consider risk to infrastructure
- Protection riparian vegetation

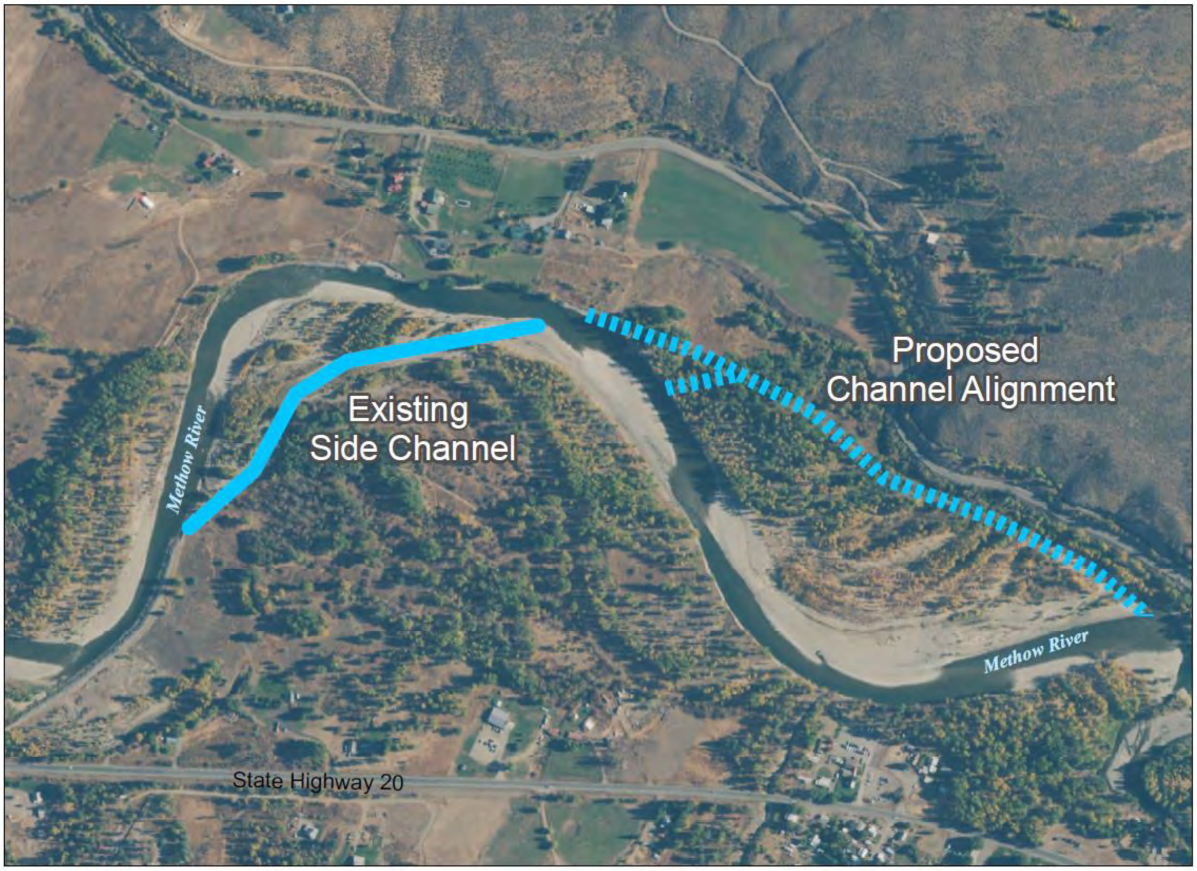
Bank Complexity

Bank Complexity



Attachment 2

Relationship Between the Existing Side Channel and the Proposed Channel Alignment on Sugar Left



Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 12 December 2020

Members Present: Jeremy Cram (WDFW), Chris Fisher (Colville Tribes), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees Chair).

Others Present: Becky Gallaher (Tributary Project Coordinator), Hans Smith (Yakama Nation alternate), and Scott Hopkins (Chelan PUD alternate). Chris Johnson (MSRF), Jessica Goldberg (MSRF), Tara Gregg (MSRF), Jen Bountry (BOR), Steve Kolk (BOR), Emily Alcott (Inter-Fluve), Mike McAllister (Inter-Fluve), Mackenzie Butler (Inter-Fluve), and Mike Brunfelt (Inter-Fluve) joined the call for the Sugar Project discussion. Lori White (DOE), Rick Mraz (Ecology), and Denny Rohr (PRCC Habitat Subcommittee facilitator) joined the call for the wetland discussion. Bill Norris (Parr Excellence), Chris Butler (YN), and Denny Rohr (PRCC Habitat Subcommittee facilitator) joined the call for the Upper Nason Fish Passage Evaluation discussion.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 10 December 2020 from 9:00 am to 1:00 pm.

I. Review and Adopt November Agenda

Tracy Hillman welcomed everyone to the meeting and the Committees adopted the proposed agenda.

II. Review and Approval of October Meeting Minutes

The draft 12 November 2020 meeting notes were reviewed and approved by the Tributary Committees.

III. Monthly Update on Ongoing Projects

Becky Gallaher gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Barkley Irrigation – Under Pressure Project – The sponsor (Trout Unlimited; TU) reported that their contractor continues to make progress on preparing the ditch for new pipe. By the second week of November, they had several thousand feet of pipe welded and in position to be bedded and backfilled.
- Icicle Boulder Field Project – The sponsor (TU) reported that the installation of the waterline and step-pool channel are complete.
- Peshastin Creek RM 10.5 PIT-Tag Detection Site Project – This project is complete. The sponsor (Washington Department of Fish and Wildlife; WDFW) provided the 2019 annual report, which was uploaded to the Extranet site.

- Beaver Fever Project – The sponsor (TU) reported they are working on end-of-season reports and permitting for next season.
- Derby Creek Fish Passage Project – The sponsor (Cascade Fisheries; CF) reported there was no new activity on this project
- Chiwawa Nutrient Enhancement Project – The Sponsor (CF) reported there was no new activity on this project.
- Twisp River Floodplain Left Bank Spring-fed Alcove Restoration Project – The sponsor (Methow Salmon Recovery Foundation; MSRF) reported there was no new activity on this project.
- Johnson Creek Habitat Restoration Project – The sponsor (TU) reported they are working on completing the 60% design. They hope to have it completed by mid-December.
- Cottonwood Flats Floodplain Restoration Project – This project is complete. The sponsor (Chelan County Natural Resources Department; CCNRD) submitted the final report, which was uploaded to the Extranet site.
- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported there was no new activity on this project.
- Peshastin RM 3.4 Side Channel Project – The Sponsor (CCNRD) reported that they continue to collect groundwater data. The engineers completed the existing conditions model and began identifying alternatives. They are currently developing conceptual designs.
- Napeequa Side Channel Connection Project – The sponsor (CF) reported they contacted the acting executive director at Tall Timbers. At this time, the director is re-evaluating priorities and trying to keep the camp running in response to the COVID-19 pandemic. The director committed to a site walk this spring to discuss a possible pathway forward.
- Monitor Side Channel Project – The sponsor (CCNRD) reported they are working on permit documents.
- Restore Chiwaukum Creek Project – The sponsor (CF) reported that the next design team meeting is scheduled for 16 December. The sponsor will share revised concepts with both the design team and USFS.
- City of Leavenworth Fish Screen Project – The sponsor (TU) reported that the placement of the waterline from the screenhouse to the City of Leavenworth treatment plant was completed on 27 November. The screen was set in place and the manufacturer will be on site in early December to assist with startup and fine tuning.
- Goodwin Side Channel Assessment Project – The Sponsor (CF) reported that in addition to collecting data, two temperature loggers were installed in the side channel adjacent to the piezometer locations. This will allow for comparisons of groundwater and side channel temperatures.
- Sugar Reach Habitat Enhancement Early Implementation Project – The Sponsor (MSRF) reported they are preparing a report that summarizes monitoring data and observations.
- Enloe Dam Removal Concept Plan Project – Because of delays associated with the COVID-19 pandemic, the contractor (Inter-Fluve) has requested a time extension on this project (see discussion below).
- Upper Beaver Creek Final Design and Restoration Project – The Sponsor (MSRF) reported that the project design is moving forward and is on schedule.

- Vandervort Appraisal Project – This project is complete. The sponsor (MSRF) noted that a third and final letter was sent to the new owners (the new owners did not respond to the first two letters). The sponsor also talked to WDFW and they (WDFW) declined interest in future ownership.
- Big Meadow Creek Fish Passage Project – The sponsor (CF) reported they continue to have conversations with project partners about the installation of a bridge instead of a culvert. The Wenatchee River Ranger District is supportive but they still need approval from the forest supervisor. They also began the process of securing a Special Use Permit.

IV. Time Extension Request

Enloe Dam Removal Concept Plan

The Wells Tributary Committee received a time extension request from Inter-Fluve on the Enloe Dam Removal Concept Plan. Because of the COVID-19 pandemic, there have been delays securing sediment data and results from USGS. As a result, the contractor requested a time extension from 28 February 2021 to 31 March 2021. The Wells Tributary Committee approved the time extension.

V. Sugar Project Discussion

Chris Johnson (MSRF), Tara Gregg (MSRF), Jessica Goldberg (MSRF), Jen Bountry (BOR), Steve Kolk (BOR), Emily Alcott (Inter-Fluve), Mike McAllister (Inter-Fluve), Mackenzie Butler (Inter-Fluve), and Mike Brunfelt (Inter-Fluve) described the status of the Sugar Project with the Committees. The purpose of the discussion is to update the Committees on current design concepts, seek feedback from the Committees, and to gauge the Committees' interest in moving forward with design develop.

Tara gave a presentation on the status of the Sugar Project (see Attachment 1). She began by describing the goals of the project, which are to allow for naturally dynamic and deformable floodplain processes to operate and to increase habitat for juvenile spring Chinook and steelhead. She then outlined the project schedule and design progression. The development of conceptual designs considered stakeholder feedback (including Committees' comments) and design team expertise. She reminded the Committees that the Sugar Project consists of five restoration areas and that there are multiple constraints within the project area including roads, homes, existing habitat projects, irrigation infrastructure, and private property. She said todays discussion will focus on the WDFW and Eagle Rocks sites (upper two sites of the Sugar Project).

1. **WDFW**

   Tara said the WDFW site includes multiple habitat restoration projects that were implemented previously. Those include the removal of an irrigation dam, updates to the MVID irrigation diversion and fish return, and multiple restoration actions (wood structures). The design team has identified additional enhancement opportunities including removing culverts to increase floodplain connectivity, improve off-channel alcove habitat, and develop a flow split that increases edge habitat in both channels at all flows. Based on feedback provided by the Committees and others on pre-appraisal concepts, MSRF is looking at three action types in this area. Two action types consider promotion of a perennial flow split (by regrading and/or channel roughening using large wood placement) and the third addresses floodplain and alcove connectivity. With regard to regrading, she said it would be used to enhance flow split, which is needed to prevent all the flow from going down the side channel (river right) and to sustain earlier habitat improvement investments. Habitat enhancement work would focus on removing culverts on the floodplain, adding wood, and enhancing low-flow connectivity at Plummers outlet/alcove. Tara noted that the outlet of the pond is primarily groundwater driven but is disconnected from the river from September to March. She said high densities of juvenile salmonids use the outlet channel during high flows. She added that during summer, water temperatures in the pond increase and dissolved oxygen levels decrease. As a result, they are evaluating the possibility of decreasing the surface area of the pond to improve water quality.

Hans Smith asked about the possibility of the side channels intercepting groundwater. MSRF said the goal is to only capture surface water. They are unable to intercept groundwater because of landowner restrictions. Tom Kahler questioned the stability of the bar that is forming in the main channel just upstream from the flow split, and whether actions under consideration to maintain the flow split included both regrading and structure placement, or only one or the other. Jen Bountry responded that although the bed material comprising the bar is mobile at high flows, the bar is in the widest part of the river favoring bar formation. Thus, actions under consideration could include both structure placement and some excavation to modify the bar.

2. **Eagle Rocks**

Tara identified the location of the Eagle Rocks site and reviewed comments/feedback received on pre-appraisal concepts. Possible enhancement actions at this site include riparian plantings, addition of large wood, riparian conservation, improvement of off-channel alcove habitat, and enhancement of edge habitat along the mainstem. Tara said the lack of landowner support has reduced their ability to reconnect the floodplain on river left. The design team identified two action types that would improve habitat conditions for Chinook and steelhead at this site. Those include developing a groundwater channel/alcove and installing wood structures. Regarding the groundwater channel/alcove project, Tara shared groundwater depths and temperatures collected within two monitoring wells on the floodplain. Based on these data, they are proposing a channel that follows topographical lows and will intercept groundwater. The channel will have a slope of 0.44%. To improve channel complexity within the mainstem, they propose a series of large wood structures mostly along the left bank. These are intended to increase edge habitat for juvenile salmon and steelhead and encourage some lateral migration. These actions are being designed to work with other restoration actions implemented within the reach (e.g., 1890s channel).

MSRF asked the Committees to provide feedback on the concepts by 8 January 2021. MSRF will provide the Committees with a comment form and the presentation. Tracy Hillman asked members to provide comments to him by 7 January 2021. He will then compile the comments and forward them to MSRF on 8 January 2021.

The Committees thanked MSRF for joining the meeting and updating them on the Sugar Project. The Committees also appreciate the opportunity to provide feedback on the Sugar Project.

VI. Wetland Regulations Discussion with Ecology

In November, while discussing the Yakama Nation proposal titled, Chewuch River Mile 4.2 Fish Enhancement Project, the Committees observed that there appears to be a disconnect between floodplain restoration projects and Ecology's wetland regulations. The Chewuch River Mile 4.2 Fish Enhancement Project, like many other proposed projects received by the Committees, intends to reconnect the floodplain, but because of a Category 1 wetland on the project site, reconnection is designed to avoid any disturbance to the wetland or other jurisdictional areas. Consequently, the project does not take full advantage of site potential and falls short of providing the greatest biological benefit to Plan Species. Some members of the Tributary Committees criticized this and other similar efforts because these efforts do not take advantage of reconnecting natural features (e.g., wetlands) on the floodplain that would benefit Plan Species. In addition, these proposed projects are often designed to "lock" side channels in place so as to avoid any disturbance to wetlands. Some members of the Committees see this as falling short of restoring natural processes. Because of this apparent conflict between floodplain restoration and wetland regulations, last month the Committees agreed to invite representatives from Ecology to the

December meeting to discuss wetland regulations and policy. The Committees identified the following questions for Ecology's consideration:

1. What are the State's requirements for impacts to wetlands resulting from stream restoration projects? Are there differences in mitigation if the project is restoration versus non-restoration?
2. What are the mitigation ratios?
3. Is it only excavation or fill that triggers mitigation, or does a change in hydrology that results from restoration work (without direct excavation or fill within the wetland) also trigger mitigation?
4. If a restoration action changes hydrology (e.g., an engineered log jam on the mainstem directs some flow onto a floodplain containing wetlands), and the change in hydrology subsequently changes the classification of a wetland, does that require mitigation?
5. Are there any exceptions to wetland mitigation?
6. What is the process for discussing wetland modifications with Ecology? Are there opportunities to discuss wetland impacts from river restoration and evaluate options for specific projects?
7. Has Ecology entered into any discussions with Fish Enhancement Groups in Washington regarding wetland and river restoration?
8. Does Ecology have time or an interest to engage in early discussions on specific projects where there may be wetland impacts?
9. Has Ecology drafted any notes on discussions Steve Manlow and other FEGs have had with Ecology on this issue?
10. How does coordination with the Corps and Ecology work?

In November, Tracy Hillman invited Ecology representatives to the Committees' December meeting and shared the questions with Ecology.

Lori White (Ecology) and Rick Mraz (Ecology) joined the meeting to discuss wetland regulations and policy. Before the meeting, Rick provided two reports that address most of the questions offered by the Committees (see Attachments 2 and 3).

Rick and Lori began by stating that Ecology treats fish restoration projects differently than they do other floodplain projects (e.g., construction of a parking lot). Rick said Ecology is actively engaged in supporting restoration of floodplain connectivity through the Floodplains by Design program. He said proposed projects are evaluated on a case-by-case basis and project sponsors must provide context for the proposed project. That is, sponsors need to provide enough information for Ecology to determine if or how a functioning wetland is decoupled or isolated from the stream. If the wetland is isolated and has been for a long period of time, it may be inappropriate to convert the functioning wetland to a stream (i.e., converting a lentic system to a lotic system). A mature forested wetland, for example, provides ecological services for a variety of plant and animal species that would be negatively affected if the wetland is converted to a stream. This conversion would likely trigger a different permit.

Rick noted that no mitigation is required if the proposed action meets requirements in Nationwide Permit 27. Lori noted that the project sponsor needs to demonstrate that the proposed action will increase ecosystem function. In this case, the sponsor must describe (through modeling or other means) that the gain in fish benefit exceeds the loss in wetland function. Ecology may require 5-10 years of monitoring to demonstrate ecosystem benefits.

When asked about how Ecology views naturally occurring wetlands versus wetlands created as a result of human activities (e.g., a wetland that formed following the construction of a levee), Rick and Lori said Ecology looks at the current state of the wetland and whether it is functioning. However, Ecology does consider whether the wetland formed naturally or was the result of human activities. Nevertheless, if it is a wetland, Ecology has regulatory authority over it. He added that it is important to know the potential loss of function resulting from a proposed action.

Chris Fisher commented that reconnecting floodplains should increase wetlands and wetland function. Rick responded that a reconnection project that converts an existing wetland to a stream may not increase wetland function. Indeed, it may reduce wetland function. For example, as a river migrates across a floodplain, it can form disconnected oxbows that function as wetlands. If a sponsor intends to convert the oxbow wetland to a flowing side channel, the function of the wetland may be reduced or lost, even though the floodplain has been reconnected.

Rick and Lori responded to the question about whether a change in hydrology resulting from restoration work (without direct excavation or fill within the wetland) triggers mitigation. Rick said if work on the floodplain converts a wetland to a flowing channel, it may require mitigation. On the other hand, if the work changes a wetland from one type to another, it may not require mitigation depending on the type of wetland. Ecology would need to evaluate the historical, current, and future conditions of the wetland. Use of the Washington State Wetland Rating system can help evaluate the change in function from before to after restoration and then determine whether mitigation is necessary. Another useful tool is the Credit-Debit Method. When asked about seasonal activation of a wetland (i.e., enhancing surface water flows through a wetland only during high flows resulting in a short-term lotic system), Rick said Ecology has authorized these actions without mitigation. Again, it would depend on lost function. Ecology is charged with achieving no net loss of wetland function through their permitting. It requires unique circumstances to accept resource trade-offs. More information on resource trade-offs is available in their newest draft Mitigation Guidance documents.

Regarding the question, "if a restoration action changes hydrology (e.g., an engineered log jam on the mainstem directs some flow onto a floodplain containing wetlands), and the change in hydrology subsequently changes the classification of a wetland, does that require mitigation," Rick and Lori indicated that where and how the wood is placed would matter. Determining whether a Clean Water Act permit is necessary is an Army Corps of Engineers (ACOE) issue. Such a proposal would also possibly require shoreline permits and other permits (e.g., HPA). Those permitting decisions could result in the need for permits from Ecology.

A member asked whether the construction of a short pilot channel that activates floodplain features, including wetlands, would require mitigation. In this case, no excavation or fill of a wetland occurs. Rick said Ecology is less concerned with actions that restore natural processes, such as floodplain activation. However, the effects of the activation on wetland function and classification would need to be described (e.g., through modeling). He and Lori understand the uncertainty associated with the proposed action and therefore Ecology would likely recommend 5-10 years of monitoring.

Justin Yeager asked about coordination with and between Ecology and ACOE. Lori said it is best to have pre-project meetings with Ecology and ACOE. Ecology and ACOE may not have all the answers to questions, because projects evolve over time and additional information may be needed to evaluate potential changes to wetland function. If the sponsor does not reach out to Ecology, the ACOE will contact Ecology. Rick noted that ACOE recently added a layer of process associated with Clean Water Act permitting (Section 401) that will take more time.

Hans Smith commented that the advice they receive from Ecology when planning a floodplain restoration project is to avoid impacts to wetlands. Rick said this is generally true as Ecology wants to avoid or minimize impacts to wetlands. However, Ecology views restoration differently because the focus of the work is to restore floodplain function. That said, the sponsor needs to demonstrate the proposed project will provide lift for fish and, if possible, maintain wetland function. Lori added that the sponsor also needs to reduce or minimize impacts to Category 1 wetlands. Hans remarked that the wetland at the Chewuch RM 4.2 Enhancement site is a Category 1 wetland, which is why they designed the project to avoid disturbing the wetland.

Rick noted that Ecology is supportive of floodplain restoration projects that benefit fish and maintain wetland function. He and Lori indicated that communicating and coordinating with Ecology early in the process is best. This allows Ecology to provide positive input on project designs.

The Committees thanked Rick and Lori for discussing wetland regulations with them. They found the discussion very helpful.

VII. Upper Nason Fish Passage Assessment Presentation

Hans Smith provided a brief introduction to the work that the Yakama Nation funded to evaluate fish passage at potential natural barriers in Upper Nason Creek between the confluences of White Pine Creek and Mill Creek. He said the potential barriers are in the Gaynor Falls Reach (RM 16.5) and the Bygone Falls Reach (RM 20.5). These reaches are upstream from the Reach Assessment conducted by the Yakama Nation. Hans said they hired Parr Excellence to conduct the surveys and evaluate passage for salmonids in both reaches. Bill Norris with Parr Excellence gave a presentation on the results of the evaluation (see Attachment 4).

Bill began by identifying the location of the barrier reaches on Nason Creek. He described the general characteristics of the reaches and noted that there are five potential barriers in the Gaynor Falls Reach and one potential barrier in the Bygone Falls Reach. He then described the methods they used to evaluate fish passage at the potential barriers. They used Real Time Kinetic (RTK) surveys, Total Station surveys, and multi-elevation unmanned aerial vehicle aerial photogrammetry. They used data from these surveys to create digital elevation models. They then conducted hydraulic modeling and calibration. They generated fish passage flow estimates, identified fish passage criteria, and identified alternate fish passage routes through each of the potential barriers. Finally, they evaluated fish passage at low flow, average flow, and high flow conditions.

For each potential barrier, Bill provided passage results for steelhead, spring Chinook, Coho salmon, and bull trout at the three flow levels. In general, each barrier is passable to most species only at certain flows. The following summarizes passage for each species.

- Spring Chinook Salmon—Adult Chinook cannot pass through the Gaynor Reach unless they hold and wait for flows to fluctuate to levels that allow passage. Unfortunately, some barriers are only passable at high flows, while others are passable only at low flows. Thus, it is unlikely adult Chinook can pass through the Gaynor Falls or Bygone Falls reaches.
- Steelhead—Adult steelhead may be able to pass through the reaches at moderate to high flows; however, passage is challenging even at these flows. They cannot pass all barriers at low flows.
- Coho Salmon—Coho cannot pass the second barrier in the Gaynor Falls Reach at any flow. Thus, the Gaynor Falls Reach is a barrier to Coho salmon.
- Bull Trout—Bull trout may be able to pass through the two reaches, but like spring Chinook, they would have to rely on different flow levels to pass different barriers. Bull trout have been observed upstream from the barriers, but they could be resident forms. Tagged fluvial bull trout have been detected in the reaches and this area was and apparently still is a popular fishing area.

Chris Fisher asked about the condition of habitat upstream from the barriers. Jeremy Cram responded that there is spawning and rearing habitat upstream from the barriers. He added there are a few miles of habitat upstream from the Bygone Falls Reach, but the basin area upstream from the barriers is small. It is mostly a plane-bed channel with possible fish passage barriers. He said the area between the Gaynor Falls and Bygone Falls reaches has high quality habitat. Chris asked about the fish assemblage upstream from the barriers. Jeremy noted that there are high densities of *O. mykiss* upstream from the barriers. Bull trout also occur upstream from the barriers.

When asked what the Yakama Nation intends to do with these results, Hans indicated that the results are intended to supplement the Reach Assessment. He added that they have no intention of trying to improve passage at the barriers. That would be extremely difficult to do based at their locations in Nason Creek. Brandon Rogers responded that these results will also help the Committees determine if it is cost-effective to fund projects upstream from the barriers.

The Committees thanked Bill and the Yakama Nation for sharing the fish passage results with them.

VIII. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests from November and December:

   Rock Island Plan Species Account:

   - $86.63 to Clifton Larson Allen for Rock Island financial administration in November 2020.
   - $12,414.10 to Chelan County Treasurer for the Peshastin RM 4.3 Side Channel Project.
   - $4,187.48 to Cascade Fisheries for the Restore Lower Chiwaukum Creek – Phase I Project.
   - $136.59 to Cascade Fisheries for the Chiwawa Nutrient Enhancement Project.
   - $258.61 to Cascade Fisheries for the Goodwin Side Channel Project.
   - $11,255.66 to Trout Unlimited for the Beaver Fever – Restoring Ecosystem Function Project.

   Rocky Reach Plan Species Account:

   - $86.62 to Clifton Larson Allen for Rocky Reach financial administration in November 2020.

   Wells Plan Species Account:

   - $3,704.81 to Inter-Fluve for the Enloe Dam Removal Concept Plan Project.

2. Becky Gallaher reported that Cordell, Neher & Company is completing the financial review of the Rock Island and Rocky Reach Plan Species Accounts. She will see if the accountants can submit the report before the end of the year.

IX. Next Steps

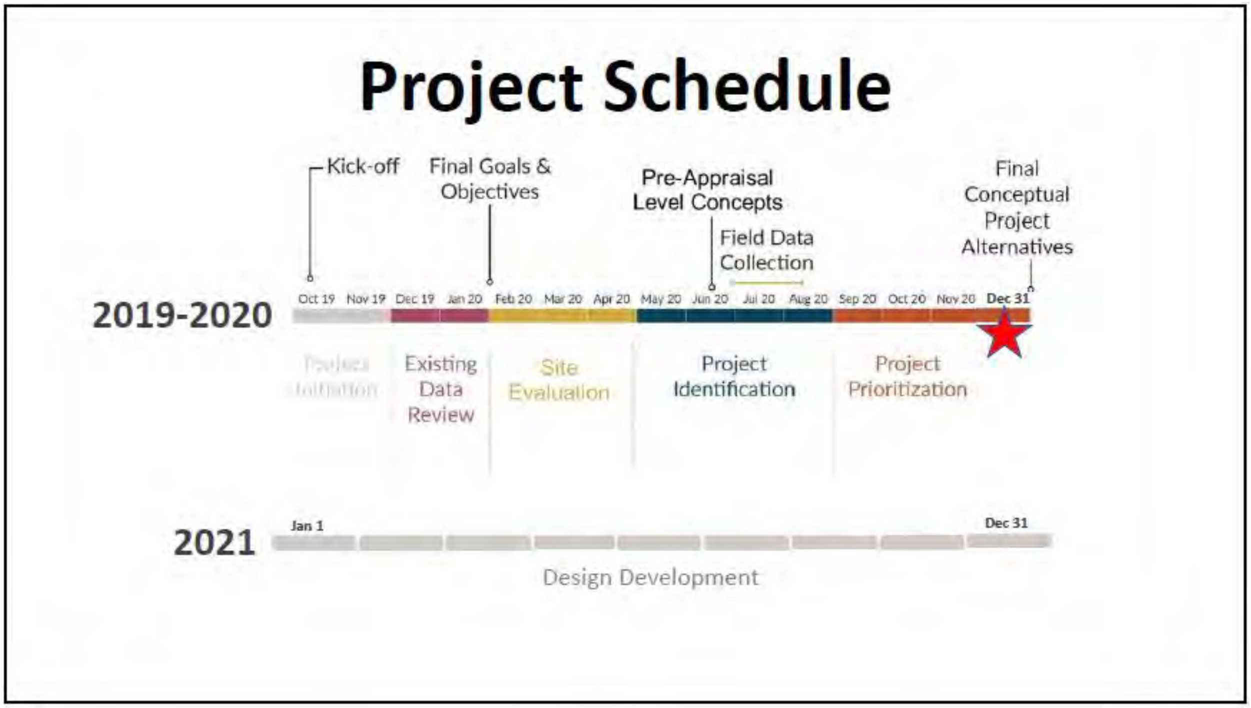
The next scheduled meeting of the Tributary Committees will be on Thursday, 14 January 2021.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

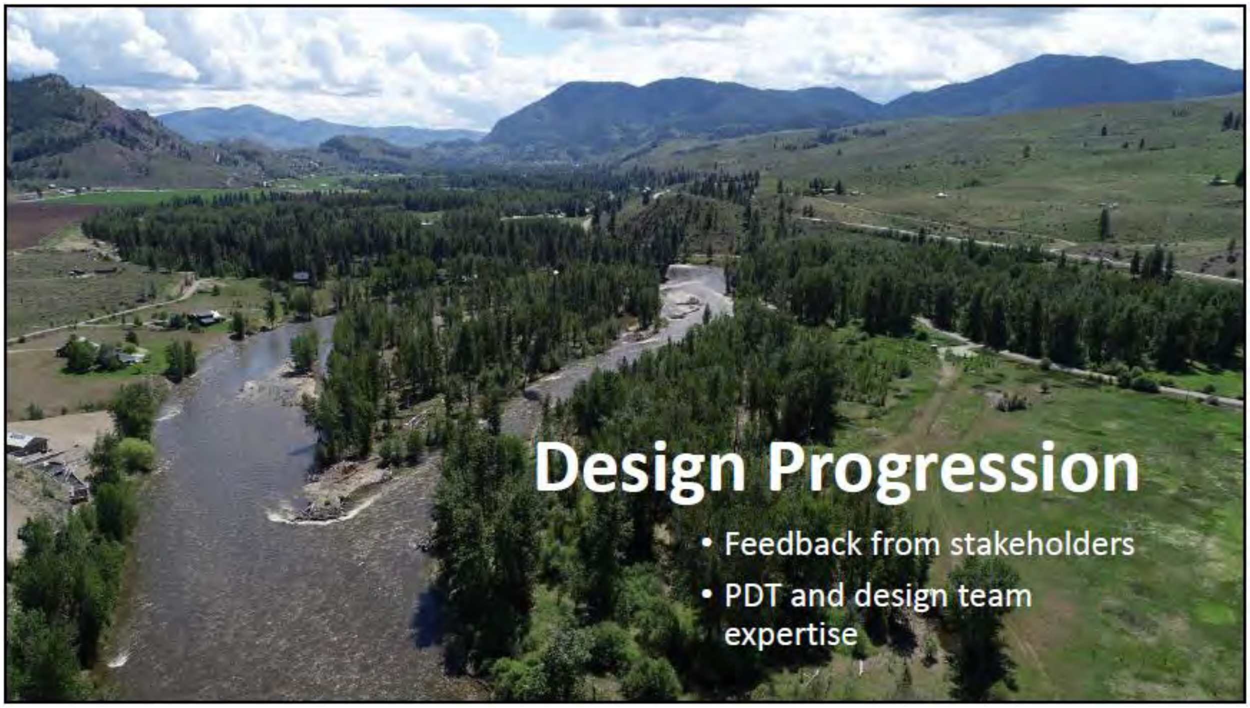
Attachment 1

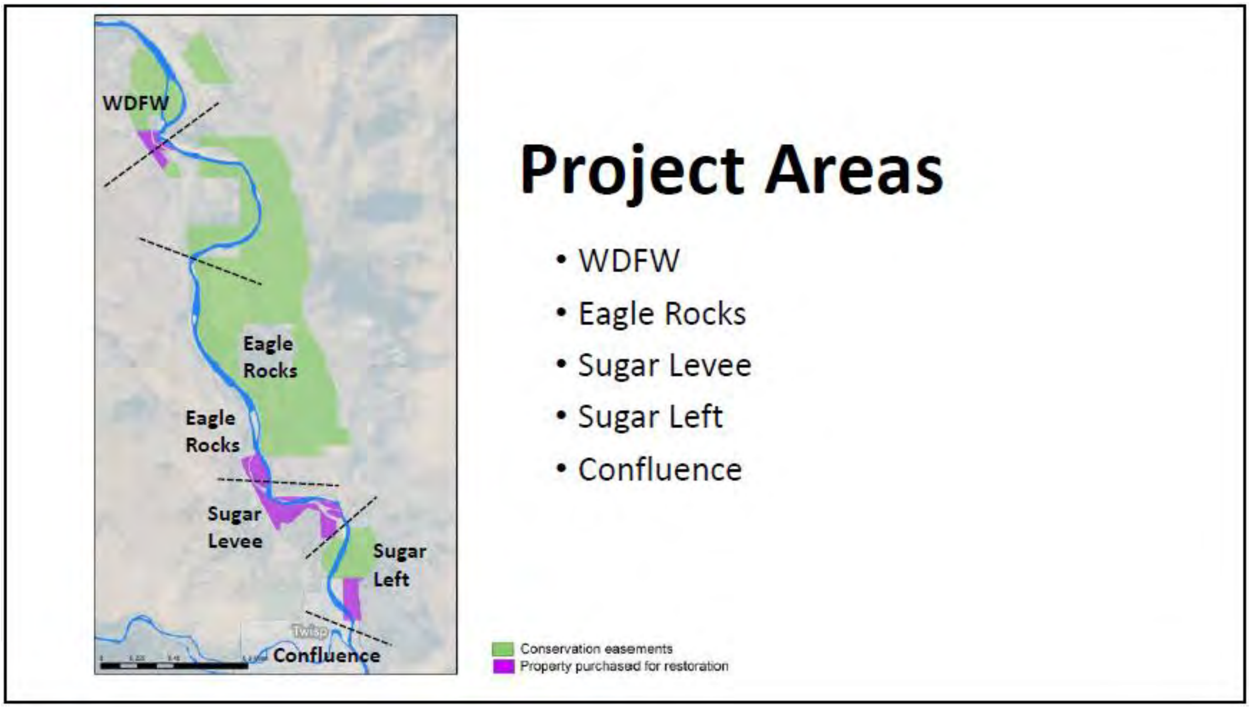
Presentation by Tara Gregg on the Sugar Project

- Data inputs at 10%
    - Emphasis concept level
    - Lidar – with some recent survey to ground truth
    - USBR geomorphic surface mapping
    - Aerial photos
    - Existing conditions hydraulic model
    - Field observations

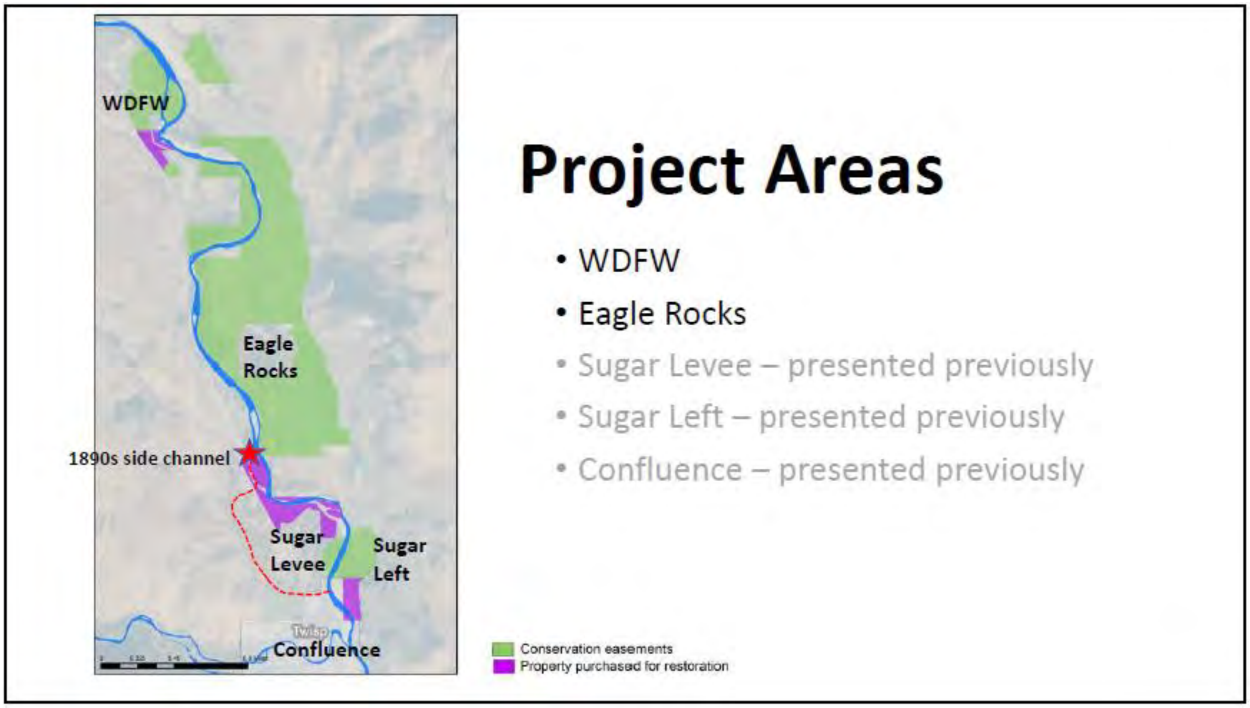


- At a decision point
  - Design development to the 30% includes data collection to answer many of the questions already posed by the PDT, landowners, stakeholders and potential funders
  - May include initial proposed conditions modeling and migration analysis to understand hydraulic changes, potential impacts/benefit
  - Additional groundwater monitoring to identify the quantity and quality of groundwater inputs

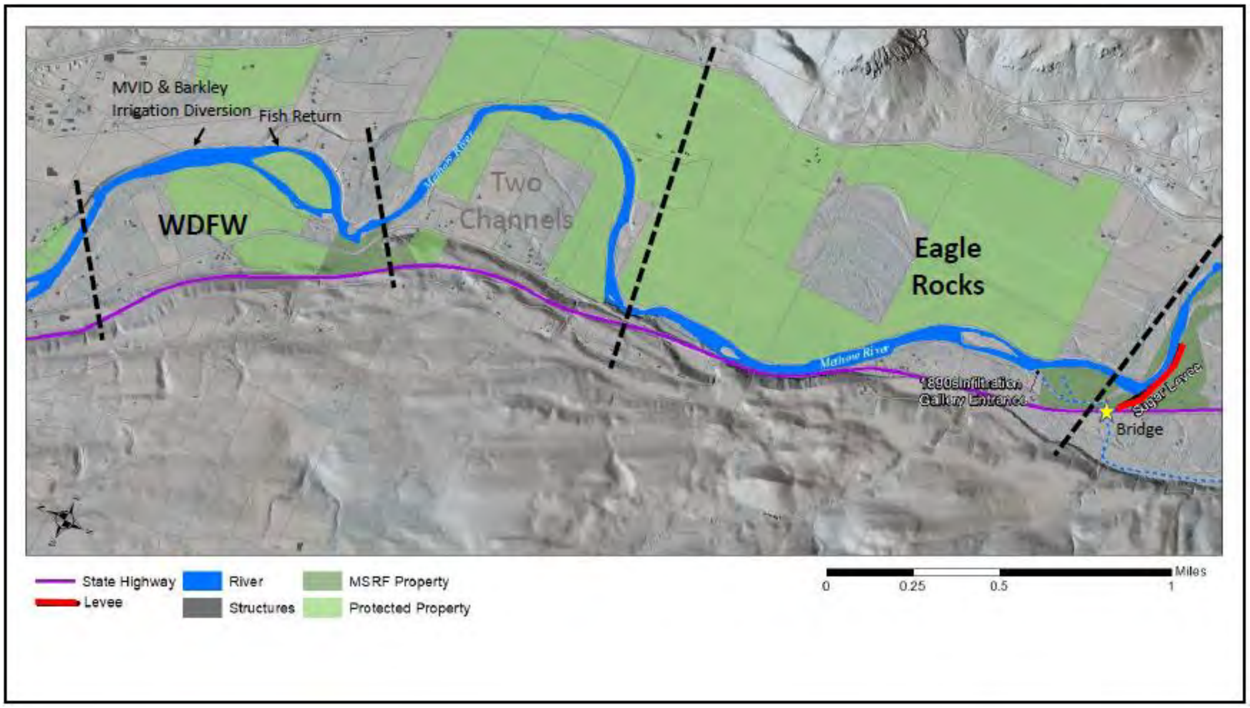

Design Progression
• Feedback from stakeholders
• PDT and design team expertise



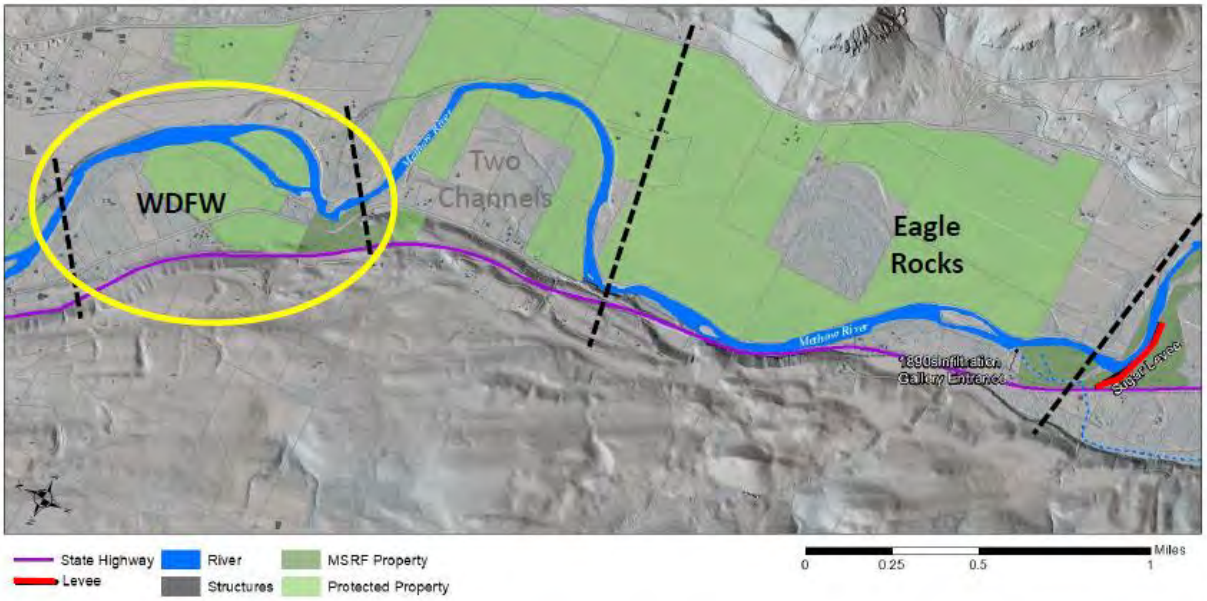
- Zones divide project into smaller subareas for organizational purposes, these boundaries are dashed and maybe adjusted
- The exception is the Yakama's Two Channels project area, no projects will be propose in this area.



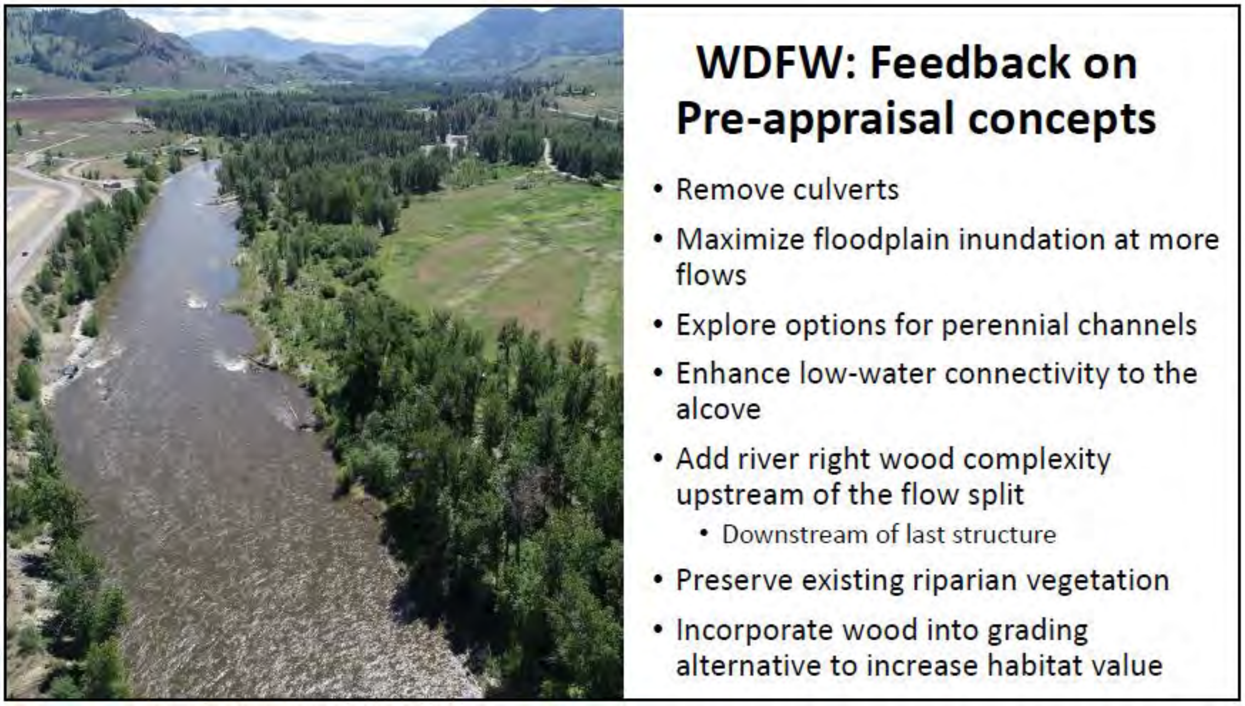
- Projects will be developed as a suite of complimentary actions.



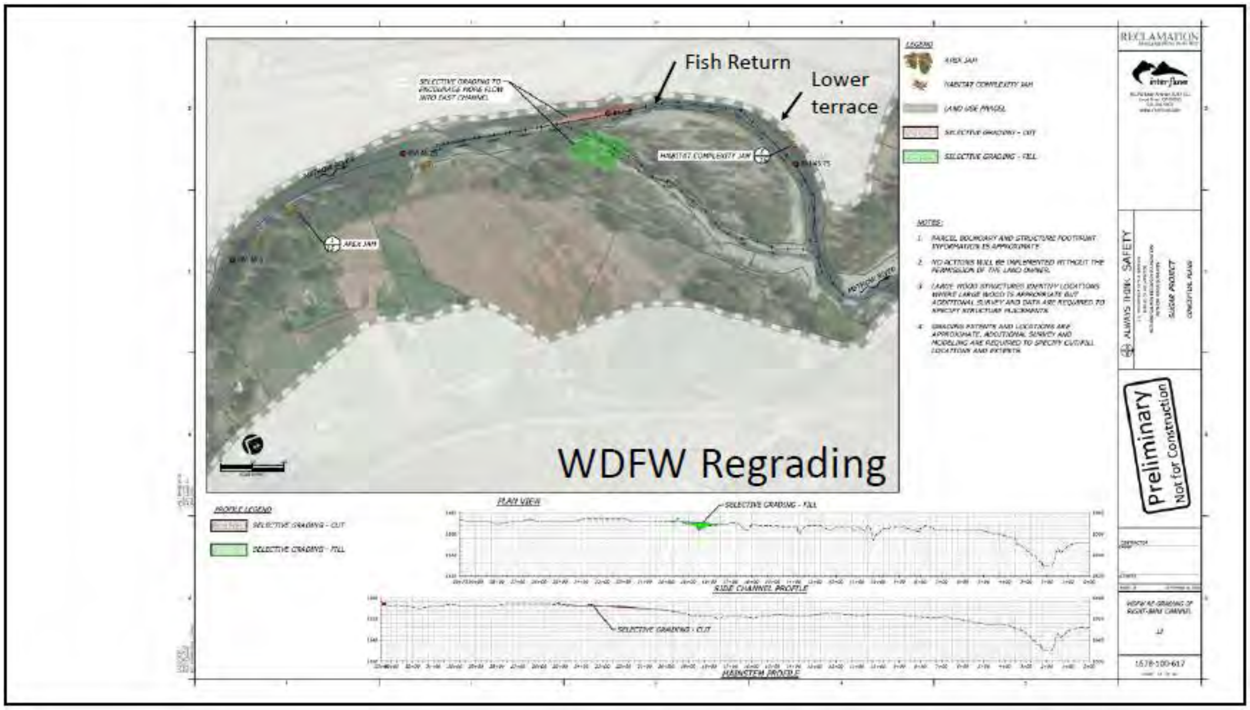
- Multiple constraints in the project area.
  - Highway (purple),
  - homes (gray squares), private property,
  - existing habitat investments (including MSRFS WDFW project and YN 1890s)
  - MVID and Barkley irrigation
- Working with landowners to identify project opportunities



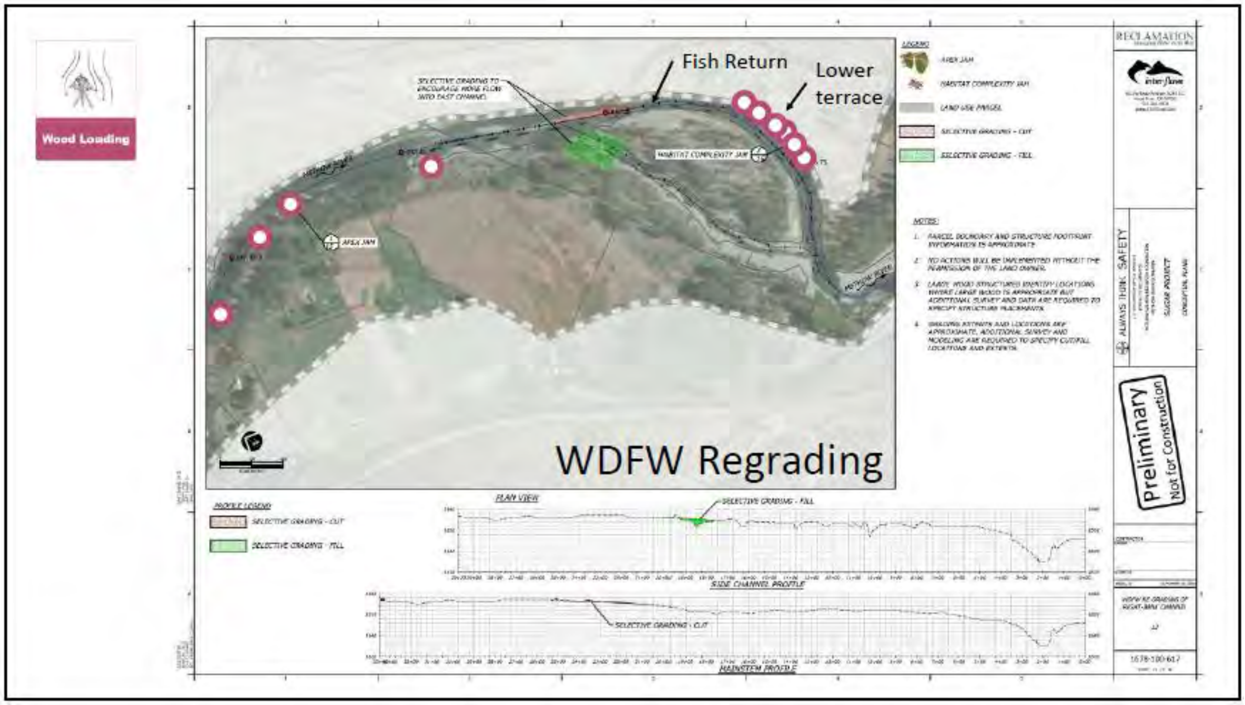
- WDFW
    - Site of multiple habitat restoration projects
        - Irrigation dam that spanned the Methow River was removed in 2010
        - A series of updates to the MVID irrigation diversion and fish return. This diversion now serves both MVID and Barkley Irrigation Company
        - Multiple restoration actions
        - Overall, functioning extremely well. Wood structures have increased the complexity of the channel and snorkel surveys show high concentrations of juveniles spring chinook around these structures
    - This project has identified additional opportunities at this site., including:
        - Increased engagement of a floodplain channel by removing culverts which currently restrict flow
        - Improvement of off channel alcove habitat
            - Large concentrations of fish find refuge in the alcove during highwater, but this project seeks to better understand how fish usage changes as water level and water quality drops to identify potential opportunities for improving habitat at this location
        - Development flow split and fringe habitat availability in both flow channels



- 3 alternatives, but could also be viewed as 3 actions types and elements could be pulled from each alternative and combined into a preferred alternative.
    - 2 actions look at promotion of a perennial flow split by either
        - Regrading
        - Channel roughening through large wood placement. Large wood would also provide fringe habitat for Juvenile spring chinook and steelhead
    - Habitat enhancement by removing flow impediments in floodplain channels and evaluating habitat improvements in the alcove/channel outlet at plummers pond.



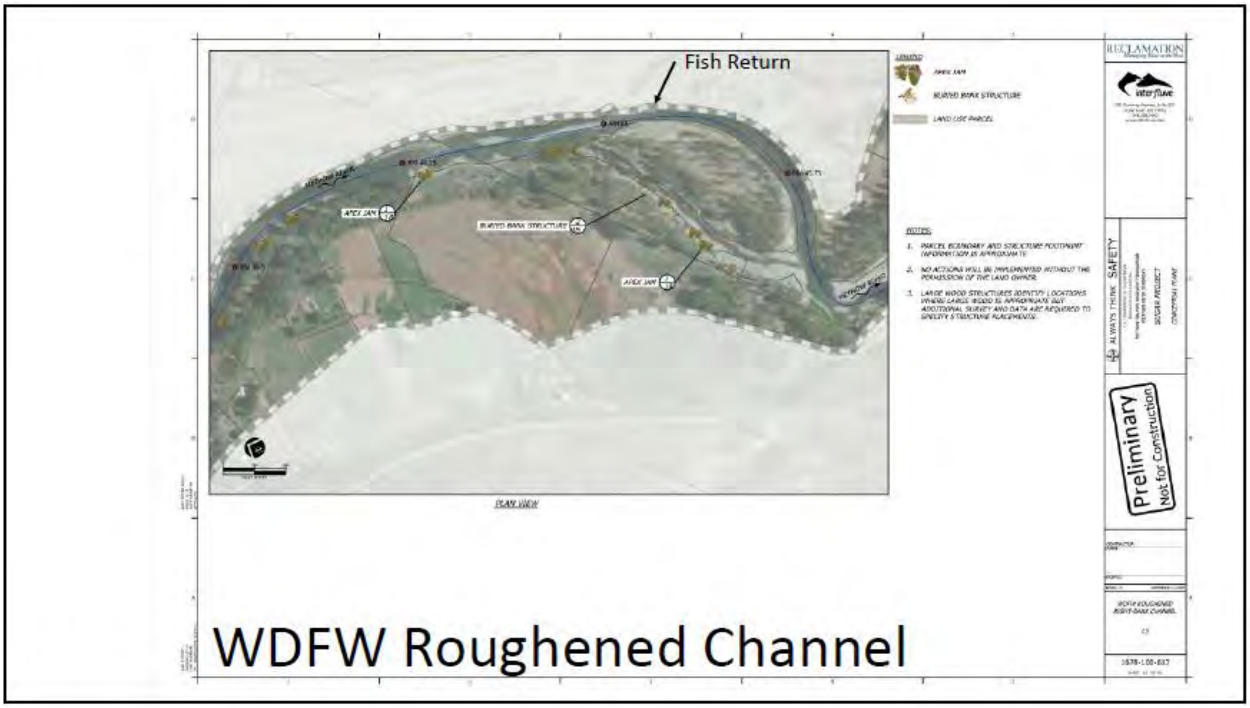
- Regrading - green area of aggradation, red indicates areas of excavation
    - Extents to be refined
    - Maintain flows to habitat investments in the right and left channel
    - And fish return
- To increase the habitat value this alternative proposes additional wood features along the right bank of the mainstem and in left flow channel
    - Left bank features are located on lower terrace bench
    - Riparian plantings could be incorporated
    - Coordinate with existing features

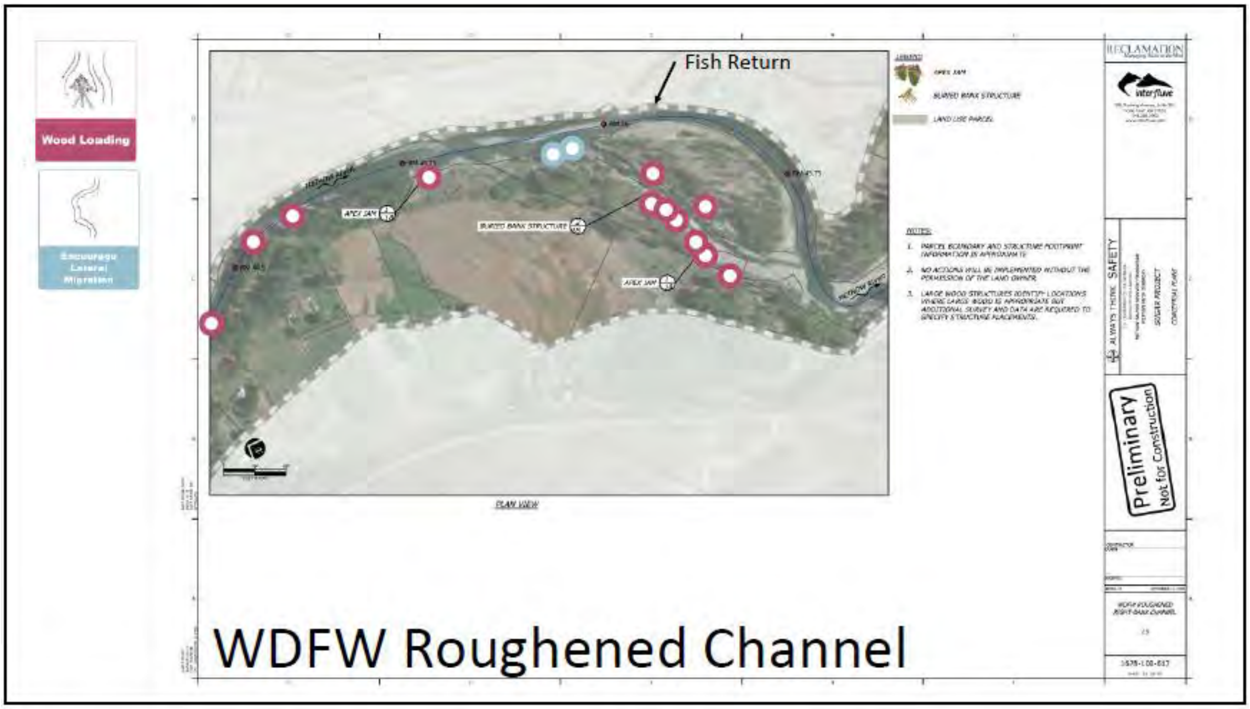


- For visual clarify the circles identify the approximate location of these features

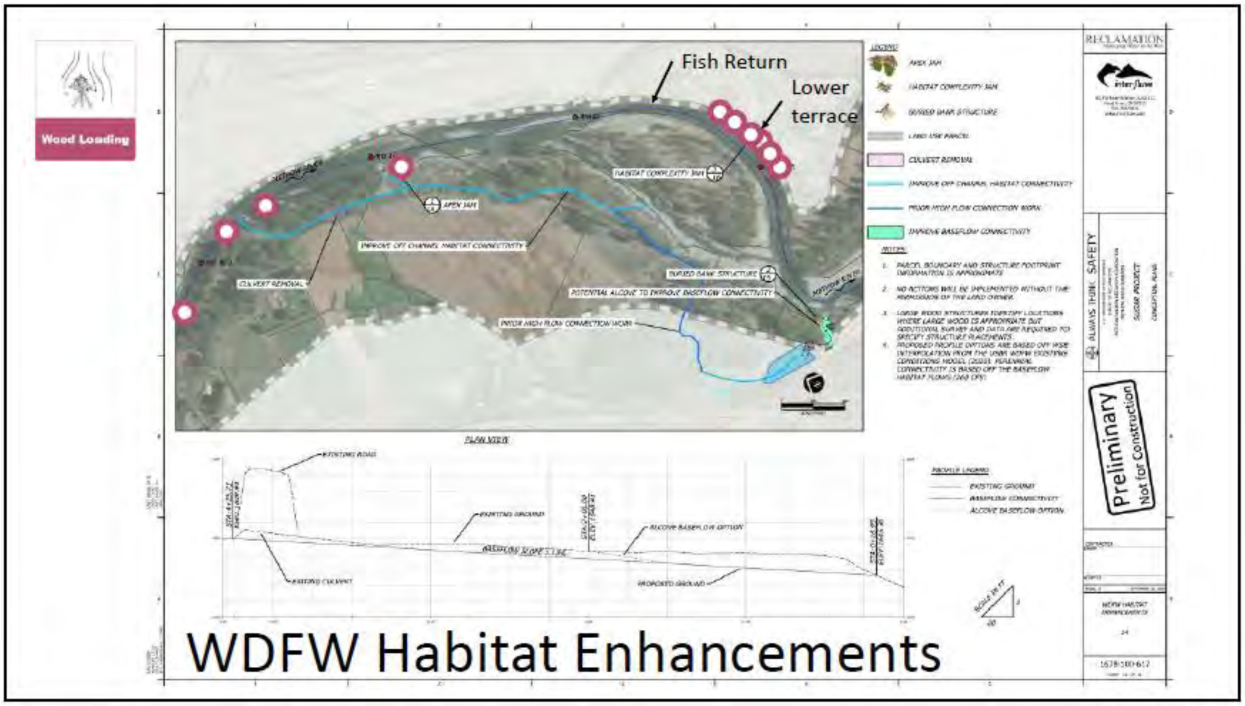
- The mid-channel gravel bar extending from the irrigation diversion to the location of the former diversion dam is a persistent feature
    - Decades of sediment accumulation behind dam
    - Had expected to see erosion here after removal but didn't
    - Dominate low flow path is to the right

- Additional wood structures just upstream of this could be added to deflect flows toward left bank and promote sediment deposition in the velocity shadow at the channel entrance.


Fish Return
RECLAMATION
APEX JAM
BURIED BANK STRUCTURE
ALWAYS THINK SAFETY
Preliminary
Not for Construction
WDFW Roughened Channel



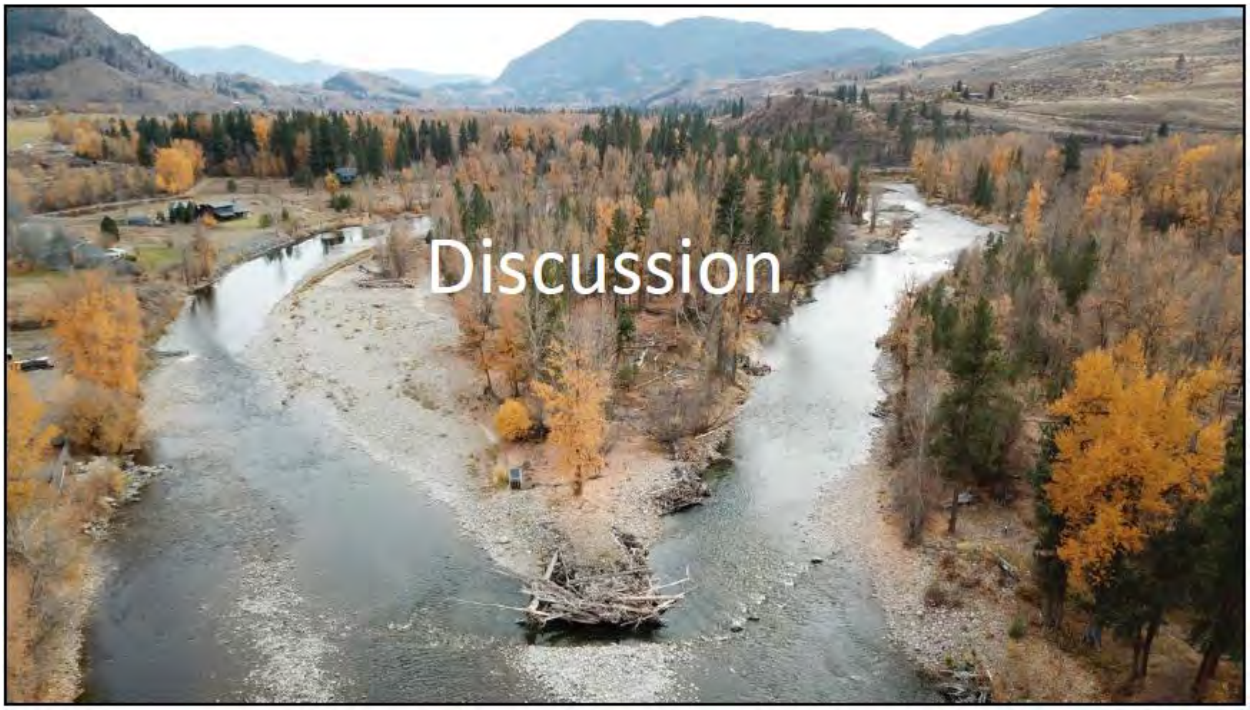
- Circles indicate the locations of these features for visual clarity
- Structures in blue/gray just upstream of the flow split would deflect flows toward left bank
- Areas of wood loading are shown in red and include
    - Additional mainstem and left flow split structures to increase habitat value
    - Additional right flow split structures in middle section of the channel length increase roughness and promote deposition
        - Base Photo from 2015. The channel has changed significantly, especially in the lower half of the side channel since the 2015 image used as background. Currently perennial flow split midway down channel.
- All wood placements are approximate. Will be refined in coordination with existing structures.

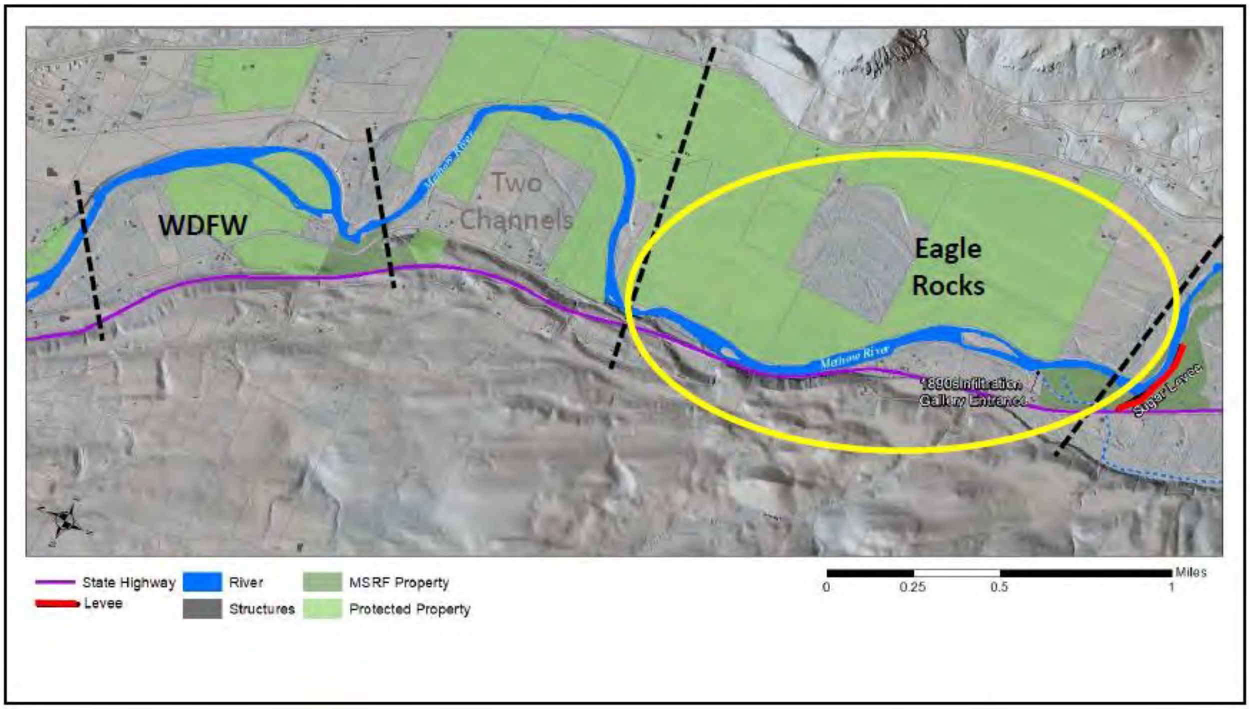


- Remove Culverts on the floodplain
  - Increase inundation of the floodplain channel
  - Will evaluate whether modifications need to be made to the North Plummer culvert under the county road to accommodate additional flows
    - The invert elevation of this arch culvert can be lowered without needing to remove the culvert
- Enhance low water connectivity at Plummers channel outlet/alcove
  - Profile shows proposed improvement of the plummers outlet/alcove.
  - The county road has large arch culvert at the pond outlet.
    - This culvert will not be removed, but the Invert elevation can be lowered
    - The proposed profile cut shows 0.5-1 ft of excavation
    - Slope = 1.13%

- Outflow of pond is driven primarily by groundwater (likely mostly from upslope irrigation ditch).
- There is some surface connection during high flows from WDFW floodplain channels via north culvert.
- Disconnected September- March.
- Sometime in the summer, water temperatures increase and oxygen saturation decreases
- Evaluating whether decreasing the surface area of the pond would help improve water quality

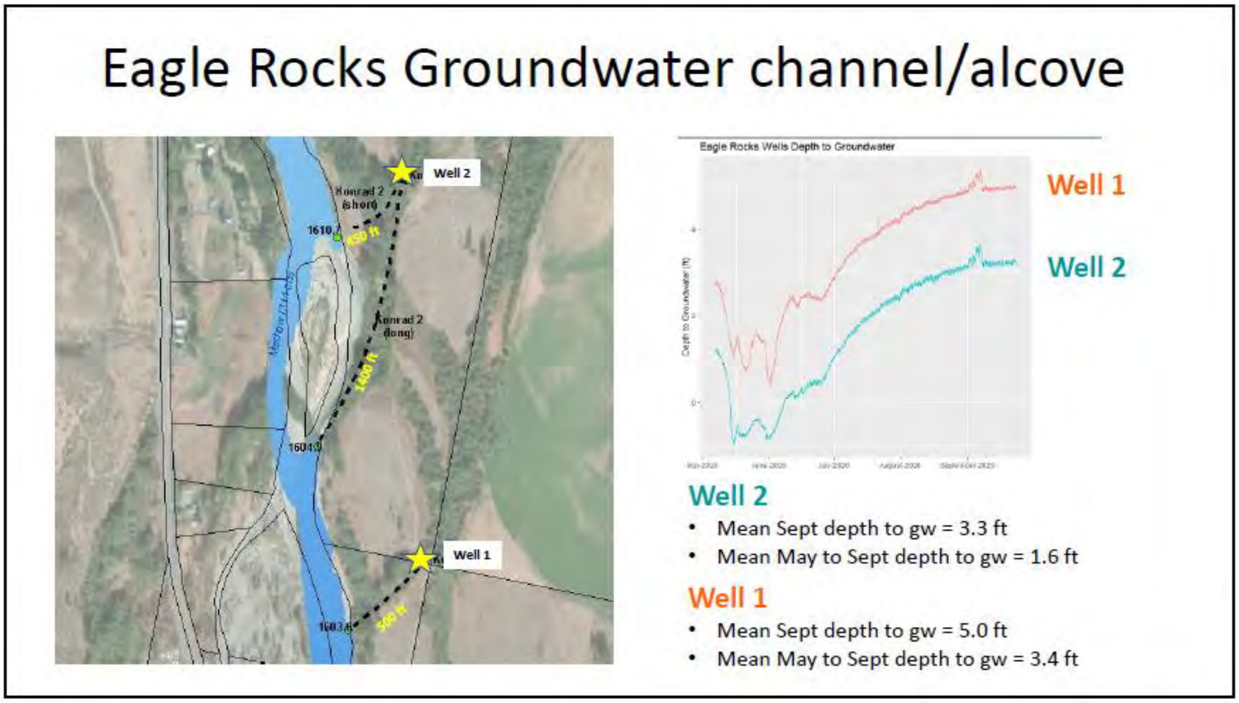
- Photo taken at 6000 cfs
- Backwater condition is driven by the river, with backwater reaching all the way back to the pond for short periods during most peaks
- The river end of the outlet channel is backwatered beginning at about 1200cfs on the Winthrop gauge.
- Many juvenile salmonids seen in the outlet channel during high flow.
- Seeking to better understand how fish usage at the site changes during late season as water level and quality drops


Discussion

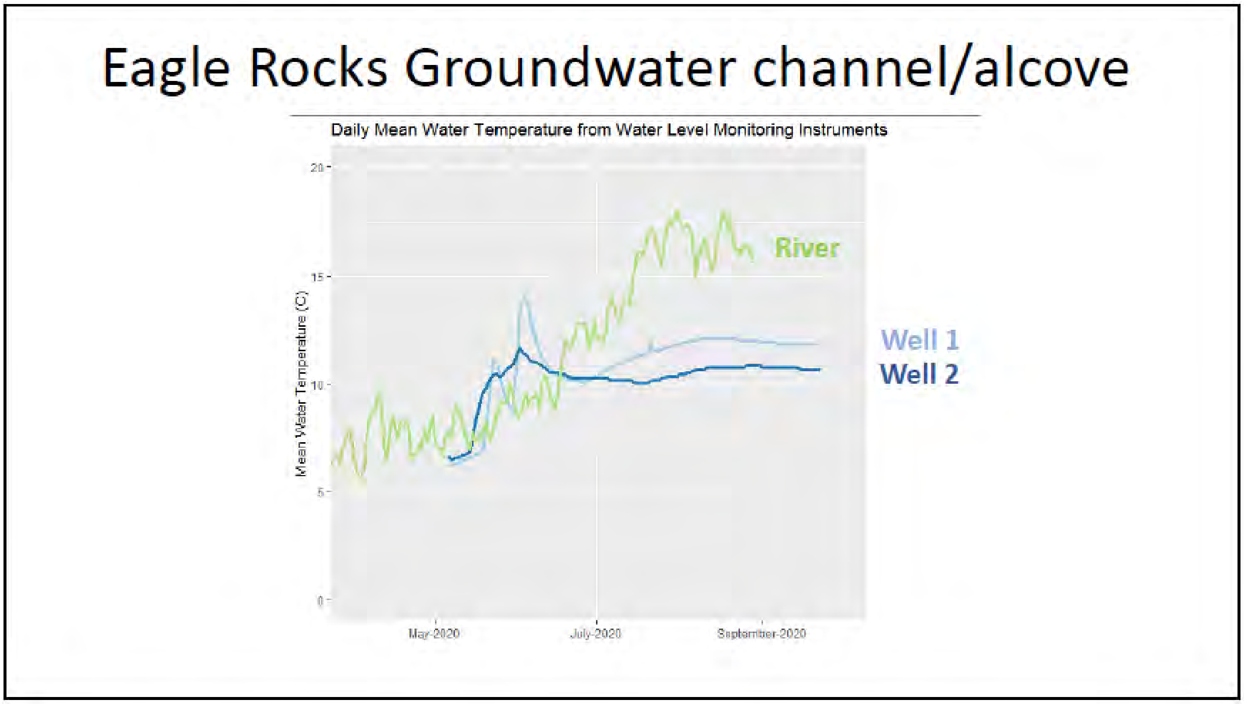


- WDFW
    - Site of multiple habitat restoration projects
        - Riparian Plantings
        - Mainstem wood loading
        - 1890s infiltration gallery
        - Considerable efforts for riparian conservation – green areas
    - At the concept design level this project has identified additional opportunities at this site, including:
        - Improvement of off channel alcove habitat
        - Development fringe habitat availability in the mainstem
        - Opportunities for floodplain engagement and channel development on the left floodplain were identified as not feasible due to landowner and stakeholder support

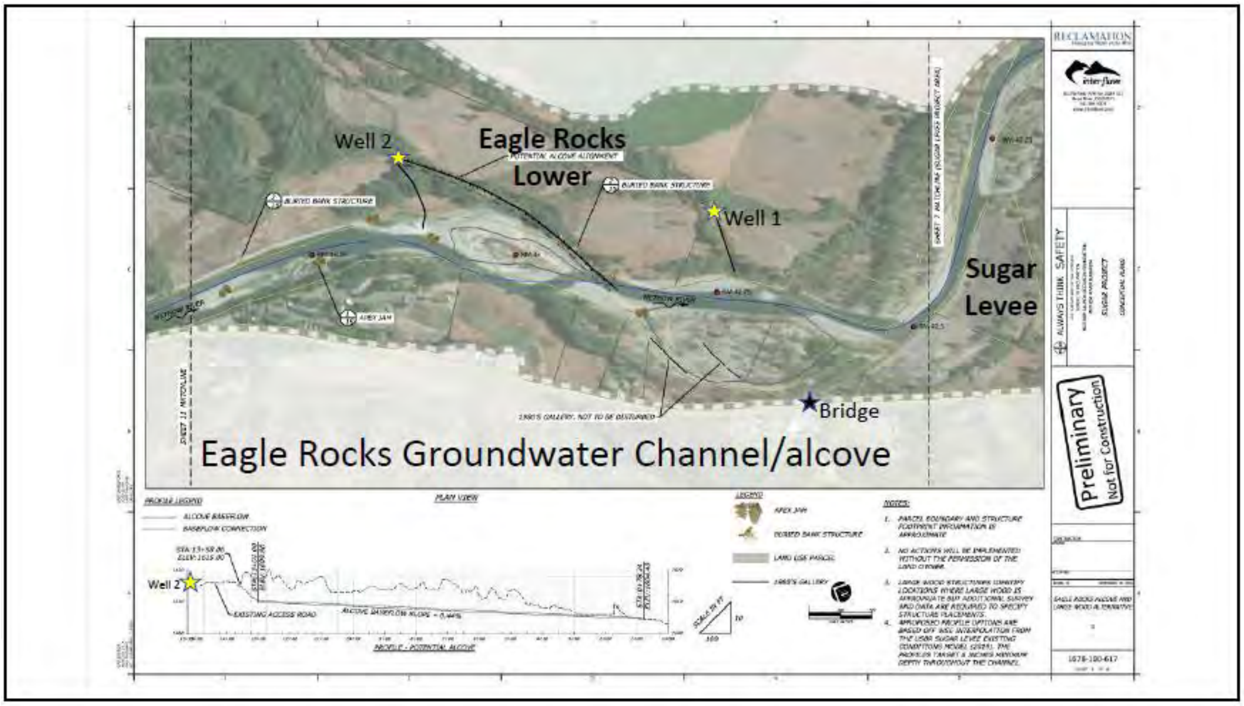
- We looked at engagement of the left floodplain, as well as channel construction, but neither of these options were viable due to landowner support. This photo shows the left floodplain area evaluated for reconnection opportunities.
- 2 alternatives, but like at WDFW these could also be viewed as 2 actions types that could be combined into a preferred alternative. Includes
    - Groundwater channel/alcove to provide refuge during highflows and overwinter for spring chinook rearing and steelhead
    - Wood loading for channel complexity and fringe habitat for Juvenile spring chinook and steelhead



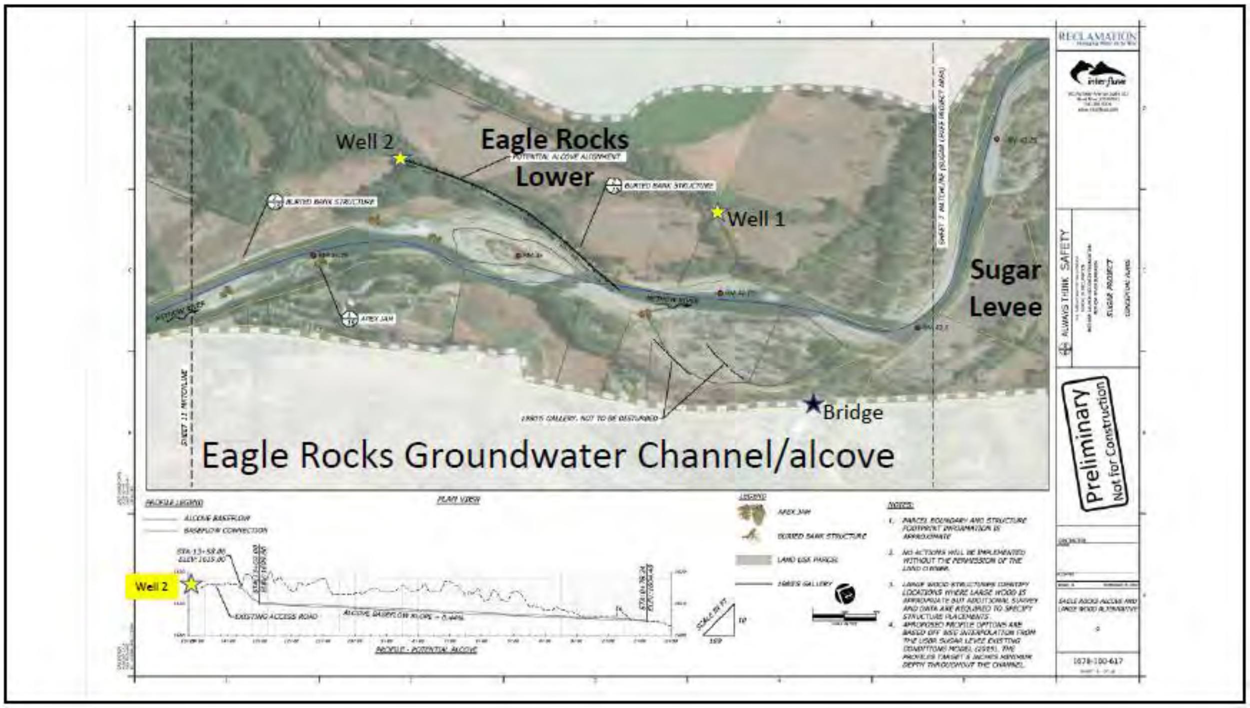
- A series of wells were installed in the Eagle Rocks project area by Yakama Nation in 2010.
- Continuous groundwater and temperature monitoring between May and Sept of this year
- Based on landowner support three potential channel alignments were evaluated based on depth to groundwater, temperature and viability of the channel outlet.
- Mean depth to groundwater at Well 2 in Sept is 3.3 ft, average depth is 1.6 for period of record
- Mean depth to groundwater at Well 1 in Sept in 5.0 ft, average depth is 3.4 ft for period of record



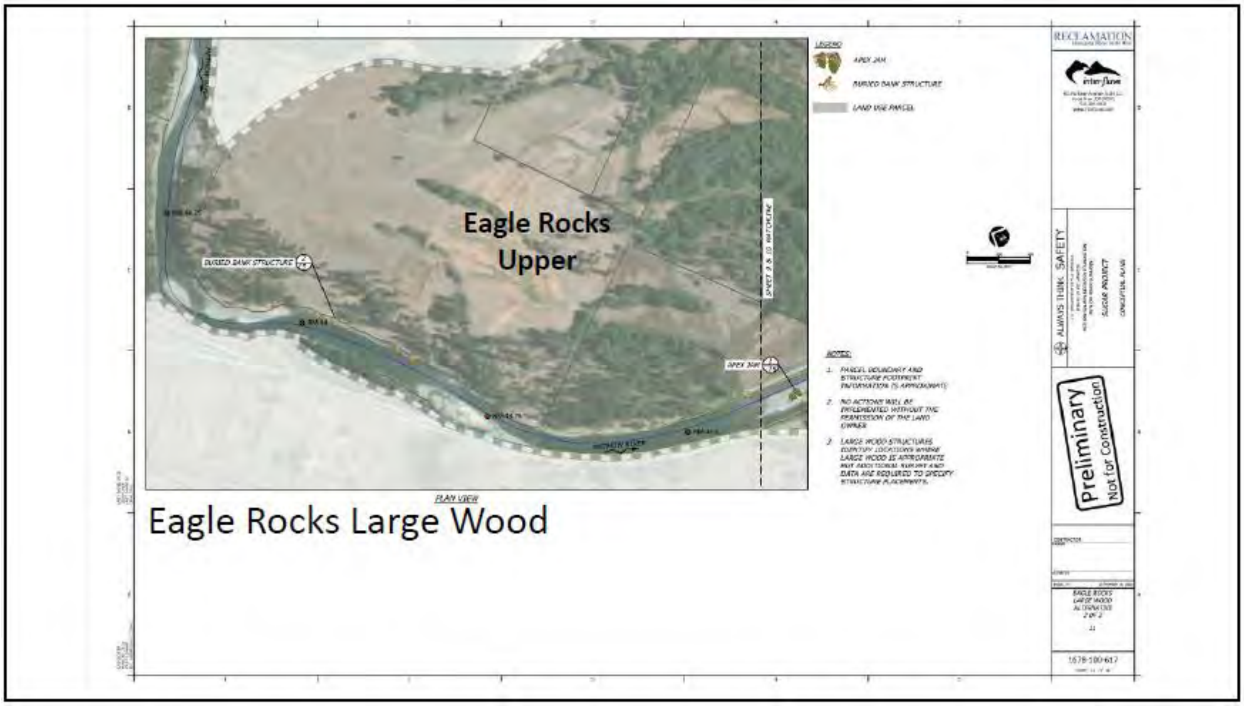
- Temperature data looks like it's about 3-5 degrees cooler during the summer months



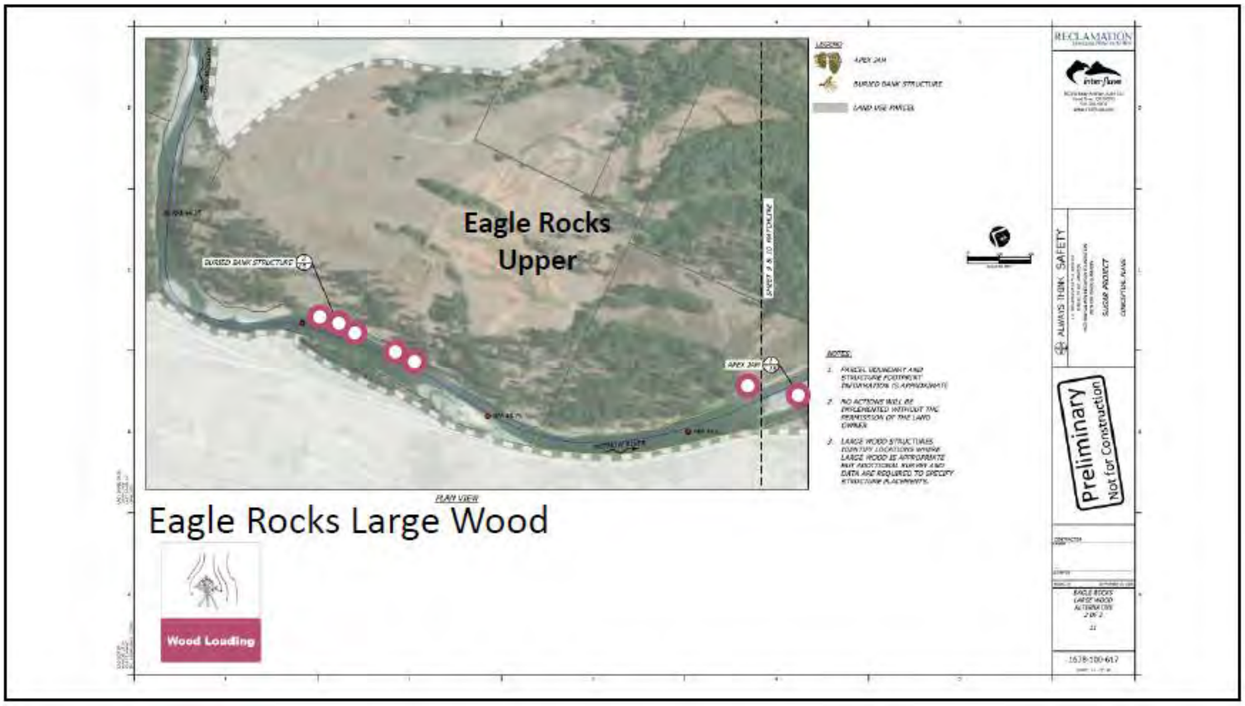
- Two shorter channels were identified as undesirable at low water
- Terrain profile pulled from lidar, likely shows artifacts from vegetation
- Proposed channel follows topographical lows, expected excavation to baseflow groundwater is approx. 3.5 ft. Proposed excavation depth is about 4.5 ft.
- Channel slope is 0.44%



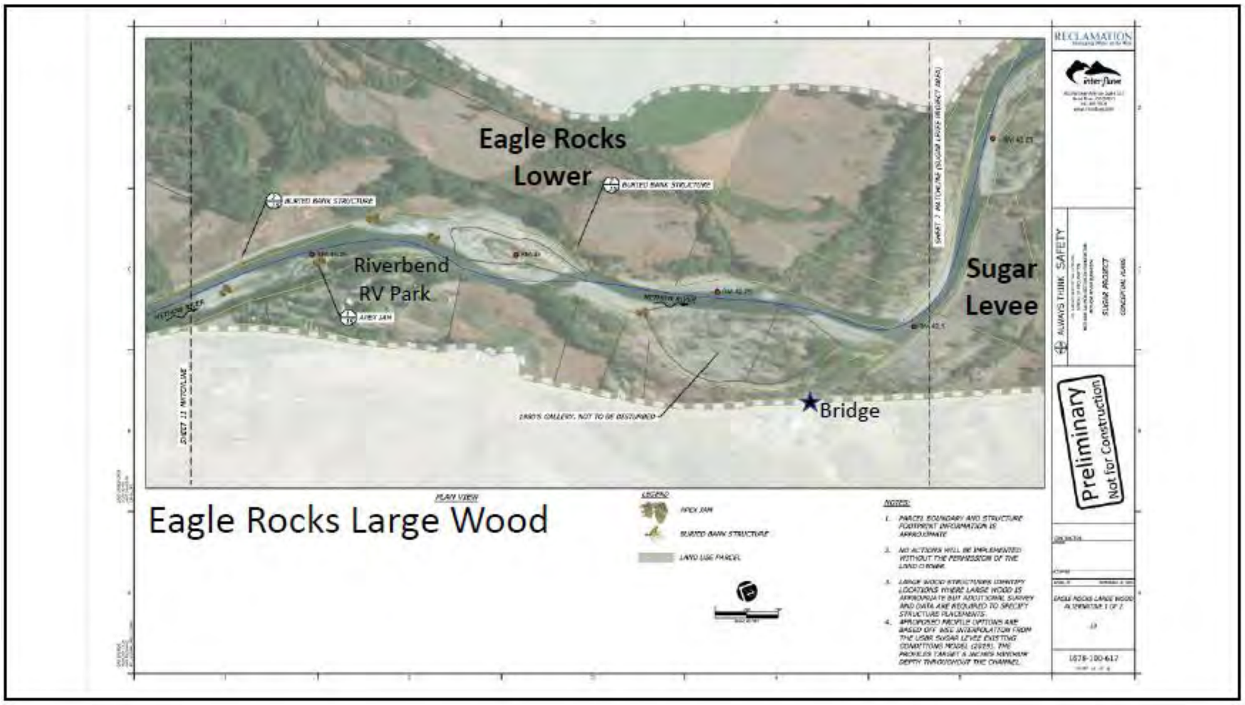
- Additional groundwater and temperature monitoring could occur to better understand winter temperatures
- And whether piping of the MVID and Barkley Irrigation ditch affects groundwater at this location
- A pump test would provide information regarding groundwater quantity

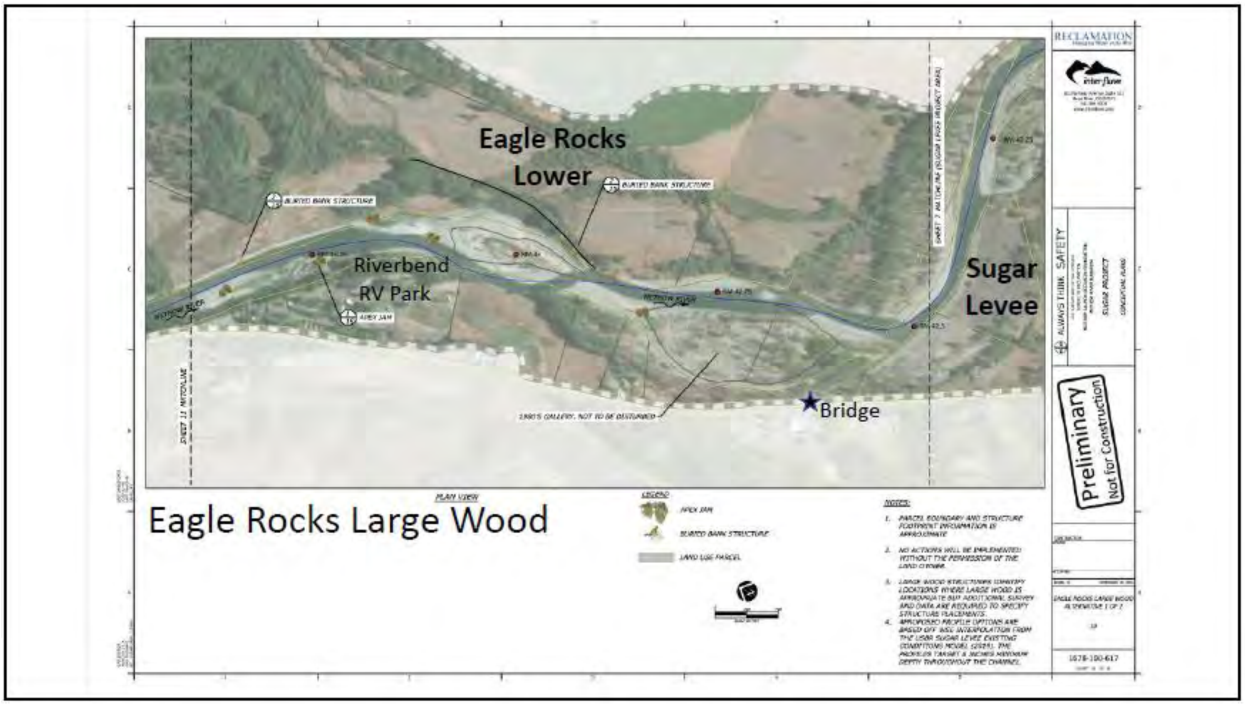


- Logjams provide a concentration of highly complex cover that fish seek out for rearing habitat.
- Including velocity refuge during high flows, hiding cover to escape from predators during all flows, and rearing opportunities during low flows.
- Logjams are also associated with areas of velocity shear, where fish can take advantage of sitting in low velocity areas while food is delivered by adjacent faster water.
- During snorkel surveys in this reach, the majority of the juvenile spring Chinook observed were associated with this type of habitat.
- Higher densities of juvenile steelhead are found associated with logjams than in adjacent reaches without logjams

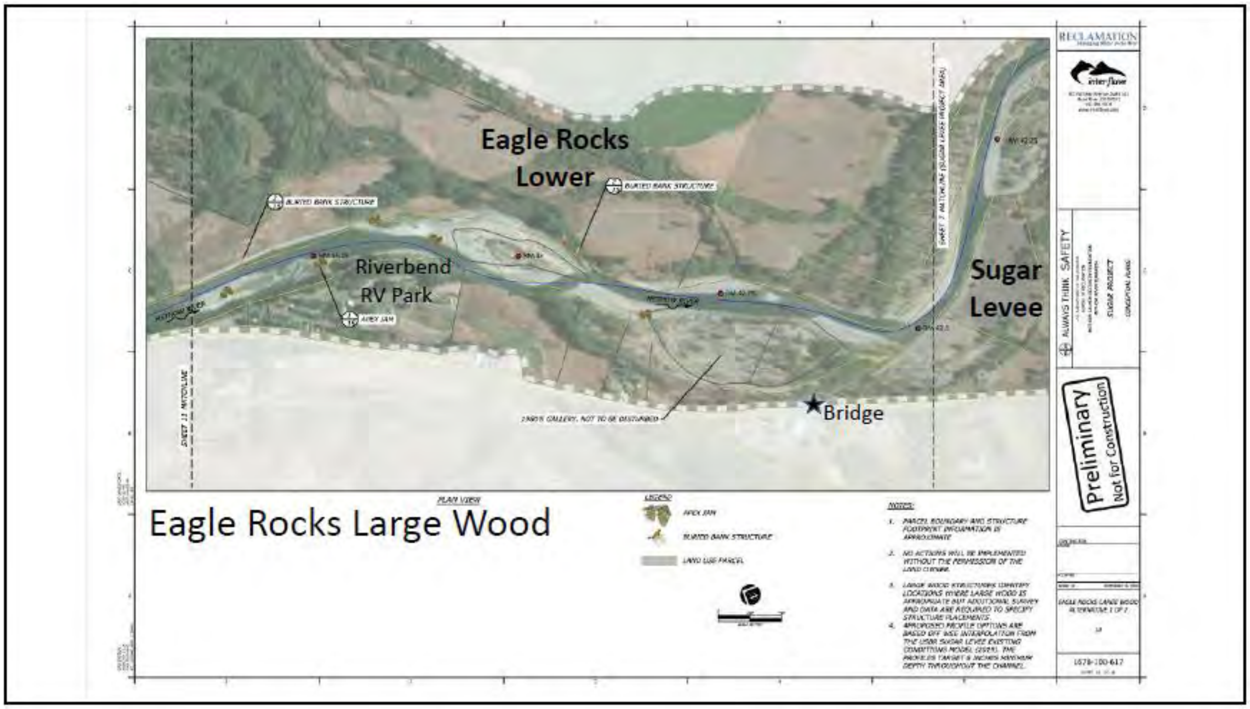


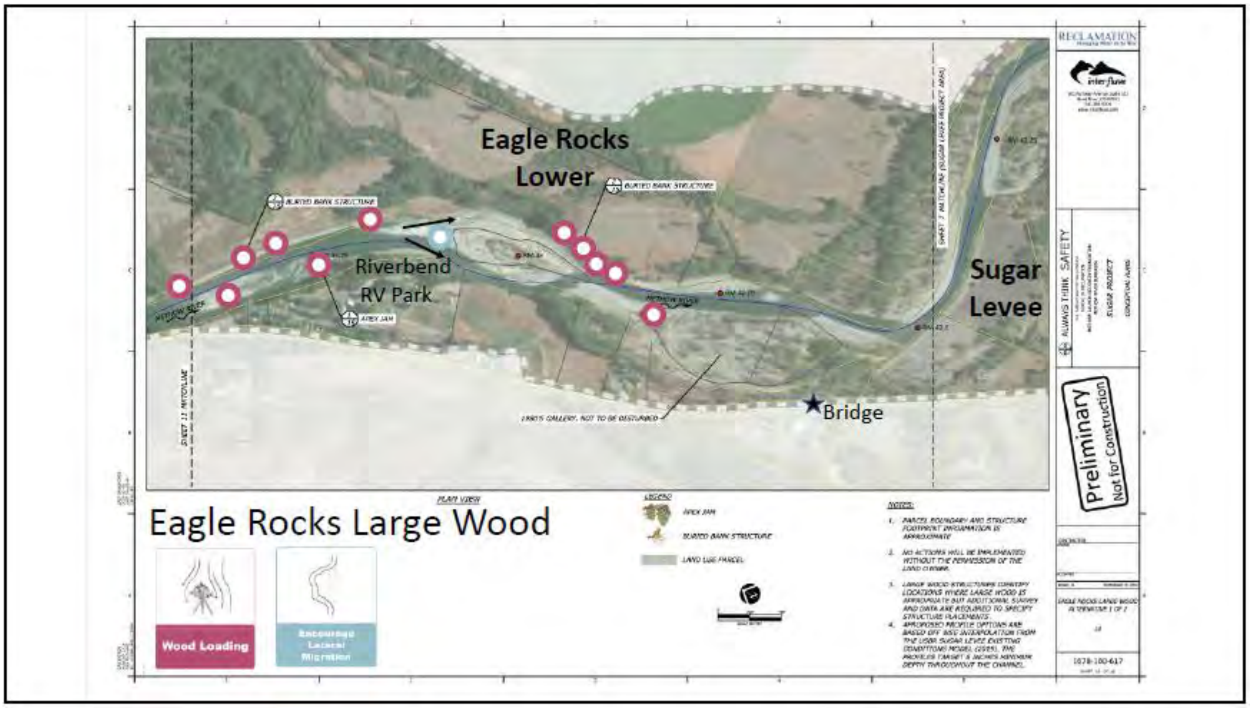
- Locations of proposed wood loading are highlighted by the circles.
- Locations approximate


Eagle Rocks
Lower
Riverbend
RV Park
Sugar
Levee
Bridge
Eagle Rocks Large Wood
Preliminary
Not for Construction
RECLAMATION



- Black line represents the proposed location of the ground water channel/alcove discussed earlier


Eagle Rocks
Lower
Riverbend
RV Park
Sugar
Levee
Bridge
Eagle Rocks Large Wood
RECLAMATION
Preliminary
Not for Construction
ALWAYS THINK SAFETY



- wood structures are highlighted with circles.
- Red = wood loading, Blue/Gray = Encourage lateral migration
- Most structures are intended to create fringe habitat for juvenile spring chinook and juvenile steelhead
- The structure at the head of the island @ RM 43.1 is intended to drive lateral migration and a flow split at this location
- Actions will also be evaluated to understand how proposed actions may impact or change river access to landowners, including the Riverbend RV park. No hydraulic analysis or migration analysis has been completed at the 10% concept level, but these methods could be used to evaluate changes as the design process moves forward
- This project is being developed in consideration of other project actions that have occurred in this reach, including the 1890s channel.
  - This project is using the same technical consultant that designed the 1890s project and all proposed actions are being evaluated to understand how they interface with the 1890s infiltration gallery
  - The wood structure placed near the entrance to the 1890s channel is intended to rack mobile wood and deflect energy toward the left bank. Moving forward we will continue to evaluate this and all proposed actions.


Discussion

Attachment 2

Draft Summary on USACE, Ecology, Regional Organization and Washington Salmon Coalition Permitting Meeting

Lower Columbia Fish Recovery Board

DRAFT SUMMARY
USACE, ECOLOGY, REGIONAL ORGANIZATION AND WASHINGTON SALMON COALITION PERMITTING MEETING
AUGUST 21, 2020
10:00 – 11:00 AM

Participants

Jess Jordan, US Army Corp of Engineers

Steve Manlow, LCFRB- Representing Council of Regions (COR)

Rick Mraz, WA Department of Ecology

Dawn Pucci, Island County LE- Representing WA Salmon Coalition

Loree Randall, WA Department of Ecology

Denise Smee, LCFRB

Tricia Snyder, YBFWB - Representing WA Salmon Coalition

Tina Tong, US Army Corp of Engineers

Meeting Objective

Develop a pathway toward finding remedies for restoration project permitting challenges. We hope to reach a common understanding of the challenges experienced, establish the general approach to address those challenges, confirm participation, and establish a clear timeline for next steps.

Meeting Notes (summary of key points)

After introductions, Steve reviewed the agenda and provided some background information on why this group is meeting, and the meeting objectives.

Steve briefly discussed the Lead Entity and Sponsor Survey Results, and the Summary Matrix. He noted that the summary matrix is intended to identify key results of the Lead Entity and sponsor surveys conducted last summer that gathered information on the challenges and potential solutions with permitting salmon recovery projects, particularly through the Section 401 and 404 permit processes. He noted that the summary matrix is intended to serve as a tool that can help focus priorities, discussions and potential solutions for both agency staff and sponsor organizations.

Jess provided an overview of previous discussions that have taken place between the USACE, Ecology and sponsors, focused on eastern Washington. He noted that some of the concerns expressed by sponsors represent constraints that simply cannot be changed, which is okay, provided agency staff communicate why those program requirements exist and supporting information may be needed. He described the challenges associated with sponsors needing to place projects within a broader watershed context, which if often why issues arise. He emphasized the importance of looking at the broader watershed picture and how their project actions fit within it.

Jess noted that many times the issues can stem from applicants not having a good understanding of the permit process, or from lack of clarity on application needs and submittal requirements. This can be often be overcome when applicants have a long-term working relationship with agency staff. He explained that such relationships can provide more “training” opportunities for everyone, which can improve an understanding of what questions to ask. The challenge of staff rotation was also noted – newer agency staff generally do not have the background or relationships with the applicants, and vice versa.

Jess explained that he has conducted permitting training workshops around the state, and that they have provided important information and have been well received. He noted that if they didn’t solve a particular problem, it was still worth doing because they provided for a better understanding of the permit process and challenges for all participants.

He also noted that another driver for permit process challenges is that “low hanging fruit” types of projects have already been done, and the projects being implemented today are more complex. Permitting these types of projects is going to take longer. Training may be helpful, but for such projects there may simply be a greater lift in terms of permit processing.

A question was asked regarding whether agencies could provide something that helps project sponsors understand how difficult permitting will be for a particular project – perhaps a checklist, or something that shows what the permitting issues are. It was noted that training (education) is 2-pronged, and involves, sponsors and applicants, and as well as agency staff. For example, the Nationwide Permit 27 language provides some flexibility/wiggle room, but can be interpreted differently, so agencies need to work internally to provide clarification.

A question was asked whether a sponsor could initiate a pre-application meeting with the agencies, or whether agency staff arrange a meeting with the sponsor if they hear about the project. It was noted that agency staff (at least those on the call) can reach out to the sponsor if they hear about the project or have knowledge of it. Challenges to this include situations where working relationships are absent, or there is lack of knowledge of restoration efforts in an areas – this highlights the importance of communications, especially when there is high staff turnover.

Rick Mraz noted that Ecology has been trying to get ahead of some of these permitting issues, particularly through their Floodplains by Design program. They recently were able to have a wetland specialist on the grant review team to help the applicant with potential permitting issues before the project even gets going. He explained that Ecology has prepared a checklist for the

Section 401 process, but the rules are changing so it's still a working internal draft only. He commented that hopefully they'll be able to go public with it at some point, and not just for Floodplains by Design, but other programs as well.

Ecology staff explained that even with a lot of work, there are still going to be hiccups between what Ecology and the Corp can approve. Ecology has different standards or policies on some issues. For example, they have a different threshold for review of mitigation and often may need more information, while the Corp can move forward. It was noted that this can frustrate and stymie applicants.

Loree noted that there is work right now on a new nationwide permits, and there may be different conditions than we have today – it may therefore not be worth putting too much into energy into developing certain products until the effort is further along. However, she noted that we still have opportunities to address some of the issues though that deal with supporting staff, communications, and other elements.

With regard to a path forward, all attendees committed to their agency or organization being involved in a workgroup going forward, and the attendees are the right contacts for representing their respective organizations. The LCFRB will send out a Doodle poll for an October meeting. COR and WSC will work together to figure out how to include sponsor input as the effort moves forward.

For next steps, attendees were asked to provide feedback on the summary matrix and potential solutions by the end of September. There were also asked to consider any changes/additions to the information or approach that relate to the COVID epidemic. Attendees were also asked to identify high priority solutions and actions by the October meeting for discussion.

Steve noted that based on the above, we'll work to develop a plan identifying timetables, leads, and action items for improving permit process and effectiveness by mid-November.

The meeting adjourned.

Attachments: August 21, 2020 Meeting Agenda

August 4, 2020 Draft Issues Matrix

Attachment 3

Floodplains by Design Projects

DEPARTMENT OF
ECOLOGY
State of Washington

Floodplains by Design projects

Clean Water Act & Water Pollution Control Act Permitting Considerations

Introduction:

Washington rivers and their floodplains and estuaries deliver a wealth of economic, natural, and cultural benefits to our communities. Yet floodplain management has not kept pace with our growing communities. People are living in the path of flood waters; our water quality is on the decline; and habitat critical to restoring salmon and orca populations is disappearing.

The Floodplains by Design (FbD) grant program seeks to advance integrated floodplain management strategies and projects that consider a broader variety of ecological functions, values, and benefits to the affected human communities. Projects can have a higher likelihood of success when they improve ecological function, reduce flood risk, and meet other community needs because they are more likely to garner the necessary community support and public funding.

Permitting:

There are typically two permitting pathways under the Clean Water Act (CWA) that are associated with FbD projects. There is also a state authorization pathway under RCW 90.48, the Water Pollution Control Act (WPCA), for projects that affect non-federally regulated waters.

The following narrative serves as a brief primer on the different permitting pathways. The accompanying checklist is intended to help you consider the wetland resources in your project area, and what information, reports and plans the agencies may request for permitting when wetlands are affected by FbD projects.

The CWA involves two permitting entities that work in tandem, yet have their own associated timelines and criteria for permitting. The U.S. Army Corps of Engineers (Corps) operates under Section 404 of the CWA, and Ecology operates under Section 401 of the CWA. The Corps makes the permit pathway decision, determining whether the project needs an Individual 404 permit (IP) or a Nationwide Permit (NWP) for work associated with an FbD project. Then Ecology needs to provide a Section 401 response based on either pathway.

Linked together: state 401 process is responsive to federal 404 permit decision.

The WPCA process involves only Ecology and authorizations are issued as administrative orders (AO) under RCW 90.48.120. Currently, there is no streamlined permit process such as the NWP process, available for wetlands not regulated under the CWA, therefore each project must receive an individual administrative order from Ecology.

CWA Pathway 1: Corps Individual 404 Permit = Ecology Individual Section 401 Water Quality Certification (WQC)

If the Corps determines that an FbD project requires an IP, then Ecology will need to issue a WQC decision prior to the Corps' issuing its permit.

Corps IP:

To obtain a permit from the Corps to fill wetlands or other waters of the United States (US), the Section 404(b)(1) Guidelines must be met. These guidelines require the applicant to take all appropriate and practicable steps to **avoid** and **minimize** adverse impacts to waters of the US. Unavoidable impacts require compensatory mitigation to comply with the Section 404(b)(1) Guidelines.

Ecology WQC:

The purpose is to verify that the project proposal will comply with state water quality standards during construction and operations. The WQC is the state's mechanism to authorize the impacts and require mitigation associated with wetland and other aquatic resource impacts. Ecology's WQC decision can be appealed to the Pollution Control Hearings Board.

Timeline: The Corps establishes what constitutes a "reasonable period of time" for Ecology to issue its decision. According to the CWA, Ecology has no more than one year from the receipt of a WQC request to issue a decision.

CWA Pathway 2: Corps Nationwide Permits → Ecology options: Coordination with Corps and No Further Action clause in NWP 27.

FbD projects are often permitted under NWP 27, Aquatic Habitat Restoration, Enhancement, and Establishment Activities. NWP 27 has specific criteria that the Corps developed to evaluate project proposals. Project designs that meet the conditions for an NWP 27 provide a more predictable process than the individual permit pathway and often a shorter review period for Ecology to make a WQC decision.

NWPs can be a quicker, more predictable permitting pathway than the Individual Permit proces.

If the Corps determines that a proposal for impacts to waters of the US is consistent with the conditions for a Corps NWP, then Ecology has several options under Section 401 of the CWA which are dependent upon state general and specific conditions that are incorporated into the NWPs.

Federal CWA and Nationwide Permits:

The activity must comply with all national and regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)). Additionally, the project must comply with any general or specific conditions added by Ecology, Indian Tribes, or the U.S. EPA pursuant to the CWA. Additionally, Ecology has specific conditions pertaining to the Coastal Zone Management Act.

Ecology options = Individual WQC, No Further Action (coordinated w/ Corps), Deny:

Ecology encourages the applicant to ensure that the proposal will be consistent with all general and specific conditions for NWP 27 during conceptual project design.

If a project qualifies for an NWP 27 and meets the state general and specific WQC conditions, then Ecology may issue a water quality certification. **Note: NWP 27 requires demonstration of net increases in aquatic resource functions and services.**

Timeline: The Corps establishes what constitutes a "reasonable period of time" for Ecology to issue its decision. (INSERT 60 days vs. 1 year). Within that timeframe, Ecology can certify the project or deny it.

Ecology's state general conditions as of March 2017 for NWP 27:

- Compliance with water quality standards for in-water construction activities.
- No further exceedance of specific listed parameter(s) in 303(d)-listed waterbodies.
- Submittal of necessary application materials.
- Consideration of aquatic resources requiring special protection (listed in NWP guidance user manual).
- Mitigation sequence followed. Mitigation plan submitted, if necessary.
- Specific approval of temporary fills in place for more than 90 days.
- Stormwater discharge pollution prevention: all projects must implement prevention and control measures.
- Ecology retains WQC review for Pre-Construction Notifications (PCN) when an applicant has not received a 45-day response from the Corps.

Ecology WQC Review Trigger(s) under NWP 27: Under NWP 27, Ecology WQC review is required if:

The project or activity involves fill in tidal waters.

The project or activity affects ½ acre or more of wetlands.

The project or activity is a mitigation bank or an advance mitigation site.

The project or activity is in or adjoining a known contaminated or cleanup site.

WPCA Permitting Pathway:

Ecology will issue administrative orders (AO) for any work in wetlands or other waters of the state that are not regulated by the Corps pursuant to the Clean Water Act. Typically, if projects are consistent with the conditions established for NWPs (see bulleted list above for examples/or link to NWP document) then the AO process should be timely.

Wetland Considerations:

As described above, most FbD projects will require a permit from the Corps with a WQC action from Ecology, or they will need an administrative order from Ecology alone. As noted in Ecology WQC Review Triggers, the state takes special note of projects that involve fill in tidal waters or wetlands.

Restoration projects are often described as self-mitigating. However, wetland impact-related elements of a proposal require review and consideration. Some projects may propose alterations to or elimination of wetland resources during the process of enhancing or restoring other habitat types.

Ecology will evaluate a proposal to determine if applicants have adequately demonstrated no net loss of wetland function and area or provided a description of the increases in aquatic functions from the project and how those increases compare to the wetland losses. Permitting may include requirements for monitoring, reporting, and adaptive management to ensure that the proposed benefits have been achieved. If the increase to aquatic functions are not sufficient to offset wetland losses, compensatory mitigation may be required.

If you have determined that there are wetlands within the project boundary, or if there is the potential for your FbD project to affect wetlands near your project, Ecology advises you to contact the wetland specialist in your area as soon as possible. Early consultation improves the permitting process. A complete list of Ecology wetland specialists can be found on our website at https://ecology.wa.gov/Water-Shorelines/Wetlands/Tools-resources/Contacts-by-subject-region.

<u>Checklist of things to consider when preparing your project before permit application</u> if wetlands are present in or near (within 300 feet of) the project:

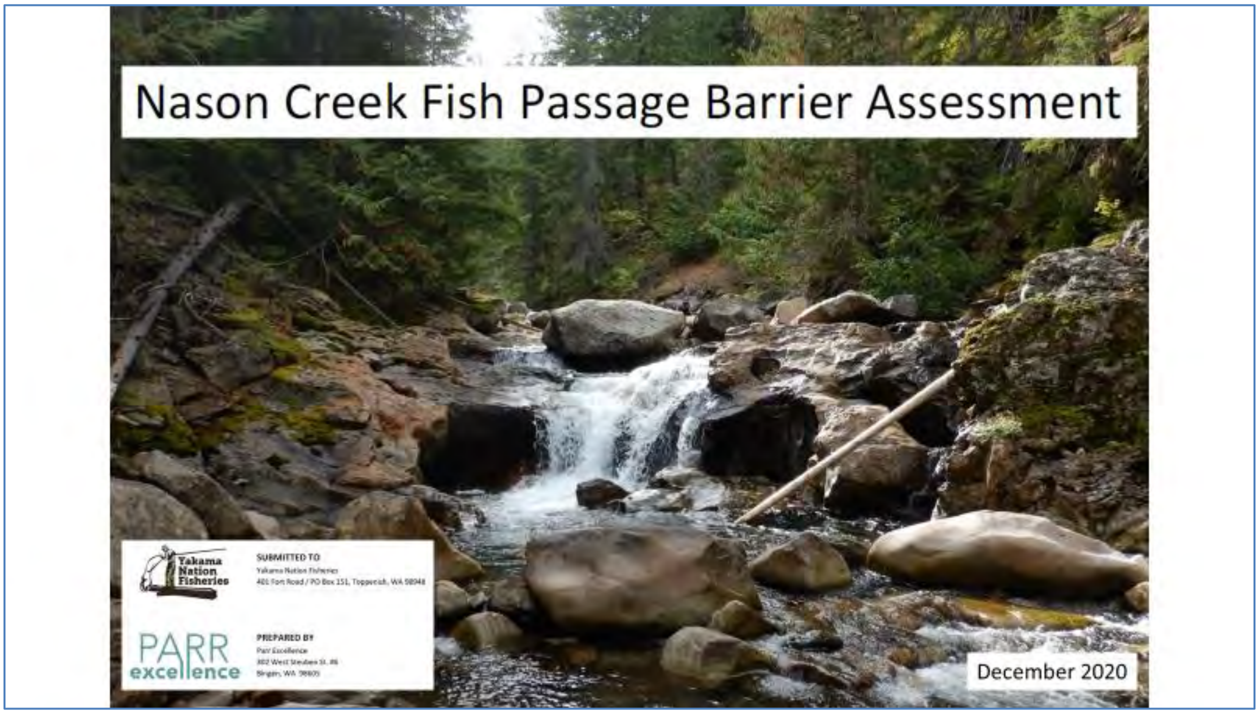
A. Description of the wetland resources	
	Hydrogeomorphic class of the wetland (e.g., depressional, slope, riverine)
	Wetland rating (category)
	Size of the wetland
	Other wetland descriptors (e.g., Prior Converted Cropland, farmed wetland)
	Proximity of the wetland to the project; nature and extent of hydrologic connectivity between the wetland and the project
	Modeling and/or data on wetlands and waterways: inundation levels, hydroperiods, sources of hydrology, gage data, etc.
	Current condition of the waterway (e.g., seasonal/perennial, degraded/impaired, incised/disconnected)

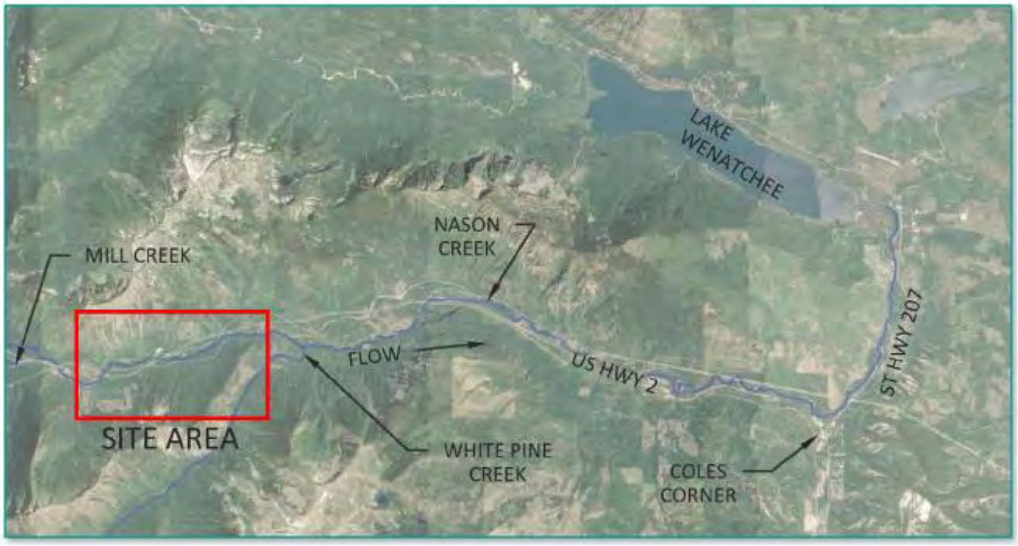
B. Impacts and information required for permitting	
	Type of permanent and temporary wetland impacts proposed
	Applicable local, state, and federal regulations and other permits, approvals, or authorizations required
	Address avoidance and minimization: Consider project design, low-impact development techniques, construction techniques, construction timing, and property management.
	Time of year and hydrologic conditions proposed for work (e.g., spring freshet, fall low water, low summer flows)
	Detail of wetland and waterway impacts (e.g., permanent and temporary, direct and indirect, and conversions of Cowardin or hydrogeomorphic classes) If wetland will be converted from depressional to riverine, hydrologic modeling may be required to demonstrate whether a loss of wetland area will occur. **Note:** Except for the relocation of non-tidal waters on a project site, NWP 27 does not authorize the conversion of a stream or natural wetlands to another aquatic habitat.
	Project construction logistics: sequencing, phasing, staging areas, access roads, easements, rights-of-way. Access is important through long-term monitoring periods associated with projects that have mitigation requirements.

C. Net Environmental Benefit: NWP 27 requires the demonstration of net increases in aquatic resource functions and services. The agencies will require clear demonstration of these benefits.	
	Demonstrate no net loss or Provide a description of the gains in aquatic functions provided by the project and how those gains compare to the wetland losses. Include how you will monitor to assess if the restoration actions result in net gain. If mitigation is needed to provide no net loss, you will need to compare the wetland compensation to the wetland impacts. For this assessment, Ecology encourages use of the Credit/Debit tool, which can be accessed at the following link: http://www.ecy.wa.gov/programs/sea/wetlands/mitigation/creditdebit/index.html
	If your project requires compensatory wetland mitigation for wetland impacts you will need to address the following;
	Monitoring and adaptive management plan, and contingency measures (should the restoration not result in the desired outcome).
	Long-term (5-10 yr. horizon) operation and maintenance plan.
	Assurance that water is available for irrigation, plant survival, etc.
	Water Quality Monitoring and Protection Plan and applicable construction plans.

Attachment 4

Presentation on Nason Creek Fish Passage Barrier Assessment by Parr Excellence

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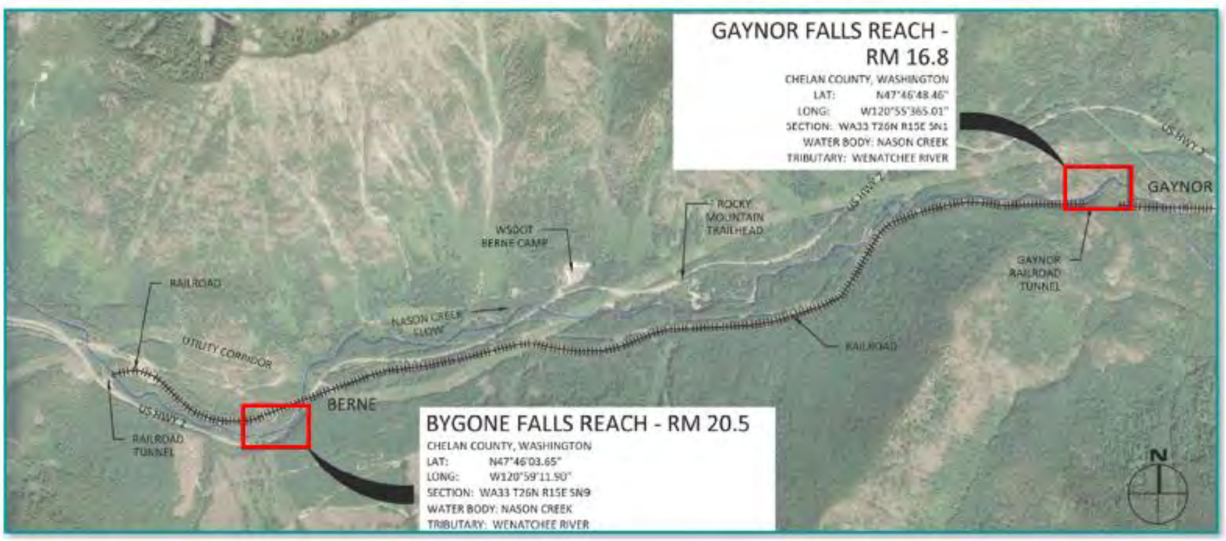
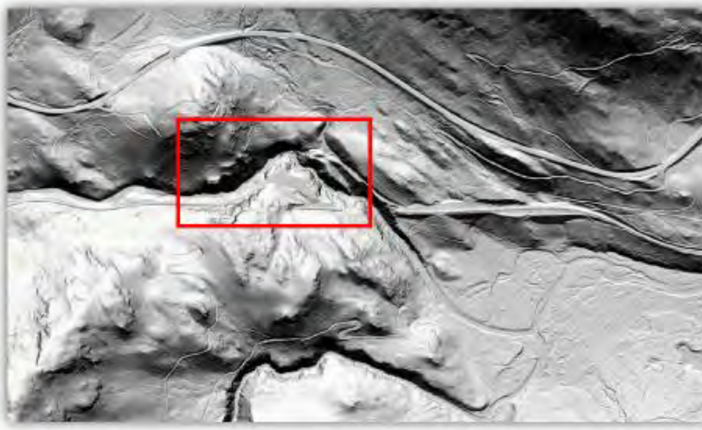
NASON CREEK
MILL CREEK
FLOW
US HWY 2
ST HWY 207
SITE AREA
WHITE PINE CREEK
COLES CORNER


GAYNOR FALLS REACH - RM 16.8
CHELAN COUNTY, WASHINGTON
LAT: N47°46'48.46"
LONG: W120°55'365.01"
SECTION: WA33 T26N R15E SN1
WATER BODY: NASON CREEK
TRIBUTARY: WENATCHEE RIVER
GAYNOR
ROCKY MOUNTAIN TRAILHEAD
WSDOT BERNE CAMP
GAYNOR RAILROAD TUNNEL
RAILROAD
NASON CREEK FLOW
UTILITY CORRIDOR
RAILROAD
BERNE
RAILROAD TUNNEL
BYGONE FALLS REACH - RM 20.5
CHELAN COUNTY, WASHINGTON
LAT: N47°46'03.65"
LONG: W120°59'11.90"
SECTION: WA33 T26N R15E SN9
WATER BODY: NASON CREEK
TRIBUTARY: WENATCHEE RIVER
N

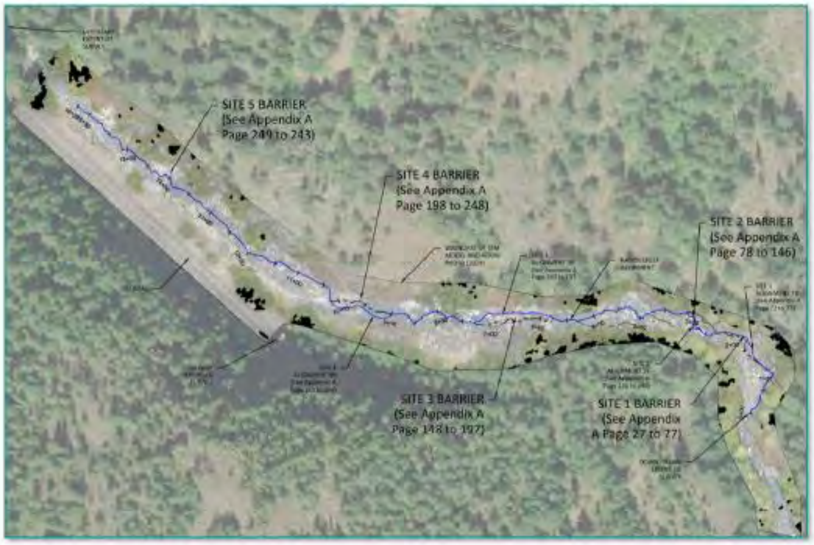
GAYNOR FALLS REACH



GAYNOR FALLS REACH

GAYNOR FALLS REACH

- Narrowly Confined Bedrock Canyon
- 5 Barrier Sites
- 1,500 FT Analysis Area



BYGONE FALLS

BYGONE FALLS

BYGONE FALLS

- Large Bedrock Step in the Streambed
- 1 Barrier Site
- 862 FT Analysis Area

Methods - Survey

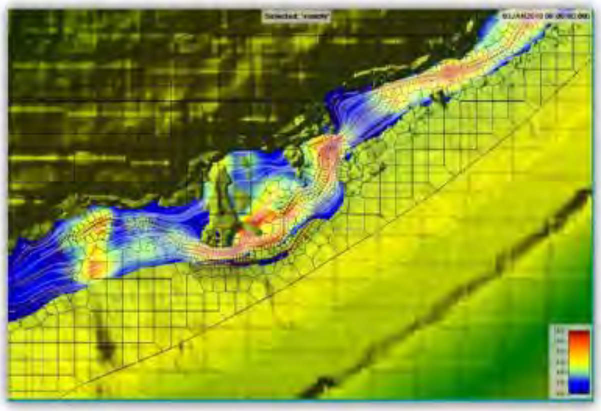
- Real Time Kinetic (RTK) survey for photogrammetric processing controls
- Total Station survey of thalweg and cross-section at hydraulic controls
- Multi-elevation UAV aerial photogrammetry

Methods – DEM Construction

- Photogrammetry processed with Structure from Motion (SfM) software
- Photogrammetry (SfM) composited with Total Station bathymetric data (5-cm accuracy)
- Topography and Bathymetry were combined with existing LiDAR to create DEM

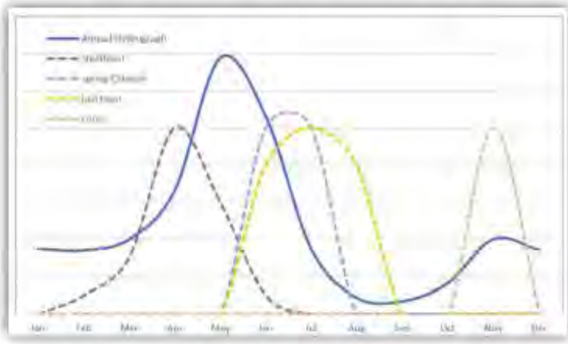
Methods – Hydraulic Modeling and Calibration

- HECRAS v 5.0.7 for hydraulic modeling
- 2-dimensional computational mesh of 5-feet cell dimensions
- 1-foot dimensional mesh in areas of hydraulic complexity
- Calibrated to water surface elevations at 14 cfs (time of survey)
- Calibrated model agreed with observed flows within 0.1 feet.



Methods – Fish Passage Flow Estimates

- Estimated Migration Timing (Nason Creek Tributary Assessment (BOR, 2008), Peven, 2003, and Murdoch, 2019).
- Log-Pearson Type III analysis of instantaneous peak flow data from Icicle, Chiwawa, and Entiat river basins.
- Discharge values were normalized by the basin area (ft3/s per mi2 = Q/A)
- Q/A multiplied by the contributing drainage area at each study site.



Basin Delineation Location	Basin Area (miles^2)	2-year (ft^3/s)	10-year (ft^3/s)	25-year (ft^3/s)	50-year (ft^3/s)	100-year (ft^3/s)
Gaynor Falls	34.8	647	1,106	1,365	1,573	1,792
Bygone Byways	25.57	475	812	1,003	1,155	1,316

Methods – Fish Passage Flow Estimates

- DOE flow gage near the mouth of Nason Creek with 15 complete years
- 16 miles downstream of study area – but best quantitative set for analysis
- Daily average flows from species specific migration time periods separated and sorted into 95% and 5% exceedance flows for low and high fish passage flows
- Average time period flows also calculated
- Results were scaled down by drainage basin area ratios to develop site-specific fish passage flows

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gaynor Falls	87	85	99	165	344	266	87	22	17	41	100	85
Bygone Byways	64	62	73	122	253	196	64	16	13	30	73	63

	Gaynor Falls			Bygone Byways		
Species	Q_{Low}	Q_{Ave}	Q_{High}	Q_{Low}	Q_{Ave}	Q_{High}
steelhead	38	165	505	28	122	371
spring Chinook salmon	12	87	550	8	64	404
bull trout	9	87 | 266	514	7	64 | 196	378
coho salmon	24	100	182	17	73	134

Methods – Fish Passage Criteria

- Leaping Criteria - WDFW Fish Passage Inventory, Assessment, and Prioritization Manual (2019)
- Green Water Burst and Sustained Speed Criteria - Bell (1986)
- Coefficient for fatigue (Powers and Orsborn, 1985)
- Eneregy Dissipation Factor (EDF - Powers and Orsborn 1985, WDFW 2019, and NMFS 2011)

Criteria, Adult	**Burst Speed, <5 seconds (Cf 0.75)**	**Sustained Speed, several minutes (Cf 0.75)**	**Leaping Height (ft) (80% Leap Angle)**	**Leaping Height (ft) (40% Leap Angle)**
steelhead	19.5 fps, Bell (1986)	10.5 fps, Bell (1986)	10 WDFW (2019)	4.5 WDFW (2019)
spring Chinook	16.5 fps, Bell (1986)	8.25 fps, Bell (1986)	7.5 WDFW (2019)	3 WDFW (2019)
bull trout	16.5 fps, Bell (1986)	8.25 fps, Bell (1986)	7.5 WDFW (2019)	3 WDFW (2019)
Coho salmon	15.75 fps, Bell (1986)	8.25 fps, Bell (1986)	7 WDFW (2019)	3 WDFW (2019)

$$EDF = y \times Q \times H/V$$

Methods – Alternate Routes

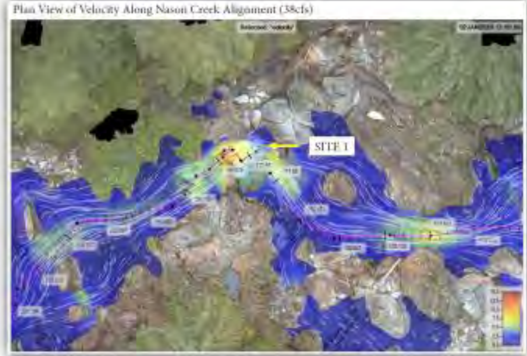
- Using steelhead migration flows
- Color gradient depth and velocity maps produced in HEC GEO-RAS to identify potential pathways
- Comparison of model outputs with fish passage thresholds occurred for these alternate routes as well

Analysis

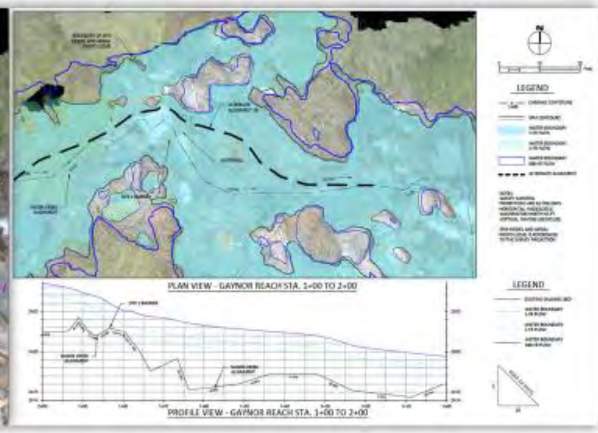
- Qlow/Qave/Qhigh runs for each species
- For Each Run:
  1. Evaluated Velocity Barriers
  2. Evaluated Depth
  3. All Barriers from 1&2 Assessed for "Jumpability"
  4. If "Jumpable" – EDF calculated

Passage Factor	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
Sustained Swimmability?	"Y" / "N" / "N/A"	"Y" / "N" / "N/A"	"Y" / "N" / "N/A"
Burst Swimmability?	"Y" / "N" / "N/A"	"Y" / "N" / "N/A"	"Y" / "N" / "N/A"
Jumpability?	"Y" / "N" / "N/A"	"Y" / "N" / "N/A"	"Y" / "N" / "N/A"

Plan View of Velocity Along Nason Creek Alignment (38cfs)



Results – Site 1 – Gaynor Reach



Results – Site 1 – Gaynor Reach

Steelhead Passage

Gaynor Falls - Site 1 Appendix A, pgs 27-77; Appendix B, pg 54	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	38 Appendix A, pgs 33-46	995 Appendix A, pgs 51-53	995 Appendix A, pgs 60-65
Max Velocity (ft/s)	12	13.7	15.8
Water Surface Slope (ft/ft)	0.18	0.18	0.18
Max Swim Distance (ft)	30	31	35
Min Swim Depth (ft)	0.2 [illegible]	1.7	2.4
Max Jump Height (ft)	5.4	N/A	N/A
Max Jump Distance (ft)	N/A	N/A	N/A
Plunge Pool Depth (ft)	N/A	N/A	N/A
Plunge Pool EDF	N/A	N/A	N/A
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	N	Y	Y
Jumpability? (Y/N)	N/A	N/A	N/A

Spring Chinook Passage

Gaynor Falls - Site 1 Appendix A, pgs 27-77; Appendix B, pg 54	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	13 Appendix A, pgs 33-35	87 Appendix A, pgs 45-47	160 Appendix A, pgs 58-71
Max Velocity (ft/s)	8.7	13.4	15.2
Water Surface Slope (ft/ft)	0.22	0.19	0.19
Max Swim Distance (ft)	21	38	38
Min Swim Depth (ft)	0.04	0.8	2.4
Max Jump Height (ft)	4.7	N/A	N/A
Max Jump Distance (ft)	4	N/A	N/A
Plunge Pool Depth (ft)	2.2	N/A	N/A
Plunge Pool EDF	52.3	N/A	N/A
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	Y	Y
Jumpability? (Y/N)	[illegible]	N/A	N/A

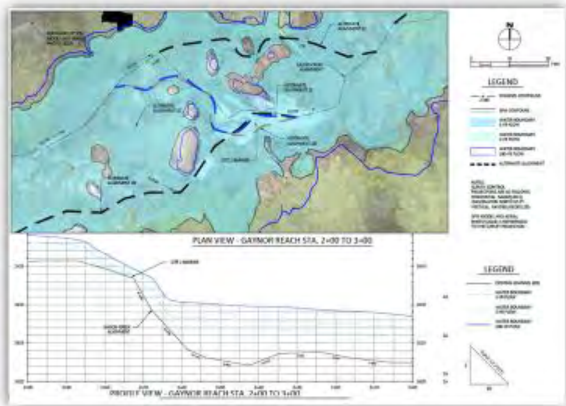
Bull Trout Passage

Gaynor Falls - Site 1 Appendix A, pgs 27-77; Appendix B, pg 54	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	9 Appendix A, pgs 27-29	260 Appendix A, pgs 40-42	334 Appendix A, pgs 64-66
Max Velocity (ft/s)	6	14.2	15.2
Water Surface Slope (ft/ft)	0.33	0.20	0.19
Max Swim Distance (ft)	21	33	35
Min Swim Depth (ft)	0	1.3	2.2
Max Jump Height (ft)	4.8	N/A	N/A
Max Jump Distance (ft)	9.8	N/A	N/A
Plunge Pool Depth (ft)	2.4	N/A	N/A
Plunge Pool EDF	36.7	N/A	N/A
Sustained Swimmability? (Y/N)	Y	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	Y	Y
Jumpability? (Y/N)	[illegible]	N/A	N/A

Coho Passage

Gaynor Falls - Site 1 Appendix A, pgs 27-77; Appendix B, pg 54	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	24 Appendix A, pgs 30-34	150 Appendix A, pgs 43-45	182 Appendix A, pgs 54-56
Max Velocity (ft/s)	10	13.4	17.5
Water Surface Slope (ft/ft)	0.27	0.30	0.19
Max Swim Distance (ft)	21	28	22.2
Min Swim Depth (ft)	0.02	0.61	1.2
Max Jump Height (ft)	4.7	N/A	N/A
Max Jump Distance (ft)	0.7	N/A	N/A
Plunge Pool Depth (ft)	2	N/A	N/A
Plunge Pool EDF	115.0	N/A	N/A
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	Y	Y
Jumpability? (Y/N)	[illegible]	N/A	N/A

Results – Site 2 – Gaynor Reach



Results – Site 2 – Gaynor Reach

Steelhead Passage

Gaynor Falls - Site 2 Appendix A, pgs [illegible]	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	38 Appendix A, pgs [illegible]	165 (Alt Alignment C) Appendix A, pgs [illegible]	505 Appendix A, pgs [illegible]
Max Velocity (ft/s)	7.9	17.2	17.6
Max Water Surface Slope (ft/ft)	0.27	0.25	0.25
Max Swim Distance (ft)	41.8	5.5	12.1
Min Swim Depth (ft)	0.2	0.64	0.93
Max Jump Height (ft)	11.1	N/A	N/A
Max Jump Distance (ft)	27.5	N/A	N/A
Plunge Pool Depth (ft)	2.5	N/A	N/A
Plunge Pool EDF	54.0	N/A	N/A
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	Y	Y
Jumpability? (Y/N)	[illegible]	N/A	N/A

Spring Chinook Passage

Gaynor Falls - Site 2 Appendix A, pgs [illegible]	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	12 Appendix A, pgs [illegible]	87 Appendix A, pgs [illegible]	550 Appendix A, pgs [illegible]
Max Velocity (ft/s)	6	11	16
Water Surface Slope (ft/ft)	0.24	0.26	0.34
Max Swim Distance (ft)	42.5	43	80.6
Min Swim Depth (ft)	0.04	0.2	0.7
Max Jump Height (ft)	10	11.1	9.9
Max Jump Distance (ft)	3.5	16.7	2
Plunge Pool Depth (ft)	1.8	3.6	8.1
Plunge Pool EDF	38.3	587.0	1740.7
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	[illegible]	Y
Jumpability? (Y/N)	[illegible]	[illegible]	N/A

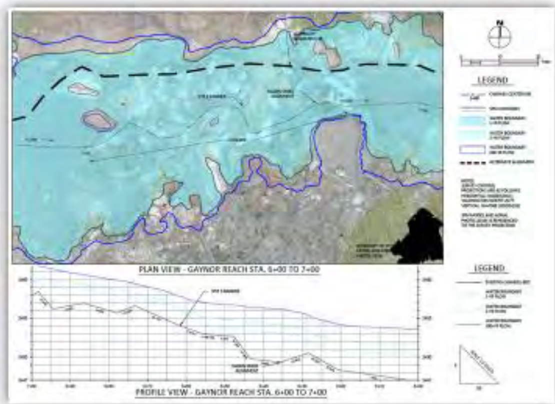
Bull Trout Passage

Gaynor Falls - Site 2 Appendix A, pgs [illegible]	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	9 Appendix A, pgs [illegible]	266 Appendix A, pgs [illegible]	514 Appendix A, pgs [illegible]
Max Velocity (ft/s)	5.6	13.5	19.3
Water Surface Slope (ft/ft)	0.26	0.25	0.24
Max Swim Distance (ft)	43.2	43.2	14
Min Swim Depth (ft)	0	0.5	1
Max Jump Height (ft)	21.1	11	9.3
Max Jump Distance (ft)	50	7.4	2.2
Plunge Pool Depth (ft)	2.2	4.6	5.9
Plunge Pool EDF	29.8	1297.1	2852.2
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	[illegible]	Y
Jumpability? (Y/N)	[illegible]	[illegible]	N/A

Coho Passage

Gaynor Falls - Site 2 Appendix A, pgs [illegible]	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	24 Appendix A, pgs [illegible]	500 Appendix A, pgs [illegible]	182 Appendix A, pgs [illegible]
Max Velocity (ft/s)	7.4	10.5	13.5
Water Surface Slope (ft/ft)	0.26	0.26	0.26
Max Swim Distance (ft)	42	43.2	48
Min Swim Depth (ft)	0.1	0.2	0.2
Max Jump Height (ft)	11	11.2	10.9
Max Jump Distance (ft)	3.6	15.5	12.5
Plunge Pool Depth (ft)	5.1	3.8	4.8
Plunge Pool EDF	59.9	603.0	951.2
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Jumpability? (Y/N)	[illegible]	[illegible]	[illegible]

Results – Site 3 – Gaynor Reach



Results – Site 3 – Gaynor Reach

Steelhead Passage

Gaynor Falls – Site 3 Appendix A, pgs 147-197; Appendix B, pg 68	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	38 Appendix A, pgs [illegible]	165 Appendix A, pgs [illegible]	505 Appendix A, pgs [illegible]
Max Velocity (ft/s)	9.0	11.5	14.8
Water Surface Slope (ft/ft)	0.22	0.17	0.17
Max Swim Distance (ft)	74	59	59
Min Swim Depth (ft)	0.2	0.5	1.4
Max Jump Height (ft)	2.8	N/A	N/A
Max Jump Distance (ft)	8.2	N/A	N/A
Plunge Pool Depth (ft)	2.6	N/A	N/A
Plunge Pool EDF	28.5	N/A	N/A
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	Y	Y
Jumpability? (Y/N)	[illegible]	N/A	N/A

Spring Chinook Passage

Gaynor Falls – Site 3 Appendix A, pgs 147-197; Appendix B, pg 68	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	12 Appendix A, pgs [illegible]	87 Appendix A, pgs [illegible]	330 Appendix A, pgs [illegible]
Max Velocity (ft/s)	6	11.4	15.2
Water Surface Slope (ft/ft)	0.14	0.17	0.17
Max Swim Distance (ft)	79.4	64	58
Min Swim Depth (ft)	0.1	0.4	1.5
Max Jump Height (ft)	3.2	2.6	N/A
Max Jump Distance (ft)	12	12	N/A
Plunge Pool Depth (ft)	3.9	5.2	N/A
Plunge Pool EDF	13.1	47.2	N/A
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	[illegible]	Y
Jumpability? (Y/N)	Y	[illegible]	N/A

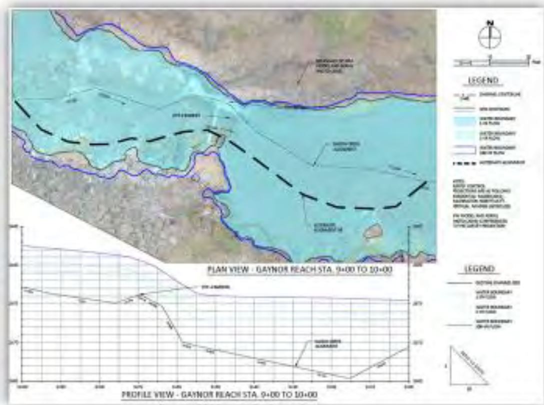
Bull Trout Passage

Gaynor Falls – Site 3 Appendix A, pgs 147-197; Appendix B, pg 68	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	9 Appendix A, pgs [illegible]	206 Appendix A, pgs [illegible]	514 Appendix A, pgs [illegible]
Max Velocity (ft/s)	5	12.9	14.5
Water Surface Slope (ft/ft)	0.24	0.16	0.09
Max Swim Distance (ft)	80	78	59
Min Swim Depth (ft)	0.01	0.83	1.4
Max Jump Height (ft)	3.2	N/A	N/A
Max Jump Distance (ft)	14.6	N/A	N/A
Plunge Pool Depth (ft)	1.8	N/A	N/A
Plunge Pool EDF	19.3	N/A	N/A
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	Y	Y
Jumpability? (Y/N)	Y	N/A	N/A

Coho Passage

Gaynor Falls – Site 3 Appendix A, pgs 147-197; Appendix B, pg 68	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	24 Appendix A, pgs [illegible]	109 Appendix A, pgs [illegible]	182 Appendix A, pgs [illegible]
Max Velocity (ft/s)	5.3	11.3	13.6
Water Surface Slope (ft/ft)	0.18	0.13	0.14
Max Swim Distance (ft)	75	85	58
Min Swim Depth (ft)	0.1	0.3	0.5
Max Jump Height (ft)	3.2	2.4	N/A
Max Jump Distance (ft)	12.5	11.9	N/A
Plunge Pool Depth (ft)	2.2	4.5	N/A
Plunge Pool EDF	22.8	94.3	N/A
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	[illegible]	Y
Jumpability? (Y/N)	[illegible]	[illegible]	N/A

Results – Site 4 – Gaynor Reach



Results – Site 4 – Gaynor Reach

Steelhead Passage

Gaynor Falls - Site 4	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	38	135	385 (Alt Alignment 5)
Max Velocity (ft/s)	11.8	15.2	16.02
Water Surface Slope (ft/ft)	0.42	0.42	0.42
Max Swim Distance (ft)	11.8	26.9	14.6
Min Swim Depth (ft)	0.8	2.3	1.04
Max Jump Height (ft)	N/A	N/A	N/A
Max Jump Distance (ft)	N/A	N/A	N/A
Plunge Pool Depth (ft)	N/A	N/A	N/A
Plunge Pool EDF	N/A	N/A	N/A
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	Y	Y	Y
Jumpability? (Y/N)	N/A	N/A	N/A

Spring Chinook Passage

Gaynor Falls - Site 4	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	12	87	350
Max Velocity (ft/s)	8.25	13.1	21.0
Water Surface Slope (ft/ft)	0.22	0.30	0.28
Max Swim Distance (ft)	14.6	20.5	25.4
Min Swim Depth (ft)	0.5	1.8	3.8
Max Jump Height (ft)	4.7	N/A	5.8
Max Jump Distance (ft)	12.6	N/A	13
Plunge Pool Depth (ft)	6.2	N/A	8.8
Plunge Pool EDF	0.7	N/A	27.4
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	Y	[illegible]
Jumpability? (Y/N)	Y	N/A	[illegible]

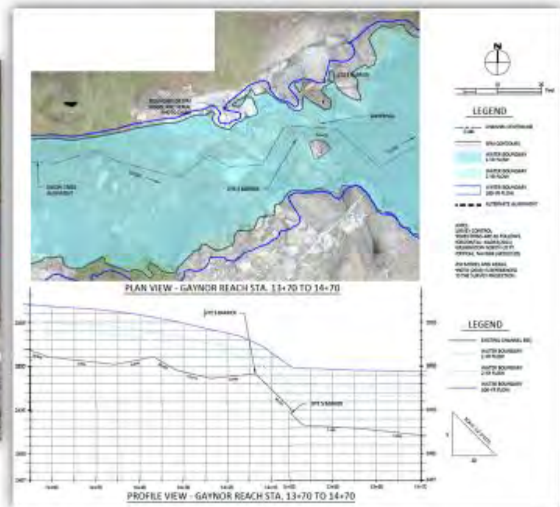
Bull Trout Passage

Gaynor Falls - Site 4	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	9	266	514
Max Velocity (ft/s)	7.6	17.4	21.3
Water Surface Slope (ft/ft)	0.18	0.27	0.29
Max Swim Distance (ft)	29.5	34	29.5
Min Swim Depth (ft)	0.2	2.8	3.7
Max Jump Height (ft)	5.8	6.5	7.6
Max Jump Distance (ft)	12.9	13.5	12.9
Plunge Pool Depth (ft)	6.1	8	8.7
Plunge Pool EDF	0.8	26.7	31.7
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Jumpability? (Y/N)	[illegible]	N	[illegible]

Coho Passage

Gaynor Falls - Site 4	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	26	180	182
Max Velocity (ft/s)	10	12.9	15.8
Water Surface Slope (ft/ft)	0.27	0.28	0.27
Max Swim Distance (ft)	22.7	22.2	21.5
Min Swim Depth (ft)	0.6	1.8	2.3
Max Jump Height (ft)	N/A	N/A	6.3
Max Jump Distance (ft)	N/A	N/A	16.9
Plunge Pool Depth (ft)	N/A	N/A	7.3
Plunge Pool EDF	N/A	N/A	11.3
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	N
Burst Swimmability? (Y/N)	Y	Y	[illegible]
Jumpability? (Y/N)	N/A	N/A	Y

Results – Site 5 – Gaynor Reach



Results – Site 5 – Gaynor Reach

Steelhead Passage

Gaynor Falls - Site 5	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	34	163	305
	Appendix A, pgs. [illegible]	Appendix A, pgs. [illegible]	Appendix A, pgs. [illegible]
Max Velocity (ft/s)	18.1	13	17.6
Water Surface Slope (ft/ft)	0.41	0.43	0.40
Max Swim Distance (ft)	12.1	14.1	11.6
Min Swim Depth (ft)	0.4	1.2	1.4
Max Jump Height (ft)	3	N/A	N/A
Max Jump Distance (ft)	11.7	N/A	N/A
Plunge Pool Depth (ft)	3.3	N/A	N/A
Plunge Pool EDF	4.1	N/A	N/A
Sustained Swimmability? (Y/N)	N	[illegible]	[illegible]
Burst Swimmability? (Y/N)	N	Y	Y
Jumpability? (Y/N)	Y	N/A	N/A

Spring Chinook Passage

Gaynor Falls - Site 5	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	12	87	560
	Appendix A, pgs. [illegible]	Appendix A, pgs. [illegible]	Appendix A, pgs. [illegible]
Max Velocity (ft/s)	8.6	11.4	20.2
Water Surface Slope (ft/ft)	0.42	0.38	0.38
Max Swim Distance (ft)	12.1	12.1	11.6
Min Swim Depth (ft)	0.4	0.6	2.4
Max Jump Height (ft)	3.1	N/A	4.5
Max Jump Distance (ft)	12.9	N/A	11.4
Plunge Pool Depth (ft)	4.0	N/A	7.2
Plunge Pool EDF	1.4	N/A	96.3
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	Y	[illegible]
Jumpability? (Y/N)	Y	N/A	[illegible]

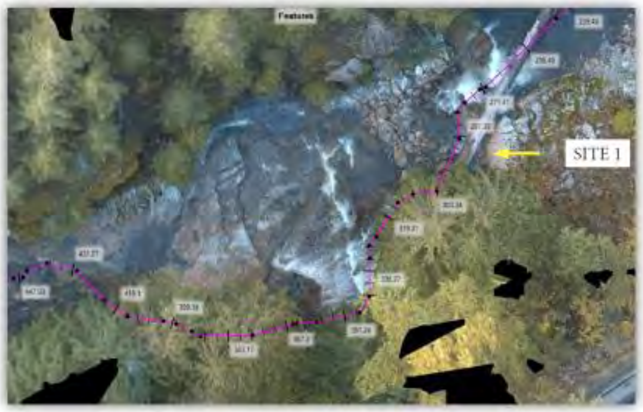
Bull Trout Passage

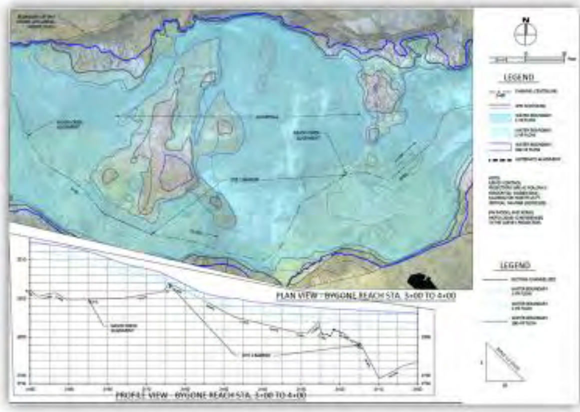
Gaynor Falls - Site 5	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	9	266	514
	Appendix A, pgs. [illegible]	Appendix A, pgs. [illegible]	Appendix A, pgs. [illegible]
Max Velocity (ft/s)	6.1	14.8	19.7
Water Surface Slope (ft/ft)	0.40	0.37	0.35
Max Swim Distance (ft)	12.2	12.5	11.6
Min Swim Depth (ft)	0.2	1.6	2.3
Max Jump Height (ft)	3	N/A	4.5
Max Jump Distance (ft)	12.5	N/A	12.5
Plunge Pool Depth (ft)	4.8	N/A	7.5
Plunge Pool EDF	1.1	N/A	33.0
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	Y	[illegible]
Jumpability? (Y/N)	Y	N/A	[illegible]

Coho Passage

Gaynor Falls - Site 5	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	24	108	182
	Appendix A, pgs. [illegible]	Appendix A, pgs. [illegible]	Appendix A, pgs. [illegible]
Max Velocity (ft/s)	10	11.6	12.8
Water Surface Slope (ft/ft)	0.41	0.38	0.38
Max Swim Distance (ft)	12.4	12.2	11.7
Min Swim Depth (ft)	0.2	0.6	1.3
Max Jump Height (ft)	3	N/A	N/A
Max Jump Distance (ft)	12.9	N/A	N/A
Plunge Pool Depth (ft)	3.1	N/A	N/A
Plunge Pool EDF	2.1	N/A	N/A
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	Y	Y
Jumpability? (Y/N)	Y	N/A	N/A

Results – Site 1 – Bygone Reach





Results – Site 1 – Bygone Reach

Steelhead Passage

Bygone Byways - Site 1	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	78	122	371
Max Velocity (ft/s)	9	10.2	10.9
Water Surface Slope (ft/ft)	0.08	0.10	0.30
Max Swim Distance (ft)	51.2	103	59.1
Min Swim Depth (ft)	0	0.4	0.8
Max Jump Height (ft)	7.3	6.5	N/A
Max Jump Distance (ft)	48.7	41.9	N/A
Plunge Pool Depth (ft)	2.9	4	N/A
Plunge Pool EDF	15.5	48.3	N/A
Sustained Swimmability? (Y/N)	[illegible]	N	N
Burst Swimmability? (Y/N)	[illegible]	N	Y
Jumpability? (Y/N)	[illegible]	[illegible]	N/A

Spring Chinook Passage

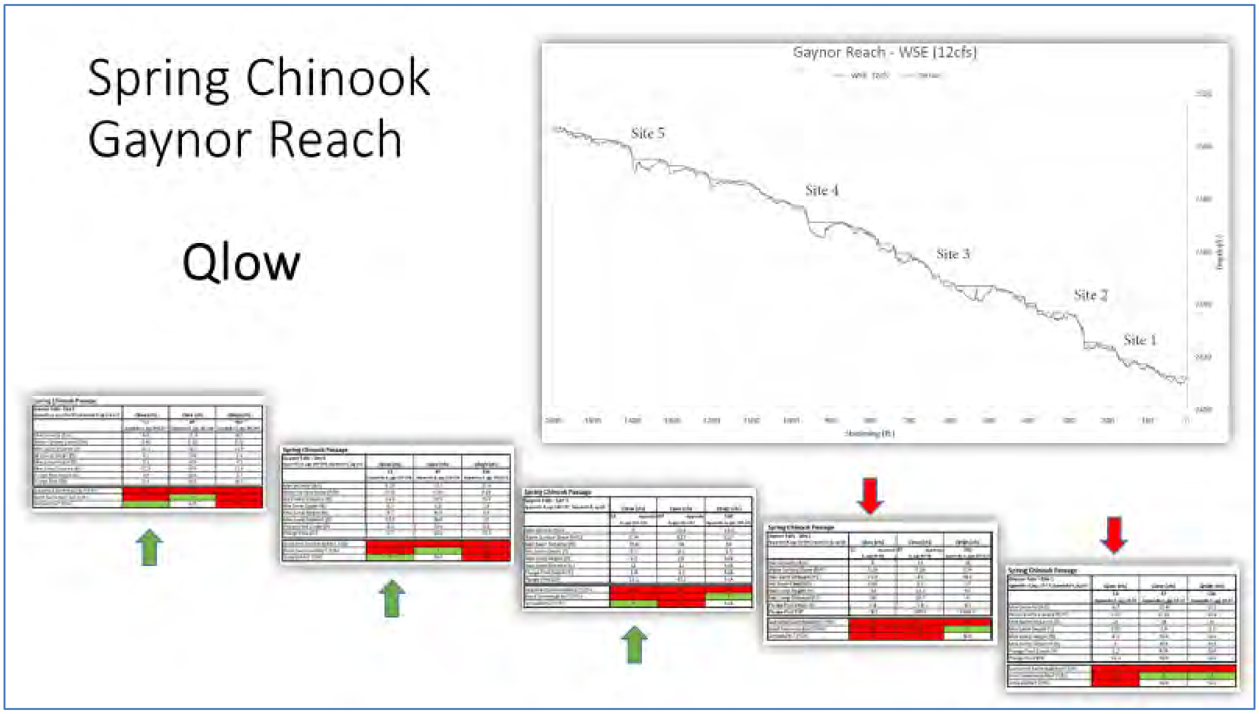
Bygone Byways - Site 1	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	8	64	404
Max Velocity (ft/s)	5.1	7.1	11.3
Water Surface Slope (ft/ft)	0.12	0.11	0.10
Max Swim Distance (ft)	51.7	40.4	38.1
Min Swim Depth (ft)	0	0.2	0.8
Max Jump Height (ft)	7.5	3.6	N/A
Max Jump Distance (ft)	57.2	40.4	N/A
Plunge Pool Depth (ft)	2.4	3.3	N/A
Plunge Pool EDF	25	16.1	N/A
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Jumpability? (Y/N)	[illegible]	[illegible]	N/A

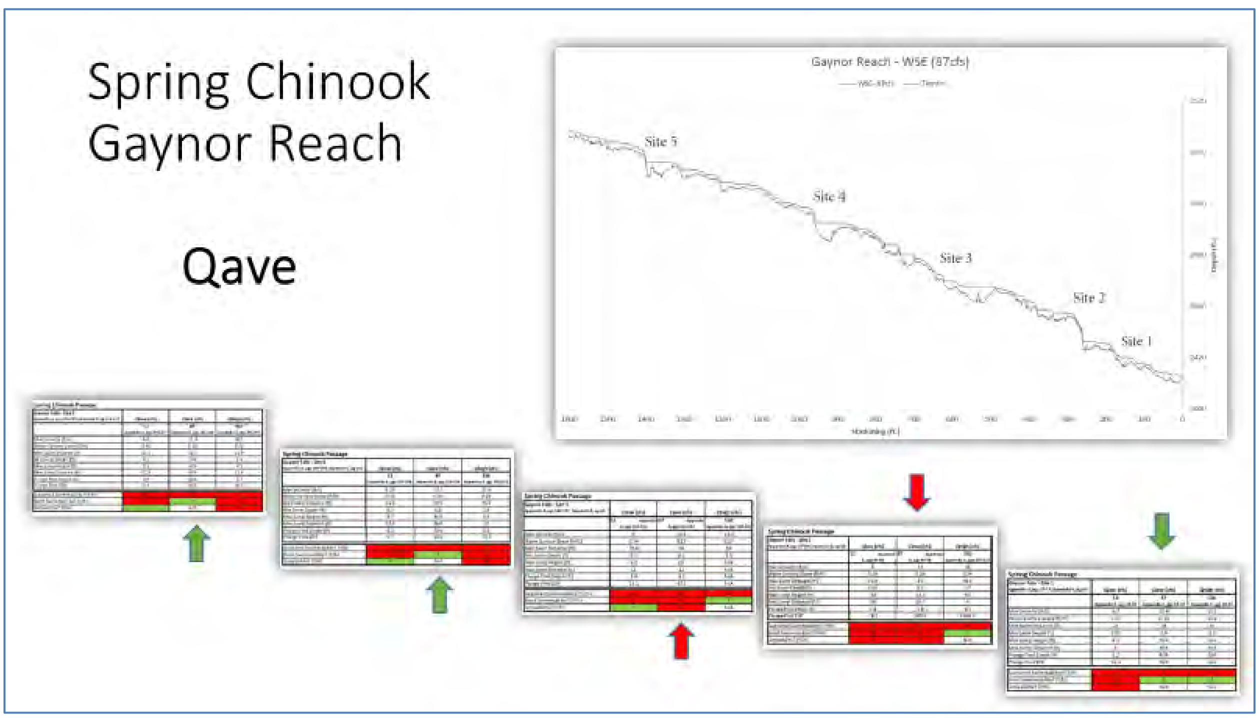
Bull Trout Passage

Bygone Byways - Site 1	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	7	106	371
Max Velocity (ft/s)	5	3.1	10.9
Water Surface Slope (ft/ft)	0.12	0.11	0.30
Max Swim Distance (ft)	55.9	87.9	95.4
Min Swim Depth (ft)	0	0	0.7
Max Jump Height (ft)	7.5	2.7	N/A
Max Jump Distance (ft)	50.2	28.4	N/A
Plunge Pool Depth (ft)	2.8	4.3	N/A
Plunge Pool EDF	5.8	36.8	N/A
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Jumpability? (Y/N)	[illegible]	[illegible]	N/A

Coho Passage

Bygone Byways - Site 1	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	12	73	128
Max Velocity (ft/s)	5.7	7.2	4.5
Water Surface Slope (ft/ft)	0.11	0.11	0.12
Max Swim Distance (ft)	59.1	58.4	87.2
Min Swim Depth (ft)	0	0	0.3
Max Jump Height (ft)	7.2	7	6.8
Max Jump Distance (ft)	59.2	46.6	44.2
Plunge Pool Depth (ft)	2.6	3.5	3.9
Plunge Pool EDF	13.9	31.6	50.5
Sustained Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Burst Swimmability? (Y/N)	[illegible]	[illegible]	[illegible]
Jumpability? (Y/N)	[illegible]	[illegible]	[illegible]

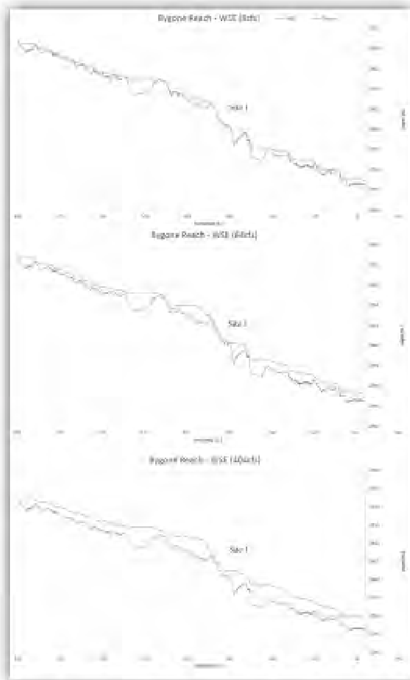

Spring Chinook
Gaynor Reach
Qlow
Gaynor Reach - WSE (12cfs)
Site 5
Site 4
Site 3
Site 2
Site 1


Spring Chinook
Gaynor Reach
Qave
Gaynor Reach - WSE (87cfs)
Site 5
Site 4
Site 3
Site 2
Site 1

Spring Chinook
Gaynor Reach

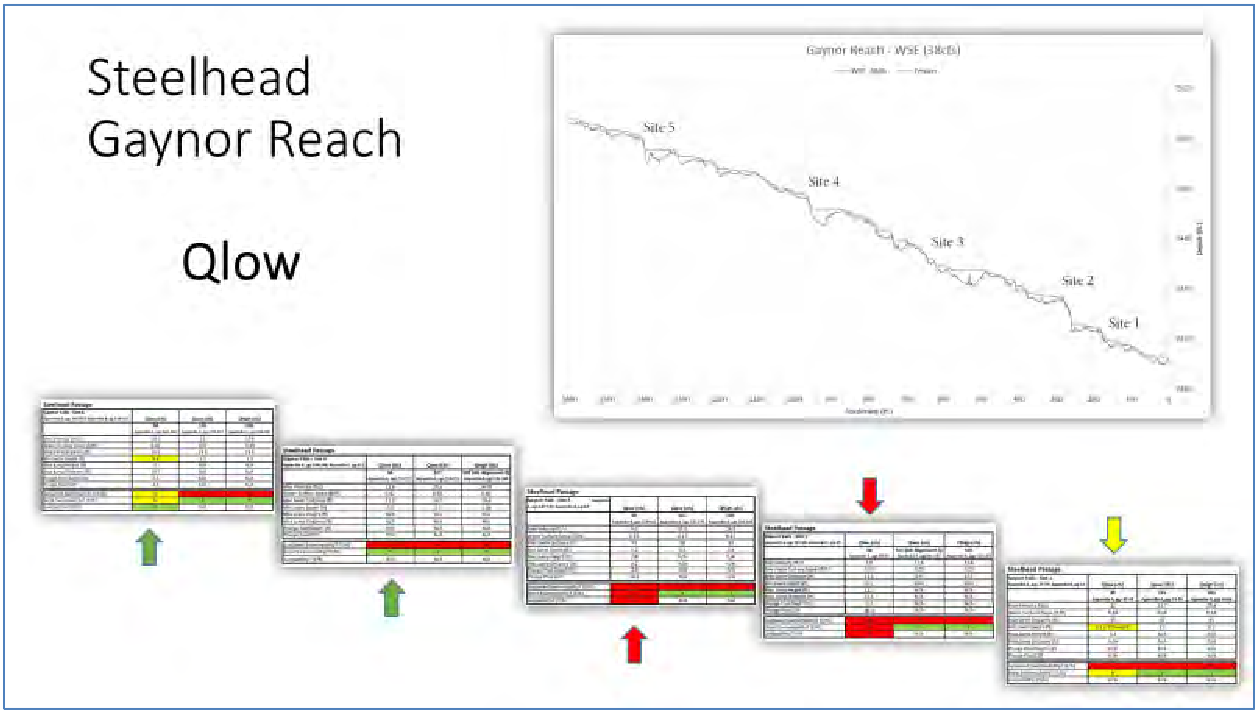
Qhigh

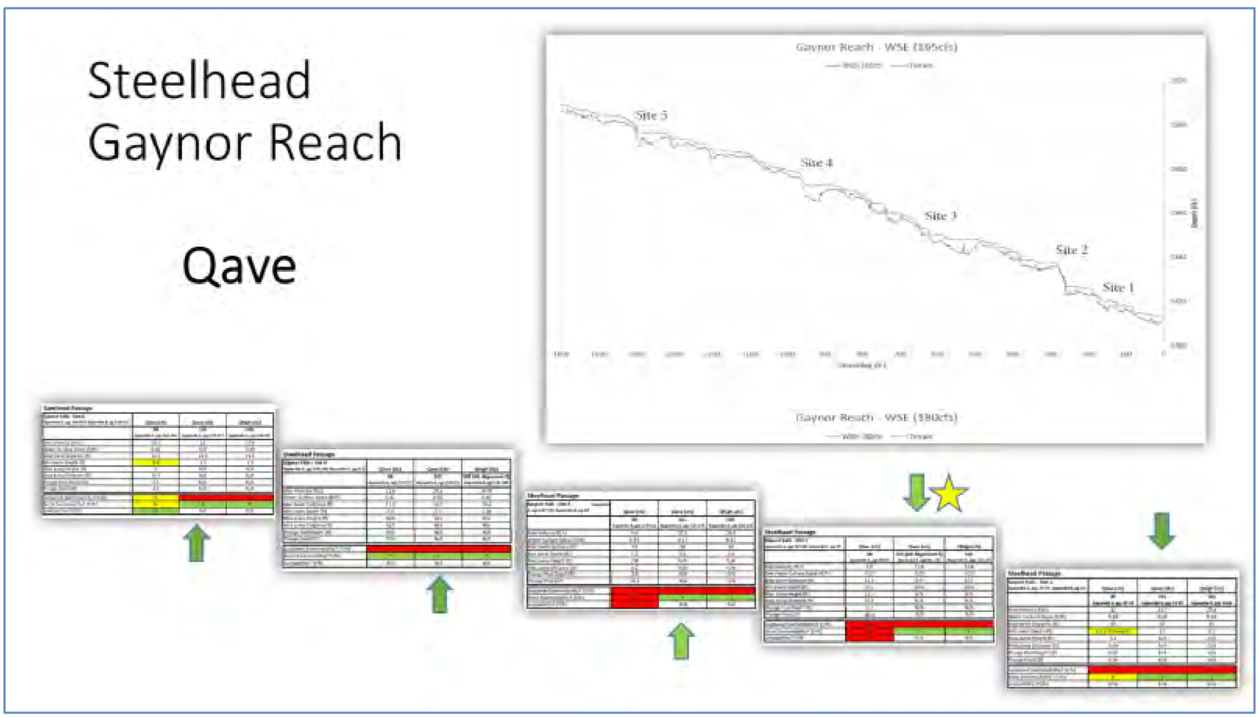
Spring Chinook
Bygone Reach



Spring Chinook Passage

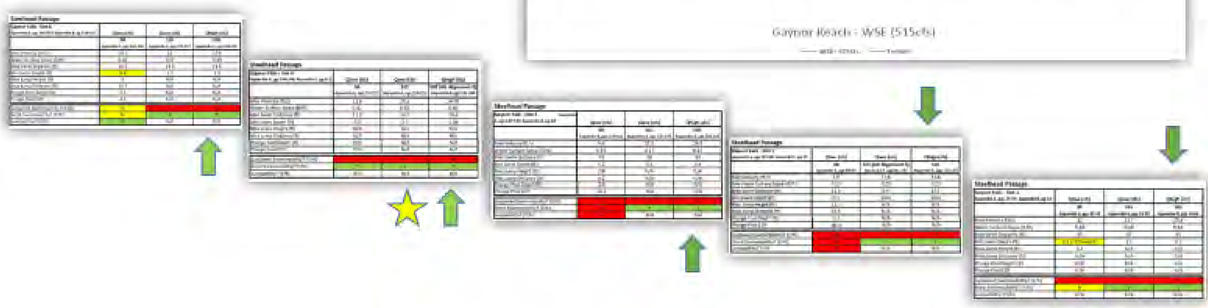
Bygone Byways - Site 1 Appendix A, pgs 354-358; Appendix B, pg B1, B3, B6	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	8 Appendix A, pgs 329-332	64 Appendix A, pgs 332-334	404 Appendix A, pgs 356-358
Max Velocity (ft/s)	5.1	7.1	11.1
Water Surface Slope (ft/ft)	0.12	0.11	0.10
Max Swim Distance (ft)	93.7	46.4	58.1
Min Swim Depth (ft)	0	0.2	0.8
Max Jump Height (ft)	7.5	3.8	N/A
Max Jump Distance (ft)	50.2	48.4	N/A
Plunge Pool Depth (ft)	2.4	3.3	N/A
Plunge Pool EDF	5.8	16.1	N/A
Sustained Swimmability? (Y/N)	N	N	N
Burst Swimmability? (Y/N)	N	N	Y
Jumpability? (Y/N)	N	N	N/A


Steelhead
Gaynor Reach
Qlow
Gaynor Reach - WSE (38cfs)
Site 5
Site 4
Site 3
Site 2
Site 1


Steelhead
Gaynor Reach
Qave
Gaynor Reach - WSE (105cfs)
Site 5
Site 4
Site 3
Site 2
Site 1
Gaynor Reach - WSE (180cfs)

Steelhead
Gaynor Reach

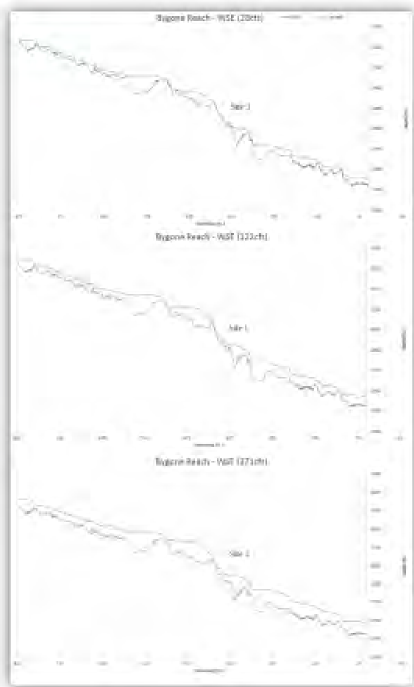
Qhigh



Steelhead
Bygone Reach

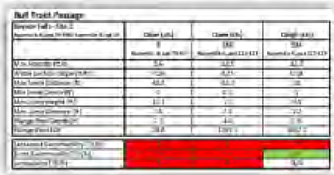
Steelhead Passage

Bygone Byways - Site 1 Appendix A, pgs 286-350; Appendix B, pg 81, 82, 88	Qlow (cfs)	Qave (cfs)	Qhigh (cfs)
	28 Appendix A, pgs 326-328	122 Appendix A, pgs 334-340	371 Appendix A, pgs 350-352
Max Velocity (ft/s)	9	10.5	10.9
Water Surface Slope (ft/ft)	0.08	0.16	0.10
Max Swim Distance (ft)	93.2	39.5	39.1
Min Swim Depth (ft)	0	0.4	0.6
Max Jump Height (ft)	7.3	6.5	N/A
Max Jump Distance (ft)	46.7	41.9	N/A
Plunge Pool Depth (ft)	2.8	4	N/A
Plunge Pool EDF	15.9	41.3	N/A
Sustained Swimmability? (Y/N)	N	N	N
Burst Swimmability? (Y/N)	N	N	Y
Jumpability? (Y/N)	N	N	N/A

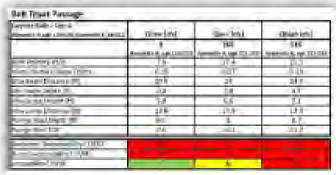


Other Species

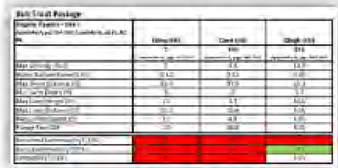
- Bull Trout
  - Complicated passage through all Gaynor and Bygone (likely can use steelhead alt. routes)



Bull Trout Passage

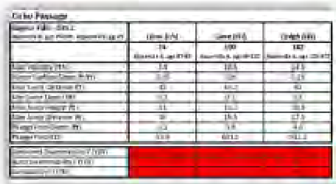


Bull Trout Passage



Bull Trout Passage

- Coho
  - No passage past Site 2 in Gaynor Reach



Coho Passage

Questions?

Underwater photo of what appears to be an adult bull trout located in a pool between sites 3 and 4 in the Gaynor Falls study reach of Nason Creek. Photo by Scott Clark, 2019.

Appendix D
Habitat Conservation Plan Policy Committees 2020 Meeting Minutes

1201 3rd Avenue, Suite 2600
Seattle, Washington 98101
206.287.9130

FINAL

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Policy Committees | Date: October 6, 2020

From: John Ferguson, HCP Policy Committees Chairman

cc: Sarah Montgomery, Kristi Geris

Re: Final Minutes of the September 1, 2020, HCP Policy Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Policy Committees met by conference call on Tuesday, September 1, 2020, from 2:00 p.m. to 4:00 p.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

- Shane Bickford will discuss with Jeff Fryer (Columbia River Inter-Tribal Fish Commission [CRITFC]) the potential implications to Fryer's research on the effect of temperature on the survival of sockeye salmon returning to the Okanagan Basin if sockeye sampling were to occur at a higher rate in the later part of the season after the thermal barrier in the Okanogan River appears, and if volitional trapping at the Wells Dam east ladder were to occur on days when Carlton Program sampling is not occurring. In particular, the HCP Policy Committees are interested in learning whether these sampling alternatives introduce a bias into estimated survival. Bickford will then report this information back to the HCP Policy Committees (Item II-A).
- Kirk Truscott and Cody Desautel will discuss with Kim Hyatt (Department of Fisheries and Oceans, Canada [DFO]) and Howie Wright (Okanagan Nation Alliance [ONA]) the potential implications to their analyses of sockeye salmon using CRITFC's information, based on the results of Shane Bickford's conversation with Jeff Fryer regarding bias associated with alternative sampling approaches and any effects tagging fewer than 800 sockeye salmon annually at the Wells Dam east ladder may have on the outputs of their analyses and its use in fisheries management decisions (Item II-A).
- David Blodgett, III, will discuss with Jeff Fryer, and other staff, potential options for using the off-ladder adult fish trap (OLAFT) at Priest Rapids Dam for regular trapping and tagging efforts for sockeye salmon (Item II-A).
- The HCP Policy Committees meeting on October 6, 2020, will be held at 9:00 a.m., by conference call (Item III-B).

Decision Summary

- There were no HCP Policy Committees Decision Items approved during today's conference call.

Agreements

- There were no HCP Policy Committees Agreements discussed during today's conference call.

Review Items

- There are no HCP Policy Committees items that are currently available for review.

Finalized Documents

- There are no HCP Policy Committees documents that have been recently finalized.

I. Welcome

A. Introductions (John Ferguson)

John Ferguson welcomed the HCP Policy Committees. He said the Committees were initially intending to have an in-person annual meeting in May 2020 to discuss HCP implementation, but that meeting was delayed due to COVID-19 and will be re-scheduled when the Committees can meet in person. He said the purpose of today's meeting is to discuss CRITFC's annual request to tag sockeye salmon at the Wells Dam east ladder and potentially come to an agreement about guidance that can be given to the HCP Coordinating Committees on this topic. Each representative and technical staff present introduced themselves.

B. Review Agenda (John Ferguson)

John Ferguson reviewed the agenda. He described his intended approach for the meeting: he will provide an overview of the discussions that have occurred to date in the HCP Coordinating Committees, each representative will provide their perspectives on the sampling, and then he will open up the conversation to the entire group. He asked if there are any additional agenda items or input on how the meeting should proceed. There were no items added to the agenda or concerns introduced about the approach, and representatives present expressed their thanks for materials that were sent in advance of the meeting. Background information distributed to the HCP Policy Committees ahead of today's meeting included: 1) the Wells HCP; 2) CRITFC's annual request to tag sockeye salmon at Wells Dam in 2020; 3) HCP Coordinating Committees meeting minute excerpts regarding sockeye salmon tagging at Wells Dam; 4) a response letter from the Canadian Okanogan

Basin Technical Working Group (COBTWG); and 5) email correspondence regarding an Investigational New Animal Drug (INAD) exemption for Aqui-S (collectively Attachment B).

II. Wells HCP

A. CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam (John Ferguson)

John Ferguson said the Wells HCP Policy Committee makes decisions by unanimous agreement per the Wells HCP Section 11.1.2, which provides guidance for today's discussion to focus on reviewing the issues and aiming to reach consensus. He summarized the issues that emerged during HCP Coordinating Committees meetings, which will be discussed today, as follows:

- The nexus for these issues and the HCP Policy Committees is the safe passage of Plan Species. Therefore, the HCP Coordinating Committees discussions focused on whether sockeye salmon can be collected, sampled, and tagged concurrent with ongoing sampling for Carlton Program summer Chinook salmon broodstock at the trap in the Wells Dam east fish ladder.
- Should sockeye salmon collection extend beyond the days on which Carlton Program summer Chinook salmon activities occur, and would this impact Plan Species?
- Should sockeye salmon be collected somewhere other than the east fish ladder at Wells Dam?
- Are the data gained from sockeye salmon sampling efforts at Wells Dam needed to make fishery management decisions?
- Data collection has been underway for a long period of time. How many more years and how many fish need to be sampled each year?
- The anesthetic Aqui-S is used on fish in the east ladder. Is there a withdrawal period for the anesthetic that would mean they should not be harvested within a certain period following their release?
- There are also some issues associated with collecting and tagging sockeye salmon at Wells Dam that are related to the Yakama Nation (YN) and the Colville Confederated Tribes (CCT) tribal relationships, which are outside the purview of the HCP. While the intent is not to delve into these issues today, the Committees are aware that these issues exist.

Ferguson summarized the options for collecting the data that the HCP Coordinating Committees have discussed, as follows:

- Cease trapping for sockeye salmon at Wells Dam because additional data are not needed for fishery management decisions or further model development, or it is believed the data collection is not warranted given the expected impacts to Plan Species associated with collecting the data.
- Collect sockeye salmon in the Wells Dam east fish ladder concurrent with Carlton Program summer Chinook salmon broodstock activities only.

- Collect sockeye in the Wells Dam east fish ladder concurrent with Carlton Program summer Chinook salmon broodstock activities, and sample additional days up to the 3 days per week, 16 hours per day limits specified in the Wells HCP and National Marine Fisheries Service's (NMFS's) permit to meet the requested sample size of 800 fish.
- Collect sockeye salmon elsewhere in the upper Columbia, such as the OLAFT at Priest Rapids Dam.

Ferguson said these options are just a starting point for the Committees consideration. He then called upon each representative to give their opinion on the topic.

Cody Desautel provided the CCT perspective. He thanked Ferguson for his summary and said a few of these items have been addressed already. He said he discussed the value of the data with ONA and based on that conversation, the CCT does not have concerns about tagging in 2020. He said the CCT prefers that sampling and tagging for sockeye salmon occurs as part of the collection process for summer Chinook salmon to minimize passage delays for sockeye salmon. He said good recruitment onto spawning beds is a priority for the CCT, and with a better understanding now of ONA's use for the data—including managing harvest, setting escapement targets, and setting fishery seasons—the CCT is supportive of the collection of these data and will likely support it in the future. He said the priority for the CCT is to minimize impacts to migrating sockeye by limiting any impacts to migration timing. He said passage delays at Wells Dam can result in sockeye salmon being delayed in their migration up the Okanogan River due to the thermal barrier that sets up. He asked Kirk Truscott to comment on the issue as well.

Truscott agreed that it was helpful to discuss the data with ONA and understand how they use the data to make management decisions. He reiterated that the CCT's priority is to minimize passage or migration impacts as a result of trapping additional days over what occurs for other Plan Species at Wells Dam. Truscott said he is not singling out this requested activity at Wells Dam. He said on some occasions at Zosel Dam, where video is used to obtain a census of sockeye salmon when the gates are closed, it was clear that sockeye salmon were stressed due to the warm water. Therefore, the census count was temporarily suspended so the gates could be opened to let the fish through. He said this is an example of CCT's stance that tagging of sockeye salmon at Wells Dam provides useful data to manage fisheries, particularly in British Columbia, but the tagging should be conducted in a manner that limits potential impacts to passage.

David Blodgett, III, provided the YN perspective. He also thanked Ferguson for organizing the materials in advance of the meeting and agreed that some of the questions about the usefulness of the data have already been answered. He said the Aqui-S question has also been addressed, and the remaining question within the purview of the Committees is whether this activity impacts Plan Species and their passage. He said during the time of year that sampling occurs, staff are seeing other Plan Species stocks migrating past Wells Dam. He said the YN supports addressing the concerns that have been raised about impacts to Plan Species and he feels that the impacts are acceptable based on the benefits of the work, and in particular, run reconstructions used to develop total allowable catch estimates by the *US vs Oregon* Technical Advisory Committee, and DFO's and ONA's work in Canada. He said there is strong evidence that this sampling needs to continue and that the concerns have been addressed. He said he appreciates Desautel's comments and noted there are also policy issues that the CCT and the YN will address in a separate venue, which he hopes that he and Desautel can discuss more outside of the HCP Policy Committees. He asked Keely Murdoch to comment on the issue from a technical perspective.

Murdoch agreed with Blodgett that the usefulness of the data has been established and that causing unnecessary negative impacts to Plan Species is undesirable. She said most of the trapping that occurs for sockeye salmon at Wells Dam is concurrent with trapping for Carlton Program summer Chinook salmon, but both efforts have weekly sample size quotas. She said occasionally, the Carlton Program's quota is met early in the week, and to obtain the target sample size for the sockeye program, trapping for days—in addition to what the Carlton Program traps for—is needed (within permit conditions for the east ladder and for the Program). In 2020, she said Washington Department of Fish and Wildlife (WDFW) was able to trap 568 sockeye salmon concurrent with Carlton Program summer Chinook salmon collection, compared to the target of 800 fish. She said staff conducted this effort in addition to their summer Chinook salmon trapping, so the success of this effort depended, in part, on how quickly the summer Chinook salmon quotas were met. She said being only 232 sockeye salmon short of the goal demonstrates that in 2020 (which was a large run but was not an unusually large run), a significant amount of additional trapping would not be needed to reach the quota of 800 fish, and she believes that collecting 800 fish each year (through additional trapping) can be considered an acceptable impact to Plan Species.

Ferguson asked, what was the sockeye escapement in 2020? Ritchie Graves said the count at Wells Dam was around 225,000 fish.

Michael Livingston provided the WDFW perspective. He said the background materials have been helpful to orient himself to these issues and he has been discussing this with Chad Jackson and other staff. He said WDFW continues to support the collection and sampling of sockeye salmon at Wells Dam. He said he believes this can be accomplished in a way that does not impact the passage of Plan Species. He said in his experience with salmon fisheries and agreements throughout the Columbia basin, this issue will take a lot of cooperation and collaboration and he looks forward to working on it with the Committees. He summarized that WDFW supports continuing this data collection effort and asked Jackson to add any additional information.

Jackson said the data gathered through this effort are useful for run reconstruction work related to *US v Oregon* as well as for forecasting processes that determine preseason allotments for fisheries in the Columbia River. He agreed with Livingston that the sampling can be accomplished in a manner that does not impact the passage of Plan Species. Ferguson asked Jackson to provide an update on what he has learned about Aqui-S. Jackson said prior to the opening day of the sockeye salmon fishery above Wells Dam, WDFW's lead fish health specialist made a determination that sockeye salmon that have been treated with Aqui-S during sampling in the trap in the Wells Dam east fish ladder do not require a withdrawal period before harvest nor a special mark. He said this determination does not apply to fish that are euthanized or that die during handling, for which the 72-hour post-treatment withdrawal period applies. He said for fish that are released alive shortly after sampling, the dosage of anesthetic they are exposed to does not trigger the need for a withdrawal period.

Jim Craig provided the U.S. Fish and Wildlife Service (USFWS) perspective. He said USFWS appreciates the data that are collected for all of the reasons previously stated, such as real-time management of fisheries and *US v Oregon* run reconstruction work. He said the USFWS supports the continuation of this work, and ideally, it would be accomplished concurrently with Carlton Program summer Chinook salmon activities to minimize negative effects to Plan Species passage. He suggested the HCP Coordinating Committees could consider annually (depending on the run size) whether additional tagging days are needed. He summarized that the USFWS supports continuing sampling of sockeye salmon at Wells Dam.

Graves provided his perspective from NMFS. He thanked the representatives and technical staff for their perspectives and said NMFS is interested in finding ways to collect data with less impacts to fish passage. He said NMFS and comanagers have disagreed about some of these issues in the past, but it is important to understand and hear concerns about passage delays. He said he thinks the data that are collected through sampling sockeye salmon at Wells Dam are useful. He said compared to other sampling operations, the target is a small percentage of the overall stock, which he said provides some comfort that the operation is not too impactful. He suggested considering how the trap is operated and asked if there are other approaches that would allow for additional sampling beyond the Carlton Program sampling period that would help address concerns about passage delays. He also said the Committees should consider the issue of climate change. He said the sockeye salmon dataset is long-term and therefore could be even more useful in the future if there are changes to survival rates, travel times, or other factors. He said he thinks it is wise to maintain a monitoring program, but the size of the monitoring program should be considered. He suggested that at Bonneville Dam, one approach to minimizing effects is to allow trapping in the morning, then once certain water conditions are reached during the day, the entrance to the trap is closed, and fish are allowed to pass up the ladder. Ferguson added that the Committees are working within the constraints of the HCP and NMFS's Biological Opinion (BiOp), which allows trapping for up to 16 hours a day, 3 days per week.

Alene Underwood said Chelan PUD has no comments on this issue.

Shane Bickford provided Douglas PUD's perspective on the trapping effort and additional details about trap operations. He said in addition to the 3 days per week limit on trapping, there is a temperature limit in effect. He said temperature shutdowns are rarely an issue with these operations; however, overcrowding has been an issue. He said the Wells Project license requires safe effective passage for Plan Species, and Douglas PUD has completed many studies about how the ladders and ladder traps operate. He said without the traps in place, fish generally pass the dam in less than 1 day with little fallback. With trap operations ongoing, he said fish can take 3 days to pass (he also noted that sockeye salmon migrate during the daytime). He said maintaining safe and effective passage for all five species of salmon and for bull trout is critically important to Douglas PUD. He noted that tagging efforts also take place during the peak of the summer Chinook salmon run, which lasts for approximately 45% of the bull trout run and approximately one third of the steelhead run (the early part). He said this issue is not just about sockeye salmon, but about other stocks migrating past Wells Dam during the duration of these trapping activities. He said Douglas PUD supports the sampling efforts due to the importance of the data, which are used for many reasons and present a long-term dataset. He said he appreciates how the ONA and CRITFC use the data, and he is especially familiar with Jeff Fryer's modeling efforts and estimates based on the PIT-tag data. He said Douglas PUD's intent is to minimize the amount of impact this research is having on natural resources, especially sockeye salmon due to the thermal barrier that sets up at the mouth of the Okanogan River later in the season each year. He said Douglas PUD's perspective is that the data are useful and should continue to be collected during the Carlton Program summer Chinook salmon activities. He said a compromise is needed to reduce issues that arise with crowding when both the summer Chinook salmon and sockeye salmon runs are peaking. He said it is important that staff who have a lot of experience with this trap are the ones operating it—this includes WDFW's Twisp and Eastbank Monitoring and Evaluation staff as well as Douglas PUD's staff who operate the trap for other species. This is because these groups have a good understanding of the crowding issues and can best reduce or attenuate delays by knowing when to open the trap. He summarized that Douglas PUD believes it is important to restrict who operates the trap to experienced staff. He also noted that the trap can also be effective as an off-ladder trap.

Ferguson summarized the perspectives shared so far: the CCT supports data collection concurrent with Carlton Program activities; the YN and WDFW support data collection including additional sampling days beyond the Carlton Program broodstock collection due to the value of the data; NMFS and USFWS support collection and reducing the impacts either through limiting sampling during low escapement years or introducing additional flexibility in how the trap is operated; and Douglas PUD supports data collection, provided more details on actual trap operations, and noted that there are additional restrictions in place now, and likely in the future, as to who can operate the trap. Ferguson said there is general consensus from the Committees regarding the usefulness of the data, and the primary issue appears to be whether the trap should be operated on days in addition to the Carlton Program activities. He asked if there are alternative data collection points that should be considered, such as the OLAFT or the trap at Bonneville Dam.

Blodgett said one option would be for the Committees to approve trapping concurrent with the Carlton Program summer Chinook salmon activities and then re-evaluate the trapping annually to approve additional trapping for sockeye salmon only that year. The decision would be based on current environmental conditions and escapement levels that year, and anticipated sample size requirements needed in addition to the sockeye salmon tagged during Carlton Program broodstock collection. He said it may be difficult to make these decisions quickly in-season, but this would allow for trapping to be restricted when conditions present too much of a risk to passage of sockeye salmon.

Ferguson questioned whether the HCP Coordinating Committees would have enough time to evaluate water temperature and river conditions to make in-season decisions. Murdoch said this presents another issue because the project is permitted to operate 3 days a week and the programs are set up with weekly quotas. She said if the Carlton Program meets their quota on the first day of the week, sampling for sockeye salmon would be shut down until approved otherwise. She said in-season decision making is an attractive idea but would need more discussion about how it would proceed so that the HCP Coordinating Committees can respond in a timely manner.

Graves said he is not opposed to exploring an in-season process but, based on his experience working on Columbia River passage issues, this would likely require multiple meetings each week during the sampling period. He said NMFS would support that process, if needed, but wanted to let everyone know that it would create the need for many more meetings. Graves asked, how long is the trapping period for the Carlton Program? Bickford said it usually lasts eight weeks, starting in mid-June, and goes through the third week of August, which covers the duration of the sockeye salmon run.

Ferguson said from the perspective of the HCP Coordinating Committees chairman, it would be difficult but not impossible to gather the representatives and the information needed for in-season decision making. He said it would be necessary to set up protocols and decision criteria in advance. He said the criteria would also include current escapement estimates at locations below Wells Dam. Desautel added that another complication is river conditions. He said with hot dry summers that result in an early warming of the Okanogan River, the CCT would like to see sockeye salmon be able to freely pass upstream. Truscott said he appreciates the idea for in-season decision making. He asked, why is the sample size target set at 800 fish, and what would happen if less than 800 fish were tagged? He suggested a retrospective analysis could be conducted using Fryer's research to determine what the impacts to the data time series would be if there were fewer than 800 fish in the model for some years. He said this question could also be asked of Howie Wright and his staff at ONA. Truscott also noted that the YN collects 10,000 sockeye salmon annually at the OLAFT at Priest Rapids Dam for their Cle Elum program, and asked whether tagging could be conducted there concurrent with sockeye salmon collection for the Cle Elum Program?

Bickford said looking at the data needs for the models is a good idea, as well as considering additional or substitute tagging sites. He said Bonneville Dam is a good tagging site; however, there are many ongoing tagging programs there along with temperature issues. He said OLAFT would be a good tagging site because both Okanogan- and Wenatchee-origin sockeye salmon can be tagged. He said it would also be good for the model to be able to tag only Okanogan-origin fish such as at Wells Dam. He said an additional issue with the east ladder trap at Wells Dam is that jack sockeye salmon are known to bypass the trap gate and pickets and therefore the run composition sample collected from the trap at Wells Dam is biased to older age, larger sockeye salmon. The OLAFT volitional trap, on the other hand, is less biased as it provides a more comprehensive assessment of run composition including all age classes of sockeye salmon. Bickford said it would be worth discussing biological thresholds at which the Committee would make certain decisions. For example, if water temperatures are above a certain level, collection could default to the OLAFT and the model could be augmented to account for the percent of Wenatchee-origin fish that are tagged (approximately 20%). He said he sees many benefits of pursuing trapping at the OLAFT. Truscott asked whether the reduced number of fish tagged at Wells Dam would result in any appreciable effects to the accuracy of Fryer's modeling work. Bickford said he will discuss this with Fryer.

Blodgett said in addition to discussing this with Fryer, changing the collection location or reducing the number of fish tagged may have impacts on in-season estimates for ONA, so they should also be consulted. He said one concern to changing the trapping location is that it would modify the dataset and potentially nullify some of its long-term benefits. Additionally, he said sampling elsewhere for Okanogan-origin fish would introduce an effect on other runs. He said there is a greater impact to the resource when more fish need to be trapped.

Truscott also asked if this year's collection of 568 fish was limited by staffing constraints or by the number of days of trapping? Bickford said there was a big summer Chinook salmon run this year, so fewer trapping days were needed than usual for Carlton Program broodstock collection. He said WDFW staff put in additional effort to collect run composition information for summer Chinook salmon and to augment the sockeye salmon tagging effort. He said typically, the summer Chinook and sockeye salmon runs are occurring at the same time, and trapping is generally occurring 2 days per week, for 8 to 9 hours in the middle of the day. He said in a normal year for both species, the target of 800 sockeye would be easily obtained within this trapping period. However, in a year like 2020 with a big summer Chinook salmon run, the quota for summer Chinook salmon is met faster than the quota for sockeye salmon, and trapping is shut down earlier than usual. Truscott asked if both ladders are used. Bickford said only the east ladder was used in 2020.

Ferguson asked for more information about the sockeye salmon migration window and temperatures in the Okanogan River. He asked how often is there a thermal barrier and how quickly does it form? He said this information would help determine whether making decisions in-season is practical. Desautel said there is a thermal barrier almost every year. He said in some years, it is clear based on the forecast when the thermal barrier will set up, with about 1 week's notice. He said in dry years such as 2015, it sets up very early and not many sockeye salmon make it into the river before the barrier is present, which is tougher to predict and respond to. Truscott added the barrier generally sets up at a temperature of 21ºC. He said by looking at water and air temperatures, it can be predicted within about 1 week, and in warm water years there is significant temperature stress as fish attempt to migrate to Lake Osoyoos.

Bickford said the Okanogan River responds quickly to weather events, and 2020 has been a cool year for water temperatures in the Methow, Okanogan, and upper Columbia rivers. He said the 21ºC temperature barrier was in place and limiting passage during most of August but there were two periods in July where fish could migrate through the thermal barrier particularly towards the beginning of the run. He said that it looks like up to half of the sockeye run this year was able to enter the Okanogan River before temperatures reached 21ºC, and that after the thermal barrier was present it lasted for only 10 days. Following the 10-day period, he said 2 days of cool weather allowed a break where fish could continue migrating. He said in most years, the barrier will be present for around one month, which is very detrimental to the sockeye salmon migration.

Ferguson thanked the representatives for their thoughts so far on this issue. He asked whether anyone present would like to discuss issues related to Aqui-S further, or if it is clear to everyone that this is no longer an issue that needs to be considered by the Committees. Truscott said he appreciates WDFW's clarification from their fish health experts and he trusts their expertise. He said he has no further concerns from a biological perspective. Desautel said he has no further concerns from a policy perspective as it appears that Aqui-S does not affect the ability to harvest or consume sockeye salmon released from the east ladder trap. Ferguson summarized that the HCP Policy Committees have resolved potential issues around the use of Aqui-S and have no further comments on this issue at this time.

Ferguson summarized some of the issues discussed so far: data can be collected in the east ladder, but there are concerns about the operations of the trap, including who operates it and jacks bypass the trap potentially introducing bias into the sample collected at Wells Dam; the OLAFT could be a better trapping location from a data and modeling standpoint; and, there is general consensus that the data should be collected, but what is the best way to minimize impacts to Plan Species? He said he sees four potential options for the committees to consider, as follows:

- Collect sockeye salmon at the Wells Dam east ladder only concurrent with Carlton Program summer Chinook salmon activities, and accept the number of sockeye salmon that can be tagged each year, which may be less than the 800 fish target.
- Collect sockeye salmon at the Wells Dam east ladder concurrent with summer Chinook salmon activities, and conduct additional trapping as needed to meet the target size of 800 fish (but tagging would still occur within permitted conditions).
- Collect sockeye salmon at the Wells Dam east ladder concurrent with summer Chinook salmon activities, but the additional trapping days would be decided in-season by the HCP Coordinating Committees.
- Collect sockeye salmon at the OLAFT (this could be completed to augment Carlton Program summer Chinook salmon activities or as a standalone method).

Jackson asked whether the first option restricts the trapping to a shorter duration than the BiOp's restriction of 16 hours a day, 3 days per week. He said the BiOp provides a determination that this trapping schedule is not an impact to Plan Species, so he is not sure this is an issue the HCP Coordinating Committees have the purview to make decisions about. Ferguson said the HCP Coordinating Committees would be considering the impacts to Plan Species from the sampling that occurs in addition to sampling for the Carlton Program. Bickford noted that the Wells HCP Coordinating Committee has operational oversight over all ladder trapping that fall within the 3 days per week, 16 hour a day limit. If trapping is expected to exceed the trapping limits established by NMFS and contained within the Incidental Take Permit, then NMFS would need to rule on those proposed additional trapping activities in coordination with the Wells HCP Coordinating Committee. So, in this case, the Wells HCP Coordinating Committee does have jurisdiction to determine if the proposed additional trapping efforts have merit and do not impact Plan Species including sockeye salmon, summer Chinook salmon, and steelhead passage.

Graves asked about the option to volitionally trap at Wells Dam and how fish would enter the trap. Tom Kahler said there is a wire mesh gate that directs fish into an Alaska-steep-pass-Denil structure. Without the gate in place some but not all of the fish would enter the Denil. Graves asked what the staff who are familiar with the trap think would happen if the trap was opened for volitional entry? He noted that volitional entry would reduce the delay effects to most fish passing the dam. Kahler said the east ladder trap has not been operated volitionally for sockeye salmon but has been operated for coho salmon and bull trout, so he is not sure what the sockeye salmon response would be. He said water comes down from the trap via a Denil into the fishway in a corner pool, and sockeye salmon readily jump at spilling water. He said sockeye salmon would probably enter the trap this way. Bickford said he suspects that enough fish would be collected if the trap were operated volitionally in addition to operating during summer Chinook salmon trapping activities. He said at the OLAFT, Fryer's staff tagged 400 fish from a volitional trap. He noted that with an average run size, there would probably be significant trapping by volitional methods. Ferguson asked if Bickford thinks WDFW staff would be open to exploring this idea. Bickford responded he would need to ask them. *(Note: Bickford temporarily left the call to discuss this topic with Fryer.)*

Ferguson asked whether Fryer has indicated how OLAFT sampling went this year. Bickford reported back from his call with Fryer with the following details:

- Fryer said the sampling effort went well at Wells Dam this year and that this was a large run, which helped. He said the issue is in the use of the data; sockeye have been tagged at the OLAFT in the past, but not consistently.
- Regarding the target of 800 sockeye, Fryer said this is not a set value. Rather, the goal is to get as many tagged sockeye salmon into the Okanogan River basin as possible. He said in 2020, the 568 fish tagged at Wells Dam—plus 400 tagged at the OLAFT—was relatively good for estimating escapement. He said he knows that the target of 800 also works for ONA's research efforts.
- Fryer said Kim Hyatt at DFO is also considering initiating a tagging effort at Zosel Dam, or at another location between Skaha Lake and Lake Osoyoos, to increase the number of tagged fish available to inform escapement estimates.
- Fryer emphasized the importance of tagging at Wells Dam.
- Fryer said jacks are an issue for the model. In previous years, Fryer installed Vexar on the ladder fence that blocks fish from continuing up the ladder so that jack sockeye salmon are forced to swim up the Denil and into the trap for sampling. The permanent gate is wire mesh, but the openings in the mesh are large enough that sockeye jacks can get through without the addition of Vexar.
- Fryer noted that the time series includes a few years where the target has not been met. In these years, he said sometimes the fish avoid the east fish ladder trap for unknown reasons and in those years trapping on the west ladder has been used to augment the sample.

Regarding Fryer's inquiry about the west ladder, Bickford said fish have been collected using the west ladder; however, that trapping location is not ideal. He said fish collected in the west ladder are sent to Wells Fish Hatchery, so they go through the adult facility and are held for an extra day when being sampled. He said Carlton Program summer Chinook salmon and sockeye salmon are not trapped in the west ladder currently; it is only used for spring Chinook and coho salmon trapping. He said trapping at the west ladder is labor intensive and sockeye salmon usually do not migrate on that side of the river, unless trapping is occurring in the east ladder.

Truscott asked if PIT-tag passage in the ladder is reported in real-time. Bickford replied yes. Truscott asked if it would be possible (if the Committees were to consider in-season management) to review the previous 5 days of trap operations and examine passage delays within season to help determine whether additional trapping should be allowed. He said it would be informative to understand whether the passage delay is just a few hours vs. several days. Ferguson asked how these data would be queried. Bickford responded the data are available in the PIT Tag Information System. He also noted that studies examining summer Chinook and sockeye salmon behavior in association with ladder trapping has been studied and documented several times (years) using radio tags. He said the studies showed that trapping for 3 days results in a 3-day passage delay for summer Chinook salmon, and some fish will not enter the ladder at all if the traps are operating. He said this may be due to stress signals released by fish in the ladder that can be detected by fish downstream.

Graves said these issues with the program at Wells Dam also fit into a regional sampling program, and the question of where in the basin sockeye salmon should be tagged. This is a much higher-level discussion, as the HCP Policy Committees are also tasked with advising the HCP Coordinating Committees on what should be done for the 2021 migration at Wells Dam. He said he is not sure enough information has been gathered to make decisions today, but the Committees have identified a number of potential options to follow up on, including volitional trapping.

Ferguson summarized that the HCP Policy Committees have reached a general consensus on three items: 1) the need for these data and the desire to obtain as full a sample size as possible, 2) tagging sockeye salmon concurrent with the Carlton Program does not present an issue, and 3) Aqui-S does not present an issue for harvest or consumption of sockeye salmon tagged and released from Wells Dam. He said given the consensus on these aspects of the issues, the HCP Policy Committee discussed alternative ways to achieve the desired sample size while minimizing impacts to Plan Species. The alternatives discussed included 1) sampling for sockeye salmon at the Wells Dam east ladder on days that are in addition to the Carlton Program's requirements, either decided in advance, or in-season, by the HCP Coordinating Committees, 2) sampling at the OLAFT as an alternative or in addition to sampling at Wells Dam, and 3) volitional trapping of sockeye sampling at Wells Dam in addition to and concurrent with Carlton Program sampling.

Blodgett suggested one more option: he said given the concerns introduced about the thermal barrier and sockeye salmon migration in the early part of the season, would it make sense to only allow additional trapping after the thermal barrier sets up (essentially relying more on trapping days later in the season to meet the quota)? He said at this point, the potential passage delay would be less of an issue.

Bickford, Jackson, and Graves agreed that this is a good idea and worth pursuing as an additional option. Graves said this would address one of the primary issues of delaying fish before the thermal barrier sets up. Desautel asked whether this approach would introduce bias into the dataset. Bickford replied that it could; ideally, samples are collected evenly throughout the run. He said it is more important for the data to be representative than to be a larger sample size, and this approach might result in underestimating escapement. Bickford said he will discuss this option with Fryer. Jackson clarified that the concurrent sampling would still occur prior to the thermal barrier setting up, but additional days would only occur after the barrier set up, if additional sampling days are needed. Ferguson also noted that WDFW staff should be consulted as to whether that would be a burden from a staffing or trap operational standpoint.

Ferguson summarized that the Committees are working to determine the best alternative for tagging additional sockeye salmon beyond concurrent sampling for the Carlton Program that has already been identified and agreed upon as being a high priority. All of the alternatives for additional trapping at Wells Dam discussed include operating the trap within the HCP and BiOp permit restrictions of 3 days per week, 16 hours per day. He said the alternatives are as follows:

- Alternative 1: Add additional trapping at the Wells Dam east ladder trap as needed weekly to meet the target sample size
- Alternative 2: Add additional trapping at the Wells Dam east ladder trap as needed weekly to meet the target sample size, but the need for additional sampling each year would be decided in-season by the HCP Coordinating Committees based on within-year information on estimated escapement, run timing, and environmental conditions
- Alternative 3: Add additional trapping at the Wells Dam east ladder trap as needed weekly to meet the target sample size, but only after the thermal barrier in the Okanagan River has set up
- Alternative 4: Add additional volitional trapping at the Wells Dam east ladder trap as needed weekly to meet the target sample size
- Alternative 5: Collect sockeye salmon at the OLAFT in addition to collecting fish concurrently with the Carlton Program summer Chinook salmon activities at the Wells Dam east ladder trap

Ferguson asked the committees what their preference is regarding discussing and reviewing these concepts. Truscott suggested that each party should review the notes from this meeting and decide on a few high priority alternatives to discuss. Desautel agreed and said it would be helpful to have more information from Bickford about how some of these alternatives would affect the dataset before proceeding. Graves suggested gathering more information about these alternatives and then making a pros and cons list of each at the next meeting to consider how each would affect the passage delay issue.

Bickford said he will talk to Fryer about the effects of trapping during the post-thermal barrier period and any potential biases introduced by volitional collection. Desautel suggested discussing these issues with ONA (Wright) and potentially DFO (Hyatt) after the committees learn more from Fryer. Blodgett said he will also follow up with Fryer and other staff about the effectiveness of trapping at the OLAFT and whether this would be a feasible option in future years.

Graves added that the Committees may also want to consider how sockeye salmon returns have developed year-to-year variation in line with pink salmon runs. He said a clear pattern has emerged since 2007 in the Columbia Basin, showing a larger run of sockeye salmon in even-numbered years compared to odd-numbered years (which correspond to years where sockeye salmon compete with large numbers of pink salmon in the Pacific Ocean). He said stressors on the sockeye salmon population such as pink salmon could also have effects on sampling strategies in low vs. high escapement years.

Ferguson thanked the Committee members for their ideas and constructive discussion today.

III. HCP Administration

A. Next Steps (John Ferguson)

John Ferguson said in addition to the action items from this meeting, the next steps for the Wells HCP Policy Committee are to reconvene to review the five potential alternatives that were discussed today and to prioritize them so that they can provide direction to the HCP Coordinating Committees.

B. Next Meetings (John Ferguson)

HCP Policy Committee representatives present reviewed their calendars and agreed to have another conference call on October 6, 2020 from 9:00 a.m. to 11:00 a.m.

IV. List of Attachments

Attachment A	List of Attendees
Attachment B	1) the Wells HCP; 2) CRITFC's annual request to tag sockeye salmon at Wells Dam in 2020; 3) HCP Coordinating Committees meeting minute excerpts regarding sockeye salmon tagging at Wells Dam; 4) a response letter from COBTWG; and 5) email correspondence regarding an Aqui-S INAD

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Sarah Montgomery	Anchor QEA, LLC
Alene Underwood*†	Chelan PUD
Shane Bickford*	Douglas PUD
Tom Kahler	Douglas PUD
Ritchie Graves*	National Marine Fisheries Service
Jim Craig*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
Michael Livingston*º	Washington Department of Fish and Wildlife
David Blodgett, III*	Yakama Nation
Keely Murdoch	Yakama Nation
Cody Desautel*	Colville Confederated Tribes
Kirk Truscott	Colville Confederated Tribes
Jeanette Finley	Colville Confederated Tribes

Notes:

* Denotes HCP Policy Committees representative or alternate

º Michael Livingston is temporarily covering James Brown's duties in Region 2 and may act as the WDFW representative when Chad Jackson is unavailable per an email from Jackson on August 18, 2020, and thus has been designated as an alternate. Jackson was designated the interim WDFW representative in an email from Brown on April 14, 2020. A letter notifying the HCP Policy Committees Chairman of their formal designation of a representative is forthcoming.

† Attended until 3:15 p.m.

EXHIBIT NO. 1

Anadromous Fish Agreement and

Habitat Conservation Plan

The Wells Hydroelectric Project

FERC License No. 2149

March 22, 2002

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Anadromous Fish Agreement and Habitat Conservation Plan
Wells Hydroelectric Project, FERC License No. 2149

THIS AGREEMENT for the Wells Hydroelectric Project (Project) is entered into between the Public Utility District No. 1 of Douglas County, Washington, (District) a Washington municipal corporation; the United States Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), the Washington Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Indian Nation (Colville), the Confederated Tribes and Bands of the Yakama Indian Nation (Yakama), the Confederated Tribes of the Umatilla Indian Reservation (Umatilla) (collectively, the Joint Fisheries Parties or the JFP); and American Rivers, Inc., (American Rivers) a Washington D.C., nonprofit corporation (the JFP and American Rivers, are referred to as the Fisheries Parties (FP); and the Power Purchasers which shall be represented through a single non-voting representative whom they will designate from time to time. All entities, who have executed this agreement, are collectively referred to as the Parties.

INTRODUCTION

A. The site of the Project is habitat for Plan Species. Prior to this Agreement the needs of the Plan Species and their habitat have been addressed through litigation and agreement. This Agreement is intended to constitute a comprehensive and long-term adaptive management plan for Plan Species and their habitat as affected by the Project.

B. The objective of this Agreement is to achieve No Net Impact (NNI) for each Plan Species affected by the Project on the schedule set out herein and to maintain the same for the duration of the Agreement. NNI consists of two components: (1) 91% Combined Adult and Juvenile Project Survival achieved by project improvement Measures implemented within the geographic area of the Project (2) 9% compensation for Unavoidable Project Mortality provided through hatchery and tributary programs, with 7% compensation provided through hatchery programs and 2% compensation provided through tributary programs. The Parties intend these actions to contribute to the rebuilding of tributary habitat production capacity and basic productivity and numerical abundance of Plan Species.

C. The District will receive a Permit for Permit Species upon this Agreement becoming effective. If the District carries out its responsibilities for fish protection and mitigation Measures set out in this Agreement, and provide the necessary monitoring and evaluation, all according to the time frames set out for each Measure, the Permit shall continue for the full term of this

Agreement subject to Section 2 (Termination) and Section 10 (Endangered Species Act Compliance). The Parties shall take the actions set out in this Agreement in support of the District before the Federal Energy Regulatory Commission (FERC) and in other forums.

D. Capitalized terms used in this Agreement are defined in Section 13 "Definitions".

NOW, THEREFORE, IN CONSIDERATION of the mutual promises and conditions set forth herein, the Parties agree as follows:

SECTION 1
TERM OF AGREEMENT

1.1 Term. Unless terminated early according to Section 2 (Termination), this Agreement shall become effective on the date this Agreement is approved by FERC and shall remain in full force and effect for a period of fifty (50) years from that date. From the date this Agreement becomes effective, it shall prospectively supersede the Wells Settlement Agreement dated October 1, 1990.

SECTION 2
TERMINATION

2.1 Automatic Termination Events. This Agreement shall terminate automatically: (1) at the end of the term of the Agreement as set forth in Section 1 (Term of Agreement), (2) in the event the FERC issues the District a non-power license for the Project, (3) in the event the FERC orders removal of the Project, (4) in the event the FERC orders drawdown of the Project or (5) the District withdraws from this Agreement based on sub-Section 2.2 (Elective Withdrawal Events). The District's obligations under this Agreement shall terminate in the event its FERC license is terminated or transferred to another entity. The Parties agree that the terms of this Agreement shall be binding on their respective successors and assigns.

2.2 Elective Withdrawal Events.

2.2.1 Enough Already.

2.2.1.1 A Party may withdraw from this Agreement when at least twenty (20) years has elapsed from March 1, 1998, subject to the following conditions: (1) No Net Impact (NNI) has not been achieved or has been achieved but has not been maintained, or (2) the Project has achieved and maintained NNI but the Plan Species are not rebuilding and the Project is a significant factor in the failure to rebuild.

2.2.1.2 If NMFS and the District are in agreement as to specific Measures to remedy the District's failure to achieve or maintain NNI and the District promptly implements agreed Measures that are applicable to the District, NMFS will refrain from suspending or revoking the Permit. In the event that NNI has not been achieved or has been achieved but has not been maintained by March 1, 2018, but the District is otherwise performing all obligations assigned to it in the Permit, and is otherwise in full compliance with all terms and conditions of this Agreement and the Permit, NMFS and USFWS will not exercise their right to withdraw from this Agreement or revoke the Permit unless such withdrawal is explicitly to seek drawdown, dam removal, and/or non-power operations, or actions for achievement of NNI. Should the District, NMFS, and USFWS agree under these circumstances, such actions may be pursued without withdrawing from the Agreement or suspension or revocation of the Permit.

2.2.2 Non-Compliance. A Party may elect at any time to withdraw from the Agreement based on non-compliance of another Party with the provisions of the Agreement, but only subject to the following procedures: (1) a Party asserts that another Party is not complying with the terms of the Agreement, (2) the Party documents and presents evidence supporting assertion of non-compliance in writing (3) the issue of non-compliance is taken to Dispute Resolution, Section 11 (Dispute Resolution), unless waived. Following Dispute Resolution, a Party choosing to withdraw, shall provide all other Parties with notice of withdrawal. The notice shall be in writing and either served in person or provided by U. S. Mail return receipt requested. The right to withdraw shall be waived if not exercised within 60 Days of Dispute Resolution being completed. Sub-Section 2.2.6 (Withdrawal of Another Party) applies to a Party's receipt of notice provided for in this sub-Section.

2.2.3 Governmental Action. A Party may elect to withdraw from this Agreement, pursuant to 9.3.2, in the event that an entity with regulatory authority takes action that (1) is detrimental to the achievement of the obligations set forth in this Agreement and (2) that materially alters or is contrary to one or more terms set forth in this Agreement.

2.2.4 Impossibility. A Party may elect to withdraw from the Agreement in the event the Parties agree in writing that the obligations imposed by this Agreement are impossible to achieve.

2.2.5 Revocation of Permit. A Party may elect to withdraw from the Agreement if the NMFS revokes the Permit.

2.2.6 Withdrawal of Another Party. Upon receipt of a Party's notice of intent to withdraw, any other Party shall have 120 Days from the date of such notice to provide notice to all Parties of its intent to withdraw from this Agreement, or this right to withdraw shall be waived.

2.3 Conditions Precedent to Withdrawal. Two conditions must be satisfied before a Party can withdraw from the Agreement pursuant to sub-Section 2.2.3 (Governmental Action), 2.2.4 (Impossibility), sub-Section 2.2.5 (Revocation of Permit) or sub-Section 2.2.6 (Withdrawl of Another Party). First, the Party desiring to withdraw from the Agreement shall provide written notice to all other Parties of its intent to withdraw. The notice shall be in writing and either served in person or provided by U. S. Mail return receipt requested. The notice shall state the date upon which the Party's withdrawal shall become effective. The date upon which the Party's withdrawal becomes effective shall be no less than sixty (60) Days from the date the notice was provided to all other Parties. Second, prior to the date upon which the Party's withdrawal becomes effective the withdrawing Party (Parties) must make itself (themselves) available for at least one policy meeting to allow remaining Parties to attempt to persuade the withdrawing Party (Parties) not to withdraw. The policy meeting must take place within the sixty (60) Day period or it is waived.

2.4 Effect of Withdrawal. Except as set forth in sub-Section 2.5 (Effect of Termination), sub-Sections 9.4.1 and 9.4.3, and sub-Sections 10.5 (Permit Suspension, Revocation and Re-Instatement) and 10.6 (Early Termination Mitigation), in the event a Party withdraws from this Agreement, this Agreement places no constraints on the withdrawing Party, shall not thereafter be binding on the withdrawing Party, and the withdrawing Party may exercise all rights and remedies that the Party would otherwise have.

2.5 Effect of Termination. Except as set forth in sub-Section 7.3.7.6 (Account Status upon Termination), sub-Sections 9.4.1 and 9.4.3 and sub-Sections 10.5 (Permit Suspension, Revocation and Re-Instatement) and 10.6 (Early Termination Mitigation), upon expiration of this Agreement, or in the event this Agreement is terminated, voided or determined for any reason to be unenforceable before the end of its term, then: (1) the District shall continue to implement the last agreed to Measures until the FERC orders otherwise, and (2) the Parties are not restrained in any manner from advocating to the FERC Measures to replace the Agreement.

SECTION 3
SURVIVAL STANDARDS AND ALLOCATION
OF RESPONSIBILITY FOR NO NET IMPACT

3.1 No Net Impact (NNI) shall be achieved on the schedule set out herein, and maintained for the duration of the Agreement for each Plan Species affected by the Project. NNI consists of two components: (1) 91% Combined Adult and Juvenile Project Survival achieved by project improvement Measures implemented within the geographic area of the Project, (2) 9% compensation for Unavoidable Project Mortality provided through hatchery and tributary programs, with 7% compensation provided through hatchery programs and 2% compensation provided through tributary programs. Measures and Survival Standards, as provided in Section 4 (Passage Survival Plan), Section 7 (Tributary Conservation Plan) and Section 8 (Hatchery Compensation Plan), shall be evaluated as provided in sub-Sections 6.9 (Progress Reports) and achieved no later than March 2013). The inability to measure a standard due to limitations of technology shall not be construed as a success or a failure to achieve NNI as further explained in sub-Section 4.1.1. (91% Combined Adult and Juvenile Survival) and sub-Section 4.1.2 (93% Juvenile Project Survival and 95% Juvenile Dam Passage Survival).

Based upon the best available information the District will achieve NNI within a few years time, well before the 2013 date. The District has achieved the 93% Juvenile Project Survival goal for yearling chinook and steelhead (See sub-Section 4.2.1 Phase I (1998-2002)) and Parties believe that the calculated Juvenile Dam Passage Survival for sockeye and sub-yearling chinook is probably greater than 95%. Adult survival cannot be conclusively measured at this time, as indicated in sub-Section 4.1.1 (91% Combined Adult and Juvenile Survival) and 4.1.3 (Adult Survival Assumptions). The Plan Species Account will be established upon FERC approval and will be used to fully compensate for adult mortality until an adult survival study can be conducted. The District has provided or is in the process of providing the 7% hatchery commitments or equivalent (in the case of sockeye). Achievement of the NNI goal by 2013 does not affect or diminish the provisions of sub-Section 2.2.1 (Enough Already) and sub-Section 9.5 (Re-Licensing).

3.2 To ensure NNI is achieved and maintained, the Coordinating Committee shall: (1) oversee monitoring and evaluation, and (2) periodically adjust the Measures to address actual project survival and Unavoidable Project Mortality as provided herein; provided that no more than 9% Unavoidable Project Mortality shall be made up through hatchery and tributary compensation without concurrence of the Coordinating Committee. Initially, adult survival estimates will be used to adjust the Plan Species Account contribution and Juvenile Project Survival estimates will be used to adjust hatchery based compensation programs (See Section 7: Example 1 and See Section 8: Example 2).

However, should adult survival rates fall below 98%, but the Combined Adult and Juvenile survival rate be maintained above 91%, additional hatchery compensation for that portion of adult losses that exceeds 2%, toward a maximum contribution of 7% hatchery funding and 2% tributary funding, would be utilized to satisfy the NNI compensation requirements for each Plan Species. Hatchery compensation shall not exceed 7% and tributary funding shall not exceed 2% unless agreed to by the Coordinating Committee.

3.3 The District shall be responsible for achieving the pertinent survival standard as provided in Section 3 (Survival Standards and Allocation of Responsibility for No Net Impact) and 4 (Passage Survival Plan) for each Plan Species affected by the Project through project improvement Measures (including adult, juvenile, and reservoir Measures). The District shall also be responsible for (1) funding the Tributary Conservation Plan as provided in Section 7; (2) providing the capacity and funding for the 7% Hatchery Compensation Plan as provided in Section 8; and (3) making capacity and funding adjustments to the Hatchery Compensation Plan to reflect and fully compensate for future increases in the run size of each Plan Species as provided in sub-Section 8.4.5 (Adjustment of Hatchery Compensation – Population Dynamics) and further adjustments to the Hatchery Compensation Plan to reflect the results of survival studies as provided in Section 8.4.4 (Adjustment of Hatchery Compensation – Survival Studies). If the District is unable to achieve the pertinent survival standard, then the District shall consult with the Parties through the Coordinating Committee to jointly seek a solution. If a solution cannot be identified to achieve the survival standards identified herein, any Party may take action under sub-Section 2.2.4 (Impossibility), or other provisions of this Agreement.

3.4 The Tributary Committee and Hatchery Committee shall develop plans and programs, which must include evaluation procedures, necessary to implement the Tributary Conservation Plan and the Hatchery Compensation Plan, respectively to compensate for Unavoidable Project Mortality. If Unavoidable Project Mortality is not compensated for through the Hatchery Compensation Plan, the Hatchery Committee may examine additional hatchery improvements to meet the Unavoidable Project Mortality hatchery obligation. If the Hatchery and Tributary Committees are unable to develop plans and programs to fully implement the Hatchery Compensation Plan and Tributary Conservation Plan, respectively, to meet compensation levels necessary to meet

NNI, then the respective committees may consult with the Coordinating Committee to jointly seek a solution.

3.5 Implementation of Measures to meet NNI shall follow the time frames set out in the Passage Survival Plan, the Tributary Conservation Plan and the Hatchery Compensation Plan. Where a deadline is not specified, implementation of Measures shall occur as soon as is reasonably possible.

SECTION 4
PASSAGE SURVIVAL PLAN

4.1 Survival Standards.

4.1.1 91% Combined Adult and Juvenile Survival. The District shall achieve and maintain 91% Combined Adult and Juvenile Project Survival, as required in sub-Section 3.3, which means that 91% of each Plan Species, juvenile and adult combined, survive Project effects. As of 2002, the Parties agree that adult fish survival cannot be conclusively measured for each Plan Species. Until technology is available to accurately determine Project effects, the District will implement the adult Measures as identified in sub-Section 4.4 (Adult Passage Plan). Given the present inability to differentiate between the sources of adult mortality, initial compliance with the Combined Adult and Juvenile Survival standard will be based upon the measurement of juvenile survival as provided in Section 4.1.2, (93% Juvenile Project Survival and 95% Juvenile Dam Passage Survival) below. It is anticipated that the District shall implement the measurement of adult survival at some time in the future should adult survival study methodologies and study plans be agreed to by the Coordinating Committee. Mitigation Measures will be adjusted at that time, if necessary, to address the new information.

4.1.2 93% Juvenile Project Survival and 95% Juvenile Dam Passage Survival. Limitations associated with the best available technology have required the development of three standards for assessing juvenile fish survival at the project. In order of priority they are: 1) Measured Juvenile Project Survival; 2) Measured Juvenile Dam Passage Survival; and 3) Calculated Juvenile Dam Passage Survival. The survival of each Plan Species shall be determined by using one of these standards, with subsequent evaluations implemented as appropriate, per the following guidelines. If the Combined Adult and Juvenile Project Survival cannot be measured, then Juvenile Project Survival shall be measured as the next best alternative until measurement is possible (See Section 13, "Juvenile Project Survival").

If Juvenile Project Survival for each Plan Species is measured to be greater than or equal to 93%, then the District will be assigned to Phase III (Standards Achieved). If Juvenile Project Survival is measured at less than 93% but greater than or equal to 91%, then the District will be assigned to Phase III (Provisional Review). If Juvenile Project Survival is measured at less than 91%, then the District will be assigned to Phase II (Interim Tools) (See Section 14, Figure 1. Wells HCP Survival Standard Decision Matrix).

<u>Wells HCP Survival Standard Decision Matrix</u>. The decision making process for implementation of the survival standards explained in Sections 4.1 (Survival Standards) and 4.2 (Phased Implementation Plans) is graphically depicted in Figure 1, Section 14 (set out below).

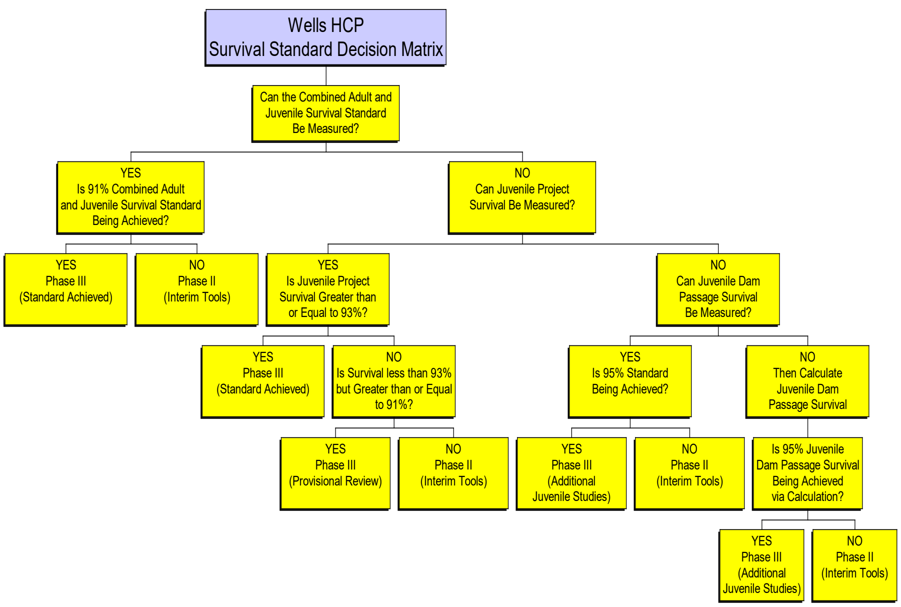

Figure 1. Wells HCP Survival Standard Decision Matrix

If Juvenile Project Survival cannot be measured, then Juvenile Dam Passage Survival shall be measured as the next best alternative until project measurement is possible (See Section 13, "Juvenile Dam Passage Survival"). The Juvenile Dam Passage Survival Standard is 95%.

For some Plan Species such as sockeye and subyearling chinook where measurement of Juvenile Project Survival and Juvenile Dam Passage Survival is not yet possible, the Juvenile Dam Passage Survival Standard will be calculated based on the best available information (including the proportion of fish utilizing specific passage routes and the use of off-site information), as determined by the Coordinating Committee. This calculation will consider the same elements as measured Juvenile Dam Passage Survival, except that off-site information may be used where site-specific information is lacking.

4.1.3 Adult Survival Assumptions. As of 2002, the Parties agree that adult fish survival cannot be conclusively measured for each Plan Species. Based on regional information, the survival of adult Plan Species is estimated to be 98-100%. Until, the Coordinating Committee approves and the District implements adult survival studies, the District will implement the adult passage Measures identified in sub-Section 4.4 (Adult Passage Plan) and provide the Tributary Conservation Plan account specified in Section 7 (Tributary Conservation Plan).

4.1.4 Methodologies. The survival standards contained within Section 4 (Passage Survival Plan) will be measured using the best available technology and study designs approved by the Coordinating Committee. Current methodologies are summarized in Supporting Document C. These methodologies are not exclusive, and may be updated based on new information or techniques. Juvenile Plan Species survival shall be measured at a ninety-five percent (95%) confidence level, with a standard error of the estimate that shall be not more than plus or minus 2.5% (i.e. 5% error). Results from a study meeting this precision level will automatically be included in the three-year average, unless the study has violated critical model assumptions or has been determined to be invalid by the Coordinating Committee. If a study meet all of the testing protocol and model assumptions and provided that the standard error around the point estimate does not exceed plus or minus 3.5%, then the Coordinating Committee, following unanimous approval, may utilize this information in the calculation of the three-year average. Point estimates of survival measured from the three years of valid studies shall be averaged (arithmetic) to compare against the pertinent Plan Species Survival Standard. The use of survival studies with standard errors between 2.5% and 3.5% shall not be subject to Dispute Resolution. If the average of the 3 years of survival measurements is no more than 0.5 percent below the survival standard, the Coordinating Committee may decide whether an additional year of study is appropriate. If an additional year of study is undertaken, the study result (if valid) will be included in the calculation of the arithmetic mean.

The testing shall reflect Representative Environmental Conditions and Representative Operational Conditions for each test, for each Plan Species and life history. Studies conducted during years where flow conditions, during the study, fall between the 10% and 90% points on the Flow Duration Curve (See Section 14, Figure 2a and 2b) shall be considered to have satisfied Representative Environmental Conditions (See Section 13, "Representative Environmental Conditions"). Should flow conditions fall outside the 10% and 90% points on the Flow Duration Curve but be between the 5% and 95% points on the Flow Duration Curve, then the Coordinating Committee, following unanimous approval, may utilize this information in the calculation of the three-year average. The use of survival studies that fall outside the 10% and 90% points on the Flow Duration Curves shall not be subject to Dispute Resolution. The Flow Duration Curves shall be subject to periodic review based upon new information.

The testing shall consider direct, indirect and delayed mortality wherever it may occur and can be measured (as it relates to the Project) given the available mark-recapture technology. The Coordinating Committee shall facilitate the availability of test fish for studies that may include rearing of additional fish beyond that required to meet NNI.

4.2 Phased Implementation Plans.

4.2.1 Phase I (1998 – 2002).

This Agreement shall be implemented in three phases. Under Phase I, the District shall implement 1) juvenile and adult operating plans and criteria to meet the Survival Standards set forth in sub-Section 4.1 (Survival Standards) and 2) a monitoring and evaluation program to determine compliance with the standards. Following the completion of the three-year monitoring and evaluation program in Phase I, the Coordinating Committee will determine whether the pertinent survival standards have been achieved. Depending on the results of this determination, the District will either proceed to Phase II (if the applicable survival standard has not been achieved) or Phase III (if the applicable survival standards has been achieved). In addition, three separate sub-phases were established within Phase III. The three sub-Phase designations are referred to as Phase III (Standards Achieved), Phase III (Provisional Review) and Phase III (Additional Juvenile Studies). The Parties to this Agreement established separate sub-phases within Phase III as a way to address existing limitations in the measurement of adult survival and Juvenile Project Survival for sockeye and subyearling chinook (See Section 14, Figure 1).

The Parties recognize that Douglas PUD has completed the three years of valid Juvenile Project Survival studies as documented in Section 15, Appendix B. The Parties further recognize that the District has achieved the 93% Juvenile Project Survival goal for yearling chinook and steelhead and that once this Agreement is implemented the District will move into Phase III (Standard Achieved) for these Plan Species. The District also recognizes that project survival information is currently limited for yearling chinook and steelhead originating from the Okanogan Basin. As a result, future Project Survival Studies (e.g. 10 year standards verification studies) shall consider and attempt to quantify the effect of the Wells reservoir on Okanogan origin yearling chinook and steelhead.

Measurement and evaluation of 91% Combined Adult and Juvenile Project Survival or 93% Juvenile Project Survival or the measurement or calculation of 95% Juvenile Dam Passage Survival will be assessed by the Coordinating Committee by 2002. Measurement of Juvenile Project Survival or Juvenile Dam Passage Survival during Phase I is expected to take three years to complete, unless additional years of study are agreed to by the Coordinating Committee.

Juvenile survival studies conducted during Phase I (See Section 15, Appendix B) may result in different phase designations for each of the Plan Species. For example, the District will move to Phase II (Interim Tools) or (Additional Tools), or to Phase III (Standard Achieved, Provisional Review or Additional Juvenile Studies) as described in Figure 1, depending on the survival results for individual Plan Species. At the conclusion of Phase I, the Coordinating Committee will determine the appropriate phase designation for each Plan Species. If the Coordinating Committee cannot agree, the Coordinating Committee may agree to require an additional year of study to resolve the disagreement, or a Party may institute Section 11 (Dispute Resolution) to address the need for additional Measures during the period of measurement and evaluation.

4.2.2 Phase II.

If the Coordinating Committee has determined, based upon Phase I monitoring and evaluation or Phase III periodic monitoring, that Juvenile Project Survival is less than 91% or Juvenile Dam Passage Survival (measured or calculated) is less than 95%, the District shall move to Phase II for that Plan Species.

4.2.3 Phase II -- (Interim Tools). If measurement and evaluation of Phase I concludes that the applicable survival standard has not been achieved, then the Wells bypass flow will be increased to 4.4 kcfs per bypass at night (1 hour before sunset to sunrise) for the period during which 80% of the Plan Species not meeting the Juvenile Dam Passage Survival Standard pass the Wells Project or for 40 Days, whichever is less. The effect of increased bypass flows will be evaluated to determine if either 95% Juvenile Dam Passage Survival or the 93% Juvenile Project Survival or the 91% Combined Adult and Juvenile Project Survival levels are being attained. The Coordinating Committee will determine the number of valid studies (not to exceed three years of study) necessary to make a Phase determination following the implementation of Interim Tools. If the Combined Adult and Juvenile Survival or the Juvenile Project Survival goals are being achieved, as measured by the re-assessment studies, the District will advance to Phase III (Standards Achieved). If Juvenile Project Survival is re-evaluated and determined to be less than 93% and greater than or equal to 91%, then the Parties shall proceed to Phase III (Provisional Review). If Juvenile Dam Passage is re-evaluated and determined to be greater than or equal to 95%, then the Parties shall proceed to Phase III (Additional Juvenile Studies). If Juvenile Dam Passage Survival continues to be less than 95% and Juvenile Project Survival continues to be less than 91%, then the District shall proceed to Phase II (Additional Tools).

4.2.4 Phase II – (Additional Tools). The Coordinating Committee shall jointly decide on additional Tools, for the District to implement in order to achieve the pertinent survival standard(s) using the following criteria:

1. Likelihood of biological success;

2. Time required to implement; and

3. Cost–effectiveness of solutions, but only where two or more alternatives are comparable in their biological effectiveness.

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Until the pertinent survival standard is achieved, the Parties shall continue to implement Phase II (Additional Tools) for the standard and for each Plan Species that is not meeting the pertinent survival standard, except as set forth in sub-Section 2.2.1 (Enough Already) and sub-Section 2.2.4 (Impossibility). The Coordinating Committee will determine the number of valid studies (not to exceed three years of study) necessary to make a Phase determination following the implementation of Additional Tools.

4.2.5 Phase III (Standard Achieved or Provisional Review or Additional Juvenile Studies).

The District proceeds to Phase III upon a determination by the Coordinating Committee that the District has 1) verified compliance with the Combined Adult and Juvenile Survival or measured Juvenile Project Survival (Standard Achieved), 2) has evaluated Juvenile Project Survival at less than 93% but greater than or equal to 91% (Provisional Review), or 3) has measured or calculated 95% Juvenile Dam Passage Survival (Additional Juvenile Studies). In short, Phase III indicates that the appropriate standard has either been achieved or is likely to have been achieved and provides additional or periodic monitoring to ensure that survival of the Plan Species remains in compliance with the survival standards set forth in Section 4 (Passage Survival Plan) for the term of the Agreement.

4.2.5.1 Phase III (Standard Achieved). The District shall proceed to Phase III (Standard Achieved) following measurement and evaluation that indicate that either the 91% Combined Adult and Juvenile Survival Standard or 93% Juvenile Project Survival is being achieved. In this case, the District shall re-evaluate performance under the applicable standards every 10 years. The Coordinating Committee shall pick representative species for all Plan Species. However, only one species will be utilized to represent spring migrants and one species for summer migrants. This re-evaluation will occur over one year and be included in the pertinent average for that particular species. If the survival standard is met, then Phase III (Standards Achieved) status will remain in effect. If the survival standard is not achieved, then an additional year of testing will occur. If the survival standard remains un-achieved over three years of re-evaluation, then Phase II (Interim or Additional Tools) will take affect for the species evaluated. The Coordinating Committee shall then consider re-evaluating the passage survival of other Plan Species. If the survival standards are exceeded then passage Measures at the Dam shall remain in effect, however supplementation rates may be adjusted from the 7% level based on actual project survival as described in sub-Section 8.4.4. (Adjustment of Hatchery Compensation – Survival Studies).

4.2.5.2 Phase III (Provisional Review). The District shall proceed to Phase III (Provisional Review) when Juvenile Project Survival is measured at less than 93% but greater than or equal to 91%. Provisional Review allows the District a one time (Plan Species specific) five year period to implement additional Measures or conduct additional Juvenile Dam Passage Survival Studies or Juvenile Project Survival Studies or Combined Adult and Juvenile Survival Studies. The results of the

Provisional Review Studies will be evaluated by the Coordinating Committee to more accurately determine whether the pertinent survival standard is being achieved. The Coordinating Committee will determine the number of valid studies (not to exceed three years of study) necessary to make a Phase determination following the completion of the Provisional Review survival studies. The Parties will then proceed based upon the results of these new studies. During Phase III (Provisional Review), supplementation levels shall be maximized at 7% for the affected Plan Species and 2% compensation shall be provided by the District to the Plan Species Account.

When the Provisional Review studies indicate that the Combined Adult and Juvenile Survival estimates are greater than or equal to 91% or when the Juvenile Project Survival studies indicate that survival is greater than or equal to 93% then the District shall proceed to Phase III (Standard Achieved).

If the Provisional Review studies indicate that the 95% Juvenile Dam Passage Survival standard has been achieved through direct measurement or calculation, then the District shall proceed to Phase III (Additional Juvenile Studies).

If after the one time, five-year Provisional Review period, Juvenile Project Survival is still less than 93% and greater than or equal to 91% and the Combined Adult and Juvenile Survival studies are inconclusive, then the District will revert back to Phase II (Interim Tools). If the increased bypass flows implemented under Phase II (Interim Tools) do not achieve either 95% Juvenile Dam Passage Survival or 93% Juvenile Project Survival, the District shall proceed to Phase II (Additional Tools).

4.2.5.3 <u>Phase III (Additional Juvenile Studies).</u> The District shall proceed to Phase III (Additional Juvenile Studies) when Juvenile Dam Passage Survival studies or Juvenile Dam Passage calculations indicate that Juvenile Dam Passage Survival is greater than or equal to 95%. Because measurement or calculation of Juvenile Dam Passage Survival does not address juvenile mortality in the pool or the indirect effects of juvenile project passage, the District will evaluate either the 91% Combined Adult and Juvenile Project Survival or the 93% Juvenile Project survival as determined appropriate by the Coordinating Committee. If at any time during Phase III (Additional Juvenile Studies), the Coordinating Committee approves the use of new survival methodologies, the District will have five years to conduct the appropriate evaluation(s). The Coordinating Committee will determine the number of valid studies (not to exceed three years of study) necessary to make a Phase determination under Additional Juvenile Studies. The Parties will then proceed based upon the results of these new studies. During Phase III (Additional

Juvenile Studies), supplementation levels shall be maximized at 7% for the affected Plan Species and 2% compensation shall be provided by the District to the Plan Species Account.

4.3 Wells Dam Juvenile Dam Passage Survival Plan.

4.3.1 The District will continue to implement a bypass program of controlled Spill using five (5) bypass baffles at the Wells Project to meet the criteria set out below.

(a) No turbine will be operated during the juvenile migration period unless the adjacent bypass system is operating according to the following criteria.

(b) The five (5) bypass system bays will be Nos. 2, 4, 6, 8, and 10. Operation of the turbines will be in pairs with the associated bypass system bays as follows:

Turbines Operated	Bypass Bays Operated
1 and/or 2	2
3 and/or 4	4
5 and/or 6	6
7 and/or 8	8
9 and/or 10	10

(For example, if turbines 1, 5, and 6 are operating, bypass systems 2 and 6 will be operating.)

(c) At least one bypass will be operating continuously throughout the juvenile migration period, even if no turbines are operating.

(d) The bypass systems and spillgates will be operated in configuration K of the 1987 bypass system report (bottom Spill, 1 foot spill gate opening, 2,200 cfs, vertical baffle opening) for all bypass system bays.

(e) Top Spill has been shown to be as effective as bottom Spill in bypass bays 2 and 10, therefore, top Spill will be allowed in these bays.

(f) If the Chief Joseph Dam Uncoordinated Discharge Estimate is 140,000 cubic feet per second (140 Kcfs) or greater for the following day, all five bypass systems will be operated continuously for 24 hours regardless of turbine unit operation.

(g) If the Chief Joseph Dam Uncoordinated Discharge Estimate is less than 140 Kcfs, bypass system operation will be as follows:

Number Turbines Operating	Minimum Number Bypass Systems Operating
10	5
9	5
8	4
7	4
6	3
5	3
4	2
3	2
2	1
1	1
0	1

4.3.2 The District shall operate the bypass system continuously between April 10 and August 15. Initiation of the bypass system may occur between April 1 and April 10 when it can be demonstrated that greater than 5% of the spring migration takes place prior to April 10. The basis for making this determination shall be the historical hydro-acoustic index, verified by historical species composition information. Termination of the bypass system between August 15 and August 31 will occur when it can be demonstrated that 95% of the summer migration has passed the project. The basis for making this determination shall be the historic hydro-acoustic index, verified by the historical species composition information. The bypass will not operate past August 31 unless a Party to this Agreement provides credible scientific evidence to the Coordinating Committee that the run timing is such that a significant component of a Plan Species migrates through the Forebay, Dam and Tailrace outside the usual migration period (April 1 through August 31).

Run timing information will be gathered through the 2002 migration. The Historic Hydroacoustic and Fyke Netting information (1982 – 2002) will be used to verify that 95% of the spring and 95% of the summer migrations are being protected by operating the bypass system from April 10 through August 15.

After the 2002 migration, changes to the April 10 through August 15 operation may be agreed to by the Coordinating Committee based upon historical hydroacoustic and species composition information that would provide bypass operations for 95% of the spring and 95% of the summer migration of juvenile Plan Species.

Additional hydroacoustic and species composition monitoring shall be conducted once every 10 years in order to verify that a significant component (greater than 5%) of the juvenile migration is not present outside the normal bypass operating period (April 10 through August 15) and to verify that the operations established by the Coordinating Committee are adequately protecting 95% of the spring and summer migrations of juvenile Plan Species.

4.3.3 Predator Control Measures shall be implemented by the District and will consist of both northern pikeminnow removal and piscivorous bird harassment and control Measures. The northern pikeminnow removal program may include a pikeminnow bounty program, fishing derbies and tournaments, the use of long lines and trapping. Piscivorous bird populations, which include, Caspian terns, double-crested cormorants, and various gull species will be hazed. Hazing techniques may include elaborate wire arrays in the tailrace to deter foraging, propane cannons, various pyrotechnics, and lethal control when necessary. This program will continue to run during the juvenile outmigration.

4.4 Adult Passage Plan. The District shall emphasize adult project passage Measures in order to give high priority to adult survival in the achievement of 91% Combined Adult and Juvenile Project Survival for each Plan Species. The District shall use Tools, including but not limited to the following:

4.4.1 The District shall use best efforts to maintain and operate adult passage systems at the Project according to criteria developed through the Coordinating Committee and as provided in Appendix A: Wells Hydroelectric Project, Adult Fish Passage Plan.

4.4.2 The District shall operate Spill and turbine units in a manner that provides for adult passage while meeting the pertinent juvenile survival standard.

4.4.3 Areas within the adult fish passage systems which are identified by the Coordinating Committee as either consistently out of criteria or where significant delay occurs (as it relates to the biological fitness of the adult Plan Species) shall be modified as soon as feasible.

4.4.4 The District shall use best efforts to eliminate identified sources of adult injury and mortality during adult migration through the Dam.

4.4.5 By the end of Phase I, the District shall identify adult fallback rates at the Dam. This evaluation will include the magnitude of voluntary and involuntary fallback, and will assess the effects of ladder trapping, project operations, the Wells Fish Hatchery and downstream tributaries upon observed rates of fallback. This assessment will also determine the biological significance of these fallback events on the overall fitness of adult Plan Species. If the observed rates of adult fallback and steelhead kelt loss are determined to be significant, then the Coordinating Committee shall determine the most cost effective methods to protect adult fallbacks and steelhead kelts at the Dam, and the District shall immediately implement the Measures. Reduction in fallback rates, mortalities and protection of kelts shall be factored into juvenile bypass and adult passage development and implementation and into Project operation decisions.

4.4.6 The Parties to this Agreement recognize that current technology does not allow for a precise estimate of hydroelectric project induced mortality to adult salmonids. Until adult survival studies can accurately differentiate between natural and hydro-project induced mortality, the District shall use the best available technology to conduct, on a periodic basis, adult passage verification studies toward the diagnosis of adult loss, injury and delay at Wells Dam. Prior to the completion of adult survival studies, compensation for adult mortality shall be assumed completely fulfilled by the District's contribution to the Plan Species Account. Following the completion of adult survival studies, should adult survival rates fall below 98% but the Combined Adult and Juvenile survival rate be maintained above 91%, additional hatchery compensation for that portion of adult losses that exceeds 2%, toward a maximum contribution of 7% compensation provided through hatchery programs and 2% tributary funding, would be utilized to satisfy NNI compensation requirements for each Plan Species.

4.4.7 Pursuant to the 2000 Biological Opinion (BiOp) for the Federal Columbia River Power System, the federal action agencies are required to conduct a comprehensive evaluation to assess adult survival at federal dams. The Bi-Op sets forth a series of evaluation methods to be employed.
The Coordinating Committee should review the information and techniques utilized in those studies and evaluate their potential for accurately measuring Combined Adult and Juvenile Project Survival. The Coordinating Committee should also evaluate technologies found at the federal dams to increase adult survival for possible implementation at the Project. Based upon those evaluations, the District shall implement as necessary, technologies appropriate for the Project.

SECTION 5
RESERVOIR AS HABITAT AND WATER QUALITY

5.1 When making land use or related permit decisions on Project owned lands that affect reservoir habitat, the District shall consider the cumulative impact effects in order to meet the conservation objectives of the Agreement, requirements of the FERC license, and other applicable laws and regulations. The District further agrees to notify and consider comments from the Parties to the Agreement regarding any land use permit application on Project owned lands.

5.2. The District shall notify all applicants for District permits to use or occupy Project lands or water that such use or occupancy may result in an incidental take of species listed as endangered or threatened under the ESA, requiring advance authorization from NMFS or USFWS.

5.3 The Parties recognize that there are potential water quality issues (temperature and dissolved gas) related to cumulative hydropower operations in the Columbia River. The Parties will work together to address water quality issues.

SECTION 6
COORDINATING COMMITTEE

6.1 Establishment of Committee. There shall be a Coordinating Committee composed of one (1) representative of each Party, provided, that the District's Power Purchasers may participate as a non-voting observer through a single representative, whom they will designate from time to time. Each representative shall have one vote. Each Party shall provide all other Parties with written notice of its designated representative to the Coordinating Committee.

6.2 Meetings. The Coordinating Committee shall meet whenever requested by any two (2) members following notice (unless waived).

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6.3 Meeting Notice. The chair of the Coordinating Committee shall provide all committee members with a minimum of ten (10) Day's advanced written notice of all meetings unless a member waives notice in writing or reflects the waiver in the approved meeting minutes. The notice shall contain an agenda of all matters to be addressed and voted on during the meeting.

6.4 Voting. The Coordinating Committee shall act by unanimous vote of those members present in person or by phone for the vote and shall develop its own rules of process, provided, that the chair shall ensure that all members are sent notice regarding agenda items that may be brought to a vote during the proposed Coordinating Committee meeting. Abstention does not prevent a unanimous vote. If a Party or its designated alternate cannot be present for an agenda item to be voted upon at a Coordinating Committee meeting, the Party must notify the chair of the Coordinating Committee who shall delay a vote on an agenda item for up to five business days on specified issue(s) to be addressed in a meeting and conference call scheduled with all interested Parties, or as otherwise agreed to by the Coordinating Committee. A Party may invoke this right only once per delayed item. If the Coordinating Committee cannot reach agreement, then upon request by any Party, that issue shall be referred to Dispute Resolution.

6.5 Chair of the Coordinating Committee. The Parties shall choose and the District shall fund a neutral third party to act as the chair the Coordinating Committee. The chair is expected to prepare an annual list of understandings based on the results of studies (See below sub-Section 6.7 (Authority)), prepare progress reports, prepare meeting minutes, facilitate and mediate the meetings, and assist the members of the Coordinating Committee in making decisions. At least every three years, the Coordinating Committee shall evaluate the performance of the chair of the Coordinating Committee.

6.6 Use of Coordinating Committee. The Coordinating Committee will be used as the primary means of consultation and coordination between the District and the FP in connection with the conduct of studies and implementation of the Measures set forth in this Agreement and for Dispute Resolution. Any entity not executing this Agreement shall not be a Party to this Agreement and shall not be entitled to vote on any committee established by this Agreement. However, any Committee established by this Agreement may agree to allow participation of any governmental entities not a Party to this Agreement.

6.7 Authority. The Coordinating Committee will oversee all aspects of standards, methodologies, and implementation. The Coordinating Committee shall 1) establish the protocol(s) and methodologies to determine whether or not the survival standards contained within Section 4 (Passage Survival Plan) are being achieved for each Plan Species; 2) determine whether the Parties are carrying out their responsibilities under this Agreement; 3) determine whether NNI is achieved; 4) determine the most appropriate standard in Section 4 (Passage Survival Plan) to be measured for each Plan Species; 5) approve all studies prior to implementation; and 6) review study results, determine their applicability, and develop an annual list of common understandings based on the studies; 7) periodically adjust the Measures (after Phase I) to address survival and Unavoidable Project Mortality as provided herein; provide that no more than 9% Unavoidable Project Mortality shall be replaced through hatchery and tributary compensation without concurrence of the Coordinating Committee, and hatchery compensation shall not exceed 7% and tributary funding shall not exceed 2% unless agreed to by the Coordinating Committee; 8) resolve disputes brought by the Hatchery and Tributary Committees, and (9) adjust schedules and dates for performance. If the Coordinating Committee cannot reach agreement, then these decisions shall be referred to Dispute Resolution as set forth in Section 11 (Dispute Resolution).

6.8 Studies and Reports. All studies and reports prepared under this Agreement will be available to all members of the Coordinating Committee as soon as reasonably possible. Draft reports will be circulated through the Coordinating Committee representatives for comment, which shall be due within 60 Days unless the Coordinating Committee decides otherwise, and comments will either be addressed in order or made an appendix to the final report. All reports will be kept on file with the District. All studies will be conducted following techniques and methodologies accepted by the Coordinating Committee. All studies will be based on sound biological and statistical design and analysis. The Coordinating Committee shall have the ability to select an independent, third party for the purpose of providing an independent scientific review of any disputed survival study results and/or reports.

6.9 Progress Reports: Each year, with assistance from the chair of the Coordinating Committee, the Hatchery Committee, and the Tributary Committee shall prepare an annual report to the Coordinating Committee describing their progress. Each year, the Coordinating Committee shall prepare an annual report to the Parties describing progress toward achieving the survival standards contained within Section 4 (Passage Survival Plan), and common understandings based upon studies. By March 2013, a comprehensive progress report shall be prepared by the District, at the direction of the Coordinating Committee, assessing overall status of achieving NNI. The Coordinating Committee shall direct an analysis to determine whether each Plan Species is rebuilding. Comprehensive progress reporting shall continue to occur at successive ten-year intervals.

SECTION 7
TRIBUTARY CONSERVATION PLAN

7.1 Tributary Plan. The Tributary Conservation Plan (Tributary Plan) consists of this Agreement and is supported by Supporting Document D, (Tributary Plan, Project Selection, Implementation, and Evaluation). The Tributary Plan is also supported by Supporting Document A (Aquatic Species and Habitat Assessment: Wenatchee, Entiat, Methow, and Okanogan Watersheds). The Parties recognize that Supporting Document A and D do not, by themselves, create contractual obligations.

7.2 Purpose. Under the Tributary Plan, the District shall provide a Plan Species Account to fund projects for the protection and restoration of Plan Species habitat within the Columbia River Watershed (from the Chief Joseph Tailrace to the Wells Tailrace) and the Methow, and Okanogan watersheds, in order to compensate for up to two percent Unavoidable Project Adult and/or Juvenile Mortality; provided that the Parties shall not be required to actually measure whether the Tributary Plan compensates for up to two percent Unavoidable Adult Project Mortality.

7.3 Tributary Committee.

7.3.1 Establishment of Committee. There shall be a Tributary Committee composed of one (1) representative of each Party, provided that an entity eligible to appoint a representative to the Tributary Committee is not required to appoint a representative, and further provided that, representatives from USFWS shall participate in a non-voting, ex-officio capacity unless they otherwise state in writing, and further provided that, the Power Purchasers may participate as a non-voting observer through a single representative, whom they will designate from time to time. The Tributary Committee may select other expert entities, such as land and water trusts/conservancy groups to serve as additional, non-voting members of the Tributary Committee. Each entity eligible to appoint a representative to the Tributary Committee shall provide all other eligible entities with written notice of its designated representative. The Tributary Committee is charged with the task of selecting projects and approving project budgets from the Plan Species Account for purposes of implementing the Tributary Plan.

7.3.2 Full Disclosure. After full written disclosure of any potential conflict of interest, which shall appear in the minutes of the Tributary Committee and prior to project approval, the Tributary Committee may approve a project that may benefit a person or entity related to a committee member, or an entity which appointed the committee member.

7.3.3 Meetings. The Tributary Committee shall meet not less than twice per year at times determined by the Tributary Committee. Additionally, the Tributary Committee may meet whenever requested by any two (2) members following a minimum of ten (10) Days advance written notice to all members of the Tributary Committee unless a member waives notice in writing or reflects the waiver in the approved meeting minutes. The notice shall contain an agenda of all matters to be addressed during the meeting including items that may be brought to a vote during the meeting.

7.3.4 Voting. Except as set forth in sub-Section 7.3.7.1 (Prohibited Use of Account), the Tributary Committee shall act by unanimous vote of those members present in person or by phone for the vote and shall develop its own rules of process, provided, that the chair shall ensure that all members are sent notice of all Tributary Committee meetings. Abstention does not prevent a unanimous vote. If a Party or its designated alternative cannot be present for an agenda item to be voted upon the Party must notify the chair of the Tributary Committee who shall delay a vote on an agenda item for up to five business days on specified issue(s) to be addressed in a meeting or conference call with all interested Parties, or as otherwise agreed to by the Tributary Committee. A Party may invoke this right only once per delayed item. If the Tributary Committee cannot reach agreement, then upon request of any Party, that issue shall be referred to the Coordinating Committee.

7.3.5 Chair of the Tributary Committee. The Parties shall choose and the District shall fund a neutral third party to chair the Tributary Committee meetings. The chair of the Tributary Committee shall have the same responsibilities and authorities with regard to the Coordinating Committee. At least every three years, the Tributary Committee shall evaluate the performance of the chair of the Tributary Committee.

7.3.6 Coordination With Other Conservation Plans. Whenever feasible, projects selected by the Tributary Committee shall take into consideration and be coordinated with other conservation plans or programs. Whenever feasible, the Tributary Committee shall cost-share with other programs, seek matching funds, and "piggy-back" programs onto other habitat efforts.

7.3.7 Plan Species Account. The District shall establish a Plan Species Account in accordance with applicable provisions of Washington State law and this Agreement. Interest earned on the funds in the Plan Species Account shall remain in the Plan Species Account. The Parties to this Agreement may audit the District's records relating to the Account during normal business hours following reasonable notice. The Tributary Committee shall select projects and approve project budgets from the Plan Species Account by joint written request of all members of the Tributary Committee. The Tributary Committee shall act in strict accordance with sub-Section 7.3.7.1 (Prohibited Uses of Account).

7.3.7.1 Prohibited Uses of Account. No money from the Plan Species Account shall be used to enforce compliance with this Agreement. Members of the Tributary Committee and their expenses to attend and participate in Tributary Committee meetings shall not be compensated through the Plan Species Account. Administrative costs, staffing and consultants, reports and brochures, landowner assistance and public education costs collectively shall not exceed $80,000 (1998 dollars) in any given year without the unanimous vote of the Tributary Committee.

7.3.7.2 Financial Reports. At least annually, the District shall provide financial reports of Plan Species account activity to the Tributary Committee.

7.3.7.3 Selection of Projects and Approval of Budgets. The Tributary Committee shall select projects and approve budgets for expenditure from the Plan Species Account for the following: (1) Any action, structure, facility, program or measure (referred to herein generally as "tributary projects") intended to further the purpose of the Tributary Plan for Plan Species. Tributary Projects shall be chosen based upon the guidelines set forth in Supporting Document D, "Tributary Compensation, Project Selection, Implementation, and Evaluation" and Supporting Document A, "Aquatic Species and Habitat Assessment: Wenatchee, Entiat, Methow, and Okanogan Watersheds ". Tributary Projects shall not be implemented outside the area specified in sub-Section 7.2 (Purpose). High priority shall be given to the acquisition of land or interests in land such as conservation easements or water rights or interests in water such as dry year lease options; (2) Studies, implementation, monitoring, evaluation, and legal expenses associated with any project financed from the Plan Species Account; and (3) Prior approved administrative expenses associated with the Plan Species Account.

7.3.7.4 Ownership of Assets. The Tributary Committee shall make determinations regarding ownership of real and personal property purchased with funds from the Plan Species Account. Title may be held by the District, by a resource agency or tribe or by a land or water conservancy group, as determined by the Tributary Committee. Unless the Tributary Committee determines that there is a compelling reason for ownership by another entity, the District shall have the right to hold title. All real property purchased shall include permanent deed restrictions to assure protection and conservation of habitat.

7.3.7.5 Account Status Upon Termination. Upon the Agreement's termination, (1) the District's unspent advanced contributions to the Plan Species Account shall be promptly released to the District, (2) if funds remain in the Plan Species Account after the return of the District's advance contributions, then the Tributary Committee shall remain in existence and continue to operate according to the terms of this Agreement until the funds in the Plan Species Account are exhausted, and 3) all real and personal property which the District holds title shall remain its property.

7.4 Funding.

7.4.1 The District shall make an initial contribution of $1,982,000 in 1998 dollars to the Plan Species Account. Five years after the initial contribution to the Plan Species Account, the District shall do one of the following: 1) make annual payments of $176,178 (2%) in 1998 dollars as long as the Agreement is in effect; or 2) provide an up front payment of $1,761,780 (2% for 10 years) in 1998 dollars, but deducting the actual cost of bond issuance and interest.

7.4.2 The District's funding of the Plan Species Account will be considered to be full and complete compensation for adult mortality associated with the Wells Hydroelectric Project until the actual adult survival rate can be accurately determined.

7.4.3 If the adult survival rate is determine to be equal to or greater than 98% and the Juvenile Project Survival rates is determined to be greater than 93%, the Tributary Fund will be reduced to reflect the actual adult survival estimate of the four Permit Species. Adult survival estimates for each Permit Species will independently determine one quarter of the Plan Species Account (See Example 1).

7.4.4 If the Juvenile Project Survival rate for each Plan Species is less than 93% but the Combined Adult and Juvenile Project Survival rate is maintained above 91%, the Plan Species Account may be used to compensate for juvenile losses, with a maximum compensation rate of 2%.

7.4.5 The choice of annual or up front payment under sub-Sections 7.4.1 shall be made by the FP.

7.4.6 If the "up front payment option" is selected then at the end of 15 years, the Parties will determine the distribution of the remaining funds to the Plan Species Account in amounts equivalent to annual payments of $176,178.00 in 1998 dollars.

7.4.7 The first installment is due within ninety (90) Days of the effective date of the Agreement. The rest of the installments are due by the 31st day of January each year thereafter. The dollar figures shall be adjusted for inflation on the 1st day of January each year based upon the Consumer Price Index for all Urban Consumers for the Seattle/Tacoma area, published by the U.S. Department of Labor, Bureau of Labor Statistics. If said index is discontinued or becomes unavailable, a comparable index suitable to the Tributary Committee shall be substituted.

7.5 <u>Tributary Assessment Program</u>.

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The District shall provide support for a Tributary Assessment Program separate from the Plan Species Account. The Tributary Assessment Program will be utilized to monitor and evaluate the relative performance of tributary enhancement projects approved by the Tributary Committee and directly funded by the initial contribution to the Plan Species Account (See Section 7.4.1). It is not the intent of the Tributary Assessment Program to measure whether the Plan Species Account has provided a 2% increase in survival for Plan Species. Instead, the program has been established to ensure that the dollars allocated to the Plan Species Account are utilized in an effective and efficient manner. The District shall develop, in coordination with and subject to approval by the Tributary Committee, the measurement protocols for the Tributary Assessment Program. The Tributary Committee may choose to either evaluate the relative merits of each individual tributary enhancement project or it may choose to evaluate an aggregation of projects provided that the total cost associated with the Tributary Assessment Program does not exceed $200,000 (not subject to inflation adjustment).

Example 1. Adult steelhead and spring chinook survival measured at 99% but no other adult Permit Species have been studied. Tributary funding would remain at 2% for sockeye and summer/fall chinook but would be reduced to 1% based upon the results from the adult steelhead and spring chinook survival studies. Annual Contributions to the Plan Species Account would reduce the prospective payments from a full 8/8 contribution to a 6/8 contribution.

Plan Species Account Calculations:

Before Adult Studies		**After Adult Studies**
Steelhead	(2%)	(1%)
Spring Chinook	(2%)	(1%)
Summer/Fall Chinook	(2%)	(2%)
Sockeye	(2%)	(2%)
	8/8th	6/8th

SECTION 8
HATCHERY COMPENSATION PLAN

8.1 Hatchery Objectives.

8.1.1 The District shall provide hatchery compensation for all of the Permit Species including; a) spring chinook salmon, b) summer/fall chinook salmon, c) sockeye salmon d) summer steelhead as further described in Section 8 (Hatchery Compensation Plan). The District shall also provide hatchery compensation for coho salmon should they become established under the criteria set forth in Section 8.4.5.1 (Coho).

8.1.2 The District shall implement the specific elements of the hatchery program consistent with overall objectives of rebuilding natural populations, and achieving NNI. Species specific hatchery program objectives developed by the JFP may include contributing to the rebuilding and recovery of naturally reproducing populations in their native habitats, while maintaining genetic and ecologic integrity, and supporting harvest. This compensation may include Measures to increase the off-site survival of naturally spawning fish or their progeny (i.e. Sockeye Enhancement Decision Tree, Section 14, Figure 3).

8.2 Hatchery Committee.

8.2.1 Establishment of the Committee. There shall be a Hatchery Committee composed of one (1) representative of each Party, provided that a Party is not required to appoint a representative and further provided that the Power Purchasers may participate as a non-voting observer through a single representative whom they will designate from time to time. A Party shall provide all other eligible Parties with written notice of its designated representative.

8.2.2 Responsibilities. The Hatchery Committee shall oversee development of recommendations for implementation of the hatchery elements of this Agreement for which the District has responsibility for funding. This includes overseeing the implementation of improvements and monitoring and evaluation relevant to the District's hatchery programs, as identified in the Hatchery Compensation Plan, the Permit and this Agreement. The Hatchery Committee shall also coordinate in-season information sharing and shall discuss unresolved issues. The Hatchery Committee decisions shall be based upon: Likelihood of biological success, Time required to implement, and cost-effectiveness of solutions.

8.2.3 Meeting Notice. The Hatchery Committee shall meet at least twice per year or whenever requested by any two (2) members following a minimum of ten (10) Days advance written notice to all members of the Hatchery Committee unless a member waives notice in writing or reflects the waiver in the approved meeting minutes. The notice shall contain an agenda of all matters to be addressed during the meeting including items that may be brought to a vote during the meeting.

8.2.4 Voting. The Hatchery Committee shall act by unanimous vote of those members present in person or by phone for the vote and shall develop its own rules of process, provided, that the chair shall insure that all members are sent notice of all Hatchery Committee meetings. Abstention does not prevent a unanimous vote. If a Party or its designated alternative cannot be present for an agenda item to be voted upon, then the Party must notify the chair of the Hatchery Committee who shall delay a vote on an agenda item for up to five business days on specified issue(s) to be addressed in a meeting or conference call scheduled with all interested Parties, or as otherwise agreed to by the Hatchery Committee. A Party may invoke this right only once per delayed agenda item. If the Hatchery Committee cannot reach agreement, then upon request of any Party, that issue shall be referred to the Coordinating Committee.

8.2.5 Chair of the Hatchery Committee. The Parties shall choose and the District shall fund a neutral third party to chair the Hatchery Committee meetings. The chair shall have the same responsibilities and authorities with regard to the Hatchery Committee as the chair of the Coordinating Committee has with regard to the Coordinating Committee. At least every three years, the Hatchery Committee shall evaluate the performance of the chair of the Hatchery Committee.

8.3 Hatchery Operations. The District or its designated agents shall operate the hatchery facilities according to the terms of Section 8 (Hatchery Compensation Plan), the ESA Section 10 permit(s) and in consultation with the Hatchery Committee.

8.4 Hatchery Production Commitments.

8.4.1 Hatchery Agreements. The District may enter into agreements with other entities for the rearing, release, monitoring and evaluation and research of hatchery obligations. However, it is the District's responsibility to ensure that their obligations under Section 8 (Hatchery Compensation Plan) are satisfied. The Hatchery Committee must approve any proposed agreements or trades of production.

8.4.2 Calculation of Hatchery Commitments. During Phase I, the District shall provide the funding and capacity required of the District to meet the 7% hatchery compensation level necessary to achieve NNI. Juvenile Project Survival estimates, when available, will be used to adjust hatchery based compensation programs and adult survival estimates will be used to adjust the Plan Species Account contribution. However, should adult survival rates fall below 98% but the Combined Adult and Juvenile survival rates be maintained above 91%, additional hatchery compensation for adult losses, toward a maximum contribution of 7% compensation provided through hatchery programs, would be utilized to provide compensation for Unavoidable Project Mortality. The rationale for determining the initial hatchery production commitment requirement is supported by Supporting Document B, "Biological Assessment and Management Plan: Mid-Columbia Hatchery Program". The Parties recognize that Supporting Document B is a supporting document and does not by itself create contractual obligations.

8.4.3 Phase I Production Commitment. Douglas will continue to fund the operation and maintenance of the Wells Hatchery and Methow Spring Chinook Supplementation Hatchery. The Parties agree that the Phase I production commitments to be provided by the District for juvenile passage losses are satisfied by maintaining current production commitments at existing facilities of 49,200 pounds of spring chinook at about 15 fish per pound (738,000 fish) and 30,000 pounds of summer steelhead at about 6 fish per pound (180,000 fish). Summer chinook passage losses are mitigated with 40,000 pounds of summer chinook at about 10 fish per pound (400,000 fish), currently being satisfied through the species trade with Chelan PUD (40,000 pounds of summer chinook are reared by Chelan PUD in exchange for 19,200 pounds of spring chinook reared by Douglas PUD). A portion of passage losses for sockeye (5%) are satisfied through the substitution of 15,000 pounds of spring chinook production (225,000 fish) at the Methow Hatchery as a species substitution for 9,240 pounds of sockeye (231,000 fish). After 2003 brood, NNI for sockeye will be accomplished through the implementation of a set of options identified in the Sockeye Enhancement Decision Tree (See Section 14, Figure 3). As a result of implementing the Sockeye Enhancement Decision Tree, the District's spring chinook obligation shall be reduced by 15,000 pounds starting with the 2004 brood.

8.4.4 Adjustment of Hatchery Compensation - Survival Studies. Hatchery production commitments, except for original inundation compensation, shall be adjusted based upon the results of survival studies conducted during Phase I, Phase II and Phase III (Standard Achieved, Additional Juvenile Studies, and Provisional Review). Hatchery compensation for yearling chinook and steelhead shall be adjusted based upon the results from the three years of accurate and precise Juvenile Project Survival studies completed at the Wells Hydroelectric Project. The arithmetic average of the three years of survival study indicate that the survival of yearling chinook and steelhead averages 96.2%. As a result, compensation for spring chinook, yearling summer chinook and steelhead shall be reduced to 3.8% as indicated below:

Spring Chinook: The District's commitment for Methow Basin spring chinook shall be 4,071 pounds at about 15 fish per pound (61,071 smolts). In addition, the District will provide 15,000 pounds of spring chinook at about 15 fish per pound (225,000 fish) through brood year 2003 as compensation for sockeye salmon losses.
The District will rear for Chelan PUD up to 19,200 pounds of spring chinook at about 15 fish per pound (288,000 fish). The terms of this Agreement can be found in the "2002 Chelan/Douglas Species Trade Agreement ".

Steelhead: The passage loss of steelhead shall be mitigated through the production of 8,143 pounds of fish at about 6 fish per pound (48,858 fish).
Sockeye: Through spring 2005 (2003 Brood), 15,000 pounds (225,000 smolts) of spring chinook salmon will be raised as species substitution for 9,240 pounds of sockeye. After 2005, NNI for sockeye will be accomplished through the implementation of a set of options identified in the Sockeye Enhancement Decision Tree (See Section 14, Figure 3).
Summer Chinook: The District's commitment for summer chinook shall be 10,857 pounds of yearling summer chinook at about 10 fish per pound (108,570 fish). Chelan PUD will rear for Douglas PUD these fish at Carlton Acclimation Pond. The terms of this Agreement can be found in the "2002 Chelan/Douglas Species Trade Agreement ".

8.4.5 Adjustment of Hatchery Compensation - Population Dynamics**.** Hatchery production commitments, except for original inundation mitigation, shall be adjusted in 2013 and every 10 years thereafter to achieve and maintain NNI as required to adjust for changes in the average adult returns of Plan Species and for changes in the adult-to-smolt survival rate and for changes to the smolt-to-adult survival rate from the hatchery production facilities, using methodologies described in Supporting Document B, "Biological Assessment and Management Plan (BAMP): Mid-Columbia Hatchery Program". However, it should be noted that Supporting Document B is a supporting document and does not by itself create contractual obligations.

Example 2: Juvenile Project Survival for steelhead measured at 96.2% with error of less than 5% at a 95% confidence interval. Hatchery supplementation commitments for steelhead would be established at 3.8% (14% compensation for steelhead under the Wells Settlement Agreement equates to 30,000 pounds of steelhead; 7% compensation for steelhead equates to 15,000 pounds). At a 3.8% compensation rate, steelhead production would be reduced to 3.8/7 of 15,000 pounds or 8,143 pounds of steelhead raised as compensation for mainstem project passage losses. This production would be in addition to the fixed inundation compensation of 50,000 pounds of steelhead. Total steelhead production would be established under Phase III (Standards Achieved) at 58,143 pounds of steelhead at 6 fish per pound.

8.4.5.1 Coho. Compensation for Methow River coho will be assessed in 2006 following the development of an anticipated long-term coho hatchery program and/or the establishment of a Threshold Population of naturally reproducing coho in the Methow Basin. The Hatchery Committee shall make a determination on whether a hatchery program and/or naturally reproducing population of coho is present in the Methow Basin (by an entity other than the District and occurring outside this Agreement). Should the Hatchery Committee determine that such a program and/or population exists, then the Hatchery Committee shall determine the most appropriate means to satisfy NNI for Methow Basin coho. Programs to meet NNI for Methow Basin coho may include but is not limited to; 1) provide operation and maintenance funding in the amount equivalent to 3.8% project passage loss or 2) provide funding for acclimation or adult collection facilities both in the amount equivalent to 3.8% juvenile passage loss at the Wells Project. The programs selected to achieve NNI for Methow Basin coho will utilize an interim value of project survival, based upon the three-year average Juvenile Project Survival estimate of 96.2%, until project survival studies can be conducted on Methow Basin coho.

8.4.5.2 Okanogan Basin Spring Chinook. Compensation for Okanogan Basin spring chinook will be assessed in 2007 following the development of a long-term spring chinook hatchery program and/or the establishment of a Threshold Population of naturally reproducing spring chinook in the Okanogan watershed (by an entity other than the District and occurring outside this Agreement). The Hatchery Committee shall make a determination on whether a hatchery program and/or naturally reproducing population of spring chinook is present in the Okanogan Basin. Should the Hatchery Committee determine that such a program and/or population exists, then the Hatchery Committee shall determine the most appropriate means to satisfy NNI for Okanogan Basin spring chinook. Programs to meet NNI for Okanogan Basin spring chinook may include but not be limited to; 1) provide O & M funding in the amount equivalent to 3.8% project passage loss or 2) replace project passage losses of hatchery spring chinook with annual releases of equivalent numbers of yearling summer chinook into the Okanogan River Basin or 3) provide funding for acclimation or provide funding for adult collection facilities in the amount equivalent to 3.8% juvenile passage loss at the Wells Project. The programs selected to achieve NNI for Okanogan Basin spring chinook will utilize an interim value of project survival based upon the three-year average Juvenile Project Survival estimate of 96.2% until project survival studies can be conducted on Okanogan Basin yearling chinook.

8.4.6 Fixed Hatchery Compensation - Inundation. Of the existing production commitment 50,000 pounds of yearling steelhead at about 6 fish per pound (300,000 fish), 32,000 pounds of yearling summer chinook at about 10 fish per pound (320,000 fish) and 24,200 pounds of subyearling summer chinook, at about 20 fish per pound (484,000 fish), production commitment is compensation for original inundation and shall not be subject to further reduction by adjustment as provided in sub-Section 8.4 (Hatchery Production Commitments).

8.5 Monitoring and Evaluation**.**

8.5.1 The Hatchery Committee shall develop a five-year monitoring and evaluation plan for the hatchery program that is updated every five years. The first monitoring and evaluation plan shall be completed by the Hatchery Committee within one year following FERC approval of this Agreement. Existing monitoring and evaluation programs will continue until replaced by the Hatchery Committee.

8.5.2 The Parties agree that over the duration of this Agreement new information and technologies may be developed and may be considered in a comprehensive hatchery evaluation program. The District shall fund the comprehensive hatchery evaluation program consistent with the hatchery goals set forth in sub-Section 8.1.2 and 8.4 (Hatchery Production Commitments) and the monitoring and evaluation guidelines as outlined in the BAMP and as determined by the Hatchery Committee.

8.5.3 The Hatchery Committee shall plan and the District shall implement the following steelhead studies that are related to the District's production program. First, the District shall fund a study to investigate the natural spawning (reproductive) success of hatchery reared steelhead relative to wild steelhead. This study should utilize a statistically valid number of fish necessary to develop baseline DNA profiles for Methow River steelhead. This analysis should be conducted for approximately 5 brood years. The District shall also conduct an assessment of longer-term acclimation for steelhead, using small scale temporary or existing facilities. This study shall continue for approximately 3 brood years and will not compromise in any way on-going supplementation programs at existing facilities.

8.6 Program Modifications**.**

8.6.1 Hatchery program modifications shall make efficient use of existing facilities owned by the District or cooperating entities including adult collection, acclimation and hatchery facilities, provided that existing facility use is compatible with and does not compromise ongoing programs. The District in consultation with the Hatchery Committee shall make reasonable efforts to implement program modifications when needed to achieve overall and specific program objectives. Program modifications may include changes to facilities, release methods, and rearing strategies necessary to achieve NNI as determined by the monitoring and evaluation program. Program modifications will be made following unanimous agreement of the Hatchery Committee, as set forth in sub-Section 8.2.4 (Voting), to achieve specific program objectives as outlined in Section 8 (Hatchery Compensation Plan), including sub-Section 8.4.4 (Adjustment of Hatchery Compensation – Survival Studies) and sub-Section 8.4.5 (Adjustment of Hatchery Compensation – Population Dynamics), as determined by Section 10 Permit and as defined in monitoring and evaluation plans to be developed. The District will make reasonable efforts to complete program modifications as soon as possible, following agreement with the Hatchery Committee.

8.6.2 As of the date this Agreement is signed by the Parties, two areas have been identified for program modification and improvement. The District working with the Hatchery Committee shall assess program modification options and implement them based upon the results of the assessment, as indicated below.

1) Improve the adult trapping facility efficiency for adult spring chinook returning to the Chewuch River without undue delay in adult migration and/or displacement of natural spawners to non-target areas. In coordination with the JFP, the District will use its best effort to implement trap improvements by removal of rock debris below Fulton Dam (Chewuch River) by May 2002. The Hatchery Committee will assess whether these improvements are sufficient to achieve the trapping objective without changing adult migration/spawning behavior. If the trapping objectives are achieved, no additional improvements will be required. In the event that these repairs do not result in achievement of the trapping objective, the District, working with the Hatchery Committee, will assess the methods to improve trap efficiency including the following options; 1) additional improvements to Fulton Dam, or 2) a new trapping facility. Based on these assessments, the Hatchery Committee shall select a preferred option and an implementation plan shall be developed by the

District. The District will complete program modifications as soon as reasonably possible (possibly 2003), following agreement with the Hatchery Committee.

2) Improve the adult trapping facility efficiency for adult spring chinook returning to the Twisp River without undue delay in adult migration and/or displacement of natural spawners to non-target areas. The Hatchery Committee will assess methods to improve trap efficiency including the following two options; 1) modifying the existing trap and weir or 2) development of a new trapping facility. Based on these assessments, the Hatchery Committee shall select a preferred option and the District shall develop an implementation plan. The District will complete program modifications as soon as reasonably possible (possibly 2003), following agreement with the Hatchery Committee.

8.6.3 In addition to these program modifications and with concurrence from the Hatchery Committee, the District may pursue the development of a memorandum of understanding between parties concerning use of shared facilities, fish, and water rights.

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8.6.4 During the duration of the Agreement, NMFS shall have the opportunity to seek hatchery program modifications (that do not change the 7% program levels) but are otherwise necessary to address emergency effects of a hatchery program on listed Permit Species. Such program modifications shall be supported by a minimum of two years of field data from the river or stream in question. Other information documenting a significant and adverse effect on the productivity of listed Permit Species from other rivers can be considered, but only if applicable to the listed Permit Species and stream in question. Any proposal to modify a hatchery program will be documented in a memorandum from the Regional Administrator to the Hatchery Committee summarizing the problem, and then followed by up to six months of Hatchery Committee evaluation. The Parties recognize that initially a portion of the production contemplated in this Agreement will be for purposes of supplementation of Plan Species or re-establishing runs in areas from which they have been extirpated. In the event the concerns raised in this sub-Section (8.6.4) involve the use of such a program, NMFS agrees to take the program design and intent into account in reaching any conclusion regarding the need for emergency modifications.

8.7 Changed Hatchery Policies under ESA.

8.7.1 Except in 2013 and every ten years hereafter, NMFS will refrain from applying hatchery policy decisions that would preclude the 7% hatchery levels (as adjusted) from being achieved. In 2013, and every 10 years thereafter (at the time of the program review), if NMFS proposes hatchery policy decisions that would preclude the 7% hatchery levels (as adjusted) from being achieved, NMFS will (a) propose application of the policies to the Hatchery Committee and seek agreement, (b) propose a revised hatchery program consistent with the principles of NNI and an expeditious transition plan from the existing hatchery program to the revised hatchery program, (c) if agreement is not possible, discuss the application of the policies with the Coordinating Committee and then with the Policy Committee, if necessary, and (d) if agreement is still not possible then allow the issue to be elevated to the Administrator of NMFS. Between 2013 and 2018, except as provided in sub-Section 8.4 (Program Commitments) and 8.6 (Program Modifications), if NMFS fails to allow full utilization of the District's hatchery capacity to achieve the 7% hatchery levels (as adjusted), this shall not be considered a basis for NMFS withdrawal from the Agreement or revocation of the Permit until 2018. In such a case, the District working with the Parties shall develop a transition plan between 2013 and 2018 to make up for the 7% hatchery levels (as adjusted). The transition plan may be implemented as soon as reasonably possible however the transition plan must be initiated by 2018. The Parties recognize that initially a portion of the production contemplated in this Agreement will be for purposes of supplementation of Plan Species or re-establishing runs in areas from which they have been extirpated. NMFS agrees to take the program design and intent into account in reaching any conclusion.

8.7.2 Until 2013, facility modifications are based on monitoring and evaluations and may not reflect changes in NMFS hatchery policy. During 2013 and every 10 years thereafter (at the time of the program review), facility modifications can also reflect changes in ESA policy with the understanding that a reasonable period of time will be provided to complete the modifications. The 2013 date for achievement of NNI in Section 3.1 will be adjusted if necessary to reflect the time needed to complete such modifications (as determined by the Hatchery Coordinating Committee).

8.8 Program Review. In 2003 and every ten years thereafter, the hatchery evaluations program, including natural population/hatchery interaction studies, will undergo a program review to determine whether or not the applicable hatchery program is operating in a manner that is consistent with the goals outlined in that particular facilities hatchery evaluation plan. In 2013 and every ten years thereafter, the hatchery program will undergo a program review to determine if adult-to-smolt and smolt-to-adult survival standards, hatchery

Formatted: Outline numbered + Level: 2 + Numbering Style: 1, 2, 3, … + Start at: 7 + Alignment: Left + Aligned at: 0" + Tab after: 0.42" + Indent at: 0.42" program goals, and objectives as defined in the Hatchery Plan, the Section 10 Permits, and as further defined in this document have been met or sufficient progress is being made towards their achievement. This review shall include a determination of whether hatchery production objectives are being achieved. The Hatchery Committee shall be responsible for conducting the hatchery program review, developing a summary report, and in the event that program objectives, as defined in sub-Section 8.1 (Hatchery Objectives) above, are not being met, shall be responsible for establishing alternative plans to the District to achieve them. The District shall be responsible for developing and funding implementation plans.

8.9 New Hatchery Facilities. Before being required to construct new hatchery facilities, the Hatchery Committee shall make efficient use of existing or modified facilities owned by the District or entities consenting to the use of their facilities including adult collection, acclimation and hatchery facilities, provided that existing or modified facility use is compatible with and does not compromise ongoing programs.

SECTION 9
ASSURANCES

9.1 Project License. The Parties agree to join with the District's filing with FERC requesting that FERC issue appropriate orders: (1) to amend the Project's existing license to include this Agreement as a condition thereof, and (2) to terminate the Wells Settlement Agreement dated October 1, 1990.

9.2 Regulatory Approval.

9.2.1 The Parties shall provide reasonable efforts to expedite any NEPA, SEPA, and other regulatory processes required for this Agreement to become effective. The Parties (except the lead agency) may file comments with the lead agency. Such comments will not advocate additional Measures or processes for Plan Species. The Parties shall provide reasonable efforts to expedite the approval process of the District's incidental take permit application.

9.3 Regulatory Approval Without Change.

9.3.1 Except for the District's obligations in sub-Section 10.2 (Permit Issuance) and sub-Section 9.1 (Project License), the terms of this Agreement shall not take effect until the NMFS issues the District a Permit, the FERC issues the required FERC orders and the USFWS completes necessary consultations under the ESA. Provided, the Parties shall continue to conduct planning and study efforts throughout the approval process.

9.3.2 Any Party may withdraw from this Agreement within 60 Days of FERC issuing a license modification in the event that: (1) the NMFS issues the District a Permit with terms and conditions in addition to or different from those set forth in this Agreement, (2) the FERC fails to include this Agreement, in its entirety, or adds terms or conditions inconsistent with this Agreement as a license condition of the current Project license or of the first new long-term Project License approved within the term of this Agreement, or (3) a Party as a result of compliance with NEPA or SEPA requires a material change to the terms or conditions of this Agreement. In order to withdraw from this Agreement, a Party shall provide all other Parties with notice of their intent to withdraw and state in the notice their reason(s) for withdrawing from the Agreement. The ability of a Party to withdraw from this Agreement, pursuant to this paragraph, terminates if not exercised within said period. The notices required by this sub-Section shall be in writing and either served in person or provided by U.S. Mail, return receipt requested.

9.4 Release, Satisfaction and Covenant Not to Sue.

9.4.1 The Parties, within the limits of their authority, shall from the date of construction of the Project to the effective date of this Agreement, release, waive, discharge the District and the District's predecessors, commissioners, agents, representatives, employees, and signatory power purchasers from any and all claims, demands, obligations, promises, liabilities, actions, damages and causes of action of any kind concerning impacts of the Project on Plan Species except for the obligation to provide compensation for original construction impacts of the Project implemented through the hatchery component of this Agreement. This release, waiver, and discharge shall not transfer any of the above listed District liabilities or obligation to any other entity.

9.4.2 Provided that the District is in full compliance with its Permit, this Agreement, and its FERC project license provisions relating to Plan Species, each Party agrees not to institute any action under the ESA, the Federal Power Act, the Fish and Wildlife Coordination Act, the Pacific Northwest Electric Power Planning and Conservation Act and the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act against the District and its signatory Power Purchasers related to impacts of the Project on Plan Species from the date this Agreement becomes effective through the date this Agreement terminates.

9.4.3 Termination of this Agreement or withdrawal of a Party shall have no effect upon the release provided for in sub-Section 9.4 (Release, Satisfaction and Covenant Not to Sue).

9.4.4 This Agreement does not affect, limit or address the imposition of annual charges under the Federal Power Act, or the right of any party in any proceeding or forum to request annual charges.

9.5 Re-Licensing.

9.5.1 With respect to Plan Species, the Parties agree to be supportive of the District's long-term license application(s) to the FERC filed during the term of the Agreement for the time period addressed in this Agreement, provided that the District has adhered to the terms and conditions of this Agreement, the Permit, and the FERC license provisions relating to Plan Species, as well as any future terms, conditions, and obligations agreed upon by the Parties hereto or imposed upon the District by the FERC. To the extent that the District has met such terms and conditions, the Parties agree that the District is a competent license holder with respect to its obligations to Plan Species. If the fifty (50)-year term of this Agreement will expire during a long-term license, any Party may advocate license conditions that take effect after this Agreement expires.

9.5.2 This Agreement shall constitute the Parties' terms, conditions and recommendations for Plan Species under Sections 10(a), 10(j) and 18 of the Federal Power Act and the Fish and Wildlife Coordination Act, provided that NMFS and USFWS maintain the right to reserve their authorities under Section 18 of the Federal Power Act on the condition that such reserved authority may be exercised only in the event that this Agreement terminates provided further that, the Parties as part of their terms, conditions and recommendations under Section 10(a) of the Federal Power Act may request that Plan Species protection or mitigation Measures contained in a competing license application be included as a condition of the District's new long-term Project license.

9.5.3 Notwithstanding sub-Section 9.5.2 and sub-Section 9.10 (Drawdowns/Dam Removal/Non-Power Operations), this Agreement does not limit the participation of any Party in any FERC proceeding to assert: (1) any condition for resources and other aspects of the District's license other than for Plan Species, and (2) to assert conditions for Plan Species to implement this Agreement.

9.6 Limitation of Reopening. During the term of this Agreement, the Parties shall not invoke or rely on any re-opener clause set forth in any FERC license applicable to the Project for the purpose of obtaining additional Measures or changes in project structures or operations for Plan Species, except as set forth in sub-Section 9.5.2 and 9.5.3.

9.7 Additional Measures. This Agreement sets out certain actions, responsibilities, and duties with regard to Plan Species to be carried out by the District and by the JFP to satisfy the legal requirements imposed under the ESA, the Federal Power Act, the Fish and Wildlife Coordinating Act, the Pacific Northwest Electric Power Planning and Conservation Act and the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act. This Agreement is not intended to prohibit the Parties from opposing or recommending actions in reference to (1) Project modifications such as pool raises and additional power houses, and (2) activities not related to Project operations that could adversely affect Plan Species. The Parties recognize that various Parties to this Agreement have governmental rights, duties, and responsibilities as well as possible rights of action under statutes, regulations and treaties that are not covered by this Agreement. This Agreement does not limit or affect the ability or right of a Party to take any action under any such law, regulation or treaties. However, the Party shall use reasonable efforts to exercise their rights and authority under such statutes, regulations, and treaties (consistent with their duties and responsibilities under those statutes, regulations and treaties) in a manner that allows this Agreement to be fulfilled.

9.8 Title 77 RCW. Provided the District is in compliance with the Agreement, the Permit, and the FERC license provisions relating to Plan Species, WDFW shall not request additional protection or mitigation for Plan Species under Title 77 RCW as now exists or as may be amended, unless WDFW is specifically required to take such action by statute.

9.9 Cooperation in Studies/Approval/Permits. The Parties shall cooperate with the District in conducting studies and in obtaining any approvals or permits which may be required for implementation of this Agreement.

9.10 Drawdowns/Dam Removal/Non-Power Operations. With respect to Plan Species under the ESA, the Federal Power Act, the Fish and Wildlife Coordination Act, the Pacific Northwest Electric Power Planning and Conservation Act, and the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act each Party during the term of this Agreement will not advocate for or support additional or different fish protection Measures or changes in Project structures or operations other than those set forth in this Agreement. For example, the Parties will not advocate or support partial or complete drawdowns, partial or complete dam removal, and partial or complete non-power operations. However, this Agreement does not preclude: Spillway or Tailrace modifications; Spill; structural modifications and concrete removal (holes in Dam) to accommodate bypass; structural modifications to accommodate adult passage facility improvements; and future consideration of additional Measures that may include reservoir elevation changes if all Parties agree. The Parties agree to work within this Agreement to address any issues that may arise in the future concerning Plan Species.

9.11 Stipulation of Plan Species. Each Party stipulates that the performance of the District's obligations under this Agreement, its Permit, and its FERC license will adequately and equitably conserve, protect, and mitigate Plan Species pursuant to the ESA, the Federal Power Act, the Fish and Wildlife Coordination Act, the Pacific Northwest Electric Power Planning and Conservation Act, and the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act as those Plan Species are affected by the Project through the term of the Agreement.

9.12 Vernita Bar. Nothing in this Agreement is intended to affect the protection of Plan Species in the Hanford Reach or the Vernita Bar Agreement, as it exists now or may be modified in the future.

9.13 Non-Plan Species. Non-Plan Species are not addressed in this Agreement.

SECTION 10
ENDANGERED SPECIES ACT COMPLIANCE

10.1. Scope. This Section 10 Endangered Species Act Compliance applies only between the NMFS and the District and does not apply to the other Parties unless specifically referenced.

10.2. Permit Issuance.

10.2.1 The District shall revise its incidental take permit applications for Permit Species based upon this Agreement and submit a directed take permit application for Hatchery Operations. This Agreement and its Figures and Appendices shall constitute the District's habitat conservation plan in support of the District's incidental take permit application. Supporting Documents A, B, C and D are to be used as supporting documents to the Agreement and as such, Supporting Documents A, B, C and D do not, by themselves, create contractual obligations under this Agreement or through the permit issued by NMFS.

10.2.2 NMFS issuance of a Permit to the District assures the District that based upon the best scientific and commercial data available and after careful consideration of all comments received, NMFS has found that with respect to all Permit Species that: (i) any take of a Permit Species by the District under this Agreement will be incidental to the carrying out of otherwise lawful activities; (ii) under this Agreement the District will, to the maximum extent practicable, minimize and mitigate any incidental take of Permit Species; (iii) the District has sufficient financial resources to adequately fund its affirmative obligations under this Agreement; (iv) as long as the actions required by this Agreement to minimize/mitigate incidental take of Permit Species are implemented, any incidental take of a Permit Species will not appreciably reduce the likelihood of the survival and recovery of such species in the wild; and (v) other Measures and assurances required by NMFS as being necessary or appropriate are included in this Agreement

10.2.3 After opportunity for public comment, compliance with NEPA and concurrent with the effective date of this Agreement, NMFS will issue a Permit to the District pursuant to Section 10(a)(1)(B) of the ESA to authorize any incidental take of listed Permit Species which may result from the District's otherwise lawful operation of the Project, conducted in accordance with this Agreement and the Permit. In addition, the Permit shall authorize any incidental take of listed Permit Species which may result from the District's otherwise lawful operation of the hatchery facilities required by this Agreement, conducted in accordance with this Agreement and the Permit. The Permit and this Agreement shall remain in full force and effect for a period of fifty (50) years from the effective date, or until revocation of the Permit under sub-Section 10.5 (Permit Suspension, Revocation and Re-Instatement), whichever occurs sooner. Amendments to the Permit or this Agreement shall remain in effect for the then-remaining term of this Agreement or until revocation under sub-Section 10.5 (Permit Suspension, Revocation and Re-Instatement), whichever occurs sooner. Withdrawal from this Agreement and revocation of the Permit as provided in Section 2 is not limited by the no surprises regulation. The Permit shall incorporate by reference the no surprises rule set forth in 50 CFR § 222.307 (g) (2001). This Agreement provides for changed circumstances and the mitigation Measures to respond to changed circumstances. Any circumstance relating to Permit Species not addressed by this Agreement is an Unforeseen Circumstance (See Section 13, "Unforeseen Circumstances").

10.2.4 The Permit shall authorize the District to incidentally take Permit Species that are listed under the ESA, to the extent that such incidental take of such species would otherwise be prohibited under Section 9 of the ESA, and its implementing regulations, or pursuant to a rule promulgated under Section 4(d) of the ESA, and to the extent that the take is incidental to the District's lawful operation of the Project, subject to the condition that the District must fully comply with all requirements of this Agreement and the Permit. The Permit will be immediately effective upon issuance for Permit Species currently listed under the ESA. The Permit will become effective for currently unlisted Permit Species upon any future listing of such species under the ESA.

10.2.5 In the event that an additional or amended Section 10 Permit is required for the implementation of any aspect of the Tributary Conservation Plan or Hatchery Compensation Plan, the NMFS shall expedite the processing of such permits or amendments. The Hatchery Permits (direct and incidental) will initially be issued to authorize take through 2013. Beginning in 2013 and every ten (10) years thereafter the District or its agent shall submit to NMFS hatchery permit applications incorporating changes in the hatchery Programs identified in ten (10) year program reviews (See Section 8.8 Program Review).

10.3. Permit Monitoring. Upon issuance of the Permit, the implementation thereof, including each of the terms of this Agreement shall be monitored and evaluated as provided for in Section 4 (Passage Survival Plan). Any reports the FERC should require regarding this Agreement shall be provided to the NMFS at the time such reports are provided to the FERC.

10.4. Permit Modification.

10.4.1 The Permit issued to the District, shall be amended in conformance with the provisions 50 CFR 222.306 (a) (2001) through 222.306 (c) (2001), provided, that if said regulations are modified the modified regulations will apply only to the extent the modifications were required by subsequent action of Congress or court order, unless the Parties otherwise agree.

10.4.2 This Agreement provides for on-going, active and adaptive management activities. Adaptive management provides for on-going modification of management practices to respond to new information and scientific development. Adaptive management will yield prescriptions that may vary over time. Such changes are provided for in this Agreement and do not require modification of the Agreement or amendment of the Permit, provided, that such changes will not result in a level of incidental take in excess of that otherwise allowed by this Agreement and the Permit.

10.5 Permit Suspension, Revocation and Re-Instatement. Except as set forth in sub-Section 2.2.1 (Enough Already), the Permit shall be suspended, revoked and reinstated in conformance with the provisions of 50 CFR 220.306 (d) (2001) and 50 CFR 222.306 (e) (2001), provided, that if said regulations are modified the modified regulations will apply only to the extent the modifications were required by subsequent action of Congress or court order, unless the Parties otherwise agree.

10.6 Early Termination Mitigation. If the Permit is terminated early and de-listing has not occurred, NMFS may require the District to mitigate for any past incidental take of Permit Species that has not been sufficiently mitigated prior to the date of termination. Such mitigation may require the District to continue relevant mitigation Measures of the Agreement for some or all of the period, which would have been covered by the Permit. NMFS agrees that the District may invoke the dispute resolution procedures of this Agreement to pursue resolution of any disagreement concerning the necessity or amount of such additional mitigation, NMFS reserves any authority it may have under the ESA or its regulations regarding additional mitigation. So long as the District meets and continues to meet the pertinent survival standards, its Tributary Plan funding obligations, and its Hatchery Plan funding and capacity obligations, early termination mitigation shall not apply to the District.

10.7 Funding. In its current financial position, the District has sufficient assets to secure funding for its affirmative obligations under the Agreement. To ensure notification of any material change in the financial position of the District during the term of the Permit, the District will provide the NMFS with a copy of its annual report each year of the Permit.

10.8 USFWS. USFWS does not exercise ESA authority over Permit Species.

SECTION 11
DISPUTE RESOLUTION

11.1 Stages of Dispute Resolution.

11.1.1 Stage 1: Coordinating Committee. Any dispute regarding this Agreement shall first be referred to the respective committee dealing with that issue (the Coordinating Committee is the default committee). That Committee shall have 20 Days within which to resolve the dispute. If at the end of 20 Days there is no resolution, any Party may request that the dispute proceed as provided in sub-Section 11.1.2 (Stage 2: Policy Committee). However, Tributary Committee and Hatchery Committee disputes must first proceed to the Coordinating Committee, before the Policy Committee is utilized to resolve the dispute.

11.1.2 Stage 2: Policy Committee. Following the completion of Stage 1, the chair of the Coordinating Committee or any Party may refer the dispute to the Policy Committee. The chair of the Coordinating Committee shall chair all meetings of the Policy Committee. The chair of the Policy Committee shall provide advanced written notice of all meetings. The Policy Committee shall have 30 Days, following the referral, to convene and consider the dispute. The notice shall contain an agenda of all matters to be addressed and voted on during the meeting.

Each Party shall designate a policy representative who shall be available to participate on the Policy Committee. Any Party that fails to name a Policy Committee representative or to have its Policy Committee representative participate in the Policy Committee shall waive that Party's right to object to the resolution of the dispute by the Policy Committee.

Agreements reached in the Policy Committee shall be based upon unanimous agreement of those Parties present in person or by phone for the vote and shall develop its own rules of process, provided, that the Policy Committee shall ensure that all Parties are sent notice of all Policy Committee meetings. Abstention from votes does not prevent a unanimous vote. If a Party or its designated representative cannot be present for an agenda item to be voted upon it must notify the chair of the Coordinating Committee who may delay a vote on the agenda item for up to five business days on specified issues to be addressed in a meeting or conference call scheduled with all interested parties. A Party may invoke this right only once per delayed agenda item.

11.1.3 Options following Stage 2. If there is no resolution of a matter following completion of Stage 1 and 2 of this Procedure, then any Party may pursue any other right that they might otherwise have. The Parties agree that the inability of the Coordinating Committee and Policy Committee to make a decision shall be considered a dispute. The Parties are encouraged to resolve disputes through alternative dispute resolution.

11.2 Implementation of Settlement Dispute. If the Procedure outlined above results in a settlement of the dispute then: (1) the Parties shall implement, consistent with the terms of the settlement, all aspects of the settlement that can lawfully be implemented without FERC approval, or the approval of another federal agency; and (2) where FERC or other federal agency approval is needed before some or all of the settlement can be implemented, all settling Parties shall jointly present the resolution of the dispute to FERC or the appropriate federal agency for approval.

11.3 No Intent to Create Jurisdiction. The Parties agree that this Agreement is not intended to create jurisdiction in any court.

SECTION 12
MISCELLANEOUS

12.1 Conflict Between Agreement and Appendix. In the event of a conflict between this Agreement and an Appendix to this Agreement, this Agreement shall control and the Parties shall cause the Appendix in conflict to be revised accordingly.

12.2 Amendment of Agreement. This Agreement may be amended or modified only with the written consent of the Parties, provided, that Parties who withdraw from the Agreement do not need to, and have no right to approve any amendments or modifications, provided further, that this Agreement provides for on-going, active and adaptive management activities. Adaptive management provides for ongoing modification of management practices to respond to new information and scientific developments. Adaptive management will yield prescriptions that may vary over time. Such changes are provided for in this Agreement and do not require modification of the Agreement or amendment of the Permit, provided that such changes will not result in a level of incidental take in excess of that otherwise allowed by this Agreement, or modify the provisions set out in Section 3 (Survival Standards and Allocation of Responsibility for No Net Impact), further provided, that unless otherwise agreed to by the Parties, NNI applies only to the identified Plan Species on the date this Agreement became effective.

12.3 Notices. Except as set forth in sub-Section 2.3 (Conditions Precedent to Withdrawal) and sub-Section 9.3 (Regulatory Approval Without Change), all written notices to be given pursuant to this Agreement shall be mailed by first-class mail, postage prepaid to each Party. Parties shall inform all Parties by written notice in the event of a change of address. Notices shall be deemed to be given three (3) Days after the date of mailing.

12.4 Waiver of Default. Any waiver at any time by any Party hereto of any right with respect to any other Party with respect to any matter arising in connection with this Agreement shall not be considered a waiver with respect to any subsequent default or matter.

12.5 Integrated Agreement. All previous communications between the Parties, either verbal or written, with reference to the subject matter of this Agreement are superseded by the terms and provisions of this Agreement, and once executed, this Agreement and Appendices (See Section 15, Appendix) shall constitute the entire Agreement between the Parties, provided, that titles to sections and sub-Sections thereof are for the assistance of the reader and are not part of the Agreement.

12.6 Benefit and Assignment. This Agreement shall be binding upon and inure to the benefit of the Parties hereto and their successors and assigns provided, no interest, right, or obligation under this Agreement shall be transferred or assigned by any Party hereto to any other Party or to any third party without the written consent of all other Parties, except by a Party: (1) to any person or entity into which or with which the Party making the assignment or transfer is merged or consolidated or to which such Party transfers substantially all of its assets, (2) to any person or entity that wholly owns, is wholly owned by, or is wholly owned in common with, the Party making the assignment or transfer, provided that, the assignee is bound by the terms of this Agreement and applies for and receives an incidental take permit for listed Plan Species.

12.7 Force Majeure. For purposes of this Agreement, a *force majeure* is defined as causes beyond the reasonable control of, and without the fault or negligence of, the District or any entity controlled by the District, including its contractors and subcontractors. Economic hardship shall not constitute, *force majeure* under this Agreement.

In the event that the District is wholly or partially prevented from performing obligations under this Agreement because of a *force majeure* event, the District shall be excused from whatever performance is affected by such *force majeure* event to the extent so affected, and such failure to perform shall not be considered a material breach. Nothing in this Section shall be deemed to authorize the District to violate the ESA or render the standards and objectives of this Agreement unobtainable. The suspension of performance shall be no greater in scope and no longer in duration than is required by the *force majeure.*

The District shall notify the other Parties to this Agreement in writing within seven calendar days after a *force majeure* event. Such notice shall: identify the event causing the delay or anticipated delay; estimate the anticipated length of delay; state the Measures taken or to be taken to minimize the delay; and estimate the timetable for implementation of the Measures. The District shall have the burden of demonstrating by a preponderance of evidence that delay is warranted by a *force majeure*.

The District shall use a good faith effort to avoid and mitigate the effects of the delay and remedy its inability to perform. A *force majeure* event may require use of the adaptive management provisions of this Agreement in remedying the effects of the *force majeure* event. When there is a delay in performance of a requirement under this Agreement that is attributable to a *force majeure*, the time period for performance of that requirement shall be reasonably extended as determined by the Coordinating Committee. When the District is able to resume performance of its obligation, the District shall give the other Parties written notice to that effect.

12.8 Appropriations. Implementation of this Agreement by the FP is subject to the availability of appropriated funds. Nothing in this Agreement will be construed by the Parties to require the obligation, appropriation, or expenditure of any money from federal, state or tribal governments. The Parties acknowledge that the FP will not be required under this Agreement to expend any of their appropriated funds unless and until an authorized official of that agency or government affirmatively acts to commit to such expenditures as evidenced in writing.

12.9 Legal Authority. Each Party to this Agreement hereby represents and acknowledges that it has legal authority to execute this Agreement and is fully bound by the terms hereof. NMFS is authorized to enter into this Agreement pursuant to the ESA, the Federal Power Act, the Fish and Wildlife Coordination Act, the Northwest Electric Power Planning and Conservation Act, and the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act.

12.10 Execution. This Agreement may be executed in counterparts. A copy with all original executed signature pages affixed shall constitute the original Agreement. The date of execution shall be the date of the final Party's signature. Approval of this Agreement must be acknowledged by the Commissioner of Indian Affairs and the Secretary of the Interior, or their delegates, to the extent required by 25 U.S.C. § 81.

12.11 Indian Tribal Treaty or Reserved Rights. Nothing in this Agreement is intended to nor shall it in any way abridge, limit, diminish, abrogate, adjudicate, or resolve any Indian right reserved or protected in any treaty, executive order, statute or court decree. This sub-Section shall be deemed to modify each and every Section and sub-Section of this Agreement as if it is set out separately in each Section.

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12.12 U.S. v Oregon. Nothing in this Agreement is intended by the signatories who are parties to the continuing jurisdiction case of U.S. v Oregon 302 F. Supp. 899 (D. OR 1969), to change the jurisdiction of that court or their participation there in.

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12.13 No Precedent/Compromise of Disputed Claims. The conditions described and measures proposed to rectify the issues set forth in this Agreement are fact specific and uniquely tied to the circumstances currently existing at the Wells Project. The Parties agree that the conditions existing here and the proposed actions to deal with them are not intended to in any way establish a precedent or be interpreted as the position of any Party in any proceeding not dealing specifically with the terms of this Agreement. Further, the Parties acknowledge that this Agreement is a compromise of disputed claims for which each Party provided consideration to the other as contemplated under Federal Rule of Evidence 408, and will not be used by any Party in a manner inconsistent with the provisions of Federal Rules of Evidence 408.

SECTION 13
DEFINITIONS

Capitalized terms are defined as follows:

13.1 "Agreement" means this document, figures and Appendix A - B. This Agreement is supported by Supporting Documents A through D but does not incorporate these documents.

13.2 "BAMP" means Supporting Document B "Biological Assessment and Management Plan (BAMP): Mid-Columbia Hatchery Program".

13.3 "Combined Adult and Juvenile Project Survival" means that 91% of each Plan Species (juvenile and adult combined) survival Project effects when migrating through the Project's reservoir, Forebay, Dam and Tailrace including direct, indirect, and delayed mortality wherever it may occur and can be measured (as it relates to the Project) given the available mark-recapture technology.

13.4 "Dam" means the concrete structure impounding the Columbia River.

13.5 "Day" is defined by the Federal Rules of Civil Procedure.

13.6 "ESA" means the Endangered Species Act, 16 U.S.C. ss 1531 through 1543, as amended, and it's implementing regulations.

13.7 "Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act" means the Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. § 1801 et seq., as amended by the Sustainable Fisheries Act and as may be amended, and its implementing regulations.

13.8 "Federal Power Act" means the Federal Power Act, 16 U.S.C. §§ 791a - 828c, as amended, and its implementing regulations.

13.9 "FERC" means the Federal Energy Regulatory Commission or its successor.

13.10 "Fish and Wildlife Coordination Act" means the Fish and Wildlife Coordination Act, 16 U.S.C. §§ 661-668c, as amended, and its implementing regulations.

13.11 "Forebay" means the body of water from the Dam face upstream approximately 500 feet.

13.12 "Historic Hydroacoustic and Fyke Netting" refers to the use of the 20-year record (1982-2002) of available hydroacoustic and species composition information collected at the Wells Project, as it relates to the passage of juvenile spring and summer migrants.

13.13 "Juvenile Dam Passage Survival" means that 95% of each juvenile Plan Species over 95% of each species migration survive Projects effects when migrating through the Project's Forebay, Dam and Tailrace including direct, indirect and delayed mortality wherever it may occur and can be measured (as it relates to the Project), given the available mark-recapture technology.

13.14 "Juvenile Project Survival" refers to the measurement of survival for juvenile Plan Species over 95% of each species migrating from tributary mouths and through the Project's reservoir, Forebay, Dam and Tailrace including direct, indirect and delayed mortality, wherever it may occur and can be measured (as it relates to the Project) given the available mark-recapture technology.

13.15 "Juvenile Project Survival Standard" refers to a surrogate measurement of the Combined Adult and Juvenile Survival Standard. If Juvenile Project Survival for each Plan Species is measured to be greater than or equal to 93%, then the District will be assigned to Phase III (Standards Achieved). If Juvenile Project Survival is measured at less than 93% but greater than or equal to 91%, then the District will be assigned to Phase III (Provisional Review). If Juvenile Project Survival is measured at less than 91%, then the District will be assigned to Phase II (Interim Tools).

13.16 "Measures" means any action, structure, facility, or program (on-site or off-site) intended to improve the survival of Plan Species, except those prohibited in sub-Section 9.10 (Drawdowns/Dam Removal/Non-Power Operation). Measures do not include fish transportation unless otherwise agreed by the Coordinating Committee.

13.17 "Pacific Northwest Electric Power Planning and Conservation Act" means the Pacific Northwest Electric Power Planning and Conservation Act, 16 U.S.C. §§ 839 - 839h, 16 U.S.C. §§ 839 - 839h, as amended, and its implementing regulations.

13.18 "Permit" shall mean permit(s) issued to the District by NMFS pursuant to Section 10 of the ESA to authorize take of Permit Species which may result from the District's or its agent's implementation of this Agreement.

13.19 “Permit Species” means all Plan Species except coho salmon (*Onocorhynchus kisutch*). Permit Species do not include coho salmon (*O. kisutch*) since wild coho salmon are extirpated from the Mid-Columbia Region and therefore not protected by the ESA.

13.20 “Plan Species” means spring, summer/fall Chinook salmon (*Onocorhynchus tshawytscha*), sockeye salmon (*O. nerka*), coho salmon (*O. kisutch*), and steelhead (*O. mykiss*).

13.21 “Power Purchasers” refers to entities that have executed long-term power sales contracts specifically Puget Sound Energy, Inc., Portland General Electric, PacifiCorp., and Avista Corp.

13.22 “Project” means the Wells Hydroelectric Project owned and operated by Public Utility District No. 1 of Douglas County, Washington pursuant to FERC Project Number 2149. The geographic boundaries of the Project including the reservoir, Forebay, Dam and Tailrace are defined in Exhibit K of the Project’s FERC License.

13.23 “Representative Environmental Conditions” means river flows between the 10% and 90% points on the Flow Duration Curve, as calculated using the best available information on historical average river flow (1929-1978, 1993-2001HydroSim) as measured at the Tailrace of Grand Coulee Dam.

13.24 “Representative Operational Conditions” means normative plant operations at Wells Dam that have and are expected to take place during future outmigrations (e.g. normal bypass, fishway and turbine operations).

13.25 “Spill” means the passage of water through spill gates.

13.26 “TDG” means total dissolved gas.

13.27 “Tailrace” means the body of water from the base of the Dam to a point approximately 1000 feet downstream.

13.28 “Threshold Population” refers to a naturally reproducing population that contains a five-year average of greater than 500 adults as assessed at Wells Dam and is composed of a population that is reproductively isolated from other populations of the same species.

13.29 “Tools” means any action, structure, facility or program (on-site only) at the Project, except those prohibited in sub-Section 9.10 (Drawdowns/Dam Removal/Non-Power Operation) that are intended to improve the survival of Plan Species migrating through the Project. Tools do not include fish transportation unless otherwise agreed by the Coordinating Committee. This term is a sub-set of Measures.

13.30 “Unavoidable Project Mortality” refers to the assumed 9% mortality caused by the Project to Plan Species that is compensated through the tributary and hatchery programs.

13.31 “Unforeseen Circumstance” is defined by 50 CFR 222.102 (2001), and implemented according to 50 CFR 222.307(g) (2001). If these regulations are modified, the modified regulations will apply only to the extent the modifications were required by subsequent action of Congress or court order, unless the Parties otherwise agree.

IN WITNESS WHEREOF, the Parties hereto execute this Agreement as of the date last signed below.

Dated ____________________________

PUBLIC UTILITY DISTRICT NO. 1 OF
DOUGLAS COUNTY, WASHINGTON

By ________________________________
Commissioner

____
Commissioner

____
Commissioner

Address for Notice:

Public Utility District No. 1 of
Douglas County, Washington
1151 Valley Mall Parkway
East Wenatchee, WA 98802-4497

Attn: Chief Executive Officer/Manager

Dated ____________________________

NATIONAL MARINE FISHERIES SERVICE,

By ________________________________

____
Director, Northwest Region

Address for Notice:

____
____
____
____
____

Dated ___________________________

UNITED STATES FISH AND WILDLIFE SERVICE,

By _______________________________

____
(Title)

Address for Notice:
____
____
____
____
____

Dated ___________________________

Washington Department of Fish and Wildlife

By _______________________________

____
(Title)

Address for Notice:
____
____
____
____
____

Dated ____________________________

CONFEDERATED TRIBES OF
THE COLVILLE RESERVATION

By ________________________________

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(Title)

Address for Notice:
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____

Dated ___________________________

CONFEDERATED TRIBES AND BANDS OF
THE YAKAMA INDIAN NATION

By _______________________________

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(Title)

Address for Notice:
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Dated ____________________________

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

By ________________________________

____
(Title)

Address for Notice:
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Dated ___________________________

AMERICAN RIVERS, INC., a Washington
D.C., nonprofit corporation

By _______________________________

____
(Title)

Address for Notice:
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Dated ___________________________

PUGET SOUND ENERGY

By _______________________________

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(Title)

Address for Notice:

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Dated ___________________________

PORTLAND GENERAL ELECTRIC

By _______________________________

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(Title)

Address for Notice:

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Dated ____________________________

PACIFICORP

By _________________________________

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(Title)

Address for Notice:

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Dated ____________________________

AVISTA CORPORATION

By ________________________________

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(Title)

Address for Notice:
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SECTION 14

FIGURES

Figure 1. Wells HCP Survival Standard Decision Matrix.

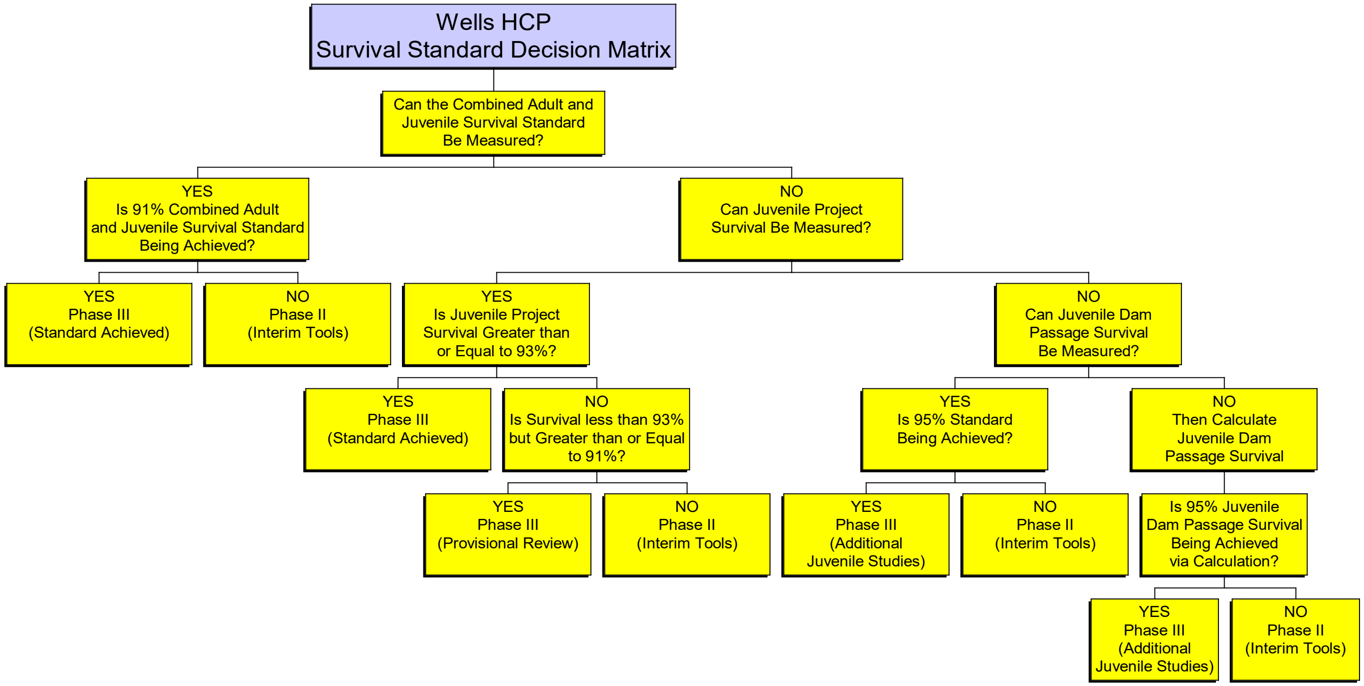


Figure 2a. Spring Flow Duration Curve

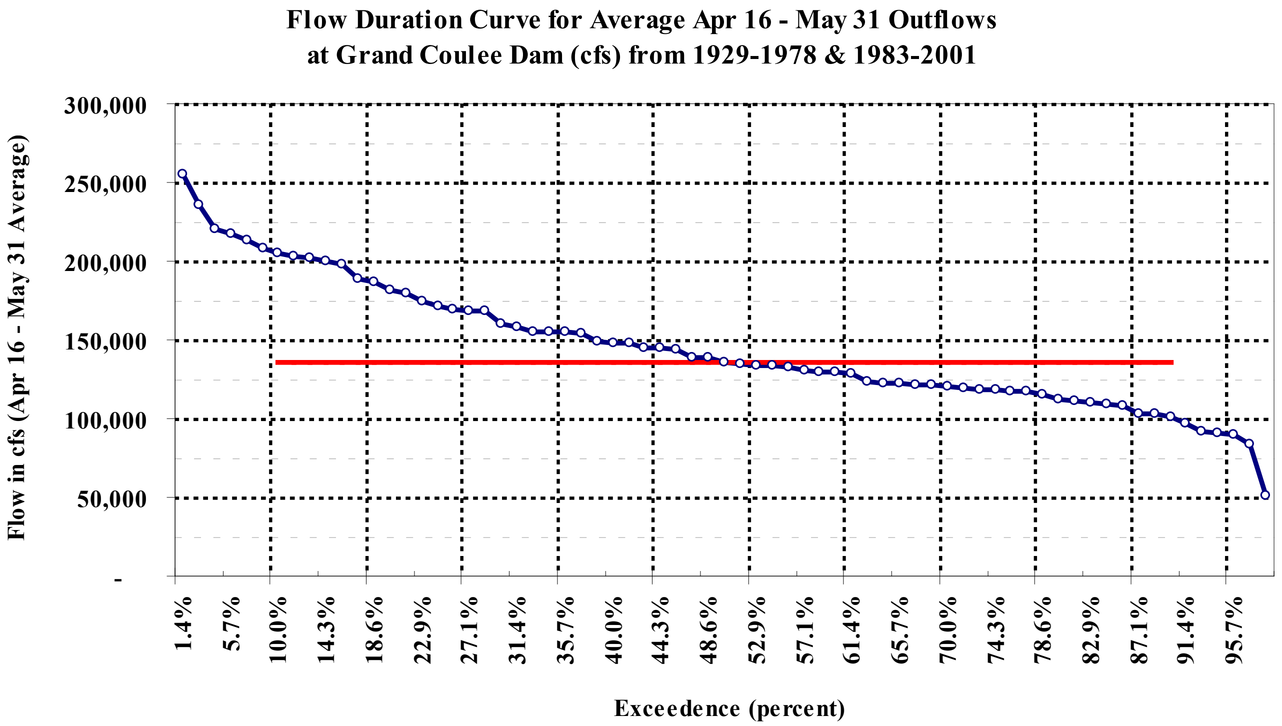


Figure 2b. Summer Flow Duration Curve

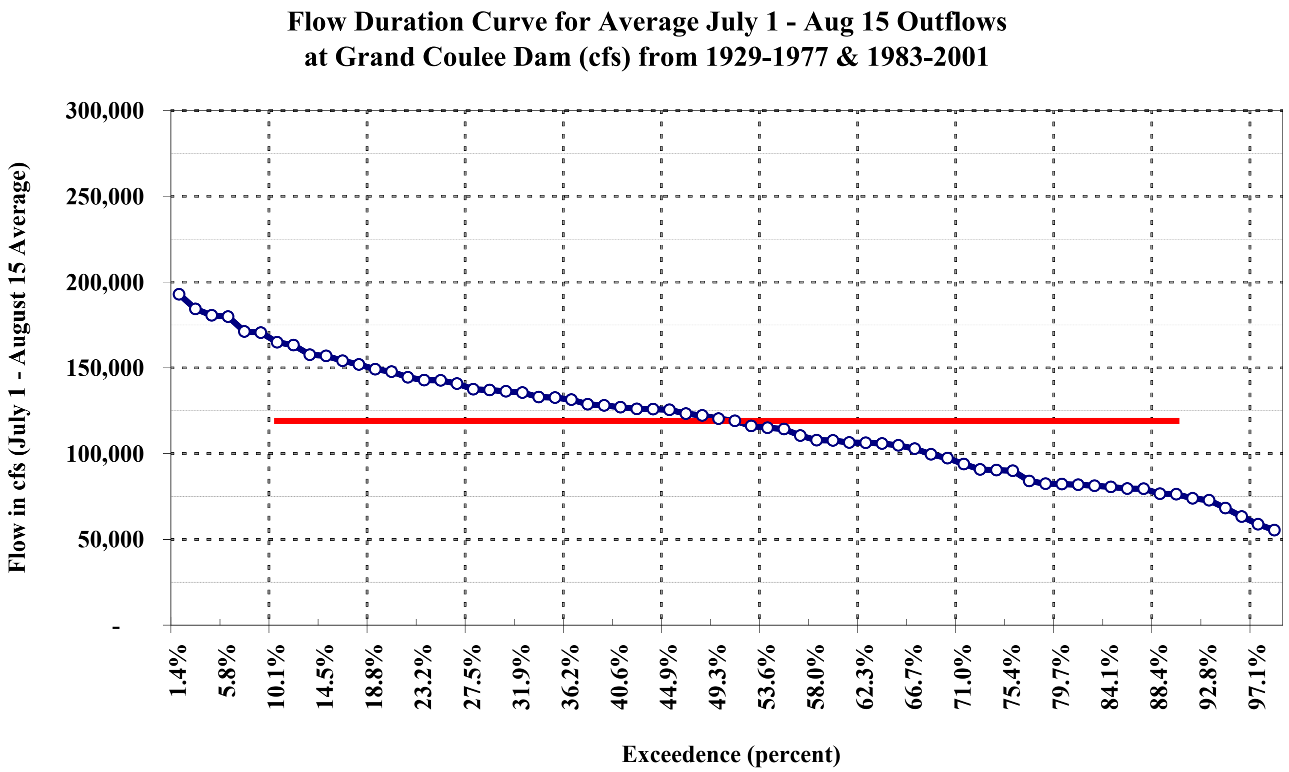
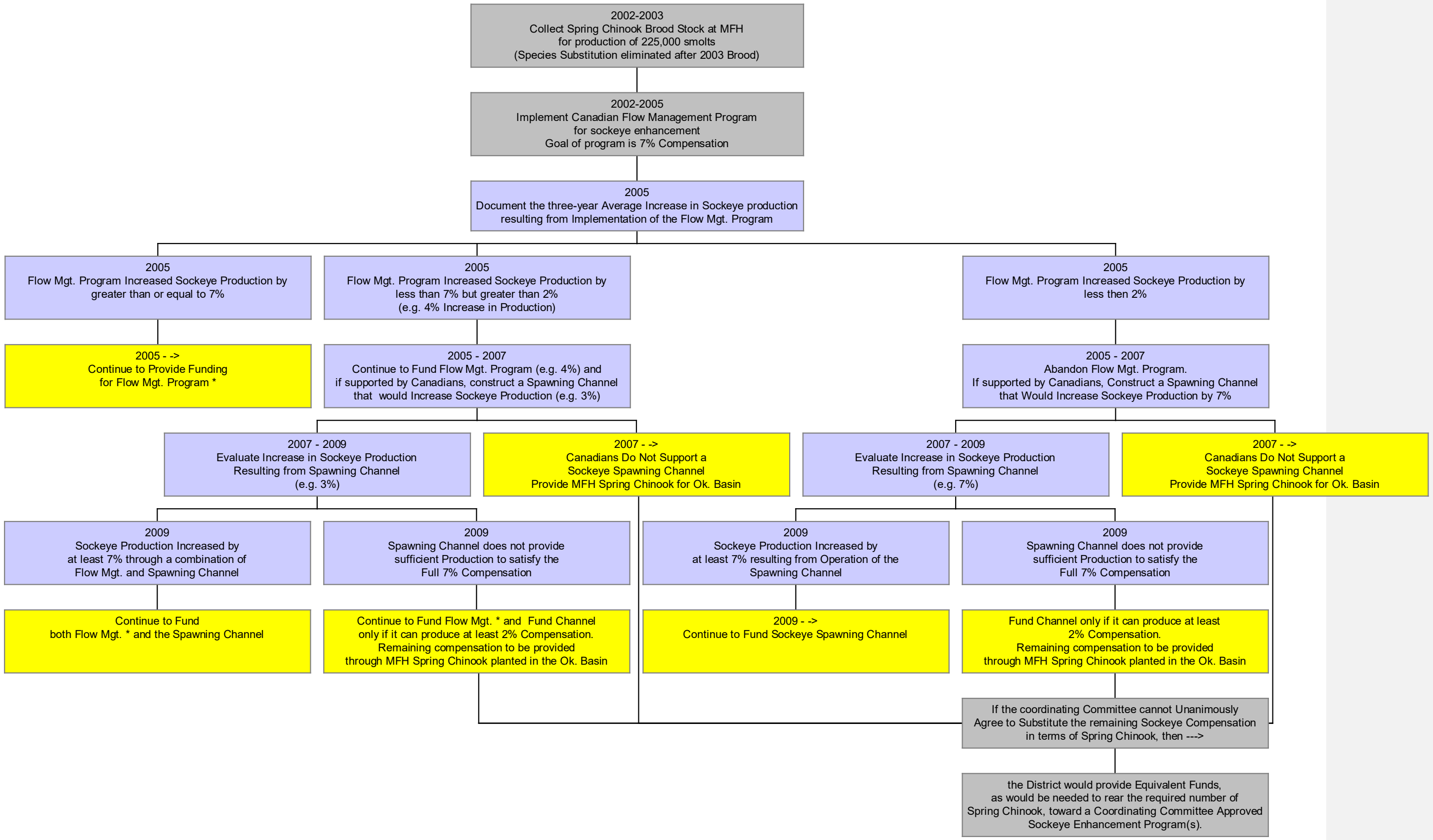


Figure 3. Sockeye Enhancement Decision Tree



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SECTION 15
APPENDIX

Appendix A: Wells Hydroelectric Project, Adult Fish Passage Plan.

Adult Passage Plan

Adult passage at Wells Dam was addressed under the project's FERC license (Project No. 2149). Minor modifications to the FERC fish passage conditions were made during negotiations of the Settlement Agreement. Fishway operations are coordinated with the Fish Passage Center. Changes in operating criteria require unanimous support of the Coordinating Committee including approval by NMFS Hydro Program.

Wells Dam was constructed with two fish ladders. Since 1967, an average of 50,000 adult salmon and steelhead have ascended Wells Dam on their way to spawning grounds above the Dam.

The two fish ladders at Wells Dam are conventional staircase type fish ladders with 73 pools. The ladders are located at the east and west ends of the Dam. The lower 56 pools discharge a constant 48 cfs of water. At each pool, the water drops approximately one foot until this water reaches the tailwater level in the collection gallery. Supplemental water can be added at each inundated pool at the upper end of the collection gallery. The upper pools in the adult fishway, pools 73 - 56, discharge water from one pool to another through fishway weirs. Each weir in the upper portion of the adult fishways contains two orifice openings. These orifices are located one foot from the base of the weir. This design provides a sanctuary pool between each of the upper fishway weirs. From pool 56 downstream to the collection gallery, each fishway weir is designed to operate with 48 cfs of water. The water passes from one weir to the next via a seven foot wide overflow section between pools and through two 18 inch by 15 inch submerged orifices.

To accommodate 10 feet of reservoir drawdown, the drop between the upper 17 pools varies from one foot at full reservoir to six inches during a 10 foot reservoir drawdown. The flow through the upper 17 ladder pools consequently varies from 44 cfs at full reservoir to about 31 cfs at maximum reservoir drawdown. To increase the flow to the 48 cfs required in the lower ladder pools, supplementary water is introduced into Pool No. 56 through a pipeline from the reservoir.

Pool No. 64 of both fishway ladders contains facilities for counting fish. The main features of the counting facility include a counting room, an observation window into the fish ladder, a telescoping gate to guide the fish closer to the observation window, a light panel and a bypass gate to control the flow and velocity past the observation window. Video records of fish passage are collected 24-hours per day starting on May 1 and continue through November 15. The video are then reviewed and counts of fish by species by ladder are made available on a daily basis through coordination with the Army Corps of Engineers adult fish counting program.

At Pool No. 40, each of the two fish ladders has provisions for sorting and trapping various species of fish. The west ladder sorting facility allows for selected fish to travel through a flume to a holding pond at the Wells Hatchery. The east ladder sorting facility allows for fish to travel to a holding container where they are anesthetized, netted and placed in transportation containers to be moved across the Dam to appropriate hatchery facilities. The fisheries agencies and tribes currently develop species-specific broodstock collection protocols at the beginning of each season. Brood stock presently collected at Wells Dam includes spring and summer chinook and summer steelhead. Brood stock collection protocols are developed by the Washington Department of Fish and Wildlife and are annually submitted to the Wells Coordinating Committee and NMFS Hydro Program for annual approval prior to trapping at the Dam. In addition to brood stock collection, the adult fish traps are occasionally used to collected information from CWT tagged steelhead, collect sockeye scales for stock identification and age analysis and collect adult bull trout, chinook, sockeye and steelhead for radio-tagging.

The 2000-2002 Wells Biological Opinion (Section 10.1.4, page 45) requires that the operation of the Wells ladder traps for the collection of broodstock or other fisheries assessment be limited to a maximum of 16-hours per day for three days per week or as approved by NMFS Hydro Program, Portland, Oregon. The Wells Biological Opinion (Section 10.1.4, page 45) requires that adult trapping facilities be manned whenever the trap is in operation and that the collection of adults from the fishway traps be discontinued whenever river water temperature exceed 69 F°. Specific operating criteria for the fish ladder traps can be found below (See: Adult Trap Operating Criteria).

At the bottom of the fish ladder, projecting downstream from the line of the hydrocombine is the portion of the endwall structure that incorporates the functions of fish attraction and collection. Two turbine pumps on each ladder deliver 800 to 2500 cfs (depending upon tailwater elevation) of fish attraction flow to the water supply chamber located immediately adjacent to the collection gallery. Supply chamber water flows into the upper sections of the collection gallery where it is used to maintain an attraction velocity of 2 feet per second; and also into the main collection gallery at the foot of the ladder through diffusion gratings. The total fishway flow from the turbine pump(s) and the 48 cfs coming down the ladder from the forebay is discharged into the tailrace through two fish entrances.

Fishway entrances are operated according to hydraulic conditions as specified in the Wells Settlement Agreement. The specific operating conditions of the ladder are described below (See: Adult Fishway Operating Criteria). Modification to the ladder operating criteria can only take place following approval by the Wells Coordinating Committee.

To reduce the total project passage times of adult fish, the main fishway entrances will be operated at an 8-foot opening. To reduce the incidence of fish falling out of the collection gallery, the side gates to the collection gallery will remain closed during normal fishway operations.

Since July 1970, the ladders have been operated with a 1.5 foot differential maintained by constantly adjusting the output of the fish pumps. Under normal conditions the fish pumps operate automatically to maintain a pre-set differential level between the water supply chamber and the main collection chamber.

Fishways are inspected daily to ensure that debris accumulations are removed, that the automated fishway instruments are calibrated properly and to ensure that lights in the fishway are maintained.

Adult Fish Ladder Operating Criteria

<u>Water Depth Criteria</u>
The water depth over the weirs of the adult fish ladder will be 1.0 to 1.2 feet.

<u>Entrance Criteria</u>
1. Head: 1.5 feet
2. Gate Settings: Main Wing Gate open 8 feet,
Side Wing Gate closed,
Side Gate Attraction Jets closed.

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<u>Staff Gauge and Water Level Indicator Criteria</u>
Staff guage and water level indicators are located and maintained upstream and downstream of the Main Wing Gates and adult fishway exit trashracks. These guages should be clearly visible from a convenient location and they should be clean and readable at all water levels. Manual staff guage readings should be checked each day to ensure that consistent readings are being displayed within the control room.

<u>Trashrack Criteria</u>
Visible buildups of debris will be cleaned immediately from picketed leads near counting stations, and from trashracks at adult fishway exits. The staff gauges located immediately upstream and downstream of the adult fishway exit trashracks should be monitored for water surface differential, which may

indicate a buildup of debris on the submerged trashracks. The trashracks will be cleaned immediately if the differential reading is greater than 1.0 foot.

Modification of Adult Passage Facilities
If adult passage studies identify biologically significant delay and/or mortality, the operating criteria described above may be changed or modified following approval of the Coordinating Committee. If changes in the operating criteria do not alleviate the problems, then structural modifications to the adult passage facilities may be required. Provided that any disagreements over the appropriateness of facility modifications of $325,000.00 or less (1988 dollars) may be taken through dispute resolution and any disagreement over the appropriateness of facility modifications of more than $325,000.00 (1988 dollars) is resolved under the FERC Rules of Practice and Procudure.

Adult Trap Operating Criteria

Startup: The adult fish traps are located on each fish ladder at Pool 40. The traps are operated by placing a barrier fence across the entire width of Pool 40. Once the barrier fence is in place, the steep-pass denil, upwelling enclosure and sorting chute jets are turned on.

Fish Sorting: Fish that swim up the denil eventually enter the upwell enclosure. Once inside the upwell enclosure, fish are attracted down the sorting chute by jets of water introduced into the upwell enclosure near the top of the sorting chute. As fish slide down the chute, they are identified and a decision is made to either shunt the fish back into the ladder immediately upstream of the barrier fence, or to retain the fish for brood stock or stock assessment. Excess water introduced into the fish ladder from the trap denil and upwell enclosure can, when necessary, be removed from the fish ladder through a piped diversion located downstream of the trap in Pool 40.

Fish Disposition: At the east ladder trap, fish retained for stock assessment are anesthetized, sampled and re-introduced back into the ladder via a recovery/re-introduction tank that is located upstream of the pool 40 barrier fence. Fish retained for brood stock are anesthetized, marked and placed into hatchery transport vehicles. On the west ladder trap, fish retained for brood stock and for stock assessment are passed into a holding pond at the Wells Fish Hatchery. Fish in the holding pond are sorted by WDFW personnel. Fish retained for brood stock are either retained in the hatchery holding pond or placed into transportation vehicles for distribution to other hatchery facilities. Fish retained for stock assessment purposes are placed into transport vehicles and released upstream of the dam.

Safety Measures: The steep-pass denil has been outfitted with two removable gates. The bottom gate prevent fish from moving into the upwell enclosure when the trap is unattended and the top gate prevents fish in the upwell enclosure from moving down the steep-pass denil. The sorting chute has also been upgraded to include a gate on the upstream end. This gate prevents fish from moving down the sorting chute once sufficient numbers of fish have already been placed in the anesthetic tank. The sorting chute has been modified to include full padding and jets of water to keep it moist and cool. Temperature monitors are deployed in the ladder at pool 40 and in the anesthetic tank to ensure compliance with the Wells 2000 BiOp trapping criteria.

Shut Down – Daily: At the end of each trapping day, the barrier fence is lifted out of the ladder, the steep-pass denil is gated first at the bottom and then at the top, the water to the upwelling enclosure is left on, the sorting chute is locked in the return to ladder direction, the sorting chute water jets are left on, the anesthetic tank is drained away from the ladder and all of the fish in the recovery tank are released back into the fish ladder.

Shut Down – Annual: At the end of the trapping season, all water is turned off, all tanks should be checked for fish and then drained. The upwell enclosure water is turned off last and all remaining fish and water should be drained directly into the fish ladder through the upwell enclosure bypass pipe.

BiOp Conditions: The 2000-2002 Wells Biological Opinion (Wells 2000 BiOp) requires that the operation of the Wells ladder traps be limited to a maximum of 16-hours per day for three days per week. To ensure adherence to this trapping schedule, the District has installed remote monitors on the fishway traps. The fish ladder trap monitors notify District personnel when the trap is in operation. The location and duration of ladder trapping is recorded daily and reviewed weekly with WDFW staff. The Wells 2000 BiOp also requires that the adult trapping facilities be manned whenever the trap is in operation and that the collection of adults from the fishway traps be discontinued whenever river water temperature exceed 69 F°. Thermographs have been installed immediately adjacent to the traps to ensure that the temperature criteria is not exceeded during adult trapping.

Annual Meeting: District and WDFW trapping personnel meet annually to review the annual brood collection goals, assessment projects, to review current ladder trapping and operating criteria and to discuss modifications to the trap.

Adult Ladder Dewatering Plan

Stage 1 (Notification): Project personnel requiring access to the submerged portions of the adult fish ladders must contact a District Fish Biologist seven days prior to initiating any temporary or extended dewatering of either of the two fishways at Wells. Emergency ladder dewatering should be coordinated with District Fish Biologists to the maximum extent practical given the extent of the emergency. Ladder dewatering to clean the visitor center and the fish counting windows is not considered an emergency. Notice is required to allow District Biologists time to ensure coordination between the scheduled dewatering event and ongoing efforts to collect brood stock for hatcheries, tag fish for stock assessment studies, coordinate fisheries passage inspections and to monitor fish behavior relative to normal project operations. In addition, due to the presence of three stocks of ESA listed fish (UCR spring chinook, UCR steelhead and Columbia River Bull trout) it is important that dewatering events be coordinated with the appropriate resource agencies responsibility for administering the ESA.

Stage 2 (Equipment Preparation): Once notice has been provided to all appropriate entities and resource agencies (including WFH staff), an agreed to ladder dewatering schedule and fish salvage plan should be discussed and coordinated with all affected departments. District personnel are responsible for gathering and inspecting all necessary equipment required to safely collect, hold, transfer and release adult and juvenile fish salvaged from the dewatered fishways. Equipment required for a successful salvage operation include dip nets, a block seine, waders, rain gear, ropes, two 20 foot extendable ladders, flood lights, head lamps, fish totes and fish transport vehicles. Equipment needed for salvaging fish from the dewatered ladder should be moved to the fish ladder at least one day prior to initiating Stage 5 (Exit Gate Closure).

Stage 3 (Day Prior to Dewatering): The day before a scheduled fish ladder dewatering and salvage operation, project personnel should turn off and bulk head each of the two fish pumps located within the water supply chamber. The collection gallery entrances and the ladder exit orifice gates should be operated at normal levels for the remainder of the day.

Stage 4 (Evening Prior to Dewatering): The evening prior to dewatering the fish ladder, the exit orifice gates should be partially closed to allow less than full orifice flow through each of the weirs located in the upper fishway (Weir 73 – 57). The Pool 56 supplemental water supply valve should be set to the fully open position. These settings should remain in place until Stage 7 (Fish Salvage – Upper Fishway) operations have been completed.

Stage 5 (Exit Gate Closure): On the morning of the scheduled dewatering and salvage operation, the exit orifice gates must be turned off gradually. It should require at least 2 hours to completely close off the exit orifice gates. It is important that a District Fish Biologist and appropriate WFH staff be in close proximity to the upper fishway, with equipment in place, prior to project personnel completely closing off the exit orifice gates.

Stage 6 (Supplemental Water): Once the exit orifice gates are closed, it is important to verify that sufficient supplemental water is being added into the middle fishway at Pool 56. If additional water is required, the control room should be contacted to ensure that the supplemental water supply system is being operated at maximum capacity. If the plant operators cannot provide additional water into Pool 56 via the supplemental water supply system, then the District Fish Biologist and the appropriate plant supervisor should discuss whether it is appropriate to move to Stage 7 (Fish Salvage – Upper Fishway). It may be more appropriate to re-open the exit orifice gate and attempt to fix the problem with the supplemental water supply system prior to proceeding to State 7. However, if a determination is made to continue to Stage 7 (Fish Salvage – Upper Fishway) then it is the responsibility of the operators to carefully add additional water into the ladder by opening the exit orifice gate until adequate amounts of water are flowing through the middle ladder. Adding supplemental water through the exit orifice gates should only be used as a last resort as this operation establishes a dangerous work environment for personnel attempting to salvage fish from the upper fishway.

Stage 7 (Fish Salvage – Upper Fishway): Provided that sufficient water exists in the middle fish ladder (below Pool 56) fish salvage operations should proceed as described below. Fish salvage operations should start at Pool 73 and move downstream until the upper fishway is free of fish. Fish found in each sanctuary pool will have to be collected with a dip net and transferred directly into the portable fish totes. The order of priority is to net and transfer ESA listed adults, ESA listed juveniles, anadromous adults, anadromous juveniles and then non-listed resident fish.

Once loaded with fish, the fish totes should be hoisted from the sanctuary pool and deposited into Pool 56. Fish collected from Pool 73 through pool 57 are to be hoisted into Pool 56 where supplemental water has been added to carry fish downstream through the middle and lower fishway and into the collection gallery and tailrace. Once all fish have been salvaged from Pool 73 through 57 and all personnel have been evacuated from the fish ladder, the operators should be contacted to initiate a Stage 8 (Middle Fishway – Pulsed Flow Operation) as described below.

State 8 (Middle Fishway – Pulsed Flow Operation): In order to move fish from Pool 56 down to the tailrace of the project, the adult fishway should be partially re-watered and then dewatered several times. It may become necessary to pulse water from the exit orifice gates several times. Typically three pulses of water are required to flush fish out of the middle and lower ladder and into the tailrace. Pool 40 is a location where fish frequently become stranded during the pulsed flow operation. A hatchery tanker truck and appropriate fish salvage personnel should be stationed at Pool 40 should fish require transport back to the river. The order of priority for fish collection shall be to net and transfer ESA listed adults, ESA listed juveniles, anadromous adults, anadromous juveniles and then net and transfer non-listed resident fish.

Once the fishway has been cleared of fish, the fish being held in the tanker truck should be released back into the river and the exit orifice gates should be closed. Fish salvaged from the east ladder will be released upstream of the dam and fish salvaged from the west ladder will be released into the tailrace.

Stage 9 (Lower Fishway – Collection Gallery): The lower fishway and collection gallery can only be dewatered following the placement of bulkheads across the entrance gates. The floor of the collection gallery can be up to 40 feet below the surface of the tailrace. Therefore the collection gallery must be dewatered with a sump pump. This operation can take several hours depending upon tailrace elevation and leakage into the collection gallery. Once the collection gallery is within one foot of becoming dry, fish salvage personnel should be hoisted with a crane down into the gallery. Once in the gallery, the fish totes should be filled with water and a seine net deployed upstream of the floor diffuser. Fish on top of the floor diffusers should be netted before the water levels drop to less than 6 inches. Once netted, fish should be placed into the fish totes. Depending upon the number and size of fish captured, the fish totes may need to be lifted out of the collection gallery before all of the fish have been collected. Once the crane has lifted the fish totes onto the deck of the dam, the fish should be placed into either a fish release container (300 gallon) or a hatchery transport truck.

Once the collection gallery has been cleared of stranded fish, the fish being held in the tanker truck should be released back into the river. Fish salvaged from the east ladder will be released upstream of the dam and fish salvaged from the west ladder will be released into the tailrace.

Appendix B: Wells Project Survival Estimates.

Wells Project Survival Estimates

1998 WELLS SURVIVAL STUDY

The 1998 Survival Study, as described in the 1998 study plan "1998 Wells Dam Pilot Survival Study", was submitted to the WCC for review on September 2, 1997. The study plan was discussed during the September 8th and October 16th meetings of the WCC. The Study plan was modified in September 1997 to include several items requested by the WCC. The Study plan was approved during a conference call on October 16th as documented in the Wells Coordinating Committee meeting minutes (97-8). All parties to the Wells Settlement Agreement were contacted and provided unanimous support for the 1998 study.

The study was completed as directed in the study plan and draft results were presented to the WCC as documented in the 98-4, -5, -6, -8 meeting minutes. The Draft report was submitted to the WCC for review and comment on February 12, 1999. No comments were received by the end of the 60-day comment period. The comment period was extended to allow NMFS additional time for review. The comment period was closed following a 90-day review and following a call from Bob Dach (NMFS) indicating that no comments were going to be submitted by NMFS. The final report entitled: "Project Survival Estimates for Yearling Chinook Salmon Migrating through the Wells Hydroelectric Facility, 1998" was completed on May 27, 1999 and was distributed to the WCC on June 7, 1999. Results of the 1998 Survival Study using yearling Chinook indicated that project survival (Mouth of the Methow River to 1000 feet downstream of Wells Dam) was 99.7% ($S\hat{E}$ = 0.015).

1999 WELLS SURVIVAL STUDY

The 1999 Survival Study, as described in the 1999 study plan "Wells Dam Steelhead Survival Study, 1999", was distributed prior to the August 12, 1998 meeting of the WCC. The study plan was discussed during the August 12th and September 22nd meetings. The study plan was revised based upon committee input in late September. The modified study plan was re-submitted to the WCC on October 2, 1998. The modified study plan was further discussed at the October 20, 1998 meetings of the WCC. The 1999 Study plan was unanimously approved during a conference call on November 2nd and reaffirmed at the next formal WCC meeting on November 12, 1998 as documented in the Wells Coordinating Committee meeting minutes (98-10, -

11). All parties to the Wells Settlement Agreement were contacted and provided unanimous support for the 1999 study.

The study was completed and preliminary results were sent to the WCC on July 13, 1999. These results were formally presented to the WCC at the September 21, 1999 meeting (99-7). The Draft report was submitted to the WCC for review and comment on November 16, 1999. No comments were received by the end of the 60-day comment period. However, comments were received on February 18, 2000 from Steve Smith (NMFS) and all of Steve's comments were addressed in the final report. Steve Smith's comments and the authors response to Steve's comments can be found in the final report in Appendix C. The final report entitled: "Project Survival Estimates for Yearling Summer Steelhead Migrating through the Wells Hydroelectric Facility, 1999" was completed on March 9, 2000 and was distributed to the WCC on March 24, 2000. Results of the 1999 Survival Study using yearling summer steelhead indicated that project survival (Mouth of the Methow River to 1000 feet downstream of Wells Dam) was 94.3% ($S\hat{E}$ = 0.016).

2000 WELLS SURVIVAL STUDY

The 2000 Survival Study, as described in the 2000 study plan "Wells Dam Steelhead Survival Study, 2000", was distributed to the WCC on September 21, 1999 (99-7). The study plan was discussed during the September, October and November 1999 meetings of the WCC (99-7, -8, -9). The Study plan was modified prior to the November meeting based upon input from the WCC. The 2000 survival study plan was approved at the November 1999 meeting as documented in the Wells Coordinating Committee meeting minutes (99-9). All parties to the Wells Settlement Agreement were contacted and provided unanimous support for the 2000 study.

The study was completed and preliminary results were presented to the WCC at the September 12, 2000 meeting (00-10). The Draft report was submitted to the WCC for review and comment on November 30, 2000. No comments were received by the end of the 60-day comment period. However, comments were later received from NMFS and these comments were addressed in the final report. NMFS comments and the author's response to NMFS's comments can be found in the final report in Appendix E of the final report. The final report entitled: "Project Survival Estimates for Yearling Summer Steelhead Migrating through the Wells Hydroelectric Facility, 2000" was completed on March 23, 2001 and was distributed to the WCC on March 29, 2001. Results of the 2000 Survival Study using yearling summer steelhead indicated that project survival (Mouth of the Methow River to 1000 feet downstream of Wells Dam) was 94.6% ($\hat{SE}$ = 0.015).

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SECTION 16
LIST OF SUPPORTING DOCUMENTS

Supporting Document A: Aquatic Species and Habitat Assessment: Wenatchee, Entiat, Methow, and Okanogan Watersheds (1998).

Supporting Document B: Biological Assessment and Management Plan (BAMP): Mid-Columbia Hatchery Program (1998).

Supporting Document C: Briefing Paper: Estimating Survival of Anadromous Fish through the Mid-Columbia PUD Hydropower Projects (2002).

Supporting Document D: Tributary Plan, Project Selection, Implementation and Evaluation (1998).

To receive copies of the Supporting Documents please refer to the District's website or contact the District directly as indicated below.

www.douglaspud.org

Public Utility District No. 1 of Douglas County
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East Wentachee, WA 98802-4497
(509) 884-7191

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
700 NE Multnomah Street, Suite 1200
Portland, Oregon 97232
(503) 238-0667
F (503) 235-4228
www.critfc.org

January 30, 2020

Tom Kahler
Fisheries Biologist
Public Utility District #1 of Douglas County
1151 Valley Mall Parkway
East Wenatchee, WA 98801

Dear Mr. Kahler:

Since 1995, the Columbia River Inter-Tribal Fish Commission (CRITFC) has conducted a scientific study of sockeye salmon near Wells Dam. The project, "Studies into Factors Limiting the Abundance of Okanagan and Wenatchee Sockeye Salmon," is currently funded by Bonneville Power Administration. CRITFC requests permission to access and conduct sampling activities at Wells Dam during the 2020 research period.

The purpose of this study is to determine the effect of temperature on the survival of sockeye salmon returning to their spawning grounds in the Okanagan Basin. It is anticipated that a maximum of 800 adult sockeye will be sampled for scales and genetic material and tagged with PIT tags. The sampling activity will take place daily, Monday-Friday, from late June 2020 through early August 2020, and will be coordinated with the Wells Hatchery broodstock collection programs.

The sampling team will consist of three to six individuals from two separate organizations, as follows: Dr. Jeff Fryer of CRITFC; Kraig Mott, Clifford Smith, Katie Weber, Jennifer Knox, and Martin Novak of the Confederated Tribes and Bands of the Yakama Nation.

Thank you for your consideration. If you have any questions or need further information, please contact the project leader, Dr. Jeff Fryer, at (503) 403-9222.

Sincerely,

Jaime A. Pinkham
Executive Director

HCP-CC May 28, 2019 meeting

IV. Douglas PUD

A. DECISION: CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam in 2019 (Tom Kahler)

CRITFC's annual request to tag sockeye salmon at Wells Dam in 2019 was distributed to the Wells HCP Coordinating Committee for review by Kristi Geris on February 20, 2019. There was an action item for Kirk Truscott to contact Jeff Fryer to obtain clarification on questions the CCT have about CRITFC's request. Tom Kahler asked Truscott if the CCT concerns were addressed by Fryer.

Truscott said he and Fryer discussed the significance of the data. Truscott said for 2019, the CCT will approve tagging; however, he said the HCP Coordinating Committees need to have a serious discussion about whether these data are still necessary. He asked, what management decisions are being made based on tagging sockeye salmon at Wells Dam? He said the CCT is conducting a qualitative assessment for almost all salmonid species except spring Chinook salmon and steelhead, and Fryer's reports are the only source of sockeye salmon data available, which has been useful. He asked, however, how many years of these data are actually needed? He said at this point, he believes handling these fish less is more important than the data.

John Ferguson asked when Truscott would like to start these discussions, and Truscott said in December 2019. The HCP Coordinating Committees will begin discussing the necessity and significance of the data behind CRITFC's annual request to tag sockeye salmon at Wells Dam during the HCP Coordinating Committees meeting in December 2019. (Note: Geris added this to the agenda for December 2019.)

Kahler said Fryer has mentioned potentially tagging fewer sockeye salmon during future events, maybe around 300 fish as (opposed to 800 fish). Truscott added that it is unknown how this water year will shape up. He said with the warmer weather it may be wise to revisit approval of this request if there are issues with water temperature and river flow. Andrew Gingerich noted that the Okanogan River is already very low this year. He said if the CCT are concerned about adult escapement, the Okanogan River may be tough by the time sockeye salmon arrive.

Wells HCP Coordinating Committee representatives present approved CRITFC's annual request to tag sockeye salmon at Wells Dam in 2019, with the caveat that approval of the tagging will be reviewed again if low flow and warm water migration conditions develop potentially affecting adult sockeye salmon survival. *(Note: Jim Craig provided USFWS approval of this request via email on May 23, 2019.)*

Ferguson suggested, if needed, the CCT request revisiting approval of tagging sockeye salmon at Wells Dam in 2019, during a future HCP Coordinating Committees meeting. Truscott agreed. *(Note: on May 29, 2019, Geris notified Fryer of the Wells HCP Coordinating Committee approval of CRITFC's request, including the caveat to revisit the approval pending river conditions.)*

HCP-CC December 17, 2019 meeting

V. Douglas PUD

C. CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam (John Ferguson)
John Ferguson asked Kirk Truscott if he wanted to revisit this topic at this time. Truscott said he needs to do a little more research on whether these data are needed to make management decisions. Chad Jackson asked if it might be beneficial to invite Jeff Fryer (CRITFC) to an HCP Coordinating Committees meeting to provide an update on the data and research. Ferguson agreed a discussion with Fryer is warranted if there are questions about the data. Keely Murdoch said the most recent report she found online was a 2018 report covering 2016 to 2017 data. She offered to call or email Fryer, if needed. Murdoch and Jackson also both suggested that maybe Tom Skiles can talk to Fryer as they are located in the same office. Truscott said he cannot think of a management decision predicated on the last 5 years of data. He said, however, this does not mean these data are not beneficial for future reports and studies. Andrew Gingerich asked if the Okanagan Nation Alliance or other agencies with sockeye salmon programs use these data. Tom Kahler and Truscott said they do not know. Murdoch noted that there are a lot of Canadian authors on these CRITFC reports and suggested that they may be using these data.

The HCP Coordinating Committees will continue considering whether to request additional information from Fryer regarding CRITFC's annual request to tag sockeye salmon at Wells Dam, to be further discussed during the HCP Coordinating Committees meeting on January 28, 2020.

HCP-CC January 28, 2020 meeting

V. HCP Administration

B. CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam (John Ferguson)
John Ferguson recalled the action item to continue considering whether to request additional information from Jeff Fryer regarding CRITFC's annual request to tag sockeye salmon at Wells Dam. This action item was created based on comments from Kirk Truscott, who is not in attendance; therefore, this action item will be carried forward.

CRITFC's annual request to tag sockeye salmon at Wells Dam in 2020 arrived following the meeting and was distributed to the HCP Coordinating Committees by Kristi Geris on February 4, 2020.

HCP-CC February 25, 2020 meeting

V. Douglas PUD

C. CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam (Tom Kahler)
Tom Kahler said CRITFC's annual request to tag sockeye salmon at Wells Dam in 2020 was distributed to the HCP Coordinating Committees by Kristi Geris on February 4, 2020. Kahler said Jeff Fryer is proposing to collect, sample (for scales and genetic material) and PIT tag 800 adults; no

acoustic tagging is proposed this year. Kahler recalled that the Wells HCP Coordinating Committee had an action item to consider the use of these data. He said he reached out to Department of Fisheries and Oceans (DFO) but has not yet heard back. He said he will be attending a meeting with Fryer, DFO, and Okanagan Nation Alliance (ONA) on February 27, 2020, and he can ask about the purpose of the data and how critical it is to continue tagging. Kahler said tagging is not proposed until late June 2020, so a decision can be deferred as late as the HCP Coordinating Committees meeting on May 26, 2020.

Kirk Truscott said he discussed this internally with the CCT and there is opposition to agreeing to CRITFC tagging sockeye salmon at Wells Dam. He said this is in part because this is a long-standing activity in conjunction with additional tagging at Bonneville Dam that has already produced a lot of data and analyses to inform sockeye salmon migration, behavior, and survival, and correlations to water temperature. He asked, how much more data are needed, and does it really need to be collected annually? He said the CCT do not believe it does. He said there are already a lot of data to make management decisions. He said additionally, there is reluctance to remove 800 fish from available harvest. He said this effort uses Aqui-S, and per the U.S. Food and Drug Administration, use of Aqui-S for research purposes requires the assumption that study fish will not be available for consumption for 3 days, and this is not the case. He said if others believe these data need to be collected on an annual basis, the CCT would propose tagging at Priest Rapids Dam during Cle Elum sockeye salmon collection. He said this will remove the issue of excluding harvestable fish for the CCT.

Jim Craig asked if tagging was moved to Priest Rapids Dam, would this require genetic analyses to separate the stocks? Truscott said his understanding is this effort is ongoing in conjunction with tagging at Bonneville Dam, which includes both stocks.

Keely Murdoch asked if there are any other precedents where a research project request to trap at Wells Dam has been denied? Kahler said he cannot think of any, but this does not mean it has not happened. He said since 2006, there have not been many research proposals that were not internal.

John Ferguson asked how many years of data does Fryer have? Kahler said he believes he has annual data since about 2005. Ferguson suggested that Kahler relay these concerns to Fryer to figure out how to get to a decision. Truscott said lastly, the CCT do not support the YN conducting operations in CCT territory. Kahler asked if this has been communicated to ONA, and Truscott said no.

Ferguson said there seems to be three issues: 1) whether enough data have been collected already; 2) use of Aqui-S on fish that could be consumed; and 3) the policy issue on the YN conducting operations in the CCT territory. He said this includes both technical- and policy-level discussions, and he asked if this needs to be elevated to another level.

Truscott said if the data need is strong, he believes tagging at Priest Rapids Dam is a reasonable consideration. Murdoch said tagging at Priest Rapids Dam will require increasing the sample size quite a bit and she is unsure if this will sit well with the Cle Elum managers. Ferguson asked if the migration timing is comingled, and Truscott said pretty much. Murdoch said the Wenatchee River and Osoyoos River stocks might be differentiated based on fish size, but this may not be absolute. Ferguson said Fryer is clearly targeting Okanagan River Basin stocks, and Murdoch said this is correct, which is why if Wenatchee River stock are included a larger collection effort will be needed to meet the target sample sizes. Truscott said the projections at the mouth of the Columbia River are roughly 246,000 returns, 200,000 of which are anticipated to be Okanagan stock. Craig said based on these numbers, maybe increasing the sample size to 1,000 fish will be adequate. Kahler agreed this might work.

Kahler said he can talk with Fryer and others about how critical these data are. Chad Jackson said discussing the data will not resolve the issue; rather, he believes there needs to be a recommendation to Fryer to propose sampling at Priest Rapids Dam and the PRCC vote in that forum. Ferguson said if the tagging is proposed at Priest Rapids Dam then the action is no longer affecting operations at Wells Dam; however, the action would be affecting stocks in the Chelan PUD project. Lance Keller agreed that Chelan PUD would need to consider what this means for the overall Lake Wenatchee adult run.

Douglas PUD will update Fryer on Wells HCP Coordinating Committee discussions regarding CRITFC's annual request to tag sockeye salmon at Wells Dam. Wells HCP Coordinating Committee representatives will discuss internally CRITFC's annual request to tag sockeye salmon at Wells Dam, for a possible decision during the HCP Coordinating Committees meeting on March 24, 2020.

Andrew Gingerich asked if there needs to be a vote in this forum. Kahler said the request is addressed to Douglas PUD, and Douglas PUD brings the request to the Wells HCP Coordinating Committee because the proposed activity could affect fish passage at Wells Dam. Murdoch asked if the HCP Coordinating Committees nexus is to vote that the activity will not impact passage? Ferguson said this request is similar to the broodstock collection protocols, where the Wells HCP Coordinating Committee approves that trapping at Wells Dam will not impact fish passage. Kahler noted that the broodstock collection protocols do not dictate that CRITFC tagging will occur.

Ferguson suggested that this topic be discussed within the PRCC and Truscott said he can do this. Ferguson also pointed out that the request to collect and tag sockeye salmon at Wells Dam has no nexus with the Wells HCP. It is being conducted for sockeye salmon management purposes and is not a requirement of the HCP. Therefore, the policy issue discussed today is between the two tribes and should not be elevated to the Wells HCP Policy Committee for resolution.

HCP-CC March 24, 2020 conference call

III. Douglas PUD

A. DECISION: 2020 Broodstock Collection Protocols (Tom Kahler)

Tom Kahler recalled that each year, the HCP Hatchery Committees develop the Broodstock Collection Protocols and the Wells HCP includes a requirement for Wells HCP Coordinating Committee approval of the protocols. Kahler said the basis for this requirement has to do with trapping at the Wells Dam fish ladders. He said proposed trapping operations at Wells Dam are outlined in Appendix D of the protocols (which were distributed to the Wells HCP Coordinating Committee by Kristi Geris on March 19, 2020), and are essentially the same as those approved last year with a few exceptions, as discussed during the last HCP Coordinating Committees meeting. He said CRITFC trapping of sockeye salmon is still included in the protocols; although, this is not an activity for PUD mitigation programs. He said in light of the concerns raised by the CCT regarding this activity, the HCP Hatchery Committees modified this language to indicate CRITFC trapping of sockeye salmon may occur if approved by the Wells HCP Coordinating Committee.

Keely Murdoch said the YN has been discussing this internally and is not certain the Wells HCP Coordinating Committee has purview in this situation. She asked, what is the Wells HCP Coordinating Committee approving or not approving? She said this issue has not been fully resolved. She said the YN does not want to limit available options if it is decided that the Wells HCP Coordinating Committee has no purview. She asked if the Broodstock Collection Protocols are a binding document. Kahler said no, the protocols are a living document. He recalled in past years, sometimes the protocols were not even finalized until December. He said the document is intended to be adjusted, as needed. Murdoch asked, just because the protocols indicate Wells HCP Coordinating Committee approval is needed for the proposed CRITFC trapping, does this lock the YN into this process (i.e., does approving the Broodstock Collection Protocols bind the Parties to language included in the protocols)? Kahler said no, he does not view the protocols as binding in this decision (note: however, the Wells HCP Coordinating Committee decision on a tagging activity at Wells Dam would be necessary regardless of the language in the protocols). Murdoch said she just wants to be sure approving the protocols does not mean the YN agrees to, or is locked into, this process.

John Ferguson said the CRITFC request for trapping sockeye salmon at Wells Dam is a request by fisheries managers to collect information at Wells Dam and is not related to the Wells HCP. He said what is related to the Wells HCP, is that the proposed CRITFC activities have the potential to affect fish passage at Wells Dam. Murdoch said she is not disagreeing with this. She said her supervisors have questions about what authority the Wells HCP Coordinating Committee has here. She said she has reviewed the Wells HCP and cannot locate language giving the Wells HCP Coordinating Committee authority to decide what data are valuable or what (incidental) take is acceptable. She said the technical merit of this project has already been reviewed and approved, and funded by the Bonneville Power Administration, and the project already has its own permit for allowable take. She said further, if the Wells HCP Coordinating Committee does have authority, the purview is related to HCP activities.

Kahler said Appendix A of the Wells HCP is the *Wells Hydroelectric Project, Adult Fish Passage Plan* (Fish Passage Plan). He said Douglas PUD interprets this plan as the Wells HCP Coordinating Committee nexus for approving activities that might affect fish passage through the Wells Dam fishways. He read the following excerpts from the Fish Passage Plan:

Changes in operating criteria require unanimous support of the Coordinating Committee including approval by NMFS Hydro Program. –page 71

Brood stock collection protocols are developed by the Washington Department of Fish and Wildlife and are annually submitted to the Wells Coordinating Committee and NMFS Hydro Program for annual approval prior to trapping at the Dam. –page 72

Modification to the ladder operating criteria can only take place following approval by the Wells Coordinating Committee. –page 73

Murdoch said it looks like the Fish Passage Plan already approves the sockeye salmon work, and she read the following excerpt from the Fish Passage Plan:

In addition to brood stock collection, the adult fish traps are occasionally used to collected information from CWT tagged steelhead, collect sockeye scales for stock identification and age analysis and collect adult bull trout, chinook, sockeye and steelhead for radio-tagging. –page 72

Murdoch said this CRITFC work started in the early 1990s and predates the HCPs, which might be why this language was included, because the activities were already happening at the time of the development of the HCPs. She reiterated that the YN is not questioning Wells HCP Coordinating Committee approval of the Broodstock Collection Protocols; rather, the question is if the Wells HCP Coordinating Committee can approve or not approve whether CRITFC can trap at Wells Dam.

Kahler said he interpreted the excerpt that Murdoch read as activities that occasionally happen at Wells Dam. Kahler said Douglas PUD routinely has third parties trap at Wells Dam. He said historically, Wells Dam was the last trap on the Columbia River as fish migrate upstream. He said now there is trapping at the Chief Joseph Dam fish ladder, as well. He said there have been situations in the past when proposed activities at the Wells Dam fish ladders would interfere with an ongoing Douglas PUD study, and as the Project Operators, Douglas PUD has had the opportunity to ask the Wells HCP Coordinating Committee whether the Committee agrees that the proposed activity might interfere with HCP activities. He said, for example, the Douglas PUD Aquatic Settlement Work Group (SWG) wanted to conduct a Pacific Lamprey study in the Wells Dam fish ladders and the Wells HCP Coordinating Committee determined the proposed study would impede fishway entrance by Plan

Species. He said the Aquatic SWG had to modify the study, per recommendations from the Wells HCP Coordinating Committee so as to not affect fishway attraction. He said the Wells HCP Coordinating Committee needs to make decisions about any activity proposed for the Wells Dam fish ladders that might affect passage for Plan Species. He said this is per the Douglas PUD Federal Energy Regulatory Commission (FERC) license.

Murdoch said it makes sense that the Wells HCP Coordinating Committee purview is related to HCP activities; however, for the CCT to not approve the activity because the CCT do not believe the data are useful does not seem to be within the Wells HCP Coordinating Committee purview.

Ferguson asked Douglas PUD to review the specific trapping operations that are expected for the Wells Dam fish ladders during the sockeye salmon migration in 2020. Kahler said CRITFC has been conducting this effort for years and has always coordinated with other trapping activities to the extent possible. He said typically, this coordination has occurred with the steelhead broodstock collection and stock assessment trapping conducted by the Washington Department of Fish and Wildlife (WDFW), and summer Chinook salmon stock-assessment and broodstock trapping conducted by WDFW and Douglas PUD, respectively. He said WDFW or Douglas PUD operates the traps, and when sockeye salmon are encountered, fish are handed over to CRITFC for tagging. He said this year, however, the steelhead stock assessment is occurring at the Priest Rapids Dam Off-Ladder Adult Fish Trap, and broodstock collection for steelhead occurs in the spring. He said trapping of summer Chinook salmon (summers) at Wells Dam for the Carlton Program and for stock-assessment sampling will only occur at the east fish ladder, and Douglas PUD collection of spring Chinook salmon (springers) will occur at both ladders, but will conclude by June 28, 2020 before most of the sockeye salmon trapping would occur. He said, for the Carlton summers, the trap will be operated by the Douglas PUD hatchery crew, a maximum of 3 days per week. He said oftentimes, all broodstock for a given week is collected within 1 day. He said in the past, when WDFW and Douglas PUD trapping operations were fulfilled, CRITFC would continue operating the trap if more sockeye salmon were needed.

Ferguson said this is something for the Wells HCP Coordinating Committee to consider, that there may be days where the trap is operated only for sockeye salmon collection to meet CRITFC tagging needs. Murdoch said during this timeframe there are few Endangered Species Act-list species migrating. She said late June to early July is the end of the springer run and the steelhead migration will not quite be started yet.

Kirk Truscott said his recollection is that the NOAA scientific research permit issued to CRITFC to tag sockeye salmon at Wells Dam in 2020 and/or the Broodstock Collection Protocols state that the proposed activity must be performed concurrent with other trapping. He said the CCT's position is there would be additional passage impacts to all anadromous species if trapping is not performed concurrently with other trapping activities. Murdoch said Jeff Fryer recently provided the YN with the

NOAA scientific research permit and permit application held by CRITFC, where the YN is listed as co-investigators, and in neither document does she see anything about the action needing to be performed concurrent with another trapping activity. Murdoch said CRITFC's permit includes a take allowance for springers and steelhead, and she noted that similar to the YN coho salmon trapping effort, when trapping occurs concurrently with another program, this does not result in additional take. The Wells HCP Coordinating Committee requested copies of the research permit and Murdoch said she will distribute the permit and permit application, which contains additional information about the study. She noted that the permit and application do include other activities in addition to the sockeye salmon tagging at Wells Dam. (Note: Murdoch provided these documents to Geris during the HCP Coordinating Committees conference call on March 24, 2020, which Geris distributed to the HCP Coordinating Committees that same day.)

Ferguson recalled another concern expressed by the CCT was about anesthetic and affects to the tribal fishery; however, this concern is outside the HCP and does not affect fish passage at the dam. Murdoch said Fryer contacted Aqui-S regarding the 3-day holding period and the representative said for wild fish there is no withdrawal period. Murdoch said the 3-day holding period for hatchery fish is based on the assumption there will be repeated exposure to the anesthetic. Truscott asked if CRITFC holds an Investigational New Animal Drug (INAD) exemption for Aqui-S. He said he found another INAD for Aqui-S and his interpretation is the fish cannot be released for 72 hours if entering authorized fisheries. Murdoch said this is not what the representative from Aqui-S said. Truscott said this is why he would like to review CRITFC's INAD. He also agreed with Ferguson that this is not an HCP issue; rather, this is a regulatory compliance issue that Douglas PUD may need to consider.

Ferguson asked about next steps if the Wells HCP Coordinating Committee cannot agree on this topic. Murdoch said it needs to be clear on what the Wells HCP Coordinating Committee is voting on. Kahler said from Douglas PUD's perspective, the Wells HCP Coordinating Committee is the entity that decides whether a change in operations of the Wells Dam fishways and trapping facilities is or is not affecting safe, effective, and timely fish passage. He said every entity using the facilities must pass a facility screening. He said the YN already has an agreement in place. He said every entity also must have and comply with a permit for the proposed activities. He said regardless, Douglas PUD has a requirement to submit to NMFS the Broodstock Collection Protocols approved by the Wells HCP Coordinating Committee. He asked if language in Appendix D can be modified so the Committee can approve this document. Ferguson read the following excerpt from Appendix D of the protocols:

> *The CRITFC may also trap sockeye at Wells Dam for tagging and stock assessment. Their request for trapping in 2020 did not specify trapping details other than timing (late June through early August), but their preference in past years has been to use the East ladder. Although this work has been done in the past, this action will need approval in 2020 by the Wells HCP Coordinating Committee. –page 50 of the version distributed on March 19, 2020*

Ferguson asked, given this language and needing to move forward and understanding this is a living document, is this language sufficient to vote on now? The Wells HCP Coordinating Committee clarified this decision on the protocols is based on impacts to HCP activities.

Wells HCP Coordinating Committee representatives present approved the 2020 Broodstock Collection Protocols, consistent with the provisions of the Wells HCP.

The final protocols were distributed to the HCP Coordinating Committees by Geris on March 24, 2020.

B. CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam (Tom Kahler)
John Ferguson said it seems more discussion is needed on this item before a decision is made and a vote taken, and he asked the Wells HCP Coordinating Committees for comments. Keely Murdoch said the YN is ready to vote right now or can wait 1 month if Committee members need additional time or information. Kirk Truscott suggested discussing how this request and activity affects safe and efficient passage of Plan Species. He said sampling takes place Monday through Friday in late June to early August. He said the only ongoing trapping will be for the Carlton Program. He said the CCT's position is that any trapping outside concurrent trapping for the Carlton Program has additional impacts to Plan Species passing via the fish ladder and the CCT do not approve this. Murdoch said this action has almost always been conducted concurrently with other trapping and if the target quota has not been achieved by the time others are done trapping, CRITFC has a permit that allows for take. She said this has been determined by NOAA Fisheries. Truscott said the action takes place on a PUD facility where signatories to the HCP approve whether the action provides safe and efficient passage—period. He said he believes this action is at an impasse. Murdoch suggested developing criteria in order to reach concurrence.

Tom Kahler said trapping for the Carlton Program may occur 3 days per week, 16 hours per day. Murdoch said, however, the trapping effort may not take this long. Kahler said this depends on how quickly brood are collected. He said trapping for the Carlton Program is planned from July 1 to September 15, 2020, and during trapping for springers prior to this time, if summers are encountered these fish are retained for the Carlton Program.

HCP-CC April 28, 2020 conference call

IV. Douglas PUD

C. DECISION: CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam (Tom Kahler)
John Ferguson recalled about 1 year ago, Kirk Truscott started questioning the need for these data. Ferguson said since then, this topic has been discussed over the course of several HCP Coordinating Committees meetings. He recalled during the last meeting, Keely Murdoch helped the Wells HCP Coordinating Committee focus on key issues to work through, including whether statements regarding the CRITFC sockeye salmon trapping in the Broodstock Collection Protocols are binding,

which the Wells HCP Coordinating Committee agreed they are not. Ferguson also recalled that Murdoch questioned whether the Wells HCP Coordinating Committee has the purview to weigh in on tagging operations at Wells Dam, and the Wells HCP Coordinating Committee seemed to agree that they do to the extent the operations could affect passage of Plan Species. Ferguson said the Wells HCP Coordinating Committee agreed not to weigh in on whether the data are valuable or who conducts the sampling; rather, they will review the request from the perspective of impacts to fish passage. He recalled reviewing and discussing the CRITFC permit for incidental take, sampling concurrent with and not in addition to sampling for the Carlton Program, the use of Aqui-S, and whether CRITFC holds an Investigational New Animal Drug (INAD) exemption for the proposed sampling. Ferguson recalled that the CRITFC request is to sample up to 800 fish. He said considering the past 25 years of passage timing, the proposed summer Chinook salmon sampling for the Carlton Program from July 1 to September 15 falls in the middle 80th percentile of the sockeye salmon migration. He recalled that the Wells HCP Coordinating Committee crafted a statement to discuss with respective HCP Policy Committees representatives and consider for concurrence, as follows:

> *Wells HCP Coordinating Committee representatives present have reviewed the CRITFC request to tag sockeye salmon at Wells Dam in 2020, and given the provisions contained within the Wells HCP, are voting on whether there are no fish passage impacts or acceptable fish passage impacts to Plan Species associated with the proposed data collection.*

Ferguson said this statement addresses the technical aspects of the CRITFC request, consistent with HCP Policy Committees guidance from 2019. He said the CRITFC request is a decision item today, but it can be postponed 1 more month, if needed.

Murdoch said she has been talking a lot with people to obtain more information. She said she understands the Wells HCP Coordinating Committee is not making a decision on whether the data are useful or not; however, she believes the importance of the data can help inform whether the impacts of the proposed activity are acceptable. She said she had a conversation with Okanagan Nation Alliance (ONA) staff about how these PIT-tag data are used and the importance of these data. She said it sounds like these data are very important for in-season escapement management, spawner distribution, and M&E for the sockeye salmon Skaha Lake reintroduction program in the Okanagan River Basin. She said all parties except for Douglas PUD have helped fund this project (with the exception of efforts related to the Fish and Water Management Tool). She noted the email from Kim Hyatt (Department of Fisheries and Oceans Canada [DFO]) to Tom Kahler that was distributed to the Wells HCP Coordinating Committee by Kristi Geris on April 27, 2020, which indicates these data are clearly very important. Murdoch said a modeling effort is underway to support discussions for the renewal of the Columbia River Treaty (Treaty), and DFO and ONA are relying on these data for the model being developed to support analyses associated with renewing the Treaty. Murdoch said further, she had a conversation with Jeff Fryer who indicated there has been a lot of restrictions on sampling at the Bonneville Dam Adult Fish Facility (Bonneville AFF) this year due to social distancing requirements associated with COVID-19 and Fryer may not be able to reach the target sample numbers at the Bonneville AFF, which makes reaching sampling targets at Wells Dam really important. Murdoch said this issue at the Bonneville AFF and the impacts to the data are so important that it will be on the agenda for discussion at the next Canadian Okanagan Basin Technical Working Group (COBTWG) meeting scheduled for June 2020. She said additionally, regarding sampling only in space and time concurrent with the Carlton Program at Wells Dam, after talking with Kraig Mott, YN Fisheries Biologist and Crew Leader for CRITFC sockeye salmon trapping, Mott said if trapping is limited only to when trapping is operating for the collection of summer Chinook salmon broodstock for the Carlton Program, Mott will not be able to reach the target sample size for CRITFC. Murdoch said further, Mott is unsure the trapping efforts can be conducted concurrently while maintaining social distancing. Murdoch said, therefore, she suggests that the YN conduct the sockeye salmon sampling independent of the Carlton Program for the reasons just discussed. She said CRITFC's sockeye salmon trapping and tagging is a collaborative effort with DFO, ONA, and the YN, and it would be a shame to not be able to collect these data this year.

Murdoch asked Truscott how implementing CRITFC's request would impact the sockeye salmon population. Murdoch asked if data exist that show a negative impact. Truscott asked if data exist that show there is no negative impact to sockeye salmon or any Plan Species. He said he is erring on the side of caution. Murdoch asked if the Colville Confederated Tribes (CCT) are an ONA tribe and Truscott said they are. Murdoch asked if the CCT have discussed this topic with ONA. Truscott said he had not known the rationale of these data until he received Hyatt's email yesterday. Truscott asked why a retrospective analysis of the last 16 years of PIT-tag data would not be sufficient to meet the needs for this evaluation? Murdoch said Hyatt's email indicates he needs these PIT-tags to validate the data from a 3-year Treaty modeling project, and Murdoch read the last paragraph of Hyatt's email, as follows:

My DFO Research Group is currently reviewing the past several years of pit tagging, migration, and survival work to complete the adult freshwater migration portion of what we intend to eventually use in a cumulative impacts life history model for sockeye [salmon] and then for Chinook [salmon]. The ongoing information from tagging sockeye [salmon] at Wells [Dam] is viewed as having especially high value to our ability to verify model performance over the three-year funding window in which this work is to be completed. I am hopeful that the tagging and biological sampling that has been undertaken in recent years at Wells [Dam] may continue in support of this new three-year research initiative.

Truscott said he is not privy to the specifics of this 3-year initiative and he cannot really provide an answer on whether he or others agree this is correct that additional data are needed. Murdoch reiterated that ONA also indicated these data are used for real-time management of escapement, spawner distribution, and M&E, and this cannot be done with a retrospective analysis.

Truscott said the Wells HCP Coordinating Committee had a path forward and this discussion is a different path. He suggested Murdoch contact ONA and have Howie Wright (ONA Fisheries Manager) call Randy Friedlander (CCT Fish and Wildlife Program Director and HCP Policy Committees Representative). Truscott said currently, his path remains unchanged. He said if CRITFC sampling is conducted concurrent with the Carlton Program there would be no additional impacts. He said this is still where he stands. Murdoch said Tom Scribner (YN HCP Hatchery Committees Representative) already spoke with Wright and it was Wright's idea to bring this issue to the COBTWG to discuss the technical implications of not reaching the target sample sizes. Murdoch said this is likely why Wright has not yet called Friedlander, because the topic will be discussed at the next COBTWG meeting in June 2020.

Ferguson asked if and how the run size forecast plays into Mott's conclusion that sockeye salmon trapping would need to go beyond the concurrent trapping window to meet sample size requirements. Murdoch said Mott's comments are based on his experience from conducting this sampling for several years. Murdoch said in the past, sockeye salmon trapping has occurred on the east fish ladder and brood collection has occurred on the west fish ladder. *(Note: Kahler later clarified that broodstock for the Carlton Program are collected on both ladders, with preference for the east ladder, and M&E run-comp trapping has typically occurred at the east ladder.)*

Murdoch said she thinks one limiting factor is sockeye salmon trapping would need to align with the brood collection schedule, which typically occurs early in the week. Kahler explained further that Fryer prefers trapping at the east fish ladder because when sockeye salmon are collected at the west fish ladder these fish are conveyed to Pond 6 and are processed along with the summer Chinook salmon the next day (compared to trapping at the east fish ladder and processing the fish the same day separate from the summer Chinook salmon).

Kahler said this year, brood collection for the Carlton Program will occur at both fish ladders. He said over the last 2 years, Chinook salmon have been favoring the east fish ladder and sockeye salmon have been favoring the west fish ladder. He said if trapping is concurrent on both fish ladders, he wonders if there might be a greater chance of reaching the quota.

Kahler said regarding COVID-19, Douglas PUD is still trying to figure out how to complete planned activities while maintaining social distancing. He said the hatchery buildings at Wells Dam are siloed off. He said he can access the old building but not the new building at Wells Fish Hatchery. He said he cannot go into Wells Dam but he can drive over the dam. He said there are a lot of older employees in hydromechanics and as dam operators, and Douglas PUD is trying to protect these staff. He said he cannot access Methow Fish Hatchery either and Methow Fish Hatchery staff are not allowed access to Wells Fish Hatchery. He said M&E and steelhead spawning staff are limited on when and where staff can be at different locations. He said now the major brood collection season has started, with spring Chinook salmon collection starting today and running through the end of

June, and summers and sockeye salmon collection starting soon after. He said that surplusing of summer Chinook salmon is also quickly approaching. He said this is all very complicated, and Douglas PUD staff plan to convene this afternoon to discuss how to address COVID-19 while allowing all these different uses of the project. He said this is a multi-party consideration that Douglas PUD is trying to sort through, and it is still unknown how things will change in June and July. He said it is good to discuss ideals; however, he hopes everyone can appreciate that everything is in flux. He said it may be that Douglas PUD needs to trap and tag sockeye salmon. He said this is not ideal for Douglas PUD, the YN, or CRITFC, but this may be the only option. He said lastly, he appreciates the utility of the data and for the modeling exercise to support discussions on the Treaty, and the real time aspect of managing the resources. He said he also appreciates the need for long-term datasets.

Ferguson suggested that Chad Jackson update WDFW and Murdoch update the YN and CRITFC about Douglas PUD's ongoing internal discussions and considerations about how to implement salmon and steelhead trapping activities at Wells Dam fish ladders in 2020, while complying with the evolving COVID-19 restrictions and concerns.

Ferguson reminded the Wells HCP Coordinating Committee, as discussed during the last meeting, the purview of the HCP Coordinating Committees is the safe and efficient passage of Plan Species as a technical decision point. He said it is important to keep this in mind. He said if there is a formal vote right now, the CCT and the YN have been clear there is not consensus. He said this means the proposed sockeye salmon trapping and tagging at Wells Dam in 2020 will not go forward. Ferguson said this topic can be elevated to the policy level and addressed by conference call; however, he is unsure whether the outcome will be any different with the Wells HCP Policy Committee. He said Truscott expressed he is still firm in his view, so it comes down to whether the YN wants to collect as many fish as possible during concurrent sampling or get no fish at all.

Jim Craig said it seems the Wells HCP Coordinating Committee is at an impasse. Ferguson asked if Craig is proposing a vote now versus postponing a decision for 1 month. Craig said he is unsure what will change in 1 month but is also supportive of waiting another month if this is preferred. Murdoch said, considering that Douglas PUD plans to meet today to discuss COVID-19 mitigation measures and the COBTWG is convening in June, she thinks discussions from these two meetings might clarify a decision or path forward before the proposed sampling start date in late June. Ferguson said there will also be two more meetings of the HCP Coordinating Committees, on May 26 and June 23, 2020, to further discuss this topic, if needed. Murdoch said the YN is supportive of postponing a decision today. She said, however, if there is no way the CCT will approve this activity, she believes an HCP Policy Committees meeting will be needed. Truscott agreed.

Ferguson said the decision will be deferred for now to allow more time for COVID-19 and COBTWG discussions. He suggested that the YN also further discuss and consider the option of implementing

CRITFC's sockeye salmon trapping and tagging concurrent with the Carlton Program trapping at Wells Dam in 2020, versus no CRITFC sockeye salmon trapping and tagging at all. Murdoch said she can discuss this with Fryer; however, with the low sample size at the Bonneville AFF it is really important to reach the sample size at Wells Dam. Kahler also suggested that Murdoch discuss with Mott and Fryer the feasibility of conducting CRITFC sockeye salmon trapping at both east and west fish ladders at Wells Dam in 2020, to possibly meet sample size requirements. Murdoch said she can discuss this with Mott and Fryer; however, Mott already indicated he does not believe numbers will be close to reaching the sample target while sampling concurrently.

Ferguson said it is worth noting that the longer the Wells HCP Coordinating Committee postpones a decision, the more difficult it will be to convene the HCP Policy Committees in a timely way to meet the needs of sampling. Jackson suggested scheduling HCP Policy Committees conference calls now to take place after each of the next HCP Coordinating Committees meetings in May and June, in case these are needed. He said canceling the meetings will be easier than trying to schedule last minute. Murdoch agreed. Ferguson said that Anchor QEA will schedule HCP Policy Committees conference calls to follow the HCP Coordinating Committees conference calls in May and June 2020, in the event the Wells HCP Coordinating Committee cannot reach consensus on whether there are no impacts or acceptable impacts to Plan Species associated with CRITFC's request to conduct sockeye salmon trapping and tagging at Wells Dam in 2020 and the issue is elevated to the policy level and needs resolution in a timely manner. He said the calls will be canceled if not necessary. *(Note: Following the meeting, Douglas PUD revised researcher access regulations to Wells Dam to address COVID-19 concerns, which made this discussion a moot point; therefore, there is no need to convene the HCP Policy Committees as discussed.)*

HCP-CC May 26, 2020 conference call

III. Douglas PUD

A. CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam (Tom Kahler)

Tom Kahler said Douglas PUD convened an internal meeting on May 28, 2020. He said Wells Dam gets a lot of use, including surplusing of hatchery fish, sockeye salmon tagging, and all the programs relying on collection at the hatchery and dam. He said Douglas PUD needed to arrive at a policy for how to deal with COVID-19 and protect staff at the dam and hatchery. He said as a result, Douglas PUD decided to only allow Wells Fish Hatchery staff and a limited number of Charlie Snow's (WDFW) crew access to the Adult Handling Facility at the hatchery. Kahler said this entails a total of four designated people who can cycle through, two at a time, to process fish for broodstock and collect surplus fish. He said similarly, only four people in total will be allowed access to the fish ladder traps, particularly at the east ladder trap because the west ladder trap sends fish to the Adult Handling Facility. He said this includes three people at a maximum from Snow's crew and one Douglas PUD staff from the Methow Fish Hatchery. Kahler said no other entities will be allowed access, which effectively eliminates the CRITFC crew from trapping. Kahler said Douglas PUD recommended to Jeff Fryer that he coordinate with Snow to determine whether his crew has the ability to tag sockeye salmon for CRITFC. Kahler said Fryer and Snow worked something out to be able to collect and tag sockeye salmon concurrent with other planned trapping activities without prolonging trapping.

John Ferguson recalled that the YN and the Colville Confederated Tribes (CCT) both had action items to discuss this internally at the policy level, and he asked both tribal representatives to share comments from those discussions.

Keely Murdoch said at this point, there is not a whole lot anyone can do because there is no access to the ladder traps. She said the YN is supportive of Snow's crew tagging as many sockeye salmon as possible; however, based on conversations with Snow, he is uncertain how many he can do because it depends on how busy he is with processing trapped Chinook salmon. Murdoch said the YN and CRITFC are seeking authorization from Grant PUD to conduct supplemental tagging of sockeye salmon at Priest Rapids Dam. She said, while these are the plans for this year, the YN believes this issue needs to be resolved for future years because the preference is to continue the CRITFC tagging at Wells Dam because it is more practical than at Priest Rapids Dam. She said the same request will come next year and suggested adding this topic to the next HCP Policy Committees meeting scheduled for fall 2020. She said the Canadian Okanagan Basin Technical Working Group (COBTWG) also plans to discuss this topic at their upcoming meeting in June 2020. Ferguson asked that Murdoch keep the HCP Coordinating Committees updated on tagging at the Priest Rapids Dam Off-Ladder Adult Fish Trap and said that this topic will be added to the next HCP Policy Committees meeting agenda.

Kirk Truscott said the CCT are in agreement that this topic needs to be addressed during the next HCP Policy Committees meeting. He urged folks who want to implement this action to coordinate more closely with the CCT. He said the CCT and Okanagan Nation Alliance (ONA) are close; however, there has not been much interaction between the two regarding the importance of this activity in managing Okanagan River sockeye salmon. He said it would be a worthwhile endeavor for ONA, Fryer, or Kim Hyatt (Department of Fisheries and Oceans Canada) to engage with the CCT on the management needs for these data and activities. Truscott said there is an opportunity here to have some dialogue and a better understanding of the potential costs and benefits of this activity being conducted at Wells Dam.

Murdoch asked if the CCT attend the COBTWG meetings. Truscott said not generally. Murdoch said she thought the purpose of discussing this issue at the next COBTWG meeting, in part, was to have this dialogue with the CCT. She said she still does not know the exact date in June because the YN is not a part of COBTWG, but she knows the meeting is still planned via a virtual conference.

Ferguson thanked the YN and the CCT for the comments and agreed this topic needs additional input from the tribes, ONA, CRITFC, and the HCP Policy Committees.

CANADIAN OKANAGAN BASIN TECHNICAL WORKING GROUP
C/O Department of Fisheries and Oceans Canada
985 McGill Place, Kamloops BC V2C6X6

Contact:	Phone:	Email:
Chairperson Kari Alex	250.707.0095	kalex@syilx.org
Secretariat Colette Louie	250.498-6935	clouie@oib.ca

Dr. Jeffery Fryer
Columbia River Inter-Tribal Fish Commission
700 NE Multnomah St Suite 1200
Portland, Or 97232

August 31, 2020

Dear Dr. Fryer,

This letter is being written on behalf of the Canadian Okanagan Basin Technical Working Group (COBTWG). The group is a tri-partite group whose membership includes the Okanagan Nation Alliance (ONA), Fisheries and Oceans Canada (DFO) and the BC provincial ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD). The principle that guides COBTWG is the commitment to developing an ecosystem and science based fish stock and habitat restoration program, specifically to;

- Conserve and protect indigenous fish stocks and habitats
- Rehabilitate and/or restore highly valued fish populations
- Rehabilitate or restore natural aquatic and riparian habitats
- Maintain and/or reestablish, within practical limits, components of natural or normative ecosystem processes.

As such, the PIT tagging and bio-sampling efforts that occur at Wells dam on an annual basis contribute important information to management decisions affecting the Okanagan Sockeye stock in Canada. To date this stock comprises annually greater than 80% of the remaining Columbia River Sockeye. Data collected from Wells dam specifically informs;

1) In season harvest management decisions for both recreational and commercial fishing opportunities in the Canadian Okanagan
2) Annual escapement estimates calculated as a mark recapture of pit releases from Wells
3) Determination of sample sizes of PIT tagged adults that return to the Canadian Okanagan
4) Elements of outcomes experienced by thermally tagged animals in temperature studies

These are but a few examples of the value of the data emanating out of the PIT/Biosampling efforts at Wells Dam. The loss of this opportunity would present challenges to sustainable management of a critically important salmon stock of the Columbia River watershed.

Sincerely,

Karilyn Alex

COBTWG Chair, Karilyn Alex

From:	Kristi Geris
To:	Kristi Geris
Subject:	RE: Aqui-S INAD
Date:	Friday, September 11, 2020 11:20:21 AM

From: John Ferguson <jferguson@anchorqea.com>
Sent: Monday, August 31, 2020 15:12
To: Sarah Montgomery <smontgomery@anchorqea.com>; Jeannette Finley (Jeannette.Finley@colvilletribes.com) <Jeannette.Finley@colvilletribes.com>; Cody Desautel (Cody.Desautel@colvilletribes.com) <Cody.Desautel@colvilletribes.com>; Kirk Truscott <kirk.truscott@colvilletribes.com>; David Blodgett, III <blod@yakamafish-nsn.gov>; Keely Murdoch <murk@yakamafish-nsn.gov>; michael.livingston@dfw.wa.gov; Jackson, Chad S (DFW) <Chad.Jackson@dfw.wa.gov>; Jim Craig <jim_l_craig@fws.gov>; Alene Underwood <Alene.Underwood@chelanpud.org>; Shane Bickford <sbickford@dcpud.org>; Tom Kahler <tomk@dcpud.org>; Ritchie Graves <ritchie.graves@noaa.gov>; Kristi Geris <kgeris@anchorqea.com>
Subject: FW: Aqui-S INAD

Please below the INAD information that Keely sent.

John

ANCHOR QEA, LLC
Jferguson@anchorqea.com
1201 Third Ave, Suite 2600
Seattle, WA 98101

Phone (direct): 206.219.5895
Cell: 206.437.7865

From: Keely Murdoch <murk@yakamafish-nsn.gov>
Sent: Monday, August 31, 2020 1:59 PM
To: John Ferguson <jferguson@anchorqea.com>
Subject: Fwd: Aqui-S INAD

[EXTERNAL EMAIL]
This is the information John Whittaker from CRITFC forwarded to me regarding the Aqui-S INAD. It looks like they are using the FWS INAD. He quotes the pertinent section below.

---------- Forwarded message ---------
From: **John Whiteaker** <whij@critfc.org>
Date: Thu, Aug 27, 2020 at 11:31 AM
Subject: RE: Aqui-S INAD
To: Keely Murdoch <murk@yakamafish-nsn.gov>
Cc: Jeff Fryer <fryj@critfc.org>

Hi Keely,

https://www.fws.gov/fisheries/aadap/inads/AQUI-SE-and-AQUI-S20E-INAD-11-741.html

Under Withdrawal period

- Freshwater and marine finfish that are sedated by resource managers as part of field-based fishery management activities can be released **immediately** after treatment. The immediate release provision is for field use only.

Let me know if this is all you need.

John Whiteaker
Fishery Scientist
Columbia River Inter-Tribal Fish Commission
700 NE Multnomah St., Suite 1200
Portland OR. 97232
(503) 238-3562

From: Keely Murdoch <murk@yakamafish-nsn.gov>
Sent: Thursday, August 27, 2020 10:02 AM
To: John Whiteaker <whij@critfc.org>
Cc: Jeff Fryer <fryj@critfc.org>
Subject: Aqui-S INAD
Hi John,
I have been working with Jeff on his Sockeye project in the Upper Columbia. The Colvilles have raised concerns about the use of Aqui-S in adult Sockeye at Wells Dam that are then subjected to a fishery. I understand Aqui-S is supposed to have a zero withdrawal period, but I am hoping to get a copy of your INAD to see how it is described therein.
Jeff Fryer indicated that you would be the person to contact for this.
Thanks,
Keely
--

Keely Murdoch
Fisheries Research Scientist
Yakama Nation
7051 Highway 97
Peshastin, WA 98847
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FINAL

1201 3rd Avenue, Suite 2600
Seattle, Washington 98101
206.287.9130

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Policy Committees

Date: November 13, 2020

From: John Ferguson, HCP Policy Committees Chairman

cc: Kristi Geris

Re: Final Minutes of the October 6, 2020, HCP Policy Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Policy Committees met by conference call on Tuesday, October 6, 2020, from 9:00 a.m. to 10:30 a.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

- Kirk Truscott and Cody Desautel will provide to the HCP Policy Committees responses from Howie Wright and Richard Bussanich (Okanagan Nation Alliance [ONA]) concerning potential implications to ONA's analyses of sockeye salmon using Columbia River Inter-Tribal Fish Commission's (CRITFC's) information, based on Shane Bickford's conversation with Jeff Fryer (CRITFC) about bias associated with alternative sampling approaches and any effects that tagging fewer than 800 sockeye salmon annually at the Wells Dam east fish ladder may have on the outputs of ONA's analyses and its use in fisheries management decisions (Item I-D). *(Note: Truscott provided a response from Wright on October 27, 2020, which Kristi Geris distributed to the HCP Policy Committees that same day.)*
- Anchor QEA will distribute a final Statement of Agreement (SOA), regarding CRITFC's annual request to tag sockeye salmon at Wells Dam, as approved by the Wells HCP Policy Committee (Item IV-A). *(Note: Kristi Geris distributed the final SOA following the HCP Policy Committees conference call on October 6, 2020.)*

Decision Summary

- Wells HCP Policy Committee representatives present approved the following language to finalize in a Wells HCP SOA, regarding CRITFC's annual request to tag sockeye salmon at Wells Dam: "The Wells HCP Policy Committee agrees to add additional trapping of sockeye salmon at the Wells Dam east ladder trap as needed weekly to meet the target sample size, but only after the thermal barrier in the Okanagan River has set up each year, contingent upon hearing back from ONA representatives regarding the potential for sampling after the thermal barrier sets up to affect ONA sockeye salmon management needs. For the purposes of this Agreement, "thermal block" refers to temperatures greater than or equal to 21 degrees

Celsius at the U.S. Geological Survey 12447200 Okanogan River at Malott Washington gage for a period greater than or equal to 12 hours." (Item III-A).

Agreements

- There were no HCP Policy Committees Agreements discussed during today's conference call.

Review Items

- There are no HCP Policy Committees items that are currently available for review.

Finalized Documents

- A final Wells HCP SOA regarding CRITFC's annual request to tag sockeye salmon at Wells Dam was distributed to the HCP Policy Committees by Kristi Geris following the HCP Policy Committees conference call on October 6, 2020 (Item IV-A).

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Policy Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. No additions or changes were requested.

B. Meeting Minutes Approval (John Ferguson)

The HCP Policy Committees reviewed the revised draft September 1, 2020, conference call minutes. Kristi Geris said the draft conference call minutes were distributed for a 2-week HCP Policy Committees review on Monday, September 14, 2020. Geris said edits and comments were received from Douglas PUD and National Marine Fisheries Service (NMFS), which were incorporated into the revised minutes. Geris said she also received indication of no comments from U.S. Fish and Wildlife Service (USFWS) and Washington Department of Fish and Wildlife (WDFW). Geris said no responses were received from the Colville Confederated Tribes (CCT), the Yakama Nation (YN), or Chelan PUD, and she asked Cody Desautel and Dave Blodgett if the CCT or the YN (respectively) would like additional time to submit edits or comments. Desautel and Blodgett both indicated they were ready to vote to approve. Geris said she also reached out to Alene Underwood for edits or comments on the revised minutes but received no response, and John Ferguson said Chelan PUD will be noted as abstaining. Ferguson and Geris reviewed edits and comments received on the draft minutes.

HCP Policy Committees members present approved the September 1, 2020, conference call minutes, as revised, with Chelan PUD abstaining.

C. Recap of Five Potential Alternatives (John Ferguson)

John Ferguson recalled that during the HCP Policy Committees conference call on September 1, 2020, the HCP Policy Committees discussed CRITFC's annual request to tag sockeye salmon at Wells Dam and identified five alternatives to achieve CRITFC's desired sample size while minimizing impacts to Plan Species. Ferguson said these included four alternatives at Wells Dam and one alternative at the Priest Rapids Dam Off-Ladder Adult Fish Trap (OLAFT).

D. Last Meeting Action Items (John Ferguson)

Action items from the HCP Policy Committees conference call on September 1, 2020, and follow-up discussions, were as follows. *(Note: Italicized text corresponds to agenda items from the meeting on September 1, 2020):*

- *Shane Bickford will discuss with Jeff Fryer the potential implications to Fryer's research on the effect of temperature on the survival of sockeye salmon returning to the Okanagan Basin if sockeye sampling were to occur at a higher rate in the later part of the season after the thermal barrier in the Okanogan River appears, and if volitional trapping at the Wells Dam east ladder were to occur on days when Carlton Program sampling is not occurring. In particular, the HCP Policy Committees are interested in learning whether these sampling alternatives introduce a bias into estimated survival. Bickford will then report this information back to the HCP Policy Committees (Item II-A).*
  Bickford said both he and Tom Kahler had discussions with Fryer. Kahler said he first asked Fryer about the potential implications for his model if sockeye salmon sampling were to occur at a higher rate in the later part of the season after the thermal barrier in the Okanogan River appears. Kahler said Fryer was not concerned about variability in sample rate because he nearly always ends up with uneven sampling and weights his analysis by the run distribution anyway. Kahler further explained that Fryer typically faces underrepresentation of the middle of the run, because the peak is so sharp, and over-representation of the shoulders of the run at Wells Dam; therefore, Fryer weights the data regardless. Kahler said his second question to Fryer was about the potential implications for his model if volitional trapping were to occur on days when Carlton trapping was not occurring. Kahler said Fryer was not concerned about biasing the sampling, but he was also not sure this would work very well. Kahler said Fryer would still be willing to try it. Kahler said his third question to Fryer was about the importance of a specific sample size, and Fryer said sample size is not a rigid requirement of his analyses but "up to 800 fish" has been the request for years. Kahler said Fryer's primary interest in maximizing sample size is because detection efficiency at the lower Okanogan River passive integrated transponder (PIT) array and Zosel Dam is poor. Kahler said 300 fish is useful, but 800 fish would be better. He said also, Fryer is not sure about ONA's sample size requirements. Kahler said his last question to Fryer was about sampling at the OLAFT and

whether this complicated his analyses. Kahler said the issue at the OLAFT is that tagging is physically complicated because the location is so far from where sampling crews operate, especially because the YN crew that normally conducts Fryer's sockeye salmon tagging comes from the Methow River Basin. Kahler said there are also constraints on the number of people allowed to work at the OLAFT at one time. He said the YN Cle Elum sockeye salmon reintroduction crew tagged around 400 fish for Fryer this year, but Fryer does not know if this is something that can be relied upon annually. Bickford said he and Fryer also discussed that Fryer's primary goal of this sampling is for stock composition. Bickford said Fryer is collecting data on age structure to use in a sockeye salmon model to predict the size of future runs. Bickford recalled that at the east ladder trap at Wells Dam, jack sockeye salmon can pass through the picketed fence used to lead fish into the trap; therefore, historically, Fryer has dropped Vexar screens in front of the picketed leads (to block fish from continuing up the ladder). Bickford said Fryer has not done this in about 10 years, but he knows the stock composition data at Wells Dam is not accurate and representative because of the behavior of jacks. Bickford said there are advantages to tagging at Wells Dam, primarily because the location is closer to the natal stream (which removes things like lake-effects with regard to collecting Okanogan River-origin fish) and there is the ability to collect a large sample size. He said, however, for purely a stock composition assessment, which is the primary goal of the program, tagging additional fish at the OLAFT and Bonneville Dam provides a better representation of the run at large compared to only tagging at Wells Dam. He said there are a combination of considerations, including logistics, stock composition, run-timing, and sample size, towards achieving the primary, secondary, and third-order objectives and strategies of the sampling. John Ferguson asked if Fryer is asking to reinstall the Vexar screens, and why have the screens not been installed in 10 years when there is a known jack bias? Bickford said there are a number of reasons, including: 1) debris loads up on the screens; and 2) the screens impede passage for Pacific lamprey and other smaller fish. He said he does not believe Fryer is proposing to reinstall the screens.

Dave Blodgett asked Keely Murdoch to share her conversations with Fryer related to this topic. Murdoch said her conversation with Fryer was very similar to the one that Kahler had. Murdoch said she and Fryer discussed the concept behind collecting a certain sample size by trapping additional days after the thermal barrier sets up—that Fryer weights the model by date sampled—so there would be no effects on the model. Murdoch said sampling at the OLAFT is logistically more complicated than at Wells Dam and she is unsure whether the YN Cle Elum crew can help every year. She said this also depends on the run size. She said this year, the crew was able to sample 400 fish, but relying on this crew is not ideal from the standpoint of collecting the Okanogan-origin sample size because the crew would need to sample even more fish to account for Lake Wenatchee turnoffs and additional harvest. She said in her opinion, and not coming from Fryer, the request to the Wells HCP Coordinating Committee pertains only to Wells Dam and the focus should only be on Wells Dam. Murdoch said the Vexar screens is new information to her. She said the YN crews have been trapping for Fryer at Wells Dam since 2007, she has never heard of Fryer using Vexar screens, and Fryer did not mention Vexar screens to her during their conversation. Kirk Truscott asked if the Cle Elum collection occurs proportional to run timing at Priest Rapids Dam, and what are the logistical issues with this crew tagging at the OLAFT, because the crew would already be there? Murdoch said she does not know whether trapping occurs proportional to the run, but she can find out. She said for this crew, trapping sockeye salmon at the OLAFT is logistically more complicated, notably during a small run year, because the crew needs to tag and release fish, split the sample size, and handle more fish than normal; which also probably causes more impacts. Truscott said in the last 6 to 7 years, Okanogan-origin fish have been the dominant portion of the return so there has not been a need to handle many more fish. Murdoch said fish turning off is not the only issue, there is also recreational harvest; that said, the request to the Wells HCP Coordinating Committee is not to find a new place to trap, but whether to trap at Wells Dam. Truscott said this is true, but the Committee is also trying to find a way to trap and minimize impacts to Plan Species and one way to do this is to not trap as many fish at Wells Dam by trapping at the OLAFT.

- *Kirk Truscott and Cody Desautel will discuss with Kim Hyatt (Department of Fisheries and Oceans, Canada) and Howie Wright (ONA) the potential implications to their analyses of sockeye salmon using CRITFC's information, based on the results of Shane Bickford's conversation with Jeff Fryer regarding bias associated with alternative sampling approaches and any effects tagging fewer than 800 sockeye salmon annually at the Wells Dam east ladder may have on the outputs of their analyses and its use in fisheries management decisions (Item II-A).*
  Truscott said he has not been able to connect with Kim Hyatt and has had only limited contact with Wright. Truscott recalled a response letter from the Canadian Okanagan Basin Technical Working Group (COBTWG; distributed to the HCP Policy Committees by John Ferguson on August 31, 2020) explaining the importance of sockeye salmon tagging at Wells Dam, which indicated that fisheries managers in British Columbia use these data for: 1) in-season harvest management decisions for both recreational and commercial fishing opportunities in the Canadian Okanagan; 2) annual escapement estimates calculated as a mark recapture of PIT-tagged fish released from Wells Dam; 3) determination of sample sizes of PIT-tagged adults that return to the Canadian Okanagan; and 4) elements of outcomes experienced by thermally tagged animals in temperature studies. Truscott said considering these four management actions, he sent an email to Wright asking if fewer than 800 sockeye salmon were

tagged at Wells Dam—he suggested, for example, 400 sockeye salmon—how will this impact the management actions? Truscott said his second question to Wright was whether additional trapping at another location would be consistent with the letter. Truscott said Wright responded that he hopes to send something back, but no specifics have been received so far. Ferguson asked if Wright provided any indication about when to expect a response. Truscott said no, and that he just received this email from Wright late last night (October 5, 2020). Ferguson said this action item will remain open. Bickford said it may be difficult to reach Hyatt because he is so busy, and Tom Kahler suggested changing Hyatt to Richard Bussanich in the new action item. Truscott said he will forward any responses from Wright or Bussanich to the HCP Policy Committees. *(Note: Truscott provided a response from Wright on October 27, 2020, which Kristi Geris distributed to the HCP Policy Committees that same day.)*

- *David Blodgett, III, will discuss with Jeff Fryer, and other staff, potential options for using the OLAFT at Priest Rapids Dam for regular trapping and tagging efforts for sockeye salmon (Item II-A).*
  This action item was already discussed above.

II. CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam

A. Discuss and Prioritize the Five Potential Alternatives (All)

John Ferguson provided a recap of the five potential alternatives identified during the HCP Policy Committees conference call on September 1, 2020, as follows:

- Alternative 1: Add additional trapping at the Wells Dam east ladder trap as needed weekly to meet the target sample size
- Alternative 2: Add additional trapping at the Wells Dam east ladder trap as needed weekly to meet the target sample size, but the need for additional sampling each year would be decided in-season by the HCP Coordinating Committees based on within-year information on estimated escapement, run timing, and environmental conditions
- Alternative 3: Add additional trapping at the Wells Dam east ladder trap as needed weekly to meet the target sample size, but only after the thermal barrier in the Okanagan River has set up
- Alternative 4: Add additional volitional trapping at the Wells Dam east ladder trap as needed weekly to meet the target sample size
- Alternative 5: Collect sockeye salmon at the OLAFT in addition to collecting fish concurrently with the Carlton Program summer Chinook salmon activities at the Wells Dam east ladder trap

David Blodgett, III, noted that each of these alternatives assume additional trapping will be needed. He said given a year without COVID-19 restrictions, which have resulted in a significant deviation from normal activities, there may be no need for additional trapping. He said the Committee should keep this in mind. Ferguson agreed and said the need for additional trapping also depends on the run size. He said essentially, the smaller the run the longer the sampling, i.e., a large summer Chinook salmon run equals a lower probability that 800 sockeye salmon can be collected due to Chinook salmon broodstock collection needs being met sooner.

Jim Craig asked when collecting summer Chinook salmon (summers), if the run is really abundant are all broodstock collected in a single day or can collection be spread out to be proportionate to the run, which might allow for more collection of sockeye salmon? Shane Bickford said the summers collection is conducted over the entire run. He said crews target a weekly quota that matches the historical run, but during a larger run crews can achieve the natural-origin collection target quicker. He said that during most weeks trapping occurs 2 days per week on Monday and Tuesday, 8 hours per day. He said he thinks Blodgett's comment is an important one. Bickford said when there is only one crew socially distancing, this slows down the processing of fish for both summer Chinook and sockeye salmon. He said having no COVID-19 restrictions allows two crews to process fish.

Ritchie Graves said he is okay with dropping the alternative he proposed regarding volitional trapping (Alternative 4). Ferguson said he views Alternative 4 as an experiment. He said he cannot say it will work, but he said the Wells HCP Policy Committee could propose to proceed with a combination of alternatives, including Alternative 4 as an experiment in the first year, to see how it goes.

Blodgett said the YN advocates for Alternative 3, based on the discussion with Jeff Fryer that this option will not affect CRITFC's analysis. Ferguson said when considering concerns about the thermal barrier and the difficulty of making in-season decisions with so many environmental changes, trying to make Alternative 2 work might be hard; therefore, he agrees it seems that Alternative 3 might be more feasible.

Cody Desautel said Alternative 3 would be the CCT's preferred alternative, and Kirk Truscott concurred. Desautel said the only other consideration is if Howie Wright or Richard Bussanich indicate the data are useless in addressing the four management actions outlined in the COBTWG letter.

Ferguson asked about trapping at the OLAFT in 2021. He asked if the Wells HCP Policy Committee and ONA support Alternative 3, does this mean continuing, reducing, or eliminating trapping at the OLAFT in 2021? Bickford said if Fryer thinks it will be useful to trap at the OLAFT this is up to him, because the OLAFT is outside the purview of the HCP. Bickford said if Fryer wants to trap at Wells

Dam, he believes Alternative 3 will support Fryer's target. Bickford said Douglas PUD supports Alternative 3.

Chad Jackson said WDFW can support Alternative 3 or Alternative 1.

Craig said USFWS also supports Alternative 3.

Graves said NMFS can support Alternative 3. He said he is still interested to know if there is anything that can be done in addition; however, he agrees Alternative 3 is a good place to start. Ferguson asked if Graves is referring to the additional information from Wright or Bussanich? Graves said yes, he is interested in hearing ONA's perspective on how Alternative 3 fits in the overall picture about fisheries management.

Ferguson summarized that the Wells HCP Policy Committee supports Alternative 3, and a question to ONA remains to be resolved about whether Alternative 3 aligns with ONA's management and model requirements. Ferguson said, as Bickford suggested, if Fryer wants to trap at the OLAFT this is up to Fryer and not this Committee. Ferguson suggested moving this discussion forward via email unless Wright or Bussanich indicate Alternative 3 will not align with ONA's requirements, and then the HCP Policy Committee can convene another conference call for further discussion.

Bickford said it seems odd for the Wells HCP Policy Committee to unanimously agree on Alternative 3 but then to defer their decision to ONA, a non-HCP party, and that depending upon ONA's answer to the question posed, could possibly put the HCP Policy Committees back into debating this issue. He said he believes if the Wells HCP Policy Committee supports Alternative 3 this should be documented, and if ONA's work needs to be changed that should be addressed within the COBTWG. He said ONA should not be able to trump the HCP Policy Committees. Ferguson thanked Bickford for this clarification and said he did not intend to suggest ONA can trump an HCP Policy Committees decision; rather, he was speaking to the outstanding action item. Ferguson agreed Wells HCP Policy Committee support of Alternative 3 should be documented for the HCP administrative record.

Blodgett said he agrees with Bickford about documenting the decision now, and he added that based on his understanding about how ONA obtains data with concurrent trapping, he does not foresee ONA having issues with Alternative 3 anyway.

Desautel said the reason behind hearing from ONA is to understand if these data are useful to them, and if not, then what would be the purpose behind additional trapping? Ferguson asked if Desautel is advocating to postpone a decision until ONA responds. Desautel said he supports voting today, but ONA's response will inform what trapping will be needed. He also reiterated that this hopefully will not be an issue during years without COVID-19 restrictions.

Graves said NMFS supports voting today, and also supports reconvening as needed based on ONA's response. He said he was not thinking this discussion was about giving ONA the ability to trump the HCP Policy Committees; rather, he just wants to be sure the HCP Policy Committees do not make an unintentional mistake about ONA's goals.

III. Statement of Agreement

A. Wells HCP Policy Committee Statement of Agreement (John Ferguson)

John Ferguson suggested drafting language for an SOA. Kristi Geris opened a blank document and typed language, as the Wells HCP Policy Committee dictated.

Chad Jackson asked if the SOA should include language that defines what a "thermal barrier" is, or if there is general agreement that temperatures of 21ºC or higher defines a thermal barrier. He noted that sometimes this varies. Shane Bickford and Tom Kahler agreed that 21ºC is generally when a migration barrier sets up. Kahler also agreed that there can be a pretty large daily swing in water temperature, but at some point, when temperatures firmly reach 22.5ºC or higher fish do not move. Cody Desautel said a thermal barrier is not only defined by temperature, but also by duration. He said water temperature can fluctuate throughout the day. Kirk Truscott agreed and said fish may slow down when temperatures reach 21ºC, but then during diurnal temperatures some fish will still move in small proportions. He suggested identifying a thermal barrier as sustained 21ºC for 12 hours or greater. Ritchie Graves asked if there is a specific temperature gage that should be referenced, and Jackson suggested using the gage at Malott, Washington[1]. Truscott noted that he only suggested 12 hours, or half a day, and he will review data from the Lower Okanogan River PIT-tag array to see what it looks like for proportional passage compared to the Malott gage.

Ferguson asked about the implementation of this SOA. Jackson suggested that Jeff Fryer notify the HCP Coordinating Committees, that based on this guidance, he believes CRITFC can engage in extra trapping days. Ferguson said, so CRITFC will sample concurrent with collection for summers for the Carlton Program, and then once the thermal barrier sets up in the Okanogan River additional sampling can occur. Desautel asked if the Malott gage reads real-time, and Jackson said it does. Truscott said he believes it reads hourly. Desautel said if there is any question then, the HCP Parties can review the temperatures, and he asked if an added step of review should be included in the SOA. Jackson suggested that Fryer send notification and HCP Parties can review the data if they want to. Jackson said it will be clear if there is thermal barrier block, per the SOA. Desautel agreed and said it is also important to not have so much process Fryer misses a trapping window. Ritchie Graves asked if Douglas PUD can monitor temperatures and send notification, since the trapping operations are

[1] U.S. Geological Survey 12447200 Okanogan River at Malott Washington gage

occurring at Wells Dam. Kahler said he can do this because he monitors temperatures every day during the sockeye salmon migration anyway, and he said the CCT also monitor temperatures daily.

Ferguson summarized that Fryer will provide a notification as to when he plans to sample sockeye salmon at Wells Dam beyond 3 days per week, per the protocols, after the thermal block sets up in the Okanogan River. Ferguson said Douglas PUD and the CCT will also be monitoring temperatures and will distribute an email[2] when it looks like the thermal block sets up, and HCP Parties can review the data and respond to the notification, if needed. Desautel said the time lag of warming water can typically be predicted, so HCP Parties can also review the forecast to see what windows are approaching.

Wells HCP Policy Committee representatives present approved the following language to finalize in a Wells HCP SOA, regarding CRITFC's annual request to tag sockeye salmon at Wells Dam: "The Wells HCP Policy Committee agrees to add additional trapping of sockeye salmon at the Wells Dam east ladder trap as needed weekly to meet the target sample size, but only after the thermal barrier in the Okanagan River has set up each year, contingent upon hearing back from ONA representatives regarding the potential for sampling after the thermal barrier sets up to affect ONA sockeye salmon management needs. For the purposes of this Agreement, "thermal block" refers to temperatures greater than or equal to 21 degrees Celsius at the U.S. Geological Survey 12447200 Okanogan River at Malott Washington gage for a period greater than or equal to 12 hours."

(Note: Following the HCP Policy Committees conference call, on October 27, 2020, the Wells HCP Coordinating Committee developed the action item, "Douglas PUD will communicate to CRITFC the discussions regarding Fryer's annual request to tag sockeye salmon at Wells Dam that took place during the HCP Policy Committees conference call on October 6, 2020 [i.e., not conducting additional sampling for sockeye salmon until a thermal barrier has set up in the Okanagan River] and during the HCP Coordinating Committees conference call on October 27, 2020 [i.e., stipulate in the next request letter, a request that sockeye salmon sampling periods are concurrent with both spring and summer Chinook salmon trapping operations]."*)*

IV. HCP Administration

A. Next Steps and Next Meetings (John Ferguson)

John Ferguson said Anchor QEA will distribute a final SOA, regarding CRITFC's annual request to tag sockeye salmon at Wells Dam, as approved by the Wells HCP Policy Committee. *(Note: Kristi Geris*

[2] *Note: this email will be distributed to the HCP Coordinating Committees Representatives, with the HCP Policy Committees Representatives copied.*

distributed the final SOA [Attachment B] following the HCP Policy Committees conference call on October 6, 2020.)

Ferguson said Anchor QEA will also distribute these draft October 6, 2020, conference call minutes for HCP Policy Committees review, and the CCT will follow-up with ONA and distribute that information. Ferguson said he does not foresee a need for another meeting at this point. He said he is glad to see the HCP Policy Committees work through a resolution to the issue, and he asked for any last comments. HCP Policy Committees representatives present expressed appreciation for the discussion and collaboration. *(Note: Ferguson will review this discussion and decision with the HCP Coordinating Committees.)*

V. List of Attachments

Attachment A List of Attendees
Attachment B Final Wells HCP Policy Committee Statement of Agreement

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Shane Bickford*	Douglas PUD
Tom Kahler	Douglas PUD
Ritchie Graves*	National Marine Fisheries Service
Jim Craig*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
David Blodgett, III*	Yakama Nation
Keely Murdoch	Yakama Nation
Cody Desautel*	Colville Confederated Tribes
Kirk Truscott	Colville Confederated Tribes

Notes:
* Denotes HCP Policy Committees representative or alternate

FINAL
Statement of Agreement

Approved October 6, 2020

The Wells HCP Policy Committee agrees to add additional trapping of sockeye salmon at the Wells Dam east ladder trap as needed weekly to meet the target sample size, but only after the thermal barrier in the Okanagan River has set up each year, contingent upon hearing back from Okanagan Nation Alliance (ONA) representatives regarding the potential for sampling after the thermal barrier sets up to affect ONA sockeye salmon management needs. For the purposes of this Agreement, ”thermal block” refers to temperatures greater than or equal to 21 degrees Celsius at the U.S. Geological Survey 12447200 Okanogan River at Malott Washington gage for a period greater than or equal to 12 hours.

Background

See HCP Policy Committees conference call minutes from September 1, 2020 and October 6, 2020.

HCP EXECUTIVE GROUP MEETING

Wells, Rocky Reach, and Rock Island HCPs

Tuesday, August 31, 2004
1:00 – 4:00
PRIME Hotel
18118 International Blvd
SeaTac, Washington

Summary Notes

I. Welcome and Introductions (Mike Schiewe, Facilitator)

See attachment A for list of attendees

II. Opening Remarks (Jeff Koenings, WDFW)

Jeff Koenings started the meeting by stating that WDFW viewed the HCP as an extremely important tool in the effort to rebuild Columbia Basin salmon, and that the hard work of implementation was still largely ahead of us. He emphasized that for a successful implementation we all need to work together.

III. Executive Group Discussion (Intro - Jeff Koenings, WDFW)

Koenings emphasized the importance of the committees and their work, noting his concern that having different chairs for the different committees was preferable.

A. Expectations for HCP Committee Chairs and Committee Members (All Executives)

What followed was an hour-long discussion in which the executives stated a variety of expectations and concerns regarding the committees and operating principles, and implementation of the HCPs. These included…

- The executives need a mechanism for regular updates and progress reports

- This is a good agreement…but just the beginning. The hard work is ahead, and the PUDs are directly accountable to their commissions for an implementation that is efficient and effective.

- There is concern that implementation will create a heavy workload on already overworked staff…and more staff might need to be involved.

- Good people have been selected as chairs; the executives need to support them and their committees in every way possible. We expect a high degree of coordination between Mike Schiewe and Bob Bugert.

- The committee chairs were selected based on the selection committee's evaluation of their abilities to get the job done. Although some executives wanted a separate chairperson for each of the three committees, it was pointed out that the coordinating committee members were comfortable with having one person for two committees.

- An action or implementation plan would be a useful product for the committees to produce and a way for the executives to track progress. However, it was pointed out that meeting minutes and the "Annual Summary of Findings" required by the HCP might be the best way to stay informed.

- The HCPs identify a very a specific committee structure and the executives support the written guidelines for how the committees will work.

- Given that the implementation phase is just starting, an early check-in and progress report in about 9 months would be useful.

B. Level of Involvement of Executives (All Executives)

- The executives want to be regularly updated on progress and agreed to meet once or twice a year to hear from the committees.

- There will be a 9-month review of the progress made toward implementation…probably at the next Executive Group Meeting

- Based on the details spelled out in the HCPs, each committee will develop an annual summary of findings for distribution to the Executive Group. The need for an action plan as well will be addressed by the Coordinating Committee.

IV. Discussion: Participation by Non-Signing Parties (Ritchie Graves, NOAA-F)

NOAA-F proposed that the Yakama Indian Nation be invited to attend and participate in committee meetings, but not vote. They indicated that this was an important mechanism for coordination and assisted NOAA in carrying out its treaty trust responsibilities. WDFW and USFWS agreed. Other signatories agreed to some level of participation in some committees, but were not ready to offer an open-ended invitation without further internal review and discussion. It was agreed that the Coordinating Committee would schedule a conference call within two weeks to see if a unanimous position could be developed.

V. Updates of FERC Process and Activities (Bob Clubb, DPUD) (Tracy Yount, CPUD)

DPUD and CPUD have requested clarification from FERC regarding the status of the Mid-Columbia Coordinating Committee. It was expected that the FERC order approving incorporation of the HCP in their licenses would have included language that eliminated the Coordinating Committee. However, the FERC order left standing the Mid-Columbia Coordinating Committee to allow for coordination between the PUDs, including Grant PUD and the agencies and tribes. It was pointed out that FERC's order approving the HCPs is in conflict with the recent order by a FERC presiding judge that terminated the Mid-Columbia proceeding for Priest Rapids, effectively dissolving the proceeding as a coordinating process between the PUDs.

CPUD indicated that the Columbia River Intertribal Fish Commission has filed a request to reopen the Chelan licenses for the purpose of making CRITFC a voting member of the HCP committees. CRITFC has asserted that this is necessary for coordination of hatchery and harvest programs under the US v Oregon settlement. FERC has indicated that they will rule on this request on October 12. CPUD would like the signatory parties to reach consensus regarding involvement of the Yakama Indian Nation (Agenda item IV) soon so that this information can be sent to FERC in time to be considered in their ruling.

VI. Concluding Comments by Members of Executive Group (Executives)

The Executive Group reiterated their desire to be kept informed of progress, and their commitment to meet 1 or 2 times per year. They will meet again in about 9 months to review progress.

Attachment A. List of attendees

Michael Schiewe	Anchor Environmental, L.L.C.
Denny Rohr	D. Rohr and Associates
Jeff Koenings	WDFW
Heather Bartlett	WDFW
Shane Bickford	Douglas PUD
Bill Dobbins	Douglas PUD
Bob Clubb	Douglas PUD
Rick Klinge	Douglas PUD
Dale Bambrick	NOAA Fisheries
Mark Miller	USFWS
Bob Bugert	Tributary Committee Chair
Christopher Fisher	Colville Tribes
Shaun Seaman	Chelan PUD
Keith Truscott	Chelan PUD
Dick Nason	Dick Nason Consulting, Inc.
Tracy Yount	Chelan PUD
Charlie Hosken	Chelan PUD
Wayne Wright	Chelan PUD
Brian Cates	USFWS
Bill Towey	Colville Tribes
Dennis Beich	WDFW
Ritchie Graves	NOAA Fisheries
Rob Walton	NOAA Fisheries
Kris Peterson	NOAA Fisheries
Keith Kirkendall	NOAA Fisheries
Terry Rabot	USFWS
Dave Allen	USFWS

Appendix E
List of Rocky Reach Habitat Conservation Plan Committees Members

Rocky Reach Mid-Columbia HCP Committees, 2020

Policy Committee

Name	Organization
John Ferguson (Chairman)	Anchor QEA, LLC
Randy Friedlander (Jan to Apr) Cody Desautel (May to Dec)	Colville Confederated Tribes
Alene Underwood	Chelan PUD
Ritchie Graves	National Marine Fisheries Service
Jim Craig	U.S. Fish and Wildlife Service
Jim Brown (Jan to Apr) Chad Jackson (Apr to Dec)	Washington Department of Fish and Wildlife
David Blodgett, III	Yakama Nation

Coordinating Committee

Name	Organization
John Ferguson (Chairman)	Anchor QEA, LLC
Kirk Truscott	Colville Confederated Tribes
Lance Keller	Chelan PUD
Scott Carlon	National Marine Fisheries Service
Jim Craig	U.S. Fish and Wildlife Service
Chad Jackson	Washington Department of Fish and Wildlife
Keely Murdoch	Yakama Nation

Hatchery Committee

Name	Organization
Tracy Hillman (Chairman)	BioAnalysts, Inc.
Kirk Truscott	Colville Confederated Tribes
Catherine Willard	Chelan PUD
Brett Farman	National Marine Fisheries Service
Matt Cooper	U.S. Fish and Wildlife Service
Mike Tonseth	Washington Department of Fish and Wildlife
Tom Scribner	Yakama Nation

Tributary Committee

Name	Organization
Tracy Hillman (Chairman)	BioAnalysts, Inc.
Chris Fisher	Colville Confederated Tribes
Catherine Willard	Chelan PUD
Justin Yeager	National Marine Fisheries Service
Kate Terrell	U.S. Fish and Wildlife Service
Jeremy Cram	Washington Department of Fish and Wildlife
Brandon Rogers	Yakama Nation

Appendix F
Statements of Agreement for Habitat Conservation Plan Coordinating Committees

Final
Rocky Reach Habitat Conservation Plan
Coordinating Committee

Statement of Agreement

Selection of Yearling Chinook and Adult Spring Chinook for Chelan PUD's 2021 Rocky Reach Confirmation Survival Study

(Approved March 24, 2020)

Agreement Statement
The Rocky Reach HCP Coordinating Committee selects yearling Chinook and adult spring Chinook for Chelan PUD's 2021 confirmation survival study of Phase III (Standard Achieved) for spring migrating Plan Species at the Rocky Reach Project. Juvenile study fish will be sourced from the Rocky Reach Juvenile Bypass System as run-of-river yearling Chinook, and returning PIT tagged adult spring Chinook will serve as adult study fish.

Background

Section 5.3.3 of the Rocky Reach HCP specifies that a designation of Phase III (Standards Achieved) shall occur for a respective species once the appropriate project survival standard has been achieved, and additional future evaluations will occur to confirm survival standards for Plan Species continues to be maintained. Section 5.3.3 specifically states: "… the District shall re-evaluate survival under the applicable standard every 10 years. Representative species shall be picked by the Coordinating Committee. This re-evaluation will occur over one year and be included in the pertinent average for that particular species. If the survival standard is met, then Phase III (Standard Achieved) status will remain." During the February meeting of the Rocky Reach HCP Coordinating Committee, yearling Chinook and adult Spring Chinook were selected as the representative species for Chelan's 2021 confirmation survival study to be compared to the 91% Combined Adult and Juvenile Survival Standard.

Final
Rocky Reach Habitat Conservation Plan
Coordinating Committee

Statement of Agreement
June 23, 2020

Deferment of the Rocky Reach Project
Confirmation Survival Study from 2021 to 2022

Agreement Statement

The Rocky Reach HCP Coordinating Committee (CC) agrees to defer for one year the 2021 Rocky Reach HCP confirmation study, to 2022, allowing Chelan PUD additional time to address trunnion bushing and servo rod seal issues in the Rocky Reach small units allowing Rocky Reach Dam to be under representative operations during the survival study confirmation.

Background

The HCP Rocky Reach Phase Designation survival studies were completed in 2011 for yearling Chinook, setting the Rocky Reach confirmation survival study to occur in 2021 (August 30, 2011 Phase Designation SOA). The goal of the HCP confirmation study is to re-evaluate survival under the applicable standard every 10 years (HCP Section 5.3.3), confirming Phase designation for HCP Plan Species under representative project operations for the next 10 years.

Beginning in January 2018, the CC was made aware of the trunnion bushing failure that occurred with unit C1, followed by a similar issue with unit C3 in February 2019 and a servo rod seal failure with unit C2 in January 2020. Engineering analysis of trunnion bushing wear shows that all of the small units in the Rocky Reach Powerhouse (C1 through C7) are experiencing accelerated trunnion bushing wear, well ahead of the manufacturer’s estimated end of life. Simultaneously and since 2013, Chelan PUD has also been repairing units C8-C11 due to servo rod cracks, with units C8 and C9 repaired to date.

The CC was notified in February 2020 that Chelan PUD would be adjusting the maintenance schedule for the Rocky Reach Powerhouse, previously structured to address one large unit and one small unit simultaneously, to a more aggressive schedule allowing for the simultaneous repair of two small units. The change was intended to allow Chelan PUD to repair trunnion bushings and servo rod seals in units C2, C7, C3, and C4, greatly increasing the powerhouse capacity and unit reliability at Rocky Reach Dam ahead of the 2021 confirmation study. In March 2020, due to the Coronavirus pandemic, the Washington State Governor issued a stay-at-home order and established social distancing requirements to prevent infection rates, resulting in all ongoing work in the Rocky Reach Powerhouse to cease for an excess of 2 months. Consequently, maintenance work on units C3 and C4 that was previously scheduled to be completed prior to the 2021 Rocky Reach HCP confirmation study now directly overlaps the scheduled confirmation study. Rescheduling the confirmation study will allow Chelan PUD to address unforeseen changes in the maintenance schedule, and allow for testing under representative project operations in 2022.

Appendix G
Statements of Agreement for Habitat Conservation Plan Hatchery Committees

There were no Statements of Agreement approved by the Rocky Reach HCP Hatchery Committee in 2020.

Appendix H
Statements of Agreement for Policy Committees

There were no Statements of Agreement approved by the Rocky Reach HCP Policy Committee in 2020.

Appendix I
2020 Rock Island and Rocky Reach HCP Action Plan

2020 Rocky Reach and Rock Island
HCP Action Plan
FINAL

COORDINATING COMMITTEE

Activity	Jan 2020	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021 RR and RI Confirmation Study Species Selection												
2021 RR and RI Confirmation Study Draft Study Design												
2020 HCP Policy Committee Meeting												
Deliver 2019 RR Bypass Evaluation Report		D	F									
Deliver 2020 RR Bypass Operations Plan		D	F									
Deliver 2019 RI Bypass Evaluation Report		D	F									
Deliver 2020 RI Bypass Operations Plan		D	F									
Update HCP CC on RR Unit Repairs												
Update HCP CC on RI PH1 B1-B4 Unit Repairs												
Pikeminnow long-line control programs		S									C	
Pikeminnow angling control programs					S					C		
Avian Predation programs				S				C				
Piscivorous Bird Monitoring				S								C
Deliver 2020 RR/RI Spill Plan			D	F								
Deliver 2020 RR/RI Spill Report									D	F		
RR 9% Summer Spill						S		C				
RI 10% Spring Spill				S				C				
RI 20% Summer Spill						S		C				
RR Juvenile Fish Bypass Operations				S				C				
RI Juvenile Bypass Trap Operations				S				C				
2019 HCP Annual Report			D	F								

HATCHERY COMMITTEE

Activity	Jan 2020	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019 Hatchery M & E Report						D			F			
2021 Hatchery M & E Implementation Plan								D		F		
Broodstock Collection Protocols	S			C								
Dryden Water Quality Monitoring (Year 8)			S						C			
Chelan Falls Broodstock Collection-Pilot Seining and Temporary Weir							S		C			
Chelan Hatchery Rehabilitation Engineering Feasibility	D											
Chiwawa Weir Maintenance Engineering Permitting	D											
Pilot Outplant adult MetComp spr Chinook to Chewuch								S	C			
Steelhead Residualism Plan - *Permit No. 18583*	D											
Implement Year 3 of 3 of the Steelhead Release Plan to inform the Steelhead Residualism Plan		S				C						
Hatchery Program Broodstock Collection					S							C
Hatchery Releases				S	C							
2020 Comprehensive Report	D											C

TRIBUTARY COMMITTEE

Activity	Jan 2020	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RR and RI Plan Species Account Annual Deposit	C											
General Salmon Fund Approval	→ Ongoing											
General Salmon Fund Implementation	→ Ongoing											
Small Project Review and Approval	→ Ongoing											
Small Project Implementation	→ Ongoing											

D = Draft Document
F = Final Document

S = Start Project
C = Complete Project

Appendix J
2020 Rocky Reach Juvenile Fish Bypass System Operations Plan

2020 Rocky Reach Juvenile Fish Bypass System Operations Plan

Final Plan

Prepared By:

Lance Keller
&
Scott Hopkins

Public Utility District No. 1 of Chelan County
P.O. Box 1231
327 North Wenatchee Avenue
Wenatchee, Washington 98801

March 2020

Introduction

The Public Utility District of Chelan County (District) constructed and installed a permanent fish bypass system (FBS) in 2002/2003. The bypass system is designed to guide juvenile salmon and steelhead away from turbine intakes at Rocky Reach Dam. The system consists of one surface collector entrance (SC) and the intake screen (IS) system in turbine units 1 and 2. Please refer to Mosey (2004) for a detailed description of the bypass production system.

Studies and data collection at the Rocky Reach FBS fall under one of two general categories “Standard Operations” or “Special Operations” for bypass evaluations. Activities and data collection under standard operations include day to day sampling of run-of-river (ROR) fish to evaluate run timing, species composition, and fish condition after passage. Special operations may include additional sampling time to supply fish for marked fish releases.

2020 Evaluation Requirements

Run-of-river fish collected at the Juvenile Sampling Facility (JSF) are used to evaluate and provide fish for the following:

1. Run timing of target species:
   a. Provide standardized juvenile capture rate data to supplement Program RealTime (UW) run-timing predictions
   b. Guide decisions about initiating summer fish spill

2. Fish species composition:
   a. Guide decisions about starting or stopping spill
      i. Currently summer fish spill occurs at Rocky Reach (9% of the daily average river flow).

3. Origin of fish stock:
   a. Fin clips/marks

4. Interrogate for tags:
   a. PIT tags
   b. Acoustic tags (sutures)

5. Fish condition:
   a. Ensure that the bypass system remains safe for migrating juvenile salmon and steelhead by evaluating:
      i. Descale: 20% or more scale loss on either side
      ii. Injury: Scratches, bruises, or hemorrhages
      iii. Mortality: Any fish dead on arrival to sampling facility

2020 Study Methods

For more information about the study methods please refer to Mosey (2004).

Standard Operations:

1. Sampling Periods (1 April to 31 August):
    a. Monday through Sunday
    b. Collections Times
        i. 30 minute maximum **(or)**
            i. 0800-0830
            ii. 0900-0930
            iii. 1000-1030
            iv. 1100-1130
        ii. Target number of fish
            i. 350 spring species
            ii. 125 summer species
2. Fish Length:
    a. Up to 100 fish of each species will be measured for fork length (mm).

3. Fish Condition:
    a. All fish of each species are examined for condition:
        i. Descale
        ii. Injury
        iii. Mortality

4. Species Composition:
    a. ROR fish collected are enumerated by species
    b. Collect data for Program RealTime to determine start and end of spill
    c. Currently summer fish spill occurs at Rocky Reach

5. Origin of fish stocks and identification of marked individuals:
    a. PIT tags
    b. Fin clips

Special Operations:

1. Marked Fish Releases (Prior 1 April):
    a. Prior to the 1 April system start-up, hatchery yearling Chinook from East Bank Hatchery will be used for marked fish releases to determine if the JFBS is causing descale, injury, or mortality.
        i. Releases will be conducted with hatchery summer Chinook prior to the 1 April start date to determine if the JFBS is working properly and to help isolate potential sources of descale, injury, and mortality.
        ii. Fish (n = 100/release) of varying sizes will be randomly selected from hatchery Chinook. Only those with no scale loss or injury will be marked.
        iii. Marked fish will be systematically released at locations upstream of the sampling screen in the bypass system and into the intake screens in C2.
        iv. If potential problems are identified, resolve problems by 1 April system start-up.

2. Marked Fish Releases (1 April to 31 August):
   a. A phased approach will be used to evaluate the descaling rate, injury rate, and mortality rate of fish passing through the bypass system. We developed a sampling protocol and threshold percentages (Table 1) for descale, injury, and mortality that will trigger study phases.
   b. Identify "ambient" rates of descale, injury, and mortality.
   c. Once the ambient rate is estimated and if further sampling shows descale problems continuing at 5%, (3% for injury, 2% for mortality) *above* ambient level for three consecutive samples.
      i. If variable rates of descale, injury, or mortality do occur between species, then collection of yearling chinook, sockeye, or steelhead may be necessary for marked releases.
      ii. Fish (n = 100/release) of varying sizes will be randomly selected at the juvenile facility and only those migrants with no scale loss or injury will be marked.
      iii. Marked fish will be systematically released at locations upstream of the sampling screen in the bypass system until the problem area is isolated.
   d. Identify circumstances when we would refer to the HCP Coordinating Committee.
   e. The District will consult with the Coordinating Committee if any abnormal fish conditions (within values outlined in Table 1) are observed in the sample population.

Table 1. Flow diagram of phased approach and threshold values for conducting marked-fish releases in the juvenile bypass system at Rocky Reach Dam *(Skalski and Townsend 2003)*

	Phase 1		**Phase 2**		**Phase 3**		**Phase 4**
Threshold		**5% initl**		**A*+5%**		**A*+15%**	
Descale	Index sampling for for descale rate	→	Mark-releases to est. ambient descale	→	In-system mark-releases to isolate descale problem	→	refer to HCP Coord. Comm.
Threshold		**3% initl**		**A*+3%**		**A*+10%**	
Injury	Index sampling for for inury rate	→	Mark-releases to est. ambient injury	→	In-system mark-releases to isolate injury problem	→	Temp. bypass shutdown refer to HCP Coord. Comm.
Threshold		**2% initl**		**A*+2%**		**A*+4%**	
Mortality	Index sampling for for mortality rate	→	Mark-releases to est ambient mortality	→	In-system mark-releases to isolate mortality problem	→	Temp. bypass shutdown refer to HCP Coord. Comm.

A* = Ambient percentage

3. Collection of Bull Trout:
    a. Document:
        i. Fork Length and weight measurements
        ii. Condition (descale, injury, or mortality)
        iii. Interrogate for PIT tags
        iv. Examine for fin clips/marks
    b. Allow to recover, then release

Daily Protocol for Fish Collection

Standard Operations:

1. Deploy sampling screen at beginning of each hour (0800, 0900, 1000, 1100 hours).
2. Use direct enumeration to count fish entering the sampling facility
3. Collect for 30 minutes **or** until approximately 350 spring migrants/125 summer migrants have been collected, whichever comes first. RETRACT SCREEN IF 200 TO 300 FISH ARE COLLECTED IN FIRST TWO MINUTES.
4. Retract screen when time period or target number of fish has been reached.
5. Determine species composition of all collected fish in the hourly sample.
6. Scan/examine each fish for PIT tags, fin clips, and acoustic tags.
7. Evaluate fish length (first 100 fish per species) and condition (all fish).
8. If needed, collect and hold fish for marked releases (Special Operations).
9. Return to step 1 for next sample period. After the 1100 hour sample, go to step 11.
10. See Special Operations (if applicable).
11. Allow anesthetized fish (examined for species composition and fish condition) to recover in the facility's holding tank for at least 1.5 hours.

Special Operations:

1. If fish are collected for marked fish releases, verify that the required number of target species has been set aside from the four sample periods.
2. If the required number of fish are not collected by the 1100 hour sample period, deploy the sampling screen and repeat steps 2 and 4 under standard operations.
3. Scan/check all anesthetized fish for PIT and acoustic tags.
4. Collect and hold fish at the facility for transport and/or marking (marked fish releases).
5. Determine species composition for any remaining anesthetized fish and scan for PIT tags.
6. After fish have been collected to meet study needs, estimate the number of fish remaining in the raceway (by species to the extent practical), record the number, and immediately release the fish back into the bypass pipe.
7. Return to step 11 under Standard Operations.

Contingencies:

1. If, after start-up of the bypass system, we encounter any unforeseen problem(s) with fish collection, we will immediately consult with the HCP Coordinating Committee on how to correct the problem(s).
2. If we accumulate many fish during a collection period (e.g. just after a hatchery release), we will only handle/sample the number of fish needed to satisfy the study requirements and then immediately release the remaining fish back into the bypass pipe.

Alternative Operations Due to Unit 2 Outage

Unit 2 is expected to be inoperable for the majority of the 2020 RR FBS season to address blade servo rod seal issues. With Unit 2 inoperable, the surface collector will utilize three additional pumps to increase the attraction flow at the entrances from 6,000 cfs to 6,660 cfs (3,330 cfs per entrance). The soft-limit set point for Unit 2 operation will be increased from 12.2 kcfs to 15.2 kcfs. These operations were implemented in 2019 with Unit 1, and no negative effects to fish collection or fish health were observed.

Diversion Screen and Trashrack Cleaning (Unit 1):

During the last week of March, the trashracks in front of Unit 1 (three intakes total) will be cleaned by divers and clammed to remove any dislodged debris. The trash rack cleaning will be repeated as differentials increase across the racks due to debris load. A mid-season cleaning will be scheduled in June. Starting 1 April, the vertical barrier and diversion screens (IS system) will be cleaned one to two times per week or as needed with an automated screen cleaner. Careful observation of trash build up will also be monitored and the screens will be cleaned on a more regular basis if warranted. Frequency of the cleanings may increase depending on debris load during spring run-off and aquatic plant load in the summer. The District will log each screen cleaning, and in the event of high descaling/injury in a single sample, the vertical barrier and diversion screens will be inspected prior to releasing marked fish.

Discussion

The 2020 biological studies at Rocky Reach will encompass the following: 1) a continuing evaluation of the juvenile bypass system, and 2) a daily sampling program to monitor fish passage for run timing. Representatives of various research agencies and the HCP Coordinating Committee will be consulted about the development of detailed study plans and protocols. A time line showing important activities and deadlines for these activities has been developed and is presented in Table 2.

Table 2. Tasks and deadlines for the Rocky Reach 2020 biological evaluations.

Task	Deadline
Present 2020 study plan to Committee	**Winter 2019-2020**
Committee discussion/comments on study plan	**Feb. 25, 2020-Mar. 25, 2020**
Pre-season JFB operations testing (marked fish releases prior to 1 April)	March 23, 2020-March 31, 2020
Begin biological evaluation of JFB	April 1, 2020
Complete 2020 biological evaluation	August 31, 2020
Present 2020 evaluation report to Committee	**December 31, 2020**
Committee comments on 2020 report	**February 1, 2021**
Present 2020 report to Committee	March 1, 2021

****Tasks printed in bold text require action by the HCP Coordinating Committee.**

References

Mosey, T. R., S. L. Hemstrom, and J. R. Skalski. 2004. Study Plan for the Biological Evaluation for the Rocky Reach Fish Bypass System-2004. Chelan County Public Utility District, Wenatchee, Washington.

Skalski, J. R., and R. L. Townsend. 2003. Protocol for conducting marked-releases in the bypass system at Rocky Reach Dam. Prepared for Chuck Peven and Thad Mosey, Chelan County Public Utility District. Columbia Basin Research School of Aquatic and Fishery Sciences, University of Washington.

Appendix K
2020 Rocky Reach and Rock Island Fish Spill Plan

2020 Fish Spill Plan

Rock Island and Rocky Reach Dams

Public Utility District No. 1 of Chelan County

Prepared By:

Thad Mosey
Fisheries Biologist

Public Utility District No. 1 of Chelan County
Wenatchee, Washington

Final
March 24, 2020

Introduction and Summary

In 2020, Public Utility No. 1 of Chelan County (Chelan PUD) will implement spill operations for fish passage at the Rock Island and Rocky Reach and projects. Spill timing and spill percentages are specified by the anadromous Habitat Conservation Plans (HCP) for each respective project. Chelan PUD conducted juvenile project survival studies from 2002 through 2011 at Rocky Reach and Rock Island under varying spill levels in order to achieve HCP survival standards. The Rock Island Project completed multiple survival studies over a nine year period (17 total studies) for spring migrating Plan Species (yearling Chinook, steelhead, sockeye), first using a 20 percent spill level, then a 10 percent spill level. Rock Island will continue to spill 10 percent of day average flow during the spring outmigration period through at least year 2021. The Rocky Reach Project completed its suite of HCP survival studies for spring migrating Plan Species in 2011 (14 studies), under spill and no-spill operation at the dam. HCP juvenile survival standards were achieved for species tested with a no spill operation (yearling Chinook, steelhead, sockeye). Project spill levels are summarized in Tables 2 and 4 of this plan. Chelan PUD holds valid Incidental Take Statements (ITS) from National Oceanic and Atmospheric Administration Fisheries (NOAA) and the United States Fish and Wildlife Service (USFWS) for HCP fish spill operations at Rocky Reach and Rock Island dams.

For the 2020 juvenile outmigration, Chelan PUD will operate the Rocky Reach juvenile fish bypass system (JFBS) starting 1 April for the spring juvenile outmigration of yearling Chinook, steelhead, and sockeye. Spring spill at Rocky Reach Dam will consist of hydraulic spill for reservoir control only. HCP Project survival standards were achieved with bypass-only operations. During the subyearling Chinook outmigration in 2020, Rocky Reach will spill 9 percent of day average river flow for a duration covering 95 percent of subyearling outmigration past the dam.

At Rock Island Dam in 2020, Chelan PUD will operate the Project with a 10 percent day-average spill level for the spring outmigration period. Rock Island has also completed HCP spring Plan Species survival testing for all Plan Species with a 10 percent spill level at the dam and has achieved juvenile survival standards for yearling Chinook, steelhead and sockeye and combined adult-juvenile survival for all three species.

During the summer period in 2020, Rock Island Dam will spill 20 percent of the day-average river flow for the outmigration of subyearling (summer) Chinook. Spill is the primary means of juvenile salmon and steelhead passage at Rock Island per Section 5.4.1(a) of the Rock Island HCP. Spring and summer spill will cover 95 percent of the juvenile fish outmigration for yearling/subyearling Chinook, steelhead, and sockeye in 2020.

Rocky Reach Juvenile Fish Bypass Operations

Rocky Reach will operate its JFBS continuously through the spring outmigration period, beginning 1 April 2020. Daily index sampling (for steelhead, yearling Chinook, and sockeye) will be performed at the bypass sampling facility to estimate the outmigration percentiles for each species through the spring period. During "index sampling" each day, a total of four 30-minute samples (Table 1) will be taken beginning at the top of each hour, 0800 to 1100 hours. Spring spill for fish passage is not required at Rocky Reach, but periods of forced spill may occur under high river flows. Some level of forced spill (river flow above 201 kcfs turbine capacity) normally occurs at Rocky Reach in the spring. Over the past 20 years, forced spill has occurred approximately 28 percent of all hours, April through June. With the projected repair/rehabilitation work on turbine units 2 and 7 this summer, instances of forced spill may occur more frequently in late spring/early summer 2020 due to reduced turbine or powerhouse capacity.

Sampling protocols at the Rocky Reach bypass system in 2020 will remain consistent with those used in 2004-2019. Daily sampling in spring and summer periods (Monday through Sunday) will use four 30-minute "index periods" at 0800, 0900, 1000, and 1100 hours (Table 1). The sample target for each 30-minute sample will be 350 smolts during the spring period (yearling Chinook, steelhead, and sockeye combined), and 125 smolts for summer period (subyearling Chinook). If the number of fish collected in the bypass sampling raceway is estimated to reach the maximum number prior to completion of the 30-minute sample, the sampling screen will be retracted from the bypass conduit, and the number of fish collected in the shortened sample period will be proportionately expanded to the entire 30-minute period.

Table 1. Index sampling times at the Rocky Reach juvenile fish bypass and the number of smolts per sample. Sample times and sample targets have remained consistent since 2004.

Time	Sample Duration	Number of Smolts	Day of Week
08:00-08:30	30 minutes*	350 (spring) 125 (summer)	Monday-Sunday
09:00-09:30	30 minutes*	350 (spring) 125 (summer)	Monday-Sunday
10:00-10:30	30 minutes*	350 (spring) 125 (summer)	Monday-Sunday
11:00-11:30	30 minutes*	350 (spring) 125 (summer)	Monday-Sunday

*Sample duration may be less than 30 minutes if smolt numbers are met prior to full 30-minute sample time

Rocky Reach 2020 Summer Spill Operations

Rocky Reach Dam will spill 9 percent of the estimated day average river flow for the subyearling Chinook outmigration (Table 2). Spill will commence in late May to early June upon arrival of subyearling Chinook smolts in the Rocky Reach bypass samples. Juvenile run-timing information at Rocky Reach will be used to estimate subyearling Chinook passage percentiles (from the University of Washington's Program RealTime run forecaster) and guide spill operations to cover 95 percent of the summer outmigration. Actual subyearling counts in combination with juvenile passage estimates from the University of Washington's Program RealTime run forecaster will determine start and stop dates for the summer spill program.

The HCP guidelines for starting and ending summer spill at Rocky Reach are as follows:

1. Summer spill will start at midnight no later than the day on which the estimated 1-percentile passage point is reached, as indicated by Program RealTime run-forecast model. Subyearling Chinook will be defined as any Chinook having a fork length from 76 to 150 mm.

2. Summer spill season will generally end no later than 15 August, but not until subyearling index counts from the juvenile bypass sampling facility are 0.3 percent or less of the cumulative run for three out of any five consecutive days (same protocol used 2004-2019) and Program RealTime is estimating that the 95th percentile passage point has been reached. In addition, spill operations must cover at least 95% of the subyearling outmigration

Diel Spill Shaping at Rocky Reach and Rock Island Dams

Daily spill volumes will be shaped within each 24-hour period at Rocky Reach Dam during the summer spill period, and at Rock Island Dam during both spring and summer spill periods (Tables 2 and 4).

Spill-shaping attempts to optimize spill water volume to maximize spill passage effectiveness for smolts. The diel spill shape functions to provide either higher or lower spill volume during periods of either higher or lower fish passage. Spill-shaping is based on the observed diel (24-hour) passage distributions of smolts at each project during spring and summer (Steig et al. 2009, Steig et al. 2010, Skalski et al. 2008, Skalski et al. 2010, Skalski et al. 2011, Skalski et al. 2012). The different spill percentages and time blocks are shaped such that the summation of water volume from all time blocks within the day equals the volume of water that would have been spilled under a constant, unshaped spill level (i.e. spill at 9 percent day-average river flow at Rocky Reach with no shaping). The hourly spill shape in 2020 will remain consistent with previous years, 2004-2019. Spill gates 2 through 8 will be used to meet daily spill percentage targets.

Table 2. Fish spill percentages and spill shape for the Rocky Reach spill program, 2020.

Project	Season	Daily Spill Average	Within-Day Spill Levels	Duration (# of hours each day)	Hourly Blocks of Spill	Spill Shape %
Rocky Reach	Spring	none	--	--	--	--
Rocky Reach	Summer*	9%	Med	1	0000-0100	9.0
			Low	6	0100-0700	6.0
			Med	2	0700-0900	9.0
			High	6	0900-1500	12.0
			Med	9	1500-2400	9.0

*Spill for subyearling Chinook

2020 Run-Timing Predictions

Chelan PUD contracts with the University of Washington (UW) to provide run-timing predictions and year-end observed values for spring and summer out-migrating percentiles for salmon and steelhead. UW's Program RealTime run-time forecasting model is used for this purpose. Program Real-Time provides daily forecasts and cumulative passage percentiles for steelhead, yearling/subyearling Chinook and sockeye at both Rocky Reach and Rock Island dams. This program enables Chelan PUD to better predict the time when a selected percentage of these species will arrive, and when a given percentage of any stock has passed. The program utilizes daily fish counts from the Rocky Reach bypass sampling facility and the juvenile fish bypass trap at Rock Island Dam. Estimates of passage percentiles are generated with the model's forecast error and are displayed with the daily predictions at:

http://www.cbr.washington.edu/crisprt/

Historic Run Timing

Estimated mean passage dates (first percentile to the 95th percentile) for each species at Rocky Reach and Rock Island dams are summarized in Table 3. Run-timing dates are estimated from daily index sample counts at the Rocky Reach JFBS (2004-2019), and from the Rock Island bypass trap, (2002-2019). At Rocky Reach Dam, the subyearling Chinook run generally begins the last week of May, with the one-percentile passage date on 31 May (mean date for years 2004-2019). Rocky Reach subyearling passage reaches the 95th percentile, on average, around 6 August (2004-2019, range: 21 July to 24 August).

Rock Island Dam juvenile salmon and steelhead sampling from the Smolt Monitoring Program (SMP; 2002-2019) indicates that the first percentile (one-percent passage) mean passage date for combined spring migrants (yearling Chinook, steelhead, and sockeye) occurs around 18 April (Table 3). The latest start date for spring spill at Rock Island Dam per the HCP is 17 April. The summer outmigration of subyearling Chinook smolts at Rock Island Dam generally begins in early June (although fry are encountered earlier), and on average, reaches the 95th percentile passage point around 6 August (range: 22 July to 19 August, 2002-2019).

Table 3. Spill percentages, bypass operation dates, and mean passage percentile dates (2002-2019) for the 1st and 95th percentile passage points for HCP spring and summer outmigrants at Rocky Reach and Rock Island dams.

Rocky Reach	**steelhead**	**yearling Chinook**	**sockeye**	**subyearling Chinook**
Percent Spill	0% Spring	0% Spring	0% Spring	9% Summer
1st, 95th percentile Passage Dates	4/16, 5/30	4/15, 5/27	5/5, 5/24	5/31, 8/6
RR Bypass System Operation	4/1 – 8/31	4/1 – 8/31	4/1 – 8/31	4/1 – 8/31
Rock Island	**steelhead**	**yearling Chinook**	**sockeye**	**subyearling Chinook**
Percent Spill	10% Spring	10% Spring	10% Spring	20% Summer
1st, 95th percentile Passage Dates	4/22, 6/7	4/15, 5/31	4/16, 6/4	6/2, 8/6
RI Bypass Trap Operation	4/1 - 8/31	4/1 - 8/31	4/1 - 8/31	4/1 - 8/31

Source - Rock Island: http://www.cbr.washington.edu/crisprt/index_midcol2_pi.html

Source- Rocky Reach: http://www.cbr.washington.edu/crisprt/index_midcol2_che.html

Rock Island 2020 Spring Spill Operations

In 2020, Rock Island Dam will spill 10 percent of the estimated day average river flow starting no later than 17 April and will end spill after 95 percent of spring outmigrants have passed the dam (usually the first week of June), with spill being provided for at least 95% of the spring species outmigration. Spill volume will be shaped to maximize spill efficiency (Table 4). Chelan PUD personnel will operate the Rock Island bypass trap, an upper Columbia SMP site, continuously from 1 April through 31 August (seven days per week) to provide daily smolt counts. Index counts will provide the basis to determine the start and end of the spring and summer outmigration periods. The HCP guidelines to start and end the spring spill program at Rock Island Dam are as follows:

1. The Rock Island spring spill program will begin when the daily smolt passage index count exceeds 400 fish for more than 3 days (this corresponds to the approximately 5 percent passage date), or no later than 17-April, as outlined in Section 5.4.1. (a) of the Rock Island HCP.

2. Rock Island spring spill will end 1) following completion of the spring outmigration (95 percent passage point), and 2) when subyearling (summer) Chinook have arrived at the Project.

Operators will utilize the following spill gate sequence to meet daily spill percentage targets in 2020: 32, 31, 30, 1, 16, 24, 29, 27*, 19*, 20, 22, 6, 7, and 8.

*Gates 18 and 26 will be converted to full-gate function prior to the spring spill season and remain as full-gates through the 2020 fish spill season, and due to this conversion, adjacent automatic gates 27 and 19 will be the first full gates to be utilized in the gate sequence. The extended conversion period is needed due to a crack in the spillway near spill gates 1 and 2 which will limit their usage for headwater control during increased river flows. The full gates at 18 and 26 will temporarily allow for the lost capacity of gates 1 and 2 and will help with emergency spill response for events beyond just spring runoff. The plant will either install automatic operators on spill gates 17 and 25, or repair the crack in the spillway by early 2021. Either action will result in providing the spill capacity needed to eliminate the need for the extended conversion of gates 18 and 26 to full-gate function through an entire fish spill season beyond 2020. In 2021, gates 18 and 26 will be converted to full-gate function during the spring runoff period **only** as they were in 2018 and 2019.

Rock Island 2020 Summer Spill Operations

Rock Island will spill 20 percent of the estimated daily average river flow for a duration covering 95 percent of the summer outmigration of subyearling Chinook. Daily smolt counts from the Rock Island bypass trap will inform decisions on when to start and stop spill. The HCP guidelines to start and stop summer spill at Rock Island Dam are outlined as follows:

1. Rock Island summer spill in 2020 will begin immediately after completion of the spring spill. The summer spill level will be 20 percent of day average flow, shaped to increase spill efficiency. Spill will continue for a duration covering 95 percent of the subyearling Chinook outmigration.

2. Summer spill will generally end no later than 15 August, or when subyearling Chinook counts from the Rock Island trap are 0.3 percent or less of the cumulative run total for three out of any five consecutive days, and UW's Program RealTime is estimating 95 percent run completion (same protocol used in 2004-2019).

Operators will utilize the following spill gate sequence to meet daily spill percentage targets in 2020: 32, 31, 30, 1, 16, 24, 29, 27*, 19*, 20, 22, 6, 7, and 8.

*Gates 18 and 26 will be converted to full-gate function prior to the spring spill season and remain as full-gates through the 2020 fish spill season, and due to this conversion, adjacent automatic gates 27 and 19 will be the first full gates to be utilized in the gate sequence. The extended conversion period is needed due to a crack in the spillway near spill gates 1 and 2 which will limit their usage for headwater control during increased river flows. The full gates at 18 and 26 will temporarily allow for the lost capacity of gates 1 and 2 and will help with emergency spill response for events beyond just spring runoff. The plant will either install automatic operators on spill gates 17 and 25, or repair the crack in the spillway by early 2021. Either action will result in providing the spill capacity needed to eliminate the need for the extended conversion of gates 18 and 26 to full-gate function through an entire fish spill season beyond 2020. In 2021, gates 18 and 26 will be converted to full-gate function during the spring runoff period **only** as they were in 2018 and 2019.

Table 4. Spill percentages and hourly spill shape for the Rock Island spring and summer fish spill program, 2019.

Project/Season	Daily Spill Average	With-in Day Spill Levels	Duration (# of hours each day)	Hourly Blocks of Spill	Spill Shape %
Rock Island Spring*	10%	High	4	0000-0400	12.5
		Med	3	0400-0700	10.0
		Low	5	0700-1200	6.0
		Med	8	1200-2000	10.0
		High	4	2000-2400	12.5
Rock Island Summer**	20%	High	1	0000-0100	23.0
		Med	1	0100-0200	19.0
		low	8	0200-1000	15.0
		Med	1	1000-1100	19.0
		High	13	1100-2400	23.0

*Spring spill for yearling Chinook, steelhead, and sockeye; **summer spill for subyearling Chinook.

Spill Program Communication

Chelan PUD's HCP representative will notify the HCPCC not less than once per week when fish passage numbers indicate that specific triggers for starting or stopping spill are likely to occur in the immediate future. Chelan PUD will notify the HCPCC regarding any unforeseen issues that pertain to the spill program as the season progresses. Communications with the HCPCC on spill information will generally be made by email, pre-scheduled conference calls, and HCPCC monthly meetings.

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Appendix L
2019 Biological Evaluation of the Rocky Reach Juvenile Fish Bypass System Final Report

2019
Biological Evaluation of the
Rocky Reach Juvenile Fish Bypass System

Final Report

Steelhead *(Oncorhynchus mykiss)* Chelan County PUD, Juvenile Bypass Facility, 2004.

Chelan County Public Utility District #1
Wenatchee, Washington

By

Scott A. Hopkins

March 2020

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Glossary of Abbreviations, Acronyms, and Terms

	Acoustic Tag. A surgically implanted device that offers an efficient means of remotely tracking fish in three dimensions with sub-meter resolution.
BC	Bypass Conduit. Fish transportation pipe that includes all fish conveyance structures (pipe, flumes, channels, and outfall) downstream of the ring-follower gates on the forebay wall to the discharge point in the tailrace.
	Diversion Screen. The inclined section of the intake screen system, extending from the bottom of the VBS used to divert fish from water entering the turbine intake.
FBE	Fish Bypass Efficiency. The percentage of fish passing the project through the fish bypass system (surface collector and screens).
FPE	Fish Passage Efficiency. The percentage of fish passing the project through non-turbine routes.
IS	Intake screen. The combined diversion screen and vertical barrier screen system installed in a turbine intake to divert fish from the flow entering the turbine.
ISS	Intake Screen System. Screens (diversion and vertical barrier) and associated screen cleaner, bulkheads, closures, roof seals, weir boxes, slide gates, and controls which are found within the turbine intakes of units 1 and 2.
JFBS	Juvenile Fish Bypass System. The overall fish bypass system consisting of the surface collector and the intake screen system.
JSF	Juvenile Sampling Facility. A structure that includes conduits, channels, a raceway, pumping equipment, and systems used for fish monitoring and sampling activities.
PIT	Passive Integrated Transponder. Small radio frequency tags with unique identification codes that are injected into fish for identification at specific monitoring locations after releases.
ROR	Run of River. Used in reference to actively outmigrating smolts that are captured at the JSF.
SC	Surface Collector. A structure positioned in the forebay to collect juvenile salmon and steelhead from surface flows, before the flows dive and enter a turbine intake. The structure includes components such as an entrance, dewatering screens, weir box, and transportation channel.
VBS	Vertical Barrier Screen. The vertical section of the intake screen.

Summary

The District constructed and installed a permanent bypass system from September 2002 to March 2003. The system consists of one surface collector (SC) and the intake screen system (ISS) in turbine units 1 and 2. Flow through the current SC entrance is designed for 6 thousand cubic feet per second (kcfs). For additional information referring to the construction and configuration of the juvenile fish bypass system, please refer to the *Biological Evaluation of the Rocky Reach Juvenile Fish Bypass System 2005* (Schoolcraft and Mosey 2006).

Multiple studies were conducted during the 2019 biological evaluation. The first priority and primary goal was to assure that the system was safe for fish prior to and during the juvenile outmigration. Marked fish releases with hatchery spring Chinook Salmon yearlings were conducted in late March to verify that the system was working properly and to locate any areas where descale, injury, and mortality might occur. The District's goal was to find and immediately repair any problems prior to the 1 April start date. Ongoing sampling at the juvenile sampling facility (JSF) occurred throughout the outmigration to: 1) assure that the system remained safe for migrating juveniles and 2) provide standardized juvenile fish capture rate data to supplement Program RealTime's (University of Washington) run-timing predictions at Rocky Reach. The bypass capture rate, along with Program RealTime and species composition data, guided decisions about initiating 2019 operations for the timing of summer fish spill.

A total of 44,213 juvenile salmonids and steelhead were collected during the 2019 sampling season; 28,124 fish were collected in the spring (1 April to 1 June) and 16,089 fish were collected in the summer (2 June to 31 August). The season-wide species composition for 2019 is as follows: 19.8% yearling Chinook Salmon (*Oncorhynchus tshawytscha*), 32.1% subyearling Chinook Salmon (*O. tshawytscha*), 7.5% steelhead (*O. mykiss*), 34.2% Sockeye Salmon (*O. nerka*), and 6.4% Coho Salmon (*O. kisutch*).

The season-wide estimates for all species in 2019 for descale, injury, and mortality are as follows: descale (0.16%), injury (0.29%), and mortality (0.03%). None of the three metrics (descale, injury, mortality) exceeded the critical thresholds over three consecutive days of sampling and no marked fish releases through the bypass system were required during bypass operations in 2019.

Introduction

In 2019, the Rocky Reach juvenile fish bypass system (JFBS) began operation on 1 April. The Chelan County Public Utility District (District) used the JSF for monitoring the physical condition of fish and species composition. The District also used the facility to evaluate seasonal run timing for target species. For additional history and developmental test of the juvenile fish bypass system, please refer to Schoolcraft and Mosey (2006).

Juvenile salmonids were routinely sampled to determine run timing and to visually examine fish for any descale, injury, and mortality. Species that were monitored on a daily basis during the 2019 out-migration for species composition and species condition included yearling and subyearling Chinook Salmon, steelhead, Sockeye Salmon, and Coho Salmon.

Major objectives for the 2019 biological evaluations were:

- to examine the daily species composition of fish using the JFBS
- to use bypass capture rate data, along with Program RealTime and species composition data to guide decisions about initiating 2019 operations for the timing of summer fish spill (Mosey, 2019), and
- to evaluate the physical condition of fish using the JFBS.

Materials and Methods

<u>Guidance Equipment</u>

Surface Collector (SC)
The SC is located in the cul-de-sac of Rocky Reach Dam, adjacent to the forebay wall and generating units 1, 2, and 3. The SC consists of three major subparts: entrance, dewatering and passage channels, and pump station (Figures 1 and 2). These components were designed to meet specific hydraulic performance criteria which provided for collection of outmigrating juvenile fish. For more detail about SC configuration and operations, please refer to Schoolcraft and Mosey (2006).

Intake Screen System (ISS) – Units 1 & 2
The ISS encompasses the intake screens in Generating Units 1 and 2 (Figure 3). This system is designed to guide fish that have been drawn into the intakes up into the gate well slot for collection. For more detail about ISS configuration and operations, please refer to Schoolcraft and Mosey (2006).

Debris accumulations on the diversion and Vertical Barrier Screens (VBS) were monitored by measuring head loss across the screens and by visual observations with an underwater camera. The screens in Units 1 and 2 were cleaned by an automated screen cleaner system.

Juvenile Fish Bypass System Operations

SC and ISS operations for the JFBS began on 1 April and continued through 31 August 2019.

Sampling Protocol
Sampling at the juvenile collection facility began on 1 April 2019. Juvenile salmonids were primarily collected during four 30 minute periods each day (7 days/week). In 2019, no collections were performed outside of the primary collection period (0800 to 1100 hours). In previous years, collections have taken place outside of the aforementioned periods to collect fish for daily acoustic tagging survival studies. The juvenile facility was routinely monitored to avoid collecting and holding more fish than necessary. The length of time needed to collect adequate numbers of fish for District studies varied depending on the number of spring migrants in the river. The collection and sampling schedules conformed to the schedules developed for acoustic tag evaluations and descale and injury evaluations. Please refer to Schoolcraft and Mosey (2006) to review the procedure for handling and sampling fish at the juvenile facility.

In 2019, collections occurred every day from 1 April to 31 August. There were no missed collections during the sampling season in 2019.

Species Composition
The primary collection period was used as the index to estimate daily run timing for each species. Sampling occurred seven days a week, April through August.

Run-of-River Fish Condition Evaluations
Fish that entered the JFBS were routinely monitored for descale, injury, and mortality from 1 April to 31 August. Please refer to Pacific States Marine Fisheries Commission (2003) for classification of descale and injury guidelines. Fish condition evaluations were conducted by trained surface collector personnel to maintain consistency in interpretations. All fish from species of interest were examined from each day's primary collection period.

Marked Fish Condition Evaluations
To determine if the JFBS was causing descale, injury, or mortality prior to system start-up on 1 April, hatchery fish were marked with either a right or left ventral fin clip and released into the bypass system at established release sites. Only fish with no previous descale or injury were used in these evaluations. Upon recapture, marked fish were re-examined and levels of descale, injury, and mortality were summarized using the same guidelines and procedures as described above for ROR condition evaluations.

The three locations for marked fish releases in 2019 included: 1) the SC north channel upstream from trashrack, 2) the SC south channel upstream of trashrack, and 3) Unit C-2. A test release for Unit C-1 was not performed in 2019 as the unit was down for maintenance for the entirety of the 2019 sampling season. Releases were conducted with hatchery spring chinook prior to the 1 April start date to determine if the JFBS was working properly and to help isolate potential sources of descale, injury, and mortality. Divers were deployed to investigate the cause of low recapture rates for the Unit C-2 release. They determined they vertical barrier screens did not engage into the proper alignment. The VBS were reinstalled and testing for Unit C-2 was repeated. Routine marked fish releases were not done after initial evaluations and were not resumed because the percentage of descale, injury or mortality never exceeded the levels established in the 2004 Rocky Reach study plan for the biological evaluation (Mosey et al. 2004).

Results

Hydraulic Conditions

Juvenile Fish Bypass System (JFBS) Flows
The 24-hr average entrance flows for the SC (both channels) and ISS weir box flows (combined flow for the 12 weirs) are presented in Appendix A along with river temperatures. Actual SC entrance flow at the North Channel averaged 3,167.0 cfs and flow at the south channel averaged 3,098.9 cfs; ISS collection flow averaged 55.0 cfs from 1 April to 31 August. Flows through the ISS were below historic average flows due to the unavailability of Unit C-1 during maintenance.

Juvenile Fish Bypass System (JFBS) Sampling

Overview of 2019 JFBS Operations
The SC and ISS operated throughout the season, except when they were temporarily shut down for repairs or debris removal. Unit 2 intake screens were cleaned with an automated screen cleaner. The unit was not shut down while the intake screens were cleaned, however a reduction in load (15.2 kcfs to 7.0 kcfs) was necessary to move the screen cleaner across the screens. As the amount of debris increased with spring runoff and growth of milfoil, frequency of cleaning was adjusted accordingly to keep up with the influx of debris. The JFBS was monitored 24-hours/7-days a week for debris build-up on the SC trash racks, SC dewatering screens and turbine unit intake screens. Racks, screens, gates and pipes were cleaned daily as needed by District bypass attendants. When high differentials were observed at the trashracks in Unit 2, an outage period of 5 to 6 hours was usually required for divers to manually remove debris from the trashracks.

Species Composition
A total of 44,213 fish were collected during the 2019 sampling season; 28,124 fish were collected in the spring (1 April to 1 June) and 16,089 fish were collected in the summer (2 June to 31 August). The season-wide species composition for 2019 was as follows: 19.8% yearling Chinook Salmon, 32.1% subyearling Chinook Salmon, 7.5% steelhead, 34.2% Sockeye Salmon, and 6.4% Coho Salmon (Figure 4). For the entire 2019 outmigration, the collection of fish from the JFBS for the biological evaluation took approximately 284 hours. Species composition of smolts in daily samples is summarized for the spring and summer study periods in Appendix B. In general, yearling Chinook Salmon and Sockeye Salmon were the predominant species captured during April into early June. Steelhead and Coho Salmon migrated through Rocky Reach Dam in early April through late May. Subyearling Chinook Salmon were the dominant species collected in June through the end of August comprising 87.7% of the daily totals during the summer months. Proportions of adipose-clipped salmonids sampled at Rocky Reach Dam (2003-2019) are summarized in Table 1, and daily adipose-clipped rates can be found in appendix B.

Table 1. Proportions of adipose-clipped juvenile salmonids sampled at the Rocky Reach JSF from 2003-2019.

Percent of Adipose-Clipped Fish Sampled					
Year	**Chinook Yearlings**	**Chinook Subyearlings**	**Steelhead**	**Sockeye**	**Coho**
2019	81.2%	47.6%	76.5%	0.0%	0.4%
2018	84.9%	51.4%	55.2%	0.0%	0.0%
2017	87.6%	29.1%	58.1%	0.1%	0.2%
2016	91.8%	34.7%	34.9%	0.0%	0.3%
2015	91.6%	30.5%	68.5%	0.0%	1.2%
2014	88.8%	37.7%	51.8%	0.0%	0.3%
2013	84.8%	15.2%	62.6%	0.1%	0.0%
2012	75.4%	65.4%	52.5%	1.0%	6.7%
2011	74.2%	47.3%	56.5%	2.9%	0.3%
2010	76.7%	28.9%	60.1%	0.03%	0.1%
2009	86.3%	34.6%	66.0%	0.1%	0.1%
2008	79.9%	29.0%	70.6%	2.1%	1.7%
2007	82.9%	43.1%	62.6%	0.01%	0.4%
2006	79.7%	22.9%	47.4%	0.7%	2.4%
2005	78.9%	27.9%	60.7%	3.3%	1.1%
2004	70.8%	18.7%	59.0%	0.1%	1.1%
2003	59.5%	9.4%	76.7%	0.2%	0.5%
Average	**80.9%**	**33.7%**	**60.0%**	**0.6%**	**1.0%**

During both the spring and summer migration, salmonid species were the primary species captured. During the migration seasons, other 'resident' fishes were captured, including Chiselmouth (*Acrocheilus alutaceus*), Peamouth *(Mylocheilus caurinus)*, Northern Pikeminnow (*Ptychocheilus oregonensis)*, Mountain Whitefish (*Prosopium williamsoni*), Redside Shiners (*Richardsonius balteatus*), Smallmouth Bass (*Micropterus dolomieu*), bullhead species (*Ameiurus sp*.), Threespine Sticklebacks (*Gasterosteus aculeatus)*, sucker species (*Catostomas sp*.), Rainbow Trout (*Oncorhynchus mykiss*), kokanee (*Oncorhynchus nerka*), and Bluegill (*Lepomis marcochirus*).

Other resident fish of special interest include juvenile and adult Pacific Lamprey (*Entosphenus tridentatus*), White Sturgeon (*Acipenser transmontanus*), and Bull Trout (*Salvelinus confluentus*). During 2019, a total of 23 juvenile Pacific Lamprey (22 migratory, one non-migratory) and five adult Pacific Lamprey were collected. The adult lamprey were released upstream near Lincoln Rock Park. There were also two White Sturgeon collected. No Bull Trout were collected in 2019. Any fish that were exposed to anesthesia were allowed to recover for 2 hours before being released (Appendix C).

Run-of-River Fish Condition Evaluations

Yearling and subyearling Chinook Salmon, steelhead, Sockeye Salmon, and Coho Salmon were collected at the juvenile facility from the JFBS and routinely inspected for descale, injury and mortality. The results from daily samples are reported in Appendix D. The District, with guidance from the Habitat Conservation Plan Coordinating Committee (HCPCC), set descale, injury, and mortality critical threshold levels at 5%, 3% and 2%, respectively. For more information about the threshold levels for fish condition, please refer to Schoolcraft and Mosey (2006). Descale estimates for combined species was below 0.2% in 2019. Figure 5 compares the season-wide descale percentage for each species from 2010 to 2019.

Injury is characterized by lacerations or bruises occurring to any part of the head or body. These types of injuries as well as severe descaling can lead to mortality. Injury estimates for combined species was below 0.3% in 2019. Figure 6 compares the season-wide injury percentage for each species from 2010-2019.

Mortalities collected during the spring and summer sampling were categorized as being *river*, *facility*, *sample*, or *research* mortalities. A *river* mortality is any fish "long-dead" on arrival in the raceway and defined by body characteristics such as pale or blotchy coloration and soft body condition. A *facility* mortality is classified as any fish recently dead, or near death upon arrival in the raceway, and exhibits fresh descale or injury. A *sample* mortality is any fish that dies as a result of the sampling activity itself. A *research* mortality is any fish that dies as a result of transferring and/or holding fish in research holding tanks for the purpose of further study or evaluation. In 2019, the percent mortality estimate for combined species was below 0.1%. Figure 7 compares the season-wide mortality percentage for each species from 2010-2019. The results from daily samples are reported in Appendix D. Proportions of descale, injury, and mortality of salmonids sampled at Rocky Reach Dam (2010-2019) are summarized in Table 2.

Table 2. Comparison of descale, injury and mortality rates at the Rocky Reach JSF **Years 2010 through 2019.**

Descale %										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Yearlings	0.12%	0.06%	0.04%	0.21%	0.05%	0.15%	0.05%	0.10%	0.12%	0.11%
Subyearling	0.17%	0.07%	0.13%	0.16%	0.09%	0.19%	0.89%	0.10%	0.08%	0.14%
Steelhead	0.51%	0.31%	0.07%	0.65%	0.23%	0.42%	0.66%	0.48%	0.68%	0.15%
Sockeye	0.01%	0.05%	0.01%	0.01%	0.00%	0.05%	0.05%	0.08%	0.03%	0.09%
Coho	0.11%	0.11%	0.11%	0.31%	0.00%	0.51%	0.15%	0.20%	0.11%	0.70%
Injury %										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Yearlings	0.17%	0.07%	0.00%	0.24%	0.12%	0.15%	0.13%	0.19%	0.41%	0.26%
Subyearling	0.14%	0.10%	0.26%	0.08%	0.08%	0.19%	0.26%	0.16%	0.22%	0.21%
Steelhead	0.70%	0.47%	0.17%	0.32%	0.90%	0.42%	0.99%	0.57%	2.03%	1.38%
Sockeye	0.00%	0.08%	0.01%	0.07%	0.05%	0.05%	0.06%	0.11%	0.13%	0.07%
Coho	0.19%	0.09%	0.16%	0.40%	0.39%	0.51%	0.67%	0.65%	1.03%	0.63%
Mortality %										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019

Yearlings	0.00%	0.01%	0.05%	0.01%	0.01%	0.01%	0.00%	0.02%	0.00%	0.07%
Subyearling	0.08%	0.11%	0.09%	0.06%	0.05%	0.04%	0.06%	0.09%	0.08%	0.04%
Steelhead	0.00%	0.03%	0.00%	0.41%	0.00%	0.03%	0.00%	0.00%	0.00%	0.00%
Sockeye	0.01%	0.00%	0.04%	0.05%	0.02%	0.02%	0.01%	0.03%	0.03%	0.01%
Coho	0.00%	0.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%	0.00%	0.00%

Marked Fish Condition Evaluations

Fish recovered from marked fish releases (prior to bypass operation on 1 April) were examined for descale, injury, and mortality associated with passage through the JFBS. Results from individual test groups are summarized in Appendix E. On 21 March, the District conducted marked fish releases. Marked releases were performed in the north and south channels of the surface collector as well as Unit 2. A test release of Unit 1 was not performed as the unit was down for maintenance and stayed out of service for the duration of the sampling season. Of the initial 200 fish released into the surface collector, 197 were recaptured. All of the recaptured fish were examined for descale, injury, and mortality. There were no signs of descale or injury and no mortality occurred in the 197 recaptured fish. Fish appeared healthy and energetic. The initial release of 100 fish for Unit 2 returned only 42 recaptured fish to the sampling facility. Due to the low recapture rate, divers were deployed and it was discovered that the vertical barrier screens were not aligned properly. Screens were extracted and reinstalled while divers monitored to confirm that correct alignment was achieved. On 26 March, a second marked fish release was performed for Unit 2. Of the initial 99 fish released, 96 were recaptured. There were no signs of descale, injury, or mortality and all fish appeared healthy and energetic.

Discussion

Juvenile Fish Bypass System Species Composition and Observations

Species composition of smolts migrating through Rocky Reach Dam in 2019 varied somewhat from that observed in 2018. Sockeye Salmon comprised the largest percentage of smolts sampled in the JFBS, however the percentage decreased from 2018 (63.4% of the total composition in 2018 compared with 34.2% in 2019). Meanwhile yearling Chinook Salmon increased to 19.8% in 2019 compared to 15.9% in 2018, while subyearling Chinook Salmon increased from 14.1% to 34.2% in 2019. Steelhead also increased from 1.9% to 7.5% in 2019. The proportion of Coho Salmon increased from 4.7% to 6.4% in 2019.

Composition of adipose-clipped smolts also varied in 2019 (Table 1). There was a slight decrease in the percentage of adipose-clipped Chinook Salmon yearlings from 2018 to 2019, 84.9% to 81.2% respectively, while subyearling Chinook Salmon also decreased from 51.4% to 47.6% respectively. Adipose-clipped steelhead smolts increased from 55.2% proportion of adipose-clipped smolts in 2018 to 76.5% in 2019. The proportion of adipose-clipped Sockeye Salmon remained relatively constant at 0.01% in 2018 compared to 0.02% in 2019, and Coho Salmon increased from 0.0% in 2018 to 0.4% in 2019.

Season-wide estimates of descale, injury, and mortality for all species combined was 0.16%, 0.29%, and 0.03% respectively (Appendix D). At no time during the 2019 spring and summer sampling months did fish condition reach critical threshold levels triggering marked fish releases.

Observed incidence of predations marks on smolts utilizing the JFBS in 2019 was 0.7%.

Conclusions from the 2019 Evaluations

- Flow spreaders with PIT antennas continue to be fish-friendly
- Unavailability of Unit C-1 had no impact to descale, injury, or mortality.
- Season-wide estimates of descale, injury, and mortality did not exceed 0.3% for combined species during the eighteenth year of operation of the permanent bypass system.

2020 Bypass Operations and Survival Studies

In 2020, the District will not be conducting a survival study at Rocky Reach, as Phase III Standards Achieved has been reached for all planned spring migrants. The District will continue to evaluate seasonal run-timing, species composition, and physical condition of ROR fish at the JSF in 2020.

Acknowledgements

Several District employees assisted in the implementation of the 2019 evaluations. Alene Underwood, Todd West, and Thad Mosey provided logistical and administrative help. Chris Nystrom and the bypass operators oversaw day to day operation of the JFBS. CM mechanics and wiremen performed critical maintenance and repairs. Fish and Wildlife personnel assisting with the 2019 Rocky Reach evaluations included: Dave Beardsley, Dennis Litchfield, and Todd Jackson.

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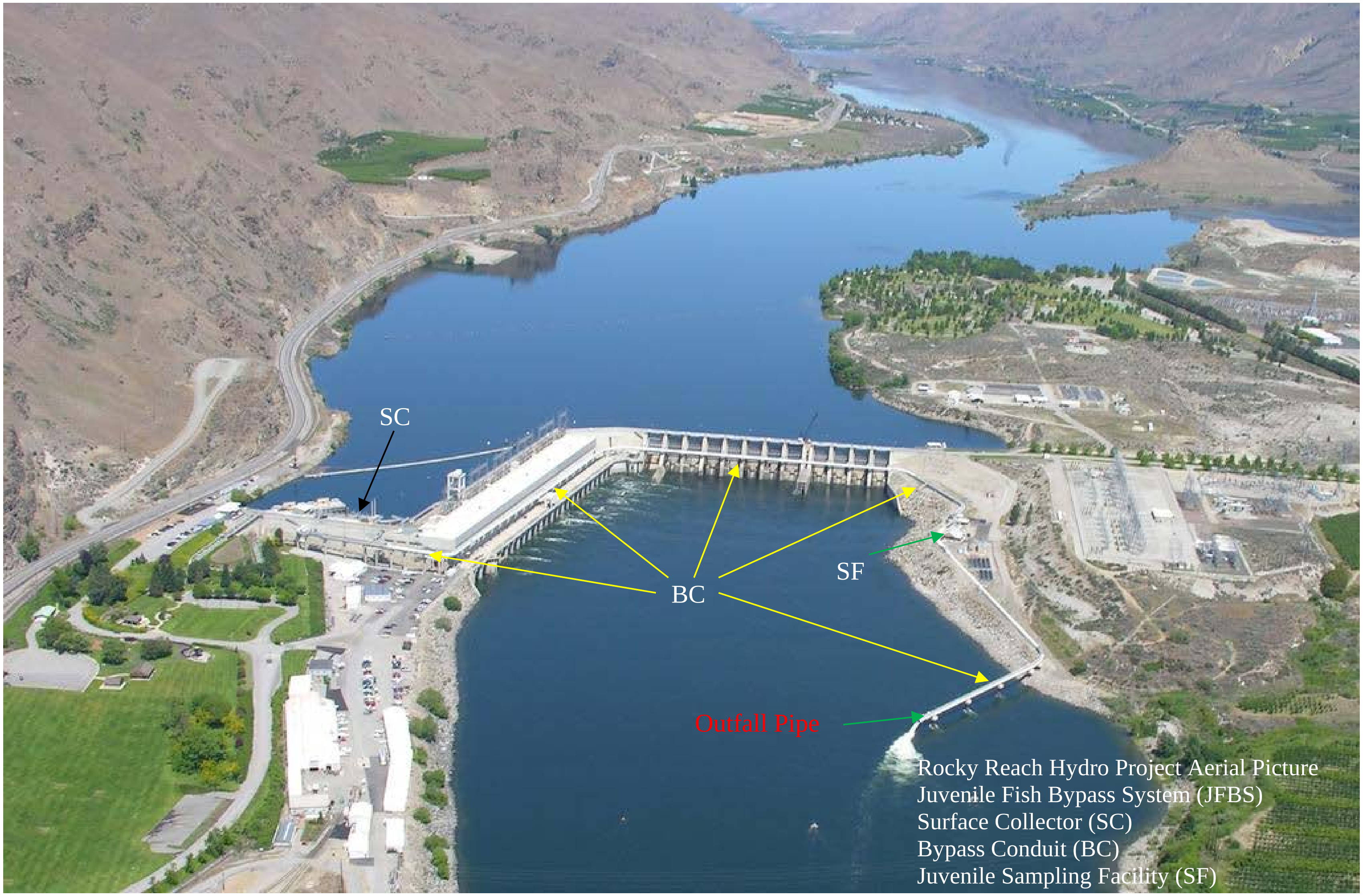


Figure 1. Aerial view of Rocky Reach Dam and the JFBS.

Figure 2. Plan view of Rocky Reach Dam and the JFBS

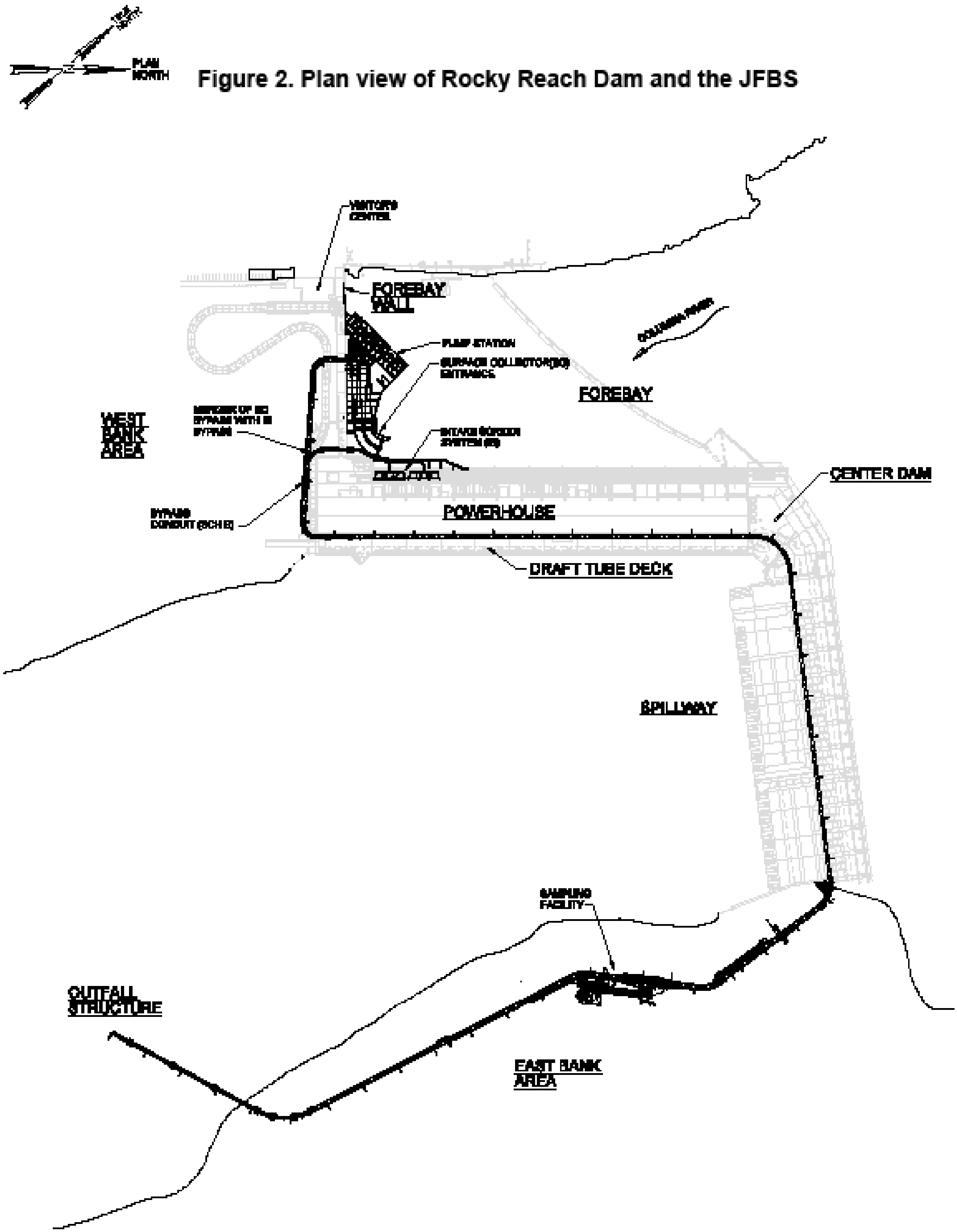
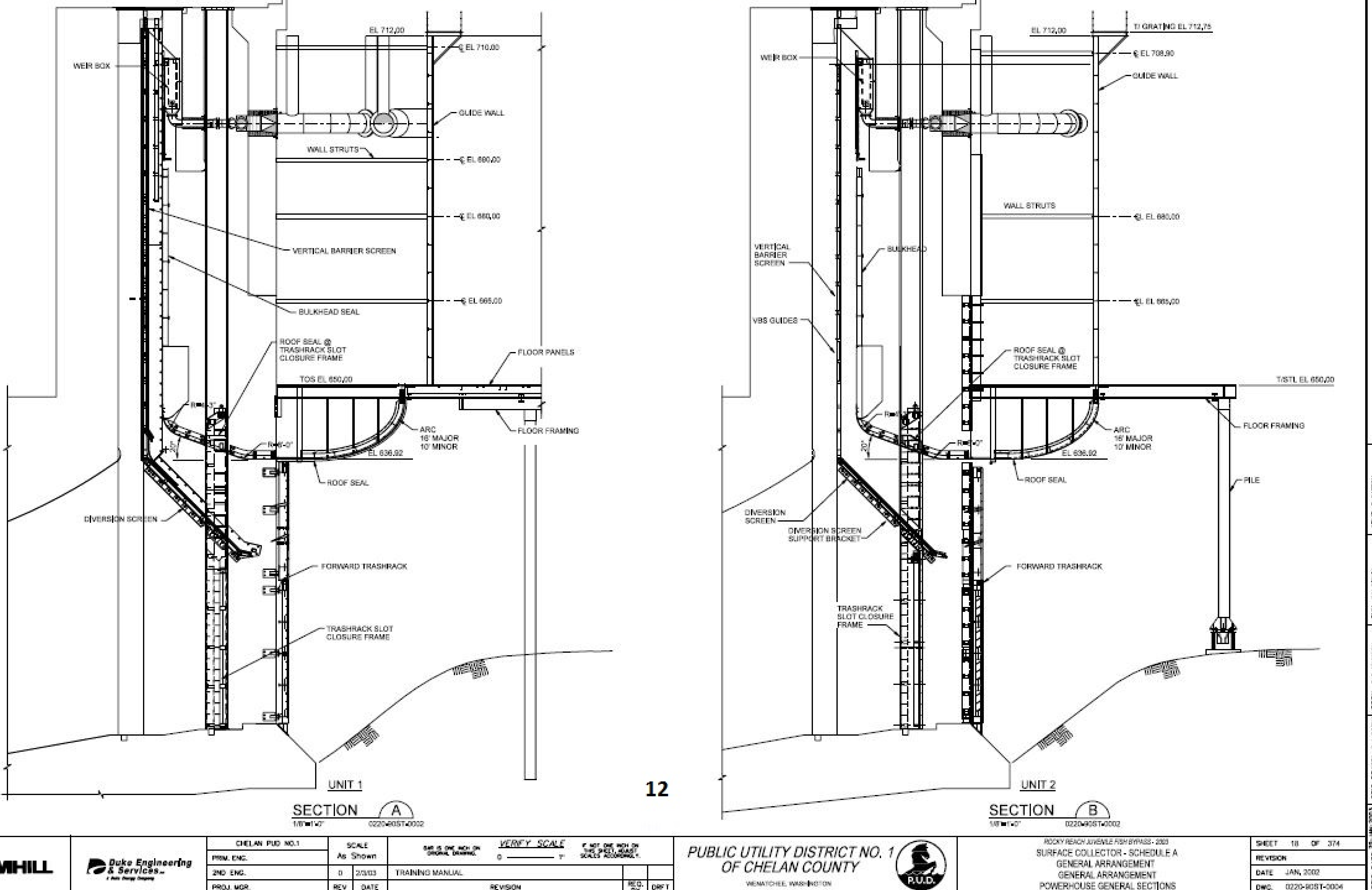


Figure 3. Intake screen system, units 1 and 2.



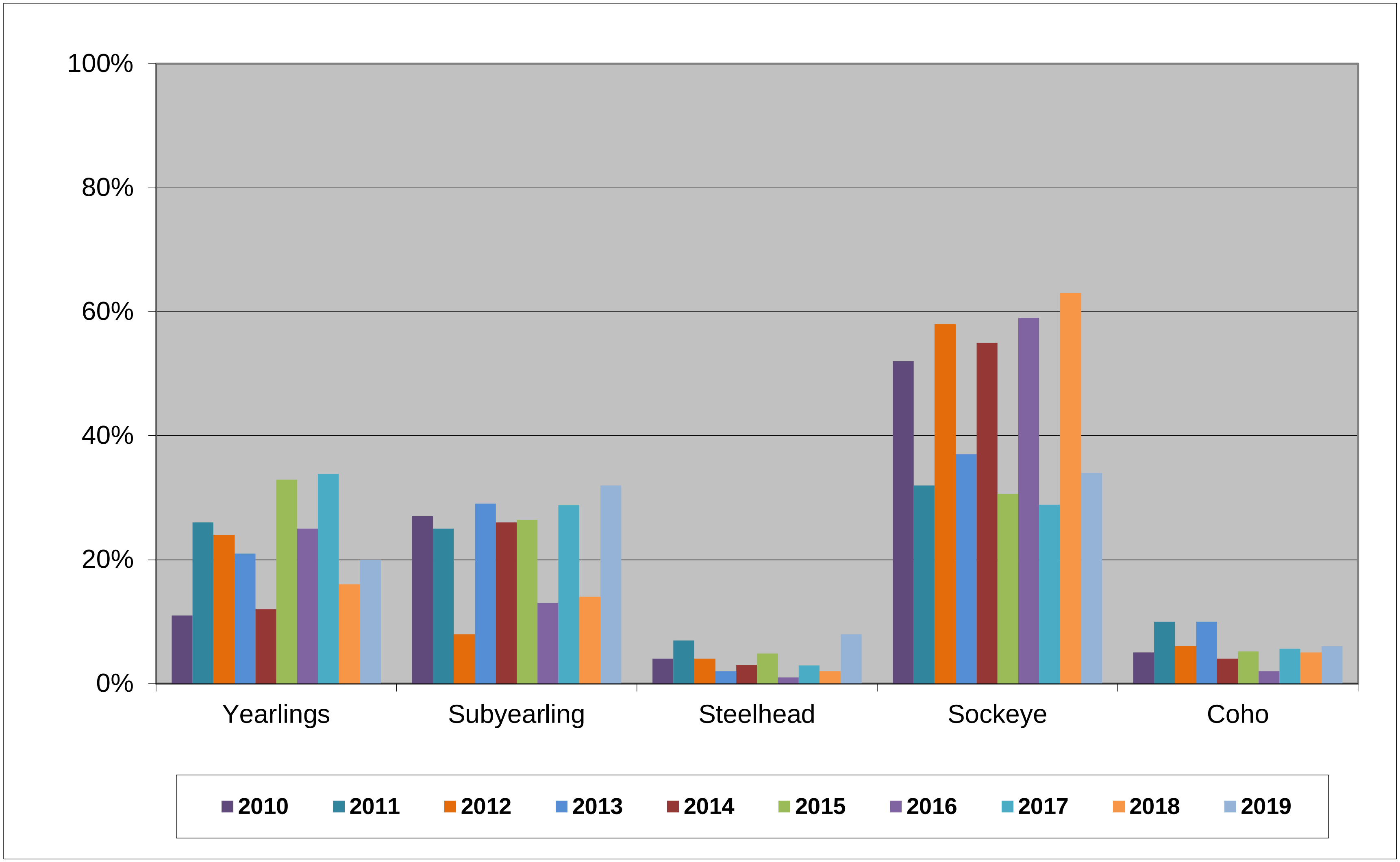


Figure 4. Ten year annual species percent composition of fish collections at the RRJSF, 2010-2019.

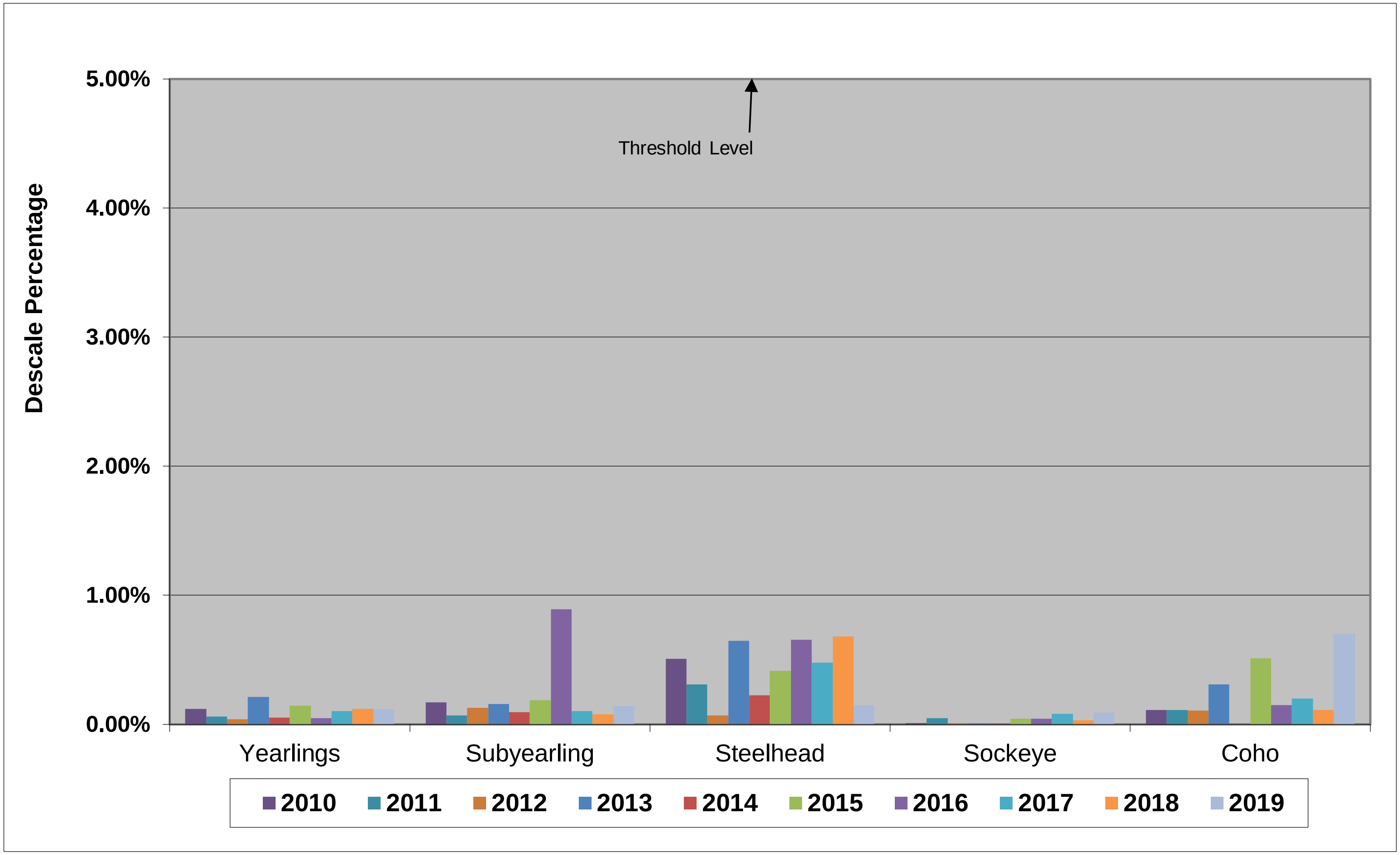


Figure 5. Ten year annual percent descale for salmon and steelhead at the RRJSF, 2010-2019.

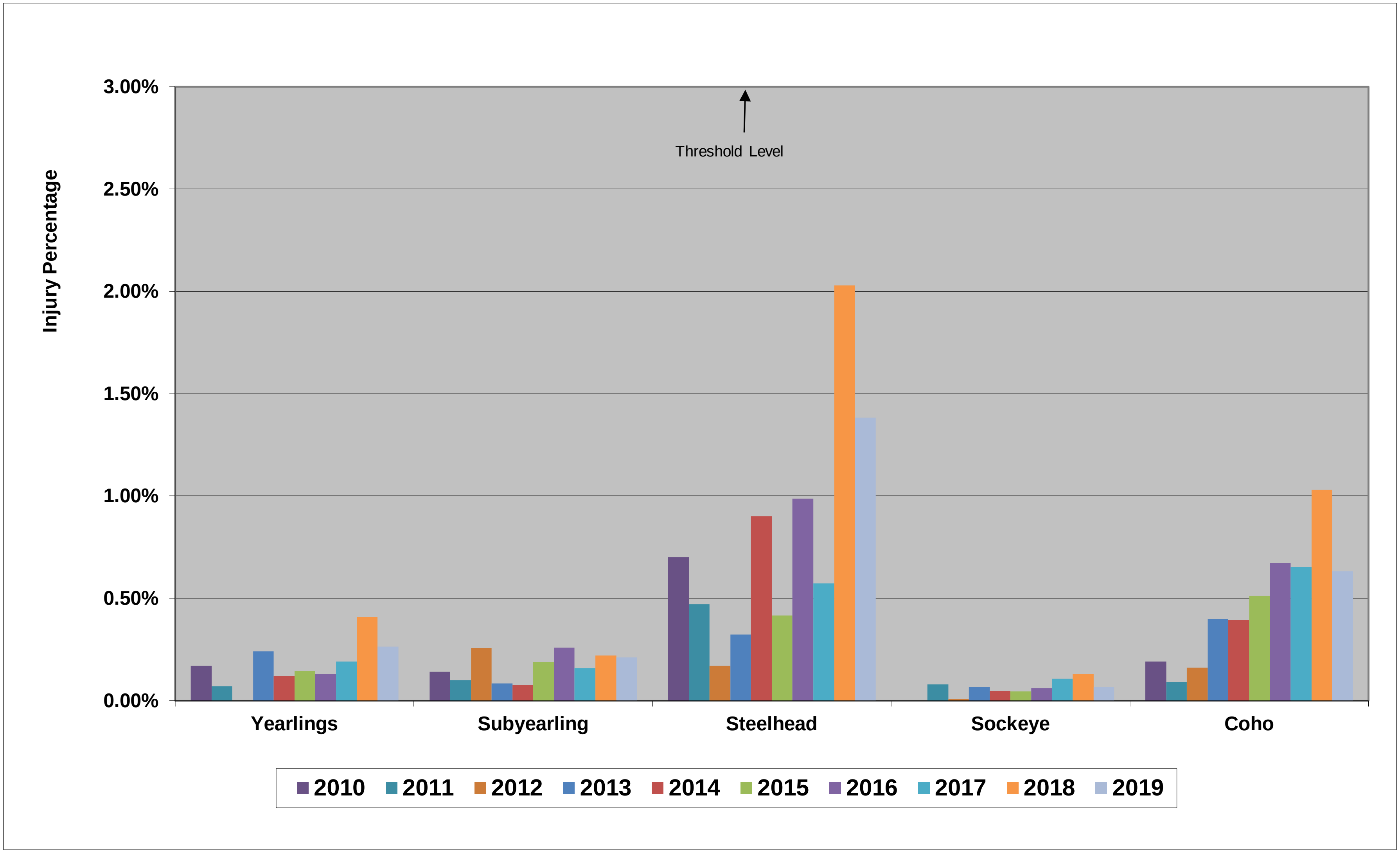


Figure 6. Ten year annual percent injury for salmon and steelhead at the RRJSF, 2010-2019.

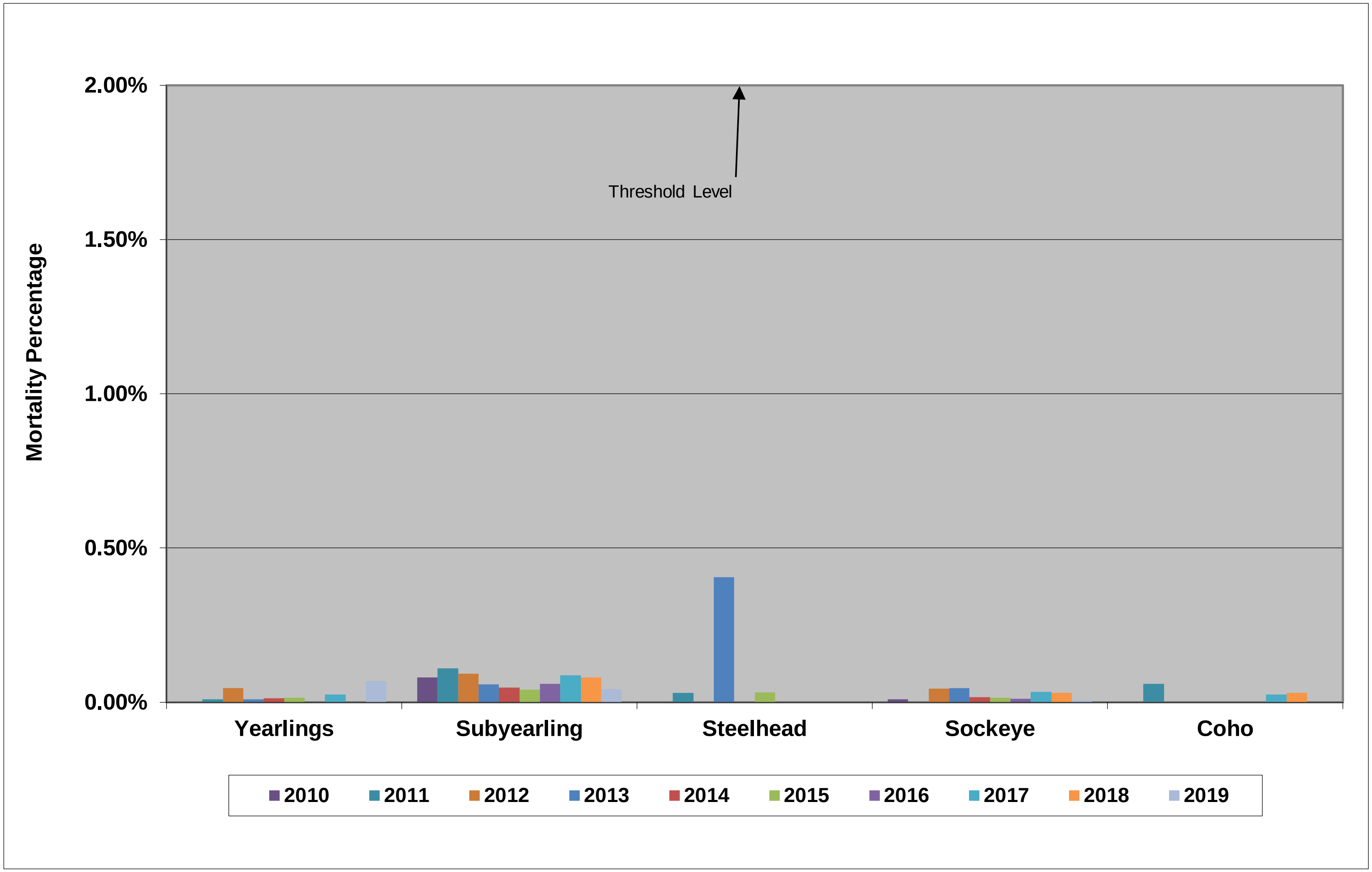


Figure 7. Ten year annual percent mortality for salmon and steelhead at the RRJSF, 2010-2019.

APPENDIX A. COLLECTION FLOWS IN THE JFBS, 2019.

Appendix A. Collection Flows in the JFBS from 1 April to 31 August, 2019.

24 Hour Averages				
Date	Surface Collector		ISS	River Temp
	North Entrance Flows (cfs)	South Entrance Flows (cfs)	Flows (cfs)	Degrees (C)
4/1/19	3218.3	3189.5	59.6	5.0
4/2/19	3206.3	3181.4	59.9	5.0
4/3/19	3248.8	3183.2	59.9	5.1
4/4/19	3252.2	3177.2	59.5	5.2
4/5/19	3214.7	3163.2	58.6	5.4
4/6/19	3247.2	3144.7	59.4	5.4
4/7/19	3089.7	3010.3	59.9	5.5
4/8/19	3105.8	3032.9	59.7	5.4
4/9/19	3108.0	3007.9	59.7	5.4
4/10/19	3103.0	2994.2	59.7	5.5
4/11/19	3131.7	2994.5	59.8	5.4
4/12/19	3098.4	2992.1	59.9	5.7
4/13/19	3156.8	3000.0	59.8	5.6
4/14/19	3155.5	2987.2	59.5	5.6
4/15/19	3286.5	3133.2	58.4	5.6
4/16/19	3249.0	3113.3	55.7	5.5
4/17/19	3267.4	3154.4	59.1	5.7
4/18/19	3283.6	3128.5	58.2	5.7
4/19/19	3266.5	3155.7	59.8	5.8
4/20/19	3250.8	3156.1	60.0	6.0
4/21/19	3261.9	3135.1	58.7	6.4
4/22/19	3252.0	3132.4	59.0	6.3
4/23/19	3158.9	3101.5	59.9	7.2
4/24/19	3194.7	3129.1	55.0	6.9
4/25/19	3223.1	3162.1	58.7	6.8
4/26/19	3211.4	3154.5	59.6	6.7
4/27/19	3204.8	3140.2	59.9	6.7
4/28/19	3216.7	3143.7	58.6	6.8
4/29/19	3206.6	3168.3	59.5	6.8
4/30/19	3231.7	3178.0	59.8	6.9
5/1/19	3265.0	3195.3	60.0	6.8
5/2/19	3259.0	3194.1	59.0	7.1
5/3/19	3308.3	3197.8	58.1	7.0
5/4/19	3104.0	3012.1	59.3	7.3
5/5/19	2677.6	2637.9	59.6	7.9
5/6/19	2765.0	2865.8	59.1	8.3
5/7/19	3194.1	3295.8	58.7	8.9
5/8/19	3207.3	3298.9	57.1	9.1
5/9/19	3242.4	3290.5	58.5	9.2
5/10/19	3194.1	3283.4	60.3	9.5
5/11/19	3208.6	3273.8	57.8	9.6

Appendix A. Collection Flows in the JFBS from 1 April to 31 August, 2019.

24 Hour Averages				
Date	Surface Collector		ISS	River Temp
	North Entrance Flows (cfs)	South Entrance Flows (cfs)	Flows (cfs)	Degrees (C)
5/12/19	3224.7	3271.0	59.6	9.8
5/13/19	3213.7	3260.3	59.7	9.8
5/14/19	3179.0	3248.7	59.9	13.6
5/15/19	3189.7	3254.0	60.0	10.0
5/16/19	3228.6	3238.2	60.2	9.8
5/17/19	3085.4	3146.2	59.9	9.7
5/18/19	3058.4	3144.8	60.2	9.9
5/19/19	3057.2	3143.8	59.9	10.4
5/20/19	3049.1	3138.8	59.5	10.6
5/21/19	3037.9	3147.0	58.7	10.5
5/22/19	3141.1	3207.5	57.1	10.3
5/23/19	3207.9	3275.4	57.3	11.1
5/24/19	3236.0	3258.3	57.1	11.4
5/25/19	3243.0	3242.1	55.2	11.4
5/26/19	3184.9	3242.4	57.9	11.3
5/27/19	3203.5	3248.1	58.4	11.2
5/28/19	3222.2	3241.6	53.3	11.5
5/29/19	3191.9	3212.3	54.5	11.8
5/30/19	3201.1	3226.1	59.2	12.2
5/31/19	3214.1	3227.1	59.1	12.6
6/1/19	3181.7	3153.7	53.7	12.9
6/2/19	3127.9	3092.3	56.3	13.0
6/3/19	3153.8	3098.8	55.5	13.6
6/4/19	3210.5	3120.7	55.6	13.7
6/5/19	3154.4	3090.4	54.8	13.6
6/6/19	3164.1	3121.6	55.1	13.2
6/7/19	3196.9	3098.0	51.9	13.0
6/8/19	3142.1	3072.7	55.1	12.9
6/9/19	3263.3	3146.2	54.1	12.8
6/10/19	3150.5	3109.5	56.8	13.0
6/11/19	3200.7	3130.5	55.1	13.2
6/12/19	3146.2	3069.3	53.9	13.3
6/13/19	3160.1	3078.7	55.3	13.7
6/14/19	3172.7	3064.2	55.5	14.0
6/15/19	3217.1	3087.5	50.6	14.4
6/16/19	3254.2	3108.2	48.3	14.9
6/17/19	3176.4	3121.9	49.3	15.2
6/18/19	3146.4	3131.7	51.5	15.3
6/19/19	3089.1	3161.9	51.6	15.5
6/20/19	3086.4	3167.5	55.0	14.9
6/21/19	3113.6	3165.7	51.5	14.5

Appendix A. Collection Flows in the JFBS from 1 April to 31 August, 2019.

24 Hour Averages				
Date	Surface Collector		ISS	River Temp
	North Entrance Flows (cfs)	South Entrance Flows (cfs)	Flows (cfs)	Degrees (C)
6/22/19	3130.4	3125.9	51.2	14.3
6/23/19	3089.2	3129.1	50.3	14.6
6/24/19	3134.8	3150.4	49.0	14.6
6/25/19	3132.6	3144.5	48.2	14.7
6/26/19	3181.8	3176.7	47.6	14.6
6/27/19	3158.1	3146.4	47.4	14.7
6/28/19	3128.2	3123.7	43.1	14.5
6/29/19	3155.6	3168.7	43.7	14.8
6/30/19	3131.1	3151.7	44.1	15.2
7/1/19	3149.4	3168.5	51.1	15.6
7/2/19	3168.8	3172.9	58.3	15.7
7/3/19	3149.1	3141.9	58.5	15.9
7/4/19	3126.1	3136.5	59.2	16.2
7/5/19	3164.1	3150.0	56.3	16.6
7/6/19	3178.0	3147.5	59.0	16.4
7/7/19	3177.4	3168.4	57.7	16.6
7/8/19	3155.3	3171.0	59.5	16.8
7/9/19	3134.4	3092.1	59.1	16.8
7/10/19	3187.2	3115.9	58.8	16.8
7/11/19	3233.0	3157.7	57.4	16.8
7/12/19	3138.5	3159.6	58.3	16.5
7/13/19	3180.4	3113.4	58.7	16.8
7/14/19	3189.6	3128.1	57.8	16.9
7/15/19	3180.5	3130.4	57.7	17.0
7/16/19	3158.6	3121.7	56.4	17.6
7/17/19	3214.8	3104.6	56.3	17.4
7/18/19	3076.1	3099.0	56.5	17.6
7/19/19	3193.1	3113.1	56.1	17.4
7/20/19	3305.1	3132.3	53.5	17.2
7/21/19	3257.6	3045.5	53.1	17.5
7/22/19	3179.6	2952.4	53.4	17.5
7/23/19	3197.1	2980.8	53.2	17.8
7/24/19	3150.1	3048.9	51.6	17.8
7/25/19	3165.1	3049.5	49.4	17.6
7/26/19	3202.7	3010.0	42.3	17.8
7/27/19	3207.1	2959.9	41.4	18.1
7/28/19	3153.6	3077.9	41.2	18.4
7/29/19	3213.6	2984.4	42.9	18.4
7/30/19	3218.0	2992.0	44.2	18.5
7/31/19	3359.1	2906.2	41.0	18.4
8/1/19	3351.6	2917.7	43.2	18.4

Appendix A. Collection Flows in the JFBS from 1 April to 31 August, 2019.

24 Hour Averages				
Date	Surface Collector		ISS	River Temp
	North Entrance Flows (cfs)	South Entrance Flows (cfs)	Flows (cfs)	Degrees (C)
8/2/19	3243.0	3007.6	46.6	18.3
8/3/19	3150.4	3098.3	43.9	18.5
8/4/19	3181.5	3032.8	46.1	19.0
8/5/19	3234.9	2993.2	52.3	19.1
8/6/19	3258.5	2847.4	54.4	19.3
8/7/19	3258.5	2775.8	51.9	19.3
8/8/19	3125.4	2834.1	53.8	19.2
8/9/19	3160.9	2837.5	56.6	19.1
8/10/19	3124.0	2903.5	57.5	18.9
8/11/19	3031.0	2852.3	58.4	19.0
8/12/19	3156.8	2795.7	55.8	19.0
8/13/19	3086.0	2930.5	52.8	19.1
8/14/19	2969.8	3010.0	51.8	19.3
8/15/19	2967.8	3008.1	49.5	19.2
8/16/19	3021.7	3062.6	47.4	19.1
8/17/19	3186.3	3150.9	50.4	19.1
8/18/19	3184.8	3075.2	50.1	18.9
8/19/19	3260.2	3202.1	48.3	19.3
8/20/19	3349.5	3196.0	48.3	19.5
8/21/19	3248.9	3095.4	47.7	19.4
8/22/19	3247.0	3081.0	50.4	19.5
8/23/19	3268.2	2975.8	50.6	19.2
8/24/19	2949.6	2903.0	56.1	19.1
8/25/19	2111.3	2093.8	57.7	18.9
8/26/19	3097.2	3089.7	55.8	19.4
8/27/19	3080.9	3101.8	56.2	19.4
8/28/19	3180.6	3194.1	56.1	19.3
8/29/19	3207.5	3159.8	56.3	19.2
8/30/19	3226.2	3116.1	57.1	19.2
8/31/19	3215.2	3089.8	53.6	19.2
Average	**3167.0**	**3098.9**	**55.0**	**13.3**

APPENDIX B. ROCKY REACH JSF DAILY COUNTS AND AD-CLIP %, SPRING AND SUMMER, 2019.

Appendix B. Rocky Reach JSF daily counts and ad-clip %, spring and summer, 2019.

Numbers of Smolts Handled and Ad-Clip %											
Date	Yearlings		Subyearling		Steelhead		Sockeye		Coho		Total Handled
1-Apr	12	8.33%	0	N/A	0	N/A	0	N/A	0	N/A	12
2-Apr	7	0.00%	0	N/A	0	N/A	0	N/A	0	N/A	7
3-Apr	3	0.00%	0	N/A	0	N/A	0	N/A	1	0.00%	4
4-Apr	6	0.00%	0	N/A	0	N/A	0	N/A	1	0.00%	7
5-Apr	10	0.00%	0	N/A	0	N/A	0	N/A	0	N/A	10
6-Apr	11	0.00%	0	N/A	0	N/A	0	N/A	0	N/A	11
7-Apr	1	0.00%	0	N/A	0	N/A	0	N/A	0	N/A	1
8-Apr	6	16.67%	0	N/A	1	0.00%	0	N/A	1	0.00%	8
9-Apr	6	0.00%	0	N/A	1	0.00%	0	N/A	0	N/A	7
10-Apr	7	0.00%	0	N/A	0	N/A	0	N/A	0	N/A	7
11-Apr	4	0.00%	0	N/A	0	N/A	0	N/A	0	N/A	4
12-Apr	2	0.00%	0	N/A	0	N/A	0	N/A	2	0.00%	4
13-Apr	6	0.00%	0	N/A	0	N/A	0	N/A	0	N/A	6
14-Apr	3	0.00%	0	N/A	0	N/A	0	N/A	1	0.00%	4
15-Apr	10	20.00%	0	N/A	3	33.33%	2	0.00%	2	0.00%	17
16-Apr	45	88.89%	0	N/A	0	N/A	0	N/A	0	N/A	45
17-Apr	95	87.37%	0	N/A	10	80.00%	0	N/A	1	0.00%	106
18-Apr	818	96.94%	0	N/A	38	94.74%	2	0.00%	0	N/A	858
19-Apr	485	98.35%	0	N/A	71	98.59%	1	0.00%	1	0.00%	558
20-Apr	117	87.18%	0	N/A	100	94.00%	0	N/A	1	0.00%	218
21-Apr	26	73.08%	0	N/A	82	87.80%	0	N/A	1	0.00%	109
22-Apr	76	94.74%	0	N/A	197	90.36%	1	0.00%	0	N/A	274
23-Apr	60	71.67%	0	N/A	38	57.89%	0	N/A	0	N/A	98
24-Apr	82	63.41%	0	N/A	53	62.26%	0	N/A	1	0.00%	136
25-Apr	106	88.68%	0	N/A	118	59.32%	0	N/A	2	0.00%	226
26-Apr	157	88.54%	0	N/A	340	82.06%	1	0.00%	0	N/A	498
27-Apr	96	90.63%	0	N/A	258	79.84%	0	N/A	8	0.00%	362
28-Apr	152	85.53%	0	N/A	97	77.32%	0	N/A	9	0.00%	258
29-Apr	81	80.25%	0	N/A	140	86.43%	0	N/A	3	0.00%	224
30-Apr	54	79.63%	0	N/A	238	76.47%	0	N/A	3	0.00%	295
1-May	45	77.78%	0	N/A	78	83.33%	0	N/A	2	0.00%	125
2-May	35	85.71%	0	N/A	216	90.74%	1	0.00%	5	0.00%	257
3-May	24	70.83%	0	N/A	46	82.61%	0	N/A	2	50.00%	72
4-May	32	81.25%	0	N/A	75	82.67%	1	0.00%	3	0.00%	111
5-May	30	100.00%	0	N/A	14	85.71%	0	N/A	5	0.00%	49
6-May	45	82.22%	0	N/A	35	88.57%	0	N/A	2	0.00%	82
7-May	53	84.91%	0	N/A	48	77.08%	0	N/A	6	0.00%	107
8-May	86	80.23%	0	N/A	44	77.27%	2	0.00%	6	0.00%	138
9-May	102	85.29%	0	N/A	124	82.26%	1	0.00%	9	0.00%	236
10-May	322	77.33%	0	N/A	79	82.28%	5	0.00%	26	0.00%	432
11-May	266	74.81%	0	N/A	170	81.18%	52	0.00%	32	3.13%	520
12-May	889	74.24%	0	N/A	69	60.87%	462	0.00%	105	0.00%	1525
13-May	854	76.93%	0	N/A	33	60.61%	603	0.00%	100	0.00%	1590

14-May	788	76.27%	0	N/A	91	73.63%	192	0.00%	174	0.00%	1245
15-May	349	75.64%	0	N/A	37	59.46%	910	0.00%	100	0.00%	1396
16-May	107	83.18%	0	N/A	34	47.06%	1444	0.00%	61	0.00%	1646
17-May	133	72.93%	0	N/A	39	64.10%	1062	0.00%	186	0.00%	1420
18-May	67	77.61%	0	N/A	34	55.88%	986	0.00%	84	0.00%	1171
19-May	60	80.00%	0	N/A	62	45.16%	595	0.00%	119	0.00%	836
20-May	26	73.08%	0	N/A	8	50.00%	596	0.17%	54	0.00%	684
21-May	49	73.47%	0	N/A	15	66.67%	1832	0.00%	58	0.00%	1954
22-May	92	79.35%	0	N/A	7	28.57%	642	0.00%	228	0.44%	969
23-May	13	61.54%	0	N/A	7	28.57%	13	0.00%	17	0.00%	50
24-May	31	80.65%	0	N/A	8	37.50%	96	0.00%	49	0.00%	184
25-May	58	74.14%	0	N/A	4	75.00%	92	0.00%	32	0.00%	186
26-May	140	76.43%	3	33.33%	11	36.36%	850	0.24%	191	0.00%	1195
27-May	199	81.91%	9	66.67%	11	27.27%	508	0.00%	176	0.57%	903
28-May	72	69.44%	8	100.00%	13	53.85%	147	0.00%	76	2.63%	316
29-May	460	76.30%	9	88.89%	19	42.11%	380	0.00%	129	0.00%	997
30-May	157	75.80%	14	85.71%	9	33.33%	140	0.00%	56	0.00%	376
31-May	38	86.84%	5	80.00%	0	N/A	1558	0.00%	25	0.00%	1626
1-Jun	14	71.43%	21	90.48%	5	0.00%	1279	0.00%	33	0.00%	1352
2-Jun	10	70.00%	13	92.31%	6	33.33%	229	0.00%	11	0.00%	269
3-Jun	4	75.00%	14	85.71%	2	50.00%	35	0.00%	12	0.00%	67
4-Jun	18	83.33%	19	89.47%	11	45.45%	135	0.00%	16	0.00%	199
5-Jun	21	80.95%	25	84.00%	1	0.00%	52	0.00%	15	6.67%	114
6-Jun	25	92.00%	21	100.00%	2	50.00%	27	0.00%	5	0.00%	80
7-Jun	30	96.67%	24	95.83%	1	0.00%	20	0.00%	5	0.00%	80
8-Jun	13	92.31%	17	94.12%	3	100.00%	27	0.00%	6	16.67%	66
9-Jun	41	95.12%	17	100.00%	2	50.00%	19	0.00%	15	0.00%	94
10-Jun	88	94.32%	41	95.12%	6	83.33%	34	0.00%	30	0.00%	199
11-Jun	171	97.08%	189	97.88%	1	100.00%	42	0.00%	56	0.00%	459
12-Jun	112	95.54%	384	95.83%	3	33.33%	10	0.00%	62	1.61%	571
13-Jun	11	90.91%	475	97.26%	0	N/A	4	0.00%	38	0.00%	528
14-Jun	0	N/A	189	96.83%	1	0.00%	5	0.00%	53	0.00%	248
15-Jun	2	100.00%	421	96.67%	4	0.00%	4	0.00%	24	0.00%	455
16-Jun	0	N/A	449	98.00%	3	33.33%	4	0.00%	29	0.00%	485
17-Jun	0	N/A	224	90.63%	0	N/A	1	0.00%	13	7.69%	238
18-Jun	0	N/A	446	96.64%	3	66.67%	1	0.00%	8	0.00%	458
19-Jun	0	N/A	595	96.81%	5	20.00%	1	0.00%	5	0.00%	606
20-Jun	0	N/A	551	97.46%	5	0.00%	0	N/A	12	0.00%	568
21-Jun	0	N/A	318	96.23%	8	50.00%	1	0.00%	34	0.00%	361
22-Jun	0	N/A	36	91.67%	1	0.00%	0	N/A	4	0.00%	41
23-Jun	1	100.00%	459	95.21%	0	N/A	0	N/A	72	0.00%	532
24-Jun	0	N/A	741	97.98%	0	N/A	0	N/A	1	0.00%	742
25-Jun	0	N/A	562	88.61%	2	0.00%	1	0.00%	0	N/A	565
26-Jun	0	N/A	565	81.42%	0	N/A	0	N/A	5	0.00%	570
27-Jun	0	N/A	207	52.17%	7	0.00%	0	N/A	17	0.00%	231
28-Jun	1	100.00%	144	32.64%	2	0.00%	0	N/A	13	0.00%	160
29-Jun	0	N/A	66	21.21%	0	N/A	2	0.00%	4	0.00%	72

30-Jun	0	N/A	44	20.45%	0	N/A	0	N/A	4	0.00%	48
1-Jul	0	N/A	12	16.67%	6	0.00%	0	N/A	4	0.00%	22
2-Jul	0	N/A	27	48.15%	1	0.00%	0	N/A	1	0.00%	29
3-Jul	0	N/A	41	7.32%	1	0.00%	0	N/A	0	N/A	42
4-Jul	0	N/A	18	38.89%	1	0.00%	0	N/A	3	0.00%	22
5-Jul	0	N/A	79	3.80%	1	0.00%	0	N/A	1	0.00%	81
6-Jul	0	N/A	60	18.33%	1	0.00%	0	N/A	0	N/A	61
7-Jul	0	N/A	48	10.42%	2	0.00%	1	0.00%	8	0.00%	59
8-Jul	0	N/A	189	7.41%	1	0.00%	1	0.00%	8	0.00%	199
9-Jul	0	N/A	565	1.42%	0	N/A	0	N/A	3	0.00%	568
10-Jul	1	100.00%	446	0.45%	0	N/A	2	0.00%	6	0.00%	455
11-Jul	0	N/A	606	0.17%	0	N/A	0	N/A	14	0.00%	620
12-Jul	0	N/A	184	0.54%	1	0.00%	0	N/A	0	N/A	185
13-Jul	0	N/A	53	0.00%	0	N/A	0	N/A	5	0.00%	58
14-Jul	2	50.00%	131	0.76%	0	N/A	0	N/A	3	0.00%	136
15-Jul	0	N/A	113	0.00%	0	N/A	0	N/A	1	0.00%	114
16-Jul	0	N/A	48	2.08%	1	0.00%	0	N/A	2	0.00%	51
17-Jul	0	N/A	66	0.00%	1	0.00%	0	N/A	4	0.00%	71
18-Jul	0	N/A	91	1.10%	0	N/A	0	N/A	3	0.00%	94
19-Jul	0	N/A	329	0.30%	0	N/A	0	N/A	3	0.00%	332
20-Jul	0	N/A	139	0.00%	0	N/A	0	N/A	1	0.00%	140
21-Jul	1	0.00%	96	2.08%	0	N/A	1	0.00%	0	N/A	98
22-Jul	0	N/A	123	0.00%	0	N/A	1	0.00%	1	0.00%	125
23-Jul	0	N/A	365	0.00%	0	N/A	1	0.00%	6	0.00%	372
24-Jul	0	N/A	205	0.00%	0	N/A	1	0.00%	1	0.00%	207
25-Jul	0	N/A	743	0.00%	0	N/A	1	0.00%	0	N/A	744
26-Jul	1	100.00%	336	0.00%	0	N/A	0	N/A	0	N/A	337
27-Jul	1	100.00%	61	1.64%	0	N/A	1	0.00%	1	0.00%	64
28-Jul	0	N/A	183	0.00%	0	N/A	0	N/A	0	N/A	183
29-Jul	0	N/A	478	0.00%	0	N/A	1	0.00%	0	N/A	479
30-Jul	1	100.00%	172	0.00%	0	N/A	0	N/A	0	N/A	173
31-Jul	0	N/A	155	0.65%	0	N/A	0	N/A	0	N/A	155
1-Aug	0	N/A	148	0.68%	0	N/A	0	N/A	0	N/A	148
2-Aug	0	N/A	24	0.00%	0	N/A	0	N/A	0	N/A	24
3-Aug	0	N/A	34	0.00%	0	N/A	0	N/A	0	N/A	34
4-Aug	0	N/A	46	0.00%	0	N/A	0	N/A	0	N/A	46
5-Aug	0	N/A	26	0.00%	0	N/A	0	N/A	0	N/A	26
6-Aug	0	N/A	27	0.00%	0	N/A	0	N/A	0	N/A	27
7-Aug	0	N/A	27	0.00%	0	N/A	1	0.00%	0	N/A	28
8-Aug	0	N/A	24	0.00%	0	N/A	1	0.00%	0	N/A	25
9-Aug	0	N/A	25	0.00%	1	100.00%	0	N/A	0	N/A	26
10-Aug	0	N/A	22	0.00%	0	N/A	0	N/A	1	0.00%	23
11-Aug	0	N/A	49	0.00%	0	N/A	0	N/A	0	N/A	49
12-Aug	0	N/A	27	0.00%	0	N/A	0	N/A	0	N/A	27
13-Aug	0	N/A	31	0.00%	0	N/A	0	N/A	3	0.00%	34
14-Aug	0	N/A	15	0.00%	0	N/A	0	N/A	0	N/A	15
15-Aug	0	N/A	16	0.00%	0	N/A	0	N/A	1	0.00%	17

16-Aug	0	N/A	13	0.00%	0	N/A	0	N/A	0	N/A	13
17-Aug	0	N/A	22	0.00%	0	N/A	0	N/A	0	N/A	22
18-Aug	0	N/A	33	0.00%	0	N/A	1	0.00%	0	N/A	34
19-Aug	0	N/A	7	0.00%	0	N/A	0	N/A	1	0.00%	8
20-Aug	0	N/A	6	0.00%	0	N/A	1	0.00%	0	N/A	7
21-Aug	0	N/A	10	0.00%	0	N/A	0	N/A	1	0.00%	11
22-Aug	0	N/A	7	0.00%	0	N/A	0	N/A	0	N/A	7
23-Aug	0	N/A	2	0.00%	0	N/A	0	N/A	1	0.00%	3
24-Aug	0	N/A	11	0.00%	0	N/A	0	N/A	0	N/A	11
25-Aug	0	N/A	9	0.00%	0	N/A	0	N/A	0	N/A	9
26-Aug	0	N/A	5	0.00%	0	N/A	0	N/A	1	0.00%	6
27-Aug	0	N/A	7	0.00%	0	N/A	0	N/A	0	N/A	7
28-Aug	0	N/A	7	0.00%	0	N/A	0	N/A	0	N/A	7
29-Aug	0	N/A	6	0.00%	0	N/A	0	N/A	0	N/A	6
30-Aug	0	N/A	5	0.00%	0	N/A	0	N/A	1	0.00%	6
31-Aug	0	N/A	1	0.00%	0	N/A	0	N/A	0	N/A	1
Totals	**8735**	**81.19%**	**14179**	**47.57%**	**3327**	**76.47%**	**15125**	**0.02%**	**2847**	**0.35%**	**44213**

APPENDIX C. ANNUAL COLLECTION OF LAMPREY, BULL TROUT, AND WHITE STURGEON AT THE ROCKY REACH JSF, 2003 TO 2019.

Appendix C. Annual Collections of Pacific Lamprey, Bull Trout, and White Sturgeon at the Rocky Reach JSF, 2003 to 2019.

Lamprey		
Year	Number of Juveniles	Number of Adults
2003	122	5
2004	6	8
2005	11	3
2006	35	0
2007	3	0
2008	10	1
2009	13	3
2010	70	0
2011	1147	0
2012	5	0
2013	6	0
2014	7	7
2015	4	5
2016	3	5
2017	5	6
2018	13	42
2019	23	5

Bull Trout	
Year	Number
2003	N/A
2004	N/A
2005	1
2006	1
2007	1
2008	14
2009	30
2010	11
2011	9
2012	0
2013	0
2014	0
2015	0
2016	1
2017	2
2018	1
2019	0

White Sturgeon	
Year	Number
2003	N/A
2004	N/A
2005	0
2006	0
2007	0
2008	0
2009	0
2010	0
2011	2
2012	0
2013	0
2014	0
2015	1
2016	0
2017	1
2018	4
2019	2

APPENDIX D. DAILY DESCALE, INJURY, AND MORTALITY DATA FOR JUVENILE RUN-OF-RIVER SALMONIDS, SPRING AND SUMMER, 2019.

Appendix D. Daily descale, injury, and mortality data for juvenile run-of-river salmonids, April to August, 2019.

All Species								
Date	Number Examined	Number OK	Number Descaled >2	Percent Descale	Number Injured	Percent Injured	Mortality	Percent Mortality
1-Apr	12	12	0	0.00%	0	0.00%	0	0.00%
2-Apr	7	7	0	0.00%	0	0.00%	0	0.00%
3-Apr	4	4	0	0.00%	0	0.00%	0	0.00%
4-Apr	7	7	0	0.00%	0	0.00%	0	0.00%
5-Apr	10	10	0	0.00%	0	0.00%	0	0.00%
6-Apr	11	11	0	0.00%	0	0.00%	0	0.00%
7-Apr	1	1	0	0.00%	0	0.00%	0	0.00%
8-Apr	8	8	0	0.00%	0	0.00%	0	0.00%
9-Apr	7	7	0	0.00%	0	0.00%	0	0.00%
10-Apr	7	7	0	0.00%	0	0.00%	0	0.00%
11-Apr	4	4	0	0.00%	0	0.00%	0	0.00%
12-Apr	4	4	0	0.00%	0	0.00%	0	0.00%
13-Apr	6	6	0	0.00%	0	0.00%	0	0.00%
14-Apr	4	4	0	0.00%	0	0.00%	0	0.00%
15-Apr	17	17	0	0.00%	0	0.00%	0	0.00%
16-Apr	45	43	1	2.22%	1	2.22%	0	0.00%
17-Apr	106	104	0	0.00%	2	1.89%	0	0.00%
18-Apr	858	858	0	0.00%	0	0.00%	0	0.00%
19-Apr	558	556	0	0.00%	2	0.36%	0	0.00%
20-Apr	218	217	0	0.00%	1	0.46%	0	0.00%
21-Apr	109	108	0	0.00%	1	0.92%	0	0.00%
22-Apr	274	271	1	0.36%	2	0.73%	0	0.00%
23-Apr	98	96	0	0.00%	1	1.02%	1	1.02%
24-Apr	136	136	0	0.00%	0	0.00%	0	0.00%
25-Apr	226	224	0	0.00%	2	0.88%	0	0.00%
26-Apr	498	498	0	0.00%	0	0.00%	0	0.00%
27-Apr	362	360	0	0.00%	2	0.55%	0	0.00%
28-Apr	258	256	0	0.00%	2	0.78%	0	0.00%
29-Apr	224	221	0	0.00%	3	1.34%	0	0.00%
30-Apr	295	292	1	0.34%	2	0.68%	0	0.00%
1-May	125	121	0	0.00%	2	1.60%	2	1.60%
2-May	257	255	0	0.00%	2	0.78%	0	0.00%
3-May	72	69	0	0.00%	2	2.78%	1	1.39%
4-May	111	108	0	0.00%	2	1.80%	1	0.90%
5-May	49	49	0	0.00%	0	0.00%	0	0.00%
6-May	82	82	0	0.00%	0	0.00%	0	0.00%
7-May	107	104	1	0.93%	2	1.87%	0	0.00%
8-May	138	136	0	0.00%	2	1.45%	0	0.00%
9-May	236	231	0	0.00%	5	2.12%	0	0.00%
10-May	432	431	0	0.00%	1	0.23%	0	0.00%
11-May	520	516	2	0.38%	1	0.19%	1	0.19%
12-May	1525	1520	0	0.00%	5	0.33%	0	0.00%

13-May	1590	1589	**0**	0.00%	**1**	0.06%	**0**	0.00%
14-May	1245	1236	**4**	0.32%	**5**	0.40%	**0**	0.00%
15-May	1396	1393	**2**	0.14%	**1**	0.07%	**0**	0.00%
16-May	1646	1640	**3**	0.18%	**2**	0.12%	**1**	0.06%
17-May	1420	1414	**2**	0.14%	**4**	0.28%	**0**	0.00%
18-May	1171	1168	**0**	0.00%	**3**	0.26%	**0**	0.00%
19-May	836	832	**0**	0.00%	**4**	0.48%	**0**	0.00%
20-May	684	677	**7**	1.02%	**0**	0.00%	**0**	0.00%
21-May	1954	1945	**4**	0.20%	**5**	0.26%	**0**	0.00%
22-May	969	960	**7**	0.72%	**2**	0.21%	**0**	0.00%
23-May	50	49	**0**	0.00%	**1**	2.00%	**0**	0.00%
24-May	184	184	**0**	0.00%	**0**	0.00%	**0**	0.00%
25-May	186	186	**0**	0.00%	**0**	0.00%	**0**	0.00%
26-May	1195	1194	**1**	0.08%	**0**	0.00%	**0**	0.00%
27-May	903	902	**0**	0.00%	**1**	0.11%	**0**	0.00%
28-May	316	310	**3**	0.95%	**3**	0.95%	**0**	0.00%
29-May	997	995	**0**	0.00%	**2**	0.20%	**0**	0.00%
30-May	376	375	**1**	0.27%	**0**	0.00%	**0**	0.00%
31-May	1626	1624	**2**	0.12%	**0**	0.00%	**0**	0.00%
1-Jun	1352	1351	**0**	0.00%	**1**	0.07%	**0**	0.00%
2-Jun	269	268	**0**	0.00%	**1**	0.37%	**0**	0.00%
3-Jun	67	66	**0**	0.00%	**1**	1.49%	**0**	0.00%
4-Jun	199	197	**1**	0.50%	**1**	0.50%	**0**	0.00%
5-Jun	114	113	**0**	0.00%	**1**	0.88%	**0**	0.00%
6-Jun	80	79	**1**	1.25%	**0**	0.00%	**0**	0.00%
7-Jun	80	76	**1**	1.25%	**3**	3.75%	**0**	0.00%
8-Jun	66	66	**0**	0.00%	**0**	0.00%	**0**	0.00%
9-Jun	94	93	**0**	0.00%	**1**	1.06%	**0**	0.00%
10-Jun	199	199	**0**	0.00%	**0**	0.00%	**0**	0.00%
11-Jun	459	455	**0**	0.00%	**4**	0.87%	**0**	0.00%
12-Jun	571	568	**1**	0.18%	**2**	0.35%	**0**	0.00%
13-Jun	528	527	**0**	0.00%	**1**	0.19%	**0**	0.00%
14-Jun	248	247	**0**	0.00%	**1**	0.40%	**0**	0.00%
15-Jun	455	455	**0**	0.00%	**0**	0.00%	**0**	0.00%
16-Jun	485	484	**0**	0.00%	**1**	0.21%	**0**	0.00%
17-Jun	238	236	**0**	0.00%	**2**	0.84%	**0**	0.00%
18-Jun	458	458	**0**	0.00%	**0**	0.00%	**0**	0.00%
19-Jun	606	605	**0**	0.00%	**1**	0.17%	**0**	0.00%
20-Jun	568	567	**0**	0.00%	**1**	0.18%	**0**	0.00%
21-Jun	361	359	**2**	0.55%	**0**	0.00%	**0**	0.00%
22-Jun	41	39	**1**	2.44%	**1**	2.44%	**0**	0.00%
23-Jun	532	532	**0**	0.00%	**0**	0.00%	**0**	0.00%
24-Jun	742	740	**2**	0.27%	**0**	0.00%	**0**	0.00%
25-Jun	565	562	**1**	0.18%	**2**	0.35%	**0**	0.00%
26-Jun	570	568	**1**	0.18%	**1**	0.18%	**0**	0.00%
27-Jun	231	230	**0**	0.00%	**0**	0.00%	**1**	0.43%
28-Jun	160	159	**0**	0.00%	**1**	0.63%	**0**	0.00%

29-Jun	72	71	**1**	1.39%	**0**	0.00%	**0**	0.00%
30-Jun	48	45	**2**	4.17%	**1**	2.08%	**0**	0.00%
1-Jul	22	20	**0**	0.00%	**0**	0.00%	**2**	9.09%
2-Jul	29	27	**0**	0.00%	**2**	6.90%	**0**	0.00%
3-Jul	42	42	**0**	0.00%	**0**	0.00%	**0**	0.00%
4-Jul	22	22	**0**	0.00%	**0**	0.00%	**0**	0.00%
5-Jul	81	81	**0**	0.00%	**0**	0.00%	**0**	0.00%
6-Jul	61	60	**1**	1.64%	**0**	0.00%	**0**	0.00%
7-Jul	59	58	**1**	1.69%	**0**	0.00%	**0**	0.00%
8-Jul	199	197	**0**	0.00%	**2**	1.01%	**0**	0.00%
9-Jul	568	568	**0**	0.00%	**0**	0.00%	**0**	0.00%
10-Jul	455	455	**0**	0.00%	**0**	0.00%	**0**	0.00%
11-Jul	620	619	**0**	0.00%	**1**	0.16%	**0**	0.00%
12-Jul	185	185	**0**	0.00%	**0**	0.00%	**0**	0.00%
13-Jul	58	58	**0**	0.00%	**0**	0.00%	**0**	0.00%
14-Jul	136	136	**0**	0.00%	**0**	0.00%	**0**	0.00%
15-Jul	114	114	**0**	0.00%	**0**	0.00%	**0**	0.00%
16-Jul	51	51	**0**	0.00%	**0**	0.00%	**0**	0.00%
17-Jul	71	71	**0**	0.00%	**0**	0.00%	**0**	0.00%
18-Jul	94	94	**0**	0.00%	**0**	0.00%	**0**	0.00%
19-Jul	332	329	**2**	0.60%	**1**	0.30%	**0**	0.00%
20-Jul	140	139	**1**	0.71%	**0**	0.00%	**0**	0.00%
21-Jul	98	97	**0**	0.00%	**1**	1.02%	**0**	0.00%
22-Jul	125	123	**0**	0.00%	**1**	0.80%	**1**	0.80%
23-Jul	372	369	**1**	0.27%	**2**	0.54%	**0**	0.00%
24-Jul	207	205	**0**	0.00%	**1**	0.48%	**1**	0.48%
25-Jul	744	743	**1**	0.13%	**0**	0.00%	**0**	0.00%
26-Jul	337	334	**2**	0.59%	**1**	0.30%	**0**	0.00%
27-Jul	64	63	**1**	1.56%	**0**	0.00%	**0**	0.00%
28-Jul	183	180	**1**	0.55%	**2**	1.09%	**0**	0.00%
29-Jul	479	478	**0**	0.00%	**1**	0.21%	**0**	0.00%
30-Jul	173	169	**1**	0.58%	**3**	1.73%	**0**	0.00%
31-Jul	155	153	**1**	0.65%	**0**	0.00%	**1**	0.65%
1-Aug	148	148	**0**	0.00%	**0**	0.00%	**0**	0.00%
2-Aug	24	24	**0**	0.00%	**0**	0.00%	**0**	0.00%
3-Aug	34	34	**0**	0.00%	**0**	0.00%	**0**	0.00%
4-Aug	46	46	**0**	0.00%	**0**	0.00%	**0**	0.00%
5-Aug	26	25	**0**	0.00%	**1**	3.85%	**0**	0.00%
6-Aug	27	27	**0**	0.00%	**0**	0.00%	**0**	0.00%
7-Aug	28	28	**0**	0.00%	**0**	0.00%	**0**	0.00%
8-Aug	25	25	**0**	0.00%	**0**	0.00%	**0**	0.00%
9-Aug	26	26	**0**	0.00%	**0**	0.00%	**0**	0.00%
10-Aug	23	23	**0**	0.00%	**0**	0.00%	**0**	0.00%
11-Aug	49	49	**0**	0.00%	**0**	0.00%	**0**	0.00%
12-Aug	27	27	**0**	0.00%	**0**	0.00%	**0**	0.00%
13-Aug	34	34	**0**	0.00%	**0**	0.00%	**0**	0.00%
14-Aug	15	15	**0**	0.00%	**0**	0.00%	**0**	0.00%

15-Aug	17	17	**0**	0.00%	**0**	0.00%	**0**	0.00%
16-Aug	13	13	**0**	0.00%	**0**	0.00%	**0**	0.00%
17-Aug	22	22	**0**	0.00%	**0**	0.00%	**0**	0.00%
18-Aug	34	34	**0**	0.00%	**0**	0.00%	**0**	0.00%
19-Aug	8	8	**0**	0.00%	**0**	0.00%	**0**	0.00%
20-Aug	7	7	**0**	0.00%	**0**	0.00%	**0**	0.00%
21-Aug	11	11	**0**	0.00%	**0**	0.00%	**0**	0.00%
22-Aug	7	7	**0**	0.00%	**0**	0.00%	**0**	0.00%
23-Aug	3	3	**0**	0.00%	**0**	0.00%	**0**	0.00%
24-Aug	11	11	**0**	0.00%	**0**	0.00%	**0**	0.00%
25-Aug	9	9	**0**	0.00%	**0**	0.00%	**0**	0.00%
26-Aug	6	6	**0**	0.00%	**0**	0.00%	**0**	0.00%
27-Aug	7	7	**0**	0.00%	**0**	0.00%	**0**	0.00%
28-Aug	7	7	**0**	0.00%	**0**	0.00%	**0**	0.00%
29-Aug	6	6	**0**	0.00%	**0**	0.00%	**0**	0.00%
30-Aug	6	5	**0**	0.00%	**1**	16.67%	**0**	0.00%
31-Aug	1	1	**0**	0.00%	**0**	0.00%	**0**	0.00%
Totals	**44213**	**44004**	**69**	**0.16%**	**127**	**0.29%**	**13**	**0.03%**

Descale = 5% for 3 consecutive days
Injury = 3% for 3 consecutive days
Mortality = 2% for 3 consecutive days

APPENDIX E. SUMMARY OF MARKED FISH RELEASES (MFR) WITHIN THE JFBS FOR EVALUATION OF DESCALE, INJURY, AND MORTALITY, SPRING, 2019.

Appendix E. Summary of Marked Fish Releases (MFR) within the JFBS for evaluation of descale, injury, and mortality, spring, 2019.

Purpose: Locate potential source of descale, injury, and mortality in bypass system prior to season startup.

Date	Release Location*	Number Released	Number Recaptured	Number Partially Descaled (<10%)	Number Descaled (>20%)	Percent Descaled	Injured	Percent Injured	Mortality	Percent Mortality	"Apparent" Conclusion
3/21/19	SC (upstream of trashrack, north channel)	100	99	0	0	0.00%	0	0.00%	0	0.00%	No injury or mortality observed. No descale greater than 10% for either channel.
	SC (upstream of trashrack, south channel)	100	98	0	0	0.00%	0	0.00%	0	0.00%	
3/21/19	Unit 2	100	42	0	0	0.00%	0	0.00%	0	0.00%	Issue discovered with Unit 2 VBS deployment. Screens were extracted, redeployed, and retested. No injuries or mortalities in either test.
3/26/19	Unit 2	99	96	0	0	0.00%	0	0.00%	0	0.00%	

*Test release for Unit 1 was not performed as unit was down for maintenance for the entirety of the 2019 sampling season
SC - surface collector

APPENDIX F. SUMMARY OF HISTORIC FISH BYPASS EFFICIENCY (FBE) FOR ROCKY REACH DAM, 2003 TO 2011.

Appendix F. Summary of Historic Fish Bypass Efficiency (FBE) for Rocky Reach Dam JFBS, 2003-2011.

Fish Bypass Efficiency					
		Radio Tags (2003) Acoustic Tags (2004-2011)			
Year	Species-(river mile release site)	SC	ISS	SC2/GCS	Total
2003[1]	Chinook Yearlings-RM 484	44.2%	9.8%	N/A	54.0%
2003[1]	Steelhead-RM 484	51.5%	7.3%	N/A	58.8%
2003[1]	Sockeye Salmon-RM 484	10.6%	6.7%	N/A	17.3%
2003[1]	Subyearling Chinook-RM 484	31.0%	6.4%	N/A	37.4%
2004	Chinook Yearlings-RM 515.8	26.8%	5.8%	N/A	32.6%
2004	Steelhead-RM 515.8	66.8%	3.6%	N/A	70.4%
2004	Sockeye Salmon-RM 515.8	38.3%	1.2%	N/A	39.5%
2004	Subyearling Chinook-RM 515.8	24.7%	6.4%	N/A	31.1%
2005	Chinook Yearlings-RM 515.8	31.7%	9.2%	N/A	40.9%
2005	Steelhead-RM 515.8	67.5%	6.3%	N/A	73.8%
2005	Sockeye Salmon-RM 515.8	31.0%	8.2%	N/A	39.2%
2006	Steelhead-RM 515.8	64.0%	4.1%	N/A	68.1%
2006	Sockeye Salmon-RM 515.8	38.9%	3.4%	N/A	42.3%
2007	Sockeye Salmon-RM 515.8	36.9%	3.5%	N/A	40.4%
2008	Sockeye Salmon-RM 515.8	41.2%	4.5%	N/A	45.7%
2009	Sockeye Salmon-RM 515.9	56.3%	3.4%	N/A	59.7%
2010	Yearling Chinook Salmon-RM 515.9	48.4%	5.2%	N/A	53.6%
2011	Yearling Chinook Salmon-RM 515.9	42.6%	6.5%	N/A	49.1%

SC = Surface Collector; ISS = Intake Screen System; GCS = Gatewell Collection System; RM = River Mile

[1] First year of FBE studies with the permanent juvenile fish bypass system.

APPENDIX G. HISTORICAL DESCALE, INJURY, AND MORTALITY PATTERNS OBSERVED AT THE ROCKY REACH JSF (2005).

Appendix G. Historical descale, injury, and mortality patterns observed at Rocky Reach JSF (2005).

<u>Scratch Pattern Descale</u>

<u>Circular Pattern Descale</u>

Patch Pattern Descale

Injury (Herring Bone Injury)

Mortality

APPENDIX H. HISTORICAL PIKEMINNOW PREDATION EVENTS OBSERVED AT THE ROCKY REACH JSF (2005).

Appendix H. Historical pikeminnow predation events observed at the Rocky Reach JSF (2005).

Left side of smolt showing descale and lacerations

Pikeminnow (350 mm) and smolt (144 mm) size comparison

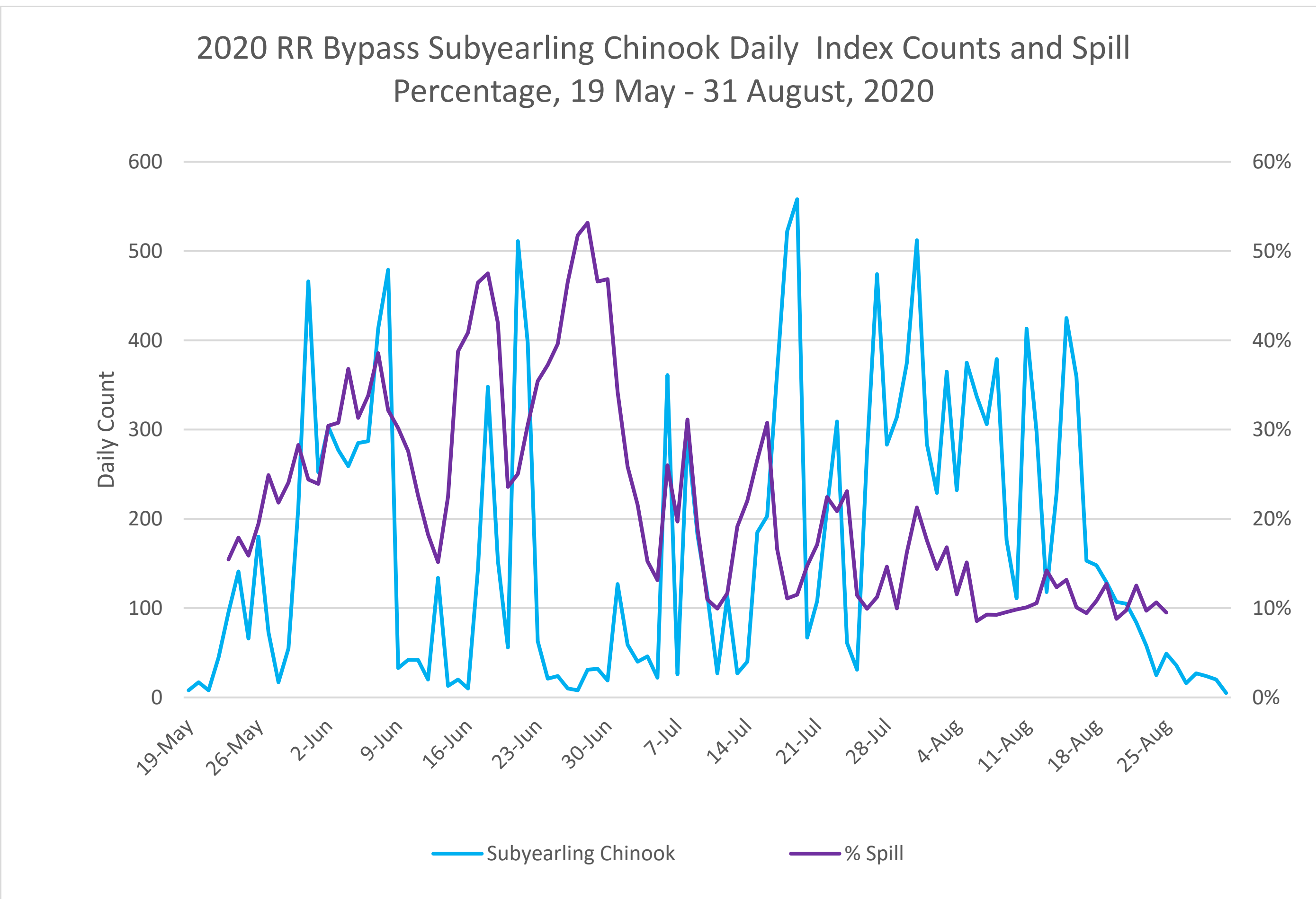
Appendix M
2020 Rocky Reach and Rock Island Fish Spill Report

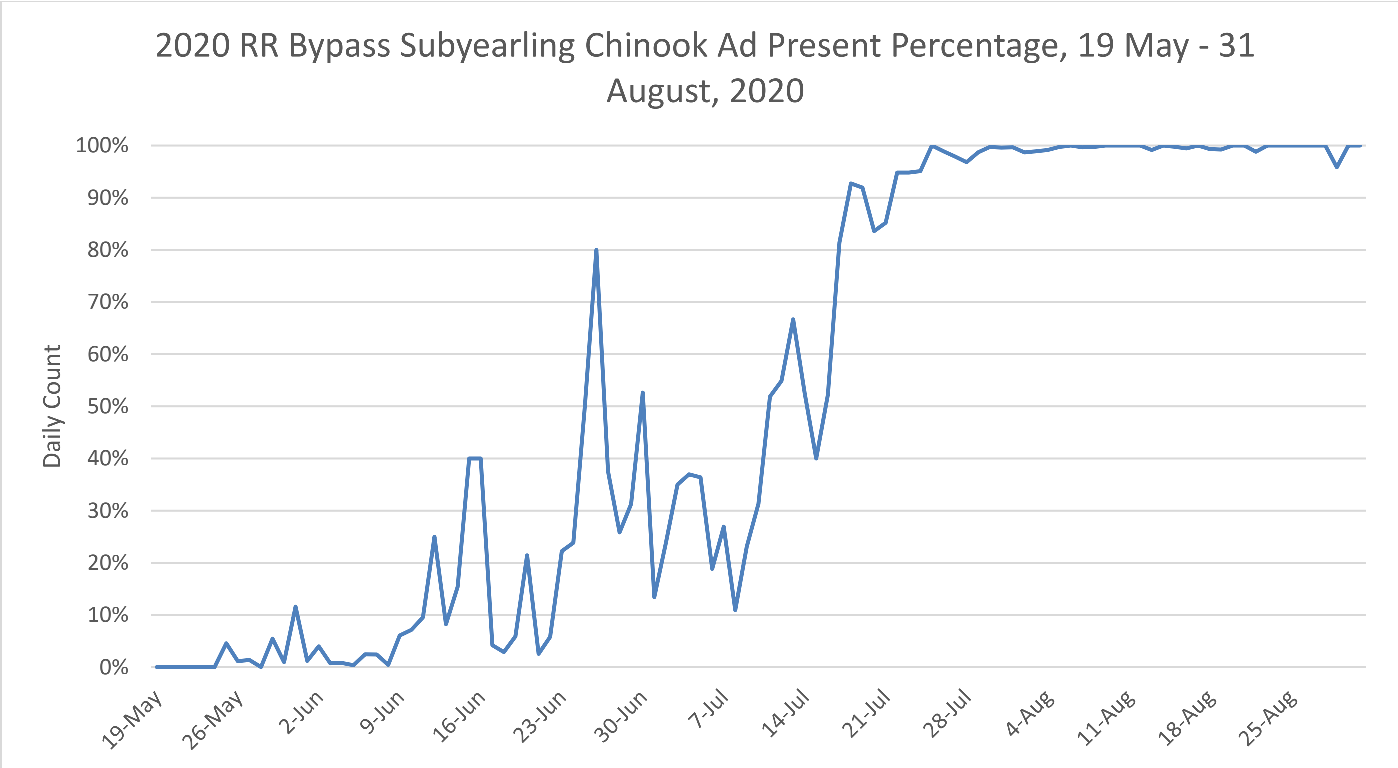
Chelan PUD
Rocky Reach and Rock Island HCPs
Final 2020 Fish Spill Report

2020 ROCKY REACH

Summer Spill

Target species:	Subyearling Chinook
Spill target percentage:	9% of day average river flow
Spill start date:	23 May, 0001 hours
Spill stop date:	25 August, 2400 hours
95% Est. passage date:	16 August
Percent of run with spill:	98.7% on 25 August (estimated as of 31 August)
Cumulative index count:	25,925 subyearling Chinook (as of 31 August)
Summer spill percentage:	24.19% (8.93% fish spill, plus 15.26% forced spill)
Avg river flow at RR:	163,054 cfs (23 May - 25 August)
Avg spill rate at RR:	39,436 cfs (23 May - 25 August)
Total spill days:	95

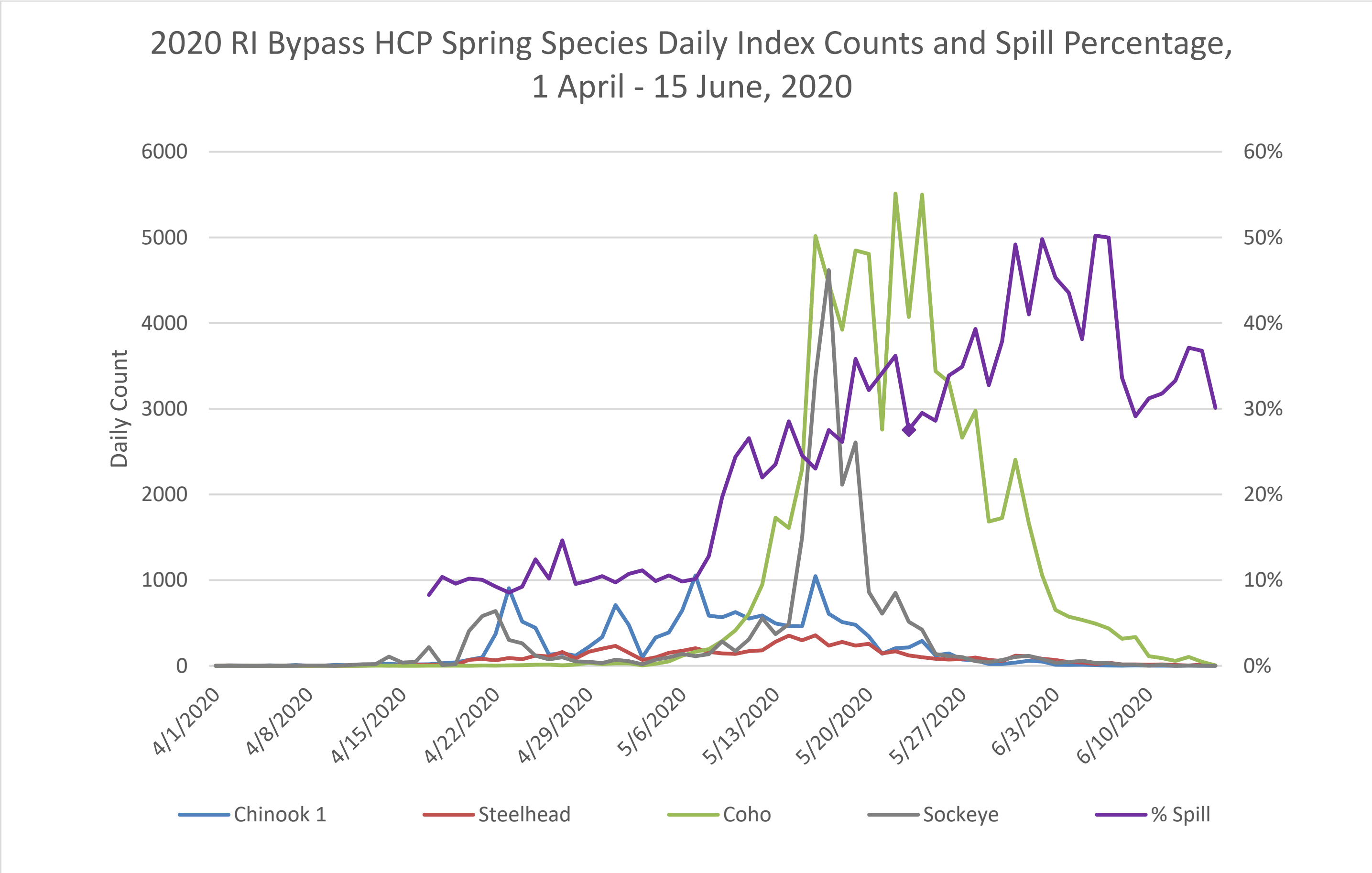




<u>2020 ROCK ISLAND</u>

Spring Spill

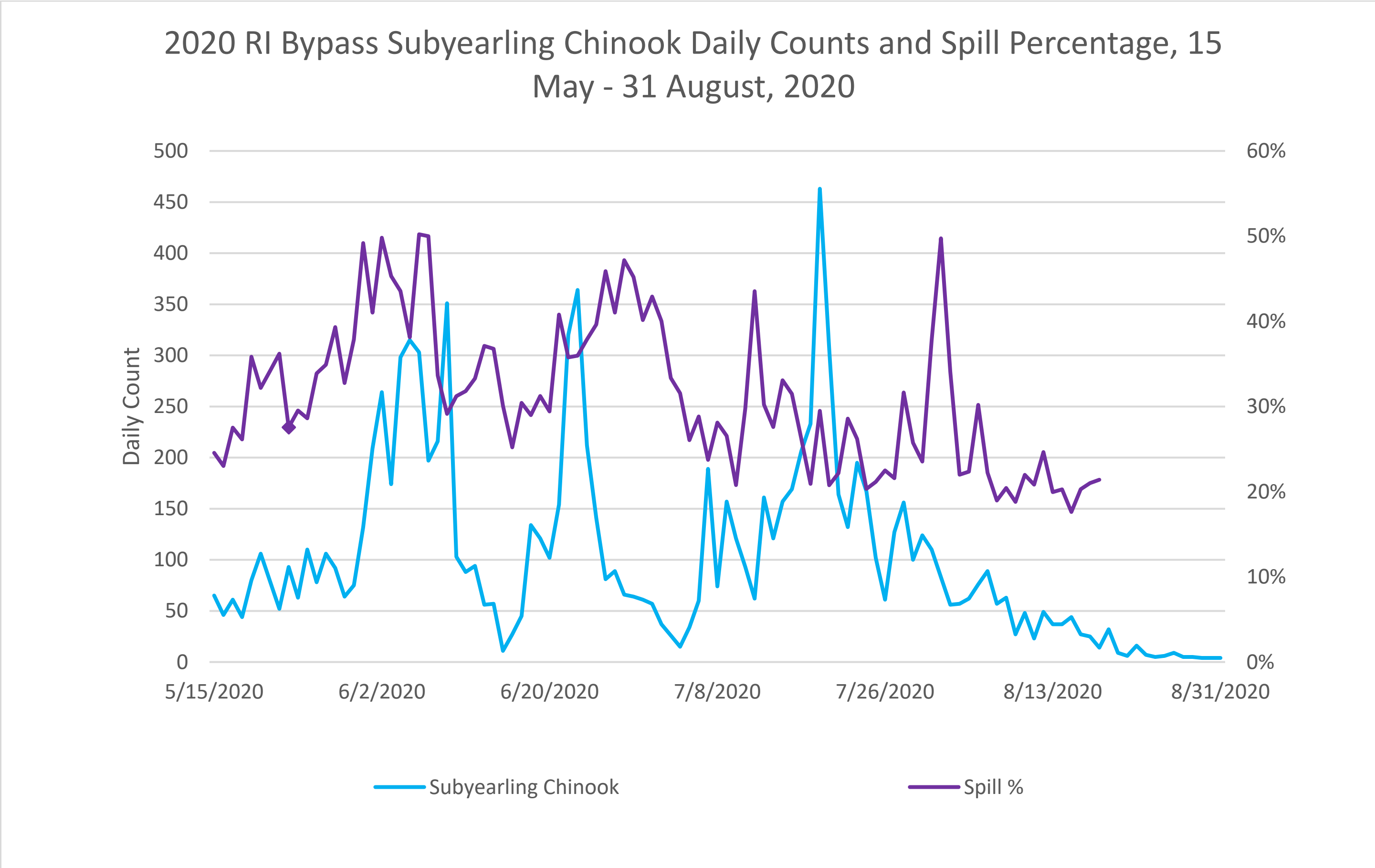
Target species:	Yearling Chinook, steelhead, sockeye
Spill target percentage:	10% of day average river flow
Spill start date:	17 April, 0001 hours
Spill stop date:	22 May, 2400 hours (immediate increase to 20% summer spill)
Percent of run with spill:	Yearling Chinook – 99.3%; steelhead – 99.6%; sockeye – 98.7% (spring and summer fish spill combined)
Cumulative index count:	24,278 yearling Chinook**;** 11,708 steelhead**;** 42,498 sockeye (as of 31 August)
Spring spill percentage:	19.07% (9.86% fish spill, plus 9.21% forced spill)
Avg river flow at RI:	147,944 cfs (17 April – 22 May)
Avg spill flow at RI:	28,214 cfs (17 April – 22 May)
Total spill days:	36



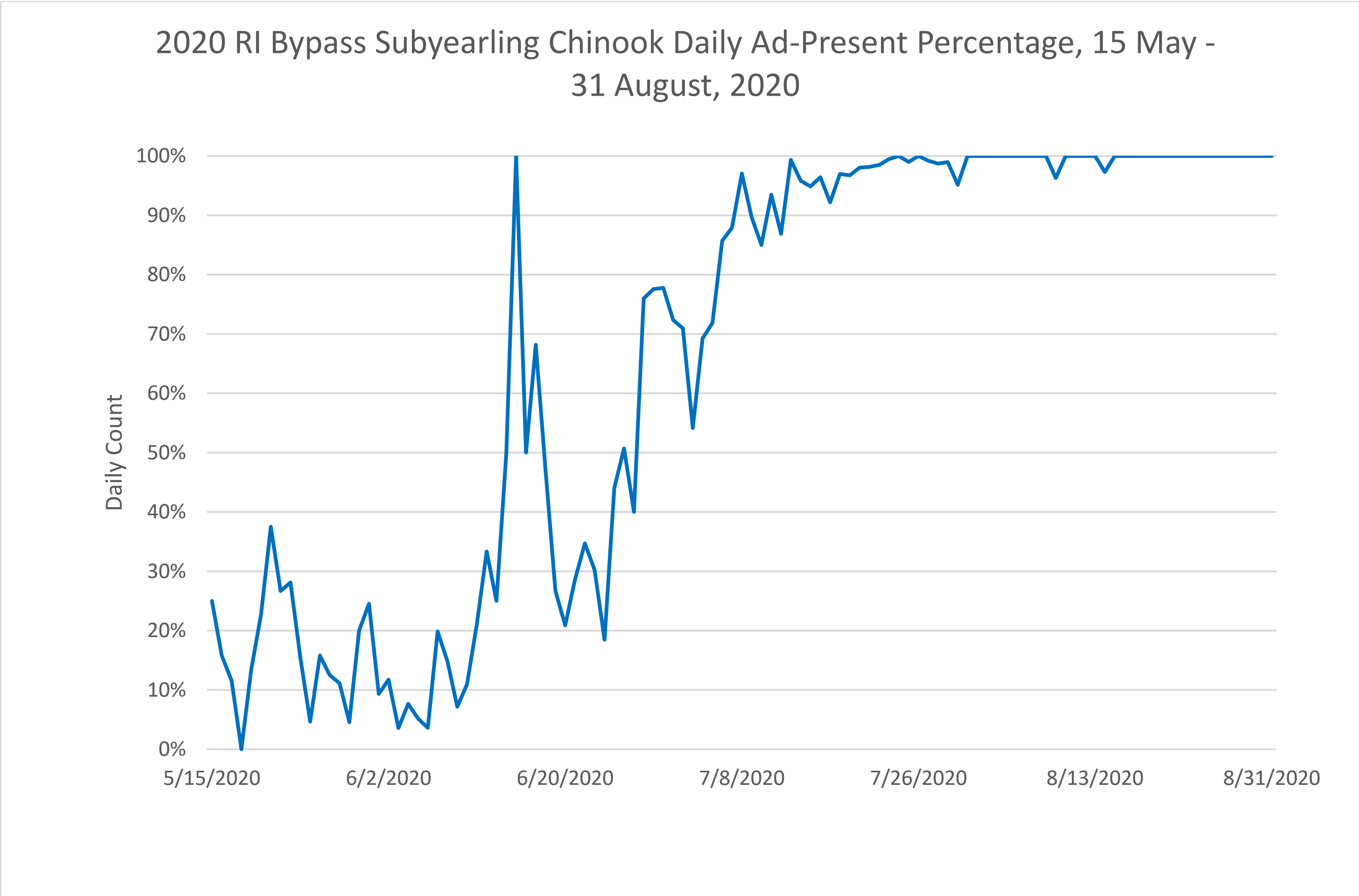
*Fish spill was instantaneously transitioned from spring fish spill(10%) to summer fish spill (20%) at 0001 hours on 23 May, 2020, as indicated by the diamond above along the % spill line.

Summer Spill

Target species:	Subyearling Chinook
Spill target percentage:	20% of day average river flow
Spill start date:	23 May, 0001 hours
Spill stop date:	18 August, 2400 hours
95% Est. passage date:	6 August
Percent of run with spill:	99.2% on 18 August (estimated as of 31 August)
Cumulative index count:	18,115 subyearling Chinook (as of 31 August)
Summer spill percentage**:**	32.84% (19.87% fish spill, plus 12.97% forced spill)
Avg river flow at RI:	171,369 cfs (23 May - 18 August)
Avg spill flow at RI:	56,280 cfs (23 May - 18 August)
Total spill days:	88



*Fish spill was instantaneously transitioned from spring fish spill(10%) to summer fish spill (20%) at 0001 hours on 23 May, 2020, as indicated by the diamond above along the % spill line.



2020 RI Bypass Subyearling Chinook Daily Ad-Present Percentage, 15 May - 31 August, 2020
Daily Count
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
5/15/2020
6/2/2020
6/20/2020
7/8/2020
7/26/2020
8/13/2020
8/31/2020

Juvenile Index Counts 2010-2020 from the Rocky Reach Juvenile Fish Bypass Sampling Facility and Rock Island Bypass Trap Smolt Monitoring Program (SMP) 1 April – 31 August (Tables 1 and 2).

Table 1. Rocky Reach Juvenile Bypass index sample counts, 2010-2020

Species	**2010**	**2011**	**2012**	**2013**	**2014***	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Sockeye	724,394	67,879	384,224	199,497	553,645	53,575	1,374,418	**60,432**	**597,162**	**34,212**	**161,608**
Steelhead	4,931	5,683	4,902	2,528	5,270	4,157	1,478	**2,928**	**1,458**	**3,769**	**2,461**
Yearling Chinook	33,840	24,400	95,207	29,018	15,871	32,220	41,676	**37,302**	**23,274**	**15,610**	**15,530**
Subyearling Chinook	59,751	17,246	5,774	22,073	22,327	37,104	8,905	**27,404**	**9,122**	**33,299**	**25,925**

Table 2. Rock Island Smolt Monitoring Program index sample counts, 2010-2020

Species	**2010**	**2011**	**2012**	**2013**	**2014***	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Sockeye	37,404	18,697	46,788	25,111	38,596	4,128	56,638	**11,117**	**76,245**	**7,416**	**42,498**
Steelhead	17,194	28,408	16,957	15,099	28,299	12,549	17,663	**32,135**	**24,731**	**9,881**	**11,708**
Yearling Chinook	11,802	26,407	25,759	28,324	26,429	16,762	44,784	**50,604**	**49,702**	**18,855**	**24,278**
Subyearling Chinook	23,205	27,397	27,298	17,170	34,527	15,349	13,270	**63,579**	**27,540**	**11,876**	**18,115**

***** In 2014, as directed by the HCP, Chelan PUD conducted bypass operations outside of the normal operating period of 1 April to 31 August to assess achievement of bypass operations for 95% of the subyearling Chinook outmigration. The Rocky Reach juvenile fish bypass operated from 1 April through 15 September, and the Rock Island bypass facility at powerhouse 2 operated from 1 April through 15 September.

Appendix N
2020 Broodstock Collection Protocols

PUBLIC UTILITY DISTRICT NO. 1 OF CHELAN COUNTY
327 North Wenatchee Avenue, Wenatchee, WA, 98801, (509)-661-4364

PUBLIC UTILITY DISTRICT NO. 1 OF DOUGLAS COUNTY
1151 Valley Mall Parkway, East Wenatchee, WA, 98801-4497, (509) 881-2208

PUBLIC UTILITY DISTRICT NO. 2 OF GRANT COUNTY
30 C Street Southwest, Ephrata, WA, 98823, (509) 793-1468

STATE OF WASHINGTON DEPARTMENT OF FISH AND WILDLIFE
Wenatchee Research Office
3515 Chelan Hwy 97-A Wenatchee, WA 98801, (509) 664-1227

March 18, 2020

To: NMFS, HCP HC's, and PRCC HSC

From: Chelan, Douglas, and Grant PUDs and WDFW

Subject: **HCP HCs and PRCC HSC-APPROVED UPPER COLUMBIA RIVER 2020 BY SALMON AND 2021 BY STEELHEAD HATCHERY PROGRAM MANAGEMENT PLAN AND ASSOCIATED PROTOCOLS FOR BROODSTOCK COLLECTION, REARING/RELEASE, AND MANAGEMENT OF ADULT RETURNS**

Introduction

The attached protocol was developed for hatchery programs rearing spring Chinook salmon, summer Chinook salmon, Coho salmon, and summer steelhead associated with the three mid-Columbia Anadromous Fish Agreement(s) and Habitat Conservation Plan(s) (HCPs); spring Chinook salmon, summer Chinook salmon and steelhead programs associated with the 2008 Biological Opinion for the Priest Rapids Hydroelectric Project and Salmon and Steelhead Settlement Agreement (FERC No. 2114); and fall Chinook salmon consistent with Grant County Public Utility District and Federal mitigation obligations associated with Priest Rapids and John Day dams (ACOE funded), respectively. These programs are funded by Chelan, Douglas, and Grant County Public Utility Districts (PUDs), and ACOE, and are predominately operated by the Washington Department of Fish and Wildlife (WDFW) with the exceptions of: 1) the Omak Creek/Okanogan Basin steelhead broodstock collection, and acclimation/release of Omak Creek steelhead, which is implemented by the Confederated Tribes of the Colville Reservation (CTCR), and 2) The Wells and Methow fish hatcheries operated by Douglas PUD. Steelhead and spring Chinook programs at the US Fish & Wildlife Service's (USFWS) Winthrop National Fish Hatchery (WNFH) are not under the purview of the HC/HSC. However, because both programs are genetically and operationally linked with HC/HSC programs in the Methow Subbasin, details are included for informational and coordination purposes.

This protocol is intended to be a guide for 2020 collection of salmon (20BY) and 2020/2021 collection of steelhead (21BY) broodstocks in the Methow, Okanogan, Wenatchee, and Columbia River basins. It is consistent with previously defined program objectives such as program operational intent (i.e., conservation and/or harvest augmentation), mitigation production levels (e.g., HCPs and Priest Rapids Salmon and Steelhead Settlement Agreement/2008 BiOp), changes to programs as approved by the HCP Hatchery Committee (HCP-HC) and Priest Rapids Coordinating Committee-Hatchery Subcommittee (PRCC-HSC), and to comply with ESA permit provisions, USFWS consultation requirements.

These protocols may be adjusted in-season, based on actual run monitoring at mainstem dams and/or other sampling locations. Additional adaptive management actions as they relate to broodstock objectives may be implemented as determined by the HCP-HC or PRCC-HSC and within the boundaries of applicable permits.

Also included in the 2020 Broodstock Collection Protocols are:

Appendix A: 2020 BY Biological Assumptions for UCR Spring, Summer, and Fall Chinook and 2021 BY Summer Steelhead Hatchery Programs
Appendix B: Current Brood Year Juvenile Production Targets, Marking Methods, Release Locations
Appendix C: Return Year Adult Management Plans
Appendix D: Site Specific Trapping Operation Plans
Appendix E: Columbia River TAC Forecast
Appendix F: Annual Chelan, Douglas, and Grant County PUD RM&E Implementation Plans
Appendix G: DRAFT Hatchery Production Management Plan
Appendix H: Program Specific Rearing and Release Descriptions
Appendix I: 2020 BY spring and Summer Chinook Disease Management Plans
Appendix J: 2020 Yakama Nation (YN) Coho Broodstock Collection Plans

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Notable in this year's protocols:

- Continuing for 2020, no age-2 or age-3 males will be incorporated into spring or summer/fall Chinook programs unless necessary to maintain effective population size (minimum female to male ratio of 1:0.75; conservation programs only) and to minimize the necessity of using hatchery origin males in lieu of.

- Continuation of spring Chinook trapping efforts at the Wells Dam East and West ladder traps consistent with 2019 operations.

- Collection of surplus hatchery origin steelhead from the Twisp Weir (up to 25% of the required broodstock) to produce the 100K Methow safety-net smolts (up to 17 adults). The remainder of the broodstock (51) will be Winthrop National Fish Hatchery (WNFH) returns collected at WNFH (or by angling/trapping for WNFH program) and/or Methow

Hatchery and surplus to the WNFH program needs. Collection of Wells stock may be used if WNFH and Twisp returns are insufficient. The collection of adults will occur in spring of 2021.

- Chelan Falls broodstock collection will prioritize 200 adults collected at Wells Dam volunteer trap (WDVT) with a minimum of 200 adults collected through a second pilot year of a temporary weir in the Chelan River Habitat Channel. Brood collected will be sufficient to meet the Chelan Falls yearling program of 576K. Adult collection via a temporary weir within the Chelan River Habitat Channel will target the full brood program. Any adults collected via the weir in excess of the minimum 200 goal will be removed from the Wells collected component and transferred to surplus holding and made available to Tribal and/or State program needs. In the event Wells FH and the pilot efforts cannot secure the appropriate number of summer Chinook broodstock for the Chelan Falls program, other locations (as determined by the Hatchery Committees) may be used

- Summer Chinook collections at Wells Dam ladder traps to support the Chief Joseph Hatchery (CJH) integrated program (adipose present non-wired adults) and Well Dam ladder traps and the Wells Hatchery volunteer trap to support the CJH segregated program (adipose clipped adults) may occur if CCT broodstock collection efforts fail to achieve broodstock collection objectives.

- Pilot elimination of NO fall Chinook broodstock from the OLAFT from 650 to 0.

- Targeted collection of about 1,250 adipose present, non-coded wire tagged fall Chinook using hook-and-line efforts in the Hanford Reach.

- Continuation of Tumwater trap operations to facilitate lamprey passage. Using Rocky Reach and Rock Island lamprey passage data as a surrogate, it is proposed to open the Tumwater Dam fishway to passage between 10PM and 6AM daily from September 1 to September 30. This should allow open passage for at least 60%-70% of the lamprey while still accommodating coho and steelhead broodstocking and steelhead adult management. Because this is the third year to operate under this schedule, some in-season adjustments may need to be made based on lamprey observations (during trapping periods) and the magnitude of steelhead adult management required.

- Addition of the 2020 YN UCR coho broodstock collection plans (includes the DPUD Coho program brood).

Methow River Basin

Coho - Douglas PUD Program- Methow Basin – Twisp River

The Douglas PUD (DPUD) coho program began with brood year 2018. The target release for BY2020 is 25,900 yearling coho. Broodstock are collected for the YN and the DPUD program collectively by the YN at Wells Dam and Hatchery, WNFH, and Methow Hatchery. The broodstock are transported to, held, and spawned at WNFH. The DPUD program obtains eggs to rear at Wells Hatchery from WNFH. See Appendix J for a complete description of the YN coho program and broodstock collection.

Spring Chinook

Inclusion of natural-origin fish in the broodstock will be prioritized for the aggregate conservation program in the Methow Basin. Collections of natural-origin fish will not exceed 33% of the Methow Composite (i.e., non-Twisp) and Twisp natural-origin run escapement consistent with take provisions in Section 10 (a)(1)(A) Permits 18925 and 20533.

Hatchery-origin spring Chinook, if needed, will be collected in numbers excess to program production requirements to facilitate BKD management, comply with ESA Section 10 permit take provisions, and to meet programmed production shortfalls. Based on historical Methow FH spring Chinook ELISA levels above 0.12, any hatchery origin spring Chinook broodstock collection will include hatchery origin spring Chinook in excess to broodstock requirements by approximately 20% (based upon the most recent 5-year mean ELISA results for the Methow/Chewuch/Twisp programs). For purposes of BKD management and to comply with maximum production levels and other take provisions specified in ESA Section 10 permits 18925 and 20533, culling will include the destruction of eggs from hatchery-origin females with ELISA levels greater than 0.12 and/or that number of hatchery-origin eggs required to maintain an aggregate production of 223,765 yearling smolts. Culling of eggs from natural-origin females will not occur unless their ELISA levels are determined by DPUD Fish Health and the Wells, Rocky Reach, and Rock Island HCP-HCs- and the PRCC-HSC to be a substantial risk to the program. Progeny of natural-origin females with ELISA levels greater than 0.12 may be differentially tagged for evaluation purposes. Annual monitoring and evaluation of the prevalence and level of BKD and the efficacy of culling returning hatchery- and natural-origin spring Chinook will continue and will be reported in the annual monitoring and evaluation report for this program.

WDFW genetic assessment of natural-origin Methow spring Chinook (Small et al. 2007) indicated that Twisp natural-origin spring Chinook can be distinguished, via genetic analysis, from non-Twisp spring Chinook with a high degree of certainty. The Wells HCP Hatchery Committee accepted that Twisp-origin fish could be genetically assigned with sufficient confidence and that natural-origin collections can occur at Wells Dam. Scale samples and non-lethal tissue samples (fin clips) for genetic/stock analysis will be obtained from adipose-present, non-CWT, non-ventral-clipped spring Chinook (suspected natural-origin spring Chinook) collected at Wells Dam, and origins assigned based on genetic analysis. Natural-origin fish retained for broodstock will be PIT tagged (pelvic girdle) for cross-referencing tissue samples/genetic analyses. Tissue samples will be preserved and sent to the WDFW genetics lab in Olympia Washington for genetic/stock analysis. Spring Chinook collected from Wells will be held until genetic analysis results are received then transferred to and retained at Methow Hatchery and spawned for each program depending on results of DNA analysis. Brood collection of NORs at Wells will be based upon assignment of Twisp NORs to the Twisp program and non-Twisp NORs being used to support Methow and Chewuch River releases. Spring Chinook collected at Methow Hatchery will be held at MFH until genetic analysis results are received and then handled accordingly.

The number of natural-origin Twisp and Methow Composite (non-Twisp) spring Chinook retained will be dependent upon the number of natural-origin adults returning and the collection objective limiting extraction to no greater than 33% of the natural-origin spring Chinook return to the Methow Basin. Natural origin fish not assigning to the Twisp or Methow Composite will be released back into the Columbia River.

Weekly estimates of the passage of Wells Dam by natural-origin spring Chinook will be provided through stock-assessment and broodstock-collection activities. This information will facilitate in-season adjustments to collection composition so that extraction of natural-origin spring Chinook remains no more than 33%. Hatchery origin adults trapped at the Winthrop NFH may be included, if needed, in the event of broodstock shortfalls.

Pre-season run-escapement of Methow-origin spring Chinook to Wells Dam during 2020 is estimated at 2,379 spring Chinook, including 1,639 hatchery and 741 natural origin spring Chinook (Table 1 and Table 2). In-season estimates of natural-origin spring Chinook will be adjusted proportional to the estimated returns to Wells Dam at weekly intervals and may result in adjustments to the broodstock collection targets presented in this document. In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected to meet program production needs, within the constraint of not collecting more the 33% of the natural-origin spring Chinook. Adjustments made to broodstock collection targets based on pre-spawn mortality exceeding current year assumptions will require review and concurrence on the additional number and composition of the broodstock necessary to backfill shortfalls.

The following broodstock collection protocol was developed based on BKD management strategies, projected return for BY 2020 Methow Basin spring Chinook at Wells Dam (Table 1 and Table 2), and biological assumptions listed in Appendix A.

The 2020 aggregate Methow spring Chinook broodstock collection will target up to 122 adult spring Chinook (16 Twisp, 106 Methow; Table 3). Collection of wild spring Chinook for broodstock requires a run size of at least 48 adults to the Twisp River and 318 adults to the Methow and Chewuch rivers in aggregate. Should the run of wild spring Chinook fall below these thresholds, the brood collection will be adjusted to meet ESA Section 10 permit and BiOp conditions. Broodstock collected for the aggregate Methow conservation programs represents 100% of the broodstock necessary to meet the Methow programs production of 223,765 smolts. The Twisp River releases will be limited to releasing progeny of broodstock identified as wild Twisp and or known Twisp hatchery-origin fish, per ESA Permit 18925. The MetComp releases will include progeny of broodstock identified as wild non-Twisp origin (or known Methow

Composite hatchery origin if needed to meet shortfalls in the production goal) fish. Age-3 males ("jacks") will not be collected for broodstock unless needed to meet effective population goals and minimize contribution of hatchery fish within the conservation program.

Table 1. Brood year 2015 and 2016 age class-at-return projection for wild spring Chinook above Wells Dam, 2020.

Brood Year	Smolt Estimate		Age-at-return							
			Twisp sub-basin				Methow sub-basin			
	Twisp[1]	Methow Basin[2]	Age-4	Age-5	Total	SAR[3]	Age-4	Age-5	Total	SAR[4]
2015	22,738	26,491	131	**20**	151	0.0074	453	**92**	545	0.0219
2016	26,827	26,290	**155**	24	179	0.0074	**449**	91	540	0.0219
Estimated 2020 Return			**155**	**20**	**175**		**449**	**92**	**541**	

[1] *Smolt estimate is based on sub-yearling and yearling emigration (Charlie Snow, personal communication).*

[2] *Estimated Methow Basin smolt emigration based on Twisp Basin smolt emigration, proportional redd deposition in the Twisp River and Twisp Basin smolt production estimate.*

[3] *Geometric mean Twisp NOR spring Chinook SAR to Wells Dam estimated using natural origin PIT tag returns (BY 2003-2009; David Grundy, personal communication).*

[4] *Geometric mean Methow NOR spring Chinook SAR to Wells Dam estimated using natural origin PIT tag returns (BY 2003-2009; David Grundy, personal communication).*

Table 2. Brood year 2015 to 2017 age class and origin run escapement projection for UCR spring Chinook at Wells Dam, 2020.

	Projected Run Escapement											
	Origin								**Total**			
	Hatchery				**Wild**				**Methow Basin**			
Stock	**Age-3**	**Age-4**	**Age-5**	**Total**	**Age-3**	**Age-4**	**Age-5**	**Total**	**Age-3**	**Age-4**	**Age-5**	**Total**
MetComp	183	633	12	**828**	18	449	92	**559**	201	1,082	104	**1,387**
%Total				50.5%				75.4%				58.3%
Twisp	15	49	14	**78**	7	155	20	**182**	22	204	34	**260**
%Total				4.8%				24.6%				10.9%
Winthrop (MetComp)	88	612	32	**733**					88	612	32	**733**
%Total				44.7%								30.8%
Total	286	1,294	46	**1,639**	25	604	112	**741**	311	1,898	170	**2,379**

Table 3. Number of broodstock needed for the combined Methow spring Chinook conservation program production obligation of 223,765 smolts, collection location, and mating strategy.

By obligation	Production target	Number of Adults: Hatchery	Number of Adults: Wild	**Total**		
Chelan PUD	60,516		16F/16M	**32**		
Douglas PUD	29,123		8F/8M	**16**		
Grant PUD	134,126		37F/37M	**74**		
Total	**223,765**		**61F/61/M**	**122**		
By program		Number of Adults: Hatchery	Number of Adults: Wild	**Total**	Collection location	Mating protocol
Twisp	**30,000**		**8F/8M**	**16**	Wells Dam/Twisp Weir	2x2 factorial
MetComp	**193,765**		**53F/53M**	**106**	Wells Dam/Methow Hatchery	2x2 factorial
Total	**223,765**		**61F/61M**	**122**		

Trapping at Wells Dam will occur at the East and West ladder traps beginning on May 1, or at such time as the first spring Chinook are observed passing Wells Dam, and continue through June 30, 2020 (collection quotas will be prioritized for the May 1-June 22 time frame). Spring Chinook broodstock collection and stock assessment sampling activities authorized through the 2020 Douglas PUD Hatchery M&E Implementation Plan will utilize a combination of trapping on the East and West ladders as per the detailed descriptions of the modified trapping operations for spring Chinook collection in Appendix D. Natural-origin spring Chinook will be retained from the run, consistent with spring Chinook run timing at Wells Dam (weekly collection quota). Collection goals will be developed by Wells M&E and DPUD staff to identify the most appropriate spatial and temporal approach to achieving the overall brood target. All natural-origin spring Chinook collected at Wells Dam for broodstock will initially be held at Wells FH pending genetic results and then transferred to Methow FH. Fish collected at MFH will remain at MFH or be transferred to WNFH.

Collection of ad-clipped +CWT spring Chinook adults may occur from facilities in the Methow basin and/or Wells Dam. These alternative collection locations will only be used if USFWS broodstock collection efforts fail to achieve broodstock collection objectives for the CJH 10j program.

Trapping at the Twisp Weir for spring Chinook may begin May 1 or at such time as spring Chinook are observed passing Wells Dam and may continue through August 23. The trap may be operated up to seven days per week/16 hours per day for spring Chinook (operations described in Appendix D).

However, trapping at the Methow Hatchery Outfall trap may continue beyond the Twisp Weir operations as needed to meet basin wide PNI/pHOS objectives. Hatchery-origin returns from the conservation program captured at the Methow Hatchery Outfall (surplus to the Methow Hatchery program) may be transferred to the WNFH for surplus/pHOS management, broodstock needs, or other beneficial use as approved by the HCP HCs, PRCC HSC, and/or co-managers and as allowed by permit conditions.

Steelhead

Douglas PUD and Grant PUD steelhead mitigation programs above Wells Dam utilize adult broodstock collections from multiple sources and locations (Table 4). Broodstock for the conservation programs (USFWS and DPUD) is achieved via angling in the Methow Basin and trapping at the Twisp Weir, WNFH, and Methow Hatchery (as needed). Broodstock for the Methow safety-net program is achieved primarily through returns to WNFH (including hook and line-caught HOR steelhead) and surplus fish removed at Methow Hatchery and the Twisp Weir. Broodstock for the Columbia safety-net is achieved primarily through adult returns to the Wells volunteer trap and through surplus adults collected at MFH and WNFH. Broodstock collection for the Okanogan conservation program (GPUD) is achieved via Omak weir, dip-netting and or box traps in tributaries to the Okanogan River, and hook-and-line angling in the mainstem Okanogan and tributaries. Broodstock collected for the Okanogan safety-net program (GPUD) is primarily collected from Omak Creek but also in the Okanogan River and tributaries to the Okanogan River via box traps, traditional dip-net methods and hook-and-line angling Further, if any shortfalls were to occur with broodstock collections in the Okanogan, any remaining collections may occur in the spring from the volunteer trap at Wells FH. Incubation and rearing for the Methow safety-net, Columbia Safety-net, and Okanogan programs, occurs at Wells Fish Hatchery (FH). Broodstock holding, spawning, and incubation to the eyed stage occurs at WNFH for the Twisp and Methow Conservation program components. PUD-components of eyed eggs are transferred to Wells Hatchery for final incubation and rearing. Methow Hatchery may be used to temporarily hold broodstock that are ultimately transferred to Wells Hatchery or WNFH. In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected to meet program production needs, within the constraint of not collecting more the 33% of the natural origin summer steelhead. Adjustments made to broodstock collection targets based on pre-spawn mortality exceeding current-year assumptions will require review and concurrence on the additional number and composition of the broodstock necessary to backfill shortfalls.

Specific program brood sources are structured as follows:

Broodstock collection for the DPUD and GPUD summer steelhead programs is designed to meet program production goals while minimizing the probability of producing overages. The following broodstock collection logic provides a step-by-step process whereby DPUD, GPUD, and WNFH summer steelhead broodstock will be collected.

1. February 2021-April 2021: Hook-and Line collections in the Methow mainstem: target sufficient natural-origin summer steelhead for the Twisp Conservation component (24,000 release; 13 broodstock collected downstream of Twisp) and the WNFH (up to 200,000 release; up to 100 broodstock collected throughout Methow mainstem). These natural-origin fish are to be transported to WNFH, spawned collectively, and a portion of the progeny sufficient to meet the 24,000-release target will be transferred to Wells Hatchery as eyed eggs. By-catch of hatchery-origin fish will be retained as broodstock for the WNFH program (Ad+snout CWT), the Methow Safety-Net (snout CWT only, Ad+snout CWT), and the Columbia Safety-Net (Ad only, Ad+snout CWT), as needed. Adults in excess of broodstock needs will be managed as surplus. Go to #2.

2. March-May 2021: Twisp Weir collection. Target sufficient natural-origin summer steelhead for the Twisp Conservation component (13 adults; 24,000 release). Hatchery-origin fish to be removed at a rate to meet pHOS management target. Snout CWT-only fish to be used as broodstock for the Methow Safety-Net up to 25% (approximately 14 broodstock). Additional snout CWT-only broodstock may be used in the Columbia Safety-Net. Snout CWT+Ad may be used in the Columbia Safety-Net. No natural-origin PIT-tagged adults that are part of the YN kelt reconditioning program will be retained for broodstock. Go to # 3.

3. March-May 2021: WNFH Volunteer Channel and Methow Hatchery Volunteer channel. Natural-origin fish may be collected if present and included in the WNFH and Methow River collected component of the Twisp Conservation Program. Hatchery-origin fish will be collected and used as broodstock in the WNFH program (Ad+snout CWT), Methow Safety-Net program (Ad+snout CWT), and the Columbia Safety-Net program (Ad+snout CWT, Ad only). Such fish may be used to augment the fish previously collected described in #s 1 and 2, above. Adults in excess of broodstock and escapement needs will be managed as surplus. Go to #4.

4. February-May 2021: Okanogan River Basin collections to target, up to 58 adult steelhead, hatchery and or natural origin with provisions included in the CTCR Tribal Resource Management Plan (TRMP) BiOP. Hatchery-origin steelhead excess to escapement and broodstock needs for Omak Creek may be removed consistent with Omak Creek pHOS objectives and adult management criteria prescribed in the CTCR TRMP BiOp. Go to #5.

5. March-May 2021: The Wells Volunteer Channel will be used to collect AD+CWT, Ad only, and CWT only hatchery-origin adult summer steelhead to be used as backfill for Methow Safety-Net, Columbia Safety-Net, Okanogan Program, and WNFH program (if desired by USFWS) should any of these programs lack sufficient broodstock for the collections described above. Adult steelhead collected that have mark/tag indicating Okanogan Program

origin will be prioritized for inclusion into the Okanogan Program to address Program shortfalls. Adult hatchery-origin steelhead in excess of broodstock needs will be surplused.

Twisp River – Conservation Releases

Due to the recent increased concern for inbreeding depression risk (Ryman-Laikre) for the Twisp program as a result of low N_e and other confounding issues, the design of the Twisp program is currently under review.

The HC and JFP are working to redefine the scope and nature of the 2020 and 2021 brood and future Twisp program. Parties will complete this task no later than October 1 (or sooner) of the current year such that an approved plan can be implemented.

The current plan (BY 2020) collects approximately 12 natural origin fish as broodstock from the Methow Mainstem (hook and line) and approximately 12 natural origin fish as broodstock from the Twisp River (weir).

Wells Hatchery – Methow River Release

The Wells Hatchery Methow River release (Methow safety-net program) uses locally collected hatchery-origin broodstock representative of the Twisp and WNFH conservation programs and as needed, the Methow safety-net program. Adults are collected in concert with adult management and broodstock collection (including hook-and-line) activities at the Twisp Weir, Methow Hatchery, and WNFH. As a backup strategy, hatchery-origin broodstock may be collected from Wells Hatchery Volunteer Channel in spring 2021 if other broodstock collection measures fall short. Beginning with the 2018 release, fish have been truck planted at Effy Bridge (RKM 13) in the lower Methow and are no longer released from MFH.

Wells Hatchery-Columbia River Release

The Wells Hatchery Columbia River releases will use progeny returns from the Methow Safety-Net broodstock (described above). The remaining production for the Columbia Safety-Net may include hatchery-origin broodstock collected via hook-and-line in the Methow River, Twisp Weir, adult returns to the Methow Hatchery and Winthrop NFH, and may be augmented with fish collected in spring 2021 from the Wells Volunteer channel if needed to fulfill the program. Surplus eggs and/or fry from the Columbia and Okanogan broodstock may be utilized for other programs in the upper Columbia. Fish are released to the Columbia River, immediately downstream of Wells Dam.

Winthrop NFH – Methow River Release

The USFWS Methow River release will primarily use natural-origin (NO) fishcollected through hook-and-line collection efforts in the Methow River each spring. In the event NO collection falls short of the target, WNFH hatchery-origin returns will be prioritized, followed by Methow safety-net hatchery returns, subject to a production/pNOB sliding scale. Transfer of adult and/or gametes/eggs between programs will be carefully choreographed to ensure fish are being utilized in the most efficient and effective manner. Fish may be released throughout the Methow basin.

Okanogan River and Tributary Releases

The Okanogan River conservation program uses a combination of natural- and hatchery-origin adults collected in Omak Creek and elsewhere in the Okanogan Basin through CCT collection efforts. Surplus eggs and/or fry from the Okanogan River program broodstock may possibly be utilized for other programs in the upper Columbia or otherwise surplused at the earliest time when overages are apparent.

Should the Okanogan Basin spring period collection fail to achieve sufficient broodstock to meet programmed production, steelhead will be collected from the Wells Hatchery volunteer ladder in the spring of 2021, sufficient to meet broodstock needs. Fish with positive CWT or PIT tag for Okanogan origin will be the priority to fill the shortfall in broodstock, followed by unknown hatchery-origin fish.

Steelhead programs located upstream of Wells Dam and at Wells Hatchery are presented in Table 4.

Table 4. 2021 brood year Steelhead Programs at Wells Hatchery and Upstream of Wells Dam

Program	Hatchery	Owner	Release Location	Release Target	Broodstock Collection Locations
DPUD Conservation[2]	WNFH – S2; Wells Hatchery S1	Douglas PUD	Twisp River @ Buttermilk Bridge, Methow basin @ WNFH or other location as determined by the HCP-HC	48,000 (S_1)	Twisp Weir and Methow basin (angling)
Methow Safety-Net	Wells Hatchery	Douglas PUD	Effy Bridge – Lower Methow River	100,000	HxH: Twisp Weir (up to 25%) + WNFH Hatchery (75%) or WNFH 1st, MFH 2nd to make up balance
Mainstem Columbia Safety-Net	Wells Hatchery	Douglas PUD	Columbia River @ Wells Hatchery	160,000	HxH: Wells FH/Dam returns (1st option); Methow FH/WNFH (2nd option)
WNFH Conservation Program	WNFH	USFWS	Methow basin @ WNFH or other locations as determined by the JFP	Up to 200,000 (S_2)	Angling in the Methow River and Spring Creek Weir.
Okanogan[1]	Wells Hatchery/ St. Mary's Pond	Grant PUD/CCT	Okanogan tributaries	100,000[1]	Okanogan Basin, Wells FH/Wells FH/Dam

[1] CCT received approval for the Okanogan steelhead HGMP as part of their Tribal Resource Management Plan in February, 2017. Up to 58 broodstock (NOB or HOB) may be collected from throughout the Okanogan basin (or Wells Dam if necessary) to meet the 100k program.
[2] The DPUD Twisp conservation program is currently under re-development after detection of inbreeding depression risk. The HC and JFP have committed to developing an approved plan in sufficient time for implementation.

The following broodstock collection protocol was developed based on mitigation program production objectives (Table 5), biological assumptions (Appendix A), and the probability that sufficient adult steelhead will return in 2020/2021 to meet production objectives absent a reliable preseason forecast at the present time.

For the 2021 brood steelhead programs operating above Wells Dam, a total of 334 adults (194 natural origin and up to 140 hatchery origin adults) are estimated to be needed to fulfill the respective mitigation obligations (Table 5). To support these obligations and to ensure sufficient backup adults are available in the event spring tributary-based collection efforts fall short of targets, spring 2021 trapping at Wells Dam and/or Wells FH may be implemented to selectively retain sufficient adults to backfill shortfalls in spring collections (west [and east, as necessary] ladder and volunteer trap collection; Table 6). As a note, all potential broodstock collected at Wells Dam or Wells FH will be scanned for PIT tags at collection and PIT tagged fish will be returned to the river to meet their monitoring objective. Any adult determined to have been part of the Yakama Nation's kelt reconditioning program will be released in the vicinity it was collected.

Twisp Conservation Program (DPUD)

The HC and JFP may redefine the scope and nature of the 2021 brood collection and future Twisp program, but would not implement a redefined program for the 2021 brood unless parties complete and approve necessary plans no later than October 1 of the current year.

Methow Safety Net Program

Up to 14 surplus hatchery-origin Twisp-stock steelhead (to meet up to 25% of the 100K Methow Safety-Net release) and a remainder from WNFH conservation program to comprise a total of no less than 40 hatchery adults will be targeted at collection locations including the Twisp Weir and moved as live adults to Wells Hatchery for spawning (some will be initially held at WNFH, then transferred to Wells Hatchery pre-spawning). (Table 6). If collection via hook-and-line, at the Twisp Weir, and WNFH and MH traps/collection efforts are unsuccessful (Table 5) then broodstock will be trapped in the Wells Volunteer channel in spring 2021. Coordination between USFWS, DPUD, and WDFW staff will occur during the season to determine prioritization.

Wells Hatchery-Columbia River Program

Up to 86 hatchery-origin steelhead will be targeted at the Wells FH volunteer trap (Table 6) and will prioritize progeny returns from the Methow Safety-Net broodstock. Any realized production shortfall for the Columbia Safety-Net may include hatchery-origin broodstock collected via hook-and-line in the Methow River, Twisp Weir, adult returns to the Methow Hatchery and Winthrop NFH, and may be augmented with fish collected in spring 2021 from the Wells Volunteer channel if needed to fulfill the program.

Methow Conservation Program (USFWS)

Approximately 100 natural-origin adults (50 pair) will be targeted for retention through hook–and-line collection efforts in the Methow River (Table 6). In the event of a shortage, excess hatchery steelhead from the Twisp Weir and volunteer returns to the WNFH (including angle-caught fish) will be utilized as needed to augment WNFH broodstock. Should there be inadequate surplus steelhead from these sources, excess hatchery steelhead (presumed Methow Safety-Net origin) captured at the Methow Hatchery volunteer trap will be used to fulfill the program. Natural-Origin females will be live-spawned and reconditioned by YN.

Okanogan Conservation Program (GPUD/CCT)

Up to 58 adult steelhead will be targeted in the Okanogan Basin, including up to 100% natural-origin adults (dependent on run size and within the 33% natural-origin extraction rate) (Table 5). Broodstock collected at Wells FH that are subsequently identified as Okanogan-origin will be transferred to the Okanogan program (as needed to meet program obligations). Due to unknown broodstock collection efficiencies in the Okanogan River Basin (Table 5) broodstock shortfalls for the Okanogan may be supplemented with broodstock collected in the spring of 2021 at the Wells Fish Hatchery Volunteer Ladder and/or Wells Dam east/west ladder traps to meet the production obligation.

Table 5. Number of broodstock needed to produce approximately 608,000 smolts for the above Wells Dam 2021 brood summer steelhead programs. Includes primary collection location(s) and mating strategy. *Broodstock totals do not include additional fish that may be collected at other locations as a backup for shortfalls from primary collection sources.*

Program	Production target/request	Number of Adults		Total	Collection location	Mating protocol
		Hatchery	Wild			
DPUD[1] Columbia R.	160,000	43F/43M		**86**	Wells FH/ Dam/Twisp Weir/	1:1
DPUD[2] Methow R.	100,000	27F/27M		**54[4]**	Twisp Weir, MFH, WNFH, Wells FH/Dam	1:1
DPUD Methow Conservation	48,000		12F/12M	**24**	Twisp Weir/Methow River	2x2 Factorial
GPUD Okanogan R.[3]	100,000		29F/29M	**58[5]**	Okanogan R./Omak Creek	1:1/2x2[7]
USFWS Conservation[8]	200,000[8]		50F/50M	**100**	Methow River[6]	2X2 Factorial
Total[4]	**608,000**	**70F/70M**	**91F/91M**	**322**		

[1] Mainstem Columbia releases at Wells Dam. Target HxH parental adults as the hatchery component.

[2] Methow River release of HxH fish produced from either adults returning from the Winthrop conservation program, adults trapped at MFH, and/or surplus hatchery adults from the Twisp weir, or Wells FH/Dam.

[3]CCT intends to achieve greater than 0.5 pNOB, but the actual number will be dependent upon run size and trap efficiency, per the HGMP. Numbers of hatchery and wild males and females in this table should not be taken as the goal or limit for any collection effort, as it could be up to 100% pNOB or pHOB.

[4] Additional hatchery adults may be collected at Wells FH to augment shortfalls in collections for the Methow safety net.

[5] Additional hatchery-origin adults may be collected during the spring of 2021 at Wells Dam/Wells FH to augment shortfalls in Okanogan Basin collection efforts.

[6] Collection priority: 1) hook and line, 2) adult returns to WNFH, 3) excess adult returns to Methow Hatchery.

[7] A 1:1 mating protocol will be used for all HxH/HxW crosses within the Okanogan. The Okanogan locally-adapted natural stock (WxW) will utilize a minimum 2x2 factorial mating to minimize potential negative effects associated with a small effective population size.

[8] Production is subject to a sliding production/pNOB scale where full 200K production is targeted only when broodstock pNOB is >0.75. Under run/environmental conditions where collection is unable to support extraction of 100 NORs, HOR broodstock are incorporated subject to a sliding scale (with a minimum release of 100K) as authorized in the 2017 Biological Opinion and Permit 23163 (2019).

Table 6. Broodstock collection locations, number, and origin by program.

Program	Number of Adults[1]		Primary collection location	Backup collection location(s)
	Hatchery	Wild		
DPUD Columbia R. SN	86		Wells FH/Dam, Methow River, WNFH, Methow Hatchery, Twisp Weir	Wells Hatchery
DPUD Methow R. SN	54[2]		Twisp weir (14), Methow River, WNFH[3] (46)	Wells Hatchery/Dam
DPUD Methow R. Conservation		24	Twisp Weir; Methow basin	NA
GPUD Okanogan R.	0-58[5]	0-58[5]	Omak Cr., Okanogan R. and tributaries	Wells Hatchery/Dam[5]
USFWS Methow Met Conservation	Up to 50[6]	100	Methow R. WNFH[4]	Methow Hatchery
Total (PUD programs)	**140-198**	**24-82**		
Total (All programs)	**140-252**	**124-182**		

[1] Assumes a 1:1 sex ratio (see Table 6). Natural-origin females will be live spawned and reconditioned. Those natural origin females successfully live-spawned from the Okanogan Program will be incorporated into the CTCR Kelt Reconditioning Program.
[2] Primarily uses hatchery-origin adults collected via the collaborative Methow hook and line efforts for natural-origin fish in the Methow River and adult returns to WNFH. May include Methow safety-net adults collected via angling, or adult returns to WNFH and Methow FH.
[3] May also include excess hatchery-origin adults collected via angling and at Methow FH and the Twisp Weir.
[4] Spring collection of hatchery-origin steelhead as needed to meet program for the Okanogan Program. Shortfall, if encountered, to be met with Wells Hatchery Volunteer Channel collection in spring.
[5] Dependent upon number of NOR broodstock collected in the Okanogan Basin, age structure and fecundity to achieve sufficient brood for a 100k smolt program for the Okanogan.
[6] Broodstock composition for the WNFH conservation program is subject to a sliding production/pNOB scale where full 200K production is targeted only when broodstock pNOB is >0.75. Under run/environmental conditions where collection is unable to support extraction of 100 NORs, HOR broodstock are incorporated subject to a sliding scale (with a minimum release of 100K) as authorized in the 2017 Biological Opinion.

Overall collection for the steelhead programs will be 224 fish (Table 6) and the aggregate NOR removal will be limited to no more than 33% of the entire run and/or 33% of the natural-origin return. Hatchery- and natural-origin collections will be consistent with the respective run-timing of hatchery- and natural-origin steelhead at Wells Dam, Omak Weir and the Twisp Weir. Trapping at the Wells Dam ladders may occur between August 1, 2020 and April 30, 2021, up to three days per week, and up to 16 hours per day, as required to meet broodstock objectives. (Appendix D). The Twisp Weir operates from early March (dependent on river conditions) through the end of the steelhead spawning run (spring Chinook trapping takes over by June 1). Trapping occurs daily for broodstock collection and gene flow management.

Adult return composition including number, origin, age structure, and sex ratio will be assessed in-season at Priest Rapids and Wells dams. Broodstock collection adjustments may be made based on in-season monitoring and evaluation. If collection of adults from the east ladder trap is necessary, access will be coordinated with staff at Wells Dam due to the rotor rewind project.

Summer/fall Chinook

The summer/fall Chinook mitigation program in the Methow River utilizes adult broodstock collections at Wells Dam and incubation/rearing at Eastbank Fish Hatchery. The total production level target is 200,000 summer/fall Chinook smolts for acclimation and release from the Carlton Acclimation Facility.

The TAC 2020 Columbia River UCR summer Chinook return projection to the Columbia River (Appendix D) and BY 2015, 2016, and 2017 spawn escapement to tributaries above Wells Dam indicate sufficient summer Chinook will return past Wells Dam to achieve full broodstock collection for supplementation programs above Wells Dam. The following broodstock collection protocol for the Methow summer Chinook program was developed based on initial run expectations of summer Chinook to the Columbia River, program objectives, and program assumptions (Appendix A).

For 2020, up to 122 natural-origin summer Chinook at Wells Dam west (and east, if necessary) ladder(s), including 61 females for the Methow summer Chinook program (Table 7). Collection will be proportional to return timing between 01 July and 15 September. Summer Chinook stock assessment will run concurrent with summer Chinook broodstock collection at the west ladder trap. Trapping may occur up to 3-days/week, 16 hours/day (48 cumulative hours per week). Age-3 males (“jacks”) will not be collected for broodstock unless needed to pair with females.

Should use of Wells Dam be needed to meet any shortfalls in Chief Joseph Hatchery broodstock for summer/fall Chinook programs, the CCT will notify the HCP-HC and Wells HCP Coordinating Committee/PRCC-HSC and coordinate with Douglas PUD, Grant PUD, and WDFW to facilitate additional broodstock collection effort. Summer Chinook broodstock collection efforts at Wells Dam, should they be required to meet CJH program objectives, will be conducted concurrent with steelhead run composition sampling at Wells Dam.

If the probability of achieving the broodstock goal is reduced based on passage at the west ladder or actual natural-origin escapement levels, broodstock collections may be expanded to the east ladder trap and/or origin composition will be adjusted to meet the broodstock collection objective. If collection of adults from the east ladder trap is necessary, access will be coordinated with staff at Wells Dam due to the rotor rewind project.

In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected to meet program production needs. Adjustments made to broodstock collection targets based on pre-spawn mortality exceeding current year assumptions will require review and concurrence on the additional number and composition of the broodstock necessary to backfill shortfalls.

Table 7. Number of broodstock needed for Grant PUDs Methow summer Chinook production obligation of 200,000 smolts, collection location, and mating strategy.

Program	Production target	Number of Adults		Total	Collection location	Mating protocol
		Hatchery	Wild			
Methow	200,000		61F/61M	**122**	Wells Dam	1:1
Total	**200,000**		**122**	**122**		

Columbia River Mainstem below Wells Dam

Summer/fall Chinook

Collection at the Wells FH volunteer channel will be used to collect the broodstock necessary for the Wells FH yearling (320,000) and sub-yearling (484,000) programs.

Because of CCT concerns about sufficient natural-origin fish reaching spawning grounds and to ensure sufficient NOR's being available to meet the CCT summer Chinook program, incorporation of natural-origin fish for the Wells program or programs with broodstock originating from the Wells volunteer channel, will be limited to fish collected in the Wells volunteer channel. The program includes up to 10% natural origin broodstock. The following broodstock collection protocol was developed based on mitigation objectives and program assumptions (Appendix A).

DPUD will target 530 run-at-large summer Chinook from the volunteer ladder trap at Wells Fish Hatchery outfall for the Wells sub-yearling and yearling programs (Table 8). Due to the possibility that the run timing of the fish is shifting earlier in the year and fish health concerns associated with the volunteer collection site (warming Columbia River water during late August), the volunteer collection will begin as early as June 15 and terminate by August 31. Adjustments made to broodstock collection targets based on pre-spawn mortality exceeding current year assumptions will require review and concurrence on the additional number and composition of the broodstock necessary to backfill shortfalls.

For 2020, broodstock collection for the Chelan Falls summer Chinook program will prioritize the collection of 200 adults (100 females/100 males) at the Wells Fish Hatchery volunteer trap. The Chelan Falls Picket Weir Trap (CFPWT) was piloted in 2019 to collect adult Chinook broodstock. While weir trapping efforts failed to meet the full brood needs of the program and experienced some challenges in implementation, the effort was still successful in obtaining about 200 adults for the program.

While about 50% of the Chelan Falls broodstocking efforts in 2020 will be prioritized at the Wells volunteer trap, Chelan PUD will continue in 2020, to implement and evaluate the installation and operation of a temporary picket weir in the Chelan River habitat channel. The 2020 weir operations will be conducted in a manner to collect the full complement of broodstock needed (386) for the Chelan Falls program. With the 2020 upper Columbia summer Chinook return expected to be similar to 2019 the minimum 186 adults identified for the weir collection efforts should be achievable. All adults collected at the weir (up to 386) will be incorporated into the Chelan Falls program and adult brood numbers from the Wells volunteer trap will be appropriately reduced and utilized in priority order to: 1) to achieve HCP/Priest Rapids Project Settlement Agreement production and 2) contribute to other authorized Tribes and/or State of Washington programs on an equal basis either directly from this surplus or in kind distributions during surplusing events at Wells Hatchery. WDFW will coordinate distribution amongst the authorized parties once a surplus has been identified.

If shortfalls in adult needs are expected and the number of females needed to meet program has not been reached by August 15th, the HCP HC will discuss whether broodstock collection may default to surplus summer Chinook collected from other HCP approved locations to make up the difference. The 2020 broodstock target for the Chelan Falls program is 386 adults (Table 8). The total production level supported by this collection is up to 576,000 yearlings for the Chelan Falls program.

In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected at the Wells FH volunteer trap, Chelan River picket weir, or beach seining efforts in the Chelan River to meet program production needs. Adjustments made to broodstock collection targets based on pre-spawn mortality exceeding current-year assumptions will require review and concurrence on the additional number and composition of the broodstock necessary to backfill shortfalls.

Table 8. Number of broodstock needed in 2020 for the combined Chelan and Douglas PUD Columbia River below Wells summer Chinook production obligations of 1,380,000 smolts, collection location, and mating strategy.

Program	Production target	Number of Adults[1]		Total	Collection location	Mating protocol
		Hatchery	Wild			
Wells 1+	320,000	96F/96M		**192**	Wells VC[2]	1:1
Wells 0+	484,000	169F/169M		**338**	Wells VC[2]	1:1
Chelan Falls 1+	576,000	100F/100M		**200**	Wells VC[2]	1:1
		93F/93M		**186**	CFPWT[3]	
Total	**1,380,000**	**458F/458M**		**916**		

[1] The number of adults collected for these programs may indirectly incorporate natural origin fish; however, because they are volunteers, the number is likely to be less than 10% of the total.
[2] Wells Hatchery volunteer channel trap.
[3] Chelan Falls picket weir trap.

Wenatchee River Basin

In 2020 the Eastbank Fish Hatchery (FH) is expecting to early rear spring Chinook salmon for the Chiwawa River and Nason Creek acclimation facilities located on the Chiwawa River and Nason Creek. The program production level target for the Chiwawa program (Chelan PUD obligation) in 2020 is 144,026 smolts and based upon the biological assumptions in Appendix A will require a total broodstock collection of about 84 natural origin spring Chinook (Table 10). The spring Chinook production obligation as currently described in the BiOp and Section 10 permit for Grant PUD in the Wenatchee Basin is 223,670 smolts (125,000 conservation and

98,670 safety net) and based upon the biological assumptions (Appendix A) will require a total broodstock collection of 136 adults (66 natural origin and 60 hatchery origin; Table 10).

Pre-season run-escapement of Wenatchee spring Chinook to Tumwater Dam during 2020 is estimated at 4,979 spring Chinook, including 4,265 hatchery and ,714 natural origin spring Chinook (does not include age-3 males; Table 9). In-season estimates of natural-origin spring Chinook to Tumwater Dam will be provided through stock-assessment and broodstock-collection activities. This information will facilitate in-season adjustments to collection composition so that extraction of natural-origin spring Chinook remains no more than 33%.

In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected to meet program production needs, within the constraint of not collecting more the 33% of the natural origin spring Chinook. Adjustments made to broodstock collection targets based on pre-spawn mortality exceeding current year assumptions will require review and concurrence on the additional number and composition of the broodstock necessary to backfill shortfalls.

Table 9. Age-4 and age-5 class return projection for wild and hatchery spring Chinook to Tumwater Dam during 2020.

	Chiwawa Basin[1]			Nason Cr. Basin[1]			Wenatchee Basin to Tumwater Dam[2]		
	Age-4	Age-5	Total	Age-4	Age-5	Total	Age-4	Age-5	Total
Estimated wild return	402	46	**448**	115	13	**128**	640	74	**714**
Estimated hatchery return	1,998	89	**2,087**	2,089	89	**2,178**	4,087	178	**4,265**
Total	2,400	135	**2,535**	2,204	102	**2,306**	**4,727**	**252**	**4,979**

[1] Reflects NOR estimates to Tumwater Dam and has not been adjusted for pre-spawn mortality.
[2] Wenatchee Basin to Tumwater Dam total includes NORs to the White, Little Wenatchee, and Chiwawa rivers and Nason Creek.

Table 10. Number of broodstock *needed* for the combined Wenatchee spring Chinook production obligation of 367,969 smolts, collection location, and mating strategy.

Program	Production target	Number of Adults		Total	Collection location	Mating protocol
		Hatchery	Wild			
Chiwawa Conservation	144,026		42F/42M	**84**	Chiwawa Weir and Tumwater Dam[3]	2x2 factorial
Nason Conservation	125,000		33F/33M	**75[1]**	Tumwater Dam[3]	2x2 factorial
Nason Safety net	98,670	30F/30M[2]		**60**	Tumwater Dam	1:1
Total	**367,969**	**60**	**150**	**219[4]**		

[1] Includes ~10% additional NO fish for the Nason program to account for fish that may assign back to the White River spawning aggregate. No more than 66 NO fish will be retained for spawning.
[2] Chiwawa hatchery fish will only be collected to satisfy the Nason Cr. safety net program if in-season estimates of returning Nason conservation fish fall short of expectations.
[3] Collection of NO fish at Tumwater for the Chiwawa program will include previously PIT tagged adults (NO juveniles PIT tagged at the Chiwawa smolt trap) and/or excess NO adults/eggs/progeny originating from females with assignments >95% to the Chiwawa from the Nason conservation program.
[4] Total includes the 10% over-collection as part of the genetic assignment variance for the Nason conservation program.

Chiwawa River Conservation Program Broodstocking:

The 2020 pre-season forecast for NO adults back to the Chiwawa is well below the 2018 forecast (527) and about 56% greater than the 2019 forecast of 151 (see Appendix C, Table 2 for specific Chiwawa tributary return estimates. While the 2020 forecast is slightly higher than 2019, there is still a great deal of concern in meeting NO brood collection targets at the Chiwawa Weir, as agreed to by the HCP HC, under recent operational conditions. For 2020, Chelan PUD and WDFW are proposing a pilot operations strategy to increase the likelihood of meeting brood targets while minimizing bull trout encounters to the extent practicable.

Consistent with the realized shortfall in NO broodstock in 2018 and 2019, the 2020 weir operations plan seeks to allow up to 20 days of trapping (sometimes back to back days) with daily operations only occurring between the hours of 6 AM and 9 PM (the goal will be to operate the weir up to 14 hours a day but to target the time period from one hour before official sunrise to one hour after official sunset, which will vary throughout the trapping period) The weir would be lowered and trap opened up nightly (10 hours minimum) to facilitate bull trout passage and minimize encounters. Bull trout encounters would be recorded for each trap day and the maximum number of bull trout which could be encountered without notification to and discussion and coordination with the USFWS would be 10% of the 2014-2019 estimated bull trout spawner abundance in the Chiwawa River subbasin (123 bull trout). Any further in-season modification of this plan would require concurrence on the part of the HC and the USFWS prior to implementation. This pilot weir operations plan is similar to the operations plan approved for the Twisp weir and will be implemented only as a pilot for 2020.

- Based upon estimates of returning previously PIT tagged NO fish to Tumwater Dam (Table 11), approximately 24 previously PIT-tagged NO spring Chinook from the Chiwawa River could be collected at TWD between June 1 and July 15, concurrent with Nason Creek brood stocking, adult management, RM&E, and the RRS Study.
- The balance of adults needed to meet the Chiwawa Conservation program (up to ~84 total or ~42 females) would be collected at the Chiwawa Weir (provisionally up to 42 HO adults will be collected at Tumwater Dam during the Nason broodstocking as backup for potential shortfalls in NO brood collection at Chiwawa).

    - The Chiwawa weir will be fished selectively between June 1 and August 15 for spring Chinook broodstock. The weir will be fished on select days (not to exceed 20 total days without additional coordination and concurrence from the USFWS) from 6:00 AM until 9:00 PM (the actual target period will be up to 14 hours per day between one hour before official sunrise to one hour after official sunset). When the weir is not fishing, the weir will be lowered to allow passage.
    - Trapping effort will be based on meeting the spring Chinook broodstock collection target of approximately 84 adult spring Chinook of natural origin with equal sex ratio (~42 males and ~42 females). In-season information derived from sampling and counts at Tumwater Dam and PIT tag detections at in-river arrays will inform trapping operations in order to target spring Chinook while reducing effort when spring Chinook are not likely to be available. Timing of trap operation would be based on NO fish passage at TWD and would use estimated travel times (derived from PIT tags) to the lower Chiwawa PIT tag antenna array.
    - Trapping will not necessarily occur every day but will be dependent on efficiency of trapping operation in obtaining broodstock. Fine-scale scheduling of trap operations will be determined on a day-to-day basis.
    - Trapping would be suspended with one lethal take of any size bull trout or when the take limit is reached (the USFWS will be notified if the take limit is expected to be met or potentially exceeded).
    - Trapping will be suspended when the broodstock target is met. When the weir is not fishing the trap will be opened to allow passage and the weir will be lowered.
    - High flows typically occur during the spring Chinook trapping season. High flows significantly limit the efficiency of the weir or prevent fishing the weir entirely. In these cases, the weir panels are lowered and the traps are opened for passage.
    - Weir operations would be on a 14 hours up (max)/10 hours (minimum) down schedule from about June 1 through August 15 (not to exceed 20 cumulative trapping days) and/or 123 bull trout encounters.
    - Using the most recent 5-year average redd count data (2014-2019; 2016 survey data was not collected due to wildfires), the 10% threshold is 123 bull trout as determined by a 5-year average number of redds in the Chiwawa sub-basin of 613 (expands to 1,226 adults at a 1:1 sex ratio).

- To ensure the production target is met for the Chiwawa program, in the event that insufficient NO adults are collected for the conservation program (either through trap inefficiency or to not exceed 33% NO extraction), HO adults (presently estimated at 50% [N=42] of the total broodstock requirement, however may be adjusted up or down depending on the run) would be collected at TWD to make up the shortfall (see Table 10) between June 1 and July 15.
- For additional assurance and to help reduce effort at the Chiwawa Weir, during broodstock collection for the Nason conservation program, any excess NO adults not genotyping to the White River will be retained for the Nason program and an equivalent number of adults that have assignment probabilities >95% for Chiwawa, will be transferred to the Chiwawa program. For example, if through NO brood collection for the Nason program we estimate that 10 fish will need to be returned to the river through genotyping but only seven are, then those three fish which would have typed for inclusion for the Nason program would be retained (rather than sent back to the river). This would leave the Nason program with three more NO fish than needed. This would result in three adults which type at the >95% level to the Chiwawa to be transferred to the Chiwawa program keeping the Nason program at the target brood level and increasing the number NO fish for the Chiwawa program.
- Historic and in-season data for NO spring Chinook timing to the lower Chiwawa array from TWD will be used to determine optimal dates for collection.
- Any bull trout that are caught at the Chiwawa trap will be immediately removed and released at a site ~10KM upstream of the weir to prevent fallback/impingement and to mitigate for potential delay. Handling and transport will be conducted by WDFW hatchery staff.
- If a bull trout is killed during trapping, despite implementing conservation measures, trapping activities will cease and not continue until additional measures to minimize risks to bull trout can be discussed with the USFWS.

Table 11. PIT tagged natural origin adults to Tumwater Dam for the most recent 5-years (2015-2019) with conversion rates from Bonneville Dam.

	Detections at Bonneville Dam		Detections at Tumwater Dam			
Return year	Nason	Chiwawa	Nason	Conversion rate	Chiwawa	Conversion rate
	6	66	1	0.167	29	0.439
2015	9	42	6	0.667	28	0.667
2016	8	34	8	1.000	24	0.706
2017	5	31	3	0.600	31	1.000
2019	3	24	3	1.000	14	0.583
Mean	5.2	31.6	4.2	0.853	24.6	0.784
Geomean	4.0	31.0	3.4	0.833	23.8	0.766

Nason Creek Conservation Program Broodstocking:

- Up to ~75 NO spring Chinook (to allow for up to 10 percent of White River NO fish estimated to be encountered at Tumwater Dam MSA; Table 10) would be collected at TWD between June 1 and July 15.
    - Only 66 NO adults (33 females) will be retained to produce the 125K Nason Conservation program.
    - Collection of additional HO fish may occur in the event NO collection/retention falls short of expectation or would exceed 33% extraction.
    - Brood stock collection would run concurrent with adult management, RM&E, and the Spring Chinook Relative Reproductive Success Study. The GAPS microsatellite panel and existing GAPS plus WDFW spring Chinook Wenatchee baseline will be used for genotyping and GSI analyses similar to methods used beginning in 2013.

- Decision Rules:
    - Any fish that assigns to the White River with greater than 90% surety will be released in the White River.
    - Unassigned fish (individuals that can't be assigned to the Wenatchee Population or Leavenworth NFH), will be released upstream of Tumwater Dam at the Alps or Swift Water rest stop.
    - In the event more fish assign to Nason or Chiwawa than are needed to meet the conservation program, the excess with the highest assignment probabilities (>95%) to the Chiwawa will be incorporated into the Chiwawa conservation program if needed or otherwise returned to the river upstream of Tumwater Dam.

Nason Creek Safety Net Program Broodstocking:

- At the current run forecast, up to ~60 HO spring Chinook adults (from conservation program [1st priority] – identified by snout wire + body wire) would be targeted at TWD (Table 10) between June 1 and July 15, concurrent with NO brood stock collection, adult management, RM&E, and the Spring Chinook Relative Reproductive Success (RRS) Study to meet a 98,670 smolt release.

Steelhead

The steelhead mitigation program in the Wenatchee Basin uses broodstock collected at Dryden and Tumwater dams located on the Wenatchee River. Per ESA section 10 Permit 18583 provisions, broodstock collection will target adults necessary to meet a natural origin – conservation (WxW) oriented program, not to exceed 33% of the natural origin steelhead return to the Wenatchee Basin and a hatchery origin (HxH) – safety net program. The conservation and safety net programs each make up approximately half of the 247,300 production obligation.

Based on these limitations and the assumptions listed in Appendix A, the following broodstock collection protocol was developed:

WDFW will retain a total of 136 mixed origin steelhead for broodstock for a smolt release objective of 247,300 smolts (Table 12). The 60 hatchery origin adults will be targeted at Dryden Dam and if necessary, Tumwater dam. The 66 natural origin adults will be targeted for collection at Tumwater Dam. Collection will be proportional to return timing between 01 July and 14 November. Collection may also occur between 15 November and 5 December at both traps, concurrent with the Yakama Nation coho broodstock collection activities. Only adipose present coded wire tagged hatchery fish (or previously PIT tagged WxW hatchery progeny) will be retained for the safety net program unless low returns require use of safety net adults (adipose clipped) to meet the production obligation. Adult return composition including number, origin, age structure, and sex ratio will be assessed in-season at Priest Rapids and at Dryden Dam. In-season broodstock collection adjustments may be made based on this monitoring and evaluation. To better ensure achieving the appropriate female equivalents for program production, the collection will include the use of ultrasonography to determine the sex of each fish retained for broodstock.

In the event steelhead collections fall substantially behind schedule, WDFW may initiate/coordinate adult steelhead collection in the mainstem Wenatchee River by hook and line. In addition to trapping and hook and line collection efforts, Tumwater and Dryden dams may be operated between February and early April the subsequent spring to supplement broodstock numbers if the fall trapping effort provides fewer than the required number of adults.

In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected to meet program production needs, within the constraint of not collecting more the 33% of the natural origin steelhead. Adjustments made to broodstock collection targets based on pre-spawn mortality exceeding current year assumptions will require review and concurrence on the additional number and composition of the broodstock necessary to backfill shortfalls.

Table 12. Number of broodstock needed for the combined 2021 BY Wenatchee summer steelhead production obligation of 247,300 smolts, collection location, and mating strategy.

Program	Production target	Number of Adults		Total	Collection location	Mating protocol
		Hatchery	Wild			
Wenatchee Conservation[1]	123,650	0	33F/33M	**66**	TWD[3]/Dryden LBT-RBT[4]	2x2 factorial
Wenatchee Safety net[2]	123,650	30F/30M	0	**60**	Dryden LBT-RBT[4] /TWD[4]	1:1
Total	**247,300**	**60**	**66**	**126**		

[1] Broodstock collection for the conservation program will occur primarily at Tumwater Dam and will only fall back to Dryden Dam trapping facilities if a shortfall is expected.

[2] Broodstock collection for the safety net program will occur primarily at the Dryden Dam trapping facilities to minimize activities at TWD that could increase unintended delays on non-target fish. Collection at Tumwater Dam will only occur if shortfalls in broodstock are expected at Dryden Dam.

[3] TWD=Tumwater Dam.

[4] Dryden LBT-RBT= Dryden Dam left and right bank trapping facilities.

Summer/fall Chinook

Summer/fall Chinook mitigation programs in the Wenatchee River Basin utilize adult broodstock collections at Dryden and Tumwater dams, incubation/rearing at Eastbank Fish Hatchery (FH) and acclimation/release from the Dryden Acclimation Pond. The total production level target for BY 2019 is 500,001 smolts (181,816 GCPUD mitigation and 318,185 CCPUD mitigation).

The TAC 2020 Columbia River UCR summer Chinook return projection to the Columbia River (Appendix E) and BY 2014, 2015 and 2016 spawner escapement to the Wenatchee River indicate sufficient summer Chinook will likely return to the Wenatchee River to achieve full broodstock collection for the Wenatchee River summer Chinook supplementation program. Review of recent summer/fall Chinook run timing past Dryden and Tumwater dams indicates that previous broodstock collection activities have omitted the early returning summer/fall Chinook, primarily due to limitations imposed by ESA Section 10 Permit 1347 to minimize impacts to listed spring Chinook. In an effort to incorporate broodstock that better represent the summer/fall Chinook run timing in the Wenatchee Basin, the broodstock collection will front-load the collection to account for the disproportionate collection timing. Approximately 43% of the summer/fall Chinook destined for the upper Basin (above Tumwater Dam) occurs prior to the end of the first week of July; therefore, the collection will provide 43% of the objective by the end of the first week of July. Weekly collection after the first week of July will be consistent with run timing of summer/fall Chinook during the remainder of the trapping period. With concurrence from NMFS, summer Chinook collections at Dryden Dam may begin up to one week earlier. Based on these limitations and the assumptions listed in Appendix A, the following broodstock collection protocol was developed:

WDFW will retain up to 274 natural-origin, summer Chinook at Dryden and/or Tumwater dams, including 137 females (Table 13). To better ensure achieving the appropriate females for program production, the collection will implement the draft Production Management Plan, including ultrasonography to determine the sex of each fish retained for broodstock. Trapping at Dryden Dam may begin 24 June and terminate no later than 15 September and operate up to 7-days/week, 24-hours/day. Trapping at Tumwater Dam if needed may begin 15 July and terminate no later than 15 September and operate up to 48 hours per week for broodstock related activities.

In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected to meet program production needs. Adjustments made to broodstock collection targets based on pre-spawn mortality exceeding current year assumptions will require review and concurrence on the additional number and composition of the broodstock necessary to backfill shortfalls.

Table 13. Number of broodstock needed for the combined 2019 BY Chelan and Grant PUD Wenatchee summer Chinook production obligations of 500,001 smolts, collection location, and mating strategy.

Program	Production target	Number of Adults Hatchery	Wild	Total	Collection location	Mating protocol
Chelan PUD	318,185		87F/87M	**174**		
Grant PUD	181,816		50F/50M	**100**		
Total	**500,001**		**137F/137M**	**274**	Dryden LBT-RBT[1] /TWD[2]	1:1

[1] Dryden LBT-RBT= Dryden Dam left and right bank trapping facilities.
[2] TWD=Tumwater Dam.

Priest Rapids Fall Chinook

Collection of fall Chinook broodstock at Priest Rapids Hatchery (PRH) will generally begin in early September and continue through about mid-December. Juvenile release objectives specific to Grant PUD (5,599,504 sub-yearlings), and Federal (1,700,000 sub-yearlings at PRH + 3,500,000 smolts at Ringold Springs Hatchery; collection of broodstock for the federal programs are conditional upon having contracts in place with the ACOE), mitigation commitments. Biological assumptions are detailed in Appendix A. For the Ringold Springs production, adult collection, holding, spawning and incubation occurs at PRH until the eyed-egg stage. Eyed eggs are transferred to Bonneville Hatchery until they are transferred for spring acclimation and release at Ringold Springs.

For 2020 NO adults will be targeted through hook-and-line angling efforts in the Hanford Reach to increase the proportion of natural-origin adults in the broodstock. It is estimated that approximately 1,250 adults may be collected through the hook-and-line efforts. Close coordination between broodstock collections at the volunteer channel and through hook-and-line efforts in the Hanford Reach will need to occur so over-collection is minimized. Trapped fish surplus to production needs will be culled at the earliest possible life-stage (e.g, prior to ponding, brood collected, brood spawned, eggs). Presumed NOR's collected and spawned from hook-and-line caught broodstock will be prioritized for PRH programs (i.e. Hanford Reach angler caught fish will be held in a separate pond from volunteer-collected fish, spawned first each week, and to the extent possible segregated and reserved for the GPUD program).

Grant PUD staff will work closely with WDFW hatchery and M&E staff to maintain separation of gametes/progeny of angling-collected adults at spawning and through incubation/early rearing.

Based upon the biological assumptions in Appendix A, the estimated number of adults to be collected to meet the 10,799,054 smolts required to meet the current three up-river bright (URB) programs which rely on adults collected at the Priest Rapids Hatchery volunteer channel trap and hook-and-line efforts on the Hanford Reach are presented in Table 14.

To increase the probability of incorporating a higher percentage of NORs from the volunteer channel, adipose present, non-CWT males and females will be prioritized for retention, and males older than age-3 will be prioritized. In addition, preliminary information suggests that the pNORs is higher in the later part of the trapping period than the earlier period. As data become available, the PRCC-HSC may choose, in-season, to retain a disproportionately high number of broodstock from the latter half of the returns to the volunteer trap.

In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected to meet program production needs. Adjustments made to broodstock collection targets based on pre-spawn mortality exceeding current year assumptions will require review and concurrence on the additional number and composition of broodstock necessary to backfill shortfalls.

Implementation Assumptions

1) Broodstock may be collected at any or all of the following locations/means: hook-and-line angling (ABC) in the Hanford Reach (actual numbers collected are uncertain but will contribute to the overall brood program and pNOB), and the Priest Rapids Hatchery volunteer channel trap..

2) Assumptions used to determine egg/adult needs is based upon current program performance metrics.

3) Broodstock retained from the volunteer channel will exclude to the degree possible, age-2 and 3 males (using length at age; i.e. retain males ≥ 73 cm) to address genetic risks/concerns of younger age-at-maturity males producing offspring which return at a younger age (decreased age-at-maturity) and also decrease the probability of using hatchery origin fish in the broodstock that are skewed towards earlier ages at maturity. Age-3 fish may be retained for broodstock if in-season run estimates suggest a shortage may occur.

4) Adipose present, non-CWT males and females will be prioritized for broodstock from the volunteer channel-collected broodstock unless a shortage is expected.

5) Broodstock collected by hook-and-line will exclude age-2 males to minimize genetic risks/concerns of younger age-at-maturity males producing offspring which return at a younger age (decreased age-at-maturity) and to ensure the highest proportion of NORs in the collection.

6) All gametes of fish spawned from hook-and-line broodstocking efforts will be incorporated into the PRH-based programs.

7) All juveniles released from PRH will, at a minimum, have a unique otolith mark so that returning adults can be identified. In addition, releases of juveniles will be staggered to evaluate the influence of release timing on survival.

8) Natural-origin broodstock collection at the volunteer trap will be prioritized for the GPUD program by collecting fish when the probability of encountering natural origin fish is highest and balancing run-time representation.

Table 14. Number of broodstock needed for the combined Grant PUD and ACOE fall Chinook production obligations of 10,799,504 sub-yearling smolts at Priest Rapids and Ringold Springs hatcheries, collection location, and mating strategy in 2020.

Program	Production target	Number of Adults		**Total**	Collection location	Mating protocol
Grant PUD	5,599,504	2,192F/1,308M		**3,500**		
ACOE-PRH	1,700,000	666F/397M		**1,063**		
ACOE – Ringold[1]	3,500,000	1,370F/818M		**2,188**		
Total	**10,799,504**	**4,228F/2,523M**		**6,751**		
Collection location		Estimated number of adults		Total		
		Hatchery	Wild			
Priest Rapids Hatchery		**3,304F/1,740M**	**299F/158M**	**5,501**	PRH volunteer trap	1:2
ABC[2],		**41F/41M**	**584F/584M**	**1,250**	Hanford Reach	1:2, 1:4
Total		**3,345F/1,781M** (5,126; 75.9%)	**883F/742M** (1,625; 24.1%)	**6,751**		

[1] As of brood year 2009, Priest Rapids Hatchery is taking sufficient eggs to meet the 3,500,000 sub-yearling smolt release at Ringold-Meseberg Hatchery funded by the ACOE – late incubation of this program occurs at Bonneville.
[2] ABC fish are adults collected from hook and line collection efforts on the Hanford Reach. Estimates of F/M were derived from recent spawn numbers.

Appendices

Appendix A

2020 Return Year Biological Assumptions and estimated adult, green egg, and eyed egg targets for UCR spring, summer, and Fall Chinook and Summer Steelhead Hatchery Programs

Table 1. 2020 Return Year Biological assumptions for UCR spring, summer, and fall Chinook and summer steelhead.

Program	Geo Mean Values for 2014-2018 Broods								Geo Mean Values 2013-2017 Brood[1]
	ELISAs		Fecundity		Prespawn Survival				
	H	W			H		W		
	≥ 0.12	≥ 0.2	H	W	M	F	M	F	G-E-R Survival
Methow SPC	0.210	0.016	3,755	4,245	0.941	0.957	0.983	0.970	0.897
Chewuch SPC	0.210	0.016	3,755	4,245	0.941	0.957	0.983	0.970	0.897
Twisp SPC	0.200	0.061	3,762	4,098	1.000	1.000	1.000	1.000	0.921
Twisp SHD				5,162			1.000	1.000	0.782
Wells SHD			5,800		0.978	0.965			0.669
Okanogan Conservation				5,041			1.000	0.956	0.741
Okanogan Safety Net			5,203		0.959	0.972			0.657
Wells SUC 1+	0.023	0.000	3,948	4,613	0.978	0.984			0.882
Wells SUC 0+	0.023	0.000	3,948	4,613	0.978	0.984			0.755
Methow SUC	0.000	0.044		4,237			0.978	0.968	0.836
Chelan Falls 1+	0.046		3,887[2]		0.988	0.965			0.836
Wenatchee SUC	0.000	0.010		4,483			0.961	0.958	0.856
Wenatchee SHD			5,673[2]	6,173[2]	0.981	0.952	0.982	0.957	0.705
Nason SPC	0.030	0.022		4,481			0.993	0.979	0.882
Chiwawa SPC	0.030	0.022	4,132[2]	4,015[2]	0.993	0.987	0.992	0.985	0.896
Priest Rapids FAC 0+			3,740		0.838	0.839			0.814
ACOE @PRH			3,740		0.838	0.839			0.814
ACOE @Ringold			3,740		0.838	0.839			0.814

[1] Green egg to release survival. 2014-2018 Brood for steelhead and sub-yearling Chinook.
[2] Geomean of 2015-2019 BY females.
[3]Geomean of 2012-2016 brood

Table 2. Summary of UCR 2020BY Chinook and 2021BY steelhead, broodstock (H/W; M/F), green egg, eyed egg, and smolt release targets by program.

Program	Adults: Hatchery Male	Adults: Hatchery Female	Adults: Wild Male	Adults: Wild Female	Green egg target[1]	Eyed egg target[1]	Smolt release target
Spring Chinook							
Methow Spring Chinook			38	38	152,243	144,631	133,249
Chewuch Spring Chinook			17	17	68,690	65,256	60,516
Twisp Spring Chinook			9	9	33,882	31,442	30,000
Nason Spring Chinook (Conservation)			33	33	144,911	134,786	125,000
Nason Spring Chinook (Safety net)	30	30			123,206	113,842	98,670
Chiwawa Spring Chinook (Conservation)			42	42	164,359	152,854	144,026
Steelhead							
Twisp Steelhead			13	13	63,915	55,734	48,000
Wells Steelhead (MR release)	27	27			152,207	129,528	100,000
Wells Steelhead (CR release)	43	43			243,531	207,245	160,000
Okanogan Steelhead			29	29	134,953	117,679	100,000
Wenatchee Steelhead (Conservation)			33	33	175,390	131,718	123,650
Wenatchee Steelhead (Safety net)	30	30			174,474	131,030	123,650
Summer Chinook							
Wells Yearling Summer Chinook	96	96			371,853	346,195	320,000
Wells Sub-yearling Summer Chinook	169	169			657,894	624,341	484,000
Methow Summer Chinook			62	62	249,946	230,700	200,000
Chelan Falls Yearling Summer Chinook	193	193			722,217	672,673	576,000
Wenatchee Summer Chinook			137	137	590,013	543,992	500,001
Fall Chinook							
Priest Rapids Fall Chinook	667	1,478	641	714	7,142,807	6,399,955	5,599,504
ACOE @PRH Fall Chinook	364	611	33	55	2,168,367	1,942,857	1,700,000
ACOE @Ringold Fall Chinook	750	1,256	68	114	4,516,129	4,046,452	3,500,000

[1] Estimated value at time of inventory to meet 100% of the production obligation at release

Appendix B

DRAFT Projected Brood Year Juvenile Production Targets, Marking Methods, Release Locations, Release Size, Release Type

Brood Year	Production Group	Program Size	Marks/Tags[3]	Additional Tags	Release Location	Release Year	Release Size (fpp)	Release Type
Summer Chinook								
2020	Methow SUC 1+ (GPUD)	200,000	Ad +CWT	5,000 PIT minimum	Methow River at CAF	2022	13-18	Forced
2020	Wells SUC 0+ (DPUD)	480,000	Ad + CWT	3K-5K PIT	Columbia R. at Wells Dam	2021	50	Forced
2020	Wells SUC 1+ (DPUD)	320,000	Ad + CWT	Up to 120,000 PIT	Columbia R. at Wells Dam	2022	10	Volitional/Study
2020	Chelan Falls SUC 1+ (CPUD)	576,000	Ad + CWT	10,000 PIT	Columbia R. at CFAF	2022	13	Forced
2020	Wenatchee SUC 1+ (CPUD/GPUD)	500,001	Ad + CWT	20,000 PIT	Wenatchee R. at DAF	2022	18	Volitional (forced out by April 30th)
2020	CJH SUS 1+	500,000	Ad + 100K CWT	5,000 PIT	CJH	2022	10	Volitional
2020	CJH SUS 0+	400,000	Ad + 100K CWT	5,000 PIT	CJH	2021	50	Volitional
2020	Okanogan SUS 1+	266,666	Ad + CWT	5,000 PIT	Omak Pond	2022	10	Volitional
2020	Okanogan SUS 1+	266,666	Ad + CWT		Riverside Pond	2022	10	Volitional
2020	Okanogan SUS 1+	266,666	Ad + CWT		Similkameen Pond	2022	10	Volitional
2020	Okanogan SUS 0+	300,000	Ad + CWT	5,000 PIT	Omak Pond	2021	50	Forced
Spring Chinook								
2020	Methow SPC (PUD)	108,249	CWT only	5,000 PIT	Methow R. at MFH	2022	15	Volitional
2020	Methow SPC (PUD)	25,000	CWT only	7,000 PIT	Methow R. at GWP (YN)	2022	15	Volitional

Brood Year	Production Group	Program Size	Marks/Tags[3]	Additional Tags	Release Location	Release Year	Release Size (fpp)	Release Type
2020	Methow SPC (PUD)	60,516	CWT only	5,000 PIT	Chewuch R. at CAF	2022	15	Volitional (forced out by April 30th)
2020	Twisp SPC (PUD)	30,000	CWT only	5,000 PIT	Twisp R. at TAF	2022	15	Volitional
2020	Methow SPC (USFWS)	400,000	Ad + CWT	20,000 PIT	Methow River at WNFH	2022	17	Forced (2-day)
2020	Okanogan SPC[4] (CCT)	200,000	CWT only	5,000 PIT	Okanogan R. at Tonasket Pond/Riverside	2022	15	Volitional
2020	Chief Joe SPC[5] (CCT)	700,000	Ad + 200K CWT	5,000 PIT	Columbia R. at CJH	2022	15	Forced
2020	Chiwawa R. SPC (CPUD) (conservation)	144,026	CWT only/TBD[1]	10,000 PIT	Chiwawa River at CPD	2022	18	Short term volitional
2020	Nason Cr. SPC (GPUD) (conservation)	100,000	CWT body tag/TBD[1,13]	5,000 PIT	Nason Cr. at NAF	2022	18	Forced
2020	Nason Cr. SPC (GPUD) (safety net)	123,670	Ad + CWT	5,000 PIT	Nason Cr. at NAF	2022	18	Forced
Fall Chinook								
2020	Priest Rapids FAC 0+ (ACOE)	1.7M	Ad + Oto	Approximately 43,000 spread across the fish released from PRH	Columbia River at PRH	2021	50	Forced
2020	Priest Rapids FAC 0+ (GPUD)	600,000	Ad+CWT+Oto		Columbia River at PRH	2021	50	Forced
2020	Priest Rapids FAC 0+ (GPUD)	600,000	CWT + Oto		Columbia River at PRH	2021	50	Forced
2020	Priest Rapids FAC 0+ (GPUD)	1M[2]	Ad + Oto		Columbia River at PRH	2021	50	Forced
2020	Priest Rapids FAC 0+ (GPUD)	3.4M	Oto only		Columbia River at PRH	2021	50	Forced
2020	Ringold Springs FAC 0+ (ACOE)	3.5M	Ad + 400K CWT		Columbia River at RSH	2021	50	Forced

Brood Year	Production Group	Program Size	Marks/Tags[3]	Additional Tags	Release Location	Release Year	Release Size (fpp)	Release Type
				Steelhead				
2021	Wenatchee Mixed (HxH/WxW) (CPUD)	35,451	Ad + CWT (HxH) CWT only (WxW)		Nason Cr. direct release	2022	6	Direct Plant
2021	Wenatchee Mixed (HxH/WxW) (CPUD)	70,582	Ad + CWT (HxH) CWT only (WxW)	33,000 PIT	Chiwawa R. direct release	2022	6	Direct Plant
2021	Wenatchee Mixed (HxH/WxW) (CPUD)	104,021	Ad + CWT (HxH) CWT only (WxW)		Upper Wenatchee R. direct release	2022	6	Direct Plant
2021	Wenatchee HxH (CPUD)	37,246	Ad + CWT		Lower Wenatchee R. direct release	2022	6	Direct Plant
2021	Twisp Conservation (DPUD)[11]	24,000	CWT only	2,500[7]	Twisp River at Buttermilk Bridge/TBD	2022	6	Direct Plant
2021	MetComp Conservation (USFWS @WNFH)	24,000	Ad+CWT	up to 5,000	Twisp River at Buttermilk Bridge	2023	4-6	Direct Plant
2021	MetComp Conservation (DPUD/USFWS @ Wells)	24,000	CWT only	2,500[7]	Methow River at WNFH[14]	2022	6	Volitional
2021	Wells HxH (DPUD)	100,000	Ad only	5,000 PIT	Methow River at Effy Bridge	2022	6	Direct Plant
2021	Wells HxH (DPUD)	160,000	Ad only	5,000 PIT	Columbia R. at Wells Dam	2022	6	Volitional
2021	MetComp Conservation (USFWS)	Up to 176,000	Ad + CWT	15,000 PIT	Methow R. at WNFH (24K to other locations TBD[14])	2023[12]	4-6	Volitional at WNFH; other locations TBD

Brood Year	Production Group	Program Size	Marks/Tags[3]	Additional Tags	Release Location	Release Year	Release Size (fpp)	Release Type
2021	Okanogan HxH/HxW (CCT/GPUD)	Up to 100K [6]	Ad /Body CWT	Up to 20,000 PIT [9]	Okanogan/Similkameen Omak, Salmon, Wildhorse Ck., other tribs. (TBD)	2022	5-8	Volitional capture Wells; truck planted in Salmon Creek, Similkameen R., and possibly other tributaries.
2021	Okanogan WxW (CCT/GPUD)	Up to 100K [6]	BodyCWT[8]	Up to 20,000 PIT [9]	Okanogan/Similkameen Omak, Salmon, Wildhorse Ck., other tribs. (TBD)	2022	5-8	Volitional from St. Mary's pond. The numbers going to Omak Creek and other tributaries.

[1] WDFW would like to have a JFP discussion on an alternate tag (internal) for progeny of hatchery adults incorporated into the conservation program such that progeny of the wild parents can be prioritized. As such the minimum mark is identified with a TBD on an additional alternate mark.
[2] Externally marking of this group is presently funded by WDFW. Marking of this 1M fish is contingent on *US v. Oregon* Policy Committee approval for 2019.
[3] Presently all CWT's are applied to the snout.
[4] The Okanogan SPC program derives its juveniles from a 200K transfer of Methow SPC from WNFH as part of a reintroduction effort. Fish are released into the Okanogan Basin.
[5] The Chief Joe Hatchery SPC program presently receives surplus adults from the Leavenworth NFH as needed. Juveniles are released on station from CJH.
[6] Total Okanogan release not to exceed 100K + 10%.
[7] DPUD will tag 2,500 of the Twisp Only S1's and 2,500 of the Methow S1's. USFWS anticipates tagging at least 2,500 of the Methow S2's for release into the Twisp and at least 2,500 of the Methow S2's, will accompany the DPUD Methow S1's for an off-station release.
[8] The Okanogan steelhead HGMP and NOAA's BiOp for the TRMP state that WxW progeny will receive a unique internal tag (CWT or PIT) and/or receive an alternative fin clip. At this time, CCT does not intend to use an alternative fin clip until/unless a high proportion of the released fish have WxW parents and there is an acceptable survival risk/benefit of the alternative fin clip.
[9] Total PIT tag release in the Okanogan 20,000
[10] Beginning with the 2017 brood, adult returns from the Nason conservation program will be utilized to meet the Nason safety net program and will receive a supplemental body tag (blank wire in the dorsal sinus) in addition to the adipose clip.
[11] With the recent detection of potential inbreeding depression effects in the Twisp conservation program, parties are continuing to develop a long-term plan for the program. Once developed and agreed to, this table will be updated to reflect any changes.
[12] Winthrop NFH steelhead program produces 2-year (S2) smolts.
[13] For the 2020 brood, CWT placement will shift from the base of adipose fin to the dorsal sinus to evaluate if the adipose tagging location is responsible for spinal deformities and elevated mortality.
[14] If these are produced at WNFH they are USFWS mitigation production.

Appendix C

DRAFT Return Year Adult Management Plans

At a gross scale, adult management plans will include all actions that *may* be taken within the current run year to address surplus hatchery fish (if any). At the time of submission for this document, spring Chinook will probably be the only group where a reasonable pre-season forecast may be available to lay out what the expected surplus is, how many can be expected to be removed through each action, etc. Preseason forecasts for steelhead will be available in September.

Wenatchee Spring Chinook

Pre-season estimates for age-4 and age-5 adults project a total of 4,979 (714 natural origin [14.3%] and 4,265 hatchery origin [85.7%]) spring Chinook back to Tumwater Dam in the Wenatchee Basin. Approximately 2,535 Chiwawa and 2,306 Nason spring Chinook are to reach Tumwater Dam in 2020, of which about 576 (11.9%) and 4,265 fish (88.1%) are expected to be natural and hatchery origin spring Chinook, respectively. The balance of about 138 natural origin spring Chinook expected back are destined to the remaining spawning aggregates (Table 1). In-season assessment of the magnitude and origin composition of the spring Chinook return above Tumwater Dam will be used to provide in-season adjustments to hatchery/wild composition and total broodstock collection, consistent with ESA Section 10 Permits 18118 and 18121.

Table 1. Age-4 and age-5 class return projection for wild and hatchery spring Chinook to Tumwater Dam during 2020.

	Chiwawa Basin[1]			Nason Cr. Basin[1]			Wenatchee Basin to Tumwater Dam[2]		
	Age-4	Age-5	Total	Age-4	Age-5	Total	Age-4	Age-5	Total
Estimated wild return	402	46	**448**	115	13	**128**	640	74	**714**
Estimated hatchery return	1,998	89	**2,087**	2,089	89	**2,178**	4,087	178	**4,265**
Total	2,400	135	**2,535**	2,204	102	**2,306**	**4,727**	**252**	**4,979**

[1] Reflects NOR estimates to Tumwater Dam and has not been adjusted for pre-spawn mortality.
[2] Wenatchee Basin to Tumwater Dam total includes NORs to the White, Little Wenatchee, and Chiwawa rivers and Nason Creek.

Absent broodstock, conservation fisheries, or adult removal at Tumwater Dam (TWD), the expected number of age-4 and age-5 Hatchery Origin Returns (HOR) for the upper Wenatchee River Basin as a whole is estimated to be approximately 3.1 times the expected number of Natural Origin Returns (HORs; 3.5 times the number of NOR's in the Chiwawa River and in Nason Creek). The combined HO and NO returns will represent about 1.3 times the number of adults needed to meet the interim Chiwawa run escapement to TWD of 900 fish indicating a disproportionate number of hatchery origin spring Chinook will be on the spawning grounds in the fall of 2018 (Table 2). The combined HO and NO returns will represent about 70.4% of the number of adults needed to meet the interim Nason run escapement to TWD of 500 fish indicating a disproportionate number of hatchery origin spring Chinook may be on the spawning grounds in the fall of 2018 (Table 3).

Additional Adult Management

Adult management actions will be used to support achieving hatchery production levels and escapement/sliding-scale PNI targets identified in the Wenatchee Spring Chinook BiOp (2013; 2105) and Permits #18118, #18129 and #18121. Adult management removal targets identified in this document may be revised based on best available in-season run estimates.

2020 adult management actions are intended to provide for near 100% removal of age-3 hatchery males (jacks), and unknown hatchery origin adults (ad-/cwt-) during broodstock collection, run composition assessment, and the RSS. No additional adult removal is expected according to current models, Table 2. The return will be managed for escapement only unless actuals return are higher than the current forecast. In addition, approximately 90 HO and 114 NO adults will be removed between TWD and the Chiwawa Weir and retained for broodstock to support meeting the combined Grant and Chelan PUD Wenatchee spring Chinook obligation.

Table 2. Run escapement and spawning escapement of Chiwawa River hatchery and natural origin fish to Tumwater Dam and the Chiwawa River in 2020.

	To Tumwater Dam		To Chiwawa River		Adults surplused at TWD3	Total Chiwawa spawners5
	Wild	Hatchery	Wild[1,2]	Hatchery[2]		
Females[4]	251	1,419	155	235	680	**390**
Males[4]	197	668	110	72	389	**182**
Sub-total	448	2,087	265	307	1,069	**572**
Pre-spawn survival[6]			0.85	0.55		
Expected PNI						**0.65**
Expected pHOS						**0.54**

Table 3. Run escapement and spawning escapement of Nason Creek hatchery and natural origin fish to Tumwater Dam and Nason Creek in 2020.

	To Tumwater Dam		To Nason Creek		Adults surplused at TWD[3]	Total Nason spawners[5]
	Wild	Hatchery	Wild[1,2]	Hatchery[2]		
Females[4]	71	1,481	50	175	1,133	**225**
Males[4]	57	697	39	75	531	**114**
Sub-total	128	2,178	89	250	1,664	**339**
Pre-spawn survival[6]			0.80	0.55		
Expected PNI						**0.58**
Expected pHOS						**0.73**

[1] Estimated Wild broodstock of 68 wild NO fish (34 females/34 males; approximately 52 NO adults are expected to come from fish destined for the Chiwawa and have been accounted for in that return component) for the Nason conservation program have already been accounted for in this total as well as pre-spawn mortality.
[2] Adjusted for pre-spawn mortality and HO broodstock needs of about 60 fish (38 females/38 males).
[3] Does not include age-3 hatchery males "jacks" removed during adult management activities at TWD.
[4] Age-4 and age-5 fish only. Gender proportions were made based upon a 5-year average sex ratio for hatchery and wild fish of the same age class.
[5] This should result in approximately 225 redds in Nason Creek under the assumption that each female produces only one redd.
[6] Estimated survival from Tumwater to spawn.

Methow Spring Chinook

Pre-season estimates project a total of 1,803 (785 natural origin [43.5%] and 1,018 hatchery origin [56.5%]) spring Chinook back to the Methow Basin. Of the 1,018 hatchery returns, about 431 are estimated to be from the conservation program with the balance of 587 from the WNFH safety net program (Table 5).

Table 5. Brood year 2015-2017 age class and origin run escapement projection for UCR spring Chinook at Wells Dam, 2020.

	Projected Run Escapement											
	Origin								**Total**			
	Hatchery				**Wild**				**Methow Basin**			
Stock	**Age-3**	**Age-4**	**Age-5**	**Total**	**Age-3**	**Age-4**	**Age-5**	**Total**	**Age-3**	**Age-4**	**Age-5**	**Total**
MetComp	48	292	10	**350**	17	453	145	**615**	65	745	155	**965**
MetComp	183	633	12	**828**	18	449	92	**559**	201	1,082	104	**1,387**
%Total				50.5%				75.4%				58.3%
Twisp	15	49	14	**78**	7	155	20	**182**	22	204	34	**260**
%Total				4.8%				24.6%				10.9%
Winthrop (MetComp)	88	612	32	**733**					88	612	32	**733**
%Total				44.7%								30.8%
Total	286	1,294	46	**1,639**	25	604	112	**741**	311	1,898	170	**2,379**

Based on the current forecast, adult management to control MFH escapement, beyond removal of age-3 hatchery males during the course of broodstock collection and M&E, will not likely be needed. Active trapping and operation of the volunteer channel traps located at both the Methow Hatchery (MH) and Winthrop NFH (WNFH) will likely be needed to retain WNFH hatchery adults, and collect returning MFH adults for potential translocation into the spawning grounds and/or incorporation into the safety-net program as determined by gene flow analyses.

Presently hatchery fish from MH are prioritized to: a) contribute to the supplementation of the natural populations (up to either the escapement objectives or PNI/pHOS goal), b) make up shortfalls in natural-origin brood for the MH conservation program, and c) to support the 400K safety-net program at WNFH. As such both hatcheries will operate volunteer hatchery ladders to support removal of excess safety-net and conservation fish (when needed). MH will operate its volunteer trap and will provide surplus hatchery adults (in excess to the MH and conservation needs) to WNFH to support the safety-net program, to support removal of excess safety-net and conservation fish, or retain adults to facilitate testing translocation of conservation fish to under-seeded spawning areas as approved by the HCP HC and PRCC HSC. The translocation of conservation program adults or will be balanced against their use as broodstock for the safety net program as long as both programs can meet full production and gene flow (pHOS/PNI) terms and conditions and minimum spawner abundance on the spawning grounds. The intention of adult translocation is to increase natural production which is the primary function of the Methow Hatchery Program. Any implementation of adult translocation as a strategy to increase the abundance of spawners in the natural environment will require the review and refinement (if necessary) of the approved 2017 Out-planting plan for implementation in 2020. Implementation of a Return Year 2020 Out-planting Plan should be supported by updated escapement estimates and outlines the targeted number, gender, out-planting location, and evaluation criteria and in-year and out-year effects to gene flow on the spawning grounds.

Specific actions are as follows:

Adult management actions will be used to support achieving hatchery production levels and escapement/sliding-scale PNI targets identified in the Methow Spring Chinook BiOp (2017) and Permits #18925, #18927 and #20533. Adult management removal targets identified in this document may be revised based on best available in-season run estimates.

Twisp River Spring Chinook: spring Chinook in the Twisp River will be managed separately from the rest of the basin.

a. Adipose-clipped fish encountered at the Twisp Weir will be removed (putative WNFH returns or strays from outside of the basin).
b. Age-3 hatchery males will be removed and euthanized or transported to WNFH for surplusing unless there is a broodstock shortage – in that case age-3 males may be used as brood on a very limited basis (up to 2 Age-3 fish may be used if necessary, but up to one is preferred, only of necessary).
c. Adult management will be performed to maintain pHOS ≤0.50. pNOB will be >0.50 and may be allowed to fluctuate between 0.50 and 1.0 in order to achieve a pHOS ≤0.50.
d. Wild fish will be collected as broodstock – up to ~18 individuals, but not to exceed 33% of the wild run. Hatchery fish may be collected as broodstock, dependent on collection success of wild fish and provided that Twisp-program pNOB may not be less than 0.50.
e. The Twisp Weir will be fished for the duration of the broodstock collection, only, in 2019. Adult management activities will be incidental to broodstock collection. Once broodstock collection is completed, the weir will be opened to fish passage to limit delay/trapping effects on bull trout. During broodstock collection, the weir will be fished from 6:00 AM to 9:00 PM on a daily basis. Deviation from this schedule may be implemented based on the run size and catch efficiency for broodstock.

Methow River (MFH and WNFH) and Chewuch River Spring Chinook (MetComp):

a. Stock assessment will be performed at Wells Dam during the spring Chinook broodstock collection. This information on stock, hatchery:wild, and male:female composition in conjunction with fish counts at Wells Dam will be used to adjust in-season adult management targets.
b. MetComp returns will be managed by removing volunteers at WNFH and Methow Hatchery using the outfall traps at these facilities.
    i. All hatchery-origin age-3 males will be removed
        1. Gender identified by ultrasound or internal exam.
    ii. The Methow FH and Winthrop NFH volunteer traps will be fished continuously (24 h per day/7 d per week) throughout the run and fish removed at least once daily (depending on specific facility limitations), or as often as needed when fish are present. Adjustments to the operation of the trapping facilities will be made based upon capture/extraction rates as well as bull trout encounters and take limitations.
    iii. Trapping may cease at Methow Hatchery if:

1. Removal of MFH and WNFH origin adults meets the broodstock and/or adult management targets established for both facilities (in this document and as adjusted in-season, and/or through the development of an approved Out-planting plan), or
2. If overall hatchery bull trout take is likely to be exceeded. However, in-season adjustment may be made to reduce the likelihood of bull trout encounters including, but not limited to: limiting 1) the time of day trap is fished, 2) hours per day fished, 3) days per week fished.

iv. Trapping may cease at Winthrop NFH if:
1. Removal of WNFH and MFH origin adults meets the broodstock and/or adult management targets established at both hatcheries (in this document and as adjusted in-season, and/or through the development of an approved Out-planting plan), or
2. If overall hatchery bull trout take is likely to be exceeded. However, in-season adjustment may be made to reduce the likelihood of bull trout encounters including, but not limited to: limiting 1) the time of day trap is fished, 2) hours per day fished, 3) days per week fished.

v. All adipose clipped returns encountered at WNFH and MFH volunteer traps will be removed.
1. Returns to WNFH will be retained at WNFH for broodstock (WNFH safety net and Okanogan 10(j) programs), or surplusing, or outplanting in the event minimum spawner abundance is not being met.
2. Returns to MFH will be transferred to WNFH for broodstock (WNFH safety net and Okanogan 10(j) programs), or surplusing, or outplanting in the event minimum spawner abundance is not being met.

vi. Conservation program returns may also be transported to specific reaches of the Methow and/or Chewuch Rivers (or other locations as determined by the HC/HSC) to meet the minimum spawning escapement objective or to experimentally augment spawner distribution (such an action will require an approved study or implementation plan by the HCP HC and PRCC HSC, and be permissible under current ESA permits).

Based on the preseason forecast for wild and hatchery spring Chinook to the Methow Basin, once NO broodstock requirements are fulfilled and accounting for an estimated prespawn mortality for NO fish of 50% (42% for HO fish), there will be approximately 519 NO spawners. Based upon the sliding PNI scale for NO run sizes >300 fish, the initial goal for 2020 will be to manage for a minimum spawning escapement of 519 spawners; to achieve this, based on the current forecast, the collection and translocation of hatchery fish will likely not be needed (Table 6). Further, the 400K WNFH (in addition to the 200K 10j program) safety net program would need to utilize WNFH returning adults for some or all of its broodstock. Any MFH HO returns retained may be used for broodstock for the WNFH safety net program to support PNI requirements.

Table 6. Calculated targets and projected adult management expectations for Methow spring Chinook in 2020 based on current run forecast.

Wild Spawning Escapement[1]		pNOB[2]	pHOS	PNI [3]	Hatchery Spawners[1,4]	Hatchery surplus[4]	Hatchery Broodstock (WNFH + 10j)	Proportion of Hatchery Fish to Remove	Total spawning escapement
Twisp	83	0.96	0.26	0.79	29	0 MH		0	112
Methow/Chewuch	227	0.89	0.44	0.67	180	504 WNFH[5]	472 (316 WH+156 WH)	0	407
Total	310	0.93	0.40	0.70	209	504	472 (316 WH+156 WH)	0	519

[1] Adjusted for prespawn mortality.
[2] pNOB of conservation program only averaged for BY15, 16, and 17. pNOB target for BY20 is 1.0 for both programs.
[3] Because of the uncertainty around run forecasts, PNI was provisionally estimated using the PNI=pNOB/(pNOB+pHOS) equation.
[4] Assumes a 90% conversion of hatchery fish to hatchery outfalls. Value already considers hatchery adults needed to meet WNFH and Okanogan 10(j) production components.
[5] If the estimated 504 surplus WNFH are allowed (or assumed) to be on the spawning grounds, PNI would drop to 0.57.

In-season assessment of the abundance and origin composition of the spring Chinook return above Wells Dam will be used to provide in-season adjustments to hatchery/wild composition and abundance, and total broodstock collection, consistent with ESA Section 10 Permits 18925, 18927, and 20533.

Methow Summer Steelhead

Depending on the outcome of preseason and in-season estimates of hatchery and natural origin steelhead to the Methow Basin should the annual run cycle monitoring at the Priest Rapids Dam Off Ladder Trap (OLAFT) occur, removal of surplus adult steelhead may occur at the Twisp Weir to meet an overall pHOS = 0.25 with 0.20 allocated to the Twisp Conservation program returns (the exception to this would be if a higher pHOS is still needed to wrap up the remaining time series on the Relative Reproductive Success Study as approved),the Wells Hatchery Volunteer Channel, volunteer returns to the Methow Hatchery and Winthrop NFH, during broodstock collection efforts (including angling), or in combination with a conservation fishery, consistent with ESA authorizations.

Okanogan Summer Steelhead

Depending on the outcome of preseason and in-season estimates of hatchery and natural origin steelhead to the Okanogan Basin should the annual run cycle monitoring at the Priest Rapids Dam Off Ladder Trap (OLAFT) occur, removal of surplus adult steelhead may utilize a conservation fishery or in combination with removal through spring Okanogan tributary weir operations, consistent with ESA authorizations.

Wenatchee Summer Steelhead

Depending on the outcome of preseason and in-season estimates of hatchery and natural origin steelhead to the Wenatchee Basin should the annual run cycle monitoring at the Priest Rapids Dam Off Ladder Trap (OLAFT) occur, removal of surplus adult steelhead may utilize a conservation fishery or in combination with removal through spring Wenatchee tributary weir operations, consistent with ESA authorizations.

Adult management plans, if needed, will be finalized then and appended to this document.

Priest Rapids Fall Chinook

The Joint Fisheries Parties have an elevated interest in ensuring any surplus adults back to Priest Rapids Hatchery are made available to back fill anticipated shortfalls in other Columbia River fall Chinook programs if the 2020 return forecast (yet to be developed) indicates a low return. As no specific action plan has yet been discussed or developed by the parties, this space is reserved for those details to be inserted at a later date.

Appendix D

DRAFT Site Specific Trapping Operation Plans

Tumwater Dam

For 2020, WDFW and Chelan PUD are proposing the following plan (a summary of activities by month for Tumwater Dam is summarized in Table 1):

1) **Real-time monitoring and trap operations:** The PIT tag antennae arrays at the entrance (low and high water entrances; A4 and A5) and at weir 18 (A1) within the Tumwater Dam ladder will be monitored by WDFW and Chelan PUD throughout all trapping activities described in this plan. Detections of previously PIT tagged fish will be evaluated to determine the median passage time of fish between first detection at the ladder entrances and last detection weir 18. Median passage estimates will be updated with every 10 PIT-tagged fish detected at the ladder entrance. If the median passage time is greater than 48 hours, trapping will cease and fish will be allowed to exit via the ladder (i.e., bypass the trap). If trapping has been stopped, PIT tag passage monitoring will continue and trapping will resume if and when the median passage time is less than 24 hours. In summary, real-time PIT tag monitoring will occur both when the trap is operational and when fish are bypassed. This will provide an opportunity to evaluate trapping effects versus baseline passage rates through the ladder for future operations.

2) **Enhanced effort for Tumwater trapping operations from June 1 and July 15**: The Tumwater trap will be operated in an active-manned trapping condition (the ladder bypass will not be used however, fish may still ascend the denil [steep pass] unimpeded). The trap will be checked a minimum of 1x per day. More frequent trap checks will be made as fish numbers increase. Between June 16 and July 15 the Tumwater trap will be actively manned 24 hours/day 7 days/week utilizing two- three person crews (two people will sample fish and the third will maintain operation of the steep pass so that it will not be closed to passage). This represents an additional person to keep the denil operating constantly. If during this period staff are not available (due to logistical, funding, or other issues) to keep the denil operating continuously, the trap will be opened to allow for nighttime passage (this is in addition to passage required under a detected delay event).

3) **Enhanced effort and limited Tumwater trapping operations from July 16 to August 31**: The trap will be operated 3 days/week for up to 16 hours/day (not to exceed 48 hours per week) to support broodstock collection activities for summer Chinook and sockeye run composition sampling (CRITFC) and sockeye spawner escapement PIT tagging. Video enumeration and full passage will occur when trapping is not occurring.

4) **Planned Tumwater trapping operations from September 1 until September 30:** To facilitate lamprey passage and meet coho and steelhead broodstocking and steelhead adult management needs, the trap is being proposed to operate up to 16 hours per day from 6AM to 10PM 7days/week manned or unmanned active trapping. The trap will be open for lamprey passage between the hours of 10PM and 6AM. During this time period

bull trout are rare and spring Chinook are not present at Tumwater. For this trapping period, real-time monitoring will be implemented with video enumeration when opened.

5) **Operations at Tumwater from mid-December until about mid-February:** During this period the trapping facility is not operated due to having been winterized. Only video enumeration and full passage are available during this period.

6) **Planned Tumwater trapping operations from mid-February through May:** The trap may return to a 24 hours/7days/week manned or unmanned active trapping for adult steelhead management and/or broodstock collection as needed. Beginning on or about May 1, limited spring Chinook broodstocking, run comp sampling, etc. may also occur. For this trapping period, real-time monitoring will continue to be implemented.

7) **Limitation in staffing or other unforeseen problems:** If WDFW staff are not available to operate the trapping facility (according to this plan) for any reason, then full passage will be allowed (fish will be allowed to bypass the trap and exit the ladder directly), until staff are able to return.

8) **Unforeseen scenarios and in season observations**: If during the trapping period, observations from field staff warrant reconsideration of any part of the plan as described above, WDFW and Chelan PUD will alert the Hatchery Committee and work cooperatively with the Services to determine whether changes are needed to further minimize incidental take or otherwise ensure that take is maintained at the manner and extent previously approved by the Services.

Table 1. Summary of broodstock collection, spawner escapement tagging, adult management, run composition sampling, and reproductive success activities anticipated to be conducted at Tumwater Dam in 2020. Blue denotes steelhead, brown spring Chinook, orange sockeye, pink summer Chinook, and green Coho.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
SHD pHOS mgt[1]		15 Feb				15 June			1 Sep			15 Dec
Su. SHD BS collection[2]									1 Sep		15 Nov	
Su. SHD Spawner Esc. tagging[3]		15 Feb				15 June			1 Sep			15 Dec
Spring Chinook RSS[4]					1 May		15 Jul					
Sp Chinook run comp[5]					1 May		15 Jul					
Sp Chinook pHOS mgt[6]					1 May		15 Jul					
Sp Chin stray mgt[7]					1 May		15 Jul					
Sp Chin BS collection					1 May		15 Jul					
Sockeye run comp[8]							15 Jul	15 Aug				
Sockeye spawner esc tagging[9]							15 Jul	15 Aug				
Su. Chin BS collection[10]							1 Jul		15 Sep			
Coho BS collection[11]									1 Sep		30 Nov	

[1] Adult management of the 2020 brood will end in June 2020. However it is anticipated that adult management will occur for the 2020 brood (if needed) beginning 1 September or earlier if conducted in conjunction with broodstock collection activities at Tumwater Dam for other species.

[2] Summer steelhead broodstock collection will be prioritized at Dryden Dam traps. However if broodstock objectives cannot be met at Dryden then trapping may occur at Tumwater concurrent with other activities.
[3] SHD spawner composition tagging at Tumwater Dam will run concurrent with SHD adult management and other (broodstock) activities at Tumwater Dam.
[4] The spring Chinook RSS will run from 1 May through about 15 July or at such time or at such time the sockeye return develops at Tumwater Dam.
[5] Spring Chinook run composition sampling will run concurrent with the RSS.
[6] Spring Chinook pHOS management will end in July consistent with the arrival of the sockeye return and run concurrent with RSS activities.
[7] Removal of unknown hatchery origin spring Chinook strays at Tumwater Dam will run concurrent with the RSS.
[8] Sockeye run composition sampling will occur at Tumwater Dam beginning no earlier than 15 July. Trapping at Tumwater Dam for run composition sampling will follow a 3d/week, 16hrs/d (48 hrs/week) trapping schedule consistent with permit 1347.
[9] Sockeye spawner escapement sampling will occur at Tumwater Dam beginning no earlier than 15 July. Trapping at Tumwater Dam for spawner escapement tagging will follow a 3d/week, 16hrs/d (48 hrs/week) trapping schedule consistent with permit 1347.
[10] Summer Chinook broodstock collection will be prioritized at Dryden Dam. However if broodstock objectives cannot be met at Dryden Dam then trapping may occur at Tumwater Dam. Trapping at Tumwater Dam for summer Chinook broodstock will follow a 3d/week 16hr/day (48 hrs/week) trapping schedule and may run concurrent with other broodstock collection, run sampling, or adult management activities.
[11] Coho trapping will be conducted at both Dryden and Tumwater Dams. Trapping at Tumwater Dam for Coho broodstock will follow a 3d/week 16hr/day (48 hrs/week) trapping schedule and may run concurrent with other broodstock collection, run sampling, or adult management activities. Collection is permitted through December 7 of each year but typically ceases by the end of November.

Dryden Dam

For 2020, WDFW and Chelan PUD are proposing the following plan (a summary of activities by month for the right and left bank Dryden Dam traps is summarized in Table 2):

The Dryden Dam left and right bank trapping facilities will operate up to 7 days per week, 24 hours per day beginning June 24 and continue until as late as November 15. Both traps, if operated, will do so on concurrent days and will be checked and cleared every 24 hours, or sooner if it appears that run contribution to the facilities exceeds reasonable limits for adult holding.

If daily river temperatures meet or exceed 21^{o} C (69.8^{o} F) trapping activities and fish handling will cease until temperatures drop below this threshold. This may require reducing trap operation to only nighttime hours with early morning traps checks to ensure the safety of the fish.

Table 2. Summary of broodstock collection, spawner escapement tagging, adult management, run composition sampling, and/or reproductive success activities anticipated to be conducted at Dryden Dam trapping facilities in 2020. Blue denotes steelhead, pink summer Chinook, and green Coho.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Left Bank												
Su. SHD BS collection[1]							1 Jul				15 Nov	
Su. SHD Run Comp.							1 Jul				15 Nov	
Su. SHD spawner esc. Tagging[2]							1 Jul				15 Nov	
Su. Chinook run comp							1 Jul		15 Sep			
Su. Chin BS collection[3]							1 Jul		15 Sep			
Coho BS collection									1 Sep		30 Nov	
Right Bank												
Su. SHD BS collection[1]							1 Jul				15 Nov	
Su. SHD Run Comp.							1 Jul					
Su. SHD spawner esc. Tagging2							1 Jul				15 Nov	
Su. Chinook run comp							1 Jul		15 Sep			
Su. Chin BS collection[3]							1 Jul		15 Sep			
Coho BS collection[4]									1 Sep		30No v	

[1] Summer steelhead broodstock collection will be prioritized at Dryden Dam traps. However if broodstock objectives cannot be met at Dryden then trapping may occur at Tumwater concurrent with other activities. In the event steelhead brood cannot be met by Nov 14 and the YN coho program does not need to operate the trap(s), steelhead brood collection may continue independently through Dec 5.
[2] SHD spawner composition tagging at Dryden Dam will run concurrent with other (broodstock or M&E) activities at Dryden Dam.
[3] Summer Chinook broodstock collection will be prioritized at Dryden Dam. However if broodstock objectives cannot be met at Dryden Dam then trapping may occur at Tumwater Dam. Trapping at Dryden Dam for summer Chinook broodstock will follow an up to 7d/week 24hr/day trapping schedule and may run concurrent with other broodstock collection, run sampling, or adult management activities.
[4] Coho trapping will be conducted at both Dryden and Tumwater Dams. Trapping at Dryden Dam for Coho broodstock will follow an up to 7d/week 24hr/day trapping schedule and may run concurrent with other broodstock collection, run sampling, or adult management activities. Collection is permitted through December 5 of each year but typically ceases by the end of November.

Chiwawa Weir

For 2020, WDFW and Chelan PUD are proposing the following pilot plan (a summary of activities by month for the Chiwawa Weir is summarized in Table 3):

The 2020 pilot weir operations will allow up to 20 days of trapping (sometimes back to back days) with daily operations only occurring between the hours of 6 AM and 9 PM (the goal will be to operate the weir up to 14 hours a day but targeting the time period of one hour before official sunrise to one hour after official sunset which will vary throughout the trapping period) The weir would be lowered and trap opened up nightly (10 hours minimum) to facilitate bull trout passage and minimize encounters. Bull trout encounters would be recorded for each trap day and the maximum number of bull trout which could be encountered without notification to,discussion and coordination with the USFWS would be 10% of the 2014-2019 estimated bull trout spawner abundance in the Chiwawa River subbasin (123 bulltrout). Any further in-season modification of this plan would require coordination with/concurrence on the part of the HC and the USFWS prior to implementation. This pilot weir operations plan is similar to the operations plan approved for the Twisp weir and will be implemented only as a pilot for 2020. Timing of trap operation will incorporate NO fish passage at TWD and would use estimated travel times (derived from PIT tags) to the lower Chiwawa PIT tag antenna array.

Table 3. Summary of broodstock collection activities anticipated to be conducted at the Chiwawa Weir in 2020. Brown denotes spring Chinook.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Sp Chin BS collection						1 June		15 Aug				

Wells Dam Ladder and Hatchery Volunteer Traps

For 2020 (and 2021 for steelhead), WDFW and Douglas PUD propose the following plan (activities by month for the Wells Dam East/West ladder and Wells FH volunteer traps are summarized in Table 4):

1). **East Ladder Trap:**

The East ladder trap will only be operated as needed to meet broodstock collection objectives and other management activities if they cannot be adequately fulfilled through the West ladder and Wells FH volunteer trap operations or if the use of either the West ladder or volunteer traps is precluded for some reason.

If the East ladder trap is used, it may begin as early as May 1 and, with two exceptions, will operate under a maximum 3-day per week/16 hours per day or 48 cumulative hours per week and will run concurrent with any trapping activities occurring at the West ladder trap. The first exception to the above is that for spring Chinook between May 1 and June 20, the trap may operate a maximum of 7-days per week/16 hours per day and will run concurrent with any trapping activities occurring at the West ladder trap. The second exception is for coho trapping after September 26. Anticipated trap operation is not expected to go beyond November 15.

For coho trapping, from September 1 through September 26 trap may be operated, concurrent with the West ladder trap, 3 days per week/16 hours per day. For September 27 through October 9, 5 days per week/9 hours per day. Beginning October 10 through December 7, 7 days per week/16 hours per day (see Appendix J). Trap operators will bypass Chinook, steelhead, and sockeye during coho trapping. Anticipated trap operation is not expected to go beyond November 15.

The CRITFC may also trap sockeye at Wells Dam for tagging and stock assessment. Their request for trapping in 2020 did not specify trapping details other than timing (late June through early August), but their preference in past years has been to use the East ladder. Although this work has been done in the past, this action will need approval in 2020 by the Wells HCP Coordinating Committee.

If daily river temperatures meet or exceed 21° C (69.8° F) trapping activities and fish handling will cease until temperatures drop below this threshold. This may require reducing trap operation to only nighttime hours with early morning traps checks to ensure the safety of the fish.

2). **West Ladder Trap:**

The West ladder may begin as early as May 1 for spring Chinook broodstock collection and, with two exceptions, will operate under a maximum 3-day per week/16 hours per day or 48 cumulative hours per week. The first exception to the above is that for spring Chinook between May 1 and June 20, the trap may operate under a maximum 7-days per week/16 hours per day and will run concurrent with any trapping activities occurring at the East ladder trap. The second exception is for coho trapping after September 26. Anticipated trap operation is not expected to go beyond November 15.

For coho trapping, the West ladder trap may be operated 5 days per week/ 9 hours per day September 27 through October 9, and 7 days per week/16 hours per day beginning October 10. Trap operators will bypass Chinook, steelhead, and sockeye during coho trapping. Anticipated trap operation is not expected to go beyond November 15.

The CRITFC may also trap sockeye at Wells Dam for tagging and stock assessment. Their request for trapping in 2020 did not specify trapping details other than timing (late June through early August), but their preference in past years has been to use the East ladder. Although this work has been done in the past, this action will need approval in 2020 by the Wells HCP Coordinating Committee.

If daily river temperatures meet or exceed 21° C (69.8° F) trapping activities and fish handling will cease until temperatures drop below this threshold. This may require reducing trap operation to only nighttime hours with early morning traps checks to ensure the safety of the fish.

3). **Wells FH Volunteer Trap:** The Wells FH volunteer trap may begin as early as June 15 for summer Chinook broodstock collection and operate through mid-June of the following year for steelhead broodstock collection and adult management if needed. The trap may operate up to seven days per week/24 hours per day to facilitate broodstock collection and adult management actions (Table 4).

If water temperatures in the trapping facility meet or exceed 21° C (69.8° F) trapping activities and fish handling will cease until temperatures drop below this threshold. This may require reducing trap operation to only nighttime hours with early morning traps checks to ensure the safety of the fish.

Table 4. Summary of broodstock collection, spawner escapement tagging, adult management, run composition sampling, and/or reproductive success activities anticipated to be conducted at Wells Dam in 2020 (and 2021 for steelhead). Blue = steelhead, brown = spring Chinook, pink = summer Chinook, orange = sockeye, and green = Coho.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
East/West Ladders												
Sp Chinook BS collection					1 May	30 Jun						
Sp Chinook run comp					1 May		15 Jul					
Sockeye SA tagging[1]						Late June		Early Aug				
Su. Chin BS collection[2]							1 Jul		15 Sep			
Coho BS collection[3]									15 Sep		15 Nov	
Wells Volunteer Trap												
Su SHD BS/pHOS mgt.[4]		15 Feb				15 June			1 Sep			15 Dec
Su. Chin BS collection[5]						15 June			15 Sep			
Su. Chin Surplussing							1 Jul			30 Oct		

[1] CRITFC trapping of sockeye for stock assessment and tagging typically begins the last week of June and extends through the third week of August, following an up to 3d/week 16hr/day (48 cumulative hours) coordinated with WDFW spring or summer Chinook broodstock collection and stock assessment trapping, preferring to trap on the East ladder.
[2] Summer Chinook broodstock collection for the Methow (Carlton) program will be prioritized at the West ladder trap. However if broodstock objectives cannot be met at the West ladder then trapping may occur at the East ladder. Trapping at the west and/or East ladders for summer Chinook broodstock will follow an up to 3d/week 16hr/day (48 cumulative hours) trapping schedule and may run concurrent with other broodstock collection, run sampling, or adult management activities.
[3] Coho trapping may be conducted at both East and/or West ladders. Trapping at Wells Dam ladder traps for Coho broodstock prior to September 27, will follow up to 3d/week 16hr/day (48 cumulative hours) coordinated with WDFW steelhead broodstock collection and stock assessment trapping; from September 27 through October 9, an up to 5d/week 9hr/day trapping schedule and may run concurrent with other broodstock collection, run sampling, or adult management activities, and 7 days per week/16 hours per day beginning October 10. Trapping at the Wells Dam ladder will cease no later than November 15.
[4] Adult management of the 2019/2020 return will end in June 2020. However, it is anticipated that adult management will occur for the 2020/2021 return beginning as early as 1 September or earlier if conducted in conjunction with broodstock collection activities at the Wells Hatchery volunteer channel for other species. Emergency collection of 2021 brood steelhead may also occur in the fall if the 2020/2021 return is deemed inadequate to support spring collection of brood.
[5] Summer Chinook broodstock collection for the Wells Hatchery programs will be prioritized at the Wells Hatchery volunteer trap. Trapping at the volunteer channel may occur up to 7 days per week, 24 hours per day and may include broodstock collection and/or adult management.

Methow Hatchery Volunteer and Twisp Weir Traps

For 2020 (and 2021 for steelhead), WDFW and Douglas PUD propose the following plan (A summary of activities by month for Methow Hatchery volunteer trap and the Twisp Weir is summarized in Table 5):

Methow Hatchery Volunteer Trap

The Methow Hatchery volunteer trap may be operated for spring Chinook as early as May 1 through August 31 for broodstock collection and gene flow management. The trap may be operated from approximately March 1 through June 1 for steelhead broodstock collection and gene flow management. In all cases, the trap may be operated 24 hours a day, seven days a week. The trap will be checked at least once every 24 hours, but will be checked two or more times a day when fish are abundant. Trap operations will be adjusted if bull trout captures approach ESA take limits. Trapping operations will be halted prior to exceeding ESA take levels for any ESA listed species.

If daily river temperatures meet or exceed 21^{o} C (69.8^{o} F) trapping activities and fish handling will cease until temperatures drop below this threshold. This may require reducing trap operation to only nighttime hours with early morning traps checks to ensure the safety of the fish.

Twisp Weir

1) **General Weir Operating Parameters:**
   a. Weir fished from ice out in late February/early March through mid-August.
   b. Steelhead trapping occurs from late February/early March through June 1.
   c. Spring Chinook Trapping occurs from June 1 until broodstock and adult management targets are achieved (usually prior to mid-August).
   d. The height of the weir panels is hydraulically controlled and panels are set at the water surface level when the weir is fishing to allow downstream migrating steelhead, spring Chinook, and bull trout to safely and effectively pass the weir.
   e. Weir is tended by DPUD or WDFW personnel whenever the trap is operated. WDFW is contracted by Douglas PUD under the HCP Monitoring and Evaluation Plan to monitor the trap.
   f. Operation of the weir under the ESA is currently authorized by Section 10 Permits 18925 and 23163.
   g. Real-time monitoring and trap operations: Throughout all trapping activities described in this plan, PIT tag interrogation locations WEL and WEA (Wells Dam), WEH (Wells Hatchery), LMR (Lower Methow River) and TWR (Twisp River) will be monitored by WDFW and DCPUD staff for detections of previously PIT tagged steelhead, spring Chinook, and bull trout. Detections at Wells Dam are nearly 100% efficient. However, detections at LMR and TWR during the higher flows, particularly when spring Chinook and bull trout are migrating, may be less than 20% efficient (comparing fall downstream movements to upstream movements). Data will be examined on a yearly basis to determine if there are peak periods when bull trout are most likely to pass the weir.

h. When the weir is not fishing, the weir panels will be lowered to the stream bottom, or the traps will be opened to passage, or both. If only the weir panels are lowered the entrances to the traps will be closed.
i. Limitation in staffing or other unforeseen problems: If staff are not available to staff the trapping facility (according to this plan) for any reason, or the trap will not be checked within 24 hours, then full passage will be allowed by lowering the weir panels or opening the traps or both, dependent on flow conditions until staff are able to return.
j. Unforeseen scenarios and in-season observations: If during the trapping period, observations from field staff warrant reconsideration of any part of the plan as described above, WDFW and the District will alert the National Marine Fisheries Service, HCP Hatchery Committee, and/or the USFWS, as appropriate, and work cooperatively with these parties to minimize incidental take or otherwise ensure that take is maintained at the manner and extent previously approved by the USFWS.
k. Trapping effort monitoring: Trapping effort in the form of daily trap operation time will be recorded by trap operators. Trapping effort will be used in subsequent years to refine this plan.
l. Nocturnal vs diurnal use: Species composition during trapping hours will be recorded to document times of day when various species are trapped.
m. Trapping will be suspended prior to exceeding the take limits specified by USFWS for bull trout and by NMFS for summer steelhead and spring Chinook.
n. Broodstock collection target numbers are established annually prior to trapping based on predicted age composition, fecundity, and survival of broodstock and rearing in-hatchery.
o. This Plan does not limit other ESA Permit (23163 and 18925, Wells Bull Trout Biological Opinion) conditions that also apply under this plan.

2) Late February/Early March through June 1 Operations:

a. Weir begins fishing in late February or early March as environmental conditions allow.
b. The weir will be fished constantly during this time to trap steelhead, as conditions allow. The weir will be tended by WDFW personnel at least once daily, but twice daily or more when fish are present. An attempt will be made to capture all adult steelhead during this time period:
    i. Steelhead are trapped during this period for Twisp River broodstock collection for the Douglas PUD Twisp Steelhead Conservation Program (N~12-26).
    ii. Steelhead are trapped for population census data collection and for a relative reproductive success study of hatchery and wild steelhead required of Douglas PUD under the Wells HCP.
    iii. Steelhead are trapped to control the relative abundance of hatchery and wild steelhead adults upstream of Twisp Weir. Steelhead removed via adult management may be used as broodstock for other Douglas PUD and WNFH programs.
c. Bull trout have not been observed or trapped at the Twisp Weir prior to June 5th.

d. No more than 118 adult and 50 sub-adult bull trout (also includes 19 juveniles) handled in the entire trapping season. Trapping would be suspended with one lethal take of any size bull trout.
e. High flows that may occur during the steelhead trapping season can significantly limit the efficiency of the weir or prevent fishing the weir. In these cases, the weir panels are lowered or over-topped by the water and the traps are opened for passage. During such flow episodes that prevent trapping, the weir and trap boxes are fully passable to all species.

3) June 1 through August Operations:

a. The weir will be fished selectively during this time period to trap spring Chinook broodstock. Normally the weir will be fished daily from 6:00 AM until 9:00 PM, but overnight trapping may be used if greater trapping effort is needed to collect spring Chinook broodstock. When the weir is not fishing, the weir panels will be lowered and/or the traps will be opened to allow passage.
b. Trapping effort will be based on meeting the spring Chinook broodstock collection target for adult spring Chinook of natural origin. In-season information derived from sampling and counts at Wells Dam and PIT tag detections at in-river arrays will inform trapping operations in order to target spring Chinook while reducing effort when spring Chinook are not likely to be available.
c. Trapping will not necessarily occur every day or for 24 consecutive hours per day, dependent on efficiency of trapping operation in obtaining broodstock. Fine-scale scheduling of trap operations will be determined on a day-to-day basis.
d. No more than 118 adult and 50 sub-adult bull trout (also includes 19 juveniles) handled in the entire trapping season. Trapping would be suspended with one lethal take of any size bull trout.
e. Trapping will be suspended when the broodstock target is met. When the weir is not fishing the traps will be opened to allow passage and the weir panels will be lowered. The traps will be removed from the river in mid- to late August.
f. High flows significantly limit the efficiency of the weir or prevent fishing the weir entirely. In these cases, the weir panels are lowered and the traps are opened for passage. During high flow episodes that prevent trapping the weir is fully passable to all species.

Table 5. Summary of broodstock collection, spawner escapement tagging, adult management, run composition sampling, and/or reproductive success activities anticipated to be conducted at Methow Hatchery and the Twisp Weir in 2020. Blue denotes steelhead and brown denotes spring Chinook.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Methow Hatchery[1]												
SHD pHOS mgt.			1 Mar			15 Jun			1 Sep		15 Nov	
Sp. Chinook BS collection					1 May			30 Aug				
Sp. Chinook pHOS mgt.[2]					1 May			30 Aug				
Twisp Weir[3]												
Steelhead RSS			1 Mar		30 May							
Su. SHD BS collection			1 Mar		30 May							
SHD pHOS mgt.			1 Mar		30 May							
Sp. Chinook BS collection						1 June		15 Aug				
Sp. Chinook pHOS mgt.						1 June		22 Aug				

[1] Specific details on how operation of the Methow Hatchery volunteer trap will work for SHD adult management are still being worked out at this time.
[2] Adult management for spring Chinook at the Methow Hatchery volunteer trap will run concurrent with broodstock collection.
[3] Specific details on how operation of the Twisp Weir will work for 2020 to include the steelhead RSS, broodstock collection, and adult management and spring Chinook broodstock collection and adult management is still being worked out at this time.

Priest Rapids Dam Off-Ladder-Adult-Fish-Trap (OLAFT)

For 2020, WDFW and Grant PUD propose the following plan for activities at the PRD OLAFT (Table 5):

Table 6. Summary of broodstock collection, VSP monitoring, and/or run composition sampling activities anticipated to be conducted at the Priest Rapids Dam Off-Ladder-Adult-Fish-Trap (OLAFT) in 2020. Blue denotes steelhead, green coho, purple fall Chinook, and orange sockeye. All users of the OLAFT must have a signed Facility Use Agreement with GPUD.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
SHD VSP Monitoring[1]							1 Jul				15 Nov	
YN Coho VSP Monitoring[2]									1 Sep		15 Nov	
Fall Chinook Run Comp.[3]									1 Sep		15 Nov	
Sockeye BS Collection[4]						22 Jun	10 Jul					

[1] Steelhead VSP monitoring, if it occurs in 2020, will target up to 15% of the annual return over Priest Rapids Dam. Presently that requires operation of the OLAFT up to 3 days/ week, 8 hours per day. The trap is opened to passage each night.
[2] Coho sample will occur concurrently with steelhead VSP monitoring.
[3] Fall Chinook run composition runs concurrent with SHD VSP monitoring.
[4] Sockeye broodstock collection to support YN reintroduction efforts in the Yakima is based upon abundance based sliding scale. Depending on the strength of the return and allowable allocation, the trap may be operated up to 5 days per week, 8 hours per day beginning about 22 June and running through about 10 July. The trap is opened to passage each night.

Appendix E

DRAFT Columbia River TAC Forecast

Table 1. 2020 Columbia River at mouth salmon returns – actual and forecast.*

		2019 Forecast	**2019 Actual**	**2020 Forecast**
Spring Chinook		**136,155**	**106,436**	**132,700**
Willamette River		40,200	27,292	40,800
Sandy River		5,500	3,260	5,200
Select Areas**		8,200	2,548	4,300
Cowlitz River		1,300	1,563	1,400
Kalama River		1,400	997	1,000
Lewis River		1,600	31,047	1,400
Lower River Total		**58,200**	**36,707**	**54,100**
Wind River**		2,800	1,598	2,000
Drano Lake/Little White Salmon River**		5,600	3,571	4,600
Hood River**		2,300	1,207	2,300
*Hood River wild***		--	--	--
Klickitat River**		1,100	404	1,800
Deschutes**		1,455	863	--
John Day**		--	2,170	2,800
Yakima River**		3,000	1,756	2,800
Umatilla River**		2,400	522	900
Mid-Columbia total *(by subtraction)*		***18,655***	***12,091***	***10,600***
Upper Columbia (total)		11,200	14,561	13,600
Upper Columbia wild		*2,100*	*1,668*	*2,300*
Snake River Spring/Summer (total)***		48,100	43,077	54,400
*Snake River wild****		*8,200*	*7,480*	*9,600*
Upriver Total		**59,300**	**57,638**	**68,000**
Summer Chinook	**Upper Columbia**	**36,340**	**34,619**	**38,300**
Sockeye	**Total Sockeye**	**94,400**	**63,222**	**246,300**
Wenatchee		18,300	7,900	39,400
Okanogan		74,500	54,300	201,800
Yakima		1,300	600	2,500
Deschutes		100	200	300
Snake River		200	****	2,300

*Components may not sum to totals shown since individual forecasts are not available for all upriver spring Chinook tributaries. Wild components are included in the stock total.

**Return to tributary mouth.

***2019 return is based on standard TAC run reconstruction methodology.

****2019 passage of sockeye at Lower Granite Dam was 81 fish but genetic analysis indicates most of these were Okanogan and Wenatchee stock.

Appendix F

DRAFT Annual Chelan, Douglas, and Grant County PUD RM&E Implementation Plans

Chelan PUD
The Final 2020 Chelan Hatchery Monitoring and Evaluation Implementation Plan (PDF) is available at the HCP Hatchery Committees Extranet Homepage. Please use the following procedure:

* Visit: https://extranet.dcpud.net/sites/nr/hcphc/
* Login using "Forms Authentication" (for non-Douglas PUD employees)

Douglas PUD
The Final 2020 DCPUD ME Implementation Plan (PDF) is available at the HCP Hatchery Committees Extranet Homepage. Please use the following procedure:

* Visit: https://extranet.dcpud.net/sites/nr/hcphc/
* Login using "Forms Authentication" (for non-Douglas PUD employees)

Grant PUD

2020 GPUD Hatchery ME Implementation Plan for the Wenatchee Basin and Methow Summer Chinook Salmon
https://partner.gcpud.org/sites/ResCom/PRCCHatchery/Final/2019_07_18%20Grant%20-%202020%20GPUD%20Hatchery%20ME%20Implementation%20Plan%20for%20the%20Wenatchee%20and%20Methow%20Basins.pdf?Web=1

2019-2020 Priest Rapids Hatchery Implementation Plan
https://partner.gcpud.org/sites/ResCom/PRCCHatchery/Final/2019_05_09%20Grant%20-%20PRH%20ME%202019-20%20Implentation%20Plan%20final.pdf?Web=1

Appendix G

DRAFT Hatchery Production Management Plan

The following management plan is intended to provide life-stage-appropriate management options for Upper Columbia River (UCR) PUD salmon and steelhead mitigation programs. Consistent, significant over-production or under-production risks the PUD's not meeting the production objectives required by FERC and overages in excess of 110% of program release goals violates the terms and conditions set forth for the implementation of programs under ESA and poses potentially significant ecological risks to natural origin salmon communities.

Under RCW 77.95.210 (Appendix A) as established by House Bill 1286, the Washington Department of Fish and Wildlife has limited latitude in disposing of salmon and steelhead eggs/fry/fish. While this RCW speaks more specifically to the sale of fish and/or eggs, WDFW takes a broader application of this statute to include any surplus fish and/or eggs irrespective of being sold or transferred.

We propose implementing specific measures during the different life-history stages to both improve the accuracy of production levels and make adjustments if over-production occurs. These measures include (1) Improved Fecundity Estimates, (2) Adult Collection Adjustments, (3) Within-Hatchery Program Adjustments, and (4) Culling at the earliest life-stage.

<u>Improved Fecundity Estimates</u>

A) Develop broodstock collection protocols based upon the most recent 5-year mean in-hatchery performance values for female to spawn, fecundity, green egg to eye, and green egg to release.
B) Use portable ultrasound units to confirm gender of broodstock collected (broodstock collection protocols assume a 1:1 male-to-female ratio). Ultrasonography, when used by properly trained staff will ensure the 1:1 assumption is met (or that the female equivalents needed to meet production objective are collected). Spawning matrices can be developed such that if broodstock for any given program are male limited, sufficient gametes are available to spawn with the females.

<u>Adult Collection Adjustments</u>

C) Make in-season adjustments to adult collections based upon a fecundity-at-length regression model for each population/program and origin composition need (hatchery/wild). This method is intended to make in-season allowances for the age structure of the return (i.e. age-5 fish are larger and therefore more fecund than age-4 fish), but will also make allowances for age-4 fish that experienced more growth through better ocean conditions compared to an age-5 fish that reared in poorer ocean conditions.

<u>Within-Hatchery Program Adjustments</u>

D) At the eyed egg inventory (first trued inventory), after adjustments have been made for culling to meet BKD management objectives, the over production will be managed in one or more of the following actions as approved by the HCP-HC or PRCC-HSC:

- Voluntary cooperative salmon culture programs under the supervision of the department under chapter 77.100 RCW;
- Regional fisheries enhancement group salmon culture programs under the supervision of the department under this chapter;
- Salmon culture programs requested by lead entities and approved by the salmon funding recovery board under chapter 77.85 RCW;
- Hatcheries of federally approved tribes in Washington to whom eggs are moved, not sold, under the interlocal cooperation act, chapter 39.34 RCW; and
- Governmental hatcheries in Washington, Oregon, and Idaho; or
- Culling for diseases such as BKD and IHN, consistent with the Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State; or
- Distribution to approved organizations/projects for research.

E) At tagging (second inventory correction) fish will be tagged up to 110% of production level at that life stage. If the balance of the population combined with the tagged population amounts to more than 110% of the total release number allowed by Section 10 permits then the excess will be distributed in one or more of the following actions as approved by the HCP-HC or PRCC-HSC:
- Voluntary cooperative salmon culture programs under the supervision of the department under chapter 77.100 RCW;
- Regional fisheries enhancement group salmon culture programs under the supervision of the department under this chapter;
- Salmon culture programs requested by lead entities and approved by the salmon recovery funding board under chapter 77.85 RCW;
- Hatcheries of federally approved tribes in Washington to whom eggs are moved, not sold, under the interlocal cooperation act, chapter 39.34 RCW; and
- Transfer to another resource manager program such as CCT, YN, or USFWS program;
- Governmental hatcheries in Washington, Oregon, and Idaho;
- Placement of fish into a resident fishery (lake) zone, provided disease risks are within acceptable guidelines; or
- Culling for diseases such as BKD and IHN, consistent with the Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State; or
- Distribution to approved organizations/projects for research.

F) In the event that a production overage occurs after the above actions have been implemented or considered, and deemed non-viable for fish health reasons in accordance with agency aquaculture disease control regulations (i.e. either a pathogen is detected in a population that may pose jeopardy to the remaining population or other programs if retained or could introduce a pathogen to a watershed where it had not previously been detected) then culling of those fish may be considered.

All, provisions, distributions, or transfers shall be consistent with the department's egg transfer and aquaculture disease control regulations as now existing or hereafter amended. Prior to department determination that eggs of a salmon stock are surplus and available for sale, the department shall assess the productivity of each watershed that is suitable for receiving eggs.

Species/Program Specific Juvenile Surplussing Protocols:

Surplus UCR Juvenile Steelhead Management

Above Wells Programs:

In the event excess HxH juveniles are produced from over-collection efforts to support the Methow Safety-Net and /or Okanogan programs which rely on spring adult collections, the parties agree that distribution of juveniles will follow the following priority matrix:

1. Progeny transferred to the Columbia Safety-Net program provided fish health and/or marking requirements for the program can be met.

2. Used to support shortfalls in the WNFH production obligation provided fish health and/or marking requirements for the program can be met and provided basin wide pHOS/PNI allow for a decrease in program pNOB.

3. Used to support shortfalls in the Ringold SHD program provided fish health and/or marking requirements for the program can be met.

4. Out-planted to landlocked lakes within Okanogan County and/or Colville Reservation provided fish health requirements can be met or provided stocking allotments are not exceeded (as determined by WDFW, YN and CCT fishery managers, as applicable; Banks Lake may be utilized as a last resort if stocking allotments for area lakes have already been met and/or if access to appropriate locations is inhibited – i.e., snow, ice, washouts, etc.).

5. In the event a surplus is identified, WDFW and the appropriate Hatchery Committee(s) will be notified via email no later than two weeks prior to fish needing to be moved off station or to another program.

In addition, surplus fish, including broodstock, will be distributed at the earliest possible life-stage (e.g., prespawn adults, eyed-egg, fry) per WDFW policy. If excess WxW production from any of the conservation programs occurs, the priority will be to incorporate those progeny either into an available conservation program (if a shortfall exists) or into the closest safety net program (in this case it would be the Methow safety net [MSN]). Excess safety net fish from the MSN will then be managed in accordance with the guidelines above.

Wenatchee Summer Steelhead:

In the event excess HxH juveniles are produced resulting from higher than expected in-hatchery survival, fecundities, etc.), the parties agree that distribution of juveniles will follow the following priority matrix:

1. Used to support shortfalls in the Ringold SHD program provided fish health and/or marking requirements for the program can be met.

2. Out-planted to landlocked lakes within Chelan, Douglas, or Grant counties provided fish health requirements can be met or provided stocking allotments are not exceeded (as determined by WDFW, YN and CCT fishery managers, as applicable; Banks Lake may be utilized as a last resort if stocking allotments for area lakes have already been met and/or if access to appropriate locations is inhibited – i.e., snow, ice, washouts, etc.).

3. In the event a surplus is identified, WDFW and the appropriate Hatchery Committee(s) will be notified via email no later than two weeks prior to fish needing to be moved off station or to another program. This is to ensure adequate and appropriate logistics can be coordinated between affected parties.

In addition, surplus fish, including broodstock, will be distributed at the earliest possible life-stage (e.g., prespawn adults, eyed-egg, fry) per WDFW policy. If excess WxW production from the conservation program occurs, the priority will be to incorporate those progeny into the closest safety net program Excess safety net fish will then be managed in accordance with the guidelines above.

Surplus Upper Columbia Juvenile Spring Chinook Management

Methow Sub-basin
In the event excess juveniles are produced from Methow Sub-basin spring Chinook programs, the parties agree that distribution of juveniles will follow the following priority matrix:

1. Excess WxW progeny from the Methow conservation program(s) may be used to support shortfalls in the WNFH safety net program provided fish health and/or marking requirements for the program can be met.

2. Excess progeny from HO broodstock which *may* be collected to support the aggregate DPUD/GPUD/CPUD production obligation may be used to support any potential shortfall in the WNFH safety net program provided fish health and/or marking requirements for the program can be met.

3. In the event no other option exists within the Methow Sub-basin, excess hatchery progeny originating from the aggregate PUD production obligation, may be used to support the CCT 10(j) spring Chinook program in the Okanogan Sub-basin provided fish health and/or marking requirements can be met.

4. In the event no other option exists for excess hatchery progeny within the Methow Sub-basin, Banks Lake may be utilized as a last resort provided fish health requirements can be met.

5. In the event a surplus is identified, WDFW and the appropriate Hatchery Committee(s) will be notified via email no later than two weeks prior to fish needing to be moved off station or to another program. This is to ensure adequate and appropriate logistics can be coordinated between affected parties.

In addition, surplus fish, including broodstock, will be distributed at the earliest possible life-stage (e.g., prespawn adults, eyed-egg, fry) per WDFW policy.

Wenatchee Sub-basin

In the event excess juveniles are produced from Wenatchee Sub-basin spring Chinook programs (excluding Leavenworth), the parties agree that distribution of juveniles will follow the following priority matrix:

1. Excess progeny from the Chiwawa conservation program may be used to support shortfalls in the Nason conservation program provided fish health and/or marking requirements for the program can be met.

2. Excess progeny from the Nason conservation program may be used to support the Chiwawa conservation program provided they are progeny from females with assignment probabilities >95%. Additionally, it will require that fish health and/or marking requirements for the program can be met.

3. In the event excess NO production from the Nason program is not needed to or cannot support the Chiwawa (for reasons of fish health, marking, or ability to identify assignment probability), they will be incorporated into the Nason safety net program and prioritized over HxH progeny.

4. Excess progeny from the HO contingency broodstock collected for the Chiwawa program may be used to support any potential shortfall in the Nason safety net program provided fish health and/or marking requirements for the program can be met.

5. In the event no other option exists for excess hatchery progeny within the Wenatchee Sub-basin, Banks Lake may be utilized as a last resort provided fish health requirements can be met.

6. In the event a surplus is identified, WDFW and the appropriate Hatchery Committee(s) will be notified via email no later than two weeks prior to fish needing to be moved off station or to another program. This is to ensure adequate and appropriate logistics can be coordinated between affected parties.

In addition, surplus fish, including broodstock, will be distributed at the earliest possible life-stage (e.g., prespawn adults, eyed-egg, fry) per WDFW policy.

Appendix H

Draft 2020 Brood Chinook and 2021 Brood Steelhead Program Specific Rearing and Release Plans

Unless specifically detailed below, rearing and release protocols will follow the number, date, and location identified in Appendix B. In addition, all releases will prioritize nighttime or necessary, late afternoon release timing to reduce potential predation related impacts. Release timing will also take advantage of increasing flows and turbidity to further provide improved post release survival advantages.

Methow Summer Chinook (Carlton Acclimation Facility):

Rearing – Early rearing growth will be modulated for a targeted size at release of approximately 18 fpp. Beginning on or about February 1, fish will be fed to satiation to maximize spring growth regardless of end size.

Release - The summer Chinook salmon acclimated at the Carlton Acclimation Facility will be forced released using the following criteria.

- all fish will be released during darkness (e.g., 9:00 PM or later),
- all fish will be released when Columbia River and Methow River flows are predicted to be satisfactory,
- all fish will be released no later than May 7 regardless of flow conditions,
- attempt's will be made to have a steady release of fish to reduce collisions on the PIT antenna array.

Satisfactory flows in the Columbia occur when spilling flows are started and flows in the Methow River are satisfactory when flows are high and turbid. Releases will not occur until satisfactory flows in the Columbia occur, but could occur if Methow River flows are not satisfactory due to insufficient snowpack.

Nason Creek spring Chinook (Nason Acclimation Facility):

Rearing – Early rearing growth will be modulated for a targeted size at release of approximately 18 fpp. Beginning on or about February 1, fish will be fed to satiation to maximize spring growth regardless of end size.

Release - Spring Chinook salmon acclimated at the Nason Creek Acclimation Facility will be forced released using the following criteria.

- all fish will be released during darkness (e.g., 9:00 PM or later),
- all fish will be released when Columbia River and Nason Creek flows/conditions are predicted to be satisfactory,
- all fish will be released no later than May 7 regardless of flow conditions,
- attempts will be made to have a steady release of fish to reduce collisions on the PIT antenna array.

Satisfactory flows in the Columbia occur when spilling flows are started and flows in Nason Creek are satisfactory when flows are high and turbid. Releases will not occur until satisfactory flows in the Columbia occur, but could occur if Nason Creek flows are not satisfactory due to insufficient snowpack.

Priest Rapids Fall Chinook Salmon

As part of a five-year pilot study, the fall Chinook Salmon subyearling smolts will be released at different times to evaluate the influence of release time on survival. Each pond will be released at night and during different dates in May and June. The approximate dates for 2020 will be May 22 (Pond E), 27 (Pond D), June 9 (Pond C), and on or after June 18th (Pond A, B; after Hanford Reach tagging is complete). The mean size of fish should be 50 fpp at release for all ponds. All fish will be released gradually throughout the night to avoid PIT tag collisions. Ponds will be released at least 2 days apart to avoid PIT tag collisions.

Appendix I

2018-2020 Brood year Adult Prophylactic Disease Management Plan for Eastbank Fish Hatchery Complex Spring and Summer Chinook Hatchery Programs.

Background: Hatchery broodstock disease profiles observed in some programs operating out of the Eastbank FH complex in 2017 (as well as other hatchery programs throughout the Columbia River Basin) resulted in higher than expected prespawn mortality and/or BKD ELISA results which required (under the terms and conditions of the Section 10 permits) culling eggs/fish at a higher rate than anticipated which put several programs considerably below the respective production targets. The inability to determine whether the deviation in performance in 2017 was the result of eliminating prophylactic antibiotic injection practices, as was historically conducted, or was related to environmental conditions (or a combination of both) has prompted WDFW to develop and implement a fish health treatment plan (adult broodstock only) beginning with the 2018 brood and running for at least three (3) consecutive brood years.

The overall goals are to primarily ensure integrated and/or recovery programs make the most efficient use of natural origin broodstock to avoid mining as well as maximize natural origin spawners while minimizing handling/unnecessary activities on broodstock. In addition, where practical, we (WDFW) would like to see the use of antibiotics and other therapeutics reduced or eliminated over time. Having a controlled approach to evaluating the use of prophylactic treatments in these programs will allow the operators/managers to determine which programs may benefit from prophylactic treatments and which programs may be able to shift away from this practice, all of which is designed to reduce overall handling and associated effects as much as possible.

Methods: To minimize handling events, injections will be scheduled to occur either at collection or during sorting (such as during genetic sorting that occurs for the Nason spring Chinook program). Only females will be injected, in the intraperitoneal cavity (IP) with Draxin for BKD and if necessary, long acting Oxytetracycline for gram negative bacteria (i.e., *Columnaris*). Generally, injections will be prioritized for natural origin females as the control and hatchery origin females as the treatment for the spring Chinook programs. A slightly different approach will be used for each of the summer Chinook programs. All females receiving the injections will be considered the control given that this was the standard hatchery practice by which current disease result data sets and decisions are built on. All females will be PIT tagged at time of collection or injection to facilitate tracking of individual females (and possibly their progeny).

The results will be evaluated annually to determine if modifications to the current plan are necessary.

<u>Program Specific Plans For 2020 Brood year:</u>

Methow (Carlton/MEOK) Summer Chinook:

1) Collected at Wells Dam
2) 62 NO females are targeted for collection in 2020 with every other female <u>will be</u> injected at collection.
    a. Since the Twisp M&E staff are conducting run comp and broodstock collection activities at the Wells Dam East/West ladders, it makes sense for them to inject while the fish are sedated.

Chelan Falls Summer Chinook:

1) Collected at Well Hatchery Volunteer Trap
    a. If injections cannot be accommodated at time of collection at Well Hatchery, adults collected over the course of a week will be placed at the head of the adult pond. At the end of the week, females will be PIT tagged and every other female will be injected then placed over the net and not handled again until spawning.
    b. 100 HO females are targeted for collection and up to 50 <u>will be</u> injected.
    c. Disease management may vary somewhat depending upon the determination of the pathogen in play (i.e., *Columnaris* may play a larger role than BKD which require different approaches).
2) Collected at Chelan Falls Picket Weir Trap
    a. Adults collected over the course of a week will be placed at the head of the adult pond. At the end of the week, females will be PIT tagged and every other female will be injected then placed over the net and not handled again until spawning.
    b. A minimum of 100 HO females are targeted for collection and no less than 50 <u>will be</u> injected.
    c. Disease management may vary somewhat depending upon the determination of the pathogen in play (i.e., *Columnaris* may play a larger role than BKD which require different approaches).

Wenatchee Summer Chinook:

1) Collected at Dryden dams or Tumwater Dam.
2) No injections planned at this time. The Wenatchee summer Chinook program was the only EB program in 2017 which did not see a negative deviation in disease/prespawn mortality outcomes from the predicted so the 2020 plan is to stay consistent with the 2019 approach of no injections. If during the three year period, it

appears the Wenatchee summer Chinook may benefit by evaluation of injection versus non-injection then we will make plans to accommodate that evaluation.
3) 137 NO females are targeted for collection and will not be injected.

Chiwawa Spring Chinook:

1) Collected at Tumwater Dam
    a. All previously PIT tagged Chiwawa NOR's collected will be combined with Nason Spring Chinook weekly collections at Eastbank.
    b. All Chiwawa NO females collected at Tumwater Dam will be injected during genetic sorting of the Nason Fish.
    c. HO females collected at Tumwater will not be injected.
2) Collected at Chiwawa Weir
    a. All female NO females collected at the weir will be injected at the time of collection.
3) 32 NO females are targeted for collection between the two locations and will be injected.
4) 4 HO females targeted for retention as part of the production shortfall backup, collected at Tumwater Dam will not be injected.

Nason Spring Chinook:

1) Collected at Tumwater Dam.
2) 26 NO females are targeted for retention and will be injected during genetic sorting.

37 HO females are targeted for retention. HO females will not be injected.

Appendix J

MID-COLUMBIA COHO BROODSTOCK COLLECTION PROTOCOLS 2020

Yakama Nation
Fisheries Resource Management
Mid-Columbia Field Office
7051 Hwy. 97
Peshastin, Washington 98847

The Yakama Nation Fisheries Resource Management's (YN FRM) 2020 broodstock collection protocols for coho (*Oncorhynchus kisutch*) were developed to meet upper Columbia (Methow and Wenatchee basins) annual smolt release goals for 2022, as per the Mid-Columbia Coho Reintroduction Program's (MCCRP) Master Plan (YN 2017). Additionally, this document identifies the applicable operational planning to achieve adult collection goals and associated broodstock spawning conventions herein.

BROODSTOCK COLLECTION GOALS

Brood Year (BY) 2020 coho smolt production goals are 1,000,000 fish for release in the Wenatchee River basin and 700,000 fish for the Methow River basin.

Adult coho returning to the Wenatchee River basin will be collected at Tumwater Dam, Dryden Dam, Leavenworth National Fish Hatchery (LNFH), and/or Priest Rapids Dam (PRD); in order of collection priority. The program strives to achieve at least 50% of adult collections from Tumwater Dam with the remainder coming from Dryden Dam, LNFH and/or PRD. Coho collections from Tumwater Dam are important to encourage stock adaptation so that returning adults can reach key, upstream habitats within the upper basin. Based upon a phased approach, the Wenatchee program currently in Broodstock Development Phase II (BDPII; YN 2017). However, collecting sufficient female broodstock from Tumwater Dam has presented a challenge and identified the need for a contingency plan (i.e.- focus on early run adults at Dryden Dam as well as Tumwater collections as high priority broodfish). The ratio of female to male coho navigating Tumwater Canyon to Tumwater Dam has been tilted heavily toward males. Due to this occurrence, the BDPII completion goal for the Wenatchee Basin has transitioned to collecting a mean of 50% female broodstock from Tumwater Dam for a three year period.

In the Methow River basin, adults will be collected from Douglas County Public Utility District's (DCPUD) Wells Dam facilities (i.e., east and west ladders and Wells Fish Hatchery (FH) volitional channel), Winthrop National Fish Hatchery (Winthrop NFH), and Methow Fish Hatchery (Methow FH); in order of priority. The program will rely on Wells Dam east and west ladder facilities as primary collection locations to achieve target goals for the initiation of Natural Production Support Phases (NPP1 and 2; YN 2017) beginning in 2022. The facility's volitional channel will be utilized on an auxiliary basis should collection shortfalls occur at the ladders (e.g., due to low projected returns). All collections at Wells Dam will run concurrent with summer Chinook and steelhead trapping efforts. In-basin collections will continue to include Winthrop NFH facilities (Spring Creek adult weir and volitional ladder) and Methow FH adult weir on a supplementary basis, as swim-ins to these facilities remain a key component in program development. While coho have not been released from Methow FH, an adult weir will be used to collect returning adults since both hatcheries' surface water withdrawals come from a common, upstream diversion on the mainstem Methow River (Foghorn Irrigation Diversion). At Winthrop NFH, the adult weir will function as the primary collection point in order to manage the proportion of returning hatchery adults incorporated into the broodstock holding pond; since adults collected from Wells Dam facilities are prioritized to achieve program goals. Additionally, both facilities' weirs will provide the primary source for outplant adults to augment natural production goals, as discussed below. The volitional ladder to the hatchery's holding pond will be utilized if shortfalls occur at Wells Dam facilities and numbers of swim-ins to the adult weirs are insufficient to meet program objectives.

Broodstock collection goals for both Wenatchee and Methow programs are calculated from measured, mean survival rates that include pre-spawn adult mortality, average female fecundity, green egg survival, and hatch rates observed during past brood years.

In the Wenatchee River basin, collection of up to 1,373 adult coho will be necessary to release 1,000,000 smolts. **Table 1** illustrates the program's anticipated release, survival, and collection goals for brood year 2020**.** Throughout the program's history, adult coho sex ratios collected at Tumwater Dam have been skewed heavily towards males. If this were to occur, additional adult females would be collected at previously identified locations downstream of Tumwater Dam to offset the shortfall to meet egg goals.

Table 1. 2020 YN Wenatchee River Basin Program Release Target, Mean Survival, and Broodstock Collection Goal

Program target smolts released	Survival green egg to eyed [1]	Survival eyed egg to release[2]	Green eggs required	Average eggs per female[3]	Adult pre-spawn mortality[4]	Viable females required	Total female collection goal	Total adult collection goal [5]
1,000,000	87.5%	82.0%	1,393,728	2,475	7.8%	563	607	1,373

1. Survival is based on a 5 yr. mean. Green to eyed accounting in B.Y.19 was adjusted as a portion of a collection suffered immediate loss attributed to an unknown external contaminant.
2. Observed 5 yr. mean. In B.Y. 2016, the eyed to release survival rate was calculated using eyed to point of transfer due to a reallocation of eyed eggs produced at LNFH and released in the Methow Basin.
3. Observed 5 yr. mean fecundity for 2015-2019 brood years.
4. Observed 5 yr. mean pre-spawn mortality observed in 2015-2019 adult brood years.
5. Based on observed, mean male-to-female ratio (55.8%M: 44.2%F) for 2015-2019 brood years.

In the Methow River basin, a maximum of 797 adult coho will be necessary to release 700,000 smolts. Anticipated release, survival, and collection goals for brood year (BY) 2020 are presented in **Table 2**. Target goals for NPP1 reflect an initial 30% reduction in hatchery origin release numbers from those required for the Implementation Phase (NPIP). Management objectives throughout NPP1 and NPP2 will focus on reducing domestication selection and increasing local adaptation. The program will utilize a phased approach to increase the proportions of natural origin adults into the brood (pNOB), while reducing numbers of hatchery origin returns (pHOS) to the spawning grounds. As these target goals are realized, the program will transition to NPP2 and continue to reduce supplemental releases, while increasing pNOB (up to 80%) and limiting pHOS (65%). The program's overall goal is to achieve a proportion of natural influence (PNI) value on the spawning grounds of ≥ 0.50 (YN, 2017). Since Wells Dam facilities will continue to provide the primary brood source for the program, collection goals for

2020 are based on data collected at these facilities.

Table 2. 2020 YN Methow River Basin Program Release Target, Mean Survival, and Broodstock Collection Goal

Program target smolts released	Survival green egg to eyed [1]	Survival eyed egg to release[2]	Green eggs required	Average eggs per female [3]	Adult pre-spawn mortality[4]	Viable females required	Total female collection goal	Total adult collection goal [5]
700,000	83.0%	84.9%	993,373	2,504	2.3%	397	406	797

1. Observed 5 yr. mean eyed-egg rate for 2015- 2019 brood years.
2. Observed. 5 yr. mean eyed to release survival rate for 2013-2017 brood years.
3. Observed. 5 yr. mean fecundity for 2015-2019 brood years.
4. Observed 5 yr. mean pre-spawn mortality observed in BY 2015-2019 adults.
5. Observed. 5 yr. mean male-to-female ratio for Wells Dam facilities (49.1%M: 50.9%F) for 2015-2019 broods. Total collection goal is based on a 1 M: 1 F ratio.

BROODSTOCK COLLECTION PROTOCOLS

Wenatchee River Basin

Based on information collected from 2000 to 2019, the first returning adult coho traditionally arrive at Dryden Dam during the second week of September. The run typically continues through the last week of November, with peak migration ordinarily occurring mid to late October. Migration timing over Tumwater Dam is characteristically one week later than observed at Dryden Dam. Past protocols focused on broodstock development in the sense of maximizing genetic diversity; attempting to collect a representative sample of returning adult coho from throughout the run. Beginning with brood year 2017, an effort to retain and distinctly mark (i.e -floy tag) early arriving fish at Dryden Dam has been instituted. Based on preferential attributes identified in female coho that would demonstrate an increased ability to ascend Tumwater Canyon within the earlier portion of the run (i.e.- Dryden observations occurring mid-September through first week of October), a shift in prioritizing adult collections from early in the run has been set in place. Goal for these uniquely marked fish is to prioritize them in the spawning process, along with naturally ascending Tumwater adults, to then release their progeny from upper basin acclimation sites and determine performance when those progeny return as adults. The long term goal to try and quantify if preferential spawning matings can enhance favorable fish attributes identified in the mark-recapture study (increase somatic lipids, levels, more fusiform shape, etc.) as well as take advantage of preferred environmental conditions (optimal flows for ascending the canyon) which could result in increased numbers of migrating coho into the upper watershed. Thus, moving the project out of Broodstock Development Phase II and into NPIP.

Bi-weekly broodstock collection goals have been established for both Tumwater and Dryden dams and are illustrated in **Table 3.** Collection goals target a minimum of 50% of the broodstock from Tumwater Dam (YN 2017). Bi-weekly goals are intended to serve as a guide for collection from throughout the run but may be adjusted to ensure the newly implemented broodstock arrival time prioritization needs and adult accessibility are optimized. If during any week the broodstock collection goals are not met, 0collected from PRD or LNFH will be assimilated into the combined weekly goal. A minimum of one male will be collected for each female to adhere to spawning protocols.

Table 3. 2020 Wenatchee River Basin Coho Broodstock Collection Goals

Calendar Week	9/1	9/6	9/13	9/20	9/27	10/4	10/11	10/18	10/25	11/1	11/8	11/15	TOTAL
Dryden Dam	32	70	99	83	71	61	102	81	52	26	9	1	687
Tumwater Dam	12	41	52	63	90	148	115	96	43	20	3	1	686
TOTALS	44	111	151	146	161	211	217	177	95	46	12	2	1,373

Between September 1 and November 6 of this year, broodstock collection at Dryden Dam will occur 5 days a week and in coordination with Washington Department of Fish and Wildlife's (WDFW) evaluation and monitoring staff and Eastbank Fish Hatchery (Eastbank FH) hatchery personnel, as it characteristically occurs concurrently with steelhead broodstock collection. YN will provide a minimum of two people each day to assist in operations and collection at Dryden Dam adult fish trapping facilities. Between November 9 and November 20, YN personnel ordinarily operate the trapping facility independently but will communicate with Eastbank FH, WDFW, and Chelan County Public Utility District (CCPUD) personnel regarding collections, trap maintenance, and operations. If YN staff foresees broodstock collection goals (through trapping efforts at Tumwater and Dryden dams) will not be met, adult coho may be collected at the LNFH adult ladder to prevent a deficit. Tumwater Dam operations will be coordinated with Eastbank FH personnel and/or WDFW evaluation crews and occur concurrently with WDFW steelhead brood collections.
Wenatchee program broodstock collection efforts in which YN is the primary operator of collection facilities would occur according to the regime stated in the NMFS BO (NMFS-WCR-2015-3778 Section 2.8.4. T&C 4e, 4f, 4g, and 4i):

Dryden Dam
Sept 1 – Dec 7: 5 day/week and 24hrs/day
Tumwater Dam
Sept 1 – Dec 7: 3 day/week and 16hrs/day
Leavenworth NFH
Sept 1 – Dec 7: 7 day/week and 24hrs/day

Methow River Basin

Prior to 2005, coho broodstock collections for the Methow River program were solely conducted at Winthrop NFH; however, few coho completed this long migration and successful returnees were typically males. In 2005, the primary collection site shifted towards Wells Dam in an effort to intercept more returning Methow Basin coho and increase female collections in the process. Broodstock Development Phase I (BDP I) was initiated in 2006 and focused on eliminating the reliance on lower Columbia stocks and transitioning to a local broodstock. During BDP I, program adults began to demonstrate the ability to return in sufficient numbers to meet collection goals from both in-basin release locations (i.e., Winthrop NFH on-station raceways and back-channel pond) and Wells FH. By 2009, average contribution of swim-ins (Winthrop NFH and Methow FH combined) into the Methow broodstock had exceeded 50% (*avg.* = 52.7%) and were a predominant portion of the program. In 2010, the program transitioned to BDP II and swim-ins to these facilities were prioritized as the primary brood source, with collections at Wells Dam facilities providing supplementary adults. Broodstock Development Phase II was accomplished in 2013 for the Methow Program and a shift back to prioritizing collections at Wells Dam facilities was made in 2014. Collection goals to meet release objectives for the initiation of NPIP, designed to terminate after one generation (3 years), were accomplished between brood years (BY) 2017 and 2019, with the first release of 1,000,000 smolts occurring in spring of 2019. Similar numbers of smolts will be released from in-basin acclimation sites through spring of 2021. Collection objectives in 2020 are intended to provide sufficient broodstock needed for the NPP1, scheduled to begin in 2022, and will continue to require incorporation of adults from all established, in-basin release locations as well as target natural origin returns (YN 2017). Since no in-basin collection locations currently exist (i.e., tributary collection weirs) that would provide for a representative sample of returning adults in-basin, Wells Dam facilities would provide those means. Adult collections will continue to occur at Winthrop NFH (Spring Creek weir and volitional ladder) and Methow FH collection weir on an auxiliary basis, as swim-ins to these facilities will continue to be a key element to program development. Additionally, during implementation of the Natural Production Support Phases, a proportion of these individuals may be used as adult outplants to supplement major tributaries where acclimated numbers were below the modeled release outputs to initiate an observable level of natural production to meet future management goals, as outlined in the Program's Master Plan (YN, 2017).

At Wells Dam, proposed trapping operations would occur on the east and west ladders according to the following schedule (National Marine Fisheries Service (NMFS), 2017; Consultation Number WCR-2015-3778):

1) Sept 1- Sept 26: 3 days/week and 16 hrs/day
2) Sept 27-Oct 9: 5 days/week and 9 hrs/day
3) Oct 10- Dec 7: 7days/week and16 hrs/day

Trapping operations will be coordinated with WDFW and DCPUD and to maximize coinciding operations with WDFW evaluations and Wells FH summer steelhead and summer Chinook collections. If during this timeframe, WDFW/Wells FH is not operating one or both of the traps, YN personnel would assume full operations of both facilities and actively operate traps with all non-target fish being documented and passed upstream while minimizing handling. When operating the west ladder trap, coho salmon will be diverted directly from the ladder into the holding facility at Wells FH. Removal of coho from the temporary holding area, to include volitional swim-ins, will be coordinated with DCPUD/Wells FH personnel. YN staff will continue to transport collected adults at a minimum of three times per week with holding criteria to not exceed 150 coho at one time. During east ladder operations, trapped coho would be placed directly into a transport tank. All coho transported from Wells Dam facilities will have a unique mark to differentiate them at spawning from volunteer swim-ins at Winthrop NFH and Methow FH adult weir.

Supplemental collections at Winthrop NFH and Methow FH could, if required, occur up to seven days per week (24 hours/day) between September 1 and December 7 at both facilities (NMFS, 2017). Adults collected from Methow FH collection weir would be transported to Winthrop NFH for holding, and either incorporated into the brood or utilized as outplant adults, depending on program need. All trapping operations at Methow FH will be coordinated with DCPUD.

Methow River basin weekly broodstock collection goals for 2020 are illustrated in **Table 4**. If during any week broodstock collection goals are not met, the deficit will carry over to subsequent weeks until collection totals are reconciled. Weekly trapping goals are intended to serve as a guide to ensure collection from throughout the run but may be adjusted mid-season to ensure that the total collection goal is met. Collection goals are expressed in numbers of adult coho needed if broodstock are solely collected from Wells Dam facilities. A minimum of one male will be collected for each female to adhere to spawning protocols.

Table 4. 2020 Methow River Basin Coho Collection Goals

Calendar Week	9/1	9/8	9/15	9/22	9/29	10/6	10/13	10/20	10/27	11/3	11/10	11/17	TOTAL
Wells Dam	2	14	54	122	170	161	141	85	34	11	2	0	797

REFERENCES

Yakama Nation Fisheries Resource Management (YN FRM). 2017. Mid-Columbia Coho Restoration Master Plan. Prepared for Northwest Power and Conservation Council.

NMFS (National Marine Fisheries Service). 2017. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation. Mid-Columbia Coho Salmon Restoration Program: Operation and Construction. Consultation Number: WCR-2015-3778)
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Appendix O
Chelan PUD 2021 Hatchery Monitoring and Evaluation Implementation Plan

Chelan County PUD Hatchery Monitoring and Evaluation Implementation Plan 2021

Prepared by:

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August
2021

1. INTRODUCTION

The Habitat Conservation Plan (HCP) specifies that a monitoring and evaluation plan will be developed for the hatchery program. The approach to monitoring the hatchery programs was guided by the "*Monitoring and Evaluation Plan for PUD Hatchery Programs: 2019 Update*" (Hillman et al. 2019).

The purpose of this document is to define the tasks associated with the approved scope of work to implement Chelan PUD's (CPUD's) hatchery monitoring and evaluation (M&E) plan for 2021. Additionally, monitoring and evaluation activities for Lake Wenatchee sockeye in 2021 are included in this document. As monitoring tasks are completed in 2020 and are evaluated for their efficacy, methodologies to accomplish the tasks defined in the 2021 Implementation Plan may be modified [with Habitat Conservation Plan's Hatchery Committees (HCP-HC) approval].

The work described in this plan has Endangered Species Act (ESA) coverage provided by NMFS Section 10(a)(1)(A) permits 18121 and 18583, Section 10(a)(1)(B) permit 23191, and Section ESA Section 7(a)(2), Biological Opinion No. 01EWFW00-2013-F-0444 Wenatchee Sub-basinHatchery Programs. All activities conducted under this Implementation Plan shall adhere to all terms and conditions as specified in the referenced permits and Biological Opinion. These permits allow for changes to monitoring or research protocols with the caveat that such modifications are approved by NMFS prior to implementing those changes. Terms and conditions relevant to monitoring and evaluating the hatchery programs have been used to inform the various measurements below and associated scopes of work with entities performing the work. A report summarizing compliance with the terms and conditions set forth under the above-references permits is required for submittal to NMFS; a copy of this completed report will be provided to the HCP HC.

The Implementation Plan includes all four components of the hatchery M&E Program including: (1) aquaculture monitoring; (2) juvenile monitoring; (3) adult monitoring; and (4) data, analysis and reporting. Under each component are study design elements that will be used to inform the overarching program components. Figure 1 illustrates the relationship of the components and study design elements used to address each component. Table 1 depicts which study design element is being performed by entity, and the associated objectives for each study design element as referred to in Hillman et al. 2019. For Lake Wenatchee sockeye salmon, the proposed M&E activities cover juvenile and adult life history stages and provide the data necessary to track or estimate viable salmonid population parameters (VSP) and is described in Section 6.0.

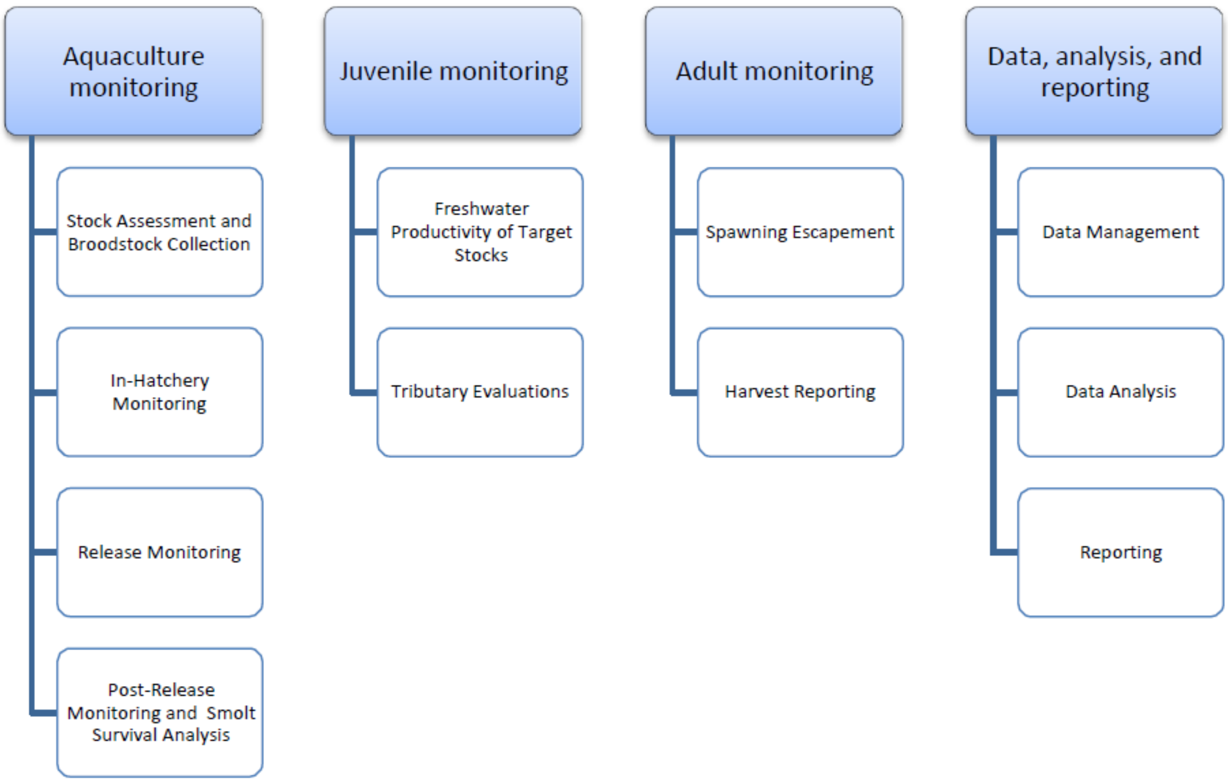

Figure 1. The four components of the hatchery monitoring and evaluation program and the study design elements within each component.

Table 1. Study design elements performed by entity, and the associated objectives for each study design element as referred to in Hillman et al. 2019.

Monitoring and evaluation component	Objectives[1]	Study Design Elements	Chiwawa spring Chinook	Wenatchee summer Chinook	Methow spring Chinook[4]	Chelan Falls summer Chinook[5]	Wenatchee Steelhead
Aquaculture Monitoring	3,5,8	Stock assessment and broodstock collection	WDFW	WDFW	WDFW DPUD	WDFW	WDFW
	5, 8	In-hatchery monitoring	WDFW CPUD[2]	WDFW CPUD[2]	DPUD Biomark[3]	WDFW CPUD[2]	WDFW CPUD[2]
	9	Release monitoring	CPUD	CPUD	DPUD	CPUD	CPUD
	9	Post-release monitoring and smolt survival analysis	BioAnalysts	BioAnalysts	WDFW	BioAnalysts	BioAnalysts
Juvenile monitoring	2	Freshwater productivity of stocks	WDFW	WDFW	WDFW	NA	WDFW
		Tributary evaluations	WDFW	WDFW	WDFW	NA	WDFW
Adult monitoring	1,2,3,4,5,6, 8,10	Spawning escapement	CPUD	WDFW	WDFW	BioAnalysts	WDFW BioAnalysts
	8	Harvest reporting	WDFW	WDFW	WDFW	WDFW	WDFW
Data, analysis, and reporting	All	Data management	WDFW CPUD BioAnalysts	WDFW BioAnalysts	WDFW	WDFW BioAnalysts	WDFW BioAnalysts
		Data analysis	WDFW CPUD BioAnalysts	WDFW BioAnalysts	WDFW	WDFW BioAnalysts	WDFW BioAnalysts
		Reporting	WDFW CPUD BioAnalysts	WDFW BioAnalysts	WDFW	WDFW BioAnalysts	WDFW BioAnalysts

[1] Monitoring questions relative to Objective 7 will be analyzed in the 2020 Comprehensive Report.
[2]CPUD crews will PIT tag in-hatchery fish.
[3]Biomark will PIT tag in-hatchery fish.
[4]In 2021, monitoring and evaluation for the Methow spring Chinook program is described in "Implementation of Comprehensive Monitoring and Evaluation of Wells Hatchery Complex Programs".
[5]The Chelan summer Chinook program is primarily an augmentation program; therefore, monitoring and evaluation efforts focus on straying, release characteristics, and harvest.

2. AQUACULTURE MONITORING

The aquaculture monitoring component is comprised of two basic elements: (1) stock assessment and broodstock collection at adult trapping locations and (2) in-hatchery monitoring including spawning, rearing, and release of juveniles. Data collected during these elements primarily support monitoring questions 5.1.1, 5.2.1, 8.1.1, 8.2.1, 8.3.1, 8.3.2, 8.4.1, 9.1.1, 9.2.1, 9.3.1 and 9.4.1, but also contribute data to monitoring questions 3.2.1, and 3.2.2 (Hillman et al. 2017). Table 2 below provides a summary of the variables to be measured in 2021 under the aquaculture monitoring component and what objective the measure(s) supports. The text that follows in this section further describes the activities.

Table 2. Monitoring and Evaluation Plan (Hillman et al. 2019) objectives and the associated measured variables for the aquaculture monitoring component.

Objectives	**Measured Variables** *(Applicable Study Component(s))*
Objective 3: Determine if the hatchery adult-to adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.	• Number of hatchery and naturally produced fish collected for broodstock (*Broodstock Collection and Stock Assessment*) • Number of broodstock used by brood year (hatchery and naturally produced fish) (*Broodstock Collection and Stock Assessment*)
Objective 5: Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.	• Ages of hatchery and naturally produced fish sampled via PIT tags or stock assessment monitoring (*Broodstock Collection and Stock Assessment*) • Time (Julian date) of ripeness of hatchery and natural origin steelhead captured for broodstock (*Broodstock Collection and Stock Assessment*)
Objective 8: Determine if hatchery programs have caused changes in phenotypic characteristics of the natural populations.	• Size (length), gender, and total/salt age of broodstock (*Broodstock Collection and Stock Assessment*) • Assess age of fish (*Broodstock Collection and Stock Assessment*) • Length, weight, and age (covariate) of hatchery and natural-origin broodstock after eggs have been removed (*Broodstock Collection and Stock Assessment*) • Number and weight of eggs (*Broodstock Collection and Stock Assessment*)
Objective 9: Determine if hatchery fish were released at the programmed size and number.	• Fork length and weights of random samples of hatchery juveniles at release (*Release Monitoring*) • Monthly individual lengths and weights of random samples of hatchery juveniles (*In-Hatchery Monitoring*) • Numbers of smolts released from the hatchery (*Release Monitoring*)

2.1 Broodstock Collection and Stock Assessment

Broodstock collection and stock assessment for Wenatchee summer steelhead, Wenatchee summer Chinook, Methow spring Chinook, Chelan Falls summer Chinook, and Chiwawa River spring Chinook, hatchery programs will, in most instances, occur concurrent to and consistent with the 2021 Broodstock Collection Protocol approved annually by the HCP-HC and relevant permits. Data collection during broodstock collection will be consistent with Hillman et al. 2019. Several biological parameters will be measured during broodstock collection at adult collection sites. Those parameters included the date and start and stop time of trapping; number collected for broodstock; origin, size, and sex of trapped fish; age from scale analysis; and pre-spawn mortality. For each species, trap efficiency, extraction rate, and trap operation effectiveness will be estimated following procedures in Hillman et al. (2019). In addition, a representative sample of most species trapped but not taken for broodstock were sampled for origin, sex, age, and size (stock assessment).

2.2 In-Hatchery Monitoring

The in-hatchery monitoring component will begin when adult fish are collected and retained for broodstock and ends when juvenile fish are released. Methods for monitoring hatchery activities are described in Hillman et al. (2019). Biological information will be collected from all spawned adult fish including age at maturity, length at maturity, spawn time, and fecundity of females. In addition, all fish will be checked for tags and females will be sampled for pathogens. Throughout the rearing period in the hatchery, fish will be sampled for growth, health, and survival. Each month, lengths and weights will be collected from a sample of fish and rearing density indices will be calculated. In addition, fish will be examined monthly for health problems following standard fish health monitoring practices for hatcheries. Various life-stage survivals will be estimated for each hatchery stock.

Fish Marking

All of Chelan PUD's hatchery fish will be coded-wire tagged (CWT) and externally marked or marked as otherwise agreed to by the HCP HC. A comprehensive marking strategy will be developed by the HCP-HC and included in the annual Broodstock Collection Protocols (Table 3). The identification of these hatchery-produced fish is needed for a suite of adult metrics and may be used for adult management and/or fisheries as contemplated by the co-managers.

Using methods described in Keller and Murauskas (2012), hatchery fish will be PIT-tagged approximately two to four weeks before the fish are transferred to acclimation ponds or in the spring prior to release. Numbers of hatchery fish to be PIT-tagged per program is described in the annual Broodstock Collection Protocol (Table 3). Additional PIT-tagging may occur for program specific studies/comparisons as approved by the HCP-HC. The data collected from the PIT-tags will assist in release monitoring, migration timing, juvenile survival, and smolt-to-adult survival. For all fish marking, quality control check will be performed during and immediately following tagging and prior to release.

Table 3. Chelan PUD's hatchery program release goals and recommended number of fish PIT tagged.

Brood Year	Production Group	Program Size	Marks/Tags	Additional Tags	Release Location	Release Year	Release Size (fpp)	Release Type
Summer Chinook								
2019	Chelan Falls SUC 1+ (CPUD)	576,000	Ad + CWT	10,000 PIT	Columbia R. at CFAF	2021	13	Forced
2019	Wenatchee SUC 1+ (CPUD/GPUD)	500,001	Ad + CWT	20,000 PIT	Wenatchee R. at DAF	2021	18	Volitional
Spring Chinook								
2019	Methow SPC (PUD)	60,516	CWT only	5,000 PIT	Chewuch R. at CAF	2021	15	Volitional
2019	Chiwawa R. SPC (CPUD) (conservation)	144,026	CWT only	10,000 PIT	Chiwawa River at CPD	2021	18	Short term volitional
Steelhead								
2020	Wenatchee Mixed (HxH/WxW) (CPUD)	TBD	Ad + CWT (HxH) CWT only (WxW)	TBD	Nason Cr. direct release	2021	6	Direct Plant
2020	Wenatchee Mixed (HxH/WxW) (CPUD)	TBD	Ad + CWT (HxH) CWT only (WxW)	TBD	Chiwawa R. direct release	2021	6	Direct Plant
2020z	Wenatchee Mixed (HxH/WxW) (CPUD)	TBD	Ad + CWT (HxH) CWT only (WxW)	TBD	Upper Wenatchee R. direct release	2021	6	Direct Plant

2.3 Release Monitoring

Hatchery fish will be released during smoltification in the spring, typically between 15 April and 1 June. Whenever possible, the exact release dates will coincide with environmental conditions that promote a rapid emigration that minimizes both the potential negative ecological interactions of hatchery fish with naturally produced fish and predation on hatchery fish by avian or other predators. The default release method will incorporate a volitional approach, as approved by the HCP HC, unless it can be demonstrated other approaches are better. The monitoring data collected for each stock are described below.

Chiwawa and Methow Spring Chinook

Pre-release sampling data will be conducted consistent with Hillman et al. 2019 including individual weights to the nearest 0.1 gram. Data collected will support monitoring questions 9.1, 9.2, 9.3 and 9.4 in the updated monitoring and evaluation plan (Hillman et al. 2019). PIT tag monitoring of spring Chinook released in the Chiwawa River will occur during the release period (April). Juvenile Chinook will pass through two 92-cm diameter PIT-tag antennas connected to Allflex 310 readers and Quantitative Sampling Technologies (QST) QuBE data logger. The release location and type (i.e., volitional, forced, or trucked) are recorded for each observation file created and uploaded to the PTAGIS database maintained by the Pacific States Marine Fisheries Commission after each year of release. PIT-tagged fish in each observation (release) file are assumed to represent untagged fish. Observation files contain the PIT tags associated with the original tag files and will be used for analysis (see Post-release Monitoring Section). The total number of fish released will be based on the population size at CWT tagging (100%), subtracting mortality enumerated by hatchery staff that occurred from tagging to release.

Wenatchee Summer Steelhead

Pre-release sampling will be conducted consistent with Hillman et al. 2019, including individual weights to the nearest 0.1 gram. Data collected will support monitoring questions 9.1, 9.2, 9.3 and 9.4 in the updated monitoring and evaluation plan. The 2021 release methodology will be determined by the HC. The number of fish in each truckload will be estimated using volumetric displacement. Observation files contain the PIT tags associated with the original tag files and will be used for analysis (see Post-release Monitoring Section). The total number of fish released will be based on the population size at CWT tagging (100%), subtracting mortality enumerated by hatchery staff that occurred from tagging to release.

Wenatchee and Chelan Falls Summer Chinook

Pre-release sampling will be conducted consistent with Hillman et al. 2019, including individual weights to the nearest 0.1 gram. Data collected will support monitoring questions 9.1, 9.2, 9.3 and 9.4 in the updated monitoring and evaluation plan. PIT-tag monitoring will occur consistent with other Chinook stocks (i.e., Chiwawa Spring Chinook). The percent of the release group that are precociously mature will be estimated by non-lethal visual observation . The total number of fish released will be based on the population size at CWT tagging (100%), subtracting mortality enumerated by hatchery staff that occurred from tagging to release.

2.4 Post-Release Monitoring and Survival Analysis

Data will be collected during rearing, acclimation, release, and the emigration period that may prove valuable in explaining variability in adult survival (Hillman et al. 2019). Rearing densities have been reported to influence the survival of hatchery fish (Martin and Wertheimer 1989; Banks 1994) and may also be linked to disease prevalence during rearing (Banks 1994; Ogut and Reno 2004). Acclimation of hatchery fish before release has been found to increase survival and reduce stray rates when the duration of the acclimation period is sufficient (Clarke et al. 2010, 2012; Rosenberger et al. 2013). These metrics (i.e., rearing density and acclimation period) will be collected annually to determine their influence on fish survival.

PIT-tagged groups of hatchery fish will be used to estimate survival during their emigration. Variation in survival during the emigration period may also inform observed adult survival rates. Survival during emigration and travel will be estimated using interrogation or release files and the standard Cormack-Jolly-Seber (CJS) estimator. CJS estimates are termed apparent survival estimates because it is unknown whether fish suffered mortality (e.g., size or time of release) or simply failed to emigrate (i.e., residualized or were precocial males). In the latter case, the proportion of PIT-tagged fish detected in the Methow sub-basin, Wenatchee or Columbia rivers after the emigration period is complete may explain variation in smolt survival rates. The post-release performance of PIT-tag groups will be estimated and monitored annually, consistent with methods in Hillman et al. 2019. Additionally, precocity of hatchery releases will be evaluated by examining the proportion of PIT tag releases detected in adult fish ladders and tributaries within the same year as release.

3. JUVENILE MONITORING

Data collected during these elements primarily support monitoring questions 2.1.1 and 2.2.1. and the monitoring objectives described in Table 4 (Hillman et al. 2019). Table 4 below provides a summary of the variables to be measured in 2021 under the juvenile monitoring component and what objective the measure supports. The text that follows in this section further describes the activities.

Table 4. Monitoring and Evaluation Plan (Hillman et al. 2019) objectives and the associated measured variables for the juvenile monitoring component.

Objective	**Measured Variables** *(Applicable Study Component(s))*
Objective 2: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.	• Number of juveniles (smolts and emigrants) (*Freshwater Productivity of Supplemented Stocks*)

3.1 Freshwater productivity of Supplemented Stocks

Steelhead, Spring Chinook, and Summer Chinook

The freshwater productivity of supplemented stocks in the Wenatchee sub-basin will be monitored using smolt traps in the Chiwawa River and the lower Wenatchee River consistent with historical trapping efforts. Additionally, a derived analytical method which uses PIT-tag mark-recapture data will be utilized that reduces bias and increases precision by including estimates of emigration during the winter non-trapping periods. Up to 3,000 parr will be targeted for PIT tagging in the Chiwawa River in the fall, to generate estimates of migration during the non- trapping periods. A random sample of a minimum of 10 percent of fish during annual sampling year in the Chiwawa River will be held in a live box for 24 hours to evaluate tag loss and delayed mortality. Using PIT tagged parr detections at the lower Chiwawa PIT array during the non-trapping period, the total number of PIT-tagged parr that emigrated will be estimated, and then expanded by the tag rate. Overwinter mortality of PIT-tagged parr is assumed to be the same as non-PIT-tagged parr. Overwinter survival estimates of Chiwawa River parr will be derived by estimating survival to McNary using the Cormack-Jolly-Seber mark-recapture model. PIT-tag mark-recapture trials conducted during the trapping period in the spring and/or fall will also be used to estimate detection probabilities of the PIT-tag array at a given discharge level. Abundance and variance will be estimated using the same methods as those used in the smolt trap estimate. The estimated abundance and variance from each method and time period (trapping and non-trapping periods) will be summed to estimate a total production estimate. Under the proposed methodology, unbiased estimates of abundance during the entire migration period will be generated with relatively high precision (PSE < 15%), which is consistent with NOAA Fisheries' recommendations (Crawford and Rumsey 2011).

4. ADULT MONITORING

The adult monitoring component is comprised of two basic elements: (1) estimating spawning escapement and (2) harvest monitoring. Data collected during these elements primarily support monitoring questions 1.1.1, 1.2.1, 2.1.1, 2.2.1, 3.2.1, 3.2.2, 4.1.1, 5.1.1, 5.2.1, 5.3.1, 5.3.2, 6.3.1, but also contribute data to monitoring questions 6.1.1, 6.2.1, 8.1.1, 8.2.1, 8.4.1, 10.1.1, 10.1.2, 10.1.3 and 10.1.4. Table 5 below provides a summary of the variables to be measured in 2021 under the adult monitoring component and what objective the measure(s) supports. The text that follows in this section further describes the activities.

Table 5. Monitoring and Evaluation Plan (Hillman et al. 2019) objectives and the associated measured variables for the adult monitoring component.

Objective	**Measured Variables** *(Applicable Study Component(s))*
Objective 1: Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.	• Number of hatchery and naturally produced fish on spawning grounds *(Spawning Escapement Estimates)* • Number of hatchery and naturally produced fish taken for broodstock (*Broodstock Collection and Stock Assessment*) • Number of hatchery and naturally produced fish taken in harvest (if recruitment is to the Columbia) *(Harvest Reporting)*
Objective 2: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.	• Number of hatchery and naturally produced fish on the spawning grounds (*Spawning Escapement Estimates*) • Number of redds *(Spawning Escapement Estimates)*
Objective 3: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.	• Number of hatchery and naturally produced fish on spawning grounds *(Spawning Escapement Estimates)* • Number of hatchery and naturally produced fish harvested *(Harvest Reporting)*
Objective 4: Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.	• Number of hatchery and naturally produced fish on spawning grounds *(Spawning Escapement Estimates)*
Objective 5: Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.	• Time (Julian date) of hatchery and naturally produced salmon carcasses or marked steelhead detected on spawning grounds within defined reaches *(Spawning Escapement Estimates)* • Time (Julian date) of arrival at mainstem projects and within tributaries (e.g., traps, PIT arrays) with

Objective	**Measured Variables** *(Applicable Study Component(s))*
	the intent to identify biologically significant differences *(Spawning Escapement Estimates)* • Location (GPS coordinates) of female salmon carcasses observed on spawning grounds *(Spawning Escapement Estimates)*
Objective 6: Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.	• Number of hatchery fish collected for broodstock (*Broodstock Collection and Stock Assessment*) • Number of hatchery fish taken in fishery (*Harvest Reporting*) • Locations of live and dead strays (used to tease out overshoot) *(Spawning Escapement Estimates)* • Number of hatchery carcasses (PIT-tagged and/or CWT) found in non-target and target spawning areas or number of returning spawners counted via PIT-tag detection or at weirs in close temporal proximity to spawning areas (stray data into the Entiat sub-basin will be obtained from USFWS Fisheries Resource Office-Leavenworth) *(Spawning Escapement Estimates)*
Objective 7: Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.	• Allele frequency • Linkage disequilibrium • Genetic distance between subpopulations and populations • Effective spawning population

<u>Objective 8:</u> Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.	• Total and salt (ocean) age and gender of hatchery and naturally produced salmon carcasses collected on spawning grounds *(Spawning Escapement Estimates)* • Whenever possible, age at maturity and sex ratio will be measured at weirs or dams near the spawning stream to avoid the size-related carcass recovery bias on spawning grounds (carcass sampling or ultrasound on live fish) *(Spawning Escapement Estimates)* • Assess age of fish, including harvested fish *(Spawning Escapement Estimates and Harvest Reporting)*
<u>Objective 10:</u> Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.	• Numbers of hatchery fish taken in harvest *(Harvest Reporting)* • Numbers of natural-origin fish taken in harvest *(Harvest Reporting)*

4.1 Spawning Escapement Estimates

Chelan Summer/Fall Chinook

Chinook spawning ground surveys will be conducted in the Chelan River and (see Appendix A for survey reaches). Spawning ground surveys will be conducted via foot or raft beginning late September and continuing until spawning has ended (usually mid-November). Frequency of surveys will vary depending on method.

Summer Chinook carcass surveys will be conducted in the Chelan River beginning in September and ending in November consistent with methods described in Hillman et al. 2019. A representative sample (i.e., 20%) of spawners as determined by spawner abundance and distribution (typically 100% of the carcasses encountered in the Chelan River) will be sampled. Biological data will include collection of scale samples for age analysis, length measurements (POH and FKL), gender, egg voidance, and a check for tags or marks. DNA samples (five-hole punches from operculum) will be collected as needed to address different objectives. These data will be used to assess length-at-age, size-at-age, egg voidance, origin (hatchery or naturally produced), stray rates, and genetics. All carcass surveys will be conducted within the historical reaches.

Wenatchee Steelhead

Brood year 2021 hatchery and natural origin adult escapement estimates to the Wenatchee sub-basin will be generated in the tributaries using mark-recapture techniques based on steelhead PIT tagged at Priest Rapids Dam and redd surveys in the mainstem Wenatchee and portions of select tributaries (Chiwawa River, Nason Creek, and Peshastin Creek). Steelhead redd counts will be conducted weekly in all major spawning areas in the mainstem Wenatchee River (see Appendix A for survey reaches). The estimated total number of redds in the Wenatchee River mainstem will be expanded by the sex ratio of the population to estimate spawner abundance. Spawner abundance in tributaries of the Wenatchee River will be estimated using a PIT tag mark recapture model (Truscott et al. 2018).

Chiwawa Spring Chinook

Chiwawa spring Chinook spawning escapement will be estimated based on the total number of redds found in each tributary (Murdoch et al. 2010) using methods described in Hillman et al. 2019. Weekly redd and carcass surveys will be conducted simultaneously from the first week of August through September (see Appendix Afor survey reaches). Redd-based estimates assume that each female constructs one redd, which WDFW has found to be appropriate for this population (Murdoch et al. 2009). The total number of redds in each reach will be estimated using methods described in Millar et al. (2012) and using the observer efficiency model developed by WDFW. Redd counts will be expanded and the number of hatchery and naturally produced fish will be estimated using methods in Murdoch et al. (2010). Carcasses encountered during surveys will be sampled according to methods outlined in Murdoch and Peven (2005). All CWTs (i.e., snout or adipose) from carcasses will be read and the data entered into the Regional Mark Processing Center database within one year of collection.

Additionally, all redds and carcasses will be geo-referenced using hand-held GPS devices. Carcass recovery bias has been detected in the Chiwawa spring Chinook population (Murdoch et al. 2010) and if not corrected will bias estimates of hatchery and naturally produced fish on the spawning grounds. While it may be appropriate to correct for carcass recovery bias for some monitoring questions (e.g., 2.2), when comparisons to reference populations are made in monitoring questions 1.1.and 1.2, carcass bias will not be corrected because other monitoring programs have not corrected for a similar bias.

Wenatchee Summer Chinook

Wenatchee summer Chinook spawning ground surveys will begin the first week in September and continue through the end of spawning in November (see Appendix A for survey reaches). Total census redd counts will be conducted by foot or raft depending on stream size, flow, and density of spawners within the stream reach (see Appendix A for survey reaches). All stream reaches will be surveyed once per week. Redd data will be collected using methods described in Hillman et al. 2019. Salmon carcass data collected during spawning ground surveys will be consistent with Hillman et al. 2019. All CWTs (i.e., snout or adipose) from carcasses will be sent to the WDFW lab in Olympia. The CWT lab will extract and read CWTs and submit all required information to RMIS within one year of collection.

4.2 Harvest Reporting

In years when the expected hatchery adult returns are in excess of the levels needed to meet the hatchery program goals (i.e., broodstock and/or escapement), surplus fish may be available for harvest. Harvesting or removal of surplus hatchery fish may have benefits to the natural populations by reducing potential negative ecological and genetic impacts (e.g., density dependent effects, loss of fitness, and loss of genetic variation). The contribution of hatchery fish to fisheries will be monitored using CWT recoveries on a brood-year basis supporting Objective 10.

To obtain the necessary data to determine if the harvest rates are meeting objectives, a statistically valid creel program will be designed and implemented for all sport and/or conservation fisheries in the Upper Columbia River to estimate harvest of hatchery fish from both Chelan and Grant County PUD funded hatchery programs Hillman et al. 2019. Information collected during creel surveys are an integral component to calculating the HRR (Objective 3), particularly given most CWT recoveries for PUD mitigation programs occur in the Upper Columbia River and its tributaries, with the exception of summer Chinook where most CWT recoveries occur in ocean fisheries. Because of considerable time lags in reporting of CWT's to the Regional Marking Information System (RMIS) database, it requires an ongoing query of recovery data until the number of estimated fish does not change.

5. DATA MANAGEMENT, ANALYSIS, AND REPORTING

5.1 Data Management

A Microsoft Access database maintained by WDFW will contain all the monitoring data collected for hatchery evaluations. The database will contain and manage all data associated with aquaculture monitoring, juvenile monitoring, and adult monitoring.

All data entered into the database are evaluated for quality control and quality assurance by WDFW. Quality control checks using analyses such as modified Z-scores, boxplots, and the Generalized Extreme Studentized Deviate Procedure (Iglewicz and Hoaglin 1993) will be conducted for all data entry. In the event outliers are identified, discussion will occur on whether identified outliers are true data points or transcription errors. This process ensures that the data used to test statistical hypotheses are correct and accurate.

5.2 Data Analysis

The analyses proposed are consistent with the Monitoring and Evaluation Plan for PUD Hatchery Programs: 2019 Update (Hillman et al. 2019). Each of the objectives will be addressed using the appropriate statistical tests, as well as graphic analyses that convey relevant information.

5.3 Reporting

An annual M&E report will be generated following the completion of each calendar year and will be available for HCP-HC review by June 1 of the following year. Additionally, monthly progress reports will be made available to the HCP-HC.

6. Lake Wenatchee Sockeye Salmon

The Chelan PUD will conduct monitoring and evaluation (M&E) activities to track key population attributes related to Lake Wenatchee sockeye salmon in 2021 (Table 6). In the absence of a sockeye hatchery program, M&E activities are no longer rooted in the context of evaluating the effects of sockeye salmon supplementation, but instead focus directly on the performance of the natural population, which is a unique departure from historic monitoring obligations. Broadly, the proposed M&E activities cover juvenile and adult life history stages and provide the data necessary to track or estimate viable salmonid population parameters (VSP): abundance, productivity, spatial structure and diversity (McElhaney et al. 2000). The data collected may also have utility in future hatchery compensation recalculation efforts.

Chelan PUD is conducting these M&E activities to support commitments made under the 2011 hatchery recalculation effort, which also included a steelhead production commitment for a sockeye species swap (SOA 2011). This section of the implementation plan describes the specific commitments by juvenile and adult life history stages.

6.1 Juvenile Monitoring

Chelan PUD will conduct or fund activities to monitor and evaluate the temporal distribution and age/size of out-migrating smolts, and estimate smolt production (Table 6). Smolt production will be estimated from data collected at the lower Wenatchee smolt trap and via back calculations based on collected adult return data (i.e., age-at-return estimates, SARs, and adult escapement to the tributaries). Collectively, these activities include: (1) funding of the lower Wenatchee River smolt trap concurrent with efforts aimed at evaluating Chelan PUD funded supplemented populations in the Wenatchee River sub-basin; (2) PIT-tagging up to 5,000 natural-origin juveniles encountered during smolt trapping activities and collecting scale samples at this location; and (3) estimating adult escapement estimates to the tributaries, and collection of adult return data at Tumwater (see the *Adult Monitoring* section for details) to back-calculate smolt production.

The monitoring data obtained will provide a useful set of tools for evaluating the performance of natural origin sockeye salmon within the sub-basin and downstream and also support the evaluation of VSP parameters [e.g., outmigration timing and size (diversity); and PIT tagging juveniles for SAR estimates (productivity)].

6.2 Adult Monitoring

Several M&E activities associated with adult returns of Lake Wenatchee sockeye salmon will be conducted and/or funded by Chelan PUD (Table 6). These efforts include (1) continuation of accurate adult counts at Rock Island, Rocky Reach, and Tumwater dams; (2) sampling of scales for age distribution, sex ratio determination, and returns of PIT-tagged adults at Tumwater Dam; (3) reach-specific conversion estimates between Rock Island Dam and spawning grounds in the White and Little Wenatchee rivers (i.e., Rock Island to Tumwater Dam to spawning tributaries); and (4) providing between 250 to 1,000 PIT tags to estimate adult spawning escapement in the Little Wenatchee and White rivers utilizing PIT tags and mark-recapture techniques (the software program Sample Size 2.0.7, developed by the University of Washington School of Aquatic and Fisheries Science (P. Westhagen, J. Lady, and J. Skalski) was used to determine the minimum number of tags required (i.e., 250) to estimate adult sockeye escapement at a +/- 7 percent confidence interval). Chelan PUD will adjust the number of PIT-tagged individuals in order to maintain precision in estimates at the lowest rate of interference to migrating populations, if it is warranted due to annual changes in escapement and detection probabilities. In an effort to PIT tag the run at large, adults will be PIT tagged at Tumwater consistent with the Tumwater Operations Protocol, daily throughout the run.

Collectively, these data will provide reliable metrics of adult returns and spawning escapement (abundance), recruits-per-spawner (productivity), distribution of spawners among tributaries (spatial structure), and run-timing and age structure for adult immigrants (diversity).

Table 6. Chelan PUD's Lake Wenatchee sockeye salmon monitoring and evaluation activities.

Life History Stage	M&E Activity	Entity Performing the Activity	Related analysis	VSP parameter addressed
Juvenile	Concurrent operation of the lower Wenatchee smolt trap to collect juvenile outmigration data	WDFW	Generate distribution of outmigration timing, estimate smolt production and determine average smolt size.	Diversity and productivity
Juvenile	PIT tagging smolts at lower Wenatchee smolt trap (up to 5,000 fish annually) and collecting/aging scale samples	WDFW	Estimate smolt-to-adult returns.	Productivity
Juvenile	Develop adult return based smolt production estimates	WDFW	Use collected data (i.e., adult age-at-return data, SARs, adult escapement to the tributaries) to back-calculate smolt production.	Productivity
Adult	Rock Island and Rocky Reach Dam adult counts	CPUD	Initial spawner abundance (Okanogan stock separation)	Abundance and spatial structure
Adult	PIT tag subsample (250 adults) of returning adults at Tumwater Dam to support mark-recapture evaluation	WDFW	Calculate spawner abundance and relative distribution among ~~in~~ tributaries	Abundance and spatial structure
Adult	Collect and age scales[1] and determine sex via ultrasound from returning adults at Tumwater Dam	WDFW	Estimate age-at-return, sex ratio, and relative productivity of contributing spawner cohorts	Productivity and diversity
Adult	Tumwater Dam adult counts	WDFW	Estimate potential spawner abundance (pre-Lake-Wenatchee harvest), potential productivity (recruits/spawner), and run timing distribution	Abundance and diversity
Adult	Operate PIT detection arrays on Little Wenatchee and White River	WDFW	Calculate spawner abundance (post-Lake Wenatchee harvest and other mortality), actual productivity (recruits/spawner), and entry-to-spawning-habitat timing distribution, and spatial spawner distribution among tributaries	Abundance, productivity, spatial structure, and diversity
All	Data management, analysis, and reporting	BioAnalysts CPUD	------	NA

[1] Scales would be collected concurrently from adults that are PIT tagged at Tumwater Dam.

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Appendix A

Designated survey reaches for Methow subbasin summer Chinook spawning ground surveys.

River	Reach	Code	RM
Methow	Mouth to Methow Bridge	M1	0.0-14.78
	Methow Bridge to Carlton Bridge	M2	14.78-27.17
	Carlton Bridge to Twisp Bridge	M3	27.17-39.55
	Twisp Bridge to MVID	M4	39.55-44.85
	MVID to Winthrop Bridge	M5	44.85-49.80
	Winthrop Bridge to Hatchery Dam	M6	49.80-51.55

Designated survey reaches for Wenatchee River basin summer Chinook spawning grounds surveys. Asterisks denotes reaches where redd observer efficiency will be assessed.

Reach Code	Reach Section	River Mile
W10	Lake Wenatchee to Bridge	54.20-53.58
	Bridge to Swamp *	53.58-52.66
	Swamp to Chiwawa River	52.66-48.39
W9	Chiwawa River to Schugart Flats	48.39-47.93
	Schugart Flats to Old Plain Bridge	47.93-46.21
	Old Plain Bridge to RR Bridge	46.21-41.91
	RR Bridge to RR Tunnel	41.91-39.28
	RR Tunnel to Swing Pool *	39.28-36.67
	Swing Pool to Tumwater Br	36.67-35.55
W8	Tumwater Br to Swiftwater Campground *	35.55-33.50
	Swiftwater Campground to Unimproved Campground	33.50-33.08
	Unimproved Campground to Tumwater Dam	33.08-30.91
W7	Tumwater Dam to Penstock Br	30.91-28.66
	Penstock Br to Icicle Road Br *	28.66-26.43
W6	Icicle Road Br to Icicle Mouth	26.43-25.61
	Icicle Mouth to Boat Takeout *	25.61-24.49
	Boat Takeout to Leavenworth Br	24.49-23.90
W5	Leavenworth Br to Irrigation Flume *	23.90-22.77
	Irrigation Flume to Peshastin Br	22.77-20.00
W4	Peshastin Br to Dryden Dam *	20.00-17.76
W3	Dryden Dam to Williams Canyon	17.76-15.54
	Williams Canyon to Upper Cashmere Br	15.54-10.22
	Upper Cashmere Br to Lower Cashmere Br	10.22-9.49
W2	Lower Cashmere Br to Old Monitor Br *	9.49-7.12
	Old Monitor Br to Sleepy Hollow Br	7.12-3.27
W1	Sleepy Hollow Br to River Bend *	3.27-1.73
	River Bend to Siphon	1.73-1.29
	Siphon to Mouth	1.29-0.45

Designated survey reaches for Wenatchee Basin spring Chinook spawning grounds surveys.

Reach Code	Reach Section	River Mile
Chiwawa River and Tributaries (Rock and Chikamin)		
C7	Buck Cr to Phelps Cr	36.39-33.46
C6	Phelps Cr (Trinity) to Maple Cr Br	33.46-29.64
C5	Maple Cr Br to Atkinson Flats	29.64-26.59
C4	Atkinson Flats to Schaefer Cr	26.59-24.24
C3	Schaefer Cr to Rock Cr Campground	24.24-22.97
R1 - Rock	Mouth to Chiwawa River Road Bridge	0.00-1.05
C2	Rock Cr Campground to Grouse Cr	22.97-12.27
K1 - Chikamin	Mouth to Chiwawa River Road Bridge	0.00-0.68
C1	Grouse Cr to Mouth	12.27-0.00
Nason Creek		
N4	White Pine Creek to Lower R.R. Bridge	16.09-13.68
N3	Lower R.R. Bridge to Hwy 2 Bridge	13.68-9.13
N2	Hwy 2 Bridge to Kahler Cr	9.13-4.46
N1	Kahler Cr to Mouth	4.46-0.00
White River and Tributaries (Panther and Napeaqua)		
H4	Falls to Grasshopper Meadows	21.16-19.78
T1 - Panther	Boulder field to Mouth	0.43-0.00
H3	Grasshopper Meadows to Napeaqua River	19.78-17.59
Q1 - Napeaqua	Take out to Mouth	0.91-0.00
H2	Napeequa River to Sears Cr Bridge	17.59-11.97
H1	Sears Cr Bridge to Mouth	11.97-0.00
Little Wenatchee River		
L3	Rainy Cr to Lost Cr	10.78-6.74
L2	Lost Cr to Old Fish Weir	6.74-2.13
L1	Old Fish Weir to Mouth	2.13-0.00
Upper Wenatchee River		
W10	Lake Wenatchee to Chiwawa River	54.20-48.39
Chiwaukum Creek		
U1	Metal bridge to Mouth	1.0 – 0.0
Icicle River		
I1	Hatchery to Mouth	3.02-0.00
Peshastin Creek and Tributaries (Ingalls Creek)		
D1 - Ingalls	Trailhead to mouth	0.64-0.00
P2	Ingalls Creek to Camas Cr	9.14-5.63
P1	Camas Cr to Mouth	5.63-0.00

Designated survey reaches for Wenatchee River basin steelhead spawning grounds surveys. Asterisks denote index reaches. Spawning escapements in tributaries will be estimates using PIT-tag arrays.

Reach Code	Reach Section	River Mile
W10	Lake Wenatchee to Chiwawa River*	54.20-48.39
W9	Chiwawa River to Tumwater Bridge*	48.39-35.55
W8	Tumwater Br to Swiftwater Campground	35.55-33.50
	Swiftwater Campground to Unimproved Campground*	33.50-33.08
	Unimproved Campground to Tumwater Dam	33.08-30.91
W7	Tumwater Dam to Icicle Road Bridge	30.91-26.43
W6	Icicle Road Br to Leavenworth boat ramp*	26.43-24.49
	Boat Takeout to Leavenworth Bridge	24.49-23.90
W5	Leavenworth Bridge to Peshastin Bridge	23.90-20.00
W4	Peshastin Bridge to Dryden Dam	20.00-17.76
W3	Dryden Dam to Lower Cashmere Bridge	17.76-9.49
W2	Lower Cashmere Bridge to Sleepy Hollow Bridge *	9.49-3.27
W1	Sleepy Hollow Bridge to Mouth	3.27-0.45

Tributary	River mile of PIT tag array
Mission Creek	0.54
Peshastin Creek	1.91
Chumstick Creek	0.31
Icicle River	0.26
Chiwaukum Creek	0.24
Chiwawa River	0.58
Nason Creek	0.52
Little Wenatchee River	1.74
White River	1.65

Appendix P
Monitoring and Evaluation of the Chelan and Grant County PUDs Hatchery Programs 2019

MONITORING AND EVALUATION OF THE CHELAN AND GRANT COUNTY PUDs HATCHERY PROGRAMS

2019 ANNUAL REPORT

September 15, 2020

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PREFACE

This annual report is the result of coordinated field efforts conducted by Washington Department of Fish and Wildlife (WDFW), the Confederated Tribes and Bands of the Yakama Nation (Yakama Nation), Chelan County Public Utility District (Chelan PUD), the Confederated Tribes of the Colville Reservation (Colville Tribes), the U.S. Fish and Wildlife Service (USFWS), and BioAnalysts, Inc. An extensive amount of work was conducted in 2006 through 2019 to collect the data needed to monitor the performance of the Chelan and Grant County PUD Hatchery Programs. This work was directed and coordinated by the Habitat Conservation Plans (HCP) Hatchery Committees, consisting of the following members: Matt Cooper and Bill Gale, USFWS; Brett Farman, National Marine Fisheries Service (NMFS); Catherine Willard, Chelan PUD; Keely Murdoch and Tom Scribner, the Yakama Nation; Mike Tonseth, WDFW; Kirk Truscott, Colville Tribes; and Tracy Hillman, BioAnalysts (Chair). This report also includes monitoring efforts funded by Grant County Public Utility District (Grant PUD). Grant PUD funds the Nason and White spring Chinook and Methow summer Chinook monitoring programs as well as co-funds the Wenatchee Summer Chinook program. Work funded by Grant PUD was directed and coordinated by the Priest Rapids Coordinating Committee (PRCC) Hatchery Sub-Committee, which consists of the same agency and tribal representatives listed for the HCP Hatchery Committee and replaces Chelan PUD representatives with Grant PUD representatives, Todd Pearsons, Peter Graf, and Deanne Pavlik-Kunkel.

The approach to monitoring the hatchery programs was guided by the updated monitoring and evaluation plan for PUD hatchery programs (Hillman et al. 2019). Technical aspects of the updated monitoring and evaluation program were developed by the Hatchery Evaluation Technical Team (HETT), which consisted of the following scientists: Matt Cooper, USFWS; Tracy Hillman, BioAnalysts; McLain Johnson, WDFW; Tom Kahler, Douglas PUD; Greg Mackey, Douglas PUD; Andrew Murdoch, WDFW; Keely Murdoch, Yakama Nation; Todd Pearsons, Grant PUD; Mike Tonseth, WDFW; and Catherine Willard, Chelan PUD. The updated plan also directs the analyses of hypotheses developed by the HETT. Most of the analyses outlined in the updated plan will be conducted in the five-year statistical reports and the ten-year program review reports.

Chelan and Grant PUDs funded most of the work reported in this document. Bonneville Power Administration purchased some of the Passive Integrated Transponder (PIT) tags that were used to mark juvenile Chinook and steelhead captured in tributaries and helped fund a portion of the screw trap efforts in Nason Creek. We thank Charlie Paulsen for analyzing PIT-tag data for each program. This is the 14th annual report written under the direction of the HCP.

"I often say that when you can measure something and express it in numbers, you know something about it. When you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind. It may be the beginning of knowledge, but you have scarcely in your thoughts advanced to the stage of science, whatever it may be."

Lord Kelvin

SECTION 1: INTRODUCTION

Chelan and Grant PUDs implement hatchery programs as part of their respective agreements related to the operation of Rocky Reach, Rock Island, Wanapum, and Priest Rapids Hydroelectric Projects. The fish resource management agencies developed the following general goal statements for the hatchery programs, which were adopted by the HCP Hatchery Committees and PRCC Hatchery Sub-Committee (hereafter, Hatchery Committees):

1. *Support the recovery of ESA-listed species by increasing the abundance of the natural adult population, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity.*

   Includes the Wenatchee spring Chinook, Wenatchee summer steelhead, and Methow spring Chinook programs.

2. *Increase the abundance of the natural adult population of unlisted plan species, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity. In addition, provide harvest opportunities in years when spawning escapement is sufficient to support harvest.*

   Includes the Wenatchee sockeye, Wenatchee summer/fall Chinook, Methow summer/fall Chinook, Okanogan summer/fall Chinook, and Okanogan sockeye programs.

3. *Provide salmon for harvest and increase harvest opportunities, while segregating returning adults from natural tributary spawning populations.*

   Includes the Chelan Falls summer Chinook program.

Following the development of the Hatchery and Genetic Management Plans (HGMPs), artificial propagation programs are now characterized into three categories. The first type, integrated conservation programs, are intended to support or restore natural populations. These programs focus on increasing the natural production of targeted fish populations. A fundamental assumption of this strategy is that adults spawned in the hatchery will produce more adult offspring than if they were left to spawn in the river and ultimately provide a demographic boost to the natural population. The second type, safety-net programs, are extensions of conservation programs, but are intended to function as reserve capacity for conservation programs in years of low returns. The safety-net provides a demographic and genetic reserve for the natural population. That is, in years of abundant returns, they function like segregated programs, and in years of low returns, they can be managed as conservation programs. Lastly, harvest augmentation programs are intended to increase harvest opportunities while limiting interactions with wild-origin counterparts.

Monitoring is needed to determine if the hatchery programs are meeting the intended management objectives of conservation, safety-net, or harvest augmentation programs. Objectives for hatchery programs are generally grouped into three categories of performance indicators:

1. In-Hatchery Indicators: Are the programs meeting the hatchery production objectives?

2. In-Nature Indicators: How do hatchery fish from the programs perform after release?

a. Conservation Programs:
   - How do the programs affect target population abundance and productivity?
   - How do the programs affect target population long-term fitness?

b. Safety-Net Programs:
   - How do the programs affect target population long-term fitness?

c. Harvest Augmentation Programs:
   - Do the programs provide harvest opportunities?

3. Risk Assessment Indicators: Do the programs pose risks to other populations?

The specific objectives identified in the updated monitoring and evaluation plan are as follows:

1. *Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.*
2. *Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.*
3. *Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.*
4. *Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.*
5. *Determine if the run timing, spawn timing, and spawning distribution of both the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.*
6. *Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.*
7. *Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.*
8. *Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.*
9. *Determine if hatchery fish were released at the programmed size and number.*
10. *Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations*

Two additional regional objectives that were not explicit in the goals specified above but were included in the updated monitoring and evaluation plan because they relate to goals and concerns of all artificial production programs include:

11. *Determine if the incidence of disease has increased in the natural and hatchery populations.*
12. *Determine if the release of hatchery fish affects non-target taxa of concern (NTTOC) within acceptable limits.*

Objective 12 was completed using an extensive risk assessment that concluded risks from the PUD hatchery programs were within containment objectives approved by the Hatchery Committees (Pearsons et al. 2012; Mackey et al. 2014).

Objectives in the updated plan have been organized in a hierarchy where productivity indicators are the primary metrics used to assess if conservation and safety-net program goals have been met; harvest rates and effects on non-targeted populations are used for harvest programs. In cases where productivity indicators are not available, or results are equivocal, monitoring indicators may be used to help evaluate the performance of the program. Evaluations of monitoring indicators may not provide sufficiently powerful conclusions on which to base management actions; although, they may provide insight as to why a productivity indicator did or did not meet the program goal. Therefore, the relationship between hatchery programs and indicators can be viewed in a chain-of-causation: management actions within the hatchery programs affect the status of monitoring indicators, which in turn influence productivity indicators (Figure 1.1).

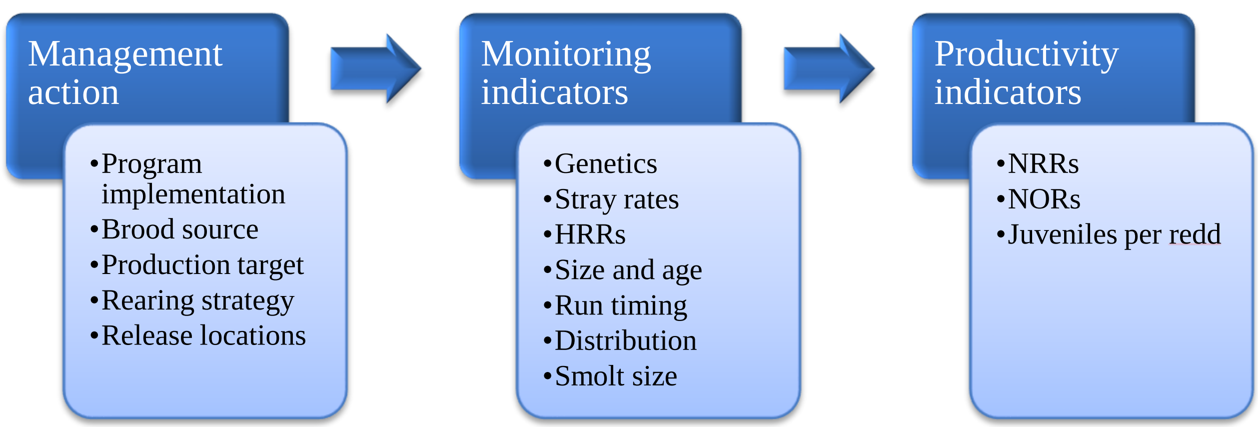


Figure 1.1. Relationship of indicators to the assessment of propagation programs. Management actions affect monitoring indicators, which influence productivity indicators. Monitoring indicators may be used to hypothesize the magnitude of influence on productivity.

Attending each objective is one or more testable hypotheses (see Hillman et al. 2019). Each hypothesis will be tested statistically following the routines identified in the updated monitoring and evaluation plan. Most of these analytical routines will be conducted at the end of five-year monitoring blocks, as outlined in the updated plan.

Both monitoring and productivity indicators will be used to evaluate the success of the hatchery programs. If the statistical power of tests that involve productivity indicators is insufficient to inform sound management decisions, some of the monitoring indicators may be used to guide management. Figure 1.2 shows the categories of indicators associated with each component of monitoring.

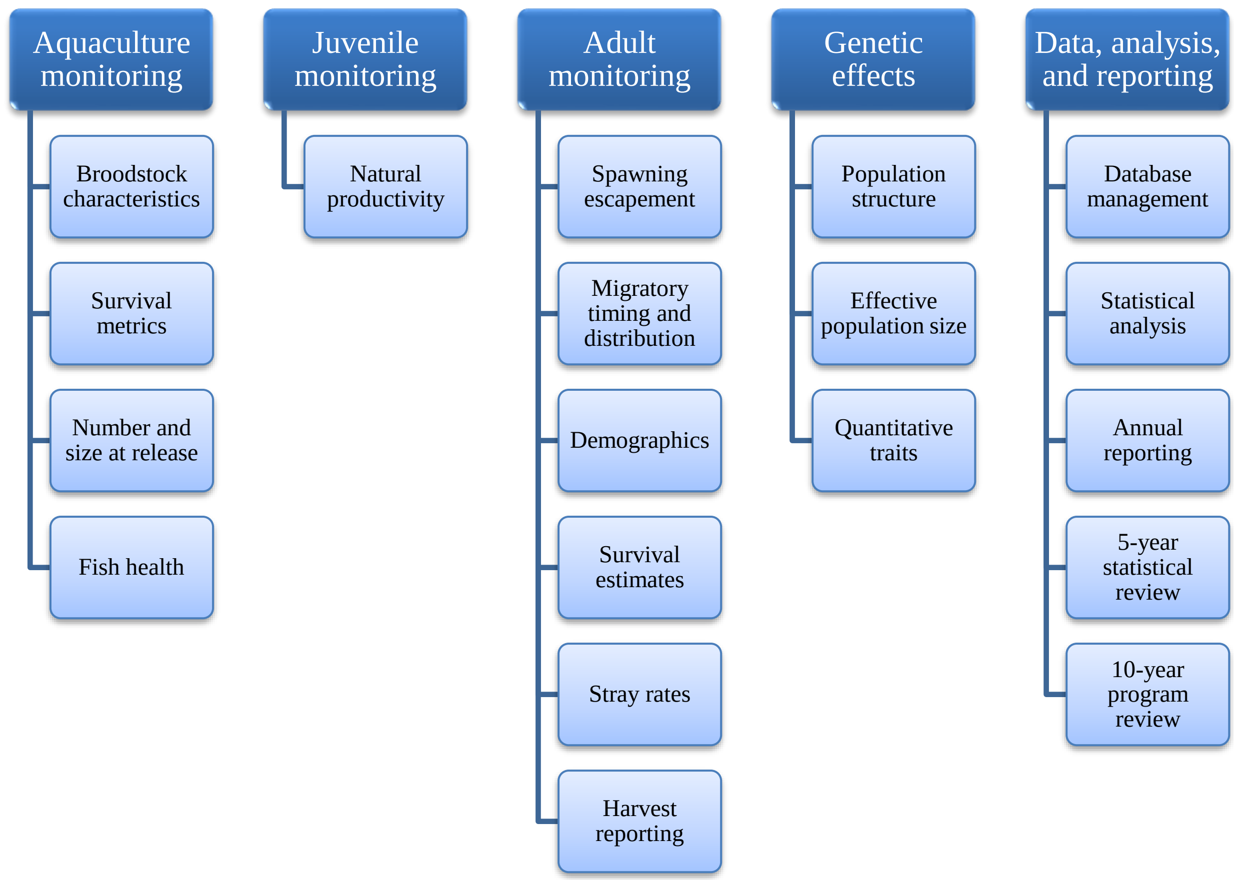


Figure 1.2. Overview of monitoring and evaluation plan categories and components (not including regional objectives).

Throughout each five-year, statistical-monitoring period, annual reports will be generated that describe the monitoring and evaluation data collected during a specific year. This is the 14th annual report developed under the direction of the Hatchery Committees. The purpose of this report is to describe monitoring activities conducted in 2019. Activities included broodstock collection, collection of life-history information, within-hatchery spawning and rearing activities, juvenile monitoring within streams, and redd and carcass surveys. Data from reference areas are not included in this annual report (reference data are in the five-year statistical reports). To the extent currently possible, we have included information collected before 2019.

This report is divided into several sections, each representing a different species, stock, or spawning aggregate (i.e., steelhead, sockeye salmon, spring Chinook salmon, and summer Chinook salmon). For all species, we provide annual broodstock information; hatchery rearing history, release data, and survival estimates; disease information; juvenile migration and productivity estimates; redd counts, distribution, and spawn timing; spawning escapements; and life-history characteristics. For Chinook salmon, we also provide information on carcasses. Brood year 2011 was the final sockeye salmon hatchery release and beginning in 2013, only natural adult and juvenile sockeye productivity monitoring results are reported. Beginning in 2013, we added a separate section on Nason Creek spring Chinook salmon and in 2014 we added a separate section on White River spring Chinook salmon. The Colville Tribes began conducting monitoring of

Okanogan summer Chinook in 2013; however, we retained the Okanogan summer Chinook section in this report because the PUDs have summer Chinook mitigation obligations in the Okanogan River basin. The Okanogan summer Chinook section includes monitoring information up to the return of brood year 2013 Chinook. Monitoring results for brood years 2013 to present can be found in annual reports prepared by the Colville Tribes to Bonneville Power Administration (BPA). Monitoring results of Grant PUD's fall Chinook salmon mitigation produced at Priest Rapids Hatchery can be found in annual reports written by WDFW and Grant PUD. Monitoring results of Grant and Chelan PUDs spring Chinook salmon mitigation produced in the Methow subbasin can be found in annual reports written by WDFW.

Finally, we end each section by addressing compliance issues with ESA/HCP mandates. For each Hatchery Program, WDFW and the PUDs are authorized annual take of ESA-listed spring Chinook and steelhead through Section 10 of the Endangered Species Act (ESA), including:

1. ESA Section 10(a)(1)(A) Amended Permit No. 18121, which authorizes the annual take of adult and juvenile endangered UCR spring Chinook and threatened UCR steelhead associated with implementing artificial propagation programs in the Chiwawa River for the enhancement of UCR spring Chinook. The authorization includes takes associated with adult broodstock collection, hatchery operations, juvenile fish releases, and monitoring and evaluation activities supporting UCR spring Chinook artificial propagation programs in the UCR region (NMFS 2013, amended in 2015).
2. ESA Section 10(a)(1)(A) Permit No. 18118, which authorizes the annual take of adult and juvenile endangered UCR spring Chinook and threatened UCR steelhead associated with implementing artificial propagation programs in Nason Creek for the enhancement of UCR spring Chinook. The authorization includes takes associated with adult broodstock collection, hatchery operations, juvenile fish releases, and monitoring and evaluation activities supporting UCR spring Chinook artificial propagation programs in the UCR region (NMFS 2013, amended in 2015).
3. ESA Section 10(a)(1)(A) Permit No. 18120, which authorizes the annual take of adult and juvenile endangered UCR spring Chinook and threatened UCR steelhead associated with implementing artificial propagation programs in the White River for the enhancement of UCR spring Chinook. The authorization includes takes associated with adult broodstock collection, hatchery operations, juvenile fish releases, and monitoring and evaluation activities supporting UCR spring Chinook artificial propagation programs in the UCR region (NMFS 2013, amended in 2015).
4. ESA Section 10(a)(1)(B) Permit No. 23191, which authorizes the annual incidental take of adult and juvenile endangered UCR spring Chinook and threatened UCR steelhead through actions associated with implementing artificial propagation programs for the enhancement of non-listed anadromous fish populations in the UCR. The authorization includes incidental takes associated with adult broodstock collection, hatchery operations, juvenile fish releases, and monitoring and evaluation activities associated with the non-listed Chelan Falls and Wenatchee summer Chinook salmon artificial propagation programs in the UCR region (NMFS 2019).
5. ESA Section 10(a)(1)(B) Permit No. 23193, which authorizes the annual incidental take of adult and juvenile endangered UCR spring Chinook and threatened UCR steelhead through actions associated with implementing artificial propagation programs for the enhancement

of non-listed anadromous fish populations in the UCR. The authorization includes incidental takes associated with adult broodstock collection, hatchery operations, juvenile fish releases, and monitoring and evaluation activities associated with the non-listed Methow and Wenatchee summer Chinook and Priest Rapids fall Chinook salmon artificial propagation programs in the UCR region (NMFS 2019).

6. ESA Section 10(a)(1)(A) Permit No. 18583, which authorizes the annual take of adult and juvenile endangered upper Columbia River (UCR) spring Chinook and threatened UCR steelhead associated with implementing artificial propagation programs for the enhancement of Wenatchee sub-basin steelhead. The authorization includes takes associated with adult broodstock collection, hatchery operations, juvenile fish releases, monitoring and evaluation activities, and management of adult returns related to the Wenatchee steelhead artificial propagation program in the UCR region (NMFS 2017).
7. ESA Section 7(a)(2), Biological Opinion No. 01EWFW00-2013-F-0444, which authorizes incidental take of bull trout associated with the five hatchery programs that operate in the Wenatchee subbasin: Chiwawa River spring Chinook salmon, Nason Creek spring Chinook salmon, White River spring Chinook salmon, Wenatchee River summer steelhead, and Wenatchee River summer Chinook salmon (USFWS 2017).

These permits and Biological Opinions (BiOps) are relevant for the brood years included in this report.

SECTION 2: SUMMARY OF METHODS

Sampling in 2019 followed the methods and protocols described in Hillman et al. (2019). In this section, we only briefly review the methods and protocols. More detailed information can be found in the updated monitoring and evaluation plan (Hillman et al. 2019).

2.1 Broodstock Collection and Sampling

Methods for collecting broodstock are described in the Annual Broodstock Collection Protocols (WDFW 2019). Generally, broodstock were collected over the migration period (to the extent allowed in ESA-permit provisions) in proportion to their temporal occurrence at collection sites, with in-season adjustments dictated by 2019 run timing and trapping success relative to achieving weekly and annual collection objectives. Pre-season weekly collection objectives are shown in Table 2.1 and assumptions associated with broodstock trapping are provided in Table 2.2.

Table 2.1. Weekly collection objectives for steelhead and Chinook in 2019.

Collection week beginning day	Chiwawa/Nason Spring Chinook[a]		Hatchery Chelan Falls Summer Chinook	Wild Wenatchee Summer Chinook	Wild Methow Summer Chinook	Wenatchee Steelhead	
	Hatchery	Wild				Hatchery	Wild
3 June							
10 June					13		
17 June					26		
24 June					26		
1 Jul			100		20	1	1
8 Jul			100		13	1	2
15 Jul			75		9	1	2
22 Jul			75		7	1	2
29 Jul			40		5	2	3
5 Aug					5	2	3
12 Aug						2	3
19 Aug						4	4
26 Aug						4	4
2 Sep						4	4
9 Sep						6	4
16 Sep						8	6
23 Sep						12	8
30 Sep						12	12
7 Oct						8	6
14 Oct						2	2
21 Oct						0	0
Total	90	114	390	274	124	70	66

[a] There was no specific weekly objective for Chiwawa and Nason spring Chinook.

Table 2.2. Biological and trapping assumptions associated with collecting broodstock for the Chelan and Grant PUD Hatchery Programs, 2019.[1]

Assumptions	Wenatchee Steelhead	Chiwawa Spring Chinook	Nason Spring Chinook		Wenatchee Summer Chinook	Chelan Falls Summer Chinook	Methow Summer Chinook
			Conservation Program	Safety Net Program			
Production level	247,300 yearling smolts	144,026 yearling smolts	125,000 yearling smolts	98,670 yearling smolts	500,001 yearling smolts	576,000 yearling smolts	200,000 yearling smolts
Broodstock required	136 adults (not to exceed 33% of NOR population)	76 adults (not to exceed 33% of NOR population)	75 adults (not to exceed 33% of population)	76 adults	274 adults (not to exceed 33% of the population)	390 adults	124 adults (not to exceed 33% of the population)
Trapping period	1 July-14 Nov	1 June – 15 July (Tumwater) 1 June-15 Aug (Chiwawa Weir)	1 June – 15 July	1 June – 15 July	24 June – 15 Sept (Dryden) 15 July- 15 Sept (Tumwater)	1 July – 15 Sep	1 July – 15 Sept
# days/week	7	7 (Tumwater) Not to exceed 15 cumulative trapping days (Chiwawa Weir)	7	7	7 (Dryden) 2 (Tumwater)	7	3
# hours/day	24	24 (Tumwater) 24 up/24 down (Chiwawa Weir)	24	24	24	24	16
Broodstock composition	49% WxW; 51% HxH	67% WxW; 33% HxH	100% WxW	100% HxH	100% WxW	100% HxH	100% WxW
Trapping site	Dryden Dam for HxH; Tumwater for WxW. (Tumwater will be used if weekly quota not achieved for WxW (hatchery) at Dryden Dam)	Tumwater Dam and Chiwawa Weir	Tumwater Dam	Tumwater Dam	Dryden Dam (Tumwater will be used if weekly quota not achieved at Dryden Dam)	Wells Dam Volunteer Trap Chelan River Water Conveyance Canal Trap	Wells Dam east or west ladder

Several biological parameters were measured during broodstock collection at adult collection sites. Those parameters included the date and start and stop time of trapping; number of each species collected for broodstock; origin, size, and sex of trapped fish; age from scale analysis; and pre-spawn mortality. For each species, trap efficiency, extraction rate, and trap operation effectiveness

[1] Throughout this document, "HxH" refers to hatchery-origin by hatchery-origin crosses and "WxW" refers to natural-origin by natural-origin crosses.

were estimated following procedures in Hillman et al. (2019). In addition, a representative sample of most species trapped but not taken for broodstock were sampled for origin, sex, age, and size (stock assessment).

2.2 Within Hatchery Monitoring

Methods for monitoring hatchery activities are described in Hillman et al. (2019). Biological information collected from all spawned adult fish included age at maturity, length at maturity, spawn time, and fecundity of females. In addition, all fish were checked for tags and females were sampled for pathogens.

Throughout the rearing period in the hatchery, fish were sampled for growth, health, and survival. Each month, lengths and weights were collected from a sample of fish and rearing density indices were calculated. In addition, fish were examined monthly for health problems following standard fish-health monitoring practices for hatcheries. Various life-stage survivals were estimated for each hatchery stock. These estimates were then compared to the "standard" survival rates identified in Table 2.3 to provide insight as to how well the hatchery operations were performing. Failure to achieve a survival standard could indicate a problem with some part of the hatchery program. However, failure to meet a standard may not be indicative of the overall success of the program to meet the goals identified in Section 1.

Table 2.3. Standard life-stage survival rates for fish reared within the Chelan PUD hatchery programs (from Hillman et al. 2019).

Life stage	Standard survival rate (%)
Collection-to-spawning (females)	90
Collection-to-spawning (males)	85
Unfertilized egg-to-eyed	92
Unfertilized egg-to-ponding	98
30 d after ponding	97
100 d after ponding	93
Ponding-to-release	90
Transport-to-release	95
Unfertilized egg-to-release	81

Nearly all hatchery fish from each stock were marked (adipose fin clip) and/or tagged (coded-wire tag) in 2019. Different combinations of marks and tags were used depending on the stock. In addition, Chelan PUD personnel PIT tagged 10,100 juvenile WxW Chiwawa spring Chinook and 10,100 juvenile Nason Creek spring Chinook (5,050 WxW and 5,049 HxH); 11,110 Wenatchee WxW steelhead (Circular Ponds) and 22,220 Wenatchee WxW and HxH steelhead (Raceway); and 10,499 Chelan River summer Chinook, 5,052 Methow (Carlton) summer Chinook, and 20,998 Wenatchee summer Chinook (10,500 Raceway and 10,498 Circular Ponds). PIT tags are used to estimate migration timing and survival rates (e.g., smolt-to-adult) outside the hatchery.

Lastly, the size and number of fish released were assessed and compared to programmed production levels. Numbers released, and their sizes, should fall within 10% of the programmed targets identified in Table 2.4. However, because of constraints due to run size and proportions of wild and hatchery adults, production levels may not be achieved every year.

Table 2.4. Targets for fish released from the PUD hatchery programs; CV = coefficient of variation.

Hatchery stock	Release targets	Size targets		
		Fork length (CV)	Weight (g)	Fish/pound
Wenatchee Summer Chinook	500,001	163 (9.0)	45.4	18[a]
Methow Summer Chinook	200,000	163 (9.0)	45.4	13-18
Chelan Falls Summer Chinook (yearlings)	576,000	161 (9.0)	45.4	13[b]
Chiwawa Spring Chinook	144,026	155 (9.0)	37.8	18
Nason Spring Chinook	223,670	155 (9.0)	37.8	18[c]
Wenatchee Steelhead	247,300	191 (9.0)	75.6	6

[a]An experimental release size of 30-45 grams (10-15 FPP) was in place for brood years 2012-2014.
[b]An experimental release size of 20-45 grams (10-22 FPP) was in place for brood years 2012-2014.
[c] This is an approximate goal.

2.3 Juvenile Sampling

Juvenile sampling within streams in 2019 included operation of rotary screw traps and PIT tagging. Snorkel surveys conducted in the Chiwawa River basin ended in 2018; however, the data from the 26-year time series are included in this report. Methods for sampling juvenile fish are described in Hillman et al. (2019).

A rotary screw trap operated on the Wenatchee River near the town of Cashmere at RM 8.3 (Lower Wenatchee Trap), in Nason Creek (Nason Creek Trap) about 0.6 miles upstream from the mouth, in the White River (White River Trap) about 5.8 miles upstream from the mouth, and in the Chiwawa River (Chiwawa River Trap) about 0.4 miles upstream from the mouth. All rotary screw traps operated throughout the smolt migration period. The Chiwawa Trap operated between 19 March and 27 November 2019, the Nason Creek Trap operated from 1 March to 27 November 2019, the White River trap operated from 1 March through 27 November 2019, and the Lower Wenatchee Trap operated between 19 February and 23 July 2019. Throughout the trapping period, the traps were briefly inoperable during periods when flows were too high or low, during high water temperatures, during large hatchery releases, and because of heavy debris loads, ice, and mechanical malfunctions.

The following data were collected at each trap site: water temperature, discharge, number and identification of all species captured, degree of smoltification for anadromous fish, presence of marks and tags, size (fork lengths and weights), and scales from smolts. Trap efficiencies at each trap site were estimated using mark-recapture trials conducted over a wide range of discharges. Linear regression models relating discharge and trap efficiencies were developed to estimate daily trap efficiencies during periods when no mark-recapture trials were conducted. The total number of fish migrating past the trap each day was estimated as the quotient of the daily number of fish captured and the estimated daily trap efficiency. Summing the daily totals resulted in the total emigration estimate.

Snorkel observations were used to estimate numbers of juvenile spring Chinook salmon, juvenile rainbow/steelhead, and bull trout within the Chiwawa River basin from 1992 to 2018 (no sampling was conducted in 2000). The focus of the study was on juvenile spring Chinook salmon. Sampling followed a stratified random design with proportional allocation of sites among strata. Strata were identified based on unique combinations of geology, land type, valley bottom type, stream state condition, and habitat types. Counts of fish within each sampling site were adjusted based on detection efficiencies, which were related to water temperature. That is, non-linear models that described relationships between water temperatures and detection efficiencies (Hillman et al. 1992) were used to estimate total numbers of fish within sampling sites. These numbers were then converted to densities by dividing total fish numbers by the wetted surface area and water volume of sample sites. Total numbers within a stratum were estimated as the product of fish densities times the total wetted surface or water volume for the stratum. The sum of fish numbers across strata resulted in the total number of fish within the basin. The calculation of total numbers, densities, and degrees of certainty are explained fully in Hillman and Miller (2004).

Working in collaboration with the Comparative Survival Study (CSS) funded by BPA, crews PIT tagged juvenile wild Chinook, wild steelhead, wild sockeye, and in some instances wild coho salmon and bull trout collected at the rotary screw traps and collected within the Chiwawa River and Nason Creek using electrofishing techniques. The proposed number of wild spring Chinook and steelhead to be tagged at each location is provided in Table 2.5. The goal of this tagging program is to estimate freshwater juvenile productivity, better understand life-history characteristics, overwinter movement, and survival of salmonids, and to calculate SARs for tagged stocks in the Wenatchee River basin. The PIT-tagging effort funded by the PUDs in the Chiwawa River and Nason Creek is specifically directed at addressing uncertainties of estimating abundance using rotary screw traps (e.g., juvenile outmigration during times when trapping is not possible).

Table 2.5. Number of wild spring Chinook, steelhead (≥65 mm), and sockeye proposed for PIT tagging at different locations within the Wenatchee River basin, 2018. NT = no sample size target.

Sampling location	Target sample size		
	Wild spring Chinook	Wild steelhead	Wild Sockeye
Chiwawa Trap	2,500-8,000	500-2,000	NT
Nason Creek Trap	2,500-8,000	500-2,000	NT
White River Trap	200-500	NT	NT
Lower Wenatchee Trap	1,000-2,500	50-250	3,000-5,000
Chiwawa Remote Sampling	3,000	NT	NT
Nason Remote Sampling	3,000	NT	NT

Survival rates for various juvenile life-stages were calculated based on estimates of seeding levels (total egg deposition), parr abundance, numbers of emigrants, and smolt abundance. Total egg deposition was estimated as the product of the number of redds counted in the basin times the mean fecundity of female spawners. An electronic egg counter was used to estimate fecundity of females collected for broodstock. Numbers of emigrants and smolts were estimated at trapping sites. Survival estimates could not be calculated for some stocks (e.g., summer Chinook) because specific life-stage abundance estimates were lacking.

2.4 Spawning/Carcass Surveys

Methods for conducting carcass and spawning ground surveys are detailed in Hillman et al. (2019). Information collected during spawning surveys included spawn time, redd location, and redd abundance. Data collected during carcass surveys included sex, size (fork length and postorbital-to-hypural length), scales for aging[2], degree of egg voidance, DNA samples, and identification of marks or tags. The sampling goal for carcasses was 20% of the spawning population.

Steelhead surveys were conducted throughout the mainstem Wenatchee River and downstream from PIT-tag interrogation systems on the Chiwawa River, Nason Creek, and Peshastin Creek. These surveys were conducted during March through June in reaches and index areas described in Table 2.6. Total redd counts in these reaches were estimated by expanding counts within non-index areas by expansion factors developed within index areas.

Table 2.6. Description of reaches and index areas surveyed for steelhead redds in the Wenatchee River basin.

Stream	Code	Reach*	Index/reference area
Wenatchee River	W1	Mouth to Sleepy Hollow Br	River Bend to Sleepy Hollow Br
	W2	Sleepy Hollow Br to L. Cashmere Br	Sleepy Hollow Br to Cashmere Boat Rmp
	W3	L. Cashmere Br to Dryden Dam	Williams Canyon to Dryden Dam
	W5	Peshastin Br to Leavenworth Br	Irrigation Flume to Leavenworth Br
	W6	Leavenworth Br to Icicle Rd Br	Leavenworth Boat Ramp to Icicle Ck
	W7	Icicle Rd Br to Tumwater Dam	Icicle Br to Penstock Br
	W8	Tumwater Dam to Tumwater Br	Island below Swiftwater to Swiftwater CG
	W9	Tumwater Br to Chiwawa R	Tumwater Br to Plain
	W10	Chiwawa R to Lk Wenatchee	Chiwawa Pump St. to Lk Wenatchee
Peshastin Creek	P1	Mouth to PIT Detection Site	Mouth to PIT Detection Site
Chiwawa River	C1	Mouth to Rd 62 Br RM 6.4	Mouth to PIT Detection Site
Nason Creek	N1	Mouth to PIT Detection Site	Mouth to PIT Detection Site

* Reaches 2, 6, 8, 9, and 10 (major spawning areas) are surveyed weekly, while Reaches 1, 3, 5, and 7 (minor survey areas) are surveyed during peak spawning.

Steelhead spawning escapements to the Wenatchee River basin have been estimated based on run reconstruction[3] (1987-present) and PIT-based mark-recapture (2014-present) methods. The steelhead run reconstruction model provides a long-term data set that can be used to evaluate escapement trends to the Wenatchee River basin (Hillman et. al 2012). Beginning in 2014, adult steelhead escapement estimates in the majority of tributaries in the Wenatchee River basin were generated using mark-recapture techniques based on steelhead PIT tagged at Priest Rapids Dam.[4]

[2] In this report, we use two methods of describing age. One is termed the "European Method." This method has two digits, separated by a period. The first digit represents the number of winters the fish spent in freshwater before migrating to the sea. The second digit indicates the number of winters the fish spent in the ocean. For example, a fish designated as 1.2 spent one winter in freshwater and two in the ocean. A fish designated as 0.3 migrated to the ocean in its first year and spent three winters in the ocean. The other method describes the total age of the fish (egg-to-spawning adult, i.e., gravel-to-gravel), so fish demarcated as 0.3 or 1.2 are considered 4-year-olds, from the same brood.

[3] Steelhead run reconstruction is based on the number of steelhead observed at Priest Rapids and Wells dams and apportioned to Upper Columbia subbasins based on previously conducted radio telemetry studies (English et al. 2001; 2003) and differences in dam counts. Run escapement to each of the subbasins is then adjusted for adult management, harvest, broodstock collection, and a 10% pre-spawn mortality to estimate spawning escapement.

[4] We assume steelhead escapement to tributaries based on mark-recapture techniques represents spawning escapement.

Mark-recapture estimates in the tributaries were then added to the estimates based on redd surveys to generate a total spawning escapement to the Wenatchee River basin.

Spring Chinook redd and carcass surveys were conducted during August through September in the Chiwawa River (including Rock and Chikamin creeks), Nason Creek, Icicle Creek, Peshastin Creek (including Ingalls Creek), upper Wenatchee River, Little Wenatchee River, and the White River (including the Napeequa River and Panther Creek). Survey reaches for spring Chinook are described in Table 2.7.

Table 2.7. Description of reaches surveyed for spring Chinook redds and carcasses in the Wenatchee River basin.

Stream	Code	Reach	River mile (RM)
Chiwawa River	C1	Mouth to Grouse Creek	0.0-11.7
	C2	Grouse Creek to Rock Creek	11.7-19.3
	C3	Rock Creek to Schaefer Creek	19.3-22.4
	C4	Schaefer Creek to Atkinson Flats	22.4-25.6
	C5	Atkinson Flats to Maple Creek	25.6-27.0
	C6	Maple Creek to Phelps Creek	27.0-30.3
	C7	Phelps Creek to Buck Creek	30.3-31.4
Rock Creek	R1	Mouth to Chiwawa River Road Bridge	0.0-0.5
Chikamin Creek	K1	Mouth to Chiwawa River Road Bridge	0.0-0.5
Nason Creek	N1	Mouth to Kahler Creek Bridge	0.0-3.9
	N2	Kahler Creek Bridge to Hwy 2 Bridge	3.9-8.3
	N3	Hwy 2 Bridge to Lower RR Bridge	8.3-13.2
	N4	Lower RR Bridge to Whitepine Creek	13.2-15.4
Little Wenatchee River	L1	Mouth to Old Fish Weir	0.0-2.7
	L2	Old Fish Weir to Lost Creek	2.7-5.2
	L3	Lost Creek to Rainy Creek	5.2-9.2
	L4	Rainy Creek to Falls	9.2-12.4
White River	H1	Mouth to Sears Creek Bridge	0.0-6.4
	H2	Sears Creek Bridge to Napeequa River	6.4-11.0
	H3	Napeequa River to Grasshopper Meadows	11.0-12.9
	H4	Grasshopper Meadows to Falls	12.9-16.1
Napeequa River	Q1	Mouth to Take Out	0.0-1.0
Panther Creek	T1	Mouth to Boulder Field	0.0-1.0
Wenatchee River	W8	Tumwater Dam to Tumwater Bridge	30.9-35.6
	W9	Tumwater Bridge to Chiwawa River	35.6-48.4
	W10	Chiwawa River to Lake Wenatchee	48.4-54.2
Chiwaukum Creek	U1	Mouth to Metal Bridge	0.0-1.0
Icicle Creek	I1	Mouth to Hatchery	0.0-2.8
	I2	Hatchery to Sleeping Lady	2.8-3.3
	I3	Sleeping Lady to Snow Creek	3.3-3.8
Peshastin Creek	P1	Mouth to Camas Creek	0.0-5.9

Stream	Code	Reach	River mile (RM)
	P2	Camas Creek to Mouth of Scotty Creek	5.9-16.3
Ingalls Creek	D1	Mouth to Trailhead	0.0-1.0

The sockeye salmon hatchery program ended after the 2011 brood year. As a result, monitoring activities that focused on evaluating the effects of the supplementation program on the natural population switched to monitoring the abundance and productivity of the natural population (McElhaney et al. 2000). Thus, estimation of spawn time and carcass surveys were discontinued in 2014. Nevertheless, this report retains the results of carcass sampling during the period 1993-2013. Survey reaches in which carcasses and live fish (for area-under-the-curve estimates) were conducted are identified in Table 2.8.

From 2009-2013, mark-recapture methods were used to estimate sockeye spawning escapement within the White River, while area-under-the-curve (AUC) methods were used to estimate spawning escapement within the Little Wenatchee River. Beginning in 2014, mark-recapture methods were used to estimate the spawning escapement of sockeye in both the White River and Little Wenatchee watersheds.

Table 2.8. Description of reaches surveyed for sockeye salmon carcasses and live fish in the Wenatchee River basin during survey years 1993-2013.

Stream	Code	Reach	River mile (RM)
Little Wenatchee River	L1	Mouth to Old Fish Weir	0.0-2.7
	L2	Old Fish Weir to Lost Creek	2.7-5.2
	L3	Lost Creek to Rainy Creek	5.2-9.2
White River	H1	Mouth to Sears Creek Bridge	0.0-6.4
	H2	Sears Creek Bridge to Napeequa River	6.4-11.0
	H3	Napeequa River to Grasshopper Meadows	11.0-12.9
Napeequa River	Q1	Mouth to End	0.0-1.0

Wenatchee summer Chinook redd and carcass surveys were conducted from September through November throughout the entire mainstem Wenatchee River, which was divided into ten reaches (Table 2.9). Surveys were conducted weekly in all reaches. All redds were enumerated during weekly census counts.

Table 2.9. Description of reaches surveyed for summer Chinook redds in the Wenatchee River basin.

Code	Reach	River mile
W1	Mouth to Sleepy Hollow Br	0.0-3.3
W2	Sleepy Hollow Br to L. Cashmere Br	3.3-9.5
W3	L. Cashmere Br to Dryden Dam	9.5-17.8
W4	Dryden Dam to Peshastin Br	17.8-20.0
W5	Peshastin Br to Leavenworth Br	20.0-23.9
W6	Leavenworth Br to Icicle Rd Br	23.9-26.4
W7	Icicle Rd Br to Tumwater Dam	26.4-30.9

Code	Reach	River mile
W8	Tumwater Dam to Tumwater Br	30.9-35.6
W9	Tumwater Br to Chiwawa River	35.6-48.4
W10	Chiwawa River to Lake Wenatchee	48.4-54.2

Summer Chinook redd and carcass surveys were also conducted in the Methow and Chelan rivers from September through November. Total (map) redd counts were conducted in these rivers. Table 2.10 describes the survey reaches on the Methow River. The Colville Tribes conducted summer Chinook redd and carcass surveys in the Okanogan River basin. Those results are reported in a separate report (annual report to BPA).

Table 2.10. Description of reaches surveyed for summer Chinook redds and carcasses on the Methow, Chelan, Okanogan, and Similkameen rivers.

Stream	Code	Reach	River mile (RM)
Methow River	M1	Mouth to Methow Bridge	0.0-14.8
	M2	Methow Bridge to Carlton Bridge	14.8-27.2
	M3	Carlton Bridge to Twisp Bridge	27.2-39.6
	M4	Twisp Bridge to MVID	39.6-44.9
	M5	MVID to Winthrop Bridge	44.9-49.8
	M6	Winthrop Bridge to Hatchery Dam	49.8-51.6
Chelan River	CoT	Columbia Tailrace	0.0-0.1
	ChT	Chelan Tailrace	0.1-0.3
	HC	Habitat Channel	0.2-0.6
	HP	Habitat Pool	0.6-0.7
Okanogan River	O1	Mouth to Mallot Bridge	0.0-16.9
	O2	Mallot Bridge to Okanogan Bridge	16.9-26.1
	O3	Okanogan Bridge to Omak Bridge	26.1-30.7
	O4	Omak Bridge to Riverside Bridge	30.7-40.7
	O5	Riverside Bridge to Tonasket Bridge	40.7-56.8
	O6	Tonasket Bridge to Zosel Dam	56.8-77.4
Similkameen River	S1	Driscoll Channel to Oroville Bridge	0.0-1.8
	S2	Oroville Bridge to Enloe Dam	1.8-5.7

For summer and spring Chinook, total spawning escapements for each population were estimated as the product of total number of redds times the ratio of fish per redd for a specific stock.[5] Fish per redd ratios were estimated as the ratio of males to females sampled at broodstock collection sites and monitoring sites (e.g., Leavenworth National Fish Hatchery, Dryden Dam, Tumwater Dam, Chiwawa Weir, etc.). For steelhead, spawning escapement was estimated with a combination of PIT-tag-based tributary and redd-based mainstem Wenatchee River estimates. Total spawning escapement for sockeye salmon in the Little Wenatchee and White River watersheds was estimated

[5] Fish per redd expansion factor = (1 + (number of males/number of females)).

using mark-recapture methods. Adult sockeye were PIT tagged at Tumwater Dam and Bonneville Dam[6] and detected in the Little Wenatchee and White rivers with stationary PIT-tag interrogation systems.

Derived metrics calculated from carcass surveys, broodstock sampling, stock assessments, and harvest records included proportion of hatchery spawners, stray rates, age-at-maturity, length-at-age, smolt-to-adult survival (SAR), hatchery replacement rates (HRR), harvest rates, and natural replacement rates (NRR). The target HRRs (from Hillman et al. 2019) for different stocks raised in the PUD hatchery programs are provided in Table 2.11. Methods for calculating derived variables are described in Hillman et al. (2019) and in "White Papers" developed by the Hatchery Evaluation Technical Team (HETT) (see Appendices in Hillman et al. 2012). The abundance of hatchery and natural-origin Chinook salmon spawners was based upon the proportion of carcasses by origin that were collected on the spawning grounds.

Table 2.11. Hatchery replacement rate (HRR) targets for stocks raised in the PUD Hatchery Programs.

Program	Number of broodstock	Smolts released	HRR targets
Chiwawa Spring Chinook	74	144,026	6.7
Nason Creek Spring Chinook (conser.)	77	125,000	6.7
Wenatchee Summer Chinook	262	500,001	5.7
Methow Summer Chinook	118	200,000	3.0
Wenatchee Steelhead	140	247,300	6.9

Derived data that rely on CWTs (e.g., HRR, SAR, stray rates, etc.) are five or more years behind release information because of the lag time for returning adult fish to enter the fishery and spawning grounds, and the processing of tags. Consequently, complete information on rates and ratios based on CWTs is generally only available for brood years before 2014.

In addition to the data required in the M&E Plan, this report contains data and analyses that go beyond the requirements of the M&E Plan. We include information on broodstock collection efforts including numbers of adult fish collected, mortalities, and numbers spawned. We also include the size, age, and sex ratios of broodstock; egg take, acclimation days, and tagging information; and incidence of disease. For natural-origin fish, we estimate juvenile carrying capacities and calculate the change in precision of stock-recruitment parameters as additional years of data are added to the time series. Finally, we include estimates of PNI, post-release survival and travel times (from release location to McNary Dam), and SARs. Although these data and analyses are not a requirement of the M&E Plan, they provide information that supports the M&E Plan and are used to help manage the hatchery programs.

[6] Adult sockeye that were tagged at Bonneville Dam and detected at Tumwater Dam were included in the mark-recapture analyses.

SECTION 3: WENATCHEE STEELHEAD

The goal of summer steelhead supplementation in the Wenatchee Basin is to use artificial production to replace adult production lost because of mortality at Rock Island and Rocky Reach dams, as well as inundation compensation for Rocky Reach Dam, while not reducing the natural production or long-term fitness of steelhead in the basin. The Rock Island Fish Hatchery Complex began operation in 1989 under funding from Chelan PUD. The Complex operated originally through the Rock Island Settlement Agreement, but since 2004 has operated under the Rock Island and Rocky Reach Anadromous Fish Agreement and Habitat Conservation Plans.

Prior to 1998, steelhead eggs were received from Wells Hatchery (adult broodstock were collected at Wells Dam); fish were reared at Eastbank Fish Hatchery and then released into the Wenatchee River. Beginning in 1998, the program changed to collecting broodstock within the Wenatchee River basin. Currently, adult hatchery steelhead are collected from the run-at-large at the right and left-bank traps at Dryden Dam, and at Tumwater Dam if the weekly quotas cannot be achieved at Dryden Dam. Natural-origin (WxW) adult steelhead are collected from the run-at-large at Tumwater Dam.

Before 2012, the goal was to collect up to 208 adult steelhead (50% natural-origin fish and 50% hatchery-origin fish) for the Wenatchee steelhead program. In 2011, the Hatchery Committees reevaluated the amount of hatchery compensation needed to achieve NNI. Based on that evaluation, the goal of the program was revised. The current goal (which began in 2012) is to collect about 130 adult steelhead (64 natural-origin and 66 hatchery-origin fish) for a 247,300 smolt program, but the number of broodstock collected cannot exceed 33% of the natural Wenatchee steelhead population. Broodstock collection occurs from about 1 July through 15 November at Dryden and Tumwater dams, with trapping occurring up to 24 hours per day, five days a week. The intent of the current program is to target adults necessary to meet a 50% natural-origin, conservation-oriented program and a 50% hatchery-origin safety-net program.

Before the 2012 brood year, adult steelhead were held and spawned at Wells Fish Hatchery because of unsuitable adult holding temperatures at Eastbank Fish Hatchery. Beginning with the 2012 brood year, holding and spawning of adult steelhead have occurred at Eastbank Fish Hatchery with the installation of a water chiller system. Before 2012, juvenile steelhead were reared at a combination of facilities including Eastbank, Chelan, Turtle Rock, Rocky Reach Annex, and Chiwawa facilities. Juvenile steelhead reared in these facilities were trucked to release locations on the Wenatchee River, Chiwawa River, and Nason Creek. A percentage of the fish were also released volitionally from Blackbird Pond and Rolfing Pond. Beginning in the fall of 2012, the entire Wenatchee steelhead program overwinters at the Chiwawa Acclimation Facility. Some of these fish are transferred to short-term remote acclimation sites (e.g., Blackbird Pond and Rolfing Pond), while others are planted from trucks throughout the Wenatchee River, Nason Creek, and Chiwawa River.

Before 2012, the production goal for the Wenatchee steelhead supplementation program was to release 400,000 yearling smolts into the Wenatchee Basin at six fish per pound. Since 2012, the revised production goal is to release 247,300 smolts (123,650 for conservation and 123,650 for safety net). Targets for fork length and weight are 191 mm (CV = 9.0) and 75.6 g, respectively; the target size at release is six fish per pound. Over 96% of these fish receive CWTs. In addition, from 2006 to 2009, juvenile steelhead from different parental-cross groups (e.g., WxW, HxW, and HxH) were PIT tagged annually. No intentional HxW crosses have been part of the Wenatchee steelhead program since brood year 2009.

Beginning in 2010 and consistent with ESA Section 10(a)(1)(A) permit 18583, adult management activities have been conducted to remove excess hatchery-origin steelhead before they spawn in the natural environment. This is accomplished through removal at Tumwater Dam and/or through conservation fisheries. The objective of these activities is to achieve proportion of hatchery-origin spawners (pHOS) and Proportionate Natural Influence (PNI) goals for the Wenatchee steelhead program. Results of adult management activities are submitted to NOAA Fisheries in a separate annual report by 31 August of the year the adult management was concluded.

3.1 Broodstock Sampling

This section focuses on results from sampling brood years 2018 and 2019, which were collected at Dryden and Tumwater dams. The 2018 brood begins the tracking of the life cycle of steelhead released in 2019. The 2019 brood is included because juveniles from this brood are still rearing within the hatchery.

Origin of Broodstock

A total of 164 Wenatchee steelhead from the 2017 return (2018 brood) were collected at Dryden and Tumwater dams (Table 3.1). About 47.0% of these were natural-origin (adipose fin present and no CWT) fish and the remaining 53.0% were hatchery-origin (adipose fin present and CWT) adults. Origin was confirmed by analyzing scales and/or otoliths. The number of steelhead spawned from the 2018 brood totaled 145 adults (48.3% natural-origin and 51.7% hatchery-origin).

A total of 125 steelhead were collected from the 2018 return (2019 brood) at Dryden and Tumwater dams; 58 (46.4%) natural-origin (adipose fin present and no CWT) and 67 (53.6%) hatchery-origin (adipose fin present and CWT) adults. A total of 116 steelhead were spawned; 51.7% were natural-origin fish and 48.3% were hatchery-origin fish (Table 3.1). Origin was confirmed by sampling scales and/or otoliths.

Table 3.1. Numbers of wild and hatchery steelhead collected for broodstock, numbers of hatchery fish surplused at Tumwater Dam, numbers that died before spawning, and numbers of steelhead spawned, 1998-2019. Unknown-origin fish (i.e., undetermined by scale analysis, no elastomer, no CWT, no fin clips, and no additional hatchery marks) were considered naturally produced. Mortality includes surplus broodstock that were culled.

Brood year	Wild steelhead					Hatchery steelhead						Total number spawned
	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	Number collected	Number surplused	Prespawn loss[a]	Mortality	Number spawned	Number released	
1998	35	0	0	35	0	43	0	4	2	37	0	72
1999	58	5	1	52	0	67	0	1	2	64	0	116
2000	39	2	1	36	0	101	0	9	12	60	20	96
2001	64	5	8	51	0	114	0	5	6	103	0	154
2002	99	0	1	96	2	113	0	1	0	64	48	160
2003	63	10	4	49	0	92	0	2	0	90	0	139
2004	85	3	0	75	7	132	0	1	0	61	70	136
2005	95	8	0	87	0	114	0	7	1	104	2	191
2006	101	5	0	93	3	98	0	0	0	69	29	162
2007	79	0	2	76	1	97	0	0	14	58	25	134

Brood year	Wild steelhead					Hatchery steelhead						Total number spawned
	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	Number collected	Number surplused	Prespawn loss[a]	Mortality	Number spawned	Number released	
2008	104	0	3	77	22	107	0	0	28	54	25	131
2009	101	2	0	86	13	107	0	1	4	73	29	159
2010	106	1	1	96	8	105	747	2	23	75	5	171
2011	104	8	1	91	4	104	403	13	2	70	0	161
Average[b]	***81***	***4***	***2***	***71***	***4***	***100***	***382***	***3***	***7***	***70***	***18***	***142***
Median	***95***	***3***	***1***	***77***	***2***	***105***	***382***	***2***	***2***	***67***	***13***	***147***
2012	63	3	0	59	1	66	1,293	0	1	65	0	124
2013	63	8	1	49	5	84	342	9	7	68	0	117
2014	63	0	1	62	0	68	597	0	2	66	0	128
2015	76	5	0	58	13	60	314	0	8	52	0	110
2016	65	0	1	64	0	66	36	0	0	66	0	130
2017	57	0	1	56	0	68	0	2	3	63	0	119
2018	77	3	0	70	4	87	0	3	8	75	1	145
2019	58	1	0	56	1	67	0	3	4	60	0	116
Average[c]	***65***	***3***	***1***	***59***	***3***	***71***	***323***	***2***	***4***	***64***	***0***	***124***
Median	***63***	***2***	***1***	***59***	***1***	***68***	***175***	***1***	***4***	***66***	***0***	***122***

[a] Pre-spawn loss represents the number of fish that died during the holding period before spawning. Mortality is the number of fish that were surplused following spawning.
[b] This average and median represent the program before recalculation in 2011.
[c] This average and median represent the current program, which began in 2012.

Age/Length Data

Broodstock ages were determined from examination of scales and/or otoliths. For the 2018 brood year, natural-origin and hatchery-origin steelhead consisted primarily of 1-salt adults (Table 3.2). For the 2019 brood year, steelhead consisted primarily of 1-salt natural-origin and 2-salt hatchery-origin adults (Table 3.2).

Table 3.2. Percent of hatchery and wild steelhead of different ages (saltwater ages) collected from broodstock, 1998-2019.

Brood year	Origin	Saltwater age		
		1	2	3
1998	Wild	39.4	60.6	0.0
	Hatchery	20.9	79.1	0.0
1999	Wild	50.0	48.3	1.7
	Hatchery	81.8	18.2	0.0
2000	Wild	56.4	43.6	0.0
	Hatchery	67.9	32.1	0.0
2001	Wild	51.7	48.3	0.0
	Hatchery	14.9	85.1	0.0
2002	Wild	55.6	44.4	0.0
	Hatchery	94.6	5.4	0.0
2003	Wild	13.1	85.3	1.6
	Hatchery	29.4	70.6	0.0
2004	Wild	94.8	5.2	0.0

Brood year	Origin	Saltwater age		
		1	2	3
	Hatchery	95.2	4.8	0.0
2005	Wild	22.1	77.9	0.0
	Hatchery	20.5	79.5	0.0
2006	Wild	28.7	71.3	0.0
	Hatchery	60.3	39.7	0.0
2007	Wild	40.3	59.3	0.0
	Hatchery	62.1	37.9	0.0
2008	Wild	65.4	33.7	0.9
	Hatchery	88.8	11.2	0.0
2009	Wild	39.8	57.8	2.4
	Hatchery	23.4	76.6	0.0
2010	Wild	65.2	33.7	1.1
	Hatchery	76.5	23.5	0.0
2011	Wild	27.5	72.5	0.0
	Hatchery	36.0	64.0	0.0
2012	Wild	42.4	52.5	5.1
	Hatchery	40.9	59.1	0.0
2013	Wild	40.7	57.4	1.9
	Hatchery	45.5	54.5	0.0
2014	Wild	47.5	50.8	1.6
	Hatchery	29.4	70.6	0.0
2015	Wild	15.9	82.5	1.6
	Hatchery	47.2	52.7	0.0
2016	Wild	33.8	66.2	0.0
	Hatchery	42.4	57.6	0.0
2017	Wild	10.5	84.2	5.3
	Hatchery	10.3	88.2	1.5
2018	Wild	72.6	27.4	0.0
	Hatchery	98.8	1.2	0.0
2019	Wild	55.4	44.6	0.0
	Hatchery	44.8	55.2	0.0
Average	***Wild***	***44.0***	***54.9***	***1.1***
	Hatchery	***51.4***	***48.5***	***0.1***
Median	***Wild***	***41.6***	***55.0***	***0.0***
	Hatchery	***45.2***	***54.9***	***0.0***

There was little difference between mean lengths of hatchery and natural-origin steelhead in the 2018 and 2019 brood years (Table 3.3). For the 2019 brood year, natural-origin fish were on average 2-3 cm larger than hatchery-origin fish for 1- and 2-salt fish. There were no 3-salt fish of hatchery or natural-origin for the 2019 brood year.

Table 3.3. Mean fork length (cm) at age (saltwater ages) of hatchery and wild steelhead collected from broodstock, 1998-2019; N = sample size and SD = 1 standard deviation.

Brood year	Origin	Steelhead fork length (cm)								
		1-Salt			2-Salt			3-Salt		
		Mean	N	SD	Mean	N	SD	Mean	N	SD
1998	Wild	63	15	4	79	20	5	-	0	-
	Hatchery	61	9	4	73	34	4	-	0	-
1999	Wild	65	29	5	74	28	5	77	1	-
	Hatchery	62	54	4	73	12	4	-	0	-
2000	Wild	64	22	3	74	17	5	-	0	-
	Hatchery	60	57	3	71	27	4	-	0	-
2001	Wild	61	33	6	77	31	5	-	0	-
	Hatchery	62	17	4	72	97	4	-	0	-
2002	Wild	64	55	4	77	44	4	-	0	-
	Hatchery	63	106	4	73	6	4	-	0	-
2003	Wild	69	8	6	77	52	5	91	1	-
	Hatchery	66	27	4	75	65	4	-	0	-
2004	Wild	63	73	6	78	4	2	-	0	-
	Hatchery	61	59	3	73	3	1	-	0	-
2005	Wild	59	21	4	74	74	5	-	0	-
	Hatchery	59	23	4	72	89	4	-	0	-
2006	Wild	63	27	5	75	67	6	-	0	-
	Hatchery	61	41	4	72	27	5	-	0	-
2007	Wild	64	31	6	76	46	5	-	0	-
	Hatchery	60	60	4	71	36	5	-	0	-
2008	Wild	64	68	4	77	35	4	80	1	-
	Hatchery	60	95	4	72	12	2	-	0	-
2009	Wild	65	33	5	76	48	6	81	2	0
	Hatchery	63	18	4	75	59	5	-	-	-
2010	Wild	64	60	5	74	31	5	76	1	-
	Hatchery	61	53	5	73	23	5	-	-	-
2011	Wild	62	28	5	76	74	5	-	0	-
	Hatchery	60	36	4	74	64	4	-	0	-
2012	Wild	63	25	3	74	31	5	74	3	2
	Hatchery	59	27	3	74	39	4	-	0	-
2013	Wild	61	22	5	77	31	5	74	1	-
	Hatchery	60	35	3	74	42	4	-	0	-
2014	Wild	61	29	4	75	31	4	61	1	-

Brood year	Origin	Steelhead fork length (cm)								
		1-Salt			2-Salt			3-Salt		
		Mean	N	SD	Mean	N	SD	Mean	N	SD
	Hatchery	60	20	3	72	48	4	-	0	-
2015	Wild	61	10	3	77	52	4	85	1	-
	Hatchery	59	26	3	76	29	5	-	0	-
2016	Wild	63	22	4	74	43	4	-	0	-
	Hatchery	61	28	4	71	38	5	-	0	-
2017	Wild	62	6	3	78	48	5	73	3	4
	Hatchery	60	7	2	75	60	5	93	1	-
2018	Wild	64	54	3	75	20	5	-	0	-
	Hatchery	62	84	3	65	1	-	-	0	-
2019	Wild	62	31	3	78	25	5	-	0	-
	Hatchery	60	30	5	75	37	4	-	0	-
Average	***Wild***	***63***	***32***	***4***	***76***	***39***	***5***	***77***	***1***	***2***
	Hatchery	***61***	***41***	***4***	***73***	***39***	***4***	***93***	***0***	***-***

Sex Ratios

Male steelhead in the 2018 brood year made up about 51.2% of the adults collected, resulting in an overall male to female ratio of 1.05:1.00 (Table 3.4). For the 2019 brood year, males made up 48.8% of the adults collected, resulting in an overall male to female ratio of 0.95:1.00. On average (1998-2019), the sex ratio is slightly less than the 1:1 ratio assumed in the broodstock protocol (Table 3.4).

Table 3.4. Numbers of male and female wild and hatchery steelhead collected for broodstock, 1998-2019. Ratios of males to females are also provided.

Brood year	Number of wild steelhead			Number of hatchery steelhead			Total M/F ratio
	Males (M)	Females (F)	M/F	Males (M)	Females (F)	M/F	
1998	13	22	0.59:1.00	15	28	0.54:1.00	0.56:1.00
1999	22	36	0.61:1.00	35	32	1.09:1.00	0.84:1.00
2000	18	21	0.86:1.00	60	41	1.46:1.00	1.26:1.00
2001	38	26	1.46:1.00	40	74	0.54:1.00	0.78:1.00
2002	32	67	0.48:1.00	81	32	2.53:1.00	1.14:1.00
2003	19	44	0.43:1.00	44	48	0.92:1.00	0.68:1.0
2004	43	42	1.02:1.00	90	42	2.14:1.00	1.58:1.00
2005	36	59	0.61:1.00	46	68	0.68:1.00	0.65:1.00
2006	38	63	0.60:1.00	47	51	0.92:1.00	0.75:1.00
2007	36	43	0.84:1.00	49	48	1.02:1.00	0.93:1.00
2008	61	43	1.42:1.00	68	39	1.74:1.00	1.57:1.00
2009	44	57	0.77:1.00	54	53	1.02:1.00	0.89:1.00
2010	49	57	0.86:1.00	62	43	1.44:1.00	1.11:1.00

Brood year	Number of wild steelhead			Number of hatchery steelhead			Total M/F ratio
	Males (M)	Females (F)	M/F	Males (M)	Females (F)	M/F	
2011	44	60	0.73:1.00	50	54	0.93:1.00	0.82:1.00
2012	30	33	0.91:1.00	31	35	0.89:1.00	0.90:1.00
2013	33	30	1.10:1.00	38	46	0.83:1.00	0.93:1.00
2014	30	33	0.91:1:00	36	36	1.00:1.00	0.96:1.00
2015	34	42	0.81:1.00	34	26	1.31:1.00	1.00:1.00
2016	34	33	1.03:1.00	33	33	1.00:1.00	1.02:1.00
2017	29	26	1.12:1.00	34	34	1.00:1.00	1.00:1.00
2018	38	39	0.97:1.00	46	41	1.12:1.00	1.05:1.00
2019	29	30	0.96:1.00	32	34	0.94:1.00	0.95:1.00
Total	***750***	***906***	***0.82:1.00***	***1025***	***938***	***1.09:1.00***	***0.96:1.00***

Fecundity

Fecundities for Wenatchee steelhead in brood years 2018 and 2019 averaged 5,024 and 6,056 eggs per female, respectively (Table 3.5). Mean fecundity for the 2018 brood year was less, while the 2019 brood year was greater than the 5,543 eggs per female assumed in the broodstock protocol.

Table 3.5. Mean fecundity of wild, hatchery, and all female steelhead collected for broodstock, 1998-2019.

Brood year	Mean fecundity		
	Wild	Hatchery	Total
1998	6,202	5,558	5,924
1999	5,691	5,186	5,424
2000	5,858	5,729	5,781
2001	5,951	6,359	6,270
2002	5,776	5,262	5,626
2003	6,561	6,666	6,621
2004	5,118	5,353	5,238
2005	5,545	6,061	5,832
2006	5,688	5,251	5,492
2007	5,840	5,485	5,660
2008	5,693	5,153	5,433
2009	6,199	6,586	6,408
2010	5,458	5,423	5,442
2011	6,276	6,100	6,203
2012	5,309	6,388	5,891
2013	5,749	5,770	5,762
2014	5,831	5,847	5,839
2015	6,220	5,532	5,895
2016	5,392	4,956	5,174
2017	6,656	6,217	6,425

Brood year	Mean fecundity		
	Wild	Hatchery	Total
2018	5,145	4,910	5,024
2019	5,718	6,383	6,056
Average	***5,813***	***5,735***	***5,792***
Median	***5,763***	***5,644***	***5,807***

To estimate fecundities by length, weight, and age[7], hatchery staff collected fecundity, fork length, weight, and age data from a subsample of steelhead females during the spawning of 2013 through 2019 broodstock. For those brood years, we compare age/fecundity, fork length/fecundity, weight/fecundity, fork length/mean egg mass, and fork length/gamete (skein) mass between hatchery and natural-origin steelhead. For these years, hatchery staff attempted to stratify the females sampled by fork length categories to obtain fecundity samples for all sizes of fish to better estimate the relationship between female size and fecundity.

Mean fecundity by salt age differed between hatchery and natural-origin steelhead and over time (Table 3.6). On average, mean fecundities differed between hatchery and natural-origin steelhead by 124 eggs for 1-salt fish and 140 eggs for 2-salt fish. There were no hatchery-origin 3-salt steelhead.

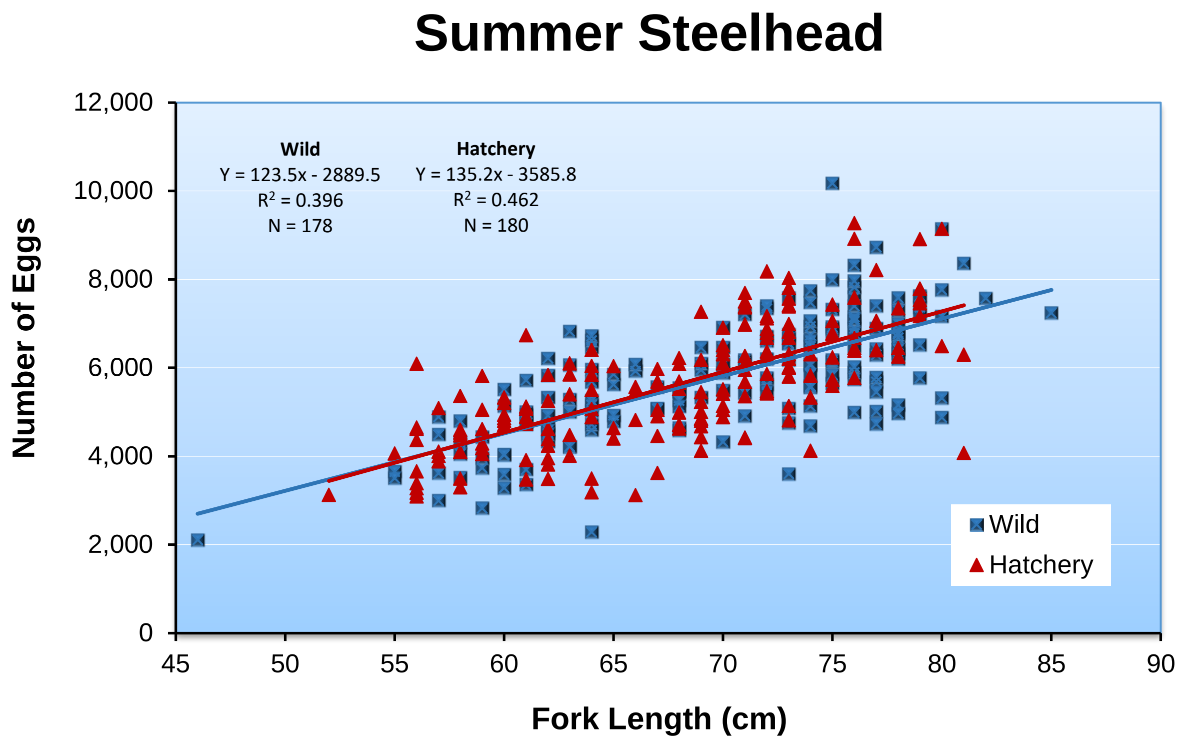
Table 3.6. Mean fecundity by age (saltwater ages) for hatchery and wild steelhead collected from broodstock, brood years 2013-2019; N = sample size and SD = 1 standard deviation.

Brood year	Origin	Steelhead fecundity								
		1-Salt			2-Salt			3-Salt		
		Mean	N	SD	Mean	N	SD	Mean	N	SD
2013	Wild	4,035	5	260.7	6,224	20	858.1	-	0	-
	Hatchery	4,496	10	866.2	6,320	24	1096	-	0	-
2014	Wild	4,924	10	530.9	6,528	18	1,225.2	6,896	1	-
	Hatchery	4,732	3	957.4	5,831	28	1,095.2	-	0	-
2015	Wild	3,879	2	1,492.7	6,361	26	1,565.1	7,238	1	-
	Hatchery	3,951	6	636.3	6,144	19	1,102.4	-	0	-
2016	Wild	4,151	8	1,049.1	5,790	25	866.7	-	0	-
	Hatchery	4,654	8	992.1	5,191	24	1,014.7	-	0	-
2017	Wild	4,004	1	-	6,854	25	1,079.7	5,888	3	1,003.2
	Hatchery	3,998	3	501.2	6,446	29	1,090.7	-	0	-
2018	Wild	5,086	28	1055.7	5,551	5	554.5	-	0	-
	Hatchery	4,910	37	785.0	-	0	-	-	0	-
2019	Wild	4,724	12	885.7	6,633	17	1,073.3	-	0	-
	Hatchery	4,930	8	1,214	6,888	23	1,419.5	-	0	-
Average	***Wild***	***4,400***	***9***	***879***	***6,277***	***19***	***1,032***	***6,674***	***1***	***1,003***

[7] Although age-fecundity relationships are not specific hypotheses tested within the Monitoring and Evaluation Plan (Hillman et al. 2019), we include them here for descriptive purposes.

Brood year	Origin	Steelhead fecundity								
		1-Salt			2-Salt			3-Salt		
		Mean	N	SD	Mean	N	SD	Mean	N	SD
	Hatchery	***4,524***	***11***	***850***	***6,137***	***21***	***1,136***	***-***	***0***	***-***

We pooled fecundity data from brood years 2013 through 2019 to increase the number of samples for a given fork length. The linear relationships between fork length and fecundity, mean egg weight, and total egg (skein) weight for hatchery and natural-origin females are shown in Figures 3.1, 3.2, and 3.3. All fecundity variables increase linearly with fork length and weight. In addition, the relationships between fish size and fecundity data were similar for hatchery and natural-origin steelhead.



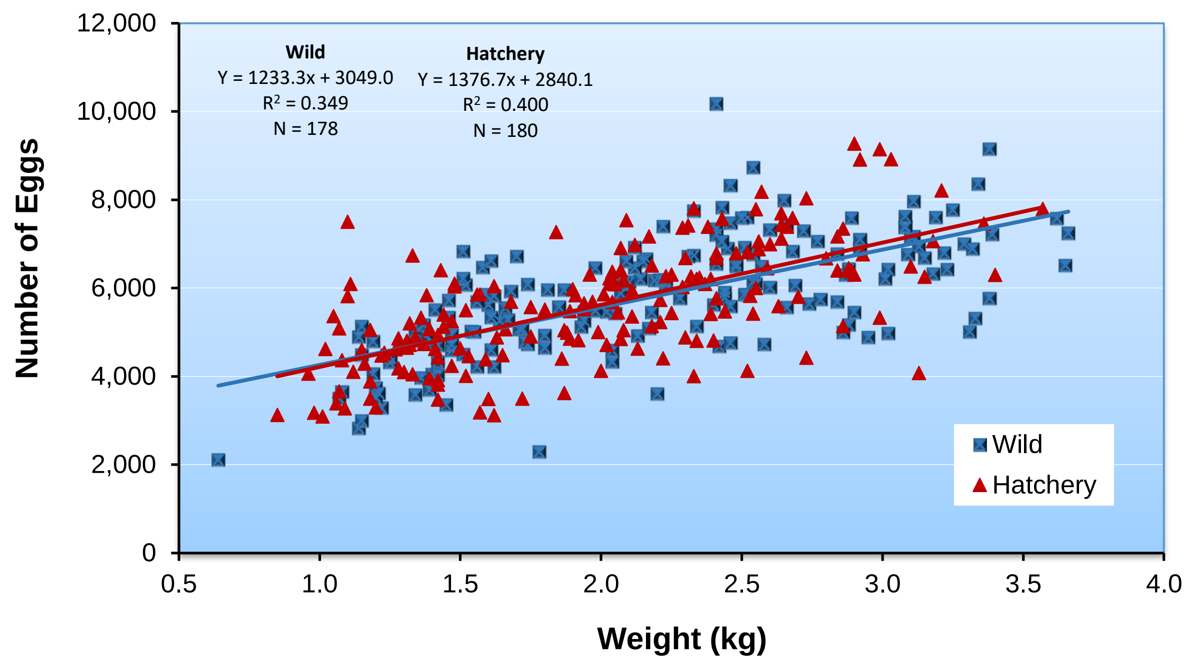


Figure 3.1. Relationships between fecundity and fork length (top figure) and fecundity and weight (bottom figure) for natural and hatchery-origin summer steelhead for return years 2013-2019.

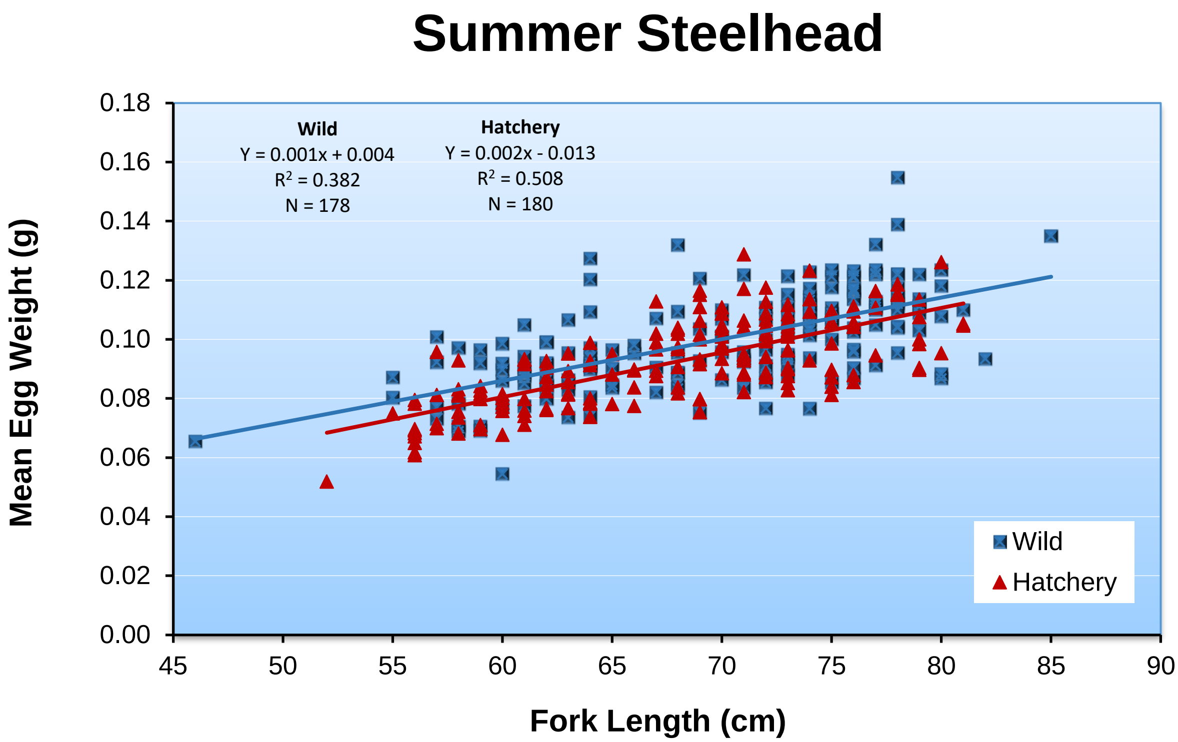


Figure 3.2. Relationships between mean egg weight and fork length for natural and hatchery-origin summer steelhead for return years 2013-2019.

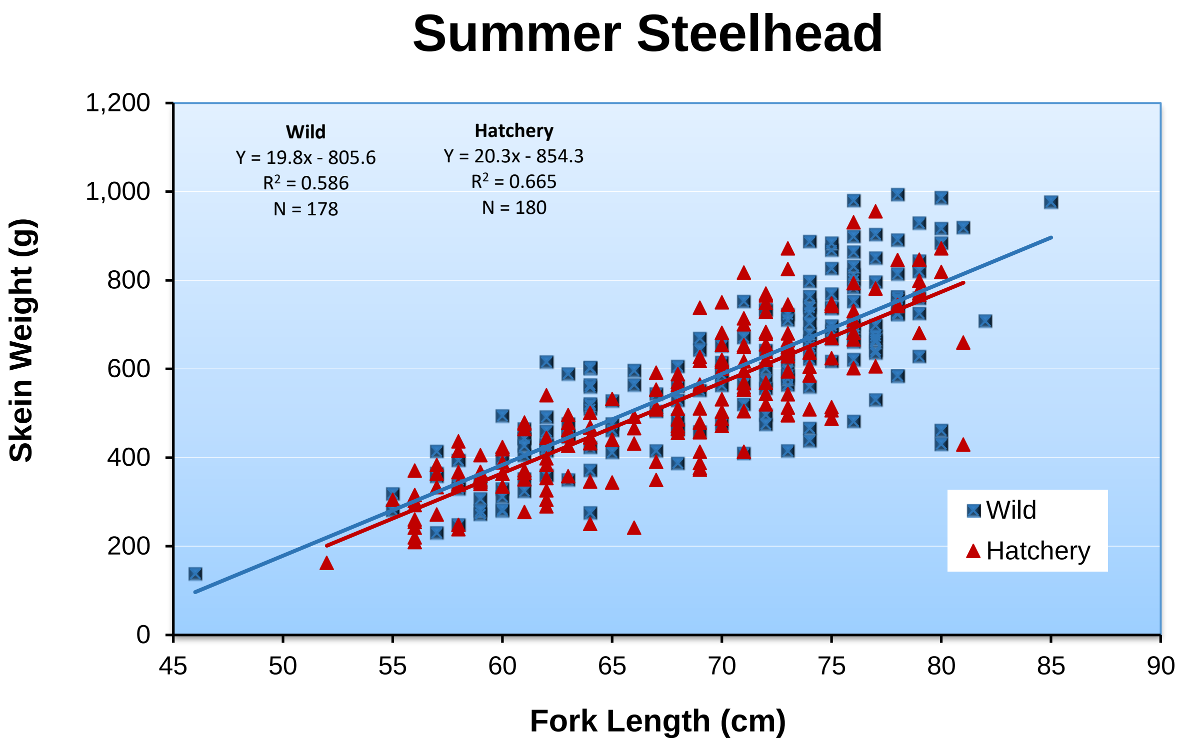


Figure 3.3. Relationships between skein weight and fork length for natural and hatchery-origin summer steelhead for return years 2013-2019.

3.2 Hatchery Rearing

Rearing History

Number of eggs taken

From 1998-2011, a total of 493,827 eggs were required to meet the program release goal of 400,000 smolts. This was based on the unfertilized egg-to-release survival standard of 81%. Since 2011, the egg take target has ranged from 350,596-376,408[8] in order to meet the revised release target of 247,300 smolts. Between 1998 and 2011, the egg take goal was reached 57% of the time (Table 3.7). Since 2011, the target has been reached or exceeded 38% of the time (Table 3.7).

Table 3.7. Numbers of eggs taken from steelhead broodstock, 1998-2019.

Brood year	Number of eggs taken
1998	224,315
1999	303,083
2000	280,872
2001	549,464

[8] The egg take target varies from year to year because of variability in fecundity and in-hatchery survival.

Brood year	Number of eggs taken
2002	503,030
2003	532,708
2004	408,538
2005	672,667
2006	546,382
2007	462,662
2008	439,980
2009	633,229
2010	499,499
2011	522,049
Average (1998-2011)	***488,782***
Median (1998-2001)	***501,265***
2012	371,151
2013	339,949
2014	395,453
2015	324,212
2016	341,511
2017	391,950
2018	361,735
2019	369,415
Average (2012-present)	***361,922***
Median (2012-present)	***365,575***

Number of acclimation days

Juvenile WxW steelhead from the Chelan Fish Hatchery and HxH steelhead from the Eastbank Fish Hatchery were transferred to Chiwawa Acclimation Facility in November 2018. All fish stayed at the Chiwawa Acclimation Facility until they were released volitionally for one week the following spring in late April to early May. Steelhead that did not emigrate volitionally were forced released from the facility.

Juvenile Wenatchee steelhead at the Chiwawa Acclimation Facility were acclimated and reared on Wenatchee and Chiwawa River water. Before 2012, Wenatchee steelhead were reared on Columbia River water from January through May before being trucked and released into the Wenatchee River basin (Table 3.8).

Table 3.8. Water source and mean acclimation period for Wenatchee steelhead, brood years 1998-2019.

Brood year	Release year	Parental origin	Water source	Number of Days
1998	1999	H x H	Wenatchee/Chiwawa	36
		H x W	Wenatchee/Chiwawa	36
		W x W	Wenatchee/Chiwawa	36

Brood year	Release year	Parental origin	Water source	Number of Days
1999	2000	H x H	Wenatchee/Chiwawa	138
		H x W	Wenatchee/Chiwawa	138
		W x W	Wenatchee/Chiwawa	138
		H x W	Eastbank	0
		W x W	Eastbank	0
2000	2001	H x H	Wenatchee/Chiwawa	122
		H x W	Wenatchee/Chiwawa	122
		H x W	Wenatchee/Chiwawa	122
		W x W	Wenatchee/Chiwawa	122
2001	2002	H x H	Columbia	92
		H x H	Wenatchee/Chiwawa	63
		H x W	Columbia	92
		H x W	Wenatchee/Chiwawa	63
		W x W	Columbia	153
2002	2003	H x H	Columbia	98
		H x W	Columbia	98
		W x W	Columbia	117
2003	2004	H x H	Columbia	88
		H x W	Wenatchee/Chiwawa	84
		W x W	Columbia	148
2004	2005	H x H	Columbia	160
		H x W	Columbia	160
		W x W	Columbia	160
2005	2006	H x H	Columbia	116
		H x W	Columbia	113
		W x W	Columbia	141
2006	2007	Early H x W	Columbia	111
		Late H x W	Columbia	112
		W x W	Columbia	148
2007	2008	Early H x W	Columbia	94-95
		Late H x W	Columbia	91-93
		W x W	Columbia	138
2008	2009	Early H x W	Columbia	120-121
		Early H x W	Columbia/Wenatchee	120-121/28-95
		Late H x W	Columbia	114-115
		W x W	Columbia	152-153
2009	2010	Early H x W	Columbia	93-94

Brood year	Release year	Parental origin	Water source	Number of Days
		Early H x W	Columbia/Wenatchee	99-111
		Early H x W	Wenatchee	31-129
		Late H x W	Columbia	84-87
		W x W	Columbia/Nason	118-120/28
2010	2011	H x H	Wenatchee	188-192
		H x H	Wenatchee	37-87
		H x H	Columbia	181
		W x W	Columbia	148-149
		W x W	Columbia/Nason	113-114/42-101
		W x W	Columbia	148-149
2011	2012	W x W	Wenatchee[a]	160-201
		W x W	Wenatchee	179-188
		W x W	Wenatchee	21-72
		W x W	Nason	56-107
2012	2013	H x H	Wenatchee[a]	168-189
		H x H	Wenatchee	168-225
		W x W	Wenatchee	168-225
		W x W	Wenatchee	168-189
		W x W	Chiwawa	187
2013	2014	H x H	Wenatchee[a]	7-67
		H x H	Wenatchee	168-169
		W x W	Wenatchee	176-197
		W x W	Wenatchee	179-204
2014	2015	H x H	Wenatchee[a]	41-110
		H x H	Wenatchee	161-179
		W x W	Wenatchee	157-172
		W x W	Wenatchee	168-171
2015	2016	H x H	Wenatchee[a]	23-81
		H x H	Wenatchee	156-172
		W x W	Wenatchee	162-178
		W x W	Wenatchee	160-176
2016	2017	H x H	Wenatchee[a]	16-83
		H x H	Wenatchee	166-185
		W x W	Wenatchee	166-185
		W x W	Wenatchee	169-183
2017	2018	H x H	Wenatchee[a]	161-167
		W x W	Wenatchee	161-167

Brood year	Release year	Parental origin	Water source	Number of Days
		W x W	Wenatchee	171-172
2018	2019	HxH	Wenatchee	159-162
		WxW	Wenatchee	163-175
		WxW	Wenatchee	166-175

[a] Steelhead overwintered in Pond 3 at the Chiwawa Acclimation Facility on Chiwawa River water before they were transferred to Blackbird Pond.

Release Information

Numbers released

In 2011, the HCP Hatchery Committee agreed to reduce the Wenatchee summer steelhead program from 400,000 smolts to 247,300 smolts. Based on this new goal and the number of WxW steelhead present, all HxH steelhead were transferred to the Ringold Fish Hatchery to be included in their production program for the 2012 release.

The release of 2018 brood Wenatchee steelhead achieved 87.6% of the 247,300 target with about 216,666 smolts released into the Wenatchee and Chiwawa rivers and Nason Creek (Table 3.9; Appendix A). Distribution of juvenile steelhead released in each of the three streams was determined by the mean proportion of steelhead redds in each basin. About 30.9% and 16.4% of the steelhead were released in Nason Creek and the Chiwawa River, respectively. The balance of the program (52.7%) were released into the Wenatchee River upstream of Tumwater Dam.

Table 3.9. Numbers of steelhead smolts released from the hatchery, brood years 1998-2018. Before brood year 2011, the release target for steelhead was 400,000 smolts. Beginning with brood year 2011, the release target is 247,300 smolts.

Brood year	Release year	Number of smolts
1998	1999	172,078
1999	2000	175,701
2000	2001	184,639
2001	2002	335,933
2002	2003	302,060
2003	2004	374,867
2004	2005	294,114
2005	2006	452,184
2006	2007	299,937
2007	2008	306,690
2008	2009	327,143
2009	2010	484,772
2010	2011	354,314
Average (1998-2010)		***312,649***
Median (1998-2010)		***306,690***
2011	2012	206,397
2012	2013	249,004

Brood year	Release year	Number of smolts
2013	2014	229,836
2014	2015	264,758
2015	2016	195,344
2016	2017	255,168
2017	2018	253,994
2018	2019	216,666
Average (2011-present)		***233,896***
Median (2011-present)		***239,420***

Numbers marked

The 2018 brood conservation program for Wenatchee hatchery steelhead were marked with coded wire tags (CWT) in the snout (no adipose clip). The safety net program was marked with CWT in the snout and adipose fin clipped. The safety net program made up 51.2% of the juveniles released (Table 3.10).

Table 3.10. Release location and marking scheme for the 1998-2018 brood Wenatchee steelhead.

Brood year	Release location	Parental origin	Proportion Ad-clip	CWT or VIE color/side	Tag rate[a]	Number released
1998	Chiwawa River	H x H	0.000	Red Left	0.994	52,765
	Chiwawa River	H x W	0.000	Green Left	0.990	37,013
	Chiwawa River	W x W	0.000	Orange Left	0.827	82,300
1999	Wenatchee River	H x H	0.000	Green Left	0.911	45,347
	Wenatchee River	H x W	0.000	Orange Left	0.927	30,713
	Chiwawa River	H x H	0.000	Red Right	0.936	25,622
	Chiwawa River	H x W	0.000	Green Right	0.936	43,379
	Chiwawa River	W x W	0.000	Orange Right	0.936	30,600
2000	Chiwawa River	H x H	0.000	Red Left	0.963	33,417
	Chiwawa River	H x W	0.000	Green Left	0.963	57,716
	Chiwawa River	H x W	0.000	Green Right	0.949	48,029
	Chiwawa River	W x W	0.000	Orange Right	0.949	45,477
2001	Nason Creek	H x W	0.000	Green Right	0.934	75,276
	Nason Creek	W x W	0.000	Orange Right	0.934	48,115
	Chiwawa River	H x W	0.000	Green Left	0.895	92,487
	Chiwawa River	H x H	0.000	Red Left	0.895	120,055
2002	Chiwawa River	H x H	0.000	Red Left	0.920	156,145
	Chiwawa River	H x W	0.000	Green Left	0.928	33,528

Brood year	Release location	Parental origin	Proportion Ad-clip	CWT or VIE color/side	Tag rate[a]	Number released
	Nason Creek	W x W	0.000	Orange Right	0.928	112,387
2003	Wenatchee River	H x H	0.000	Red Left	0.968	117,663
	Chiwawa River	H x W	0.000	Green Left	0.927	191,796
	Nason Creek	W x W	0.000	Orange Right	0.962	65,408
2004	Wenatchee River	H x H	0.500	Red Left	0.804	39,636
	Chiwawa River	H x W	0.000	Green Left	0.977	153,959
	Nason Creek	W x W	0.000	Pink Right	0.940	100,519
2005	Wenatchee River	H x H	1.000	Red Left	0.983	104,552
	Wenatchee River	H x W	0.616	Green Left	0.979	190,319
	Chiwawa River	H x W	0.616	Green Left	0.979	18,634
	Chiwawa River	W x W	0.000	Pink Right	0.969	14,124
	Nason Creek	W x W	0.000	Pink Right	0.969	124,555
2006	Wenatchee River	H x W (early)	1.000	Green Right	0.918	66,022
	Wenatchee River	H x W (late)	0.671	Green Left	0.935	92,176
	Chiwawa River	H x W (late)	0.671	Green Left	0.935	41,240
	Chiwawa River	W x W	0.000	Pink Right	0.945	7,500
	Nason Creek	W x W	0.000	Pink Right	0.945	92,999
2007	Wenatchee River	H x W (early)	0.967	Green Right	0.950	64,310
	Wenatchee River	H x W (late)	0.586	Green Left	0.951	97,549
	Chiwawa River	H x W (late)	0.586	Green Left	0.951	43,011
	Chiwawa River	W x W	0.000	Pink Right	0.952	7,026
	Nason Creek	W x W	0.000	Pink Right	0.952	94,794
2008	Blackbird Pond	HxW (early)	0.917	Green Right	0.910	49,878
	Wenatchee River	H x W (early)	0.917	Green Right	0.910	48,624
	Wenatchee River	H x W (late)	0.595	Green Left	0.908	74,848
	Chiwawa River	H x W (late)	0.595	Green Left	0.908	25,835
	Chiwawa River	W x W	0.000	Pink Right	0.904	25,778
	Nason Creek	W x W	0.000	Pink Right	0.904	102,170
2009	Blackbird Pond	H x W (early)	0.969	Green Right	0.934	50,248
	Wenatchee River	H x W (early)	0.969	Green Right	0.934	105,239
	Wenatchee River	H x W (late)	0.973	Green Left	0.975	27,612
	Wenatchee River	H x W (late)	0.000	Green Left	0.975	45,435

Brood year	Release location	Parental origin	Proportion Ad-clip	CWT or VIE color/side	Tag rate[a]	Number released
	Chiwawa River	H x W (early)	0.969	Green Right	0.934	23,835
	Chiwawa River	H x W (late)	0.973	Green Left	0.975	33,047
	Chiwawa River	H x W (late)	0.000	Green Left	0.975	54,381
	Nason Creek	W x W	0.000	Pink Right	0.979	145,029
2010	Wenatchee River	H x H	0.994	-	0.984	24,838
	Wenatchee River	H x H	0.994	-	0.984	45,000
	Wenatchee River	H x H	0.994	-	0.984	92,113
	Chiwawa River	W x W	0.000	Pink Right	0.917	81,174
	Nason Creek	W x W	0.000	Pink R/Pink L	0.884	20,000
	Nason Creek	W x W	0.000	Pink Right	0.917	91,189
2011	Wenatchee River	W x W	0.985	CWT	0.953	70,885
	Wenatchee River	W x W	0.985	CWT	0.953	24,992
	Wenatchee River	W x W	0.000	CWT	0.987	25,569
	Chiwawa River	W x W	0.985	CWT	0.953	31,050
	Nason Creek	W x W	0.000	CWT	0.989	18,254
	Nason Creek	W x W	0.985	CWT	0.953	36,225
2012	Wenatchee River	W x W	0.000	CWT	0.965	14,824
	Wenatchee River	H x H	1.000	AD/CWT	0.920	9,841
	Wenatchee River	W x W	0.000	CWT	0.965	28,362
	Wenatchee River	H x H	1.000	AD/CWT	0.920	76,695
	Chiwawa River	W x W	0.000	CWT	0.965	12,760
	Chiwawa River	H x H	1.000	AD/CWT	0.920	34,503
	Nason Creek	W x W	0.000	CWT	0.965	43,854
	Nason Creek	W x W	0.000	CWT	0.965	28,165
2013	Wenatchee River	W x W	0.000	CWT	0.963	36,736
	Wenatchee River	H x H	0.998	AD/CWT	0.990	55,055
	Wenatchee River	H x H	0.998	AD/CWT	0.990	25,316
	Chiwawa River	W x W	0.000	CWT	0.963	9,360
	Chiwawa River	H x H	0.998	AD/CWT	0.990	14,040
	Nason Creek	W x W	0.000	CWT	0.963	50,503
	Nason Creek	H x H	0.998	AD/CWT	0.990	38,826
2014	Wenatchee River	W x W	0.000	CWT	0.968	72,345

Brood year	Release location	Parental origin	Proportion Ad-clip	CWT or VIE color/side	Tag rate[a]	Number released
	Wenatchee River	H x H	0.996	AD/CWT	0.996	58,130
	Wenatchee River	H x H	0.996	AD/CWT	0.996	28,122
	Chiwawa River	W x W	0.000	CWT	0.968	20,443
	Chiwawa River	H x H	0.996	AD/CWT	0.996	14,599
	Nason Creek	W x W	0.000	CWT	0.968	41,188
	Nason Creek	H x H	0.996	AD/CWT	0.996	29,931
2015	Wenatchee River	W x W	0.000	CWT	0.972	52,446
	Wenatchee River	H x H	0.993	AD/CWT	0.980	28,633
	Wenatchee River	H x H	0.993	AD/CWT	0.980	21,386
	Chiwawa River	W x W	0.000	CWT	0.972	20,022
	Chiwawa River	H x H	0.993	AD/CWT	0.980	17,752
	Nason Creek	W x W	0.000	CWT	0.972	35,148
	Nason Creek	H x H	0.993	AD/CWT	0.980	19,957
2016	Wenatchee River	W x W	0.000	CWT	0.968	68,976
	Wenatchee River	H x H	0.998	AD/CWT	0.963	92,387
	Wenatchee River	H x H	0.998	AD/CWT	0.999	933
	Chiwawa River	W x W	0.000	CWT	0.968	21,292
	Chiwawa River	H x H	0.998	AD/CWT	0.963	24,741
	Chiwawa River	H x H	0.998	AD/CWT	0.960	251
	Nason Creek	W x W	0.000	CWT	0.968	34,403
	Nason Creek	H x H	0.998	AD/CWT	0.963	12,063
	Nason Creek	H x H	0.998	AD/CWT	0.967	122
2017[b]	Wenatchee River	W x W	0.000	CWT	0.990	31,283
	Wenatchee River	W x W	0.000	CWT	0.990	31,284
	Wenatchee River	H x H	1.000	AD/CWT	1.000	26,962
	Wenatchee River	H x H	1.000	AD/CWT	1.000	26,961
	Chiwawa River	W x W	0.000	CWT	0.990	26,121
	Chiwawa River	W x W	0.000	CWT	0.990	26,120
	Chiwawa River	H x H	1.000	AD/CWT	1.000	12,872
	Chiwawa River	H x H	1.000	AD/CWT	1.000	12,871
	Nason Creek	W x W	0.000	CWT	0.990	16,516
	Nason Creek	W x W	0.000	CWT	0.990	16,516

Brood year	Release location	Parental origin	Proportion Ad-clip	CWT or VIE color/side	Tag rate[a]	Number released
	Nason Creek	H x H	1.000	AD/CWT	1.000	13,244
	Nason Creek	H x H	1.000	AD/CWT	1.000	13,244
2018	Wenatchee River	WxW	0.000	CWT	0.951	44,155
	Wenatchee River	HxH	1.000	AD/CWT	0.956	19,374
	Wenatchee River	HxH	1.000	AD/CWT	0.956	50,567
	Chiwawa River	WxW	0.000	CWT	0.951	35,587
	Nason Creek	WxW	0.000	CWT	0.951	25,922
	Nason Creek	HxH	1.000	AD/CWT	0.956	11,374
	Nason Creek	HxH	1.000	AD/CWT	0.956	29,687

[a] Tagging rate was adjusted for tag loss before the fish were released.

[b] No QC on clip rates occurred due to WxW and HxH fish being combined before QC was conducted.

Numbers PIT tagged

Table 3.11 summarizes the number of hatchery steelhead of different parental origins that have been PIT-tagged and released into the Wenatchee River basin are shown in Table 3.11. For brood years 2006-2018, the number of fish tagged and released has ranged from 2,512 to 21,912.

Table 3.11. Summary of PIT-tagging activities for Wenatchee hatchery steelhead, brood years 2006-2018.

Brood year	Release location	Parental origin	Number of fish tagged	Number of tagged fish that died	Number of tags shed	Number of tagged fish released
2006	Wenatchee River	H x W (early)	10,036	479	24	9,533
	Wenatchee/Chiwawa rivers	H x W (late)	10,031	922	20	9,089
	Chiwawa River/Nason	W x W	10,019	152	352	9,515
2007	Wenatchee River	H x W (early)	9,852	22	10	9,820
	Wenatchee/Chiwawa rivers	H x W (late)	10,063	73	78	9,912
	Chiwawa River/Nason	W x W	10,038	55	1	9,982
2008	Wenatchee River	H x W (early)	10,101	59	15	10,027
	Wenatchee/Chiwawa rivers	H x W (late)	10,104	106	17	9,981
	Chiwawa River/Nason	W x W	10,101	159	80	9,862
2009	Wenatchee/Chiwawa rivers	H x W (early)	10,114	574	11	9,529
	Wenatchee (Blackbird)	H x W (early)	8,100	0	0	8,100
	Wenatchee/Chiwawa rivers	H x W (late)	10,115	271	11	9,833
	Chiwawa pilot	H x W (early)	10,107	532	103	9,472
	Chiwawa River/Nason	W x W	10,101	38	3	10,060

Brood year	Release location	Parental origin	Number of fish tagged	Number of tagged fish that died	Number of tags shed	Number of tagged fish released
2010	Wenatchee River	HxH	10,100	624	21	9,455
	Chiwawa River/Nason	WxW	10,100	206	0	9,894
	Wenatchee (Blackbird)	HxH	10,101	235	8	9,858
	Wenatchee River	HxH	10,100	46	28	10,026
2011	Wenatchee/Chiwawa/Nason	WxW (circular)	10,101	139	30	9,932
	Wenatchee/Chiwawa/Nason	WxW (raceway)	20,220	121	35	20,064
2012	Wenatchee/Chiwawa/Nason	WxW (circular)	15,244	176	4	15,064
	Wenatchee/Chiwawa/Nason	HxH (raceway)	10,223	140	13	10,070
2013	Wenatchee/Chiwawa/Nason	WxW	5,100	95	1	5,004
	Wenatchee/Chiwawa/Nason	HxH	10,201	84	12	10,105
2014	Wenatchee/Chiwawa/Nason	WxW	9,051	53	0	8,998
	Wenatchee/Chiwawa/Nason	HxH	10,129	243	76	9,810
2015	Wenatchee/Chiwawa/Nason	WxW	12,101	60	0	12,041
	Wenatchee/Chiwawa/Nason	HxH	11,115	55	0	11,060
2016	Wenatchee/Chiwawa/Nason	WxW	5,050	183	3	4,864
	Wenatchee/Chiwawa/Nason	HxH & WxW	12,626	204	7	12,415
	Wenatchee (Blackbird)	HxH	2,525	2	11	2,512
2017	Chiwawa	WxW	11,110	74	0	11,036
	Chiwawa	HxH & WxW	22,220	282	26	21,912
2018	Chiwawa	WxW	11,110	57	0	11,053
	Chiwawa	HxH & WxW	22,220	1,994	23	20,203

2019 Brood Wenatchee WxW Summer Steelhead (Circular Ponds)—A total of 11,110 Wenatchee WxW summer steelhead were PIT tagged at the Chiwawa Acclimation Facility on 24-28 February 2020. These fish were PIT tagged in circular ponds #1 and #3. Fish were not fed during PIT tagging or for two days before and after tagging. Fish averaged 125-141 mm in length and 20-30 g at time of tagging.

2019 Brood Wenatchee HxH and WxW Summer Steelhead (Raceway)—A total of 22,222 Wenatchee HxH and WxW summer steelhead were PIT tagged at the Chiwawa Acclimation Facility on 9-20 March 2020. These fish were PIT tagged in raceway #2. Fish were not fed during PIT tagging or for two days before and after tagging. Fish averaged 109-156 mm in length and 14-40 g at time of tagging.

Fish size and condition at release

All 2018 brood steelhead were trucked and released from the end of April to early May 2019. Both WxW and HxH steelhead did not meet the targets for length, weight, or coefficient of variation (CV) for fork length (Table 3.12). The HxH group was combined with the WxW group in Pond 2 once they were transferred to Chiwawa Acclimation Facility. The HxH and WxW fish were about the same size at the time of transfer, but Pond 2 fish were smaller at the time of release than the WxW fish that reared in the circular vessels.

Table 3.12. Mean lengths (FL, mm), weight (g and fish/pound), and coefficient of variation (CV) of steelhead smolts released from the hatchery, brood years 1998-2018. Size targets are provided in the last row of the table. RCY = raceway; circular = recirculating aquaculture system; NA = not available.

Brood year	Release year	Parental origin	Rearing vessel	Fork length (mm)		Mean weight	
				Mean	CV	Grams (g)	Fish/pound
1998	1999	H x H	RCY	201	11.1	92.3	5
		H x W	RCY	190	12.8	76.9	6
		W x W	RCY	173	12.0	55.3	8
1999	2000	H x H	RCY	181	8.9	70.6	6
		H x W	RCY	187	7.2	75.3	6
		W x W	RCY	184	11.3	71.5	6
2000	2001	H x H	RCY	218	15.2	122.4	4
		H x W	RCY	209	10.6	107.5	4
		W x W	RCY	205	10.7	100.9	5
2001	2002	H x H	RCY	179	17.4	67.0	7
		H x W	RCY	192	15.6	82.8	6
		W x W	RCY	206	11.6	102.6	4
2002	2003	H x H	RCY	194	13.1	83.0	6
		H x W	RCY	191	13.0	77.4	6
		W x W	RCY	180	19.1	70.3	7
2003	2004	H x H	RCY	191	14.4	73.1	6
		H x W	RCY	199	12.9	83.9	5
		W x W	RCY	200	11.1	90.1	5
2004	2005	H x H	RCY	204	11.3	87.2	6
		H x W	RCY	202	13.5	71.9	5
		W x W	RCY	198	12.4	76.6	6
2005	2006	H x H	RCY	215	12.6	116.6	4
		H x W	RCY	198	11.8	86.3	5
		W x W	RCY	189	15.4	55.3	6
2006	2007	H x H (early)	RCY	213	12.1	109.6	4
		H x W (late)	RCY	186	11.8	68.3	7
		W x W	RCY	178	11.1	58.6	8

Brood year	Release year	Parental origin	Rearing vessel	Fork length (mm)		Mean weight	
				Mean	CV	Grams (g)	Fish/pound
2007	2008	H x W (early)	RCY	192	17.4	77.1	6
		H x W (late)	RCY	179	19.3	63.8	7
		W x W	RCY	183	12.3	62.8	7
2008	2009	H x W (early)	RCY	184	11.6	68.0	7
		H x W (late)	RCY	186	11.6	73.5	6
		W x W	RCY	181	13.0	59.7	8
2009	2010	H x W (early)	Circular	197	11.3	84.2	5
		H x W (late)	RCY	192	11.1	72.7	6
		W x W	RCY	190	9.6	70.5	6
2010	2011	H x H	RCY	183	14.1	68.9	4
		W x W	RCY	188	10.5	68.1	7
		H x W	Circular	NA	NA	NA	NA
2011	2012	H x H	RCY	NA	NA	NA	NA
		W x W	RCY	NA	NA	NA	NA
		W x W	Circular	156	17.1	45.2	10
2012	2013	H x H / W x W	RCY	150	16.1	40.8	11
		H x H / W x W	RCY	157	16.4	45.0	10
		W x W	Circular	156	18.7	49.0	9
2013	2014	H x H / W x W	RCY	157	14.5	49.4	9
		H x H	RCY	127	16.2	26.8	17
		W x W	Circular	162	20.4	55.8	8
2014	2015	H x H / W x W	RCY	152	15.4	40.9	11
		H x H	RCY	145	13.5	36.6	12
		W x W	Circular	162	15.3	50.6	9
2015	2016	H x H / W x W	RCY	163	16.1	53.1	9
		H x H	RCY	162	9.4	46.1	10
		W x W	Circular	180	13.8	70.6	6
2016	2017	H x H / W x W	RCY	155	19.3	44.6	10
		H x H	RCY	147	11.0	32.6	14
		W x W	Circular	152	19.9	42.6	9
2017	2018	W x W	RCY	139	18	34	13
		H x H	RCY	135	22	31	15
		W x W	Circular	164	14	56	8
		W x W	Circular	161	16	54	8
2018	2019	WxW	RCY	147	16	39	12
		HxH	RCY	149	17	37	12

Brood year	Release year	Parental origin	Rearing vessel	Fork length (mm)		Mean weight	
				Mean	CV	Grams (g)	Fish/pound
		WxW	Circular	168	18	55	8
		WxW	Circular	167	20	56	8
Targets				***191***	***9.0***	***75.6***	***6***

Survival Estimates

Overall survival of 2018 brood year Wenatchee steelhead (WxW and HxH) from green (unfertilized) egg to release was below the standard set for the program. Losses were greatest at the ponding to release survival stage. Survival was highest at the 30 days after ponding stage (Table 3.13).

The Wenatchee steelhead program, from its inception, has experienced highly variable fertilization rates. It is unknown at this time what mechanisms may be influencing stock performance at these stages; however, the 2018 brood experienced the highest unfertilized egg to eyed egg survival since the inception of the program.

Table 3.13. Hatchery life-stage survival rates (%) for steelhead, brood years 1998-2018. Survival standards or targets are provided in the last row of the table.

Brood year	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
1998	92.0	100.0	85.5	91.7	99.2	98.8	97.8	99.9	76.7
1999	91.2	100.0	66.9	93.0	95.9	94.9	93.1	99.7	58.0
2000	83.9	96.2	77.6	86.7	99.3	98.9	97.7	99.5	65.7
2001	90.0	100.0	73.0	91.8	99.1	97.8	91.3	99.7	61.1
2002	99.0	100.0	69.2	93.1	95.9	94.4	89.6	89.6	60.0
2003	87.0	96.8	86.3	83.8	97.2	94.8	97.6	85.3	70.4
2004	97.6	98.5	83.4	93.7	97.8	94.1	92.2	99.9	72.0
2005	91.3	95.1	81.3	92.1	95.6	91.8	89.7	99.6	67.2
2006	99.1	95.3	73.2	85.4	95.4	94.6	87.8	98.5	54.9
2007	100.0	100.0	80.3	92.0	95.7	92.7	89.8	99.1	66.3
2008	100.0	100.0	87.1	88.4	99.0	97.4	96.6	99.5	74.4
2009	97.3	100.0	89.0	97.2	96.0	95.2	88.6	96.6	76.6
2010	96.7	100.0	93.8	93.9	91.0	86.2	80.6	96.0	70.9
2011[a]	96.3	94.4	74.2	97.7	96.6	89.5	86.4	98.4	62.7
2012	95.2	98.4	74.7	99.7	97.8	94.0	90.1	98.9	67.1
2013	80.8	97.0	75.0	96.5	97.8	96.6	93.4	99.2	67.6
2014	100.0	100.0	83.3	96.7	95.8	89.9	87.9	98.7	70.8
2015	93.3	98.6	68.5	94.9	96.6	95.8	92.7	97.8	60.3
2016	100	100	86.9	97.5	99	97.4	88.2	94.7	74.7
2017	98.4	96.8	86.4	98.1	98.0	97.2	95.0	98.5	80.6

Brood year	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
2018	92.3	100	94.6	90.9	94.8	93.3	81.8	88.8	70.4
Average	***94.4***	***98.4***	***80.5***	***93.1***	***96.8***	***94.5***	***90.9***	***97.0***	***68.0***
Median	***96.3***	***100.0***	***81.3***	***93.1***	***96.6***	***94.8***	***90.1***	***98.7***	***67.6***
Standard	***90.0***	***85.0***	***92.0***	***98.0***	***97.0***	***93.0***	***90.0***	***95.0***	***81.0***

[a] Survival estimates are only for WxW steelhead.

3.3 Disease Monitoring

Rearing of the 2018 brood Wenatchee summer steelhead was similar to previous years with fish being held on Chelan Hatchery spring water, Eastbank Fish Hatchery well water, and Chelan Hatchery well water before being transferred for overwinter acclimation at the Chiwawa Acclimation Facility. All fish were force-released into Nason Creek, Chiwawa River, and the Wenatchee River. The 2018 Wenatchee summer steelhead had the following issues during the rearing period at Chelan Fish Hatchery: sunburn, fungus, and bacterial cold-water disease. Fish were treated with potassium permanganate and salt. In addition, bacterial cold-water disease with a secondary fungal infection was observed at Chiwawa Fish Hatchery before release. Fish were treated with Aquaflor feed and a shade cloth was applied.

3.4 Natural Juvenile Productivity

During 2019, juvenile steelhead were sampled at the Lower Wenatchee, Chiwawa, and Nason Creek rotary screw traps. Snorkel surveys conducted in the Chiwawa River basin ended in 2018; however, the time series of counts through 2018 are included in this section for completeness. Because the snorkel surveys targeted juvenile Chinook salmon, the entire distribution of juvenile steelhead/rainbow in the Chiwawa River basin was not surveyed. Therefore, the juvenile steelhead/rainbow numbers presented below represent a minimum estimate.

Parr Estimates

During the snorkel survey period 1992-2018, numbers of age-0 and 1+ steelhead/rainbow ranged from 1,410 to 45,727 and 754 to 22,130, respectively, in the Chiwawa River basin (Table 3.14 and 3.15; Figure 3.4). Numbers of all fish counted in the Chiwawa River basin are reported in Appendix B.

Juvenile steelhead/rainbow were distributed primarily throughout the lower seven reaches of the Chiwawa River (downstream from Rock Creek). Their densities were highest in the lower portions of the river and in tributaries. Age-0 steelhead/rainbow most often used riffle and multiple channel habitats in the Chiwawa River, although they also associated with woody debris in pool and glide habitat. In tributaries, they were generally most abundant in small pools. Those that were observed in riffles selected stations in quiet water behind small and large boulders, or occupied stations in quiet water along the stream margin. In pool and multiple-channel habitats, age-0 steelhead/rainbow used the same kinds of habitat as age-0 Chinook salmon.

Age-1+ steelhead/rainbow most often used pool, riffle, and multiple-channel habitats. Those that used pools were usually in deeper water than subyearling steelhead/rainbow and Chinook salmon. Like age-0 steelhead/rainbow, age-1+ steelhead/rainbow generally selected stations in quiet water behind boulders in riffles, but the two age groups rarely occurred together. Age-1+ steelhead/rainbow used deeper and faster water than did subyearling steelhead/rainbow.

Table 3.14. Total numbers of age-0 steelhead/rainbow trout estimated in different steams in the Chiwawa River basin during snorkel surveys in August 1992-2018; NS = not sampled.

Sample Year	Chiwawa River	Phelps Creek	Chikamin Creek	Rock Creek	Unnamed Creek	Big Meadow Creek	Alder Creek	Brush Creek	Clear Creek	Total
1992	4,927	NS	NS	NS	NS	NS	NS	NS	NS	**4,927**
1993	3,463	0	356	185	NS	NS	NS	NS	NS	**4,004**
1994	953	0	256	24	0	177	0	0	0	**1,410**
1995	6,005	0	744	90	0	371	40	107	0	**7,357**
1996	3,244	0	71	40	0	763	127	0	0	**4,245**
1997	6,959	224	84	324	0	1,124	58	50	0	**8,823**
1998	2,972	22	280	96	113	397	18	22	0	**3,921**
1999	5,060	20	253	189	0	255	34	27	0	**5,838**
2000	NS	NS	NS	NS	NS	NS	NS	NS	NS	**NS**
2001	35,759	192	1,449	1,826	0	6,345	156	0	0	**45,727**
2002	12,137	0	2,252	889	0	4,948	277	18	0	**20,521**
2003	9,911	296	996	1,166	96	5,366	73	116	0	**18,020**
2004	8,464	110	583	113	40	957	35	78	0	**10,380**
2005	4,852	120	2,931	477	45	2,973	65	0	0	**11,463**
2006	10,669	21	858	872	34	3,647	73	71	0	**16,245**
2007	8,442	53	2,137	348	11	2,955	65	28	34	**14,073**
2008	9,863	0	2,260	859	0	1,987	57	168	36	**15,230**
2009	13,231	0	1,183	449	0	2,062	170	67	17	**17,179**
2010	17,572	0	2,870	1,478	5	2,843	182	35	33	**25,018**
2011	35,825	0	1,503	804	0	1,066	56	152	40	**39,446**
2012	21,537	0	1,817	1,501	0	2,164	42	54	19	**27,134**
2013	17,889	0	602	816	0	2,189	44	99	43	**21,682**
2014	12,256	21	1,617	1,039	0	1,005	32	56	57	**16,083**
2015	4,532	0	1,989	1,675	0	1,761	170	62	19	**10,208**
2016	10,971	0	1,419	996	0	2,721	50	62	25	**16,244**
2017	10,120	0	2,127	1,025	0	3,954	36	22	12	**17,296**
2018	7,655	0	1,022	1,674	0	1,387	20	78	18	**11,854**
Average	***10,972***	***43***	***1,266***	***758***	***14***	***2,226***	***78***	***57***	***15***	***15,166***
Median	***9,164***	***0***	***1,183***	***816***	***0***	***2,025***	***57***	***55***	***6***	***14,652***

Table 3.15. Total numbers of age-1+ steelhead/rainbow trout estimated in different steams in the Chiwawa River basin during snorkel surveys in August 1992-2018; NS = not sampled.

Sample Year	Chiwawa River	Phelps Creek	Chikamin Creek	Rock Creek	Unnamed Creek	Big Meadow Creek	Alder Creek	Brush Creek	Clear Creek	Total
1992	2,533	NS	NS	NS	NS	NS	NS	NS	NS	**2,533**
1993	2,530	0	228	102	NS	NS	NS	NS	NS	**2,860**

Sample Year	Chiwawa River	Phelps Creek	Chikamin Creek	Rock Creek	Unnamed Creek	Big Meadow Creek	Alder Creek	Brush Creek	Clear Creek	Total
1994	4,972	0	476	296	5	107	0	0	0	**5,856**
1995	8,769	0	494	71	0	183	0	0	0	**9,517**
1996	11,381	0	6	27	0	435	0	0	0	**11,849**
1997	6,574	160	0	105	0	66	0	0	0	**6,905**
1998	10,403	0	133	49	0	0	0	0	0	**10,585**
1999	21,779	0	68	201	0	82	0	0	0	**22,130**
2000	NS	NS	NS	NS	NS	NS	NS	NS	NS	**NS**
2001	9,368	16	186	407	0	646	0	0	0	**10,623**
2002	7,200	0	199	165	0	1,526	0	0	0	**9,090**
2003	4,745	362	426	599	0	47	0	0	0	**6,179**
2004	7,700	107	209	0	0	174	0	0	0	**8,190**
2005	4,624	63	957	257	0	287	0	0	0	**6,188**
2006	7,538	76	748	1,186	0	985	0	0	0	**10,533**
2007	6,976	0	945	96	0	431	0	0	0	**8,448**
2008	8,317	0	1,168	298	0	793	0	0	0	**10,576**
2009	4,998	16	320	102	0	167	21	0	5	**5,629**
2010	8,324	32	366	393	0	780	21	0	0	**9,916**
2011	13,329	0	415	470	0	689	0	0	0	**14,903**
2012	7,671	0	285	410	0	210	0	0	0	**8,576**
2013	6,439	0	0	48	0	766	0	0	0	**7,253**
2014	4,568	13	96	211	0	165	0	0	31	**5,084**
2015	614	0	40	100	0	0	0	0	0	**754**
2016	3,418	0	256	40	0	309	0	8	0	**4,031**
2017	5,535	0	415	76	0	897	0	0	0	**6,923**
2018	2,778	0	66	64	0	243	0	0	0	**3,151**
Average	***7,042***	***34***	***340***	***231***	***0***	***416***	***2***	***0***	***2***	***8,011***
Median	***6,775***	***0***	***256***	***105***	***0***	***265***	***0***	***0***	***0***	***7,722***

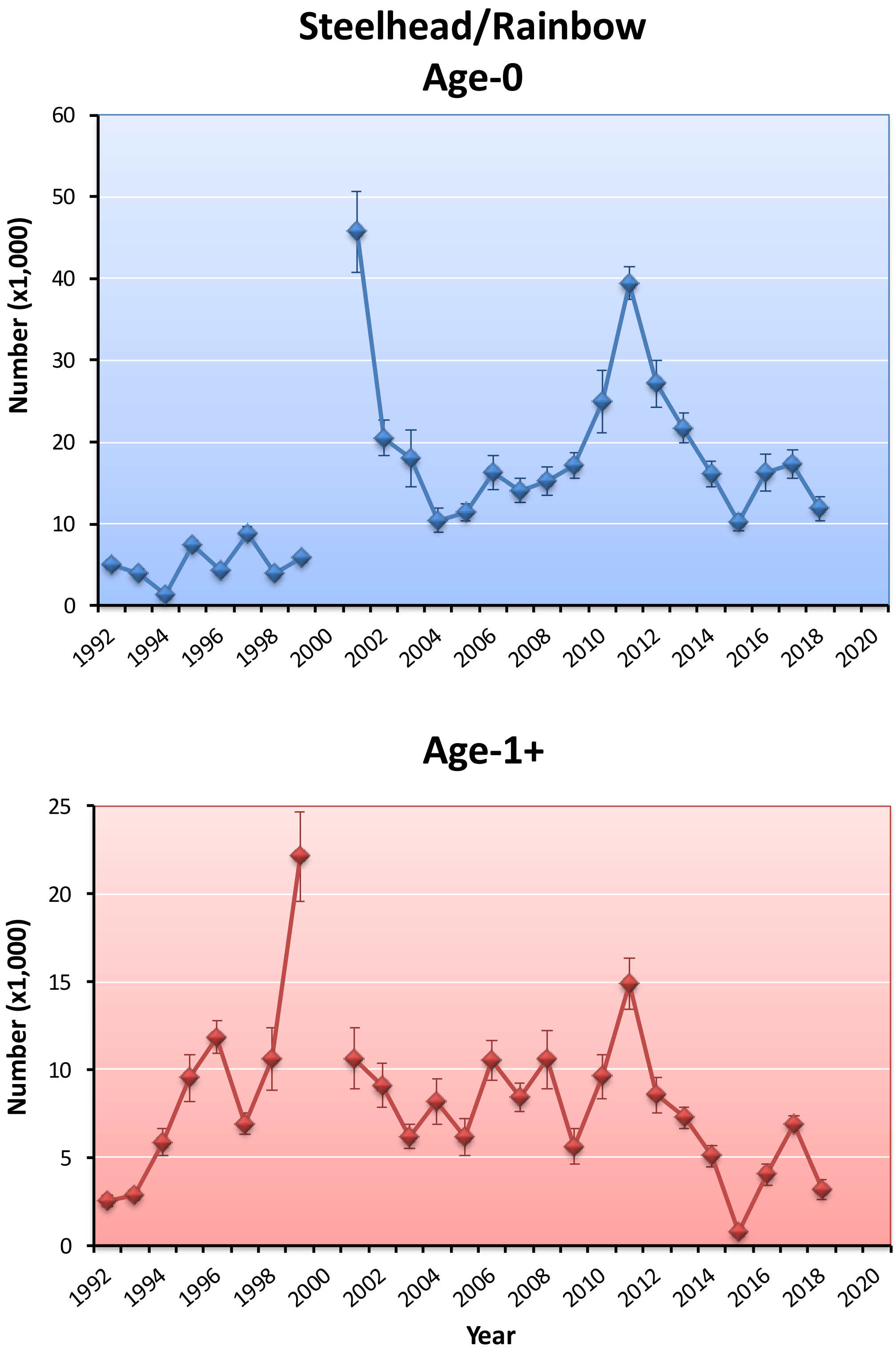


Figure 3.4. Numbers of subyearling and yearling steelhead/rainbow trout within the Chiwawa River basin in August 1992-2018; ND = no data. Vertical bars indicate 95% confidence bounds.

Emigrant and Smolt Estimates

Numbers of steelhead smolts and emigrants were estimated at the Chiwawa, Nason, and Lower Wenatchee traps in 2018.

Chiwawa Trap

The Chiwawa Trap operated between 19 March and 27 November 2019. During the trapping period, the trap was inoperable for 12 days because of high or low river discharge, debris, major hatchery releases, and mechanical issues. Throughout the trapping season, the trap operated in two positions, the upper position and low-flow position. Monthly captures of all fish collected at the Chiwawa Trap are reported in Appendix C.

A total of 196 wild steelhead/rainbow smolts, 3,822 hatchery steelhead/rainbow, and 1,322 wild parr and fry were captured at the Chiwawa Trap in 2019. Based on capture efficiencies, the total number of wild steelhead (including fry, parr, and smolts/transitionals) from the Chiwawa River basin was 28,512 (95% CI = ±3,360). Removing fry from the estimate, a total of 28,062 (±3,354) juvenile steelhead emigrated from the Chiwawa River basin in 2019 (Table 3.16). Most (98%) of the hatchery steelhead were collected in May, while most (55%) of the wild steelhead smolts were captured in April (Figure 3.5). Although steelhead/rainbow parr and fry emigrated throughout the sampling period, peaks in emigration were observed in April, May, June, August, and in October (Figure 3.5). Of the total number of wild steelhead captured, 87% were classified as parr and fry. Seven mark-recapture efficiency trials were conducted in 2019 using 389 fish. This produced an observed pooled trap efficiency of 6.9%.

Table 3.16. Estimated numbers of wild steelhead that emigrated from the Chiwawa River basin during migration years 2015-2019 (because there were few mark-recapture trials conducted prior to 2015, there are no reliable estimates before 2015). Estimates are provided with and without fry. Numbers in parentheses indicate 95% confidence intervals.

Migration year	Numbers of wild steelhead migrants	
	Migrants (excluding fry)	Migrants (including fry)
2015	46,500 (±156,250)	52,274 (±156,251)
2016	32,277 (±108,458)	34,092 (±114,557)
2017	27,849 (±129,192)	28,142 (±91,356)
2018	13,495 (±35,747)	13,824 (±35,748)
2019	28,062 (±3,354)	28,512 (±3,360)
Average	***29,637***	***31,369***
Median	***28,062***	***28,512***

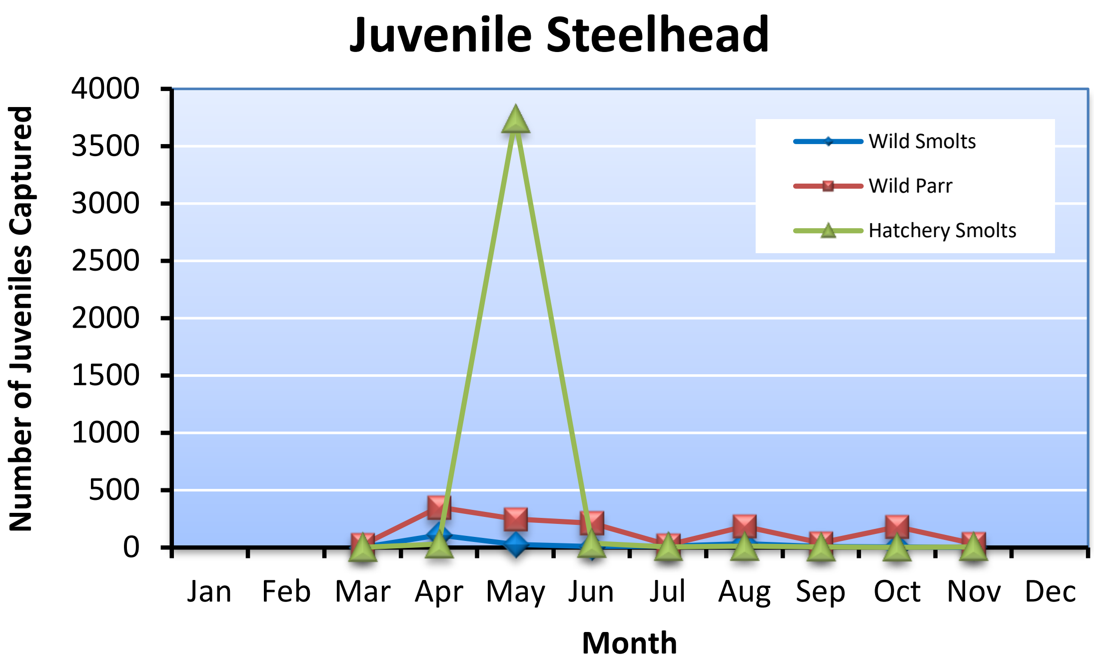


Figure 3.5. Monthly captures of wild smolts, wild parr, and hatchery smolt steelhead/rainbow at the Chiwawa Trap, 2019.

Wild steelhead smolts/transitionals sampled in 2019 averaged 164 mm in length, 46.7 g in weight, and had a mean condition of 0.99 (Table 3.17). These size estimates were larger than the overall mean of steelhead smolts/transitionals sampled in previous years (overall means: 159 mm, 45.3 g, and condition of 1.02). Wild steelhead parr sampled in 2019 at the Chiwawa Trap averaged 86 mm in length, averaged 8.8 g, and had a mean condition of 1.03 (Table 3.17). Parr sampled in 2019 were smaller than the overall mean of parr sampled in previous years (overall means, 91 mm, 12.4 g, and condition of 1.01).

Table 3.17. Mean fork length (mm), weight (g), and condition factor of wild juvenile steelhead collected in the Chiwawa Trap, 1997-2019. Numbers in parentheses indicate 1 standard deviation; NA = not available.

Sample year	Life stage	Sample size[a]	Mean size		
			Length (mm)	Weight (g)	Condition (K)
1997	Fry	5	38 (4)	0.6 (0.2)	1.17 (0.32)
	Parr	150	121 (37)	22.8 (17.2)	1.06 (0.20)
	Smolt/Transitional	107	169 (32)	51.1 (30.4)	0.97 (0.14)
1998	Fry	6	44 (4)	0.9 (0.2)	1.07 (0.11)
	Parr	506	99 (45)	17.6 (28.8)	1.07 (0.11)
	Smolt/Transitional	112	156 (30)	42.3 (20.7)	1.03 (0.08)
1999	Fry	NA	NA	NA	NA
	Parr	122	114 (32)	18.5 (14.2)	1.03 (0.12)
	Smolt/Transitional	130	164 (36)	50.4 (33.4)	1.02 (0.20)
2000	Fry	7	46 (5)	1.1 (0.4)	1.05 (0.24)

Sample year	Life stage	Sample size[a]	Mean size		
			Length (mm)	Weight (g)	Condition (K)
	Parr	218	137 (65)	42.1 (52.5)	1.08 (0.15)
	Smolt/Transitional	104	170 (25)	50.8 (25.3)	0.98 (0.07)
2001	Fry	96	44 (6)	1.0 (0.3)	1.11 (0.18)
	Parr	733	79 (26)	7.2 (10.1)	1.10 (0.12)
	Smolt/Transitional	54	182 (33)	67.8 (40.3)	1.05 (0.22)
2002	Fry	43	44 (4)	0.8 (0.3)	0.96 (0.14)
	Parr	584	90 (32)	10.6 (11.9)	1.04 (0.10)
	Smolt/Transitional	91	154 (42)	47.6 (36.7)	1.09 (0.11)
2003	Fry	58	45 (4)	0.9 (0.3)	0.97 (0.17)
	Parr	1,093	84 (32)	9.3 (14.1)	1.04 (0.11)
	Smolt/Transitional	35	175 (26)	55.8 (23.4)	1.09 (0.10)
2004	Fry	18	47 (2)	1.1 (0.2)	1.05 (0.19)
	Parr	1,012	89 (30)	9.1 (10.6)	0.97 (0.16)
	Smolt/Transitional	120	158 (25)	41.1 (19.8)	0.96 (0.14)
2005	Fry	56	43 (4)	0.9 (0.3)	1.04 (0.14)
	Parr	924	82 (33)	9.3 (15.2)	1.05 (0.11)
	Smolt/Transitional	43	171 (34)	56.5 (36.6)	1.02 (0.11)
2006	Fry	36	42 (7)	0.9 (0.5)	1.16 (0.40)
	Parr	1,200	81 (25)	7.9 (15.6)	1.12 (0.19)
	Smolt/Transitional	53	171 (14)	50.1 (12.5)	0.99 (0.09)
2007	Fry	22	38 (9)	0.6 (0.5)	0.84 (0.32)
	Parr	968	91 (30)	11.3 (18.2)	1.07 (0.13)
	Smolt/Transitional	153	152 (27)	38.8 (18.9)	1.03 (0.12)
2008	Fry	263	41 (7)	0.9 (0.5)	1.23 (0.38)
	Parr	1,168	88 (34)	11.5 (17.5)	1.10 (0.15)
	Smolt/Transitional	367	143 (36)	35.0 (27.0)	1.01 (0.10)
2009	Fry	295	40 (7)	0.8 (0.4)	1.04 (0.29)
	Parr	1,299	87 (37)	11.9 (19.7)	1.08 (0.13)
	Smolt/Transitional	204	150 (39)	42.7 (33.6)	1.06 (0.09)
2010	Fry	137	43 (5)	0.9 (0.3)	1.11 (0.27)
	Parr	932	90 (39)	12.7 (18.8)	1.09 (0.17)
	Smolt/Transitional	210	124 (35)	24.3 (19.8)	1.04 (0.10)
2011	Fry	70	40 (8)	0.8 (0.4)	1.04 (0.23)
	Parr	894	95 (42)	15.3 (24.9)	1.05 (0.13)
	Smolt/Transitional	192	163 (20)	43.6 (16.9)	0.97 (0.08)
2012	Fry	178	43 (6)	0.9 (0.4)	1.10 (0.23)
	Parr	1,503	79 (36)	9.1 (16.3)	1.06 (0.16)
	Smolt/Transitional	116	161 (27)	44.4 (20.4)	0.99 (0.08)

Sample year	Life stage	Sample size[a]	Mean size		
			Length (mm)	Weight (g)	Condition (K)
2013	Fry	217	45 (4)	1.0 (0.3)	1.05 (0.17)
	Parr	1,622	81 (34)	9.2 (16.0)	1.04 (0.11)
	Smolt/Transitional	83	164 (19)	46.5 (15.5)	1.03 (0.08)
2014	Fry	328	38 (8)	0.7 (0.4)	1.03 (0.29)
	Parr	1,583	81 (30)	8.3 (13.2)	1.04 (0.13)
	Smolt/Transitional	44	136 (37)	30.5 (19.6)	1.02 (0.08)
2015	Fry	267	40 (9)	0.7 (0.5)	0.93 (0.34)
	Parr	2,557	76 (23)	6.0 (7.9)	1.05 (0.37)
	Smolt/Transitional	253	167 (22)	50.1 (19.1)	1.02 (0.09)
2016	Fry	103	37 (8)	0.6 (0.4)	0.90 (0.21)
	Parr	1,393	84 (23)	7.8 (9.4)	1.06 (0.38)
	Smolt/Transitional	194	147 (33)	37.3 (23.7)	1.04 (0.20)
2017	Fry	14	37 (8)	0.7 (0.4)	0.98 (0.29)
	Parr	706	85 (24)	7.6 (7.9)	1.03 (0.08)
	Smolt/Transitional	236	156 (24)	39.4 (17.3)	0.97 (0.09)
2018	Fry	3	33 (7)	0.7 (0.4)	1.12 (0.23)
	Parr	346	86 (26)	8.75 (10.4)	1.03 (0.08)
	Smolt/Transitional	142	170 (21)	49.28 (22.1)	0.96 (0.96)
2019	Fry	13	36 (10)	0.6 (0.5)	0.77 (0.27)
	Parr	1,151	80 (21)	6.5 (6.5)	1.04 (0.09)
	Smolt/Transitional	192	164 (25)	46.6 (19.9)	0.99 (0.10)
Average	***Fry***	***102***	***41***	***0.8***	***1.03***
	Parr	***985***	***90***	***12.2***	***1.06***
	Smolt/Transitional	***141***	***159***	***45.3***	***1.01***
Median	***Fry***	***57***	***41***	***0.9***	***1.05***
	Parr	***968***	***86***	***9.3***	***1.05***
	Smolt/Transitional	***120***	***163***	***46.5***	***1.02***

[a] Sample size represents the number of fish that were measured for both length and weight.

White River Trap

The White River Trap operated between 1 March and 27 November 2019. During that period, the trap was inoperable for 26 days because of debris blockages and periods of high discharge. Because so few steelhead are captured in the trap and there is no flow-efficiency model for the trap, there are no estimates of total steelhead emigration. However, the few steelhead captured with the trap were enumerated and measured. In 2019, wild steelhead parr averaged 125 mm in length, 21.9 g in weight, and had a mean condition of 0.96 (Table 3.18). These size estimates were less than the overall mean of steelhead parr sampled in previous years (overall means: 152 mm, 43.4 g, and condition of 1.03). No wild steelhead smolts/transitionals were collected in the White River in 2019.

Table 3.18. Mean fork length (mm), weight (g), and condition factor of steelhead smolts collected in the White River Trap, 2007-2019. Numbers in parentheses indicate 1 standard deviation.

Sample year	Life Stage	Sample size	Mean size		
			Length (mm)	Weight (g)	Condition (K)
2007	Fry	0	–	–	–
	Parr	8	166 (32)	50.2 (21.3)	1.06 (0.37)
	Smolt/Transitional	0	–	–	–
2008	Fry	0	–	–	–
	Parr	14	150 (50)	47.8 (42.3)	1.06 (0.21)
	Smolt/Transitional	0	–	–	–
2009	Fry	0	–	–	–
	Parr	12	180 (30)	64.1 (30.7)	1.02 (0.13)
	Smolt/Transitional	0	–	–	–
2010	Fry	0	–	–	–
	Parr	11	155 (40)	57.6 (30.9)	1.12 (0.15)
	Smolt/Transitional	0	–	–	–
2011	Fry	0	–	–	–
	Parr	5	141 (20)	32.9 (12.7)	1.12 (0.04)
	Smolt/Transitional	0	–	–	–
2012	Fry	1	30	0.1	0.37
	Parr	3	177 (10)	56.5 (10.9)	1.01 (0.01)
	Smolt/Transitional	2	200 (13)	78.6 (19.2)	0.98 (0.04)
2013	Fry	0	–	–	–
	Parr	7	141 (50)	39 (44.4)	1.05 (0.11)
	Smolt/Transitional	1	153	38.8	1.08
2014	Fry	0	–	–	–
	Parr	5	165 (50)	56.9 (40.4)	1.04 (0.07)
	Smolt/Transitional	0	–	–	–
2015	Fry	0	–	–	–
	Parr	5	156 (61)	51.3 (43.1)	0.95 (0.10)
	Smolt/Transitional	1	167	57.5	1.23
2016	Fry	0	–	–	–
	Parr	5	145 (23)	32.9 (12.6)	1.02 (0.06)
	Smolt/Transitional	0	–	–	–
2017	Fry	0	–	–	–
	Parr	2	141 (13)	29.2 (10.9)	1.02 (0.10)
	Smolt/Transitional	0	–	–	–
2018	Fry	0	–	–	–
	Parr	2	133 (16)	24.0 (9.9)	1.00 (0.05)
	Smolt/Transitional	0	–	–	–

Sample year	Life Stage	Sample size	Mean size		
			Length (mm)	Weight (g)	Condition (K)
2019	Fry	0	–	–	–
	Parr	4	125(53)	21.9 (20.6)	0.96 (0.15)
	Smolt/Transitional	0	–	–	–
Average	***Fry***	***0***	***30***	***0.1***	***0.37***
	Parr	***6***	***152 (17)***	***43.4 (14.1)***	***1.03(0.05)***
	Smolt/Transitional	***0***	***173 (24)***	***58.3 (19.9)***	***1.10 (0.13)***
Median	***Fry***	***0***	***30***	***0.1***	***0.37***
	Parr	***5***	***150 (15)***	***47.8 (13.1)***	***1.02 (0.05)***
	Smolt/Transitional	***0***	***167 (24)***	***57.5 (19.9)***	***1.08 (0.13)***

Nason Creek Trap

The Nason Creek Trap operated between 1 March and 27 November 2019. During the nine-month sampling period the trap was inoperable for 120 days because of low discharge and flooding. The trap captured a total of 21 wild steelhead smolts, 723 hatchery steelhead smolts, 277 wild steelhead parr, and 244 wild steelhead fry. Because a flow-efficiency regression model for steelhead has not yet been developed at the current trap location, a pooled efficiency was used to estimate emigrant abundance. The estimated wild steelhead smolt/transitional emigration for 2019 was 464 (±921) (Table 3.19).

Table 3.19. Estimated numbers of wild and hatchery steelhead smolts/transitionals that emigrated from Nason Creek during migration years 2003-2019; NS = no data. Numbers in parentheses indicate 95% confidence intervals.

Migration year	Numbers of steelhead smolts/transitionals	
	Wild smolts	Hatchery smolts
2003	187 (±461)	7,798 (±5,830)
2004	0 (±0)	8,362 (±2,436)
2005	858 (±256)	11,880 (±3,664)
2006[a]	35 (±35)	NS
2007	1,703 (±808)	34,159 (±10,445)
2008	6,603 (±3,469)	131,118 (±104,661)
2009	272 (±119)	53,758 (±17,124)
2010	1,269 (±873)	76,660 (±42,095)
2011	488 (±618)	36,010 (±29,600)
2012	5,438 (±3,812)	64,423 (±61,848)
2013	1,599 (±2,221)	63,001 (±95,002)
2014	1,198 (±1,263)	62,890 (±47,205)
2015[b]	1,392 (±7,741)	51,968 (±287,566)
2016[b]	648 (±2,367)	7,056 (±25,398)
2017[b]	772 (±1,165)	23,108 (±34,159)
2018[b]	1,664 (±665)	19,621 (±62,582)

Migration year	Numbers of steelhead smolts/transitionals	
	Wild smolts	Hatchery smolts
2019[b]	464 (±921)	17,844 (±34,531)
Average	***1,446 (1,822)***	***41,854 (33,396)***
Median	***858 (256)***	***35,085 (20,023)***

[a] Hatchery-origin steelhead not enumerated

[b] Pooled estimate used.

Wild steelhead smolts/transitionals sampled in 2019 averaged 144 mm in length, 31.1 g in weight, and had a mean condition of 1.00 (Table 3.20). These size estimates were greater than the overall mean of steelhead smolts/transitionals sampled in previous years (overall means: 134 mm, 27.8 g, and condition of 1.00). Wild steelhead parr sampled in 2019 at the Nason Creek Trap averaged 87 mm in length, averaged 7.5 g, and had a mean condition of 1.07 (Table 3.20). Parr sampled in 2019 were greater than the overall mean of parr sampled in previous years (overall means, 81 mm, 6.8 g, and condition of 1.06).

Table 3.20. Mean fork length (mm), weight (g), and condition factor of steelhead smolts collected in the Nason Creek Trap, 2003-2019. Numbers in parentheses indicate 1 standard deviation.

Sample year	Life Stage	Sample size	Mean size		
			Length (mm)	Weight (g)	Condition (K)
2003	Fry	NS	NS	NS	NS
	Parr	63	74 (12)	5.3 (3.1)	1.23 (0.50)
	Smolt/Transitional	3	122 (42)	21.1 (17.6)	0.93 (0.16)
2004	Fry	4	45 (5)	1.0 (0.5)	1.03 (0.30)
	Parr	678	92 (30)	10.4 (11.0)	1.05 (0.23)
	Smolt/Transitional	0	–	–	–
2005	Fry	236	38 (7)	0.6 (0.5)	0.90 (0.68)
	Parr	850	76 (18)	5.4 (4.3)	1.04 (0.19)
	Smolt/Transitional	207	143 (21)	31.1 (14.6)	1.01 (0.22)
2006	Fry[a]	NS	NS	NS	NS
	Parr	1,162	89 (28)	8.9 (11.4)	0.92 (0.14)
	Smolt/Transitional	2	81 (17)	4.5 (2.1)	0.83 (0.12)
2007	Fry	121	43 (4)	1.0 (0.3)	1.16 (0.32)
	Parr	1,534	81 (19)	6.5 (5.8)	1.06 (0.16)
	Smolt/Transitional	97	136 (27)	28.0 (13.2)	1.03 (0.19)
2008	Fry	378	43 (5)	0.8 (0.3)	0.95 (0.21)
	Parr	2,343	80 (20)	6.3 (6.5)	1.06 (0.12)
	Smolt/Transitional	206	129 (32)	25.6 (17.7)	1.04 (0.10)
2009	Fry	106	48 (1.4)	1.1 (0.1)	1.02 (0.10)
	Parr	1,085	75 (27)	6.5 (10.4)	1.05 (0.10)
	Smolt/Transitional	16	153 (28)	38.7 (15.6)	1.00 (0.05)
2010	Fry	117	46 (3)	1.1 (0.3)	1.13 (0.17)

Sample year	Life Stage	Sample size	Mean size		
			Length (mm)	Weight (g)	Condition (K)
	Parr	1,907	79 (23)	6.9 (8.1)	1.10 (0.12)
	Smolt/Transitional	56	149 (26)	37.2 (16.3)	1.05 (0.15)
2011	Fry	517	39 (6)	0.6 (0.3)	0.93 (0.30)
	Parr	1,096	73 (22)	5.5 (12.2)	1.08 (0.14)
	Smolt/Transitional	7	114 (42)	19.7 (15.6)	1.02 (0.10)
2012	Fry	29	46 (3)	0.8 (0.3)	0.82 (0.29)
	Parr	1,166	80 (20)	6.6 (6.5)	1.06 (0.13)
	Smolt/Transitional	83	134 (30)	27.6 (14.8)	1.03 (0.16)
2013	Fry	152	44 (4)	0.8 (0.3)	0.96 (0.23)
	Parr	2,396	74 (16)	4.7 (4.2)	1.01 (0.10)
	Smolt/Transitional	22	115 (33)	19.2 (14.3)	1.02 (0.06)
2014	Fry	155	44 (4)	0.8 (0.2)	0.96 (0.17)
	Parr	991	78 (17)	5.7 (5.2)	1.02 (0.09)
	Smolt/Transitional	18	139 (24)	29.8 (12.1)	1.03 (0.10)
2015	Fry	24	43 (5)	0.9 (0.3)	1.03 (0.24)
	Parr	389	84 (19)	7.3 (6.5)	1.05 (0.08)
	Smolt/Transitional	12	145 (23)	33.0 (15.7)	0.99 (0.08)
2016	Fry	275	41 (5)	0.8 (0.3)	0.99 (0.19)
	Parr	631	79 (21)	6.3 (6.1)	1.05 (0.11)
	Smolt/Transitional	9	120 (30)	20.7 (15.6)	1.02 (0.15)
2017	Fry	76	38 (5)	0.6 (0.3)	1.05 (0.16)
	Parr	1,377	86 (19)	8.0 (6.4)	1.08 (0.09)
	Smolt/Transitional	36	153 (18)	37.1 (12.5)	1.01 (0.08)
2018	Fry	137	29 (4)	0.2 (0.2)	0.83 (0.19)
	Parr	538	88 (21)	8.5 (7.4)	1.08 (0.08)
	Smolt/Transitional	24	159 (16)	39.8 (10.4)	0.98 (0.08)
2019	Fry	79	54 (21)	2.6 (2.0)	1.02 (0.23)
	Parr	277	87 (13)	7.5 (3.6)	1.07 (0.08)
	Smolt/Transitional	21	144 (17)	31.1 (11.2)	1.00 (0.08)
Average	***Fry***	***160***	***43 (6)***	***0.9 (0.5)***	***1.00 (0.08)***
	Parr	***1,087***	***81 (6)***	***6.8 (1.5)***	***1.06 (0.06)***
	Smolt/Transitional	***48***	***134 (20)***	***27.8 (9.2)***	***1.00 (0.05)***
Median	***Fry***	***121***	***43 (5)***	***0.8 (0.3)***	***0.99 (0.19)***
	Parr	***1,085***	***80 (20)***	***6.5 (10.4)***	***1.06 (0.13)***
	Smolt/Transitional	***21***	***138 (24)***	***28.9 (12.7)***	***1.02 (0.06)***

Lower Wenatchee Trap

The Lower Wenatchee River Trap operated between 19 February and 23 July 2019. During that time, the trap was inoperable for 16 days because of high or low river discharge, debris, elevated river temperatures, large hatchery releases, and mechanical issues. At the beginning of the season the trap operated in the low-flow position until 26 March. It then operated in the lower position until 5 July when it was switched back into the low-flow position for the remainder of the season. During the sampling period, a total of 96 wild steelhead parr and fry, 125 wild steelhead smolts, and 1,918 hatchery steelhead were captured at the trap. Because of the low numbers of steelhead encountered at the trap, it was not possible to conduct mark-recapture trials using steelhead. In addition, because there was a poor relationship between trap efficiency and river flow, a pooled estimate was used to derive the number of steelhead emigrants. Using this pooled method, it was estimated that 8,924 (±89,944) wild steelhead (including fry, parr, and smolt/transitional) emigrated out of the Wenatchee River basin during the trapping season. Excluding fry, it is estimated that 8,050 (±81,137) wild steelhead emigrated from the Wenatchee River basin (Table 3.21). Figure 3.6 shows the monthly captures of all steelhead collected at the Lower Wenatchee Trap. All fish captured in the trap are reported in Appendix C.

Table 3.21. Estimated numbers of wild steelhead that emigrated from the Wenatchee River basin during migration years 2000-2019. Estimates are provided with and without fry. Numbers in parentheses indicate 95% confidence intervals; NS = not sampled.

Migration year	Numbers of wild steelhead migrants	
	Migrants (excluding fry)	Migrants (including fry)
2000	33,255 (±31,868)	NS
2001	27,114 (±81,454)	NS
2002	36,790 (±103,406)	NS
2003	32,710 (±30,190)	NS
2004	32,344 (±12,749)	NS
2005	41,414 (±4,066)	NS
2006	17,499 (±33,554)	NS
2007	85,443 (±94,717)	NS
2008	31,902 (±8,979)	NS
2009	27,513 (±7,097)	NS
2010	36,826 (±22,782)	NS
2011	NS	NS
2012	NS	NS
2013	10,813 (±69,699)	NS
2014	6,149 (±32,095)	NS
2015	8,632 (±45,053)	12,207 (±123,032)
2016	10,135 (±102,145)	18,400 (±185,447)
2017	5,784 (±58,303)	7,532 (±75,918)
2018	9,758 (±98,353)	10,496 (±105,785)
2019	8,050 (±81,137)	8,924 (±89,944)
Average	***25,822***	***11,512***
Median	***27,314***	***10,496***

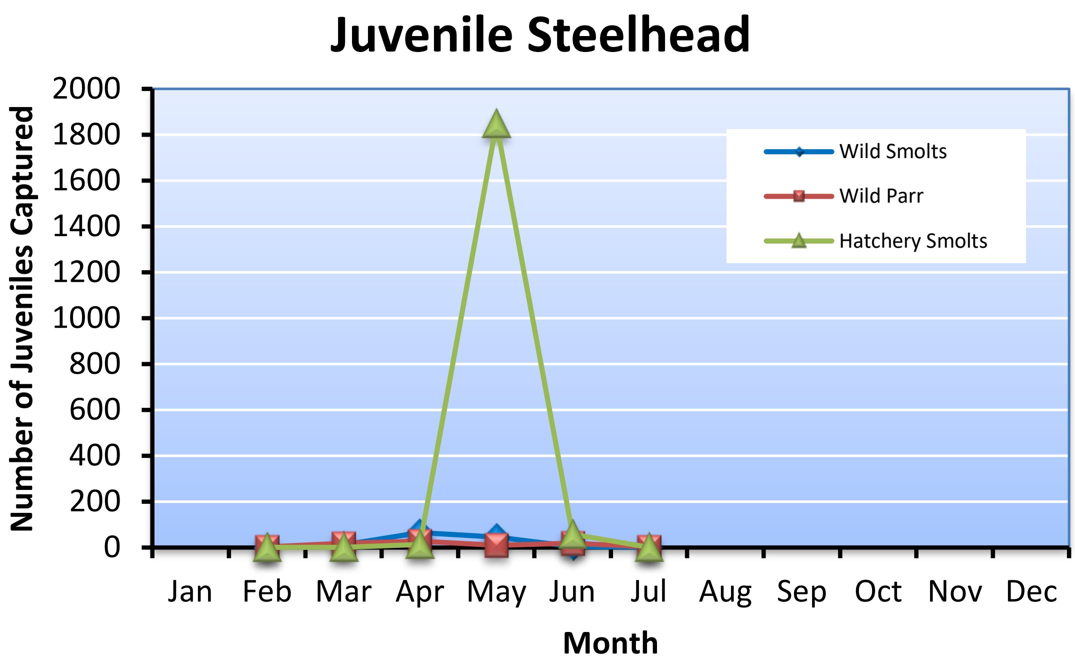


Figure 3.6. Monthly captures of wild smolts, wild parr, and hatchery smolt steelhead/rainbow at the Lower Wenatchee Trap, 2018.

Wild steelhead smolts/transitionals sampled in 2019 averaged 166 mm in length, 46.4 g in weight, and had a mean condition of 0.97 (Table 3.22). These size estimates were similar to the overall mean of steelhead smolts/transitionals sampled in previous years (overall means: 165 mm, 47.8 g, and condition of 0.99). Wild steelhead parr sampled in 2019 at the Lower Wenatchee Trap averaged 100 mm in length, averaged 11.9 g, and had a mean condition of 1.02 (Table 3.22). Parr sampled in 2019 were larger than the overall mean of parr sampled in previous years (overall means, 91 mm, 10.3 g, and condition of 1.06).

Table 3.22. Mean fork length (mm), weight (g), and condition factor of wild juvenile steelhead collected in the Lower Wenatchee River Trap, 2000-2019. Numbers in parentheses indicate 1 standard deviation; NS = not sampled.

Sample year	Life stage	Sample size[a]	Mean size		
			Length (mm)	Weight (g)	Condition (K)
2000	Fry	3	45 (3)	1.0 (0.2)	1.01 (0.06)
	Parr	8	72 (25)	7.4 (7.7)	1.05 (0.11)
	Smolt/Transitional	18	178 (26)	39.3 (22.0)	1.01 (0.13)
2001	Fry	0	NS	NS	NS
	Parr	60	107 (29)	14.7 (14.9)	1.00 (0.10)
	Smolt/Transitional	273	170 (23)	50.1 (23.5)	0.97 (0.10)
2002	Fry	427	33 (5)	0.3 (0.2)	0.82 (0.25)
	Parr	75	110 (34)	18.5 (20.0)	1.03 (0.08)
	Smolt/Transitional	182	173 (26)	54.5 (25.9)	1.00 (0.08)
2003	Fry	15	31 (4)	0.8 (0.3)	1.02 (0.15)

Sample year	Life stage	Sample size[a]	Mean size		
			Length (mm)	Weight (g)	Condition (K)
	Parr	67	89 (26)	9.6 (10.1)	1.07 (0.12)
	Smolt/Transitional	328	182 (20)	61.1 (20.5)	0.98 (0.06)
2004	Fry	5	29 (4)	0.5 (0.1)	0.87 (0.13)
	Parr	58	101 (27)	13.1 (10.7)	1.05 (0.13)
	Smolt/Transitional	301	170 (21)	51.1 (19.2)	1.01 (0.10)
2005	Fry	9	30 (3)	0.4 (0.3)	1.09 (0.70)
	Parr	36	97 (25)	11.7 (14.5)	1.04 (0.10)
	Smolt/Transitional	208	173 (27)	54.9 (23.4)	1.00 (0.11)
2006	Fry	73	35 (6)	0.5 (0.3)	0.86 (0.20)
	Parr	52	93 (26)	10.4 (9.0)	1.05 (0.21)
	Smolt/Transitional	105	156 (32)	41.0 (22.5)	0.98 (0.11)
2007	Fry	146	31 (6)	0.3 (0.3)	0.79 (0.25)
	Parr	58	88 (17)	8.2 (5.5)	1.08 (0.10)
	Smolt/Transitional	436	161 (31)	45.3 (23.1)	1.00 (0.12)
2008	Fry	45	31 (5)	0.4 (0.3)	0.90 (0.24)
	Parr	68	87 (13)	7.9 (5.2)	1.14 (0.15)
	Smolt/Transitional	233	155 (32)	42.0 (22.4)	1.02 (0.12)
2009	Fry	167	31 (6)	0.5 (0.3)	0.93 (0.28)
	Parr	22	80 (39)	9.0 (16.2)	1.26 (0.23)
	Smolt/Transitional	212	159 (37)	43.6 (24.6)	1.00 (0.10)
2010	Fry	53	30 (5)	0.4 (0.3)	0.92 (0.39)
	Parr	33	81 (8)	5.6 (1.6)	1.07 (0.13)
	Smolt/Transitional	445	154 (38)	40.5 (24.5)	0.97 (0.12)
2011	Fry	NS	NS	NS	NS
	Parr	NS	NS	NS	NS
	Smolt/Transitional	NS	NS	NS	NS
2012	Fry	NS	NS	NS	NS
	Parr	NS	NS	NS	NS
	Smolt/Transitional	NS	NS	NS	NS
2013	Fry	237	32 (6)	0.5 (0.3)	1.03 (0.18)
	Parr	498	84 (28)	8.8 (13.6)	1.06 (0.13)
	Smolt/Transitional	172	162 (31)	45.3 (21.0)	0.98 (0.08)
2014	Fry	113	33 (6)	0.4 (0.3)	0.93 (0.22)
	Parr	95	91 (32)	10.5 (13.8)	1.03 (0.12)
	Smolt/Transitional	80	165 (34)	46.8 (23.1)	0.96 (0.15)
2015	Fry	21	34 (6)	0.4 (0.3)	0.95 (0.36)
	Parr	71	93 (23)	10.4 (9.4)	1.08 (0.36)
	Smolt/Transitional	226	179 (25)	60.2 (25.5)	1.00 (0.16)

Sample year	Life stage	Sample size[a]	Mean size		
			Length (mm)	Weight (g)	Condition (K)
2016	Fry	207	34 (7)	0.4 (0.3)	0.94 (0.22)
	Parr	99	83 (24)	7.7 (6.6)	1.04 (0.13)
	Smolt/Transitional	66	159 (30)	45.7 (27.4)	1.03 (0.07)
2017	Fry	23	31 (4)	0.3 (0.2)	0.74 (0.24)
	Parr	64	91 (19)	8.9 (5.7)	1.03 (0.07)
	Smolt/Transitional	52	149 (30)	37.0 (21.8)	1.00 (0.09)
2018	Fry	3	28 (4)	0.2 (0.1)	0.69 (0.17)
	Parr	21	97 (18)	10.5 (6.1)	1.04 (0.80)
	Smolt/Transitional	206	155 (44)	56.0 (21.6)	0.97 (0.80)
2019	Fry	15	32 (6)	0.4 (0.2)	0.91 (0.32)
	Parr	69	100 (25)	11.9 (10.5)	1.02 (0.09)
	Smolt/Transitional	123	166 (22)	46.4 (20.4)	0.97 (0.09)
Average	***Fry***	***92***	***32***	***0.5***	***0.91***
	Parr	***81***	***91***	***10.3***	***1.06***
	Smolt/Transitional	***201***	***165***	***47.8***	***0.99***
Median	***Fry***	***92***	***32***	***0.5***	***0.91***
	Parr	***81***	***91***	***10.3***	***1.06***
	Smolt/Transitional	***201***	***165***	***47.8***	***0.99***

[a] Sample size represents the number of fish that were measured for both length and weight.

PIT Tagging Activities

As part of the Comparative Survival Study (CSS) and PUD studies, a total of 1,724 juvenile steelhead/rainbow trout (1,722 wild and 2 hatchery) were PIT tagged and released in 2019 in the Wenatchee River basin (Table 3.23). Most of these (70%) were tagged at the Chiwawa Trap. See Appendix D for a complete list of all fish captured, tagged, lost, and released.

Table 3.23. Numbers of wild and hatchery steelhead/rainbow trout that were captured, tagged, and released at different locations within the Wenatchee River basin, 2019. Numbers of fish that died or shed tags are also given.

Sampling location	Origin	Number captured	Number of recaptures	Number tagged	Number died	Shed tags	Total tagged fish released	Percent mortality
Chiwawa Trap	Wild	1,517	41	1,213	10	1	1,213	0.66
	Hatchery	3,822	1	1	4	0	1	0.10
	Total	**5,339**	**42**	**1,214**	**14**	**1**	**1,214**	**0.26**
Nason Creek Trap	Wild	542	0	320	4	0	320	0.74
	Hatchery	723	0	0	0	0	0	0.00
	Total	**1,265**	**0**	**320**	**4**	**0**	**320**	**0.32**
White River Trap	Wild	4	0	4	0	0	4	0.00
	Hatchery	0	0	0	0	0	0	0.00
	Total	**4**	**0**	**4**	**0**	**0**	**4**	**0.00**

Sampling location	Origin	Number captured	Number of recaptures	Number tagged	Number died	Shed tags	Total tagged fish released	Percent mortality
Lower Wenatchee Trap	Wild	221	0	185	1	0	185	0.45
	Hatchery	1,918	0	1	0	0	1	0.00
	Total	**2,139**	**0**	**186**	**1**	**0**	**186**	**0.05**
Total:	**Wild**	***2,284***	***41***	***1,722***	***15***	***1***	***1,722***	***0.66***
	Hatchery	***6,463***	***1***	***2***	***4***	***0***	***2***	***0.06***
Grand Total:		***8,747***	***42***	***1,724***	***19***	***1***	***1,724***	***0.22***

Numbers of steelhead/rainbow PIT-tagged and released as part of CSS and PUD studies during the period 2007-2019 are shown in Table 3.24.

Table 3.24. Summary of the numbers of wild and hatchery steelhead/rainbow trout that were tagged and released at different locations within the Wenatchee River basin, 2007-2019.

Sampling location	Origin	Numbers of PIT-tagged steelhead/rainbow released												
		2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Chiwawa Trap	Wild	832	1,431	1,127	930	1,012	1,011	1,228	1,186	1,795	1,313	909	435	1,213
	Hatchery	3	2	1	2	1	2	0	3	1	1	2	0	1
	Total	**835**	**1,433**	**1,128**	**932**	**1,013**	**1,013**	**1,228**	**1,189**	**1,796**	**1,314**	**911**	**435**	**1,214**
Chiwawa River (Angling or Electrofish)	Wild	167	94	35	99	0	0	0	23	0	0	0	0	0
	Hatchery	47	35	43	64	0	0	0	0	0	0	0	0	0
	Total	**214**	**129**	**78**	**163**	**0**	**0**	**0**	**23**	**0**	**0**	**0**	**0**	**0**
Upper Wenatchee Trap[1]	Wild	37	24	46	69	82	70	43	--	--	--	--	--	--
	Hatchery	0	0	0	0	0	0	0	--	--	--	--	--	--
	Total	**37**	**24**	**46**	**69**	**82**	**70**	**43**	**--**	**--**	**--**	**--**	**--**	**--**
Nason Creek Trap	Wild	1,335	2,154	753	1,557	805	1,087	1,998	838	383	530	1,353	513	320
	Hatchery	0	0	0	0	0	538	0	0	0	0	0	0	0
	Total	**1,335**	**2,154**	**753**	**1,557**	**805**	**1,625**	**1,998**	**838**	**383**	**530**	**1,353**	**513**	**320**
Nason Creek (Angling or Electrofish)	Wild	452	255	459	318	0	0	0	0	0	0	0	0	0
	Hatchery	75	87	197	32	0	0	0	0	0	0	0	0	0
	Total	**527**	**342**	**656**	**350**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
White River Trap	Wild	0	0	12	10	5	5	6	5	6	5	3	2	4
	Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	**0**	**0**	**12**	**10**	**5**	**5**	**6**	**5**	**6**	**5**	**3**	**2**	**4**
Lower Wenatchee Trap	Wild	461	285	227	465	0	0	613	133	290	131	106	222	185
	Hatchery	0	0	1	0	0	0	0	4	1	0	0	1	1
	Total	**461**	**285**	**228**	**465**	**0**	**0**	**613**	**137**	**291**	**131**	**106**	**223**	**186**
Total:	**Wild**	**4,285**	**5,347**	**3,694**	**5,302**	**1,904**	**2,173**	**4,738**	**2,185**	**2,474**	**1,979**	**2,371**	**1,172**	**1,722**
	Hatchery	**189**	**171**	**279**	**164**	**1**	**540**	**2**	**7**	**2**	**1**	**2**	**1**	**2**
Grand Total:		**4,474**	**5,518**	**3,973**	**5,466**	**1,905**	**2,713**	**4,740**	**2,192**	**2,476**	**1,980**	**2,373**	**1,173**	**1,724**

[1] 2013 was the last year that the Upper Wenatchee Trap operated.

3.5 Spawning Surveys

Surveys for steelhead redds were conducted from March through late May 2019, in the mainstem Wenatchee River and lower portions of select tributaries (Chiwawa River, Nason Creek, and Peshastin Creek). Beginning in 2014, adult steelhead escapement estimates in the majority of tributaries in the Wenatchee River basin were generated using mark-recapture techniques based on steelhead PIT tagged at Priest Rapids Dam (BPA funded; see Appendix E and Truscott et al. 2017 for details).

Redd Counts

A total of 64 steelhead redds were estimated in the Wenatchee River and the lower portions of select tributaries in 2019 (Table 3.25). Because steelhead escapement estimates in tributaries are based on mark-recapture techniques, there are no or limited redd counts in tributaries beginning in 2014. Additionally, mainstem redd counts since 2014 were expanded based on estimates of observer efficiency (see Appendix E). Thus, evaluation of trends in redd counts is appropriate only before 2014 or 2014 to present.

Table 3.25. Numbers of steelhead redds estimated within different streams/watersheds within the Wenatchee River basin, 2001-2019; NS = not surveyed. Redd counts from 2004-2014 have been conducted within the same areas and with the same methods. Beginning in 2014, complete redd counts were conducted only within the mainstem Wenatchee River. Therefore, trends in redd counts are only appropriate for the mainstem Wenatchee River from 2004 through 2013 or 2014 to present. Since 2014, steelhead redds are counted only within the lower portions of the Chiwawa River, Nason Creek, and Peshastin Creek (downstream from PIT-tag arrays).

Survey year	Number of steelhead redds							
	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River[a]	Icicle	Peshastin	Total
2001	25	27	NS	NS	116	19	NS	**187**
2002	80	80	1	0	315	27	NS	**503**
2003	64	121	5	3	248	16	15	**472**
2004	62	127	0	0	151	23	34	**397**
2005	162	412	0	2	459	8	97	**1,140**
2006	19	77	NS	0	191	41	67	**395**
2007	11	78	0	1	46	6	17	**159**
2008	11	88	NS	1	100	37	49	**286**
2009	75	126	0	0	327	102	32	**662**
2010	74	270	4	3	380	120	118	**969**
2011	77	235	2	0	323	180	115	**932**
2012	8	158	0	0	137	47	65	**415**
2013	27	135	NS	NS	200	48	62	**472**
Average[b]	***53***	***149***	***1***	***1***	***230***	***52***	***61***	***538***
Median[b]	***62***	***126***	***0***	***0***	***200***	***37***	***62***	***472***
2014	5	0	NS	NS	195[c]	NS	5	**205**
2015	1	1	NS	NS	258[c]	NS	1	**262**

Survey year	Number of steelhead redds							
	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River[a]	Icicle	Peshastin	Total
2016	0	0	NS	NS	126[c]	NS	0	**126**
2017	0	1	NS	NS	189[c]	NS	1	**191**
2018	0	0	NS	NS	49[c]	NS	1	**50**
2019	0	0	NS	NS	63[c]	NS	1	**89**
Average[d]	***1***	***0***	***--***	***--***	***147***	***--***	***2***	***154***
Median[d]	***0***	***0***	***--***	***--***	***158***	***--***	***1***	***159***

[a] Includes redds in Beaver and Chiwaukum creeks.
[b] Summary statistics for the period 2001-2013 when redd surveys were conducted in the mainstem Wenatchee River and tributaries.
[c] Steelhead redd counts in the mainstem Wenatchee River were expanded based on estimated observer efficiency (see Appendix E).
[d] Summary statistics for the period 2014-present when redd surveys are conducted within the mainstem Wenatchee River and in tributaries downstream from PIT-tag interrogation systems.

Redd Distribution

Steelhead redds were not evenly distributed among survey reaches on the Wenatchee River in 2019 (Table 3.26). Most of the spawning (90.4% of observed redds) in the Wenatchee River occurred upstream from Tumwater Dam.

Table 3.26. Numbers and percentages of steelhead redds counted within different reaches on the Wenatchee River during March through late May 2019; CV = coefficient of variation, NA = not available, NS = not surveyed. Survey reaches are described in Table 2.6.

Reach	Reach type	Number of redds counted	Expanded redd counts		Percent of redds within stream/watershed
			Estimated	CV	
Wenatchee 1 (W1)	Non-index	0	0	-	0.0
Wenatchee 2 (W2)	Index	0	0	-	0.0
Wenatchee 3 (W3)	Non-index	0	0	-	0.0
Wenatchee 4 (W4)	Non-index	0	0	-	0.0
Wenatchee 5 (W5)	Non-index	0	0	-	0.0
Wenatchee 6 (W6)	Index	5	5	0.5	0.06
Wenatchee 6 (W6)	Non-index	0	0	-	0.0
Wenatchee 7 (W7)	NS	NS	-	-	NS
Wenatchee 8 (W8)	Index	1	1	0.3	0.02
Wenatchee 9 (W9)	Index	18	19	0.3	0.35
Wenatchee 9 (W9)	Non-index	1	1	0.2	0.02
Wenatchee 10 (W10)	Index	25	35	0.3	0.48
Wenatchee 10 (W10)	Non-index	2	2	0.0	0.04
Total		**52**	**63**	**0.2**	**100.0**

Spawn Timing

Steelhead began spawning early April in the Wenatchee River in 2019. Spawning activity appeared to begin once the mean daily stream temperature reached about 4.0°C and was observed in water temperatures ranging from 1.0-11.0°C. Steelhead spawning peaked during the middle of April in the Wenatchee River and surveys concluded during the first week of June (Figure 3.7).

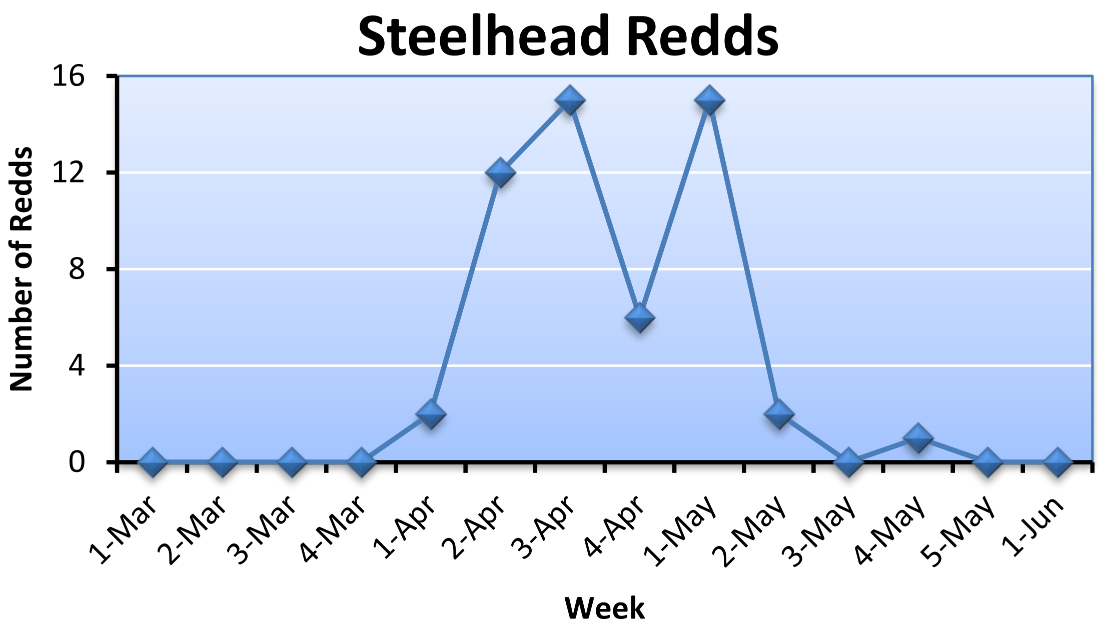


Figure 3.7. Numbers of steelhead redds counted during different weeks on the Wenatchee River, March through early June 2019.

Spawning Escapement

Steelhead spawning escapements to the Wenatchee River basin have been estimated based on run reconstruction[9] and mark-recapture (PIT tag) models. The use of the mark-recapture model began in 2014. Since then, escapements in tributaries were estimated using PIT-tag mark-recapture techniques (Truscott et al. 2017; Table 3.27), while observer-efficiency-expanded redd counts were used to estimate escapements in the mainstem Wenatchee River (Appendix E). Total redd counts were also used to estimate escapements in the lower portions of the main tributaries (downstream from the PIT interrogation sites).

[9] Steelhead run reconstruction is based on the number of steelhead observed at Priest Rapids and Wells dams and apportioned to Upper Columbia subbasins based on previously conducted radio telemetry studies (English et al. 2001; 2003) and differences in dam counts. Run escapement to each of the subbasins is then adjusted for adult management, harvest, broodstock collection, and a 10% pre-spawn mortality to estimate spawning escapement.

Table 3.27. Spawning escapement estimates for natural-origin and hatchery-origin steelhead within tributaries of the Wenatchee River, brood year 2019. Escapement estimates were based on PIT-tag mark-recapture techniques (Truscott et al. 2017). CV = coefficient of variation and NA = not available.

Tributary	Natural-origin steelhead		Hatchery-origin steelhead	
	Estimate	CV	Estimate	CV
Mission Creek	13	0.61	9	0.74
Peshastin Creek	48	0.31	9	0.67
Chumstick Creek	9	0.74	10	0.76
Icicle Creek	12	0.60	25	0.40
Chiwaukum Creek	0	--	0	--
Chiwawa River	23	0.40	51	0.31
Nason Creek	16	0.51	17	0.49
Little Wenatchee River	0	--	0	--
White River	0	--	0	--

Based on run reconstruction, the steelhead spawning escapement in the Wenatchee River in 2019 was 644 steelhead (Table 3.28a). This was less than the overall average escapement of 2,049 steelhead. The estimated escapement in 2019 based on the mark-recapture model was 345 steelhead (Table 3.28b).

Table 3.28a. Estimated Wenatchee River steelhead spawning escapements based on run reconstruction (1987-2019). Run reconstruction was developed to estimate steelhead spawning escapements for the entire Wenatchee River basin. Escapements within tributaries were estimated by partitioning the total escapement estimate based on redd count proportions (2004 to 2013) and mark-recapture estimates (2014 to 2019). NA = not available because complete redd census surveys did not begin until 2004.

Brood year	Steelhead spawning escapement (from run reconstruction)							
	Peshastin	Icicle	Chiwawa	Nason	L Wen	White	Wen R	Total
1987	NA	NA	NA	NA	NA	NA	NA	4,493
1988	NA	NA	NA	NA	NA	NA	NA	4,036
1989	NA	NA	NA	NA	NA	NA	NA	2,569
1990	NA	NA	NA	NA	NA	NA	NA	2,186
1991	NA	NA	NA	NA	NA	NA	NA	1,326
1992	NA	NA	NA	NA	NA	NA	NA	2,008
1993	NA	NA	NA	NA	NA	NA	NA	3,168
1994	NA	NA	NA	NA	NA	NA	NA	1,167
1995	NA	NA	NA	NA	NA	NA	NA	1,748
1996	NA	NA	NA	NA	NA	NA	NA	1,307
1997	NA	NA	NA	NA	NA	NA	NA	471
1998	NA	NA	NA	NA	NA	NA	NA	604
1999	NA	NA	NA	NA	NA	NA	NA	345
2000	NA	NA	NA	NA	NA	NA	NA	1,049
2001	NA	NA	NA	NA	NA	NA	NA	1,656

Brood year	Steelhead spawning escapement (from run reconstruction)							
	Peshastin	Icicle	Chiwawa	Nason	L Wen	White	Wen R	Total
2002	NA	NA	NA	NA	NA	NA	NA	5,050
2003	NA	NA	NA	NA	NA	NA	NA	2,598
2004	252	170	459	941	0	0	1,118	2,940
2005	307	25	513	1,304	0	6	1,453	3,609
2006	375	230	106	431	0	0	1,070	2,212
2007	93	33	60	426	0	5	251	869
2008	314	237	70	563	0	6	640	1,831
2009	84	267	196	330	0	0	857	1,734
2010	678	689	425	1,550	23	17	2,182[a]	5,564
2011	284	445	190	581	5	0	798[a]	2,304
2012	319	231	39	776	0	0	673	2,039
2013	123	95	54	268	0	0	397	936
Average	***283***	***242***	***211***	***717***	***3***	***3***	***944***	***2,216***
Median	***296***	***231***	***148***	***572***	***0***	***0***	***828***	***2,008***
2014	245	147	268	365	0	0	521	1,547
2015	237	126	277	306	0	0	743[b]	1,689
2016	324	208	286	305	0	26	910[b]	2,059
2017	84	73	101	112	0	0	577[b]	947
2018	151	142	112	136	13	19	339[b]	911
2019	106	69	138	62	0	0	269[b]	644
Average	***191***	***128***	***197***	***214***	***2***	***8***	***560***	***1,300***
Median	***194***	***134***	***203***	***221***	***0***	***0***	***549***	***1,247***

[a] Estimates for the Wenatchee River were generated from redds counts that included Chiwaukum Creek.
[b] Estimates for the Wenatchee River were generated from mark-recapture tributary escapement estimates that included Mission, Chumstick, and Chiwaukum creeks.

Table 3.28b. Estimated Wenatchee River steelhead spawning escapements based on mark-recapture (2014-present) models. Mark-recapture models (based on PIT tags) were developed to estimate steelhead spawning escapements for the entire Wenatchee River basin.

Brood year	Steelhead spawning escapement (from mark-recapture modeling)									
	Mission	Pesh	Chum	Icicle	Chiwauk	Chiw	Nason	L Wen	White	Wen R[a]	Total
2014	124	218	90	131	55	239	325	0	0	195	1,378
2015	90	238	45	127	59	279	308	0	0	553	1,699
2016	49	151	113	97	65	133	142	0	12	197	959
2017	34	38	14	33	0	46	51	0	0	214	430
2018	55	81	27	76	43	60	73	7	10	57	489
2019	22	57	19	37	0	74	33	0	0	103	345
Ave	***62***	***131***	***51***	***84***	***37***	***139***	***155***	***1***	***4***	***220***	***883***
Med	***52***	***116***	***36***	***87***	***49***	***104***	***108***	***0***	***0***	***196***	***724***

[a] Estimate is based on redd counts in the Wenatchee River.

3.6 Life History Monitoring

Life history characteristics of steelhead were assessed by examining fish collected at broodstock collection sites, examining videotape at Tumwater Dam, and by reviewing tagging data and fisheries statistics. Before brood year 2011, some statistics could not be calculated because few steelhead were tagged with CWTs. Since brood year 2011, nearly all steelhead released from the hatchery program have been tagged with CWTs. In addition, about 33,330 of the 2018 brood were PIT tagged. With the placement of remote PIT tag detectors in spawning streams in 2007 and 2008, statistics such as origin on spawning grounds, stray rates, and SARs can be estimated more accurately.

Migration Timing

Sampling at Tumwater Dam indicates that steelhead migrate throughout the year; however, the migration distribution is bimodal, indicating that steelhead migrate past Tumwater Dam in two pulses: one pulse during summer-autumn the year before spawning and another during winter-spring the year of spawning (Figure 3.8). Most steelhead passed Tumwater Dam during July through October and April. The highest proportion of both wild and hatchery fish migrated during October.

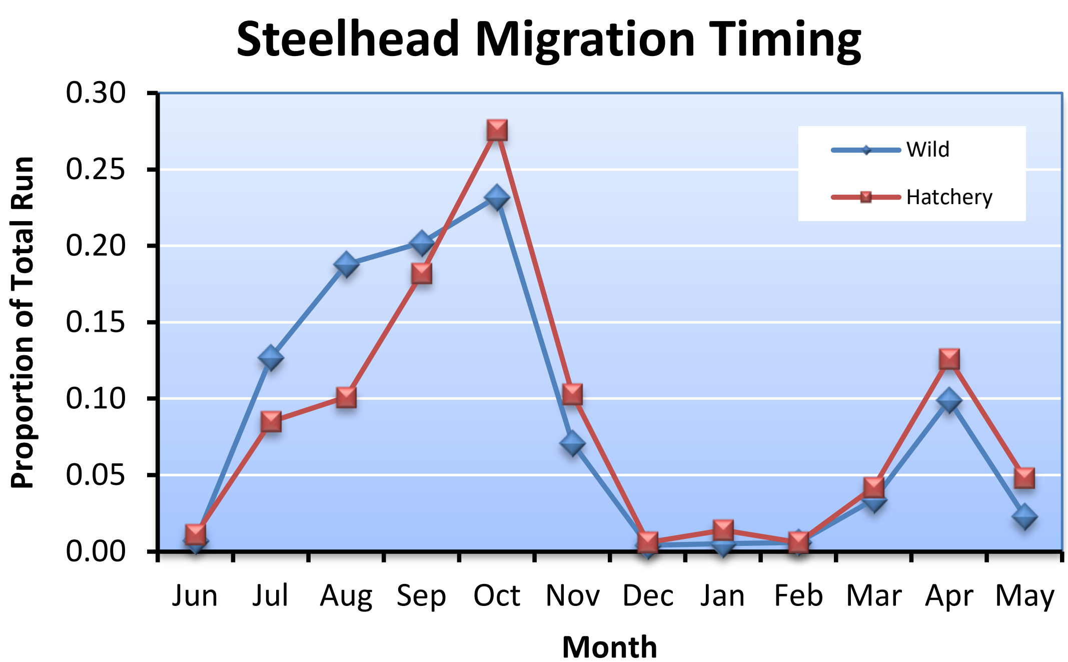


Figure 3.8. Proportion of wild and hatchery steelhead sampled at Tumwater Dam for the combined brood years of 1999-2019.

Because the migration of steelhead is bimodal, we estimated migration statistics separately for each migration pulse (i.e., summer-autumn migration and winter-spring migration). We compared migration statistics for wild and hatchery steelhead passing Tumwater Dam during the summer-autumn period independent of those for the winter-spring migration period. We estimated the week and month that 10%, 50% (median), and 90% of the wild and hatchery steelhead passed Tumwater

Dam during the two migration periods. We also estimated the mean weekly and monthly migration timing for wild and hatchery steelhead.

Migration timing of wild and hatchery fish at Tumwater Dam varied depending on the migration season (Table 3.29a and b; Figure 3.5). For the summer-autumn migration period, wild steelhead arrived at the dam about one week earlier than hatchery steelhead. In contrast, there was little difference in migration timing of wild and hatchery steelhead during the winter-spring migration period.

Table 3.29a. The week that 10%, 50% (median), and 90% of the wild and hatchery steelhead passed Tumwater Dam during their summer-autumn migration (June through December) and during their winter-spring migration (January through May), 1999-2019. The average week is also provided for both migration periods. Migration timing is based on video sampling at Tumwater. Unknown-origin fish (i.e., undetermined by scale analysis, no elastomer, no CWT, no fin clips, and no additional hatchery marks) were considered naturally produced. Estimates also include steelhead collected for broodstock.

Spawn year	Origin	Steelhead Migration Time (week)									
		Summer-Autumn Migration (Jun-Dec)					Winter-Spring Migration (Jan-May)				
		10%	50%	90%	Mean	Sample size	10%	50%	90%	Mean	Sample size
1999	Wild	27	32	47	35	81	12	16	17	15	29
	Hatchery	25	31	47	34	47	12	16	18	15	27
2000	Wild	31	36	41	36	238	11	14	18	14	40
	Hatchery	31	34	41	36	194	12	14	16	14	69
2001	Wild	29	34	41	35	391	13	15	17	15	84
	Hatchery	30	38	41	36	227	12	16	17	15	156
2002	Wild	29	39	46	38	810	13	14	17	14	181
	Hatchery	35	42	46	41	610	12	15	18	15	124
2003	Wild	30	33	40	35	731	3	9	16	9	193
	Hatchery	30	35	51	37	372	3	9	15	9	538
2004	Wild	30	40	45	39	644	13	16	18	16	222
	Hatchery	29	40	44	38	677	11	17	19	16	361
2005	Wild	30	39	43	38	986	10	15	17	15	206
	Hatchery	27	38	42	36	1,112	12	16	18	15	377
2006	Wild	29	40	43	39	428	12	15	17	15	191
	Hatchery	29	41	43	39	334	4	13	16	12	181
2007	Wild	30	36	41	35	277	11	17	17	15	108
	Hatchery	29	38	43	36	90	11	17	18	16	214
2008	Wild	30	38	43	38	397	13	15	18	16	123
	Hatchery	33	41	45	40	554	14	18	19	17	311
2009	Wild	30	37	46	37	338	13	15	19	15	87
	Hatchery	29	35	46	36	1,133	13	16	19	16	229
2010	Wild	31	37	45	38	648	11	15	18	15	171
	Hatchery	31	40	45	40	1,207	12	16	19	16	309
2011	Wild	29	36	44	36	797	13	17	19	17	118

Spawn year	Origin	Steelhead Migration Time (week)									
		Summer-Autumn Migration (Jun-Dec)					Winter-Spring Migration (Jan-May)				
		10%	50%	90%	Mean	Sample size	10%	50%	90%	Mean	Sample size
	Hatchery	31	39	45	39	991	15	18	19	18	240
2012	Wild	31	34	41	35	642	15	20	20	17	83
	Hatchery	32	39	43	38	715	15	19	19	17	223
2013	Wild	31	36	43	37	755	13	16	18	15	55
	Hatchery	31	42	45	40	1431	16	17	18	16	210
2014	Wild	29	35	41	35	549	14	18	19	17	57
	Hatchery	32	40	42	38	511	15	17	19	17	78
2015	Wild	29	38	43	37	714	11	14	17	14	48
	Hatchery	32	39	43	39	928	12	16	17	15	57
2016	Wild	34	41	45	39	610	13	16	19	16	58
	Hatchery	36	41	44	40	692	12	16	19	15	56
2017	Wild	28	39	43	36	300	16	17	19	17	15
	Hatchery	29	42	44	39	233	16	17	18	17	20
2018	Wild	31	39	43	38	173	6	14	17	13	109
	Hatchery	35	43	44	41	206	6	14	17	13	113
2019	Wild	28	33	45	35	130	14	17	20	17	2[a]
	Hatchery	29	37	45	36	133	20	20	20	20	1[a]
Average	***Wild***	***30***	***37***	***43***	***37***	***507***	***12***	***15***	***18***	***15***	***104***
	Hatchery	***31***	***39***	***44***	***38***	***590***	***12***	***16***	***18***	***15***	***185***
Median	***Wild***	***30***	***37***	***43***	***37***	***549***	***13***	***15***	***18***	***15***	***87***
	Hatchery	***31***	***39***	***44***	***38***	***554***	***12***	***16***	***18***	***16***	***181***

[a] A total of 12 steelhead passed Tumwater Dam during the winter-spring period; however, the origin of only three fish could be identified (one hatchery steelhead and two wild steelhead).

Table 3.29b. The month that 10%, 50% (median), and 90% of the wild and hatchery steelhead passed Tumwater Dam during their summer-autumn migration (June through December) and during their winter-spring migration (January through May), 1999-2019. The average month is also provided for both migration periods. Migration timing is based on video sampling at Tumwater. Unknown-origin fish (i.e., undetermined by scale analysis, no elastomer, no CWT, no fin clips, and no additional hatchery marks) were considered naturally produced. Estimates also include steelhead collected for broodstock.

Spawn year	Origin	Steelhead Migration Time (month)									
		Summer-Autumn Migration (Jun-Dec)					Winter-Spring Migration (Jan-May)				
		10%	50%	90%	Mean	Sample size	10%	50%	90%	Mean	Sample size
1999	Wild	7	8	11	8	81	3	4	4	4	29
	Hatchery	6	8	11	8	47	3	4	4	4	27
2000	Wild	8	9	10	9	238	3	4	5	4	40
	Hatchery	8	8	10	9	194	3	4	4	4	69

Spawn year	Origin	Steelhead Migration Time (month)									
		Summer-Autumn Migration (Jun-Dec)					Winter-Spring Migration (Jan-May)				
		10%	50%	90%	Mean	Sample size	10%	50%	90%	Mean	Sample size
2001	Wild	7	8	10	8	391	3	4	4	4	84
	Hatchery	7	9	10	9	227	3	4	4	4	156
2002	Wild	7	9	11	9	810	3	4	4	4	181
	Hatchery	9	10	11	10	610	3	4	5	4	124
2003	Wild	7	8	10	8	731	1	3	4	3	193
	Hatchery	7	8	12	9	372	1	3	4	2	538
2004	Wild	7	10	11	9	644	3	4	4	4	222
	Hatchery	7	10	10	9	677	3	4	5	4	361
2005	Wild	7	9	10	9	986	3	4	4	4	206
	Hatchery	7	9	10	9	1,112	3	4	5	4	377
2006	Wild	7	10	10	10	428	3	4	4	4	191
	Hatchery	7	10	10	9	334	1	3	4	3	181
2007	Wild	7	9	10	9	277	3	4	4	4	108
	Hatchery	7	9	10	9	90	3	4	5	4	214
2008	Wild	7	9	10	9	397	3	4	5	4	123
	Hatchery	8	10	11	10	554	4	4	5	4	311
2009	Wild	7	9	11	9	338	3	4	5	4	87
	Hatchery	7	8	11	9	1,133	3	4	5	4	229
2010	Wild	8	9	11	9	648	3	4	5	4	171
	Hatchery	8	10	11	10	1,207	3	4	5	4	309
2011	Wild	7	9	11	9	797	4	4	5	4	118
	Hatchery	8	9	11	9	991	4	5	5	5	240
2012	Wild	8	8	10	9	642	4	4	5	4	83
	Hatchery	8	9	10	9	715	4	4	5	4	223
2013	Wild	8	9	10	9	755	4	4	5	4	55
	Hatchery	8	10	11	10	1431	4	4	5	4	210
2014	Wild	7	9	10	9	549	4	4	5	4	57
	Hatchery	8	10	10	9	511	4	4	5	4	78
2015	Wild	7	9	10	9	714	3	4	4	4	48
	Hatchery	8	9	10	9	928	3	4	4	4	57
2016	Wild	8	10	11	9	610	3	4	5	4	58
	Hatchery	9	10	10	10	692	3	4	5	4	56
2017	Wild	7	9	10	9	300	4	4	5	4	15
	Hatchery	7	10	11	9	233	4	4	5	4	20
2018	Wild	8	9	10	9	173	2	4	4	3	109
	Hatchery	8	10	11	10	206	2	4	4	3	113
2019	Wild	7	8	11	9	130	3	4	5	4	2[a]

Spawn year	Origin	Steelhead Migration Time (month)									
		Summer-Autumn Migration (Jun-Dec)					Winter-Spring Migration (Jan-May)				
		10%	50%	90%	Mean	Sample size	10%	50%	90%	Mean	Sample size
	Hatchery	7	9	11	9	133	5	5	5	5	1[a]
Average	***Wild***	***7***	***9***	***10***	***9***	***507***	***3***	***4***	***5***	***4***	***104***
	Hatchery	***8***	***9***	***11***	***9***	***590***	***3***	***4***	***5***	***4***	***185***
Median	***Wild***	***7***	***9***	***10***	***9***	***549***	***3***	***4***	***5***	***4***	***87***
	Hatchery	***8***	***9***	***11***	***9***	***554***	***3***	***4***	***5***	***4***	***181***

[a] A total of 12 steelhead passed Tumwater Dam during the winter-spring period; however, the origin of only three fish could be identified (one hatchery steelhead and two wild steelhead).

Age at Maturity

All 2019 brood year steelhead broodstock collected at Tumwater and Dryden dams lived in saltwater 1 to 2 years (saltwater age) (Table 3.30). No saltwater age-3 fish were collected for broodstock. On average, there was a difference between the saltwater age at return of wild and hatchery fish. A greater proportion of hatchery fish collected for broodstock returned as saltwater age-1 fish than did wild fish. In contrast, a greater number of wild fish collected for broodstock returned as saltwater 2 and 3 fish than did hatchery fish (Figure 3.9). For the 2019 brood year, natural-origin steelhead consisted primarily of saltwater age-1 and hatchery-origin steelhead consisted primarily of saltwater age-2 fish.

Table 3.30. Proportions of wild and hatchery steelhead broodstock of different ages collected at Tumwater and Dryden dams, brood years 1998-2019. Age represents the number of years the fish lived in saltwater.

Brood year	Origin	Saltwater age			Sample size
		1	2	3	
1998	Wild	0.39	0.61	0.00	35
	Hatchery	0.21	0.79	0.00	43
1999	Wild	0.50	0.48	0.02	58
	Hatchery	0.82	0.18	0.00	67
2000	Wild	0.56	0.44	0.00	39
	Hatchery	0.68	0.32	0.00	101
2001	Wild	0.52	0.48	0.00	64
	Hatchery	0.15	0.85	0.00	114
2002	Wild	0.56	0.44	0.00	99
	Hatchery	0.95	0.05	0.00	113
2003	Wild	0.13	0.85	0.02	63
	Hatchery	0.29	0.71	0.00	92
2004	Wild	0.95	0.05	0.00	85
	Hatchery	0.95	0.05	0.00	132
2005	Wild	0.22	0.78	0.00	95
	Hatchery	0.21	0.79	0.00	114
2006	Wild	0.29	0.71	0.00	101

Brood year	Origin	Saltwater age			Sample size
		1	2	3	
	Hatchery	0.60	0.40	0.00	98
2007	Wild	0.40	0.59	0.00	79
	Hatchery	0.62	0.38	0.00	97
2008	Wild	0.65	0.34	0.01	104
	Hatchery	0.89	0.11	0.00	107
2009	Wild	0.40	0.58	0.20	83
	Hatchery	0.23	0.77	0.0	77
2010	Wild	0.65	0.34	0.01	92
	Hatchery	0.77	0.23	0.00	98
2011	Wild	0.28	0.73	0.00	102
	Hatchery	0.36	0.64	0.00	100
2012	Wild	0.42	0.53	0.05	59
	Hatchery	0.41	0.59	0.00	66
2013	Wild	0.41	0.57	0.02	54
	Hatchery	0.46	0.55	0.00	77
2014	Wild	0.48	0.51	0.02	61
	Hatchery	0.29	0.71	0.00	68
2015	Wild	0.16	0.83	0.02	63
	Hatchery	0.47	0.53	0.00	55
2016	Wild	0.34	0.66	0.00	65
	Hatchery	0.42	0.58	0.00	66
2017	Wild	0.11	0.84	0.05	57
	Hatchery	0.10	0.88	0.02	68
2018	Wild	0.73	0.27	0.0	73
	Hatchery	0.99	0.01	0.0	85
2019	Wild	0.55	0.45	0.0	56
	Hatchery	0.45	0.55	0.0	67
Average	***Wild***	***0.44***	***0.54***	***0.02***	***73***
	Hatchery	***0.54***	***0.46***	***0.00***	***87***
Median	***Wild***	***0.44***	***0.54***	***0.02***	***73***
	Hatchery	***0.54***	***0.46***	***0.00***	***87***

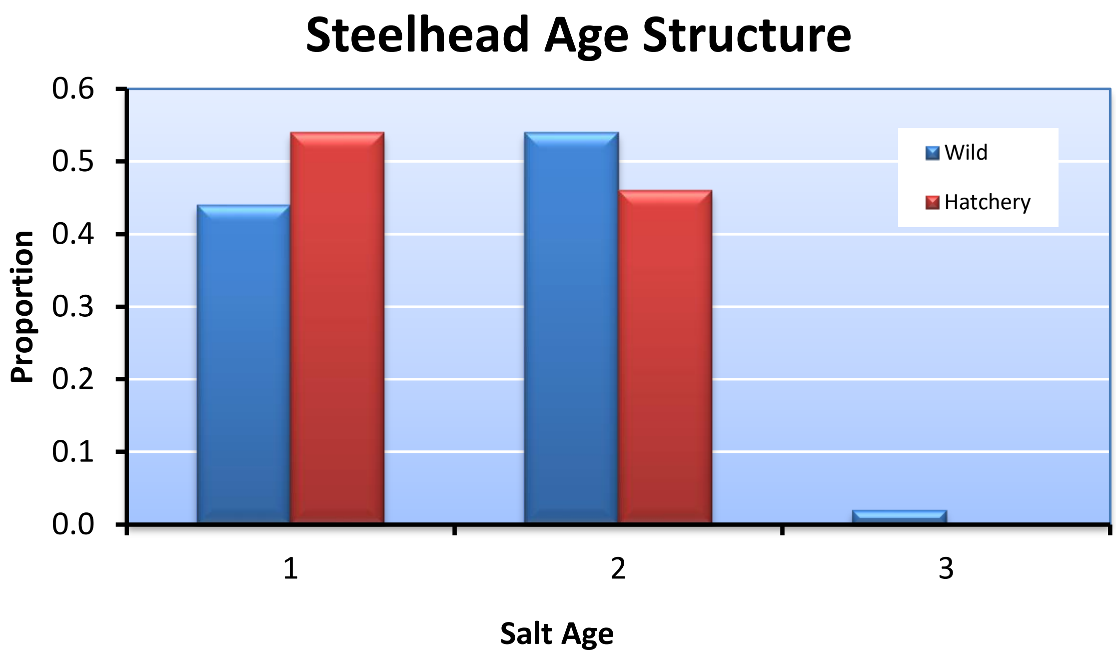


Figure 3.9. Proportions of wild and hatchery steelhead of different saltwater ages sampled at Tumwater Dam for the combined years 1998-2019.

Size at Maturity

On average, hatchery steelhead collected at Tumwater and Dryden dams were about 2 to 3 cm smaller than wild steelhead for 1- and 2-salt fish. No 3-salt steelhead were observed (Table 3.31).

Table 3.31. Mean fork length (cm) at age (saltwater ages) of hatchery and wild steelhead collected from broodstock, brood years 1998-2019; N = sample size and SD = 1 standard deviation.

Brood year	Origin	Steelhead fork length (cm)								
		1-Salt			2-Salt			3-Salt		
		Mean	N	SD	Mean	N	SD	Mean	N	SD
1998	Wild	63	15	4	79	20	5	-	0	-
	Hatchery	61	9	4	73	34	4	-	0	-
1999	Wild	65	29	5	74	28	5	77	1	-
	Hatchery	62	54	4	73	12	4	-	0	-
2000	Wild	64	22	3	74	17	5	-	0	-
	Hatchery	60	57	3	71	27	4	-	0	-
2001	Wild	61	33	6	77	31	5	-	0	-
	Hatchery	62	17	4	72	97	4	-	0	-
2002	Wild	64	55	4	77	44	4	-	0	-
	Hatchery	63	106	4	73	6	4	-	0	-
2003	Wild	69	8	6	77	52	5	91	1	-
	Hatchery	66	27	4	75	65	4	-	0	-
2004	Wild	63	73	6	78	4	2	-	0	-

Brood year	Origin	Steelhead fork length (cm)								
		1-Salt			2-Salt			3-Salt		
		Mean	N	SD	Mean	N	SD	Mean	N	SD
	Hatchery	61	59	3	73	3	1	-	0	-
2005	Wild	59	21	4	74	74	5	-	0	-
	Hatchery	59	23	4	72	89	4	-	0	-
2006	Wild	63	27	5	75	67	6	-	0	-
	Hatchery	61	41	4	72	27	5	-	0	-
2007	Wild	64	31	6	76	46	5	-	0	-
	Hatchery	60	60	4	71	36	5	-	0	-
2008	Wild	64	68	4	77	35	4	80	2	-
	Hatchery	60	95	4	72	12	2	-	0	-
2009	Wild	65	33	5	76	48	6	81	2	0
	Hatchery	63	18	4	75	59	5	-	0	-
2010	Wild	64	60	5	74	31	5	76	1	-
	Hatchery	61	53	5	73	23	5	-	0	-
2011	Wild	62	28	5	76	74	5	-	0	-
	Hatchery	60	36	4	74	64	4	-	0	-
2012	Wild	63	25	3	74	31	5	74	3	2
	Hatchery	59	27	3	74	39	4	-	0	-
2013	Wild	61	22	5	77	31	5	74	1	-
	Hatchery	60	35	3	74	42	4	-	0	-
2014	Wild	61	29	4	75	31	4	61	1	-
	Hatchery	60	20	3	72	48	4	-	0	-
2015	Wild	61	10	3	77	52	4	85	1	-
	Hatchery	59	26	3	76	29	5	-	0	-
2016	Wild	63	22	4	74	43	4	-	0	-
	Hatchery	61	28	4	71	38	5	-	0	-
2017	Wild	62	6	3	78	48	5	73	3	4
	Hatchery	60	7	2	75	60	5	93	1	-
2018	Wild	64	53	3	75	20	5	-	0	-
	Hatchery	62	84	3	65	1	-	-	0	-
2019	Wild	62	31	3	78	25	5	-	0	-
	Hatchery	60	30	5	75	37	4	-	0	-
Average	***Wild***	***63***	***32***	***4***	***76***	***39***	***5***	***77***	***1***	***2***
	Hatchery	***61***	***41***	***4***	***73***	***39***	***4***	***93***	***0***	***-***
Median	***Wild***	***63***	***29***	***4***	***76***	***33***	***5***	***77***	***0***	***2***
	Hatchery	***61***	***33***	***4***	***73***	***37***	***4***	***93***	***0***	***-***

Contribution to Fisheries

Nearly all harvest on Wenatchee steelhead occurs within the Columbia basin. Harvest rates on steelhead in the Lower Columbia River fisheries (both tribal and non-tribal) are generally less than 5-10% (NMFS 2004). A sport fishery may be opened on Upper Columbia River steelhead when the natural-origin steelhead run is predicted to exceed 1,300 fish at Priest Rapids Dam and the total Upper Columbia River steelhead run is predicted to exceed 9,550 steelhead. To minimize effects on natural-origin steelhead in the tributary fisheries, a three-tiered system as outlined in Permit 1395 is used to determine maximum allowable natural-origin steelhead take during the fishery (Table 3.32).

Table 3.32. Three-tiered system for determining natural-origin effects during the recreational fishery on steelhead in tributaries upstream from Rock Island Dam.

Tier	Wenatchee		Methow		Okanogan	
	NOR[1]	Effect[2]	NOR[1]	Effect[2]	NOR[1]	Effect[2]
No Fishery	≤ 599	0%	≤ 499	0%	≤ 119	0%
Tier 1	600	2%	500	2%	120	5%
Tier 2	1700	4%	1600	4%	120	7%
Tier 3	2500	6%	2500	6%	600	10%

[1] Estimated natural-origin escapement to tributaries.
[2] Maximum allowable take on natural-origin fish.

No selective recreational steelhead fishery was implemented in the upper Columbia River during fall 2016 through winter 2018 (Table 3.33). Over the eight years that the Wenatchee River had a recreational fishery, average harvest has been about 183 hatchery steelhead and 16 wild steelhead hook-and-release mortalities. In the mixed population fishery within the mainstem Columbia from Priest Rapids Dam to Chief Joseph Dam, the average harvest of hatchery steelhead has been 861steelhead with 17 wild hook-and-release mortalities.

Table 3.33. Harvest and mortality estimates for Upper Columbia steelhead in the Wenatchee and mainstem Columbia River (Priest Rapids Dam to Chief Joseph Dam). Estimated steelhead sport harvest on Wenatchee hatchery (H) steelhead and hook-and-release mortality on wild (W) steelhead (WDFW 2016). The wild steelhead mortality estimate is based on a hook-and-release mortality rate of 5%. Mainstem harvest from Priest Rapids Dam to Chief Joseph Dam is a mixed-population steelhead fishery that may contain fish from the Wenatchee, Entiat, Methow, and Okanogan rivers.

Year	Priest Rapids Escapement			Wenatchee			Mainstem Columbia		
	H	W	Total	H	W	Total	H	W	Total
2006-2007	8,738	1,677	10,415	-	-	-	694	3	697
2007-2008	12,160	3,097	15,257	444	15	459	1,137	13	1,150
2008-2009	13,528	3,030	16,558	-	-	-	921	10	931
2009-2010	32,557	7,439	39,996	251	17	268	1,448	29	1,477
2010-2011	18,792	7,639	26,431	106	12	118	1,412	40	1,452
2011-2012	15,910	4,896	20,806	250	19	269	855	22	877
2012-2013	13,908	3,284	17,192	125	26	151	722	20	744
2013-2014	10,415	4,657	15,072	135	17	152	506	9	515
2014-2015	13,836	5,930	19,766	99	14	113	99	14	113
2015-2016	9,955	4,348	14,303	56	8	64	678	13	690

Year	Priest Rapids Escapement			Wenatchee			Mainstem Columbia		
	H	W	Total	H	W	Total	H	W	Total
2016-2017	4,991	1,516	6,507	-	-	-	-	-	-
2017-2018	2,642	1,701	4,343	-	-	-	-	-	-
Average	***13,119***	***4,101***	***17,221***	***183***	***16***	***199***	***861***	***17***	***865***
Median	***12,844***	***3,816***	***15,908***	***130***	***16***	***152***	***855***	***13***	***811***

Origin on Spawning Grounds

With the implementation of PIT-tag mark-recapture techniques in 2014, we can estimate the contribution of natural-origin and hatchery-origin fish on the spawning grounds (Table 3.34). Based on mark-recapture estimates, naturally produced steelhead made up about 57.7% of the escapement in 2019. Importantly, the abundance of hatchery fish in the upper Wenatchee Basin is regulated through surplusing (removal) at Tumwater Dam. However, because of low steelhead returns in 2019, no surplusing of hatchery steelhead occurred in 2019.

Table 3.34. Spawning escapement estimates for natural-origin and hatchery-origin steelhead within the Wenatchee River, brood years 2014-2019; NS = not sampled. Escapement estimates were based on PIT-tag mark-recapture techniques (see Appendix E).

Year	Origin	Survey stream										Total
		Mission	Peshastin	Chumstick	Icicle	Chiwaukum	Chiwawa	Nason	L Wen	White	Wenatchee	
2014	Natural	94	226	78	76	37	142	190	NS	NS	340	***978***
	Hatchery	31	6	7	45	9	103	148	NS	NS	251	***545***
2015	Natural	71	206	38	83	48	168	237	NS	NS	252	***1,103***
	Hatchery	23	40	0	52	12	168	68	NS	NS	298	***661***
2016	Natural	33	151	74	72	64	45	57	NS	NS	118	***614***
	Hatchery	13	0	39	18	11	134	94	NS	NS	91	***400***
2017	Natural	20	37	12	11	0	12	24	NS	NS	116	***232***
	Hatchery	12	0	0	21	0	34	26	NS	NS	138	***231***
2018	Natural	54	80	16	49	20	25	32	6	0	34	***316***
	Hatchery	0	0	8	24	20	31	37	0	8	31	***159***
2019	Natural	12	50	8	11	0	22	15	0	0	96	***214***
	Hatchery	7	7	8	23	0	49	15	0	0	48	***157***

Straying

Stray rates of Wenatchee steelhead can be estimated by examining the locations where PIT-tagged hatchery steelhead were last detected. PIT tagging of steelhead began with brood year 2005, which allows estimation of stray rates by return year and brood return. These data only provide estimates for brood years 2005 through 2013, because later brood years are still rearing in the ocean. The most recent completed brood year is 2013. Targets for strays based on return year (recovery year) outside the Wenatchee River basin should be less than 5%.

Based on return year and PIT-tag analysis, hatchery-origin Wenatchee steelhead have strayed into the Entiat, Methow, and Okanogan basins[10] (Table 3.35). Before 2014, hatchery-origin Wenatchee

[10] Number of strays to each basin were expanded by tag rate and detection efficiency of individual interrogation arrays where steelhead were last detected.

steelhead generally made up more than 5% of the escapement in the Entiat and Methow rivers. Since then, they have made up less than 5% of the escapement in those basins. (Table 3.35). Few have strayed into the Okanogan River.

Table 3.35. Number and percent of PIT-based run escapements within non-target basins that consisted of hatchery-origin Wenatchee steelhead, spawn years 2011-2018. For example, for spawn year 2014, 1.9% of the steelhead escapement in the Entiat River basin consisted of hatchery-origin Wenatchee steelhead. Percent strays should be less than 5%.

Return year	Entiat River		Methow River		Okanogan River	
	Number	Percent	Number	Percent	Number	Percent
2011	94	11.0	238	6.2	0	0.0
2012	161	26.1	108	3.9	0	0.0
2013	49	13.3	151	5.8	10	1.1
2014	9	1.9	109	3.7	0	0.0
2015	17	2.7	11	0.3	0	0.0
2016	0	0.0	70	2.5	0	0.0
2017	0	0.0	0	0.0	15	2.5
2018	0	0.0	0	0.0	8	1.8
Average	***41***	***6.9***	***86***	***2.8***	***4***	***0.7***
Median	***13***	***2.3***	***89***	***3.1***	***0***	***0.0***

* Run escapement estimated at Wells Dam.

Based on brood year and PIT-tag analyses, about 9% of brood year 2013 was last detected in streams outside of the Wenatchee River basin. Beginning with brood year 2011, steelhead have been overwinter-acclimated at the Chiwawa Acclimation Facility. This may be the reason for the observed reduction in stray rates since 2011. On average, for brood years 2011 through 2013, about 5% of the hatchery steelhead returns were last detected in streams outside the Wenatchee River basin (Table 3.36). Steelhead have been detected in the Entiat and Methow rivers as well as in the Deschutes and Tucannon rivers. Several were last detected at Wells Dam. The numbers in Table 3.36 should be considered rough estimates because they are not based on confirmed spawning (only last detections).

Table 3.36. Number and percent of hatchery-origin Wenatchee steelhead that homed to target spawning areas and the target hatchery program, and number and percent that strayed to non-target spawning areas and hatchery programs for brood years 2005-2014. Estimates were based on last detections of PIT-tagged hatchery steelhead.

Brood Year	Homing				Straying			
	Target streams		Target hatchery*		Non-target stream		Non-target hatchery	
	Number	%	Number	%	Number	%	Number	%
2005	76	73.0	1	1.0	27	26.0	0	0.0
2006	818	60.4	3	2.4	504	37.2	0	0.0
2007	2,829	67.4	2	0.5	1,349	32.1	0	0.0
2008	1,389	88.1	2	1.4	165	10.5	0	0.0
2009	2,585	86.8	2	0.7	371	12.5	0	0.0

Brood Year	Homing				Straying			
	Target streams		Target hatchery*		Non-target stream		Non-target hatchery	
	Number	%	Number	%	Number	%	Number	%
2010	712	78.8	1	1.0	182	20.2	0	0.0
2011	948	89.6	13	8.4	21	2.0	0	0.0
2012	1,573	90.6	9	5.1	75	4.3	0	0.0
2013	498	88.3	1	2.7	51	9.0	0	0.0
Average	***1,270***	***80.3***	***4***	***2.6***	***305***	***17.1***	***0***	***0.0***
Median	***948***	***86.8***	***2***	***1.4***	***165***	***12.5***	***0***	***0.0***

* Homing to the target hatchery includes Wenatchee hatchery steelhead that are captured and included as broodstock in the Wenatchee Hatchery program. These hatchery fish are typically collected at Dryden and Tumwater dams.

Genetics

Genetic studies were conducted in 2012 to determine the potential effects of the Wenatchee Supplementation Program on natural-origin summer steelhead in the Wenatchee River basin (Seamons et al. 2012; the entire report is appended as Appendix F). Temporal collections were obtained from hatchery and natural-origin adult summer steelhead captured at Dryden and Tumwater dams during summer and fall of 1997 through 2009 (excepting 2004 and 2005). Natural-origin steelhead consisted of a mixed collection representing all the spawning subpopulations located upstream. Therefore, to determine population substructure within the basin, samples were also taken from juvenile steelhead collected at smolt traps located within the Chiwawa River, Nason Creek, and Peshastin Creek, and from the Entiat River. Samples were also taken from juvenile steelhead collected at the smolt trap in the lower Wenatchee River. These, like natural-origin adult collections, consisted of a mixed collection representing all subpopulations located upstream. A total of 1,468 hatchery-origin and natural-origin adults were processed and 1,542 juvenile steelhead from the Wenatchee and Entiat Rivers were processed for genetic variation with 132 genetic (single nucleotide polymorphism loci; SNPs) markers. Peshastin Creek and the Entiat River served as no-hatchery-outplant controls. Genetic data were interrogated for the presence or absence of spatial and temporal trends in allele frequencies, genetic distances, and effective population size.

Allele Frequencies—Changes to the summer steelhead hatchery supplementation program had no detectable effect on genetic diversity of wild populations. On average, hatchery-origin adults had higher minor allele frequencies (MAF) than natural-origin adults, which may simply reflect the mixed ancestry of hatchery adults. Both hatchery and natural-origin adults had MAF similar to juveniles collected in spawning tributaries and in the Entiat River. There was no temporal trend in allele frequencies or observed heterozygosity in adult or juvenile collections and allele frequencies in control populations were no different than those still receiving hatchery outplants. This suggests that the hatchery program has had little effect on allele frequencies since broodstock sources changed in 1998 from mixed-ancestry broodstock collected in the Columbia River to using broodstock collected in the Wenatchee River.

Genetic Distances—As intended, interbreeding of Wenatchee River hatchery and natural-origin adults reduced the genetic differences between Wells Hatchery adults and Wenatchee River natural-origin adults observed in the first few years after changing the broodstock collection protocol. Although there were detectable genetic differences between hatchery and natural-origin adults, the magnitude of that difference declined over time. Hatchery adults were genetically different from natural-origin adults and juveniles based on pair-wise F_{ST} and principal components analysis, most likely because of the smaller effective population size (N_b) in the hatchery population (see below). Pair-wise F_{ST} estimates and genetic distances between hatchery and natural-origin adults collected the same year declined over time suggesting that the interbreeding of hatchery and natural-origin adults in the hatchery (and presumably in the wild) is slowly homogenizing Wenatchee River summer steelhead. Analyses using brood year were inconclusive because of limitations in the data.

Effective Population Size—Although the effective population size of the Wenatchee River hatchery steelhead program was consistently small, it does not appear to have caused a reduction in the effective population size of wild populations. On average, estimates of N_b were much lower and varied less for hatchery adults than for natural-origin adults and juveniles. Estimates of N_b for hatchery adults declined from the earliest brood years to a stable new low value after broodstock practices were changed in 1998. There was no indication that this had any effect on N_b in natural-origin adults and juveniles; N_b estimates for natural-origin adults and juveniles were, on average, higher and varied considerably over the 1998-2010 period and showed no temporal trend.

It is important to note that no new information will be reported on genetics until the next comprehensive report (data collected through 2018).

Proportionate Natural Influence

Another method for assessing the genetic risk of a supplementation program is to determine the influence of the hatchery and natural environments on the adaptation of the composite population. This is estimated by the proportion of natural-origin fish in the hatchery broodstock (pNOB) and the proportion of hatchery-origin fish in the natural spawning escapement (pHOS). We calculated Proportionate Natural Influence (PNI) by iterating Ford's (2002) equations 5 and 6 to equilibrium, using a heritability of 0.3 and a selection strength of three standard deviations.[11] The larger the PNI value, the greater the strength of selection in the natural environment relative to that of the hatchery environment. For the natural environment to dominate selection, PNI should be greater than 0.50, and integrated populations should have a PNI of at least 0.67 (HSRG/WDFW/NWIFC 2004). For the Wenatchee steelhead program, PNI criteria are implemented in accordance with Permit 18583 to achieve a basin-wide, five-year running average of PNI $\geq$ 0.67. In years when the natural-origin escapement is low (i.e., < 433 fish), the Wenatchee steelhead population will be managed to meet escapement goals rather than PNI.

For brood years 2014-2019 (period when basin-wide estimates are available based on mark-recapture methods), PNI values were less than 0.67 and the five-year running average ranged from 0.53 to 0.55 (Table 3.37), suggesting that the hatchery environment has a greater influence on adaptation of Wenatchee steelhead than does the natural environment. Because of low escapement, the Wenatchee steelhead population was managed to meet escapement goals rather than PNI in one (brood year 2017) out of five brood years.

[11] According to authorized annual take permits, PNI is calculated using the PNI approximate equation 11 (HSRG 2009; Appendix A). However, in this report, we used Ford's (2002) equations 5 and 6 with a heritability of 0.3 and a selection strength of three standard deviations to calculate PNI (C. Busack, NOAA Fisheries, 21 March 2016, provided the model for calculating PNI). This approach is more accurate than using the PNI approximate equation.

Table 3.37. Proportionate Natural Influence (PNI) values for the Wenatchee steelhead supplementation program for brood years 2001-2019. NOS = number of natural-origin steelhead on the spawning grounds; HOS = number of hatchery-origin steelhead on the spawning grounds; NOB = number of natural-origin steelhead collected for broodstock; and HOB = number of hatchery-origin steelhead included in hatchery broodstock. PNI estimates for the period 2001-2013 are based on estimates of spawners upstream from Tumwater Dam; PNI estimates for the period 2014-present are based on mark-recapture modeling for the entire Wenatchee River basin.

Brood year	Spawners[a]			Broodstock			PNI[b]	PNI (5-yr mean)
	NOS	HOS	pHOS	NOB	HOB	pNOB		
2001	158	127	0.45	51	103	0.33	0.45	--
2002	731	542	0.43	96	64	0.60	0.59	--
2003	355	350	0.50	49	90	0.35	0.43	--
2004	371	445	0.55	75	61	0.55	0.51	--
2005	690	862	0.56	87	104	0.46	0.47	0.49
2006	253	210	0.45	93	69	0.57	0.57	0.51
2007	145	115	0.44	76	58	0.57	0.58	0.51
2008	168	279	0.62	77	54	0.59	0.50	0.53
2009	171	545	0.76	86	73	0.54	0.43	0.51
2010	524	970	0.65	96	75	0.56	0.48	0.51
2011	351	472	0.57	91	70	0.57	0.51	0.50
2012	381	209	0.35	59	65	0.48	0.59	0.50
2013	322	148	0.31	49	68	0.42	0.59	0.52
Average[c]	***355***	***406***	***0.51***	***76***	***73***	***0.51***	***0.52***	***0.51***
Median[c]	***351***	***350***	***0.50***	***77***	***69***	***0.55***	***0.51***	***0.51***
2014	901	477	0.35	62	66	0.48	0.59	--
2015	988	711	0.42	58	52	0.53	0.57	--
2016	587	372	0.39	64	66	0.49	0.57	--
2017	198	232	0.54	56	63	0.47	0.48	--
2018	324	165	0.34	70	75	0.48	0.52	0.55
2019	188	157	0.46	56	60	0.48	0.53	0.53
Average[d]	***531***	***352***	***0.41***	***61***	***64***	***0.49***	***0.54***	***0.54***
Median[d]	***456***	***302***	***0.40***	***60***	***65***	***0.48***	***0.55***	***0.54***

[a] The presence of eroded fins or missing adipose fins was used to distinguish hatchery fish from wild fish during video monitoring at Tumwater Dam. Unknown-origin fish (i.e., undetermined by scale analysis, no elastomer, no CWT, no fin clips, and no additional hatchery marks) were considered naturally produced. Therefore, because not all hatchery fish have eroded fins or missing adipose fins, it is likely we are underestimating WxW-cross hatchery steelhead returns based on video monitoring. The PNI estimates are appropriate for steelhead spawning upstream from Tumwater Dam but may not represent PNI for steelhead spawning downstream from Tumwater Dam. Dam.

[b] PNI was calculated previously using PNI approximate equation 11 (HSRG 2009; their Appendix A). All PNI values presented here were recalculated by iterating Ford's (2002) equations 5 and 6 to equilibrium using a heritability of 0.3 and a selection strength of three standard deviations. C. Busack, NOAA Fisheries, 21 March 2016, provided the model for calculating PNI.

[c] Descriptive statistics using escapements estimated upstream from Tumwater Dam.

[d] Descriptive statistics using escapement estimates based on mark-recapture modeling.

Post-Release Survival and Travel Time

We used PIT-tagged fish to estimate survival rates and travel time (arithmetic mean days) of hatchery steelhead from release sites (e.g., Chiwawa River, Nason Creek, and Wenatchee River) to McNary Dam, and smolt to adult ratios (SARs) from release to detection at Bonneville Dam (Table 3.38).[12] Over the 15 brood years for which PIT-tagged hatchery fish are available, survival rates from the release sites to McNary Dam ranged from 0.055 to 0.785 (note that survival rates of 0.000 were associated with very small sample sizes); SARs from release to detection at Bonneville Dam ranged from 0.000 to 0.038. Average travel time from the release sites to McNary Dam ranged from 10 to 100 days.

All PIT-tagged fish were released on the same day and in the same location (Chiwawa River) since 2018 (brood year 2017). Fish overwinter acclimated in circular vessels that were WxW origin had higher survival and generally shorter travel times than both WxW and HxH origin fish reared in the raceway. Travel times and survival to McNary Dam were variable for WxW and HxH fish overwinter acclimated in the raceway.

Table 3.38. Total number of Wenatchee hatchery summer steelhead released with PIT tags, their survival and travel times (mean days) to McNary Dam, and smolt-to-adult (SAR) ratios for brood years 2005-2018. SARs were estimated to Bonneville Dam. Standard errors are shown in parentheses. NA = not available (i.e., for SARs, not all the adults from the release groups have returned to the Columbia River).

Brood year	Release location[a]	Crosses[b]	Type of release	Rearing scenario[c]	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
2003	Chiwawa	HxW	NA	Turtle Rock	29,801	0.755 (0.029)	18.2 (16.7)	0.003 (0.000)
	Nason	WxW	NA	Turtle Rock	34,823	0.648 (0.026)	19.3 (19.6)	0.004 (0.000)
	Wenatchee	HxH	NA	Turtle Rock	30,018	0.767 (0.030)	18.1 (20.6)	0.003 (0.000)
2004	Chiwawa	HxW	NA	Turtle Rock	2,439	0.480 (0.037)	26.9 (59.5)	0.011 (0.002)
	Chiwawa	WxW	NA	Turtle Rock	853	0.485 (0.054)	21.1 (8.8)	0.008 (0.003)
	Nason	WxW	NA	Turtle Rock	8,826	0.412 (0.017)	26.7 (56.1)	0.010 (0.001)
	Wenatchee	HxH	NA	Turtle Rock	9,705	0.621 (0.022)	15.8 (6.3)	0.033 (0.002)
	Wenatchee	HxW	NA	Turtle Rock	7,379	0.606 (0.029)	19.3 (7.4)	0.013 (0.001)
2005	Chiwawa	HxW	NA	Turtle Rock	3,448	0.540 (0.065)	22.6 (27.2)	0.017 (0.002)
	Chiwawa	WxW	NA	Turtle Rock	717	0.521 (0.128)	22.2 (8.0)	0.013 (0.004)
	Nason	WxW	NA	Turtle Rock	7,306	0.416 (0.031)	21.3 (9.2)	0.009 (0.001)
	Wenatchee	HxH	NA	Turtle Rock	8,610	0.656 (0.057)	20.1 (35.8)	0.017 (0.001)
	Wenatchee	HxW	NA	Turtle Rock	5,021	0.649 (0.074)	20.2 (9.0)	0.014 (0.002)
2006	NA	NA	NA	NA	NA	NA	NA	NA
2007	Chiwawa	HxW	NA	Turtle Rock	2,882	0.520 (0.057)	22.3 (7.9)	0.020 (0.003)
	Chiwawa	WxW	NA	Turtle Rock	785	0.467 (0.069)	18.7 (9.0)	0.038 (0.007)

[12] It is important to point out that because of fish size differences among rearing tanks or raceways, fish PIT tagged in one tank or raceway may not represent untagged fish rearing in other tanks or raceways.

Brood year	Release location[a]	Crosses[b]	Type of release	Rearing scenario[c]	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
	Nason	WxW	NA	Turtle Rock	8,060	0.505 (0.030)	22.3 (24.1)	0.030 (0.002)
	Wenatchee	HxW	NA	Turtle Rock	9,047	0.631 (0.041)	18.2 (17.2)	0.038 (0.002)
2008	Chiwawa	HxW L	NA	Turtle Rock	2,008	0.574 (0.080)	20.3 (7.0)	0.006 (0.002)
	Chiwawa	WxW	NA	Turtle Rock	1,457	0.546 (0.090)	31.6 (108.5)	0.010 (0.003)
	Nason	WxW	NA	Turtle Rock	7,951	0.500 (0.037)	21.4 (17.5)	0.014 (0.001)
	Wenatchee	HxW E	NA	Turtle Rock	4,517	0.510 (0.044)	19.5 (7.7)	0.008 (0.001)
	Wenatchee	HxW L	NA	Turtle Rock	6,710	0.545 (0.038)	19.3 (6.8)	0.010 (0.001)
2009	Chiwawa	HxW E	Forced	Turtle Rock	4,874	0.576 (0.076)	24.3 (8.3)	0.012 (0.002)
	Chiwawa	HxW E	Volitional	Chiw. Circ	8,653	0.785 (0.100)	19.4 (26.0)	0.007 (0.001)
	Nason	WxW	Forced	Turtle Rock	8,918	0.504 (0.042)	27.2 (26.6)	0.017 (0.001)
	Wenatchee	HxW E	Forced	Turtle Rock	11,300	0.543 (0.041)	25.8 (54.8)	0.014 (0.001)
	Wenatchee	HxW E	Forced	Turtle Rock	6,681	0.597 (0.063)	28.9 (72.2)	0.013 (0.001)
	Wenatchee	HxW L	Forced	Turtle Rock	4,619	0.478 (0.052)	21.7 (7.6)	0.015 (0.002)
	Wenatchee	HxW E	Volitional	Blackbird	2,184	0.317 (0.054)	80.4 (11.7)	0.010 (0.002)
	Wenatchee	WxW	Volitional	Rohlfing	566	0.443 (0.187)	78.1 (8.6)	0.014 (0.005)
2010	Chiwawa	WxW	Forced	Turtle Rock	4,226	0.586 (0.057)	24.4 (60.1)	0.009 (0.001)
	Nason	WxW	Forced	Turtle Rock	5,256	0.548 (0.044)	23.5 (53.3)	0.010 (0.001)
	Wenatchee	HxH	Forced	Turtle Rock	8,506	0.582 (0.053)	30.2 (50.1)	0.004 (0.001)
	Wenatchee	HxH	Volitional	Blackbird	9,858	0.629 (0.046)	17.9 (17.4)	0.006 (0.001)
	Wenatchee	HxH	Volitional	Chiw. Circ	10,031	0.412 (0.043)	21.6 (66.1)	0.001 (0.000)
2011	Chiwawa	WxW	Volitional	RCY	3,603	0.403 (0.056)	15.1 (8.3)	0.005 (0.001)
	Nason	WxW	Volitional	RCY	4,065	0.330 (0.042)	20.9 (60.9)	0.005 (0.001)
	Wenatchee	WxW	Non-movers	Circular	1,122	0.341 (0.220)	40.6 (89.1)	0.000 (--)
	Wenatchee	WxW	Non-movers	RCY	2,395	0.312 (0.071)	22.7 (57.0)	0.004 (0.001)
	Wenatchee	WxW	Volitional	Blackbird	2,099	0.378 (0.067)	48.2 (90.0)	0.010 (0.002)
	Wenatchee	WxW	Volitional	Circular	7,206	0.275 (0.042)	31.6 (74.3)	0.006 (0.001)
	Wenatchee	WxW	Volitional	RCY	4,422	0.323 (0.032)	15.2 (25.6)	0.008 (0.001)
	All	WxW	NA	Circular	1,628	0.055 (0.016)	100.4 (151.7)	0.002 (0.001)
	All	WxW	NA	RCY	3,479	0.229 (0.031)	13.6 (8.4)	0.004 (0.001)
2012	Chiwawa	HxH	Volitional	RCY	2,891	0.397 (0.055)	15.2 (7.2)	0.010 (0.002)
	Nason	WxW	Forced	Circular	4,271	0.376 (0.064)	25.0 (33.1)	0.007 (0.001)
	Nason	WxW	Volitional	Circular	5,404	0.364 (0.048)	24.9 (31.6)	0.007 (0.001)
	L Wenatchee	HxH	Forced	RCY	587	0.146 (0.086)	52.2 (114.7)	0.000 (--)

Brood year	Release location[a]	Crosses[b]	Type of release	Rearing scenario[c]	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
	U Wenatchee	HxH	Volitional	RCY	2,224	0.573 (0.138)	18.7 (8.4)	0.010 (0.002)
	U Wenatchee	HxH	Forced	RCY	1,969	0.603 (0.140)	24.7 (42.5)	0.012 (0.002)
	Wenatchee	HxH	Volitional	Blackbird	1,658	0.400 (0.095)	50.0 (7.6)	0.004 (0.002)
	All	HxH	NA	RCY	769	0.293 (0.146)	97.3 (286.2)	0.004 (0.002)
	All	WxW	NA	Circular	5,397	0.327 (0.049)	25.4 (45.0)	0.007 (0.001)
2013	Chiwawa	Mixed	Volitional	RCY	1,567	0.356 (0.064)	15.2 (7.0)	0.010 (0.002)
	Nason	Mixed	Volitional	RCY	3,796	0.448 (0.115)	20.2 (9.4)	0.005 (0.001)
	Nason	Mixed	Volitional	Circ or RCY	308	0.146 (0.053)	17.4 (2.9)	0.003 (0.003)
	Nason	WxW	Non-movers	Circular	74	-- (-)	-- (-)	0.014 (0.013)
	Nason	WxW	Volitional	Circular	1,286	0.190 (0.062)	18.4 (6.4)	0.005 (0.002)
	L Wenatchee	Mixed	Non-movers	RCY	3,275	0.317 (0.131)	35.3 (69.5)	0.001 (0.001)
	U Wenatchee	Mixed	Volitional	RCY	2,862	0.455 (0.080)	16.3 (9.7)	0.008 (0.002)
	Wenatchee	HxH	Volitional	Blackbird	819	0.337 (0.128)	33.5 (11.9)	0.002 (0.002)
	All	HxH	NA	RCY	907	-- (-)	36.7 (17.6)	0.000 (-)
	All	WxW	NA	Circ or RCY	232	-- (--)	38.0 (--)	0.004 (0.004)
2014	Chiwawa	Mixed	Movers	RCY	793	0.754 (0.497)	27.7 (7.6)	0.000 (-)
	Chiwawa	Mixed	Non-screen	RCY	915	0.367 (0.236)	25.0 (8.1)	0.000 (-)
	Nason	Mixed	Movers	RCY	1,553	0.216 (0.084)	28.4 (29.4)	0.000 (-)
	Nason	Mixed	Non-screen	RCY	1,653	0.076 (0.018)	24.2 (7.1)	0.000 (-)
	Nason	WxW	Movers	Circular	949	0.244 (0.104)	47.4 (91.0)	0.000 (-)
	Nason	WxW	Non-screen	Circular	873	0.369 (0.190)	20.8 (6.9)	0.000 (-)
	L Wenatchee	Mixed	Non-movers	RCY	2,596	0.139 (0.026)	26.4 (59.5)	0.000 (0.000)
	U Wenatchee	Mixed	Movers	RCY	2,042	0.278 (0.051)	21.9 (8.2)	0.000 (-)
	U Wenatchee	Mixed	Non-screen	RCY	1,563	0.126 (0.026)	28.7 (8.2)	0.000 (-)
	U Wenatchee	WxW	Movers	Circular	356	0.278 (0.165)	17.0 (6.5)	0.000 (-)
	U Wenatchee	WxW	Non-movers	Circular	596	0.381 (0.192)	15.8 (6.8)	0.000 (-)
	U Wenatchee	WxW	Non-screen	Circular	1,230	0.349 (0.104)	25.8 (57.4)	0.000 (-)
	Wenatchee	HxH	Volitional	Blackbird	1,814	0.225 (0.055)	31.0 (9.8)	0.000 (-)
	All	Mixed	NA	Circ or RCY	1,884	0.113 (0.030)	41.7 (61.8)	0.000 (-)
2015	Chiwawa	Mixed	Movers	RCY	4,365	0.418 (0.039)	13.6 (5.7)	NA
	Nason	Mixed	Mixed	RCY	675	0.173 (0.037)	30.5 (61.8)	NA
	Nason	Mixed	Movers	RCY	2,427	0.335 (0.054)	23.8 (61.0)	NA
	Nason	Mixed	Non-movers	RCY	2,123	0.278 (0.057)	20.0 (7.6)	NA

Brood year	Release location[a]	Crosses[b]	Type of release	Rearing scenario[c]	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
	Nason	WxW	Movers	Circular	1,105	0.416 (0.083)	15.5 (5.3)	NA
	Nason	WxW	Non-movers	Circular	916	0.408 (0.113)	14.9 (5.1)	NA
	L Wenatchee	Mixed	Non-movers	RCY	1,658	0.252 (0.075)	13.0 (6.5)	NA
	U Wenatchee	Mixed	Movers	RCY	2,773	0.342 (0.032)	16.3 (7.9)	NA
	U Wenatchee	Mixed	Non-movers	RCY	1,435	0.469 (0.094)	19.7 (8.9)	NA
	U Wenatchee	WxW	Movers	Circular	1,061	0.555 (0.079)	13.9 (7.3)	NA
	U Wenatchee	WxW	Non-movers	Circular	849	0.362 (0.065)	12.7 (5.5)	NA
	Wenatchee	HxH	Vlitional	Blackbird	2,337	0.364 (0.039)	42.1 (8.5)	NA
	All	Mixed	NA	Circ or RCY	1,381	0.167 (0.105)	19.4 (10.8)	NA
2016	Chiwawa	Mixed	Movers	RCY	2,254	0.382 (0.093)	16.9 (9.8)	NA
	Nason	Mixed	Mixed	RCY	1,084	0.392 (0.136)	21.8 (9.9)	NA
	Nason	WxW	Movers	Circular	3,436	0.227 (0.044)	21.1 (11.5)	NA
	Nason	WxW	Non-movers	Circular	753	--	90.6 (155.2)	NA
	L Wenatchee	Mixed	Non-movers	RCY	2,134	0.285 (0.114)	45.1 (102.5)	NA
	M Wenatchee	Mixed	Non-movers	RCY	3,452	0.135 (0.030)	54.8 (109.1)	NA
	U Wenatchee	Mixed	Movers	RCY	2,712	0.312 (0.063)	14.8 (6.5)	NA
	Wenatchee	HxH	Volitional	Blackbird	2,512	0.209 (0.055)	25.9 (11.1)	NA
	All	Mixed	NA	Circ or RCY	1,481	0.200 (0.096)	9.7 (7.7)	NA
2017	Chiwawa	HxH	Forced	RCY	10,876	0.213 (0.039)	29.4 (46.7)	NA
	Chiwawa	WxW	Forced	RCY	10,828	0.194 (0.025)	30.6 (42.9)	NA
	Chiwawa	WxW	Forced	Circular	11,036	0.540 (0.083)	22.1 (35.9)	NA
2018	Chiwawa	HxH	Forced	RCY	10,138	0.206 (0.035)	18.1 (5.8)	NA
	Chiwawa	WxW	Forced	RCY	10,065	0.286 (0.057)	21.2 (9.6)	NA
	Chiwawa	WxW	Forced	Circular	5,518	0.328 (0.063)	19.6 (7.6)	NA
	Chiwawa	WxW	Forced	Circular	5,535	0.341 (0.059)	18.2 (6.7)	NA

[a] All = Chiwawa River, Nason Creek, and the Wenatchee River.
[b] HxH = hatchery by hatchery cross; WxW = wild by wild cross; Mixed = both HxH and WxW crosses; E = early; and L = late.
[c] Circ = circulars; RCY = raceway.

We also used PIT-tags to estimate survival rates and travel time (arithmetic mean days) of wild steelhead smolts tagged at the Chiwawa, Nason, and Lower Wenatchee smolt trap. Survival rates and travel times were estimated from the traps to McNary Dam, and smolt to adult ratios (SARs) from the traps to returning adults detected at Bonneville Dam (Table 3.40). Over the survey years for which wild steelhead smolts were tagged and released at the traps, survival rates from the Chiwawa River to McNary Dam ranged from 0.027 to 0.309; SARs from release to detection at Bonneville Dam ranged from 0.001 to 0.017. Average travel time from Chiwawa River to McNary

Dam ranged from 80 to 259 days. Survival rates from Nason Creek to McNary Dam ranged from 0.000 to 0.141; SARs from release to detection at Bonneville Dam ranged from 0.000 to 0.012. Average travel time from Nason Creek to McNary Dam ranged from 239 to 532 days. Survival rates from the Lower Wenatchee River to McNary Dam ranged from 0.000 to 0.630; SARs from release to detection at Bonneville Dam ranged from 0.000 to 0.042. Average travel time from the Lower Wenatchee River to McNary Dam ranged from 4 to 85 days.

Table 3.39. Total number of wild steelhead smolts released with PIT tags at the Chiwawa, Nason, and Lower Wenatchee traps, their survival and travel times (mean days) to McNary Dam, and smolt-to-adult (SAR) ratios for available survey years. Standard errors are shown in parentheses. NA = not available (i.e., not all the adults from the release groups have returned to the Columbia River).

Survey year	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
Chiwawa River Trap				
2006	1,287	0.053 (0.013)	247.2 (196.3)	0.008 (0.002)
2007	833	0.155 (0.045)	205.2 (183.6)	0.017 (0.004)
2008	1,420	0.165 (0.035)	203.7 (203.8)	0.008 (0.002)
2009	1,129	0.160 (0.059)	79.5 (101.0)	0.005 (0.002)
2010	941	0.092 (0.052)	163.7 (162.0)	0.001 (0.001)
2011	976	0.200 (0.055)	116.6 (181.1)	0.009 (0.003)
2012	1,004	0.296 (0.190)	209.6 (237.1)	0.006 (0.002)
2013	1,267	0.309 (0.290)	189.1 (166.2)	0.003 (0.002)
2014	1,206	0.037 (0.020)	258.8 (119.6)	0.001 (0.001)
2015	1,796	0.088 (0.024)	186.9 (163.5)	0.002 (0.001)
2016	1,313	0.060 (0.022)	123.7 (148.9)	0.002 (0.001)
2017	910	0.273 (0.250)	122.1 (182.4)	NA
2018	436	--	158.5 (268.5)	NA
2019	1,198	0.027 (0.009)	163.8 (198.8)	NA
Nason Creek Trap				
2006	1,350	0.113 (0.030)	283.3 (180.3)	0.007 (0.002)
2007	1,702	0.141 (0.048)	309.6 (145.2)	0.012 (0.003)
2008	2,342	0.105 (0.022)	320.4 (242.3)	0.004 (0.001)
2009	1,207	0.128 (0.079)	239.0 (218.1)	0.002 (0.001)
2010	1,839	0.094 (0.034)	287.9 (277.7)	0.004 (0.002)
2011	1,075	0.047 (0.026)	319.3 (202.3)	0.002 (0.001)
2012	1,101	--	453.4 (222.4)	0.003 (0.002)
2013	1,997	0.090 (0.083)	433.9 (231.1)	0.001 (0.001)

Survey year	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
2014	835	0.038 (0.013)	350.6 (285.7)	0.000 (-)
2015	380	--	304.0 (157.0)	0.000 (-)
2016	528	0.031 (0.012)	314.3 (252.6)	0.004 (0.003)
2017	1,353	--	443.6 (143.8)	NA
2018	539	0.030 (0.021)	532.0 (222.0)	NA
2019	319	--	372.5 (10.6)	NA
Lower Wenatchee River Trap				
2006	130	0.508 (0.223)	11.8 (6.6)	0.015 (0.011)
2007	461	0.535 (0.091)	17.4 (52.4)	0.030 (0.008)
2008	286	0.330 (0.082)	85.1 (147.5)	0.042 (0.012)
2009	227	0.465 (0.110)	10.1 (4.5)	0.022 (0.010)
2010	462	0.380 (0.102)	40.1 (97.8)	0.011 (0.005)
2011	0	--	--	--
2012	0	--	--	--
2013	622	0.102 (0.046)	13.7 (9.8)	0.008 (0.004)
2014	131	0.305 (0.253)	19.8 (22.6)	0.023 (0.013)
2015	290	0.630 (0.261)	47.9 (105.0)	0.010 (0.006)
2016	131	--	13.2 (6.5)	0.000 (-)
2017	104	--	4.0 (-)	NA
2018	222	--	50.3 (125.2)	NA
2019	182	--	16.0 (-)	NA

Natural and Hatchery Replacement Rates

Natural replacement rates (NRR) were calculated as the ratio of natural-origin recruits (NOR) to the parent spawning population (spawning escapement). Natural-origin recruits are naturally produced (wild) fish that survive to contribute to harvest (directly or indirectly), to broodstock, and to spawning grounds. We do not account for fish that died in route to the spawning grounds (migration mortality) or died just before spawning (pre-spawn mortality) (see Appendix B in Hillman et al. 2012). For brood years 1998-2013, NRR for summer steelhead in the Wenatchee River basin averaged 0.72 (range, 0.09-2.10) if harvested fish were included in the estimate (Table 3.40).

Hatchery replacement rates (HRR) are the hatchery adult-to-adult returns and were calculated as the ratio of hatchery-origin recruits (HOR) to the parent broodstock collected. These rates should be greater than the NRRs and greater than or equal to 6.9 (the calculated target value in Hillman et al. 2019). The target value of 6.9 includes harvest. In all years, HRRs were greater than NRRs

(Table 3.40). HRRs averaged 11.04 and exceeded the estimated target value of 6.9 in 8 of the 16 years.

Table 3.40. Broodstock collected, spawning escapements (based on run reconstruction for the entire Wenatchee River basin), natural and hatchery-origin recruits (NOR and HOR), and natural and hatchery replacement rates (NRR and HRR with harvest) for summer steelhead in the Wenatchee River basin, brood years 1998-2013.

Brood year	Broodstock Collected	Spawning Escapement[a]	Harvest included			
			HOR	NOR	HRR	NRR
1998	78	604	367	1,267	4.71	2.10
1999	125	345	4,312	501	34.50	1.45
2000	120	1,049	691	1,075	5.76	1.02
2001	178	1,656	4,575	1,085	25.70	0.66
2002	162	5,050	1,035	464	6.39	0.09
2003	155	2,598	1,020	566	6.58	0.22
2004	140	2,940	501	787	3.58	0.27
2005	207	3,609	2,442	1,483	11.80	0.41
2006	167	2,212	1,424	2,926	8.53	1.32
2007	150	869	3,741	1,384	24.94	1.59
2008	164	1,831	1,013	1,230	6.18	0.67
2009	166	1,734	1,664	1,145	10.02	0.66
2010	198	5,564	966	1,947	4.88	0.35
2011	204	2,304	521	907	2.55	0.39
2012	128	2,039	1,298	384	10.14	0.19
2013	142	936	1,471	152	10.36	0.16
Average	***155***	***2,209***	***1,690***	***1,081***	***11.04***	***0.72***
Median	***159***	***1,935***	***1,167***	***1,080***	***7.55***	***0.53***

[a] Spawning escapement is based on run reconstruction for the entire Wenatchee River basin.

Smolt-to-Adult Survivals

Smolt-to-adult ratios (SARs) are calculated as the number of returning hatchery adults divided by the number of tagged hatchery smolts released. SARs are generally based on CWT returns. However, prior to brood year 2011, Wenatchee steelhead were not extensively tagged with CWTs. Therefore, elastomer-tagged fish were used to estimate SARs from release to capture at Priest Rapids Dam. With the return of brood year 2011, SARs are based on PIT-tag detections at Bonneville Dam.

SARs (not adjusted for tag loss) for Wenatchee steelhead ranged from 0.0009 to 0.0315 (mean = 0.0093) for brood years 1996-2010 (Table 3.41). For brood years 2011 to present, SARs (to Bonneville Dam) averaged 0.0039 (Table 3.41).

Table 3.41. Smolt-to-adult ratios (SARs) for Wenatchee hatchery steelhead. Estimates for brood years 1996-2010 were based on elastomer tags recaptured at Priest Rapids Dam. SARs were not adjusted for tag loss after release. For brood years 2011 to present, SARs are based on PIT-tag detections to Bonneville Dam.

Brood year	Number of tagged smolts released	SAR
1996	348,693	0.0034
1997	429,422	0.0041
1998	172,078	0.0009
1999	175,661	0.0111
2000	184,639	0.0017
2001	335,933	0.0308
2002	302,060	0.0063
2003	374,867	0.0025
2004	294,114	0.0038
2005	452,184	0.0107
2006	258,697	0.0100
2007	306,690	0.0315
2008	327,133	0.0090
2009	484,826	0.0080
2010[a]	192,363	0.0054
Average	***309,291***	***0.0093***
Median	***306,690***	***0.0063***
2011	30,019	0.0057
2012	25,134	0.0055
2013	15,109	0.0042
2014	18,817	0.0001
Average	***22,270***	***0.0039***
Median	***21,976***	***0.0049***

[a] Only 192,363 WxW progeny from brood year 2010 were elastomer tagged; 161,951 HxH steelhead were released.

3.7 ESA/HCP Compliance

Broodstock Collection

Collection of brood year 2018 broodstock for Wenatchee summer steelhead at Dryden and Tumwater dams began on 26 July and ended on 27 October 2017 at Dryden Dam and 31 October 2017 at Tumwater Dam consistent with the collection period identified in the 2017 broodstock collection protocol. The broodstock collection achieved a total collection of 119 steelhead, including 58 natural-origin steelhead.

About 400 steelhead were handled and released at Tumwater and Dryden dams during brood year 2018 Wenatchee steelhead broodstock collection. Most were hatchery-origin fish handled at

Tumwater Dam and all were released back into the river. Fish released at Dryden Dam were released because the weekly quota for hatchery or wild steelhead had been attained, but not for both hatchery and wild fish, or because they were non-target fish (adipose clipped), or they were unidentifiable hatchery-origin steelhead. All steelhead released were allowed to fully recover from the anesthesia and released immediately upstream from the trap sites.

In addition to steelhead encountered at Dryden Dam during steelhead broodstock collection, an estimated 74 spring Chinook salmon were captured and released unharmed immediately upstream from the trap facility. Consistent with ESA Section 10 Permit 18583 impact minimization measures, all ESA species handled were subject to water-to-water transfers.

Hatchery Rearing and Release

The 2018 brood Wenatchee steelhead reared throughout all life stages without significant mortality (defined as >10% population mortality associated with a single event). Lower than expected fertilization rates and eyed-egg to ponding and ponding to release survival resulted in production below the targets (see Section 3.2).

Juvenile rearing occurred at three separate facilities including Eastbank Fish Hatchery, Chelan Fish Hatchery, and the Chiwawa Acclimation Facility. Multiple facilities were used to take advantage of variable water temperatures to manipulate growth of juveniles from different parental crosses. Typically, wild steelhead spawn later than their hatchery cohort and are therefore reared at Chelan Fish Hatchery on warmer water to accelerate their growth, so they achieve a size-at-release similar to HxH parental cross progeny reared on cooler water at Eastbank Fish Hatchery. All parental cross groups received final rearing and over-winter acclimation at the Chiwawa Acclimation Facility on Wenatchee River and Chiwawa River surface water before direct release (scatter planting) in the Wenatchee River basin.

The 2018 brood steelhead smolt release in the Wenatchee River basin totaled 216,666 smolts, representing about 87.6% of the program target of 247,300 smolts identified in the Rocky Reach and Rock Island Dam HCPs and well below the maximum 110% allowed in ESA Section 10 Permit 18583. As specified in ESA Section 10 Permit 18583, all steelhead smolts released were externally marked or internally tagged and a representative number were PIT tagged (see Section 3.2).

Hatchery Effluent Monitoring

Per ESA Permit Numbers 1347, 18118, 18120, 18121, and 18583, permit holders shall monitor and report hatchery effluents in compliance with applicable National Pollution Discharge Elimination Systems (NPDES) (EPA 1999) permit limitations. There were no NPDES violations reported at Eastbank or Chelan hatcheries or the Chiwawa acclimation facility. NPDES monitoring and reporting for PUD Hatchery Programs during 2019 are provided in Appendix G.

Smolt and Emigrant Trapping

Per ESA Section 10 Permit No. 18583, the permit holders are authorized a direct take of up to 20% of the emigrating steelhead population and a lethal take not to exceed 2% of the fish captured (NMFS 2017). Based on the estimated wild steelhead population (smolt trap expansion) and hatchery juvenile steelhead population estimate (hatchery release data) for the Wenatchee River basin, the reported steelhead encounters during the 2019 emigration complied with take provisions in the Section 10 permit and are detailed in Table 3.42. Additionally, juvenile fish captured at the trap locations were handled consistent with provisions in ESA Section 10 Permit 18583 Section B.

Table 3.41. Estimated take of Upper Columbia River steelhead resulting from juvenile emigration monitoring in the Wenatchee River basin, 2019. NA = not available.

Trap location	Population estimate				Number trapped				Total	Take allowed by Permit
	Wild[a]	Hatchery[b]	Parr	Fry	Wild	Hatchery	Parr	Fry		
Chiwawa Trap										
Population	28,062	35,587	NA	NA	196	3,822	1,283	38	5,339	
Encounter rate	NA	NA	NA	NA	0.0070	0.1074	NA	NA	0.08	0.2
Mortality[c]	NA	NA	NA	NA	2	4	7	1	14	
Mortality rate	NA	NA	NA	NA	0.0102	0.0010	0.0055	0.0263	0.0026	0.02
Lower Wenatchee Trap										
Population	8,050	216,666	NA	NA	125	1,908	72	24	2,129	
Encounter rate	NA	NA	NA	NA	0.0155	0.0088	NA	NA	0.01	0.2
Mortality[c]	NA	NA	NA	NA	0	0	0	1	1	
Mortality rate	NA	NA	NA	NA	0.0000	0.0000	0.0000	0.0417	0.0005	0.02
Wenatchee River Basin Total										
Population	8,050	216,666	NA	NA	321	5,730	1,355	62	7,468	
Encounter rate	NA	NA	NA	NA	0.0399	0.0216	NA	NA	0.03	0.2
Mortality[c]	NA	NA	NA	NA	2	4	7	2	15	
Mortality rate	NA	NA	NA	NA	0.0062	0.0007	0.0052	0.0323	0.0020	0.02

[a] Excludes fish under 50mm fork length

[b] 2018 BY smolt release data for the Wenatchee River basin.

[c] Mortality includes trapping and PIT-tag mortalities.

Spawning Surveys

Steelhead spawning ground surveys were conducted in the Wenatchee River basin during 2019, as authorized by ESA Section 10 Permit No. 18583. Because of the difficulty of quantifying the level of take associated with spawning ground surveys, the Permit does not specify a take level associated with these activities, even though it does authorize implementation of spawning ground surveys. Therefore, no take levels are reported. However, to minimize potential effects to established redds, wading was restricted to the extent practical, and extreme caution was used to avoid established redds when wading was required.

Stock Assessment at Priest Rapids Dam

Upper Columbia River steelhead stock assessment sampling at Priest Rapids Dam (PRD) is authorized through ESA Section 10 Permit No. 18583 (NMFS 2017). Permit authorizations include interception and biological sampling of up to 15% of the Upper Columbia River steelhead passing PRD to determine upriver adult population size, estimate hatchery to wild ratios, determine age-class contribution, and evaluate the need for managing hatchery steelhead consistent with ESA recovery objectives, which include fully seeding spawning habitat with naturally produced Upper Columbia River steelhead supplemented with artificially propagated steelhead (NMFS 2017). The 2017-2018 run-cycle report (BY 2018) for stock assessment sampling at Priest Rapids Dam was compiled under provisions of ESA Section 10 Permit 18583. Data and reporting information are included in Appendix H.

Bull Trout

Bull trout encounters associated with implementation of hatchery production and monitoring and evaluation activities for Chinook and steelhead programs in the Wenatchee sub-basin are required to be reported as outlined in Biological Opinion 01EWF00-2013-0444. The 2020 report for bull trout encounters in 2019 was compiled under provisions of ESA Section 10 Permits 18118, 18120, 18121, and 18583. Data and reporting information are included in Appendix I.

SECTION 4: WENATCHEE SOCKEYE SALMON

The goal of sockeye salmon supplementation in the Wenatchee Basin was to use artificial production to replace adult production lost because of mortality at Rock Island Dam, while not reducing the natural production or long-term fitness of sockeye in the basin. The Rock Island Fish Hatchery Complex began operation in 1989 under funding from Chelan PUD. The Complex operated originally through the Rock Island Settlement Agreement, but since 2004 has operated under the Anadromous Fish Agreement and Habitat Conservation Plans.

Adult sockeye were collected for broodstock from the run-at-large at Tumwater Dam. Beginning in 2011, because of passage delays at Tumwater Dam during trapping operations, sockeye broodstock were collected at Dryden Dam. The goal was to collect up to 260 natural-origin adult sockeye for the program. Broodstock collection occurred from about 7 July through 28 August with trapping occurring no more than 16 hours per day, three days a week at Tumwater Dam and up to seven days per week at the Dryden Dam left and right-bank facilities.

Adult sockeye were held and spawned at Eastbank Fish Hatchery. The fertilized eggs were also incubated at the hatchery. For brood years 1989 through 1998, unfed fry were transferred from the hatchery to Lake Wenatchee net pens. From 1998 to 2011, juvenile sockeye were reared at Eastbank Fish Hatchery until July when they were transferred to the net pens. The initial rearing at Eastbank was to increase growth rates. During most years up through 2005, juvenile sockeye were released from net pens at two different times, August and November. From 2006-2012, all juvenile sockeye were released in late October.

The production goal for the Wenatchee sockeye supplementation program was to release 200,000 subyearlings into Lake Wenatchee at 20 fish per pound. Targets for fork length and weight were 133 mm (CV = 9.0) and 22.7 g, respectively. Over 90% of these fish were marked with CWTs. In addition, from 2006-2011, about 15,000 juvenile sockeye were PIT tagged annually. Following an evaluation of the supplementation program in 2011, the Hatchery Committees decided to convert the Wenatchee sockeye hatchery program to summer steelhead in 2012. Currently, monitoring occurs annually to track the status of the natural sockeye population.

4.1 Broodstock Sampling

As noted above, the Wenatchee sockeye program was terminated in 2012. Thus, no broodstock have been collected since 2011 and the release of juvenile sockeye into Lake Wenatchee in 2012 (2011 brood) was the last. This section presents the history of the program.

Origin of Broodstock

Wenatchee sockeye broodstock have not been collected since 2011. Table 4.1 shows the history of the number of broodstock that were collected during the period 1989 to 2011.

Table 4.1. Numbers of wild and hatchery sockeye salmon collected for broodstock, numbers that died before spawning, and numbers of sockeye spawned, 1989-2011. Unknown-origin fish (i.e., undetermined by scale analysis, no CWT or fin clips, and no additional hatchery marks) were considered naturally produced. Mortality includes sockeye that died of natural causes typically near the end of spawning and were not needed for the program, surplus sockeye killed at spawning, sockeye that died but were not recovered from the net pens, and sockeye that may have jumped out of the net pens.

Brood year	Wild sockeye					Hatchery sockeye					Total number spawned
	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	
1989	299	93	47	115	44	0	0	0	0	0	115
1990	333	7	7	302	17	0	0	0	0	0	302
1991	357	18	16	199	124	0	0	0	0	0	199
1992	362	18	5	320	19	0	0	0	0	0	320
1993	307	79	21	207	0	0	0	0	0	0	207
1994	329	15	9	236	69	5	0	0	5	0	241
1995	218	5	7	194	12	3	0	0	3	0	197
1996	291	2	0	225	64	20	0	0	0	20	225
1997	283	12	3	192	76	19	0	0	19	0	211
1998	225	37	25	122	41	6	0	0	6	0	128
1999	90	7	1	79	3	60	0	0	60	0	139
2000	256	19	1	170	66	5	0	0	5	0	175
2001	252	27	10	200	15	8	1	0	7	0	207
2002	257	0	1	256	0	0	0	0	0	0	256
2003	261	12	9	198	42	0	0	0	0	0	198
2004	211	13	12	177	9	0	0	0	0	0	177
2005	243	29	12	166	36	0	0	0	0	0	166
2006	260	2	4	214	40	0	0	0	0	0	214
2007	248	15	3	210	20	0	0	0	0	0	210
2008	258	4	11	243	0	2	0	0	2	0	245
2009	258	5	14	239	0	3	0	3	0	0	239
2010	256	3	0	198	55	0	0	0	0	0	198
2011	204	0	8	196	0	0	0	0	0	0	196
Average	***263***	***18***	***10***	***203***	***33***	***6***	***0***	***0***	***5***	***1***	***208***
Median	***258***	***12***	***8***	***199***	***20***	***0***	***0***	***0***	***0***	***0***	***207***

[a] Pre-spawn loss represents the number of fish that died during the holding period before spawning. Mortality is the number of fish that were surplused following spawning.

Age/Length Data

Ages of sockeye were determined from scales and otoliths collected from broodstock and are shown in Table 4.2.

Table 4.2. Percent of hatchery and wild sockeye salmon of different ages (total age) collected from broodstock, 1994-2011.

Return year	Origin	Total age		
		4	5	6
1994	Wild	57.3	41.7	1.0
	Hatchery	40.0	60.0	0.0
1995	Wild	77.3	20.7	2.0
	Hatchery	66.7	33.3	0.0
1996	Wild	65.8	34.2	0.0
	Hatchery	0.0	0.0	0.0
1997	Wild	86.5	13.5	0.0
	Hatchery	57.9	42.1	0.0
1998	Wild	9.9	88.6	1.5
	Hatchery	66.7	33.3	0.0
1999	Wild	21.8	74.7	3.5
	Hatchery	90.0	8.3	1.7
2000	Wild	97.7	2.3	0.0
	Hatchery	100.0	0.0	0.0
2001	Wild	69.9	29.6	0.5
	Hatchery	71.4	28.6	0.0
2002	Wild	31.6	67.6	0.8
	Hatchery	0.0	0.0	0.0
2003	Wild	2.6	90.5	6.9
	Hatchery	0.0	0.0	0.0
2004	Wild	97.5	2.0	0.5
	Hatchery	0.0	0.0	0.0
2005	Wild	74.2	25.8	0.0
	Hatchery	0.0	0.0	0.0
2006	Wild	34.0	65.5	0.5
	Hatchery	0.0	0.0	0.0
2007	Wild	1.9	88.4	9.7
	Hatchery	0.0	0.0	0.0
2008	Wild	95.0	4.0	1.0
	Hatchery	100.0	0.0	0.0
2009	Wild	78.5	21.5	0.0
	Hatchery	100.0	0.0	0.0
2010	Wild	67.4	32.6	0.0
	Hatchery	0.0	0.0	0.0
2011	Wild	53.7	44.3	2.0
	Hatchery	0.0	0.0	0.0

Return year	Origin	Total age		
		4	5	6
Average	***Wild***	***56.8***	***41.5***	***1.7***
	Hatchery	***38.5***	***11.4***	***0.1***
Median	***Wild***	***66.6***	***33.4***	***0.7***
	Hatchery	***20.0***	***0.0***	***0.0***

Lengths and ages of sockeye sampled during the life of the program are provided in Table 4.3.

Table 4.3. Mean fork length (cm) at age (total age) of hatchery and wild sockeye salmon collected for broodstock, 1994-2011; SD = 1 standard deviation.

Return year	Origin	Sockeye fork length (cm)								
		Age-4			Age-5			Age-6		
		Mean	N	SD	Mean	N	SD	Mean	N	SD
1994	Wild	56	125	3	55	91	3	54	2	3
	Hatchery	57	2	1	56	3	1	-	0	-
1995	Wild	51	153	2	55	41	4	54	4	5
	Hatchery	53	2	4	59	1	-	-	0	-
1996	Wild	52	146	4	53	76	3	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-
1997	Wild	50	166	3	53	26	5	-	0	-
	Hatchery	54	11	4	59	8	2	-	0	-
1998	Wild	51	13	4	55	117	3	53	2	3
	Hatchery	52	4	2	55	2	8	-	0	-
1999	Wild	52	19	4	50	65	4	56	3	1
	Hatchery	50	54	3	56	5	4	56	1	-
2000	Wild	52	167	2	54	4	3	-	0	-
	Hatchery	54	5	1	-	0	-	-	0	-
2001	Wild	54	151	3	56	65	4	58	1	-
	Hatchery	51	5	5	55	2	4	-	0	-
2002	Wild	54	77	2	56	165	4	57	2	0
	Hatchery	-	0	-	-	0	-	-	0	-
2003	Wild	54	5	4	60	172	2	60	13	4
	Hatchery	-	0	-	-	0	-	-	0	-
2004	Wild	53	192	3	56	4	3	63	1	-
	Hatchery	-	0	-	-	0	-	-	0	-
2005	Wild	51	132	3	57	46	4	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-
2006	Wild	52	70	3	56	135	4	54	2	3
	Hatchery	-	0	-	-	0	-	-	0	-
2007	Wild	57	4	2	58	182	5	58	20	5

Return year	Origin	Sockeye fork length (cm)								
		Age-4			Age-5			Age-6		
		Mean	N	SD	Mean	N	SD	Mean	N	SD
	Hatchery	-	0	-	-	0	-	-	0	-
2008	Wild	52	245	3	52	11	3	62	2	6
	Hatchery	53	2	3	-	-	-	-	-	-
2009	Wild	54	197	3	59	54	4	-	-	-
	Hatchery	54	2	1	-	-	-	-	-	-
2010	Wild	55	130	2	57	63	4	-	-	-
	Hatchery	-	-	-	-	-	-	-	-	-
2011	Wild	55	109	2	59	90	3	61	4	3
	Hatchery	-	-	-	-	-	-	-	-	-
Average	***Wild***	***53***	***116***	***3***	***55***	***78***	***4***	***57***	***3***	***3***
	Hatchery	***53***	***5***	***3***	***57***	***2***	***4***	***56***	***1***	***-***

Sex Ratios

Sex ratios of wild and hatchery sockeye collected during the life of the sockeye hatchery program are presented in Table 4.4.

Table 4.4. Numbers of male and female wild and hatchery sockeye collected for broodstock, 1989-2011. Ratios of males to females are also provided.

Return year	Number of wild sockeye			Number of hatchery sockeye			Total M/F ratio
	Males (M)	Females (F)	M/F	Males (M)	Females (F)	M/F	
1989	162	137	1.18:1.00	0	0	-	1.18:1.00
1990	177	156	1.13:1.00	0	0	-	1.13:1.00
1991	260	97	2.68:1.00	0	0	-	2.68:1.00
1992	180	182	0.99:1.00	0	0	-	0.99:1.00
1993	130	177	0.73:1.00	0	0	-	0.73:1.00
1994	162	167	0.97:1.00	1	4	0.25:1.00	0.95:1.00
1995	102	116	0.88:1.00	1	2	0.50:1.00	0.87:1.00
1996	150	161	0.93:1.00	0	0	-	0.93:1.00
1997	139	144	0.97:1.00	10	9	1.11:1.00	0.97:1.00
1998	115	110	1.05:1.00	2	4	0.50:1.00	1.03:1.00
1999	22	68	0.32:1.00	37	23	1.61:1.00	0.65:1.00
2000	155	101	1.53:1.00	3	2	1.50:1.00	1.53:1.00
2001	114	138	0.83:1.00	4	4	1.00:1.00	0.83:1.00
2002	128	129	0.99:1.00	0	0	-	0.99:1.00
2003	161	100	1.61:1.00	0	0	-	1.61:1.00
2004	108	103	1.05:1.00	0	0	-	1.05:1.00
2005	130	113	1.15:1.00	0	0	-	1.15:1.00
2006	130	130	1.00:1.00	0	0	-	1.00:1.00

Return year	Number of wild sockeye			Number of hatchery sockeye			Total M/F ratio
	Males (M)	Females (F)	M/F	Males (M)	Females (F)	M/F	
2007	127	121	1.05:1.00	0	0	-	1.05:1.00
2008	127	131	0.97:1.00	1	1	1.00:1.00	0.97:1.00
2009	133	125	1.06:1.00	0	3	0.00:1.00	1.04:1.00
2010	127	129	0.98:1.00	0	0	-	0.98:1.00
2011	106	98	1.08:1.00	0	0	-	1.08:1.00
Total	***2,074***	***2,017***	***1.03:1.00***	***58***	***48***	***1.21***	***1.03:1.00***

Fecundity

Fecundities of sockeye collected throughout the duration of the hatchery program are presented in Table 4.5.

Table 4.5. Mean fecundity of female sockeye salmon collected for broodstock, 1989-2011. Fecundities were determined from pooled egg lots and were not identified for individual females.

Return year	Mean fecundity
1989	2,344
1990	2,225
1991	2,598
1992	2,341
1993	2,340
1994	2,798
1995	2,295
1996	2,664
1997	2,447
1998	2,813
1999	2,319
2000	2,673
2001	2,960
2002	2,856
2003	3,511
2004	2,505
2005	2,718
2006	2,656
2007	3,115
2008	2,555
2009	2,459
2010	2,782
2011	2,960
Average	***2,649***
Median	***2,656***

4.2 Hatchery Rearing

Rearing History

Number of eggs taken

Numbers of eggs taken from sockeye broodstock throughout the duration of the sockeye hatchery program are shown in Table 4.6.

Table 4.6. Numbers of eggs taken from sockeye broodstock, 1989-2011.

Return year	Number of eggs taken
1989	133,600
1990	326,267
1991	231,254
1992	381,561
1993	231,700
1994	338,562
1995	247,900
1996	314,390
1997	254,459
1998	163,278
1999	190,732
2000	227,234
2001	301,925
2002	356,982
2003	319,470
2004	225,499
2005	211,985
2006	292,136
2007	302,363
2008	316,476
2009	304,963
2010	278,171
2011	290,046
Average	***271,389***
Median	***290,046***

Number of acclimation days

During the life of the program, Wenatchee sockeye were acclimated on Lake Wenatchee water in net pens. Acclimation days are presented in Table 4.7.

Table 4.7. Water source and mean acclimation period for Wenatchee sockeye, brood years 1989-2011.

Brood year	Release year	Transfer date	Release date	Number of Days	Water source
1989	1990	5-Apr	24-Oct	202	Lake Wenatchee
1990	1991	10-Apr	19-Oct	192	Lake Wenatchee
1991	1992	1-Apr	20-Oct	202	Lake Wenatchee
1992	1993	5-Apr	7-Sep	155	Lake Wenatchee
		5-Apr	26-Oct	204	Lake Wenatchee
1993	1994	5-Apr	1-Sep	149	Lake Wenatchee
		5-Apr	17-Oct	195	Lake Wenatchee
1994	1995	4-Apr	15-Sep	164	Lake Wenatchee
		4-Apr	23-Oct	202	Lake Wenatchee
1995	1996	4-Apr	25-Oct	204	Lake Wenatchee
1996	1997	4-Apr	22-Oct	201	Lake Wenatchee
1997	1998	1-Apr	9-Nov	222	Lake Wenatchee
1998	1999	1-Apr	29-Oct	211	Lake Wenatchee
1999	2000	25-Jul	28-Aug	34	Lake Wenatchee
		26-Jul	1-Nov	98	Lake Wenatchee
2000	2001	2-Jul	27-Aug	56	Lake Wenatchee
		3-Jul	27-Sep	86	Lake Wenatchee
2001	2002	15-Jul	28-Aug	44	Lake Wenatchee
		16-Jul	22-Sep	68	Lake Wenatchee
2002	2003	30-Jun	25-Aug	56	Lake Wenatchee
		1-Jul	22-Oct	113	Lake Wenatchee
2003	2004	6-Jul	25-Aug	50	Lake Wenatchee
		7-Jul	3-Nov	119	Lake Wenatchee
2004	2005	5-Jul	29-Aug	55	Lake Wenatchee
		6-Jul	2-Nov	120	Lake Wenatchee
2005	2006	11-Jul	30-Oct	111	Lake Wenatchee
2006	2007	9-10 Jul	31-Oct	113-114	Lake Wenatchee
2007	2008	7-8 Jul	29-Oct	113-114	Lake Wenatchee
2008	2009	21-Jul	28-Oct	100	Lake Wenatchee
2009	2010	19-20, 23-Jul	27-Oct	97-101	Lake Wenatchee
2010	2011	6, 11-12-Jul	26-Oct	107-113	Lake Wenatchee
2011	2012	9-10-Jul	29-Oct	112-113	Lake Wenatchee

Release Information

Numbers released

Numbers of juvenile sockeye released into Lake Wenatchee throughout the duration of the program are shown in Table 4.8. Coded wire tag marking rates and numbers of PIT-tagged juvenile sockeye released are also shown in Table 4.8.

Table 4.8. Total number of sockeye parr released and numbers of released fish with CWTs and PIT tags for brood years 1989-2011. The release target for sockeye was 200,000 fish.

Brood year	Release year	CWT mark rate	Number of released fish with PIT tags	Number released
1989	1990	Not marked	0	108,400
1990	1991	0.9308	0	270,802
1991	1992	0.8940	0	167,523
1992	1993	0.9240	0	340,597
1993	1994	0.7278	0	190,443
1994	1995	0.8869	0	252,859
1995[a]	1996	1.0000	0	150,808
1996[a]	1997	0.9680	0	284,630
1997[a]	1998	0.9642	0	197,195
1998[a]	1999	0.8713	0	121,344
1999	2000	0.9527	0	167,955
2000	2001	0.9558	0	190,174
2001	2002	0.9911	0	200,938
2002	2003	0.9306	0	315,783
2003	2004	0.9291	0	240,459
2004	2005	0.8995	0	172,923
2005	2006	0.9811	14,859	140,542
2006	2007	0.9735	14,764	225,670
2007	2008	0.9863	14,947	252,133
2008	2009	0.9576	14,858	154,772
2009	2010	0.9847	14,486	227,743
2010	2011	0.9564	5,039	241,918
2011	2012	0.9690	5,074	256,120
Average		***0.9379***	***11,994[b]***	***208,271***
Median		***0.9561***	***14,764[b]***	***197,195***

[a] These groups were only adipose fin clipped.
[b] Average and median are based on brood years 2004 to 2010.

Fish size and condition at release

The size and condition of the juvenile sockeye released into Lake Wenatchee throughout the duration of the hatchery program are presented in Table 4.9.

Table 4.9. Mean lengths (FL, mm), weight (g and fish/pound), and coefficient of variation (CV) of sockeye released, brood years 1989-2011. Size targets are provided in the last row of the table.

Brood year	Release year	Fork length (mm)		Mean weight	
		Mean	CV	Grams (g)	Fish/pound
1989	1990	128	-	18.2	25
1990	1991	131	-	18.9	24
1991	1992	117	3.0	20.6	22
1992	1993	73	6.8	4.2	44
1993	1994	103	-	13.6	40
1994	1995	75	6.1	4.5	38
1995	1996	137	8.2	14.7	30
1996	1997	107	5.6	15.1	30
1997	1998	122	6.1	21.3	21
1998	1999	112	5.4	17.0	27
1999	2000	94	9.5	9.5	48
		134	11.5	31.3	15
2000	2001	123	6.5	22.3	20
		146	8.4	26.0	12
2001	2002	118	7.4	20.7	22
		135	7.3	30.5	15
2002	2003	73	5.6	4.4	104
		118	7.7	13.7	23
		145	9.4	38.6	13
2003	2004	79	4.6	4.8	96
		118	5.9	17.0	26
		158	8.1	44.3	10
2004	2005	116	4.5	17.2	18
		151	7.0	39.3	12
2005	2006	149	7.5	43.7	10
2006	2007	138	10.6	32.4	14
2007	2008	137	9.3	33.0	14
2008	2009	138	9.6	34.6	13

Brood year	Release year	Fork length (mm)		Mean weight	
		Mean	CV	Grams (g)	Fish/pound
2009	2010	143	8.9	35.5	13
2010	2011	132	14.3	30.7	15
2011	2012	142	9.6	35.3	13
Targets		***133***	***9.0***	***22.7***	***20***

Survival Estimates

Life-stage survival estimates for juvenile sockeye throughout the duration of the hatchery program are shown in Table 4.10.

Table 4.10. Hatchery life-stage survival rates (%) for sockeye salmon, brood years 1989-2011. Survival standards or targets are provided in the last row of the table.

Brood year	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
1989	41.6	100.0	88.1	63.9	99.2	98.9	98.1	65.2	83.0
1990	96.2	99.4	90.8	96.3	99.9	99.2	98.4	98.4	81.1
1991	91.8	94.1	79.2	94.8	99.8	99.3	96.4	96.4	72.4
1992	91.1	98.8	92.3	98.0	99.9	99.8	98.6	98.8	89.2
1993	57.1	99.2	89.2	98.3	99.6	99.1	93.7	93.8	82.2
1994	89.8	99.2	79.2	96.0	99.5	98.6	98.3	98.2	74.7
1995	97.5	99.1	87.5	95.0	99.0	93.3	73.2	73.2	60.8
1996	99.2	100.0	95.1	98.7	99.7	99.3	96.4	96.5	90.5
1997	92.8	99.3	84.8	97.9	97.9	97.6	95.5	94.9	77.5
1998	75.4	95.5	77.7	98.4	98.6	98.2	97.1	97.2	74.3
1999	92.3	100.0	92.2	97.3	99.6	99.3	98.2	99.7	88.1
2000	84.5	98.1	93.8	97.7	96.7	96.1	91.4	96.8	83.7
2001	75.4	99.2	78.5	97.6	98.0	97.6	86.9	95.1	66.6
2002	100.0	100.0	95.7	97.8	99.6	99.2	94.6	99.8	88.5
2003	91.0	98.1	87.2	96.9	99.0	98.2	94.8	95.5	74.6
2004	88.7	92.6	88.0	93.1	97.9	97.4	93.7	96.1	76.7
2005	98.5	98.5	85.3	94.9	97.8	96.6	95.5	99.2	66.3
2006	95.3	99.1	73.2	85.4	95.4	94.6	87.8	98.5	54.9
2007	88.4	99.2	89.1	98.6	97.0	95.9	94.9	99.0	83.4
2008	97.0	100.0	59.0	88.3	99.1	97.2	93.8	97.4	48.9
2009	95.8	98.3	89.1	94.8	96.9	96.2	88.4	92.3	74.7
2010	99.0	98.0	92.6	98.2	97.5	96.5	95.6	99.6	87.0
2011	100.0	100.0	92.6	100.0	96.8	96.0	95.4	99.7	88.3
Average	***88.6***	***98.5***	***86.1***	***94.7***	***98.5***	***97.6***	***93.8***	***94.8***	***76.8***

Brood year	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
Median	*92.3*	*99.2*	*88.1*	*97.3*	*99.0*	*97.6*	*95.4*	*97.2*	*77.5*
Standard	*90.0*	*85.0*	*92.0*	*98.0*	*97.0*	*93.0*	*90.0*	*95.0*	*81.0*

4.3 Disease Monitoring

Because the sockeye hatchery program ended in 2012, there are no disease-monitoring results.

4.4 Natural Juvenile Productivity

Sockeye smolt abundance was estimated at a rotary screw trap located near the mouth of Lake Wenatchee during the period 1997 to 2011. Because the efficiency of the trap was difficult to assess, the operation was terminated in 2011. In 2012, the trap was relocated downstream near the mouth of the Chiwawa River and operated there for two years. Again, because few marked sockeye smolts were recaptured, the operation was terminated in 2013. Beginning in 2013, smolt abundance has been estimated at the Lower Wenatchee Trap located near Cashmere, WA.

Emigrant and Smolt Estimates

The Lower Wenatchee Trap operated between 19 February and 23 July 2019. During that time, the trap was inoperable for 16 days because of high or low river discharge, debris, elevated river temperatures, large hatchery releases, and mechanical issues. At the beginning of the season the trap operated in the low-flow position until 26 March. It then operated in the lower position until 5 July when it was switched back into the low-flow position for the remainder of the season. During the sampling period, a total of 1,096 wild juvenile sockeye were captured at the Lower Wenatchee Trap. There was no significant relationship between trap efficiency and river discharge ($R^2 = 0.34$, $P > 0.061$); therefore, a pooled estimate was used. Using this pooled model, the number of juvenile sockeye emigrants was estimated at 192,705 (95% CI = ±1,449,588) during the 2019 trapping season (Table 4.11). Figure 4.1 shows the monthly captures of sockeye collected at the Lower Wenatchee Trap in 2019. All fish captured in the Lower Wenatchee trap are reported in Appendix C.

Table 4.11. Estimated numbers of wild and hatchery sockeye smolts that emigrated from Lake Wenatchee during outmigration years 1997-2019; NS = no data. Estimates for the outmigration years 1997-2011 were based on sampling at the Upper Wenatchee smolt trap; estimates beginning in 2013 were based on sampling at the Lower Wenatchee smolt trap.

Outmigration year	Numbers of sockeye smolts	
	Wild smolts	Hatchery smolts
1997	55,359	28,828
1998	1,447,259	55,985
1999	1,944,966	112,524
2000	985,490	24,684
2001	39,353	94,046
2002	729,716	121,511

Outmigration year	Numbers of sockeye smolts	
	Wild smolts	Hatchery smolts
2003	5,439,032	140,322
2004	5,771,187	216,023
2005	723,413	122,399
2006	1,266,971	159,500
2007	2,797,313	140,542
2008[a]	549,682	121,843
2009[a]	355,549	119,908
2010[a]	3,958,888	126,326
2011	1,500,730	159,089
2012	ND	ND
2013	873,096 (±95,132)	No program
2014	1,275,027 (±211,615)	No program
2015	1,065,614 (±238,901)	No program
2016	208,250 (±29,447)	No program
2017	121,825 (±22,904)	No program
2018	1,806,164 (±13,586,160)	No program
2019	192,705 (±1,449,588)	No program
Average	***1,504,890***	***116,235[a]***
Median	***1,025,552***	***121.511[a]***

[a] Summary statistics were calculated for years in which hatchery fish were being released (1997-2011).

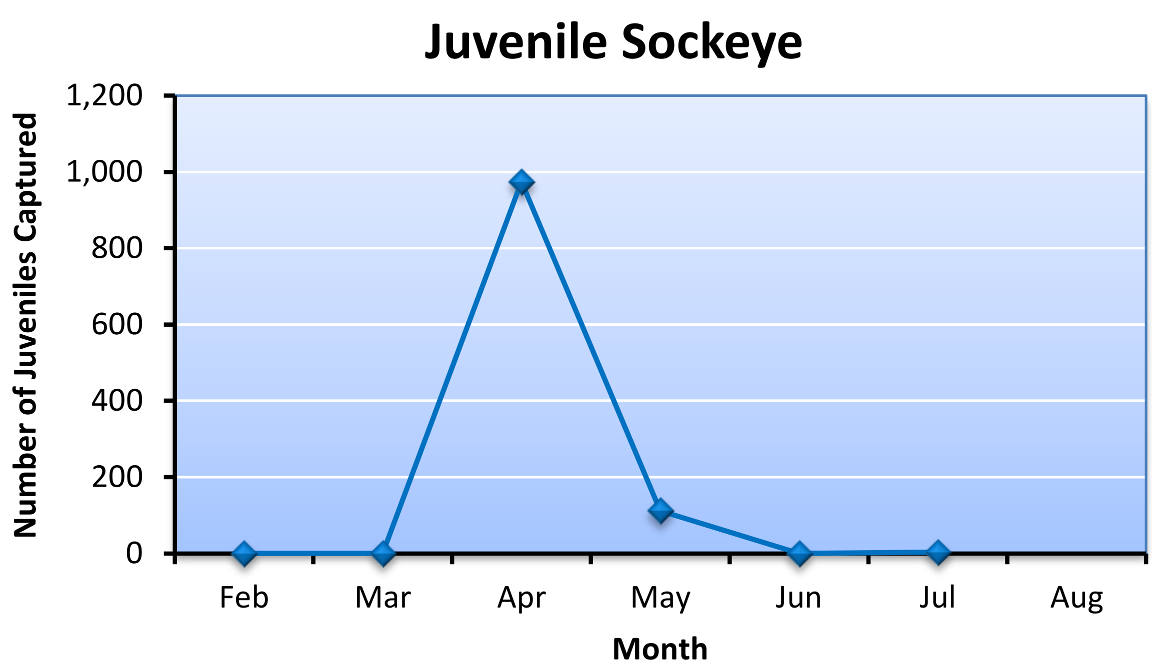


Figure 4.1. Monthly captures of wild sockeye salmon smolts at the Lower Wenatchee Trap, 2019.

Age classes of wild sockeye were determined from a length frequency analysis based on scales collected randomly (1997 through 2011) or in a stratified random sample (2012 to present) (Table 4.12). Each year, a small number of markedly smaller sockeye (<50 mm FL) are collected, and starting with run year 2013, an age-0 class was retroactively assigned based on catch records. For the available run years, most wild sockeye smolts migrated as age 1+ fish. Only in two years (1997 and 2005) did more smolts migrate as age 2+ fish. Relatively few smolts migrated at age 3+.

Table 4.12. Age structure and estimated number of wild sockeye smolts that emigrated from Lake Wenatchee, 1997-2019; ND = no data. Estimates for outmigration years 1997-2011 were based on sampling at the Upper Wenatchee smolt trap; estimates beginning in 2013 were based on sampling at the Lower Wenatchee smolt trap.

Outmigration year	Proportion of wild smolts				Total wild emigrants
	Age 0	Age 1+	Age 2+	Age 3+	
1997	ND	0.075	0.906	0.019	55,359
1998	ND	0.955	0.037	0.008	1,447,259
1999	ND	0.619	0.381	0.000	1,944,966
2000	ND	0.599	0.400	0.001	985,490
2001	ND	0.943	0.051	0.006	39,353
2002	ND	0.961	0.039	0.000	729,716
2003	ND	0.740	0.026	0.000	5,439,032
2004	ND	0.929	0.071	0.000	5,771,187
2005	ND	0.230	0.748	0.022	723,413
2006	ND	0.994	0.006	0.000	1,266,971
2007	ND	0.996	0.004	0.000	2,797,313
2008	ND	0.804	0.195	0.001	549,682
2009	ND	0.927	0.073	0.000	355,549
2010	ND	0.963	0.036	0.001	3,958,888
2011	ND	0.786	0.214	0.000	1,500,730
2012	ND	ND	ND	ND	ND
2013	0.008	0.919	0.073	0.000	873,096
2014	0.003	0.948	0.049	0.000	1,275,027
2015	0.003	0.777	0.220	0.000	1,065,614
2016	0.046	0.895	0.059	0.000	208,250
2017	0.053	0.868	0.079	0.000	121,825
2018	0.001	0.989	0.010	0.000	1,806,164
2019	0.006	0.944	0.049	0.000	192,705
Average	***0.017***	***0.812***	***0.169***	***0.003***	***1,504,890***
Median	***0.006***	***0.923***	***0.065***	***0.000***	***1,025,552***

Freshwater Productivity

Egg-smolt survival estimates for wild sockeye salmon are provided in Table 4.13. Estimates of egg deposition were calculated based on the spawner escapement at Tumwater Dam and the sex ratio and fecundity of the broodstock. For brood years 2012 to present, years in which brood was not collected, a linear relationship with post-orbital to hypural length as the independent variable was used to calculate mean fecundity of sockeye sampled at Tumwater Dam ($r^2 = 0.36$, $P < 0.01$). No smolt estimates are available for brood years 2009 and 2010. Egg-smolt survival rates for brood years 1995-2016 have ranged from 0.003 to 0.212 (mean = 0.071).

Table 4.13. Estimated egg deposition (estimated as mean fecundity times estimated number of females), numbers of smolts, and survival rates for wild Wenatchee sockeye salmon, brood years 1995-2016; ND = no data.

Brood year	Number of females	Mean fecundity	Total eggs	Numbers of wild smolts					Egg-smolt survival
				Age 0	Age 1+	Age 2+	Age 3+	Total	
1995	2,136	2,295	4,902,120	ND	4,152	53,549	0	57,701	0.012
1996	3,767	2,664	10,035,288	ND	1,382,133	741,032	985	2,124,150	0.212
1997	5,404	2,447	13,223,588	ND	1,203,934	394,196	236	1,598,366	0.121
1998	2,024	2,813	5,693,512	ND	590,309	2,007	0	592,316	0.104
1999	513	2,319	1,189,647	ND	37,110	28,459	0	65,569	0.055
2000	11,413	2,673	30,506,949	ND	701,257	1,414,148	0	2,115,405	0.069
2001	21,685	2,960	64,187,600	ND	4,024,884	409,754	15,915	4,450,553	0.069
2002	17,226	2,856	49,197,456	ND	5,361,433	541,113	0	5,902,546	0.120
2003	2,158	3,511	7,576,738	ND	166,385	7,602	0	173,987	0.023
2004	15,469	2,505	38,749,845	ND	1,259,369	11,189	550	1,270,833	0.033
2005	5,867	2,718	15,946,506	ND	2,786,123	107,243	0	2,893,366	0.181
2006	2,747	2,656	7,296,032	ND	442,164	25,919	3,959	472,042	0.065
2007	2,001	3,115	6,232,804	ND	329,594	142,520	0	472,114	0.076
2008	11,775	2,555	30,084,691	ND	3,812,409	321,156	ND	4,133,565	0.137
2009	3,939	2,459	9,684,965	ND	1,179,574	ND	0	ND	ND
2010	11,918	2,785	33,190,467	ND	ND	63,736	0	ND	ND
2011	9,722	2,970	28,873,491	ND	802,375	62,476	0	864,852	0.030
2012	14,753	2,693	39,245,089	6,985	1,208,726	234,435	0	1,450,145	0.037
2013	9,477	2,729	25,862,733	3,825	827,982	12,287	0	844,094	0.033
2014	31,203	2,520	78,631,560	3,197	186,384	9,673	0	199,253	0.003
2015	12,953	2,771	35,892,763	9,580	105,744	18,062	0	133,385	0.004
2016	23,558	2,543	59,907,994	6,408	1,786,296	9,443	0	1,802,147	0.030
Average	***10,078***	***2,707***	***27,095,993***	***5,999***	***1,342,778***	***219,524***	***1,031***	***1,580,819***	***0.071***
Median	***9,600***	***2,683***	***27,368,112***	***6,408***	***827,982***	***62,476***	***0***	***1,067,843***	***0.060***

Juvenile survival rates for hatchery sockeye salmon are provided in Table 4.14. Release-smolt survival rates for brood years 1995-2011 have ranged from 0.000 to 1.000 (mean = 0.570). Egg-smolt survival rates for the same brood years ranged from 0.000 to 0.710 (mean = 0.294). On average, egg-smolt survival of hatchery sockeye is about three times greater than egg-smolt survival of wild sockeye.

Table 4.14. Juvenile survival rates for hatchery Wenatchee sockeye, brood years 1995-2011.

Brood year	Number of eggs	Number of parr released	Date of release	Estimated number of smolts	Egg-smolt survival	Release-smolt survival
1995	247,900	150,808	10/25/96	28,828	0.116	0.191
1996	314,390	284,630	10/22/97	55,985	0.178	0.197
1997	254,459	197,195	11/9/98	112,524	0.442	0.571
1998	163,278	121,344	10/27/99	24,684	0.151	0.203
1999	190,732	84,466	8/28/00	30,326	0.159	0.359
		83,489	11/1/00	63,720	0.334	0.763
2000	227,234	92,055	8/27/01	30,918	0.136	0.336
		98,119	9/27/01	90,593	0.399	0.923
2001	301,925	96,486	8/28/02	36,484	0.121	0.378
		104,452	9/23/02	103,838	0.344	0.994
2002	356,982	98,509	6/16/03	5,192	0.015	0.053
		104,855	8/25/03	98,412	0.276	0.939
		112,419	10/22/03	112,419	0.315	1.000
2003	319,470	32,755	6/15/04	0	0.000	0.000
		104,879	8/25/04	19,574	0.061	0.187
		102,825	11/3/04	102,825	0.322	1.000
2004	225,499	81,428	8/29/05	159,500	0.707	0.922
		91,495	11/2/05			
2005	211,985	70,386	10/30/06	140,542	0.663	1.000
		70,156	10/30/06			
2006	292,136	225,670	10/31/07	121,843	0.412	0.540
2007	302,363	252,133	10/29/08	119,908	0.397	0.476
2008	316,476	154,772	10/28/09	126,326	0.399	0.813
2009	304,963	227,743	10/27/10	159,089	0.522	0.699
2010	278,171	241,918	10/26/11	ND[a]	--	--
2011	290,046	256,120	10/29/12	ND[a]	--	--

[a] There are no emigrant estimates for the 2010 and 2011 brood years (not enough recaptures for valid estimate).

PIT Tagging Activities

A total of 1,062 wild juvenile sockeye salmon were PIT tagged and released in 2019 at the Lower Wenatchee Trap. Numbers of wild sockeye salmon PIT-tagged and released as part of the Comparative Survival Study and PUD studies during the period 2008-2019 are shown in Table 4.15. See Appendix D for a complete list of all fish captured, tagged, lost, and released.

Table 4.15. Summary of the numbers of wild sockeye salmon that were tagged and released at the Upper and Lower Wenatchee Traps within the Wenatchee River basin, 2008-2019.

Year	Sampling location	
	Upper Wenatchee Trap	Lower Wenatchee Trap
2008	3,165	0
2009	3,683	0
2010	10,006	0
2011	--	0
2012	--	0
2013	--	0
2014	--	4,821
2015	--	3,922
2016	--	1,065
2017	--	968
2018	--	8,822
2019	--	1,062

4.5 Spawning Escapement

The sockeye salmon hatchery program ended after the 2011 brood year. As a result, monitoring activities that focused on evaluating the effects of the supplementation program on the natural population transitioned to monitoring the abundance and productivity of the natural population. Broadly, the proposed monitoring and evaluation activities cover juvenile and adult life-history stages and provide the data necessary to track or estimate viable salmonid population (VSP) parameters: abundance, productivity, spatial structure, and diversity (McElhaney et al. 2000).

From 2009-2013, mark-recapture methods were used to estimate spawning escapement within the White River, while area-under-the-curve (AUC) methods were used to estimate spawning escapement within the Little Wenatchee River. Beginning in 2014, mark-recapture methods were used to estimate the spawning escapement of sockeye in both the White River and Little Wenatchee watersheds (see Appendix J for more details).

Mark-Recapture Estimates

Spawning escapement of sockeye salmon in 2019 was estimated using mark-recapture methods. This method relied on PIT tags to estimate sockeye spawning escapement (see Appendix J for more details).

Using mark-recapture methods, the estimated total escapement of sockeye in the Upper Wenatchee River basin in 2019 was 11,007 (Table 4.16). About 78% of the escapement entered the White River watershed (including the Napeequa River).

Table 4.16. Estimated escapement of adult sockeye into the Little Wenatchee and White River watersheds for return years 2009-2019. Escapement was based on recapture of PIT-tagged fish.

Return year	Tumwater Dam count	Recreational harvest	Little Wenatchee escapement	White River escapement	Total spawning escapement
2009	16,034	2,285	576	13,876	14,452
2010	35,821	4,129	2,062	19,542	21,604
2011[a]	18,634	0	2,431	14,582	17,013
2012	66,520	12,107	4,607	23,866	28,473
2013[a]	29,015	6,262	2,426	14,294	16,720
2014	99,898	16,281	4,319	49,021	53,340
2015	51,435	7,916	2,707	20,097	22,804
2016	73,697	14,630	6,747	38,802	45,549
2017	23,854	0	2,085	18,436	20,521
2018	13,975	0	974	10,411	11,384
2019	11,007	0	715	8,542	9,257
Average	***39,990***	***5,783***	***2,695***	***21,043***	***23,738***
Median	***29,015***	***4,129***	***2,426***	***18,436***	***20,521***

[a] Spawning escapements in 2011 and 2013 were calculated using AUC counts and a regression model.

The spawning escapement of 9,257 Wenatchee sockeye was less than the overall average of 18,009 (Table 4.17).

Table 4.17. Spawning escapements for sockeye salmon in the Wenatchee River basin for return years 1989-2019; NA = not available and AUC = area under the curve.

Return year	Escapement estimation method	Spawning escapement		
		Little Wenatchee	White	Total
1989	Counts at Tumwater Dam	NA	NA	**21,802**
1990	Counts at Tumwater Dam	NA	NA	**27,325**
1991	Counts at Tumwater Dam	NA	NA	**26,689**
1992	Counts at Tumwater Dam	NA	NA	**16,461**
1993	Counts at Tumwater Dam	NA	NA	**27,726**
1994	Counts at Tumwater Dam	NA	NA	**7,330**
1995	Counts at Tumwater Dam	NA	NA	**3,448**
1996	Counts at Tumwater Dam	NA	NA	**6,573**
1997	Counts at Tumwater Dam	NA	NA	**9,693**
1998	Counts at Tumwater Dam	NA	NA	**4,014**
1999	Counts at Tumwater Dam	NA	NA	**1,025**
2000	Counts at Tumwater Dam	NA	NA	**20,735**
2001	Counts at Tumwater Dam	NA	NA	**29,103**
2002	Counts at Tumwater Dam	NA	NA	**27,565**
2003	Counts at Tumwater Dam	NA	NA	**4,855**

Return year	Escapement estimation method	Spawning escapement		
		Little Wenatchee	White	Total
2004	Counts at Tumwater Dam	NA	NA	**27,556**
2005	Counts at Tumwater Dam	NA	NA	**14,011**
2006	AUC	574	5,634	**6,208**
2007	AUC	150	1,720	**1,870**
2008	AUC	3,491	16,757	**20,248**
2009	AUC and Mark-Recap	763	7,004	**7,767**
2010	AUC and Mark-Recap	2,543	19,157	**21,700**
2011	AUC and Mark-Recap	2,431	14,582	**17,013**
2012	AUC and Mark-Recap	4,607	23,866	**28,473**
2013	AUC and Mark-Recap	2,426	14,294	**16,720**
2014	Mark-Recapture	4,391	49,021	**53,340**
2015	Mark-Recapture	2,707	20,097	**22,804**
2016	Mark-Recapture	6,747	38,321	**45,068**
2017	Mark-Recapture	2,085	18,436	**20,521**
2018	Mark-Recapture	974	10,411	**11,384**
2019	Mark-Recapture	715	8,542	**9,257**
Average		***2,472***	***17,703***	***18,009***
Median		***2,429***	***15,670***	***17,013***

4.6 Carcass Surveys

As described earlier, carcass surveys were not conducted in 2016. The information contained in this section represents carcass data collected before 2014.

Number sampled

Table 4.18 shows the number of carcasses sampled within different survey streams during the period 1993-2013.

Table 4.18. Numbers of sockeye carcasses sampled within different streams/watersheds within the Wenatchee River basin, 1989-2013.

Survey year	Numbers of sockeye carcasses			
	Little Wenatchee	White	Napeequa	Total
1993	90	195	0	**285**
1994	121	165	0	**286**
1995	0	56	0	**56**
1996	43	1,387	3	**1,433**
1997	69	1,425	41	**1,535**
1998	61	524	4	**589**
1999	40	186	0	**226**
2000	821	5,494	0	**6,315**

Survey year	Numbers of sockeye carcasses			
	Little Wenatchee	White	Napeequa	Total
2001	650	3,127	0	**3,777**
2002	506	7,258	55	**7,819**
2003	86	1,002	14	**1,102**
2004	625	6,960	138	**7,723**
2005	1	7	0	**8**
2006	101	2,158	38	**2,297**
2007	17	363	3	**383**
2008	476	5,132	125	**5,733**
2009	84	3,103	103	**3,290**
2010	217	7,832	70	**8,119**
2011	372	3,322	48	**3,742**
2012	1,309	7,479	31	**8,819**
2013	179	2,996	27	**3,202**
Average	***279***	***2,865***	***33***	***3,178***
Median	***101***	***2,158***	***14***	***2,297***

Carcass Distribution and Origin

Based on the available data (1993-2013), the largest percentage of both wild and hatchery sockeye spawned in Reach 2 on the White River (Table 4.19 and Figure 4.2). However, a greater percentage of wild fish was found in Reach 2 than hatchery fish.

Table 4.19. Numbers of wild and hatchery sockeye carcasses sampled within different reaches in the Wenatchee River basin, 1993-2013. Reach codes are described in Table 2.8.

Survey year	Origin	Numbers of sockeye carcasses					
		Little Wenatchee		White River			Total
		L2	L3	H1	H2	Q1	
1993	Wild	86	0	0	183	0	**269**
	Hatchery	4	0	0	12	0	**16**
1994	Wild	112	0	0	155	0	**267**
	Hatchery	9	0	0	9	0	**18**
1995	Wild	0	0	0	55	0	**55**
	Hatchery	0	0	0	1	0	**1**
1996	Wild	41	0	0	1,299	3	**1,343**
	Hatchery	2	0	0	88	0	**90**
1997	Wild	65	0	0	1,411	40	**1,516**
	Hatchery	4	0	0	11	1	**16**
1998	Wild	61	0	0	515	4	**580**
	Hatchery	0	0	0	9	0	**9**
1999	Wild	30	0	0	164	0	**194**
	Hatchery	10	0	0	22	0	**32**

Survey year	Origin	Numbers of sockeye carcasses					
		Little Wenatchee		White River			Total
		L2	L3	H1	H2	Q1	
2000	Wild	694	0	3	5,239	0	**5,936**
	Hatchery	127	0	0	252	0	**379**
2001	Wild	625	0	0	3,063	0	**3,688**
	Hatchery	25	0	0	64	0	**89**
2002	Wild	504	0	0	7,207	55	**7,766**
	Hatchery	2	0	0	51	0	**53**
2003	Wild	81	0	0	993	14	**1,088**
	Hatchery	5	0	0	9	0	**14**
2004	Wild	606	0	0	6,755	166	**7,527**
	Hatchery	19	0	0	205	22	**246**
2005	Wild	201	0	5	2,966	21	**3,193**
	Hatchery	1	0	0	8	0	**9**
2006	Wild	80	0	0	2,112	36	**2,228**
	Hatchery	21	0	0	46	2	**69**
2007	Wild	17	0	0	346	3	**366**
	Hatchery	0	0	0	17	0	**17**
2008	Wild	472	0	0	5,118	124	**5,714**
	Hatchery	4	0	0	14	1	**19**
2009	Wild	80	0	0	3,084	103	**3,267**
	Hatchery	4	0	0	19	0	**23**
2010	Wild	210	0	0	7,711	69	**7,990**
	Hatchery	7	0	0	121	1	**129**
2011	Wild	266	0	0	3,079	43	**3,388**
	Hatchery	106	0	0	243	5	**354**
2012	Wild	1,270	0	21	7,368	30	**8,689**
	Hatchery	39	0	3	87	1	**130**
2013	Wild	174	0	1	2,936	26	**3,137**
	Hatchery	3	0	0	56	1	**60**
Average	***Wild***	***270***	***0***	***1***	***2,941***	***35***	***3,248***
	Hatchery	***18***	***0***	***0***	***61***	***2***	***81***
Median	***Wild***	***112***	***0***	***0***	***2,936***	***21***	***3,137***
	Hatchery	***4***	***0***	***0***	***22***	***0***	***32***

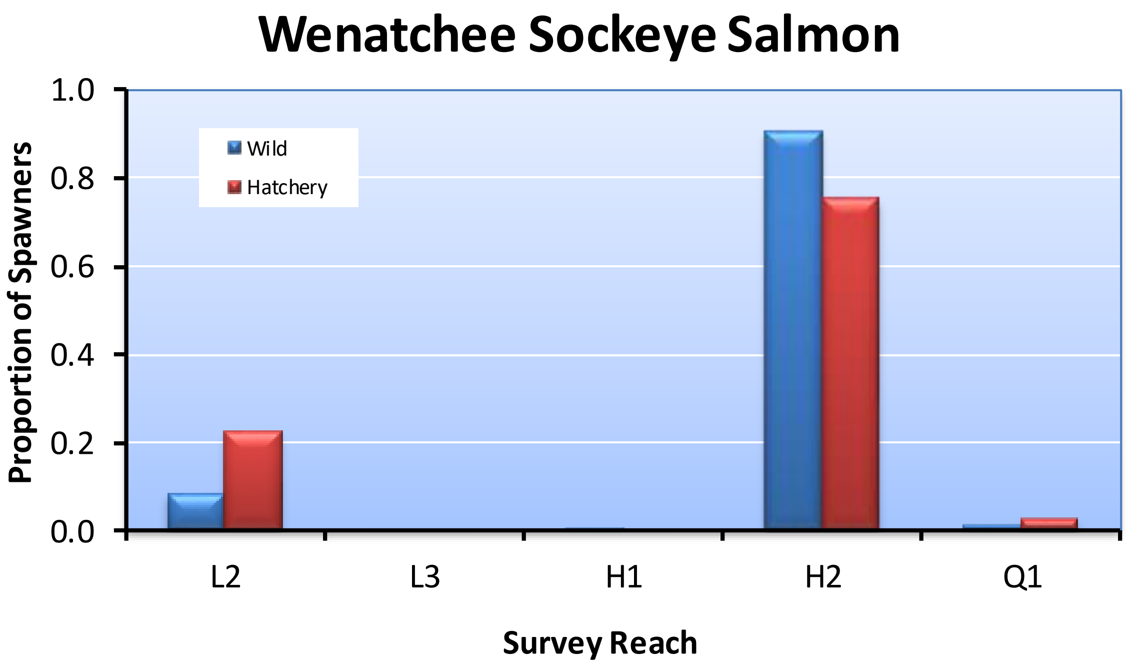


Figure 4.2. Distribution of wild and hatchery produced carcasses in different reaches in the Wenatchee River basin, pooled data from 1993-2013. Reach codes are described in Table 2.8; L = Little Wenatchee, H = White River, and Q = Napeequa River.

4.7 Life History Monitoring

Life history characteristics of Wenatchee sockeye were assessed by examining carcasses on spawning grounds and fish sampled at broodstock collection sites or during stock assessment, and by reviewing tagging data and fisheries statistics.

Migration Timing

There was little difference in migration timing of hatchery and wild sockeye past Tumwater Dam (Table 4.20a and b; Figure 4.3). On average, early in the run, hatchery and wild sockeye arrived at the dam at about the same time. Toward the end of the migration period, hatchery sockeye tended to arrive at the dam slightly later than did wild sockeye. Most hatchery and wild sockeye migrated upstream past Tumwater Dam during July through early August. The peak migration time for both hatchery and wild sockeye was the last two weeks of July (Figure 4.3).

Table 4.20a. The Julian day and date that 10%, 50% (median), and 90% of the wild and hatchery sockeye salmon passed Tumwater Dam, 1998-2019. The average Julian day and date are also provided. Migration timing is based on video sampling at Tumwater. Data for 1998 through 2003 were based on videotapes and broodstock trapping and may not reflect the actual number of hatchery sockeye salmon. All sockeye were visually examined during trapping from 2004 to present. The return of Wenatchee hatchery sockeye ended in 2017.

Survey year	Origin	Sockeye Migration Time (days)								Sample size
		10 Percentile		50 Percentile		90 Percentile		Mean		
		Julian	Date	Julian	Date	Julian	Date	Julian	Date	
1998	Wild	195	14-Jul	201	20-Jul	208	27-Jul	202	21-Jul	4,173
	Hatchery	196	15-Jul	204	23-Jul	220	8-Aug	206	25-Jul	31
1999	Wild	226	14-Aug	233	21-Aug	241	29-Aug	234	22-Aug	908
	Hatchery	228	16-Aug	234	22-Aug	242	30-Aug	235	23-Aug	264
2000	Wild	200	18-Jul	206	24-Jul	213	31-Jul	207	25-Jul	18,390
	Hatchery	199	17-Jul	206	24-Jul	213	31-Jul	206	24-Jul	2,589
2001	Wild	189	8-Jul	194	13-Jul	214	2-Aug	198	17-Jul	32,554
	Hatchery	199	18-Jul	212	31-Jul	240	28-Aug	214	2-Aug	79
2002	Wild	204	23-Jul	208	27-Jul	219	7-Aug	210	29-Jul	27,241
	Hatchery	204	23-Jul	209	28-Jul	222	10-Aug	211	30-Jul	580
2003	Wild	194	13-Jul	200	19-Jul	208	27-Jul	201	20-Jul	4,699
	Hatchery	194	13-Jul	201	20-Jul	211	30-Jul	203	22-Jul	375
2004	Wild	191	9-Jul	196	14-Jul	207	25-Jul	198	16-Jul	31,408
	Hatchery	189	7-Jul	194	12-Jul	203	21-Jul	196	14-Jul	1,758
2005	Wild	192	11-Jul	199	18-Jul	227	15-Aug	204	23-Jul	14,176
	Hatchery	187	6-Jul	200	19-Jul	251	8-Sep	212	31-Jul	42
2006	Wild	201	20-Jul	204	23-Jul	214	2-Aug	206	25-Jul	9,151
	Hatchery	202	21-Jul	219	7-Aug	228	16-Aug	215	3-Aug	507
2007	Wild	201	20-Jul	210	29-Jul	227	15-Aug	213	1-Aug	2,542
	Hatchery	205	24-Jul	213	1-Aug	231	19-Aug	216	4-Aug	65
2008	Wild	200	18-Jul	207	25-Jul	219	6-Aug	208	26-Jul	29,229
	Hatchery	201	19-Jul	206	24-Jul	215	2-Aug	208	26-Jul	103
2009	Wild	198	17-Jul	204	23-Jul	213	1-Aug	206	25-Jul	15,552
	Hatchery	199	18-Jul	205	24-Jul	215	3-Aug	207	26-Jul	534
2010	Wild	199	18-Jul	205	24-Jul	220	8-Aug	208	27-Jul	34,519
	Hatchery	200	19-Jul	215	3-Aug	244	1-Sep	218	6-Aug	1,302
2011	Wild	213	1-Aug	216	4-Aug	224	12-Aug	217	5-Aug	17,680
	Hatchery	213	1-Aug	213	1-Aug	231	19-Aug	216	4-Aug	954
2012[a]	Wild	207	25-Jul	212	30-Jul	216	3-Aug	212	30-Jul	21,246
	Hatchery	207	25-Jul	207	25-Jul	228	15-Aug	213	31-Jul	348
2013	Wild	196	15-Jul	200	19-Jul	207	26-Jul	201	20-Jul	28,245
	Hatchery	197	16-Jul	201	20-Jul	211	30-Jul	203	22-Jul	770

Survey year	Origin	Sockeye Migration Time (days)								Sample size
		10 Percentile		50 Percentile		90 Percentile		Mean		
		Julian	Date	Julian	Date	Julian	Date	Julian	Date	
2014	Wild	194	13-Jul	199	18-Jul	210	29-Jul	201	20-Jul	97,670
	Hatchery	196	15-Jul	201	20-Jul	211	30-Jul	203	22-Jul	2,229
2015	Wild	191	10-Jul	199	18-Jul	215	3-Aug	203	22-Jul	49,628
	Hatchery	181	30-Jun	199	18-Jul	212	31-Jul	200	19-Jul	1,782
2016	Wild	190	8-Jul	196	14-Jul	208	26-Jul	198	16-Jul	73,619
	Hatchery	192	10-Jul	195	13-Jul	207	25-Jul	197	15-Jul	78
2017	Wild	198	17-Jul	204	23-Jul	211	30-Jul	204	23-Jul	23,845
	Hatchery	202	21-Jul	205	24-Jul	212	31-Jul	207	26-Jul	9
Average (1998-2017)	***Wild***	***199***	--	***205***	--	***216***	--	***207***	--	***26,824***
	Hatchery	***200***	--	***207***	--	***222***	--	***209***	--	***720***
Median (1998-2017)	***Wild***	***198***	--	***204***	--	***214***	--	***205***	--	***22,546***
	Hatchery	***199***	--	***206***	--	***218***	--	***208***	--	***441***
2018	Wild	194	13-Jul	198	17-Jul	207	26-Jul	200	19-Jul	13,960
2019	Wild	192	11-Jul	198	17-Jul	208	27-Jul	200	19-Jul	8,875
Average	***Wild***	***193***	--	***198***	--	***208***	--	***200***	--	***11,418***
Median	***Wild***	***193***	--	***198***	--	***208***	--	***200***	--	***11,418***

[a] The origin of sockeye passing Tumwater Dam during 8 through 11 August 2012 was not assessed. The total number of sockeye passing Tumwater Dam in 2012 was 30,617 adults. Thus, about 9,023 adults of unknown origin passed Tumwater Dam in 2012.

Table 4.20b. The week that 10%, 50% (median), and 90% of the wild and hatchery sockeye salmon passed Tumwater Dam, 1998-2019. The average week is also provided. Migration timing is based on video sampling at Tumwater. Data for 1998 through 2003 were based on videotapes and broodstock trapping and may not reflect the actual number of hatchery sockeye salmon. All sockeye were visually examined during trapping from 2004 to present.

Survey year	Origin	Sockeye Migration Time (week)				Sample size
		10 Percentile	50 Percentile	90 Percentile	Mean	
1998	Wild	28	29	30	29	4,173
	Hatchery	28	30	32	30	31
1999	Wild	33	34	35	34	908
	Hatchery	33	34	35	34	264
2000	Wild	29	30	31	30	18,390
	Hatchery	29	30	31	30	2,589
2001	Wild	27	28	31	29	32,554
	Hatchery	29	31	35	31	79
2002	Wild	30	30	32	30	27,241
	Hatchery	30	30	32	31	580
2003	Wild	28	29	30	29	4,699
	Hatchery	28	29	31	29	375

Survey year	Origin	Sockeye Migration Time (week)				Sample size
		10 Percentile	50 Percentile	90 Percentile	Mean	
2004	Wild	28	28	28	29	31,408
	Hatchery	27	28	29	28	1,758
2005	Wild	28	29	33	30	14,176
	Hatchery	27	29	36	31	42
2006	Wild	29	29	31	30	9,151
	Hatchery	29	32	33	31	507
2007	Wild	29	30	33	31	2,542
	Hatchery	30	31	33	31	65
2008	Wild	29	30	32	30	29,229
	Hatchery	29	30	31	30	103
2009	Wild	29	30	31	30	15,552
	Hatchery	29	29	31	30	534
2010	Wild	29	30	32	30	34,519
	Hatchery	29	31	35	32	1,302
2011	Wild	31	31	32	31	17,680
	Hatchery	31	31	33	31	954
2012[a]	Wild	30	31	31	31	21,246
	Hatchery	30	30	33	31	348
2013	Wild	28	29	30	29	28,245
	Hatchery	29	29	31	29	770
2014	Wild	28	29	30	29	97,670
	Hatchery	28	29	29	29	2,229
2015	Wild	28	29	31	30	49,628
	Hatchery	26	29	31	29	1,782
2016	Wild	28	28	30	29	73,619
	Hatchery	28	28	30	29	78
2017	Wild	29	30	31	30	23,845
	Hatchery	29	30	31	30	9
Average (1998-2017)	***Wild***	***29***	***30***	***31***	***30***	***26,824***
	Hatchery	***29***	***30***	***32***	***30***	***720***
Median (1998-2017)	***Wild***	***29***	***30***	***31***	***30***	***22,546***
	Hatchery	***29***	***30***	***32***	***30***	***441***
2018	Wild	28	29	30	29	13,960
2019	Wild	28	29	30	29	8,875
Average[b]	***Wild***	***29***	***30***	***31***	***30***	***11,418***
Median[b]	***Wild***	***29***	***29***	***31***	***30***	***11,418***

[a] The origin of sockeye passing Tumwater Dam during 8 through 11 August 2012 was not assessed. The total number of sockeye passing Tumwater Dam in 2012 was 30,617 adults. Thus, about 9,023 adults of unknown origin passed Tumwater Dam in 2012.

[b] Statistics are from 2018 to present.

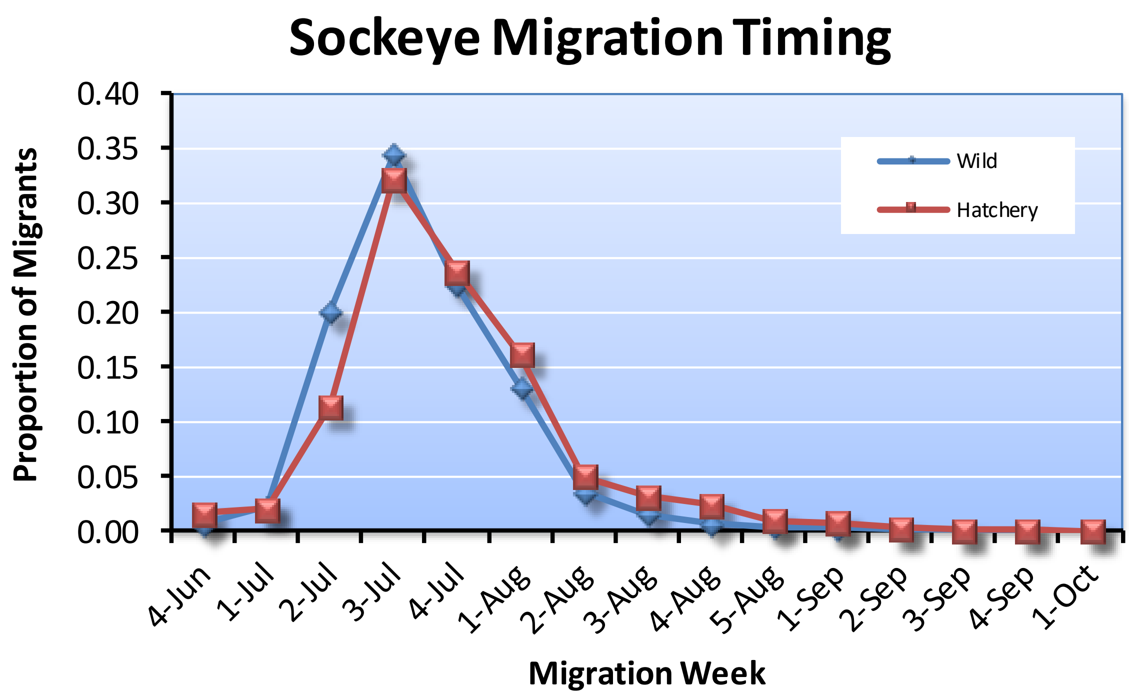


Figure 4.3. Proportion of wild and hatchery sockeye observed (using video) passing Tumwater Dam each week during their migration period late-June through early-October; data were pooled over survey years 1998-2017.

Age at Maturity

Although sample sizes are small, most hatchery sockeye returned as age-4 fish, while most wild sockeye returned as age-4 and 5 fish (Table 4.21; Figure 4.4). Only wild fish have returned at age-6. No hatchery fish have been observed since 2017.

Table 4.21. Proportions of wild and hatchery sockeye of different ages (total age) sampled in broodstock (1994-2011), on spawning grounds (1994-2012), and at Tumwater Dam (2013-2019).

Survey year	Origin	Total age						Sample size
		2	3	4	5	6	7	
1994	Wild	0.00	0.00	0.00	0.00	0.00	0.00	0
	Hatchery	0.00	0.00	0.88	0.13	0.00	0.00	16
1995	Wild	0.00	0.00	0.00	0.00	0.00	0.00	0
	Hatchery	0.00	0.00	0.00	1.00	0.00	0.00	1
1996	Wild	0.00	0.00	0.00	0.00	0.00	0.00	0
	Hatchery	0.00	0.00	1.00	0.00	0.00	0.00	82
1997	Wild	0.00	0.00	0.00	0.00	0.00	0.00	0
	Hatchery	0.00	0.00	0.77	0.23	0.00	0.00	13
1998	Wild	0.00	0.08	0.85	0.08	0.00	0.00	26

Survey year	Origin	Total age						Sample size
		2	3	4	5	6	7	
	Hatchery	0.00	0.00	0.64	0.36	0.00	0.00	11
1999	Wild	0.00	0.00	0.18	0.73	0.10	0.00	113
	Hatchery	0.00	0.00	0.65	0.35	0.00	0.00	31
2000	Wild	0.00	0.00	0.00	1.00	0.00	0.00	1
	Hatchery	0.00	0.00	0.98	0.02	0.00	0.00	359
2001	Wild	0.00	0.00	0.76	0.24	0.00	0.00	29
	Hatchery	0.00	0.00	0.75	0.25	0.00	0.00	171
2002	Wild	0.00	0.00	0.20	0.80	0.00	0.00	5
	Hatchery	0.00	0.00	0.29	0.71	0.00	0.00	63
2003	Wild	0.00	0.00	0.00	1.00	0.00	0.00	5
	Hatchery	0.00	0.33	0.67	0.00	0.00	0.00	6
2004	Wild	0.00	0.00	0.00	0.00	0.00	0.00	0
	Hatchery	0.00	0.02	0.93	0.05	0.00	0.00	244
2005	Wild	0.00	0.00	0.00	0.00	0.00	0.00	0
	Hatchery	0.00	0.13	0.75	0.13	0.00	0.00	8
2006	Wild	0.00	0.00	0.34	0.65	0.01	0.00	207
	Hatchery	0.00	0.00	1.00	0.00	0.00	0.00	65
2007	Wild	0.00	0.00	0.02	0.88	0.10	0.00	206
	Hatchery	0.00	0.00	0.35	0.65	0.00	0.00	17
2008	Wild	0.00	0.00	0.95	0.04	0.01	0.00	258
	Hatchery	0.00	0.08	0.92	0.00	0.00	0.00	12
2009	Wild	0.00	0.00	0.79	0.21	0.00	0.00	251
	Hatchery	0.00	0.00	1.00	0.00	0.00	0.00	2
2010	Wild	0.00	0.00	0.67	0.33	0.00	0.00	193
	Hatchery	0.00	0.00	0.98	0.02	0.00	0.00	130
2011	Wild	0.00	0.00	0.63	0.36	0.01	0.00	270
	Hatchery	0.00	0.02	0.96	0.02	0.00	0.00	274
2012	Wild	0.00	0.00	0.92	0.08	0.00	0.00	13
	Hatchery	0.00	0.00	0.96	0.03	0.01	0.00	128
2013	Wild	0.00	0.002	0.56	0.44	0.002	0.00	457
	Hatchery	0.00	0.00	0.50	0.50	0.00	0.00	2
2014	Wild	0.00	0.00	0.88	0.12	0.00	0.00	1,332
	Hatchery	0.00	0.03	0.95	0.02	0.00	0.00	40
2015	Wild	0.00	0.00	0.81	0.19	0.00	0.00	882
	Hatchery	0.00	0.00	1.00	0.00	0.00	0.00	53
2016	Wild	0.00	0.00	0.77	0.23	0.00	0.00	765
	Hatchery	0.00	0.00	0.00	1.00	0.00	0.00	1
2017	Wild	0.00	0.00	0.49	0.47	0.04	0.00	470

Survey year	Origin	Total age						Sample size
		2	3	4	5	6	7	
	Hatchery	0.00	0.00	0.50	0.00	0.50	0.00	2
Average (1994-2017)	***Wild***	***0.00***	***0.00***	***0.70***	***0.29***	***0.01***	***0.00***	***229***
	Hatchery	***0.00***	***0.01***	***0.90***	***0.09***	***0.00***	***0.00***	***72***
Median (1994-2017)	***Wild***	***0.00***	***0.00***	***0.71***	***0.29***	***0.00***	***0.00***	***71***
	Hatchery	***0.00***	***0.00***	***0.91***	***0.09***	***0.00***	***0.00***	***24***
2018	Wild	0.00	0.00	0.65	0.34	0.01	0.00	412
2019	Wild	0.00	0.00	0.21	0.74	0.05	0.00	737
Average[a]	***Wild***	***0.00***	***0.00***	***0.43***	***0.54***	***0.03***	***0.00***	***575***
Median[a]	***Wild***	***0.00***	***0.00***	***0.43***	***0.54***	***0.03***	***0.00***	***575***

[a] Statistics are from 2018 to present.

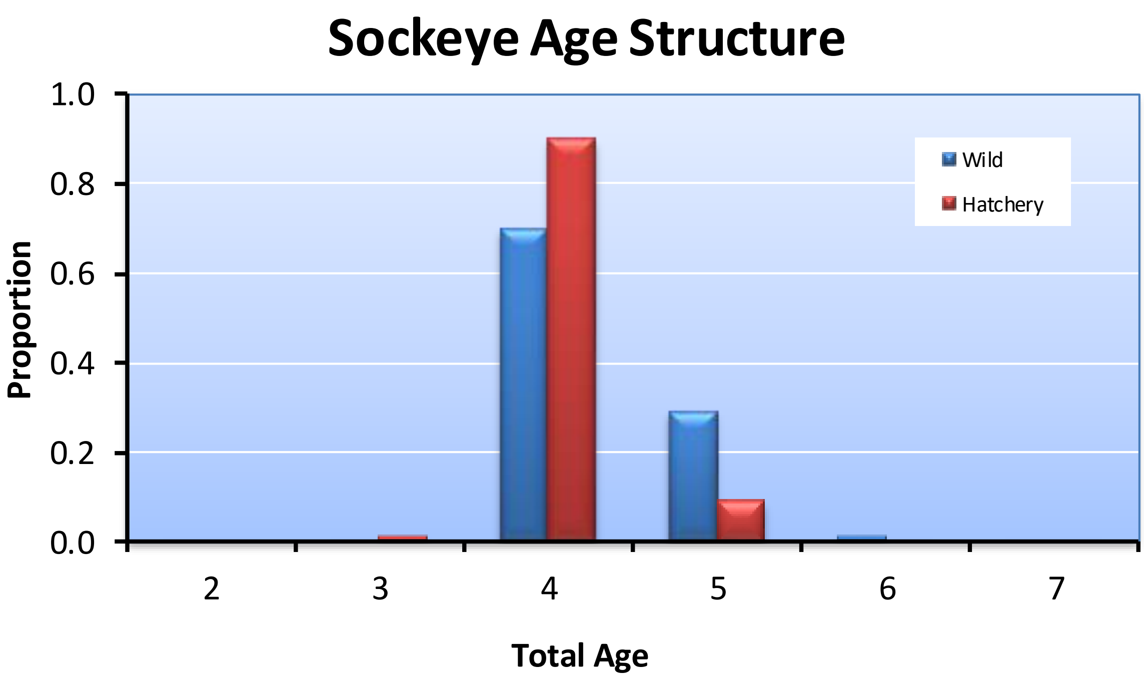


Figure 4.4. Proportions of wild and hatchery sockeye salmon of different total ages sampled at Tumwater Dam and on spawning grounds in the Wenatchee River basin for the combined years 1994-2017.

Size at Maturity

Because no hatchery sockeye have returned since 2017, there are no comparisons in sizes between hatchery and wild sockeye from 2018 to present (Table 4.22). However, for the period 1994-2017, the pooled data indicate that there is little difference in mean sizes of hatchery and wild sockeye salmon, with wild fish slightly greater in length (Table 4.22). Analyses for the five-year statistical reports will compare sizes of hatchery and wild fish of the same age groups and sex.

Table 4.22. Mean lengths (POH; cm) and variability statistics for wild and hatchery sockeye salmon sampled at Dryden Dam (broodstock) and on spawning grounds in the Wenatchee River basin, 1994-2019; SD = 1 standard deviation. From 2014 to present, data are collected from sockeye sampled at Tumwater Dam.

Survey year	Origin	Sample size	Sockeye length (POH; cm)			
			Mean	SD	Minimum	Maximum
1994	Wild	0	-	-	-	-
	Hatchery	14	42	3	37	47
1995	Wild	0	-	-	-	-
	Hatchery	1	53	-	53	53
1996	Wild	0	-	-	-	-
	Hatchery	5	51	3	49	55
1997	Wild	6	40	3	38	45
	Hatchery	17	41	3	37	50
1998	Wild	585	43	3	34	50
	Hatchery	20	43	3	40	51
1999	Wild	99	42	3	36	50
	Hatchery	31	41	3	36	47
2000	Wild	1	48	-	48	48
	Hatchery	377	40	2	30	49
2001	Wild	29	42	2	38	47
	Hatchery	184	43	3	35	51
2002	Wild	5	42	1	40	43
	Hatchery	52	44	3	37	49
2003	Wild	5	44	4	38	47
	Hatchery	13	42	5	30	48
2004	Wild	0	-	-	-	-
	Hatchery	230	40	3	33	49
2005	Wild	0	-	-	-	-
	Hatchery	8	43	9	35	64
2006	Wild	248	45	4	34	52
	Hatchery	17	41	5	31	48
2007	Wild	248	45	3	32	52
	Hatchery	16	41	5	31	48
2008	Wild	261	52	3	44	66
	Hatchery	20	39	3	30	41
2009	Wild	260	43	3	33	53
	Hatchery	22	41	2	36	46
2010	Wild	200	56	3	48	66
	Hatchery	131	41	2	35	45
2011	Wild	277	43	3	35	51

Survey year	Origin	Sample size	Sockeye length (POH; cm)			
			Mean	SD	Minimum	Maximum
	Hatchery	282	40	3	32	49
2012	Wild	15	40	4	34	48
	Hatchery	130	40	3	31	48
2013	Wild	2	49	3	47	51
	Hatchery	64	50	4	43	65
2014	Wild	1,367	42	2	31	51
	Hatchery	43	41	3	32	45
2015	Wild	920	43	2	37	53
	Hatchery	54	43	2	39	47
2016	Wild	798	43	3	36	51
	Hatchery	1	38	-	38	38
2017	Wild	493	44	3	35	52
	Hatchery	2	44	5	38	49
Pooled (1994-2017)	***Wild***	***5,821***	***45***	***4***	***31***	***66***
	Hatchery	***1,732***	***43***	***4***	***30***	***65***
2018	Wild	429	42	2	35	59
2019	Wild	766	45	3	30	52
Pooled[a]	***Wild***	***1,195***	***44***	***3***	***30***	***59***

[a] Statistics are from 2018 to present.

Contribution to Fisheries

The total number of hatchery and wild sockeye captured in different fisheries is provided in Tables 4.23 and 4.24. Harvest on hatchery-origin sockeye has been less than the harvest on wild sockeye.

Table 4.23. Estimated number and percent (in parentheses) of hatchery-origin Wenatchee sockeye captured in different fisheries, brood years 1989-2011. Brood year 2011 was last release of hatchery sockeye salmon into Lake Wenatchee.

Brood year	Ocean fisheries	Columbia River Fisheries			Total
		Tribal	Commercial (Zones 1-5)	Recreational[a] (sport)	
1989	0 (0)	279 (30)	4 (0)	639 (69)	922
1990	0 (0)	23 (100)	0 (0)	0 (0)	23
1991	0 (0)	6 (100)	0 (0)	0 (0)	6
1992	0 (0)	38 (97)	1 (3)	0 (0)	39
1993	0 (0)	4 (100)	0 (0)	0 (0)	4
1994	0 (0)	3 (100)	0 (0)	0 (0)	3
1995	0 (0)	10 (100)	0 (0)	0 (0)	10
1996	0 (0)	62 (82)	9 (12)	5 (7)	76
1997	0 (0)	69 (73)	11 (12)	15 (16)	95
1998	0 (0)	7 (100)	0 (0)	0 (0)	7

Brood year	Ocean fisheries	Columbia River Fisheries			Total
		Tribal	Commercial (Zones 1-5)	Recreational[a] (sport)	
1999	0 (0)	3 (20)	0 (0)	12 (80)	15
2000	0 (0)	59 (12)	9 (2)	414 (86)	482
2001	0 (0)	0 (0)	0 (0)	3 (100)	3
2002	0 (0)	16 (100)	0 (0)	0 (0)	16
2003	0 (0)	3 (100)	0 (0)	0 (0)	3
2004	0 (0)	6 (3)	1 (1)	192 (96)	199
2005	0 (0)	61 (41)	8 (5)	79 (54)	147
2006	0 (0)	124 (23)	2 (0)	409 (76)	535
2007	0 (0)	96 (81)	13 (11)	9 (8)	118
2008	0 (0)	96 (19)	12 (2)	400 (79)	508
2009	0 (0)	20 (16)	2 (2)	104 (83)	126
2010	0 (0)	97 (36)	5 (2)	170 (63)	272
2011	0 (0)	261 (49)	13 (2)	257 (48)	531
Average	***0 (0)***	***58 (60)***	***4 (2)***	***118 (38)***	***180***
Median	***0 (0)***	***23 (73)***	***1 (0)***	***9 (16)***	***76***

[a] Includes the Lake Wenatchee fishery.

Table 4.24. Estimated number and percent (in parentheses) of wild Wenatchee sockeye captured in different fisheries, brood years 1989-2013.

Brood year	Ocean fisheries	Columbia River Fisheries			Total
		Tribal	Commercial (Zones 1-5)	Recreational[a] (sport)	
1989	0 (0)	2,192 (31)	26 (0)	4,838 (69)	7,056
1990	0 (0)	191 (100)	0 (0)	0 (0)	191
1991	0 (0)	293 (99)	2 (1)	0 (0)	295
1992	0 (0)	345 (99)	5 (1)	0 (0)	350
1993	0 (0)	661 (99)	4 (1)	0 (0)	665
1994	0 (0)	146 (100)	0 (0)	0 (0)	146
1995	0 (0)	63 (85)	4 (5)	7 (9)	74
1996	0 (0)	1,553 (56)	247 (9)	993 (36)	2,793
1997	0 (0)	3,060 (54)	376 (7)	2,266 (40)	5,702
1998	0 (0)	937 (98)	7 (1)	10 (1)	954
1999	0 (0)	22 (19)	3 (3)	90 (78)	115
2000	0 (0)	1,188 (19)	165 (3)	4,881 (78)	6,234
2001	0 (0)	827 (100)	1 (0)	0 (0)	828
2002	0 (0)	379 (83)	2 (0)	73 (16)	454
2003	0 (0)	129 (24)	14 (3)	383 (73)	526
2004	0 (0)	1,559 (24)	173 (3)	4,825 (74)	6,557

Brood year	Ocean fisheries	Columbia River Fisheries			Total
		Tribal	Commercial (Zones 1-5)	Recreational[a] (sport)	
2005	0 (0)	2,498 (44)	197 (3)	2,996 (53)	5,691
2006	0 (0)	2,845 (52)	135 (2)	2,505 (46)	5,485
2007	0 (0)	1,534 (57)	216 (8)	976 (36)	2,726
2008	0 (0)	5,069 (26)	596 (3)	13,560 (71)	19,225
2009	0 (0)	1,204 (19)	94 (1)	5,336 (80)	6,670
2010	0 (0)	5,303 (25)	292 (1)	15,615 (74)	21,210
2011	0 (0)	6,691 (40)	369 (2)	9,566 (58)	16,626
2012	0 (0)	4,196 (27)	320 (2)	11,254 (71)	15,770
2013	0 (0)	1242 (93)	89 (7)	0 (0)	1,331
Average	***0 (0)***	***1,767 (59)***	***133 (3)***	***3,207 (39)***	***5,107***
Median	***0 (0)***	***1,240 (54)***	***89 (2)***	***976 (40)***	***2,726***

[a] Includes the Lake Wenatchee fishery.

Straying

Stray rates of hatchery-origin sockeye were determined by examining CWTs recovered on spawning grounds within and outside the Wenatchee River basin for return years 2008-2017. In addition, PIT tagging of hatchery sockeye, which began with brood year 2005, allows estimation of stray rates by return year and brood return. Targets for strays based on return year (recovery year) outside the Wenatchee River basin should be less than 5%.

Based on return year and PIT-tag analysis, hatchery-origin Wenatchee sockeye have strayed into the Methow and Okanogan basins, but these hatchery fish made up less than 1% of the run escapement upstream from Wells Dam (Table 4.25).

Table 4.25. Number and percent of run escapement within other non-target basins that consisted of hatchery-origin Wenatchee sockeye salmon, return years 2008-2017. For example, for return year 2015, 0.46% of the sockeye run escapement upstream of Wells Dam consisted of hatchery-origin Wenatchee sockeye. Percent strays should be less than 5%.

Return year	Methow and Okanogan Run Escapement		
	Run escapement*	Expanded detections	Percent
2008	165,334	0	0.00
2009	134,937	57	0.04
2010	291,764	183	0.06
2011	111,508	51	0.05
2012	326,107	75	0.02
2013	129,993	78	0.06
2014	490,804	0	0.00
2015	187,055	858	0.46
2016	216,036	0	0.00
2017	42,299	0	0.00
Average	***209,584***	***130***	***0.07***

Return year	Methow and Okanogan Run Escapement		
	Run escapement*	Expanded detections	Percent
Median	***176,195***	***54***	***0.03***

* Run escapement estimated at Wells Dam.

Based on CWTs and brood-year analysis, virtually no hatchery-origin Wenatchee sockeye strayed into non-target spawning areas or hatchery programs before brood year 2006 (Table 4.26).[13] However, sockeye from brood years 2006 through 2011 strayed into the Entiat River and a few into the Methow River (non-target streams) and non-target hatcheries (Umpqua Trap, Chief Joseph Hatchery, and Entiat National Fish Hatchery) (Table 4.26). The number of returning hatchery sockeye has decreased since brood year 2008. Because carcass surveys in the Wenatchee River basin ended in 2013, the last brood-year homing estimate based on CWTs is 2009.

Table 4.26. Number and percent of hatchery-origin Wenatchee sockeye that homed to target spawning areas and the target hatchery program, and number and percent that strayed to non-target spawning areas and hatchery programs, by brood years 1990-2009. Hatchery-origin sockeye from brood years 1995-1998 were not tagged because of columnaris disease (NA = not available).

Brood year	Homing				Straying			
	Target streams		Target hatchery*		Non-target streams		Non-target hatcheries	
	Number	%	Number	%	Number	%	Number	%
1990	402	99.5	2	0.5	0	0.0	0	0.0
1991	1	100.0	0	0.0	0	0.0	0	0.0
1992	92	98.9	0	0.0	0	0.0	1	1.1
1993	29	96.7	1	3.3	0	0.0	0	0.0
1994	66	94.3	4	5.7	0	0.0	0	0.0
1995	NA	NA	NA	NA	NA	NA	NA	NA
1996	NA	NA	NA	NA	NA	NA	NA	NA
1997	NA	NA	NA	NA	NA	NA	NA	NA
1998	NA	NA	NA	NA	NA	NA	NA	NA
1999	65	100.0	0	0.0	0	0.0	0	0.0
2000	571	100.0	0	0.0	0	0.0	0	0.0
2001	17	100.0	0	0.0	0	0.0	0	0.0
2002	251	100.0	0	0.0	0	0.0	0	0.0
2003	11	100.0	0	0.0	0	0.0	0	0.0
2004	56	100.0	0	0.0	0	0.0	0	0.0
2005	67	97.1	2	2.9	0	0.0	0	0.0
2006	117	41.9	0	0.0	160	57.3	2	0.7
2007	260	82.0	1	0.3	56	17.7	0	0.0
2008	86	90.5	0	0.0	9	9.5	0	0.0

[13] This is likely because few sockeye surveys were conducted in non-target streams (e.g., Entiat and Methow rivers) before the return of brood year 2016.

Brood year	Homing				Straying			
	Target streams		Target hatchery*		Non-target streams		Non-target hatcheries	
	Number	%	Number	%	Number	%	Number	%
2009	11	73.3	0	0.0	4	26.7	0	0.0
2010	NA	NA	0	0.0	2	100.0	0	0.0
2011	NA	NA	0	0.0	2	8.0	23	92.0
Average	***131***	***92.1***	***1***	***0.7***	***13***	***12.2***	***1***	***5.2***
Median	***67***	***99.2***	***0***	***0.0***	***0***	***0.0***	***0***	***0.0***

* Homing to the target hatchery includes Wenatchee hatchery sockeye that are captured and included as broodstock in the Wenatchee Hatchery program. These hatchery fish were collected at Tumwater Dam.

Based on PIT-tags and brood-year analyses, on average, about 11% of the hatchery sockeye returns were last detected in streams outside the Wenatchee River basin (Table 4.27). The numbers in Table 4.27 should be considered rough estimates because they are not based on confirmed spawning (only last detections). Nevertheless, these data do indicate that some hatchery sockeye from the Wenatchee program have strayed into the Entiat and Methow rivers and possibly into the Okanogan system (based on sockeye detected at Wells Dam but not in the Methow River).

Table 4.27. Number and percent of hatchery-origin Wenatchee sockeye that homed to target spawning areas and the target hatchery program, and number and percent that strayed to non-target spawning areas and hatchery programs for brood years 2005-2012. Estimates were based on last detections of PIT-tagged hatchery sockeye.

Brood Year	Homing				Straying			
	Target streams		Target hatchery*		Non-target stream		Non-target hatchery	
	Number	%	Number	%	Number	%	Number	%
2005	1,561	92.2	0	0.0	132	7.8	0	0.0
2006	6,680	94.6	0	0.0	382	5.4	0	0.0
2007	3,239	95.0	0	0.0	169	5.0	0	0.0
2008	1,281	89.1	0	0.0	156	10.9	0	0.0
2009	645	82.0	0	0.0	141	18.0	0	0.0
2010	2,544	100.0	0	0.0	0	0.0	0	0.0
2011	3,331	72.5	0	0.0	1,262	27.5	0	0.0
Average	***2,754***	***89.4***	***0***	***0.0***	***320***	***10.6***	***0***	***0.0***
Median	***2,544***	***92.2***	***0***	***0.0***	***156***	***7.8***	***0***	***0.0***

* Homing to the target hatchery includes Wenatchee hatchery sockeye that are captured and included as broodstock in the Wenatchee Hatchery program. These hatchery fish were collected at Tumwater Dam.

Genetics

Genetic studies were conducted in 2008 to determine the potential effects of the Wenatchee sockeye supplementation program on natural-origin sockeye in the upper Wenatchee River basin (Blankenship et al. 2008; the entire report is appended as Appendix K). Specifically, the objective of the study was to determine if the genetic composition of the Lake Wenatchee sockeye population had been altered by the supplementation program, which was based on the artificial propagation of a small subset of the Wenatchee population. Microsatellite DNA allele frequencies were used to differentiate between temporally replicated collections of natural and hatchery-origin sockeye in the Wenatchee River basin. A total of 13 collections of Wenatchee sockeye were analyzed; eight temporally replicated collections of natural-origin sockeye (N = 786) and five temporally replicated collections of hatchery-origin sockeye (N = 248). Paired natural-hatchery collections were available from return years 2000, 2001, 2004, 2006, and 2007. All collections were taken at Tumwater Dam and consisted of dried scales and fin clips.

Overall, the study showed that allele frequency distributions were consistent over time, regardless of origin, resulting in small, insignificant measures of genetic differentiation among collections. This indicates that there were no year-to-year differences in allele frequencies between natural and hatchery-origin sockeye. In addition, the analyses found no differences between pre- and post-supplementation collections. Thus, it was concluded that the allele frequencies of the broodstock collections equaled the allele frequency of the natural collections.

Proportionate Natural Influence

Another method for assessing the genetic risk of a supplementation program is to determine the influence of the hatchery and natural environments on the adaptation of the composite population. This is estimated by the proportion of natural-origin fish in the hatchery broodstock (pNOB) and the proportion of hatchery-origin fish in the natural spawning escapement (pHOS). We calculated Proportionate Natural Influence (PNI) by iterating Ford's (2002) equations 5 and 6 to equilibrium, using a heritability of 0.3 and a selection strength of three standard deviations. The larger the PNI value, the greater the strength of selection in the natural environment relative to that of the hatchery environment. For the natural environment to dominate selection, PNI should be greater than 0.50, and integrated populations should have a PNI of at least 0.67 (HSRG/WDFW/NWIFC 2004).

The PNI values for the life of the program (brood years 1989-2011) are shown in Table 4.28. Throughout the program, PNI was consistently greater than 0.67. The hatchery program was terminated in 2012.

Table 4.28. Proportionate Natural Influence (PNI) values for the Wenatchee sockeye supplementation program for brood years 1989-2019. NOS = number of natural-origin sockeye counted at Tumwater Dam; HOS = number of hatchery-origin sockeye counted at Tumwater Dam; NOB = number of natural-origin sockeye collected for broodstock; and HOB = number of hatchery-origin sockeye included in hatchery broodstock. NP = no hatchery program.

Brood year	Escapement[a]			Broodstock			PNI[b]
	NOS	HOS	pHOS	NOB	HOB	pNOB	
1989	21,802	0	0.00	115	0	1.00	1.00
1990	27,325	0	0.00	302	0	1.00	1.00
1991	26,689	0	0.00	199	0	1.00	1.00
1992	16,461	0	0.00	320	0	1.00	1.00
1993	25,064	2,662	0.10	207	0	1.00	0.91
1994	6,934	396	0.05	236	5	0.98	0.95
1995	3,262	186	0.05	194	3	0.98	0.95
1996	6,027	546	0.08	225	0	1.00	0.93

Brood year	Escapement[a]			Broodstock			PNI[b]
	NOS	HOS	pHOS	NOB	HOB	pNOB	
1997	8,376	68	0.01	192	19	0.91	0.99
1998	3,982	32	0.01	122	6	0.95	0.99
1999	961	64	0.06	79	60	0.57	0.91
2000	19,620	1,164	0.06	170	5	0.97	0.94
2001	28,288	815	0.03	200	7	0.97	0.97
2002	27,371	193	0.01	256	0	1.00	0.99
2003	4,797	58	0.01	198	0	1.00	0.99
2004	26,095	1,460	0.05	177	0	1.00	0.95
2005	13,983	28	0.00	166	0	1.00	1.00
2006	9,182	255	0.03	214	0	1.00	0.97
2007	2,320	59	0.02	210	0	1.00	0.98
2008	22,931	92	0.00	243	2	0.99	1.00
2009	13,043	445	0.03	239	0	1.00	0.97
2010	30,357	1,134	0.04	198	0	1.00	0.96
2011	17,490	940	0.05	196	0	1.00	0.95
Average	***15,755***	***461***	***0.03***	***203***	***5***	***0.97***	***0.97***
Median	***16,461***	***186***	***0.03***	***199***	***0***	***1.00***	***0.97***
2012	30,903	502	0.02	NP	NP	NP	NP
2013	22,118	614	0.03	NP	NP	NP	NP
2014	81,804	1840	0.02	NP	NP	NP	NP
2015	42,132	1528	0.03	NP	NP	NP	NP
2016	59,008	59	0.00	NP	NP	NP	NP
2017	23,844	10	0.00	NP	NP	NP	NP
2018	13,960	16	0.00	NP	NP	NP	NP
2019	8,875	0	0.00	NP	NP	NP	NP
Average	***35,331***	***571***	***0.01***	***NP***	***NP***	***NP***	***NP***
Median	***27,374***	***281***	***0.01***	***NP***	***NP***	***NP***	***NP***

[a] Proportions of natural-origin and hatchery-origin spawners were determined from reading video tape at Tumwater Dam, adjusted for fish harvested in the Lake Wenatchee recreational fishery.

[b] PNI was calculated previously using PNI approximate equation 11 (HSRG 2009; their Appendix A). All PNI values presented here were recalculated by iterating Ford's (2002) equations 5 and 6 to equilibrium using a heritability of 0.3 and a selection strength of three standard deviations. C. Busack, NOAA Fisheries, 21 March 2016, provided the model for calculating PNI.

Post-Release Survival and Travel Time

We used PIT-tagged fish to estimate survival rates and travel time (arithmetic mean days) of hatchery sockeye salmon from Lake Wenatchee to McNary Dam, and smolt to adult ratios (SARs) from release to detection at Bonneville Dam (Table 4.29).[14] Over the seven brood years for which PIT-tagged hatchery fish were released, survival rates from Lake Wenatchee to McNary Dam

[14] It is important to point out that because of fish size differences among rearing tanks or raceways, fish PIT tagged in one tank or raceway may not represent untagged fish rearing in other tanks or raceways.

ranged from 0.211 to 0.370; SARs from release to detection at Bonneville Dam ranged from 0.005 to 0.044. Average travel time from Lake Wenatchee to McNary Dam ranged from 176 to 202 days.

Table 4.29. Total number of hatchery sockeye parr released with PIT tags, their survival and travel times (mean days) to McNary Dam, and smolt-to-adult (SAR) ratios for brood years 2005-2011. Standard errors are shown in parentheses.

Brood year	Number of sockeye released with PIT tags	Survival to McNary Dam	Travel time[1] to McNary Dam (d)	SAR to Bonneville Dam
2005	14,859	0.334 (0.013)	176.4 (61.9)	0.020 (0.001)
2006	14,764	0.370 (0.030)	202.0 (9.1)	0.044 (0.002)
2007	14,947	0.312 (0.013)	199.9 (8.6)	0.024 (0.001)
2008	14,858	0.307 (0.020)	192.9 (35.7)	0.015 (0.001)
2009	14,486	0.211 (0.015)	194.2 (29.1)	0.005 (0.001)
2010	5,039	0.302 (0.048)	191.7 (26.6)	0.014 (0.002)
2011	5,074	0.318 (0.038)	196.7 (7.3)	0.036 (0.003)

[1] Travel time is calculated from the date of release from the net pens in the fall, overwintering in Lake Wenatchee, to spring outmigration.

We also used PIT tags to estimate survival rates and travel times (arithmetic mean days) of wild sockeye salmon smolts tagged at the Lower Wenatchee Trap (before 2013, the trap was located near Monitor, WA; since 2013, the trap have been operating near Cashmere, WA). Survival rates and travel times were estimated from the Lower Wenatchee Trap to McNary Dam, and smolt to adult ratios (SARs) from the trap to detection of returning adults at Bonneville Dam (Table 4.30). Over the nine survey years for which PIT-tagged wild sockeye smolts were released, survival rates from the Lower Wenatchee Trap to McNary Dam ranged from 0.248 to 0.675; SARs from release to detection at Bonneville Dam ranged from 0.004 to 0.076. Average travel time from the Lower Wenatchee Trap to McNary Dam ranged from 10 to 28 days.

Table 4.30. Total number of wild sockeye smolts PIT tagged at the Lower Wenatchee Trap, their survival and travel times (mean days) to McNary Dam, and smolt-to-adult (SAR) ratios for survey years 2008-2019. Standard errors are shown in parentheses. NA = not available (i.e., not all the adults from the release groups have returned to the Columbia River).

Survey year[1]	Number of sockeye released with PIT tags	Survival to McNary Dam	Travel time[2] to McNary Dam (d)	SAR to Bonneville Dam
2008	3,165	0.675 (0.077)	15.3 (47.1)	0.076 (0.005)
2009	3,683	0.653 (0.030)	12.2 (4.0)	0.053 (0.004)
2010	10,003	0.359 (0.017)	28.3 (9.8)	0.012 (0.001)
2011	0	--	--	--
2012	0	--	--	--
2013	0	--	--	--
2014	4,820	0.432 (0.048)	24.4 (10.5)	0.011 (0.001)
2015	4,018	0.446 (0.049)	23.7 (11.3)	0.006 (0.001)
2016	1,065	0.248 (0.045)	21.0 (9.2)	0.004 (0.002)

Survey year[1]	Number of sockeye released with PIT tags	Survival to McNary Dam	Travel time[2] to McNary Dam (d)	SAR to Bonneville Dam
2017	933	0.589 (0.158)	9.9 (3.6)	NA
2018	8,822	0.639 (0.053)	12.2 (5.5)	NA
2019	1,062	0.640 (0.133)	15.9 (6.3)	NA

[1] Prior to 2013, the Lower Wenatchee Trap operated near Monitor, WA. Since 2013, the trap has operated near Cashmere, WA.
[2] Travel time is calculated from the date of release at the Lower Wenatchee smolt trap to detection at McNary Dam.

Natural and Hatchery Replacement Rates

Natural replacement rates (NRR) were calculated as the ratio of natural-origin recruits (NOR) to the parent spawning population. Natural-origin recruits are naturally produced (wild) fish that survive to contribute to harvest (directly or indirectly), to broodstock, and to spawning grounds. We do not account for fish that died in route to the spawning grounds (migration mortality) or died just before spawning (pre-spawn mortality) (see Appendix B in Hillman et al. 2012). We calculated NORs with and without harvest. NORs without harvest include all returning fish that either returned to the basin or were collected as wild broodstock. NORs with harvest include all fish harvested and are based on a brood year harvest rates from the hatchery program. For brood years 1989-2013, NRR in the Wenatchee averaged 1.61 (range, 0.13-5.72) if harvested fish were not included in the estimate and 1.94 (range, 0.14-6.86) if harvested fish were included in the estimate (Table 4.31).

Hatchery replacement rates (HRR) were estimated as hatchery adult-to-adult returns. These rates should be greater than the NRRs and greater than or equal to 5.4 (the calculated target value in Hillman et al. 2019). The target value of 5.4 includes harvest. HRRs exceeded NRRs in 15 or 16 of the 23 years of data depending on if harvest was or was not included in the estimates (Table 4.31). Hatchery replacement rates for Wenatchee sockeye have equaled or exceeded the estimated target value of 5.4 in six of the 23 years (Table 4.31).

Table 4.31. Broodstock collected, spawning escapements (for the entire Wenatchee River basin), natural and hatchery-origin recruits (NOR and HOR), and natural and hatchery replacement rates (NRR and HRR; with and without harvest) for sockeye salmon in the Wenatchee River basin, 1989-2013.

Brood year	Broodstock Collected	Spawning Escapement	Harvest not included				Harvest included			
			HOR	NOR	HRR	NRR	HOR	NOR	HRR	NRR
1989	255	21,802	2,757	23,616	10.81	1.08	3,680	30,672	14.43	1.41
1990	316	27,325	401	3,509	1.27	0.13	423	3,701	1.34	0.14
1991	233	26,689	95	4,820	0.41	0.18	101	5,116	0.43	0.19
1992	343	16,461	576	5,336	1.68	0.32	615	5,685	1.79	0.35
1993	307	27,726	71	11,151	0.23	0.40	75	11,815	0.24	0.43
1994	265	7,330	47	1,191	0.18	0.16	50	1,337	0.19	0.18
1995	209	3,448	121	840	0.58	0.24	131	913	0.63	0.26
1996	227	6,573	1,351	28,093	5.95	4.27	1,427	30,886	6.29	4.70
1997	226	8,444	739	36,097	3.27	4.27	834	41,798	3.69	4.95
1998	190	4,014	104	16,165	0.55	4.03	111	17,120	0.58	4.27
1999	147	1,025	68	566	0.46	0.55	83	682	0.56	0.67
2000	195	20,784	1,425	29,082	7.31	1.40	1,907	35,316	9.78	1.70
2001	245	29,103	24	17,241	0.10	0.59	28	18,068	0.11	0.62

Brood year	Broodstock Collected	Spawning Escapement	Harvest not included				Harvest included			
			HOR	NOR	HRR	NRR	HOR	NOR	HRR	NRR
2002	257	27,564	281	5,752	1.09	0.21	297	6,207	1.16	0.23
2003	219	4,855	32	2,054	0.15	0.42	35	2,590	0.16	0.53
2004	202	27,555	94	23,589	0.47	0.86	293	30,148	1.45	1.09
2005	207	14,011	460	20,793	2.22	1.48	606	26,485	2.93	1.89
2006	220	9,437	1,147	26,966	5.21	2.86	1,682	32,450	7.65	3.44
2007	228	2,379	917	13,619	4.02	5.72	1,037	16,312	4.55	6.86
2008	260	23,023	808	38,327	3.11	1.66	1,314	57,552	5.05	2.50
2009	261	13,488	344	22,202	1.32	1.65	469	28,871	1.80	2.14
2010	201	31,491	1,748	80,037	8.70	2.54	2,020	101,247	10.05	3.22
2011	204	18,430	1,658	48,651	8.13	2.64	2,190	65,278	10.74	3.54
2012	---	31,405	---	56,779	---	1.81	---	72,524	---	2.31
2013	---	22,732	---	16,874	---	0.74	---	18,106	---	0.80
Average[a]	***236***	***17,084***	***664***	***21,334***	***2.92***	***1.61***	***844***	***26,435***	***3.72***	***1.94***
Median[a]	***227***	***18,430***	***401***	***17,241***	***1.32***	***1.08***	***469***	***18,106***	***1.79***	***1.41***

[a] Statistics are based on the period 1989 through 2011.

Juvenile-to-Adult Survivals

When possible, both parr-to-adult ratios (PAR) and smolt-to-adult ratios (SAR) were calculated for hatchery sockeye salmon. Ratios were calculated as the number of hatchery adult recaptures divided by the number of tagged hatchery parr released or the estimated number of smolts emigrating from Lake Wenatchee. Here, survival ratios were based on CWT returns, when available, or on the estimated number of hatchery adults recovered on the spawning grounds, in broodstock, and harvested. For the available brood years, PARs have ranged from 0.0001 to 0.0339 for hatchery sockeye salmon and SARs have ranged from 0.0002 to 0.0255 (Table 4.32).

Table 4.32. Parr-to-adult ratios (PAR) and smolt-to-adult ratios (SAR) for Wenatchee hatchery sockeye salmon, brood years 1990-2011; NA = not available.

Brood year	Number of parr released	Number of smolts	Estimated adult recaptures	PAR	SAR
1989	108,400	NA	3,680	0.0339	NA
1990	270,802	NA	423	0.0016	NA
1991	167,523	NA	101	0.0006	NA
1992	340,597	NA	615	0.0018	NA
1993	190,443	NA	75	0.0004	NA
1994	252,859	NA	50	0.0002	NA
1995	150,808	28,828	131	0.0009	0.0045
1996	284,630	55,985	1,427	0.0050	0.0255
1997	197,195	112,524	834	0.0042	0.0074
1998	121,344	24,684	111	0.0009	0.0045
1999	167,955	94,046	83	0.0005	0.0009
2000	190,174	121,511	1,907	0.0100	0.0157
2001	200,938	140,322	28	0.0001	0.0002

Brood year	Number of parr released	Number of smolts	Estimated adult recaptures	PAR	SAR
2002	315,783	216,023	297	0.0009	0.0014
2003	240,459	122,399	35	0.0001	0.0003
2004	172,923	159,500	293	0.0017	0.0018
2005	140,542	140,542	606	0.0043	0.0043
2006	225,670	121,843	1,682	0.0075	0.0138
2007	252,133	119,908	1,037	0.0041	0.0086
2008	154,772	126,326	1,314	0.0085	0.0104
2009	227,743	159,089	469	0.0021	0.0027
2010	241,918	NA	2,020	0.0083	NA
2011	256,120	NA	2,190	0.0086	NA
Average	***211,814***	***116,235***	***844***	***0.0046***	***0.0068***
Median	***200,938***	***121,843***	***469***	***0.0018***	***0.0045***

4.8 ESA/HCP Compliance

Smolt and Emigrant Trapping

ESA-listed spring Chinook and steelhead were encountered during operation of the Lower Wenatchee trap. ESA takes are reported in the steelhead (Section 3.8) and spring Chinook (Section 5.8) sections and will not be repeated here.

SECTION 5: WENATCHEE (CHIWAWA) SPRING CHINOOK

The goal of Chiwawa spring Chinook salmon supplementation is to achieve “No Net Impact” to the productivity of spring Chinook caused by the operation of the Rock Island Hydroelectric Project. The Rock Island Fish Hatchery Complex began operation in 1989 under funding from Chelan PUD. The Complex operated originally through the Rock Island Settlement Agreement, but since 2004 has operated under the Rock Island and Rocky Reach Anadromous Fish Agreement and Habitat Conservation Plans.

Adult spring Chinook are collected for broodstock at the Chiwawa Weir and Tumwater Dam. From 2011 through 2013, all spring Chinook broodstock were collected at the Chiwawa Weir in order to reduce passage delays caused by trapping at Tumwater Dam. Before 2009, the goal was to collect up to 379 adult spring Chinook for the program with natural-origin fish making up not less than 33% of the broodstock. In 2011, the Hatchery Committees reevaluated the amount of hatchery compensation needed to achieve NNI. Based on that evaluation, the goal of the program was revised. The current goal (beginning with brood year 2013) is to collect 74 natural-origin spring Chinook. The number collected cannot exceed 33% of the natural-origin spring Chinook returns to Tumwater. Beginning in 2014, previously PIT-tagged natural-origin Chiwawa spring Chinook are collected at Tumwater Dam, while the Chiwawa Weir is used to collect the remaining natural-origin brood required for the Chiwawa spring Chinook program. Broodstock collection occurs from May through 15 July at Tumwater with trapping occurring up to 24 hours per day, seven days a week and at the Chiwawa Weir with trapping occurring from 15 June to 1 August (not to exceed 15 cumulative trapping days) on a 24-hour-up/24-hour-down schedule consistent with annual broodstock collection protocols.

Adult spring Chinook are spawned and reared at Eastbank Fish Hatchery. Juvenile spring Chinook are transferred from the hatchery to the Chiwawa Acclimation Facility in late September or early October. Volitional releases are initiated in April of the following spring and any fish that remain are forced out by early May.

The production goal for the Chiwawa spring Chinook supplementation program up to brood year 2009 was to release 672,000 yearling smolts into the Chiwawa River at 12 fish per pound. Brood years 2010-2011, and 2012 were transition years to a reduced program of 298,000 smolts and 205,000 smolts, respectively. Beginning with the 2013 brood, the revised production goal is to release 144,026 smolts as part of a conservation program at 18 fish per pound. Targets for fork length and weight are 155 mm (CV = 9.0) and 37.8 g, respectively. Over 90% of these fish are marked with CWTs. In addition, since 2006, juvenile spring Chinook have been PIT tagged annually.

With issuance of ESA Section 10 permit 18121 in 2013 (this permit expires in 2026), adult management (i.e., removal of excess hatchery-origin adults at dams, traps, and weirs, and in conservation fisheries) was implemented in 2014 to achieve pHOS and PNI goals for the Chiwawa spring Chinook program.

Although this section of the report focuses on results from monitoring the Chiwawa spring Chinook program, information on spring Chinook collected throughout the Wenatchee River basin is also provided. Information specific to the Nason Creek spring Chinook conservation program is presented in Section 6 and the White River Captive Broodstock Program is presented in Section 7.

5.1 Broodstock Sampling

This section focuses on results from sampling 2017-2019 Chiwawa spring Chinook broodstock, which were collected at the Chiwawa Weir and at Tumwater Dam, consistent with methods in the broodstock collections protocols (Tonseth 2019). Some information for the 2019 return is not available at this time (e.g., age structure and final origin determination). This information will be provided in the 2020 annual report.

Origin of Broodstock

Natural-origin adults made up between 31.0% and 73.5% of the Chiwawa spring Chinook broodstock spawned for brood years 2017-2019 (Table 5.1). Natural and hatchery-origin adults were collected at Tumwater Dam and the Chiwawa Weir for return year 2019. Broodstock were trapped at Tumwater Dam from the end of May through mid-July 2019, and at the Chiwawa Weir from the end of June through early July. Hatchery-origin broodstock were collected at Tumwater Dam in 2019 to fill potential shortfalls of natural-origin broodstock requirements for the Chiwawa River Conservation program. Additional hatchery-origin broodstock were collected to ensure production obligations were achieved in the event that insufficient natural-origin collections could be made. One hatchery-origin fish collected in 2019 was surplused at Eastbank Fish Hatchery.

Table 5.1. Numbers of wild and hatchery Chiwawa spring Chinook collected for broodstock, numbers that died before spawning, and numbers of Chinook spawned, 1989-2019. Unknown-origin fish (i.e., undetermined by scale analysis, no CWT or fin clips, and no additional hatchery marks) were considered naturally produced.

Brood year	Wild spring Chinook					Hatchery spring Chinook						Total number spawned
	Number collected	Prespawn loss[a]	Mortality[a]	Number spawned	Number released	Number collected	Number surplused[b]	Prespawn loss[a]	Mortality[a]	Number spawned	Number released	
1989	28	0	0	28	0	0	0	0	0	0	0	28
1990	19	1	0	18	0	0	0	0	0	0	0	18
1991	32	0	5	27	0	0	0	0	0	0	0	27
1992	113	0	0	78	35	0	0	0	0	0	0	78
1993	100	3	3	94	0	0	0	0	0	0	0	94
1994	9	0	1	8	0	4	0	0	0	4	0	12
1995	No Program											
1996	8	0	0	8	0	10	0	0	0	10	0	18
1997	37	0	5	32	0	83	0	1	3	79	0	111
1998	13	0	0	13	0	35	0	1	0	34	0	47
1999	No Program											
2000	10	0	1	9	0	38	0	1	16	21	0	30
2001	115	2	0	113	0	267	0	8	0	259	0	372
2002	21	0	1	20	0	63	0	1	11	51	0	71
2003	44	1	2	41	0	75	0	2	20	53	0	94
2004	100	1	16	83	0	196	0	30	34	132	0	215
2005	98	1	6	91	0	185	0	3	1	181	0	279
2006	95	0	4	91	0	303	0	0	29	224	50	315
2007	45	1	1	43	0	124	0	2	18	104	0	147
2008	88	2	3	83	0	241	0	5	16	220	0	303
2009	113	6	11	96	0	151	0	3	37	111	0	207
2010	83	0	6	77	0	103	0	0	5	98	0	175

Brood year	Wild spring Chinook					Hatchery spring Chinook						Total number spawned
	Number collected	Prespawn loss[a]	Mortality[a]	Number spawned	Number released	Number collected	Number surplused[b]	Prespawn loss[a]	Mortality[a]	Number spawned	Number released	
2011	80	0	0	80	0	101	0	2	6	93	0	173
Average[c]	***60***	***1***	***3***	***54***	***2***	***94***	***0***	***3***	***9***	***80***	***2***	***134***
Median[c]	***45***	***0***	***1***	***43***	***0***	***75***	***0***	***1***	***3***	***53***	***0***	***94***
2012	68	2	0	66	0	48	1	0	3	45	0	111
2013[e]	159	5	0	68	86	63	296	1	50	2	10	70
2014[f]	58	0	0	58	0	208	1,145	1	68	139	0	197
2015[g]	70	1	5	64	0	58	291	0	5	45	8	109
2016	57	0	0	57	0	66	788	3	21	42	0	99
2017	50	0	0	50	0	66	383	0	25	18	23	68
2018	36	2	0	30	4	58	211	0	1	57	0	87
2019	31	1	0	28	2	36	153	2	1	33	0	61
Average[d]	***66***	***1***	***1***	***53***	***12***	***75***	***409***	***1***	***22***	***48***	***5***	***100***
Median[d]	***58***	***1***	***0***	***58***	***0***	***61***	***294***	***1***	***13***	***44***	***0***	***93***

[a] Pre-spawn loss represents the number of fish that died during the holding period before spawning. Mortality is the number of fish that were surplused following spawning.
[b] Number surplused represents the number of Adult Managed hatchery fish at Tumwater Dam.
[c] The average and median represent the program before recalculation in 2011.
[d] The average and median represent the current program, which began in 2012. Origin determinations should be considered preliminary pending scale analyses.
[e] Pilot year when all NOR Chiwawa and Nason spring Chinook were collected at Tumwater Dam and genotyped by tributary assignment.
[f] HOR Chiwawa spring Chinook were collected to meet both Chiwawa and Nason Creek obligations; broodstock and subsequent progeny were pooled together in the hatchery. About 12 Chiwawa HOR's were used to fulfill the Chiwawa Program; about 122 Chiwawa HOR's were used to fulfill the Nason Creek safety net obligation.
[g] For the Chiwawa program, 36 hatchery-origin returns were collected in case the program fell short on natural-origin returns. After eye-up, all of the hatchery-origin recruit eggs were culled because fecundity of natural-origin recruits was high enough to meet the WxW program.

Age/Length Data

Ages were determined from scales and/or coded wire tags (CWT) collected from broodstock. For both the 2018 and 2019 returns, most adults, regardless of origin, were age-4 Chinook (Table 5.2). Most age-5 Chinook were natural-origin fish. There were no age-3 natural- or hatchery-origin Chinook collected for broodstock in 2019.

Table 5.2. Percent of hatchery and wild spring Chinook of different ages (total age) collected from broodstock, 1991-2019.

Return year	Origin	Total age			
		2	3	4	5
1991	Wild	0.0	0.0	22.0	78.0
	Hatchery	0.0	0.0	0.0	0.0
1992	Wild	0.0	0.0	28.6	71.4
	Hatchery	0.0	0.0	50.0	50.0
1993	Wild	0.0	0.0	22.0	78.0
	Hatchery	0.0	0.0	0.0	0.0
1994	Wild	0.0	0.0	28.6	71.4
	Hatchery	0.0	0.0	50.0	50.0
1995	Wild	No program			

Return year	Origin	Total age			
		2	3	4	5
	Hatchery				
1996	Wild	0.0	28.6	71.4	0.0
	Hatchery	0.0	50.0	50.0	0.0
1997	Wild	0.0	0.0	87.5	12.5
	Hatchery	0.0	1.2	98.8	0.0
1998	Wild	0.0	0.0	63.6	36.4
	Hatchery	0.0	0.0	62.9	37.1
1999	Wild	No program			
	Hatchery				
2000	Wild	0.0	20.0	70.0	10.0
	Hatchery	0.0	59.1	40.9	0.0
2001	Wild	0.0	2.8	94.4	2.8
	Hatchery	0.0	1.5	98.5	0.0
2002	Wild	0.0	0.0	66.7	33.3
	Hatchery	0.0	0.0	93.4	6.6
2003	Wild	0.0	27.0	2.7	70.3
	Hatchery	0.0	21.3	5.3	73.3
2004	Wild	1.0	6.1	88.8	4.1
	Hatchery	0.0	40.4	59.6	0.0
2005	Wild	0.0	1.0	85.0	14.0
	Hatchery	0.0	4.4	95.6	0.0
2006	Wild	0.0	2.0	70.4	27.6
	Hatchery	0.0	1.3	81.2	17.4
2007	Wild	0.0	15.6	53.3	31.1
	Hatchery	0.0	27.4	60.5	12.1
2008	Wild	0.0	6.3	78.8	15.0
	Hatchery	0.0	8.2	86.8	4.9
2009	Wild	0.0	8.6	79.0	12.4
	Hatchery	0.0	18.5	79.5	2.0
2010	Wild	0.0	5.3	94.7	0.0
	Hatchery	0.0	0.0	99.0	1.0
2011	Wild	0.0	2.7	52.7	44.6
	Hatchery	0.0	20.4	60.2	19.4
2012	Wild	0.0	0.0	79.0	21.0
	Hatchery	0.0	4.3	95.7	0.0
2013	Wild	0.0	0.0	65.7	34.3
	Hatchery	0.0	2.2	86.7	11.1
2014	Wild	0.0	0.0	91.2	8.8

Return year	Origin	Total age			
		2	3	4	5
	Hatchery[a]	0.0	0.0	98.5	1.5
2015	Wild	0.0	0.0	88	11.0
	Hatchery[a]	0.0	0.0	100	0.0
2016	Wild	0.0	0.0	82.6	17.4
	Hatchery[a]	0.0	0.0	85.0	15.0
2017	Wild	0.0	4.3	87.2	8.5
	Hatchery[a]	0.0	9.5	88.1	2.4
2018	Wild	0.0	0.0	83.3	16.7
	Hatchery[a]	0.0	0.0	100	0
2019	Wild	0.0	0.0	85.7	14.3
	Hatchery[a]	0.0	0.0	94.0	0.06
Average	***Wild***	***0.0***	***4.8***	***67.5***	***27.6***
	Hatchery	***0.0***	***10.0***	***71.1***	***11.3***
Median	***Wild***	***0.0***	***0.0***	***78.8***	***16.7***
	Hatchery	***0.0***	***1.3***	***85.0***	***1.5***

[a] Comprised of age results for both Chiwawa and Nason Creek obligations.

In 2018, no age-3 fish were included in natural or hatchery-origin broodstock. Additionally, there were no age-5 hatchery-origin fish included in broodstock in 2018. Mean lengths of hatchery and natural-origin broodstock of age-4 Chinook were similar in 2018. There was a small difference in mean lengths between hatchery and natural-origin broodstock of age-4 Chinook in 2019. Age-4 hatchery-origin Chinook were slightly larger than natural-origin fish, also age-5 hatchery-origin Chinook were considerably larger than natural-origin fish, although sample size was small (Table 5.3).

Table 5.3. Mean fork length (cm) at age (total age) of hatchery and wild spring Chinook collected from broodstock, 1991-2019; N = sample size and SD = 1 standard deviation.

Return year	Origin	Spring Chinook fork length (cm)											
		Age-2			Age-3			Age-4			Age-5		
		Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD
1991	Wild	-	0	-	-	5	-	-	19	-	-	8	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-
1992	Wild	-	0	-	-	0	-	-	0	-	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-
1993	Wild	-	0	-	-	0	-	79	4	3	92	8	4
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-
1994	Wild	-	0	-	-	0	-	79	2	3	96	5	6
	Hatchery	-	0	-	-	0	-	82	2	11	92	2	2
1995	Wild	No program											
	Hatchery												

Return year	Origin	Spring Chinook fork length (cm)											
		Age-2			Age-3			Age-4			Age-5		
		Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD
1996	Wild	-	0	-	51	2	1	79	5	7	-	0	-
	Hatchery	-	0	-	56	5	4	74	5	6	-	0	-
1997	Wild	-	0	-	-	0	-	80	28	5	99	4	8
	Hatchery	-	0	-	56	1	-	82	82	4	-	0	-
1998	Wild	-	0	-	-	0	-	78	7	13	83	4	18
	Hatchery	-	0	-	-	0	-	77	22	8	93	13	7
1999	Wild	No program											
	Hatchery												
2000	Wild	-	0	-	51	2	3	82	7	4	98	1	-
	Hatchery	-	0	-	59	13	4	79	9	8	-	0	-
2001	Wild	-	0	-	49	3	6	82	101	6	95	3	3
	Hatchery	-	0	-	56	4	7	83	261	5	-	0	-
2002	Wild	-	0	-	-	0	-	79	12	4	96	6	10
	Hatchery	-	0	-	-	0	-	81	57	6	94	4	9
2003	Wild	-	0	-	55	10	5	83	1	-	99	26	6
	Hatchery	-	0	-	59	16	5	86	4	18	96	55	6
2004	Wild	47	1	-	60	6	6	80	87	5	99	4	3
	Hatchery	-	0	-	51	80	7	80	118	5	-	0	-
2005	Wild	-	0	-	49	1	-	80	85	6	96	14	8
	Hatchery	-	0	-	56	8	5	82	175	6	-	0	-
2006	Wild	-	0	-	50	2	2	79	69	7	97	27	5
	Hatchery	-	0	-	46	1	-	80	205	6	95	43	7
2007	Wild	-	0	-	54	7	3	79	24	6	93	14	7
	Hatchery	-	0	-	59	34	8	81	75	5	93	15	7
2008	Wild	-	0	-	54	5	9	83	63	5	93	12	6
	Hatchery	-	0	-	56	20	10	82	211	6	96	12	7
2009	Wild	-	0	-	52	9	6	81	83	5	94	13	6
	Hatchery	-	0	-	56	28	6	82	120	5	87	3	11
2010	Wild	-	0	-	58	4	9	80	72	6	-	0	-
	Hatchery	-	0	-	-	0	-	82	102	6	101	1	-
2011	Wild	-	0	-	56	2	3	79	39	5	95	33	7
	Hatchery	-	0	-	63	21	7	80	62	6	95	20	6
2012	Wild	-	0	-	-	0	-	81	49	6	97	13	8
	Hatchery	-	0	-	51	2	0	80	41	5	-	0	-
2013	Wild	-	0	-	-	1	-	74	44	6	92	23	8
	Hatchery	-	0	-	60	1	-	78	39	6	88	5	7
2014	Wild	-	0	-	-	0	-	82	52	7	93	5	6

Return year	Origin	Spring Chinook fork length (cm)											
		Age-2			Age-3			Age-4			Age-5		
		Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD
	Hatchery[a]	-	0	-	-	0	-	81	192	6	85	3	2
2015	Wild	-	0	-	-	0	-	83	45	4	93	10	5
	Hatchery	-	0	-	-	0	-	80	35	6	-	0	-
2016	Wild	-	0	-	-	-	-	80	38	6	97	8	5
	Hatchery	-	0	-	-	-	-	83	51	6	94	9	4
2017	Wild	-	0	-	65	2	1	82	41	6	98	4	6
	Hatchery	-	0	-	65	4	1	85	37	7	95	1	-
2018	Wild	-	0	-	-	0	-	80	27	8	95	6	13
	Hatchery	-	0	-	-	0	-	81	70	5	-	0	-
2019	Wild	-	0	-	-	0	-	78	24	6	89	4	3
	Hatchery	-	0	-	-	0	-	79	34	4	96	2	7
Average	***Wild***	***47***	***0***	***-***	***54***	***2***	***5***	***80***	***38***	***6***	***95***	***9***	***7***
	Hatchery	***-***	***0***	***-***	***57***	***9***	***5***	***81***	***75***	***7***	***93***	***7***	***6***

[a] Comprised of age results from HOR's used for both Chiwawa and Nason Creek obligations.

Sex Ratios

Male spring Chinook in the 2017-2019 return years made up 50.9%, 50.5%, and 49.0%, respectively, of the adults collected. This resulted in overall male to female ratios of 1.04:1.00, 1.02:1.00, and 0.97:1.00, respectively (Table 5.4). For the 2019 return year, natural-origin fish consisted of a slightly lower proportion of males than females, whereas hatchery-origin fish had a higher proportion of males than females (Table 5.4).

Table 5.4. Numbers of male and female wild and hatchery spring Chinook collected for broodstock, 1989-2019. Ratios of males to females are also provided.

Return year	Number of wild spring Chinook			Number of hatchery spring Chinook			Total M/F ratio
	Males (M)	Females (F)	M/F	Males (M)	Females (F)	M/F	
1989	11	17	0.65:1.00	-	-	-	0.65:1.00
1990	7	12	0.58:1.00	-	-	-	0.58:1.00
1991	13	19	0.68:1.00	-	-	-	0.68:1.00
1992	39	39	1.00:1.00	-	-	-	1.00:1.00
1993	50	50	1.00:1.00	-	-	-	1.00:1.00
1994	5	4	1.25:1.00	2	2	1.00:1.00	1.17:1.00
1995	No program						
1996	6	2	3.00:1.00	8	2	4.00:1.00	3.50:1.00
1997	14	23	0.61:1.00	34	49	0.69:1.00	0.67:1.00
1998	9	4	2.25:1.00	18	17	1.06:1.00	1.29:1.00
1999	No program						
2000	5	5	1.00:1.00	32	6	5.33:1.00	3.36:1.00
2001	45	70	0.64:1.00	90	177	0.51:1.00	0.55:1.00

Return year	Number of wild spring Chinook			Number of hatchery spring Chinook			Total M/F ratio
	Males (M)	Females (F)	M/F	Males (M)	Females (F)	M/F	
2002	9	12	0.75:1.00	30	33	0.91:1.00	0.87:1.00
2003	28	16	1.75:1.00	42	33	1.27:1.00	1.43:1.00
2004	58	42	1.38:1.00	102	94	1.09:1.00	1.18:1.00
2005	58	40	1.45:1.00	89	96	0.93:1.00	1.08:1.00
2006	49	46	1.07:1.00	123	179	0.69:1.00	0.77:1.00
2007	20	25	0.80:1.00	66	58	1.14:1.00	1.04:1.00
2008	41	47	0.87:1.00	109	132	0.83:1.00	0.84:1.00
2009	53	60	0.88:1.00	79	72	1.10:1.00	1.00:1.00
2010	41	42	0.98:1.00	53	50	1.06:1.00	1.02:1.00
2011	38	42	0.90:1.00	53	48	1.10:1.00	1.01:1.00
2012	35	40	0.87:1.00	20	21	0.95:1.00	0.90:1.00
2013	83	87	0.95:1.00	26	26	1.00:1.00	0.96:1.00
2014[a]	29	32	0.91:1.00	101	102	0.99:1.00	0.97:100
2015	44	36	1.22:1.00	24	23	1.04:1.00	1.15:1.00
2016	29	33	0.88:1.00	29	32	0.90:1.00	0.89:1.00
2017	24	26	0.92:1.00	35	31	1.13:1.00	1.04:1.00
2018	22	15	1.46:1.00	32	38	0.84:1.00	1.02:1.00
2019	13	16	0.81:1.00	24	22	0.88:1.00	0.97:1.00
Total	***878***	***902***	***0.97:1.00***	***1221***	***1343***	***0.91:1.00***	***0.94:1.00***

[a] Comprised of HOR's used for both Chiwawa and Nason Creek obligations.

Fecundity

Mean fecundities for the 2017-2019 returns of spring Chinook ranged from 4,129 to 4,615 eggs per female (Table 5.5). These fecundities were slightly lower than the overall average of 4,617 eggs per female and near the expected fecundity of 4,247 to 4,272 eggs per female assumed in the 2017-2019 broodstock protocols. For the 2019 return year, natural-origin Chinook produced less eggs per female than did hatchery-origin fish. This could be attributed to differences in size, age, and sample size of hatchery and natural-origin fish as described above (Tables 5.2 and 5.3).

Table 5.5. Mean fecundity of wild, hatchery, and all female spring Chinook collected for broodstock, 1989-2019; NA = not available.

Return year	Mean fecundity		
	Wild	Hatchery	Total
1989*	NA	NA	2,832
1990*	NA	NA	5,024
1991*	NA	NA	4,600
1992*	NA	NA	5,199[a]
1993*	NA	NA	5,249
1994*	NA	NA	5,923
1995	No program		

Return year	Mean fecundity		
	Wild	Hatchery	Total
1996*	NA	NA	4,645
1997	4,752	4,479	4,570
1998	5,157	5,376	5,325
1999	No program		
2000	5,028	5,019	5,023
2001	4,530	4,663	4,624
2002	5,024	4,506	4,654
2003	6,191	5,651	5,844
2004	4,846	4,775	4,799
2005	4,365	4,312	4,327
2006	4,773	4,151	4,324
2007	4,656	4,351	4,441
2008	4,691	4,560	4,592
2009	4,691	4,487	4,573
2010	4,548	4,114	4,314
2011	4,969	3,884	4,385
2012	4,522	3,682	4,223
2013	4,716	No program	4,716
2014	4,467	3,834	4,045
2015	5,132	4,278	4,847
2016	4,674	4,126	4,467
2017	4,574	4,747	4,615
2018	4,026	4,160	4,166
2019	4,080	4,170	4,129
Average	***4,749***	***4,444***	***4,617***
Median	***4,691***	***4,351***	***4,596***

* Individual fecundities were not tracked with females until 1997.
[a] Estimated as the mean of fecundities two years before and two years after 1992.

To estimate fecundities by length, weight, and age[15], hatchery staff collected fecundity, fork length, weight, and age data from spring Chinook females during the spawning of 1997 through 2019 broodstock. We compare age/fecundity, fork length/fecundity, weight/fecundity, fork length/mean egg mass, and fork length/gamete (skein) mass between hatchery and natural-origin spring Chinook. Hatchery staff attempted to stratify the females sampled by fork length categories to obtain fecundity samples for all sizes of fish to better estimate the relationship between size and fecundity.

Mean fecundity by total age differed between hatchery and natural-origin spring Chinook and over time (Table 5.6). On average, mean fecundities were slightly greater for natural-origin spring

[15] Although age-fecundity relationships are not specific hypotheses tested within the Monitoring and Evaluation Plan (Hillman et al. 2019), we include them here for descriptive purposes.

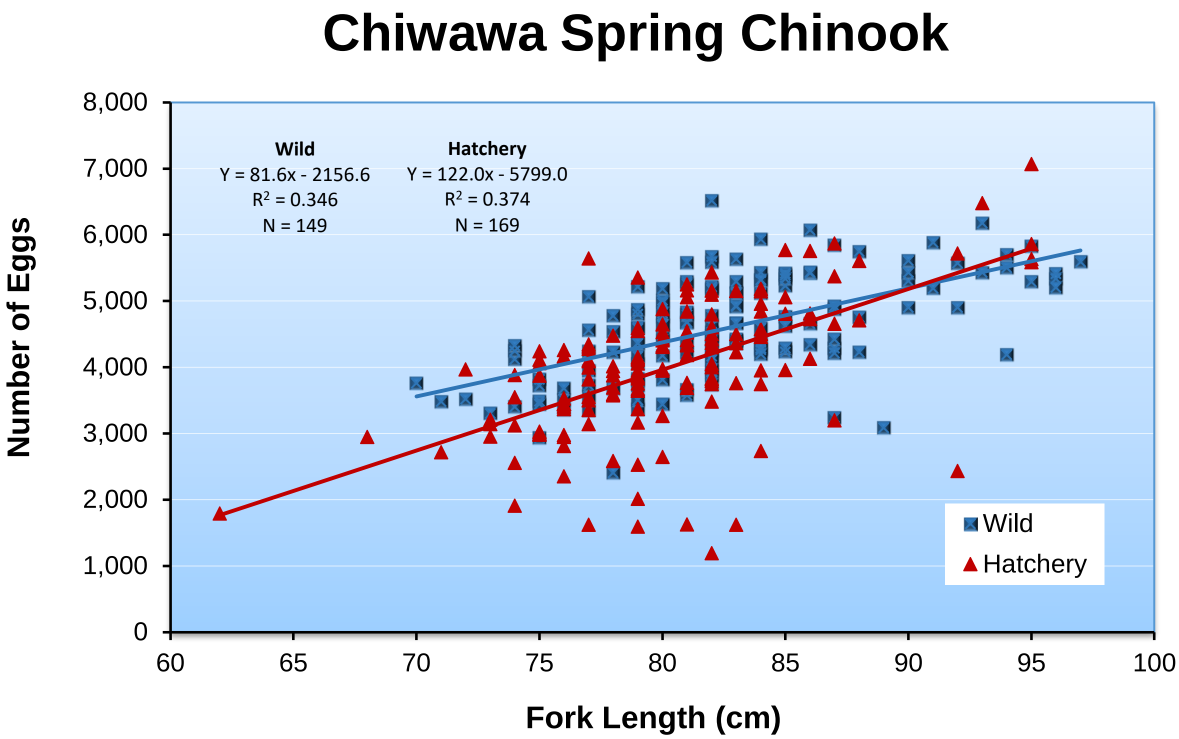
Chinook compared to hatchery-origin spring Chinook by 164 eggs for age-4 fish and 188 eggs for age-5 fish. Too few age-3 fish were collected to evaluate fecundity relationships.

Table 5.6. Mean fecundity by age (total age) for hatchery and wild spring Chinook collected from broodstock for the Chiwawa River program, brood years 1997-2019; N = sample size and SD = 1 standard deviation.

Brood year	Origin	Spring Chinook fecundity								
		Age 3			Age 4			Age 5		
		Mean	N	SD	Mean	N	SD	Mean	N	SD
1997	Wild	-	0	-	4,663	15	671	5,972	2	1,520
	Hatchery	-	0	-	4,479	44	551	-	0	-
1998	Wild	-	0	-	4,739	1	-	5,153	2	245
	Hatchery	-	0	-	5,023	9	794	6,171	4	433
1999	Wild	No Program								
	Hatchery									
2000	Wild	-	0	-	4,801.	4	866	5,936	1	-
	Hatchery	-	0	-	5,019	6	611	-	0	-
2001	Wild	-	0	-	4,460	61	712	5,579	3	597
	Hatchery	-	0	-	4,663	164	631	-	0	-
2002	Wild	-	0	-	4,616	9	660	5,614	1	-
	Hatchery	-	0	-	4,444	28	582	5,368	2	583
2003	Wild	-	0	-	4,209	1	-	6,217	12	882
	Hatchery	-	0	-	-	0	-	5,651	27	685
2004	Wild	-	0	-	4,846	40	694	-	0	-
	Hatchery	-	0	-	4,775	81	791	-	0	-
2005	Wild	-	0	-	4,045	28	568	5,642	7	1,327
	Hatchery	-	0	-	4,312	84	590	-	0	-
2006	Wild	-	0	-	4,386	29	716	5,450	18	837
	Hatchery	-	0	-	3,911	90	565	4930	25	711
2007	Wild	-	0	-	4,592	17	690	4,996	8	981
	Hatchery	-	0	-	4,244	48	815	4,746	8	1,217
2008	Wild	-	0	-	4,563	36	996	4,542	9	1,643
	Hatchery	-	0	-	4,381	121	961	5,257	4	1,098
2009	Wild	-	0	-	4,437	42	745	5,929	9	1,146
	Hatchery	-	0	-	4,460	66	4,460	4,905	3	1,241
2010	Wild	-	0	-	4,621	36	758	-	0	-
	Hatchery	-	0	-	4,193	47	783	-	0	-
2011	Wild	-	0	-	4,262	15	430	5,697	16	933
	Hatchery	3,055	1	-	3,793	32	773	4,364	11	679
2012	Wild	-	0	-	4,278	22	586	5,219	9	899
	Hatchery	-	0	-	3,715	23	906	-	0	-

Brood year	Origin	Spring Chinook fecundity								
		Age 3			Age 4			Age 5		
		Mean	N	SD	Mean	N	SD	Mean	N	SD
2013	Wild	-	0	-	4,085	17	608	5,574	15	997
	Hatchery	-	0	-	3,614	1	-	-	0	-
2014	Wild	-	0	-	4,329	25	660	5,575	4	233
	Hatchery	-	0	-	3,708	61	981	5,373	1	-
2015	Wild	-	0	-	5,049	23	599	5,561	6	457
	Hatchery	-	0	-	4,149	15	545	-	0	-
2016	Wild	-	0	-	4,313	18	641	5,411	4	143
	Hatchery	-	0	-	4,196	19	805	5,746	5	840
2017	Wild	-	0	-	4,574	26	620	5,202	1	-
	Hatchery	-	0	-	4,587	7	1,112	5,862	1	-
2018	Wild	-	0	-	3,937	13	570	5,184	1	-
	Hatchery	-	0	-	4,160	32	528	-	0	-
2019	Wild	-	0	-	4,021	12	699	4,925	2	713
	Hatchery	-	0	-	4,122	17	581	5,001	1	-
Average	***Wild***	***-***	***0***	***-***	***4,447***	***22***	***674***	***5,469***	***6***	***847***
	Hatchery	***-***	***0***	***-***	***4,283***	***45***	***918***	***5,281***	***4***	***832***

We pooled fecundity data from brood years 2014 through 2018 (the only brood years with complete data for all variables) to increase the number of samples for a given fork length. The linear relationships between fork length and fecundity, mean egg weight, and total egg (skein) weight for hatchery and natural-origin females are shown in Figures 5.1, 5.2, and 5.3. Most fecundity variables increase linearly with fork length—the relationship between fork length and mean egg weight for hatchery fish was the exception. In addition, except for fish size and mean egg weight, the relationships between fish size and fecundity data were similar for hatchery and natural-origin spring Chinook.



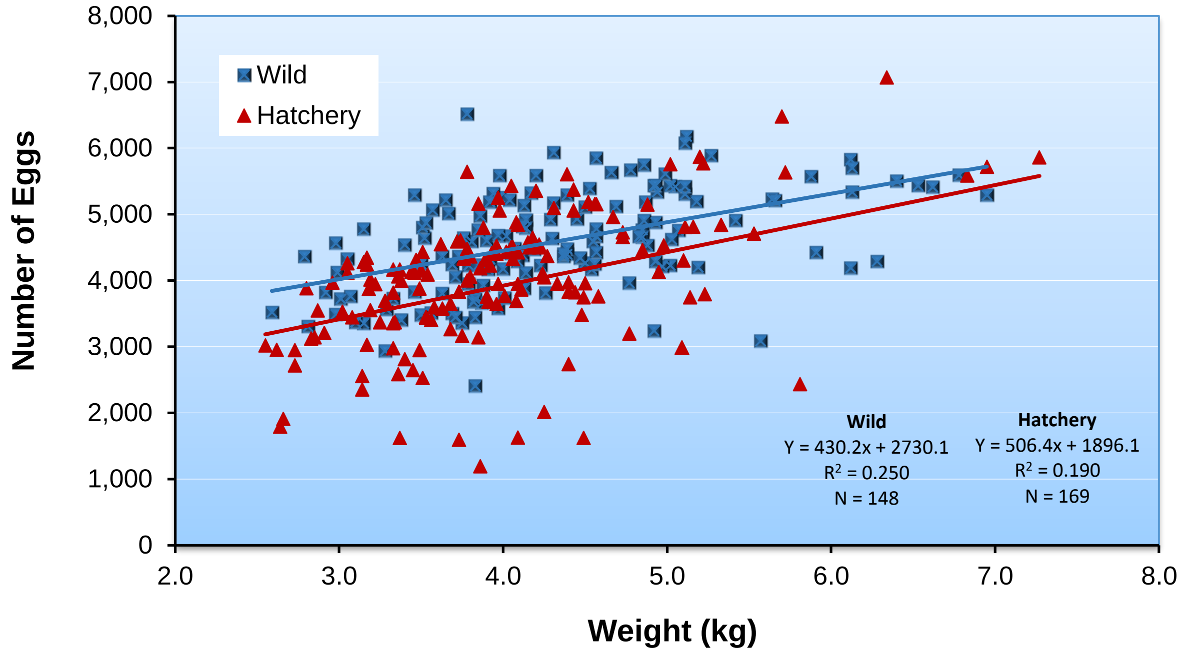


Figure 5.1. Relationships between fecundity and fork length (top figure) and fecundity and weight (bottom figure) for natural and hatchery-origin, Chiwawa spring Chinook for return years 2014-2019.

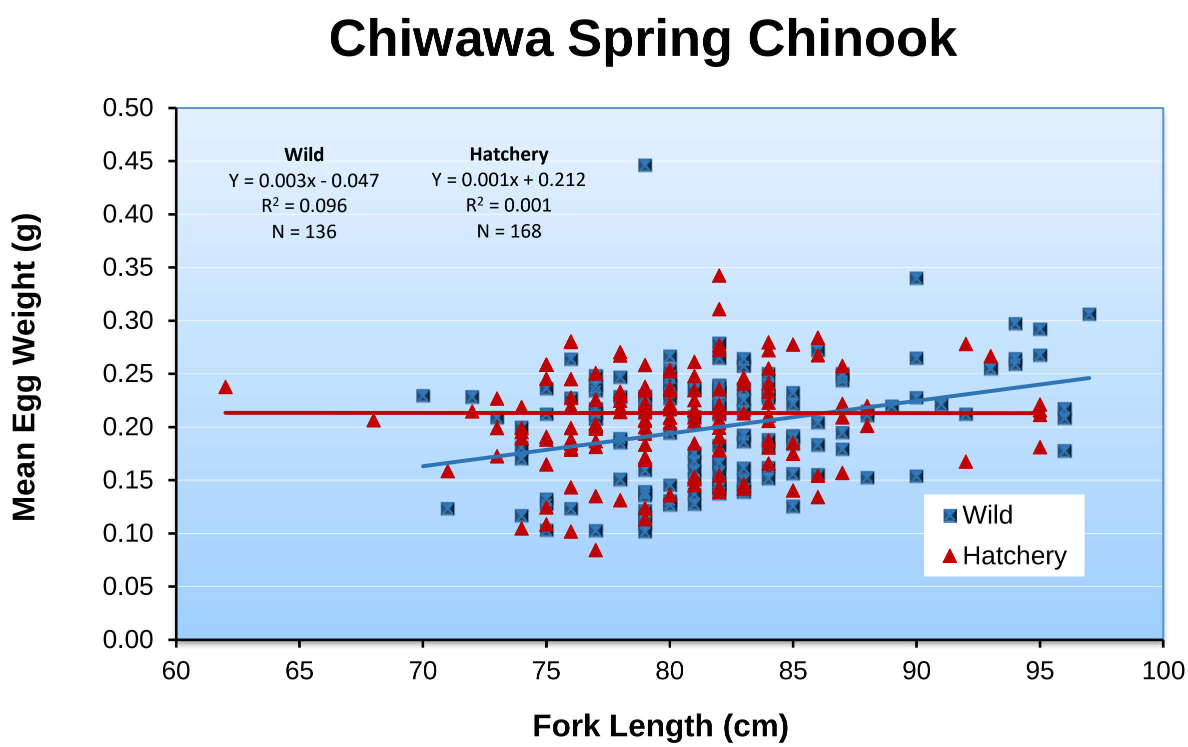


Figure 5.2. Relationships between mean egg weight and fork length for natural and hatchery-origin, Chiwawa spring Chinook for return years 2014-2019.

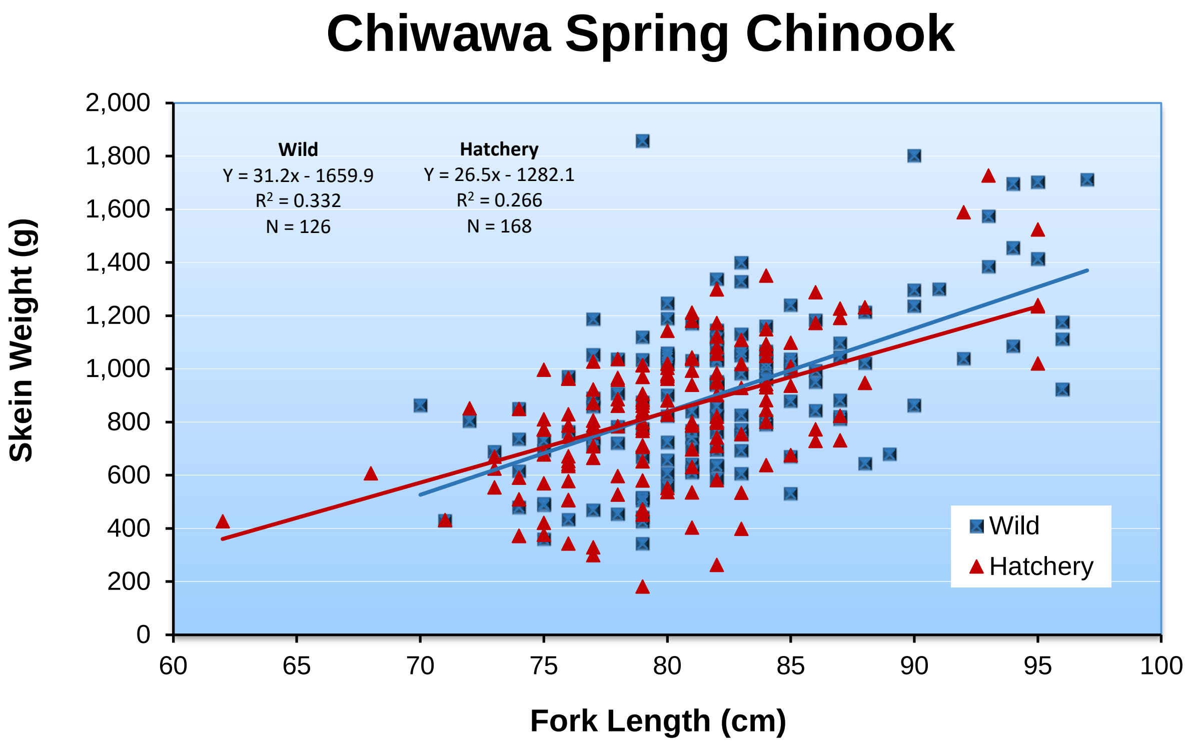


Figure 5.3. Relationships between skein weight and fork length for natural and hatchery-origin, Chiwawa spring Chinook for return years 2014-2019.

5.2 Hatchery Rearing

Rearing History

Number of eggs taken

Based on the unfertilized egg-to-release survival standard of 81%, a total of 829,630 eggs were required to meet the program release goal of 672,000 smolts for brood years 1989-2010. For the 2011 and 2012 brood years, a total of 367,536 and 252,410 eggs were required to meet the release goals of 298,000 and 204,452 smolts, respectively. Since 2013, 161,389-182,496 eggs have been required to achieve a release goal of 144,026 smolts for the Chiwawa spring Chinook Program. Between 2013 and 2019, the egg take goal was reached in 2015, 2016, and 2018 (Table 5.7). In 2016 and 2018, the natural-origin egg-take goal was not achieved, but the program goal was achieved. The green egg takes for 2017-2019 brood years were 89.2%, 120.7%, and 84.4% of program goals, respectively.

At the beginning of the Chiwawa spring Chinook program, the production level was set at 372,000 smolts. The primary reason for not meeting the egg take requirements included a lack of returning hatchery adults (because of program start up) and low wild fish abundance (along with no weir in the Chiwawa for the first few years). Post-ESA listing and issuance of Section 10(a)(1(A) permit 1196 in 1999, continued low abundance (hatchery and natural origin), as well as the permit limitation requiring a minimum of 33% natural-origin fish in the broodstock further constrained meeting the requisite egg take goal for a 672,000 program. In 2010, it was expected that recalculation of the mitigation obligation beginning with the 2012 brood year was going to result in a significant reduction in the production level and the HCP Hatchery Committees subsequently agreed to reduce the production target to 298,000 in advance of recalculation to increase the likelihood of meeting the overall production goal. In 2011, the Joint Fisheries Parties developed the Wenatchee Basin Spring Chinook Management Plan, which identified the Chiwawa spring Chinook program as a conservation program, which used natural-origin spring Chinook broodstock.

Per amended Section 10(a)(1)(A) permit 18121, natural-origin broodstock is currently collected for the Chiwawa spring Chinook Program using PIT-tagged wild fish (tagged as juveniles) intercepted at Tumwater Dam and natural-origin brood intercepted at the Chiwawa Weir. Operational limitations (e.g., flows, days per season, and bull trout encounters) at the Chiwawa Weir reduce the opportunity to meet the natural-origin broodstock requirement, particularly in years of low adult abundance. Subsequently, to ensure the mitigation obligation is met, a component of hatchery-origin adult returns is trapped and retained from Tumwater Dam.

Table 5.7. Numbers of eggs taken from spring Chinook broodstock, 1989-2019; NP = no program.

Return year	Number of eggs taken for the Chiwawa Program
1989	45,311
1990	60,287
1991	73,601
1992	111,624
1993	257,208
1994	35,539
1995	NP
1996	18,579
1997	312,182
1998	90,521
1999	NP
2000	55,256
2001	1,099,630
2002	196,186
2003	247,501
2004	538,176
2005	536,490
2006	744,344
2007	359,739
2008	761,821

Return year	Number of eggs taken for the Chiwawa Program
2009	564,912
2010	383,944
2011	366,244
Average (1989-2011)	***326,624***
Median (1989-2011)	***257,208***
2012[a]	250,695
2013	165,047
2014	163,358
2015	184,734
2016[b]	184,712
2017	150,419
2018	211,344
2019	136,269
Average (2012-present)	***180,822***
Median (2012-present)	***174,880***

[a] Egg take included a one-time agreement for eggs for the Methow spring Chinook program obligation.
[b] Although the program egg-take goal was achieved, the natural-origin egg-take goal was not.

Number of acclimation days

Early rearing of the 2017 brood Chiwawa spring Chinook was similar to previous years with fish being held on well water before being transferred in the fall to the Chiwawa Acclimation Facility for final acclimation. Beginning in 2006 (2005 brood acclimation), modifications were made to the Chiwawa Acclimation Facility intakes so that Wenatchee River water could be applied to the Chiwawa River intakes during severe cold periods to prevent the formation of frazzle ice. During acclimation of the 2017 brood, fish were acclimated for 203 to 211 days on Chiwawa River water (Table 5.8).

Table 5.8. Number of days spring Chinook broods were acclimated and water source, brood years 1989-2017; NA = not available.

Brood year	Release year	Transfer date	Release date	Number of days and water source		
				Total	Chiwawa	Wenatchee
1989	1991	19-Oct	11-May	204	NA	NA
1990	1992	13-Sep	27-Apr	227	NA	NA
1991	1993	24-Sep	24-Apr	212	NA	NA
1992	1994	30-Sep	20-Apr	202	NA	NA
1993	1995	28-Sep	20-Apr	204	NA	NA

Brood year	Release year	Transfer date	Release date	Number of days and water source		
				Total	Chiwawa	Wenatchee
1994	1996	1-Oct	25-Apr	207	NA	NA
1995	1997	No Program				
1996	1998	25-Sep	29-Apr	216	NA	NA
1997	1999	28-Sep	22-Apr	206	NA	NA
1998	2000	27-Sep	24-Apr	210	NA	NA
1999	2001	No Program				
2000	2002	26-Sep	25-Apr	211	NA	NA
2001	2003	22-Oct	1-May	191	NA	NA
2002	2004	25-Sep	2-May	220	NA	NA
2003	2005	30-Sep	3-May	215	NA	NA
		30-Sep	18-Apr-18-May	200	NA	NA
2004	2006	3-Sep	1-May	240	88-104	124
		3-Sep	17-Apr-17-May	226	NA	NA
2005	2007	25-Sep	1-May	217	217	98[a]
		26-Sep	16-Apr-15-May	202-232	202-232	98[a]
2006	2008	24-27-Sep	14-Apr-13-May	231	231	95[a]
2007	2009	1-Oct	15-Apr-13-May	223	223	103[a]
2008	2010	14-15-Sep	14-Apr-12-May	212-241	212-241	129
2009	2011	14-15-Sep	26-Apr-19-May	225-249	225-249	88
2010	2012	3, 5-6-Oct	17-Apr-1-May	195-212	195-212	132
2011	2013	24-26-Sep	16-22-Apr	202-210	202-210	40
2012	2014	23-25-Sep	14-21-Apr	204-211	204-211	107[a]
2013	2015	29-Sep	13-20-Apr	196-203	196-203	106
2014	2016	5-8-Oct	15-20-Apr	190-198	190-198	103
2015	2017	26-27 Sept	12-19 Apr	198-205	198-205	90
2016	2018	26-28 Sept	16 Apr- 1 May	200-217	200-217	126
2017	2019	24 Sept	15-23 Apr	203-211	203-211	119

[a] Represents the number of days Wenatchee River water was applied to the Chiwawa River intake screen to prevent the formation of frazzle ice.

Release Information

Numbers released

The 2017 brood Chiwawa spring Chinook program achieved 104% of the 144,026 goal with about 105,929 WxW and 43,938 HxH smolts released volitionally into the Chiwawa River in 2019 (Table 5.9).

Table 5.9. Numbers of spring Chinook smolts tagged and released from the hatchery, brood years 1989-2017. The release target for Chiwawa spring Chinook is 144,026 smolts. For brood years 2012 to present, conservation program fish are not adipose fin clipped (they receive CWT only). All CWT mark rates were adjusted for tag loss before the fish were released.

<table>
<tr><th>Brood year</th><th>Release year</th><th>Type of release</th><th>CWT mark rate</th><th>Number released that were PIT tagged</th><th>Number of smolts released</th><th>Total number of smolts released</th></tr>
<tr><td>1989</td><td>1991</td><td>Volitional</td><td>0.9932</td><td>0</td><td>43,000</td><td>43,000</td></tr>
<tr><td>1990</td><td>1992</td><td>Volitional</td><td>0.9931</td><td>0</td><td>53,170</td><td>53,170</td></tr>
<tr><td>1991</td><td>1993</td><td>Volitional</td><td>0.9831</td><td>0</td><td>62,138</td><td>62,138</td></tr>
<tr><td>1992</td><td>1994</td><td>Volitional</td><td>0.9747</td><td>0</td><td>85,113</td><td>85,113</td></tr>
<tr><td>1993</td><td>1995</td><td>Volitional</td><td>0.9892</td><td>0</td><td>223,610</td><td>223,610</td></tr>
<tr><td>1994</td><td>1996</td><td>Volitional</td><td>0.9967</td><td>0</td><td>27,226</td><td>27,226</td></tr>
<tr><td>1995</td><td>1997</td><td colspan="5">No program</td></tr>
<tr><td>1996</td><td>1998</td><td>Forced</td><td>0.8413</td><td>0</td><td>15,176</td><td>15,176</td></tr>
<tr><td>1997</td><td>1999</td><td>Volitional</td><td>0.9753</td><td>0</td><td>266,148</td><td>266,148</td></tr>
<tr><td>1998</td><td>2000</td><td>Volitional</td><td>0.9429</td><td>0</td><td>75,906</td><td>75,906</td></tr>
<tr><td>1999</td><td>2001</td><td colspan="5">No program</td></tr>
<tr><td>2000</td><td>2002</td><td>Volitional</td><td>0.9920</td><td>0</td><td>47,104</td><td>47,104</td></tr>
<tr><td rowspan="2">2001</td><td rowspan="2">2003</td><td>Forced</td><td>0.9961</td><td>0</td><td>192,490[a]</td><td rowspan="2">377,544</td></tr>
<tr><td>Volitional</td><td>0.9856</td><td>0</td><td>185,054[a]</td></tr>
<tr><td>2002</td><td>2004</td><td>Volitional</td><td>0.9693</td><td>0</td><td>149,668</td><td>149,668</td></tr>
<tr><td rowspan="2">2003</td><td rowspan="2">2005</td><td>Forced</td><td>0.9783</td><td>0</td><td>69,907</td><td rowspan="2">222,131</td></tr>
<tr><td>Volitional</td><td>0.9743</td><td>0</td><td>152,224</td></tr>
<tr><td rowspan="2">2004</td><td rowspan="2">2006</td><td>Forced</td><td>0.9533</td><td>0</td><td>243,505</td><td rowspan="2">494,517</td></tr>
<tr><td>Volitional</td><td>0.9493</td><td>0</td><td>251,012</td></tr>
<tr><td rowspan="2">2005</td><td rowspan="2">2007</td><td>Forced</td><td>0.9882</td><td>4,993</td><td>245,406</td><td rowspan="2">494,012</td></tr>
<tr><td>Volitional</td><td>0.9864</td><td>4,988</td><td>248,606</td></tr>
<tr><td rowspan="2">2006</td><td>2007</td><td>Direct</td><td>0.0000</td><td>0</td><td>12,977[b]</td><td rowspan="2">612,482</td></tr>
<tr><td>2008</td><td>Volitional</td><td>0.9795</td><td>9,894</td><td>612,482</td></tr>
<tr><td rowspan="2">2007</td><td>2008</td><td>Direct</td><td>0.0000</td><td>0</td><td>9,494</td><td rowspan="2">305,542</td></tr>
<tr><td>2009</td><td>Volitional</td><td>0.9948</td><td>10,035</td><td>296,048</td></tr>
<tr><td>2008</td><td>2010</td><td>Volitional</td><td>0.9835</td><td>10,006</td><td>609,789</td><td>609,789</td></tr>
<tr><td>2009</td><td>2011</td><td>Forced</td><td>0.9874</td><td>0</td><td>241,181</td><td>438,561</td></tr>
</table>

Brood year	Release year	Type of release	CWT mark rate	Number released that were PIT tagged	Number of smolts released	Total number of smolts released
		Volitional	0.9874	9,412	197,380	
2010[c]	2012	Volitional	0.9904	5,020	346,248	346,248
2011	2013	Volitional	0.9902	9,945	281,821	281,821
2012[d]	2014	Volitional	0.9841	5,061	222,504	222,504
2013[d]	2015	Volitional	0.9753	10,021	147,480	147,480
2014[d]	2016	Volitional	0.9818	10,179	144,360	341,226[e]
		Volitional	0.9853	0	196,866[f]	
2015[d]	2017	Volitional	0.9571	10,149	163,411	163,411
2016 [d]	2018	Volitional	0.9222	10,089	158,189	158,189
2017[d]	2019	Volitional	0.9752	10,000	149,867	149,867

[a] This does not include the 226,456 eyed eggs that were planted in the Chiwawa River.
[b] This high ELISA group was only adipose fin clipped and directly planted into Big Meadow Creek in May.
[c] This does not include 18,480 eyed eggs that were culled because of high ELISA.
[d] For brood years 2013 to present, WxW spring Chinook are not adipose fin clipped (they receive CWT only); HxH Chinook are adipose fin clipped and receive a CWT.
[e] The total number of smolts released includes the HxH Nason Creek program that was transferred to the Chiwawa Acclimation Facility on 2-3 March 2016 because of water-intake concerns at the Nason Creek Acclimation Facility.
[f] The HxH Nason Creek program that was released from the Chiwawa Acclimation Facility.

Numbers tagged

The 2017 brood Chiwawa spring Chinook were 97.5% CWT based on tag retention determination during quality control[16] (Table 5.9).

On 2-6 March 2020, a total of 10,100 WxW Chiwawa spring Chinook from the 2018 brood were PIT tagged at the Chiwawa Acclimation Facility. Fish were not fed during PIT tagging or for two days before and after tagging. Fish averaged 122 mm in length and 22 g at time of tagging.

The number of hatchery spring Chinook that have been PIT tagged and released into the Chiwawa River during the period 2007-2019 are shown in Table 5.10. During this period, the number of fish tagged and released has ranged from 5,020 to 10,179.

Table 5.10. Summary of PIT-tagging activities for Chiwawa hatchery spring Chinook, brood years 2005-2017.

Brood year	Release year	Number of fish tagged	Number of tagged fish that died	Number of tags shed	Number of tagged fish released
2005	2007	10,063	74	8	9,981[a]
2006	2008	10,055	134	27	9,894
2007	2009	10,112	61	16	10,035

[16] A minimum of 60 days after tagging, taggers conduct a quality control procedure, which includes collecting a sample of tagged fish and scanning for tag retention. Thus, the number of tagged fish released is adjusted for tag loss.

Brood year	Release year	Number of fish tagged	Number of tagged fish that died	Number of tags shed	Number of tagged fish released
2008	2010	10,101	81	14	10,006
2009	2011	10,101	655	34	9,412
2010	2012	5,102	82	0	5,020
2011	2013	10,200	254	1	9,945
2012	2014	5,100	37	2	5,061
2013	2015	10,114	93	0	10,021
2014	2016	10,200	21	0	10,179
2015	2017	10,207	58	0	10,149
2016	2018	10,100	3	8	10,089
2017	2019	10,100	5	13	10,082

[a] This release consisted of 4,988 tagged Chinook that were released volitionally and 4,993 that were forced released.

Fish size and condition at release

Spring Chinook from the 2017 brood were released as yearling smolts between 15-23 April 2019. Size at release (17 fpp) was near the target of 18 fpp established for the program. The CV for fork length was slightly greater than the target (Table 5.11).

Table 5.11. Mean lengths (FL, mm), weight (g and fish/pound), and coefficient of variation (CV) of spring Chinook smolts released from the hatchery, brood years 1989-2017. Size targets are provided in the last row of the table.

Brood year	Release year	Fork length (mm)		Mean weight	
		Mean	CV	Grams (g)	Fish/pound
1989	1991	147	4.4	37.8	12
1990	1992	137	5.0	32.4	14
1991	1993	135	4.2	30.3	15
1992	1994	133	5.0	28.4	16
1993	1995	136	4.5	30.2	15
1994	1996	139	7.1	34.4	13
1995	1997	No Program			
1996	1998	157	5.3	52.1	9
1997	1999	146	7.2	38.7	12
1998	2000	143	9.1	39.5	12
1999	2001	No Program			
2000	2002	150	6.8	46.7	10
2001	2003	142	7.1	37.6	12
2002	2004	146	8.5	40.3	11
2003	2005	167[a]	5.9	59.4	8

Brood year	Release year	Fork length (mm)		Mean weight	
		Mean	CV	Grams (g)	Fish/pound
		151[b]	7.4	44.2	10
2004	2006	146[a]	6.4	39.1	12
		139[b]	5.7	34.3	13
2005	2007	136[a]	4.6	30.8	15
		129[b]	5.8	26.6	17
2006	2008	124	8.8	23.5	19
2007	2008	70[a]	4.0	3.7	122
	2009	140[b]	11.0	33.6	14
2008	2010	141	10.7	36.0	13
2009	2011	167	12.9	56.8	8
2010	2012	129	8.1	25.8	18
2011	2013	134	6.4	29.5	15
2012	2014	130	6.7	28.5	16
2013	2015	130	8.2	25.3	18
2014[c]	2016	141	16.3	34.8	13
2015	2017	127[b]	10.1	25.4	18
2016	2018	131	9.3	26.6	17
2017	2019	131	9.3	26.3	17
Average		***140***	***7.5***	***34.1***	***17***
Median		***138***	***7.1***	***33.6***	***14***
Targets		***155***	***9.0***	***37.8***	***18***

[a] Forced-release group.
[b] Volitional-release group.
[c] This represents the combination of the WxW Chiwawa, HxH Chiwawa, and the HxH Nason Creek programs. The HxH Nason Creek program was transferred to the Chiwawa Acclimation Facility on 2-3 March 2016 because of water-intake concerns at the Nason Creek Acclimation Facility.

Survival Estimates

Overall survival of the 2017 brood Chiwawa spring Chinook from green (unfertilized) egg to release was above the standard set for the program (Table 5.12). There was higher than expected survivals throughout all stages, contributing to increased program performance overall. Pre-spawn survival of adults was also above the standard set for the program.

Table 5.12. Hatchery life-stage survival rates (%) for spring Chinook, brood years 1989-2017. Survival standards or targets are provided in the last row of the table.

Brood year	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
1989	100.0	100.0	98.0	99.1	99.1	99.0	96.4	99.3	94.8
1990	100.0	85.7	91.8	98.1	99.5	98.9	97.9	99.2	88.2
1991	100.0	100.0	94.4	96.1	99.6	97.9	93.2	95.0	84.4

Brood year	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
1992	100.0	100.0	98.4	96.7	99.9	99.9	80.0	80.6	76.2
1993	96.0	98.0	89.7	98.0	99.7	99.3	98.9	99.7	86.9
1994	100.0	100.0	98.6	100.0	99.8	99.4	77.0	78.9	76.6
1995	No program								
1996	100.0	100.0	88.3	100.0	93.8	93.0	89.9	97.7	81.7
1997	98.6	100.0	93.2	95.7	98.3	99.6	95.6	99.3	85.3
1998	95.2	100.0	94.5	99.0	98.5	98.3	89.6	99.1	83.9
1999	No program								
2000	100.0	100.0	91.0	98.1	97.2	96.6	95.4	99.3	85.2
2001	97.6	97.0	88.9	98.1	99.7	99.6	51.3	51.8	34.3
2002	97.8	100.0	82.1	98.0	97.4	96.7	94.8	99.1	76.3
2003	93.9	100.0	93.2	97.7	99.5	99.3	98.5	98.1	89.7
2004	97.8	82.5	93.3	98.4	98.8	94.3	93.9	97.2	91.9
2005	97.1	100.0	95.9	98.0	99.2	99.0	97.9	99.1	92.1
2006	100.0	100.0	90.1	98.1	99.2	99.0	95.3	97.7	84.2
2007	98.8	97.7	92.9	97.2	99.4	99.0	98.0	99.4	88.5
2008	96.6	99.3	90.8	93.2	97.4	97.1	95.6	97.6	80.0
2009	94.4	97.6	92.5	88.3	97.6	97.4	89.2	92.8	77.6
2010[a]	98.9	100.0	99.2	100.0	97.9	97.5	95.6	98.2	94.8
2011	98.9	98.9	93.2	88.4	96.8	96.4	93.4	97.1	76.9
2012	98.3	100.0	94.6	98.3	99.7	99.3	98.5	99.4	91.6
2013	91.7	94.6	96.5	97.0	97.9	96.8	95.5	98.9	89.4
2014[b]	100.0	100.0	91.1	98.8	99.6	99.1	98.0	99.3	88.3
2015	98.2	100.0	94.5	97.9	99.0	98.6	97.9	99.6	90.5
2016	98.5	98.3	91.6	98.4	99.3	98.7	97.7	99.2	88.1
2017	100.0	100.0	98.5	98.1	99.7	99.5	98.2	98.8	94.9
Average	***98.1***	***98.1***	***93.2***	***97.2***	***98.7***	***98.1***	***92.7***	***95.2***	***84.2***
Median	***98.6***	***100***	***93.2***	***98.1***	***99.2***	***98.9***	***95.6***	***98.9***	***86.9***
Standard	***90.0***	***85.0***	***92.0***	***98.0***	***97.0***	***93.0***	***90.0***	***95.0***	***81.0***

[a] Survival estimates do not include the 18,840 eyed eggs that were culled because of high ELISA levels.
[b] Survival estimates do not include the HxH Nason Creek program that was transferred to the Chiwawa Acclimation Facility because of water-intake concerns at the Nason Creek Acclimation Facility.

5.3 Disease Monitoring

Results of 2019 adult broodstock bacterial kidney disease (BKD) monitoring indicated that 76% of the females had ELISA values less than 0.099. Eighty-two percent of the females had ELISA values less than 0.119 and 3% had ELISA values higher 0.450 (Table 5.13).

The 2017 brood had no significant health issues during the juvenile rearing period.

Table 5.13. Proportion of bacterial kidney disease (BKD) titer groups for the Chiwawa spring Chinook broodstock, brood years 1996-2019. Also included are the proportions to be reared at either 0.125 fish per pound or 0.060 fish per pound.

Brood year[a]	Optical density values by titer group				Proportion at rearing densities (fish per pound, fpp)[b]	
	Very Low (≤ 0.099)	Low (0.1-0.199)	Moderate (0.2-0.449)	High (≥ 0.450)	≤ 0.125 fpp (<0.119)	≤ 0.060 fpp (>0.120)
1996	0.0000	0.2500	0.2500	0.5000	0.0000	1.0000
1997	0.1176	0.7353	0.0588	0.0882	0.3529	0.6471
1998	0.1176	0.8235	0.0588	0.0000	0.4706	0.5294
1999	No Program					
2000	0.0000	0.9091	0.0909	0.0000	0.1818	0.8182
2001	0.4066	0.5436	0.0373	0.0124	0.6515	0.3485
2002	0.2195	0.6585	0.0732	0.0488	0.5610	0.4390
2003	0.6957	0.1087	0.0652	0.1304	0.7174	0.2826
2004	0.8182	0.1515	0.0227	0.0076	0.8939	0.1061
2005	0.9084	0.0916	0.0000	0.0000	0.9695	0.0305
2006	0.7222	0.2556	0.0000	0.0222	0.8444	0.1556
2007	0.5854	0.3415	0.0244	0.0488	0.7073	0.2927
2008	0.8304	0.1520	0.0058	0.0117	0.9357	0.0643
2009	0.7600	0.1840	0.0080	0.0480	0.8480	0.1520
2010	0.8791	0.0769	0.0000	0.0439	0.9451	0.0549
2011	0.7640	0.2022	0.0000	0.0337	0.8764	0.1236
2012	0.8333	0.1333	0.0167	0.0167	0.9170	0.0830
2013	0.8285	0.1429	0.0286	0.0000	0.8857	0.1143
2014[c]	0.8282	0.1720	0.0000	0.0000	0.8889	0.1111
2015	0.9818	0.0000	0.0000	0.0182	0.9818	0.0182
2016	0.7547	0.2075	0.0189	0.0189	0.8113	0.1887
2017	1.0000	0.0000	0.0000	0.0000	1.000	0.0000
2018	0.9200	0.0600	0.0000	0.0200	0.9400	0.0600
2019	0.7575	0.2121	0.0000	0.0303	0.8181	0.1818
Average	***0.6404***	***0.2788***	***0.0330***	***0.0478***	***0.7478***	***0.2522***
Median	***0.7600***	***0.1840***	***0.0167***	***0.0189***	***0.8480***	***0.1520***

[a] Individual ELISA samples were not collected before the 1996 brood.
[b] ELISA values from broodstock BKD testing dictate what density the progeny of the broodstock are reared. Progeny of broodstock with high ELISA values are reared at lower density.
[c] Comprised of HOR's used for both Chiwawa and Nason Creek obligations.

5.4 Natural Juvenile Productivity

During 2019, juvenile spring Chinook were sampled at the Lower Wenatchee, Nason Creek, White River, and Chiwawa River traps. Snorkel surveys conducted in the Chiwawa River basin ended in

2018; however, the time series of counts through 2018 are included in this section for completeness. Results from sampling at the Nason Creek Trap are provided in Section 6 and from the White River Trap in Section 7.

Parr Estimates

During the snorkel survey period 1992-2017, numbers of subyearling and yearling Chinook have ranged from 5,815 to 149,563 and 5 to 967, respectively, in the Chiwawa River basin (Table 5.14 and 5.15; Figure 5.4). Numbers of all fish counted in the Chiwawa River basin are reported in Appendix B.

Table 5.14. Total numbers of subyearling spring Chinook estimated in different streams in the Chiwawa River basin during snorkel surveys in August 1992-2018; NS = not sampled.

Sample Year	Number of subyearling spring Chinook									
	Chiwawa River	Phelps Creek	Chikamin Creek	Rock Creek	Unnamed Creek	Big Meadow Creek	Alder Creek	Brush Creek	Clear Creek	Total
1992	45,483	NS	NS	NS	NS	NS	NS	NS	NS	**45,483**
1993	77,269	0	1,258	586	NS	NS	NS	NS	NS	**79,113**
1994	53,492	0	398	474	68	624	0	0	0	**55,056**
1995	52,775	0	1,346	210	0	683	67	160	0	**55,241**
1996	5,500	0	29	10	0	248	28	0	0	**5,815**
1997	15,438	0	56	92	0	480	0	0	0	**16,066**
1998	65,875	0	1,468	496	57	506	0	13	0	**68,415**
1999	40,051	0	366	592	0	598	22	0	0	**41,629**
2000	NS	NS	NS	NS	NS	NS	NS	NS	NS	**NS**
2001	106,753	168	2,077	2,855	354	2,332	78	0	0	**114,617**
2002	117,230	75	8,233	2,953	636	5,021	429	0	297	**134,874**
2003	80,250	4,508	1,570	3,255	118	1,510	22	45	0	**91,278**
2004	43,360	102	717	215	54	637	21	71	0	**45,177**
2005	45,999	71	2,092	660	17	792	0	0	0	**49,631**
2006	73,478	113	2,500	1,681	51	1,890	62	127	0	**79,902**
2007	53,863	125	5,235	870	51	538	20	28	22	**60,752**
2008	72,431	214	3,287	4,730	163	1,221	28	255	22	**82,351**
2009	101,085	125	2,486	1,849	14	1,082	29	18	17	**106,705**
2010	117,499	526	4,571	4,052	0	1,449	56	42	25	**128,220**
2011	136,424	64	2,762	1,330	53	581	42	214	40	**141,510**
2012	96,036	78	4,125	2,227	49	1,322	35	31	37	**103,940**
2013	140,485	120	3,301	3,214	0	2,345	31	21	46	**149,563**
2014	113,869	361	2,384	3,124	28	1,367	11	28	68	**121,240**
2015	103,710	285	1,917	4,158	0	1,013	71	62	8	**111,224**
2016	135,819	107	1,644	991	0	1,508	20	58	25	**140,172**
2017	94,401	120	3,069	2,349	18	2,026	13	96	14	**102,106**
2018	78,449	73	1,995	2,033	17	1,024	32	95	11	**83,729**
Average	***79,501***	***289***	***2,355***	***1,800***	***73***	***1,283***	***47***	***57***	***26***	***85,147***
Median	***77,859***	***102***	***2,077***	***1,681***	***23***	***1,053***	***28***	***30***	***10***	***83,040***

Table 5.15. Total numbers of yearling spring Chinook estimated in different streams in the Chiwawa River basin during snorkel surveys in August 1992-2018; NS = not sampled.

Sample Year	Number of yearling spring Chinook									
	Chiwawa River	Phelps Creek	Chikamin Creek	Rock Creek	Unnamed Creek	Big Meadow Creek	Alder Creek	Brush Creek	Y Creek	Total
1992	563	NS	NS	NS	NS	NS	NS	NS	NS	**563**
1993	174	0	0	0	NS	NS	NS	NS	NS	**174**
1994	14	0	0	4	0	0	0	0	0	**18**
1995	13	0	0	0	0	0	0	0	0	**13**
1996	22	0	0	0	0	0	0	0	0	**22**
1997	5	0	0	0	0	0	0	0	0	**5**
1998	63	0	0	0	0	0	0	0	0	**63**
1999	41	0	0	0	0	0	0	0	0	**41**
2000	NS	NS	NS	NS	NS	NS	NS	NS	NS	**NS**
2001	66	0	3	0	0	0	0	0	0	**69**
2002	32	0	0	0	0	0	0	0	0	**32**
2003	134	0	0	0	0	0	0	0	0	**134**
2004	14	0	0	0	0	7	0	0	0	**21**
2005	62	0	17	0	0	0	0	0	0	**79**
2006	345	0	0	43	0	0	0	0	0	**388**
2007	41	0	0	0	0	0	0	0	0	**41**
2008	144	0	45	0	0	0	0	0	0	**189**
2009	49	0	0	5	0	0	0	0	0	**54**
2010	207	27	19	38	0	0	0	0	0	**291**
2011	645	0	71	194	0	57	0	0	0	**967**
2012	748	0	0	19	0	0	0	0	0	**767**
2013	836	0	0	8	0	8	0	0	0	**852**
2014	867	28	4	38	0	2	0	0	0	**939**
2015	488	0	22	110	0	0	0	0	0	**620**
2016	254	0	0	0	0	28	0	0	0	**282**
2017	483	0	0	43	0	0	0	0	0	**526**
2018	739	0	0	0	0	0	0	0	0	**739**
Average	***271***	***2***	***7***	***20***	***0***	***4***	***0***	***0***	***0***	***303***
Median	***139***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***154***

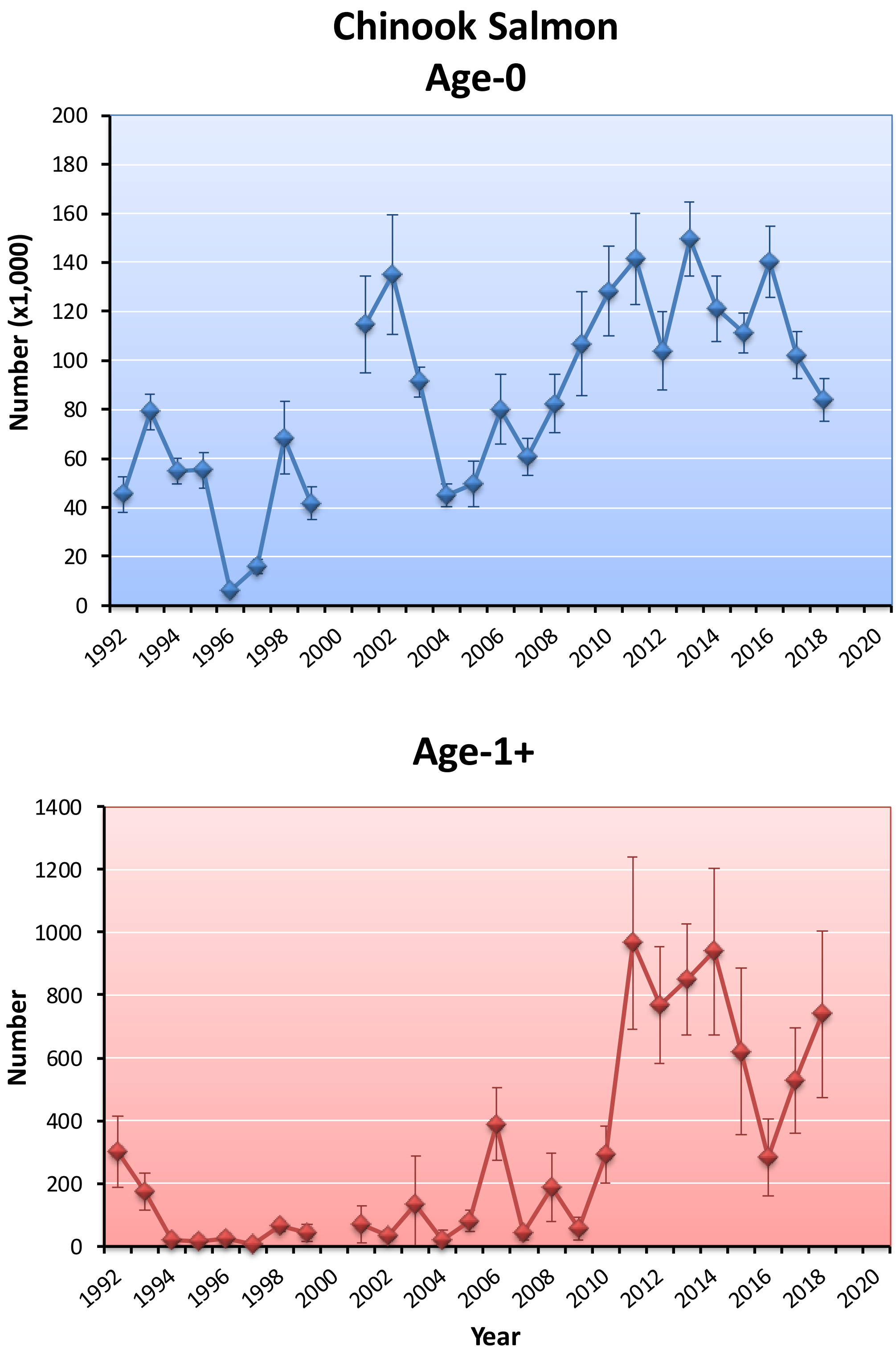


Figure 5.4. Numbers of subyearling and yearling Chinook salmon within the Chiwawa River Basin in August 1992-2018; ND = no data. Vertical bars indicate 95% confidence bounds.

During the survey period 1992-2018, juvenile Chinook were distributed contagiously among reaches in the Chiwawa River. Their densities were highest in the upper portions of the basin, with the highest densities within tributaries. Juvenile Chinook were most abundant in multiple channels and pools, and least abundant in glides and riffles. Most Chinook associated closely with woody debris in multiple channels. During the survey period 1992-2018, multiple channels made up on average 19% of the total area of the Chiwawa River basin used by juvenile Chinook, but they provided habitat for 54% of all subyearling Chinook in the basin (multiple channel use index = 2.82)[17]. In contrast, riffles made up on average 53% of the total area but provided habitat for only 13% of all juvenile Chinook in the Chiwawa River basin (riffle use index = 0.23). Pools made up 19% of the total area on average and provided habitat for 32% of all juvenile Chinook in the basin (pool use index = 1.62). Few Chinook used glides that lacked woody debris (glide use index = 0.24).

Mean densities of juvenile Chinook in two reaches of the Chiwawa River were generally less than those in corresponding reference areas on the Little Wenatchee River (Figure 5.5). Within both the Chiwawa River and its reference areas, pools and multiple channels consistently had the highest densities of juvenile Chinook.

[17] The habitat use index was calculated as follows: Multiple channel use = ($parr_{mc}/parr_t$) / ($area_{mc}/area_t$), where $parr_{mc}$ = the number of parr counted in multiple channel habitat, $parr_t$ = the total number of parr counted within all habitat types, $area_{mc}$ = the area of multiple channel habitat within the sampling frame, and $area_t$ = the total area of the sampling frame. A multiple channel use index value of 1 would indicate that parr were uniformly distributed among habitat types and exhibited no preference for multiple habitat types. Values greater than 1 indicate use of multiple channels to a greater extent than the average, while scores between 0 and 1 indicate below-average use of multiple channel habitat.

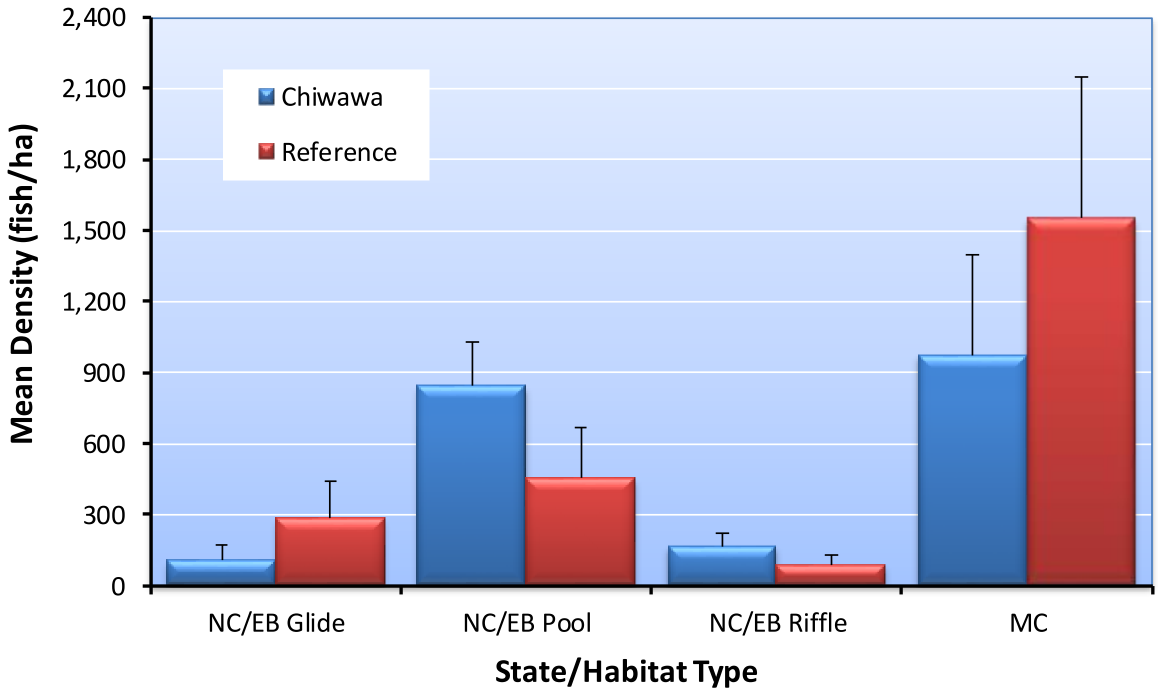


Figure 5.5. Comparison of the 25-year means of subyearling spring Chinook densities within state/habitat types in reaches 3 and 8 of the Chiwawa River and their matched reference areas on the Little Wenatchee River. NC = natural channel; S = straight channel; EB = eroded banks; MC = multiple channel. There was no sampling in 2000 and no sampling within reference areas in 1992.

Smolt and Emigrant Estimates

Numbers of spring Chinook smolts and emigrants were estimated at the Chiwawa and Lower Wenatchee traps in 2019.

Chiwawa Trap

The Chiwawa Trap operated between 19 March and 27 November 2019. During the trapping period, the trap was inoperable for 12 days because of high or low river discharge, debris, major hatchery releases, and mechanical issues. Throughout the trapping season, the trap operated in two positions, the upper position and low-flow position. Daily trap efficiencies were estimated for each age class of fish (e.g., subyearling and yearling). The daily number of fish captured was expanded by the estimated trap efficiency to estimate daily total emigration. Monthly captures of all fish and results of mark-recapture efficiency tests at the Chiwawa Trap are reported in Appendix C.

Wild yearling spring Chinook (2017 brood year) were primarily captured in of April 2019 (Figure 5.6). A significant relationship between trap efficiency and river flow (R^2 = 0.539; $P < 0.05$) was developed for the upper cone position. The total number of wild yearling Chinook emigrating from the Chiwawa River was estimated at 39,015 (95% CI ±6,825). Combining the total number of subyearling (fry included) spring Chinook (48,194 ±38,089) that emigrated during the fall of 2018 with the total number of yearling Chinook (39,015 ±6,825) that emigrated during 2019, the total emigrant estimate for brood year 2017 was 87,209 (±38,695) (Table 5.16). If fry are removed from the estimate, the subyearling estimate becomes 76,825 (95% CI ±37,478). A non-trapping estimate of 2,915 (95% CI ±769) was also produced for the 2017 brood year (see Electrofishing Surveys Section). Adding the non-trapping period estimate to the subyearling and yearling estimates, the complete brood year 2017 estimate is 90,124 (95% CI ±38,703) if fry are included or 79,740 (95% CI ± 37,486) if fry are excluded (see Appendix C).

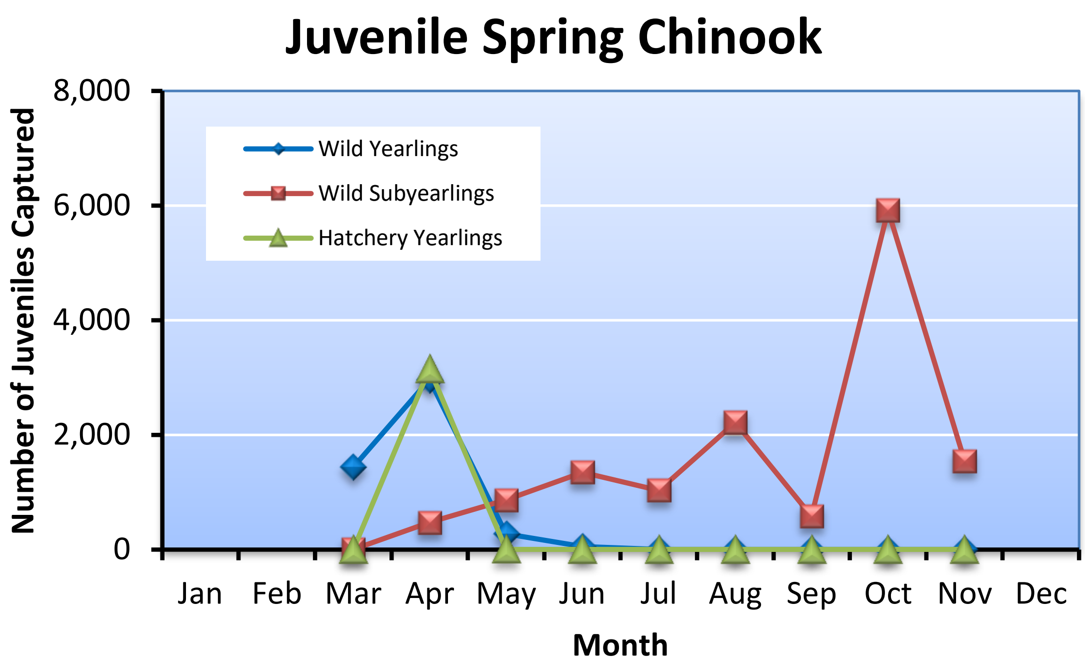


Figure 5.6. Monthly captures of wild subyearling, wild yearling, and hatchery yearling spring Chinook at the Chiwawa Trap, 2019.

Table 5.16. Numbers of redds and juvenile spring Chinook at different life stages in the Chiwawa River basin for brood years 1991-2017; NS = not sampled. Parr were estimated using snorkel techniques, while smolts and total emigrants were estimated using smolt traps.

Brood year	Number of redds	Egg deposition	Number of parr	Number of smolts[a]	Number of emigrants
1991	104	478,400	45,483[b]	42,525	NS
1992	302	1,570,098	79,113	39,723	65,541
1993	106	556,394	55,056	8,662	22,698
1994	82	485,686	55,240	16,472	25,067
1995	13	66,248	5,815	3,830	5,951
1996	23	106,835	16,066	15,475	19,183
1997	82	374,740	68,415	27,555	44,562
1998	41	218,325	41,629	19,257	25,923
1999	34	166,090	NS	10,931	15,649

Brood year	Number of redds	Egg deposition	Number of parr	Number of smolts[a]	Number of emigrants
2000	128	642,944	114,617	39,812	55,685
2001	1,078	4,984,672	134,874	79,814	546,266
2002	345	1,605,630	91,278	82,845	184,279
2003	111	648,684	45,177	16,559	33,637
2004	241	1,156,559	49,631	67,491	116,158
2005	333	1,440,891	79,902	58,833	177,659
2006	297	1,284,228	60,752	41,951	107,972
2007	283	1,256,803	82,351	23,766	86,006
2008	689	3,163,888	106,705	32,849	120,184
2009	421	1,925,233	128,220	32,979	61,955
2010	502	2,165,628	141,510	47,511	101,130
2011	492	2,157,420	103,940	37,185	108,832
2012	880	3,716,240	149,563	37,493	109,413
2013	714	3,367,224	121,240	39,396	113,091
2014	485	1,961,825	111,224	46,615	124,125
2015	543	2,631,921	140,172	53,344	139,863
2016	312	1,393,704	102,106	31,300	130,668
2017	222	1,024,530	83,729	39,015	79,740
Average	***328***	***1,501,883***	***85,146***	***38,165***	***100,817***
Median	***297***	***1,284,228***	***83,040***	***37,185***	***93,568***

[a] Smolt estimates for brood years 1992-1996 were calculated with a mark-recapture model; brood years 1997-present were calculated with a flow model.
[b] Estimate only includes numbers of Chinook in the Chiwawa River. Tributaries were not sampled at that time.

Wild subyearling spring Chinook (2018 brood year) were primarily captured in August and October 2019 (Figure 5.6). Based on capture efficiencies, the total number of wild subyearling (fry and parr) Chinook from the Chiwawa River basin was 109,275 (95% CI ±28,841). Removing fry from the estimate, a total of 68,038 (±20,716) subyearling parr emigrated from the Chiwawa River basin in 2019. Although subyearling parr migrated during all months of sampling, the majority 96%) migrated after 1 July (Figure 5.6).

Yearling spring Chinook sampled in 2019 averaged 94 mm in length, 9.2 g in weight, and had a mean condition of 1.08 (Table 5.17). These size estimates were similar to the overall mean of yearling spring Chinook sampled in previous years (overall means: 93 mm, 9.0 g, and condition of 1.08). Subyearling spring Chinook sampled in 2019 at the Chiwawa Trap averaged 76 mm in length, averaged 4.7 g, and had a mean condition of 1.07 (Table 5.17). In general, subyearlings were similar to previous years (overall means, 76 mm, 5.2 g, and condition of 1.09).

Table 5.17. Mean fork length (mm), weight (g), and condition factor of subyearling (excluding fry) and yearling spring Chinook collected in the Chiwawa Trap, 1996-2019. Numbers in parentheses indicate 1 standard deviation.

Sample year	Life stage	Sample size[a]	Mean size		
			Length (mm)	Weight (g)	Condition (K)
1996	Subyearling	514	78 (25)	6.9 (4.2)	1.11 (0.11)
	Yearling	1,589	94 (9)	9.5 (3.0)	1.11 (0.08)
1997	Subyearling	840	86 (8)	7.5 (2.1)	1.16 (0.08)
	Yearling	1,114	100 (7)	10.2 (2.6)	1.02 (0.10)
1998	Subyearling	3,743	82 (11)	6.2 (2.2)	1.08 (0.09)
	Yearling	2,663	97 (7)	10.3 (2.8)	1.12 (0.23)
1999	Subyearling	569	89 (9)	8.5 (2.4)	1.15 (0.07)
	Yearling	3,664	95 (8)	9.6 (3.4)	1.09 (0.19)
2000	Subyearling	1,810	85 (10)	7.4 (2.4)	1.15 (0.10)
	Yearling	1,891	97 (8)	10.5 (5.2)	1.13 (0.07)
2001	Subyearling	4,657	82 (11)	6.6 (3.4)	1.14 (0.09)
	Yearling	2,935	97 (7)	10.5 (2.4)	1.15 (0.08)
2002	Subyearling	6,130	64 (12)	3.0 (1.6)	1.06 (0.10)
	Yearling	1,735	94 (8)	9.0 (2.3)	1.09 (0.08)
2003	Subyearling	3,679	64 (12)	3.2 (1.7)	1.08 (0.10)
	Yearling	2,657	87 (9)	7.2 (3.5)	1.07 (0.10)
2004	Subyearling	2,278	75 (16)	4.3 (2.1)	0.92 (0.16)
	Yearling	1,032	91 (9)	8.5 (2.7)	1.09 (0.10)
2005	Subyearling	2,702	73 (12)	4.6 (2.2)	1.08 (0.09)
	Yearling	803	96 (9)	9.9 (2.8)	1.08 (0.08)
2006	Subyearling	3,462	76 (11)	5.1 (2.0)	1.12 (0.21)
	Yearling	4,645	95 (7)	9.4 (2.3)	1.10 (0.13)
2007	Subyearling	1,718	72 (12)	4.5 (2.1)	1.13 (0.16)
	Yearling	2,245	91 (8)	8.6 (2.5)	1.10 (0.09)
2008	Subyearling	10,443	79 (12)	5.9 (2.3)	1.15 (0.15)
	Yearling	8,792	93 (7)	8.8 (2.1)	1.08 (0.10)
2009	Subyearling	10,536	75 (10)	5.0 (2.2)	0.91 (0.11)
	Yearling	3,630	92 (7)	8.8 (2.1)	0.89 (0.07)
2010	Subyearling	3,888	77 (12)	5.4 (2.3)	1.11 (0.16)
	Yearling	5,799	91 (8)	8.9 (2.2)	1.15 (0.14)
2011	Subyearling	6,870	73 (11)	4.8 (2.2)	1.15 (0.16)
	Yearling	4,734	94 (8)	8.7 (2.2)	1.04 (0.10)
2012	Subyearling	8,756	75 (10)	4.8 (2.2)	1.13 (0.28)
	Yearling	7,290	90 (7)	8.0 (2.6)	1.06 (0.24)
2013	Subyearling	10,181	71 (10)	4.1 (1.7)	1.09 (0.39)

Sample year	Life stage	Sample size[a]	Mean size		
			Length (mm)	Weight (g)	Condition (K)
	Yearling	3,135	88 (9)	7.7 (2.8)	1.09 (0.20)
2014	Subyearling	7,122	71 (10)	3.7 (1.6)	1.08 (0.10)
	Yearling	3,956	89 (8)	7.7 (2.2)	1.05 (0.08)
2015	Subyearling	14,661	72 (10)	4.2 (1.7)	1.10 (0.14)
	Yearling	6,267	92 (9)	8.8 (2.8)	1.08 (0.08)
2016	Subyearling	10,947	71 (13)	4.5 (2.3)	1.08 (0.08)
	Yearling	2,784	91 (9)	8.2 (2.5)	1.05 (0.08)
2017	Subyearling	8,237	74 (12)	4.2 (2.2)	1.09 (0.20)
	Yearling	5,790	93 (7)	8.6 (2.1)	1.06 (0.06)
2018	Subyearling	5,519	78 (12)	5.35 (2.2)	1.09 (0.09)
	Yearling	3,488	93 (7)	8.61 (2.0)	1.06 (0.06)
2019	Subyearling	7,322	76 (10)	4.7 (1.9)	1.07 (0.08)
	Yearling	4,144	94 (7)	9.2 (2.3)	1.08 (0.07)
Average	***Subyearling***	***5,691***	***76***	***5.2***	***1.09***
	Yearling	***3,616***	***93***	***9.0***	***1.08***
Median	***Subyearling***	***5,088***	***75***	***4.8***	***1.10***
	Yearling	***3,312***	***93***	***8.8***	***1.08***

[a] Sample size represents the number of fish that were measured for both length and weight.

Lower Wenatchee Trap

The Lower Wenatchee River Trap operated between 19 February and 23 July 2019. During that time, the trap was inoperable for 16 days because of high or low river discharge, debris, elevated river temperatures, large hatchery releases, and mechanical issues. At the beginning of the season the trap operated in the low-flow position until 26 March. It then operated in the lower position until 5 July when it was switched back into the low-flow position for the remainder of the season. During the sampling period, a total of 1,485 wild yearling Chinook, 28,534 wild subyearling Chinook (mostly summer Chinook), and 36,104 hatchery yearling Chinook were captured at the Lower Wenatchee Trap. Based on capture efficiencies and river discharge, a significant model was developed ($R^2 = 0.792$, $P < 0.05$) producing an emigrant estimate of 101,793 (95% CI ±19,396) wild yearling Chinook that emigrated past the Lower Wenatchee Trap (Table 5.18). Monthly captures of all fish collected at the Lower Wenatchee Trap are reported in Appendix C.

Table 5.18. Numbers of redds and wild spring Chinook smolts produced in the Wenatchee River basin for brood years 2000-2017; NS = not sampled. From 2000-2010 the trap operated at Monitor; from 2013 to present the trap operated near Cashmere.

Brood year	Number of redds	Egg deposition	Number of smolts produced within Wenatchee River basin
2000	350	1,758,050	76,643
2001	2,109	8,674,624	243,516
2002	1,139	5,300,906	165,116

Brood year	Number of redds	Egg deposition	Number of smolts produced within Wenatchee River basin
2003	323	1,887,612	70,738
2004	574	2,663,445	55,619
2005	830	3,587,083	302,116
2006	588	2,542,512	85,558
2007	466	2,069,506	60,219
2008	1,411	6,479,312	82,137
2009	733	NS	NS
2010	968	NS	NS
2011	872	3,823,720	89,917
2012	1,704	7,195,992	67,973
2013	1,159	5,512,204	58,595
2014[a]	965	3,919,605	36,752
2015[a]	1047	5,071,668	130,426
2016[a]	638	2,849,946	99,045
2017[a]	430	1,984,450	101,793
Average	***906***	***4,082,540***	***107892***
Median	***851***	***3,705,402***	***83,848***

[a] The number of redds from 2014 to 2017 are estimated numbers of redds calculated from the number of redds observed on the spawning grounds.

Yearling spring Chinook sampled in 2019 at the Lower Wenatchee Trap averaged 99 mm in length, 10.5 g in weight, and had a mean condition of 1.05 (Table 5.19). These size estimates were similar to the overall mean of yearling spring Chinook sampled in previous years (overall means: 98 mm, 10.5 g, and condition of 1.09).

Table 5.19. Mean fork length (mm), weight (g), and condition factor of yearling spring Chinook collected in the Lower Wenatchee Trap, 2000-2019. From 2000-2010 the trap operated at Monitor; from 2013 to present the trap operated near Cashmere. Numbers in parentheses indicate 1 standard deviation.

Sample year	Sample size[a]	Mean size		
		Length (mm)	Weight (g)	Condition (K)
2000	29	111 (15.1)	15.6 (7.4)	1.15 (0.1)
2001	204	106 (9.6)	13.0 (3.6)	1.10 (0.1)
2002	301	99 (10.0)	10.7 (3.3)	1.11 (0.1)
2003	1,427	96 (9.4)	9.7 (10.0)	1.11 (0.1)
2004	1,046	97 (10.3)	10.0 (3.4)	1.11 (0.1)
2005	325	101 (10.5)	11.3 (3.7)	1.08 (0.1)
2006	642	99 (9.5)	10.6 (4.9)	1.08 (0.1)
2007	1,902	94 (8.4)	9.4 (2.5)	1.12 (0.1)
2008	615	97 (9.3)	10.5 (3.1)	1.14 (0.1)
2009	483	98 (10.8)	10.8 (3.9)	1.16 (0.1)
2010	1,057	98 (9.4)	10.5 (3.1)	1.10 (0.1)

Sample year	Sample size[a]	Mean size		
		Length (mm)	Weight (g)	Condition (K)
2011	ND	ND	ND	ND
2012	ND	ND	ND	ND
2013	1729	94 (9.6)	9.0 (2.9)	1.07 (0.1)
2014	1,643	94 (9.8)	8.7 (2.8)	1.04 (0.1)
2015	1,481	96 (9.6)	9.4 (3.7)	1.05 (0.1)
2016	598	94 (9.4)	9.0 (2.9)	1.05 (0.1)
2017	1,313	97 (8.4)	9.7 (2.6)	1.05 (0.1)
2018	1,355	98 (8.7)	10.3 (2.8)	1.05 (0.1)
2019	1,434	99 (9.0)	10.5 (3.0)	1.05 (0.1)
Average	***977***	***98***	***10.5***	***1.09***
Median	***1,052***	***97***	***10.4***	***1.09***

[a] Sample size represents the number of fish that were measured for both length and weight.

Electrofishing Surveys

The Chiwawa River was sampled between 1 October and 14 November 2019 with a backpack electrofisher. During this sampling, 3,448 wild subyearling Chinook salmon were collected of which 3,309 received a PIT tag. Additionally, 24 wild coho parr, 559 bull trout juvenile, and one lamprey ammocoete were collected. The greatest concentration of juvenile Chinook salmon occurred between Rkm 21 and 40 with a mean sample rate of one juvenile Chinook salmon collected for every 18 seconds of sampling. Over the sampling period, nine Chinook salmon died resulting in a mortality rate of 0.3%. No other mortality was recorded.

Of the 3,737 wild subyearling Chinook salmon PIT tagged remotely in the Chiwawa basin in 2018, there were 35 detections during the non-trapping season (4 December 2018 through 19 March 2019) at the lower Chiwawa PIT-tag antenna array (Table 5.20). These detections were used in a significant flow efficiency model (R^2 = 0.79; P > 0.001) to produce a non-trapping emigration estimate for the Chiwawa basin of 2,915 (95% CI; ±769).

Table 5.20. Number of remotely sampled subyearling spring Chinook salmon captured with electrofishing gear and PIT tagged in the Chiwawa River, 2014-2019.

Sample year	Number captured	Number tagged	Number captured at smolt trap in fall of sample year	Number detected at the lower-most array on the Chiwawa R. during non-trapping period	Number captured at smolt trap in spring of following year	Survival to McNary Dam (%)
2014	1,083	1,033	17	16	46	5.2
2015	1,103	1,052	32	3	26	13.8
2016	1,829	1,772	38	25	65	18.3
2017	2,740	2,703	114	11	69	18.7
2018	3,800	3,737	226	35	141	14.4
2019	3,448	3,309	158	17	--	--

Sample year	Number captured	Number tagged	Number captured at smolt trap in fall of sample year	Number detected at the lower-most array on the Chiwawa R. during non-trapping period	Number captured at smolt trap in spring of following year	Survival to McNary Dam (%)
Average	***2,334***	***2,268***	***98***	***18***	***69***	***14.1***
Median	***2,285***	***2,238***	***76***	***17***	***65***	***14.4***

PIT-Tagging Activities

As part of the Comparative Survival Study (CSS) and PUD studies, a total of 23,649 wild juvenile Chinook (17,448 subyearling and 6,201 yearlings) were PIT tagged and released in 2019 in the Wenatchee River basin (Table 5.21). Most of these (60%) were tagged at the Chiwawa trap. See Appendix D for a complete list of all fish captured, tagged, lost, and released.

Table 5.21. Numbers of wild Chinook that were captured, tagged, and released at different locations within the Wenatchee River basin, 2019. Numbers of fish that died or shed tags are also given.

Sampling location	Life stage	Number captured	Number of recaptures	Number tagged	Number died	Shed tags	Total tagged fish released	Percent mortality
Chiwawa Trap	Subyearling	13,970	247	9,634	78	0	9,634	0.56
	Yearling	4,730	91	4,540	9	0	4,540	0.19
	Total	**18,700**	**338**	**14,174**	**87**	**0**	**14,174**	**0.47**
Chiwawa River (Electrofishing)	Subyearling	3,448	67	3,309	9	1	3,309	0.26
	Yearling	0	0	0	0	0	0	0.00
	Total	**3,448**	**67**	**3,309**	**9**	**1**	**3,309**	**0.26**
Nason Creek Trap	Subyearling	1,759	20	959	25	0	959	1.42
	Yearling	296	18	269	2	0	269	0.68
	Total	**2,055**	**38**	**1,228**	**27**	**0**	**1,228**	**1.31**
Nason Creek (Electrofishing)	Subyearling	3,447	76	3,212	86	0	3,212	2.49
	Yearling	0	0	0	0	0	0	0.00
	Total	**3,447**	**76**	**3,212**	**86**	**0**	**3,212**	**2.49**
White River Trap	Subyearling	372	1	332	6	0	332	1.61
	Yearling	119	1	103	9	0	103	7.56
	Total	**491**	**2**	**435**	**15**	**0**	**435**	**3.05**
Lower Wenatchee Trap	Subyearling	28,534	101	2	167	0	2	0.59
	Yearling	1,485	4	1,289	2	0	1,289	0.13
	Total	**30,019**	**105**	**1,291**	**169**	**0**	**1,291**	**0.56**
Total:	**Subyearling**	***51,530***	***512***	***17,448***	***371***	***1***	***17,448***	***0.72***
	Yearling	***6,630***	***114***	***6,201***	***22***	***0***	***6,201***	***0.33***
Grand Total:		***58,160***	***626***	***23,649***	***393***	***1***	***23,649***	***0.68***

Numbers of wild Chinook salmon PIT-tagged and released as part of CSS and PUD studies during the period 2008-2019 are shown in Table 5.22.

Table 5.22. Summary of the numbers of wild Chinook that were tagged and released at different locations within the Wenatchee River basin, 2008-2019.

Sampling location	Life stage	Numbers of PIT-tagged wild Chinook salmon released											
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Chiwawa Trap	Subyearling	8,755	8,765	3,324	6,030	7,644	9,086	11,358	10,471	7,354	8,241	5,686	9,634
	Yearling	8,397	3,694	6,281	4,318	7,980	3,093	4,383	6,204	2,729	5,711	3,447	4,540
	Total	**17,152**	**12,459**	**9,605**	**10,348**	**15,624**	**12,179**	**15,741**	**16,675**	**10,083**	**13,952**	**9,133**	**14,174**
Chiwawa River (Angling or Electro-fishing)	Subyearling	43	128	531	0	3,181	3,017	1,032	1,054	1,776	2,703	3,737	3,309
	Yearling	0	3	4	0	0	0	0	0	0	0	0	0
	Total	**43**	**131**	**535**	**0**	**3,181**	**3,017**	**1,032**	**1,054**	**1,776**	**2,703**	**3,737**	**3,309**
Upper Wenatchee Trap	Subyearling	0	37	3	1	1	0	--	--	--	--	--	--
	Yearling	159	296	486	714	75	94	--	--	--	--	--	--
	Total	**159**	**333**	**489**	**715**	**76**	**94**	**--**	**--**	**--**	**--**	**--**	**--**
Nason Creek Trap	Subyearling	1,741	1,890	2,828	822	1,939	3,290	1,113	219	434	1,877	686	959
	Yearling	894	185	364	147	357	237	456	142	61	346	296	269
	Total	**2,635**	**2,075**	**3,192**	**969**	**2,296**	**3,527**	**1,569**	**361**	**495**	**2,223**	**982**	**1,228**
Nason Creek (Angling or Electro-fishing)	Subyearling	4	701	595	0	0	0	1,816	1,089	802	3,240	2,524	3,212
	Yearling	0	13	3	0	0	0	0	0	0	0	0	0
	Total	**4**	**714**	**598**	**0**	**0**	**0**	**1,816**	**1,089**	**802**	**3,240**	**2,524**	**3,212**
White River Trap	Subyearling	0	441	143	144	285	374	156	149	136	507	220	332
	Yearling	0	265	359	65	180	22	49	34	3	41	106	103
	Total	**0**	**706**	**502**	**209**	**465**	**396**	**205**	**183**	**139**	**548**	**326**	**435**
Lower Wenatchee Trap	Subyearling	2	0	0	0	0	0	36	0	18	0	5	2
	Yearling	506	468	917	0	0	1,712	1,506	1,301	538	1,220	1,243	1,289
	Total	**508**	**468**	**917**	**0**	**0**	**1,712**	**1,542**	**1,301**	**556**	**1,220**	**1,248**	**1,291**
Total:	**Subyearling**	**10,545**	**11,962**	**7,424**	**6,997**	**13,050**	**15,767**	**15,511**	**12,982**	**10,520**	**16,568**	**12,858**	**17,448**
	Yearling	**9,956**	**4,924**	**8,414**	**5,244**	**8,592**	**5,158**	**6,394**	**7,681**	**3,331**	**7,318**	**5,092**	**6,201**
Grand Total:		***20,501***	***16,886***	***15,838***	***12,241***	***21,642***	***20,925***	***21,905***	***20,663***	***13,851***	***23,886***	***17,950***	***23,649***

Freshwater Productivity

Both productivity and survival estimates for different life stages of spring Chinook in the Chiwawa River basin are provided in Table 5.23. Estimates for brood year 2017 fall within the ranges estimated over the period of brood years 1991-2017. During that period, freshwater productivities ranged from 125-1,015 parr/redd, 39-673 smolts/redd, and 124-834 emigrants/redd. Survivals during the same period ranged from 2.7-19.1% for egg-parr, 0.9-14.5% for egg-smolt, and 2.9-

18.0% for egg-emigrants. Overwinter survival rates for juvenile spring Chinook within the Chiwawa River basin have ranged from 15.7-100.0%.

Table 5.23. Productivity (fish/redd) and survival (%) estimates for different juvenile life stages of spring Chinook in the Chiwawa River basin for brood years 1991-2017; ND = no data. These estimates were derived from data in Table 5.16.

Brood year	Parr/Redd	Smolts/Redd[a]	Emigrants/ Redd	Egg-Parr (%)	Parr-Smolt[b] (%)	Egg-Smolt[a] (%)	Egg-Emigrant (%)
1991	437	409	ND	9.5	93.5	8.9	ND
1992	262	132	217	5.0	50.2	2.5	4.2
1993	519	82	214	9.9	15.7	1.6	4.1
1994	674	201	306	11.4	29.8	3.4	5.2
1995	447	295	458	8.8	65.9	5.8	9.0
1996	699	673	834	15.0	96.3	14.5	18.0
1997	834	346	543	18.3	41.4	7.6	11.9
1998	1,015	563	632	19.1	55.4	10.6	11.9
1999	ND	314	460	ND	ND	6.4	9.4
2000	895	319	435	17.8	35.6	6.4	8.7
2001	125	80	507	2.7	64.1	1.7	11.0
2002	265	264	534	5.7	99.6	5.7	11.5
2003	407	151	303	7.0	37.1	2.6	5.2
2004	206	299	482	4.3	100.0	6.2	10.0
2005	240	207	534	5.5	86.4	4.8	12.3
2006	205	152	364	4.7	74.2	3.5	8.4
2007	291	91	304	6.6	31.3	2.1	6.8
2008	155	51	174	3.4	32.8	1.1	3.8
2009	305	74	147	6.7	24.1	1.6	3.2
2010	282	95	201	6.5	33.6	2.2	4.7
2011	211	76	221	4.8	35.8	1.7	5.0
2012	170	39	124	4.0	23.0	0.9	2.9
2013	170	55	158	3.6	32.5	1.2	3.4
2014	229	77	236	5.7	33.4	1.9	5.8
2015	258	98	358	5.3	38.1	2.0	5.3
2016	327	100	419	7.3	30.7	2.2	9.4
2017	377	176	359	8.2	46.6	3.8	7.8
Average	***385***	***201***	***363***	***8.0***	***50.3***	***4.2***	***7.6***
Median	***286***	***151***	***332***	***6.5***	***37.6***	***2.6***	***7.3***

[a] These estimates include Chiwawa smolts produced only within the Chiwawa River basin.
[b] These estimates represent overwinter survival within the Chiwawa River basin. It does not include Chiwawa smolts produced outside the Chiwawa River basin.

Seeding level (egg deposition) explained most of the variability in productivity and survival of juvenile spring Chinook in the Chiwawa River basin. That is, for estimates based on “within-Chiwawa-Basin” life stages (e.g., parr and smolts), survival and productivity decreased as seeding levels increased (Figure 5.7). This suggests that density dependence regulates juvenile productivity and survival within the Chiwawa River basin. This form of population regulation is less apparent with total emigrants. However, one would expect the number of emigrants to increase as seeding levels exceed the rearing capacity of the Chiwawa River basin.

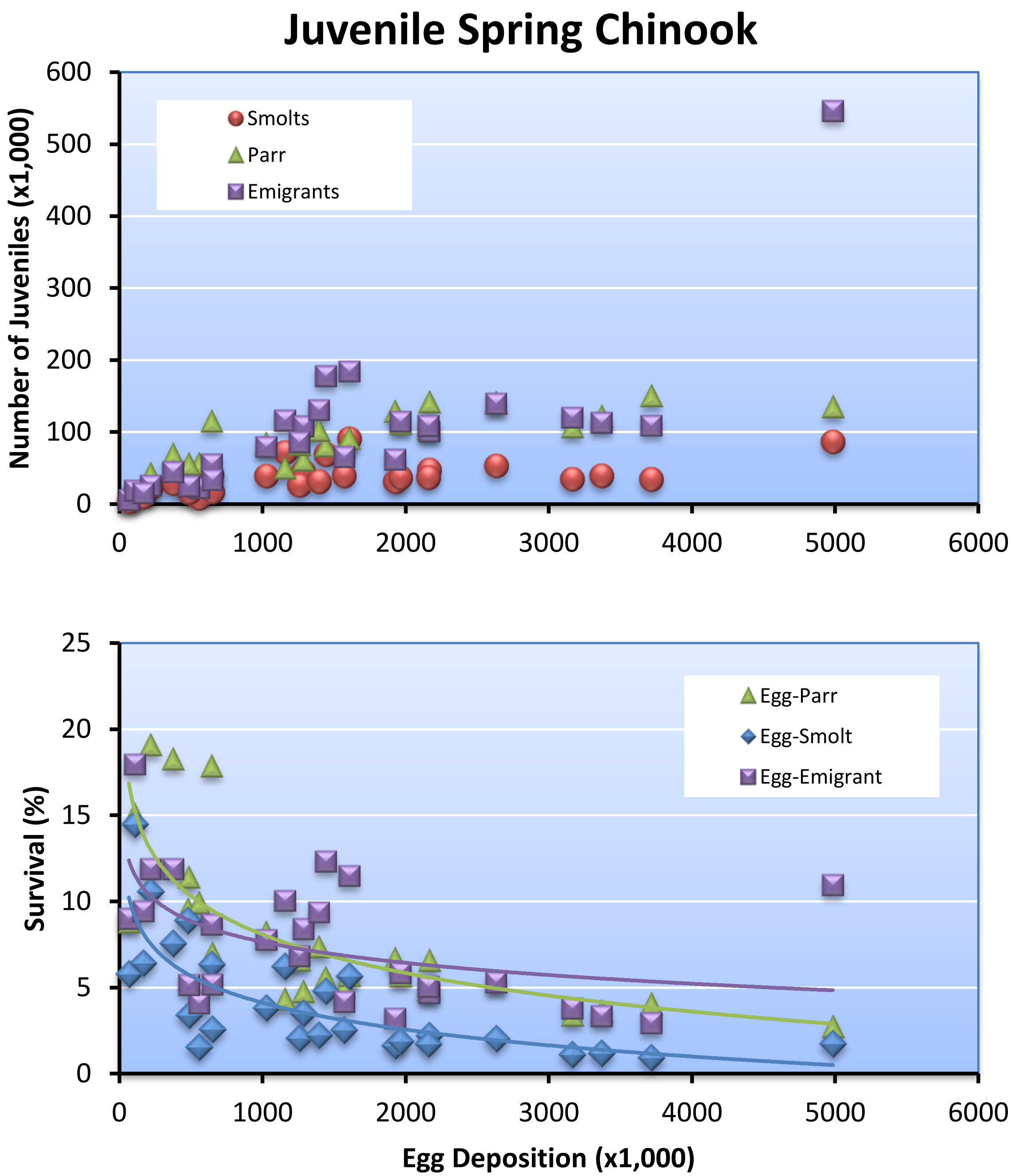


Figure 5.7. Relationships between seeding levels (egg deposition) and juvenile life-stage survivals and productivities for Chiwawa spring Chinook, brood years 1991-2017. Smolts represent yearling Chinook produced within the Chiwawa River basin.

Population Carrying Capacity

Population carrying capacity (*K*) is defined as the maximum equilibrium population size estimated with population models (e.g., logistic equation, Beverton-Holt model, hockey stick model, and the

Ricker model).[18] Maximum equilibrium population size is generated from density dependent mechanisms that reduce population growth rates as population size increases (negative density dependence). This is referred to as compensation. Population size fluctuates about the maximum equilibrium size because of variability in vital rates that are unrelated to density (density independent factors) and measurement error. In this section, we estimate parr and smolt carrying capacities using the smooth hockey stick stock-recruitment model (see Appendix 6 in Hillman et al. 2019 for a detailed description of methods). This model explains most of the information contained in the juvenile spring Chinook data (see Appendix B).

Based on the smooth hockey stick model, the population carrying capacity for spring Chinook parr in the Chiwawa River basin is 114,419 parr (95% CI: 95,041 – 138,496) (Figure 5.8). The capacity for spring Chinook smolts is 44,080 (95% CI: 34,721 – 52,528) (Figure 5.9). Here, smolts are defined as the number of yearling spring Chinook produced entirely within the Chiwawa River basin. These estimates reflect current conditions (most recent two decades) within the Chiwawa River basin. Land use activities such as logging, mining, roads, development, and recreation have altered the historical conditions of the watershed. Thus, the estimated population capacity estimates may not reflect historical capacities for spring Chinook parr and smolts in the Chiwawa River basin.

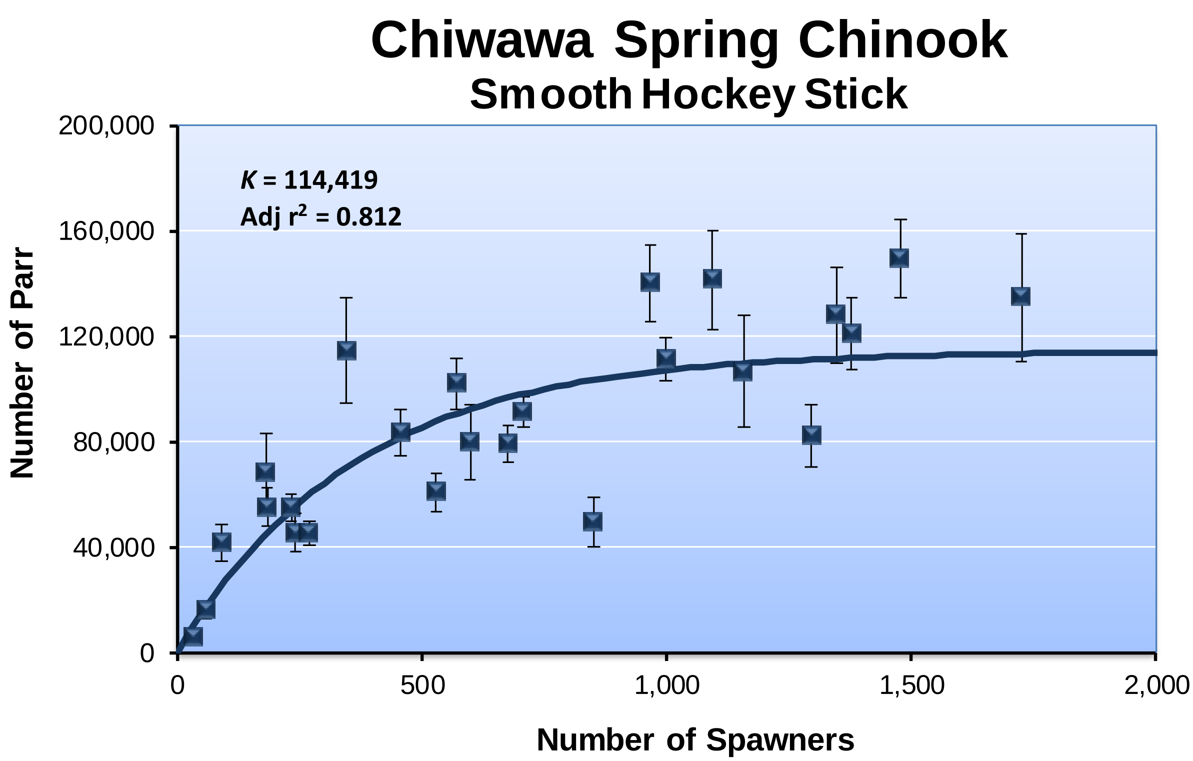


Figure 5.8. Relationship between spawners and number of parr produced in the Chiwawa River basin. Population carrying capacity (*K*) was estimated using the smooth hockey stick model, which explained most of the information in the data. Vertical bars represent 95% confidence intervals on parr estimates.

[18] Population carrying capacity (*K*) should not be confused with habitat carrying capacity (*C*), which is defined as the maximum population of a given species that a particular environment can sustain.

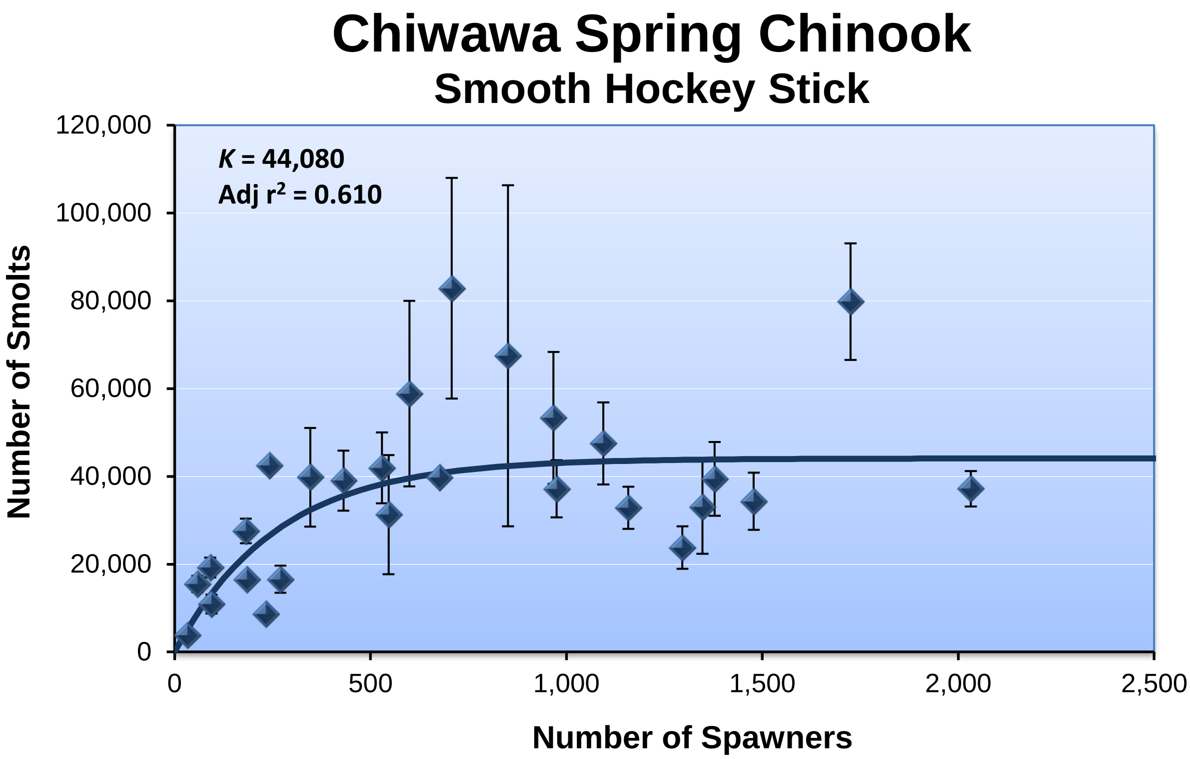


Figure 5.9. Relationship between spawners and number of yearling smolts produced in the Chiwawa River basin. Population carrying capacity (*K*) was estimated using the smooth hockey stick model, which explained most of the information in the data. At this time, 95% confidence intervals have only been calculated for the most recent six years of smolt data.

We tracked the precision of the smooth hockey stick parameters for Chiwawa spring Chinook smolts over time to see if precision improves with additional years of data, and the parameters and statistics stabilize over time. Examination of variation in the alpha (*A*) and beta (*B*) parameters of the smooth hockey stick model and their associated standard errors and confidence intervals indicates that the parameters appear to stabilize after 19 years of smolt and spawning escapement data (Table 5.24; Figure 5.10). This was also apparent in the estimates of population carrying capacity (Figure 5.11). That is, after 19 years of data, additional years of data had relatively little effect on the parameters of the smooth hockey stick model and its statistics. This observation will change if more extreme spawning escapements occur in the future or density independent factors overwhelm the influence of density dependent factors.

Table 5.24. Estimated parameters and statistics associated with fitting the smooth hockey stick model to spawning escapement and smolt data. Smolts represent numbers of smolts produced entirely within the Chiwawa River basin. *A* = alpha parameter; *B* = beta parameter; SE = standard error (estimated from 5,000 bootstrap samples); and r^2 = coefficient of determination. Spawners represent the stock size needed to achieve population capacity.

Years of data	Parameter				Population capacity	Intrinsic productivity	Spawners	r^2
	A	*A* SE	*B*	*B* SE				
5	10.80	11.51	110.23	942.46	49,257	110	1,339	0.706
6	10.43	30.61	163.03	28,174.86	34,022	163	625	0.562
7	10.47	70.66	173.00	1,918.57	35,362	173	613	0.567
8	10.40	13.26	206.97	41,705.63	32,750	207	474	0.513
9	10.43	16.70	190.98	96,463.71	33,727	191	529	0.518
10	10.56	41.60	184.83	719.39	38,590	185	625	0.564
11	11.10	8.98	154.07	246,309.06	66,371	154	1,291	0.653
12	11.31	71.48	150.98	2,254.06	81,605	151	1,620	0.701
13	11.28	43.85	142.41	236.06	79,572	142	1,674	0.664
14	11.34	5.26	141.43	118.39	84,292	141	1,786	0.699
15	11.40	15.61	141.76	35.71	89,256	142	1,887	0.718
16	11.38	2.77	141.35	37.66	87,522	141	1,856	0.723
17	11.02	3.10	155.71	38.89	60,965	156	1,173	0.651
18	10.92	0.79	160.92	38.85	55,020	161	1,023	0.635
19	10.82	0.25	166.78	39.68	50,150	167	901	0.614
20	10.82	0.20	166.99	39.58	49,972	167	897	0.622
21	10.78	0.17	169.82	38.50	48,142	170	849	0.618
22	10.75	0.15	172.32	39.35	46,494	172	809	0.611
23	10.73	0.13	173.36	40.07	45,815	173	792	0.612
24	10.73	0.13	173.36	39.82	45,815	173	792	0.612
25	10.72	0.12	174.08	41.00	45,161	174	777	0.610
26	10.72	0.12	174.08	41.29	45,161	174	777	0.610
27	10.73	0.12	173.45	38.05	45,780	173	791	0.617
28	10.70	0.11	166.90	35.17	44,205	167	793	0.642
29	10.69	0.11	168.12	35.88	44,080	168	785	0.610

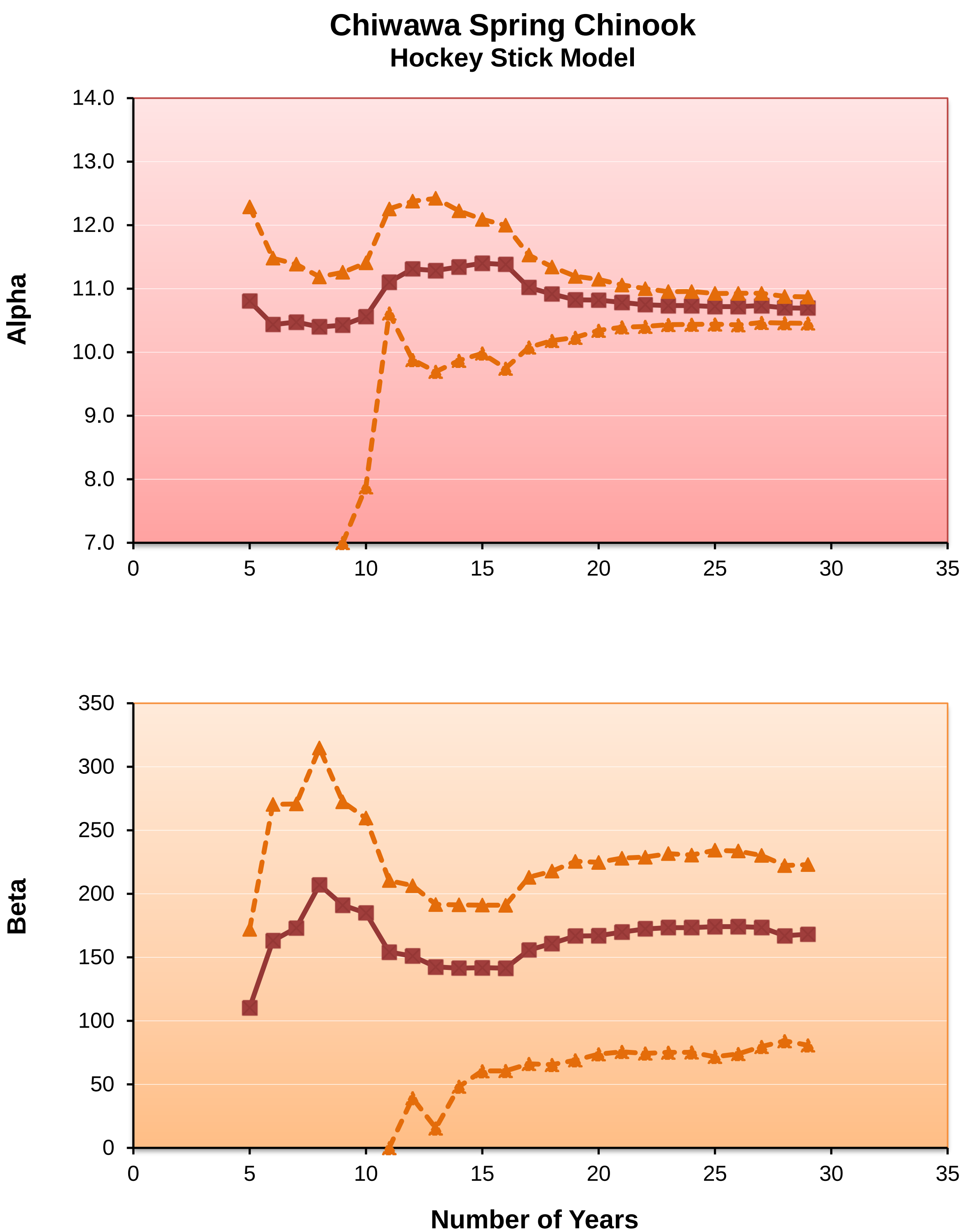


Figure 5.10. Time series of alpha and beta parameters and 95% confidence intervals for the smooth hockey stick model that was fit to Chiwawa spring Chinook smolt and spawning escapement data. Confidence intervals were estimated from 5,000 bootstrap samples.

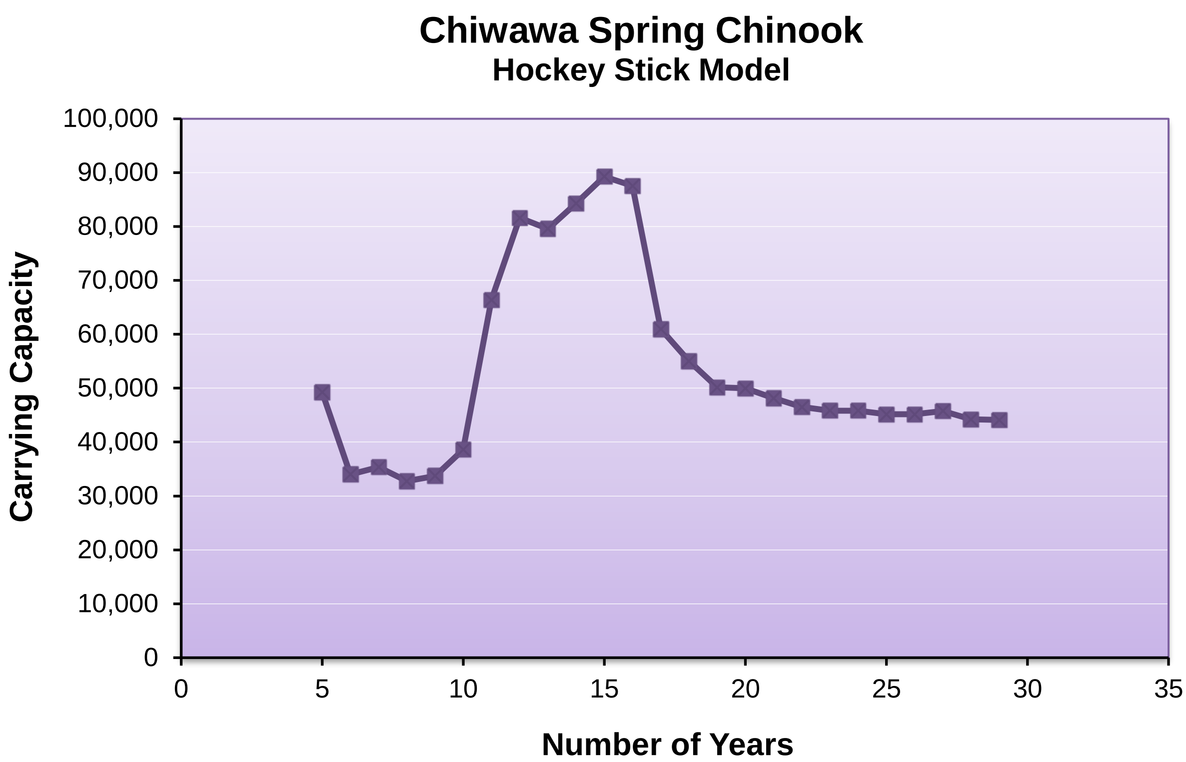


Figure 5.11. Time series of population carrying capacity estimates derived from fitting the smooth hockey stick model to Chiwawa spring Chinook smolt and spawning escapement data.

5.5 Spawning Surveys

Surveys for spring Chinook redds were conducted from late July through September 2019 in the Chiwawa River (including Rock, Chikamin, and Phelps creeks), Nason Creek, Icicle Creek, Peshastin Creek (including Ingalls Creek), Upper Wenatchee River (including Chiwaukum Creek), Little Wenatchee River, and the White River (including the Napeequa River and Panther Creek).

Spawning escapement for spring Chinook was calculated as the total number of redds times one plus the male-to-female ratio (i.e., fish per redd expansion factor) estimated from broodstock and fish sampled at adult trapping sites.[19] Beginning with return year 2015, we used the Gaussian area-under-the-curve (AUC) method (Millar et al. 2012) to estimate the number of redds within survey reaches (see Appendix L). The number of redds within each reach were then divided by the mean net error (ratio of observed redds to the estimated number of redds) to calculate the "adjusted" or "estimated" number of redds within each reach. The mean net error was modeled based on covariates such as surveyor experience, channel complexity (mean thalweg CV), and observed redd density (number of redds per km).

[19] Expansion factor = (1 + (number of males/number of females)).

Redd Counts

A total of 460 spring Chinook redds were counted in the Wenatchee River basin in 2019 (Table 5.25). This is lower than the average of 653 redds counted during the period 1989-2018 in the Wenatchee River basin. Most spawning occurred in the Chiwawa River (49.8% or 229 redds) (Table 5.25; Figure 5.12). Nason Creek contained 42.8% (197 redds), White River contained 3.3% (15 redds), Little Wenatchee contained 2.2% (10 redds), Upper Wenatchee River contained 1.7% (8 redds), and Icicle Creek contained 0.2% (1 redd). There were no redds observed in Peshastin Creek.

Table 5.25. Numbers of spring Chinook redds counted (not "adjusted" estimates) within different streams or watersheds within the Wenatchee River basin, 1989-2019. WDFW began full implementation of adult management in 2014.

Survey year	Number of spring Chinook redds							
	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River	Icicle	Peshastin	Total
1989	314	127	45	64	94	24	NS	**668**
1990	255	105	30	22	36	50	4	**502**
1991	104	67	18	21	41	40	1	**292**
1992	302	81	35	35	38	37	0	**528**
1993	106	223	61	66	86	53	5	**600**
1994	82	27	7	3	6	15	0	**140**
1995	13	7	0	2	1	9	0	**32**
1996	23	33	3	12	1	12	1	**85**
1997	82	55	8	15	15	33	1	**209**
1998	41	29	8	5	0	11	0	**94**
1999	34	8	3	1	2	6	0	**54**
2000	128	100	9	8	37	68	0	**350**
2001	1,078	374	74	104	218	88	173*	**2,109**
2002	345	294	42	42	55	245	107*	**1,130**
2003	111	83	12	15	24	18	60	**323**
2004	239	169	13	22	46	30	55	**574**
2005	333	193	64	86	143	8	3	**830**
2006	297	152	21	31	27	50	10	**588**
2007	283	101	22	20	12	17	11	**466**
2008	689	336	38	31	180	116	21	**1,411**
2009	421	167	39	54	5	32	15	**733**
2010	502	187	38	33	47	155	5	**967**
2011	492	170	30	20	12	122	26	**872**
2012	880	413	43	86	73	199	10	**1,704**
2013	714	212	51	54	17	107	4	**1,159**
2014	485	115	25	26	23	211	0	**885**
2015	543	85	28	70	55	132	10	**923**
2016	312	85	22	44	17	72	2	**554**

Survey year	Number of spring Chinook redds							
	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River	Icicle	Peshastin	Total
2017	222	68	10	15	9	40	3	**367**
2018	331	90	8	20	20	3	2	**474**
2019	229	197	10	15	8	1	0	**460**
Average	***322***	***139***	***26***	***34***	***44***	***65***	***9***	***647***
Median	***297***	***101***	***22***	***22***	***24***	***40***	***3***	***554***

* Redd counts in Peshastin Creek in 2001 and 2002 were elevated because the U.S. Fish and Wildlife Service planted 487 and 350 spring Chinook adults, respectively, into the stream. These counts were not included in the average and median calculations.

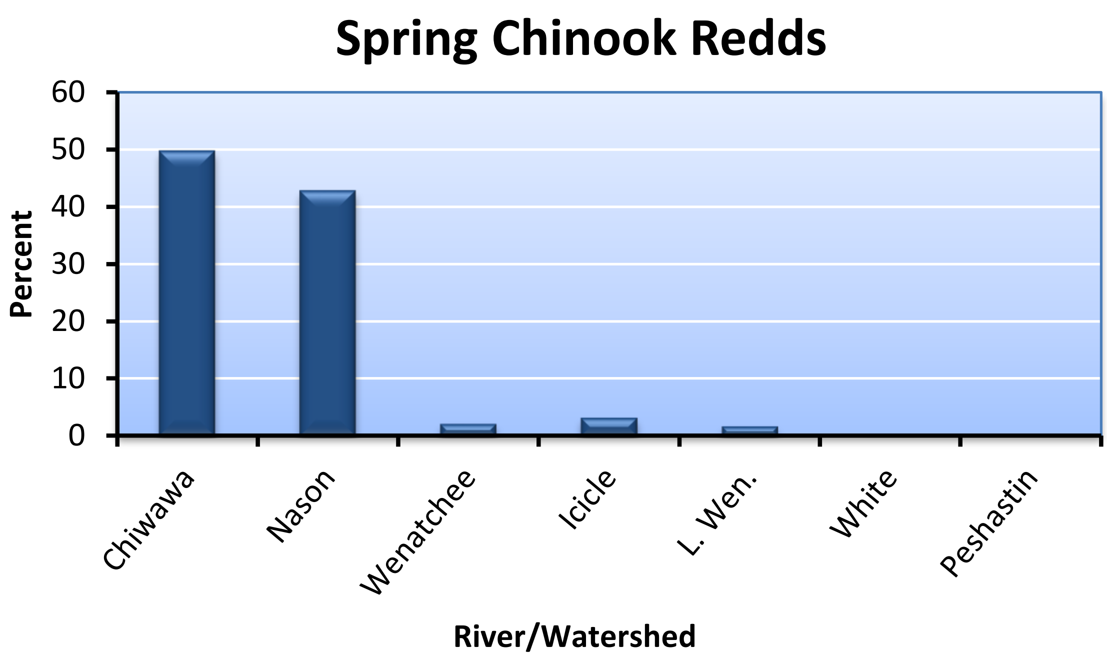


Figure 5.12. Percent of the total number of spring Chinook redds counted in different streams/watersheds within the Wenatchee River basin during August through September 2019.

As noted above, since 2015, we calculated the "adjusted" or "estimated" number of redds within survey areas in the Wenatchee River basin using the Gaussian area-under-the-curve method. Based on five years of data, the average difference between the observed (counted) and adjusted estimate is about 93 redds (Table 5.26).

Table 5.26. Comparison of the observed number and estimated number of spring Chinook redds within different streams/watersheds within the Wenatchee River basin, 2015-2019.

Survey year	Calculation	Survey stream							Total
		Chiwawa	Nason	Little Wenatchee	White	Wenatchee	Peshastin	Icicle	
2015	Observed	543	85	28	70	55	10	132	***923***
	Estimated	607	103	38	91	66	10	132	***1047***

Survey year	Calculation	Survey stream							Total
		Chiwawa	Nason	Little Wenatchee	White	Wenatchee	Peshastin	Icicle	
2016	Observed	312	85	22	44	17	2	72	***554***
	Estimated	354	100	35	53	22	2	72	***638***
2017	Observed	222	68	10	15	9	3	40	***367***
	Estimated	254	87	16	19	11	3	40	***430***
2018	Observed	331	90	8	20	20	2	3	***474***
	Estimated	394	108	11	27	27	2	3	***572***
2019	Observed	229	197	10	15	8	0	1	***460***
	Estimated	274	235	14	19	11	0	1	***554***

Redd Distribution

Spring Chinook redds were not evenly distributed among reaches within survey streams in 2019 (Table 5.27). Based on "estimated" redd counts, most of the spawning in the Chiwawa River basin occurred in Reaches 1 through 2. About 75% of the spawning in the Chiwawa River basin occurred in the lower two reaches (RKM 0.0-36.97; from the mouth to Rock Creek). Relatively few fish spawned in Rock and Chikamin creeks. The spatial distribution of redds in Nason Creek was weighted towards Reach 3 having 53% of the Nason Creek redds while Reaches 1, 2, and 4 had 7%, 21%, and 19%, respectively. In the Little Wenatchee River, about 90% of all spawning occurred in Reach 3 (RKM 9.2-14.0; Lost Creek to Falls). On the White River, 84% of the spawning occurred in Reach 3 (RKM 20.3-23.3; Napeequa River to Grasshopper Meadows). In the Wenatchee River about 18% of the fish spawned downstream from the mouth of the Chiwawa River (Reach 9) and 82% spawned upstream from the mouth (Reach 10). In Icicle Creek, 100% of spawning occurred in Reach 2 (RKM 4.9-6.7; Hatchery to Sleeping Lady). No spawning was observed in Peshastin Creek.

Table 5.27. Numbers (both observed and estimated) and proportions of spring Chinook redds estimated within different streams/watersheds within the Wenatchee River basin during August through September 2019. NS = not surveyed. See Table 2.7 for description of survey reaches.

Stream/watershed	Reach	Observed number of redds	Estimated number of redds	Proportion of estimated redds within stream/watershed
Chiwawa	Chiwawa 1 (C1)	53	60	0.22
	Chiwawa 2 (C2)	121	145	0.53
	Chiwawa 3 (C3)	5	6	0.02
	Chiwawa 4 (C4)	13	16	0.06
	Chiwawa 5 (C5)	17	22	0.08
	Chiwawa 6 (C6)	15	19	0.07
	Chiwawa 7 (C7)	2	3	0.01
	Phelps 1 (S1)	0	0	0.00
	Rock 1 (R1)	1	1	0.00
	Chikamin 1 (K1)	2	2	0.01

Stream/watershed	Reach	Observed number of redds	Estimated number of redds	Proportion of estimated redds within stream/watershed
	Total	**229**	**274**	**1.00**
Nason	Nason 1 (N1)	14	17	0.07
	Nason 2 (N2)	37	48	0.21
	Nason 3 (N3)	107	125	0.53
	Nason 4 (N4)	39	45	0.19
	Total	**197**	**235**	**1.00**
Little Wenatchee	Little Wen 1 (L1)[a]	0	--	--
	Little Wen 2 (L2)	1	1	0.07
	Little Wen 3 (L3)	9	13	0.93
	Total	**10**	**14**	**1.00**
White	White 1 (H1)[a]	0	--	--
	White 2 (H2)	0	--	--
	White 3 (H3)	12	16	0.84
	White 4 (H4)	0	0	--
	Napeequa 1 (Q1)	3	3	0.16
	Panther 1 (T1)	0	0	--
	Total	**15**	**19**	**1.00**
Wenatchee River	Wen 9 (W9)	1	2	0.18
	Wen 10 (W10)	7	9	0.82
	Chiwaukum (A1)	0	0	--
	Total	**8**	**11**	**1.00**
Icicle	Icicle 1 (I1)	0	0	--
	Icicle 2 (I2)	1	0	1.00
	Icicle 3 (I3)	0	0	--
	Total	**1**	**1**	**1.00**
Peshastin	Peshastin 1 (P1)	0	0	--
	Peshastin 2 (P2)	0	0	--
	Ingalls (D1)	0	0	--
	Total	**0**	**0**	**1.00**
Grand Total		***460***	***554***	***1.00***

[a] Reaches L1 of the Little Wenatchee River and H1 of the White River were surveyed once during the peak of the season to verify that no spawning was occurring in the lower portion of each river.

Spawn Timing

Spring Chinook began spawning during the third week of August in the Chiwawa River and in Nason Creek. Spawning began the fourth week of August in the White River and the last week of August in Icicle Creek and the Little Wenatchee River. Spawning began the first week of September in the Wenatchee River (Figure 5.13). Spawning peaked the first week of September in the Chiwawa River and Nason Creek. Spawning in the Little Wenatchee River and Nason Creek peaked the second week of September while spawning in the Wenatchee River peaked the third week of September. Chinook completed spawning by the end of September.

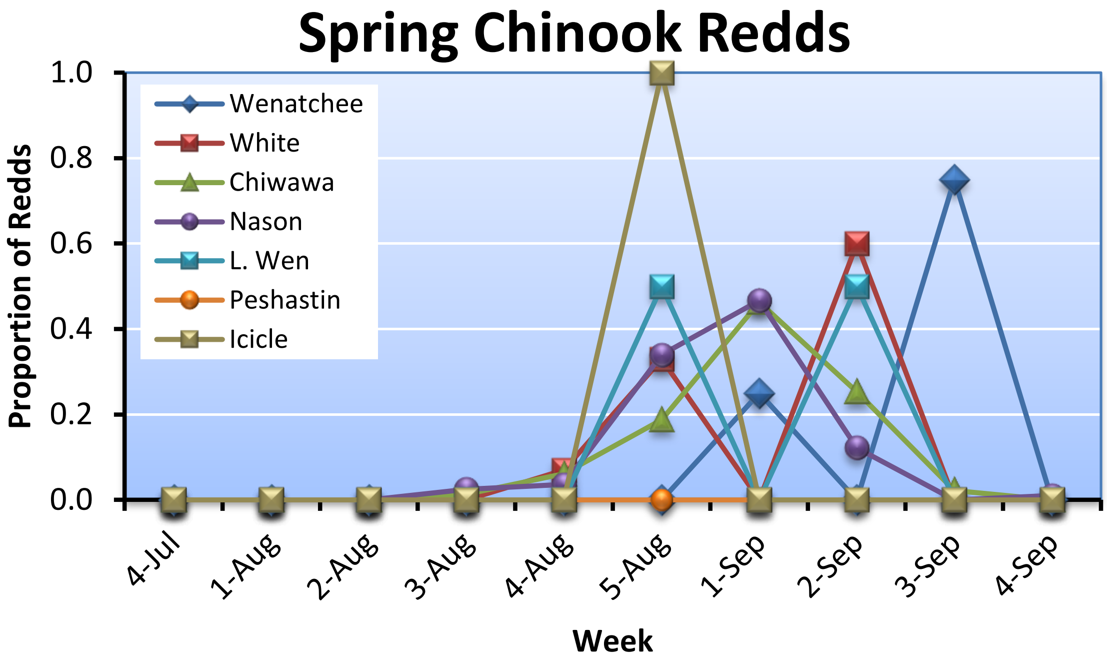


Figure 5.13. Proportion of spring Chinook redds counted during different weeks in different sampling streams within the Wenatchee River basin, August through September 2019.

Spawning Escapement

Spawning escapement for spring Chinook was calculated as the observed (unadjusted) and estimated (adjusted) number of redds times the fish per redd expansion factor, which was estimated from broodstock and fish sampled at adult trapping sites.[20] The estimated fish per redd ratio for spring Chinook upstream from Tumwater in 2019 was 1.93 (based on sex ratios estimated at Tumwater Dam). The estimated fish per redd ratio for spring Chinook downstream from Tumwater (Icicle and Peshastin creeks) was 1.86 (derived from broodstock collected at the Leavenworth National Fish Hatchery). Multiplying the number of redds estimated in the Wenatchee River basin by the expansion factor resulted in a total spawning escapement of 1,069 spring Chinook (Table 5.28). The Chiwawa River basin had the highest spawning escapement (529 Chinook), while Peshastin Creek had the lowest (0 Chinook).

Table 5.28. Number of observed redds, fish per redd ratios, and total spawning escapement for spring Chinook in the Wenatchee River basin, 2019. Spawning escapement was estimated as the product of redds times fish per redd.

Sampling area	Total number of redds		Fish/redd	Total spawning escapement*	
	Observed	Estimated		Observed	Estimated
Chiwawa	229	274	1.93	442	529
Nason	197	235	1.93	380	454

[20] Expansion factor = (1 + (number of males/number of females)).

Sampling area	Total number of redds		Fish/redd	Total spawning escapement*	
	Observed	Estimated		Observed	Estimated
Upper Wenatchee River	8	11	1.93	15	21
Icicle	1	1	1.86	2	2
Little Wenatchee	10	14	1.93	19	27
White	15	19	1.93	29	37
Peshastin	0	0	1.86	0	0
Total	***460***	***554***	***--***	***888***	***1,069***

* Spawning escapement estimate is based on total number of observed redds by stream. If escapement is calculated at the reach scale, then the total escapement may vary from what is shown here because of rounding errors.

The estimated spawning escapement (based on observed redds) of 888 spring Chinook in 2019 was less than the 1989-2019 average of 1,375 spring Chinook (Table 5.29a). The estimated spawning escapement (based on adjusted redds) of 1,069 spring Chinook in 2019 was less than the 2015-2019 average of 1,194 spring Chinook (Table 5.29b). The highest escapements occurred in the Chiwawa River and Nason Creek.

Table 5.29a. Spawning escapements for spring Chinook in the Wenatchee River basin for return years 1989-2019; NA = not available. Note that these estimates represent observed redds and have not been adjusted for redd count bias.

Return year	Upper basin spawning escapement						Lower basin spawning escapement			Total
	Fish/redd	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River	Fish/redd	Icicle	Peshastin	
1989	2.27	713	288	102	145	213	1.56	37	NA	**1,498**
1990	2.24	571	235	67	49	81	1.71	86	7	**1,096**
1991	2.33	242	156	42	49	96	1.73	69	2	**656**
1992	2.24	676	181	78	78	85	1.65	61	0	**1,159**
1993	2.20	233	491	134	145	189	1.66	88	8	**1,288**
1994	2.24	184	60	16	7	13	2.11	32	0	**312**
1995	2.51	33	18	0	5	3	2.01	18	0	**77**
1996	2.53	58	83	8	30	3	2.09	25	2	**209**
1997	2.22	182	122	18	33	33	1.69	56	2	**446**
1998	2.21	91	64	18	11	0	1.81	20	0	**204**
1999	2.77	94	22	8	3	6	2.06	12	0	**145**
2000	2.70	346	270	24	22	100	1.68	114	0	**876**
2001	1.60	1,725	598	118	166	349	1.72	151	298	**3,405**
2002	2.05	707	603	86	86	113	1.55	380	166	**2,141**
2003	2.43	270	202	29	36	58	1.93	35	116	**746**
2004[a]	3.56/3.00	851	507	39	66	138	1.76	53	97	**1,751**
2005	1.80	599	347	115	155	257	1.67	13	5	**1,491**
2006	1.78	529	271	37	55	48	1.68	84	17	**1,041**
2007	4.58	1,296	463	101	92	55	1.91	32	21	**2,060**
2008	1.68	1,158	564	64	52	302	1.78	206	37	**2,383**
2009	3.20	1,347	534	125	173	16	2.22	71	33	**2,299**
2010	2.18	1,094	408	83	72	102	1.56	242	8	**2,009**

Return year	Upper basin spawning escapement						Lower basin spawning escapement			Total
	Fish/redd	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River	Fish/redd	Icicle	Peshastin	
2011	4.13	2,032	702	124	83	50	2.60	317	68	**3,376**
2012	1.68	1,478	694	72	144	123	1.60	318	16	**2,845**
2013	1.93	1,378	409	98	104	33	1.98	212	8	**2,242**
2014	2.01	975	231	50	52	46	1.93	407	0	**1,761**
2015	1.78	967	151	50	125	98	1.87	247	19	**1,657**
2016	1.75	546	149	39	77	30	1.81	130	4	**975**
2017	1.94	431	132	19	29	17	1.81	72	5	**705**
2018	1.88	622	169	15	38	38	1.73	5	3	**890**
2019	1.93	442	380	19	29	15	1.86	2	0	**888**
Average	--	***705***	***307***	***58***	***71***	***87***	--	***116***	***31***	***1,375***
Median	--	***599***	***270***	***50***	***55***	***55***	--	***71***	***6***	***1,159***

[a] In 2004, the fish/redd expansion estimate of 3.56 was applied to the Chiwawa River only and 3.00 fish/redd was applied to the rest of the upper basin.

The estimated spawning escapement (based on adjusted redds) of 1,069 spring Chinook in 2019 was less than the overall average of 1,194 spring Chinook (Table 5.29b).

Table 5.29b. Spawning escapements for spring Chinook in the Wenatchee River basin for return years 2015-2019; NA = not available. Note that these estimates have been adjusted for redd count bias.

Return year	Upper basin spawning escapement						Lower basin spawning escapement			Total
	Fish/redd	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River	Fish/redd	Icicle	Peshastin	
2015	1.78	1,080	183	68	162	117	1.87	247	19	**1,876**
2016	1.75	620	175	61	93	39	1.81	130	4	**1,121**
2017	1.94	493	169	31	37	21	1.81	72	5	**829**
2018	1.88	741	203	21	51	51	1.73	5	3	**1,075**
2019	1.93	529	454	27	37	21	1.86	2	0	**1,069**
Average	--	***693***	***237***	***42***	***76***	***50***	--	***91***	***6***	***1,194***
Median	--	***620***	***183***	***31***	***51***	***39***	--	***72***	***4***	***1,075***

5.6 Carcass Surveys

Surveys for spring Chinook carcasses were conducted during August through September 2019 in the Chiwawa River (including Rock, Chikamin, and Phelps creeks), Nason Creek, Icicle Creek, Peshastin Creek (including Ingalls Creek), Upper Wenatchee River (including Chiwaukum Creek), Little Wenatchee River, and White River (including the Napeequa River and Panther Creek).

Number sampled

A total of 419 spring Chinook carcasses were sampled during August through September in the Wenatchee River basin (Table 5.30). Most were sampled in Nason Creek (60% or 253 carcasses) and in the Chiwawa River basin (35% or 148 carcasses) (Figure 5.14). A total of nine carcasses were sampled in the Wenatchee River, five in the White River basin, and four in the Little Wenatchee River. There were no carcasses sampled in Icicle or Peshastin creeks.

Table 5.30. Numbers of spring Chinook carcasses sampled within different streams/watersheds within the Wenatchee River basin, 1996-2019.

Survey year	Number of spring Chinook carcasses							
	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River	Icicle	Peshastin	Total
1996	22	3	0	2	0	1	0	**28**
1997	17	42	3	8	1	28	1	**100**
1998	24	25	3	2	1	6	0	**61**
1999	15	5	0	0	2	1	0	**23**
2000	122	110	8	1	37	52	0	**330**
2001	763	388	68	81	213	163	63	**1,739**
2002	210	292	30	25	34	91	65	**747**
2003	70	100	8	8	11	37	64	**298**
2004	178	186	1	13	29	16	40	**463**
2005	391	217	48	52	120	2	0	**830**
2006	241	190	13	25	15	7	0	**491**
2007	250	201	16	13	24	15	6	**525**
2008	386	243	15	13	94	67	5	**823**
2009	240	128	20	20	1	67	2	**478**
2010	192	141	7	11	29	39	2	**421**
2011	177	98	7	4	3	40	3	**332**
2012	390	332	24	21	23	61	3	**854**
2013	396	142	20	22	8	28	1	**617**
2014	320	68	15	8	19	44	0	**474**
2015	275	43	12	25	25	67	3	**450**
2016	211	95	5	13	13[a]	25	0	**362**
2017	140	78	3	9	5	22	3	**260**
2018	211	98	3	12	23[b]	2	1	**350**
2019	148	253	4	5	9	0	0	**419**
Average	***225***	***145***	***14***	***16***	***31***	***37***	***11***	***478***
Median	***211***	***119***	***8***	***13***	***17***	***28***	***2***	***436***

[a] The number of carcasses sampled in the Wenatchee River in 2016 include two recovered in reach (W6) just downstream from the mouth of Icicle Creek.

[b] The number of carcasses sampled in the Wenatchee River in 2018 include three recovered in reach (W6) just downstream from the mouth of Icicle Creek and two recovered in reach (W8).

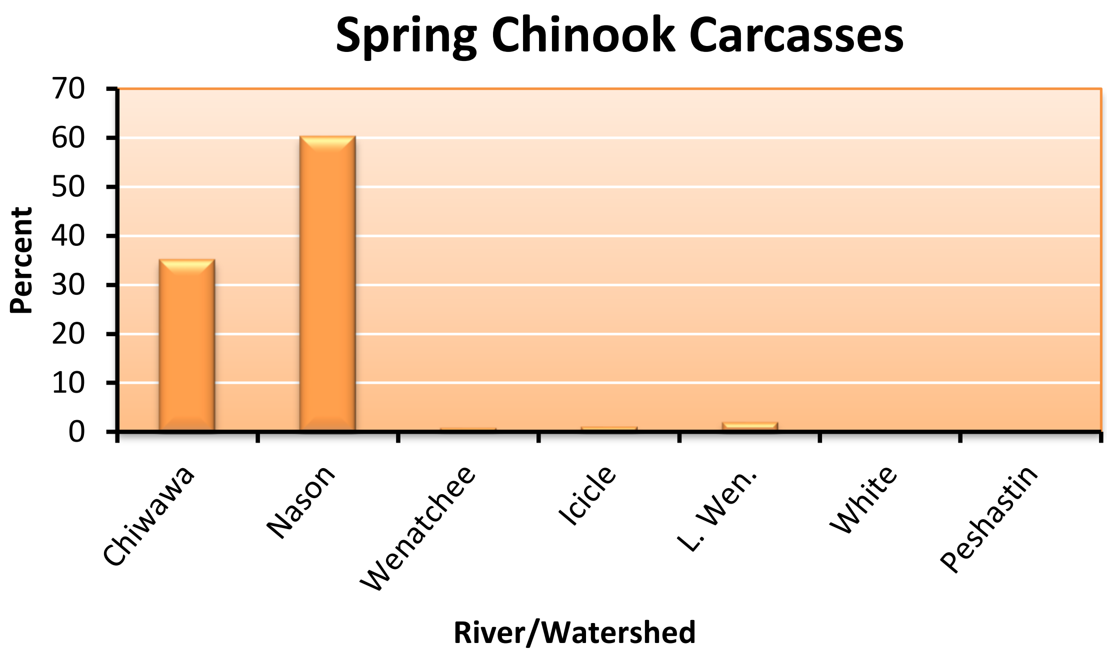


Figure 5.14. Percent of the total number of spring Chinook carcasses sampled in different streams/watersheds within the Wenatchee River basin during August through September 2019.

Carcass Distribution and Origin

Spring Chinook carcasses were not evenly distributed among reaches within survey streams in 2019 (Table 5.31). Most of the carcasses (86%) in the Chiwawa River basin occurred in Reaches 1 and 2 (downstream from Rock Creek). In Nason Creek, most carcasses (51%) were collected in Reach 3 and the fewest (3%) in Reach 1. All carcasses in the Little Wenatchee River were sampled in Reach 3 (Lost Creek to Rainy Creek). On the White River, most (80%) occurred in Reach 3 (Napeequa River to Grasshopper Meadows). On the Wenatchee River, 78% of the carcasses were found upstream from the confluence of the Chiwawa River and 22% were found downstream from the confluence. There were no carcasses found in either Icicle Creek or Peshastin Creek.

Table 5.31. Numbers and proportions of carcasses sampled within different streams/watersheds within the Wenatchee River basin during August through September 2019. See Table 2.7 for description of survey reaches.

Stream/watershed	Reach	Number of carcasses	Proportion of carcasses within stream/watershed
Chiwawa	Chiwawa 1 (C1)	46	0.31
	Chiwawa 2 (C2)	82	0.55
	Chiwawa 3 (C3)	3	0.02
	Chiwawa 4 (C4)	0	0.00
	Chiwawa 5 (C5)	6	0.04
	Chiwawa 6 (C6)	8	0.05
	Chiwawa 7 (C7)	1	0.01
	Phelps 1 (S1)	0	0.00

Stream/watershed	Reach	Number of carcasses	Proportion of carcasses within stream/watershed
	Rock 1 (R1)	1	0.01
	Chikamin 1 (K1)	1	0.01
	Total	**148**	**1.00**
Nason	Nason 1 (N1)	7	0.03
	Nason 2 (N2)	54	0.21
	Nason 3 (N3)	130	0.51
	Nason 4 (N4)	62	0.25
	Total	**253**	**1.00**
Little Wenatchee	Little Wen 1 (L1)	0	0.00
	Little Wen 2 (L2)	0	0.00
	Little Wen 3 (L3)	4	1.00
	Total	**4**	**1.00**
White	White 1 (H1)	0	0.00
	White 2 (H2)	0	0.00
	White 3 (H3)	4	0.80
	White 4 (H4)	0	0.00
	Napeequa 1 (Q1)	1	0.20
	Panther 1 (T1)	0	0.00
	Total	**5**	**1.00**
Wenatchee River	Wen 8 (W8)	0	0.00
	Wen 9 (W9)	2	0.22
	Wen 10 (W10)	7	0.78
	Chiwaukum 1 (U1)	0	0.00
	Total	**9**	**1.00**
Icicle	Icicle 1 (I1)	0	0.00
	Icicle 2 (I2)	0	0.00
	Icicle 3 (I3)	0	0.00
	Total	**0**	**0.00**
Peshastin	Peshastin 1 (P1)	0	0.00
	Peshastin 2 (P2)	0	0.00
	Ingalls (D1)	0	0.00
	Total	**0**	**0.00**
Grand Total		**419**	**1.00**

Origin was determined for the 148 carcasses sampled in the Chiwawa River basin in 2019. Of those sampled in the Chiwawa River basin, 72% were hatchery fish (Table 5.32). In the Chiwawa River basin, the spatial distribution of hatchery and wild fish was not equal (Table 5.32). A larger percentage of hatchery fish were found in the lower reaches (C1 and C2; i.e., Mouth to Rock Creek). This general trend was also apparent in the pooled data (Figure 5.15).

Table 5.32. Numbers of wild and hatchery spring Chinook carcasses sampled within different reaches in the Chiwawa River basin, 1993-2019. Numbers represent recovered carcasses that had definitive origins. See Table 2.7 for description of survey reaches.

Survey year	Origin	Survey Reach									Total
		C-1	C-2	C-3	C-4	C-5	C-6	C-7	Chikamin	Rock	
1993	Wild	0	0	0	0	0	0	--	0	0	**0**
	Hatchery	1	0	0	0	0	0	--	0	0	**1**
1994	Wild	0	6	0	2	0	2	--	0	0	**10**
	Hatchery	1	1	0	2	0	0	--	0	0	**4**
1995	Wild	0	0	0	0	0	0	--	0	0	**0**
	Hatchery	2	3	0	1	0	0	--	0	0	**6**
1996	Wild	13	1	1	1	0	0	--	0	0	**16**
	Hatchery	6	0	0	0	0	0	--	0	0	**6**
1997	Wild	5	2	0	1	0	0	--	0	0	**8**
	Hatchery	3	1	0	0	0	1	--	1	3	**9**
1998	Wild	0	3	6	1	2	4	--	0	0	**16**
	Hatchery	1	3	2	0	1	1	--	0	0	**8**
1999	Wild	1	8	0	5	0	0	--	0	0	**14**
	Hatchery	0	0	0	0	1	0	--	0	0	**1**
2000	Wild	29	29	1	1	1	1	--	0	0	**62**
	Hatchery	42	12	0	0	0	2	--	0	0	**56**
2001	Wild	27	60	15	43	16	21	--	1	3	**186**
	Hatchery	164	284	19	58	14	21	--	8	0	**568**
2002	Wild	22	15	10	6	9	7	--	1	0	**70**
	Hatchery	46	41	12	5	1	15	--	15	4	**139**
2003	Wild	7	13	0	12	4	2	--	0	0	**38**
	Hatchery	14	14	0	3	1	0	--	0	0	**32**
2004	Wild	25	50	2	12	7	2	--	0	1	**99**
	Hatchery	48	21	1	1	1	4	--	0	2	**78**
2005	Wild	18	36	3	5	3	2	--	0	0	**67**
	Hatchery	170	132	7	7	4	3	--	0	1	**324**
2006	Wild	10	17	2	8	4	3	--	1	0	**45**
	Hatchery	84	75	5	7	6	13	--	3	3	**196**
2007	Wild	3	15	3	4	2	2	--	0	0	**29**
	Hatchery	42	118	15	14	18	12	--	2	0	**221**
2008	Wild	4	23	0	4	4	8	--	0	0	**43**
	Hatchery	174	122	2	9	15	15	--	4	1	**342**
2009	Wild	3	21	4	8	4	1	--	0	3	**44**
	Hatchery	89	70	6	14	7	5	--	0	5	**196**
2010	Wild	4	30	7	8	10	3	--	0	0	**62**
	Hatchery	64	35	2	10	7	5	--	0	5	**128**
2011	Wild	8	26	10	6	8	6	--	0	1	**65**
	Hatchery	43	40	4	5	5	10	--	1	4	**112**

Survey year	**Origin**	**Survey Reach**									**Total**
		C-1	**C-2**	**C-3**	**C-4**	**C-5**	**C-6**	**C-7**	**Chikamin**	**Rock**	
2012	Wild	11	74	6	21	13	18	0	0	3	**146**
	Hatchery	94	91	9	13	16	16	0	0	6	**245**
2013	Wild	8	38	7	21	16	14	1	0	3	**108**
	Hatchery	101	112	19	23	13	15	0	5	3	**291**
2014	Wild	18	77	9	28	19	21	0	0	0	**172**
	Hatchery	64	48	6	10	6	9	1	2	2	**148**
2015	Wild	14	37	6	12	12	13	0	0	0	**94**
	Hatchery	65	89	7	9	6	5	0	0	0	**181**
2016	Wild	13	73	8	18	15	10	0	2	0	**139**
	Hatchery	25	37	1	4	2	1	1	0	0	**71**
2017	Wild	5	31	2	4	5	1	0	0	0	**48**
	Hatchery	30	36	1	3	3	7	0	8	3	**91**
2018	Wild	6	26	2	8	4	5	0	1	0	**52**
	Hatchery	31	99	5	6	5	7	1	3	2	**159**
2019	Wild	7	20	1	0	5	7	0	1	0	**41**
	Hatchery	39	62	2	0	1	1	1	0	1	**107**
Average	***Wild***	***10***	***27***	***4***	***9***	***6***	***6***	***0***	***0***	***1***	***62***
	Hatchery	***54***	***57***	***5***	***8***	***5***	***6***	***0***	***2***	***2***	***138***
Median	***Wild***	***8***	***25***	***3***	***6***	***4***	***3***	***0***	***0***	***0***	***48***
	Hatchery	***43***	***39***	***2***	***5***	***4***	***5***	***0***	***0***	***1***	***112***

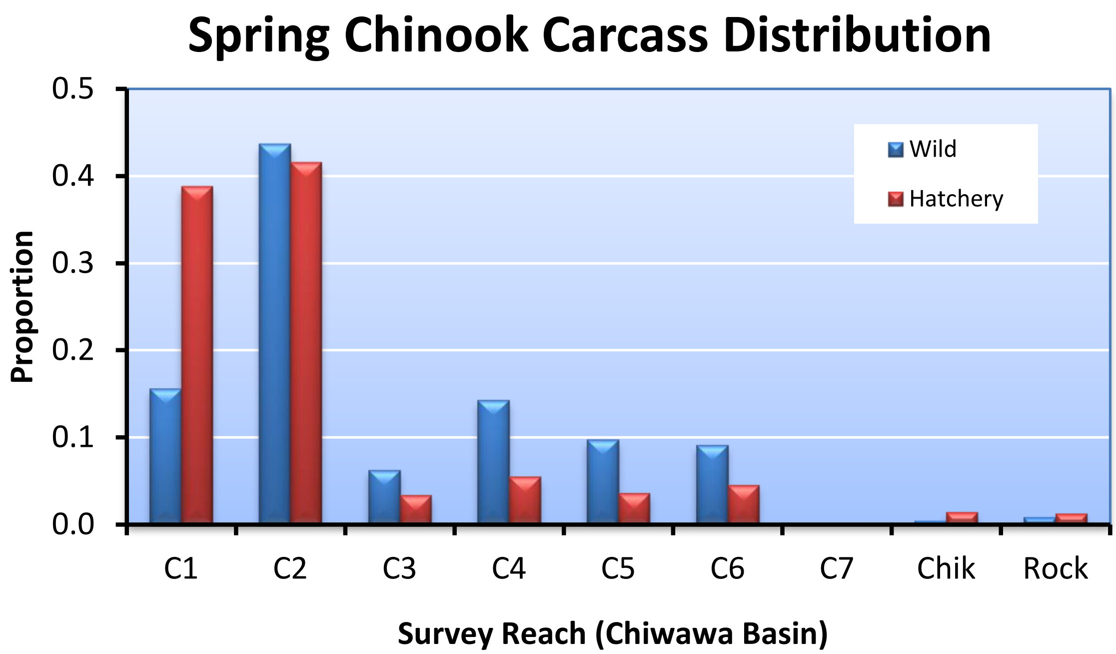


Figure 5.15. Distribution of wild and hatchery produced carcasses in different reaches in the Chiwawa River basin, 1993-2019; Chik = Chikamin Creek and Rock = Rock Creek. Reach codes are described in Table 2.7.

Sampling Rate

Overall, 39% of the estimated total spawning escapement of spring Chinook in the Wenatchee River basin was sampled in 2019 (Table 5.33). Sampling rates among streams/watershed varied from 0 to >100%.

Table 5.33. Number of redds and carcasses, total spawning escapement, and sampling rates for spring Chinook salmon in the Wenatchee River basin, 2019.

Sampling area	Total number of redds (adjusted)	Total number of carcasses	Total spawning escapement	Sampling rate
Chiwawa	274	148	529	0.28
Nason	235	253	454	0.56
Upper Wenatchee	11	4	21	0.19
Icicle	1	5	2	2.50
Little Wenatchee	14	9	27	0.33
White	19	0	37	0.00
Peshastin	0	0	0	0.00
Total	***554***	***419***	***1,069***	0.39

Length Data

Mean lengths (POH, cm) of male and female spring Chinook carcasses sampled during surveys in the Wenatchee River basin in 2019 are provided in Table 5.34. The average sizes of males and females sampled in the Wenatchee River basin in 2019 was 59 cm and 62 cm, respectively.

Table 5.34. Mean lengths (postorbital-to-hypural length; cm) and standard deviations (in parentheses) of male and female spring Chinook carcasses sampled in different streams/watersheds in the Wenatchee River basin, 2019.

Stream/watershed	Mean lengths (cm)	
	Male	Female
Chiwawa	63 (9.3)	63 (4.9)
Nason	57 (8.4)	61 (3.5)
Upper Wenatchee	62 (13.3)	65 (3.0)
Icicle	0	0
Little Wenatchee	59 (--)	58 (3.8)
White	39 (--)	60 (2.2)
Peshastin	0	0
Total	***59 (9.2)***	***62 (4.1)***

5.7 Life History Monitoring

Life history characteristics of spring Chinook were assessed by examining carcasses on spawning grounds and fish collected at broodstock collection sites, and by reviewing tagging data and fisheries statistics.

Migration Timing

In 2019, there was a small difference in migration timing of hatchery and wild spring Chinook past Tumwater Dam (Table 5.35a and b; Figure 5.16). On average, hatchery fish arrived at the dam later and ended their migration earlier than did wild fish. Most hatchery and wild spring Chinook migrated upstream past Tumwater Dam during June and July (Figure 5.16).

Table 5.35a. The Julian day and date that 10%, 50% (median), and 90% of the wild and hatchery spring Chinook salmon passed Tumwater Dam, 1998-2019. The average Julian day and date are also provided. Migration timing is based on video sampling at Tumwater. Data for 1998 through 2003 were based on videotapes and broodstock trapping and may not reflect the actual number of hatchery spring Chinook. Most[21] spring Chinook were visually examined during trapping from 2004 to present; however, enumeration errors may still exist because of misidentified run-type assignment (i.e., spring or summer runs).

Survey year	Origin	Spring Chinook Migration Time (days)								Sample size
		10 Percentile		50 Percentile		90 Percentile		Mean		
		Julian	Date	Julian	Date	Julian	Date	Julian	Date	
1998	Wild	156	5-Jun	156	5-Jun	156	5-Jun	156	5-Jun	49

[21] Trapping switched from 24/7 to 48 hours/week during mid-July and therefore some spring Chinook could ascend Tumwater when the trap did not operate.

Survey year	Origin	Spring Chinook Migration Time (days)								Sample size
		10 Percentile		50 Percentile		90 Percentile		Mean		
		Julian	Date	Julian	Date	Julian	Date	Julian	Date	
	Hatchery	156	5-Jun	156	5-Jun	156	5-Jun	156	5-Jun	25
1999	Wild	192	11-Jul	207	26-Jul	224	12-Aug	207	26-Jul	173
	Hatchery	200	19-Jul	211	30-Jul	229	17-Aug	213	1-Aug	25
2000	Wild	171	19-Jun	186	4-Jul	194	12-Jul	184	2-Jul	651
	Hatchery	179	27-Jun	189	7-Jul	201	19-Jul	190	8-Jul	357
2001	Wild	154	3-Jun	166	15-Jun	185	4-Jul	167	16-Jun	2,073
	Hatchery	157	6-Jun	169	18-Jun	185	4-Jul	170	19-Jun	4,244
2002	Wild	174	23-Jun	189	8-Jul	204	23-Jul	189	8-Jul	1,033
	Hatchery	178	27-Jun	189	8-Jul	199	18-Jul	189	8-Jul	1,363
2003	Wild	162	11-Jun	181	30-Jun	200	19-Jul	181	30-Jun	919
	Hatchery	157	6-Jun	179	28-Jun	192	11-Jul	178	27-Jun	423
2004	Wild	156	4-Jun	172	20-Jun	189	7-Jul	172	20-Jun	969
	Hatchery	161	9-Jun	177	25-Jun	189	7-Jul	177	25-Jun	1,295
2005	Wild	153	2-Jun	172	21-Jun	193	12-Jul	173	22-Jun	1,038
	Hatchery	153	2-Jun	173	22-Jun	187	6-Jul	172	21-Jun	2,808
2006	Wild	177	26-Jun	184	3-Jul	193	12-Jul	185	4-Jul	577
	Hatchery	178	27-Jun	185	4-Jul	194	13-Jul	186	5-Jul	1601
2007	Wild	169	18-Jun	185	4-Jul	203	22-Jul	185	4-Jul	351
	Hatchery	174	23-Jun	192	11-Jul	209	28-Jul	192	11-Jul	3,232
2008	Wild	173	21-Jun	188	6-Jul	209	27-Jul	189	7-Jul	634
	Hatchery	177	25-Jun	193	11-Jul	210	28-Jul	193	11-Jul	5,368
2009	Wild	174	23-Jun	186	5-Jul	201	20-Jul	187	6-Jul	1,008
	Hatchery	175	24-Jun	187	6-Jul	202	21-Jul	188	7-Jul	4,106
2010	Wild	173	22-Jun	190	9-Jul	214	2-Aug	191	10-Jul	977
	Hatchery	180	29-Jun	194	13-Jul	213	1-Aug	195	14-Jul	4,450
2011	Wild	183	2-Jul	198	17-Jul	213	1-Aug	198	17-Jul	1,433
	Hatchery	187	6-Jul	200	19-Jul	210	29-Jul	199	18-Jul	4,707
2012	Wild	180	28-Jun	191	9-Jul	205	23-Jul	192	10-Jul	1,482
	Hatchery	182	30-Jun	194	12-Jul	206	24-Jul	194	12-Jul	4,449
2013	Wild	163	12-Jun	182	1-Jul	199	18-Jul	183	2-Jul	1,106
	Hatchery	164	13-Jun	181	30-Jun	195	14-Jul	181	30-Jun	3,681
2014	Wild	171	20-Jun	188	7-Jul	202	21-Jul	187	6-Jul	1,329
	Hatchery	167	16-Jun	182	1-Jul	195	14-Jul	181	30-Jun	2,510
2015	Wild	150	30-May	170	19-Jun	184	3-Jul	170	19-Jun	1,370
	Hatchery	148	28-May	168	17-Jun	180	29-Jun	167	16-Jun	1,773
2016	Wild	158	6-Jun	180	28-Jun	200	18-Jul	181	29-Jun	1,252
	Hatchery	160	8-Jun	179	27-Jun	191	9-Jul	178	26-Jun	1,284
2017	Wild	175	24-Jun	184	3-Jul	195	14-Jul	184	3-Jul	483
	Hatchery	177	26-Jun	185	4-Jul	196	15-Jul	187	6-Jul	1,035
2018	Wild	165	14-Jun	175	24-Jun	188	7-Jul	177	26-Jun	684

Survey year	Origin	Spring Chinook Migration Time (days)								Sample size
		10 Percentile		50 Percentile		90 Percentile		Mean		
		Julian	Date	Julian	Date	Julian	Date	Julian	Date	
	Hatchery	161	10-Jun	172	21-Jun	188	7-Jul	175	24-Jun	1,437
2019	Wild	161	10-Jun	174	23-Jun	188	7-Jul	174	23-Jun	386
	Hatchery	162	11-Jun	171	20-Jun	187	6-Jul	174	23-Jun	1,349
Average	Wild	***168***	--	***182***	--	***197***	--	***182***	--	***894***
	Hatchery	***170***	--	***183***	--	***196***	--	***183***	--	***2,342***
Median	Wild	***170***	--	***184***	--	***200***	--	***184***	--	***973***
	Hatchery	***171***	--	***184***	--	***195***	--	***184***	--	***1,687***

Table 5.35b. The week that 10%, 50% (median), and 90% of the wild and hatchery spring Chinook salmon passed Tumwater Dam, 1998-2019. The average week is also provided. Migration timing is based on video sampling at Tumwater. Data for 1998 through 2003 were based on videotapes and broodstock trapping and may not reflect the actual number of hatchery spring Chinook. Most spring Chinook were visually examined during trapping from 2004 to present; however, enumeration errors may still exist because of misidentified run-type assignment (i.e., spring or summer runs).

Survey year	Origin	Spring Chinook Migration Time (week)				Sample size
		10 Percentile	50 Percentile	90 Percentile	Mean	
1998	Wild	23	23	23	23	49
	Hatchery	23	23	23	23	25
1999	Wild	28	30	32	30	173
	Hatchery	29	31	34	31	25
2000	Wild	24	27	27	27	651
	Hatchery	26	27	29	28	357
2001	Wild	22	24	27	24	2,073
	Hatchery	23	25	27	25	4,244
2002	Wild	25	27	30	27	1,033
	Hatchery	26	27	29	27	1,363
2003	Wild	24	26	29	26	919
	Hatchery	23	26	28	26	423
2004	Wild	23	25	27	25	969
	Hatchery	23	26	27	26	1,295
2005	Wild	22	25	28	25	1,038
	Hatchery	22	25	27	25	2,808
2006	Wild	26	27	28	27	577
	Hatchery	26	27	28	27	1,601
2007	Wild	25	27	29	27	351
	Hatchery	25	28	30	28	3,232
2008	Wild	25	27	30	27	634
	Hatchery	26	28	30	28	5,368

Survey year	Origin	Spring Chinook Migration Time (week)				Sample size
		10 Percentile	50 Percentile	90 Percentile	Mean	
2009	Wild	25	27	29	27	1,008
	Hatchery	25	27	29	27	4,106
2010	Wild	25	28	31	28	977
	Hatchery	26	28	31	28	4,450
2011	Wild	27	29	31	29	1,433
	Hatchery	27	29	30	29	4,707
2012	Wild	26	28	30	28	1,482
	Hatchery	26	28	30	28	4,449
2013	Wild	24	26	29	27	1,106
	Hatchery	24	26	28	26	3,681
2014	Wild	25	27	29	27	1,329
	Hatchery	24	26	28	26	2,510
2015	Wild	22	25	27	25	1,370
	Hatchery	22	24	26	24	1,773
2016	Wild	23	26	29	26	1,252
	Hatchery	23	26	28	26	1,284
2017	Wild	25	27	28	27	483
	Hatchery	26	27	28	27	1,035
2018	Wild	24	25	27	26	384
	Hatchery	23	25	27	25	1,437
2019	Wild	23	25	27	25	386
	Hatchery	23	25	27	25	1,349
Average	Wild	***24***	***26***	***29***	***27***	***894***
	Hatchery	***25***	***27***	***28***	***27***	***2,342***
Median	Wild	***25***	***27***	***29***	***27***	***973***
	Hatchery	***25***	***27***	***28***	***27***	***1,687***

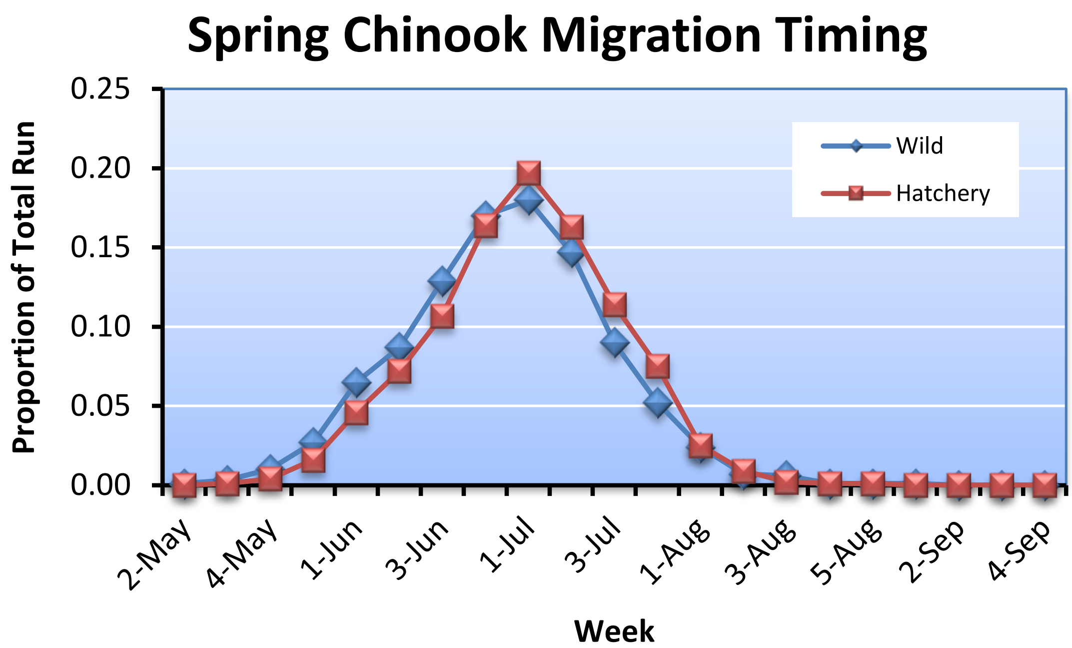


Figure 5.16. Proportion of wild and hatchery spring Chinook observed (using video) passing Tumwater Dam each week during their migration period May through September; data were pooled over survey years 1998-2019.

Age at Maturity

Most of the wild and hatchery spring Chinook sampled during the period 1994-2019 in the Chiwawa River basin were age-4 fish (total age) (Table 5.36; Figure 5.17). On average, a higher proportion of age-5 wild fish returned than did age-5 hatchery fish. This follows the trend observed across most years where wild fish tended to return at an older age than hatchery fish.

Table 5.36. Proportions of wild and hatchery spring Chinook of different ages (total age) sampled on spawning grounds in the Chiwawa River basin, 1994-2019.

Sample year	Origin	Total age					Sample size
		2	3	4	5	6	
1994	Wild	0.00	0.00	0.33	0.67	0.00	9
	Hatchery	0.00	0.20	0.00	0.80	0.00	5
1995	Wild	0.00	0.00	0.00	0.00	0.00	0
	Hatchery	0.00	0.00	1.00	0.00	0.00	5
1996	Wild	0.00	0.36	0.64	0.00	0.00	14
	Hatchery	0.00	0.83	0.17	0.00	0.00	6
1997	Wild	0.00	0.00	0.75	0.25	0.00	8
	Hatchery	0.00	0.00	1.00	0.00	0.00	9
1998	Wild	0.00	0.00	0.00	1.00	0.00	15
	Hatchery	0.00	0.00	0.13	0.88	0.00	8
1999	Wild	0.00	0.07	0.50	0.43	0.00	14

Sample year	Origin	Total age					Sample size
		2	3	4	5	6	
	Hatchery	0.00	0.00	0.00	1.00	0.00	1
2000	Wild	0.00	0.02	0.95	0.04	0.00	56
	Hatchery	0.00	0.50	0.50	0.00	0.00	52
2001	Wild	0.00	0.01	0.95	0.04	0.00	176
	Hatchery	0.00	0.02	0.98	0.00	0.00	571
2002	Wild	0.00	0.00	0.56	0.44	0.00	54
	Hatchery	0.00	0.00	0.91	0.09	0.00	129
2003	Wild	0.00	0.08	0.00	0.92	0.00	36
	Hatchery	0.00	0.19	0.03	0.78	0.00	32
2004	Wild	0.00	0.05	0.94	0.01	0.00	99
	Hatchery	0.00	0.42	0.58	0.00	0.00	78
2005	Wild	0.00	0.02	0.78	0.21	0.00	67
	Hatchery	0.00	0.04	0.96	0.00	0.00	324
2006	Wild	0.02	0.02	0.51	0.44	0.00	45
	Hatchery	0.01	0.04	0.78	0.18	0.00	196
2007	Wild	0.00	0.10	0.24	0.67	0.00	29
	Hatchery	0.00	0.35	0.59	0.06	0.00	221
2008	Wild	0.02	0.02	0.81	0.14	0.00	43
	Hatchery	0.00	0.07	0.89	0.05	0.00	340
2009	Wild	0.00	0.09	0.86	0.05	0.00	44
	Hatchery	0.00	0.24	0.75	0.02	0.00	196
2010	Wild	0.00	0.00	0.90	0.10	0.00	63
	Hatchery	0.00	0.07	0.91	0.02	0.00	127
2011	Wild	0.00	0.08	0.38	0.54	0.00	65
	Hatchery	0.00	0.26	0.45	0.30	0.00	112
2012	Wild	0.00	0.01	0.80	0.19	0.00	141
	Hatchery	0.00	0.03	0.96	0.02	0.00	243
2013	Wild	0.00	0.09	0.60	0.31	0.00	105
	Hatchery	0.00	0.13	0.78	0.09	0.00	275
2014	Wild	0.00	0.04	0.89	0.07	0.00	169
	Hatchery	0.00	0.08	0.90	0.02	0.00	148
2015	Wild	0.00	0.01	0.83	0.16	0.00	96
	Hatchery	0.00	0.06	0.93	0.01	0.00	185
2016	Wild	0.00	0.04	0.67	0.29	0.00	138
	Hatchery	0.00	0.04	0.80	0.16	0.00	71
2017	Wild	0.00	0.02	0.85	0.13	0.00	48
	Hatchery	0.00	0.03	0.90	0.07	0.00	91
2018	Wild	0.00	0.00	0.92	0.08	0.00	52

Sample year	Origin	Total age					Sample size
		2	3	4	5	6	
	Hatchery	0.00	0.00	0.99	0.01	0.00	157
2019	Wild	0.00	0.08	0.80	0.13	0.00	40
	Hatchery	0.00	0.02	0.94	0.04	0.00	104
Average	***Wild***	***0.00***	***0.04***	***0.75***	***0.21***	***0.00***	***63***
	Hatchery	***0.00***	***0.10***	***0.84***	***0.06***	***0.00***	***142***
Median	***Wild***	***0.00***	***0.03***	***0.82***	***0.15***	***0.00***	***50***
	Hatchery	***0.00***	***0.06***	***0.90***	***0.03***	***0.00***	***120***

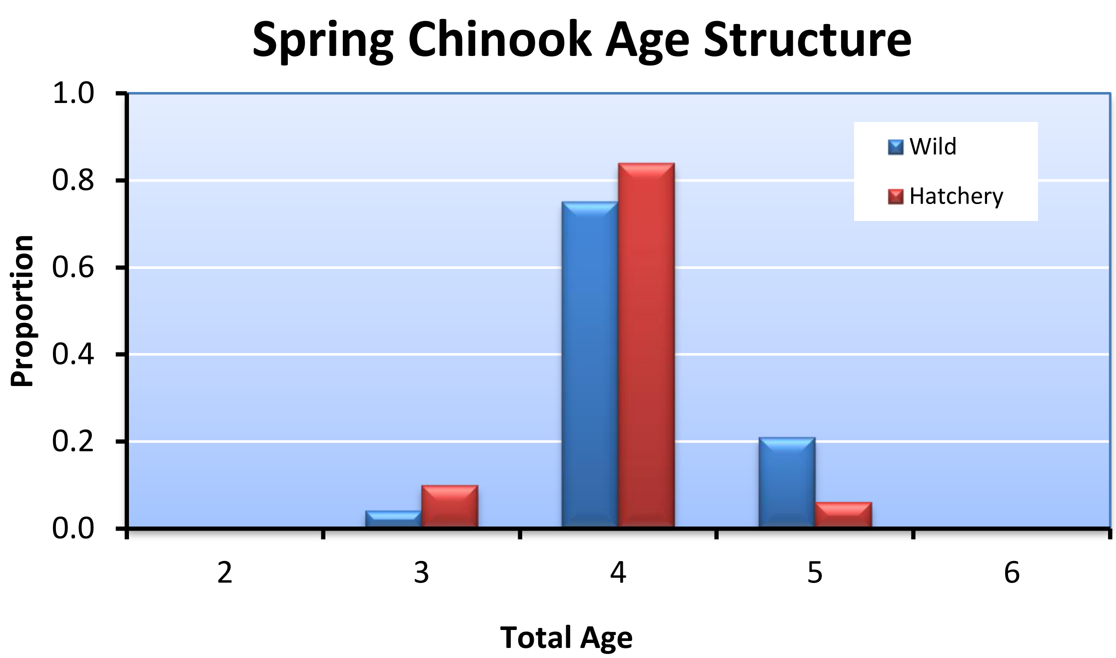


Figure 5.17. Proportions of wild and hatchery spring Chinook of different total ages sampled at the Chiwawa Weir and on spawning grounds in the Chiwawa River basin for the combined years 1994-2019.

Size at Maturity

On average, hatchery and wild spring Chinook of a given age differed slightly in length (Table 5.37). Differences were usually no more than 4 cm between hatchery and wild fish of the same age.

Table 5.37. Mean lengths (POH in cm; ±1SD) and sample sizes (in parentheses) of different ages (total age) of male and female spring Chinook of wild and hatchery-origin sampled in the Chiwawa River basin, 1994-2019. Return years 2004-2019 include carcasses and live fish PIT-tag detections. In addition, 2005 and 2006 include fish released at the weir.

Return year	Total age	Mean length (cm)			
		Male		Female	
		Wild	Hatchery	Wild	Hatchery
1994	3				43 ±0 (1)
	4			62 ±3 (3)	
	5	76 ±0 (1)		73 ±2 (5)	
	6				
1995	3				
	4		61 ±5 (5)		
	5				
	6				
1996	3	45 ±3 (5)	49 ±7 (10)		
	4	69 ±4 (6)	69 ±0 (1)	67 ±8 (2)	
	5				
	6				
1997	3				
	4	61 ±1 (2)	68 ±0 (1)	67 ±5 (3)	63 ±3 (8)
	5	67 ±5 (2)			
	6				
1998	3				
	4				54 ±0 (1)
	5	77 ±7 (8)	75 ±4 (4)	74 ±4 (7)	76 ±4 (3)
	6				
1999	3	44 ±0 (1)			
	4	61 ±0 (1)		64 ±3 (6)	
	5	76 ±5 (3)		72 ±5 (3)	66 ±0 (1)
	6				
2000	3		46 ±3 (17)		50 ±7 (3)
	4	60 ±8 (23)	62 ±5 (5)	61 ±5 (26)	62 ±3 (20)
	5	77 ±1 (2)			
	6				
2001	3	37 ±0 (1)	42 ±4 (11)	41 ±0 (1)	60 ±0 (1)
	4	63 ±5 (57)	65 ±5 (151)	62 ±4 (110)	63 ±4 (407)
	5	75 ±5 (2)	83 ±0 (1)	76 ±1 (5)	
	6				
2002	3				
	4	64 ±4 (14)	66 ±5 (46)	60 ±4 (15)	63 ±4 (71)
	5	80 ±6 (13)	75 ±5 (4)	72 ±3 (12)	73 ±6 (6)
	6				
2003	3	45 ±2 (3)	45 ±1 (6)		

Return year	Total age	Mean length (cm)			
		Male		Female	
		Wild	Hatchery	Wild	Hatchery
	4		63 ±0 (1)		
	5	78 ±5 (12)	74 ±8 (11)	75 ±3 (19)	72 ±5 (14)
	6				
2004	3	42 ±3 (3)	44 ±5 (33)		
	4	63 ±7 (60)	66 ±5 (9)	63 ±4 (59)	63 ±6 (36)
	5			74 ±0 (1)	
	6				
2005	3		43 ±5 (48)		
	4	61 ±5 (32)	65 ±5 (224)	62 ±4 (61)	62 ±4 (382)
	5	74 ±5 (6)	54±0 (1)	71 ±3 (11)	
	6				
2006	3	45 ±3 (3)	43 ±3 (73)		
	4	64 ±3 (7)	62 ±6 (91)	63 ±5 (41)	60 ±4 (227)
	5	74 ±6 (8)	75 ±6 (17)	71 ±4 (26)	71± 4 (37)
	6				
2007	3	39 ±3 (5)	45 ±6 (90)		50 ±3 (7)
	4	60 ±4 (4)	66 ±5 (45)	61 ±4 (10)	63 ±3 (142)
	5	78 ±6 (15)	76 ±5 (8)	74 ±3 (20)	73 ±5 (12)
	6				
2008	3	43 ±0 (1)	44 ±5 (22)		
	4	65 ±4 (9)	64 ±6 (73)	62 ±4 (26)	64 ±4 (229)
	5	65 ±5 (3)	79 ±5 (10)	73 ±3 (4)	72 ±3 (5)
	6				
2009	3	45 ±3 (8)	46 ±6 (68)		65 ±0 (1)
	4	64 ±4 (38)	65 ±5 (136)	63 ±3 (67)	64 ±4 (202)
	5	79 ±0 (1)		72 ±2 (4)	71 ±4 (10)
	6				
2010	3		46 ±4 (11)		65 ±3 (3)
	4	64 ±5 (31)	66 ±5 (74)	64 ±4 (82)	65 ±3 (196)
	5	77 ±4 (6)		73 ±5 (9)	73 ±6 (4)
	6				
2011	3	43 ±4 (133)	44 ±4 (1374)		53 ±4 (17)
	4	62 ±5 (137)	64 ±5 (169)	64 ±3 (94)	64 ±3 (258)
	5	80 ±5 (78)	79 ±4 (85)	75 ±3 (116)	75 ±3 (63)
	6				
2012	3	56 ±0 (1)	52 ±7 (7)		
	4	79 ± 6 (37)	80 ±6 (49)	79 ±3 (76)	78 ±4 (180)
	5	97 ±7 (11)	96 ±3 (4)	93 ±4 (16)	87 ±0 (1)
	6				
2013	3	45 ±4 (8)	43 ±4 (32)	35 ±0 (1)	49 ±12 (3)
	4	60 ±6 (29)	63 ±7 (41)	61 ±6 (34)	61 ±4 (171)

Return year	Total age	Mean length (cm)			
		Male		Female	
		Wild	Hatchery	Wild	Hatchery
	5	75 ±5 (9)	71 ±2 (7)	71 ±3 (24)	69 ±4 (18)
	6				
2014	3	45 ±7 (5)	45±4 (11)	50±0 (1)	47±0 (1)
	4	64 ±7 (60)	62 ±7 (30)	63 ±4 (91)	61 ±4 (99)
	5	81 ±4 (4)		72 ±6 (8)	69 ±4 (3)
	6				
2015	3	56±0 (1)	48±4 (11)		52±0 (1)
	4	65±5 (23)	65±6 (42)	63±5 (57)	63±4 (126)
	5	75±7 (6)	71±0 (1)	69±6 (9)	73±0 (1)
	6				
2016	3	41±5 (5)	43±4 (3)		
	4	63±7 (30)	64±7 (12)	63±5 (62)	61±5 (45)
	5	76±7 (13)	75±0 (1)	73±5 (27)	67±4 (10)
	6				
2017	3	41±0 (1)	47±7 (3)		
	4	67±6 (21)	65±5 (20)	63±5 (19)	62±4 (62)
	5	71±1 (2)	80±3 (3)	72±5 (4)	70±8 (3)
	6				
2018	3				
	4	62±6 (21)	61±6 (55)	61±3 (27)	60±4 (100)
	5	70±0 (1)		65±7 (3)	68±1 (2)
	6				
2019	3	39±2 (3)	42±1 (2)		
	4	65±6 (15)	64±7 (40)	62±3 (17)	62±4 (58)
	5		74±2 (2)	72±5 (5)	76±4 (2)
	6				

Contribution to Fisheries

Nearly all the harvest on hatchery-origin Chiwawa spring Chinook occurs within the Columbia River basin. Ocean catch records (Pacific Fishery Management Council) indicate that very few Upper Columbia spring Chinook are taken in ocean fisheries. Most of the harvest on hatchery-origin Chiwawa spring Chinook occurs in the Lower Columbia River fisheries, which are managed by the states and tribes pursuant to management plans developed in *U.S. v Oregon*. The Lower Columbia River fisheries occur during what is referred to in *U.S. v Oregon* as the winter, spring, and summer seasons, which begin in February and ends 31 July of each year. The Tribal fishery occurs upstream from Bonneville Dam, but primarily in Zone 6, the area between Bonneville and McNary dams; the non-treaty commercial fisheries occur in Zones 1-5, which are downstream from Bonneville Dam. The non-treaty recreational (sport) fishery occurs in the lower mainstem.

The total number of hatchery-origin spring Chinook captured in different fisheries has been relatively low (Table 5.38). The largest harvest occurred on the 2008 brood year.

Table 5.38. Estimated number and percent (in parentheses) of hatchery-origin Chiwawa spring Chinook captured in different fisheries, brood years 1989-2013; NP = no hatchery program.

Brood year	Ocean fisheries	Columbia River Fisheries			Total	Percent of brood year escapement harvested[b]
		Tribal[a]	Commercial (Zones 1-5)	Recreational (sport)		
1989	3 (13)	5 (21)	0 (0)	16 (67)	24	11.8
1990	0 (0)	0 (0)	0 (0)	18 (100)	18	94.7
1991	0 (0)	3 (100)	0 (0)	0 (0)	3	8.6
1992	0 (0)	1 (100)	0 (0)	0 (0)	1	3.1
1993	3 (75)	1 (25)	0 (0)	0 (0)	4	1.4
1994	0 (0)	0 (0)	0 (0)	0 (0)	0	0.0
1995	NP	NP	NP	NP	NP	NP
1996	0 (0)	2 (100)	0 (0)	0 (0)	2	2.5
1997	1 (0)	193 (51)	68 (18)	115 (31)	377	14.4
1998	10 (5)	47 (24)	12 (6)	126 (65)	195	16.4
1999	NP	NP	NP	NP	NP	NP
2000	0 (0)	17 (74)	0 (0)	6 (26)	23	6.1
2001	36 (64)	8 (14)	1 (2)	11 (20)	56	3.0
2002	12 (17)	11 (15)	22 (31)	26 (37)	71	9.1
2003	18 (21)	29 (35)	11 (13)	26 (31)	84	10.6
2004	3 (1)	188 (40)	31 (7)	253 (53)	475	15.8
2005	6 (5)	31 (24)	18 (14)	74 (57)	129	8.5
2006	25 (3)	469 (60)	85 (11)	201 (26)	780	29.8
2007	14 (3)	180 (43)	75 (18)	151 (36)	420	32.2
2008	8 (1)	298 (21)	41 (3)	1,045 (75)	1,392	35.9
2009	6 (2)	92 (25)	73 (20)	200 (54)	371	23.4
2010	0 (0)	372 (59)	45 (7)	216 (34)	633	29.8
2011	3 (0)	393 (53)	138 (19)	206 (28)	740	42.1
2012	1 (0)	89 (42)	42 (20)	80 (38)	212	7.8
2013	0 (0)	19 (31)	3 (5)	40 (65)	62	12.5
Average	***6 (9)***	***106 (42)***	***29 (8)***	***122 (37)***	***264***	***18.3***
Median	***3 (1)***	***29 (35)***	***12 (6)***	***40 (34)***	***84***	***11.8***

[a] Includes the Wanapum fishery and the Icicle and Wenatchee fisheries when they occurred.

[b] Percent of brood year escapement harvested = Total brood year harvest / (Total brood year harvest + ∑Hatchery collection + ∑escapement) * 100. In other words, this indicates the percentage of all detected CWTs that ended up in harvest.

Straying

Stray rates were determined by examining CWTs recovered on spawning grounds within and outside the Wenatchee River basin. Targets for strays based on return year (recovery year) within the Wenatchee River basin should be less than 10% and targets for strays outside the Wenatchee River basin should be less than 5%.

The percentage of the spawning escapement in non-target spawning areas within the Wenatchee River basin made up of hatchery-origin Chiwawa spring Chinook has been high in some years and exceeded the target of 10% (Table 5.39). Over the years of sampling, Chiwawa spring Chinook have strayed into all non-target spawning areas, but, on average, have contributed most to the Nason Creek and Upper Wenatchee spawning escapements.

Table 5.39. Number (No.) and percent (%) of the spawning escapement in other non-target spawning streams within the Wenatchee River basin that consisted of hatchery-origin Chiwawa spring Chinook, return years 1992-2018. For example, for return year 2001, 35.3% of the spring Chinook spawning escapement in Nason Creek consisted of hatchery-origin Chiwawa spring Chinook. Percent strays should be less than 10%.

Return year	Nason Creek		Icicle Creek		Peshastin Creek		Upper Wenatchee		White River		Little Wenatchee	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1992	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1993	61	12.4	0	0.0	0	0.0	34	18.0	7	4.8	0	0.0
1994	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1995	0	0.0	0	0.0	0	0.0	2	66.7	0	0.0	0	0.0
1996	25	30.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1997	55	45.1	8	14.3	0	0.0	0	0.0	0	0.0	0	0.0
1998	3	4.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1999	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2000	45	16.7	0	0.0	0	0.0	31	31.0	0	0.0	6	25.0
2001	211	35.3	0	0.0	0	0.0	271	77.7	46	27.7	52	44.1
2002	188	31.2	10	2.6	0	0.0	60	53.1	14	16.3	21	24.4
2003	14	6.9	0	0.0	0	0.0	30	51.7	0	0.0	0	0.0
2004	139	27.4	0	0.0	0	0.0	54	39.1	6	9.1	0	0.0
2005	252	72.6	7	53.8	0	0.0	256	99.6	106	68.4	65	56.5
2006	131	48.3	13	15.5	0	0.0	28	58.3	9	16.4	12	32.4
2007	303	65.4	0	0.0	0	0.0	37	67.3	7	7.6	6	5.9
2008	381	67.6	48	23.3	29	78.4	258	85.4	30	57.7	52	81.3
2009	289	54.1	8	11.3	0	0.0	16	100.0	63	36.4	56	44.8
2010	272	66.7	58	24.0	11	137.5	86	84.3	23	31.9	59	71.1
2011	397	56.6	61	19.2	0	0.0	41	82.0	0	0.0	53	42.7
2012	398	57.3	49	15.4	7	43.8	98	79.7	45	31.3	15	20.8
2013	281	68.7	15	7.1	0	0.0	24	72.7	5	4.8	10	10.2
2014	204	88.3	19	4.7	0	0.0	41	89.1	0	0.0	1	2.0
2015	11	7.3	12	4.9	0	0.0	50	51.0	8	6.4	0	0.0
2016	18	12.1	0	0.0	0	0.0	25	83.3	0	0.0	62	159.0
2017	51	38.6	0	0.0	0	0.0	8	47.1	9	31.0	0	0.0
2018	86	50.9	0	0.0	3	100.0	38	100.0	14	36.8	5	33.3
Average	***141***	***35.7***	***11***	***7.3***	***2***	***13.3***	***55***	***53.2***	***15***	***14.3***	***18***	***24.2***
Median	***86***	***35.3***	***0***	***0.0***	***0***	***0.0***	***31***	***58.3***	***6***	***4.8***	***5***	***5.9***

Hatchery-origin Chiwawa spring Chinook have strayed into the Methow and Entiat basins (Table 5.40). Based on return year analyses, rates of hatchery-origin Chiwawa spring Chinook straying into these populations have been low in recent years; although, strays into the Entiat exceeded 5% in 2018.

Table 5.40. Number and percent of spawning escapements within other non-target basins that consisted of hatchery-origin Chiwawa spring Chinook, return years 1992-2018. Percent strays should be less than 5%. NS = not sampled.

Return year	Methow River basin		Entiat River basin	
	Number	%	Number	%
1992	0	0.0	0	0.0
1993	0	0.0	0	0.0
1994	0	0.0	0	0.0
1995	0	0.0	0	0.0
1996	0	0.0	0	0.0
1997	0	0.0	0	0.0
1998	0	0.0	0	0.0
1999	0	0.0	0	0.0
2000	0	0.0	1	0.8
2001	0	0.0	1	0.3
2002	0	0.0	34	18.3
2003	0	0.0	6	3.6
2004	0	0.0	0	0.0
2005	10	0.7	15	5.9
2006	8	0.5	30	18.9
2007	9	0.8	24	12.4
2008	12	1.2	61	26.8
2009	7	0.3	15	7.6
2010	10	0.4	18	5.2
2011	51	1.7	190	37.6
2012	13	1.0	133	33.0
2013	9	0.8	18	9.5
2014	0	0.0	0	0.0
2015	7	0.5	24	5.9
2016	5	0.7	1	0.3
2017	0	0.0	2	2.0
2018	3	0.6	6	8.0
Average	***5***	***0.3***	***21***	***7.3***
Median	***0***	***0.0***	***2***	***2.0***

Based on brood year analyses, on average, about 29% of the hatchery returns have strayed into non-target spawning areas (Table 5.41). Depending on brood year, percent strays into non-target spawning areas have ranged from 0-81%. In most years, few (<2%) have strayed into non-target hatchery programs.

Table 5.41. Number and percent of hatchery-origin Chiwawa spring Chinook that homed to target spawning areas and the target hatchery program, and number and percent that strayed to non-target spawning areas and non-target hatchery programs, by brood years 1989-2013.

Brood year	Homing				Straying			
	Target stream		Target hatchery*		Non-target streams		Non-target hatcheries	
	Number	%	Number	%	Number	%	Number	%
1989	74	41.1	1	0.6	102	56.7	3	1.7
1990	0	0.0	1	100.0	0	0.0	0	0.0
1991	29	90.6	0	0.0	2	6.3	1	3.1
1992	2	6.5	4	12.9	25	80.6	0	0.0
1993	134	47.5	82	29.1	63	22.3	3	1.1
1994	4	19.0	14	66.7	3	14.3	0	0.0
1995	No program							
1996	58	75.3	7	9.1	12	15.6	0	0.0
1997	1,242	55.6	298	13.4	687	30.8	5	0.2
1998	553	55.8	109	11.0	329	33.2	0	0.0
1999	No program							
2000	149	42	115	32	90	25	0	0.0
2001	647	35.8	276	15.3	881	48.7	4	0.2
2002	314	44.3	238	33.6	156	22.0	1	0.1
2003	556	78.6	11	1.6	133	18.8	7	1.0
2004	1,198	47.4	203	8.0	1,104	43.7	23	0.9
2005	822	59.3	139	10.0	415	29.9	10	0.7
2006	1,007	54.8	147	8.0	669	36.4	14	0.8
2007	510	57.8	60	6.8	294	33.3	19	2.2
2008	1,160	46.6	64	2.6	1,144	45.9	122	4.9
2009	746	61.4	81	6.7	356	29.3	31	2.6
2010	799	53.7	386	25.9	275	18.5	29	1.9
2011	570	56.1	289	28.4	150	14.8	7	0.7
2012	200	32.6	256	41.8	129	21.0	28	4.6
2013	278	63.9	93	21.4	64	14.7	0	0.0
Average	***481***	***49.0***	***125***	***21.1***	***308***	***28.8***	***13***	***1.2***
Median	***510***	***53.7***	***93***	***12.9***	***150***	***25.4***	***4***	***0.7***

* Homing to the target hatchery includes Chiwawa hatchery spring Chinook that are captured and included as broodstock in the Chiwawa Hatchery program. These hatchery fish are typically collected at the Chiwawa weir and Tumwater Dam.

Ford et al. (2015) used parentage analysis to estimate rates of straying and homing of spring Chinook within the Wenatchee River basin. They found that stray rates of hatchery spring Chinook based on parentage analysis were consistent with rates estimated using physical tag recoveries (the latter estimates are shown in the tables above). They also found that stray rates among the major spawning tributaries were higher than stray rates of tagged fish to areas outside of the Wenatchee River basin (e.g., Entiat and Methow basins), which is consistent with the results shown in the tables above. Finally, the researchers noted that hatchery spring Chinook homed at a far lower rate than natural-origin fish and stray rates of natural-origin fish ranged from about 0-100%. Rates of straying of natural-origin spring Chinook were affected by spawning tributary and by parental origin (i.e., progeny of naturally spawning hatchery-produced fish strayed at higher rates than progeny whose parents were of natural origin).

Genetics

Genetic studies were conducted in 2007 to determine the potential effects of the Chiwawa Supplementation Program on natural-origin spring Chinook in the upper Wenatchee River basin (Blankenship et al. 2007; the entire report is appended as Appendix M). A total of 32 population collections of adult spring Chinook were obtained from the Wenatchee River basin between 1989 and 2006. This included nine collections of natural-origin Chinook adults from the Chiwawa River (N = 501) and nine collections of Chiwawa hatchery-origin Chinook (N = 595) at the Chiwawa weir. Collections in 1993 and 1994 included hatchery-origin smolts. Additional samples were collected from the White River, Little Wenatchee River, and Nason Creek; six collections of natural-origin Chinook from the White River (N = 179), one collection from the Little Wenatchee (N = 19), and six collections from Nason Creek (N = 268). A single collection was obtained for Chinook spawning in the mainstem Wenatchee River and from the Leavenworth National Fish Hatchery. Finally, an out-of-basin collection from the Entiat River was included in the analysis. Scale, fin clips, or operculum punches were collected from each sample. Microsatellite DNA allele frequencies were used to statistically assign individual fish to specific demes (locations) within the Wenatchee population. In addition, genetic effects of the hatchery program were assessed by examining relationships between census and effective population sizes (N_e) from samples collected before and after supplementation.

Overall, this work showed that although allele frequencies within and between natural and hatchery-origin spring Chinook were significantly different, there was no evidence (i.e., robust signal) that the difference was the result of the hatchery program. Rather, the differences were more likely the result of life history characteristics. However, there was an increasing trend toward homogenization of the allele frequencies of the natural and hatchery-origin fish that comprised the broodstock, even though there was consistent year-to-year variation in allele frequencies among hatchery and natural-origin fish. In addition, there were no robust signals indicating that hatchery-origin hatchery broodstock, hatchery-origin natural spawners, natural-origin hatchery broodstock, and natural-origin natural spawners were substantially different from each other. Finally, the N_e estimate of 387 was only slightly larger than the pre-hatchery N_e (based on demographic data from 1989-1992), which means that the Chiwawa hatchery program has not reduced the N_e of the Wenatchee spring Chinook population.

Significant differences in allele frequencies were observed within and among major spawning areas in the Upper Wenatchee River basin. However, these differences made up only a very small portion of the overall variation, indicating genetic similarity among the major spawning areas. There was no evidence that the Chiwawa program has changed the genetic structure (allele frequency) of spring Chinook in Nason Creek and the White River, despite the presence of hatchery-origin spawners in both systems.

It is important to note that no new information will be reported on genetics until the next comprehensive report (data collected through 2018).

Proportionate Natural Influence

Another method for assessing the genetic risk of a supplementation program is to determine the influence of the hatchery and natural environments on the adaptation of the composite population. This is estimated by the proportion of natural-origin fish in the hatchery broodstock (pNOB) and the proportion of hatchery-origin fish in the natural spawning escapement (pHOS). We calculated Proportionate Natural Influence (PNI) by iterating Ford's (2002) equations 5 and 6 to equilibrium, using a heritability of 0.3 and a selection strength of three standard deviations.[22] The larger the PNI value, the greater the strength of selection in the natural environment relative to that of the hatchery environment. For the natural environment to dominate selection, PNI should be greater than 0.50, and integrated populations should have a PNI of at least 0.67 (HSRG/WDFW/NWIFC 2004).

For brood years 1989-1994, PNI values were greater than or equal to 0.67 (Table 5.42). Since brood year 1994, PNI has been less than 0.67, except for brood year 2016, which was 0.68.

Table 5.42. Proportionate Natural Influence (PNI) values for the Chiwawa spring Chinook supplementation program for brood years 1989-2019. NOS = number of natural-origin Chinook on the spawning grounds; HOS = number of hatchery-origin Chinook on the spawning grounds; NOB = number of natural-origin Chinook collected for broodstock; and HOB = number of hatchery-origin Chinook included in hatchery broodstock.

Brood year	Spawners			Broodstock			PNI[a]
	NOS	HOS	pHOS	NOB	HOB	pNOB	
1989	713	0	0.00	28	0	1.00	1.00
1990	571	0	0.00	18	0	1.00	1.00
1991	242	0	0.00	27	0	1.00	1.00
1992	676	0	0.00	78	0	1.00	1.00
1993	231	2	0.01	94	0	1.00	0.99
1994	123	61	0.33	8	4	0.67	0.68
1995	0	33	1.00	No Program			
1996	41	17	0.29	8	10	0.44	0.62
1997	60	122	0.67	32	79	0.29	0.32
1998	59	32	0.35	13	34	0.28	0.47
1999	87	7	0.07	No Program			
2000	233	113	0.33	9	21	0.30	0.50
2001	506	1219	0.71	113	259	0.30	0.32
2002	254	453	0.64	20	51	0.28	0.33
2003	168	102	0.38	41	53	0.44	0.55

[22] According to authorized annual take permits, PNI is calculated using the PNI approximate equation 11 (HSRG 2009; Appendix A). However, in this report, we used Ford's (2002) equations 5 and 6 with a heritability of 0.3 and a selection strength of three standard deviations to calculate PNI (C. Busack, NOAA Fisheries, 21 March 2016, provided the model for calculating PNI). This approach is more accurate than using the PNI approximate equation.

Brood year	Spawners			Broodstock			PNI[a]
	NOS	HOS	pHOS	NOB	HOB	pNOB	
2004	574	277	0.33	83	132	0.39	0.56
2005	139	460	0.77	91	181	0.33	0.32
2006	114	415	0.78	91	224	0.29	0.29
2007	155	1141	0.88	43	104	0.29	0.27
2008	190	968	0.84	83	220	0.27	0.26
2009	297	1050	0.78	96	111	0.46	0.39
2010	419	675	0.62	77	98	0.44	0.43
2011	801	1231	0.61	80	93	0.46	0.45
Average[b]	***289***	***364***	***0.45***	***54***	***80***	***0.52***	***0.56***
Median[b]	***231***	***113***	***0.38***	***43***	***53***	***0.44***	***0.47***
2012	574	904	0.61	66	45	0.59	0.50
2013	422	956	0.69	68	2	0.97	0.59
2014	538	461	0.46	58	12	0.83	0.65
2015	337	630	0.65	64	0	1.00	0.61
2016	407	164	0.29	57	42	0.58	0.68
2017	171	288	0.63	50	18	0.74	0.55
2018	166	456	0.73	30	57	0.34	0.34
2019	146	296	0.67	28	33	0.46	0.42
Average[c]	***345***	***519***	***0.59***	***53***	***26***	***0.69***	***0.54***
Median[c]	***372***	***459***	***0.64***	***58***	***26***	***0.67***	***0.57***

[a] PNI was calculated previously using PNI approximate equation 11 (HSRG 2009; their Appendix A). All PNI values presented here were recalculated by iterating Ford's (2002) equations 5 and 6 to equilibrium using a heritability of 0.3 and a selection strength of three standard deviations. C. Busack, NOAA Fisheries, 21 March 2016, provided the model for calculating PNI.
[b] Descriptive statistics represent the program before recalculation in 2011.
[c] Descriptive statistics represent the current program, which began in 2012. Origin determinations should be considered preliminary pending scale analyses.

Post-Release Survival and Travel Time

We used PIT-tagged fish to estimate survival rates and travel time (arithmetic mean days) of hatchery spring Chinook from the Chiwawa River release site to McNary Dam, and smolt to adult ratios (SARs) from release to detection at Bonneville Dam (Table 5.43).[23] Over the 13 brood years for which PIT-tagged hatchery fish were released, survival rates from the Chiwawa River to McNary Dam ranged from 0.435 to 0.662; SARs from release to detection at Bonneville Dam ranged from 0.001 to 0.018. Average travel time from the Chiwawa River to McNary Dam ranged from 14 to 44 days. Although there is only one year in which a forced release was compared to a volitional release (brood year 2005), hatchery spring Chinook that were forced out of the Chiwawa Acclimation Facility had slightly higher survival rates and SARs, and a faster travel time to McNary Dam, than did the volitional release.

[23] It is important to point out that because of fish size differences among rearing tanks or raceways, fish PIT tagged in one tank or raceway may not represent untagged fish rearing in other tanks or raceways.

Table 5.43. Total number of Chiwawa hatchery spring Chinook released with PIT tags, their survival and travel times (mean days) to McNary Dam, and smolt-to-adult (SAR) ratios for brood years 2005-2017. Standard errors are shown in parentheses. NA = not available (i.e., not all the adults from the release groups have returned to the Columbia River).

Brood year	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
2005	4,993 (forced)	0.662 (0.027)	22.9 (6.6)	0.008 (0.001)
	4,988 (volitional)	0.638 (0.027)	43.6 (6.9)	0.003 (0.001)
2006	9,894	0.619 (0.038)	30.6 (7.6)	0.011 (0.001)
2007	10,031	0.435 (0.019)	32.9 (7.7)	0.007 (0.001)
2008	10,006	0.631 (0.038)	39.9 (10.3)	0.018 (0.001)
2009	9,412	0.547 (0.044)	30.2 (6.7)	0.006 (0.001)
2010	5,020	0.547 (0.038)	18.9 (7.3)	0.008 (0.001)
2011	9,987	0.458 (0.029)	14.2 (7.5)	0.009 (0.001)
2012	5,061	0.478 (0.043)	30.9 (6.5)	0.008 (0.001)
2013	10,021	0.438 (0.041)	29.5 (5.9)	0.006 (0.001)
2014	10,179	0.628 (0.029)	24.9 (6.2)	0.004 (0.001)
2015	10,148	0.463 (0.030)	32.7 (7.0)	NA
2016	10,089	0.574 (0.056)	23.9 (7.5)	NA
2017	10,082	0.442 (0.050)	27.9 (9.3)	NA

We also used PIT-tags to estimate survival rates and travel time (arithmetic mean days) of wild spring Chinook smolts tagged at the Chiwawa smolt trap. Survival rates and travel times were estimated from the Chiwawa trap to McNary Dam, and smolt to adult ratios (SARs) from the trap to returning adults detected at Bonneville Dam (Table 5.44). Over the 14 brood years for which wild spring Chinook smolts were tagged and released at the Chiwawa trap, survival rates from the Chiwawa River to McNary Dam ranged from 0.374 to 0.485; SARs from release to detection at Bonneville Dam ranged from 0.001 to 0.011. Average travel time from the Chiwawa River to McNary Dam ranged from 23 to 41 days.

Table 5.44. Total number of Chiwawa wild spring Chinook smolts released with PIT tags at the Chiwawa Trap, their survival and travel times (mean days) to McNary Dam, and smolt-to-adult (SAR) ratios for brood years 2004-2017. Standard errors are shown in parentheses. NA = not available (i.e., not all the adults from the release groups have returned to the Columbia River).

Brood year	Tag year	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
2004	2006	2,343	22.7 (8.5)	0.485 (0.029)	0.009 (0.002)
2005	2007	2,682	36.5 (17.7)	0.385 (0.021)	0.002 (0.001)
2006	2008	6,721	34.2 (17.1)	0.467 (0.025)	0.011 (0.001)
2007	2009	2,376	41.2 (13.1)	0.464 (0.046)	0.006 (0.002)

Brood year	Tag year	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
2008	2010	5,096	36.8 (13.9)	0.410 (0.024)	0.005 (0.001)
2009	2011	3,256	28.6 (12.4)	0.417 (0.040)	0.005 (0.001)
2010	2012	5,855	38.3 (16.3)	0.420 (0.026)	0.003 (0.001)
2011	2013	1,860	36.8 (28.3)	0.388 (0.043)	0.005 (0.002)
2012	2014	2,452	31.1 (12.6)	0.402 (0.043)	0.003 (0.001)
2013	2015	5,018	31.9 (20.5)	0.341 (0.028)	0.001 (0.001)
2014	2016	1,422	28.5 (12.0)	0.416 (0.041)	0.004 (0.002)
2015	2017	3,699	29.8 (12.8)	0.430 (0.041)	NA
2016	2018	1,897	31.6 (14.3)	0.418 (0.088)	NA
2017	2019	3,018	38.5 (12.9)	0.374 (0.060)	NA

Natural and Hatchery Replacement Rates

Natural replacement rates (NRR) were calculated as the ratio of natural-origin recruits (NOR) to the parent spawning population (spawning escapement). Natural-origin recruits are naturally produced (wild) fish that survive to contribute to harvest (directly or indirectly), to broodstock, and to spawning grounds. We do not account for fish that died in route to the spawning grounds (migration mortality) or died just before spawning (pre-spawn mortality) (see Appendix B in Hillman et al. 2012). We calculated NORs with and without harvest. NORs without harvest include all returning fish that either returned to the basin or were collected as wild broodstock. NORs with harvest include all fish harvested and are based on a brood year harvest rates from the hatchery program. For brood years 1989-2013, NRR for spring Chinook in the Chiwawa averaged 0.95 (range, 0.01-4.40) if harvested fish were not included in the estimate and 1.07 (range, 0.01-4.81) if harvested fish were included in the estimate (Table 5.45). NRRs for more recent brood years will be calculated as soon as all tag recoveries and sampling rates have been loaded into the database.

Hatchery replacement rates (HRR) are the hatchery adult-to-adult returns and were calculated as the ratio of hatchery-origin recruits (HOR) to the parent broodstock collected. These rates should be greater than the NRRs and greater than or equal to 6.7 (the calculated target value in Hillman et al. 2019). The target value of 6.7 includes harvest. In nearly all years, HRRs were greater than NRRs, regardless if harvest was or was not included (Table 5.45). HRRs exceeded the estimated target value of 6.7 in 12 of the 23 years.

Table 5.45. Broodstock collected, spawning escapements, natural and hatchery-origin recruits (NOR and HOR), and natural and hatchery replacement rates (NRR and HRR; with and without harvest) for spring Chinook in the Chiwawa River basin, brood years 1989-2013; NP = no hatchery program.

Brood year	Broodstock Collected	Spawning Escapement	Harvest not included				Harvest included			
			HOR	NOR	HRR	NRR	HOR	NOR	HRR	NRR
1989	28	713	180	194	6.43	0.27	204	282	7.29	0.40
1990	19	571	1	34	0.05	0.06	19	40	1.00	0.07
1991	32	242	32	2	1.00	0.01	35	2	1.09	0.01
1992	78	676	31	46	0.40	0.07	32	48	0.41	0.07
1993	100	233	282	159	2.82	0.68	286	163	2.86	0.70
1994	13	184	21	37	1.62	0.20	21	38	1.62	0.21
1995	NP	33	NP	66	NP	2.00	NP	69	NP	2.09
1996	18	58	77	255	4.28	4.40	79	279	4.39	4.81
1997	120	182	2,232	714	18.60	3.92	2,609	795	21.74	4.37
1998	48	91	991	349	20.65	3.84	1,186	409	24.71	4.49
1999	NP	94	NP	11	NP	0.12	NP	12	NP	0.13
2000	48	346	354	693	7.38	2.00	377	738	7.85	2.13
2001	382	1,725	1,808	309	4.73	0.18	1,864	319	4.88	0.18
2002	84	707	709	244	8.44	0.35	780	254	9.29	0.36
2003	119	270	707	107	5.94	0.40	791	115	6.65	0.43
2004	296	851	2,528	276	8.54	0.32	3,003	298	10.15	0.35
2005	283	599	1,386	396	4.90	0.66	1,515	409	5.35	0.68
2006	348	529	1,837	967	5.28	1.83	2,617	1,215	7.52	2.30
2007	169	1,296	883	476	5.22	0.37	1,303	569	7.71	0.44
2008	329	1,158	2,490	735	7.57	0.63	3,882	824	11.80	0.71
2009	264	1,347	1,214	347	4.60	0.26	1,585	377	6.00	0.28
2010	186	1,094	1,489	617	8.01	0.56	2,122	761	11.41	0.70
2011	181	2,032	1,016	487	5.61	0.24	1,756	653	9.70	0.32
2012	116	1,478	613	336	5.28	0.23	825	385	7.11	0.26
2013	126	1,378	435	215	3.45	0.16	497	226	3.94	0.16
Average	***147***	***716***	***927***	***323***	***6.12***	***0.95***	***1,191***	***371***	***7.59***	***1.07***
Median	***119***	***599***	***709***	***276***	***5.28***	***0.35***	***825***	***298***	***7.11***	***0.40***

Smolt-to-Adult Survivals

Smolt-to-adult survival ratios (SARs) were calculated as the number of hatchery adult recaptures divided by the number of tagged hatchery smolts released. Here, SARs were based on CWT returns. For the available brood years, SARs have ranged from 0.00036 to 0.01563 for hatchery spring Chinook (Table 5.46).

Table 5.46. Smolt-to-adult ratios (SARs) for Chiwawa hatchery spring Chinook, brood years 1989-2013.

Brood year	Number of tagged smolts released[a]	Estimated adult captures[b]	SAR
1989	42,707	204	0.00478
1990	52,798	19	0.00036
1991	61,088	35	0.00057
1992	82,976	31	0.00037
1993	221,316	284	0.00128
1994	27,135	21	0.00077
1995	No hatchery program		
1996	12,767	67	0.00525
1997	259,585	2,549	0.00982
1998	71,571	1,119	0.01563
1999	No hatchery program		
2000	46,726	375	0.00803
2001	374,129	1,849	0.00494
2002	145,074	760	0.00524
2003	216,702	775	0.00358
2004	491,987	2,992	0.00608
2005	489,664	1,506	0.00308
2006	548,777	2,605	0.00475
2007	292,682	1,301	0.00445
2008	609,286	3,882	0.00637
2009	433,608	1,571	0.00362
2010	342,778	2,108	0.00615
2011	278,801	1,743	0.00625
2012	218,968	817	0.00373
2013	143,837	488	0.00339
Average	***237,607***	***1,178***	***0.00472***
Median	***218,968***	***817***	***0.00475***

[a] Includes all tag codes and CWT released fish (CWT + Ad Clip fish and CWT-only fish).
[b] Includes estimated recoveries (spawning ground, hatcheries, harvest, etc.) and observed recoveries if estimated recoveries were unavailable.

5.8 ESA/HCP Compliance

Broodstock Collection

The collection of 2017 Brood Chiwawa River spring Chinook broodstock was consistent with the 2017 Upper Columbia River salmon and steelhead broodstock objectives and site-based broodstock collection protocols. Specifically, broodstock collection targeted previously PIT-tagged natural-origin fish at Tumwater Dam and operation of the Chiwawa Weir. In-season adjustments were made to the natural-origin spring Chinook collected for broodstock as needed and were based on in-season escapement monitoring at Tumwater Dam and estimated Chiwawa run-escapement.

Trapping at Tumwater Dam began on 29 May 2017 and concluded on 14 July 2017. Operation of the Chiwawa Weir was limited to 15 days between 1 June and 15 August and was further constrained by flows and total available bull trout effects. Dates of actual weir operation was 11 July through 2 August. Broodstock collection targeted natural-origin spring Chinook and hatchery-origin spring Chinook as needed to attain a 100% natural-origin broodstock and a maximum 33% extraction of the estimated natural-origin return to the Chiwawa River.

The 2017 brood collection spawned a total of 50 natural-origin and 18 hatchery-origin spring Chinook. All spring Chinook, steelhead, and bull trout that were captured were anesthetized with tricaine methanesulfonate (MS-222) and subject to water-to-water transfers during handling. All fish were allowed to fully recover before release.

The estimated broodstock extraction rate of natural-origin Chiwawa spring Chinook and overall extraction of spring Chinook upstream from Tumwater Dam complied with provisions of ESA Permit 18121.

Hatchery Rearing and Release

The rearing and release of 2017 brood Chiwawa spring Chinook was completed without incident. No mortality events occurred that exceeded 10% of the population. Fish were acclimated on Chiwawa River water with regulated amounts of Wenatchee River water to prevent frazzle ice formation during the winter months (see Section 5.2).

The release of 2017 brood Chiwawa spring Chinook smolts totaled 149,867 fish, representing 104.1% of the program objective of 144,023 smolts, which was compliant with the ESA Section 10 Permit 18121 program not to exceed the maximum level of 158,425 smolts.

Hatchery Effluent Monitoring

Per ESA Permit Numbers 1347, 18118, 18120, 18121, and 18583, permit holders shall monitor and report hatchery effluents in compliance with applicable National Pollution Discharge Elimination Systems (NPDES) (EPA 1999) permit limitations. There were no NPDES violations reported at Eastbank Hatchery or the Chiwawa Acclimation Facility in 2019. NPDES monitoring and reporting for PUD Hatchery Programs during 2019 are provided in Appendix G.

Smolt and Emigrant Trapping

Per ESA Section 10 Permit Nos. 18118, 18120, and 18121, the permit holders are authorized a direct take of up to 20% of the emigrating spring Chinook population during juvenile emigration monitoring and a lethal take not to exceed 2% of the fish captured (NMFS 2013). Based on the estimated wild spring Chinook population (smolt trap expansion) and hatchery juvenile spring Chinook population estimate (hatchery release data) for the Wenatchee River basin, the reported spring Chinook encounters during 2019 emigration monitoring complied with take provisions in the Section 10 permit. Spring Chinook encounter and mortality rates for each trap site (including PIT-tag mortalities) are detailed in Table 5.47. Additionally, juvenile fish captured at the trap locations were handled consistent with provisions in ESA Section 10 Permits 18118, 18120, and 18121, Section B.

Table 5.47. Estimated take of Upper Columbia River spring Chinook resulting from juvenile emigration monitoring in the Wenatchee River basin, 2019.

Trap location	Population estimate			Number trapped			Total	Take allowed under Permit
	Wild[a]	Hatchery[b]	Sub-yearling[c]	Wild	Hatchery	Sub-yearling		
Chiwawa Trap								
Population	39,015	149,867	68,038	4,730	3,151	13,970	21,851	
Encounter rate	NA	NA	NA	0.1212	0.0210	0.2053	0.0850	0.20
Mortality[d]	NA	NA	NA	9	0	78	87	
Mortality rate	NA	NA	NA	0.0019	0.0000	0.0056	0.0040	0.02
White River Trap								
Population	3,401	NA	3,541	119	NA	372	491	
Encounter rate	NA	NA	NA	0.0350	NA	0.1051	0.0707	0.20
Mortality[d]	NA	NA	NA	9	NA	6	0	
Mortality rate	NA	NA	NA	0.0756	NA	0.0161	0.0000	0.02
Nason Creek Trap								
Population	4,494	231,859	29,530	296	2,898	1,759	4,953	
Encounter rate	NA	NA	NA	0.0659	0.0125	0.0596	0.0186	0.20
Mortality[d]	NA	NA	NA	2	1	25	28	
Mortality rate	NA	NA	NA	0.0068	0.0003	0.0142	0.0057	0.02
Lower Wenatchee Trap								
Population	101,793	381,726	2,439,434	1,485	36,104	28,534	66,123	
Encounter rate	NA	NA	NA	0.0146	0.0946	0.0117	0.0226	0.20
Mortality[d]	NA	NA	NA	2	10	167	179	
Mortality rate	NA	NA	NA	0.0013	0.0003	0.0059	0.0027	0.02
Wenatchee River Basin Total								
Population	146,597	381,726	2,540,543	6,630	42,153	44,635	93,418	
Encounter rate	NA	NA	NA	0.0446	0.1104	0.0176	0.0304	0.20
Mortality[d]	NA	NA	NA	20	44	375	439	
Mortality rate	NA	NA	NA	0.0030	0.0010	0.0084	0.0047	0.02

[a] Smolt population estimate derived from juvenile emigration trap data.
[b] 2017 BY smolt release data for the Wenatchee River basin.
[c] Based on size, date of capture and location of capture. Subyearling Chinook encountered at the Lower Wenatchee Trap are categorized as summer Chinook salmon.
[d] Combined trapping and PIT-tagging mortality.

Precocity Monitoring

For the purpose of addressing permit requirements, we used the PIT Tag Information System (PTAGIS) to identify probable hatchery-origin mini-jack spring Chinook salmon from the Chiwawa River from 2015 through 2019. The query results returned fish that were last detected after 1 July of the year in which they were released. Fish that remained in freshwater during this time period were likely precocious males. We looked for detections in three regions: lower Columbia River mainstem dams (Bonneville, The Dalles, and McNary dams), mid-Columbia mainstem dams (Priest Rapids and Rock Island dams), and within the Wenatchee River basin. The occurrence of mini-jacks was rare, ranging from 0.14% to 0.26% of the tagged population (Table 5.48).

Table 5.48. Numbers of Chiwawa River hatchery spring Chinook with final PIT-tag detections after 1 July of the release year. These fish are likely mini-jacks. Lower Columbia River detections occurred at Bonneville, The Dalles, and McNary dams, while Mid-Columbia River detections occurred at Priest Rapids and Rock Island dams.

Year	Number of PIT tags released	Number of tags detected in Lower Columbia River	Number of tags detected in Mid-Columbia River	Number of tags detected within the Wenatchee River basin	Percent of tagged population
2015	10,021	9	0	6	0.15
2016	10,179	22	1	3	0.26
2017	10,148	11	0	3	0.14
2018	10,089	15	3	7	0.25
2019	10,082	15	2	2	0.19

Spawning Surveys

Spring Chinook spawning ground surveys were conducted in the Wenatchee River basin during 2019, as authorized by ESA Section 10 Permits 18118, 18120, and 18121. Because of the difficulty of quantifying the level of take associated with spawning ground surveys, the Permit does not specify a take level associated with these activities, even though it does authorize implementation of spawning ground surveys. Therefore, no take levels are reported. However, to minimize potential effects to established redds, wading was restricted to the extent practical, and extreme caution was used to avoid established redds when wading was required.

Spring Chinook Reproductive Success Study

ESA Section 10 Permit Numbers 18118, 18120, and 18121 specifically provide authorization to capture, anesthetize, biologically sample, PIT tag, and release adult spring Chinook at Tumwater Dam for reproductive success studies and general program monitoring. During 2010 through 2019, all spring Chinook passing Tumwater Dam were enumerated, anesthetized, biologically sampled, PIT tagged, and released (not including hatchery-origin Chinook retained for broodstock) as a component of the reproductive success study (BPA Project No. 2003-039-00). Please refer to Ford et al. (2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, and 2019) for complete details on the methods and results of the spring Chinook reproductive success study for the period 2010-2019.

Bull Trout

Bull trout encounters associated with implementation of hatchery production and monitoring and evaluation activities for Chinook and steelhead programs in the Wenatchee sub-basin are required to be reported as outlined in the Biological Opinion 01EWF00-2013-0444. The 2020 report for bull trout encounters in 2019 was compiled under provisions of ESA Section 10 Permit 18118, 18120, 18121, and 18583. Data and reporting information are included in Appendix I.

SECTION 6: NASON CREEK SPRING CHINOOK

The goals of the Nason Creek spring Chinook salmon supplementation program are to conserve, aid in the recovery, and prevent the extinction of naturally spawning spring Chinook in Nason Creek, and to meet the mitigation responsibilities of Grant County PUD. In 1998, a spring Chinook captive-broodstock program was initiated for the Nason Creek population to reduce the risk of extinction. Improvements in adult escapement in Nason Creek have reduced the near-term risk of extinction and therefore the captive-broodstock program was discontinued in 1999. An adult-based supplementation program began with the collection of broodstock in 2013. The first releases of the program occurred from the Nason Creek Acclimation Facility in the spring of 2015.

In 2013, natural-origin adult spring Chinook were collected for broodstock at Tumwater Dam and from Nason Creek using tangle and dip nets. In 2014, all natural-origin broodstock were collected from Nason Creek using tangle and dip nets. While these brood collection methods were successful at collecting adults from the Nason Creek spawning aggregate, they were unable to collect the necessary number of adults to meet mitigation production goals in 2013 and 2014. The PRCC Hatchery Subcommittee decided to implement the Nason Creek conservation program using a composite of Nason and Chiwawa natural-origin broodstock beginning with brood year 2015 in order to be able to consistently meet program goals. The decision was also made to collect all the brood at Tumwater Dam.

The production goal for the Nason Creek program requires collection of 126 adult spring Chinook (64 natural-origin fish and 66 hatchery-origin fish). However, the Section 10 permit requirements restrict the number of natural-origin adults collected and collection cannot exceed 33% of the natural-origin spring Chinook estimates to Tumwater Dam.

Adult spring Chinook broodstock are spawned and reared at Eastbank Fish Hatchery. Juvenile spring Chinook are transferred from the hatchery to the Nason Creek Acclimation Facility in late September or early October. Fish are reared in 30-foot dual-drain circular tanks throughout winter at the Nason Creek Acclimation Facility. Yearling Chinook were released volitionally during April and May in 2015. Beginning in 2016, all fish were force released at night to improve survival and reduce ecological risks.

The current production goal is to release 223,670 smolts (125,000 for conservation and 98,670 for safety net). Juveniles released from the Nason facility are 100% marked with CWTs and a minimum of 5,000 fish are PIT tagged annually.

The following information focuses on results from monitoring the Nason Creek spring Chinook program. Information on spring Chinook collected throughout the Wenatchee River basin is presented in Section 5.

6.1 Captive Brood Program

As described above, Grant County PUD began a spring Chinook captive-broodstock program in Nason Creek in 1998 to reduce the extinction risk of spring Chinook within Nason Creek. The program collected broodstock for two years. Collections ended because of increased escapements of spring Chinook into Nason Creek. See Murdoch and Hopley (2015) and Murdoch and Tonseth (2006) for more information on this program.

The starting point of the captive brood program was to collect progeny of naturally spawning spring Chinook in Nason Creek. Eyed eggs and/or alevins collected in Nason Creek were transported to AquaSeed Corporation in Rochester, Washington and reared to adults. Table 6.1 summarizes the collection of eyed eggs/alevins for the captive brood program.

Table 6.1. Numbers of eyed-eggs/alevins brood stock collected for the Nason Creek captive brood program, brood years 1998-1999 (1999 was the last year for broodstock collection). Also shown are the number of redds that were sampled for eggs and the hatchery in which the fish were reared.

Brood year	Number of eyed eggs/alevins collected	Number of redds sampled	Rearing facility
1998	1,054	23	AquaSeed
1999	235	7	AquaSeed
Average	***645***	***15***	

After rearing broodstock to maturity in captivity, adult spring Chinook were spawned and their progeny were grown to smolt size, acclimated at Early Pond on Nason Creek, and ultimately released into Nason Creek. Table 6.2 summarizes the adults spawned from their respective brood years.

Table 6.2. Number of adults spawned by brood year and estimated egg take.

Spawn year	1998 brood year		1999 brood year		Estimated egg take
	Males	Females	Males	Females	
2002	4	33	17	1	45,117
2003	0	5	14	27	43,734
Total	***4***	***38***	***31***	***28***	***88, 851***

Numbers of smolts released are summarized in Table 6.3. All smolts were tagged with a CWT at the base of the adipose fin. None of these fish were adipose fin clipped.

Table 6.3. Numbers of Nason Creek spring Chinook smolts released, their acclimation histories, and marking rates for release years 2004 and 2005.

Release year	Acclimation site	Release date	Number of acclimation days	CWT mark rate (%)	Number of smolts released
2004	Early Pond (Rkm 15.0)	4/19 – 5/7	26-44	100	8,986
2005	Eight tanks (Rkm 18.5)	5/6	32-34	100	4,244

In 2003, 36 adult captive broodstock were returned to Nason Creek for natural spawning. No captive brood fish were observed spawning nor were any spawned-out carcasses recovered. By 2004, all captive broodstock died or had been released the previous year into Nason Creek. Based on ongoing monitoring efforts, there is no evidence that any of the smolts released in 2004 or 2005 returned as adults.

6.2 Adult Broodstock Sampling

An adult-based supplementation program began with the collection of broodstock in 2013. This section focuses on results from sampling 2017-2019 Nason Creek spring Chinook broodstock, which were collected at Tumwater Dam in 2017, 2018, and 2019.

Origin of Broodstock

Natural-origin adults made up between 35% and 50% of the Nason Creek spring Chinook broodstock for return years 2017-2019 (Table 6.4). Beginning with brood year 2015, natural-origin adults were targeted for collection at Tumwater Dam during trapping operations. Natural-origin fish collected at Tumwater Dam were used for broodstock if genotyping confirmed they were natural-origin fish from the Nason or Chiwawa subpopulation and they were not White River Chinook. Fish that were genotyped to the White River were returned to the upper Wenatchee River basin to spawn naturally.

Table 6.4. Numbers of wild and hatchery Nason Creek spring Chinook collected for broodstock, numbers that died before spawning, and numbers of Chinook spawned, brood years 2013-2019. Unknown-origin fish (i.e., undetermined by scale analysis, no CWT or fin clips, and no additional hatchery marks) were considered naturally produced. Mortality includes fish that died of natural causes typically near the end of spawning and were not needed for the program or were surplus fish killed at spawning.

Brood year	Wild spring Chinook					Hatchery spring Chinook					Total number spawned
	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	
2013	21	0	1	20	0	5	0	0	5	0	25
2014[b]	27	2	4	21	0	1	0	1	0	0	21
2015	78	1	6	60	11	63	0	0	63	0	123
2016	82	0	1	70	11	68	1	1	66	0	136
2017	72	1	0	70	1	70	3	3	64	0	134
2018	72	0	1	53	18	57	2	1	54	0	107
2019	48	1	0	47	0	90	3	2	85	0	132
Average[c]	***57***	***1***	***2***	***49***	***6***	***51***	***1***	***1***	***48***	***0***	***97***
Median[c]	***72***	***1***	***1***	***53***	***1***	***63***	***1***	***1***	***63***	***0***	***123***

[a] Pre-spawn loss represents the number of fish that died during the holding period before spawning. Mortality is the number of fish that were surplused following spawning.
[b] Until sufficient Nason Creek Spring Chinook HOR's were collected to meet broodstock objectives, Chiwawa Spring Chinook HOR's were utilized to fulfill program goals (see Table 5.1 and the 2014 Broodstock Protocols). About 12 Chiwawa HORs were used to fulfill the Chiwawa Program; about 122 Chiwawa HORs were used to fulfill the Nason Creek safety-net obligation.
[c] Origin determinations should be considered preliminary pending scale analyses.

Age/Length Data

Ages were determined from scales and/or coded wire tags (CWT) collected from broodstock. For both the 2018 and 2019 returns, most adults, regardless of origin, were age-4 Chinook (Table 6.5). All age-3 fish and the majority of age-5 Chinook were natural-origin.

Table 6.5. Percent of hatchery and wild spring Chinook of different ages (total age) collected from broodstock, 2013-2019.

Return year	Origin	Total age			
		2	3	4	5
2013	Wild	0.0	14.3	85.7	0.0
	Hatchery	0.0	0.0	100.0	0.0
2014	Wild	0.0	18.2	68.2	13.6
	Hatchery[a]	0.0	0.0	98.5	1.5
2015	Wild	0.0	0.0	92.0	8.0
	Hatchery	0.0	0.0	100.0	0.0
2016	Wild	0.0	0.0	69.6	30.4
	Hatchery	0.0	0.0	93.4	6.6
2017	Wild	0.0	0.0	84.5	15.5
	Hatchery	0.0	25.7	72.9	1.4
2018	Wild	0.0	1.4	88.9	9.7
	Hatchery	0.0	0.0	94.7	5.3
2019	Wild	0.0	0.0	91.5	8.5
	Hatchery	0.0	0.0	97.7	2.3
Average	***Wild***	***0.0***	***4.8***	***82.9***	***12.2***
	Hatchery	***0.0***	***3.7***	***93.9***	***2.4***
Median	***Wild***	***0.0***	***0.0***	***85.7***	***9.7***
	Hatchery	***0.0***	***0.0***	***97.7***	***1.5***

[a] Data are from Table 5.2.

Age-4 hatchery-origin Chinook were larger in length than natural-origin broodstock in 2018; however, in 2019, age-4 natural-origin broodstock were larger than hatchery-origin broodstock (Table 6.6). Although sample sizes are low, in both 2018 and 2019, age-5 natural-origin Chinook were larger than hatchery-origin Chinook.

Table 6.6. Mean fork length (cm) at age (total age) of hatchery and wild spring Chinook collected from broodstock, 2013-2019; N = sample size and SD = 1 standard deviation.

Return year	Origin	Spring Chinook fork length (cm)											
		Age-2			Age-3			Age-4			Age-5		
		Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD
2013	Wild	-	0	-	56	3	2	75	16	6	-	0	-
	Hatchery	-	0	-	-	0	-	79	5	6	-	0	-
2014	Wild	-	0	-	57	4	6	82	15	7	86	3	8
	Hatchery[a]	-	0	-	-	0	-	81	192	6	85	3	2
2015	Wild	-	0	-	-	0	-	82	43	5	97	8	6
	Hatchery	-	0	-	-	0	-	82	55	5	-	0	-
2016	Wild	-	0	-	-	0	-	81	39	5	94	17	6
	Hatchery	-	0	-	-	0	-	84	57	6	89	4	9

Return year	Origin	Spring Chinook fork length (cm)											
		Age-2			Age-3			Age-4			Age-5		
		Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD
2017	Wild	-	0	-	-	0	-	83	60	6	95.8	11	7
	Hatchery	-	0	-	67	18	4	81	51	6	106	1	-
2018	Wild	-	0	-	55	1	-	80	49	6	94	5	2
	Hatchery	-	0	-	-	0	-	81	54	5	80	3	8
2019	Wild	0	0	0	0	0	0	79	43	7	94	4	4
	Hatchery	0	0	0	0	0	0	76	85	5	93	2	7
Average	***Wild***	***-***	***0***	***-***	***42***	***1***	***3***	***80***	***38***	***6***	***94***	***7***	***6***
	Hatchery	***-***	***0***	***-***	***34***	***3***	***2***	***81***	***71***	***6***	***91***	***2***	***7***

[a] Data are from Table 5.3.

Sex Ratios

Male spring Chinook in the 2017-2019 return years made up 50%, 46%, and 51%, respectively, of the adults collected. This resulted in overall male to female ratios of 1.00:1.00, 0.84:1.00, and 1.03:1.00, respectively (Table 6.7).

Table 6.7. Numbers of male and female wild and hatchery spring Chinook collected for broodstock, 2013-2019. Ratios of males to females are also provided.

Return year	Number of wild spring Chinook			Number of hatchery spring Chinook			Total M/F ratio
	Males (M)	Females (F)	M/F	Males (M)	Females (F)	M/F	
2013	12	10	1.20:1:00	1	3	0.33:1.00	1.00:1.00
2014[a]	18	12	1.50:1.00	0	0	-	1.50:1.00
2015	40	38	1.05:1.00	31	32	0.97:1.00	1.01:1.00
2016	40	42	0.95:1.00	33	35	0.94:1.00	0.95:1.00
2017	35	37	0.95:1.00	36	34	1.06:1.00	1.00:1.00
2018	35	37	0.95:1.00	24	33	0.73:1.00	0.84:1.00
2019	24	24	1.00:1.00	46	44	1.05:1.00	1.03:1.00
Total	***204***	***200***	***1.02:1.00***	***171***	***181***	***34:01.0***	***0.98:1.00***

[a] Data for HOR brood are in Table 5.4.

Fecundity

The mean fecundities for the 2017-2019 returns of Nason Creek spring Chinook ranged from 4,063 to 4,731 eggs per female (Table 6.8). The mean fecundities in 2018 and 2019 were lower than the expected mean fecundity assumed in the broodstock protocols of 4,323 and 4,217, respectively.

Table 6.8. Mean fecundity of wild, hatchery, and all female spring Chinook collected for broodstock, 2016-2019. The first hatchery-origin fish from the Nason Creek spring Chinook program returned in 2016.

Return year	Mean fecundity		
	Wild	Hatchery	Total
2016	4,688	4,274	4,487
2017	4,930	4,513	4,731

Return year	Mean fecundity		
	Wild	Hatchery	Total
2018	4,217	4,009	4,108
2019	4,437	3,849	4,063
Average	***4,568***	***4,161***	***4,347***

[a] Average fecundities are from Table 5.5.

To estimate fecundities by length, weight, and age[24], hatchery staff collected fecundity, fork length, weight, and age data from a subsample of spring Chinook females during the spawning of 2016 through 2019 broodstock. For those brood years, we compare age/fecundity, fork length/fecundity, weight/fecundity, fork length/mean egg mass, and fork length/gamete (skein) mass between hatchery and natural-origin spring Chinook. Hatchery staff attempted to stratify the females sampled by fork length categories to obtain fecundity samples for all sizes of fish to better estimate the relationship between size and fecundity.

Mean fecundity by total age differed between hatchery and natural-origin spring Chinook and over time (Table 6.9). On average, mean fecundities differed between hatchery and natural-origin spring Chinook by 167 eggs for age-4 fish and 1,293 eggs for age-5 fish. No eggs from age-3 fish were collected.

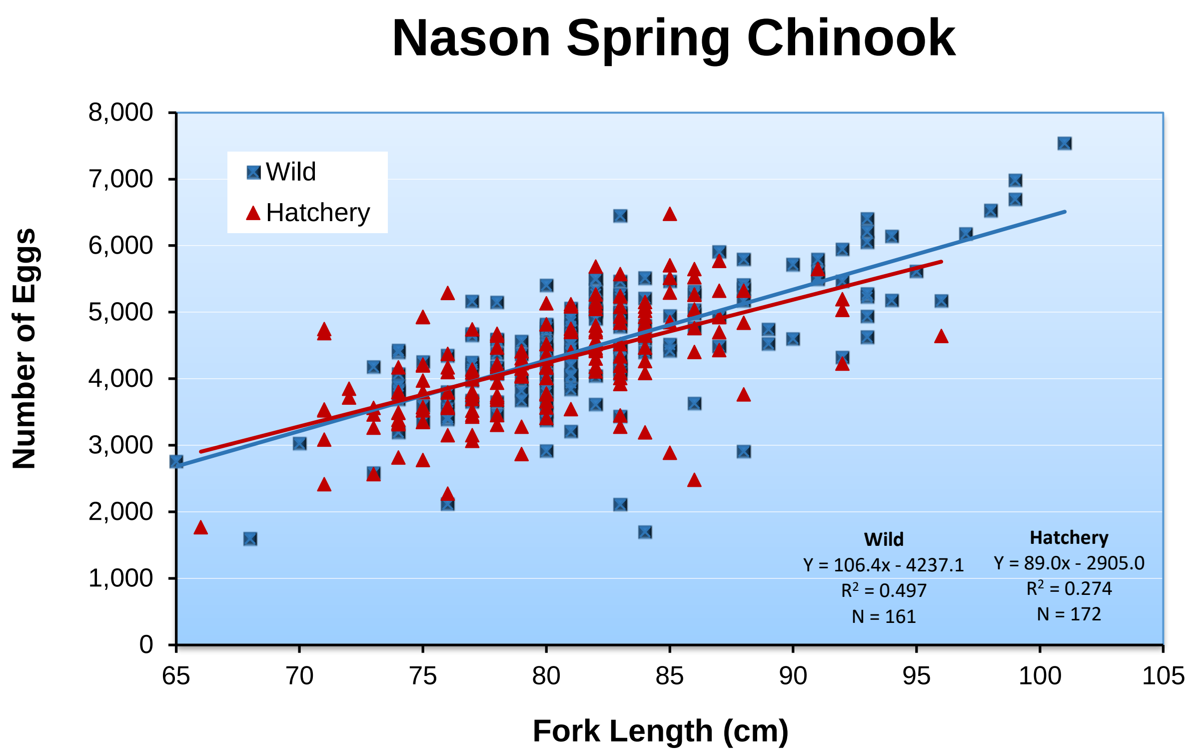
Table 6.9. Mean fecundity by age (total age) for hatchery and wild spring Chinook collected from broodstock for the Nason Creek program, brood years 2016-2019; N = sample size and SD = 1 standard deviation. The first hatchery-origin fish from the Nason Creek spring Chinook program returned in 2016.

Brood year	Origin	Spring Chinook fecundity								
		Age 3			Age 4			Age 5		
		Mean	N	SD	Mean	N	SD	Mean	N	SD
2016	Wild	-	0	-	4,262	18	795	5,377	10	552
	Hatchery	-	0	-	4,284	29	815	4,414	4	1,113
2017	Wild	-	0	-	4,633	29	589	6,365	6	871
	Hatchery	-	0	-	4,513	32	1,064	-	0	-
2018	Wild	-	0	-	4,103	26	929	5,703	2	341
	Hatchery	-	0	-	3,982	29	658	4,402	2	1,223
2019	Wild	-	0	-	4,306	21	684	5,360	3	808
	Hatchery	-	0	-	3,857	40	751	-	0	-
Average	***Wild***	***-***	***0***	***-***	***4,326***	***24***	***749***	***5,701***	***5***	***643***
	Hatchery	***-***	***0***	***-***	***4,159***	***33***	***822***	***4,408***	***2***	***1,168***

We pooled fecundity data from brood years 2016 through 2019 to increase the number of samples for a given fork length. The linear relationships between fork length and fecundity, mean egg weight, and total egg (skein) weight for hatchery and natural-origin females are shown in Figures 6.1, 6.2, and 6.3. All fecundity variables increase linearly with fork length. In addition, the

[24] Although age-fecundity relationships are not specific hypotheses tested within the Monitoring and Evaluation Plan (Hillman et al. 2019), we include them here for descriptive purposes.

relationships between fish size and fecundity data were similar for hatchery and natural-origin spring Chinook.



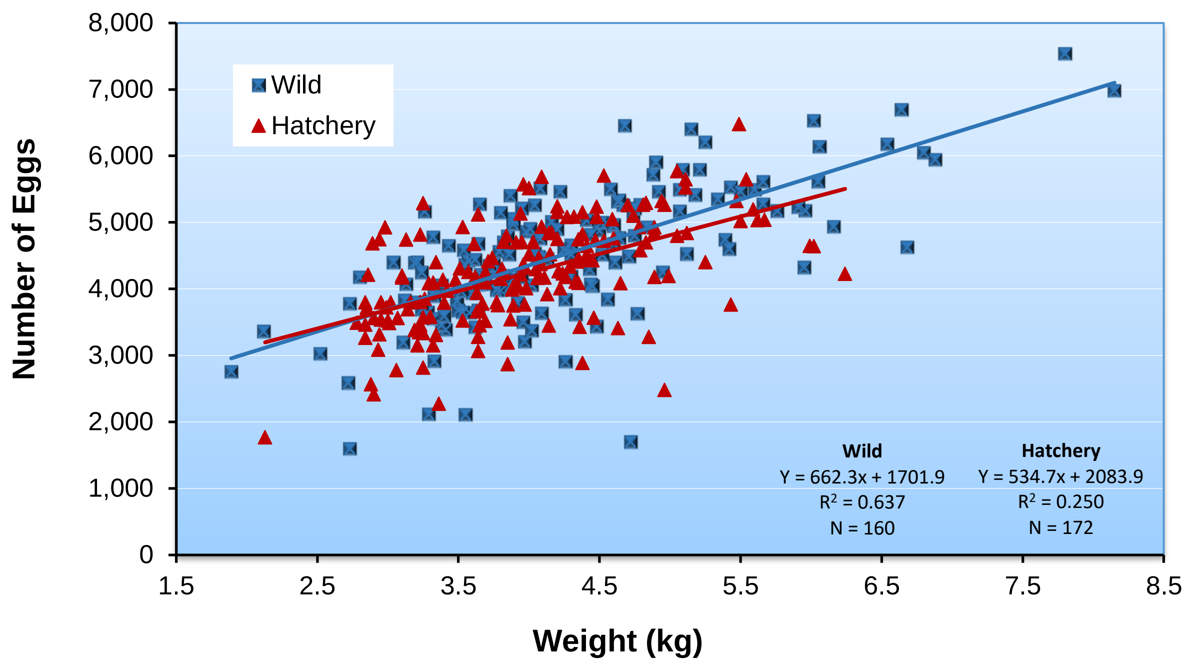


Figure 6.1. Relationships between fecundity and fork length (top figure) and fecundity and weight (bottom figure) for natural and hatchery-origin, Nason Creek, spring Chinook for return years 2016-2019.

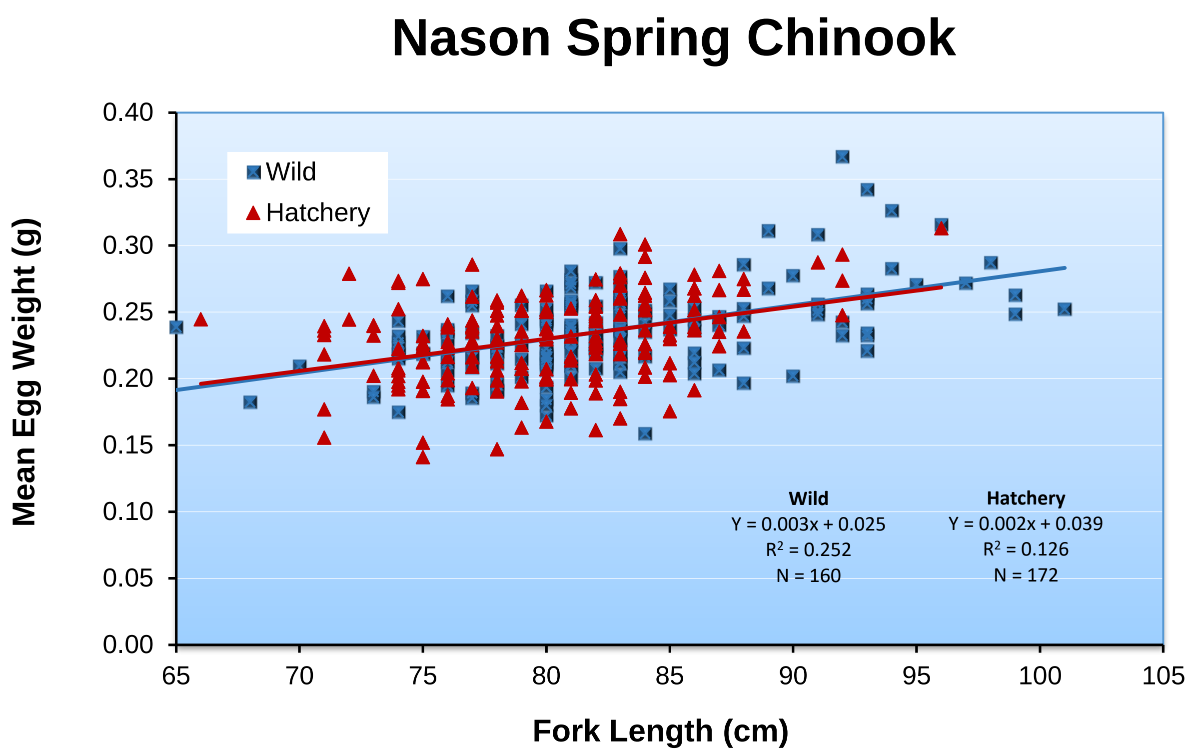


Figure 6.2. Relationships between mean egg weight and fork length for natural and hatchery-origin, Nason Creek, spring Chinook for return years 2016-2019.

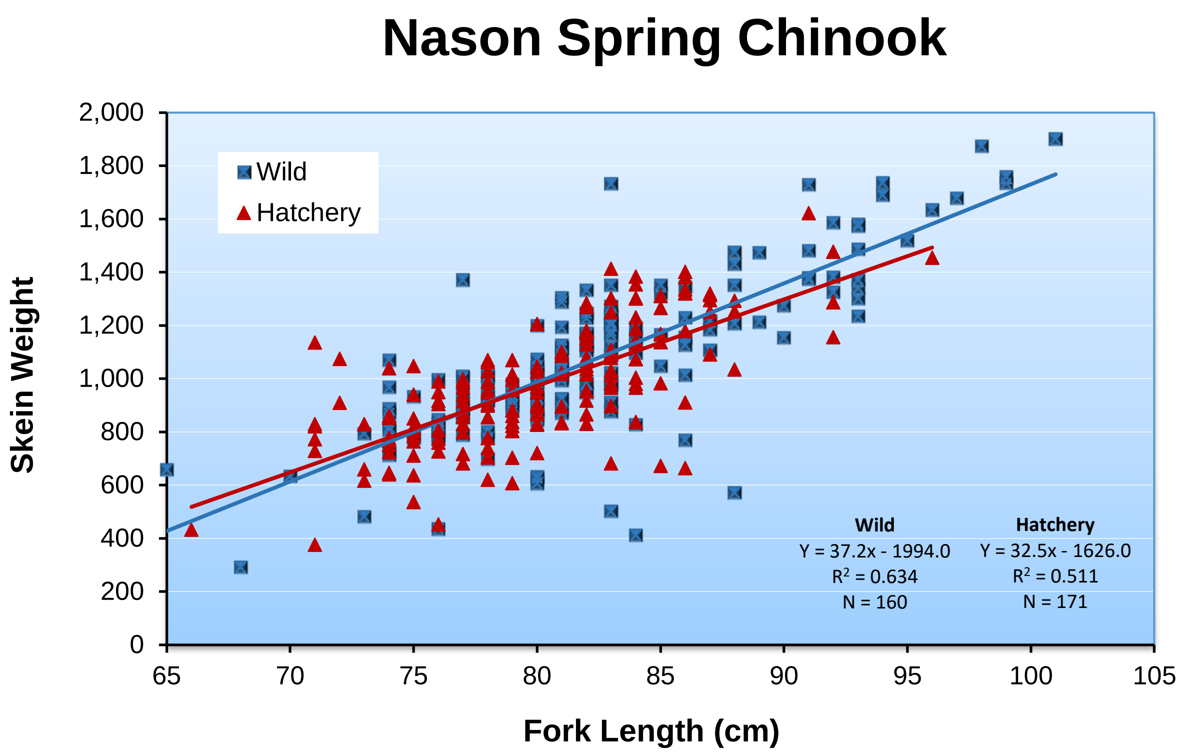


Figure 6.3. Relationships between skein weight and fork length for natural and hatchery-origin, Nason Creek, spring Chinook for return years 2016-2019.

6.3 Hatchery Rearing

Rearing History

Number of eggs taken

Based on the 2017-2019 brood year unfertilized egg-to-release survival standard of 87.0-88.9% established in the broodstock protocols, a total of 256,307 to 282,632 eggs are required to meet the program release goal of 223,670 smolts (Table 6.10). The green egg take for the 2017-2019 brood years was 106%, 89%, and 105% of program goal, respectively.

Table 6.10. Numbers of eggs taken from spring Chinook broodstock, 2013-2019.

Return year	Number of eggs taken
2013[a]	49,720
2014[b]	267,783
2015	268,247
2016	314,090
2017	299,392
2018	242,372

Return year	Number of eggs taken
2019	268,167
Average	***244,253***
Median	***268,167***

[a] Safety-net obligation met through the White River Program. Conservation egg take goal was 116,082.
[b] Includes surrogate Chiwawa HxH egg take calculated from tagging proportions.

Number of acclimation days

Fish from the 2017 brood were acclimated for 178-180 days on Nason Creek water and zero days on well water with oxygen (Table 6.11).

Table 6.11. Number of days spring Chinook broods were acclimated on Nason Creek water and well water, brood years 2013-2017.

Brood year	Release year	Transfer date	Release date	Number of acclimation days
2013	2015	13 Oct	13 Apr – 1 May	182-200
2014[a]	2016	21-23 Oct	15-20 Apr	119-122 Nason, 12 Well
2015	2017	2 Nov	17-18 Apr	166-167
2016	2018	25-27 Oct	16-17 Apr	171-174
2017	2019	25-27 Oct	23 Apr	178-180

[a] Because of water-intake concerns at the Nason Creek Acclimation Facility, the HxH Chinook were transferred to the Chiwawa Acclimation Facility on 2-3 March for final acclimation and release. The WxW fish were on Nason Creek water for 166 days. The HxH fish were on Nason Creek water for 119-122 days and on Chiwawa River water for 43-49 days. WxW and HxH fish were on well water and oxygen for 12 days while rearing at the Nason Creek Acclimation Facility.

Release Information

Numbers released

The 2017 brood Nason Creek spring Chinook program achieved 121.0% of the 125,000 target goal with about 151,179 WxW smolts released into Nason Creek in 2019 (Table 6.12). A total of 80,680 HxH smolts were released from the Nason Creek Acclimation Facility for the Nason spring Chinook program.

Table 6.12. Numbers of spring Chinook smolts tagged and released from the hatchery, brood years 2013-2017. The release target for Nason Creek spring Chinook is 223,670 smolts. CWT marking rates were adjusted for tag loss before the fish were released.

Brood year	Release year	Type of release	CWT mark rate	Number released that were PIT tagged	Total number of smolts released
2013	2015	Volitional	0.9303	20,139	43,082
2014[a]	2016	Forced	0.9650	5,009	32,215
2015	2017	Forced	0.9681	10,009	243,127
2016	2018	Forced	0.9675	10,094	233,471

Brood year	Release year	Type of release	CWT mark rate	Number released that were PIT tagged	Total number of smolts released
2017	2019	Forced	0.9672	10,058	231,859

[a] Only the WxW Nason program was released from the Nason Creek Acclimation Facility because of water-intake concerns. The HxH Nason program was transferred to the Chiwawa Acclimation Facility on 2-3 March 2016 (see Table 5.9).

Numbers tagged

The 2017 brood Nason spring Chinook were 96.7% CWT[25] and blank wire adipose tagged (Table 6.13).

On 18-21 March 2020, a total of 10,104 Nason Creek spring Chinook from the 2018 brood were PIT tagged at the Nason Creek Acclimation Facility. Chinook PIT tagged in Ponds 1-4 were HxH fish, while Chinook tagged in Ponds 5-8 were WxW fish. Fish were not fed during PIT tagging or for two days before and after tagging. Fish averaged 111-119 mm in length and 16-19 g at time of tagging.

The number of hatchery spring Chinook that have been PIT-tagged and released into Nason Creek are shown in Table 6.13. The number of fish tagged and released has ranged from 5,009 to 20,139.

Table 6.13. Summary of PIT-tagging activities for Nason Creek hatchery spring Chinook, brood years 2013-2017.

Brood year	Release year	Number of fish tagged	Number of tagged fish that died	Number of tags shed	Number of tagged fish released
2013	2015	20,234	94	1	20,139
2014	2016	5,010	1	0	5,009
2015	2017	10,104	5	0	10,099
2016	2018	10,104	10	0	10,094
2017	2019	10,100	42	0	10,058

Fish size and condition at release

The WxW spring Chinook from the 2017 brood were force released as yearling smolts on 23 April 2019. Size at release (22 fpp) was smaller than the approximate target of 18 fpp established for the program. The CV for fork length was lower than the target (Table 6.14).

The HxH spring Chinook were force released as yearling smolts on 23 April 2019 into Nason Creek. Size at release (24 fpp) was smaller than the approximate target of 18 fpp established for the program. The CV for fork length was lower than the target (Table 6.14).

[25] At least 60 days after tagging, taggers conduct a quality control procedure, which includes collecting a sample of tagged fish and scanning for tag retention. Thus, the number of tagged fish released is adjusted for tag loss.

Table 6.14. Mean lengths (FL, mm), weight (g and fish/pound), and coefficient of variation (CV) of spring Chinook smolts released from the hatchery, brood years 2013-2017. Size targets are provided in the last row of the table.

Brood year	Release year	Origin	Fork length (mm)		Mean weight	
			Mean	CV	Grams (g)	Fish/pound
2013	2015	WxW	129	8.3	27.6	16
		HxH	-	-	-	-
2014[a]	2016	WxW	124	7.7	21.7	21
		HxH	134	13	29	16
2015	2017	WxW	120	6.7	21.3	21
		HxH	118	7.7	20	23
2016	2018	WxW	120	6.6	20.8	22
		HxH	120	5.8	20.3	22
2017	2019	WxW	119	6.5	21.1	22
		HxH	115	8.1	19.3	24
Average		***WxW***	***122***	***7.2***	***22.5***	***20***
		HxH	***122***	***8.7***	***22.2***	***21***
Median		***WxW***	***120***	***6.7***	***21.3***	***21***
		HxH	***119***	***7.9***	***20.2***	***23***
Targets		***WxW***	***155***	***9.0***	***37.8***	***18***
		HxH	***155***	***9.0***	***37.8***	***18***

[a] This represents only the WxW Nason program released from the Nason Creek Acclimation Facility. The HxH program was transferred to the Chiwawa Acclimation Facility on 2-3 March 2016 for release because of water-intake concerns at the Nason Creek Acclimation Facility. Statistics on the 2014 brood HxH program pre-release sample at the Chiwawa Acclimation Facility were 134 mean length, 17.5 length CV, 28.6 g mean wt., and 16 fpp.

Survival Estimates

Overall survival of Nason Creek spring Chinook from green (unfertilized) egg to release was above the standard set for the program (Table 6.15). There was higher than expected survivals throughout most stages (except eyed egg to ponding) contributing to increased program performance. Pre-spawn survival of adults was also above the standard set for the program.

Table 6.15. Hatchery life-stage survival rates (%) for spring Chinook, brood years 2013-2017. Survival standards or targets are provided in the last row of the table.

Brood year	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
2013	100.0	100.0	93.5	98.8	99.4	98.2	93.8	99.1	86.6
2014[a]	97.3	100.0	91.3	97.6	99.5	99.0	98.1	99.5	87.4
2015	91.9	97.1	94.5	97.9	99.5	99.2	97.9	99.4	90.6
2016	98.6	100.0	92.2	97.9	99.6	98.9	98.0	99.5	88.4
2017	95.6	93.9	97.5	94.2	99.7	99.4	94.5	95.5	86.8

Brood year	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
Average	***96.7***	***98.2***	***93.8***	***97.3***	***99.5***	***98.9***	***96.5***	***98.6***	***88.0***
Median	***97.3***	***100.0***	***93.5***	***97.9***	***99.5***	***99.0***	***97.9***	***99.4***	***87.4***
Standard	***90.0***	***85.0***	***92.0***	***98.0***	***97.0***	***93.0***	***90.0***	***95.0***	***81.0***

[a] The survival estimates are a combination of the WxW and HxH Nason programs. The WxW program was reared at the Nason Creek Acclimation Facility until release. The HxH Chinook that were reared at the Nason Creek Acclimation Facility until transferred to the Chiwawa Acclimation Facility on 2-3 March 2016 because of water-intake concerns at the Nason Creek Acclimation Facility. The HxH fish were released from the Chiwawa Acclimation Facility on 15-20 April 2016.

6.4 Disease Monitoring

Results of 2019 adult broodstock bacterial kidney disease (BKD) monitoring indicated that 96% of females had ELISA values less than 0.199. (Table 6.16).

Table 6.16. Proportion of bacterial kidney disease (BKD) titer groups for the Nason Creek spring Chinook broodstock by origin, brood years 2013-2019. Also included are the proportions to be reared at either 0.125 fish per pound or 0.060 fish per pound.

Brood year	Optical density values by titer group								Proportion at rearing densities (fish per pound, fpp)[b]			
	Very Low ($\leq$ 0.099)		Low (0.1-0.199)		Moderate (0.2-0.449)		High ($\geq$ 0.450)		$\leq$ 0.125 fpp (<0.119)		$\leq$ 0.060 fpp (>0.120)	
	Wild	Hatch	Wild	Hatch	Wild	Hatch	Wild	Hatch	Wild	Hatch	Wild	Hatch
2013	0.7000	0.3333	0.3000	0.6666	0.0000	0.0000	0.0000	0.0000	0.9231	0.1000	0.0769	0.0000
2014	0.5000	--	0.3000	--	0.0000	--	0.2000	--	0.8000	--	0.2000	--
2015[a]	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.000	0.0000	0.0000
2016	0.8888	0.9118	0.1111	0.0882	0.0000	0.0000	0.0000	0.0000	0.8888	0.9118	0.1111	0.0882
2017	0.9429	0.9375	0.0571	0.0625	0.0000	0.0000	0.0000	0.0000	0.9714	0.9375	0.0286	0.0625
2018	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.000	1.0000	0.0000	0.0000
2019	0.9565	0.9211	0.0000	0.0263	0.0000	0.0263	0.0435	0.0263	0.9565	0.9211	0.0790	0.0435
Average	***0.8555***	***0.8506***	***0.1097***	***0.1406***	***0.0000***	***0.0044***	***0.0348***	***0.0044***	***0.9343***	***0.8117***	***0.0708***	***0.0324***
Median	***0.9429***	***0.9293***	***0.0571***	***0.0444***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.9565***	***0.9293***	***0.0769***	***0.0218***

[a] Determination of origin should be considered preliminary pending scale analyses.
[b] ELISA values from broodstock BKD testing dictate what density the progeny of the broodstock are reared. Progeny of broodstock with high ELISA values are reared at lower density.

6.5 Natural Juvenile Productivity

During 2019, juvenile spring Chinook were sampled at the Nason Creek trap.

Smolt and Emigrant Estimates

Numbers of spring Chinook smolts and emigrants were estimated at the Nason Creek trap in 2019. A complete description of trapping operations on Nason Creek can be found in Appendix N.

Nason Creek Trap

The Nason Creek Trap operated between 1 March and 27 November 2019. During that time, the trap was inoperable for 120 days because of low stream discharge or flooding. Daily trap efficiencies were estimated from a flow-efficiency regression model. The daily number of fish captured was expanded by the estimated trap efficiency to estimate total emigration. If a viable flow-efficiency regression model could not be developed, a pooled efficiency was used to expand daily catch. All pooled estimates will be recalculated as flow-efficiency models are developed.

Wild yearling spring Chinook (2017 brood year) were captured primarily during April and May 2019 (Figure 6.4). Because a viable yearling emigrant flow-efficiency regression model could not be established at the downstream trap location, a pooled estimate was employed as a temporary method of expansion. The estimated wild yearling Chinook emigration from the Nason Creek basin was 4,494 (±14,383). Combining the number of subyearling spring Chinook (23,196) that emigrated during the fall of 2018 with the total number of yearling Chinook (4,494) that emigrated during 2019 resulted in an emigrant estimate of 27,690 (±14,634) spring Chinook (Table 6.17).

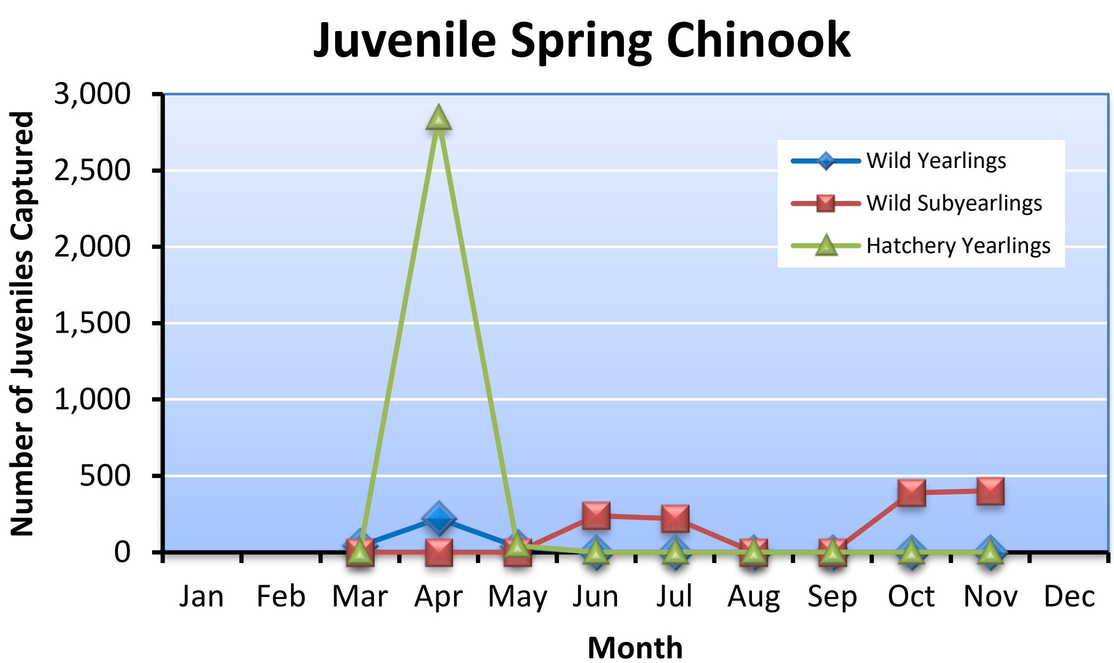


Figure 6.4. Monthly captures of wild subyearling and wild and hatchery yearling spring Chinook at the Nason Creek Trap, 2019.

Table 6.17. Numbers of redds and juvenile spring Chinook at different life stages in the Nason Creek basin for brood years 2002-2018; ND = no data.

Brood year	Number of redds	Egg deposition[a]	Number of subyearling emigrants[b]	Number of smolts produced within Nason Creek basin	Number of emigrants[c]
2002	294	1,368,276	ND	4,683	ND
2003	83	485,052	13,067	6,358	19,425
2004	169	811,031	12,111	2,597	14,708
2005	193	835,111	14,565	8,696	23,261
2006	152	657,248	4,144	7,798	11,942
2007	101	448,541	17,097	5,679	22,776
2008	336	1,542,912	26,284	3,611	29,895

Brood year	Number of redds	Egg deposition[a]	Number of subyearling emigrants[b]	Number of smolts produced within Nason Creek basin	Number of emigrants[c]
2009	167	763,691	27,720	1,705	29,425
2010	188	811,032	8,685	3,535	12,220
2011	170	745,450	18,457	2,422	20,879
2012	413	1,744,099	34,961	4,561	39,522
2013	212	859,024	26,657	6,992	33,649[d]
2014	115	435,505	8,359	930	9,289[d]
2015	85	379,355	10,812	7,247	18,059[d]
2016	85	381,395	26,923	5,082	32,005[d]
2017	68	321,708	23,196	4,494	27,690[d]
Average	***177***	***786,839***	***17,837***	***4,780***	***22,983***
Median	***168***	***754,571***	***17,097***	***4,561***	***22,776***

[a] Egg deposition is calculated as the number of redds times the fecundity of both wild and hatchery spring Chinook salmon (from Table 5.5).
[b] Subyearling emigrants does not include fry that left the watershed before 1 July.
[c] Brood years 2002-2012 do not include estimates of numbers of juvenile spring Chinook that emigrated during non-trapping periods (1 Dec to 28 Feb). Brood years 2013 to present include estimates of numbers of juvenile spring Chinook that emigrated during non-trapping periods.
[d] Numbers expanded based on mark-recapture studies during non-trapping periods.

Wild subyearling spring Chinook (2018 brood year) were captured between 1 July and 27 November 2019 (Figure 6.1). Based on capture efficiencies estimated from the flow model, the total number of wild subyearling Chinook emigrating from Nason Creek was 29,530 (±3,587).

Yearling spring Chinook sampled in 2019 averaged 97 mm in length, 10.1 g in weight, and had a mean condition of 1.08 (Table 6.18). Estimated length, weight, and condition for these fish were greater than the overall means of yearling spring Chinook sampled in previous years (overall means, 93 mm, 8.8 g, and 1.06). Subyearling spring Chinook sampled in 2019 at the Nason Creek Trap averaged 75 mm in length, 4.8 g in weight, and had a mean condition of 1.05 (Table 6.18). Fork length and weight estimates were less than the overall means of subyearling spring Chinook sampled in previous years (overall means, 77 mm, 5.2 g, and 1.07).

Table 6.18. Mean fork length (mm), weight (g), and condition factor of subyearling and yearling spring Chinook collected in the Nason Creek Trap, 2004-2019. Numbers in parentheses indicate 1 standard deviation.

Sample year	Life stage	Sample size[a]	Mean size		
			Length (mm)	Weight (g)	Condition (K)
2004	Subyearling	656	82 (7)	5.9 (1.7)	1.04 (0.11)
	Yearling	323	92 (8)	8.2 (2.3)	1.04 (0.08)
2005	Subyearling	872	76 (9)	4.8 (1.7)	1.02 (0.13)
	Yearling	276	94 (7)	8.7 (2.0)	1.04 (0.12)
2006	Subyearling	1422	73 (9)	3.9 (1.9)	0.92 (0.16)
	Yearling	362	91 (7)	7.5 (1.8)	0.98 (0.11)
2007	Subyearling	609	78 (14)	5.9 (2.6)	1.15 (0.16)

Sample year	Life stage	Sample size[a]	Mean size		
			Length (mm)	Weight (g)	Condition (K)
	Yearling	678	88 (9)	7.4 (2.4)	1.05 (0.13)
2008	Subyearling	1,001	75 (14)	5.0 (2.5)	1.10 (0.11)
	Yearling	881	96 (6)	9.5 (2.0)	1.06 (0.09)
2009	Subyearling	2,147	72 (11)	4.4 (2.1)	1.08 (0.08)
	Yearling	162	96 (8)	9.6 (2.4)	1.08 (0.09)
2010	Subyearling	3,032	81 (11)	6.2 (2.3)	1.13 (0.10)
	Yearling	366	97 (7)	10.2 (2.3)	1.10 (0.09)
2011	Subyearling	1,064	72 (13)	4.7 (2.5)	1.13 (0.12)
	Yearling	150	89 (10)	7.7 (1.8)	1.09 (0.12)
2012	Subyearling	2,141	78 (11)	5.3 (2.0)	1.05 (0.09)
	Yearling	363	93 (6)	9.3 (2.2)	1.11 (0.08)
2013	Subyearling	4,408	70 (11)	3.8 (1.7)	1.03 (0.10)
	Yearling	239	91 (7)	7.9 (2.1)	1.03 (0.07)
2014	Subyearling	1,543	69 (12)	3.8 (2.3)	1.05 (0.06)
	Yearling	464	90 (7)	7.5 (1.8)	1.03 (0.06)
2015	Subyearling	209	84 (8)	6.5 (1.7)	1.08 (0.08)
	Yearling	152	93 (7)	8.4 (2.1)	1.03 (0.09)
2016	Subyearling	490	85 (13)	6.9 (2.5)	1.07 (0.09)
	Yearling	61	96 (6)	9.0 (1.7)	1.01 (0.06)
2017	Subyearling	1,864	74 (12)	4.7 (2.1)	1.10 (0.08)
	Yearling	357	96 (7)	9.8 (2.1)	1.09 (0.07)
2018	Subyearling	710	83 (12)	6.5 (2.4)	1.09 (0.08)
	Yearling	301	95 (7)	9.5 (2.1)	1.09 (0.07)
2019	Subyearling	1,249	75 (12)	4.8 (2.1)	1.05 (0.08)
	Yearling	294	97 (7)	10.1 (2.1)	1.08 (0.09)
Average	***Subyearling***	***1,464***	***77 (5)***	***5.2 (1.0)***	***1.07 (0.05)***
	Yearling	***339***	***93 (3)***	***8.8 (1.0)***	***1.06 (0.04)***
Median	***Subyearling***	***1,157***	***76 (9)***	***4.9 (2.2)***	***1.08 (0.08)***
	Yearling	***312***	***94 (7)***	***8.9 (2.2)***	***1.06 (0.09)***

[a] Sample size represents the number of fish that were measured for both length and weight.

Electrofishing Surveys

Nason Creek was sampled between 3 September and 13 November with a backpack electrofisher. During this sampling, 3,447 wild subyearling Chinook salmon were collected of which 3,212 received a PIT tag. Additionally, 327 wild coho parr, eight juvenile bull trout, and 54 lamprey ammocoetes were collected. The greatest concentration of juvenile Chinook salmon occurred between Rkm 6 and 17 with a mean sample rate of one Chinook salmon collected for every nine seconds of sampling. Over the sampling period 86 Chinook salmon died resulting in a mortality rate of 2.5%. No other mortality was recorded.

Of the 2,524 wild subyearling Chinook salmon PIT tagged remotely in Nason Creek in 2018, there were 74 detections during the non-trapping season (1 December 2018 through 1 March 2019) at the lower Nason Creek PIT-tag antenna array (Table 6.19). These detections were used in a significant flow efficiency model (R^2 = 0.61; P > 0.001) to produce a non-trapping emigration estimate for the Chiwawa basin of 5,793 (95% CI; ±1,257).

Table 6.19. Number of remotely sampled subyearling spring Chinook salmon captured with electrofishing gear and PIT tagged in Nason Creek, 2014-2019.

Sample year	Number captured	Number tagged	Number captured at smolt trap in fall of sample year	Number detected at the lower-most array on the Chiwawa R. during non-trapping period	Number captured at smolt trap in spring of following year	Survival to McNary Dam (%)
2014	1,908	1,816	27	12	4	5.3
2015	1,153	1,087	5	0	0	19.1
2016	828	802	9	26	11	12.4
2017	3,401	3,242	63	34	12	12.9
2018	2,648	2,524	36	74	17	12.9
2019	3,447	3,212	20	--	--	--
Average	***2,231***	***2,114***	***27***	***29***	***9***	***12.5***
Median	***2,278***	***2,170***	***24***	***26***	***11***	***12.9***

PIT-Tagging Activities

As part of the Comparative Survival Study (CSS) and PUD studies, a total of 23,649 wild juvenile Chinook (17,448 subyearling and 6,201 yearlings) were PIT tagged and released in 2019 in the Wenatchee River basin (Table 6.20). A total of 4,440 juvenile Chinook were PIT tagged in Nason Creek in 2019. See Appendix D for a complete list of all fish captured, tagged, lost, and released.

Table 6.20. Numbers of wild Chinook that were captured, tagged, and released at different locations within the Wenatchee River basin, 2019. Numbers of fish that died or shed tags are also given.

Sampling location	Life stage	Number captured	Number of recaptures	Number tagged	Number died	Shed tags	Total tagged fish released	Percent mortality
Chiwawa Trap	Subyearling	13,970	247	9,634	78	0	9,634	0.56
	Yearling	4,730	91	4,540	9	0	4,540	0.19
	Total	**18,700**	**338**	**14,174**	**87**	**0**	**14,174**	**0.47**
Chiwawa River (Electrofishing)	Subyearling	3,448	67	3,309	9	1	3,309	0.26
	Yearling	0	0	0	0	0	0	0.00
	Total	**3,448**	**67**	**3,309**	**9**	**1**	**3,309**	**0.26**
Nason Creek Trap	Subyearling	1,759	20	959	25	0	959	1.42
	Yearling	296	18	269	2	0	269	0.68
	Total	**2,055**	**38**	**1,228**	**27**	**0**	**1,228**	**1.31**

Sampling location	Life stage	Number captured	Number of recaptures	Number tagged	Number died	Shed tags	Total tagged fish released	Percent mortality
Nason Creek (Electrofishing)	Subyearling	3,447	76	3,212	86	0	3,212	2.49
	Yearling	0	0	0	0	0	0	0.00
	Total	**3,447**	**76**	**3,212**	**86**	**0**	**3,212**	**2.49**
White River Trap	Subyearling	372	1	332	6	0	332	1.61
	Yearling	119	1	103	9	0	103	7.56
	Total	**491**	**2**	**435**	**15**	**0**	**435**	**3.05**
Lower Wenatchee Trap	Subyearling	28,534	101	2	167	0	2	0.59
	Yearling	1,485	4	1,289	2	0	1,289	0.13
	Total	**30,019**	**105**	**1,291**	**169**	**0**	**1,291**	**0.56**
Total:	**Subyearling**	***51,530***	***512***	***17,448***	***371***	***1***	***17,448***	***0.72***
	Yearling	***6,630***	***114***	***6,201***	***22***	***0***	***6,201***	***0.33***
Grand Total:		***58,160***	***626***	***23,649***	***393***	***1***	***23,649***	***0.68***

Numbers of wild Chinook salmon PIT-tagged and released as part of CSS and PUD studies during the period 2008-2019 are shown in Table 6.21.

Table 6.21. Summary of the numbers of wild Chinook that were tagged and released at different locations within the Wenatchee River basin, 2008-2019.

Sampling location	Life stage	Numbers of PIT-tagged wild Chinook salmon released											
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Chiwawa Trap	Subyearling	8,755	8,765	3,324	6,030	7,644	9,086	11,358	10,471	7,354	8,241	5,686	9,634
	Yearling	8,397	3,694	6,281	4,318	7,980	3,093	4,383	6,204	2,729	5,711	3,447	4,540
	Total	**17,152**	**12,459**	**9,605**	**10,348**	**15,624**	**12,179**	**15,741**	**16,675**	**10,083**	**13,952**	**9,133**	**14,174**
Chiwawa River (Angling or Electro-fishing)	Subyearling	43	128	531	0	3,181	3,017	1,032	1,054	1,776	2,703	3,737	3,309
	Yearling	0	3	4	0	0	0	0	0	0	0	0	0
	Total	**43**	**131**	**535**	**0**	**3,181**	**3,017**	**1,032**	**1,054**	**1,776**	**2,703**	**3,737**	**3,309**
Upper Wenatchee Trap	Subyearling	0	37	3	1	1	0	--	--	--	--	--	--
	Yearling	159	296	486	714	75	94	--	--	--	--	--	--
	Total	**159**	**333**	**489**	**715**	**76**	**94**	**--**	**--**	**--**	**--**	**--**	**--**
Nason Creek Trap	Subyearling	1,741	1,890	2,828	822	1,939	3,290	1,113	219	434	1,877	686	959
	Yearling	894	185	364	147	357	237	456	142	61	346	296	269
	Total	**2,635**	**2,075**	**3,192**	**969**	**2,296**	**3,527**	**1,569**	**361**	**495**	**2,223**	**982**	**1,228**
Nason Creek (Angling or Electro-fishing)	Subyearling	4	701	595	0	0	0	1,816	1,089	802	3,240	2,524	3,212
	Yearling	0	13	3	0	0	0	0	0	0	0	0	0
	Total	**4**	**714**	**598**	**0**	**0**	**0**	**1,816**	**1,089**	**802**	**3,240**	**2,524**	**3,212**
White River Trap	Subyearling	0	441	143	144	285	374	156	149	136	507	220	332
	Yearling	0	265	359	65	180	22	49	34	3	41	106	103
	Total	**0**	**706**	**502**	**209**	**465**	**396**	**205**	**183**	**139**	**548**	**326**	**435**

Sampling location	Life stage	Numbers of PIT-tagged wild Chinook salmon released											
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lower Wenatchee Trap	Subyearling	2	0	0	0	0	0	36	0	18	0	5	2
	Yearling	506	468	917	0	0	1,712	1,506	1,301	538	1,220	1,243	1,289
	Total	**508**	**468**	**917**	**0**	**0**	**1,712**	**1,542**	**1,301**	**556**	**1,220**	**1,248**	**1,291**
Total:	**Subyearling**	**10,545**	**11,962**	**7,424**	**6,997**	**13,050**	**15,767**	**15,511**	**12,982**	**10,520**	**16,568**	**12,858**	**17,448**
	Yearling	**9,956**	**4,924**	**8,414**	**5,244**	**8,592**	**5,158**	**6,394**	**7,681**	**3,331**	**7,318**	**5,092**	**6,201**
Grand Total:		***20,501***	***16,886***	***15,838***	***12,241***	***21,642***	***20,925***	***21,905***	***20,663***	***13,851***	***23,886***	***17,950***	***23,649***

Freshwater Productivity

Productivity and survival estimates for different life stages of spring Chinook in the Nason Creek watershed are provided in Table 6.22. During the period 2002-2017, freshwater productivities ranged from 8-85 smolts/redd and 65-363 emigrants/redd. Survivals during the same period ranged from 0.2-1.9% for egg-smolt and 1.5-8.1% for egg-emigrants.

Table 6.22. Productivity (fish/redd) and survival (%) estimates for different juvenile life stages of spring Chinook in the Nason Creek watershed for brood years 2002-2017; ND = no data. These estimates were derived from data in Table 6.17. Numbers in parentheses are estimates that have been adjusted based on mark-recapture studies conducted during non-trapping periods (for brood years 2013 to present). Summary statistics do not include adjusted estimates.

Brood year	Smolts/Redd[a]	Emigrants/ Redd	Egg-Smolt[a] (%)	Egg-Emigrant (%)
2002	16	ND	0.3	ND
2003	77	234	1.3	4.0
2004	15	87	0.3	1.8
2005	45	121	1.0	2.8
2006	51	79	1.2	1.8
2007	56	226	1.3	5.1
2008	11	89	0.2	1.9
2009	10	176	0.2	3.9
2010	19	65	0.4	1.5
2011	14	123	0.3	2.8
2012	11	96	0.3	2.3
2013	33 (65)	127 (159)	0.8 (1.6)	3.1 (3.9)
2014	8 (21)	68 (81)	0.2 (0.5)	1.8 (2.1)
2015	85 (137)	161 (212)	1.9 (3.1)	3.6 (4.8)
2016	60 (73)	363 (377)	1.3 (1.6)	8.1 (8.4)
2017	66 (151)	322 (407)	1.4 (3.2)	6.8 (8.6)
Average	***36***	***156***	***0.8***	***3.4***
Median	***26***	***123***	***0.6***	***2.8***

[a] These estimates include Nason Creek smolts produced only within the Nason Creek basin.

Seeding level (egg deposition) explained most of the variability in productivity and survival of juvenile spring Chinook in the Nason Creek watershed. That is, for estimates based on smolts produced within the Nason Creek watershed (not adjusted for non-trapping periods), survival and productivity decreased as seeding levels increased (Figure 6.5). This suggests that density dependence regulates juvenile productivity and survival within the Nason Creek watershed.

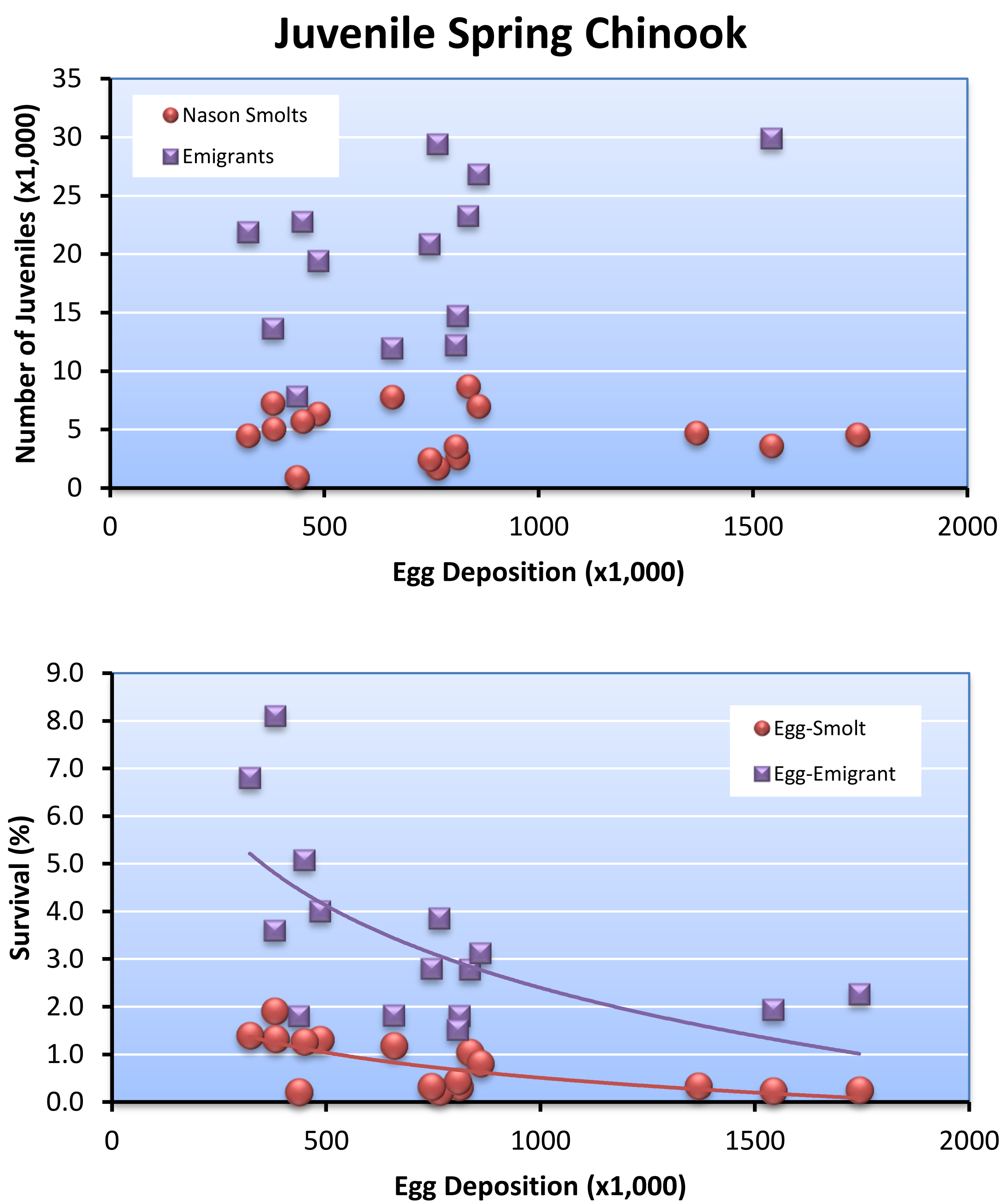


Figure 6.5. Relationships between seeding levels (egg deposition) and juvenile life-stage survivals and productivities for Nason Creek spring Chinook, brood years 2002-2017. Nason Creek smolts are smolts produced only in the Nason Creek watershed.

Population Carrying Capacity

Population carrying capacity (*K*) is defined as the maximum equilibrium population size estimated with population models (e.g., logistic equation, Beverton-Holt model, hockey stick model, and the Ricker model).[26] Maximum equilibrium population size is generated from density dependent mechanisms that reduce population growth rates as population size increases (negative density dependence). This is referred to as compensation. Population size fluctuates about the maximum equilibrium size because of variability in vital rates that are unrelated to density (density independent factors) and measurement error. In this section, we estimate smolt carrying capacities using the Ricker stock-recruitment model (see Appendix 6 in Hillman et al. 2019 for a detailed description of methods). For consistency, only unadjusted smolt estimates were used to model stock-recruitment relationships (i.e., adjusted estimates based on mark-recapture studies conducted for brood years 2015 to present were not included in the analyses). The Ricker model was the only stock-recruitment model that could be fit to the juvenile spring Chinook data.

Based on the Ricker model, the population carrying capacity for spring Chinook smolts in the Nason Creek watershed is 5,146 smolts (95% CI: 1,022 – 8,134) (Figure 6.6). Here, smolts are defined as the number of yearling spring Chinook produced entirely within Nason Creek. These estimates reflect current environmental conditions (most recent 16 years) within the Nason Creek watershed. Land use activities such as logging, roads, railways, development, and recreation have altered the historical conditions of the watershed. Thus, the estimated population capacity estimates may not reflect historical capacities for spring Chinook smolts in Nason Creek.

[26] Population carrying capacity (*K*) should not be confused with habitat carrying capacity (*C*), which is defined as the maximum population of a given species that a particular environment can sustain.

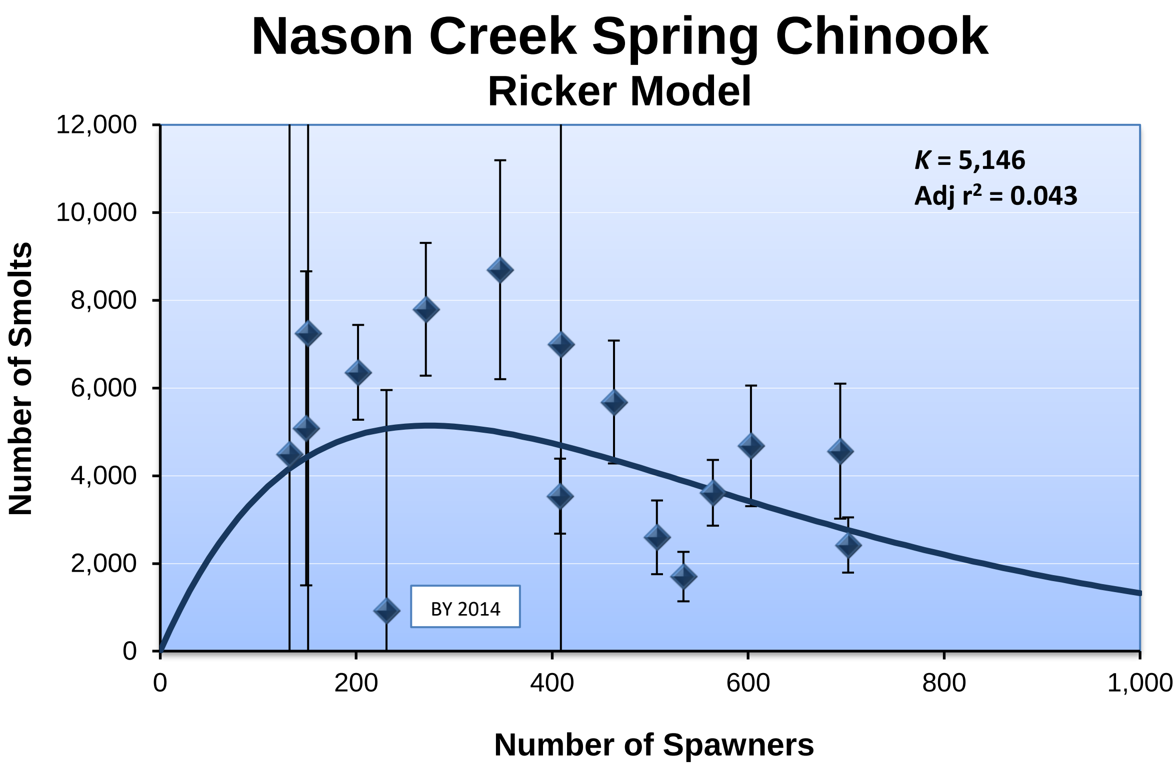


Figure 6.6. Relationship between spawners and number of yearling smolts produced in the Nason Creek watershed. Population carrying capacity (*K*) was estimated using the Ricker model. Vertical bars represent 95% confidence intervals on smolt estimates.

We tracked the precision of the Ricker parameters for Nason Creek spring Chinook smolts over time to see if precision improves with additional years of data and the parameters and statistics stabilize over time. Examination of variation in the alpha (*A*) and beta (*B*) parameters of the Ricker model and their associated standard errors and confidence intervals indicates that the parameters have not stabilized, and they lack precision (Table 6.23; Figure 6.7). This was also apparent in the estimates of population carrying capacity (Figure 6.8).

Brood year 2014 appeared to have a large effect on the precision of the fit of the stock-recruitment model to the data. The low freshwater productivity measured for brood year 2014 may be related to the relocation of the smolt trap, which was moved from the Campground site (Rkm 0.9) to the Bolser site (Rkm 0.3) in 2014. Relocating the trap required a few years of "fine tuning" the position of the trap to optimize efficiency. Thus, the number of smolts captured after moving the trap may have affected catch of brood year 2014 smolts. A more likely factor affecting the estimate of brood year 2014 productivity was the early onset of high flows in Nason Creek in 2016. An unseasonably large increase in stream flows occurred in February 2016 before the smolt trap was installed in the river. Consequently, a large number of smolts may have emigrated from Nason Creek in February before trapping began (trapping in Nason Creek begins on 1 March). Relatively large captures of spring Chinook smolts during February at the Lower Wenatchee Trap supports the early emigration of smolts in 2016. Finally, adults spawning in 2014 had lower than average fecundities, which may have affected smolt production. Therefore, a combination of factors may be responsible for the low freshwater productivity measured for brood year 2014.

Table 6.23. Estimated parameters and statistics associated with fitting the Ricker model to spawning escapement and smolt data. Smolts represent numbers of smolts produced entirely within the Nason Creek watershed. *A* = alpha parameter; *B* = beta parameter; SE = standard error (estimated from 5,000 bootstrap samples); and r^2 = coefficient of determination. Spawners represent the stock size needed to achieve population capacity.

Years of data	Parameter				Population capacity	Intrinsic productivity	Spawners	r^2
	A	*A* SE	*B*	*B* SE				
5	90.60	87.13	0.0046	0.0015	7,293	91	219	0.453
6	90.02	5,618.57	0.0045	0.0014	7,360	90	222	0.442
7	92.67	1,696.44	0.0046	0.0009	7,395	93	217	0.517
8	107.07	1,208.15	0.0052	0.0012	7,575	107	192	0.454
9	99.89	1,125.42	0.0051	0.0012	7,149	100	195	0.409
10	90.35	50.04	0.0049	0.0008	6,825	90	205	0.470
11	72.26	34.50	0.0043	0.0009	6,240	72	235	0.308
12	76.76	31.24	0.0043	0.0008	6,522	77	231	0.337
13	35.98	32.48	0.0030	0.0013	4,412	36	333	0.049
14	47.48	29.79	0.0035	0.0011	4,962	47	284	0.038
15	49.93	24.34	0.0036	0.0009	5,088	50	277	0.042
16	51.05	18.89	0.0037	0.0008	5,146	51	274	0.043

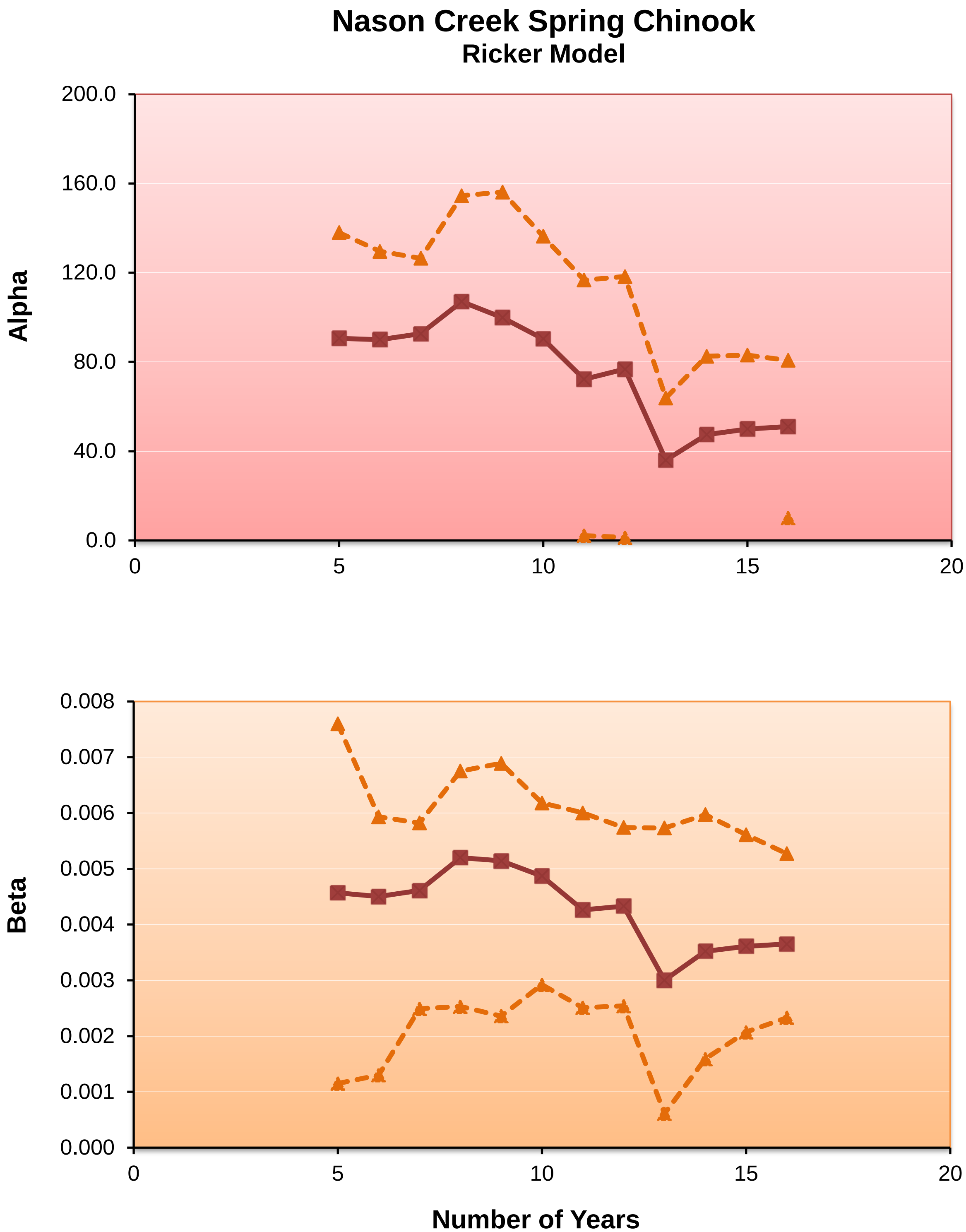


Figure 6.7. Time series of alpha and beta parameters and 95% confidence intervals for the Ricker model that was fit to Nason Creek spring Chinook smolt and spawning escapement data. Confidence intervals were estimated from 5,000 bootstrap samples.

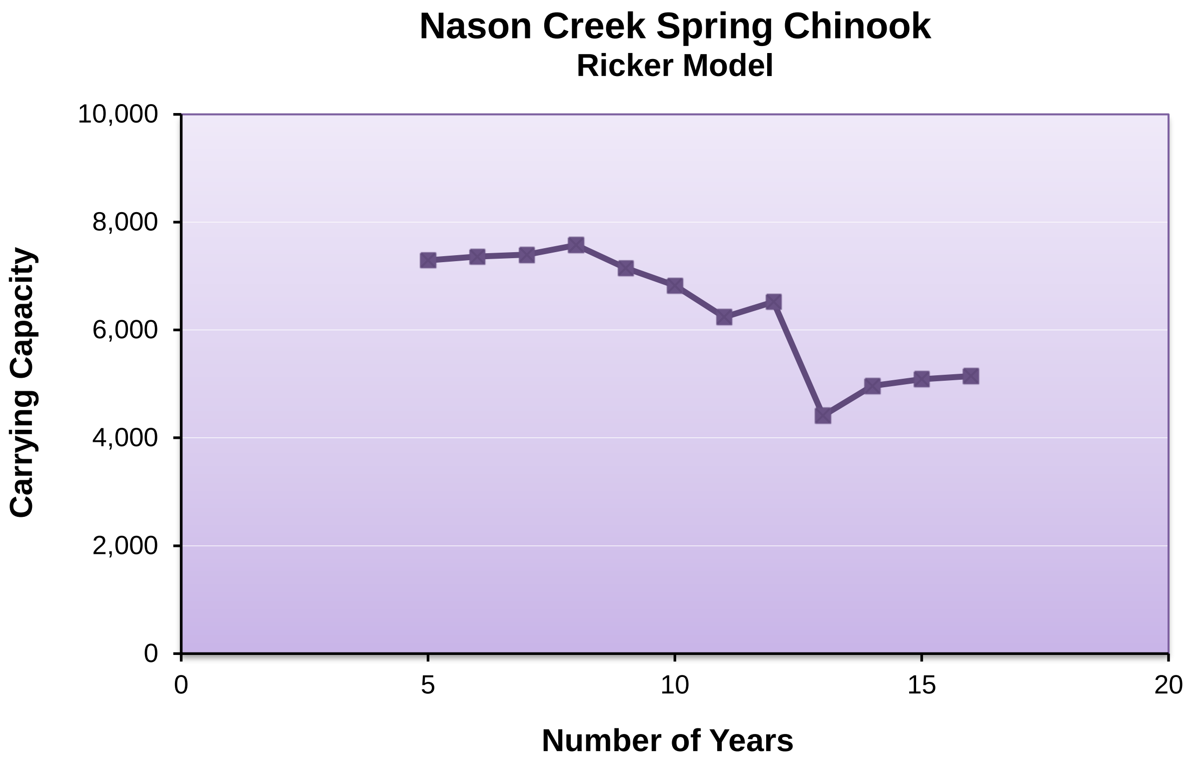


Figure 6.8. Time series of population carrying capacity estimates derived from fitting the Ricker model to Nason Creek spring Chinook smolt and spawning escapement data.

6.6 Spawning Surveys

Surveys for spring Chinook redds were conducted from August through September 2019 in Nason Creek. In the following section, we describe the number and distribution of redds within the Nason Creek basin.

Redd Counts and Distribution

A total of 197 spring Chinook redds were counted in Nason Creek in 2019 (Table 6.24). This is lower than the average of 139 redds counted during the period 1989-2018 in Nason Creek. The adjusted number of redds, based on the Guassian area-under-the-curve method, was 235 redds in Nason Creek in 2019 (Table 6.24). Redds were not distributed evenly among the four reaches in Nason Creek. Most redds (74%) were located in Reaches 2 and 3 (Table 6.24).

Table 6.24. Numbers (both counted and estimated) and proportions of spring Chinook redds counted within different reaches within Nason Creek during August through September 2019. See Table 2.7 for description of survey reaches.

Stream/watershed	Reach	Number of observed redds	Estimated number of redds*	Proportion of redds estimated within stream/watershed
Nason	Nason 1 (N1)	14	17	0.07
	Nason 2 (N2)	37	48	0.21
	Nason 3 (N3)	107	125	0.53
	Nason 4 (N4)	39	45	0.19
Total		***197***	***235***	***1.00***

* Estimated redds represent the "adjusted" number of redds based on Guassian area-under-the-curve method (see Appendix L).

Spawn Timing

Spring Chinook began spawning during the third week of August in Nason Creek and peaked the first week of September (Figure 6.9). Spawning in Nason Creek ended the last week of September.

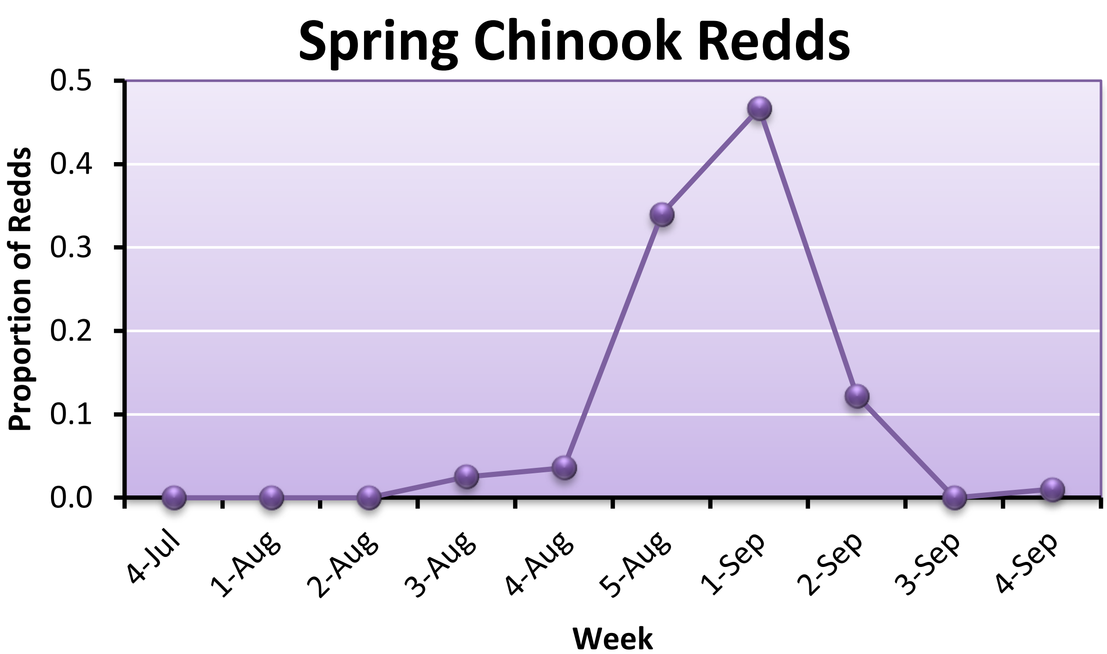


Figure 6.9. Proportion of spring Chinook redds counted during different weeks within Nason Creek, August through September 2019.

Spawning Escapement

Spawning escapement for spring Chinook was calculated as the observed (unadjusted for bias) and estimated (adjusted for bias) number of redds times the fish per redd expansion factor, which was estimated from broodstock and fish sampled at adult trapping sites.[27] The estimated fish per redd ratio for spring Chinook upstream from Tumwater in 2019 was 1.93 (based on sex ratios estimated at Tumwater Dam). Multiplying this ratio by the number of redds counted in Nason Creek in 2019 resulted in a total spawning escapement of 380 spring Chinook (based on unadjusted redd counts; Table 6.25a) or 454 spring Chinook (based on adjusted redd counts; Table 6.25b) in Nason Creek.

Table 6.25a. Spawning escapements for spring Chinook in the Wenatchee River basin for return years 1989-2019; NA = not available. Note that these estimates represent observed redds and have not been adjusted for redd count bias.

Return year	Upper basin spawning escapement						Lower basin spawning escapement			Total
	Fish/redd	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River	Fish/redd	Icicle	Peshastin	
1989	2.27	713	288	102	145	213	1.56	37	NA	**1,498**
1990	2.24	571	235	67	49	81	1.71	86	7	**1,096**
1991	2.33	242	156	42	49	96	1.73	69	2	**656**
1992	2.24	676	181	78	78	85	1.65	61	0	**1,159**
1993	2.20	233	491	134	145	189	1.66	88	8	**1,288**
1994	2.24	184	60	16	7	13	2.11	32	0	**312**
1995	2.51	33	18	0	5	3	2.01	18	0	**77**
1996	2.53	58	83	8	30	3	2.09	25	2	**209**
1997	2.22	182	122	18	33	33	1.69	56	2	**446**
1998	2.21	91	64	18	11	0	1.81	20	0	**204**
1999	2.77	94	22	8	3	6	2.06	12	0	**145**
2000	2.70	346	270	24	22	100	1.68	114	0	**876**
2001	1.60	1,725	598	118	166	349	1.72	151	298	**3,405**
2002	2.05	707	603	86	86	113	1.55	380	166	**2,141**
2003	2.43	270	202	29	36	58	1.93	35	116	**746**
2004[a]	3.56/3.00	851	507	39	66	138	1.76	53	97	**1,751**
2005	1.80	599	347	115	155	257	1.67	13	5	**1,491**
2006	1.78	529	271	37	55	48	1.68	84	17	**1,041**
2007	4.58	1,296	463	101	92	55	1.91	32	21	**2,060**
2008	1.68	1,158	564	64	52	302	1.78	206	37	**2,383**
2009	3.20	1,347	534	125	173	16	2.22	71	33	**2,299**
2010	2.18	1,094	408	83	72	102	1.56	242	8	**2,009**
2011	4.13	2,032	702	124	83	50	2.60	317	68	**3,376**
2012	1.68	1,478	694	72	144	123	1.60	318	16	**2,845**
2013	1.93	1,378	409	98	104	33	1.98	212	8	**2,242**
2014	2.01	975	231	50	52	46	1.93	407	0	**1,761**
2015	1.78	967	151	50	125	98	1.87	247	19	**1,657**
2016	1.75	546	149	39	77	30	1.81	130	4	**975**
2017	1.94	431	132	19	29	17	1.81	72	5	**705**
2018	1.88	622	169	15	38	38	1.73	5	3	**890**
2019	1.93	442	380	19	29	15	1.86	2	0	**888**

[27] Expansion factor = (1 + (number of males/number of females)).

Return year	Upper basin spawning escapement						Lower basin spawning escapement			Total
	Fish/redd	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River	Fish/redd	Icicle	Peshastin	
Average	--	***705***	***307***	***58***	***71***	***87***	--	***116***	***31***	***1,375***
Median	--	***599***	***270***	***50***	***55***	***55***	--	***71***	***6***	***1,159***

[a] In 2004, the fish/redd expansion estimate of 3.56 was applied to the Chiwawa River only and 3.00 fish/redd was applied to the rest of the upper basin.

Table 6.25b. Spawning escapements for spring Chinook in the Wenatchee River basin for return years 1989-2019; NA = not available. Note that these estimates have been adjusted for redd count bias.

Return year	Upper basin spawning escapement						Lower basin spawning escapement			Total
	Fish/redd	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River	Fish/redd	Icicle	Peshastin	
2015	1.78	1,080	183	68	162	117	1.87	247	19	**1,876**
2016	1.75	620	175	61	93	39	1.81	130	4	**1,121**
2017	1.94	493	169	31	37	21	1.81	72	5	**829**
2018	1.88	741	203	21	51	51	1.73	5	3	**1,075**
2019	1.93	529	454	27	37	21	1.86	2	0	**1,069**
Average	--	***693***	***237***	***42***	***76***	***50***	--	***91***	***6***	***1,194***
Median	--	***620***	***183***	***31***	***51***	***39***	--	***72***	***4***	***1,075***

6.7 Carcass Surveys

Surveys for spring Chinook carcasses were conducted during August through September 2019 in Nason Creek. In 2019, 253 spring Chinook carcasses were sampled in Nason Creek. Most of these were sampled in Reach 3 (51%). The number of carcasses sampled in 2019 was more than the overall average of 140 carcasses sampled during the period 1996-2018.

In the Nason Creek watershed, the spatial distribution of hatchery and wild fish was not equal among survey reaches (Table 6.26). In 2019, more hatchery fish were collected during surveys than wild fish. On average, over the survey years, more hatchery fish were collected than wild fish in each of the reaches (Figure 6.10).

Table 6.26. Numbers of wild and hatchery spring Chinook carcasses sampled within different reaches in the Nason Creek watershed, 1999-2019. Numbers represent recovered carcasses that had definitive origins. See Table 2.7 for description of survey reaches.

Survey year	Origin	Survey Reach				Total
		N-1	N-2	N-3	N-4	
1999	Wild	2	3	0	0	**5**
	Hatchery	0	0	0	0	**0**
2000	Wild	19	21	0	9	**49**
	Hatchery	11	9	0	1	**21**
2001	Wild	25	22	0	41	**88**
	Hatchery	91	54	0	22	**167**
2002	Wild	16	34	0	37	**87**

Survey year	Origin	Survey Reach				Total
		N-1	N-2	N-3	N-4	
	Hatchery	33	29	0	35	**97**
2003	Wild	6	19	0	22	**47**
	Hatchery	3	9	0	3	**15**
2004	Wild	29	33	18	24	**104**
	Hatchery	42	26	11	3	**82**
2005	Wild	19	6	11	7	**43**
	Hatchery	130	17	22	4	**173**
2006	Wild	24	17	28	9	**78**
	Hatchery	50	31	17	14	**112**
2007	Wild	2	13	8	6	**29**
	Hatchery	54	77	26	15	**172**
2008	Wild	14	13	16	10	**53**
	Hatchery	102	39	36	13	**190**
2009	Wild	1	12	10	16	**39**
	Hatchery	25	21	20	23	**89**
2010	Wild	3	6	6	4	**19**
	Hatchery	47	29	30	16	**122**
2011	Wild	8	11	11	5	**35**
	Hatchery	22	12	21	8	**63**
2012	Wild	24	11	65	7	**107**
	Hatchery	95	37	70	23	**225**
2013	Wild	4	2	9	8	**23**
	Hatchery	51	12	28	27	**118**
2014	Wild	19	5	13	2	**39**
	Hatchery	25	1	3	0	**29**
2015	Wild	8	4	20	2	**34**
	Hatchery	2	0	7	0	**9**
2016	Wild	9	8	39	15	**71**
	Hatchery	10	0	9	3	**22**
2017	Wild	4	11	15	5	**35**
	Hatchery	3	13	18	8	**42**
2018	Wild	0	5	6	3	**14**
	Hatchery	6	18	40	20	**84**
2019	Wild	0	3	14	8	**25**
	Hatchery	7	51	116	54	**228**
Average	***Wild***	***11***	***12***	***14***	***11***	***49***
	Hatchery	***39***	***23***	***23***	***14***	***98***
Median	***Wild***	***8***	***11***	***11***	***8***	***39***
	Hatchery	***25***	***18***	***18***	***13***	***89***

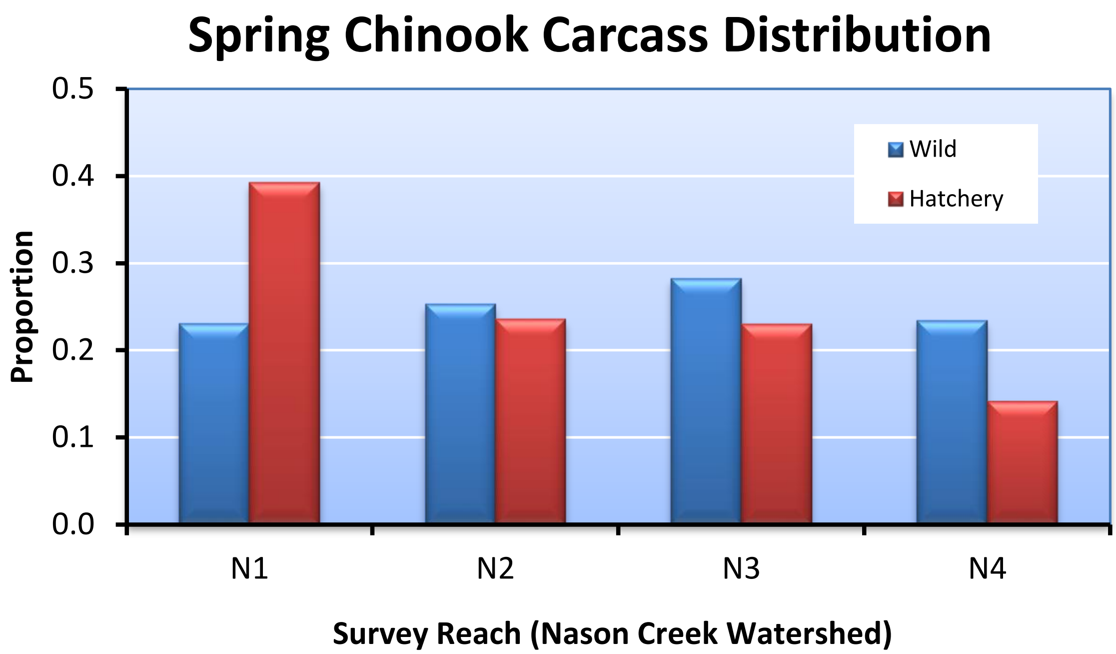


Figure 6.10. Distribution of wild and hatchery produced carcasses in different reaches in the Nason Creek watershed, 1999-2019. Reach codes are described in Table 2.7.

6.8 Life History Monitoring

Life history characteristics of spring Chinook were assessed by examining carcasses on spawning grounds and fish collected at broodstock collection sites, and by reviewing tagging data and fisheries statistics.

Migration Timing

In 2019, there was a small difference in migration timing of hatchery and wild spring Chinook past Tumwater Dam (Table 6.27a and b; Figure 6.11). On average, hatchery fish arrived at the dam later and ended their migration later than did wild fish. Most hatchery and wild spring Chinook migrated upstream past Tumwater Dam during June and July (Figure 6.11).

Table 6.27a. The Julian day and date that 10%, 50% (median), and 90% of the wild and hatchery spring Chinook salmon passed Tumwater Dam, 1998-2019. The average Julian day and date are also provided. Migration timing is based on video sampling at Tumwater. Data for 1998 through 2003 were based on videotapes and broodstock trapping and may not reflect the actual number of hatchery spring Chinook. All spring Chinook were visually examined during trapping from 2004 to present; however, enumeration errors may still exist because of misidentified run-type assignment (i.e., spring or summer runs).

Survey year	Origin	Spring Chinook Migration Time (days)								Sample size
		10 Percentile		50 Percentile		90 Percentile		Mean		
		Julian	Date	Julian	Date	Julian	Date	Julian	Date	
1998	Wild	156	5-Jun	156	5-Jun	156	5-Jun	156	5-Jun	49
	Hatchery	156	5-Jun	156	5-Jun	156	5-Jun	156	5-Jun	25
1999	Wild	192	11-Jul	207	26-Jul	224	12-Aug	207	26-Jul	173
	Hatchery	200	19-Jul	211	30-Jul	229	17-Aug	213	1-Aug	25

Survey year	Origin	Spring Chinook Migration Time (days)								Sample size
		10 Percentile		50 Percentile		90 Percentile		Mean		
		Julian	Date	Julian	Date	Julian	Date	Julian	Date	
2000	Wild	171	19-Jun	186	4-Jul	194	12-Jul	184	2-Jul	651
	Hatchery	179	27-Jun	189	7-Jul	201	19-Jul	190	8-Jul	357
2001	Wild	154	3-Jun	166	15-Jun	185	4-Jul	167	16-Jun	2,073
	Hatchery	157	6-Jun	169	18-Jun	185	4-Jul	170	19-Jun	4,244
2002	Wild	174	23-Jun	189	8-Jul	204	23-Jul	189	8-Jul	1,033
	Hatchery	178	27-Jun	189	8-Jul	199	18-Jul	189	8-Jul	1,363
2003	Wild	162	11-Jun	181	30-Jun	200	19-Jul	181	30-Jun	919
	Hatchery	157	6-Jun	179	28-Jun	192	11-Jul	178	27-Jun	423
2004	Wild	156	4-Jun	172	20-Jun	189	7-Jul	172	20-Jun	969
	Hatchery	161	9-Jun	177	25-Jun	189	7-Jul	177	25-Jun	1,295
2005	Wild	153	2-Jun	172	21-Jun	193	12-Jul	173	22-Jun	1,038
	Hatchery	153	2-Jun	173	22-Jun	187	6-Jul	172	21-Jun	2,808
2006	Wild	177	26-Jun	184	3-Jul	193	12-Jul	185	4-Jul	577
	Hatchery	178	27-Jun	185	4-Jul	194	13-Jul	186	5-Jul	1601
2007	Wild	169	18-Jun	185	4-Jul	203	22-Jul	185	4-Jul	351
	Hatchery	174	23-Jun	192	11-Jul	209	28-Jul	192	11-Jul	3,232
2008	Wild	173	21-Jun	188	6-Jul	209	27-Jul	189	7-Jul	634
	Hatchery	177	25-Jun	193	11-Jul	210	28-Jul	193	11-Jul	5,368
2009	Wild	174	23-Jun	186	5-Jul	201	20-Jul	187	6-Jul	1,008
	Hatchery	175	24-Jun	187	6-Jul	202	21-Jul	188	7-Jul	4,106
2010	Wild	173	22-Jun	190	9-Jul	214	2-Aug	191	10-Jul	977
	Hatchery	180	29-Jun	194	13-Jul	213	1-Aug	195	14-Jul	4,450
2011	Wild	183	2-Jul	198	17-Jul	213	1-Aug	198	17-Jul	1,433
	Hatchery	187	6-Jul	200	19-Jul	210	29-Jul	199	18-Jul	4,707
2012	Wild	180	28-Jun	191	9-Jul	205	23-Jul	192	10-Jul	1,482
	Hatchery	182	30-Jun	194	12-Jul	206	24-Jul	194	12-Jul	4,449
2013	Wild	163	12-Jun	182	1-Jul	199	18-Jul	183	2-Jul	1,106
	Hatchery	164	13-Jun	181	30-Jun	195	14-Jul	181	30-Jun	3,681
2014	Wild	171	20-Jun	188	7-Jul	202	21-Jul	187	6-Jul	1,329
	Hatchery	167	16-Jun	182	1-Jul	195	14-Jul	181	30-Jun	2,510
2015	Wild	150	30-May	170	19-Jun	184	3-Jul	170	19-Jun	1,370
	Hatchery	148	28-May	168	17-Jun	180	29-Jun	167	16-Jun	1,773
2016	Wild	158	6-Jun	180	28-Jun	200	18-Jul	181	29-Jun	1,252
	Hatchery	160	8-Jun	179	27-Jun	191	9-Jul	178	26-Jun	1,284
2017	Wild	175	24-Jun	184	3-Jul	195	14-Jul	184	3-Jul	483
	Hatchery	177	26-Jun	185	4-Jul	196	15-Jul	187	6-Jul	1,035
2018	Wild	165	14-Jun	175	24-Jun	188	7-Jul	177	26-Jun	684
	Hatchery	161	10-Jun	172	21-Jun	188	7-Jul	175	24-Jun	1,437
2019	Wild	161	10-Jun	174	23-Jun	188	7-Jul	174	23-Jun	386
	Hatchery	162	11-Jun	171	20-Jun	187	6-Jul	174	23-Jun	1,349

Survey year	Origin	Spring Chinook Migration Time (days)								Sample size
		10 Percentile		50 Percentile		90 Percentile		Mean		
		Julian	Date	Julian	Date	Julian	Date	Julian	Date	
Average	Wild	***168***	--	***182***	--	***197***	--	***182***	--	***894***
	Hatchery	***170***	--	***183***	--	***196***	--	***183***	--	***2,342***
Median	Wild	***170***	--	***184***	--	***200***	--	***184***	--	***973***
	Hatchery	***171***	--	***184***	--	***195***	--	***184***	--	***1,687***

Table 6.27b. The week that 10%, 50% (median), and 90% of the wild and hatchery spring Chinook salmon passed Tumwater Dam, 1998-2019. The average week is also provided. Migration timing is based on video sampling at Tumwater. Data for 1998 through 2003 were based on videotapes and broodstock trapping and may not reflect the actual number of hatchery spring Chinook. All spring Chinook were visually examined during trapping from 2004 to present; however, enumeration errors may still exist because of misidentified run-type assignment (i.e., spring or summer runs).

Survey year	Origin	Spring Chinook Migration Time (week)				Sample size
		10 Percentile	50 Percentile	90 Percentile	Mean	
1998	Wild	23	23	23	23	49
	Hatchery	23	23	23	23	25
1999	Wild	28	30	32	30	173
	Hatchery	29	31	34	31	25
2000	Wild	24	27	27	27	651
	Hatchery	26	27	29	28	357
2001	Wild	22	24	27	24	2,073
	Hatchery	23	25	27	25	4,244
2002	Wild	25	27	30	27	1,033
	Hatchery	26	27	29	27	1,363
2003	Wild	24	26	29	26	919
	Hatchery	23	26	28	26	423
2004	Wild	23	25	27	25	969
	Hatchery	23	26	27	26	1,295
2005	Wild	22	25	28	25	1,038
	Hatchery	22	25	27	25	2,808
2006	Wild	26	27	28	27	577
	Hatchery	26	27	28	27	1,601
2007	Wild	25	27	29	27	351
	Hatchery	25	28	30	28	3,232
2008	Wild	25	27	30	27	634
	Hatchery	26	28	30	28	5,368
2009	Wild	25	27	29	27	1,008
	Hatchery	25	27	29	27	4,106
2010	Wild	25	28	31	28	977

Survey year	Origin	Spring Chinook Migration Time (week)				Sample size
		10 Percentile	50 Percentile	90 Percentile	Mean	
	Hatchery	26	28	31	28	4,450
2011	Wild	27	29	31	29	1,433
	Hatchery	27	29	30	29	4,707
2012	Wild	26	28	30	28	1,482
	Hatchery	26	28	30	28	4,449
2013	Wild	24	26	29	27	1,106
	Hatchery	24	26	28	26	3,681
2014	Wild	25	27	29	27	1,329
	Hatchery	24	26	28	26	2,510
2015	Wild	22	25	27	25	1,370
	Hatchery	22	24	26	24	1,773
2016	Wild	23	26	29	26	1,252
	Hatchery	23	26	28	26	1,284
2017	Wild	25	27	28	27	483
	Hatchery	26	27	28	27	1,035
2018	Wild	24	25	27	26	384
	Hatchery	23	25	27	25	1,437
2019	Wild	23	25	27	25	386
	Hatchery	23	25	27	25	1,349
Average	Wild	***24***	***26***	***29***	***27***	***894***
	Hatchery	***25***	***27***	***28***	***27***	***2,342***
Median	Wild	***25***	***27***	***29***	***27***	***973***
	Hatchery	***25***	***27***	***28***	***27***	***1,687***

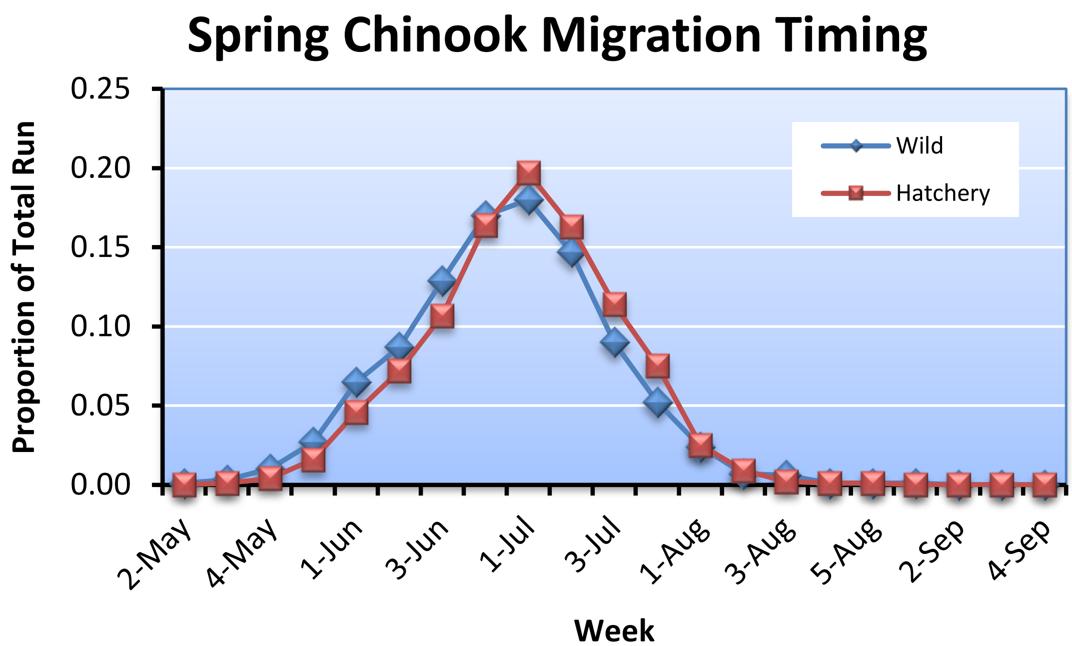


Figure 6.11. Proportion of wild and hatchery spring Chinook observed (using video) passing Tumwater Dam each week during their migration period May through September; data were pooled over survey years 1998-2019.

Age at Maturity

Most of the wild and hatchery spring Chinook sampled during the period 1999-2019 in the Nason Creek watershed were age-4 fish (total age) (Table 6.28; Figure 6.12). Except for 2014 fish, hatchery fish made up a higher percentage of age-3 Chinook than did wild fish. No age-5 fish were recovered in 2019. However, in other years, a higher proportion of age-5 wild fish returned than did age-5 hatchery fish. Thus, wild fish tended to return at an older age than hatchery fish.

Table 6.28. Numbers of wild and hatchery spring Chinook of different ages (total age) sampled on spawning grounds in the Nason Creek watershed, 1999-2019.

Sample year	Origin	Total age					Sample size
		2	3	4	5	6	
1999	Wild	0	0	5	0	0	**5**
	Hatchery	0	0	0	0	0	**0**
2000	Wild	0	1	45	0	0	**46**
	Hatchery	0	18	3	0	0	**21**
2001	Wild	0	0	63	13	0	**76**
	Hatchery	0	5	159	3	0	**167**
2002	Wild	0	0	58	23	0	**81**
	Hatchery	0	0	85	11	0	**96**
2003	Wild	0	4	3	36	0	**43**
	Hatchery	0	3	1	5	0	**9**

Sample year	Origin	Total age					Sample size
		2	3	4	5	6	
2004	Wild	0	1	101	1	0	**103**
	Hatchery	0	57	23	2	0	**82**
2005	Wild	0	1	25	17	0	**43**
	Hatchery	0	3	170	0	0	**173**
2006	Wild	0	0	60	18	0	**78**
	Hatchery	0	12	78	22	0	**112**
2007	Wild	0	0	18	11	0	**29**
	Hatchery	0	123	40	9	0	**172**
2008	Wild	0	2	46	4	0	**52**
	Hatchery	0	21	163	6	0	**190**
2009	Wild	0	1	36	2	0	**39**
	Hatchery	0	19	65	4	0	**88**
2010	Wild	0	1	18	0	0	**19**
	Hatchery	0	5	116	1	0	**122**
2011	Wild	0	3	24	8	0	**35**
	Hatchery	0	33	17	13	0	**63**
2012	Wild	0	1	89	17	0	**107**
	Hatchery	0	25	198	2	0	**225**
2013	Wild	0	0	16	7	0	**23**
	Hatchery	0	22	92	5	0	**119**
2014	Wild	0	16	19	3	0	**38**
	Hatchery	0	9	20	0	0	**29**
2015	Wild	0	1	25	4	0	**30**
	Hatchery	0	4	9	0	0	**13**
2016	Wild	0	3	61	7	0	**71**
	Hatchery	0	11	10	0	0	**21**
2017	Wild	0	2	22	8	0	**32**
	Hatchery	0	9	30	2	0	**41**
2018	Wild	0	0	12	2	0	**14**
	Hatchery	0	11	70	0	0	**81**
2019	Wild	0	7	19	0	0	**26**
	Hatchery	0	9	225	0	0	**234**
Average	***Wild***	***0***	***2***	***36***	***9***	***0***	***47***
	Hatchery	***0***	***19***	***75***	***4***	***0***	***98***
Median	***Wild***	***0***	***1***	***25***	***7***	***0***	***41***
	Hatchery	***0***	***11***	***68***	***2***	***0***	***91***

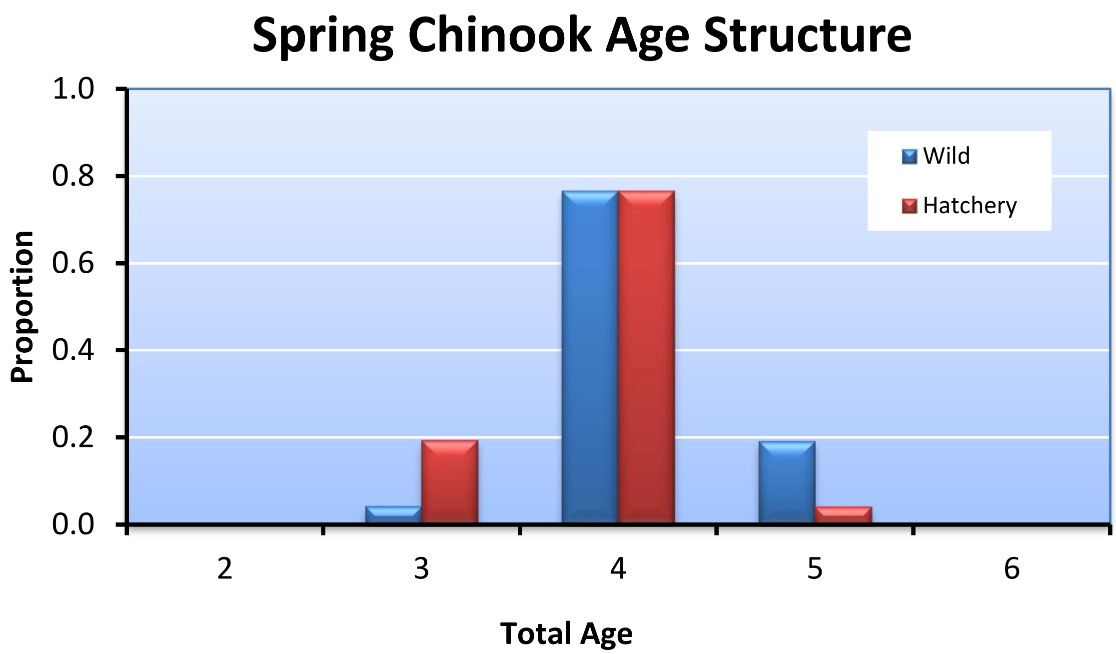


Figure 6.12. Proportions of wild and hatchery spring Chinook of different total ages sampled on spawning grounds in the Nason Creek watershed for the combined years 1999-2019.

Size at Maturity

On average, hatchery and wild spring Chinook of a given age differed little in length (Table 6.29). Differences were usually no more than 5 cm between hatchery and wild fish of the same age.

Table 6.29. Mean lengths (POH in cm; ±1SD) and sample sizes (in parentheses) of different ages (total age) of male and female spring Chinook of wild and hatchery-origin sampled in the Nason Creek watershed, 1999-2019.

Return year	Total age	Mean length (cm)			
		Male		Female	
		Wild	Hatchery	Wild	Hatchery
1999	3				
	4	71 ±2 (2)		64 ±2 (3)	
	5				
	6				
2000	3	46 ±0 (1)	44 ±4 (14)		52 ±10 (4)
	4	62 ±4 (19)		63 ±3 (25)	60 ±1 (3)
	5				
	6				
2001	3		47 ±12 (5)		
	4	65 ±4 (21)	66 ±5 (36)	63 ±4 (42)	63 ±4 (123)
	5	81 ±5 (3)		72 ±3 (10)	71 ±7 (3)
	6				
2002	3				

Return year	Total age	Mean length (cm)			
		Male		Female	
		Wild	Hatchery	Wild	Hatchery
	4	62 ±6 (24)	66 ±5 (35)	63 ±4 (34)	62 ±5 (50)
	5	77 ±4 (12)	81 ±7 (8)	75 ±3 (11)	71 ±5 (3)
	6				
2003	3	44 ±7 (3)	43 ±5 (3)		
	4	58 ±7 (2)	79 ±0 (1)	67 ±0 (1)	
	5	75 ±9 (11)	81 ±6 (2)	72 ±6 (25)	71 ±2 (3)
	6				
2004	3	46 ±0 (1)	43 ±4 (56)		
	4	61 ±4 (35)	60 ±3 (6)	61 ±3 (66)	62 ±4 (17)
	5			81 ±0 (1)	73 ±4 (2)
	6				
2005	3	37 ±0 (1)	41 ±7 (3)		
	4	59 ±6 (8)	63 ±4 (54)	61 ±3 (17)	61 ±3 (116)
	5	73 ±5 (4)		71 ±1 (13)	
	6				
2006	3		41 ±3 (12)		
	4	60 ±5 (26)	62 ±3 (29)	61 ±3 (34)	59 ±4 (49)
	5	72 ±5 (10)	73 ±5 (6)	69 ±4 (8)	70 ±4 (16)
	6				
2007	3		44 ±4 (122)		51 ±0 (1)
	4	62 ±4 (6)	60 ±7 (13)	63 ±4 (12)	61 ±4 (27)
	5	77 ±5 (7)	67 ±5 (3)	68 ±2 (4)	70 ±2 (6)
	6				
2008	3	51 ±21 (2)	45 ±5 (20)		45 ±0 (1)
	4	60 ±5 (15)	63 ±4 (42)	61 ±3 (31)	63 ±3 (121)
	5		77 ±2 (3)	71 ±3 (4)	64 ±7 (3)
	6				
2009	3	41 ±0 (1)	46 ±5 (18)		65 ±0 (1)
	4	60 ±5 (12)	63 ±4 (19)	60 ±3 (24)	61 ±4 (46)
	5		71 ±1 (2)	72 ±4 (2)	73 ±3 (2)
	6				
2010	3	44 ±0 (1)	45 ±5 (5)		
	4	62 ±5 (7)	63 ±4 (42)	61 ±3 (10)	62 ±4 (74)
	5		75 ±0 (1)		
	6				
2011	3	48 ±11 (3)	43 ±4 (31)		48 ±2 (2)
	4	61 ±5 (11)	59 ±11 (6)	60 ±5 (12)	63 ±5 (11)
	5	79 ±2 (3)	73 ±3 (6)	75 ±4 (5)	70 ±3 (7)
	6				
2012	3	41 ±0 (1)	42 ±3 (24)		
	4	61 ±7 (35)	60 ±5 (45)	61 ±4 (54)	60 ±4 (151)

Return year	Total age	Mean length (cm)			
		Male		Female	
		Wild	Hatchery	Wild	Hatchery
	5	77 ±4 (6)		66 ±5 (11)	70 ±3 (2)
	6				
2013	3		42 ±4 (21)		
	4	60 ±6 (5)	62 ±4 (23)	60 ±4 (10)	60 ±4 (69)
	5	71 ±0 (1)	75 ±0 (1)	68 ±3 (6)	70 ±4 (4)
	6				
2014	3	44 ±5 (15)	49 ±4 (9)	60 ±0 (1)	
	4	64 ±7 (8)	59 ±4 (8)	63 ±3 (11)	60 ±3 (12)
	5			69 ±8 (3)	
	6				
2015	3	44 ±0 (1)	45 ±1 (4)		
	4	61 ±7 (15)	56 ±4 (3)	63 ±5 (10)	58 ±2 (6)
	5	72 ±7 (3)		65 ±0 (1)	
	6				
2016	3	43 ±2 (3)	46 ±5 (10)		45 ±0 (1)
	4	64 ±6 (32)	65 ±1 (3)	64 ±5 (29)	60 ±2 (7)
	5	67 ±0 (1)		71 ±5 (6)	
	6				
2017	3	44 ±4 (3)	48 ±4 (9)		
	4	63 ±5 (10)	64 ±6 (15)	61 ±4 (17)	63 ±4 (16)
	5	71 ±4 (3)		88 ±0 (1)	68 ±0 (1)
	6				
2018	3		46±3 (11)		
	4	62±7 (9)	60±6 (21)	63±2 (3)	60±4 (49)
	5	70±1 (1)		76±1 (1)	
	6				
2019	3	40±3 (7)	46±5 (9)		
	4	59±10 (9)	60±6 (84)	61±4 (9)	61±4 (137)
	5				
	6				

Contribution to Fisheries

Based on one brood year, all the harvest on hatchery-origin Nason Creek spring Chinook occurred in the ocean fishery (Table 6.30). No Nason Creek spring Chinook have been captured in the Columbia River fisheries. The Lower Columbia River fisheries are managed by the states and tribes pursuant to management plans developed in *U.S. v Oregon*. The Lower Columbia River fisheries occur during what is referred to in *U.S. v Oregon* as the winter, spring, and summer seasons, which begin in February and ends 31 July of each year. The Tribal fishery occurs upstream from Bonneville Dam, but primarily in Zone 6, the area between Bonneville and McNary dams;

the non-treaty commercial fisheries occur in Zones 1-5, which are downstream from Bonneville Dam. The non-treaty recreational (sport) fishery occurs in the lower mainstem.

Table 6.30. Estimated number and percent (in parentheses) of hatchery-origin Nason Creek spring Chinook captured in different fisheries, brood year 2013.

Brood year	Ocean fisheries	Columbia River Fisheries			Total	Percent of brood year escapement harvested[b]
		Tribal[a]	Commercial (Zones 1-5)	Recreational (sport)		
2013	2 (100)	0 (0)	0 (0)	0 (0)	2	2 (100)
Average	***1 (50)***	***0 (0)***	***0 (0)***	***0 (0)***	***1***	***1 (50)***
Median	***1 (50)***	***0 (0)***	***0 (0)***	***0 (0)***	***1***	***1 (50)***

[a] Includes the Wanapum fishery and the Icicle and Wenatchee fisheries when they occurred.

[b] Percent of brood year escapement harvested = Total brood year harvest / (Total brood year harvest + ∑Hatchery collection + ∑escapement) * 100. In other words, this indicates the percentage of all detected CWTs that ended up in harvest.

Straying

Stray rates were determined by examining CWTs recovered on spawning grounds within and outside the Wenatchee River basin. Targets for strays based on return year (recovery year) within the Wenatchee River basin should be less than 10% and targets for strays outside the Wenatchee River basin should be less than 5%.

The percentage of the spawning escapement in non-target spawning areas within the Wenatchee River basin made up of hatchery-origin Nason Creek spring Chinook has generally been low. Only in the White and Upper Wenatchee River have Nason Creek strays made up more than 10% of the spawning escapements (Table 6.31). Over the years of sampling, Nason Creek spring Chinook have strayed into the White River and Upper Wenatchee spawning area.

Table 6.31. Number (No.) and percent (%) of the spawning escapement in other non-target spawning streams within the Wenatchee River basin that consisted of hatchery-origin Nason Creek spring Chinook, return years 2016-2018. Percent strays should be less than 10%.

Return year	Chiwawa River		Icicle Creek		Peshastin Creek		Upper Wenatchee		White River		Little Wenatchee	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
2016	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2017	0	0.0	0	0.0	0	0.0	8	47.1	0	0.0	0	0.0
2018	0	0.0	0	0.0	0	0.0	0	0.0	4	10.5	0	0.0
Average	***0***	***0.0***	***0***	***0.0***	***0***	***0.0***	***3***	***15.7***	***1***	***3.5***	***0***	***0.0***
Median	***0***	***0.0***	***0***	***0.0***	***0***	***0.0***	***0***	***0.0***	***0***	***0.0***	***0***	***0.0***

Hatchery-origin Nason Creek spring Chinook have strayed into the Entiat basin but not the Methow basin (Table 6.32). Based on return year analyses, rates of hatchery-origin Nason Creek spring Chinook straying into these populations has been low and these fish have not made up more than 5% of the spawning escapement within Entiat or Methow basins.

Table 6.32. Number and percent of spawning escapements within other non-target basins that consisted of hatchery-origin Nason Creek spring Chinook, return years 2016-2018. For example, for return year 2016, 0.3% of the spring Chinook spawning escapement in the Entiat River basin consisted of hatchery-origin Nason Creek spring Chinook. Percent strays should be less than 5%.

Return year	Methow River basin		Entiat River basin	
	Number	%	Number	%
2016	0	0.0	1	0.3
2017	0	0.0	0	0.0
2018	0	0.0	0	0.0
Average	***0***	***0.0***	***0***	***0.1***
Median	***0***	***0.0***	***0***	***0.0***

Based on brood year analyses, on average, 0.9% of the hatchery returns have strayed into non-target spawning areas (Table 6.33). Few (0.9%) have strayed into non-target hatchery programs.

Table 6.33. Number and percent of hatchery-origin Nason Creek spring Chinook that homed to target spawning areas and the target hatchery program, and number and percent that strayed to non-target spawning areas and non-target hatchery programs, by brood year.

Brood year	Homing				Straying			
	Target stream		Target hatchery*		Non-target streams		Non-target hatcheries	
	Number	%	Number	%	Number	%	Number	%
2013	47	40.5	67	57.8	1	0.9	1	0.9
Average	***47***	***40.5***	***67***	***57.8***	***1***	***0.9***	***1***	***0.9***
Median	***47***	***40.5***	***67***	***57.8***	***1***	***0.9***	***1***	***0.9***

* Homing to the target hatchery includes Chiwawa hatchery spring Chinook that are captured and included as broodstock in the Chiwawa Hatchery program. These hatchery fish are typically collected at the Chiwawa weir and Tumwater Dam.

Ford et al. (2015) used parentage analysis to estimate rates of straying and homing of spring Chinook within the Wenatchee River basin. They found that stray rates of hatchery spring Chinook based on parentage analysis were consistent with rates estimated using physical tag recoveries (the latter estimates are shown in the tables above). They also found that stray rates among the major spawning tributaries were higher than stray rates of tagged fish to areas outside of the Wenatchee River basin (e.g., Entiat and Methow basins), which is consistent with the results shown in the tables above. Finally, the researchers noted that hatchery spring Chinook homed at a far lower rate than natural-origin fish and stray rates of natural-origin fish ranged from about 0-100%. Rates of straying of natural-origin spring Chinook were affected by spawning tributary and by parental origin (i.e., progeny of naturally spawning hatchery-produced fish strayed at higher rates than progeny whose parents were of natural origin).

Genetics

Because the Nason Creek spring Chinook program began in 2013 with the collection of broodstock, there are no studies that examine the effects of the program on the genetics of natural-origin spring Chinook in the Wenatchee River basin. However, genetic studies were conducted to determine the potential effects of the Chiwawa Supplementation Program on natural-origin spring

Chinook in the upper Wenatchee River basin (Blankenship et al. 2007; the entire report is appended as Appendix M). This work included the analysis of Nason Creek spring Chinook. Researchers collected microsatellite DNA allele frequencies from temporally replicated natural and hatchery-origin spring Chinook to statistically assign individual fish to specific demes (locations) within the Wenatchee population.

Significant differences in allele frequencies were observed within and among major spawning areas in the Upper Wenatchee River basin. However, these differences made up only a very small portion of the overall variation, indicating genetic similarity among the major spawning areas. There was no evidence that the Chiwawa program has changed the genetic structure (allele frequency) of spring Chinook in Nason Creek and the White River, despite the presence of hatchery-origin spawners in both systems.

Proportionate Natural Influence

Another method for assessing the genetic risk of a supplementation program is to determine the influence of the hatchery and natural environments on the adaptation of the composite population. This is estimated by the proportion of natural-origin fish in the hatchery broodstock (pNOB) and the proportion of hatchery-origin fish in the natural spawning escapement (pHOS). We calculated Proportionate Natural Influence (PNI) by iterating Ford's (2002) equations 5 and 6 to equilibrium, using a heritability of 0.3 and a selection strength of three standard deviations.[28] The larger the PNI value, the greater the strength of selection in the natural environment relative to that of the hatchery environment. For the natural environment to dominate selection, PNI should be greater than 0.50, and integrated populations should have a PNI of at least 0.67 (HSRG/WDFW/NWIFC 2004).

For brood years 1989-2012, when no brood stock were collected for the Nason Creek Program, the PNI values ranged from 0.28 to 1.00 (Table 6.34). During this period, PNI values varied over time because of Chiwawa spring Chinook straying into Nason Creek. For brood years 2013-2019, a period when brood stock was collected for the Nason Creek Program, PNI values for the Nason Creek Program ranged from 0.30 to 0.79 (Table 6.34).

Table 6.34. Proportionate Natural Influence (PNI) Index of hatchery spring Chinook spawning in Nason Creek, brood years 1989-2019. See notes below the table for description of each metric. NA = not available (data to calculate HOS_N and $pHOS_N$ will be available in November).

Brood year	Spawners					Broodstock			PNI
	NOS	HOS_N	HOS_S	$pHOS_N$	$pHOS_{N+S}$	NOB_N	HOB_N	pNOB	
1989	288	0	0	0.00	0.00	0	0	*1.00*	1.00
1990	235	0	0	0.00	0.00	0	0	*1.00*	1.00
1991	156	0	0	0.00	0.00	0	0	*1.00*	1.00
1992	181	0	0	0.00	0.00	0	0	*1.00*	1.00
1993	430	0	61	0.00	0.12	0	0	*1.00*	0.90
1994	60	0	0	0.00	0.00	0	0	*0.67*	1.00

[28] According to authorized annual take permits, PNI is calculated using the PNI approximate equation 11 (HSRG 2009; Appendix A). However, in this report, we used Ford's (2002) equations 5 and 6 with a heritability of 0.3 and a selection strength of three standard deviations to calculate PNI (C. Busack, NOAA Fisheries, 21 March 2016, provided the model for calculating PNI). This approach is more accurate than using the PNI approximate equation.

Brood year	Spawners					Broodstock			PNI
	NOS	HOS_N	HOS_S	$pHOS_N$	$pHOS_{N+S}$	NOB_N	HOB_N	pNOB	
1995	18	0	0	0.00	0.00	0	0	*0.00*	1.00
1996	58	0	25	0.00	0.30	0	0	*0.44*	0.61
1997	67	0	55	0.00	0.45	0	0	*0.29*	0.42
1998	61	0	3	0.00	0.05	0	0	*0.28*	0.86
1999	22	0	0	0.00	0.00	0	0	*0.00*	1.00
2000	189	0	81	0.00	0.30	0	0	*0.30*	0.52
2001	257	0	341	0.00	0.57	0	0	*0.30*	0.37
2002	313	0	290	0.00	0.48	0	0	*0.28*	0.39
2003	152	0	50	0.00	0.25	0	0	*0.44*	0.65
2004	297	0	210	0.00	0.41	0	0	*0.39*	0.51
2005	81	0	266	0.00	0.77	0	0	*0.33*	0.32
2006	117	0	154	0.00	0.57	0	0	*0.29*	0.36
2007	83	0	380	0.00	0.82	0	0	*0.29*	0.28
2008	139	0	425	0.00	0.75	0	0	*0.27*	0.29
2009	163	0	371	0.00	0.69	0	0	*0.46*	0.42
2010	59	0	349	0.00	0.86	0	0	*0.44*	0.35
2011	250	0	452	0.00	0.64	0	0	*0.46*	0.43
2012	220	0	474	0.00	0.68	0	0	*0.66*	0.50
Average*	***159***	***0***	***166***	***0.00***	***0.36***	***0***	***0***	**0.48**	***0.63***
Median*	***154***	***0***	***71***	***0.00***	***0.36***	***0***	***0***	**0.42**	***0.52***
2013	70	0	339	0.00	0.83	20	5	0.80	0.50
2014	165	0	66	0.00	0.29	21	0	1.00	0.78
2015	130	0	21	0.00	0.14	60	63	0.49	0.79
2016	120	11	18	0.07	0.19	70	66	0.51	0.74
2017	61	32	39	0.24	0.54	70	64	0.52	0.51
2018	21	70	78	0.41	0.88	53	54	0.50	0.38
2019	35	NA	345	NA	0.91	47	85	0.36	0.30
Average*	***86***	***19***	***129***	***0.12***	***0.54***	***49***	***48***	***0.60***	***0.57***
Median*	***70***	***6***	***66***	***0.04***	***0.54***	***53***	***63***	***0.51***	***0.51***

HOS_N = hatchery-origin spawners in Nason Creek from the Nason Creek spring Chinook Supplementation Program.
$pHOS_N$ = proportion of hatchery-origin spawners from Nason Creek spring Chinook Supplementation Program.
HOS_S = stray hatchery-origin spawners in Nason Creek.
$pHOS_S$ = proportion of stray hatchery-origin spawners.
NOB_N = natural-origin broodstock spawned in the Nason Creek spring Chinook Supplementation Program.
HOB_N = hatchery-origin broodstock spawned in the Nason Creek spring Chinook Supplementation Program.
pNOB = proportion of hatchery-origin broodstock. Because of the high incidence of strays to Nason Creek from the Chiwawa River spring Chinook program, pNOB values from the Chiwawa program were used to estimate PNI values during the period from 1989 to 2012 (*italicized*). The weighting for those years was 100% based on the Chiwawa program broodstock selection, because there have been no hatchery returns from the Nason Creek spring Chinook program (see Table 5.1 for Chiwawa broodstock selection).
PNI_N = Proportionate Natural Influence for Nason Creek spring Chinook calculated using the gene-flow model for multiple programs.
* Average and median for the period 1989-2012, a period when no brood stock were collected for the Nason Creek Program.
** Average and median for the period 2013-present, a period when brood stock was collected for the Nason Creek Program.

Post-Release Survival and Travel Time

We used PIT-tagged fish to estimate survival rates and travel time (arithmetic mean days) of hatchery spring Chinook from the Nason Creek release site to McNary Dam, and smolt to adult ratios (SARs) from release to detection at Bonneville Dam (Table 6.35).[29] Over the brood years for which PIT-tagged hatchery fish were released, survival rates from Nason Creek to McNary Dam ranged from 0.317 to 0.572. Average travel time from Nason Creek to McNary Dam ranged from 21 to 38 days. SARs from release to detection at Bonneville Dam equaled 0.005 for available brood years.

Table 6.35. Total number of Nason hatchery spring Chinook released with PIT tags, their survival and travel times (mean days) to McNary Dam, and smolt-to-adult (SAR) ratios for brood years 2013-2017. Standard errors are shown in parentheses. NA = not available (i.e., not all the adults from the release groups have returned to the Columbia River).

Brood year	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
2013	20,139 (WxW)	0.346 (0.030)	38.1 (5.9)	0.005 (0.000)
2014	5,007 (WxW)	0.572 (0.038)	20.6 (5.3)	0.005 (0.001)
2015	5,050 (HxH)	0.482 (0.052)	27.3 (6.8)	NA
	5,047 (WxW)	0.515 (0.055)	27.3 (7.0)	NA
2016	5,050 (HxH)	0.454 (0.064)	24.1 (6.6)	NA
	5,044 (WxW)	0.490 (0.078)	24.7 (6.8)	NA
2017	5,038 (HxH)	0.317 (0.046)	29.2 (7.3)	NA
	5,020 (WxW)	0.474 (0.085)	26.2 (8.5)	NA

We also used PIT-tags to estimate survival rates and travel time (arithmetic mean days) of wild spring Chinook smolts tagged at the Nason Creek smolt trap. Survival rates and travel times were estimated from the Nason Creek trap to McNary Dam, and smolt to adult ratios (SARs) from the trap to returning adults detected at Bonneville Dam (Table 6.36). Over the 14 brood years for which wild spring Chinook smolts were tagged and released at the Nason Creek trap, survival rates from Nason Creek to McNary Dam ranged from 0.201 to 0.785; SARs from release to detection at Bonneville Dam ranged from 0.000 to 0.018. Average travel time from Nason Creek to McNary Dam ranged from 20 to 47 days.

[29] It is important to point out that because of fish size differences among rearing tanks or raceways, fish PIT tagged in one tank or raceway may not represent untagged fish rearing in other tanks or raceways.

Table 6.36. Total number of Nason Creek wild spring Chinook smolts released with PIT tags at the Nason Creek Trap, their survival and travel times (mean days) to McNary Dam, and smolt-to-adult (SAR) ratios for brood years 2004-2017. Standard errors are shown in parentheses. NA = not available (i.e., not all the adults from the release groups have returned to the Columbia River).

Brood year	Tag year	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
2004	2006	319	0.374 (0.068)	29.7 (10.2)	0.003 (0.003)
2005	2007	36	--	--	0.000 (-)
2006	2008	878	0.425 (0.074)	32.1 (14.4)	0.018 (0.005)
2007	2009	190	0.568 (0.338)	39.9 (16.6)	0.000 (-)
2008	2010	357	0.367 (0.068)	35.3 (14.8)	0.003 (0.003)
2009	2011	121	0.463 (0.386)	46.5 (18.5)	0.000 (-)
2010	2012	346	0.365 (0.069)	36.9 (17.4)	0.000 (-)
2011	2013	235	0.393 (0.131)	41.8 (18.2)	0.009 (0.006)
2012	2014	456	0.289 (0.066)	41.0 (17.0)	0.002 (0.002)
2013	2015	139	0.201 (0.103)	37.4 (12.6)	0.000 (-)
2014	2016	61	0.541 (0.177)	32.9 (13.6)	0.016 (0.016)
2015	2017	346	0.373 (0.080)	35.4 (16.1)	NA
2016	2018	281	0.785 (0.491)	20.4 (8.6)	NA
2017	2019	269	0.314 (0.121)	35.7 (11.1)	NA

Natural and Hatchery Replacement Rates

Natural replacement rates (NRR) were calculated as the ratio of natural-origin recruits (NOR) to the parent spawning population (spawning escapement). Natural-origin recruits are naturally produced (wild) fish that survive to contribute to harvest (directly or indirectly), to broodstock, and to spawning grounds. We do not account for fish that died in route to the spawning grounds (migration mortality) or died just before spawning (pre-spawn mortality) (see Appendix B in Hillman et al. 2012). We calculated NORs with and without harvest. NORs without harvest include all returning fish that either returned to the basin or were collected as wild broodstock. NORs with harvest include all fish harvested and are based on brood-year harvest rates from the Chiwawa Hatchery program. For brood years 1989-2012, before the initiation of the current hatchery program in Nason Creek, NRR averaged 0.79 (range, 0.05-5.48) if harvested fish were not included in the estimate and 0.90 (range, 0.05-6.42) if harvested fish were included in the estimate (Table 6.37). Since the initiation of the current hatchery program, NRR averaged 0.28 if harvested fish were not included in the estimate and 0.30 if harvested fish were included in the estimate. NRRs for more recent brood years will be calculated as soon as all tag recoveries and sampling rates have been loaded into the database.

Hatchery replacement rates (HRR) are the hatchery adult-to-adult returns and were calculated as the ratio of hatchery-origin recruits (HOR) to the parent broodstock collected. These rates should be greater than the NRRs and greater than or equal to 6.7 (the calculated target value in Hillman et al. 2019). The target value of 6.7 includes harvest and was based on HRRs for Chiwawa spring Chinook salmon. For the one complete brood year of data, HRR was greater than NRR, regardless if harvest was or was not included (Table 6.37). HRR did not exceed the estimated target value of 6.7.

Table 6.37. Spawning escapements, natural-origin recruits (NOR), and natural replacement rates (NRR; with and without harvest) for spring Chinook in the Nason Creek watershed, brood years 1989-2013.

Brood year	Broodstock Collected	Spawning Escapement	Harvest not included				Harvest included			
			HOR	NOR	HRR	NRR	HOR	NOR	HRR	NRR
1989	---	288	---	171	---	0.59	---	249	---	0.86
1990	---	235	---	15	---	0.06	---	18	---	0.08
1991	---	156	---	21	---	0.13	---	23	---	0.15
1992	---	181	---	47	---	0.26	---	49	---	0.27
1993	---	491	---	133	---	0.27	---	137	---	0.28
1994	---	60	---	3	---	0.05	---	3	---	0.05
1995	---	18	---	22	---	1.22	---	23	---	1.28
1996	---	83	---	229	---	2.76	---	250	---	3.01
1997	---	122	---	306	---	2.51	---	341	---	2.80
1998	---	64	---	351	---	5.48	---	411	---	6.42
1999	---	22	---	14	---	0.64	---	15	---	0.68
2000	---	270	---	337	---	1.25	---	359	---	1.33
2001	---	598	---	77	---	0.13	---	79	---	0.13
2002	---	603	---	123	---	0.20	---	128	---	0.21
2003	---	202	---	63	---	0.31	---	67	---	0.33
2004	---	507	---	131	---	0.26	---	141	---	0.28
2005	---	347	---	155	---	0.45	---	160	---	0.46
2006	---	271	---	118	---	0.44	---	148	---	0.55
2007	---	463	---	210	---	0.45	---	251	---	0.54
2008	---	564	---	243	---	0.43	---	272	---	0.48
2009	---	534	---	71	---	0.13	---	77	---	0.14
2010	---	408	---	123	---	0.30	---	152	---	0.37
2011	---	702	---	279	---	0.40	---	374	---	0.53
2012	---	694	---	182	---	0.26	---	208	---	0.30
Average[a]	***---***	***328***	***---***	***143***	***---***	***0.79***	***---***	***164***	***---***	***0.90***
Median[a]	***---***	***280***	***---***	***127***	***---***	***0.36***	***---***	***145***	***---***	***0.42***
2013	25	409	24	115	0.92	0.28	24	121	0.92	0.30
Average[b]	***25***	***409***	***24***	***115***	***0.92***	***0.28***	***24***	***121***	***0.92***	***0.30***
Median[b]	***25***	***409***	***24***	***115***	***0.92***	***0.28***	***24***	***121***	***0.92***	***0.30***

[a] Statistics before the initiation of the current spring Chinook hatchery program in Nason Creek.
[b] Statistics after the initiation of the current spring Chinook hatchery program in Nason Creek.

Smolt-to-Adult Survivals

Smolt-to-adult survival ratios (SARs) were calculated as the number of hatchery adult recaptures divided by the number of tagged hatchery smolts released. Here, SARs were based on CWT returns, which were adjusted for tag loss before the fish were released. For the available brood year, SAR was 0.00274 for hatchery spring Chinook (Table 6.38).

Table 6.38. Smolt-to-adult ratios (SARs) for Nason Creek hatchery spring Chinook, brood year 2013.

Brood year	Number of tagged smolts released[a]	Estimated adult captures[b]	SAR
2013	40,079	110	0.00274
Average	***40,079***	***110***	***0.00274***
Median	***40,079***	***110***	***0.00274***

[a] Includes all tag codes and CWT released fish (CWT + Ad Clip fish and CWT-only fish).
[b] Includes estimated recoveries (spawning ground, hatcheries, harvest, etc.) and observed recoveries if estimated recoveries were unavailable.

6.9 ESA/HCP Compliance

Broodstock Collection

Collection of brood year 2017 broodstock for Nason Creek spring Chinook targeted a combination of natural-origin adults and hatchery-origin adults intercepted at Tumwater Dam. Total broodstock spawned for the 2017 brood Nason Creek spring Chinook program was 70 and 64 natural and hatchery-origin adults, respectively (Table 6.4). A total of 74 bull trout were handled and/or observed during broodstock collection at Tumwater Dam in 2017.

Hatchery Rearing and Release

The 2017 brood Nason Creek spring Chinook reared throughout all life stages without significant mortality (defined as >10% population mortality associated with a single event). A total of 151,179 WxW and 80,680 HxH smolts were released (121% of the conservation program goal and 104% of the aggregate Nason program goal) (Table 6.12).

Hatchery Effluent Monitoring

Per ESA Permit Numbers 1347, 18118, 18120, 18121, and 18583 permit holders shall monitor and report hatchery effluents in compliance with applicable National Pollution Discharge Elimination Systems (NPDES) (EPA 1999) permit limitations. There were no NPDES violations reported at Eastbank Hatchery or at the Nason Creek Acclimation Facility during the period 1 January through 31 December 2019. NPDES monitoring and reporting for PUD Hatchery Programs during 2019 are provided in Appendix G.

Smolt and Emigrant Trapping

Per ESA Section 10 Permit No. 1196, 18118, 18120, and 18121 the permit holders are authorized a direct take of 20% of the emigrating spring Chinook population during juvenile emigration monitoring and a lethal take not to exceed 2% of the fish captured (NMFS 2003). Based on the estimated wild spring Chinook population (smolt trap expansion) and hatchery juvenile spring Chinook population estimate (hatchery release data) for the Wenatchee River basin, the reported spring Chinook encounters during 2019 emigration monitoring complied with take provisions in the Section 10 permit. Spring Chinook encounter and mortality rates for each trap site (including PIT-tag mortalities) are detailed in Table 6.39. Additionally, juvenile fish captured at the trap locations were handled consistent with provisions in ESA Section 10 Permit 18118, 18120, and 18121, Section B. Table 6.39 includes incidental and direct take associated with the Nason Creek smolt trap operated by the Yakama Nation under separate permits.

Table 6.39. Estimated take of Upper Columbia River spring Chinook resulting from juvenile emigration monitoring in the Wenatchee River basin, 2019.

Trap location	Population estimate			Number trapped			Total	Take allowed under Permit
	Wild[a]	Hatchery[b]	Sub-yearling[c]	Wild	Hatchery	Sub-yearling		
Chiwawa Trap								
Population	39,015	149,867	68,038	4,730	3,151	13,970	21,851	
Encounter rate	NA	NA	NA	0.1212	0.0210	0.2053	0.0850	0.20
Mortality[d]	NA	NA	NA	9	0	78	87	
Mortality rate	NA	NA	NA	0.0019	0.0000	0.0056	0.0040	0.02
White River Trap								
Population	3,401	NA	3,541	119	NA	372	491	
Encounter rate	NA	NA	NA	0.0350	NA	0.1051	0.0707	0.20
Mortality[d]	NA	NA	NA	9	NA	6	0	
Mortality rate	NA	NA	NA	0.0756	NA	0.0161	0.0000	0.02
Nason Creek Trap								
Population	4,494	231,859	29,530	296	2,898	1,759	4,953	
Encounter rate	NA	NA	NA	0.0659	0.0125	0.0596	0.0186	0.20
Mortality[d]	NA	NA	NA	2	1	25	28	
Mortality rate	NA	NA	NA	0.0068	0.0003	0.0142	0.0057	0.02
Lower Wenatchee Trap								
Population	101,793	381,726	2,439,434	1,485	36,104	28,534	66,123	
Encounter rate	NA	NA	NA	0.0146	0.0946	0.0117	0.0226	0.20
Mortality[d]	NA	NA	NA	2	10	167	179	
Mortality rate	NA	NA	NA	0.0013	0.0003	0.0059	0.0027	0.02
Wenatchee River Basin Total								
Population	146,597	381,726	2,540,543	6,630	42,153	44,635	93,418	
Encounter rate	NA	NA	NA	0.0446	0.1104	0.0176	0.0304	0.20
Mortality[d]	NA	NA	NA	20	44	375	439	
Mortality rate	NA	NA	NA	0.0030	0.0010	0.0084	0.0047	0.02

[a] Smolt population estimate derived from juvenile emigration trap data.
[b] 2017 BY smolt release data for the Wenatchee River basin.
[c] Based on size, date of capture and location of capture. Subyearling Chinook encountered at the Lower Wenatchee Trap are categorized as summer Chinook salmon.
[d] Combined trapping and PIT-tagging mortality.

Precocity Monitoring

For the purpose of addressing permit requirements, we used the PIT Tag Information System (PTAGIS) to identify probable hatchery-origin mini-jack spring Chinook from Nason Creek from 2015 through 2019. The query results returned fish that were last detected after 1 July of the year in which they were released. Fish that remained in freshwater during this time period were likely precocious males. We looked for detections in three regions: lower Columbia River mainstem dams (Bonneville, The Dalles, and McNary dam), mid-Columbia mainstem dams (Priest Rapids and Rock Island dams), and within the Wenatchee River basin. The occurrence of mini-jacks was rare, ranging from 0.04% to 0.27% of the tagged population (Table 6.40).

Table 6.40. Numbers of Nason Creek hatchery spring Chinook with final PIT-tag detections after 1 July of the release year. These fish are likely mini-jacks. Lower Columbia River detections occurred at Bonneville, The Dalles, and McNary dams, while Mid-Columbia River detections occurred at Priest Rapids and Rock Island dams.

Year	Number of PIT tags released	Number of tags detected in Lower Columbia River	Number of tags detected in Mid-Columbia River	Number of tags detected within the Wenatchee River basin	Percent of tagged population
2015	20,139	6	0	49	0.27
2016	5,017	4	0	0	0.08
2017	10,098	3	0	1	0.04
2018	10,094	6	1	2	0.09
2019	10,058	5	0	0	0.05

Spawning Surveys

Spring Chinook spawning ground surveys were conducted in the Wenatchee River basin during 2019, as authorized by ESA Section 10 Permit Numbers 18118, 18120, and 18121. Because of the difficulty of quantifying the level of take associated with spawning ground surveys, the Permit does not specify a take level associated with these activities, even though it does authorize implementation of spawning ground surveys. Therefore, no take levels are reported. However, to minimize potential effects to established redds, wading was restricted to the extent practical, and extreme caution was used to avoid established redds when wading was required.

Spring Chinook Reproductive Success Study

ESA Section 10 Permit Numbers 18118, 18120, and 18121 specifically provide authorization to capture, anesthetize, biologically sample, PIT tag, and release adult spring Chinook at Tumwater Dam for reproductive success studies and general program monitoring. During 2010 through 2019, all spring Chinook passing Tumwater Dam were enumerated, anesthetized, biologically sampled, PIT tagged, and released (not including hatchery-origin and natural-origin Chinook retained for broodstock) as a component of the reproductive success study (BPA Project No. 2003-039-00). Please refer to Ford et al. (2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, and 2019) for complete details on the methods and results of the spring Chinook reproductive success study for the period 2010-2019.

Bull Trout

Bull trout encounters associated with implementation of hatchery production and monitoring and evaluation activities for Chinook and steelhead programs in the Wenatchee sub-basin are required to be reported as outlined in Biological Opinion 01EWF00-2013-0444. The 2020 report for bull trout encounters in 2019 was compiled under provisions of ESA Section 10 Permit 18118, 18120, 18121, and 18583. Data and reporting information are included in Appendix I.

SECTION 7: WHITE RIVER SPRING CHINOOK

The White River spring Chinook salmon captive brood program began in 1997 with goals to conserve, aid in the recovery, and prevent the extinction of naturally spawning spring Chinook in the White River, and to meet the mitigation responsibilities of Grant County PUD. Collection of eggs or juveniles from the White River (brood years 1997-2009) made up the first-generation (F_1) component of the White River captive brood program. Initially, rearing occurred at AquaSeed in Rochester, Washington, but transitioned to the Little White Salmon National Fish Hatchery near Cook, Washington, in 2006. The F_1 component was reared to maturation and spawned within the hatchery. The resulting progeny (F_2) were then reared in the hatchery until final acclimation and released in the upper Wenatchee Basin. The first large release of F_2 juveniles was in 2007. The last release of juveniles from the captive brood program occurred in 2015 (brood year 2013).

The production goal for the White River captive brood program following the 2013 hatchery recalculation was to release 74,556 yearling smolts into the upper Wenatchee River basin at 18-24 fish per pound. Fish lengths and weights for the recent broods were manipulated to evaluate different approaches for reducing precocious maturation. All fish were marked with CWTs. In addition, from 2008 through 2015, a portion of juvenile spring Chinook were PIT tagged annually.

Since its inception, the captive brood program underwent several adaptive changes designed to improve program success. These changes included: (1) use of a pedigree approach to reduce the use of stray fish in the broodstock, (2) transfer of fish from Aquaseed to the Little White Salmon National Fish Hatchery to improve fish quality, (3) injection of hormones into F_1 females to improve maturation of eggs, (4) manipulation of diet and ration for the F_2 fish to reduce precocious maturation of males, (5) use of temporary tanks and natural enclosures during acclimation to improve homing, and (6) trucking juvenile fish around Lake Wenatchee to improve survival.

The following information focuses on results from monitoring the White River spring Chinook program. More detailed information on the White River program can be found in Lauver et al. (2012).

7.1 Captive Brood Collection

The captive brood program was designed to provide a rapid, short-term demographic boost to the White River spring Chinook spawning aggregate, which was at a high risk of local extinction (Lauver et al. 2012). This section describes the collection of broodstock for the White River program.

Brood Collection and Rearing

A primary objective of the White River program was to collect progeny of naturally spawning spring Chinook in the White River. The progeny (eggs or juveniles) make up the first-generation (F_1) of the captive brood program. However, strays from the Chiwawa supplementation program made this a challenge. As a result, researchers attempted to identify the origin of spawners on redds in the White River and then focused egg and juvenile collection efforts on those redds that had the highest likelihood of being produced from White River parents. During most years, this limited the number of redds from which eggs or juveniles could be collected. Starting with brood year

2006, a pedigree approach was adopted to improve the likelihood that eggs or juveniles used in the captive brood program were of White River origin.

During 1997 to 2009, first-generation broodstock for the captive brood program originated from about 10,353 natural-origin eggs and juveniles collected from 122 redds in the White River. Broodstock from brood year 1997 were trapped as parr with nets in the fall of 1998. Broodstock from brood year 2006 were trapped as fry with nets in the spring of 2007. It was assumed that the parr and fry near known redds were produced from those redds, and origin was confirmed with pedigree analyses. All other brood years were collected as eggs in the fall using redd pumping techniques. Broodstock collection levels were calculated based on the following assumptions and the known number of suitable redds each year (Tonseth and Maitland 2011):

1. 150,000 smolt target/0.70 (green egg to release survival) = 214,000 green eggs
2. 214,000 green eggs/1,500 eggs per female = 143 females/0.50 (sex ratio) = 286 fish
3. 286 fish/0.30 (eyed egg to maturity survival) = 953 eyed eggs
4. 953 eyed eggs/***X*** redds = ***Y*** eyed-eggs per redd

Eyed eggs or juveniles collected in the White River were transported to Aquaseed (brood years 1997-2007) or to the Little White Salmon Hatchery (brood years 2008-2009) and reared to adults. Table 7.1 summarizes the collection of eyed eggs or juveniles for the captive brood program.

Table 7.1. Numbers of eyed eggs or juvenile brood stock collected for the White River captive brood program, brood years 1997-2009 (2009 was the last year for broodstock collection). Also shown are the number of redds that were sampled for eggs or juveniles and the hatchery in which the fish were reared (LWSFH = Little White Salmon Fish Hatchery); NS = no sample.

Brood year	Number of eyed eggs collected	Number of juvenile Chinook collected	Number of redds sampled	Rearing facility
1997	0	527 (parr)	8	Aquaseed
1998	182	0	4	Aquaseed
1999	NS	NS	NS	--
2000	272	0	NS	Aquaseed
2001	NS	NS	NS	--
2002	167	0	3	Aquaseed
2003	250	0	8	Aquaseed
2004	1,216	0	10	Aquaseed
2005	2,733	0	21	Aquaseed/LWSFH[1]
2006	0	1,487 (fry)	29	Aquaseed/ LWSFH[2]
2007	1,153	0	13	Aquaseed/ LWSFH[3]
2008	933	0	11	LWSFH
2009	1,433	0	15	LWSFH
Total	***8,339***	***2,014***	***122***	**--**
Average	***927***	***1,007***	***12***	**--**

[1] Fish were transferred on 30 June and 2 July 2008 and 20 January 2009.
[2] Fish were transferred on 21 October and 13 November 2008.

[3] Fish were transferred on 26 September and 21 October 2008.

7.2 Hatchery Spawning and Release

Captive Brood Spawning

As noted above, eyed eggs or juveniles collected in the White River were transported to Aquaseed (for brood years 1997-2007) or to the Little White Salmon Hatchery (for brood years 2008-2009) and reared to adults (Lauver et al. 2012). After rearing broodstock to maturity in captivity, adult spring Chinook were spawned and their progeny were grown to smolt size, acclimated to White River water, and ultimately released into the White River, Lake Wenatchee, or trucked and released in the Wenatchee River downstream from Lake Wenatchee.

During spawning, eggs and sperm were collected and those gametes were crossed based on a 2x2 factorial spawning matrix. That is, each female was spawned with two males and each male was spawned with two females. Using pedigree analysis, spawning crosses were arranged to maximize genetic diversity. Because incomplete maturation of ova was an issue in the program, implementation of hormone treatments began in 2011 to facilitate maturation. In addition, following spawning, milt from excess males was collected for cryopreservation. Based on a pilot study, the cryopreserved milt was relatively ineffective at fertilizing eggs, so it was not used widely in the program. There are no plans to use the cryopreserved milt in the future. It is noteworthy that most of the males used in spawning were mini-jacks and there were many females that matured at age 3. Table 7.2 shows the ages of first-generation males and females spawned for the captive brood program.

Table 7.2. Total ages of first-generation (F_1) male and female spring Chinook spawned for the White River captive brood program, spawning years 2001-2011; NA = not available.

Spawning year	Sex	Total age				Total
		2	3	4	5	
2001	Female	0	0	3	0	3
	Male	0	2	0	0	2
2002	Female	0	0	4	4	8
	Male	10	0	0	0	10
2003	Female	0	5	0	0	5
	Male	0	2	0	0	2
2004	Female	0	0	2	0	2
	Male	4	0	0	0	4
2005	Female	0	85*	0	0	85
	Male	90	1	0	0	91
2006	Female	2	104	110	0	216
	Male	104	6	0	0	110
2007	Female	0	21	118	1	140
	Male	113	7	0	0	120
2008	Female	0	58	0	0	58

Spawning year	Sex	Total age				Total
		2	3	4	5	
	Male	NA	NA	NA	NA	NA
2009	Female	0	0	119	0	119
	Male	65	54	0	0	119
2010	Female	0	0	42	0	42
	Male	22	23	0	0	45
2011	Female	0	0	0	150	150
	Male	0	148	2	0	150
Average	***Female***	***0***	***25***	***36***	***14***	***75***
	Male	***41***	***24***	***0***	***0***	***65***
Median	***Female***	***0***	***0***	***3***	***0***	***58***
	Male	***16***	***4***	***0***	***0***	***68***

* Included some unknown number of second-generation females.

Release Information

Numbers released

Several different acclimation and release scenarios were conducted since 1997. Acclimation scenarios have involved naturalized features such as in-channel enclosures, stream-side tanks supplied with pass-through surface water, and net pens in Lake Wenatchee near the mouth of the White River. Release scenarios have included on-site releases from tanks, in-channel enclosures, and net pens in Lake Wenatchee. The low survival of fish released in the lake and White River prompted exploring the release of fish near the mouth of the lake and downstream from the lake. In 2010, acclimated fish were towed in net pens to the mouth of the lake and released there. In 2011, tank and net-pen acclimated fish were loaded into transport trucks and released into the Wenatchee River. In addition, subyearling and yearling Chinook with no acclimation have been released from transport trucks directly into Lake Wenatchee and the White River. A total of 944,591 second-generation (F_2) juvenile spring Chinook have been released from the captive brood program. Table 7.3 summarizes the acclimation and release history of F_2 spring Chinook released into the upper Wenatchee River basin.

Table 7.3. Numbers of White River juvenile spring Chinook released and their acclimation histories for brood years 2002-2013.

Brood year	Acclimation site	Acclimation vessel	Number of smolts released	Release scenario	Release date	Number of acclimation days
2002	WR RM 11.5	Tanks	2,589	White River	4/22/2004	17
2003	WR RM 11.5	Tanks	2,096	White River	5/2/2005	47
2004	WR RM 17.7	Truck/Tanks	1,654	White River	4/4/2006	9
2005	Lake Wen	Net Pens	69,032	Lake Wen	5/2/2007	34
2006	NA	NA	139,644*	White River	4/17, 4/25/2007	0
	NA	NA	142,033	White River	3/18, 3/20/2008	0

Brood year	Acclimation site	Acclimation vessel	Number of smolts released	Release scenario	Release date	Number of acclimation days
2007	Lake Wen	Net Pens	87,671	Lake Wen	5/5/2009	35-40
	None	None	44,172	Lake Wen	4/1/2009	0
2008	WR Bridge	Eddy Pen	10,156	Escape	~4/12/2010	~10
	Lake Wen	Net Pens	38,400	Mouth of lake	5/5, 5/6/2010	38-41
2009	WR RM 11.5	Side Channel	12,000	Escape	~3/31/2011	~7
	WR RM 11.5	Tanks	10,000	White River	5/12/2011	49
	WR Bridge	Tanks	28,000	White River	5/14/2011	51
	WR Bridge	Tanks		Wen River	5/13/2011	50
	WR Bridge	Eddy Pen	14,596	Escape	~3/27/2011	~3
	Lake Wen	Net Pens	48,000	Wen River	5/14/2011	46
	Lake Wen	Net Pens		Wen River	5/14/2011	44
2010	WR Bridge	Tanks	18,850	Wen River	5/9/2012	44
2011	WR Bridge	Tanks	42,000	Wen & White R	5/6, 5/7, 5/8/13	49, 50, 51
	Lake Wen	Net Pens	105,000	Wen River	5/8, 5/13, 5/14/13	51, 56, 57
2012	WR Bridge	Tanks	42,000	Wen River	5/6/14	50
	Lake Wen	Net Pens	55,713	Wen River	5/8/14	49
2013	WR Bridge	Tanks	31,000	Wen River	5/4/15	56

* Subyearling release.

Numbers tagged

Brood years 2005 and 2007-2013 spring Chinook were tagged with a CWT in their peduncle. None of these fish were adipose fin clipped.[30] Subyearling fish from the 2006 brood year were tagged with half of a CWT in their snouts. Yearling fish from the 2006 brood year were tagged with CWTs in the peduncle. None of these fish were adipose fin clipped. In addition, beginning in 2008 (brood year 2006), 258,375 juvenile spring Chinook were PIT tagged before release. Table 7.4 identifies the number of second-generation (F_2) juvenile spring Chinook tagged with PIT tags.

Table 7.4. Numbers of second-generation (F2) White River spring Chinook smolts tagged and released in the upper Wenatchee River basin, brood years 2002-2013. NA = not available.

Brood year	Acclimation site	Acclimation vessel	Release scenario	CWT mark rate	Number released that were PIT tagged	Number of smolts released
2002	WR RM 11.5	Tanks	White River	NA	0	2,589
2003	WR RM 11.5	Tanks	White River	NA	0	2,096

30 Given that juvenile spring Chinook were tagged with CWTs in the peduncle and were not ad-clipped, it is possible that field crews missed hatchery-origin adults on the spawning grounds because they did not know they were supposed to sample fish with adipose fins. Thus, this bias in carcass sampling may bias derived metrics such as spawning distribution of hatchery and natural-origin fish, spawn timing of hatchery and natural-origin fish, age at maturity, size at maturity, contributions to fisheries, HOR, NOR, HRR, NRR, PNI, straying, and SARs.

Brood year	Acclimation site	Acclimation vessel	Release scenario	CWT mark rate	Number released that were PIT tagged	Number of smolts released
2004	WR RM 11.5	Tanks	White River	NA	0	1,639
2005	Lake Wen	Net Pens	Lake Wen	1.00	0	69,032
2006	NA	NA	White River	NA	29,881	139,644*
	NA	NA	White River	NA		142,033
2007	Lake Wen	Net Pens	Lake Wen	1.00	29,863	87,671
	None	None	Lake Wen	1.00	9,957	44,172
2008	WR Bridge	Eddy Pen	Escape	1.00	38,148	10,156
	Lake Wen	Net Pens	Lake Mouth	1.00		38,400
2009	WR RM 11.5	Side Channel	Escape	1.00	41,886	12,000
	WR RM 11.5	Tanks	White River	1.00		10,000
	WR Bridge	Tanks	White River	1.00		28,000
	WR Bridge	Tanks	Wen River	1.00		
	WR Bridge	Eddy Pen	Escape	1.00		14,596
	Lake Wen	Net Pens	Wen River	1.00		48,000
	Lake Wen	Net Pens	Wen River	1.00		
2010	WR Bridge	Tanks	Wen River	1.00	12,283	18,850
2011	WR Bridge	Tanks	Wen & White	1.00	2,490	42,000
	Lake Wen	Net Pens	Wen River	1.00	51,697	105,000
2012	WR Bridge	Tanks	Wen River	1.00	52,097	42,000
	Lake Wen	Net Pens	Wen River	1.00		55,713
2013	WR Bridge	Tanks	Wen River	1.00	19,954	31,000

* Subyearling release.

Fish size and condition at release

Table 7.5 summarizes the size and condition of second-generation White River juvenile spring Chinook released in the upper Wenatchee River basin.

Table 7.5. Mean lengths (FL, mm), weight (g and fish/pound), and coefficient of variation (CV) of second-generation White River (WR) juvenile spring Chinook released in the upper Wenatchee River basin, brood years 2002-2013. Size targets are provided in the last row of the table. NA = not available.

Brood year	Acclimation site	Release scenario	Fork length (mm)		Mean weight	
			Mean	CV	Grams (g)	Fish/pound
2002	WR RM 11.5	White River	NA	NA	NA	NA
2003	WR RM 11.5	White River	166	12.4	53.7	8
2004	WR RM 11.5	White River	207	11.6	117.7	4
2005	Lake Wen	Lake Wen	145	9.7	36.9	31
2006	NA	White River	NA	NA	NA	NA

Brood year	Acclimation site	Release scenario	Fork length (mm)		Mean weight	
			Mean	CV	Grams (g)	Fish/pound
	NA	White River	NA	NA	NA	NA
2007	Lake Wen	Lake Wen	135	7.8	29.2	29
	None	Lake Wen	NA	NA	NA	NA
2008	WR Bridge	Escape	--	--	--	--
	Lake Wen	Mouth of lake	138	10.0	32.5	14
2009	WR RM 11.5	Escape	--	--	--	--
	WR RM 11.5	White River	134	8.7	29.3	16
	WR Bridge	White River	138	9.3	28.6	16
	WR Bridge	Wen River	NA	NA	NA	NA
	WR Bridge	Escape	--	--	--	--
	Lake Wen	Wen River	140	8.9	31.6	14
	Lake Wen	Wen River	142	9.8	39.3	12
2010	WR Bridge	Wen River	125	8.0	22.8	20
2011	WR Bridge	Wen & White	130	8.4	24.1	19
	Lake Wen	Wen River	128	8.2	24.0	19
2012	WR Bridge	Wen River	131	8.1	24.2	18.8
	Lake Wen	Wen River	NA	NA	NA	NA
2013	WR Bridge	Wen River	132	8.7	24.5	19
Average			142	9.3	37.0	17

Post-Release Survival of Hatchery Fish

We used PIT-tagged fish to estimate survival rates and travel time (arithmetic mean days) of released second-generation (F_2) White River spring Chinook smolts to McNary Dam, and smolt to adult ratios (SARs) from release to detection at Bonneville Dam.[31] Based on the available data, post-release survival has been low for fish released into the White River and Lake Wenatchee (Table 7.6). In contrast, survival of fish released in the Wenatchee River tends to be higher than those released in the White River or in Lake Wenatchee. These results suggest that high mortality in Lake Wenatchee may explain why adult returns of program fish have been consistently poor; however, other factors such as high precocious maturation may also contribute to the estimated low survival (e.g., see Ford et al. 2015).

Average travel time from release to McNary Dam ranged from 21 to 82 days (Table 7.6). Spring Chinook released in the Wenatchee River typically traveled faster to McNary Dam than those released in the White River or in Lake Wenatchee. Because of uncertain release times for several groups, we were unable to estimate travel times for all release groups.

[31] It is important to point out that because of fish size differences among rearing net pens, tanks, or raceways, fish PIT tagged in one pen, tank, or raceway may not represent untagged fish rearing in other pens, tanks, or raceways.

Table 7.6. Survival and travel times (mean days) of second-generation (F2) White River spring Chinook smolts to McNary Dam and SARs to Bonneville Dam for different release scenarios, brood years 2006-2013. Values in parentheses represent the standard error of the estimate. NA = not available (i.e., not all the fish from the release groups have returned to the Columbia River).

Brood year	Release scenario	Number of Chinook released with PIT tags	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
2006	White River	29,881	0.037 (0.008)	82.3 (16.1)	0.000 (0.000)
2007	Lake Wen Pens	29,863	0.096 (0.010)	41.4 (11.1)	0.000 (--)
	Lake Wenatchee	9,957	0.080 (0.015)	40.4 (12.9)	0.000 (--)
2008	Lake Wenatchee	38,146	0.065 (0.010)	65.2 (14.0)	0.001 (0.000)
2009	White and Wenatchee rivers	19,912	0.269 (0.027)	22.8 (9.1)	0.002 (0.000)
	White River	21,829	0.055 (0.013)	45.6 (21.0)	0.000 (0.000)
2010	Wenatchee River	12,283	0.266 (0.017)	21.3 (5.1)	0.001 (0.000)
2011	Wenatchee River	2,490	0.385 (0.042)	21.7 (6.2)	0.004 (0.001)
	White and Wenatchee rivers	51,696	0.433 (0.010)	23.4 (12.7)	0.003 (0.000)
2012	Wenatchee River	52,113	0.353 (0.013)	20.9 (6.9)	0.001 (0.000)
2013	Wenatchee River	19,954	0.328 (0.026)	20.6 (5.7)	0.000 (0.000)

7.3 Disease Monitoring

First-Generation Health Maintenance

First-generation (F_1) adults were fed an azithromycin-medicated feed in the spring to prevent bacterial kidney disease (BKD), which is a common affliction of spring Chinook salmon. As needed, fish received a dose of 20 mg/kg of body weight. The fish also received formalin treatments as needed throughout the year to prevent and treat fungus infections. This was especially important during the pre-spawning period when individual fish were maturing in preparation for spawning. Formalin treatments were conducted three times per week and consist of one hour of flow-through at a concentration of 167 parts per million (ppm).

Second-Generation Health Maintenance

Following fertilization and initial incubation in September, second-generation (F_2) eggs were shocked in October. Eggs were treated with a 1,667 ppm formalin solution in a 15-minute flow-through treatment three times a week to prevent fungus growth. Formalin treatments ended after hatching, and water flow was increased from three to five gallons per minute. Dead and deformed fry were removed before relocating the fry to nursery tanks in late January or early February. Fry were then relocated to raceways in July, where they remained until transfer to the White River for acclimation the following March. Coded-wire tagging was typically conducted in July, and PIT tagging occurred the following January or February, just before the fish were transferred to acclimation facilities on the White River in March.

7.4 Natural Juvenile Productivity

Juvenile productivity estimation began with the monitoring of emigration of spring Chinook in the White River in 2007 (Lauver et al. 2012). A five-foot diameter rotary screw trap is operated annually from about 1 March through November. A second screw trap was installed in 2017 to increase catch and improve capture efficiency estimates. The purpose of the program is to estimate the number and timing of subyearlings and yearling spring Chinook emigrating from the White River basin.

Smolt and Emigrant Estimates

In 2019, the White River Trap operated between 1 March and 27 November 2019. During that period, the trap was inoperable for 26 days because of debris blockages and periods of high discharge. Daily trap efficiencies were estimated by conducting mark-recapture trials. The daily number of fish captured was expanded by the estimated trap efficiency to estimate daily total emigration. If trap efficiencies could not be assessed because of low numbers of juvenile Chinook trapped, a composite model based on efficiency trials from previous years was used to calculate abundance. Daily captures of fish and results of mark-recapture efficiency tests at the White River trap are reported in Appendix O.

Wild yearling spring Chinook (2017 brood year) were captured primarily in March and April 2019 (Figure 7.1). Based on a composite regression model, the total number of wild yearling Chinook emigrating from the White River was 3,401(±4,435). Combining the total number of subyearling spring Chinook (1,679 ±537) that emigrated during the fall of 2018 with the total number of yearling Chinook (3,401) that emigrated during 2019 resulted in a total emigrant estimate of 5,080 (±4,468) spring Chinook for the 2017 brood year (Table 7.7).

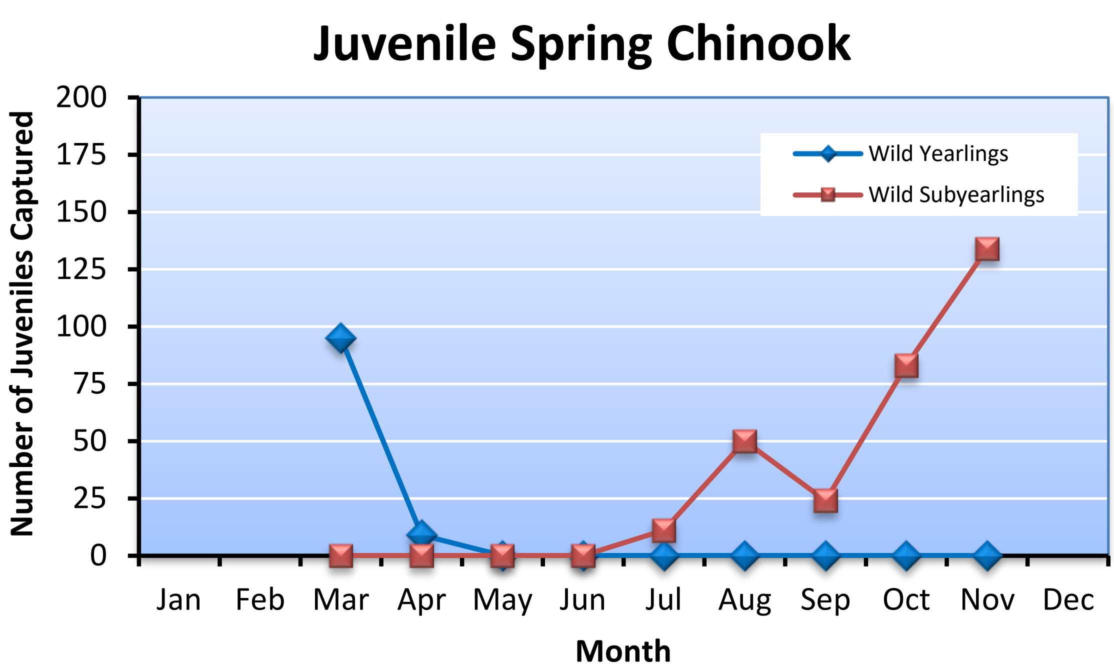


Figure 7.1. Monthly captures of wild subyearling (parr) and yearling spring Chinook at the White River Trap, 2019.

Table 7.7. Numbers of redds and juvenile spring Chinook at different life stages in the White River basin for brood years 2005-2017; ND = no data.

Brood year	Number of redds	Egg deposition[a]	Number of subyearling emigrants[b]	Number of smolts produced within White River basin	Number of emigrants
2005	86	372,122	ND	4,856	ND
2006	31	134,044	874	2,202	3,076
2007	20	88,820	2,710	6,493	9,203
2008	31	142,352	5,913	4,981	10,894
2009	54	246,942	2,819	3,476	6,295
2010	33	142,362	1,922	4,853	6,775
2011	20	87,700	4,197	3,027	7,224
2012	86	363,178	3,814	8,357	12,171
2013	54	254,664	2,457	5,787	8,244
2014	26	105,170	1,957	580	2,537
2015	70	339,290	2,436	6,848	9,284
2016	44	196,548	4,851	11,170	16,201
2017	15	69,225	1,679	3,401	5,080
Average[c]	***44***	***195,571***	***3,013***	***5,219***	***8,082***
Median[c]	***33***	***142,361***	***2,584***	***4,919***	***7,734***

[a] Egg deposition is calculated as the number of redds times the fecundity of both wild and hatchery spring Chinook salmon (from Table 5.5.
[b] Subyearling emigrants do not include fry that left the watershed before 1 July.
[c] Average and median are based on the entire time series of data, not just the period 2006 through 2012.

Wild subyearling spring Chinook (2018 brood year) were captured between 1 July and 24 November 2019, with peak catch during late October/early November (Figure 7.1). Based on a composite regression model, the total number of wild subyearling Chinook emigrating from the White River was 3,541 (±2,392).

Yearling spring Chinook sampled in 2019 averaged 101 mm in length, 12.0 g in weight, and had a mean condition of 1.10 (Table 7.8). The average length and weight were greater than the overall means of yearling spring Chinook sampled in previous years, while condition factor was the same (overall means, 100 mm, 11.2 g, and 1.10). Subyearling spring Chinook parr sampled in 2019 at the White River Trap averaged 86 mm in length, averaged 7.4 g, and had a mean condition of 1.11 (Table 7.8). Estimated length and weight and condition were less than the overall means of subyearling spring Chinook sampled in previous years, while the condition factor was greater (overall means, 90 mm, 8.3 g, and 1.10).

Table 7.8. Mean fork length (mm), weight (g), and condition factor of subyearling (parr) and yearling spring Chinook collected in the White River Trap, 2007-2019. Numbers in parentheses indicate 1 standard deviation.

Sample year	Life stage	Sample size[a]	Mean size		
			Length (mm)	Weight (g)	Condition (K)
2007	Subyearling	33	95 (12)	9.8 (4.1)	1.07 (0.11)
	Yearling	173	93 (9)	8.6 (2.2)	1.03 (0.09)
2008	Subyearling	202	95 (9)	9.4 (2.5)	1.08 (0.13)
	Yearling	105	100 (12)	11.3 (3.3)	1.07 (0.13)
2009	Subyearling	499	85 (11)	7.1 (2.6)	1.09 (0.11)
	Yearling	274	104 (6)	12.5 (2.6)	1.11 (0.10)
2010	Subyearling	168	87 (13)	7.8 (3.1)	1.12 (0.11)
	Yearling	346	100 (7)	11.2 (2.4)	1.12 (0.09)
2011	Subyearling	145	94 (9)	9.3 (2.5)	1.10 (0.10)
	Yearling	64	99 (8)	11.3 (2.8)	1.14 (0.09)
2012	Subyearling	285	91 (10)	8.9 (2.7)	1.13 (0.09)
	Yearling	179	98 (8)	10.9 (2.8)	1.14 (0.08)
2013	Subyearling	444	84 (12)	6.6 (2.5)	1.05 (0.09)
	Yearling	20	102 (7)	12.3 (3.0)	1.12 (0.14)
2014	Subyearling	185	86 (14)	7.5 (3.3)	1.10 (0.11)
	Yearling	43	94 (7)	9.4 (2.2)	1.11 (0.13)
2015	Subyearling	148	96 (8)	9.9 (2.3)	1.11 (0.07)
	Yearling	31	104 (7)	13.0 (2.8)	1.14 (0.07)
2016	Subyearling	147	89 (11)	8.3 (2.8)	1.13 (0.10)
	Yearling	3	106 (2)	12.4 (0.3)	1.05 (0.03)
2017	Subyearling	516	85 (10)	7.1 (2.3)	1.09 (0.02)
	Yearling	36	99 (6)	10.7 (2.3)	1.11 (0.08)
2018	Subyearling	94	95 (8)	9.3 (2.3)	1.08 (0.07)
	Yearling	114	98 (7)	10.6 (2.2)	1.11 (0.08)
2019	Subyearling	301	86 (9)	7.4 (2.3)	1.11 (0.09)
	Yearling	101	101 (7)	12.0 (2.2)	1.10 (0.11)
Average	***Subyearling***	***244***	***90 (5)***	***8.3 (1.1)***	***1.10 (0.02)***
	Yearling	***115***	***100 (4)***	***11.2 (1.3)***	***1.10 (0.03)***
Median	***Subyearling***	***185***	***89 (11)***	***8.3 (2.8)***	***1.10 (0.11)***
	Yearling	***101***	***100 (7)***	***11.3 (3.3)***	***1.11 (0.08)***

[a] Sample size represents the number of fish that were measured for both length and weight.

PIT Tagging Activities

As part of the Comparative Survival Study (CSS) and PUD studies, a total of 23,649 wild juvenile Chinook (17,448 subyearling and 6,201 yearlings) were PIT tagged and released in 2019 in the

Wenatchee River basin (Table 7.9). A total of 435 juvenile Chinook were PIT tagged in the White River in 2019. See Appendix D for a complete list of all fish captured, tagged, lost, and released.

Table 7.9. Numbers of wild Chinook that were captured, tagged, and released at different locations within the Wenatchee River basin, 2019. Numbers of fish that died or shed tags are also given.

Sampling location	Life stage	Number captured	Number of recaptures	Number tagged	Number died	Shed tags	Total tagged fish released	Percent mortality
Chiwawa Trap	Subyearling	13,970	247	9,634	78	0	9,634	0.56
	Yearling	4,730	91	4,540	9	0	4,540	0.19
	Total	**18,700**	**338**	**14,174**	**87**	**0**	**14,174**	**0.47**
Chiwawa River (Electrofishing)	Subyearling	3,448	67	3,309	9	1	3,309	0.26
	Yearling	0	0	0	0	0	0	0.00
	Total	**3,448**	**67**	**3,309**	**9**	**1**	**3,309**	**0.26**
Nason Creek Trap	Subyearling	1,759	20	959	25	0	959	1.42
	Yearling	296	18	269	2	0	269	0.68
	Total	**2,055**	**38**	**1,228**	**27**	**0**	**1,228**	**1.31**
Nason Creek (Electrofishing)	Subyearling	3,447	76	3,212	86	0	3,212	2.49
	Yearling	0	0	0	0	0	0	0.00
	Total	**3,447**	**76**	**3,212**	**86**	**0**	**3,212**	**2.49**
White River Trap	Subyearling	372	1	332	6	0	332	1.61
	Yearling	119	1	103	9	0	103	7.56
	Total	**491**	**2**	**435**	**15**	**0**	**435**	**3.05**
Lower Wenatchee Trap	Subyearling	28,534	101	2	167	0	2	0.59
	Yearling	1,485	4	1,289	2	0	1,289	0.13
	Total	**30,019**	**105**	**1,291**	**169**	**0**	**1,291**	**0.56**
Total:	**Subyearling**	***51,530***	***512***	***17,448***	***371***	***1***	***17,448***	***0.72***
	Yearling	***6,630***	***114***	***6,201***	***22***	***0***	***6,201***	***0.33***
Grand Total:		***58,160***	***626***	***23,649***	***393***	***1***	***23,649***	***0.68***

Numbers of wild Chinook salmon PIT-tagged and released as part of CSS and PUD studies during the period 2008-2019 are shown in Table 7.10.

Table 7.10. Summary of the numbers of wild Chinook that were tagged and released at different locations within the Wenatchee River basin, 2008-2019.

Sampling location	Life stage	Numbers of PIT-tagged wild Chinook salmon released											
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Chiwawa Trap	Subyearling	8,755	8,765	3,324	6,030	7,644	9,086	11,358	10,471	7,354	8,241	5,686	9,634
	Yearling	8,397	3,694	6,281	4,318	7,980	3,093	4,383	6,204	2,729	5,711	3,447	4,540
	Total	**17,152**	**12,459**	**9,605**	**10,348**	**15,624**	**12,179**	**15,741**	**16,675**	**10,083**	**13,952**	**9,133**	**14,174**
Chiwawa River (Angling or	Subyearling	43	128	531	0	3,181	3,017	1,032	1,054	1,776	2,703	3,737	3,309
	Yearling	0	3	4	0	0	0	0	0	0	0	0	0

Sampling location	Life stage	Numbers of PIT-tagged wild Chinook salmon released											
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Electro-fishing)	**Total**	**43**	**131**	**535**	**0**	**3,181**	**3,017**	**1,032**	**1,054**	**1,776**	**2,703**	**3,737**	**3,309**
Upper Wenatchee Trap	Subyearling	0	37	3	1	1	0	--	--	--	--	--	--
	Yearling	159	296	486	714	75	94	--	--	--	--	--	--
	Total	**159**	**333**	**489**	**715**	**76**	**94**	**--**	**--**	**--**	**--**	**--**	**--**
Nason Creek Trap	Subyearling	1,741	1,890	2,828	822	1,939	3,290	1,113	219	434	1,877	686	959
	Yearling	894	185	364	147	357	237	456	142	61	346	296	269
	Total	**2,635**	**2,075**	**3,192**	**969**	**2,296**	**3,527**	**1,569**	**361**	**495**	**2,223**	**982**	**1,228**
Nason Creek (Angling or Electro-fishing)	Subyearling	4	701	595	0	0	0	1,816	1,089	802	3,240	2,524	3,212
	Yearling	0	13	3	0	0	0	0	0	0	0	0	0
	Total	**4**	**714**	**598**	**0**	**0**	**0**	**1,816**	**1,089**	**802**	**3,240**	**2,524**	**3,212**
White River Trap	Subyearling	0	441	143	144	285	374	156	149	136	507	220	332
	Yearling	0	265	359	65	180	22	49	34	3	41	106	103
	Total	**0**	**706**	**502**	**209**	**465**	**396**	**205**	**183**	**139**	**548**	**326**	**435**
Lower Wenatchee Trap	Subyearling	2	0	0	0	0	0	36	0	18	0	5	2
	Yearling	506	468	917	0	0	1,712	1,506	1,301	538	1,220	1,243	1,289
	Total	**508**	**468**	**917**	**0**	**0**	**1,712**	**1,542**	**1,301**	**556**	**1,220**	**1,248**	**1,291**
Total:	**Subyearling**	**10,545**	**11,962**	**7,424**	**6,997**	**13,050**	**15,767**	**15,511**	**12,982**	**10,520**	**16,568**	**12,858**	**17,448**
	Yearling	**9,956**	**4,924**	**8,414**	**5,244**	**8,592**	**5,158**	**6,394**	**7,681**	**3,331**	**7,318**	**5,092**	**6,201**
Grand Total:		***20,501***	***16,886***	***15,838***	***12,241***	***21,642***	***20,925***	***21,905***	***20,663***	***13,851***	***23,886***	***17,950***	***23,649***

Freshwater Productivity

Productivity and survival estimates for different life stages of spring Chinook in the White River basin are provided in Table 7.11. Freshwater productivities ranged from 22-325 smolts/redd and 98-460 emigrants/redd. Survivals during the same period ranged from 0.6-7.3% for egg-smolt and 2.3-10.4% for egg-emigrants.

Table 7.11. Productivity (fish/redd) and survival (%) estimates for different juvenile life stages of spring Chinook in the White River basin for brood years 2005-2017. These estimates were derived from data in Table 7.7. ND = no data.

Brood year	Smolts/Redd[a]	Emigrants/ Redd	Egg-Smolt[a] (%)	Egg-Emigrant (%)
2005	56	ND	1.3	ND
2006	71	99	1.6	2.3
2007	325	460	7.3	10.4
2008	161	351	3.5	7.7
2009	64	117	1.4	2.5
2010	147	205	3.4	4.7
2011	151	362	3.5	8.3
2012	97	142	2.3	3.4

Brood year	Smolts/Redd[a]	Emigrants/ Redd	Egg-Smolt[a] (%)	Egg-Emigrant (%)
2013	107	153	2.3	3.2
2014	22	98	0.6	2.4
2015	98	133	2.0	2.7
2016	254	364	5.7	8.2
2017	227	339	4.9	7.3
Average	***137***	***235***	***3.1***	***5.3***
Median	***107***	***179***	***2.3***	***4.0***

[a] These estimates include White River smolts produced only within the White River basin.

Seeding level (egg deposition) explained part of the variability in productivity and survival of juvenile spring Chinook in the White River basin. That is, for estimates based on smolts produced within the White River basin, survival and productivity decreased as seeding levels increased (Figure 7.2). This suggests that density dependence in part regulates juvenile productivity and survival within the White River basin.

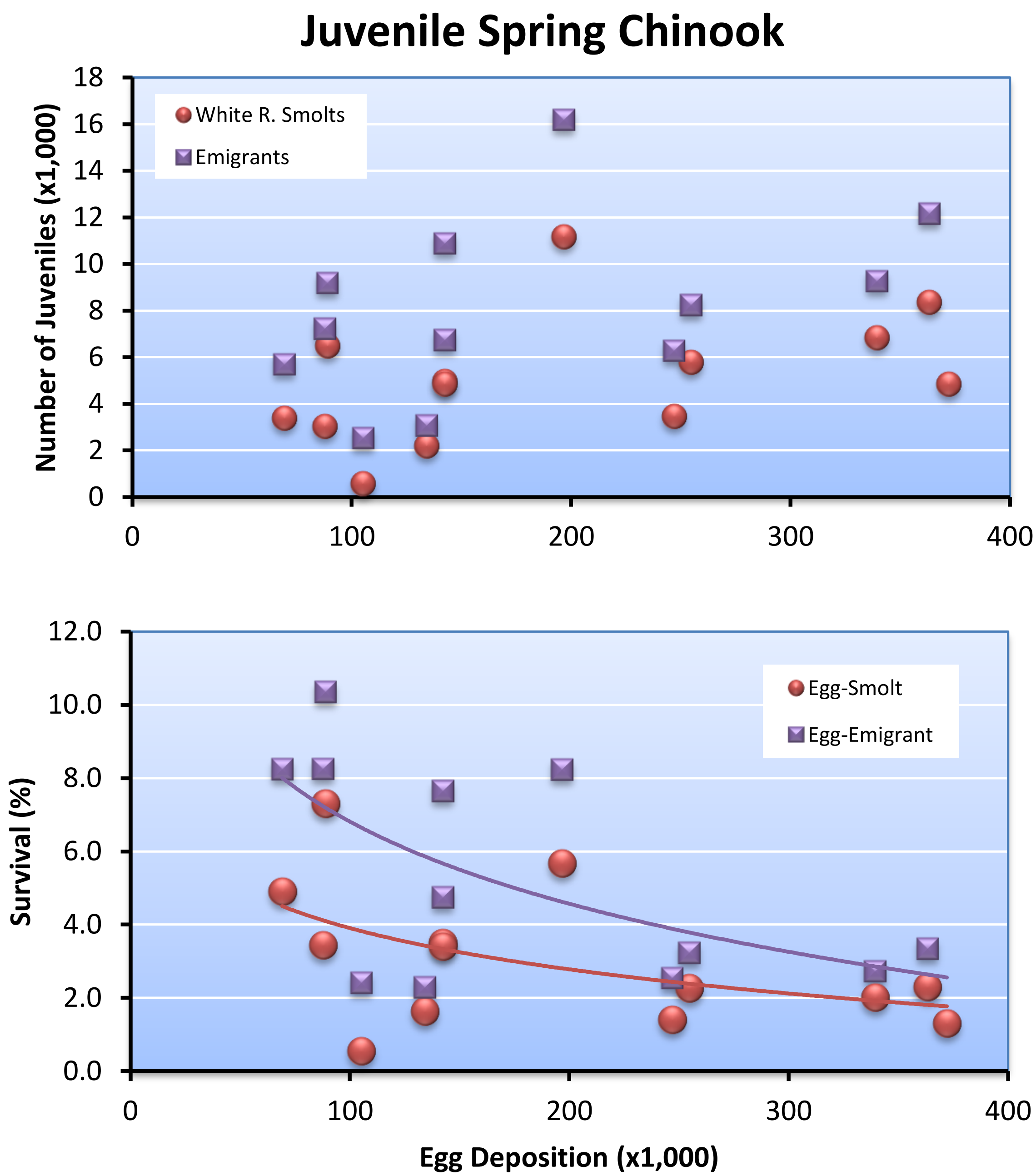


Figure 7.2. Relationships between seeding levels (egg deposition) and juvenile life-stage survivals and productivities for White River spring Chinook, brood years 2005-2017. White River smolts are smolts produced only within the White River basin.

Population Carrying Capacity

Population carrying capacity (*K*) is defined as the maximum equilibrium population size estimated with population models (e.g., logistic equation, Beverton-Holt model, hockey stick model, and the

Ricker model).[32] Maximum equilibrium population size is generated from density dependent mechanisms that reduce population growth rates as population size increases (negative density dependence). This is referred to as compensation. Population size fluctuates about the maximum equilibrium size because of variability in vital rates that are unrelated to density (density independent factors) and measurement error. In this section, we estimate smolt carrying capacities using the Ricker stock-recruitment model (see Appendix 6 in Hillman et al. 2019 for a detailed description of methods). The Ricker model was the best fitting stock-recruitment model to the juvenile spring Chinook data.

Based on the Ricker model, the population carrying capacity for spring Chinook smolts in the White River basin is 5,962 smolts (95% CI: 0 – 9,210) (Figure 7.3). Here, smolts are defined as the number of yearling spring Chinook produced entirely within the White River basin. These estimates reflect current conditions (most recent decades) within the White River basin. Land use activities such as logging, roads, development, and recreation have altered the historical conditions of the watershed. Thus, the estimated population capacity estimates may not reflect historical capacities for spring Chinook smolts in the White River basin.

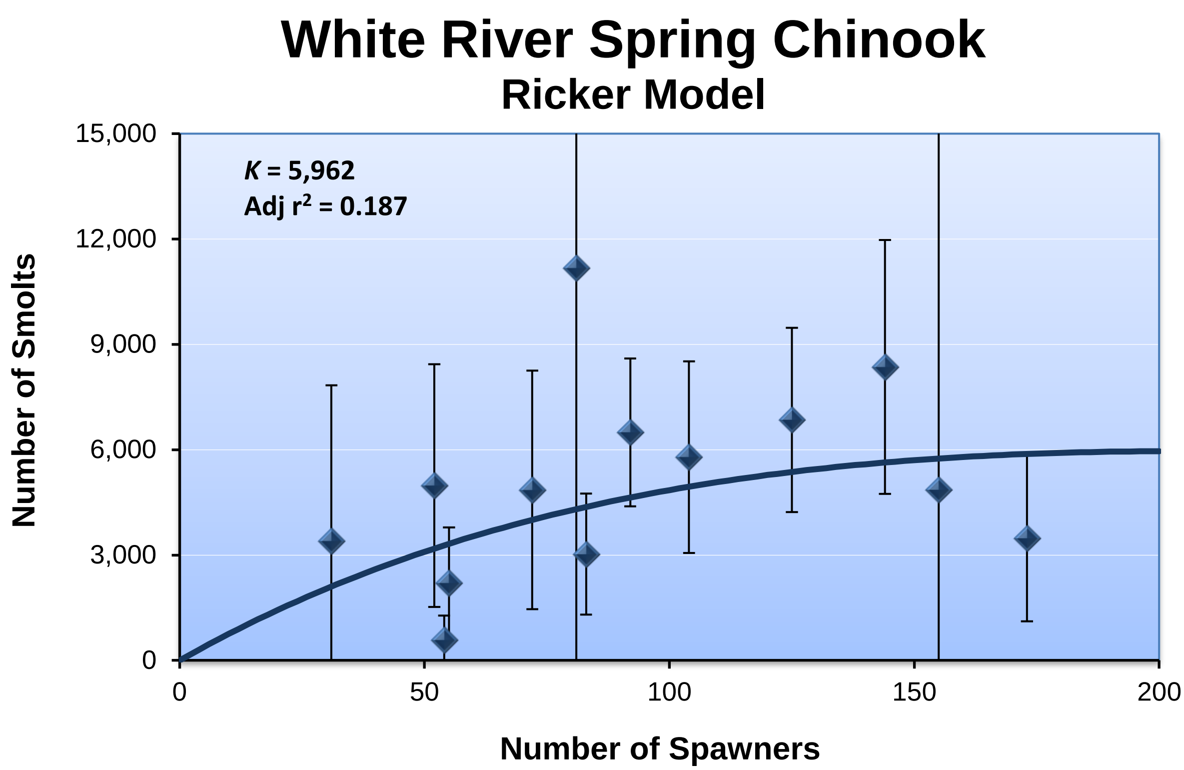


Figure 7.3. Relationship between spawners and number of smolts produced in the White River basin. Population carrying capacity (*K*) was estimated using the Ricker model. Vertical bars represent 95% confidence intervals on smolt estimates.

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32 Population carrying capacity (*K*) should not be confused with habitat carrying capacity (*C*), which is defined as the maximum population of a given species that a particular environment can sustain.

We tracked the precision of the Ricker parameters for White River spring Chinook smolts over time to see if precision improves with additional years of data, and the parameters and statistics stabilize over time. Examination of variation in the alpha (*A*) and beta (*B*) parameters of the Ricker model and their associated standard errors and confidence intervals indicates that the parameters have not stabilized and lack precision (Table 7.12; Figure 7.4). This was also apparent in the estimates of population carrying capacity (Figure 7.5).

Table 7.12. Estimated parameters and statistics associated with fitting the Ricker model to spawning escapement and smolt data. Smolts represent numbers of smolts produced entirely within the White River basin. *A* = alpha parameter; *B* = beta parameter; SE = standard error (estimated from 5,000 bootstrap samples); and r^2 = coefficient of determination. Spawners represent the stock size needed to achieve population capacity.

Years of data	Parameter				Population capacity	Intrinsic productivity	Spawners	r^2
	A	*A* SE	*B*	*B* SE				
5	95.89	44.84	0.0090	0.0040	3,928	96	111	0.001
6	100.65	37.65	0.0092	0.0034	4,007	101	108	0.019
7	81.75	36.97	0.0084	0.0042	3,602	82	120	0.000
8	80.32	32.78	0.0080	0.0036	3,675	80	124	0.000
9	78.79	42.85	0.0080	0.0037	3,605	79	124	0.000
10	40.02	33.48	0.0032	0.0040	4,659	40	316	0.183
11	40.20	32.47	0.0033	0.0040	4,441	40	300	0.182
12	52.58	49.87	0.0048	0.0045	4,056	53	210	0.114
13	78.92	42.64	0.0049	0.0036	5,962	79	205	0.187

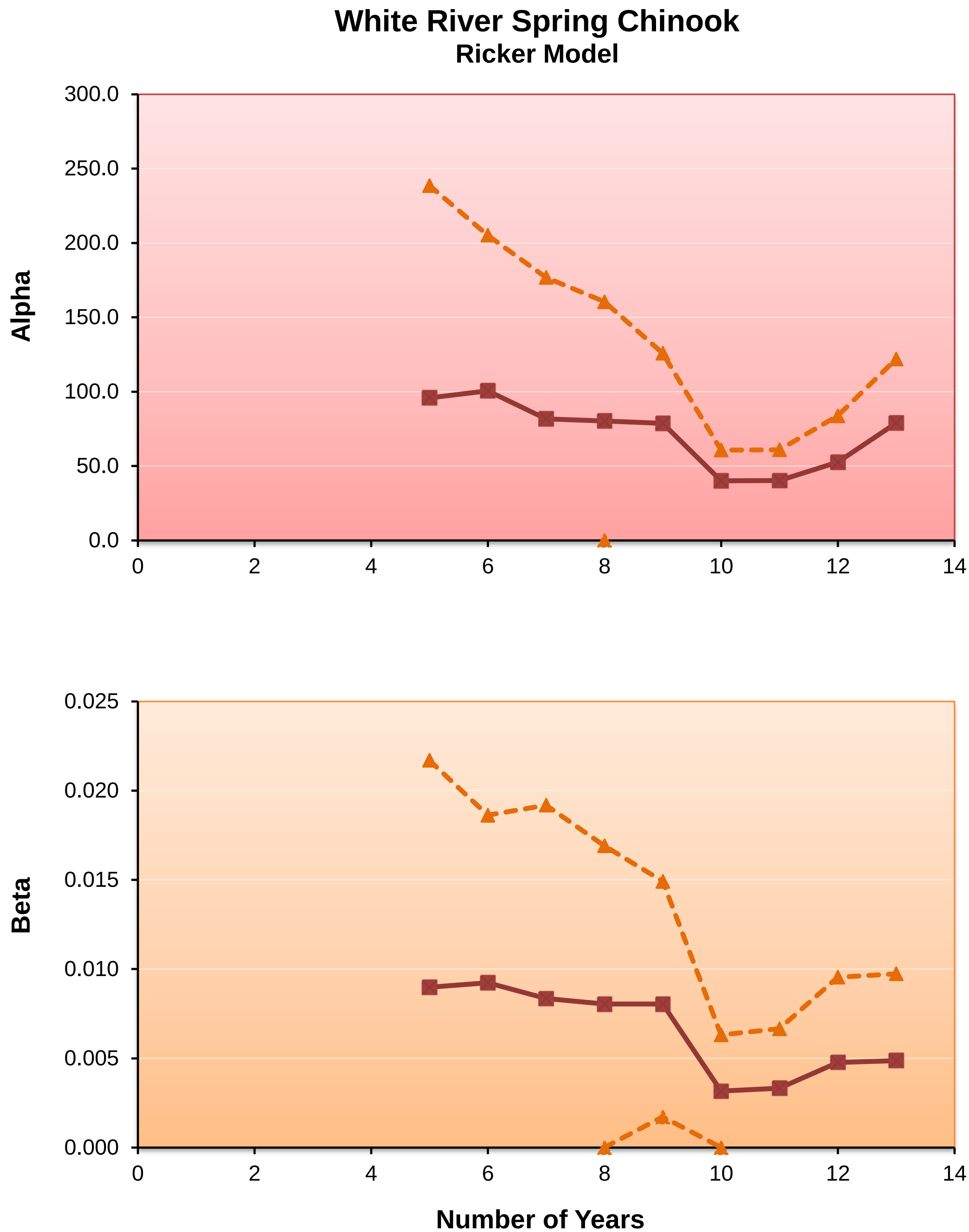


Figure 7.4. Time series of alpha and beta parameters and 95% confidence intervals for the Ricker model that was fit to White River spring Chinook smolt and spawning escapement data. Confidence intervals were estimated from 5,000 bootstrap samples.

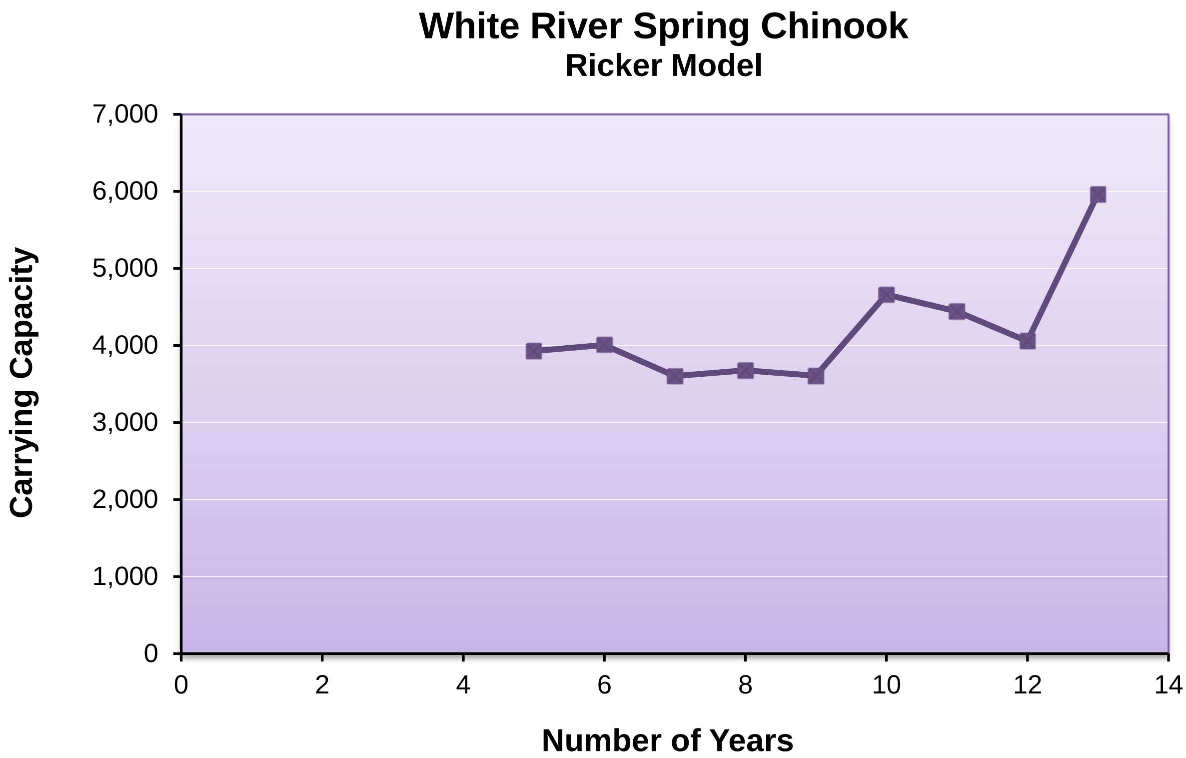


Figure 7.5. Time series of population carrying capacity estimates derived from fitting the Ricker model to White River spring Chinook smolt and spawning escapement data.

7.5 Spawning Surveys

Surveys for spring Chinook redds were conducted during August through September 2019 in the White River (including the Napeequa River and Panther Creek). In the following section, we describe the number and distribution of redds within the White River basin.

Redd Counts and Distribution

A total of 15 spring Chinook redds were counted in the White River in 2019 (Table 7.13). This is lower than the average of 34 redds counted during the period 1989-2018 in Nason Creek. The adjusted number of redds, based on the Guassian area-under-the-curve method, was 19 redds in Nason Creek in 2019 (Table 7.13). Redds were not distributed evenly among the six survey areas in the White River basin. Most redds (84%) were located in Reach 3 (Napeequa River to Grasshopper Meadows) in the White River (Table 7.13).

Table 7.13. Numbers (both observed and estimated) and proportions of spring Chinook redds counted within different survey areas within the White River basin during August through September 2019. See Table 2.7 for description of survey reaches.

Stream/watershed	Reach	Number of observed redds	Estimated number of redds*	Proportion of estimated redds within stream/watershed
White River	White 1 (H1)	0	--	--
	White 2 (H2)	0	0	--
	White 3 (H3)	12	16	0.84
	White 4 (H4)	0	0	--
	Napeequa 1 (Q1)	3	3	--
	Panther 1 (T1)	0	0	0.16
Total		***15***	***19***	***1.00***

* Estimated redds represent the "adjusted" number of redds based on Guassian area-under-the-curve method (see Appendix L).

Spawn Timing

Spring Chinook began spawning during the fourth week of August in the White River and peaked the second week of September (Figure 7.6). Spawning in the White River ended the third week of September.

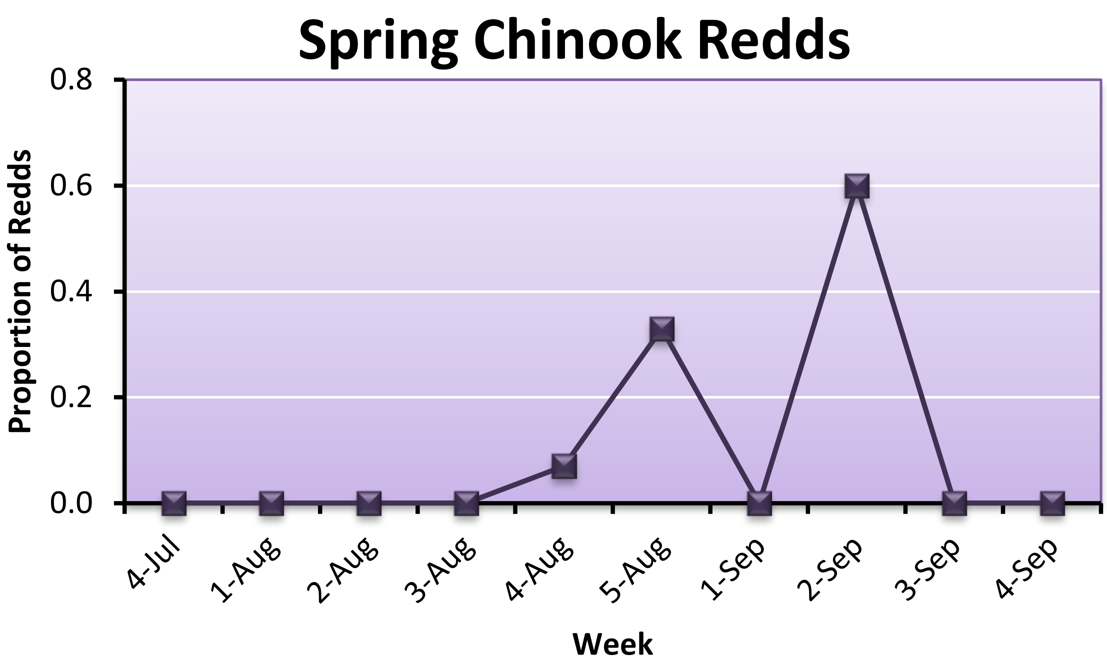


Figure 7.6. Proportion of spring Chinook redds counted during different weeks within the White River basin, August through September 2019.

Spawning Escapement

Spawning escapement for spring Chinook was calculated as the observed (unadjusted for bias) and estimated (adjusted for bias) number of redds times the fish per redd expansion factor, which was estimated from broodstock and fish sampled at adult trapping sites.[33] The estimated fish per redd ratio for spring Chinook upstream from Tumwater in 2019 was 1.93 (based on sex ratios estimated at Tumwater Dam). Multiplying this ratio by the number of redds counted in the White River in 2019 resulted in a total spawning escapement of 29 spring Chinook (based on unadjusted redd counts; Table 7.14a) or 37 spring Chinook (based on adjusted redd counts; Table 7.14b) in the White River.

Table 7.14a. Spawning escapements for spring Chinook in the Wenatchee River basin for return years 1989-2019; NA = not available. Note that these estimates represent observed redds and have not been adjusted for redd count bias.

Return year	Upper basin spawning escapement						Lower basin spawning escapement			Total
	Fish/redd	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River	Fish/redd	Icicle	Peshastin	
1989	2.27	713	288	102	145	213	1.56	37	NA	**1,498**
1990	2.24	571	235	67	49	81	1.71	86	7	**1,096**
1991	2.33	242	156	42	49	96	1.73	69	2	**656**
1992	2.24	676	181	78	78	85	1.65	61	0	**1,159**
1993	2.20	233	491	134	145	189	1.66	88	8	**1,288**
1994	2.24	184	60	16	7	13	2.11	32	0	**312**
1995	2.51	33	18	0	5	3	2.01	18	0	**77**
1996	2.53	58	83	8	30	3	2.09	25	2	**209**
1997	2.22	182	122	18	33	33	1.69	56	2	**446**
1998	2.21	91	64	18	11	0	1.81	20	0	**204**
1999	2.77	94	22	8	3	6	2.06	12	0	**145**
2000	2.70	346	270	24	22	100	1.68	114	0	**876**
2001	1.60	1,725	598	118	166	349	1.72	151	298	**3,405**
2002	2.05	707	603	86	86	113	1.55	380	166	**2,141**
2003	2.43	270	202	29	36	58	1.93	35	116	**746**
2004[a]	3.56/3.00	851	507	39	66	138	1.76	53	97	**1,751**
2005	1.80	599	347	115	155	257	1.67	13	5	**1,491**
2006	1.78	529	271	37	55	48	1.68	84	17	**1,041**
2007	4.58	1,296	463	101	92	55	1.91	32	21	**2,060**
2008	1.68	1,158	564	64	52	302	1.78	206	37	**2,383**
2009	3.20	1,347	534	125	173	16	2.22	71	33	**2,299**
2010	2.18	1,094	408	83	72	102	1.56	242	8	**2,009**
2011	4.13	2,032	702	124	83	50	2.60	317	68	**3,376**
2012	1.68	1,478	694	72	144	123	1.60	318	16	**2,845**
2013	1.93	1,378	409	98	104	33	1.98	212	8	**2,242**
2014	2.01	975	231	50	52	46	1.93	407	0	**1,761**
2015	1.78	967	151	50	125	98	1.87	247	19	**1,657**
2016	1.75	546	149	39	77	30	1.81	130	4	**975**
2017	1.94	431	132	19	29	17	1.81	72	5	**705**
2018	1.88	622	169	15	38	38	1.73	5	3	**890**

[33] Expansion factor = (1 + (number of males/number of females)).

Return year	Upper basin spawning escapement						Lower basin spawning escapement			Total
	Fish/redd	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River	Fish/redd	Icicle	Peshastin	
2019	1.93	442	380	19	29	15	1.86	2	0	**888**
Average	--	***705***	***307***	***58***	***71***	***87***	--	***116***	***31***	***1,375***
Median	--	***599***	***270***	***50***	***55***	***55***	--	***71***	***6***	***1,159***

[a] In 2004, the fish/redd expansion estimate of 3.56 was applied to the Chiwawa River only and 3.00 fish/redd was applied to the rest of the upper basin.

Table 7.14b. Spawning escapements for spring Chinook in the Wenatchee River basin for return years 1989-2019; NA = not available. Note that these estimates have been adjusted for redd count bias.

Return year	Upper basin spawning escapement						Lower basin spawning escapement			Total
	Fish/redd	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River	Fish/redd	Icicle	Peshastin	
2015	1.78	1,080	183	68	162	117	1.87	247	19	**1,876**
2016	1.75	620	175	61	93	39	1.81	130	4	**1,121**
2017	1.94	493	169	31	37	21	1.81	72	5	**829**
2018	1.88	741	203	21	51	51	1.73	5	3	**1,075**
2019	1.93	529	454	27	37	21	1.86	2	0	**1,069**
Average	--	***693***	***237***	***42***	***76***	***50***	--	***91***	***6***	***1,194***
Median	--	***620***	***183***	***31***	***51***	***39***	--	***72***	***4***	***1,075***

7.6 Carcass Surveys

Surveys for spring Chinook carcasses were conducted during August through September 2019 in the White River (including the Napeequa River and Panther Creek). In 2019, 5 spring Chinook carcasses were sampled in the White River basin. Most of these were sampled in Reach 3. The total number of carcasses sampled in 2019 was less than the overall average of 19 carcasses sampled during the period 1996-2018.

In the White River basin in 2019, the spatial distribution of hatchery strays (primarily from the Chiwawa Spring Chinook program) and wild spring Chinook was not equal (Table 7.15). Only one carcass was recovered in the Napeequa River, which was of wild origin, while Reach 3 had three carcasses of hatchery origin and one of wild origin. In 2019, Reach 3 accounted for 80% of the recovered carcasses on the White River (Table 7.15). Over the years, spring Chinook have spawned more often in this reach than in other reaches (Figure 7.7).

Table 7.15. Numbers of wild, hatchery strays, and captive brood spring Chinook carcasses sampled within different reaches in the White River basin, 2000-2019. See Table 2.7 for description of survey reaches.

Survey year	Origin	Survey Reach					Total
		H-2	H-3	H-4	Napeequa	Panther	
2000	Wild	1	0	0	0	0	**1**
	Hatchery Strays	0	0	0	0	0	**0**
2001	Wild	5	40	5	3	1	**54**
	Hatchery Strays	1	19	3	1	2	**26**

Survey year	Origin	Survey Reach					Total
		H-2	H-3	H-4	Napeequa	Panther	
2002	Wild	3	15	0	0	0	**18**
	Hatchery Strays	0	6	0	0	1	**7**
2003	Wild	0	6	0	0	0	**6**
	Hatchery Strays	0	1	1	0	0	**2**
2004	Wild	1	9	1	0	0	**11**
	Hatchery Strays	0	1	0	0	1	**2**
2005	Wild	1	10	0	1	0	**12**
	Hatchery Strays	3	37	0	0	0	**40**
	Captive Brood	0	0	0	0	0	**0**
2006	Wild	2	16	0	1	0	**19**
	Hatchery Strays	0	6	0	0	0	**6**
	Captive Brood	0	0	0	0	0	**0**
2007	Wild	1	7	0	0	2	**10**
	Hatchery Strays	0	3	0	0	0	**3**
	Captive Brood	0	0	0	0	0	**0**
2008	Wild	1	3	0	0	1	**5**
	Hatchery Strays	1	4	0	0	1	**6**
	Captive Brood	0	0	0	0	0	**0**
2009	Wild	0	9	0	0	0	**9**
	Hatchery Strays	0	8	0	0	3	**11**
	Captive Brood	0	0	0	0	0	**0**
2010	Wild	0	3	0	0	0	**3**
	Hatchery Strays	0	8	0	0	0	**8**
	Captive Brood	0	0	0	0	0	**0**
2011	Wild	0	4	0	0	0	**4**
	Hatchery Strays	0	0	0	0	0	**0**
	Captive Brood	0	0	0	0	0	**0**
2012	Wild	0	13	0	0	0	**13**
	Hatchery Strays	0	8	0	0	0	**8**
	Captive Brood	0	0	0	0	0	**0**
2013	Wild	0	9	0	0	0	**9**
	Hatchery Strays	0	7	0	0	3	**10**
	Captive Brood	0	2	0	0	0	**2**
2014	Wild	0	6	0	0	0	**6**
	Hatchery Strays	0	2	0	0	0	**2**
	Captive Brood	0	0	0	0	0	**0**
2015	Wild	1	13	0	0	0	**14**
	Hatchery Strays	2	4	0	0	0	**6**
	Captive Brood	2	3	0	0	0	**5**
2016	Wild	0	10	1	0	0	**11**
	Hatchery Strays	0	1	0	0	0	**1**
	Captive Brood	1	0	0	0	0	**1**

Survey year	Origin	Survey Reach					Total
		H-2	H-3	H-4	Napeequa	Panther	
2017	Wild	2	2	0	1	0	**5**
	Hatchery Strays	0	3	0	0	0	**3**
	Captive Brood	0	1	0	0	0	**1**
2018	Wild	1	6	0	0	0	**7**
	Hatchery Strays	0	5	0	0	0	**5**
	Captive Brood	0	0	0	0	0	**0**
2019	Wild	0	1	0	1	0	**2**
	Hatchery Strays	0	3	0	0	0	**3**
	Captive Brood	0	0	0	0	0	**0**
Average	***Wild***	***1***	***9***	***0***	***0***	***0***	***11***
	Hatchery Stray	***0***	***6***	***0***	***0***	***1***	***7***
	Captive Brood	***0***	***0***	***0***	***0***	***0***	***1***
Median	***Wild***	***1***	***7***	***0***	***0***	***0***	***9***
	Hatchery Stray	***0***	***4***	***0***	***0***	***0***	***5***
	Captive Brood	***0***	***0***	***0***	***0***	***0***	***0***

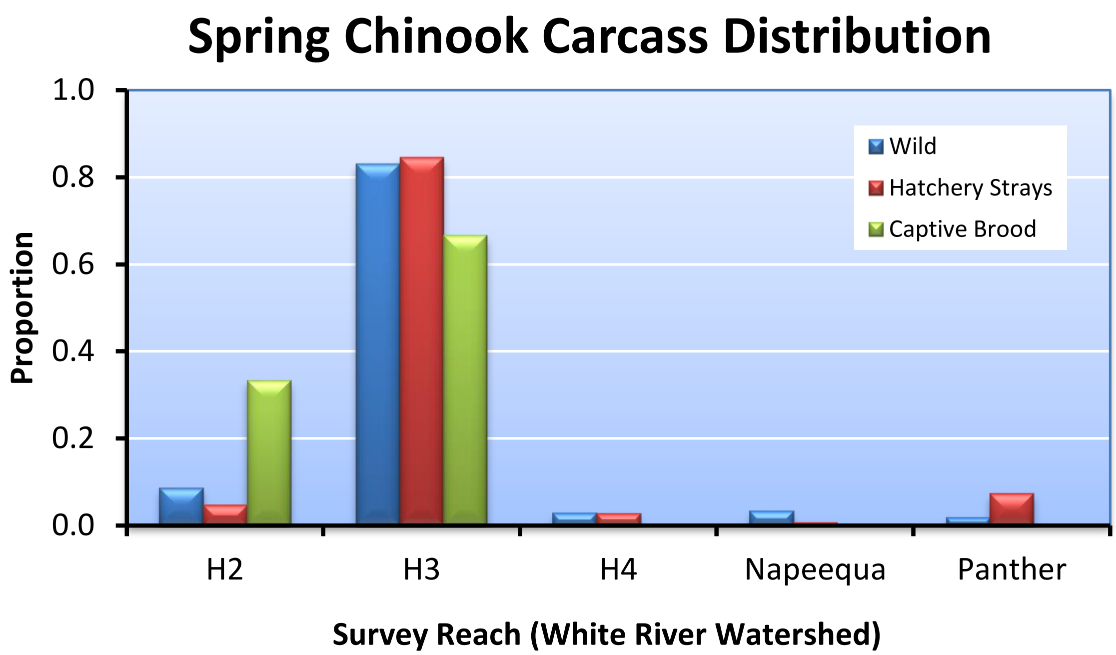


Figure 7.7. Distribution of wild, hatchery strays, and captive brood produced carcasses in different reaches in the White River basin, 2000-2019. Reach codes are described in Table 2.7.

7.7 Life History Monitoring

Life history characteristics of White River spring Chinook were assessed by examining carcasses on spawning grounds and fish collected at broodstock collection sites, and by reviewing tagging data and fisheries statistics.

Migration Timing

In general, wild spring Chinook arrived at Tumwater Dam earlier than did White River hatchery spring Chinook (Table 7.16a and b; Figure 7.8). On average, White River hatchery fish arrived at the dam about 12 days later and ended their migration about 2 days later than did wild fish. Most hatchery and wild spring Chinook migrated upstream past Tumwater Dam during June and July (Figure 7.8).

Table 7.16a. The Julian day and date that 10%, 50% (median), and 90% of the wild and White River hatchery spring Chinook salmon passed Tumwater Dam, 2009-2019. The average Julian day and date are also provided. Migration timing is based on PIT-tag detections at Tumwater Dam. PIT tag releases of hatchery-origin White River spring Chinook occurred for brood years 2006-2013. Wild fish include all wild spring Chinook sampled at Tumwater Dam; however, enumeration errors may still exist because of misidentified run-type assignment (i.e., spring or summer runs).

Survey year	Origin	Spring Chinook Migration Time (days)								Sample size
		10 Percentile		50 Percentile		90 Percentile		Mean		
		Julian	Date	Julian	Date	Julian	Date	Julian	Date	
2009	Wild	171	20-Jun	176	25-Jun	185	4-Jul	177	25-Jun	31
	Hatchery	---	---	---	---	---	---	---	---	0
2010	Wild	175	24-Jun	184	3-Jul	190	9-Jul	184	3-Jul	80
	Hatchery	182	1-Jul	182	1-Jul	182	1-Jul	182	1-Jul	1
2011	Wild	181	29-Jun	193	12-Jul	207	26-Jul	194	12-Jul	97
	Hatchery	206	25-Jul	207	26-Jul	208	26-Jul	207	26-Jul	2
2012	Wild	181	29-Jun	189	7-Jul	202	19-Jul	190	8-Jul	66
	Hatchery	182	30-Jun	194	12-Jul	207	25-Jul	194	11-Jul	20
2013	Wild	166	15-Jun	179	28-Jun	191	10-Jul	179	27-Jun	32
	Hatchery	159	7-Jun	175	24-Jun	187	5-Jul	175	24-Jun	43
2014	Wild	169	18-Jun	179	27-Jun	195	13-Jul	181	29-Jun	32
	Hatchery	182	1-Jul	194	12-Jul	207	25-Jul	193	12-Jul	52
2015	Wild	149	29-May	170	19-Jun	193	12-Jul	170	19-Jun	45
	Hatchery	160	8-Jun	175	24-Jun	197	16-Jul	176	25-Jun	60
2016	Wild	155	2-Jun	174	22-Jun	188	6-Jul	172	20-Jun	37
	Hatchery	166	14-Jun	182	30-Jun	192	10-Jul	180	28-Jun	21
2017	Wild	172	21-Jun	180	29-Jun	194	13-Jul	183	1-Jul	31
	Hatchery	---	---	---	---	---	---	---	---	0
2018	Wild	135	14-May	170	18-Jun	194	13-Jul	167	16-Jun	40
	Hatchery	---	---	---	---	---	---	---	---	0
2019	Wild	163	12-Jun	179	28-Jun	204	22-Jul	183	1-Jul	33
	Hatchery	---	---	---	---	---	---	---	---	0
Average	Wild	***165***		***179***		***195***		***180***		***48***
	Hatchery	***177***		***187***		***197***		***187***		***18***
Median	Wild	***169***		***179***		***194***		***181***		***37***
	Hatchery	***182***		***182***		***197***		***182***		***2***

Table 7.16b. The week that 10%, 50% (median), and 90% of the wild and White River hatchery spring Chinook salmon passed Tumwater Dam, 2009-2019. The average week is also provided. Migration timing is based on PIT-tag detections at Tumwater Dam. PIT tag releases of hatchery-origin White River spring Chinook occurred for brood years 2006-2013. Wild fish include all wild spring Chinook sampled at Tumwater Dam; however, enumeration errors may still exist because of misidentified run-type assignment (i.e., spring or summer runs).

Survey year	Origin	Spring Chinook Migration Time (week)				Sample size
		10 Percentile	50 Percentile	90 Percentile	Mean	
2009	Wild	25	26	27	26	31
	Hatchery	---	---	---	---	0
2010	Wild	25	27	28	27	80
	Hatchery	26	26	26	26	1
2011	Wild	26	28	30	28	97
	Hatchery	30	30	30	30	2
2012	Wild	26	27	29	28	66
	Hatchery	27	28	30	28	20
2013	Wild	24	26	28	26	32
	Hatchery	23	25	27	25	43
2014	Wild	25	26	28	26	32
	Hatchery	26	28	30	28	52
2015	Wild	22	25	28	25	45
	Hatchery	23	25	29	26	60
2016	Wild	23	25	27	25	37
	Hatchery	24	26	28	26	21
2017	Wild	25	26	28	27	31
	Hatchery	---	---	---	---	0
2018	Wild	20	25	28	24	40
	Hatchery	---	---	---	---	0
2019	Wild	24	26	30	27	33
	Hatchery	---	---	---	---	0
Average	Wild	***24***	***26***	***28***	***26***	***48***
	Hatchery	***26***	***27***	***29***	***27***	***18***
Median	Wild	***25***	***26***	***28***	***26***	***37***
	Hatchery	***26***	***26***	***29***	***26***	***2***

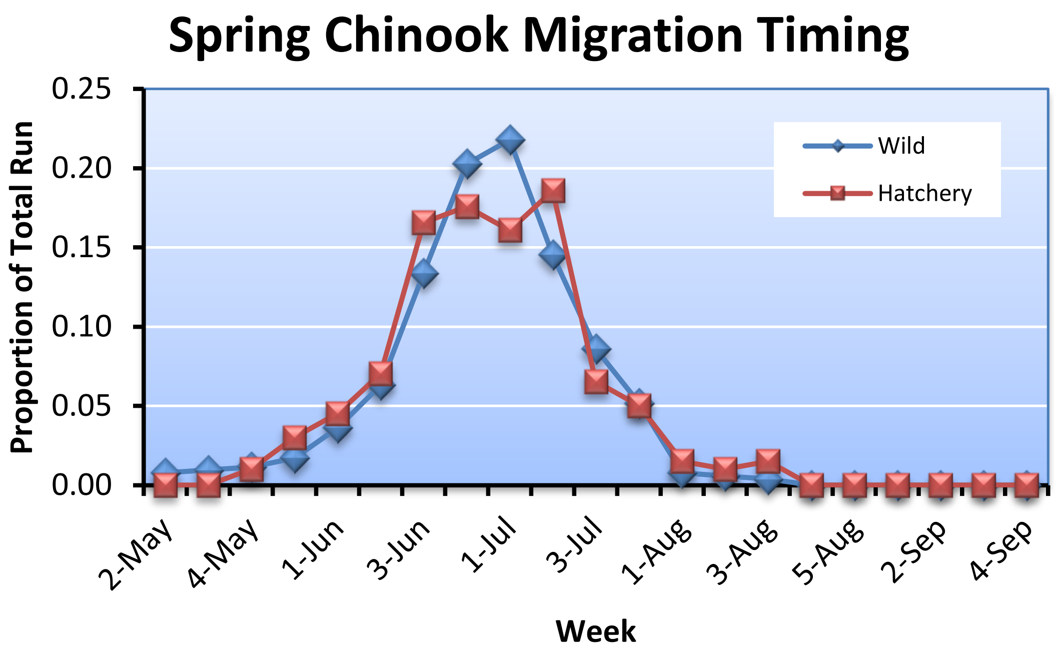


Figure 7.8. Proportion of wild and White River hatchery spring Chinook observed passing Tumwater Dam each week during their migration period May through September; data were pooled over survey years 2009-2019. Wild fish include all wild spring Chinook sampled at Tumwater Dam.

Age at Maturity

Most of the wild and hatchery stray spring Chinook sampled during the period 2001-2019 in the White River basin were age-4 fish (total age) (Table 7.17; Figure 7.9). A higher proportion of age-5 wild fish returned than did age-5 hatchery strays. Thus, wild fish tended to return at an older age than hatchery strays. Few captive brood carcasses have been identified on the spawning grounds; most were age-4 and one was age-5. There has been a conspicuous absence of age-3 fish recovered as carcasses. In all years except 2007, 2018 and 2019, no age-3 carcasses have been recovered.

Table 7.17. Numbers of wild, hatchery strays, and captive brood spring Chinook of different ages (total age) sampled on spawning grounds in the White River basin, 2001-2019.

Sample year	Origin	Total age					Sample size
		2	3	4	5	6	
2001	Wild	0	0	47	0	0	**47**
	Hatchery Strays	0	0	27	0	0	**27**
2002	Wild	0	0	7	11	0	**18**
	Hatchery Strays	0	0	6	1	0	**7**
2003	Wild	0	0	0	6	0	**6**
	Hatchery Strays	0	0	0	1	0	**1**
2004	Wild	0	0	9	0	0	**9**
	Hatchery Stray	0	0	2	0	0	**2**
2005	Wild	0	0	12	0	0	**12**

Sample year	Origin	Total age					Sample size
		2	3	4	5	6	
	Hatchery Strays	0	0	40	0	0	**40**
	Captive Brood	0	0	0	0	0	**0**
2006	Wild	0	0	7	12	0	**19**
	Hatchery Strays	0	0	3	3	0	**6**
	Captive Brood	0	0	0	0	0	**0**
2007	Wild	0	0	2	8	0	**10**
	Hatchery Strays	0	2	1	0	0	**3**
	Captive Brood	0	0	0	0	0	**0**
2008	Wild	0	0	4	1	0	**5**
	Hatchery Strays	0	0	6	0	0	**6**
	Captive Brood	0	0	0	0	0	**0**
2009	Wild	0	0	8	1	0	**9**
	Hatchery Strays	1	0	10	0	0	**11**
	Captive Brood	0	0	0	0	0	**0**
2010	Wild	0	0	3	0	0	**3**
	Hatchery Strays	0	0	8	0	0	**8**
	Captive Brood	0	0	0	0	0	**0**
2011	Wild	0	0	0	4	0	**4**
	Hatchery Strays	0	0	0	0	0	**0**
	Captive Brood	0	0	0	0	0	**0**
2012	Wild	0	0	13	0	0	**13**
	Hatchery Strays	0	0	8	0	0	**8**
	Captive Brood	0	0	0	0	0	**0**
2013	Wild	0	0	7	2	0	**9**
	Hatchery Strays	0	0	9	0	0	**9**
	Captive Brood	0	0	1	1	0	**2**
2014	Wild	0	0	5	1	0	**6**
	Hatchery Strays	0	0	2	0	0	**2**
	Captive Brood	0	0	0	0	0	**0**
2015	Wild	0	0	13	1	0	**14**
	Hatchery Strays	0	0	6	0	0	**6**
	Captive Brood	0	0	5	0	0	**5**
2016	Wild	0	0	5	6	0	**11**
	Hatchery Strays	0	0	1	0	0	**1**
	Captive Brood	0	0	1	0	0	**1**
2017	Wild	0	0	4	1	0	**5**
	Hatchery Strays	0	0	3	0	0	**3**
	Captive Brood	0	0	1	0	0	**1**

Sample year	Origin	Total age					Sample size
		2	3	4	5	6	
2018	Wild	0	2	5	0	0	**7**
	Hatchery Strays	0	0	5	0	0	**5**
	Captive Brood	0	0	0	0	0	**0**
2019	Wild	0	1	1	0	0	**2**
	Hatchery Strays	0	0	3	0	0	**3**
	Captive Brood	0	0	0	0	0	**0**
Average	***Wild***	***0***	***0***	***8***	***3***	***0***	***11***
	Hatchery Strays	***0***	***0***	***7***	***1***	***0***	***8***
	Captive Brood	***0***	***0***	***1***	***0***	***0***	***1***
Median	***Wild***	***0***	***0***	***5***	***1***	***0***	***9***
	Hatchery Strays	***0***	***0***	***4***	***0***	***0***	***6***
	Captive Brood	***0***	***0***	***0***	***0***	***0***	***0***

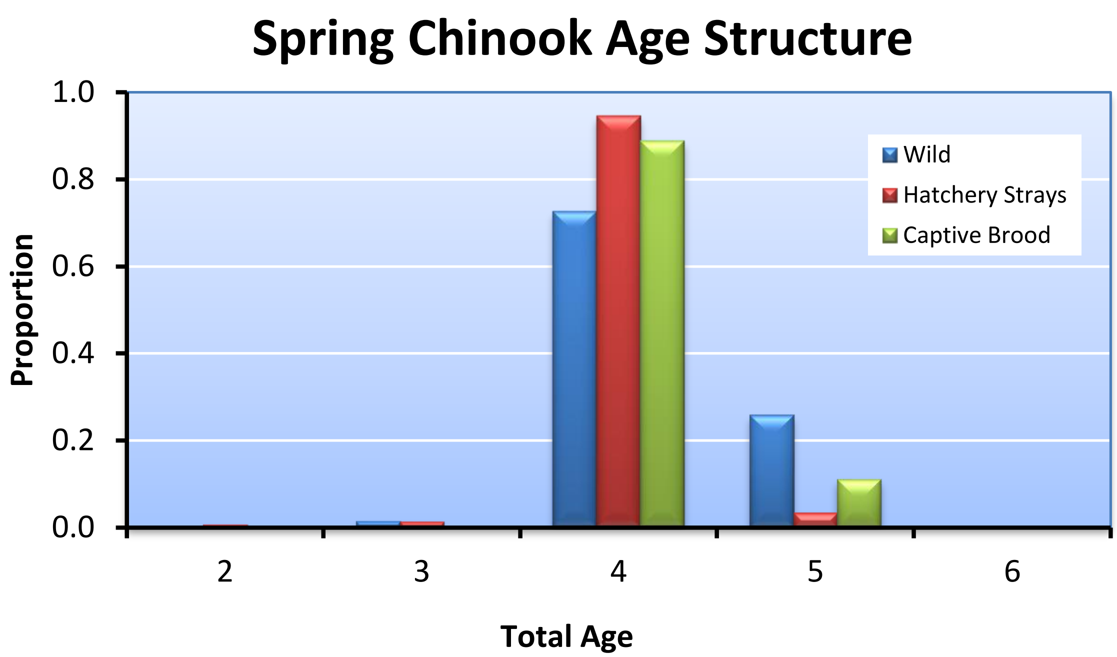


Figure 7.9. Proportions of wild, hatchery strays, and captive brood spring Chinook of different total ages sampled on spawning grounds in the White River basin for the combined years 2000-2019.

For comparison, Table 7.18 and Figure 7.10 show the age structure of spring Chinook carcasses sampled in the Little Wenatchee River. Similar to the White River, most of the wild and hatchery stray spring Chinook sampled during the period 2001-2019 in the Little Wenatchee River basin were age-4 fish (total age). A higher proportion of age-5 wild fish returned than did age-5 hatchery strays. Thus, wild fish tended to return at an older age than hatchery strays. As in the White River, few age-3 fish have been recovered in the Little Wenatchee River.

Table 7.18. Numbers of wild and hatchery stray spring Chinook of different ages (total age) sampled on spawning grounds in the Little Wenatchee River basin, 2001-2019.

Sample year	Origin	Total age					Sample size
		2	3	4	5	6	
2001	Wild	0	0	31	2	0	**33**
	Hatchery Strays	0	0	33	1	0	**34**
2002	Wild	0	0	6	8	0	**14**
	Hatchery Strays	0	0	12	2	0	**14**
2003	Wild	0	0	1	3	0	**4**
	Hatchery Strays	0	0	0	4	0	**4**
2004	Wild	0	0	1	0	0	**1**
	Hatchery Stray	0	0	0	0	0	**0**
2005	Wild	0	0	12	0	0	**12**
	Hatchery Strays	0	0	40	0	0	**40**
2006	Wild	0	0	7	12	0	**19**
	Hatchery Stray	0	0	3	3	0	**6**
2007	Wild	0	0	2	8	0	**10**
	Hatchery Strays	0	2	1	0	0	**3**
2008	Wild	0	0	4	1	0	**5**
	Hatchery Stray	0	0	6	0	0	**6**
2009	Wild	0	0	8	1	0	**9**
	Hatchery Strays	1	0	10	0	0	**11**
2010	Wild	0	0	3	0	0	**3**
	Hatchery Stray	0	0	7	0	0	**7**
2011	Wild	0	0	0	4	0	**4**
	Hatchery Strays	0	0	0	0	0	**0**
2012	Wild	0	0	13	0	0	**13**
	Hatchery Stray	0	0	8	0	0	**8**
2013	Wild	0	0	7	2	0	**9**
	Hatchery Strays	0	0	9	0	0	**9**
2014	Wild	0	0	5	1	0	**6**
	Hatchery Stray	0	0	2	0	0	**2**
2015	Wild	0	0	13	1	0	**14**
	Hatchery Strays	0	0	6	0	0	**6**
2016	Wild	0	0	5	6	0	**11**
	Hatchery Strays	0	0	1	0	0	**1**
2017	Wild	0	0	4	1	0	**5**
	Hatchery Strays	0	0	3	0	0	**3**
2018	Wild	0	2	5	0	0	**7**
	Hatchery Strays	0	0	5	0	0	**5**

Sample year	Origin	Total age					Sample size
		2	3	4	5	6	
2019	Wild	0	0	2	1	0	**3**
	Hatchery Strays	0	0	1	0	0	**1**
Average	***Wild***	***0***	***0***	***7***	***3***	***0***	***10***
	Hatchery Strays	***0***	***0***	***8***	***1***	***0***	***8***
Median	***Wild***	***0***	***0***	***5***	***1***	***0***	***9***
	Hatchery Strays	***0***	***0***	***6***	***0***	***0***	***6***

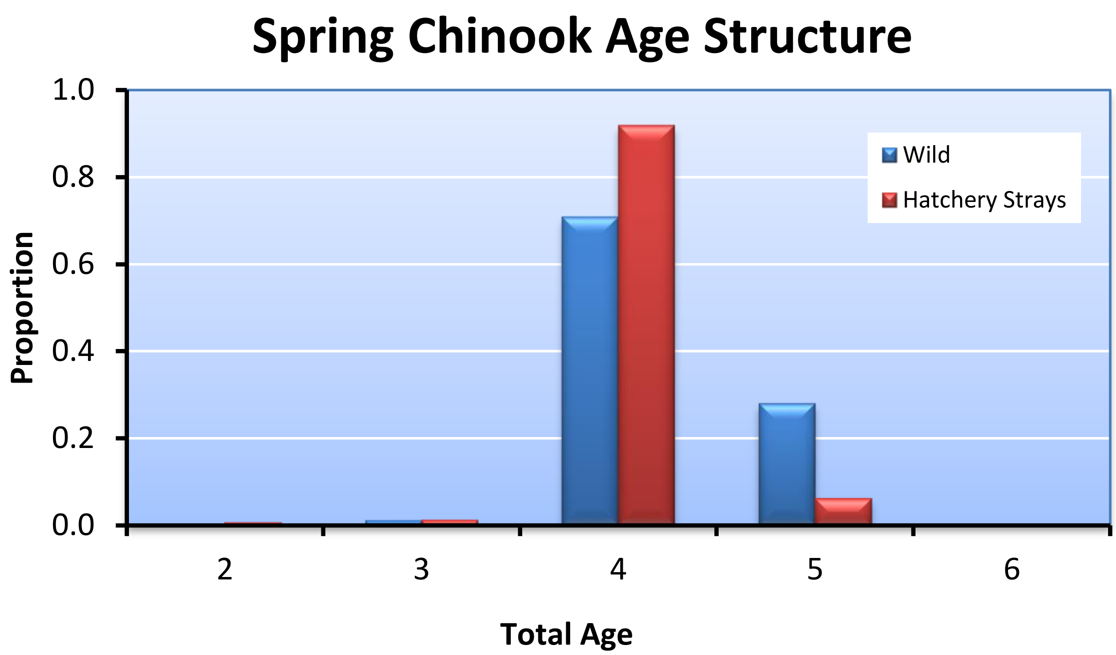


Figure 7.10. Proportions of wild and hatchery stray spring Chinook of different total ages sampled on spawning grounds in the Little Wenatchee River basin for the combined years 2000-2019.

Size at Maturity

On average, hatchery strays and wild spring Chinook of a given age differed little in length (Table 7.19). Differences were generally small (1-2 cm) between hatchery strays and wild fish of the same age. Few captive brood carcasses have been identified on the spawning grounds; most were females. Those fish were about the same size as wild and hatchery strays of the same age.

Table 7.19. Mean lengths (POH in cm; ±1SD) and sample sizes (in parentheses) of different ages (total age) of male and female spring Chinook of wild, hatchery strays, and captive brood origin sampled in the White River basin, 2001-2019.

Return year	Total age	Mean length (cm)					
		Male			Female		
		Wild	Hatchery stray	Captive brood	Wild	Hatchery stray	Captive brood
2001	3						
	4	65 ±3 (17)	66 ±4 (5)		63 ±3 (30)	63 ±4 (21)	
	5						
	6						
2002	3						
	4	66 ±0 (1)	69 ±0 (1)		63 ±4 (6)	59 ±6 (5)	
	5	75 ±11 (2)			72 ±3 (9)	72 ±0 (1)	
	6						
2003	3						
	4						
	5				75 ±5 (6)	73 ±0 (1)	
	6						
2004	3						
	4	68 ±3 (3)			63 ±3 (6)	59 ±2 (2)	
	5						
	6						
2005	3						
	4	64 ±4 (3)	62 ±7 (4)		57 ±5 (8)	62 ±4 (33)	
	5						
	6						
2006	3						
	4	65 ±1 (3)			61 ±3 (4)	60 ±2 (3)	
	5	69 ±3 (4)			67 ±5 (8)	70 ±4 (3)	
	6						
2007	3		49 ±4 (2)				
	4				61 ±3 (2)	67 ±0 (1)	
	5	75 ±4 (3)			75 ±1 (5)		
	6						
2008	3						
	4	56 ±0 (1)	61 ±0 (1)		63 ±6 (2)	61 ±2 (5)	
	5				75 ±0 (1)		
	6						
2009	3						
	4	61 ±4 (3)	68 ±3 (2)		63 ±1 (5)	62 ±2 (8)	
	5				78 ±0 (1)		
	6						
2010	3						

Return year	Total age	Mean length (cm)					
		Male			Female		
		Wild	Hatchery stray	Captive brood	Wild	Hatchery stray	Captive brood
	4		65 ±3 (2)		60 ±5 (3)	61 ±5 (5)	
	5						
	6						
2011	3						
	4						
	5				73 ±4 (5)		
	6						
2012	3						
	4	47 ±0 (1)			62 ±3 (12)	60 ±4 (8)	
	5						
	6						
2013	3						
	4	64 ±3 (3)	60 ±3 (2)		62 ±2 (4)	60 ±3 (5)	63 ±0 (1)
	5				67 ±1 (2)		71 ±0 (1)
	6						
2014	3						
	4		54 ±0 (1)		60 ±2 (5)	58 ±0 (1)	
	5				74 ±0 (1)		
	6						
2015	3						
	4	60 ±6 (5)	74 ±0 (1)	61 ±0 (1)	64 ±4 (8)	64 ±4 (5)	64 ±4 (4)
	5				75 ±0 (1)		
	6						
2016	3						
	4	65 ±0 (1)			63 ±4 (4)	59 ±4 (2)	
	5	71 ±3 (2)			71 ±5 (4)		
	6						
2017	3						
	4	69 ±0 (1)	68±0 (1)		66 ±2 (3)	62 ±2 (2)	61 ±0 (1)
	5				67 ±0 (1)		
	6						
2018	3	40 ±2 (2)					
	4	63 ±5 (2)			63 ±2 (3)	61 ±4 (5)	
	5						
	6						
2019	3	39 ±1 (1)					
	4				59 ±1 (1)	62 ±2 (3)	
	5						
	6						

Contribution to Fisheries

No White River spring Chinook from the captive brood program tagged with CWTs or PIT tags have been recaptured (or reported) in ocean or Columbia River (tribal, commercial, or recreational) fisheries. This may be because of the marking scheme used. That is, given that juvenile spring Chinook from the White River program were tagged with CWTs in the peduncle and were not ad-clipped, it is likely that any White River spring Chinook captured in fisheries were not retained because they were considered wild fish.

Straying

Stray rates of White River spring Chinook from the captive brood program were determined by examining the locations where PIT-tagged Chinook demonstrating anadromy (based on detections at Bonneville Dam) were last detected. PIT tagging of White River spring Chinook began with release year 2008, which allows estimation of stray rates by brood return. Targets for strays based on return year (recovery year) within the Wenatchee River basin should be less than 10% and targets for strays outside the Wenatchee River basin should be less than 5%.

Based on PIT-tag analyses, on average, about 57% of the brood year returns of White River spring Chinook were last detected in streams outside the White River (Table 7.20). The numbers in Table 7.20 should be considered rough estimates because they are not based on confirmed spawning (only last detections) and they represent small sample sizes. In addition, last detections in adult fishways (i.e., Bonneville, Rock Island, and Tumwater dams) were not included, nor were detections in areas outside the distribution of known spring Chinook spawning (i.e., Lower and Middle Wenatchee River). All fish reported in Table 7.20 are at least age-3 fish (total age) and some of them may not have migrated all the way to the ocean but rather resided completely in freshwater downstream from Bonneville Dam.

Table 7.20. Number and percent of White River spring Chinook from the captive brood program that homed to target spawning areas on the White River and the target hatchery program (Little White Salmon Fish Hatchery), and number and percent that strayed to non-target spawning areas and hatchery programs for brood years 2006-2013. Only PIT-tagged fish demonstrating anadromy were included in the analysis. Estimates were based on last detections of PIT-tagged spring Chinook.

Brood year	Homing				Straying			
	Target stream		Target hatchery*		Non-target streams		Non-target hatcheries	
	Number	%	Number	%	Number	%	Number	%
2006	9	100.0	0	0.0	0	0.0	0	0.0
2007	0	0.0	0	0.0	0	0.0	0	0.0
2008	0	0.0	0	0.0	19	100.0	0	0.0
2009	8	13.8	0	0.0	65	86.2	0	0.0
2010	0	0.0	0	0.0	9	100.0	0	0.0
2011	38	17.1	0	0.0	184	82.9	0	0.0
2012	6	12.0	0	0.0	38	88.0	0	0.0
2013	0	0.0	0	0.0	0	0.0	0	0.0
Average	***8***	***17.9***	***0***	***0.0***	***39***	***57.1***	***0***	***0.0***
Median	***3***	***6.0***	***0***	***0.0***	***14***	***84.6***	***0***	***0.0***

* Homing to the target hatchery includes White River hatchery spring Chinook that are captured and included as broodstock in the White River Hatchery program.

The percentage of the PIT-tagged White River spring Chinook from the captive brood program that were last detected in different watersheds within and outside the Wenatchee River basin are shown in Table 7.21. On average, a small percentage of the PIT-tagged White River spring Chinook homed to the White River. Relatively high percentages of them were last detected in the Little Wenatchee River, Upper Wenatchee River, Nason Creek, and the Chiwawa River.

Few returning adults have strayed into spawning areas outside the Wenatchee River basin. Three were last detected in the Entiat River. No other returning adults were detected outside the Wenatchee River basin. On the other hand, several juveniles were last detected in rivers outside the Wenatchee River basin. Juveniles were last detected in the Deschutes, Walla Walla, Hood, and North Fork Teanaway rivers. Juveniles were also last detected at the Little White Salmon Fish Hatchery. There is no evidence that these fish entered the ocean and returned as adults.

Table 7.21. Number and percent (in parentheses) of PIT-tagged White River spring Chinook from the captive brood program that were last detected in different tributaries within the Wenatchee River basin, return years 2010-2019. Only PIT-tagged fish demonstrating anadromy were included in the analysis.

Return year	Homing	Straying							
	White River	Chiwawa River	Chiwaukum Creek	Icicle Creek	Little Wenatchee	Nason Creek	Peshastin Creek	Upper Wenatchee	Entiat River
2010	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
2011	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (50.0)	1 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)
2012	3 (16.0)	3 (16.0)	0 (0.0)	0 (0.0)	10 (66.7)	1 (7.6)	0 (0.0)	0 (0.0)	0 (0.0)
2013	5 (7.4)	20 (28.0)	3 (3.7)	5 (7.4)	13 (18.1)	20 (28.0)	0 (0.0)	5 (7.4)	0 (0.0)
2014	11 (8.6)	44 (34.9)	0 (0.0)	3 (2.2)	8 (6.5)	44 (34.9)	0 (0.0)	14 (10.8)	3 (2.2)
2015	24 (22.8)	59 (55.2)	3 (2.5)	0 (0.0)	0 (0.0)	3 (2.5)	0 (0.0)	18 (16.9)	0 (0.0)
2016	8 (23.0)	19 (51.7)	0 (0.0)	3 (7.5)	0 (0.0)	2 (5.2)	0 (0.0)	5 (12.6)	0 (0.0)
2017	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
2018	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Average	***7 (19.8)***	***16 (20.6)***	***1 (0.7)***	***1(1.9)***	***4 (15.0)***	***8 (14.2)***	***0 (0.0)***	***5 (5.3)***	***0 (0.2)***
Median	***5 (8.6)***	***3 (16.0)***	***0 (0.0)***	***0 (0.0)***	***0 (0.0)***	***1 (5.2)***	***0 (0.0)***	***0 (0.0)***	***0 (0.0)***

Genetics

At this time, there are no studies that examine the effects of the White River captive brood program on the genetics of natural-origin spring Chinook in the Wenatchee River basin. However, genetic studies were conducted to determine the potential effects of the Chiwawa Supplementation Program on natural-origin spring Chinook in the upper Wenatchee River basin (Blankenship et al. 2007; the entire report is appended as Appendix M). This work included the analysis of White River spring Chinook. Researchers collected microsatellite DNA allele frequencies from temporally replicated natural and hatchery-origin spring Chinook to statistically assign individual fish to specific demes (locations) within the Wenatchee population.

Significant differences in allele frequencies were observed within and among major spawning areas in the Upper Wenatchee River basin. However, these differences made up only a very small portion of the overall variation, indicating genetic similarity among the major spawning areas.

There was no evidence that the Chiwawa program has changed the genetic structure (allele frequency) of spring Chinook in the White River, despite the presence of hatchery-origin spawners in both systems.

Proportionate Natural Influence

Another method for assessing the genetic risk of a supplementation program is to determine the influence of the hatchery and natural environments on the adaptation of the composite population. This is estimated by the proportion of natural-origin fish in the hatchery broodstock (pNOB) and the proportion of hatchery-origin fish in the natural spawning escapement (pHOS). We calculated Proportionate Natural Influence (PNI) by iterating Ford's (2002) equations 5 and 6 to equilibrium, using a heritability of 0.3 and a selection strength of three standard deviations.[34] The larger the PNI value, the greater the strength of selection in the natural environment relative to that of the hatchery environment. In order for the natural environment to dominate selection, PNI should be greater than 0.50, and integrated populations should have a PNI of at least 0.67 (HSRG/WDFW/NWIFC 2004).

For brood years 1989-2000, PNI values ranged from 0.95 to 1.00 (Table 7.22). For brood years 2001-2013, PNI for the White River Program averaged 0.60 (range, 0.33-1.00) (Table 7.22). The captive brood program ended with brood year 2013.

Table 7.22. Proportionate Natural Influence (PNI) values for hatchery spring Chinook spawning in the White River, brood years 1989-2013. See notes below the table for description of each metric.

Brood year	Spawners					Broodstock			PNI
	NOS	HOS_W	HOS_S	$pHOS_W$	$pHOS_S$	NOB_N	HOB_N	pNOB	
1989	145	0	0	0.00	0.00	0	0	*1.00*	1.00
1990	49	0	0	0.00	0.00	0	0	*1.00*	1.00
1991	49	0	0	0.00	0.00	0	0	*1.00*	1.00
1992	78	0	0	0.00	0.00	0	0	*1.00*	1.00
1993	138	0	7	0.00	0.05	0	0	*0.99*	0.95
1994	7	0	0	0.00	0.00	0	0	*0.67*	1.00
1995	5	0	0	0.00	0.00	0	0	*1.00*	1.00
1996	30	0	0	0.00	0.00	0	0	*0.60*	1.00
1997	33	0	0	0.00	0.00	0	0	*0.30*	1.00
1998	11	0	0	0.00	0.00	0	0	*0.44*	1.00
1999	3	0	0	0.00	0.00	0	0	*1.00*	1.00
2000	22	0	0	0.00	0.00	0	0	*0.48*	1.00
Average*	***48***	***0***	***1***	***0.00***	***0.00***	***0***	***0***	***0.79***	***1.00***
Median*	***32***	***0***	***0***	***0.00***	***0.00***	***0***	***0***	***1.00***	***1.00***
2001	111	0	55	0.00	0.33	5	0	1.00	0.50
2002	60	0	26	0.00	0.30	18	0	1.00	0.51

[34] According to authorized annual take permits, PNI is calculated using the PNI approximate equation 11 (HSRG 2009; Appendix A). However, in this report, we used Ford's (2002) equations 5 and 6 with a heritability of 0.3 and a selection strength of three standard deviations to calculate PNI (C. Busack, NOAA Fisheries, 21 March 2016, provided the model for calculating PNI). This approach is more accurate than using the PNI approximate equation.

Brood year	Spawners					Broodstock			PNI
	NOS	HOS_W	HOS_S	$pHOS_W$	$pHOS_S$	NOB_N	HOB_N	pNOB	
2003	31	0	5	0.00	0.14	7	0	1.00	0.77
2004	54	0	12	0.00	0.18	6	0	1.00	0.70
2005	38	11	106	0.07	0.68	103	73	0.59	0.33
2006	41	5	9	0.09	0.16	191	135	0.59	0.61
2007	62	23	7	0.25	0.08	254	6	0.98	0.67
2008	20	2	30	0.04	0.58	116	0	1.00	0.34
2009	81	29	63	0.17	0.36	238	0	1.00	0.53
2010	27	22	23	0.31	0.32	90	0	1.00	0.50
2011	83	0	0	0.00	0.00	306	0	1.00	1.00
2012	89	10	45	0.07	0.31	390	0	1.00	0.73
2013	44	55	5	0.53	0.05	383	0	1.00	0.64
Average	***57***	***12***	***30***	***0.12***	***0.27***	***162***	***16***	***0.94***	***0.60***
Median	***54***	***5***	***23***	***0.07***	***0.30***	***116***	***0***	***1.00***	***0.61***

HOS_W = hatchery-origin spawners in White River from the White River spring Chinook Supplementation Program.
$pHOS_W$ = proportion of hatchery-origin spawners from White River spring Chinook Supplementation Program.
HOS_S = stray hatchery-origin spawners in the White River.
$pHOS_S$ = proportion of stray hatchery-origin spawners.
NOB_W = natural origin broodstock spawned for the White River spring Chinook Supplementation Program.
HOB_W = hatchery-origin broodstock spawned in the White River spring Chinook Supplementation Program.
pNOB = proportion of hatchery-origin broodstock. Because of the high incidence of strays to the White River from the Chiwawa River spring Chinook program, pNOB values from the Chiwawa program were used to estimate PNI values during the period from 1989 to 2000 (*italicized*). The weighting for those years was 100% based on the Chiwawa program broodstock selection, because there have been no hatchery returns from the White River spring Chinook program during this period (see Table 5.1 for Chiwawa broodstock selection).
PNI = Proportionate Natural Influence for White River spring Chinook calculated using the gene-flow model for multiple programs.
* Average and median for the period 1989-2000.
** Average and median for the period 2001-2013.

Post-Release Survival and Travel Time of Wild Fish

We used PIT-tags to estimate survival rates and travel time (arithmetic mean days) of wild spring Chinook smolts tagged at the White River smolt trap. Survival rates and travel times were estimated from the White River trap to McNary Dam, and smolt to adult ratios (SARs) from the trap to returning adults detected at Bonneville Dam (Table 7.23). Over the 11 brood years for which wild spring Chinook smolts were tagged and released at the White River trap, survival rates from the White River to McNary Dam ranged from 0.000 to 0.485; SARs from release to detection at Bonneville Dam ranged from 0.000 to 0.006. Average travel time from the White River to McNary Dam ranged from 52 to 257 days.

Table 7.23. Total number of White River wild spring Chinook smolts released with PIT tags at the White River Trap, their survival and travel times (mean days) to McNary Dam, and smolt-to-adult (SAR) ratios for brood years 2007-2017. Standard errors are shown in parentheses. NA = not available (i.e., not all the adults from the release groups have returned to the Columbia River).

Brood year	Tag year	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
2007	2009	693	0.485 (0.451)	117.1 (84.7)	0.003 (0.002)
2008	2010	484	0.114 (0.024)	71.3 (65.6)	0.006 (0.004)

Brood year	Tag year	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
2009	2011	172	0.244 (0.203)	66.2 (55.6)	0.000 (--)
2010	2012	463	0.078 (0.024)	96.2 (70.1)	0.004 (0.003)
2011	2013	386	0.047 (0.020)	133.0 (89.9)	0.000 (--)
2012	2014	202	0.020 (0.013)	52.0 (19.8)	0.005 (0.005)
2013	2015	183	0.051 (0.018)	203.1 (65.7)	0.000 (--)
2014	2016	139	0.000 (--)	257.0 (--)	0.000 (--)
2015	2017	545	0.027 (0.010)	175.5 (22.5)	NA
2016	2018	328	0.335 (0.201)	81.3 (72.7)	NA
2017	2019	433	0.092 (0.077)	194.2 (92.4)	NA

Natural and Hatchery Replacement Rates

In general, natural replacement rates (NRR) are calculated as the ratio of natural-origin recruits (NOR) to the parent spawning population (spawning escapement). Natural-origin recruits are naturally produced (wild) fish that survive to contribute to harvest (directly or indirectly), to broodstock, and to spawning grounds. We do not account for fish that died in route to the spawning grounds (migration mortality) or died just before spawning (pre-spawn mortality) (see Appendix B in Hillman et al. 2012). We calculated NORs with and without harvest. NORs include all returning fish that either returned to the basin or were collected as wild broodstock. For brood years 1989-2013, NRR for spring Chinook in the White River basin averaged 0.97 (range, 0.00-4.91) if harvested fish were not included in the estimate and 1.11 (range, 0.00-5.73) if harvested fish were included in the estimate (Table 7.24a). NRRs for more recent brood years will be calculated as soon as all tag recoveries and sampling rates have been loaded into the database.

Hatchery replacement rates (HRR) are the hatchery adult-to-adult returns and are calculated as the ratio of hatchery-origin recruits (HOR) detected at Tumwater Dam to the parent broodstock collected (the number of eggs or juveniles that were collected, survived, and spawned in the hatchery). For brood years 2006-2013, hatchery replacement rates averaged 0.03 (range, 0.00-0.21) if harvest is not included and 0.04 (range, 0.00-0.28) if harvest is included (Table 7.24a). HRR was less than the NRR in all years. The HRR values are generally higher when they are calculated using the number of adult equivalents taken from the natural environment to initiate the captive brood program (brood years 2006-2009; Table 7.24b).

Table 7.24a. Numbers of brood stock spawned, spawning escapements, hatchery-origin recruits (HOR), natural-origin recruits (NOR), hatchery replacement rates (HRR), and natural replacement rates (NRR) with and without harvest for spring Chinook in the White River basin, brood years 1989-2013.

Brood year	Brood stock spawned	Spawning Escapement	Harvest not included				Harvest included			
			HOR[1]	NOR[2]	HRR[1]	NRR[2]	HOR[3]	NOR[4]	HRR[3]	NRR[4]
1989	--	145	--	81	--	0.56	--	118	--	0.81
1990	--	49	--	2	--	0.04	--	2	--	0.04

Brood year	Brood stock spawned	Spawning Escapement	Harvest not included				Harvest included			
			HOR[1]	NOR[2]	HRR[1]	NRR[2]	HOR[3]	NOR[4]	HRR[3]	NRR[4]
1991	--	49	--	3	--	0.06	--	3	--	0.06
1992	--	78	--	30	--	0.38	--	32	--	0.41
1993	--	145	--	44	--	0.30	--	45	--	0.31
1994	--	7	--	1	--	0.14	--	1	--	0.14
1995	--	5	--	9	--	1.80	--	9	--	1.80
1996	--	30	--	15	--	0.50	--	16	--	0.53
1997	--	33	--	148	--	4.48	--	165	--	5.00
1998	--	11	--	54	--	4.91	--	63	--	5.73
1999	--	3	--	0	--	0.00	--	0	--	0.00
2000	--	22	--	54	--	2.45	--	58	--	2.64
2001	5	166	--	64	--	0.39	--	66	--	0.40
2002	18	86	--	70	--	0.81	--	68	--	0.79
2003	7	36	--	11	--	0.31	--	17	--	0.47
2004	6	66	--	25	--	0.38	--	27	--	0.41
2005	176	155	--	72	--	0.46	--	74	--	0.48
2006	326	55	0	110	0.00	2.00	0	138	0.00	2.51
2007	260	92	0	0	0.00	0.00	0	0	0.00	0.00
2008	116	52	1	100	0.01	1.92	1	111	0.01	2.13
2009	238	173	1	39	0.00	0.23	1	43	0.00	0.25
2010	90	72	0	40	0.00	0.56	0	47	0.00	0.65
2011	306	83	64	110	0.21	1.33	86	145	0.28	1.75
2012	390	144	12	34	0.03	0.24	14	36	0.04	0.25
2013	383	104	8	10	0.02	0.10	8	11	0.02	0.11
Average	***179***	***74***	***11***	***45***	***0.03***	***0.97***	***14***	***52***	***0.04***	***1.11***
Median	***176***	***66***	***1***	***39***	***0.01***	***0.39***	***1***	***43***	***0.01***	***0.47***

[1] HOR and HRR values represented here are based on expanded CWT recoveries.
[2] NOR and NRR values represented here are based on carcasses recovery in the White River adjusted by H:W ratios and age composition and expanded to the escapement in the White River.
[3] Harvest on hatchery-origin White River spring Chinook was estimated based on harvest rates observed for Chiwawa spring Chinook.
[4] Expanded NORs for harvest were based on harvest rates from Chiwawa River spring Chinook.

Table 7.24b. Hatchery-origin recruits (HOR) and hatchery replacement rates (HRR) based on adult equivalents for spring Chinook in the White River basin, brood years 2006-2009. HORs were estimated at Tumwater Dam.

Brood year	Adult equivalents	Harvest not included		Harvest included	
		HOR	HRR	HOR	HRR
2006	1.03	0	0.00	0	0.00
2007	1.21	0	0.00	0	0.00
2008	0.36	1	2.78	9	25.00
2009	1.05	1	0.95	13	12.38
Average	***0.91***	***1***	***0.93***	***6***	***9.35***

Brood year	Adult equivalents	Harvest not included		Harvest included	
		HOR	HRR	HOR	HRR
Median	***1.04***	***1***	***0.48***	***5***	***6.19***

For comparison, we calculated NRR for spring Chinook within the Little Wenatchee River basin. Spring Chinook from both the White River and Little Wenatchee River must migrate through Lake Wenatchee. Therefore, a comparison between the two subpopulations is appropriate.

NRRs for spring Chinook in the Little Wenatchee River basin were on average less than those for spring Chinook in the White River basin. For brood years 1989-2013, NRR for spring Chinook in the Little Wenatchee River basin averaged 0.80 (range, 0.00-4.83) if harvested fish were not included in the estimate and 0.90 (range, 0.00-5.39) if harvested fish were included in the estimate (Table 7.25). NRRs for more recent brood years will be calculated as soon as all tag recoveries and sampling rates have been loaded into the database.

Table 7.25. Spawning escapements, natural-origin recruits (NOR), and natural replacement rates (NRR) with and without harvest for spring Chinook in the Little Wenatchee River basin, brood years 1989-2013.

Brood year	Spawning Escapement	Harvest not included		Harvest included	
		NOR	NRR	NOR	NRR
1989	102	87	0.85	127	1.25
1990	67	0	0.00	0	0.00
1991	42	0	0.00	0	0.00
1992	78	8	0.10	8	0.10
1993	134	27	0.20	28	0.21
1994	16	11	0.69	11	0.69
1995	0	10	0.00	10	0.00
1996	8	14	1.75	15	1.88
1997	18	87	4.83	97	5.39
1998	18	35	1.94	41	2.28
1999	8	4	0.50	4	0.50
2000	24	39	1.63	42	1.75
2001	118	51	0.43	53	0.45
2002	86	79	0.92	82	0.95
2003	29	13	0.45	14	0.48
2004	39	13	0.33	14	0.36
2005	115	44	0.38	45	0.39
2006	37	49	1.32	62	1.68
2007	101	59	0.58	70	0.69
2008	64	72	1.13	81	1.27
2009	125	52	0.42	57	0.46
2010	83	46	0.55	57	0.69
2011	124	66	0.53	88	0.71
2012	72	14	0.19	16	0.22

Brood year	Spawning Escapement	Harvest not included		Harvest included	
		NOR	NRR	NOR	NRR
2013	98	15	0.15	16	0.16
Average	***64***	***36***	***0.80***	***42***	***0.90***
Median	***67***	***35***	***0.50***	***41***	***0.50***

Smolt-to-Adult Survivals

Smolt-to-adult survival ratios (SARs) were calculated as the number of hatchery adults detected at Tumwater Dam divided by the number of tagged hatchery smolts released. SARs were based on PIT-tag detections. For the available brood years, SARs have ranged from 0.00000 to 0.00196 (Table 7.26). The captive brood program ended with brood year 2013.

Table 7.26. Smolt-to-adult ratios (SARs) for White River spring Chinook from the captive brood program, brood years 2006-2013. Detections at Tumwater Dam are adjusted for PIT-tag detection efficiency.

Brood year	Number of smolts released	Number of PIT-tagged smolts released	PIT-tags	
			Adjusted Tumwater Detections	SAR
2006	142,033	29,881	1	0.00003
2007	131,843	39,820	0	0.00000
2008	48,556	38,650	23	0.00060
2009	112,596	41,742	42	0.00101
2010	18,850	12,283	6	0.00049
2011	147,000	54,187	106	0.00196
2012	97,713	52,440	25	0.00048
2013	31,000	19,954	2	0.00010
Average	***91,199***	***36,120***	***26***	***0.00058***
Median	***105,155***	***39,235***	***15***	***0.00048***

7.8 ESA/HCP Compliance

Brood Collection

The last collection of eggs or fry for this program occurred in 2010 (brood year 2009). The hatchery program ended with the last release of juveniles in 2015 (brood year 2013).

Hatchery Rearing, Spawning, and Release

The hatchery program ended with the last release of juveniles in 2015 (brood year 2013). No release of juveniles occurred under Section 10(a)(1)(A) Permit 18120 in 2017.

Hatchery Effluent Monitoring

No juveniles were reared or released as part of the White River captive brood program in 2017 due to sun-setting of the program with the 2013 brood. Therefore, no effluent monitoring was required or conducted in 2018.

Smolt and Emigrant Trapping

Per ESA Section 10 Permit Nos. 18118, 18120, and 18121, the permit holders are authorized a direct take of 20% of the emigrating spring Chinook population during juvenile emigration monitoring and a lethal take not to exceed 2% of the fish captured (NMFS 2003). Based on the estimated wild spring Chinook population (smolt trap expansion) and hatchery juvenile spring Chinook population estimate (hatchery release data) for the Wenatchee River basin, the reported spring Chinook encounters during 2019 emigration monitoring complied with take provisions in the Section 10 permit. Spring Chinook encounter and mortality rates for each trap site (including PIT-tag mortalities) are detailed in Table 7.27. Additionally, juvenile fish captured at the trap locations were handled consistent with provisions in ESA Section 10 Permits 18118, 18120, and 18121, Section B. Table 7.27 includes incidental or direct take associated with the White River smolt trap operated by the Yakama Nation under separate permits.

Table 7.27. Estimated take of Upper Columbia River spring Chinook resulting from juvenile emigration monitoring in the Wenatchee River basin, 2019.

Trap location	Population estimate			Number trapped			Total	Take allowed under Permit
	Wild[a]	Hatchery[b]	Sub-yearling[c]	Wild	Hatchery	Sub-yearling		
Chiwawa Trap								
Population	39,015	149,867	68,038	4,730	3,151	13,970	21,851	
Encounter rate	NA	NA	NA	0.1212	0.0210	0.2053	0.0850	0.20
Mortality[d]	NA	NA	NA	9	0	78	87	
Mortality rate	NA	NA	NA	0.0019	0.0000	0.0056	0.0040	0.02
White River Trap								
Population	3,401	NA	3,541	119	NA	372	491	
Encounter rate	NA	NA	NA	0.0350	NA	0.1051	0.0707	0.20
Mortality[d]	NA	NA	NA	9	NA	6	0	
Mortality rate	NA	NA	NA	0.0756	NA	0.0161	0.0000	0.02
Nason Creek Trap								
Population	4,494	231,859	29,530	296	2,898	1,759	4,953	
Encounter rate	NA	NA	NA	0.0659	0.0125	0.0596	0.0186	0.20
Mortality[d]	NA	NA	NA	2	1	25	28	
Mortality rate	NA	NA	NA	0.0068	0.0003	0.0142	0.0057	0.02
Lower Wenatchee Trap								
Population	101,793	381,726	2,439,434	1,485	36,104	28,534	66,123	
Encounter rate	NA	NA	NA	0.0146	0.0946	0.0117	0.0226	0.20
Mortality[d]	NA	NA	NA	2	10	167	179	
Mortality rate	NA	NA	NA	0.0013	0.0003	0.0059	0.0027	0.02
Wenatchee River Basin Total								
Population	146,597	381,726	2,540,543	6,630	42,153	44,635	93,418	
Encounter rate	NA	NA	NA	0.0446	0.1104	0.0176	0.0304	0.20

Mortality[d]	NA	NA	NA	20	44	375	439	
Mortality rate	NA	NA	NA	0.0030	0.0010	0.0084	0.0047	0.02

[a] Smolt population estimate derived from juvenile emigration trap data.
[b] 2017 BY smolt release data for the Wenatchee River basin.
[c] Based on size, date of capture and location of capture. Subyearling Chinook encountered at the Lower Wenatchee Trap are categorized as summer Chinook salmon.
[d] Combined trapping and PIT-tagging mortality.

Spawning Surveys

Spring Chinook spawning ground surveys were conducted in the Wenatchee River basin during 2019, as authorized by ESA Section 10 Permits Numbers 18118, 18120, and 18121. Because of the difficulty of quantifying the level of take associated with spawning ground surveys, the Permit does not specify a take level associated with these activities, even though it does authorize implementation of spawning ground surveys. Therefore, no take levels are reported. However, to minimize potential effects to established redds, wading was restricted to the extent practical, and extreme caution was used to avoid established redds when wading was required.

Spring Chinook Reproductive Success Study

ESA Section 10 Permit Numbers 18118, 18120, and 18121 specifically provide authorization to capture, anesthetize, biologically sample, PIT tag, and release adult spring Chinook at Tumwater Dam for reproductive success studies and general program monitoring. During 2010 through 2019, all spring Chinook passing Tumwater Dam were enumerated, anesthetized, biologically sampled, PIT tagged, and released (not including hatchery-origin and natural-origin Chinook retained for broodstock or removed as part of adult management activities) as a component of the reproductive success study (BPA Project No. 2003-039-00). Please refer to Ford et al. (2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, and 2019) for complete details on the methods and results of the spring Chinook reproductive success study for the period 2010-2019.

Bull Trout

Bull trout encounters associated with implementation of hatchery production and monitoring and evaluation activities for Chinook and steelhead programs in the Wenatchee sub-basin are required to be reported as outlined in Biological Opinion 01EWF00-2013-0444. The 2020 report for bull trout encounters in 2019 was compiled under provisions of ESA Section 10 Permit 18118, 18120, 18121, and 18583. Data and reporting information are included in Appendix I.

SECTION 8: WENATCHEE SUMMER CHINOOK

The goal of summer Chinook salmon supplementation in the Wenatchee Basin is to use artificial production to replace adults lost because of mortality at Priest Rapids, Wanapum, and Rock Island dams, while not reducing the natural production or long-term fitness of summer Chinook in the basin. The Rock Island Fish Hatchery Complex began operation in 1989 under funding from Chelan PUD and subsequently Grant PUD began cost-sharing the program in 2012. The Complex operated originally through the Rock Island Settlement Agreement, but since 2004 has operated under the Anadromous Fish Agreement and Habitat Conservation Plans as well as the Priest Rapids Project Salmon and Steelhead Settlement Agreement.

Adult summer Chinook are collected for broodstock from the run-at-large at the right and left-bank traps at Dryden Dam, and at Tumwater Dam if weekly quotas cannot be achieved at Dryden Dam. Before 2012, the goal was to collect up to 492 natural-origin adult summer Chinook for the Wenatchee program for an annual release of 864,000 smolts. In 2011, the Hatchery Committees reevaluated the amount of hatchery compensation needed to achieve NNI. Based on that evaluation, the goal of the program was reduced. The current goal (beginning in 2012) is to collect up to 256 adult natural-origin summer Chinook for an annual release of 500,001 smolts. The 500,001 smolts is the combined Grant PUD and Chelan PUD smolt production target. Chelan PUD's smolt production obligation is 318,000 and Grant PUD's smolt production obligation is 182,001. Broodstock collection occurs from about 1 July through 15 September with trapping occurring up to 24 hours per day, seven days a week. If natural-origin broodstock collection falls short of expectation, hatchery-origin adults can be collected to meet the collection quota.

Adult summer Chinook are spawned at Eastbank Fish Hatchery. At Eastbank, the majority of summer Chinook are reared in raceways, and a portion in re-use circular tanks. Juvenile summer Chinook are transferred from the hatchery to Dryden Acclimation Pond in March. They are released from the pond in late April.

Before 2012, the production goal for the Wenatchee summer Chinook supplementation program was to release 864,000 yearling smolts into the Wenatchee River at ten fish per pound. Beginning with the 2012 brood, the revised production goal is to release 500,001 yearling smolts into the Wenatchee River at 18 fish per pound. Targets for fork length and weight are 163 mm (CV = 9.0) and 45.4 g, respectively. Over 95% of these fish are marked with CWTs. In addition, since 2009, about 10,000 juvenile summer Chinook have been PIT tagged annually.

8.1 Broodstock Sampling

This section focuses on results from sampling 2017-2019 Wenatchee summer Chinook broodstock, which were collected at Dryden and Tumwater dams.

Origin of Broodstock

Consistent with the broodstock collection protocol, the 2017-2019 broodstock consisted primarily of natural-origin (adipose fin present and no CWT) summer Chinook (Table 8.1). Since 2012, less than 1% of the broodstock has consisted of hatchery-origin fish (hatchery-origin was determined by examination of scales and/or CWTs).

Table 8.1. Number of wild and hatchery summer Chinook collected for broodstock, mortality prior to spawning, and number spawned, 1989-2019. Unknown-origin fish (i.e., undetermined by scale analysis, no CWT or fin clips, and no additional hatchery marks) were considered naturally produced. Mortality includes fish that died of natural causes typically near the end of spawning and were not needed for the program and surplus fish killed at spawning.

Brood year	Wild summer Chinook					Hatchery summer Chinook					Total number spawned
	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	
1989	346	29	27	290	0	0	0	0	0	0	290
1990	87	6	24	57	0	0	0	0	0	0	57
1991	128	9	14	105	0	0	0	0	0	0	105
1992	341	48	19	274	0	0	0	0	0	0	274
1993	480	28	46	406	0	44	0	0	44	0	450
1994	363	29	1	333	0	55	1	0	54	0	387
1995	382	15	4	363	0	16	0	0	16	0	378
1996	331	34	34	263	0	3	0	0	3	0	266
1997	225	14	6	205	0	15	1	1	13	0	218
1998	378	40	39	299	0	94	4	12	78	0	377
1999	250	7	1	242	0	238	1	1	236	0	478
2000	298	18	5	275	0	194	7	7	180	0	455
2001	311	41	60	210	0	182	8	38	136	0	346
2002	469	28	32	409	0	13	1	2	10	0	419
2003	488	90	61	337	0	8	1	0	7	0	344
2004	494	24	46	424	0	2	0	0	2	0	426
2005	491	29	19	397	46	3	0	0	3	0	400
2006	483	30	21	432	0	5	1	0	4	0	436
2007	415	54	98	263	0	4	0	1	3	0	266
2008	398	11	11	376	0	74	2	1	71	0	447
2009	479	22	8	449	0	9	0	1	8	0	457
2010	427	11	28	388	0	7	2	0	5	0	393
2011	398	11	12	375	0	7	0	0	7	0	382
Average[b]	***368***	***27***	***27***	***312***	***2***	***42***	***1***	***3***	***38***	***0***	***350***
Median[b]	***382***	***28***	***21***	***333***	***0***	***8***	***1***	***0***	***7***	***0***	***382***
2012	273	5	1	267	0	1	0	0	1	0	268
2013	257	13	10	234	0	2	0	0	2	0	236
2014	279	18	0	261	0	2	0	0	2	0	263
2015	257	9	0	248	0	0	0	0	0	0	248
2016	271	9	3	259	0	0	0	0	0	0	259
2017	261	8	1	252	0	1	0	0	1	0	253
2018	211	5	1	205	0	5	0	0	5	0	210
2019	269	12	2	250	5	5	0	1	3	1	253
Average[c]	***260***	***10***	***2***	***247***	***1***	***2***	***0***	***0***	***2***	***0***	***249***
Median[c]	***265***	***9***	***1***	***251***	***0***	***2***	***0***	***0***	***2***	***0***	***253***

[a] Pre-spawn loss represents the number of fish that died during the holding period before spawning. Mortality is the number of fish that were surplused following spawning.
[a] This average represents the program before recalculation in 2011.
[b] This average represents the current program, which began in 2012.

Age/Length Data

Ages of summer Chinook broodstock were determined from analysis of scales and/or CWTs. Broodstock collected from the 2017 return consisted primarily of age-4 and age-5 natural-origin Chinook (98.8%). Age-3 and age-6 natural-origin fish made up 0.4% and 0.8% of the broodstock, respectively (Table 8.2). One hatchery Chinook was included in broodstock.

Broodstock collected from the 2018 return consisted primarily of age-4 and age-5 natural-origin Chinook (96.4%). Age-3 and age-6 natural-origin fish made up 3.1% and 0.5% of the broodstock, respectively (Table 8.2). Four hatchery-origin Chinook were included in broodstock.

Broodstock collected from the 2019 return consisted primarily of age-4 and age-5 natural-origin Chinook (95.6%). Age-3 and age-6 natural-origin fish made up 4.0% and 0.4% of the broodstock, respectively (Table 8.2). Three hatchery-origin Chinook were included in broodstock.

Table 8.2. Percent of hatchery and wild Wenatchee summer Chinook of different ages (total age) collected from broodstock in the Wenatchee River basin, 1991-2019.

Return Year	Origin	Total age				
		2	3	4	5	6
1991	Wild	0.0	4.6	36.8	57.5	1.1
	Hatchery	0.0	0.0	0.0	0.0	0.0
1992	Wild	0.0	2.6	40.4	50.9	6.1
	Hatchery	0.0	0.0	0.0	0.0	0.0
1993	Wild	0.0	1.5	35.7	60.4	2.3
	Hatchery	0.0	0.0	93.2	6.8	0.0
1994	Wild	0.0	1.0	33.7	64.3	1.0
	Hatchery	0.0	0.0	1.9	98.1	0.0
1995	Wild	0.0	3.3	19.2	76.3	1.2
	Hatchery	0.0	0.0	0.0	0.0	100.0
1996	Wild	0.0	4.6	40.1	53.3	2.0
	Hatchery	0.0	0.0	33.3	66.7	0.0
1997	Wild	0.0	2.3	42.6	53.2	1.9
	Hatchery	0.0	26.7	66.7	6.7	0.0
1998	Wild	0.0	5.5	34.7	58.6	1.2
	Hatchery	0.0	5.3	68.1	20.2	6.4
1999	Wild	0.5	1.9	39.0	56.3	2.3
	Hatchery	0.0	1.3	23.2	72.2	3.4
2000	Wild	2.6	6.3	24.6	66.5	0.0
	Hatchery	0.0	24.2	14.9	42.8	18.0
2001	Wild	0.3	16.6	53.6	27.7	1.7
	Hatchery	0.0	6.1	80.5	10.4	3.0
2002	Wild	0.7	8.4	61.6	28.5	0.7
	Hatchery	0.0	0.0	41.7	58.3	0.0
2003	Wild	0.9	2.8	31.4	64.8	0.0

Return Year	Origin	Total age				
		2	3	4	5	6
	Hatchery	0.0	12.5	25.0	62.5	0.0
2004	Wild	0.2	3.6	10.1	83.9	2.1
	Hatchery	0.0	0.0	50.0	50.0	0.0
2005	Wild	0.0	4.3	53.5	35.1	7.1
	Hatchery	0.0	0.0	0.0	100.0	0.0
2006	Wild	0.9	0.9	14.9	82.1	1.1
	Hatchery	0.0	0.0	0.0	80.0	20.0
2007	Wild	3.1	15.0	18.7	46.6	16.6
	Hatchery	0.0	0.0	0.0	100.0	0.0
2008	Wild	0.5	6.4	65.5	26.0	1.6
	Hatchery	0.0	2.9	13.0	69.6	14.5
2009	Wild	1.1	6.9	45.8	46.8	0.0
	Hatchery	0.0	0.0	11.1	88.9	0.0
2010	Wild	1.0	6.3	66.1	26.6	0.0
	Hatchery	0.0	0.0	62.5	37.5	0.0
2011	Wild	0.8	8.2	50.3	40.4	0.3
	Hatchery	0.0	42.9	14.3	42.9	0.0
2012	Wild	0.0	3.5	47.2	49.2	0.0
	Hatchery	0.0	0.0	0.0	100.0	0.0
2013	Wild	0.0	12.1	57.1	29.1	1.6
	Hatchery	0.0	0.0	50.0	50.0	0.0
2014	Wild	0.0	4.5	74.7	20.0	0.0
	Hatchery	0.0	0.0	100.0	0.0	0.0
2015	Wild	0.0	7.8	33.0	59.1	0.0
	Hatchery	0.0	0.0	0.0	0.0	0.0
2016	Wild	0.0	1.3	46.1	52.3	0.4
	Hatchery	0.0	0.0	0.0	0.0	0.0
2017	Wild	0.0	0.4	41.2	57.6	0.8
	Hatchery	0.0	0.0	0.0	0.0	100.0
2018	Wild	0.0	3.1	33.3	63.1	0.5
	Hatchery	0.0	0.0	25.0	75.0	0
2019	Wild	0.0	4.0	63.9	31.7	0.4
	Hatchery	0.0	0.0	33.3	33.3	33.3
Average	***Wild***	***0.4***	***5.2***	***41.9***	***50.6***	***1.9***
	Hatchery	***0.0***	***4.2***	***27.9***	***43.9***	***10.3***
Median	***Wild***	***0.0***	***4.3***	***40.4***	***53.2***	***1.1***
	Hatchery	***0.0***	***0.0***	***14.9***	***42.9***	***0.0***

Mean lengths of natural-origin summer Chinook of a given age differed little among return years (Table 8.3).

Table 8.3. Mean fork length (cm) at age (total age) of hatchery and wild Wenatchee summer Chinook collected from broodstock in the Wenatchee River basin, 1991-2019; N = sample size and SD = 1 standard deviation.

Return year	Origin	Summer Chinook fork length (cm)														
		Age-2			Age-3			Age-4			Age-5			Age-6		
		Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD
1991	Wild	-	0	-	-	4	-	-	32	-	-	50	-	-	1	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-
1992	Wild	-	0	-	66	3	10	69	46	5	81	58	3	87	7	1
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-
1993	Wild	-	0	-	68	6	10	84	138	9	98	235	6	100	9	6
	Hatchery	-	0	-	-	0	-	79	41	8	101	3	8	-	0	-
1994	Wild	-	0	-	74	3	5	86	101	8	96	193	7	106	3	7
	Hatchery	-	0	-	-	0	-	75	1	-	90	53	8	-	0	-
1995	Wild	-	0	-	66	11	8	85	64	7	97	255	6	106	4	7
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-	91	16	8
1996	Wild	-	0	-	69	14	5	86	121	6	97	161	6	104	6	5
	Hatchery	-	0	-	-	0	-	63	1	-	96	2	4	-	0	-
1997	Wild	-	0	-	54	5	10	85	92	7	98	115	6	97	4	9
	Hatchery	-	0	-	46	4	2	74	10	4	98	1	-	-	0	-
1998	Wild	-	0	-	66	19	9	85	119	7	99	201	7	106	4	7
	Hatchery	-	0	-	53	5	2	77	64	8	95	19	8	98	6	8
1999	Wild	42	1	-	65	4	6	86	83	6	97	120	7	103	5	8
	Hatchery	-	0	-	52	3	6	79	55	7	90	171	6	100	8	6
2000	Wild	43	7	3	60	17	7	84	67	5	98	181	6	-	0	-
	Hatchery	-	0	-	53	47	7	76	29	8	93	83	7	102	35	9
2001	Wild	48	1	-	66	48	7	88	155	7	97	80	6	102	5	3
	Hatchery	-	0	-	51	10	3	75	132	8	91	17	8	100	5	8
2002	Wild	51	3	3	64	37	8	89	270	7	100	125	7	99	7	5
	Hatchery	-	0	-	-	0	-	78	5	8	95	7	5	-	0	-
2003	Wild	41	4	2	58	13	4	87	144	8	100	297	7	-	0	-
	Hatchery	-	0	-	40	1	-	78	2	4	101	5	8	-	0	-
2004	Wild	51	1	-	69	17	5	84	47	8	99	392	6	109	10	7
	Hatchery	-	0	-	-	0	-	84	1	-	108	1	-	-	0	-
2005	Wild	-	0	-	68	20	7	86	247	8	95	162	6	101	33	6
	Hatchery	-	0	-	-	0	-	-	0	-	90	3	9	-	0	-
2006	Wild	44	4	7	63	4	11	88	66	7	99	363	6	96	5	7
	Hatchery	-	0	-	-	0	-	-	0	-	99	4	7	100	1	-
2007	Wild	44	12	5	65	58	7	89	72	8	99	180	7	102	64	6
	Hatchery	-	0	-	-	0	-	-	0	-	90	4	5	-	0	-
2008	Wild	46	2	3	69	24	7	90	247	6	98	98	7	105	6	9

Return year	Origin	Summer Chinook fork length (cm)														
		Age-2			Age-3			Age-4			Age-5			Age-6		
		Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD
	Hatchery	-	0	-	63	2	14	81	9	7	93	48	6	99	10	5
2009	Wild	46	5	5	68	31	8	89	207	8	101	209	6	-	0	-
	Hatchery	-	0	-	61	4	7	81	1	-	98	8	14	-	0	-
2010	Wild	45	4	4	70	26	9	89	273	7	99	110	6	-	0	-
	Hatchery	-	0	-	-	0	-	72	5	8	88	3	7	-	0	-
2011	Wild	49	3	3	66	30	7	88	183	7	98	147	7	114	1	-
	Hatchery	-	0	-	55	3	2	90	1	-	81	3	5	-	0	-
2012	Wild	-	0	-	71	9	4	87	120	7	96	125	7	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-	83	1	-	-	0	-
2013	Wild	-	0	-	72	30	3	87	141	7	98	72	7	97	4	6
	Hatchery	-	0	-	-	0	-	79	1	-	96	1	-	-	0	-
2014	Wild	-	0	-	74	12	5	88	198	6	98	53	7	-	0	-
	Hatchery	-	0	-	-	0	-	86	2	6	-	0	-	-	0	-
2015	Wild	-	0	-	72	18	3	86	76	6	98	136	6	-	0	-
	Hatchery	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	Wild	-	0	-	70	3	8	86	106	7	95	121	7	99	1	-
	Hatchery	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	Wild	-	0	-	64	103	5	81	103	7	93	144	7	92	2	4
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-	98	1	-
2018	Wild	-	0	-	70	6	3	85	65	6	92	123	7	97	1	-
	Hatchery	-	0	-	-	0	-	64	1	-	90	3	5	-	0	-
2019	Wild	-	0	-	70	10	3	87	161	7	95	80	6	92	1	-
	Hatchery	-	0	-	-	0	-	82	1	-	76	1	-	98	1	-
Average	***Wild***	***46***	***2***	***4***	***67***	***20***	***7***	***86***	***129***	***7***	***97***	***158***	***6***	***101***	***7***	***6***
	Hatchery	***-***	***0***	***-***	***53***	***4***	***5***	***78***	***14***	***7***	***93***	***17***	***7***	***98***	***4***	***7***

Sex Ratios

Male summer Chinook in the 2017, 2018, and 2019 broodstock made up about 49.6%, 44.0%, and 51.8% of the adults collected, resulting in overall male to female ratios of 0.98:1.00, 0.79:1.00, and 1.08:1.00, respectively (Table 8.4). The ratios in 2017-2018 were below the 1:1 ratio goal in the broodstock protocol.

Table 8.4. Numbers of male and female wild and hatchery summer Chinook collected for broodstock in the Wenatchee River basin, 1989-2019. Ratios of males to females are also provided.

Return year	Number of wild summer Chinook			Number of hatchery summer Chinook			Total M/F ratio
	Males (M)	Females (F)	M/F	Males (M)	Females (F)	M/F	
1989	166	180	0.92:1.00	0	0	-	0.92:1.00
1990	45	39	1.15:1.00	0	0	-	1.15:1.00
1991	60	68	0.88:1.00	0	0	-	0.88:1.00
1992	154	187	0.82:1.00	0	0	-	0.82:1.00

Return year	Number of wild summer Chinook			Number of hatchery summer Chinook			Total M/F ratio
	Males (M)	Females (F)	M/F	Males (M)	Females (F)	M/F	
1993	208	228	0.91:1.00	35	9	3.89:1.00	1.03:1.00
1994	158	179	0.88:1.00	24	31	0.77:1.00	0.87:1.00
1995	169	213	0.79:1.00	1	15	0.07:1.00	0.75:1.00
1996	150	181	0.83:1.00	2	1	2.00:1.00	0.84:1.00
1997	104	121	0.86:1.00	15	0	-	0.98:1.00
1998	211	167	1.26:1.00	64	30	2.13:1.00	1.40:1.00
1999	130	120	1.08:1.00	108	130	0.83:1.00	0.95:1.00
2000	153	145	1.06:1.00	112	82	1.37:1.00	1.17:1.00
2001	187	124	1.51:1.00	132	50	2.64:1.00	1.83:1.00
2002	266	203	1.31:1.00	5	8	0.63:1.00	1.28:1.00
2003	270	218	1.24:1.00	5	3	1.67:1.00	1.24:1.00
2004	230	264	0.87:1.00	1	1	1.00:1.00	0.87:1.00
2005	291	200	1.46:1.00	2	1	2.00:1.00	1.46:1.00
2006	237	246	0.96:1.00	1	4	0.25:1.00	0.95:1.00
2007	239	176	1.36:1.00	2	2	1.00:1.00	1.35:1.00
2008	208	192	1.08:1.00	29	43	0.67:1.00	1.01:1.00
2009	223	236	0.94:1.00	25	7	3.57:1.00	1.02:1.00
2010	217	198	1.10:1.00	5	2	2.50:1.00	1.12:1.00
2011	198	200	0.99:1.00	4	3	1.33:1.00	0.99:1.00
2012	138	135	1.02:1.00	1	0	-	1.03:1.00
2013	127	130	0.98:1.00	1	1	1.00:1.00	0.98:1.00
2014	140	139	1.01:1.00	0	2	0.00:1.00	0.99:1.00
2015	122	123	0.99:1.00	0	0	--	0.99:1.00
2016	134	136	0.99:1.00	0	0	--	0.99:1.00
2017	130	131	0.99:1.00	0	1	--	0.98:1.00
2018	94	118	0.80:1.00	1	3	0.33:1.00	0.79:1.00
2019	138	131	1.05:1.00	4	1	4.00:1.00	1.08:1.00
Total	***5,297***	***5,128***	***1.03:1.00***	***579***	***430***	***1.35:1.00***	***1.06:1.00***

Fecundity

Fecundities for the 2017-2019 returns of summer Chinook averaged 4,361, 4,298, and 4,547 eggs per female, respectively (Table 8.5). Although 2019 experienced a higher average fecundity than the previous two years, the values for all three years are less than the overall average of 5,030 eggs per female. Mean observed fecundities for the 2017 and 2018 returns were lower than the expected fecundities of 4,834 and 4,697, whereas the 2019 returns were higher than the 4,484 eggs per female assumed in the broodstock collection protocols.

Table 8.5. Mean fecundity of wild, hatchery, and all female summer Chinook collected for broodstock in the Wenatchee River basin, 1989-2019; NA = not available.

Return year	Mean fecundity		
	Wild	Hatchery	Total
1989*	NA	NA	5,280
1990*	NA	NA	5,436
1991*	NA	NA	4,333
1992*	NA	NA	5,307
1993*	NA	NA	5,177
1994*	NA	NA	5,899
1995*	NA	NA	4,402
1996*	NA	NA	4,941
1997	5,385	5,272	5,390
1998	5,393	4,825	5,297
1999	5,036	4,942	4,987
2000	5,464	5,403	5,441
2001	5,280	4,647	5,097
2002	5,502	5,027	5,484
2003	5,357	5,696	5,361
2004	5,372	6,681	5,377
2005	5,045	6,391	5,053
2006	5,126	5,633	5,133
2007	5,124	4,510	5,115
2008	5,147	4,919	5,108
2009	5,308	4,765	5,291
2010	4,971	3,323	4,963
2011	4,943	2,983	4,913
2012	4,801	NA	4,801
2013	4,987	5,272	4,990
2014	4,788	4,429	4,756
2015	4,982	NA	4,982
2016	4,423	NA	4,423
2017	4,351	5,621	4,361
2018	4,303	4,097	4,298
2019	4,551	4,005	4,547
Average	***5,028***	***4,922***	***5,030***
Median	***5,045***	***4,931***	***5,097***

* Individual fecundities were not tracked with females until 1997.

To estimate fecundities by length, weight, and age[35], hatchery staff collected fecundity, fork length, weight, and age data from summer Chinook females during the spawning of 2003 through 2019 broodstock. Beginning in 2014, hatchery staff began randomly sampling about fifty females for gonadal mass. For the available brood years, we compare age/fecundity, fork length/fecundity, weight/fecundity, fork length/mean egg mass, and fork length/gamete (skein) mass for natural-origin summer Chinook (very few hatchery fish were examined because they were not targeted for broodstock).

On average, fecundities for natural-origin age-4 and age-5 Chinook were 4,578 and 5,086 eggs, respectively. Although hatchery-origin fish were not targeted for inclusion in broodstock, mean fecundity by age differed between natural-origin and the few hatchery-origin summer Chinook over time (Table 8.6).

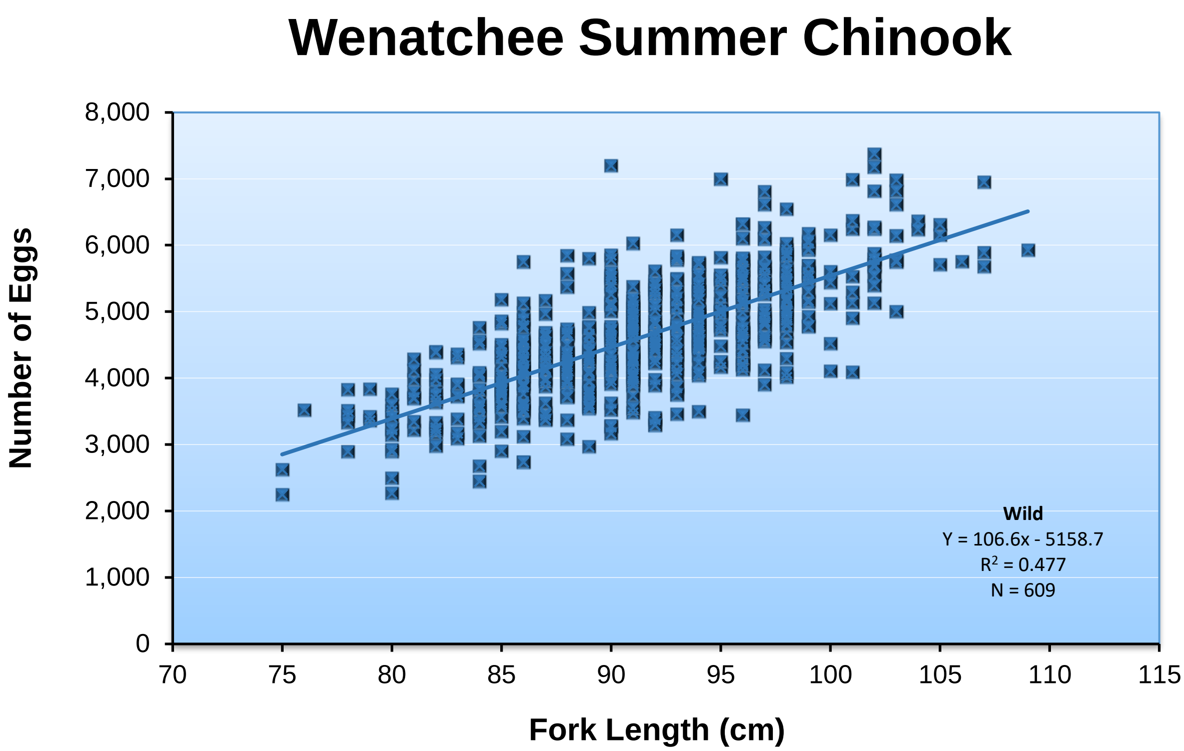
Table 8.6. Mean fecundity by age (total age) for hatchery and wild summer Chinook collected from broodstock for the Wenatchee River program, brood years 2003-2019; N = sample size and SD = 1 standard deviation.

Brood year	Origin	Summer Chinook fecundity											
		Age 3			Age 4			Age 5			Age 6		
		Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD
2003	Wild	-	0	-	4,643	23	601	5,463	126	832	-	0	-
	Hatchery	-	0	-	-	0	-	5,696	2	603	-	0	-
2004	Wild	-	0	-	4,419	6	753	5,387	223	746	6,181	4	877
	Hatchery	-	0	-	-	0	-	6,681	1	-	-	0	-
2005	Wild	-	0	-	4,823	56	716	5,047	85	762	5,846	17	778
	Hatchery	-	0	-	-	0	-	6,391	1	-	-	0	-
2006	Wild	-	0	-	4,503	14	791	5,264	186	889	5,000	4	1,049
	Hatchery	-	0	-	-	0	-	5,633	3	224	-	0	-
2007	Wild	-	0	-	4,829	24	952	5,123	73	911	5,445	18	1,023
	Hatchery	-	0	-	-	0	-	4,510	2	685	-	0	-
2008	Wild	-	0	-	5,019	113	807	5,448	57	658	4,756	2	286
	Hatchery	-	0	-	4,124	3	425	4,841	27	714	5,389	8	1,015
2009	Wild	-	0	-	4,947	98	814	5,612	116	822	-	0	-
	Hatchery	-	0	-	-	0	-	3,944	1	-	-	0	-
2010	Wild	1,631	1	-	4,891	123	756	5,219	59	884	-	0	-
	Hatchery	-	0	-	-	0	-	3,323	1	-	-	0	-
2011	Wild	3,780	1	-	4,727	84	739	5,155	91	818	-	0	-
	Hatchery	-	0	-	-	0	-	2,983	3	761	-	0	-
2012	Wild	-	0	-	4,697	39	680	4,857	83	848	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-
2013	Wild	-	0	-	4,730	61	887	5,280	45	1,048	5,181	3	767
	Hatchery	-	0	-	-	0	-	5,272	1	-	-	0	-

[35] Although age-fecundity relationships are not specific hypotheses tested within the Monitoring and Evaluation Plan (Hillman et al. 2019), we include them here for descriptive purposes.

Brood year	Origin	Summer Chinook fecundity											
		Age 3			Age 4			Age 5			Age 6		
		Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD
2014	Wild	-	0	-	4,658	87	893	5,164	31	796	-	0	-
	Hatchery	-	0	-	4,429	2	1,906	-	0	-	-	0	-
2015	Wild	-	0	-	4,332	25	761	5,159	92	827	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-
2016	Wild	-	0	-	4,198	55	596	4,550	69	870	5,690	1	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-
2017	Wild	-	0	-	3,897	34	764	4,494	84	803	5,002	1	-
	Hatchery	-	0	-	-	0	-	-	0	-	5,621	1	-
2018	Wild	-	0	-	4,137	27	737	4,398	75	759	3,897	1	-
	Hatchery	-	0	-	-	0	-	4,453	3	867	-	0	-
2019	Wild	-	0	-	4,373	69	780	4,849	49	883	5,507	1	-
	Hatchery	-	0	-	-	0	-	4,005	1	-	-	0	-
Average	***Wild***	***-***	***0***	***-***	***4,578***	***55***	***766***	***5,086***	***91***	***833***	***5,251***	***3***	***797***
	Hatchery	***-***	***0***	***-***	***4,277***	***0***	***1,166***	***4,811***	***3***	***642***	***5,505***	***1***	***1,015***

We pooled fecundity data from brood years 2014 through 2019 (years with complete data for all variables) to increase the number of samples for a given fork length. The linear relationships between fork length and fecundity, mean egg weight, and total egg mass for natural-origin females are shown in Figures 8.1, 8.2, and 8.3. All fecundity variables increase linearly with fork length.



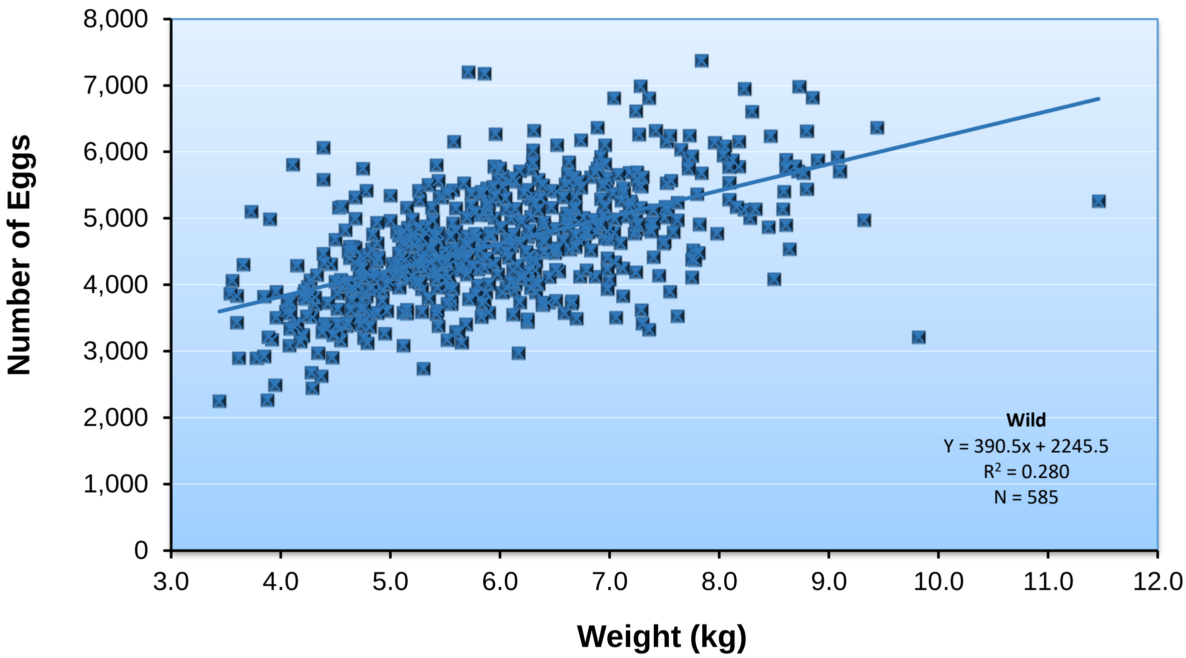


Figure 8.1. Relationships between fecundity and fork length (top figure) and fecundity and weight (bottom figure) for natural-origin summer Chinook for return years 2014-2019.

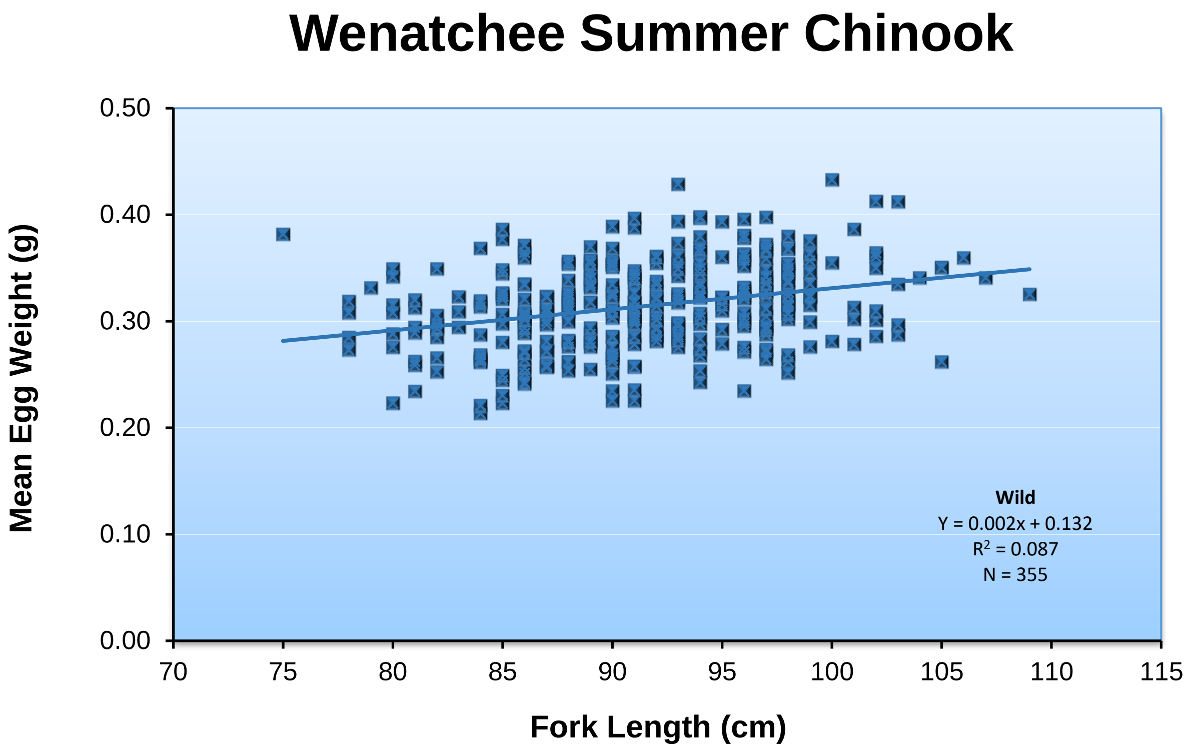


Figure 8.2. Relationships between mean egg weight and fork length for natural-origin summer Chinook for return years 2014-2019.

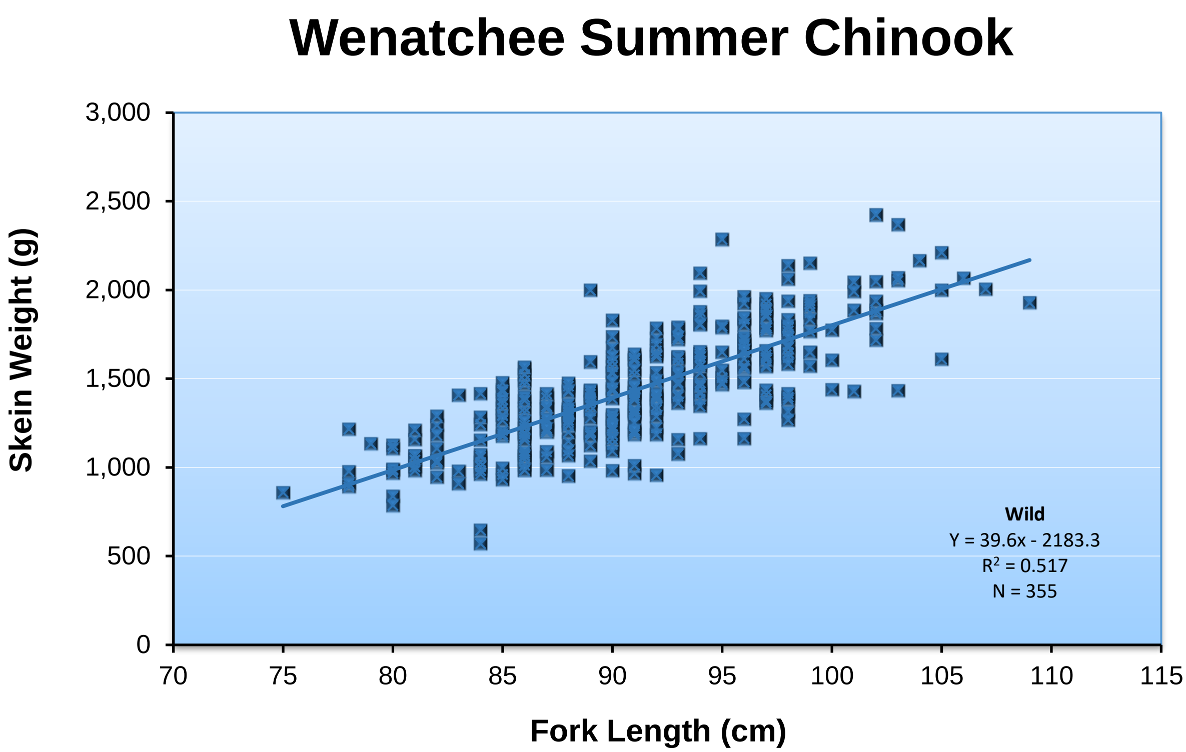


Figure 8.3. Relationships between skein weight and fork length for natural-origin summer Chinook for return years 2014-2019.

8.2 Hatchery Rearing

Rearing History

Number of eggs taken

Based on the unfertilized egg-to-release survival standard of 81%, a total of 1,066,667 eggs were required to meet the program release goal of 864,000 smolts for brood years 1989-2011. An evaluation of the program in 2011 revised the release goal to 500,001 smolts beginning with brood year 2012. Since 2012, egg take goals have been established annually in the broodstock protocols. From 1989 to 2011, the egg take goal was reached in seven of those years (Table 8.7). The average egg take goal of 590,013 eggs was achieved once.

Table 8.7. Numbers of eggs taken from Wenatchee summer Chinook broodstock, 1989-2019.

Return year	Number of eggs taken
1989	829,012
1990	163,109
1991	247,000
1992	827,911
1993	1,133,852
1994	999,364

Return year	Number of eggs taken
1995	949,531
1996	756,000
1997	554,617
1998	854,997
1999	1,182,130
2000	1,113,159
2001	733,882
2002	1,049,255
2003	901,095
2004	1,311,051
2005	883,669
2006	1,190,757
2007	655,201
2008	1,145,330
2009	1,217,028
2010	947,875
2011	959,202
Average (1989-2011)	***895,871***
Median (1989-2011)	***947,875***
2012	633,677
2013	578,513
2014	612,422
2015	610,718
2016	588,606
2017	550,478
2018	498,527
2019	581,537
Average (2012-present)	***581,810***
Median (2012-present)	***585,072***

Number of acclimation days

The 2017 brood Wenatchee summer Chinook were transferred to the Dryden Acclimation Pond between 1-4 April 2019. These fish received 18-28 days of acclimation on Wenatchee River water before being released volitionally from 22-29 April 2019 (Table 8.8).

Table 8.8. Number of days Wenatchee summer Chinook were acclimated at Dryden Acclimation Pond, brood years 1989-2017. Numbers in parenthesis represents the number of days fish reared at Chiwawa Acclimation Facility.

Brood year	Release year	Transfer date	Release date	Number of days
1989	1991	2-Mar	7-May	66
1990	1992	19-Feb	2-May	73
1991	1993	10-Mar	8-May	59
1992	1994	1-Mar	6-May	66
1993	1995	3-Mar	1-May	59
1994	1996	2-Oct	6-May	217 (154)
		5-Mar	6-May	62
1995	1997	16-Oct	8-May	205 (139)
		27-Feb	8-May	70
1996	1998	6-Oct	28-Apr	204 (142)
		25-Feb	28-Apr	62
1997	1999	23-Feb	27-Apr	63
1998	2000	5-Mar	1-May	57
1999	2001	8-Mar	23-Apr	46
2000	2002	1-Mar	6-May	66
2001	2003	19-Feb	23-Apr	63
2002	2004	5-Mar	23-Apr	49
2003	2005	15-Mar	25-Apr	41
2004	2006	25-Mar	27-Apr	33
2005	2007	15-Mar	30-Apr	46
2006	2008	11-14-Mar	28-Apr	45-48
2007	2009	30-31-Mar	29-Apr	29-30
2008	2010	9-12, 15, 22-Mar	28-Apr	38-51
2009	2011	15-18, 21-Mar, 22-Apr	26-Apr	5-43
2010	2012	26-30-Mar	25-Apr	26-30
2011	2013	25-29-Mar	24-Apr	26-30
2012	2014	17-27-Mar	30-Apr	34-44
2013	2015	9-13-Mar, 17-Apr	28-Apr	11-50
2014	2016	21-24-Mar	18-27-Apr	25-37
2015	2017	13-15-Mar	17-26-Apr	33-44
2016	2018	7-9, 12-14, 24 Mar	17 Apr- 30 May	24-83

Brood year	Release year	Transfer date	Release date	Number of days
2017	2019	1-4 Apr	22-29 Apr	18-28

Release Information

Numbers released

The 2017 Wenatchee summer Chinook program achieved 96.3% of the 500,001 goal with 481,728 fish being released in 2019 (Table 8.9). For brood years 2012-2017, the Wenatchee summer Chinook program has averaged 102% of the smolt obligation.

Table 8.9. Numbers of Wenatchee summer Chinook smolts released from the hatchery, brood years 1989-2017. Up to 2012, the release target for Wenatchee summer Chinook was 864,000 smolts. Beginning in 2012, the release target is 500,001 smolts. CWT marking rates include adjustments for tag loss before the fish were released.

Brood year	Release year	CWT mark rate	Number released with PIT tags	Number of smolts released
1989	1991	0.2013	0	720,000
1990	1992	0.9597	0	124,440
1991	1993	0.9957	0	191,179
1992	1994	0.9645	0	627,331
1993	1995	0.9881	0	900,429
1994	1996	0.9697	0	797,350
1995	1997	0.9725	0	687,439
1996	1998	0.9758	0	600,127
1997	1999	0.9913	0	438,223
1998	2000	0.9869	0	649,612
1999	2001	0.9728	0	1,005,554
2000	2002	0.9723	0	929,496
2001	2003	0.9868	0	604,668
2002	2004	0.9644	0	835,645
2003	2005	0.9778	0	653,764
2004	2006	0.9698	0	892,926
2005	2007	0.9596	0	644,182
2006	2008	0.9676	0	51,550[a]
		0.9676	0	899,107
2007	2009	0.9768	0	456,805
2008	2010	0.9664	10,035	888,811
2009	2011	0.9767	29,930	843,866
2010	2012	0.9964	0	792,746
2011	2013	0.9904	5,020	827,709
Average (1989-2011)		***0.9761***	***1,874***	***667,085***
Median (1989-2011)		***0.9727***	***0***	***720,000***

Brood year	Release year	CWT mark rate	Number released with PIT tags	Number of smolts released
2012	2014	0.9700	19,911	550,877
2013	2015	0.9872	20,486	470,570
2014	2016	0.9639	10,432	535,255
2015	2017	0.9831	20,605	525,366
2016	2018	0.9976	20,677	493,333
2017	2019	0.9695	20,723	481,728
Average (2012-present)		***0.9786***	***18,806***	***515,080***
Median (2012-present)		***0.9766***	***20,546***	***525,366***

[a] Represents high ELISA group planted directly in the Wenatchee River at Leavenworth Boat Launch.

Numbers tagged

The 2017 brood Wenatchee summer Chinook were 97.0% CWT[36] and 72.2% adipose fin-clipped (Table 8.9).

2018 Brood Wenatchee Summer Chinook (Raceway)—A total of 10,496 Wenatchee summer Chinook were PIT tagged at Eastbank Hatchery on 28 October to 1 November 2019. These were PIT tagged and released into raceway #11. Fish were not fed during PIT tagging or for two days before and after tagging. Fish averaged 92 mm in length and 9.3 g at time of tagging.

2018 Brood Wenatchee Summer Chinook (Reuse Circular Ponds)—A total of 10,501 Wenatchee summer Chinook were PIT tagged at Eastbank Hatchery on 4-7 November 2019. These were PIT tagged and released into water-reuse circular ponds #1 and #2. Fish were not fed during PIT tagging or for two days before and after tagging. Fish averaged 97 mm in length and 10.4 g at time of tagging.

The number of hatchery summer Chinook that have been PIT-tagged and released into the Wenatchee River are shown in Table 8.10. During the period 2010-2019, the number of fish tagged and released has ranged from 0 to 10,452.

Table 8.10. Summary of PIT-tagging activities for Wenatchee hatchery summer Chinook, brood years 2008-2017.

Brood year	Release year	Number of fish tagged	Number of tagged fish that died	Number of tags shed	Number of tagged fish released
2008	2010	10,100	64	1	10,035
2009	2011	10,108 (Control)	140	3	9,965
		10,100 (R1)	129	0	9,971
		10,099 (R2)	105	0	9,994
2010	2012	0	0	0	0

36 Sixty days after tagging, taggers conduct a quality control procedure, which includes collecting a sample of tagged fish and scanning for tag retention. Thus, the number of tagged fish released is adjusted for tag loss.

Brood year	Release year	Number of fish tagged	Number of tagged fish that died	Number of tags shed	Number of tagged fish released
2011	2013	5,100	80	0	5,020
2012	2014 (Raceway)	5,150 (small-size)	90	12	5,048
		5,153 (big-size)	379	34	4,740
	2014 (Reuse Circular)	5,150 (small-size)	109	0	5,041
		5,151 (big-size)	69	0	5,082
2013	2015 (Raceway)	5,150 (small-size)	44	0	5,116
		5,153 (big-size)	31	0	5,129
	2015 (Reuse Circular)	5,150 (small-size)	41	0	5,120
		5,151 (big-size)	38	1	5,121
2014	2016 (Raceway)	5,250 (small-size)	54	0	5,196
		5,250 (big-size)	92	0	5,158
	2016 (Reuse Circular)	5,250 (small-size)	19	0	5,231
		5,250 (big-size)	49	0	5,201
2015	2017 (Raceway)	10,565	213	0	10,352
	2017 (Reuse Circular)	10,429	176	0	10,253
2016	2018 (Raceway)	10,500	126	3	10,371
	2018 (Reuse Circular)	10,500	188	6	10,306
2017	2019 (Raceway)	10,500	228	1	10,271
	2019 (Reuse Circular)	10,498	45	1	10,452

Fish size and condition at release

About 481,728 summer Chinook from the 2017 brood were released volitionally from Dryden Acclimation Pond from 22-29 April 2019. Since the program began, Wenatchee summer Chinook have not met the target length and CV values (Table 8.11). The target weight (fish/pound or FPP) of juvenile fish has been met in some years (Table 8.11).

Table 8.11. Mean lengths (FL, mm), weight (g and fish/pound), and coefficient of variation (CV) of Wenatchee summer Chinook smolts released from the hatchery, brood years 1989-2017; NA = not available. Size targets are provided in the last row of the table.

Brood year	Release year	Fork length (mm)		Mean weight	
		Mean	CV	Grams (g)	Fish/pound
1989	1991	158	13.7	45.4	10
1990	1992	155	14.2	45.4	10

Brood year	Release year	Fork length (mm)		Mean weight	
		Mean	CV	Grams (g)	Fish/pound
1991	1993	156	15.5	42.3	11
1992	1994	152	13.1	40.1	10
1993	1995	149	NA	34.9	13
1994	1996	138	NA	21.7	21
1995	1997	149	12.2	42.5	11
1996	1998	151	16.6	43.2	10
1997	1999	154	10.1	42.8	11
1998	2000	166	9.7	53.1	9
1999	2001	137	16.1	29.0	16
2000	2002	148	14.6	37.1	12
2001	2003	148	NA	38.9	12
2002	2004	146	15.1	37.3	14
2003	2005	147	13.2	36.5	12
2004	2006	147	10.7	35.4	13
2005	2007	153	16.3	40.6	11
2006	2008	136	21.5	29.2	16
2007	2009	163	21.6	49.7	9
2008	2010	166	15.0	52.0	9
2009	2011	152	15.9	39.0	12
2010	2012	154	17.2	43.1	11
2011	2013	149	13.8	41.4	11
Average (1989-2011)		***151***	***14.8***	***40.0***	***12***
Targets (1989-2011)		***176***	***9.0***	***45.4***	***10***
2012	2014	158	12.6	40.7	11
2013	2015	156	10.1	40.7	11
2014	2016	145	10.2	31.1	15
2015	2017	139	9.5	29.8	15
2016	2018	140	9.2	29.2	16
2017	2019	148	6.6	30.1	15
Average (2012-present)		***148***	***9.7***	***33.6***	***14***
Targets (2012-present)[a]		***163***	***9.0***	***45.4***	***18***

[a] For brood year 2012, the fish per pound (fpp) targets were 10 fpp and 15 fpp.

Survival Estimates

Overall survival of the 2017 brood Wenatchee summer Chinook from green (unfertilized) egg to release was higher than the standard set for the program. This was due to achieving or exceeding survival at all stages (Table 8.12).

Table 8.12. Hatchery life-stage survival rates (%) for Wenatchee summer Chinook, brood years 1989-2017. Survival standards or targets are provided in the last row of the table.

Brood year	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
1989	90.0	93.4	90.9	97.0	99.7	99.3	98.5	99.4	86.9
1990	89.7	95.6	80.9	96.6	99.6	99.2	97.7	98.8	76.3
1991	88.2	98.3	86.9	96.1	99.3	98.5	94.9	98.1	77.4
1992	84.3	92.2	79.8	97.8	99.9	99.9	97.1	98.1	75.8
1993	92.4	95.9	84.2	97.5	99.6	99.3	96.7	98.8	79.4
1994	90.7	95.3	83.7	100	99.2	97.0	95.3	98.4	79.8
1995	94.7	98.2	86.0	100	96.7	96.4	74.9	90.8	72.4
1996	84.6	96.1	84.1	100	97.9	97.7	94.4	97.7	79.4
1997	89.3	98.3	82.6	97.3	97.1	96.9	98.3	98.2	79.0
1998	85.3	94.6	80.9	98.3	99.4	98.6	95.6	99.8	76.0
1999	98.4	98.3	90.4	97.9	98.1	97.9	96.2	99.4	85.1
2000	93.0	96.6	88.3	98.0	99.6	99.3	96.5	98.9	83.5
2001	87.4	91.5	90.6	97.7	99.8	99.6	93.1	93.3	82.4
2002	93.8	94.1	85.1	99.8	98.1	97.6	93.7	96.5	79.6
2003	77.4	85.1	80.5	98.1	99.6	99.1	91.9	93.5	72.6
2004	92.8	97.8	85.7	87.8	99.9	99.6	86.6	92.1	65.1
2005	97.3	89.6	83.5	98.0	99.7	99.4	89.1	99.5	72.9
2006	92.4	95.2	85.6	98.4	99.3	98.4	94.8	97.2	79.8
2007	73.6	97.5	73.7	97.9	99.5	98.7	96.6	99.1	69.7
2008	96.6	97.9	90.4	97.3	99.4	98.7	88.2	89.6	77.6
2009	95.1	95.6	92.0	99.6	97.3	97.3	84.8	98.2	78.1
2010	94.7	97.8	96.1	99.3	97.6	97.1	87.2	90.3	83.2
2011	98.0	96.4	92.3	97.9	99.5	98.9	95.9	97.3	86.7
2012	97.8	97.2	92.3	98.1	99.7	99.1	96.1	97.3	86.9
2013	91.5	98.4	87.5	98.8	97.1	96.6	94.1	98.4	81.3
2014	92.2	95.0	92.6	99.4	99.6	98.7	97.8	99.3	90.0
2015	96.2	97.7	89.8	97.8	99.7	99.4	98.2	99.4	86.2
2016	97.1	96.3	88.3	98.4	99.8	99.5	96.4	97.4	83.8
2017	96.9	97.6	92.4	98.0	99.3	99.0	96.7	98.5	87.5
Average	***91.4***	***95.6***	***86.8***	***97.9***	***99.0***	***98.5***	***93.7***	***97.0***	***79.8***
Median	***92.4***	***96.3***	***86.9***	***98.0***	***99.5***	***98.7***	***95.6***	***98.2***	***79.6***
Standard	***90.0***	***85.0***	***92.0***	***98.0***	***97.0***	***93.0***	***90.0***	***95.0***	***81.0***

8.3 Disease Monitoring

Rearing of the 2017 brood Wenatchee summer Chinook was similar to previous years with fish being held on well water before being transferred to the Dryden Acclimation Pond for final acclimation in April 2019. Fish were transferred to the Dryden Acclimation Pond from 1-4 April.

Results of the 2019 adult broodstock bacterial kidney disease (BKD) monitoring indicated that most females (86.7%) had ELISA values less than 0.199. Additionally, 16 females had ELISA values higher than 0.120, which means that their progeny could have been reared at densities less than 0.06 fish per pound (Table 8.13). Thirteen of these females' progeny were culled due to moderate or high ELISA values. There was an additional female with a high value that had no live eggs.

Table 8.13. Proportion of bacterial kidney disease (BKD) titer groups for the Wenatchee summer Chinook broodstock, brood years 1997-2019. Also included are the proportions to be reared at either 0.125 fish per pound or 0.060 fish per pound.

Brood year[a]	Optical density values by titer group				Proportion at rearing densities (fish per pound, fpp)[b]	
	Very Low (≤ 0.099)	Low (0.1-0.199)	Moderate (0.2-0.449)	High (≥ 0.450)	≤ 0.125 fpp (<0.119)	≤ 0.060 fpp (>0.120)
1997	0.7714	0.0857	0.0381	0.1048	0.8095	0.1905
1998	0.3067	0.2393	0.1656	0.2883	0.4479	0.5521
1999	0.9590	0.0123	0.0123	0.0164	0.9713	0.0287
2000	0.6268	0.1053	0.1627	0.1053	0.7321	0.2679
2001	0.6513	0.0263	0.0987	0.2237	0.6776	0.3224
2002	0.7868	0.0457	0.0711	0.0964	0.8325	0.1675
2003	0.9825	0.0000	0.0058	0.0117	0.9825	0.0175
2004	0.9593	0.0081	0.0163	0.0163	0.9675	0.0325
2005	0.9833	0.0056	0.0000	0.0111	0.9833	0.0167
2006	0.9134	0.0563	0.0000	0.0303	0.9351	0.0649
2007	0.9535	0.0078	0.0078	0.0310	0.9535	0.0465
2008	0.9868	0.0088	0.0044	0.0000	0.9868	0.0132
2009	0.9957	0.0000	0.0000	0.0043	0.9957	0.0043
2010	0.9897	0.0025	0.0000	0.0025	0.9949	0.0051
2011	0.9585	0.0363	0.0000	0.0052	0.9896	0.0104
2012	0.9697	0.0303	0.0000	0.0000	1.0000	0.0000
2013	0.8120	0.1790	0.0000	0.0090	0.8890	0.1110
2014	0.9462	0.0154	0.0000	0.0385	0.9462	0.0538
2015	0.9919	0.0000	0.0000	0.0081	0.9919	0.0081
2016	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000
2017	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000
2018	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000
2019	0.8359	0.0547	0.0469	0.0625	0.8672	0.1328

Brood year[a]	Optical density values by titer group				Proportion at rearing densities (fish per pound, fpp)[b]	
	Very Low (≤ 0.099)	Low (0.1-0.199)	Moderate (0.2-0.449)	High (≥ 0.450)	≤ 0.125 fpp (<0.119)	≤ 0.060 fpp (>0.120)
Average	***0.8861***	***0.0400***	***0.0274***	***0.0463***	***0.9110***	***0.0890***
Median	***0.9590***	***0.0123***	***0.0000***	***0.0117***	***0.9713***	***0.0287***

[a] Individual ELISA samples were not collected before the 1997 brood.
[b] ELISA values from broodstock BKD testing dictate what density the progeny of the broodstock are reared. Progeny of broodstock with high ELISA values are reared at lower density.

8.4 Natural Juvenile Productivity

During 2019, juvenile summer Chinook were sampled at the Lower Wenatchee Trap located near the town of Cashmere. The Lower Wenatchee Trap was moved to its present location in 2013 and smolt abundance estimates occur at this location.

Emigrant Estimates

Lower Wenatchee Trap

The Lower Wenatchee River Trap operated between 19 February and 23 July 2019. During that time, the trap was inoperable for 16 days because of high or low river discharge, debris, elevated river temperatures, large hatchery releases, and mechanical issues. At the beginning of the season the trap operated in the low-flow position until 26 March. It then operated in the lower position until 5 July when it was switched back to the low-flow position for the remainder of the season. During the sampling period, 28,534 wild subyearling Chinook were captured at the Lower Wenatchee Trap. Based on nine capture efficiency trials, a significant relationship between trap efficiency and river discharge was created (R^2 = 0.70, P < 0.02) and an estimated 2,439,434 (±534,405; 95% CI) wild subyearling Chinook passed the trap within the sampling period (Table 8.14).

Table 8.14. Numbers of redds and juvenile summer Chinook emigrants in the Wenatchee River basin for brood years 1999-2018; NS = not sampled. From 2000-2010 the trap operated at Monitor; from 2013 to present the trap operated near Cashmere.

Brood year	Number of redds	Egg deposition	Number of emigrants upstream from trap	Total number of emigrants
1999	2,738	13,654,406	9,572,392	9,685,591
2000	2,540	13,820,140	1,299,476	1,322,383
2001	3,550	18,094,350	8,229,920	8,340,342
2002	6,836	37,488,624	13,167,855	13,475,368
2003	5,268	28,241,748	20,336,968	20,426,149
2004	4,874	26,207,498	14,764,141	14,935,745
2005	3,538	17,877,514	11,612,939	11,695,581
2006	8,896	45,663,168	9,397,044	9,595,512
2007	1,970	10,076,550	4,470,672	4,546,838
2008	2,800	14,302,400	4,309,496	4,405,473
2009	3,441	18,206,331	6,695,977	6,814,805

Brood year	Number of redds	Egg deposition	Number of emigrants upstream from trap	Total number of emigrants
2010	3,261	16,184,343	NS	NS
2011	3,078	15,122,214	NS	NS
2012	2,504	12,021,704	9,333,214	10,034,508
2013	3,241	16,172,590	11,936,928	12,605,925
2014	3,458	16,446,248	14,157,778	14,763,064
2015	1,804	8,987,528	4,023,310	4,199,697
2016	2,797	12,371,131	7,593,243	8,505,733
2017	3,908	17,042,788	5,823,795	6,298,641
2018	1,510	6,489,980	2,439,434	2,477,473
Average	***3,601***	***18,223,563***	***8,842,477***	***9,118,268***
Median	***3,251***	***16,178,467***	***8,781,567***	***9,050,623***

A total of 23 summer Chinook redds were observed downstream from the trap in 2018. Thus, the total number of summer Chinook emigrating from the Wenatchee River in 2019 was expanded using the ratio of the number of redds downstream from the trap to the number upstream from the trap. This resulted in a total summer Chinook emigrant estimate of 2,477,473 fish (Table 8.14). Most of the fish emigrated during May and June (Figure 8.4). Monthly captures and mortalities of all fish collected at the Lower Wenatchee Trap are reported in Appendix C.

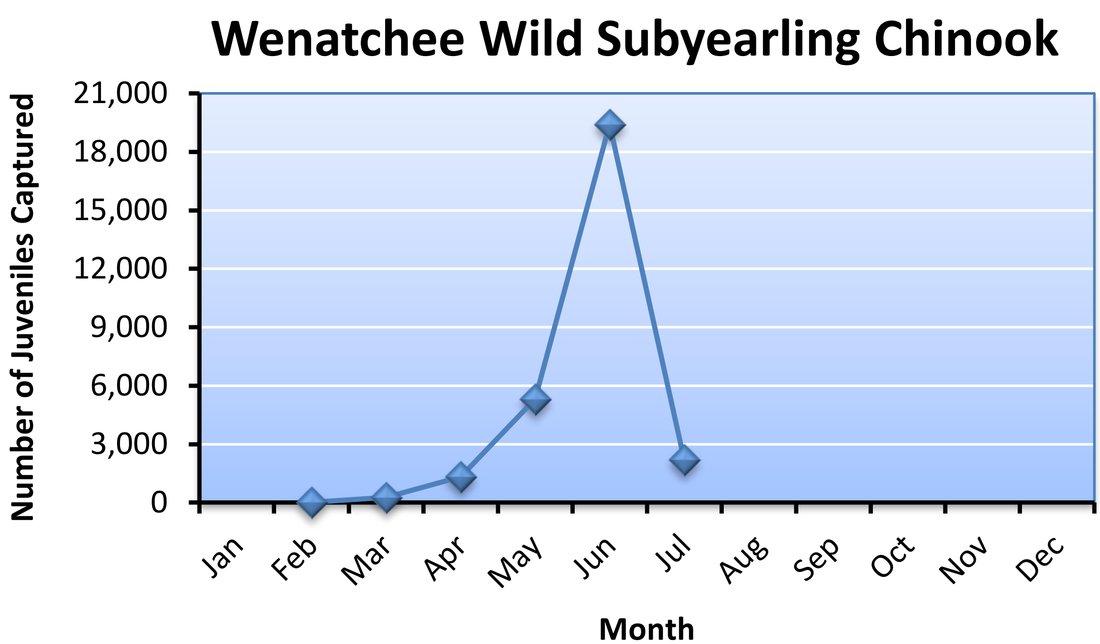


Figure 8.4. Numbers of wild subyearling Chinook captured at the Lower Wenatchee Trap during mid-February to late July 2019.

Subyearling summer Chinook sampled in 2019 averaged 57 mm in length, 2.5 g in weight, and had a mean condition of 1.02 (Table 8.15). These size estimates were larger than the overall mean of subyearling summer Chinook sampled in previous years (overall means: 50 mm, 1.8 g, and condition of 0.99).

Table 8.15. Mean fork length (mm), weight (g), and condition factor of subyearling summer Chinook collected in the Lower Wenatchee Trap, 2000-2019; NS = not sampled. From 2000-2010 the trap operated at Monitor; from 2013 to present the trap operated near Cashmere. Numbers in parentheses indicate 1 standard deviation.

Sample year	Sample size[a]	Mean size		
		Length (mm)	Weight (g)	Condition (K)
2000	1,069	55 (16)	1.7 (2.2)	1.01 (0.29)
2001	402	48 (13)	2.3 (1.9)	1.03 (0.17)
2002	2,259	58 (18)	3.0 (2.7)	1.04 (0.17)
2003	818	47 (14)	2.8 (2.6)	1.09 (0.16)
2004	1,723	46 (11)	1.2 (1.5)	0.91 (0.20)
2005	2,947	43 (7)	1.0 (1.0)	0.91 (0.21)
2006	2,863	50 (15)	1.8 (2.0)	0.96 (0.23)
2007	3,061	48 (13)	1.4 (1.8)	0.92 (0.21)
2008	2,201	48 (13)	1.5 (1.7)	1.03 (0.27)
2009	2,474	49 (14)	1.6 (2.0)	0.98 (0.21)
2010	2,366	45 (10)	1.0 (1.2)	0.94 (0.23)
2011	NS	NS	NS	NS
2012	NS	NS	NS	NS
2013	4,431	52 (17)	2.0 (2.5)	0.99 (0.30)
2014	5,107	45 (11)	1.1 (1.3)	0.92 (0.20)
2015	4,560	49 (13)	1.5 (1.5)	0.96 (0.24)
2016	5,998	53 (15)	2.0 (1.9)	0.99 (0.17)
2017	3,417	53 (12)	1.8 (1.5)	1.02 (0.16)
2018	3,895	51 (13)	1.7 (1.7)	0.97 (0.17)
2019	2,357	57 (16)	2.5 (2.1)	1.02 (0.18)
Average	***2,886***	***50***	***1.8***	***0.98***
Median	***2,669***	***49***	***1.7***	***0.99***

[a] Sample size represents the number of fish that were measured for both length and weight.

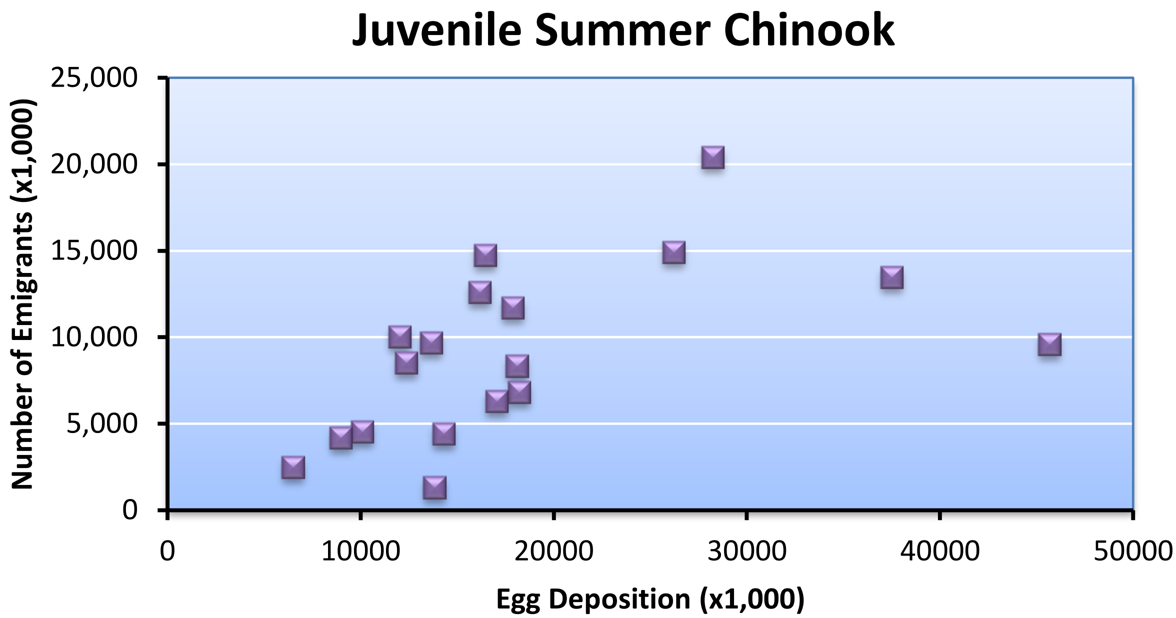
Freshwater Productivity

Both productivity and survival estimates for juvenile emigrants of summer Chinook in the Wenatchee River basin are provided in Table 8.16. During the period 1999-2018, freshwater productivities ranged from 521-4,269 emigrants/redd. Survivals during the same period ranged from 9.6-89.8% for egg-emigrants.

Table 8.16. Productivity (emigrants/redd) and survival (egg-emigrant) estimates for summer Chinook in the Wenatchee River basin for brood years 1999-2018; ND = no data. These estimates were derived from data in Table 8.14.

Brood year	Emigrants/ Redd	Egg-Emigrant (%)
1999	3,537	70.9
2000	521	9.6
2001	2,349	46.1
2002	1,971	35.9
2003	3,877	72.3
2004	3,064	57.0
2005	3,306	65.4
2006	1,079	21.0
2007	2,308	45.1
2008	1,573	30.8
2009	1,980	37.4
2010	ND	ND
2011	ND	ND
2012	4,007	83.5
2013	3,890	77.9
2014	4,269	89.8
2015	2,328	46.7
2016	3,041	68.8
2017	1,612	37.0
2018	1,641	38.2
Average	***2,575***	***51.9***
Median	***2,339***	***46.4***

Numbers of juvenile emigrants increased with increasing egg deposition; however, egg-emigrant survival did not decrease significantly with increasing egg deposition (Figure 8.5). This suggests a density-independent relationship between seeding levels and emigrants within the Wenatchee River basin (see Population Carrying Capacity section below).



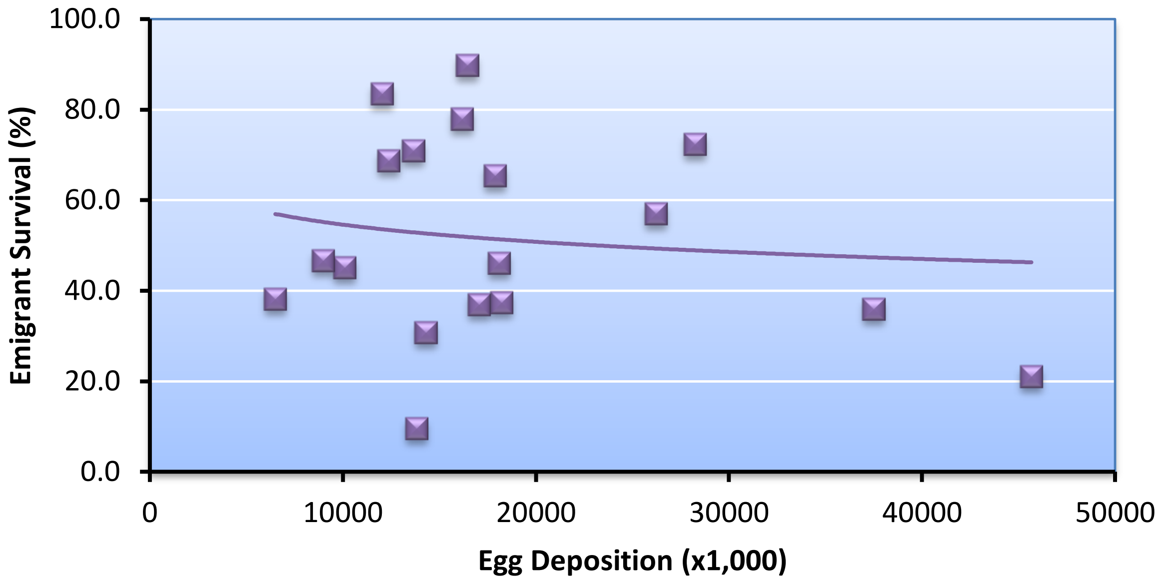


Figure 8.5. Relationships between seeding levels (egg deposition) and juvenile productivity (top figure) and emigrant survival (bottom figure) for Wenatchee summer Chinook, brood years 1999-2018.

Population Carrying Capacity

Population carrying capacity (*K*) is defined as the maximum equilibrium population size estimated with population models (e.g., logistic equation, Beverton-Holt model, hockey stick model, and the Ricker model).[37] Maximum equilibrium population size is generated from density dependent mechanisms that reduce population growth rates as population size increases (negative density

[37] Population carrying capacity (*K*) should not be confused with habitat carrying capacity (*C*), which is defined as the maximum population of a given species that a particular environment can sustain.

dependence). This is referred to as compensation. Population size fluctuates about the maximum equilibrium size because of variability in vital rates that are unrelated to density (density independent factors) and measurement error. In this section, we used population models to estimate juvenile summer Chinook carrying capacities (see Appendix 6 in Hillman et al. 2019 for a detailed description of methods).

Only the density-independent model adequately fit the juvenile emigrant data for Wenatchee summer Chinook (Figure 8.6). This means that under the range of seeding levels examined, there is no estimate of carrying capacity for juvenile emigrants. This implies that spawning habitat is not currently limiting juvenile productivity within the Wenatchee River basin. It does not mean that there is no limit to juvenile rearing within the Wenatchee River basin. Indeed, there is likely a limit to the number of parr that can rear within the basin; however, there are no parr data to estimate rearing capacity.

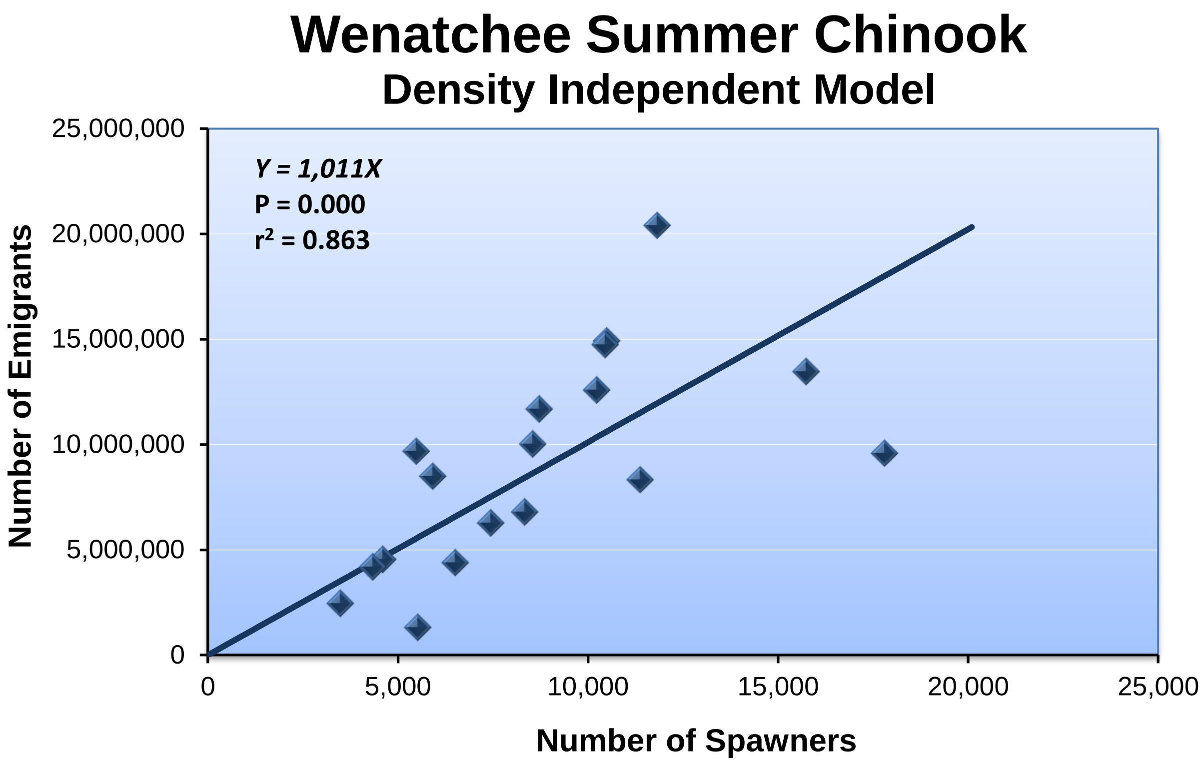


Figure 8.6. Density-independent relationship between spawners and number of juvenile emigrants produced in the Wenatchee River basin.

8.5 Spawning Surveys

Surveys for Wenatchee summer Chinook redds were conducted from 9 September to 5 November 2019 in the Wenatchee River and Icicle Creek.

Redd Counts

A total count of summer Chinook redds was estimated in 2019 based on weekly census surveys conducted in the Wenatchee River. Redds were counted in Icicle Creek when feasible. A total of 883 summer Chinook redds were counted in the Wenatchee River basin in 2019 (Table 8.17).

In the future, spawning escapement estimates may be derived using the area-under-the-curve (AUC) method described in Millar et al. (2012). We now have six years of data (2014-2019) to inform model parameters (e.g., observer efficiency of redd counts at variable temporal and spatial scales). Model calibration has begun with existing data. We now have prototype models to generate updated spawning escapements with associated variance. These updated estimates will be incorporated into this report when the models are fully calibrated.

Table 8.17. Numbers of redds counted in the Wenatchee River basin, 1989-2019; ND = no data. From 1989-2013, numbers of redds were based on expanding "peak counts" to generate a Total Count. Since 2014, numbers of redds were based on weekly census surveys that encompass all reaches.

Survey year	Redd counts		Total count
	Wenatchee River	Icicle Creek	
1989	3,331	ND	4,215
1990	2,479	ND	3,103
1991	2,180	ND	2,748
1992	2,328	ND	2,913
1993	2,334	ND	2,953
1994	2,426	ND	3,077
1995	1,872	ND	2,350
1996	1,435	ND	1,814
1997	1,388	ND	1,739
1998	1,660	ND	2,230
1999	2,188	ND	2,738
2000	2,022	ND	2,540
2001	2,857	ND	3,550
2002	5,419	ND	6,836
2003	4,281	ND	5,268
2004	4,003	ND	4,874
2005	2,895	ND	3,538
2006	7,165	68	8,896
2007	1,857	13	1,970
2008	2,338	23	2,800
2009	2,667	21	3,441
2010	2,553	11	3,261
2011	2,583	9	3,078
2012	2,301	2	2,504
2013	2,875	42	3,241
2014	3,383	75	3,458

Survey year	Redd counts		Total count
	Wenatchee River	Icicle Creek	
2015	1,781	23	1,804
2016	2,725	72	2,797
2017	3,872	36	3,908
2018	1,498	12	1,510
2019	881	2	883
Average			***3,227***
Median			***2,953***

Redd Distribution

Summer Chinook redds were not evenly distributed among reaches within the Wenatchee River basin in 2019 (Table 8.18; Figure 8.7). Most of the spawning occurred upstream from the Leavenworth Bridge in Reaches 6, 8, 9, and 10. The highest density of redds occurred in Reach 6 near the confluence of the Icicle River.

Table 8.18. Total numbers of summer Chinook redds counted in different reaches in the Wenatchee River basin during September through mid-November 2019.

Survey reach	Reach description	Total redd count
Wenatchee 1 (W1)	Mouth to Sleepy Hollow Br	4
Wenatchee 2 (W2)	Sleepy Hollow Br to L. Cashmere Br	46
Wenatchee 3 (W3)	L. Cashmere Br to Dryden Dam	107
Wenatchee 4 (W4)	Dryden Dam to Peshastin Br	9
Wenatchee 5 (W5)	Peshastin Br to Leavenworth Br	16
Wenatchee 6 (W6)	Leavenworth Br to Icicle Rd Br	297
Wenatchee 7 (W7)	Icicle Rd Br to Tumwater Dam	33
Wenatchee 8 (W8)	Tumwater Dam to Tumwater Br	135
Wenatchee 9 (W9)	Tumwater Br to Chiwawa River	174
Wenatchee 10 (W10)	Chiwawa River to Lake Wenatchee	60
Icicle Creek (I1)	Mouth to Hatchery	2
Totals		***883***

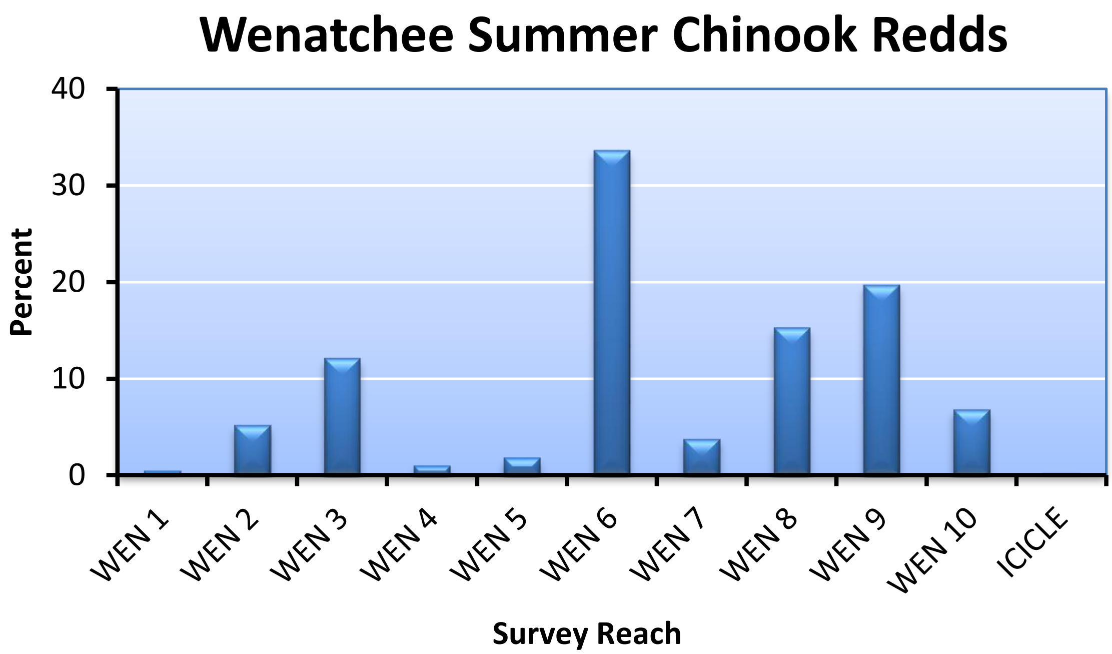


Figure 8.7. Percent of the total number of summer Chinook redds counted in different reaches in the Wenatchee River basin during September through early-November 2019. Reach codes are described in Table 2.9.

Spawn Timing

In 2019, spawning in the Wenatchee River began during the end of September, peaked the second week of October, and ended the first week of November (Figure 8.8).

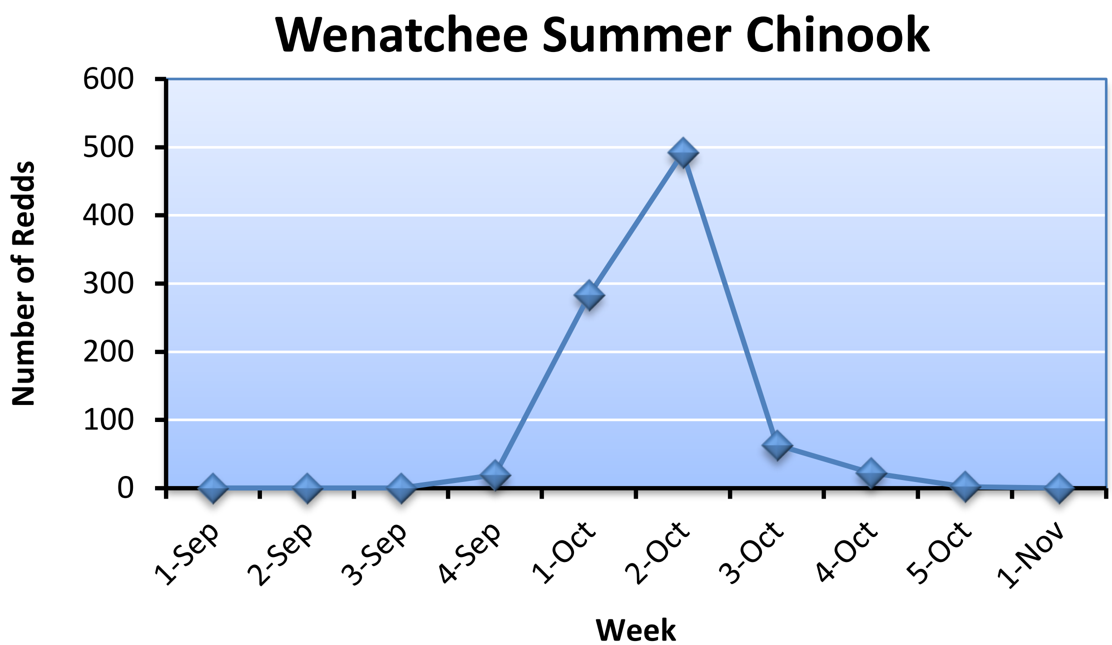


Figure 8.8. Number of new summer Chinook redds counted during different weeks in the Wenatchee River, September through early November 2019.

Spawning Escapement

Spawning escapement for Wenatchee summer Chinook was calculated as the total number of redds (expanded peak counts for return years 1989-2013) times the fish per redd ratio estimated from broodstock and fish sampled at adult trapping sites.[38] The estimated fish per redd ratio for summer Chinook in 2019 was 1.47. Multiplying this ratio by the number of redds counted in the Wenatchee River basin resulted in a total spawning escapement of 1,298 summer Chinook (Table 8.19). This is less than the overall average spawning escapement of 8,621 summer Chinook and is the lowest since redd counts began in 1989.

Table 8.19. Spawning escapements for summer Chinook in the Wenatchee River basin, return years 1989-2019. Number of redds is based on expanded peak redd counts for the period 1989-2013.

Return year	Fish/Redd	Redds	Total spawning escapement
1989	3.40	4,215	14,331
1990	3.50	3,103	10,861
1991	3.70	2,748	10,168
1992	4.00	2,913	11,652
1993	3.20	2,953	9,450
1994	3.30	3,077	10,154
1995	3.30	2,350	7,755
1996	3.40	1,814	6,168

[38] Expansion factor = (1 + (number of males/number of females)).

Return year	Fish/Redd	Redds	Total spawning escapement
1997	3.40	1,739	5,913
1998	2.40	2,230	5,352
1999	2.00	2,738	5,476
2000	2.17	2,540	5,512
2001	3.20	3,550	11,360
2002	2.30	6,836	15,723
2003	2.24	5,268	11,800
2004	2.15	4,874	10,479
2005	2.46	3,538	8,703
2006	2.00	8,896	17,792
2007	2.33	1,970	4,590
2008	2.32	2,800	6,496
2009	2.42	3,441	8,327
2010	2.29	3,261	7,468
2011	3.20	3,078	9,850
2012	3.41	2,504	8,539
2013	3.15	3,241	10,209
2014	3.02	3,458	10,443
2015	2.40	1,804	4,330
2016	2.11	2,797	5,902
2017	1.90	3,908	7,425
2018	2.30	1,510	3,473
2019	1.47	883	1,298
Average	***2.72***	***3,227***	***8,613***
Median	***2.42***	***2,953***	***8,539***

8.6 Carcass Surveys

Surveys for Wenatchee summer Chinook carcasses were conducted from early September to early November 2019 in the Wenatchee River and Icicle Creek.

Number sampled

A total of 147 summer Chinook carcasses were sampled during early September through early November in the Wenatchee River basin in 2019 (Table 8.20).

Table 8.20. Numbers of summer Chinook carcasses sampled within each survey reach in the Wenatchee River basin, 1993-2019. Reach codes are described in Table 2.9.

Survey year	Number of summer Chinook carcasses											
	W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8	W-9	W-10	Icicle	Total
1993	68	151	696	13	82	150	215	41	0	0	0	**1,416**
1994	0	6	25	1	21	50	20	49	131	1	0	**304**
1995	0	10	14	0	0	117	50	37	20	0	0	**248**
1996	0	5	84	42	10	206	27	37	43	0	0	**454**
1997	1	47	127	5	29	312	8	80	70	13	0	**692**
1998	6	81	159	4	1	270	32	395	354	65	0	**1,367**
1999	0	169	112	16	35	932	68	146	185	79	0	**1,742**
2000	8	118	178	9	85	693	82	121	172	208	0	**1,674**
2001	0	49	138	31	0	338	36	124	101	94	0	**911**
2002	0	249	189	0	205	848	0	341	564	166	6	**2,568**
2003	6	369	195	72	149	768	66	266	537	58	40	**2,526**
2004	8	157	193	177	173	1,086	103	346	493	409	16	**3,161**
2005	8	85	106	39	46	709	70	140	353	258	7	**1,821**
2006	22	140	160	64	112	953	435	343	703	658	18	**3,608**
2007	3	15	49	10	26	475	38	38	96	91	8	**849**
2008	10	34	63	38	36	676	47	42	106	144	8	**1,204**
2009	11	29	43	32	27	389	16	58	240	175	6	**1,026**
2010	3	31	98	57	122	681	135	49	124	194	15	**1,509**
2011	5	88	126	19	38	1,332	77	45	211	289	9	**2,239**
2012	8	82	95	22	40	600	53	62	173	183	0	**1,318**
2013	3	100	149	22	109	767	5	60	353	265	14	**1,847**
2014	3	42	64	18	59	659	89	160	329	282	34	**1,739**
2015	9	7	36	15	19	296	27	110	314	150	5	**988**
2016	7	55	96	33	90	494	27	79	245	178	5	**1,309**
2017	18	74	100	29	47	415	22	122	202	147	4	**1,180**
2018	2	7	48	14	33	283	48	99	190	71	1	**796**
2019	6	12	16	5	14	59	5	5	20	3	2	**147**
Average	***8***	***82***	***124***	***29***	***60***	***539***	***67***	***126***	***234***	***155***	***7***	***1,431***
Median	***6***	***55***	***100***	***19***	***38***	***494***	***47***	***80***	***187***	***147***	***5***	***1,318***

Carcass Distribution and Origin

Summer Chinook carcasses were not evenly distributed among reaches within the Wenatchee River basin in 2019 (Table 8.20; Figure 8.9). Most of the carcasses in the Wenatchee River basin were found upstream from the Leavenworth Bridge. The highest percentage of carcasses (40%) was sampled in Reach 6.

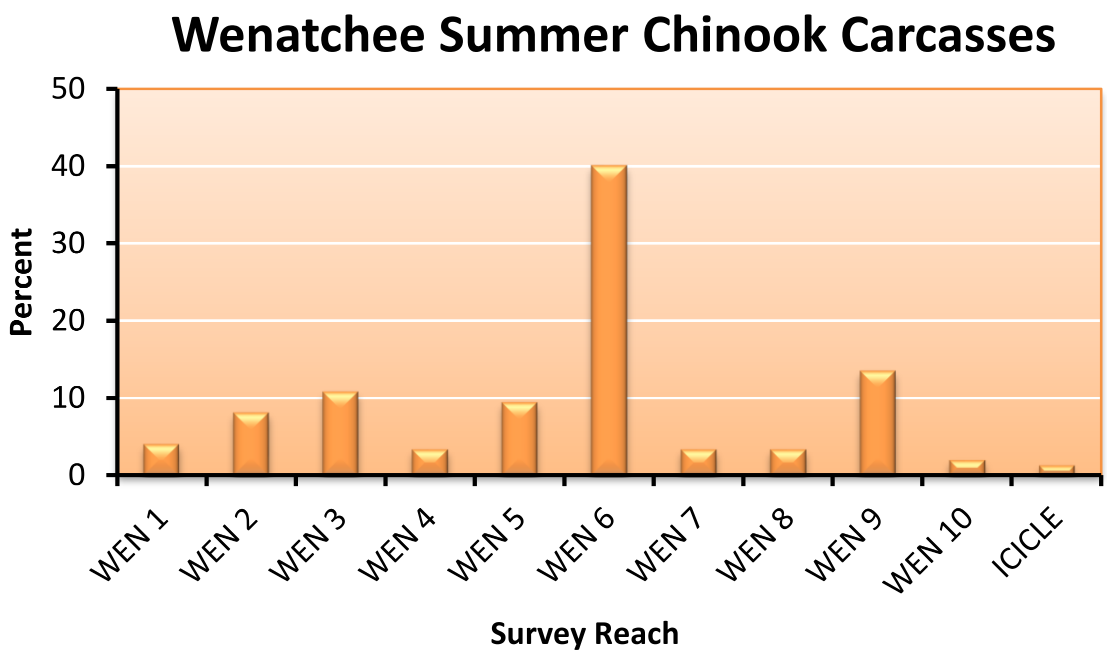


Figure 8.9. Percent of summer Chinook carcasses sampled within different reaches in the Wenatchee River basin during September through mid-November 2019. Reach codes are described in Table 2.9.

As in previous years, regardless of origin, most summer Chinook were found in Reach 6 (Leavenworth Bridge to Icicle Road Bridge) (Table 8.21). In general, a larger percentage of wild fish were found in the upper reaches than were hatchery fish (Figure 8.10). In contrast, a larger percentage of hatchery fish were found in reaches downstream from the Icicle Road Bridge.

Table 8.21. Numbers of wild and hatchery summer Chinook carcasses sampled within different reaches in the Wenatchee River basin, 1993-2019; ND = no data. Reach codes are described in Table 2.9.

Survey year	Origin	Survey reach											Total
		W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8	W-9	W-10	Icicle	
1993	Wild	59	146	660	12	82	133	213	40	0	0	0	**1,345**
	Hatchery	9	5	36	1	0	17	2	1	0	0	0	**71**
1994	Wild	0	2	18	1	19	36	20	49	130	1	0	**276**
	Hatchery	0	4	7	0	2	14	0	0	1	0	0	**28**
1995	Wild	0	4	11	0	0	105	50	35	20	0	0	**225**
	Hatchery	0	6	3	0	0	12	0	2	0	0	0	**23**
1996	Wild	0	5	82	40	9	196	27	37	43	0	0	**439**
	Hatchery	0	0	2	2	1	10	0	0	0	0	0	**15**
1997	Wild	1	38	112	5	22	266	8	80	69	13	0	**614**
	Hatchery	0	9	15	0	7	46	0	0	1	0	0	**78**
1998	Wild	6	62	124	3	1	191	29	374	327	62	0	**1,179**
	Hatchery	0	19	35	1	0	79	3	21	27	3	0	**188**
1999	Wild	0	88	70	8	18	600	58	137	169	75	0	**1,223**
	Hatchery	0	81	42	8	17	332	10	9	16	4	0	**519**

Survey year	Origin	Survey reach											Total
		W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8	W-9	W-10	Icicle	
2000	Wild	5	78	115	8	57	485	75	110	167	200	0	**1,300**
	Hatchery	3	40	63	1	28	208	7	11	5	8	0	**374**
2001	Wild	0	37	100	9	0	245	32	122	97	91	0	**733**
	Hatchery	0	12	38	22	0	93	4	2	4	3	0	**178**
2002	Wild	0	151	127	0	103	479	0	330	558	161	3	**1,912**
	Hatchery	0	98	62	0	102	369	0	11	6	5	3	**656**
2003	Wild	5	261	147	32	111	519	62	252	498	57	15	**1,959**
	Hatchery	1	108	48	40	38	249	4	14	39	1	25	**567**
2004	Wild	7	124	163	120	112	749	90	316	481	399	11	**2,572**
	Hatchery	1	33	30	56	61	337	13	30	12	10	5	**588**
2005	Wild	4	49	78	24	26	399	66	125	336	244	0	**1,351**
	Hatchery	4	36	28	15	20	310	4	15	17	14	7	**470**
2006	Wild	15	91	122	44	75	688	388	309	646	593	5	**2,976**
	Hatchery	7	49	38	20	37	265	47	34	57	65	13	**632**
2007	Wild	1	7	24	1	10	197	34	30	95	81	3	**483**
	Hatchery	2	8	25	9	16	278	4	8	1	10	5	**366**
2008	Wild	7	15	38	24	21	361	41	31	98	133	2	**771**
	Hatchery	3	19	25	14	15	315	6	11	8	11	6	**433**
2009	Wild	6	22	32	23	19	288	13	55	236	173	4	**871**
	Hatchery	5	7	11	9	8	101	3	3	4	2	2	**155**
2010	Wild	2	22	62	44	64	477	125	47	121	192	0	**1,156**
	Hatchery	1	9	36	13	58	204	10	2	3	2	15	**353**
2011	Wild	4	46	75	11	25	914	74	45	211	287	3	**1,695**
	Hatchery	1	42	51	7	13	418	3	0	0	2	6	**543**
2012	Wild	4	49	72	13	24	490	47	62	173	182	0	**1,116**
	Hatchery	4	33	23	9	16	110	6	0	0	1	0	**202**
2013	Wild	1	63	89	16	69	374	5	59	340	261	0	**1,277**
	Hatchery	2	52	60	6	40	395	0	1	13	4	0	**573**
2014	Wild	3	35	57	16	48	572	89	158	329	281	12	**1600**
	Hatchery	0	7	7	2	11	87	0	2	0	0	22	**139**
2015	Wild	6	6	36	13	16	263	26	107	301	148	6	**928**
	Hatchery	3	1	0	2	3	33	1	3	13	2	0	**61**
2016	Wild	5	40	78	29	75	426	27	79	243	175	4	**1,181**
	Hatchery	2	15	18	4	15	68	0	0	3	3	1	**129**
2017	Wild	13	58	85	25	36	328	22	120	202	147	0	**1,036**
	Hatchery	5	16	15	4	11	87	0	2	0	0	4	**144**
2018	Wild	1	4	37	9	19	162	42	95	186	71	1	**627**
	Hatchery	1	3	11	5	14	121	6	4	4	0	0	**169**
2019	Wild	3	7	8	4	8	31	5	5	20	2	0	**93**
	Hatchery	3	7	8	1	6	28	0	0	0	1	1	**55**
Average	***Wild***	***6***	***56***	***97***	***20***	***40***	***369***	***62***	***119***	***226***	***149***	***3***	***1,146***

Survey year	Origin	Survey reach											Total
		W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8	W-9	W-10	Icicle	
	Hatchery	*2*	*27*	*27*	*9*	*20*	*170*	*5*	*7*	*9*	*6*	*4*	*286*
Median	*Wild*	*4*	*40*	*78*	*13*	*24*	*361*	*41*	*80*	*186*	*147*	*0*	*1,156*
	Hatchery	*1*	*15*	*25*	*5*	*14*	*110*	*3*	*2*	*4*	*2*	*1*	*188*

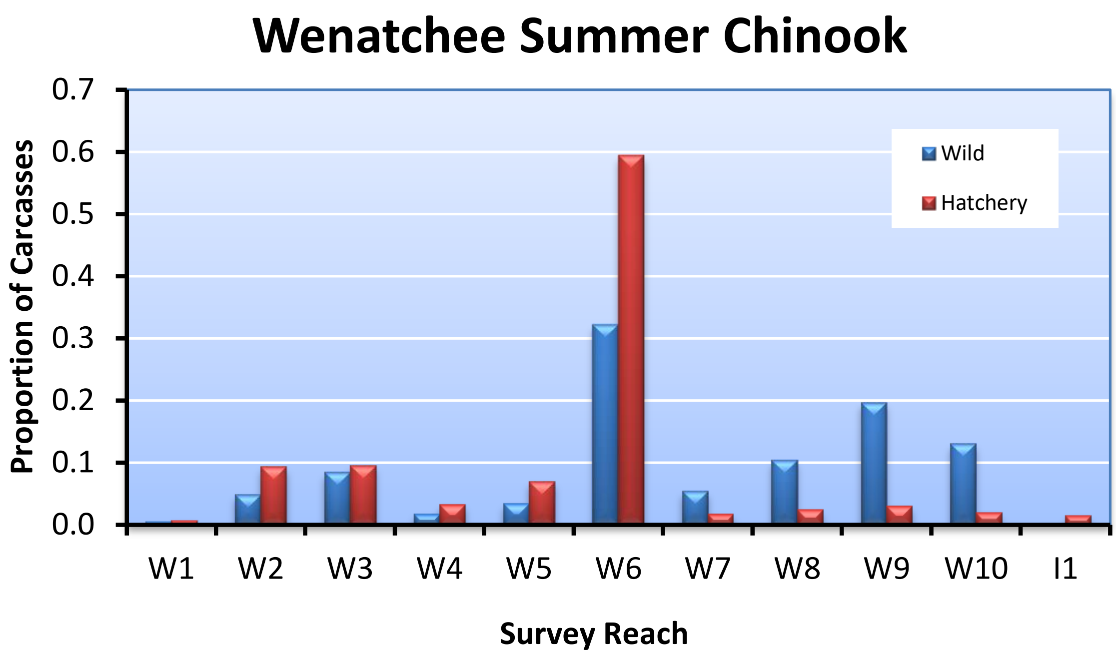


Figure 8.10. Distribution of wild and hatchery produced carcasses in different reaches in the Wenatchee River basin, 1993-2019. Reach codes are described in Table 2.9.

Sampling Rate

If spawning escapement is based on total numbers of redds, then about 11% of the total spawning escapement of summer Chinook in the Wenatchee River basin was sampled in 2019 (Table 8.22). Sampling rates among survey reaches varied from 3 to 100%.

Table 8.22. Number of redds and carcasses, total spawning escapement, and sampling rates for summer Chinook in the Wenatchee River basin, 2019.

Sampling reach	Total number of redds	Total number of carcasses	Total spawning escapement	Sampling rate
Wenatchee 1 (W1)	4	6	6	1.00
Wenatchee 2 (W2)	46	12	68	0.18
Wenatchee 3 (W3)	107	16	157	0.10
Wenatchee 4 (W4)	9	5	13	0.38
Wenatchee 5 (W5)	16	14	24	0.60

Sampling reach	Total number of redds	Total number of carcasses	Total spawning escapement	Sampling rate
Wenatchee 6 (W6)	297	59	437	0.14
Wenatchee 7 (W7)	33	5	49	0.10
Wenatchee 8 (W8)	135	5	198	0.03
Wenatchee 9 (W9)	174	20	256	0.08
Wenatchee 10 (W10)	60	3	88	0.03
Icicle Creek (I1)	2	2	3	0.68
Total	***883***	***147***	***1,298***	***0.11***

Length Data

Mean lengths (POH, cm) of male and female summer Chinook carcasses sampled during surveys in the Wenatchee River basin in 2019 are provided in Table 8.23. The average size of males and females sampled in the Wenatchee River basin were 64 cm and 68 cm, respectively.

Table 8.23. Mean lengths (postorbital-to-hypural length; cm) and standard deviations (in parentheses) of male and female summer Chinook carcasses sampled in different streams/watersheds in the Wenatchee River basin, 2019. NA = not available.

Stream/watershed	Mean length (cm)	
	Male	Female
Wenatchee 1 (W1)	70 (17.5)	63 (1.9)
Wenatchee 2 (W2)	46 (NA)	65 (6.8)
Wenatchee 3 (W3)	68 (6.1)	71 (5.1)
Wenatchee 4 (W4)	68 (18.0)	72 (9.0)
Wenatchee 5 (W5)	67 (11.5)	67 (2.5)
Wenatchee 6 (W6)	62 (9.9)	69 (6.4)
Wenatchee 7 (W7)	63 (NA)	67 (1.5)
Wenatchee 8 (W8)	51 (NA)	73 (1.7)
Wenatchee 9 (W9)	64 (14.8)	72 (4.1)
Wenatchee 10 (W10)	NA	67 (12.3)
Icicle Creek (I1)	NA	77 (NA)
Total	***64 (12.4)***	***69 (6.5)***

8.7 Life History Monitoring

Life history characteristics of Wenatchee summer Chinook were assessed by examining carcasses on spawning grounds and fish collected or examined at broodstock collection sites, and by reviewing tagging data and fisheries statistics.

Migration Timing

Migration timing of hatchery and wild Wenatchee summer Chinook was determined from broodstock data and stock assessment data collected at Dryden Dam. Sampling at Dryden Dam occurs from late June through late October. On average, during the early part of the migration, hatchery summer Chinook arrived about one week later than wild Chinook (Table 8.24). This pattern carried throughout the migration distribution of summer Chinook at Dryden Dam. By the end of the migration, hatchery fish passed Dryden Dam about two weeks after 90% of the wild fish passed the dam.

Table 8.24. The week that 10%, 50% (median), and 90% of the wild and hatchery summer Chinook salmon passed Dryden Dam, 2007-2019. The average week is also provided. Migration timing is based on collection of summer Chinook broodstock at Dryden Dam.

Survey year	Origin	Wenatchee Summer Chinook Migration Time (week)				Sample size
		10 Percentile	50 Percentile	90 Percentile	Mean	
2007	Wild	28	31	37	31	274
	Hatchery	30	33	41	35	305
2008	Wild	29	31	40	32	219
	Hatchery	32	37	41	37	576
2009	Wild	27	29	41	31	469
	Hatchery	28	34	42	35	382
2010	Wild	30	33	35	32	403
	Hatchery	29	30	33	30	268
2011	Wild	30	31	34	32	293
	Hatchery	32	34	39	35	304
2012	Wild	30	32	39	33	247
	Hatchery	31	37	41	36	366
2013	Wild	28	30	34	31	494
	Hatchery	29	33	39	33	570
2014	Wild	29	31	37	32	512
	Hatchery	29	32	40	33	338
2015	Wild	25	30	40	31	511
	Hatchery	28	35	40	35	88
2016	Wild	28	30	40	32	407
	Hatchery	29	34	41	35	184
2017	Wild	27	30	36	31	386
	Hatchery	29	32	32	33	214
2018	Wild	29	32	41	34	237
	Hatchery	27	29	35.9	30	202
2019	Wild	26	29	33	29	312
	Hatchery	28	31	41	33	359
Average	***Wild***	***28***	***31***	***37***	***32***	***366***
	Hatchery	***29***	***33***	***39***	***34***	***320***
Median	***Wild***	***28***	***31***	***37***	***32***	***386***
	Hatchery	***29***	***33***	***40***	***35***	***305***

Age at Maturity

Because hatchery summer Chinook are released after one year of rearing and natural-origin summer Chinook migrate primarily as age-0 fish, total ages will differ between hatchery and natural-origin Chinook (see Hillman et al. 2011). Therefore, in this section, we evaluated age at maturity by comparing differences in salt (ocean) ages between the two groups.

Most of the wild and hatchery summer Chinook sampled during the period 1993-2019 in the Wenatchee River basin were salt age-3 fish (Table 8.25; Figure 8.11). Over the survey years, a higher percentage of salt age-4 wild Chinook returned to the basin than did salt age-4 hatchery Chinook. In contrast, a higher proportion of salt age-1 and 2 hatchery fish returned than did salt age-1 and 2 wild fish. Thus, a higher percentage of wild fish returned at an older age than did hatchery fish.

Table 8.25. Proportions of wild and hatchery summer Chinook of different salt (ocean) ages sampled on spawning grounds in the Wenatchee River basin, 1993-2019.

Sample year	Origin	Salt age					Sample size
		1	2	3	4	5	
1993	Wild	0.02	0.24	0.62	0.12	0.00	1,224
	Hatchery	0.03	0.91	0.03	0.03	0.00	64
1994	Wild	0.02	0.21	0.45	0.32	0.00	257
	Hatchery	0.00	0.14	0.86	0.00	0.00	21
1995	Wild	0.02	0.15	0.65	0.18	0.00	216
	Hatchery	0.00	0.00	0.05	0.95	0.00	21
1996	Wild	0.01	0.25	0.66	0.08	0.00	512
	Hatchery	0.00	0.33	0.33	0.29	0.05	21
1997	Wild	0.01	0.24	0.57	0.18	0.00	561
	Hatchery	0.05	0.20	0.67	0.08	0.00	75
1998	Wild	0.02	0.23	0.66	0.09	0.00	1,041
	Hatchery	0.03	0.49	0.38	0.10	0.00	187
1999	Wild	0.01	0.34	0.55	0.10	0.00	1,087
	Hatchery	0.01	0.15	0.79	0.05	0.00	510
2000	Wild	0.02	0.20	0.64	0.15	0.00	1,181
	Hatchery	0.07	0.11	0.66	0.15	0.00	342
2001	Wild	0.01	0.16	0.74	0.08	0.00	653
	Hatchery	0.05	0.76	0.14	0.04	0.00	181
2002	Wild	0.00	0.14	0.62	0.24	0.00	1,744
	Hatchery	0.01	0.16	0.80	0.02	0.00	646
2003	Wild	0.01	0.07	0.51	0.41	0.00	1,653
	Hatchery	0.05	0.07	0.75	0.12	0.00	530
2004	Wild	0.00	0.12	0.32	0.54	0.01	2,233
	Hatchery	0.08	0.57	0.25	0.10	0.00	566
2005	Wild	0.00	0.12	0.75	0.13	0.00	1,190
	Hatchery	0.02	0.09	0.86	0.03	0.00	450

Sample year	Origin	Salt age					Sample size
		1	2	3	4	5	
2006	Wild	0.00	0.02	0.27	0.71	0.00	2,972
	Hatchery	0.02	0.16	0.24	0.57	0.00	299
2007	Wild	0.01	0.09	0.31	0.53	0.07	480
	Hatchery	0.00	0.15	0.75	0.07	0.03	275
2008	Wild	0.01	0.06	0.76	0.17	0.00	767
	Hatchery	0.02	0.12	0.76	0.11	0.00	329
2009	Wild	0.01	0.07	0.51	0.41	0.00	797
	Hatchery	0.10	0.36	0.49	0.05	0.00	132
2010	Wild	0.01	0.18	0.65	0.16	0.00	1,068
	Hatchery	0.00	0.49	0.47	0.03	0.00	294
2011	Wild	0.01	0.11	0.60	0.29	0.00	1,533
	Hatchery	0.06	0.04	0.90	0.01	0.00	472
2012	Wild	0.00	0.04	0.48	0.48	0.00	1,017
	Hatchery	0.00	0.03	0.88	0.08	0.03	200
2013	Wild	0.00	0.07	0.58	0.34	0.01	1,277
	Hatchery	0.00	0.01	0.13	0.86	0.00	573
2014	Wild	0.00	0.05	0.70	0.25	0.00	1,437
	Hatchery	0.02	0.06	0.20	0.70	0.02	128
2015	Wild	0.00	0.09	0.40	0.51	0.00	819
	Hatchery	0.00	0.10	0.65	0.24	0.00	49
2016	Wild	0.00	0.03	0.66	0.31	0.00	1,023
	Hatchery	0.03	0.11	0.83	0.03	0.00	97
2017	Wild	0.00	0.02	0.35	0.62	0.01	976
	Hatchery	0.01	0.40	0.45	0.14	0.00	117
2018	Wild	0.00	0.03	0.38	0.59	0.00	558
	Hatchery	0.03	0.23	0.74	0.00	0.00	134
2019	Wild	0.01	0.07	0.52	0.40	0.00	81
	Hatchery	0.00	0.29	0.67	0.04	0.00	48
Average	***Wild***	***0.01***	***0.12***	***0.53***	***0.34***	***0.00***	***1,050***
	Hatchery	***0.03***	***0.21***	***0.59***	***0.17***	***0.00***	***250***
Median	***Wild***	***0.01***	***0.09***	***0.63***	***0.27***	***0.00***	***1,023***
	Hatchery	***0.03***	***0.29***	***0.58***	***0.10***	***0.00***	***187***

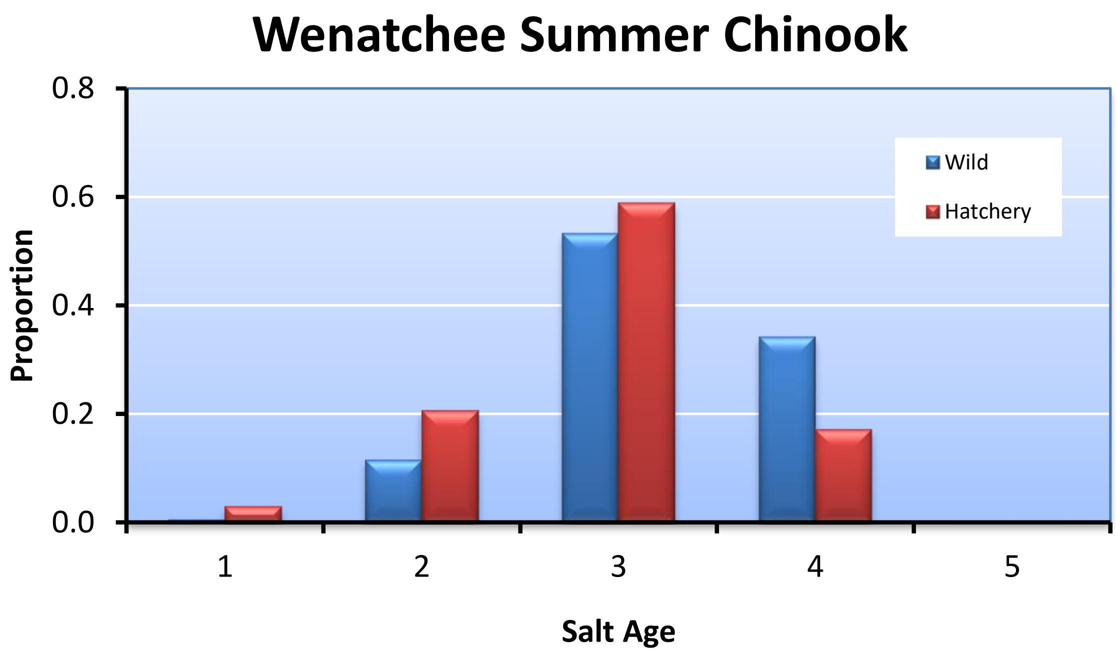


Figure 8.11. Proportions of wild and hatchery summer Chinook of different salt (ocean) ages sampled at broodstock collection sites and on spawning grounds in the Wenatchee River basin for the combined years 1993-2019.

Size at Maturity

On average, hatchery summer Chinook were about 4 cm smaller than wild summer Chinook sampled in the Wenatchee River basin (Table 8.26). This is likely because a higher percentage of hatchery fish returned as salt age-2 and 3 fish than did wild fish. In contrast, a higher percentage of wild fish returned as salt age-4 fish than did hatchery fish. Analyses for the statistical and comprehensive reports will compare sizes of hatchery and wild fish of the same age groups and sex.

Table 8.26. Mean lengths (POH; cm) and variability statistics for wild and hatchery summer Chinook sampled in the Wenatchee River basin, 1993-2019; SD = 1 standard deviation.

Sample year	Origin	Sample size	Summer Chinook length (POH; cm)			
			Mean	SD	Minimum	Maximum
1993[a]	Wild	1,344	73	8	33	94
	Hatchery	68	61	9	37	83
1994[a]	Wild	276	73	8	31	89
	Hatchery	25	70	8	54	85
1995[a]	Wild	225	75	7	48	87
	Hatchery	23	74	7	57	85
1996[a]	Wild	210	74	7	43	92
	Hatchery	9	66	12	52	84
1997	Wild	614	74	8	29	99

Sample year	Origin	Sample size	Summer Chinook length (POH; cm)			
			Mean	SD	Minimum	Maximum
	Hatchery	79	69	10	29	83
1998	Wild	1,179	73	8	28	97
	Hatchery	188	67	10	37	87
1999	Wild	1,217	72	8	29	95
	Hatchery	518	71	8	26	94
2000	Wild	1,301	71	10	24	94
	Hatchery	369	69	11	33	91
2001	Wild	728	70	9	30	93
	Hatchery	178	63	10	28	86
2002	Wild	1,911	72	8	39	94
	Hatchery	656	71	8	34	95
2003	Wild	1,943	74	9	24	105
	Hatchery	554	69	10	26	97
2004	Wild	2,570	72	9	32	98
	Hatchery	584	59	11	25	91
2005	Wild	1,352	69	7	41	92
	Hatchery	469	69	8	39	91
2006	Wild	3,249	74	6	29	99
	Hatchery	350	71	9	35	90
2007	Wild	566	73	9	29	92
	Hatchery	269	70	7	45	87
2008	Wild	836	69	8	29	89
	Hatchery	363	70	9	24	94
2009	Wild	872	71	8	30	94
	Hatchery	153	64	11	32	84
2010	Wild	1,147	68	8	32	92
	Hatchery	351	65	10	25	87
2011	Wild	1,698	68	8	33	101
	Hatchery	541	66	9	34	85
2012	Wild	1,116	70	7	29	91
	Hatchery	202	60	7	40	79
2013	Wild	1,277	66	9	24	95
	Hatchery	573	67	7	24	85
2014	Wild	1,600	68	7	29	98
	Hatchery	139	66	10	26	85
2015	Wild	928	68	8	39	86
	Hatchery	61	62	9	36	81
2016	Wild	1,180	69	6	43	93

<table>
<tr><th rowspan="2">Sample year</th><th rowspan="2">Origin</th><th rowspan="2">Sample size</th><th colspan="4">Summer Chinook length (POH; cm)</th></tr>
<tr><th>Mean</th><th>SD</th><th>Minimum</th><th>Maximum</th></tr>
<tr><td></td><td>Hatchery</td><td>129</td><td>67</td><td>8</td><td>37</td><td>82</td></tr>
<tr><td rowspan="2">2017</td><td>Wild</td><td>976</td><td>70</td><td>7</td><td>42</td><td>88</td></tr>
<tr><td>Hatchery</td><td>117</td><td>65</td><td>8</td><td>38</td><td>82</td></tr>
<tr><td rowspan="2">2018</td><td>Wild</td><td>626</td><td>70</td><td>6</td><td>42</td><td>89</td></tr>
<tr><td>Hatchery</td><td>169</td><td>65</td><td>8</td><td>38</td><td>81</td></tr>
<tr><td rowspan="2">2019</td><td>Wild</td><td>93</td><td>70</td><td>8</td><td>43</td><td>87</td></tr>
<tr><td>Hatchery</td><td>54</td><td>63</td><td>9</td><td>44</td><td>82</td></tr>
<tr><td rowspan="2">Pooled</td><td>Wild</td><td>31,034</td><td>71</td><td>8</td><td>24</td><td>105</td></tr>
<tr><td>Hatchery</td><td>7,193</td><td>67</td><td>9</td><td>24</td><td>97</td></tr>
</table>

[a] These years include sizes reported in annual reports. The data contained in the WDFW database do not include all these data.

Contribution to Fisheries

Most of the harvest on hatchery-origin Wenatchee summer Chinook occurred in the ocean (Table 8.27). Ocean harvest has made up 47% to 100% of all hatchery Wenatchee summer Chinook harvested. Total harvest on early brood years (e.g., 1990-1996) was generally lower than for brood years 1997-2013.

Table 8.27. Estimated number and percent (in parentheses) of hatchery-origin Wenatchee summer Chinook captured in different fisheries, brood years 1989-2013.

<table>
<tr><th rowspan="2">Brood year</th><th rowspan="2">Ocean fisheries</th><th colspan="3">Columbia River Fisheries</th><th rowspan="2">Total</th><th rowspan="2">Percent of the brood year escapement harvested[a]</th></tr>
<tr><th>Tribal</th><th>Commercial (Zones 1-5)</th><th>Recreational (sport)</th></tr>
<tr><td>1989</td><td>1,510 (51)</td><td>1,432 (48)</td><td>0 (0)</td><td>20 (1)</td><td>2,962</td><td>58.0</td></tr>
<tr><td>1990</td><td>30 (100)</td><td>0 (0)</td><td>0 (0)</td><td>0 (0)</td><td>30</td><td>25.4</td></tr>
<tr><td>1991</td><td>30 (63)</td><td>0 (0)</td><td>0 (0)</td><td>18 (38)</td><td>48</td><td>67.6</td></tr>
<tr><td>1992</td><td>147 (79)</td><td>39 (21)</td><td>0 (0)</td><td>0 (0)</td><td>186</td><td>29.6</td></tr>
<tr><td>1993</td><td>35 (58)</td><td>25 (42)</td><td>0 (0)</td><td>0 (0)</td><td>60</td><td>39.5</td></tr>
<tr><td>1994</td><td>641 (91)</td><td>62 (9)</td><td>2 (0)</td><td>0 (0)</td><td>705</td><td>36.3</td></tr>
<tr><td>1995</td><td>562 (98)</td><td>9 (2)</td><td>5 (1)</td><td>0 (0)</td><td>576</td><td>36.5</td></tr>
<tr><td>1996</td><td>196 (96)</td><td>3 (1)</td><td>0 (0)</td><td>6 (3)</td><td>205</td><td>35.6</td></tr>
<tr><td>1997</td><td>2,982 (95)</td><td>49 (2)</td><td>12 (0)</td><td>106 (3)</td><td>3,149</td><td>42.0</td></tr>
<tr><td>1998</td><td>5,026 (92)</td><td>128 (2)</td><td>16 (0)</td><td>287 (5)</td><td>5,457</td><td>70.5</td></tr>
<tr><td>1999</td><td>1,550 (84)</td><td>168 (9)</td><td>21 (1)</td><td>104 (6)</td><td>1,843</td><td>74.3</td></tr>
<tr><td>2000</td><td>7,966 (73)</td><td>1,248 (11)</td><td>447 (4)</td><td>1,224 (11)</td><td>10,885</td><td>76.6</td></tr>
<tr><td>2001</td><td>1,061 (60)</td><td>238 (13)</td><td>106 (6)</td><td>364 (21)</td><td>1,769</td><td>73.2</td></tr>
<tr><td>2002</td><td>1,527 (56)</td><td>557 (21)</td><td>189 (7)</td><td>430 (16)</td><td>2,703</td><td>59.7</td></tr>
<tr><td>2003</td><td>833 (50)</td><td>484 (29)</td><td>89 (5)</td><td>257 (15)</td><td>1,663</td><td>53.7</td></tr>
<tr><td>2004</td><td>409 (47)</td><td>218 (25)</td><td>70 (8)</td><td>167 (19)</td><td>864</td><td>59.4</td></tr>
<tr><td>2005</td><td>1,329 (58)</td><td>481 (21)</td><td>187 (8)</td><td>287 (13)</td><td>2,284</td><td>63.0</td></tr>
<tr><td>2006</td><td>3,738 (51)</td><td>1,983 (27)</td><td>406 (6)</td><td>1,142 (16)</td><td>7,269</td><td>68.2</td></tr>
</table>

Brood year	Ocean fisheries	Columbia River Fisheries			Total	Percent of the brood year escapement harvested[a]
		Tribal	Commercial (Zones 1-5)	Recreational (sport)		
2007	212 (55)	109 (29)	8 (2)	53 (14)	382	75.0
2008	3,747 (52)	1,837 (26)	227 (3)	1,364 (19)	7,175	64.5
2009	1,592 (51)	1,000 (32)	99 (3)	452 (14)	3,143	74.1
2010	1,342 (56)	558 (23)	81 (3)	401 (17)	2,382	80.2
2011	3,227 (58)	1,389 (25)	119 (2)	846 (15)	5,581	72.2
2012	695 (53)	330 (25)	24 (2)	274 (21)	1,323	67.2
2013	796 (47)	549 (32)	4 (0)	349 (21)	1,698	77.6
Average	***1,647 (67)***	***516 (19)***	***84 (3)***	***326 (11)***	***2,574***	***59.2***
Median	***1,061 (58)***	***238 (21)***	***21 (2)***	***257 (14)***	***1,769***	***64.5***

[a] Percent of brood year escapement harvested = Total brood year harvest / (Total brood year harvest + ∑Hatchery collection + ∑escapement) * 100. In other words, this indicates the percentage of all detected CWTs that ended up in harvest.

Straying

Stray rates were determined by examining CWTs recovered on spawning grounds within and outside the Wenatchee River basin. Targets for strays based on return year (recovery year) within the Upper Columbia River basin (Priest Rapids Dam to Chief Joseph Dam) should be less than 10% and targets for strays outside the upper Columbia River should be less than 5%.

Within the Upper Columbia summer Chinook population, hatchery-origin Wenatchee summer Chinook have strayed into the Entiat, Chelan, Methow, and Okanogan River basins and onto the Hanford Reach (Table 8.28). Since 2011, stray rates have been less than 10% within the Upper Columbia River basin.

Hatchery-origin Wenatchee summer Chinook have also strayed into areas outside the Upper Columbia population. A small number of tagged hatchery summer Chinook from the Wenatchee have been detected at Lower Granite Dam on the Snake River, at Three Mile Dam on the Umatilla River, in Big and Sand Hollow creeks, in the Baker and Elway rivers, and at Spring Creek, Skookum Creek, Crisp Creek, Lyons Ferry, Bonneville, Cowlitz, and Kalama Falls hatcheries.

Table 8.28. Number and percent of spawning escapements within other non-target spawning streams within the upper Columbia River basin that consisted of hatchery-origin Wenatchee summer Chinook, return years 1994-2018. For example, for return year 2000, 3% of the summer Chinook escapement in the Methow River basin consisted of hatchery-origin Wenatchee summer Chinook. Percent strays should be less than 10%.

Return year	Methow		Okanogan		Chelan		Entiat		Hanford Reach	
	Number	%	Number	%	Number	%	Number	%	Number	%
1994	0	0.0	75	1.9	--	--	--	--	--	--
1995	0	0.0	0	0.0	--	--	--	--	--	--
1996	0	0.0	0	0.0	--	--	--	--	--	--
1997	0	0.0	0	0.0	--	--	--	--	--	--
1998	25	3.7	0	0.0	0	0.0	0	0.0	0	0.0
1999	20	2.0	3	0.1	0	0.0	0	0.0	13	0.0

Return year	Methow		Okanogan		Chelan		Entiat		Hanford Reach	
	Number	%	Number	%	Number	%	Number	%	Number	%
2000	36	3.0	13	0.4	0	0.0	0	0.0	0	0.0
2001	163	5.9	57	0.5	30	3.0	0	0.0	0	0.0
2002	153	3.3	53	0.4	40	6.9	74	14.8	0	0.0
2003	80	2.0	24	0.7	44	10.5	132	19.1	26	0.0
2004	113	5.2	42	0.6	30	7.2	0	0.0	0	0.0
2005	245	9.6	67	0.8	51	9.7	49	13.4	0	0.0
2006	170	6.2	12	0.1	12	2.9	61	15.3	0	0.0
2007	127	9.3	5	0.1	9	4.8	49	34.5	20	0.1
2008	87	4.5	24	0.3	10	2.0	31	14.4	0	0.0
2009	101	5.7	13	0.2	2	0.3	12	6.6	0	0.0
2010	208	8.3	35	0.6	55	4.9	34	13.0	0	0.0
2011	258	8.8	5	0.1	78	6.1	15	5.1	0	0.0
2012	109	3.7	24	0.3	53	4.1	54	8.4	0	0.0
2013	252	7.0	57	0.7	2	0.1	8	1.7	0	0.0
2014	13	0.8	0	0.0	4	0.4	12	2.0	0	0.0
2015	75	1.9	13	0.1	4	0.3	12	3.1	0	0.0
2016	52	2.3	6	0.1	17	1.9	5	0.9	0	0.0
2017	24	1.7	0	0.0	0	0.0	7	1.2	0	0.0
2018	0	0.0	0	0.0	0	0.0	6	1.2	0	0.0
Average	***92***	***3.8***	***21***	***0.3***	***21***	***3.1***	***27***	***7.4***	***3***	***0.0***
Median	***80***	***3.3***	***13***	***0.1***	***10***	***2.0***	***12***	***3.1***	***0***	***0.0***

Based on brood year analyses, on average, about 10% of the hatchery-origin Wenatchee summer Chinook spawners strayed into non-target streams (Table 8.29). Depending on brood year, percent strays into non-target spawning areas have ranged from 0-20%. In addition, on average, about 15% of hatchery-origin Wenatchee summer Chinook broodstock have been included in non-target hatchery programs.

Table 8.29. Number and percent of hatchery-origin Wenatchee summer Chinook spawners (HOS) that home to the target stream or stray into non-target streams, and the number and percent of hatchery-origin summer Chinook broodstock (HOB) collected for the target hatchery or that were collected for non-target hatcheries, brood years 1989-2013.

Brood year	Hatchery-origin spawner (HOS)				Hatchery-origin broodstock (HOB)			
	Homing		Straying		Broodstock Collection			
	Target stream[1]		Non-target streams[2]		Target hatchery[3]		Non-target hatcheries[4]	
	Number	%	Number	%	Number	%	Number	%
1989	1,352	62.9	75	3.5	60	2.8	662	30.8
1990	74	84.1	0	0.0	1	1.1	13	14.8
1991	15	65.2	0	0.0	0	0.0	8	34.8

Brood year	Hatchery-origin spawner (HOS)				Hatchery-origin broodstock (HOB)			
	Homing		Straying		Broodstock Collection			
	Target stream[1]		Non-target streams[2]		Target hatchery[3]		Non-target hatcheries[4]	
	Number	%	Number	%	Number	%	Number	%
1992	375	84.8	0	0.0	7	1.6	60	13.6
1993	67	72.8	4	4.3	9	9.8	12	13.0
1994	890	71.8	61	4.9	207	16.7	81	6.5
1995	748	74.8	48	4.8	139	13.9	65	6.5
1996	261	70.4	53	14.3	42	11.3	15	4.0
1997	3,609	83.0	397	9.1	171	3.9	170	3.9
1998	1,790	78.5	416	18.2	11	0.5	64	2.8
1999	507	79.7	121	19.0	0	0.0	8	1.3
2000	2,745	82.5	545	16.4	0	0.0	37	1.1
2001	521	80.4	118	18.2	0	0.0	9	1.4
2002	1,521	83.4	284	15.6	10	0.5	8	0.4
2003	1,268	88.5	114	8.0	42	2.9	9	0.6
2004	497	84.2	72	12.2	3	0.5	18	3.1
2005	1,126	84.0	193	14.4	3	0.2	19	1.4
2006	2,693	79.4	623	18.4	8	0.2	69	2.0
2007	99	78.0	25	19.7	1	0.8	2	1.6
2008	3,260	82.5	458	11.6	61	1.5	173	4.4
2009	720	65.6	106	9.7	54	4.9	218	19.9
2010	158	26.8	16	2.7	47	8.0	368	62.5
2011	542	26.0	173	8.3	54	2.6	1,313	63.1
2012	382	59.1	20	3.1	11	1.7	233	36.1
2013	262	53.5	18	3.7	0	0.0	210	42.9
Average	***1,019***	***72.1***	***158***	***9.6***	***38***	***3.4***	***154***	***14.9***
Median	***542***	***78.5***	***75***	***9.1***	***10***	***1.5***	***60***	***4.4***

[1] Target stream includes hatchery-origin summer Chinook that spawned in the Wenatchee River basin.
[2] Non-target streams include hatchery-origin summer Chinook that spawned outside the Wenatchee River basin.
[3] Target hatchery includes broodstock collection at Tumwater and Dryden dams. Some adult hatchery-origin Wenatchee summer Chinook salmon have been used as broodstock to support the Chelan Falls summer Chinook Program (formerly Turtle Rock Hatchery program). Those adult fish are included in this table.
[4] Non-target hatcheries include broodstock collections that may be strays or intercepted summer Chinook used in hatchery programs other than the Wenatchee summer Chinook hatchery program. The Chief Joseph Hatchery intercepted large numbers of summer Chinook during the last four years.

Genetics

Genetic studies were conducted in 2011 to investigate relationships among temporally replicated collections of summer Chinook from the Wenatchee River, Methow River, and Okanogan River in the upper Columbia River basin (Kassler et al. 2011; the entire report is appended as Appendix

P). A total of 2,416 summer Chinook were collected from tributaries in the upper Columbia River basin. Two collections of natural-origin summer Chinook from 1993 (prior to the supplementation program) were taken from the Wenatchee River basin (N = 139) and compared to collections of hatchery and natural-origin Chinook from 2006 and 2008 (N = 380). Two pre-supplementation collections from the Methow River (1991 and 1993) were compared to supplementation collections from 2006 and 2008 (N = 362). Three pre-supplementation collections from the Okanogan River Basin (1991, 1992, and 1993) were compared with supplementation collections from 2006 and 2008 (N = 669). A collection of natural-origin summer Chinook from the Chelan River was also analyzed (N = 70). Additionally, hatchery collections from Eastbank Hatchery (Wenatchee and Methow/Okanogan stock; N = 221) and Wells Hatchery (N = 294) were analyzed and compared to the in-river collections. Summer Chinook data (provided by the USFWS) from the Entiat River (N = 190) were used for comparison. Lastly, data from eight collections of fall Chinook (N = 2,408) were compared to the collections of summer Chinook. Samples of natural and hatchery-origin summer Chinook were analyzed and compared to determine if the supplementation programs have affected the genetic structure of these populations. The study also calculated the effective number of breeders for collection locations of natural and hatchery-origin summer Chinook from 1993 and 2008.

In general, population differentiation was not observed among the temporally replicated collection locations. A single collection from the Okanogan River (1993) was the only collection showing statistically significant differences. The effective number of breeders was not statistically different from the early collection in 1993 in comparison to the late collection in 2008. Overall, these analyses revealed a lack of differentiation among the temporal replicates from the same locations and among the collection from different locations, suggesting the populations have been homogenized or that there has been substantial gene flow among populations. Additional comparisons among summer-run and fall-run Chinook populations in the upper Columbia River were conducted to determine if there was any differentiation between Chinook with different run timing. These analyses revealed pairwise F_{ST} values that were less than 0.01 for the collections of summer Chinook to collections of fall Chinook from Hanford Reach, lower Yakima River, Priest Rapids, and Umatilla. Collections of fall Chinook from Crab Creek, Lyons Ferry Hatchery, Marion Drain, and Snake River had pairwise F_{ST} values that were higher in comparison to the collections of summer Chinook. The consensus clustering analysis did not provide good statistical support to the groupings but did show relationships among collections based on geographic proximity. Overall the summer and fall run Chinook that have historically been spawned together were not differentiated while fall Chinook from greater geographic distances were differentiated.

It is important to note that no new information will be reported on genetics until the next comprehensive report (data collected through 2018).

Proportionate Natural Influence

Another method for assessing the genetic risk of a supplementation program is to determine the influence of the hatchery and natural environments on the adaptation of the composite population. This is estimated by the proportion of natural-origin fish in the hatchery broodstock (pNOB) and the proportion of hatchery-origin fish in the natural spawning escapement (pHOS). We calculated Proportionate Natural Influence (PNI) by iterating Ford's (2002) equations 5 and 6 to equilibrium, using a heritability of 0.3 and a selection strength of three standard deviations. The larger the PNI value, the greater the strength of selection in the natural environment relative to that of the hatchery environment. For the natural environment to dominate selection, PNI should be greater than 0.50, and integrated populations should have a PNI of at least 0.67 (HSRG/WDFW/NWIFC 2004).

For all brood years, the PNI value has been greater than 0.67 (Table 8.30). This suggests that the natural environment has a greater influence on adaptation of Wenatchee summer Chinook than does the hatchery environment.

Table 8.30. Proportionate Natural Influence (PNI) values for the Wenatchee summer Chinook supplementation program for brood years 1989-2019. NOS = number of natural-origin Chinook on the spawning grounds; HOS = number of hatchery-origin Chinook on the spawning grounds; NOB = number of natural-origin Chinook collected for broodstock; and HOB = number of hatchery-origin Chinook included in hatchery broodstock.

Brood year	Spawners			Broodstock			PNI[a]
	NOS	HOS	pHOS	NOB	HOB	pNOB	
1989	14,331	0	0.00	290	0	1.00	1.00
1990	10,861	0	0.00	57	0	1.00	1.00
1991	10,168	0	0.00	105	0	1.00	1.00
1992	11,652	0	0.00	274	0	1.00	1.00
1993	8,868	582	0.06	406	44	0.90	0.94
1994	8,476	1,678	0.17	333	54	0.86	0.84
1995	6,862	893	0.12	363	16	0.96	0.89
1996	6,002	166	0.03	263	3	0.99	0.97
1997	5,408	505	0.09	205	13	0.94	0.92
1998	4,611	741	0.14	299	78	0.79	0.85
1999	4,101	1,375	0.25	242	236	0.51	0.68
2000	4,462	1,050	0.19	275	180	0.60	0.77
2001	9,414	1,946	0.17	210	136	0.61	0.79
2002	11,892	3,831	0.24	409	10	0.98	0.81
2003	10,025	1,775	0.15	337	7	0.98	0.87
2004	9,220	1,259	0.12	424	2	1.00	0.90
2005	6,862	1,841	0.21	397	3	0.99	0.83
2006	16,060	1,732	0.10	432	4	0.99	0.91
2007	3,173	1,417	0.31	263	3	0.99	0.77
2008	4,452	2,044	0.31	376	71	0.84	0.74
2009	7,098	1,229	0.15	449	8	0.98	0.87
2010	5,886	1,582	0.21	388	5	0.99	0.83
2011	8,150	1,700	0.17	375	7	0.98	0.86
2012	7,327	1,212	0.14	267	1	1.00	0.88
2013	7,431	2,778	0.27	234	2	0.99	0.79
2014	9,676	767	0.07	261	2	0.99	0.94
2015	4,076	254	0.06	248	0	1.00	0.95
2016	5,416	486	0.08	259	0	1.00	0.93
2017	6,578	847	0.11	252	1	1.00	0.90

Brood year	Spawners			Broodstock			PNI[a]
	NOS	HOS	pHOS	NOB	HOB	pNOB	
2018	2,767	678	0.20	205	5	0.98	0.83
2019	933	371	0.28	250	3	0.99	0.78
Average	***7,492***	***1,121***	***0.14***	***295***	***29***	***0.93***	***0.87***
Median	***7,098***	***1,050***	***0.14***	***274***	***4***	***0.99***	***0.87***

[a] PNI was calculated previously using PNI approximate equation 11 (HSRG 2009; their Appendix A). All PNI values presented here were recalculated by iterating Ford's (2002) equations 5 and 6 to equilibrium using a heritability of 0.3 and a selection strength of three standard deviations. C. Busack, NOAA Fisheries, 21 March 2016, provided the model for calculating PNI.

Post-Release Survival and Travel Time

We used PIT-tagged fish to estimate survival rates and travel time (arithmetic mean days) of hatchery summer Chinook from the Wenatchee River release site to McNary Dam, and smolt to adult ratios (SARs) from release to detection at Bonneville Dam (Table 8.31).[39] Over the nine brood years for which PIT-tagged hatchery fish were released, survival rates from the Wenatchee River to McNary Dam ranged from 0.609 to 0.910; SARs from release to detection at Bonneville Dam ranged from 0.003 to 0.017. Average travel time from the Wenatchee River to McNary Dam ranged from 11 to 29 days.

Most of the variation in survival rates and travel time resulted from releases of different experimental groups (Table 8.31). For example, brood year 2009 was split into three groups (control raceway group, long-term recirculating aquaculture system (RAS) group (R1), and short-term RAS group (R2)). In this case, the control group appeared to have a higher survival rate but a longer travel time from release to McNary Dam than did the two treatment groups. SARs varied little among the three groups.

Another evaluation was conducted with brood years 2012 and 2013. These brood years were split into four different treatment groups (small-size fish in raceway, large-size fish in raceway, small-size fish in RAS, and large-size fish in RAS). Although the number of replicates is small, releases from the RAS had higher survival rates to McNary Dam and faster travel times. Large-size fish from the RAS had the highest survival rates and fastest travel times. There was no clear relationship among experimental groups and SARs (Table 8.31).

Performance of fish reared in raceways compared to fish reared in recirculating aquaculture systems is ongoing. Based on four brood years, fish released from recirculating systems generally had higher survival rates to McNary Dam and faster travel times (Table 8.31). For the one complete brood year (2014), fish from recirculating systems had a higher SAR than fish from raceways.

[39] It is important to point out that because of fish size differences among rearing tanks or raceways, fish PIT tagged in one tank or raceway may not represent untagged fish rearing in other tanks or raceways.

Table 8.31. Total number of Wenatchee hatchery summer Chinook released with PIT tags, their survival and travel times (mean days) to McNary Dam, and smolt-to-adult (SAR) ratios for brood years 2008-2017. SARs were adjusted for both tag loss before release and detection efficiencies. Standard errors are shown in parentheses. RAS = recirculating aquaculture system; NA = not available (i.e., not all the fish from the release groups have returned to the Columbia River).

Brood year	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
2008	10,035	0.847 (0.054)	28.9 (9.6)	0.017 (0.001)
2009	9,965 (Control)	0.702 (0.039)	19.3 (10.3)	0.006 (0.001)
	9,971 (R1)	0.646 (0.030)	16.4 (8.8)	0.005 (0.001)
	9,994 (R2)	0.648 (0.031)	16.0 (8.4)	0.005 (0.001)
2010	0	--	--	--
2011	5,018	0.753 (0.070)	20.9 (8.9)	0.010 (0.001)
2012 (Raceway)	5,047 (small size)	0.724 (0.066)	18.9 (9.2)	0.005 (0.001)
	4,740 (large size)	0.619 (0.061)	16.9 (8.6)	0.004 (0.001)
2012 (RAS)	5,041 (small size)	0.784 (0.060)	11.8 (5.0)	0.003 (0.001)
	5,082 (large size)	0.910 (0.077)	11.1 (4.6)	0.004 (0.001)
2013 (Raceway)	5,116 (small size)	0.770 (0.101)	17.5 (6.0)	0.004 (0.001)
	5,127 (large size)	0.704 (0.085)	16.7 (6.2)	0.006 (0.001)
2013 (RAS)	5,120 (small size)	0.834 (0.124)	15.6 (5.3)	0.012 (0.002)
	5,121 (large size)	0.768 (0.112)	14.7 (4.4)	0.009 (0.001)
2014	10,430 (Circular)	0.826 (0.044)	17.5 (5.3)	0.006 (0.001)
	10,354 (Raceway)	0.755 (0.044)	19.2 (5.8)	0.004 (0.001)
2015	10,253 (Circular)	0.759 (0.068)	20.9 (6.9)	NA
	10,351 (Raceway)	0.694 (0.054)	26.2 (15.5)	NA
2016	10,306 (Circular)	0.673 (0.052)	22.7 (6.2)	NA
	10,371 (Raceway)	0.763 (0.067)	25.5 (7.2)	NA
2017	10,452 (Circular)	0.650 (0.076)	21.3 (7.0)	NA
	10,271 (Raceway)	0.609 (0.082)	24.4 (8.7)	NA

Natural and Hatchery Replacement Rates

Natural replacement rates (NRR) were calculated as the ratio of natural-origin recruits (NOR) to the parent spawning population (spawning escapement). Natural-origin recruits are naturally produced (wild) fish that survive to contribute to harvest (directly or indirectly), to broodstock, and to spawning grounds. We do not account for fish that died in route to the spawning grounds (migration mortality) or died just before spawning (pre-spawn mortality) (see Appendix B in Hillman et al. 2012). We calculated NORs with and without harvest. NORs without harvest include all returning fish that either returned to the basin or were collected as wild broodstock. NORs with harvest include all fish harvested and are based on brood year harvest rates from the hatchery program. For brood years 1989-2013, NRR for summer Chinook in the Wenatchee averaged 0.95 (range, 0.15-2.95) if harvested fish were not included in the estimate and 2.61 (range, 0.33-10.04) if harvested fish were included in the estimate (Table 8.32). NRRs for more recent brood years will be calculated as soon as all tag recoveries and sampling rates have been loaded into the database.

Hatchery replacement rates (HRR) are the hatchery adult-to-adult returns and were calculated as the ratio of hatchery-origin recruits (HOR) to the parent broodstock collected. These rates should be greater than the NRRs and greater than or equal to 5.7 (the calculated target value in Hillman et al. 2019). The target value of 5.7 includes harvest. HRRs exceeded NRRs in 20 of the 25 years of data, regardless if harvest was or was not included in the estimate (Table 8.32). Hatchery replacement rates for Wenatchee summer Chinook have exceeded the estimated target value of 5.7 in 14 of the 25 years of data.

Table 8.32. Broodstock collected, spawning escapements, natural and hatchery-origin recruits (NOR and HOR), and natural and hatchery replacement rates (NRR and HRR; with and without harvest) for summer Chinook in the Wenatchee River basin, brood years 1989-2013.

Brood year	Broodstock Collected	Spawning Escapement	Harvest not included				Harvest included			
			HOR	NOR	HRR	NRR	HOR	NOR	HRR	NRR
1989	346	14,331	2,149	9,181	6.21	0.64	5,111	21,808	14.77	1.52
1990	87	10,861	88	9,595	1.01	0.88	118	12,984	1.36	1.20
1991	128	10,168	23	5,562	0.18	0.55	71	17,164	0.55	1.69
1992	341	11,652	442	5,858	1.30	0.50	628	8,393	1.84	0.72
1993	524	9,450	92	5,385	0.18	0.57	152	8,901	0.29	0.94
1994	418	10,154	1,239	4,219	2.96	0.42	1,944	6,634	4.65	0.65
1995	398	7,755	1,000	5,329	2.51	0.69	1,576	8,459	3.96	1.09
1996	334	6,168	371	4,441	1.11	0.72	576	6,950	1.72	1.13
1997	240	5,913	4,347	9,761	18.11	1.65	7,496	16,858	31.23	2.85
1998	472	5,352	2,281	15,795	4.83	2.95	7,738	53,724	16.39	10.04
1999	488	5,476	636	12,081	1.30	2.21	2,479	45,417	5.08	8.29
2000	492	5,512	3,327	3,885	6.76	0.70	14,212	16,532	28.89	3.00
2001	493	11,360	648	19,209	1.31	1.69	2,417	71,675	4.90	6.31
2002	482	15,723	1,823	4,954	3.78	0.32	4,526	12,385	9.39	0.79
2003	496	11,800	1,433	1,782	2.89	0.15	3,096	3,874	6.24	0.33
2004	496	10,479	590	7,197	1.19	0.69	1,454	17,727	2.93	1.69
2005	494	8,703	1,341	5,131	2.71	0.59	3,625	13,190	7.34	1.52
2006	488	17,792	3,393	6,814	6.95	0.38	10,662	17,078	21.85	0.96
2007	419	4,590	127	10,733	0.30	2.34	509	31,754	1.21	6.92
2008	472	6,496	3,952	6,282	8.37	0.97	11,127	13,716	23.57	2.11
2009	488	8,327	1,098	7,434	2.25	0.89	4,241	21,301	8.69	2.56
2010	434	7,468	589	9,971	1.36	1.34	2,971	32,061	6.85	4.29
2011	405	9,850	2,082	4,151	5.14	0.42	7,663	11,467	18.92	1.16

Brood year	Broodstock Collected	Spawning Escapement	Harvest not included				Harvest included			
			HOR	NOR	HRR	NRR	HOR	NOR	HRR	NRR
2012	274	8,539	646	8,345	2.36	0.98	1,969	18,795	7.19	2.20
2013	259	10,209	490	4,343	1.89	0.43	2,188	12,097	8.45	1.18
Average	***399***	***9,365***	***1,368***	***7,498***	***3.48***	***0.95***	***3,942***	***20,038***	***9.53***	***2.61***
Median	***434***	***9,450***	***1,000***	***6,282***	***2.36***	***0.69***	***2,479***	***16,532***	***6.85***	***1.52***

Smolt-to-Adult Survivals

Smolt-to-adult survival ratios (SARs) were calculated as the number of hatchery adult recaptures divided by the number of tagged hatchery smolts released. Here, SARs were based on CWT returns, which were adjusted for marking rates and tag loss before release. For the available brood years, SARs have ranged from 0.00037 to 0.01552 for hatchery summer Chinook in the Wenatchee River basin (Table 8.33).

Table 8.33. Smolt-to-adult ratios (SARs) for Wenatchee hatchery summer Chinook, brood years 1989-2013.

Brood year	Number of tagged smolts released[a]	Estimated adult captures[b]	SAR
1989	144,905	1,027	0.00709
1990	119,214	115	0.00096
1991	190,371	71	0.00037
1992	605,055	613	0.00101
1993	210,626	152	0.00072
1994	452,340	1,919	0.00424
1995	668,409	1,542	0.00231
1996	585,590	568	0.00097
1997	480,418	7,456	0.01552
1998	641,109	7,664	0.01195
1999	988,328	2,457	0.00249
2000	903,368	13,861	0.01534
2001	596,618	2,403	0.00403
2002	805,919	4,395	0.00545
2003	639,381	3,048	0.00477
2004	875,758	1,439	0.00164
2005	631,492	3,578	0.00567
2006	931,880	10,484	0.01125
2007	453,719	509	0.00112
2008	859,401	10,803	0.01257
2009	822,986	4,203	0.00511
2010	789,056	2,969	0.00376

Brood year	Number of tagged smolts released[a]	Estimated adult captures[b]	SAR
2011	819,724	7,627	0.00930
2012	524,535	1,898	0.00362
2013	467,580	2,184	0.00467
Average	***608,311***	***3,719***	***0.00544***
Median	***631,492***	***2,403***	***0.00424***

[a] Includes all tag codes and CWT released fish (CWT + Ad Clip fish and CWT-only fish).
[b] Includes estimated recoveries (spawning ground, hatcheries, harvest, etc.) and observed recoveries if estimated recoveries were unavailable.

8.8 ESA/HCP Compliance

Broodstock Collection

Per the 2017 broodstock collection protocol, 262 natural-origin (adipose fin present) summer Chinook adults were targeted for collection at Dryden and Tumwater dams. The actual 2017 collection totaled 262 natural-origin summer Chinook in combination from Dryden and Tumwater dams. Trapping began 26 June and ended on 15 September 2017.

Summer Chinook and steelhead broodstock collections occurred concurrently at Dryden Dam. Thus, steelhead and spring Chinook encounters at Dryden Dam during Wenatchee summer Chinook broodstock collection were attributable to steelhead broodstock collections authorized under ESA Permit 18583 take authorizations. No steelhead or spring Chinook takes were associated with the Wenatchee summer Chinook collection. No bull trout were encountered during summer Chinook broodstock collection at Dryden Dam in 2017.

Consistent with impact minimization measures in ESA Permit 1347, all ESA-listed species handled during summer Chinook broodstock collection were subject to water-to-water transfers or anesthetized if removed from the water during handling.

Hatchery Rearing and Release

The 2017 Wenatchee summer Chinook program released an estimated 481,728 smolts, representing 96.3% of the 500,001-programmed production, and was within the 110% overage allowance identified in ESA permit 1347.

Hatchery Effluent Monitoring

Per ESA Permit Numbers 1347, 18118, 18120, 18121, and 18583, permit holders shall monitor and report hatchery effluents in compliance with applicable National Pollution Discharge Elimination Systems (NPDES) (EPA 1999) permit limitations. There were no NPDES violations reported at Eastbank Hatchery or the Dryden acclimation facility during the period 1 January through 31 December 2019. NPDES monitoring and reporting for PUD Hatchery Programs during 2019 are provided in Appendix G.

Smolt and Emigrant Trapping

ESA-listed spring Chinook and steelhead were encountered during operation of the Lower Wenatchee Trap. ESA takes are reported in the steelhead (Section 3.8) and spring Chinook (Section 5.8) sections and are not repeated here.

Spawning Surveys

Summer Chinook spawning ground surveys conducted in the Wenatchee River basin during 2019 were consistent with ESA Section 10 Permit No. 1347. Because of the difficulty of quantifying the level of take associated with spawning ground surveys, the Permit does not specify a take level associated with these activities, even though it does authorize implementation of spawning ground surveys. Therefore, no take levels are reported. However, to minimize potential effects to established redds, wading was restricted to the extent practical, and extreme caution was used to avoid established redds when wading was required.

Bull Trout

Bull trout encounters associated with implementation of hatchery production and monitoring and evaluation activities for Chinook and steelhead programs in the Wenatchee sub-basin are required to be reported as outlined in Biological Opinion 01EWF00-2013-0444. The 2020 report for bull trout encounters in 2019 was compiled under provisions of ESA Section 10 Permit 18118, 18120, 18121, and 18583. Data and reporting information are included in Appendix I.

SECTION 9: METHOW SUMMER CHINOOK

The original goal of summer Chinook salmon supplementation in the Methow Basin was in part to use artificial production to replace adult production lost because of mortality at Wells, Rocky Reach, and Rock Island dams, while not reducing the natural production or long-term fitness of summer Chinook in the basin. The Rock Island Fish Hatchery Complex began operation in 1989 under funding from Chelan PUD. The Complex operated originally through the Rock Island Settlement Agreement, but since 2004 has operated under the Anadromous Fish Agreement and Habitat Conservation Plans. Beginning with broodstock collection in 2012, Grant PUD took over the summer Chinook salmon supplementation program in the Methow River basin. Grant PUD constructed a new overwinter acclimation facility adjacent to the Carlton Acclimation Pond and the first fish released from this facility was 2014. The first fish that were overwinter acclimated in the facility were released in 2015. The new facility includes eight, 30-foot diameter dual-drain circular tanks.

Presently, adult summer Chinook are collected for broodstock from the run-at-large at the west-ladder trapping facility at Wells Dam. Before 2012, the goal was to collect up to 222 natural-origin adult summer Chinook for the Methow program. In 2011, the Hatchery Committees reevaluated that amount of hatchery compensation needed to achieve NNI. Based on that evaluation, the goal of the program was revised. The current goal (beginning in 2012) is to collect up to 102 natural-origin summer Chinook for the Methow program. Broodstock collection occurs from about 1 July through 15 September with trapping occurring no more than 16 hours per day, three days a week. If natural-origin broodstock collection falls short of expectation, hatchery-origin adults can be collected to make up the difference.

Adult summer Chinook are spawned and reared at Eastbank Fish Hatchery. Juvenile summer Chinook were transferred from the hatchery to Carlton Acclimation Pond in March until overwinter acclimation was initiated with the 2013 brood year. They are now transferred to the Carlton Acclimation Facility in October or November and released from the new facility in mid-April to early May.

Before 2012, the production goal for the Methow summer Chinook supplementation program was to release 400,000 yearling smolts into the Methow River at ten fish per pound. Beginning with the 2012 brood, the revised goal is to release 200,000 yearling smolts at 13-17 fish per pound. Targets for fork length and weight are 163 mm (CV = 9.0) and 45.4 g, respectively. Over 90% of these fish are marked with CWTs. In addition, since 2009, juvenile summer Chinook have been PIT tagged annually.

9.1 Broodstock Sampling

This section focuses on results from sampling 2017-2019 Methow summer Chinook broodstock that were collected in the East and West Ladder of Wells Dam.

Origin of Broodstock

Broodstock collected in 2017-2019 consisted mostly of natural-origin (adipose fin present) summer Chinook (Table 9.1).

Table 9.1. Numbers of wild and hatchery summer Chinook collected for broodstock, numbers that died before spawning, and numbers of Chinook spawned for the Methow/Okanogan programs during 1989-2011. Numbers of broodstock collected from 2012 to present are only for the Methow summer Chinook Program. Unknown-origin fish (i.e., undetermined by scale analysis, no CWT or fin clips, and no additional hatchery marks) were considered naturally produced. Mortality includes fish that died of natural causes typically near the end of spawning and were not needed for the program and surplus fish killed at spawning.

Brood year	Wild summer Chinook					Hatchery summer Chinook					Total number spawned
	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	
1989[b]	1,419	72	-	1,297	-	341	17	-	312	-	1,609
1990[b]	864	34	-	828	-	214	8	-	206	-	1,034
1991[b]	1,003	59	-	924	-	341	20	-	314	-	1,238
1992[b]	312	6	-	297	-	428	9	-	406	-	703
1993[b]	813	48	-	681	-	464	28	-	388	-	1,069
1994	385	33	11	341	12	266	15	7	244	1	585
1995	254	13	10	173	58	351	28	9	240	74	413
1996	316	15	11	290	0	234	2	9	223	0	513
1997	214	11	5	198	0	308	24	20	264	0	462
1998	239	28	58	153	0	348	18	119	211	0	364
1999	248	5	19	224	0	307	2	16	289	0	513
2000	184	15	5	164	0	373	17	17	339	0	503
2001	135	8	36	91	0	423	29	128	266	0	357
2002	270	2	21	247	0	285	11	33	241	0	488
2003	449	14	53	381	0	112	2	9	101	0	482
2004	541	23	12	506	0	17	0	1	16	0	522
2005	551	29	76	391	55	12	2	0	9	1	400
2006	579	50	10	500	19	12	2	0	10	0	510
2007	504	22	26	456	0	19	0	2	17	0	473
2008	418	5	9	404	0	41	0	0	41	0	445
2009	553	31	15	507	0	5	5	0	0	0	507
2010	503	13	6	484	0	8	0	0	8	0	492
2011	498	18	13	467	0	30	4	0	26	0	493
Average[c]	***380***	***19***	***22***	***332***	***8***	***175***	***9***	***21***	***141***	***4***	***473***
Median[c]	***434***	***18***	***13***	***391***	***0***	***266***	***8***	***8***	***223***	***0***	***503***
2012	125	5	0	98	22	3	0	0	1	2	99
2013	98	1	0	97	0	4	0	0	4	0	101
2014	100	4	0	96	0	0	0	0	0	0	96
2015	97	0	0	97	0	1	0	0	1	0	98
2016	106	2	1	103	0	0	0	0	0	0	103
2017	118	4	3	111	0	0	0	0	0	0	111
2018	135	5	0	130	0	1	0	0	1	0	131
2019	118	2	0	116	0	6	0	1	5	0	121
Average[d]	***112***	***3***	***1***	***106***	***3***	***2***	***0***	***0***	***2***	***0***	***108***
Median[d]	***111***	***3***	***0***	***101***	***0***	***1***	***0***	***0***	***1***	***0***	***102***

[a] Pre-spawn loss represents the number of fish that died during the holding period before spawning. Mortality is the number of fish that were surplused following spawning.
[b] Number of fish spawned and collected during these years included fish retained from the right- and left-bank ladder traps at Wells Dam and fish collected from the volunteer channel. There was no distinction made between fish collected at trap locations and program (i.e., aggregated population used for Wells, Methow, and Okanogan summer Chinook programs).

[c] The average and median represent broodstock collected for the combined Methow and Okanogan programs. Because of bias from aggregating the spawning population from 1989-1993, averages are based on adult numbers collected from 1994-2011.
[d] The average and median represent broodstock collected only for the Methow program.

Age/Length Data

Ages of summer Chinook broodstock were determined from analysis of scales and/or CWTs. Broodstock collected from the 2019 return consisted primarily of age-4 and 5 natural-origin Chinook (78.2%). Age-3 natural-origin Chinook made up 21.8% of the broodstock. All hatchery-origin Chinook were age-4 and 5 (Table 9.2).

Table 9.2. Percent of hatchery and wild summer Chinook of different ages (total age) collected from broodstock for the Methow/Okanogan programs, 1991-2019.

Return Year	Origin	Total age				
		2	3	4	5	6
1991	Wild	0.5	6.8	35.1	55.4	2.2
	Hatchery	0.5	5.1	36.2	49.0	9.2
1992	Wild	0.0	13.0	36.2	50.7	0.0
	Hatchery	0.0	0.0	0.0	0.0	0.0
1993	Wild	0.0	3.9	75.3	20.8	0.0
	Hatchery	0.0	1.0	85.7	13.3	0.0
1994	Wild	3.1	9.7	26.3	60.3	0.6
	Hatchery	0.0	14.7	11.2	74.0	0.0
1995	Wild	0.0	4.6	15.3	75.6	4.6
	Hatchery	0.0	0.4	13.0	25.6	61.0
1996	Wild	0.0	8.4	56.7	30.4	4.6
	Hatchery	0.0	3.0	31.0	47.0	19.0
1997	Wild	0.5	9.4	53.0	35.1	2.0
	Hatchery	0.0	20.6	11.1	61.8	6.5
1998	Wild	1.1	12.1	56.3	30.5	0.0
	Hatchery	2.1	18.9	56.2	16.0	6.8
1999	Wild	4.7	5.1	53.7	36.0	0.5
	Hatchery	0.3	3.5	29.3	65.0	1.9
2000	Wild	0.6	14.0	28.7	56.1	0.6
	Hatchery	0.0	27.0	14.3	54.3	4.3
2001	Wild	0.0	23.5	58.8	11.8	5.9
	Hatchery	1.8	21.1	64.6	10.1	2.4
2002	Wild	0.4	17.4	65.6	16.6	0.0
	Hatchery	0.0	2.4	39.4	58.3	0.0
2003	Wild	0.7	3.9	65.8	29.5	0.0
	Hatchery	0.0	5.6	18.7	70.1	5.6
2004	Wild	0.6	15.4	11.6	72.2	0.2
	Hatchery	0.0	6.7	53.3	33.3	6.7
2005	Wild	0.0	17.1	69.9	11.0	1.9

Return Year	Origin	Total age				
		2	3	4	5	6
	Hatchery	0.0	10.0	40.0	50.0	0.0
2006	Wild	1.7	3.0	41.0	52.9	1.5
	Hatchery	0.0	16.7	25.0	50.0	8.3
2007	Wild	1.8	15.3	8.2	70.3	4.4
	Hatchery	0.0	0.0	21.1	57.9	21.1
2008	Wild	0.3	17.9	67.1	13.3	1.4
	Hatchery	0.0	7.2	62.7	47.7	2.4
2009	Wild	1.3	10.1	68.7	19.9	0.0
	Hatchery	0.0	0.0	16.7	83.3	0.0
2010	Wild	0.2	16.2	51.0	32.6	0.0
	Hatchery	0.0	12.5	50.0	25.0	12.5
2011	Wild	0.1	7.1	75.5	17.0	0.0
	Hatchery	0.0	30.0	20.0	40.0	0.0
2012	Wild	0.0	3.9	49.0	46.1	1.0
	Hatchery	0.0	0.0	0.0	100.0	0.0
2013	Wild	0.0	15.2	70.7	14.1	0.0
	Hatchery	0.0	0.0	50.0	50.0	0.0
2014	Wild	0.0	4.1	71.1	24.7	0.0
	Hatchery	0.0	0.0	0.0	0.0	0.0
2015	Wild	0.0	12.2	42.2	45.6	0.0
	Hatchery	0.0	0.0	100.0	0.0	0.0
2016	Wild	0.0	1.1	71.7	26.1	1.1
	Hatchery	0.0	0.0	0.0	0.0	0.0
2017	Wild	0.0	2.6	43.9	54.4	0.0
	Hatchery	0.0	0.0	0.0	0.0	0.0
2018	Wild	0.0	12.4	37.2	50.4	0.0
	Hatchery	0.0	0.0	0.0	100.0	0.0
2019	Wild	0.0	21.8	45.5	32.7	0.0
	Hatchery	0.0	0.0	62.5	37.5	0.0
Average	***Wild***	***0.6***	***10.6***	***50.0***	***37.7***	***1.1***
	Hatchery	***0.2***	***7.1***	***31.4***	***42.0***	***5.8***
Median	***Wild***	***0.1***	***10.1***	***53.0***	***32.7***	***0.2***
	Hatchery	***0.0***	***3.0***	***25.0***	***47.7***	***0.0***

Mean lengths of natural-origin summer Chinook of a given age differed little among return years 2016-2019 (Table 9.3). No hatchery-origin adults were collected for the 2016 and 2017 brood; however, there was one collected in 2018. A total of eight hatchery-origin adults were collected in 2019. Differences in hatchery-origin and natural-origin fish were difficult to assess given the small sample size of hatchery-origin fish (i.e., few hatchery fish were included in the broodstock).

Table 9.3. Mean fork length (cm) at age (total age) of hatchery and wild Methow/Okanogan summer Chinook collected from broodstock for the Methow/Okanogan programs, 1991-2019; N = sample size and SD = 1 standard deviation.

Return year	Origin	Summer Chinook fork length (cm)														
		Age-2			Age-3			Age-4			Age-5			Age-6		
		Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD
1991	Wild	47	1	-	68	15	6	82	78	10	94	123	8	97	5	5
	Hatchery	47	1	-	49	10	6	78	71	5	91	96	8	96	18	6
1992	Wild	-	0	-	55	9	5	69	25	6	78	35	6	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-
1993	Wild	-	0	-	72	3	4	86	58	7	98	16	5	-	0	-
	Hatchery	-	0	-	42	1	-	75	84	8	88	13	6	-	0	-
1994	Wild	42	10	6	50	31	7	80	84	9	93	193	8	104	2	13
	Hatchery	-	0	-	49	38	5	76	29	7	88	191	7	-	0	-
1995	Wild	-	0	-	67	6	8	79	20	9	96	99	5	94	6	5
	Hatchery	-	0	-	52	1	-	73	32	9	89	63	9	95	150	7
1996	Wild	-	0	-	68	22	9	83	149	8	95	79	7	101	12	5
	Hatchery	-	0	-	52	7	10	77	72	7	90	109	8	100	44	6
1997	Wild	31	1	-	60	19	7	85	107	8	96	71	7	98	4	11
	Hatchery	-	0	-	45	63	5	72	34	9	92	189	7	97	20	7
1998	Wild	39	2	1	59	23	6	83	107	7	96	58	7	-	0	-
	Hatchery	43	7	6	50	64	6	74	190	7	92	54	8	98	23	5
1999	Wild	38	10	3	64	11	8	82	115	7	96	76	6	104	1	-
	Hatchery	37	1	-	53	11	9	75	92	6	91	204	6	98	6	5
2000	Wild	39	1	-	66	23	7	83	47	6	96	92	5	95	1	-
	Hatchery	-	0	-	54	100	7	78	53	8	92	201	6	99	16	6
2001	Wild	-	0	-	63	4	12	88	10	9	90	2	4	94	1	-
	Hatchery	41	9	3	55	107	9	79	327	8	93	51	7	101	12	9
2002	Wild	56	1	-	65	44	7	88	166	6	100	42	7	-	0	-
	Hatchery	-	0	-	45	6	5	76	100	7	95	148	5	-	0	-
2003	Wild	43	3	6	61	16	6	87	268	7	99	120	6	-	0	-
	Hatchery	-	0	-	55	6	9	73	20	8	91	75	7	102	6	9
2004	Wild	51	3	5	67	78	6	81	59	6	97	367	7	99	1	-
	Hatchery	-	0	-	52	1	-	70	8	5	97	5	8	109	1	-
2005	Wild	-	0	-	68	89	6	83	363	7	94	57	6	101	10	7
	Hatchery	-	0	-	55	1	-	70	4	4	89	5	4	-	0	-
2006	Wild	38	9	3	54	16	4	69	221	6	77	286	5	78	8	4
	Hatchery	-	0	-	42	2	1	62	3	2	69	6	6	76	1	-
2007	Wild	39	8	5	53	69	5	67	37	6	78	317	5	77	20	7
	Hatchery	-	0	-	-	0	-	54	4	2	75	11	5	78	4	3
2008	Wild	41	1	-	55	62	4	69	233	6	76	46	4	82	5	3
	Hatchery	-	0	-	59	6	9	67	52	5	73	23	6	79	2	8
2009	Wild	38	7	5	54	54	5	72	367	5	79	106	5	-	0	-

Return year	Origin	Summer Chinook fork length (cm)														
		Age-2			Age-3			Age-4			Age-5			Age-6		
		Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD
	Hatchery	-	0	-	-	0	-	59	1	-	71	5	7	-	0	-
2010	Wild	43	1	-	54	78	5	71	246	5	78	157	5	-	0	-
	Hatchery	-	0	-	57	1	-	67	4	5	79	2	1	89	1	-
2011	Wild	43	2	3	66	32	8	87	338	7	97	76	5	-	0	-
	Hatchery	-	0	-	63	9	11	78	9	6	92	12	9	-	0	-
2012	Wild	-	0	-	70	10	3	84	62	5	96	54	6	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-	90	1	-	-	0	-
2013	Wild	-	0	-	72	14	5	86	65	7	97	13	5	-	0	-
	Hatchery	-	0	-	-	0	-	76	2	6	92	2	0	-	0	-
2014	Wild	-	0	-	75	4	3	88	69	6	94	24	4	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-
2015	Wild	-	0	-	71	11	4	83	38	5	94	41	6	-	0	-
	Hatchery	-	0	-	-	0	-	75	1	0	-	0	-	-	0	-
2016	Wild	-	0	-	72	1	-	84	66	6	96	24	7	102	1	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-
2017	Wild	-	0	-	72	0	1	82	50	8	90	62	8	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-
2018	Wild	-	0	-	71	15	7	83	45	6	91	61	9	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-	86	1	-	-	0	-
2019	Wild	-	0	-	70	24	4	85	50	7	94	36	6	-	0	-
	Hatchery	-	0	-	-	0	-	76	5	6	92	3	4	-	0	-
Average	***Wild***	***42***	***2***	***4***	***64***	***27***	***6***	***81***	***122***	***7***	***92***	***94***	***6***	***95***	***3***	***7***
	Hatchery	***42***	***1***	***5***	***52***	***15***	***7***	***72***	***41***	***6***	***87***	***51***	***6***	***94***	***10***	***6***

Sex Ratios

Male summer Chinook in the 2017 broodstock made up just under 50.8% of the adults collected, resulting in an overall male to female ratio of 1.04:1.00 (Table 9.4.). In 2018, males made up about 49.3% of the adults collected, resulting in an overall male to female ratio of 0.97:1.00 (Table 9.4). In 2019, males made up about 50.8% of the adults collected, resulting in an overall male to female ratio of 1.03:1.00 (Table 9.4). The ratios for 2017 and 2019 broodstock were above or at the assumed 1:1 ratio goal in the broodstock protocol.

Table 9.4. Numbers of male and female wild and hatchery summer Chinook collected for broodstock at Wells Dam for the Methow/Okanogan programs, 1991-2019. Ratios of males to females are also provided.

Return year	Number of wild summer Chinook			Number of hatchery summer Chinook			Total M/F ratio
	Males (M)	Females (F)	M/F	Males (M)	Females (F)	M/F	
1989[a]	752	667	1.13:1.00	181	160	1.13:1.00	1.13:1.00
1990[a]	381	482	0.79:1.00	95	120	0.79:1.00	0.79:1.00
1991[a]	443	559	0.79:1.00	151	191	0.79:1.00	0.79:1.00
1992[a]	349	318	1.10:1.00	38	35	1.09:1.00	1.10:1.00

Return year	Number of wild summer Chinook			Number of hatchery summer Chinook			Total M/F ratio
	Males (M)	Females (F)	M/F	Males (M)	Females (F)	M/F	
1993[a]	513	300	1.71:1.00	293	171	1.71:1.00	1.71:1.00
1994	205	180	1.14:1.00	165	101	1.63:1.00	1.32:1.00
1995	103	149	0.69:1.00	158	197	0.80:1.00	0.75:1.00
1996	178	138	1.29:1.00	132	102	1.29:1.00	1.29:1.00
1997	102	112	0.91:1.00	174	134	1.30:1.00	1.12:1.00
1998	130	109	1.19:1.00	263	85	3.09:1.00	2.03:1.00
1999	138	110	1.25:1.00	161	146	1.10:1.00	1.17:1.00
2000	82	102	0.80:1.00	243	130	1.87:1.00	1.40:1.00
2001	89	46	1.93:1.00	311	112	2.78:1.00	2.53:1.00
2002	166	104	1.60:1.00	149	136	1.10:1.00	1.31:1.00
2003	255	194	1.31:1.00	61	51	1.20:1.00	1.29:1.00
2004	263	278	0.95:1.00	12	5	2.40:1.00	0.97:1.00
2005	365	186	1.96:1.00	6	6	1.00:1.00	1.93:1.00
2006	287	292	0.98:1.00	9	3	3.00:1.00	1.00:1.00
2007	228	276	0.83:1.00	11	8	1.38:1.00	0.84:1.00
2008	210	208	1.01:1.00	13	28	0.46:1.00	0.94:1.00
2009	261	292	0.89:1.00	2	3	0.67:1.00	0.89:1.00
2010	248	255	0.97:1.00	5	3	1.67:1.00	0.98:1.00
2011	236	262	0.90:1.00	23	7	3.29:1.00	0.96:1.00
2012	50	53	0.94:1.00	1	0	--	0.96:1.00
2013	49	49	1.00:1.00	3	1	3.00:1.00	1.04:1.00
2014	50	50	1.00:1.00	0	0	--	1.00:1.00
2015	49	49	1.00:1.00	1	0	--	1.02:1.00
2016	52	54	0.96:1.00	0	0	--	0.96:1.00
2017	60	58	1.04:1.00	0	0	-	1.04:1.00
2018	67	69	0.97:1.00	0	0	-	0.97:1.00
2019	61	55	1.11:1.00	2	6	0.33:1.00	1.03:1.00
Total[b]	***3,984***	***3,730***	***1.07:1.00***	***1,905***	***1,264***	***1.51:1.00***	***1.18:1.00***

[a] Numbers and male to female ratios were derived from the aggregate population collected at Wells Fish Hatchery volunteer channel and left- and right-ladder traps at Wells Dam.
[b] Total values were derived from 1994-present data to exclude aggregate population bias from 1989-1993 returns.

Fecundity

Fecundities for the 2017, 2018, and 2019 summer Chinook broodstock averaged 3,858, 4,156, and 4,437 eggs per female, respectively (Table 9.5). These values were below the overall average of 4,777 eggs per female. Mean observed fecundities for the 2018 and 2019 returns were also above the expected fecundity of 3,858 and 4,156 eggs per female assumed in the broodstock protocols, respectively.

Table 9.5. Mean fecundity of wild, hatchery, and all female summer Chinook collected for broodstock at Wells Dam for the Methow/Okanogan programs, 1989-2019; NA = not available.

Return year	Mean fecundity		
	Wild	Hatchery	Total
1989*	NA	NA	4,750
1990*	NA	NA	4,838
1991*	NA	NA	4,819
1992*	NA	NA	4,804
1993*	NA	NA	4,849
1994*	NA	NA	5,907
1995*	NA	NA	4,930
1996*	NA	NA	4,870
1997	5,166	5,296	5,237
1998	5,043	4,595	4,833
1999	4,897	4,923	4,912
2000	5,122	5,206	5,170
2001	5,040	4,608	4,735
2002	5,306	5,258	5,279
2003	5,090	4,941	5,059
2004	5,130	5,118	5,130
2005	4,545	4,889	4,553
2006	4,854	4,824	4,854
2007	5,265	5,093	5,260
2008	4,814	4,588	4,787
2009	5,115	--	5,115
2010	5,124	4,717	5,116
2011	4,594	3,915	4,578
2012	4,470	--	4,470
2013	4,700	5,490	4,717
2014	4,685	--	4,685
2015	4,410	--	4,410
2016	4,509	--	4,509
2017	3,858	--	3,858
2018	4,156	--	4,156
2019	4,488	3,982	4,437
Average	***4,799***	***4,840***	***4,777***
Median	***4,854***	***4,906***	***4,787***

* Individual fecundities were not assigned to females until 1997 brood.

To estimate fecundities by length, weight, and age[40], hatchery staff collected fecundity, fork length, weight, and age data from summer Chinook females during the spawning of 2003 through 2019 broodstock (complete data for all variables are available for years 2014-2019). For the available brood years, we compare age/fecundity, fork length/fecundity, weight/fecundity, fork length/mean egg mass, and fork length/gamete (skein) mass between hatchery and natural-origin summer Chinook. Hatchery staff attempted to stratify the females sampled by fork length categories to obtain fecundity samples for all sizes of fish to better estimate the relationship between size and fecundity.

Mean fecundity by age differed between hatchery and natural-origin summer Chinook and over time (Table 9.6). On average, mean fecundities differed between hatchery and natural-origin summer Chinook by 472 eggs for age-4 fish, 349 eggs for age-5 fish, and 77 eggs for age-6 fish.

Table 9.6. Mean fecundity by age (total age) for hatchery and wild summer Chinook collected from broodstock for the Methow River program, brood years 2003-2019; N = sample size and SD = 1 standard deviation.

Brood year	Origin	Summer Chinook fecundity											
		Age 3			Age 4			Age 5			Age 6		
		Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD
2003	Wild	-	0	-	4,836	88	935	5,485	74	806	-	0	-
	Hatchery	-	0	-	-	0	-	4,939	41	857	5,186	4	515
2004	Wild	4,984	1	-	4,086	12	644	5,216	223	821	6,005	1	-
	Hatchery	-	0	-	3,673	1	-	5,430	3	152	5,628	1	-
2005	Wild	-	0	-	4,461	108	683	4,722	38	821	4,704	5	491
	Hatchery	-	0	-	-	0	-	4,681	3	546	-	0	-
2006	Wild	-	0	-	4,642	73	824	4,951	167	894	4,808	2	216
	Hatchery	-	0	-	-	0	-	4,824	2	1,957	-	0	-
2007	Wild	-	0	-	4,973	13	974	5,260	191	851	5,394	13	662
	Hatchery	-	0	-	-	0	-	4,955	6	678	5,505	2	13
2008	Wild	4,345	1	-	4,843	115	912	5,155	29	793	5,849	3	414
	Hatchery	4,259	3	852	4,405	42	903	4,882	20	871	5,283	1	-
2009	Wild	3,582	2	96	5,070	186	826	5,491	73	811	-	0	-
	Hatchery	-	0	-	-	0	-	4,151	2	552	-	0	-
2010	Wild	-	0	-	4,887	118	834	5,236	112	719	-	0	-
	Hatchery	-	0	-	3,849	1	-	5,006	2	820	-	0	-
2011	Wild	3,605	1	-	4,508	148	773	5,018	41	801	-	0	-
	Hatchery	3,652	1	-	4,074	1	-	3,950	3	948	-	0	-
2012	Wild	-	0	-	4,216	15	645	4,675	32	704	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-
2013	Wild	4,173	1	-	4,614	33	787	5,120	11	491	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-

[40] Although age-fecundity relationships are not specific hypotheses tested within the Monitoring and Evaluation Plan (Hillman et al. 2019), we include them here for descriptive purposes.

Brood year	Origin	Summer Chinook fecundity											
		Age 3			Age 4			Age 5			Age 6		
		Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD
2014	Wild	-	0	-	4,532	26	864	4,845	18	630	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-
2015	Wild	-	0	-	3,998	18	525	4,776	26	693	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-
2016	Wild	-	0	-	4,323	31	672	4,921	15	634	5,182	1	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-
2017	Wild	-	0	-	3,608	17	744	3,957	36	895	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-
2018	Wild	-	0	-	3,669	16	768	4,366	40	665	-	0	-
	Hatchery	-	0	-	-	0	-	3,477	1	-	-	0	-
2019	Wild	-	0	-	4,375	23	661	4,589	29	718	-	0	-
	Hatchery	-	0	-	3,887	3	759	4,077	3	666	-	0	-
Average	***Wild***	***4,138***	***0***	***96***	***4,449***	***61***	***769***	***4,928***	***68***	***750***	***5,324***	***1***	***446***
	Hatchery	***3,956***	***0***	***852***	***3,978***	***3***	***831***	***4,579***	***5***	***805***	***5,401***	***0***	***264***

We pooled fecundity data from brood years 2014 through 2019 (only brood years with complete data for all variables) to increase the number of samples for a given fork length. The linear relationships between fork length and fecundity, mean egg weight, and total egg (skein) weight for natural-origin females are shown in Figures 9.1, 9.2, and 9.3. Note that no hatchery-origin Chinook were included in broodstock in 2014-2018. There were six hatchery-origin female Chinook include in 2019. All fecundity variables increase linearly with fork length.

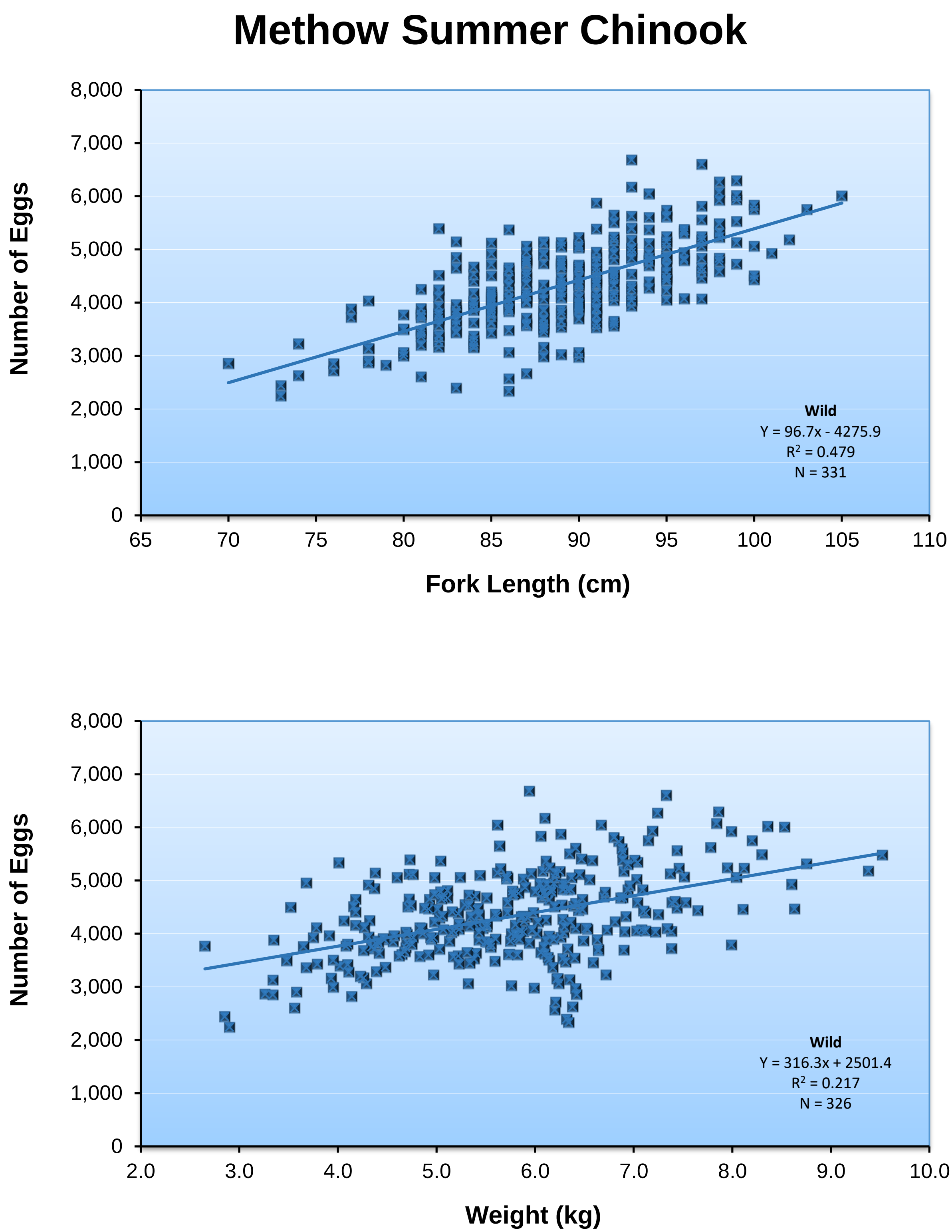


Figure 9.1. Relationships between fecundity and fork length (top figure) and fecundity and weight (bottom figure) for natural-origin summer Chinook for return years 2014-2019.

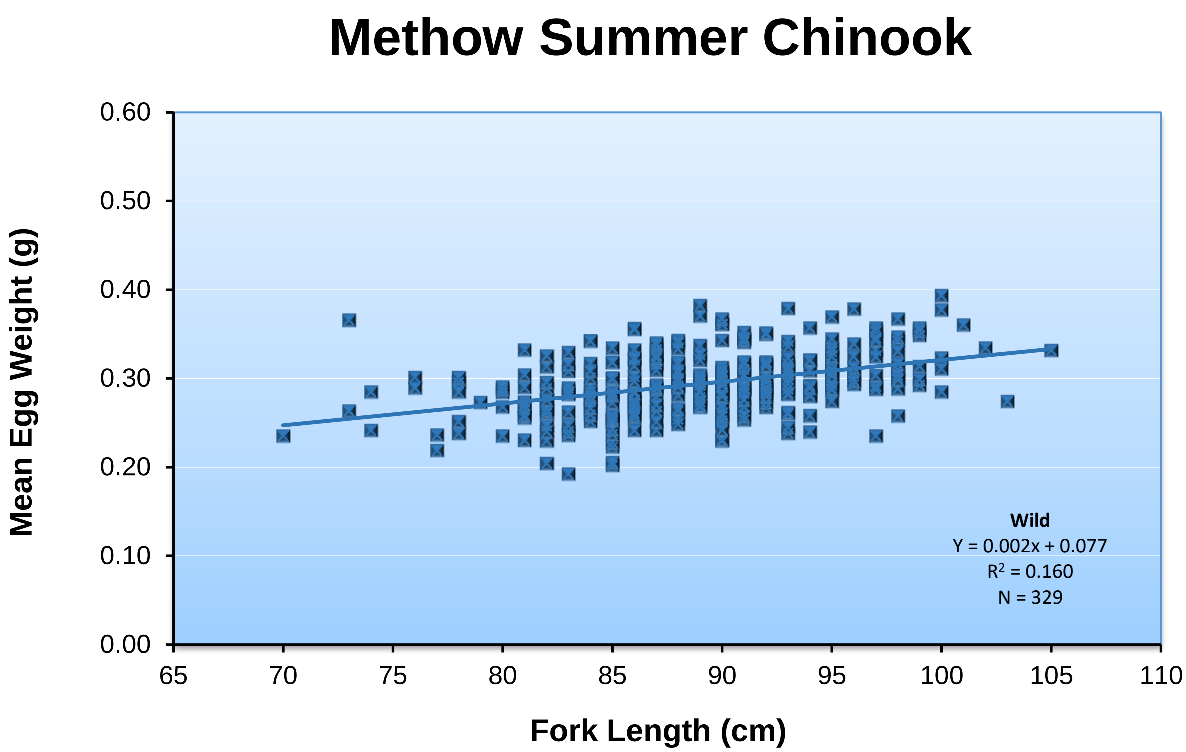


Figure 9.2. Relationships between mean egg weight and fork length for natural-origin summer Chinook for return years 2014-2019.

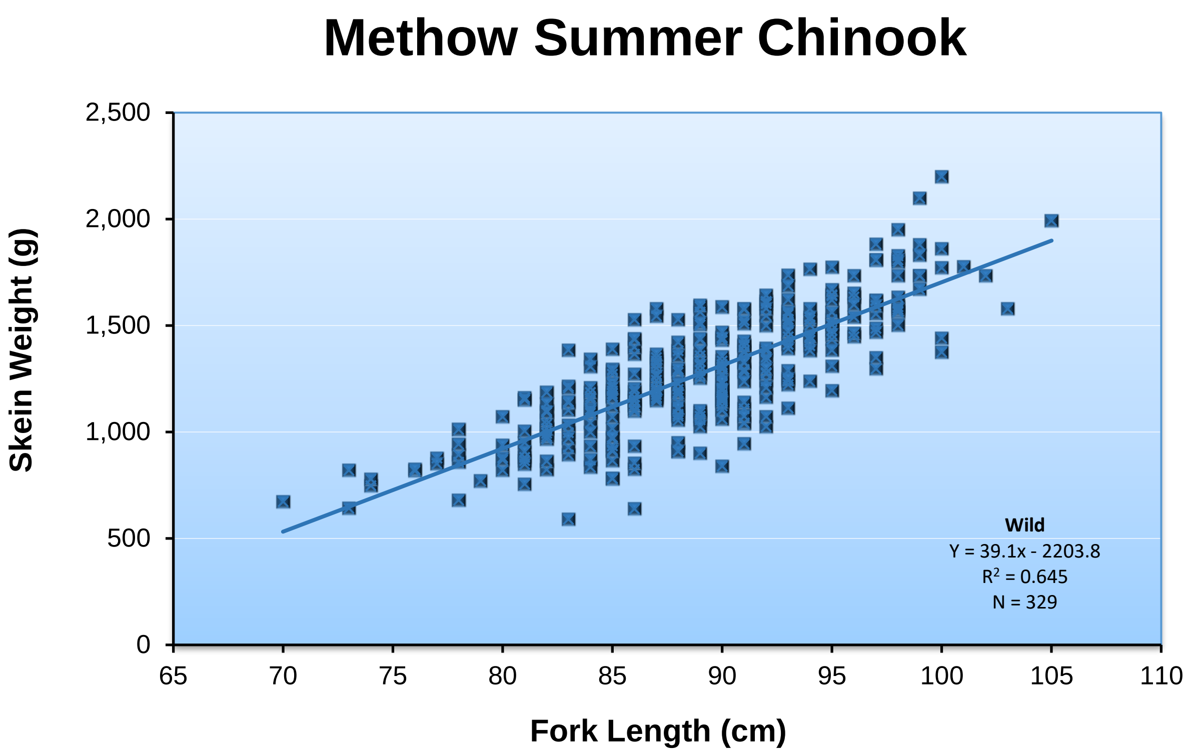


Figure 9.3. Relationships between skein weight and fork length for natural-origin summer Chinook for return years 2014-2019.

9.2 Hatchery Rearing

Rearing History

Number of eggs taken

Based on the unfertilized egg-to-release survival standard of 81%, a total of 493,827 eggs were needed to meet the program release goal of 400,000 smolts for brood years 1989-2011. An evaluation of the program in 2011 determined that 246,913 eggs are needed to meet the revised release goal of 200,000 smolts. This revised goal began with brood year 2012. From 1989 through 2011, the egg take goal was reached in eight of those years (Table 9.7). From 2012 to present, the egg take goal was achieved twice (Table 9.7).

Table 9.7. Numbers of eggs taken from summer Chinook broodstock collected at Wells Dam for the Methow/Okanogan programs, 1989-2019.

Return year	Number of eggs taken
1989	482,800
1990	464,097
1991	586,594
1992	486,260

Return year	Number of eggs taken
1993	531,490
1994	595,390
1995	491,000
1996	448,000
1997	401,162
1998	389,346
1999	483,726
2000	403,268
2001	279,272
2002	466,530
2003	473,681
2004	537,210
2005	305,826
2006	509,334
2007	549,802
2008	441,778
2009	560,602
2010	505,188
2011	488,747
Average (1989-2011)	***473,091***
Median (1989-2011)	***483,726***
2012	245,245
2013	231,136
2014	223,839
2015	216,098
2016	239,025
2017	208,341
2018	278,463
2019	266,237
Average (2012-present)	***238,548***
Median (2012-present)	***235,081***

Number of acclimation days

Improvements to the facility at the Carlton Acclimation Pond made overwinter rearing feasible beginning with the 2013 brood Methow summer Chinook. Fish are held on well water at Eastbank Fish Hatchery before being transferred to Carlton Acclimation Pond for final acclimation on Methow River water in October (Table 9.8). Only the 1994 and 1995 broods were reared for longer durations at the Methow Fish Hatchery on Methow River water.

Table 9.8. Number of days Methow summer Chinook were acclimated at Carlton Acclimation Pond, brood years 1989-2017.

Brood year	Release year	Transfer date	Release date	Number of days
1989	1991	15-Mar	6-May	52
1990	1992	26-Feb	28-Apr	61
1991	1993	10-Mar	23-Apr	44
1992	1994	4-Mar	21-Apr	48
1993	1995	18-Mar	2-May	45
1994	1996	25-Sep	28-Apr	215
		19-Mar	28-Apr	40
1995	1997	22-Oct	8-Apr	168
		19-Mar	22-Apr	34
1996	1998	9-Mar	14-Apr	36
1997	1999	10-Mar	20-Apr	41
1998	2000	19-Mar	2-May	44
1999	2001	18-Mar	18-Apr	31
2000	2002	28-Mar	1-May	34
2001	2003	27-Mar	24-Apr	28
2002	2004	16-Mar	24-Apr	39
2003	2005	18-Mar	21-Apr	34
2004	2006	12-Mar	22-Apr	41
2005	2007	12-Mar	15-Apr – 8-May	34-57
2006	2008	4-7-Mar	16-Apr – 2 May	40-59
2007	2009	18-24-Mar	21-Apr	28-34
2008	2010	4-5, 8-9-Mar	4-21-Apr	33-50
2009	2011	25, 29, 31-Mar & 4-Apr	11-25-Apr	8-31
2010	2012	19-21, 24-Mar	23-24-Apr	31-37
2011	2013	13-21-Mar	15-23-Apr	25-41
2012	2014	19-21-Mar	7-Apr – 14 May	18-57
2013	2015	20-21-Oct	13-May	204-205
2014	2016	26 & 28-Oct	18-Apr	173-175
2015	2017	20-21-Oct	18-Apr	179-180
2016	2018	19-20, 23-24-Oct	24-25-Apr	182-188
2017	2019	22, 24-Oct	24-Apr	182-184

Release Information

Numbers released

The 2017 brood Methow summer Chinook program achieved 71.8% of the 200,000 goal with about 143,594 Chinook being force released from the circular ponds on the night of 24 April 2019 (Table 9.9). Forced releases at night were initiated in 2016 to improve post-release survival.

Table 9.9. Numbers of Methow summer Chinook smolts released from the hatchery, brood years 1989-2017. Beginning with the 2014 release group (brood year 2012), the release target for Methow summer Chinook is 200,000 smolts. CWT marking rates were adjusted for tag loss before the fish were released.

Brood year	Release year	CWT mark rate	Number of smolts released
1989	1991	0.8529	420,000
1990	1992	0.9485	391,650
1991	1993	0.6972	540,900
1992	1994	0.9752	402,641
1993	1995	0.4623	433,375
1994	1996	0.9851	406,560
1995	1997	0.9768	353,182
1996	1998	0.9221	298,844
1997	1999	0.9884	384,909
1998	2000	0.9429	205,269
1999	2001	0.9955	424,363
2000	2002	0.9928	336,762
2001	2003	0.9902	248,595
2002	2004	0.9913	399,975
2003	2005	0.9872	354,699
2004	2006	0.9848	400,579
2005	2007	0.9897	263,723
2006	2008	0.9783	419,734
2007	2009	0.9837	433,256
2008	2010	0.9394	397,554
2009	2011	0.9862	404,956
2010	2012	0.9962	439,000
2011	2013	0.9734	436,092
Average (1989-2011)		***0.9365***	***382,462***
Median (1989-2011)		***0.9837***	***400,579***
2012	2014	0.9987	197,391
2013	2015	0.9903	188,834
2014	2016	0.9921	167,616
2015	2017	0.9923	177,762
2016	2018	0.9926	209,490
2017	2019	0.9826	143,594

Brood year	Release year	CWT mark rate	Number of smolts released
Average (2012-present)		***0.9914***	***180,781***
Median (2012-present)		***0.9922***	***183,298***

Numbers tagged

The 2017 brood Methow summer Chinook were 98.3% CWT[41] and 74.5% adipose fin-clipped (Table 9.9).

On 11-13 February 2020, a total of 5,056 Methow summer Chinook from the 2018 brood were PIT tagged at the Carlton Acclimation Facility. These fish were PIT tagged in circular ponds #1-8. Fish were not fed during PIT tagging or for two days before and after tagging. Fish averaged 126 mm in length and 23 g at time of tagging.

Table 9.10 summarizes the number of hatchery summer Chinook that have been PIT-tagged and released into the Methow River are shown in Table 9.10. During release years 2010-2019, the number of fish tagged and released has ranged from 0 to 10,123.

Table 9.10. Summary of PIT-tagging activities for Methow hatchery summer Chinook, brood years 2008-2017.

Brood year	Release year	Number of fish tagged	Number of tagged fish that died	Number of tags shed	Number of tagged fish released
2008	2010	10,100	4	0	10,096
2009	2011	5,050	17	9	5,024
2010	2012	0	--	--	0
2011	2013	0	--	--	0
2012	2014	10,099	41	7	10,051
2013	2015	10,159	35	1	10,123
2014	2016	5,000	8	0	4,992
2015	2017	5,064	0	0	5,064
2016	2018	4,424	0	0	4,424
2017	2019	5,052	0	0	5,052

Fish size and condition at release

A forced release of yearling Chinook smolts took place on the night of 24 April 2019. Size at release was within the respective size range for fish per pound goals (Table 9.11). For this brood year, CV was less than the target CV for length by 7%.

[41] Sixty days after tagging, taggers conduct a quality control procedure, which includes collecting a sample of tagged fish and scanning for tag retention. Thus, the number of tagged fish released is adjusted for tag loss.

Table 9.11. Mean lengths (FL, mm), weight (g and fish/pound), and coefficient of variation (CV) of Methow summer Chinook smolts released from the hatchery, brood years 1991-2017. Size targets are provided in the last row of the table.

Brood year	Release year	Fork length (mm)		Mean weight	
		Mean	CV	Grams (g)	Fish/pound
1991	1993	152	13.6	40.3	11
1992	1994	145	16.0	37.2	12
1993	1995	154	8.6	37.1	12
1994	1996	163	8.2	48.2	9
1995	1997	141	9.6	37.0	12
1996	1998	199	13.1	105.1	4
1997	1999	153	7.6	39.5	12
1998	2000	164	8.7	51.7	9
1999	2001	153	9.3	41.5	11
2000	2002	170	10.2	54.2	8
2001	2003	167	7.4	52.7	9
2002	2004	148	13.1	35.7	13
2003	2005	148	10.1	35.5	13
2004	2006	142	9.8	31.1	15
2005	2007	158	15.0	42.2	11
2006	2008	156	18.0	42.8	11
2007	2009	138	21.0	32.1	14
2008	2010	155	14.2	42.0	11
2009	2011	170	15.8	56.9	8
2010	2012	145	16.7	34.5	13
2011	2013	160	13.0	43.6	6
Average		***156***	***12.3***	***44.8***	***11***
Targets		***163***	***9.0***	***45.4***	***10***
2012	2014	158	12.1	41.6	11
2013	2015	130	12.6	27.2	17
2014	2016	125	10.8	23.0	20
2015	2017	134	8.4	29.4	15
2016	2018	131	8.0	26.7	17
2017	2019	135	8.4	29.0	16
Average		***136***	***10.1***	***29.5***	***16***
Targets		***163***	***9.0***	***45.4***	***13-17***

Survival Estimates

Overall survival of the 2017 brood Methow summer Chinook from green (unfertilized) egg-to-release was below the standard set for the program (Table 9.12). There was lower than expected survival in the unfertilized egg to eyed egg and eyed egg to ponding stages. Pre-spawn survival of adults was above the standard set for the program.

Table 9.12. Hatchery life-stage survival rates (%) for Methow summer Chinook, brood years 1989-2017. Survival standards or targets are provided in the last row of the table.

Brood year	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
1989[a]	89.8	99.5	89.9	96.7	99.7	99.4	73.3	98.5	87.0
1990[a]	93.9	99.0	84.9	97.1	81.2	80.6	97.7	99.5	84.4
1991[a]	93.1	95.5	88.2	98.0	99.4	99.1	97.5	99.6	92.2
1992[a]	96.9	99.0	87.8	98.0	99.9	99.9	90.9	98.3	82.8
1993[a]	82.2	99.4	85.4	97.6	99.8	99.5	92.0	99.4	81.5
1994	96.1	90.0	86.6	100.0	98.1	97.4	73.1	99.1	68.3
1995	91.9	96.2	98.2	84.1	96.5	96.2	92.7	89.6	71.9
1996	95.4	98.1	83.2	100.0	97.7	96.9	86.5	89.0	66.7
1997	91.9	94.6	86.1	98.4	98.7	98.3	98.8	99.7	95.9
1998	84.0	96.2	54.1	98.0	99.4	98.9	96.6	99.9	52.7
1999	98.8	98.7	92.9	96.9	98.0	97.6	96.9	99.9	87.7
2000	90.5	96.9	89.2	98.1	98.5	98.3	94.6	94.4	83.5
2001	96.2	92.3	89.1	97.6	97.2	97.1	97.5	99.8	89.0
2002	97.1	98.1	88.3	99.9	97.7	97.5	96.7	99.9	85.7
2003	96.7	97.5	82.8	98.2	99.7	99.2	93.7	99.9	74.9
2004	93.6	98.2	84.0	97.8	99.6	99.2	98.3	98.5	74.6
2005	97.0	89.6	88.0	95.5	99.6	98.9	96.6	99.9	86.2
2006	92.9	89.5	86.3	98.3	99.6	98.7	97.2	99.5	82.4
2007	92.6	99.6	84.1	98.5	99.7	99.5	98.9	99.8	81.9
2008	99.6	97.9	91.9	99.5	99.3	98.9	98.5	99.9	90.0
2009[b]	93.6	93.5	91.0	97.7	99.7	99.2	98.8	100.0	87.9
2010[c]	96.5	100.0	91.1	100.0	96.4	96.1	95.4	99.5	86.9
2011	94.9	96.4	93.8	97.8	99.7	99.1	98.6	99.9	90.4
2012	94.3	94.2	93.1	97.8	99.4	99.0	97.0	98.3	88.3
2013	98.0	100.0	89.5	97.8	99.9	99.2	93.4	94.2	81.7
2014	96.0	96.0	94.0	95.8	99.6	99.4	87.1	88.0	78.4
2015	93.1	95.0	89.1	98.0	99.7	99.4	94.2	95.6	82.3
2016	100.0	100.0	92.4	98.3	99.7	99.5	96.6	97.4	87.6
2017	93.1	100.0	84.4	94.9	99.8	99.5	97.3	98.0	77.9
Average	***94.1***	***96.6***	***87.6***	***97.5***	***98.4***	***98.0***	***94.0***	***97.8***	***82.1***

Brood year	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
Median	*94.3*	*97.5*	*88.3*	*98.0*	*99.6*	*99.0*	*96.6*	*99.5*	*83.5*
Standard	*90.0*	*85.0*	*92.0*	*98.0*	*97.0*	*93.0*	*90.0*	*95.0*	*81.0*

[a] Survival rates were calculated from aggregate population collected at Wells Fish Hatchery volunteer channel and left- and right-ladder traps at Wells Dam.

[b] Survival rates were calculated from aggregate collections at Wells east fish ladder for the Methow and Okanogan/Similkameen programs. About 41% of the total fish collected were used to estimate survival rates.

[c] Survival rates were calculated from aggregate collections at Wells West Ladder for the Methow and Similkameen programs. About 71% of the total fish collected were used to estimate survival rates.

9.3 Disease Monitoring

Results of 2019 adult broodstock bacterial kidney disease (BKD) monitoring indicated that 100% of females had ELISA values less than 0.120 (Table 9.13).

Table 9.13. Proportion of bacterial kidney disease (BKD) titer groups for the Methow/Okanogan summer Chinook broodstock, brood years 1997-2019. Also included are the proportions to be reared at either 0.125 fish per pound or 0.060 fish per pound.

Brood year[a]	Optical density values by titer group				Proportion at rearing densities (fish per pound, fpp)[b]	
	Very Low (≤ 0.099)	Low (0.1-0.199)	Moderate (0.2-0.449)	High (≥ 0.450)	≤ 0.125 fpp (<0.119)	≤ 0.060 fpp (>0.120)
1997	0.6267	0.1333	0.0622	0.1778	0.6844	0.3156
1998	0.9632	0.0184	0.0123	0.0061	0.9816	0.0184
1999	0.9444	0.0198	0.0238	0.0119	0.9643	0.0357
2000	0.7476	0.0952	0.0238	0.1333	0.8000	0.2000
2001	0.9801	0.0199	0.0000	0.0000	1.0000	0.0000
2002	0.9567	0.0130	0.0130	0.0173	0.9740	0.0260
2003	0.9620	0.0127	0.0169	0.0084	0.9747	0.0253
2004	0.9585	0.0151	0.0075	0.0189	0.9736	0.0264
2005	0.9884	0.0000	0.0000	0.0116	0.9884	0.0116
2006	0.9962	0.0038	0.0000	0.0000	0.9962	0.0038
2007	0.9202	0.0266	0.0152	0.0380	0.9354	0.0646
2008	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000
2009	0.9891	0.0073	0.0037	0.0000	0.9927	0.0073
2010	0.9960	0.0040	0.0000	0.0000	1.0000	0.0000
2011	0.9766	0.0140	0.0000	0.0093	0.9860	0.0140
2012	0.9341	0.0440	0.0110	0.0110	0.9780	0.0220
2013	0.8776	0.1224	0.0000	0.0000	0.9388	0.0612
2014	0.9170	0.0210	0.0210	0.0420	0.9381	0.0630
2015	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000

Brood year[a]	Optical density values by titer group				Proportion at rearing densities (fish per pound, fpp)[b]	
	Very Low (≤ 0.099)	Low (0.1-0.199)	Moderate (0.2-0.449)	High (≥ 0.450)	≤ 0.125 fpp (<0.119)	≤ 0.060 fpp (>0.120)
2016	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000
2017	0.7778	0.0556	0.0556	0.1111	0.7778	0.0222
2018	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000
2019	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000
Average	***0.9353***	***0.0272***	***0.0116***	***0.0259***	***0.9515***	***0.0399***
Median	***0.9632***	***0.0140***	***0.0037***	***0.0084***	***0.9816***	***0.0184***

[a] Individual ELISA samples were not collected before the 1997 brood.
[b] ELISA values from broodstock BKD testing dictate what density the progeny of the broodstock are reared. Progeny of broodstock with high ELISA values are reared at lower density.

9.4 Natural Juvenile Productivity

During 2019, juvenile summer Chinook were sampled at the Methow Trap located near RM 18.6. Trapping has occurred in this location since 2004.

Emigrant Estimates

Methow Trap

On the Methow River, WDFW used traps with cone diameters of 2.4 m and 1.5 m to increase trap efficiency over a greater range of river discharge. Large variation in discharge and channel configuration required the use of two trapping positions. The 1.5-m trap was deployed in the lower position at discharges less than 45.3 m^3/s. At discharges greater than 45.3 m^3/s, the 2.4-m trap was installed and operated in tandem with the 1.5 m trap.

A pooled-efficiency model estimated the total number of emigrants when the trap was operated in the low trapping position. A flow-efficiency model estimated the total number of emigrants when the trap was operated in the upper trapping position. The pooled-efficiency estimate was based on twelve mark-recapture release groups in 2019. The flow-efficiency estimate was based on 16 mark-recapture release groups that were conducted over the period 2007-2019.

The Methow Trap operated at night between 6 March and 27 November 2019. During that time, the trap was inoperable for 2 days because of miscommunication. During the nine-month sampling period, a total of 4,859 wild subyearling summer Chinook were captured at the Methow Trap. Based on the pooled-efficiency model and the flow efficiency model, the total number of wild subyearling summer Chinook that emigrated past the Methow Trap in 2019 was 326,262 (±434,462) (Table 9.13). This value contains an estimated 7,601 fish that likely emigrated past the trapping location during the 2 days in which the trap was not operating. Because 142 summer Chinook redds were observed downstream from the trap in 2018, the total number of summer Chinook emigrating from the Methow River in 2019 was expanded using the ratio of the number of redds downstream from the trap to the number upstream from the trap. This resulted in a total summer Chinook emigrant estimate of 428,761 (±498,054) fish (Table 9.14). Most of these fish emigrated during March through June (Figure 9.4).

Table 9.14. Numbers of redds and juvenile summer Chinook emigrants in the Methow River basin for brood years 2003-2018; NA = not available.

Brood year	Number of redds	Egg deposition	Number of emigrants upstream from trap	Total number of emigrants
2003	1,624	8,215,816	1,454,913	NA
2004*	973	4,991,490	2,016,696	NA
2005*	874	3,979,322	269,870	NA
2006	1,353	6,567,462	2,481,762	3,465,247
2007	620	3,261,200	446,860	664,396
2008	599	2,867,413	385,087	508,077
2009	692	3,539,580	838,989	1,202,030
2010	887	4,537,892	514,724	703,483
2011	941	4,307,898	1,861,614	2,292,904
2012	960	4,291,200	7,533,462	11,212,595
2013	1,551	7,316,067	473,625	709,066
2014	591	2,768,835	706,071	742,505
2015	1,231	5,428,710	761,769	1,219,425
2016	1,115	5,027,535	669,432	829,352
2017	690	2,662,020	352,899	427,193
2018	594	2,468,664	326,262	428,761
Average	***956***	***4,514,444***	***1,318,377***	***1,877,310***
Median	***914***	***4,299,549***	***687,752***	***742,505***

* Trap did not operate for entire migration period.

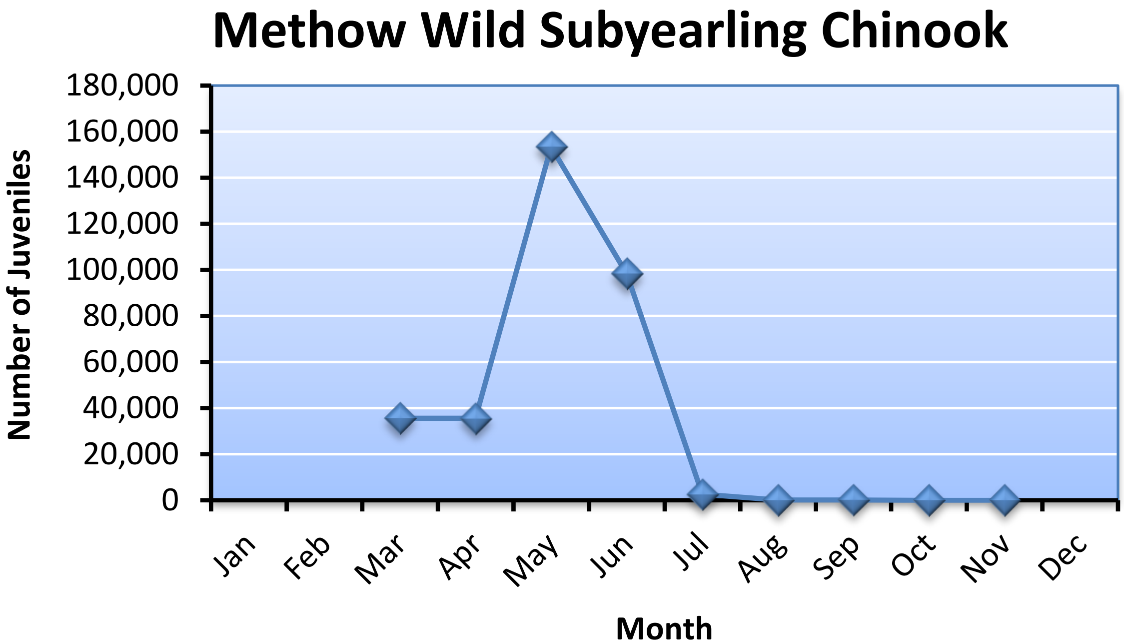


Figure 9.4. Estimated numbers of wild subyearling Chinook at the Methow Trap during March to late November 2019.

Subyearling summer Chinook sampled in 2019 averaged 63.1 mm in length, 3.2 g in weight, and had a mean condition of 1.14 (Table 9.15). These size estimates were similar to the overall mean of subyearling summer Chinook sampled in previous years (overall means: 63.6 mm, 3.7 g, and condition of 1.21). Environmental conditions at the trapping location do not allow for accurate weight measurements on fry (i.e., <50 mm fork length), so this size class is underrepresented in the averages.

Table 9.15. Mean fork length (mm), weight (g), and condition factor of subyearling summer Chinook collected in the Methow Trap, 2004-2019. Numbers in parentheses indicate 1 standard deviation.

Sample year	Sample size[a]	Mean size		
		Length (mm)	Weight (g)	Condition (K)
2004	506	56.5 (17.5)	2.8 (2.8)	1.29 (0.36)
2005	326	42.6 (6.5)	1.1 (0.6)	1.34 (0.39)
2006	787	38.5 (3.0)	0.6 (0.3)	1.02 (0.28)
2007	437	73.9 (17.3)	5.8 (3.8)	1.24 (0.26)
2008	123	78.8 (16.3)	6.7 (3.9)	1.27 (0.35)
2009	162	67.4 (12.4)	4.3 (2.3)	1.31 (0.34)
2010	142	69.7 (14.4)	4.6 (2.9)	1.26 (0.50)
2011	590	70.6 (13.5)	4.9 (2.8)	1.28 (0.31)
2012	373	61.4 (10.9)	2.9 (2.1)	1.16 (0.22)
2013	602	62.0 (11.0)	3.2 (2.1)	1.22 (0.23)
2014	707	67.1 (13.2)	3.9 (2.6)	1.16 (0.18)

Sample year	Sample size[a]	Mean size		
		Length (mm)	Weight (g)	Condition (K)
2015	633	69.2 (13.6)	4.6 (2.8)	1.25 (0.22)
2016	645	65.6 (12.8)	3.8 (2.6)	1.20 (0.24)
2017	424	67.1 (14.1)	4.0 (3.0)	1.14 (0.23)
2018	575	63.7 (12.7)	3.3 (2.5)	1.13 (0.18)
2019	680	63.1 (11.4)	3.2 (2.1)	1.14 (0.21)
Average	***482***	***63.6 (12.5)***	***3.7 (2.5)***	***1.21 (0.28)***
Median	***541***	***66.4 (13.0)***	***3.9 (2.6)***	***12.3 (0.25)***

[a] Sample size represents the number of fish that were measured for both length and weight.

Freshwater Productivity

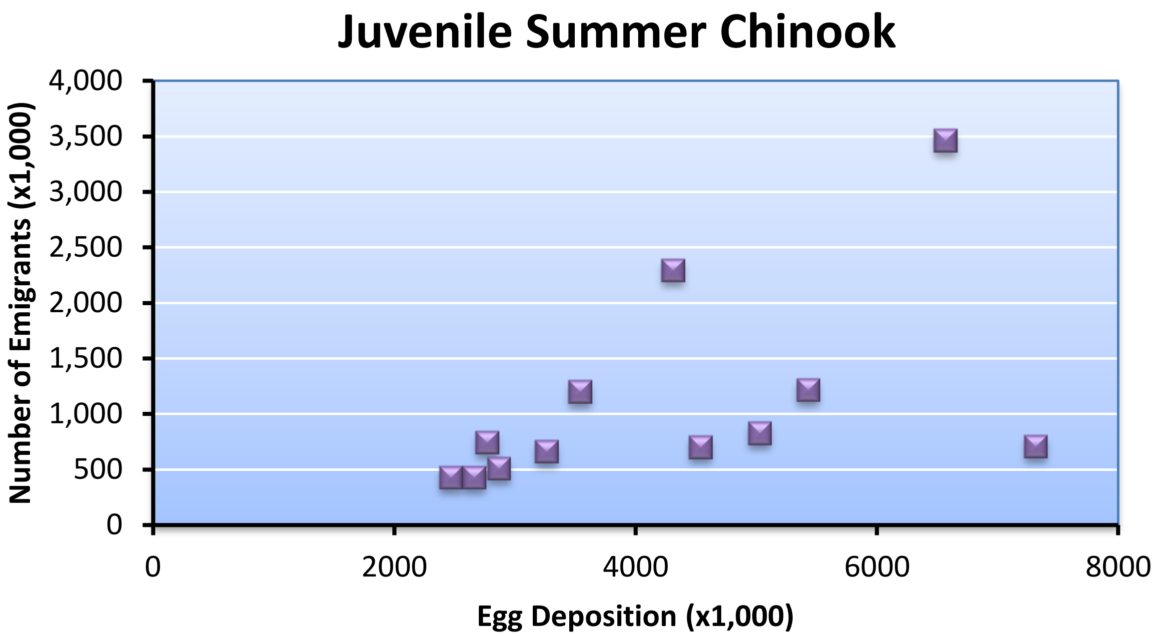
Both productivity and survival estimates for juvenile emigrants of summer Chinook in the Methow River basin are provided in Table 9.16. During the period 2006-2018, freshwater productivities ranged from 457-2,561 emigrants/redd. Survivals during the same period ranged from 9.7-53.2% for egg-emigrants.

Table 9.16. Productivity (emigrants/redd) and survival (egg-emigrant) estimates for summer Chinook in the Methow River basin for brood years 2006-2018; ND = no data. These estimates were derived from data in Table 9.14.

Brood year	Emigrants/ Redd	Egg-Emigrant (%)
2006	2,561	52.8
2007	1,072	20.4
2008	848	17.7
2009	1,737	34.0
2010	793	15.5
2011	2,437	53.2
2012	11,680[a]	261.3[a]
2013	457	9.7
2014	1,256	26.8
2015	991	22.5
2016	744	16.5
2017	619	16.0
2018	722	17.4
Average	***1,186***	***25.2***
Median	***919***	***19.0***

[a] Because these values are extreme outliers (e.g., >100% survival), they are not included in statistical summaries or analyses.

Numbers of juvenile emigrants increased with increasing egg deposition; however, egg-emigrant survival did not decrease significantly with increasing egg deposition (Figure 9.5). This suggests a density-independent relationship between seeding levels and emigrants within the Methow River basin (see Population Carrying Capacity section below).



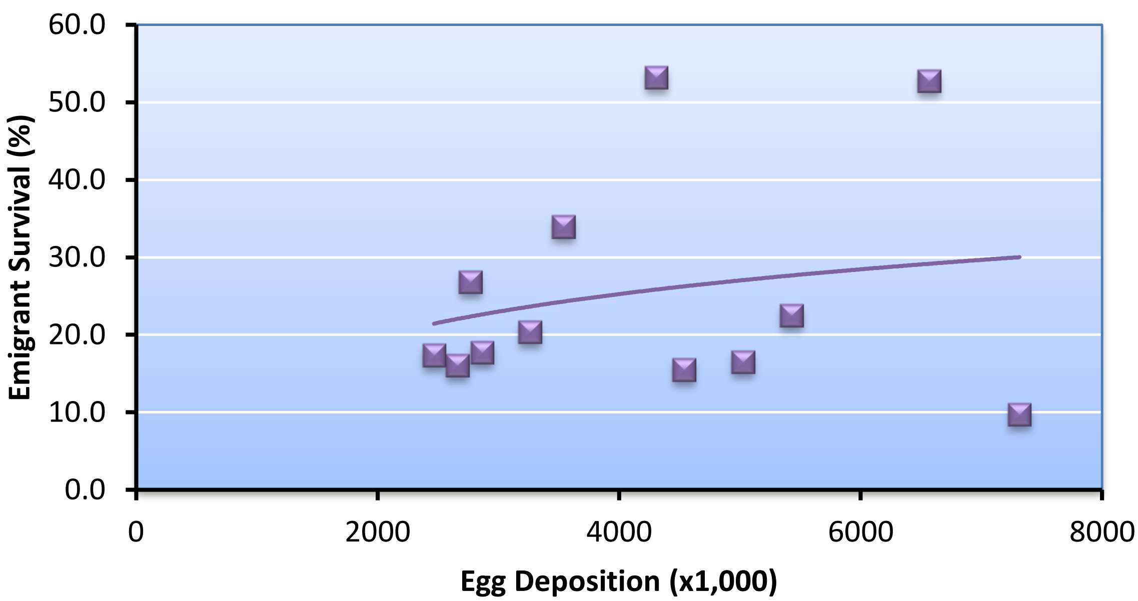


Figure 9.5. Relationships between seeding levels (egg deposition) and juvenile productivity (top figure) and emigrant survival (bottom figure) for Methow summer Chinook, brood years 2006-2018.

Population Carrying Capacity

Population carrying capacity (*K*) is defined as the maximum equilibrium population size estimated with population models (e.g., logistic equation, Beverton-Holt model, hockey stick model, and the Ricker model).[42] Maximum equilibrium population size is generated from density dependent

[42] Population carrying capacity (*K*) should not be confused with habitat carrying capacity (*C*), which is defined as the maximum population of a given species that a particular environment can sustain.

mechanisms that reduce population growth rates as population size increases (negative density dependence). This is referred to as compensation. Population size fluctuates about the maximum equilibrium size because of variability in vital rates that are unrelated to density (density independent factors) and measurement error. In this section, we used population models to estimate juvenile summer Chinook carrying capacities (see Appendix 6 in Hillman et al. 2019 for a detailed description of methods).

Only the density-independent model adequately fit the juvenile emigrant data for Methow summer Chinook (Figure 9.6). This means that under the range of seeding levels examined, there is no estimate of carrying capacity for juvenile emigrants. This implies that spawning habitat is not currently limiting juvenile productivity within the Methow River basin. It does not mean that there is no limit to juvenile rearing within the Methow River basin. Indeed, there is likely a limit to the number of parr that can rear within the basin; however, there are no parr data to estimate rearing capacity.

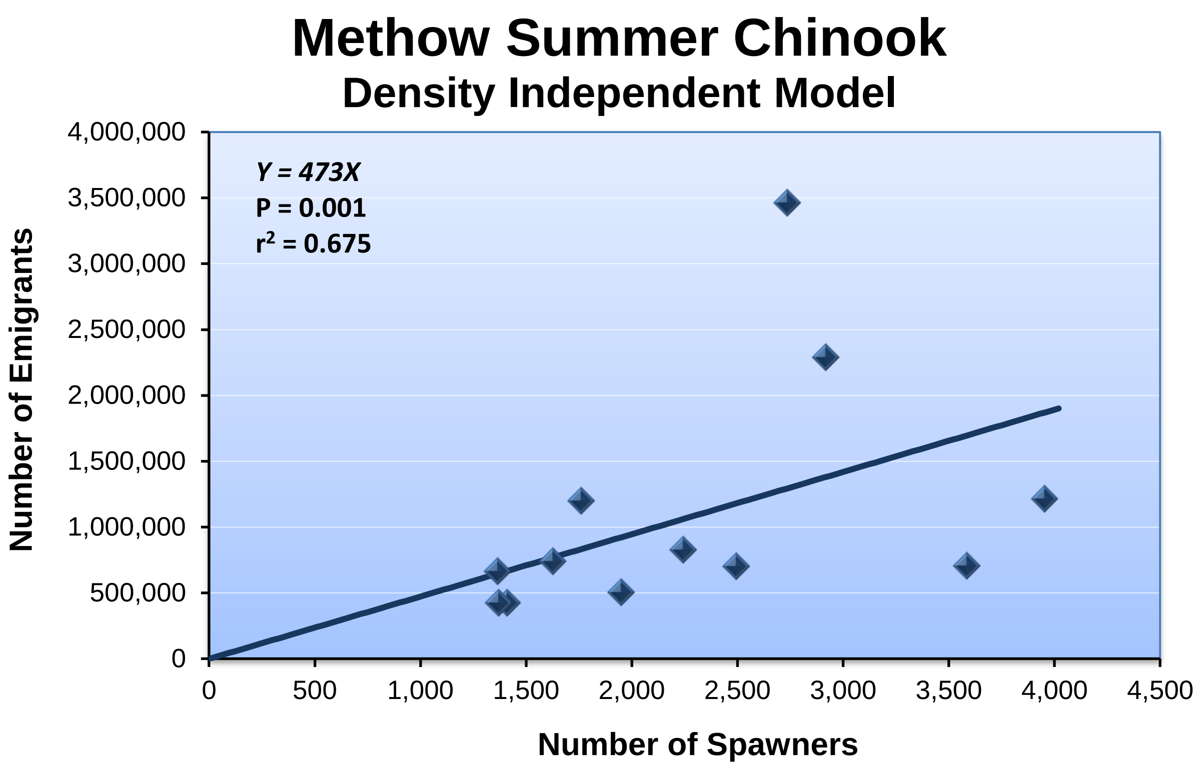


Figure 9.6. Density-independent relationship between spawners and number of juvenile emigrants produced in the Methow River basin.

9.5 Spawning Surveys

Surveys for Methow summer Chinook redds were conducted from late September to mid-November 2019 in the Methow River. Total redd counts (not peak counts) were conducted in the river (see Appendix Q for more details).

Redd Counts

A total of 706 summer Chinook redds were counted in the Methow River in 2019 (Table 9.17). This equals the overall average of 706 redds.

Table 9.17. Total number of redds counted in the Methow River, 1989-2019.

Survey year	Total redd count
1989	149*
1990	418*
1991	153
1992	107
1993	154
1994	310
1995	357
1996	181
1997	205
1998	225
1999	448
2000	500
2001	675
2002	2,013
2003	1,624
2004	973
2005	874
2006	1,353
2007	620
2008	599
2009	692
2010	887
2011	941
2012	960
2013	1,551
2014	591
2015	1,231
2016	1,115
2017	690
2018	594
2019	706
Average	***706***
Median	***620***

* Total counts based on expanded aerial counts.

Redd Distribution

Summer Chinook redds were not evenly distributed among the seven reaches in the Methow River. Most redds (89%) were located within the lower three reaches (downstream from Twisp) (Table 9.18; Figure 9.7). Few Chinook spawned upstream from Winthrop (Reaches 6 and 7).

Table 9.18. Total number of summer Chinook redds counted in different reaches on the Methow River during September through early November 2019. Reach codes are described in Table 2.10.

Survey reach	Total redd count	Percent
Methow 1 (M1)	220	31.2
Methow 2 (M2)	230	32.6
Methow 3 (M3)	178	25.2
Methow 4 (M4)	22	3.1
Methow 5 (M5)	42	5.9
Methow 6 (M6)	1	0.1
Methow 7 (M7)	13	1.8
Totals	***706***	***100***

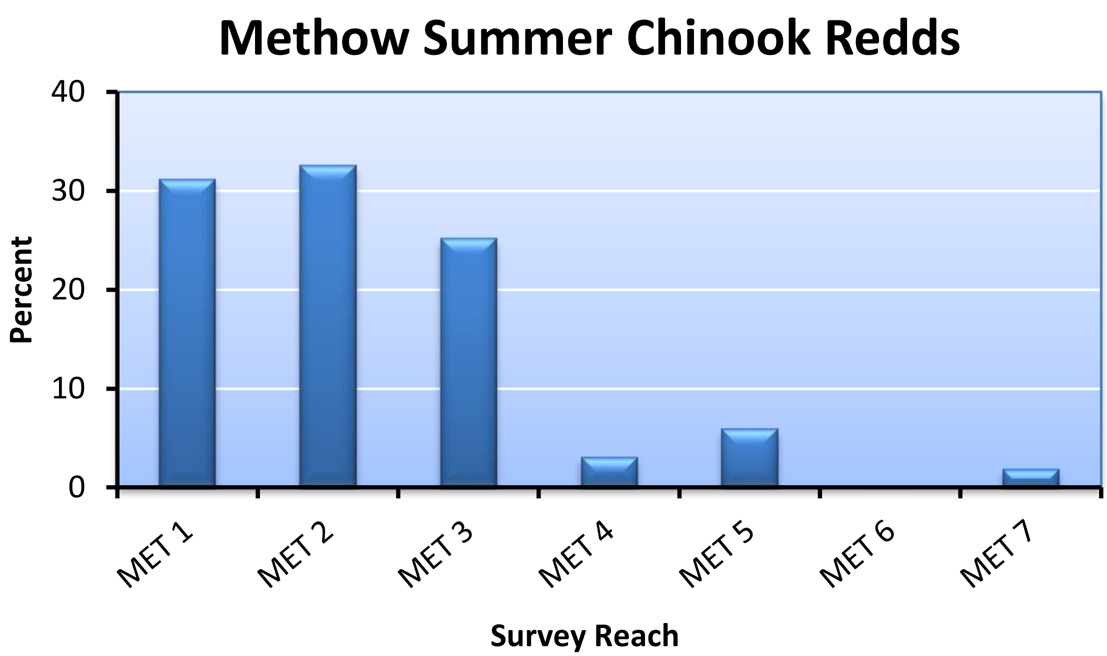


Figure 9.7. Percent of the total number of summer Chinook redds counted in different reaches on the Methow River during September through mid-November 2019. Reach codes are described in Table 2.10.

Spawn Timing

Spawning in 2019 began the last week of September, peaked in mid-October, and ended the third week of November (Figure 9.8). Stream temperatures in the Methow River, when spawning began, varied from 10.0-12.0°C.

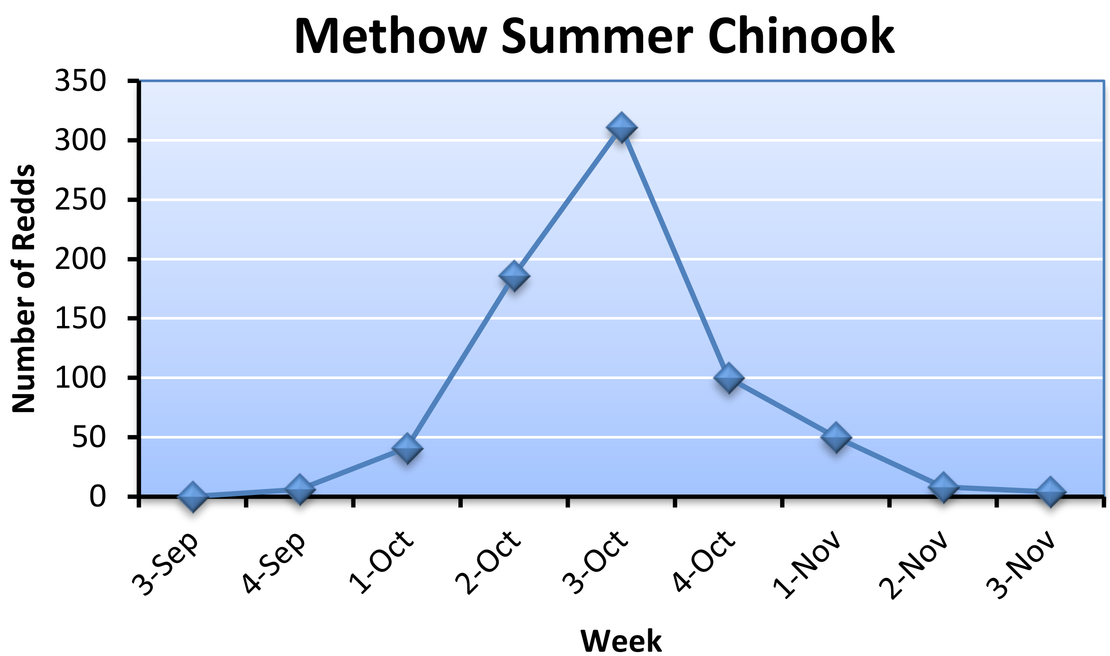


Figure 9.8. Number of new summer Chinook redds counted during different weeks in the Methow River, September through mid-November 2019.

Spawning Escapement

Spawning escapement for Methow summer Chinook was calculated as the total number of redds times the fish per redd ratio estimated from fish sampled at Wells Dam.[43] The estimated fish per redd ratio for Methow summer Chinook in 2019 was 2.32. Multiplying this ratio by the number of redds counted in the Methow River resulted in a total spawning escapement of 1,638 summer Chinook (Table 9.19).

Table 9.19. Spawning escapements for summer Chinook in the Methow River for return years 1989-2019.

Return year	Fish/Redd	Redds	Total spawning escapement
1989*	3.30	149	492
1990*	3.40	418	1,421
1991*	3.70	153	566
1992*	4.30	107	460
1993*	3.30	154	508
1994*	3.50	310	1,085
1995*	3.40	357	1,214
1996*	3.40	181	615
1997*	3.40	205	697
1998	3.00	225	675

[43] Expansion factor = (1 + (number of males/number of females)).

Return year	Fish/Redd	Redds	Total spawning escapement
1999	2.20	448	986
2000	2.40	500	1,200
2001	4.10	675	2,768
2002	2.30	2,013	4,630
2003	2.42	1,624	3,930
2004	2.25	973	2,189
2005	2.93	874	2,561
2006	2.02	1,353	2,733
2007	2.20	620	1,364
2008	3.25	599	1,947
2009	2.54	692	1,758
2010	2.81	887	2,492
2011	3.10	941	2,917
2012	3.07	960	2,947
2013	2.31	1,551	3,583
2014	2.75	591	1,625
2015	3.21	1,231	3,952
2016	2.01	1,115	2,241
2017	2.04	690	1,408
2018	2.30	594	1,367
2019	2.32	706	1,638
Average	***2.88***	***706***	***1,870***
Median	***2.93***	***620***	***1,625***

* Spawning escapement was calculated using the "Modified Meekin Method" (i.e., 3.1 x jack multiplier).

9.6 Carcass Surveys

Surveys for Methow summer Chinook carcasses were conducted during late September to mid-November 2019 in the Methow River (see Appendix Q for more details).

Number sampled

A total of 372 summer Chinook carcasses were sampled during September through mid-November in the Methow River (Table 9.20). This was less than the overall average of 507 carcasses sampled since 1991.

Table 9.20. Numbers of summer Chinook carcasses sampled within each survey reach on the Methow River, 1991-2019. Reach codes are described in Table 2.10.

Survey year	Number of summer Chinook carcasses							
	M-1	M-2	M-3	M-4	M-5	M-6	M-7	Total
1991	0	12	8	4	2	0	0	**26**
1992	8	8	19	0	17	1	0	**53**

Survey year	Number of summer Chinook carcasses							
	M-1	M-2	M-3	M-4	M-5	M-6	M-7	Total
1993	19	25	14	2	5	0	0	**65**
1994[a]	43	33	20	5	13	0	0	**114**
1995	14	33	58	7	7	0	0	**119**
1996	6	30	46	5	2	0	0	**89**
1997	6	12	38	2	19	1	0	**78**
1998	90	84	99	17	30	0	0	**320**
1999	47	144	232	32	37	12	2	**506**
2000	62	118	105	9	99	5	0	**398**
2001	392	275	88	14	76	11	1	**857**
2002	551	318	518	164	219	34	10	**1,814**
2003	115	268	317	115	128	5	0	**948**
2004	40	173	187	82	92	2	1	**577**
2005	154	173	182	42	112	3	0	**666**
2006	121	148	110	56	144	3	1	**583**
2007	142	132	108	27	53	0	0	**462**
2008	64	128	197	33	57	3	0	**482**
2009	144	158	159	36	94	0	0	**591**
2010	105	180	184	38	63	5	1	**576**
2011	56	134	201	78	83	5	1	**558**
2012	127	154	169	75	82	14	7	**628**
2013	296	287	385	90	100	7	5	**1,170**
2014	6	14	176	53	148	73	17	**487**
2015	229	194	221	56	95	19	25	**839**
2016	83	168	216	44	70	1	5	**587**
2017	61	149	120	22	51	5	12	**420**
2018	64	118	98	12	33	2	0	**327**
2019	142	141	70	5	14	0	0	**372**
Average	***110***	***131***	***150***	***39***	***67***	***7***	***3***	***507***
Median	***64***	***141***	***120***	***32***	***63***	***3***	***0***	***487***

[a] An additional 113 carcasses were sampled, but reach was not identified.

Carcass Distribution and Origin

Summer Chinook carcasses were not evenly distributed among reaches within the Methow River in 2019 (Table 9.20; Figure 9.9). Most of the carcasses were found in the lower three reaches (downstream from Twisp). Few carcasses were observed upstream from Winthrop (Reaches 6 and 7).

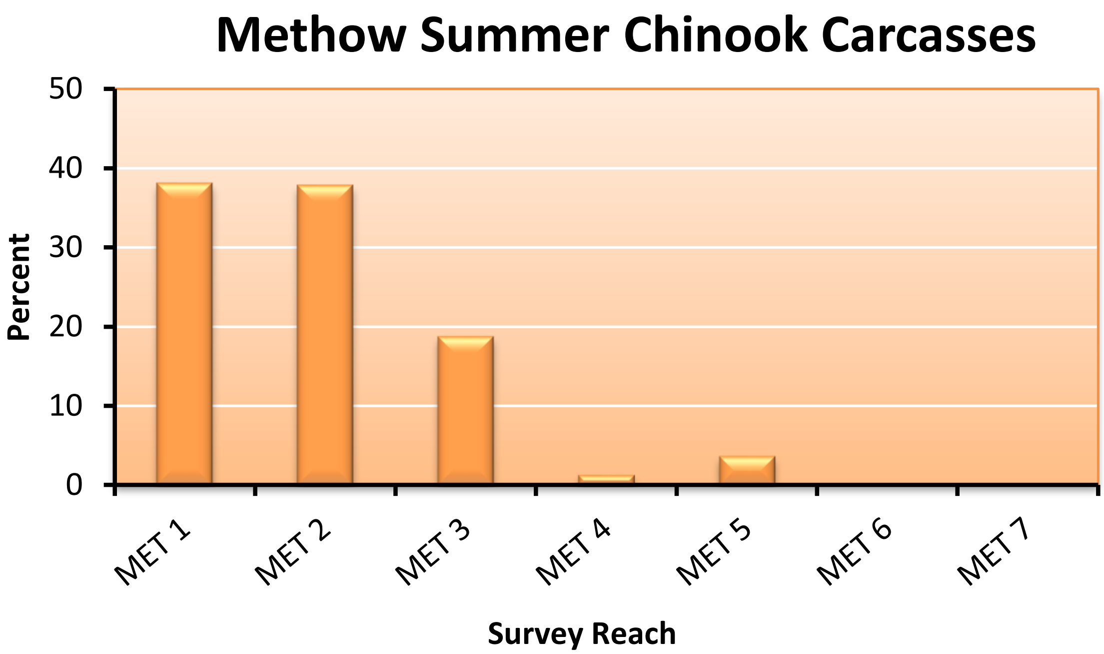


Figure 9.9. Percent of summer Chinook carcasses sampled within different reaches on the Methow River during September through mid-November 2019. Reach codes are described in Table 2.10.

Based on the available data (1991-2019), hatchery and wild summer Chinook carcasses were not distributed equally among the reaches in the Methow River (Table 9.21). A larger percentage of hatchery carcasses occurred in the lower reaches, while a larger percentage of wild summer Chinook carcasses occurred in upstream reaches (Figure 9.10).

Table 9.21. Numbers of wild and hatchery summer Chinook carcasses sampled within different reaches on the Methow River, 1991-2019. Reach codes are described in Table 2.10.

Survey year	Origin	Survey reach							Total
		M-1	M-2	M-3	M-4	M-5	M-6	M-7	
1991	Wild	0	12	8	4	2	0	0	**26**
	Hatchery	0	0	0	0	0	0	0	**0**
1992	Wild	8	8	19	0	17	1	0	**53**
	Hatchery	0	0	0	0	0	0	0	**0**
1993	Wild	11	18	9	0	3	0	0	**41**
	Hatchery	8	7	5	2	2	0	0	**24**
1994	Wild	23	18	9	5	10	0	0	**65**
	Hatchery	20	15	11	0	3	0	0	**49**
1995	Wild	7	9	33	7	6	0	0	**62**
	Hatchery	7	24	25	0	1	0	0	**57**
1996	Wild	1	23	35	4	2	0	0	**65**
	Hatchery	5	7	11	1	0	0	0	**24**
1997	Wild	5	8	31	1	17	0	0	**62**
	Hatchery	1	4	7	1	2	1	0	**16**
1998	Wild	42	48	71	11	25	0	0	**197**

Survey year	Origin	Survey reach							Total
		M-1	M-2	M-3	M-4	M-5	M-6	M-7	
	Hatchery	48	36	28	6	5	0	0	**123**
1999	Wild	32	87	130	15	24	4	2	**294**
	Hatchery	15	57	102	17	13	8	0	**212**
2000	Wild	25	85	85	8	83	3	0	**289**
	Hatchery	37	33	20	1	16	2	0	**109**
2001	Wild	62	118	56	10	70	11	1	**328**
	Hatchery	330	157	32	4	6	0	0	**529**
2002	Wild	138	177	380	140	197	34	9	**1,075**
	Hatchery	413	141	138	24	22	0	1	**739**
2003	Wild	33	146	188	76	92	3	0	**538**
	Hatchery	82	122	129	39	36	2	0	**410**
2004	Wild	16	120	155	65	78	1	0	**435**
	Hatchery	24	53	32	17	14	1	1	**142**
2005	Wild	62	99	133	33	107	3	0	**437**
	Hatchery	92	74	49	9	5	0	0	**229**
2006	Wild	52	82	67	44	109	2	1	**357**
	Hatchery	69	66	43	12	35	1	0	**226**
2007	Wild	35	58	59	16	40	0	0	**208**
	Hatchery	107	74	49	11	13	0	0	**254**
2008	Wild	13	62	146	27	52	2	0	**302**
	Hatchery	51	66	51	6	5	1	0	**180**
2009	Wild	45	87	103	27	84	0	0	**346**
	Hatchery	99	71	56	9	10	0	0	**245**
2010	Wild	33	79	101	24	53	5	1	**296**
	Hatchery	72	101	83	14	10	0	0	**280**
2011	Wild	21	56	87	54	56	5	1	**280**
	Hatchery	35	78	114	24	27	0	0	**278**
2012	Wild	59	53	96	58	74	13	7	**360**
	Hatchery	73	101	73	17	8	1	0	**273**
2013	Wild	110	128	178	67	64	7	5	**559**
	Hatchery	186	160	208	23	36	0	0	**613**
2014	Wild	5	10	148	48	140	70	17	**438**
	Hatchery	2	4	27	5	8	3	0	**49**
2015	Wild	169	136	182	50	90	19	25	**671**
	Hatchery	60	58	39	6	5	0	0	**168**
2016	Wild	51	107	126	33	61	1	5	**384**
	Hatchery	32	61	90	11	9	0	0	**203**
2017	Wild	38	97	91	21	43	5	11	**306**
	Hatchery	23	52	29	1	8	0	1	**114**
2018	Wild	19	51	58	7	22	1	0	**158**
	Hatchery	45	67	40	5	11	1	0	**169**

Survey year	Origin	Survey reach							Total
		M-1	M-2	M-3	M-4	M-5	M-6	M-7	
2019	Wild	25	36	25	1	9	0	0	**96**
	Hatchery	117	105	45	4	5	0	0	**276**
Average	***Wild***	***39***	***70***	***97***	***30***	***56***	***7***	***3***	***301***
	Hatchery	***71***	***62***	***53***	***9***	***11***	***1***	***0***	***207***
Median	***Wild***	***32***	***62***	***87***	***21***	***53***	***2***	***0***	***296***
	Hatchery	***48***	***61***	***40***	***6***	***8***	***0***	***0***	***180***

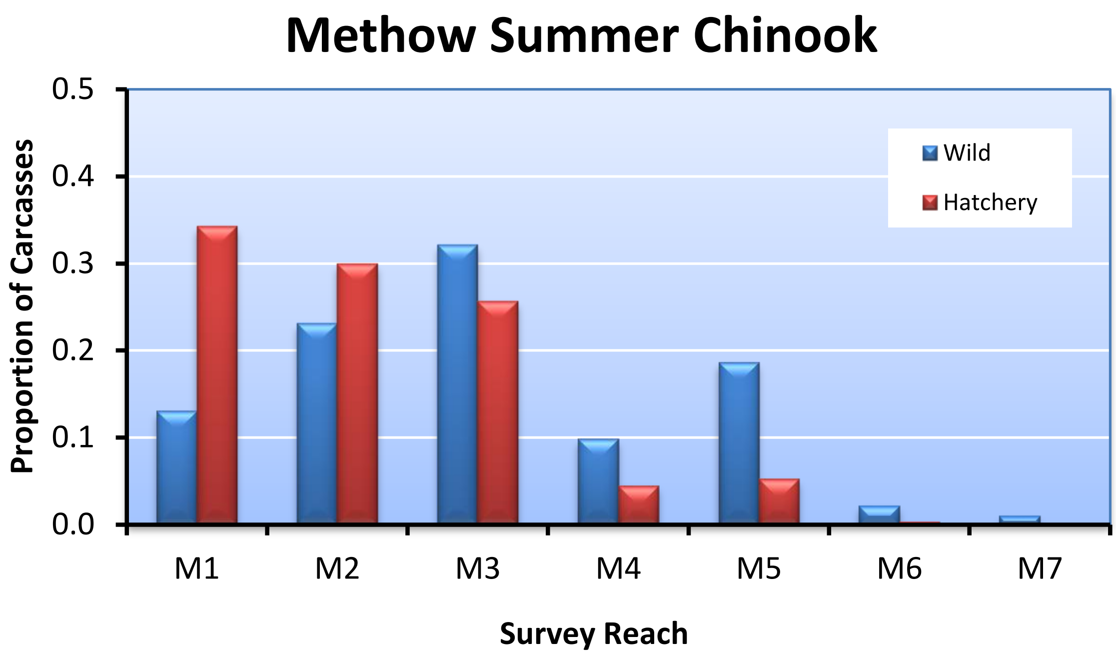


Figure 9.10. Distribution of wild and hatchery produced carcasses in different reaches on the Methow River, 1993-2019. Reach codes are described in Table 2.10.

Sampling Rate

Overall, 23% of the total spawning escapement of summer Chinook in the Methow River basin was sampled in 2019 (Table 9.22). Sampling rates among survey reaches varied from 0 to 28%.

Table 9.22. Number of redds and carcasses, total spawning escapement, and sampling rates for summer Chinook in the Methow River basin, 2019. Reach codes are described in Table 2.10.

Survey reach	Total number of redds	Total number of carcasses	Total spawning escapement	Sampling rate
Methow 1 (M1)	220	142	510	0.28
Methow 2 (M2)	230	141	534	0.26
Methow 3 (M3)	178	70	413	0.17
Methow 4 (M4)	22	5	51	0.10

Survey reach	Total number of redds	Total number of carcasses	Total spawning escapement	Sampling rate
Methow 5 (M5)	42	14	97	0.14
Methow 6 (M6)	1	0	2	0.00
Methow 7 (M7)	13	0	30	0.00
Total	***706***	***372***	***1,638***	***0.23***

Length Data

Mean lengths (POH, cm) of male and female summer Chinook carcasses sampled during surveys on the Methow River in 2019 are provided in Table 9.23. The average size of males and females sampled in the Methow River were 64 cm and 70 cm, respectively.

Table 9.23. Mean lengths (postorbital-to-hypural length; cm) and standard deviations (in parentheses) of male and female summer Chinook carcasses sampled in different reaches on the Methow River, 2019. Reach codes are described in Table 2.10.

Stream/watershed	Mean length (cm)	
	Male	Female
Methow 1 (M1)	63.9 (10.3)	69.1 (5.9)
Methow 2 (M2)	64.0 (10.8)	70.5 (5.6)
Methow 3 (M3)	66.6 (10.8)	69.3 (6.9)
Methow 4 (M4)	58.7 (13.2)	67.5 (7.8)
Methow 5 (M5)	69.3 (6.4)	66.4 (5.3)
Methow 6 (M6)	---	---
Methow 7 (M7)	---	---
Total	***64.2 (10.5)***	***69.5 (6.1)***

9.7 Life History Monitoring

Life history characteristics of Methow summer Chinook were assessed by examining carcasses on spawning grounds and fish collected or examined at broodstock collection sites, and by reviewing tagging data and fisheries statistics.

Migration Timing

Migration timing of hatchery and wild Methow/Okanogan summer Chinook was determined from broodstock data collected at Wells Dam. Counting of summer/fall Chinook at Wells Dam occurs from 29 June to 15 November. Broodstock collection at the Dam occurs from early July (week 27) to mid-September (week 37) (see Table 2.1). Based on broodstock sampling in 2019, wild and hatchery summer Chinook arrived at Wells Dam at the same time early in the run. However, later in the migration period, wild summer Chinook arrived at Wells Dam later than did hatchery summer Chinook (Table 9.24). This general pattern was also observed when the data were pooled for the 2007-2019 survey period.

Table 9.24. The week that 10%, 50% (median), and 90% of the wild and hatchery summer Chinook salmon passed Wells Dam, 2007-2019. The average week is also provided. Migration timing is based on collection of summer Chinook broodstock at Wells Dam.

Survey year	Origin	Methow/Okanogan Summer Chinook Migration Time (week)				Sample size
		10 Percentile	50 Percentile	90 Percentile	Mean	
2007	Wild	27	30	34	30	485
	Hatchery	27	30	33	30	433
2008	Wild	28	30	34	30	542
	Hatchery	28	30	36	31	884
2009	Wild	27	29	34	30	585
	Hatchery	27	29	33	29	708
2010	Wild	27	29	33	29	377
	Hatchery	27	29	32	29	801
2011	Wild	30	32	36	32	516
	Hatchery	30	32	35	33	1223
2012	Wild	28	30	34	31	192
	Hatchery	28	31	34	31	591
2013	Wild	27	30	33	30	229
	Hatchery	27	30	33	30	282
2014	Wild	27	31	40	32	316
	Hatchery	27	30	35	30	208
2015	Wild	26	28	30	28	217
	Hatchery	27	28	31	29	164
2016	Wild	26	29	39	30	314
	Hatchery	25	28	34	29	251
2017	Wild	27	30	35	30	228
	Hatchery	28	31	35	31	236
2018	Wild	25	29	34	29	232
	Hatchery	26	28	33	29	760
2019	Wild	25	29	38	30	244
	Hatchery	25	27	36	28	417
Average	***Wild***	***27***	***30***	***35***	***30***	***344***
	Hatchery	***27***	***29***	***34***	***30***	***535***
Median	***Wild***	***27***	***30***	***34***	***30***	***314***
	Hatchery	***27***	***30***	***34***	***30***	***433***

Age at Maturity

Because hatchery summer Chinook are released after one year of rearing and natural-origin summer Chinook migrate primarily as age-0 fish, total ages will differ between hatchery and natural-origin Chinook (see Hillman et al. 2011). Therefore, in this section, we evaluated age at maturity by comparing differences in salt (ocean) ages between the two groups.

Most of the wild and hatchery summer Chinook sampled during the period 1993-2019 in the Methow River were salt age-3 fish (Table 9.25; Figure 9.11). A higher percentage of salt age-4 wild Chinook returned to the basin than did salt age-4 hatchery Chinook. In contrast, a higher proportion of salt age-1, 2, and 3 hatchery fish returned than did salt age-1, 2, and 3 wild fish. Thus, a higher percentage of wild fish returned at an older age than did hatchery fish.

Table 9.25. Proportions of wild and hatchery summer Chinook of different salt (ocean) ages sampled on spawning grounds in the Methow River, 1993-2019.

Sample year	Origin	Salt age						Sample size
		1	2	3	4	5	6	
1993	Wild	0.05	0.08	0.76	0.11	0.00	0.00	38
	Hatchery	0.00	1.00	0.00	0.00	0.00	0.00	20
1994	Wild	0.03	0.26	0.51	0.20	0.00	0.00	101
	Hatchery	0.00	0.07	0.93	0.00	0.00	0.00	111
1995	Wild	0.00	0.09	0.70	0.20	0.00	0.00	54
	Hatchery	0.02	0.04	0.44	0.51	0.00	0.00	55
1996	Wild	0.04	0.30	0.54	0.13	0.00	0.00	56
	Hatchery	0.00	0.05	0.50	0.41	0.05	0.00	22
1997	Wild	0.00	0.22	0.51	0.27	0.00	0.00	55
	Hatchery	0.13	0.06	0.56	0.25	0.00	0.00	16
1998	Wild	0.09	0.38	0.45	0.09	0.00	0.00	188
	Hatchery	0.02	0.52	0.41	0.04	0.00	0.00	123
1999	Wild	0.01	0.51	0.43	0.05	0.00	0.00	252
	Hatchery	0.00	0.07	0.90	0.03	0.00	0.00	210
2000	Wild	0.01	0.09	0.75	0.16	0.00	0.00	257
	Hatchery	0.10	0.16	0.62	0.11	0.00	0.00	97
2001	Wild	0.02	0.20	0.72	0.07	0.00	0.00	292
	Hatchery	0.10	0.60	0.26	0.04	0.00	0.00	526
2002	Wild	0.01	0.17	0.61	0.21	0.00	0.00	1,003
	Hatchery	0.01	0.41	0.57	0.01	0.00	0.00	734
2003	Wild	0.01	0.11	0.50	0.37	0.00	0.00	478
	Hatchery	0.02	0.03	0.90	0.04	0.00	0.00	399
2004	Wild	0.00	0.09	0.35	0.56	0.00	0.00	394
	Hatchery	0.07	0.28	0.30	0.35	0.00	0.00	141
2005	Wild	0.11	0.74	0.14	0.01	0.00	0.00	410
	Hatchery	0.06	0.26	0.65	0.02	0.00	0.00	220
2006	Wild	0.00	0.02	0.33	0.64	0.00	0.00	356
	Hatchery	0.01	0.19	0.50	0.30	0.00	0.00	164
2007	Wild	0.03	0.09	0.24	0.59	0.05	0.00	208

Sample year	Origin	Salt age						Sample size
		1	2	3	4	5	6	
	Hatchery	0.07	0.09	0.75	0.09	0.01	0.00	213
2008	Wild	0.01	0.14	0.71	0.13	0.01	0.00	298
	Hatchery	0.10	0.45	0.30	0.15	0.00	0.00	138
2009	Wild	0.00	0.11	0.41	0.48	0.00	0.00	317
	Hatchery	0.17	0.26	0.53	0.04	0.00	0.00	242
2010	Wild	0.01	0.16	0.59	0.24	0.00	0.00	269
	Hatchery	0.01	0.69	0.29	0.02	0.00	0.00	247
2011	Wild	0.02	0.09	0.60	0.30	0.00	0.00	255
	Hatchery	0.16	0.10	0.74	0.01	0.00	0.00	261
2012	Wild	0.03	0.24	0.53	0.21	0.00	0.00	315
	Hatchery	0.09	0.71	0.16	0.04	0.00	0.00	243
2013	Wild	0.02	0.25	0.62	0.11	0.00	0.00	533
	Hatchery	0.02	0.18	0.79	0.01	0.00	0.00	570
2014	Wild	0.01	0.12	0.69	0.18	0.00	0.00	412
	Hatchery	0.06	0.43	0.47	0.04	0.00	0.00	47
2015	Wild	0.00	0.20	0.45	0.35	0.00	0.00	588
	Hatchery	0.02	0.61	0.35	0.02	0.00	0.00	136
2016	Wild	0.00	0.02	0.77	0.20	0.00	0.00	350
	Hatchery	0.02	0.14	0.84	0.00	0.00	0.00	175
2017	Wild	0.00	0.02	0.24	0.73	0.01	0.00	283
	Hatchery	0.02	0.45	0.36	0.17	0.00	0.00	104
2018	Wild	0.00	0.06	0.52	0.41	0.01	0.00	144
	Hatchery	0.02	0.56	0.42	0.01	0.00	0.00	146
2019	Wild	0.00	0.06	0.70	0.23	0.00	0.00	81
	Hatchery	0.02	0.26	0.71	0.00	0.00	0.00	246
Average	***Wild***	***0.02***	***0.18***	***0.52***	***0.28***	***0.00***	***0.00***	***296***
	Hatchery	***0.05***	***0.32***	***0.57***	***0.05***	***0.00***	***0.00***	***208***
Median	***Wild***	***0.01***	***0.15***	***0.57***	***0.26***	***0.00***	***0.00***	***283***
	Hatchery	***0.03***	***0.33***	***0.59***	***0.05***	***0.00***	***0.00***	***164***

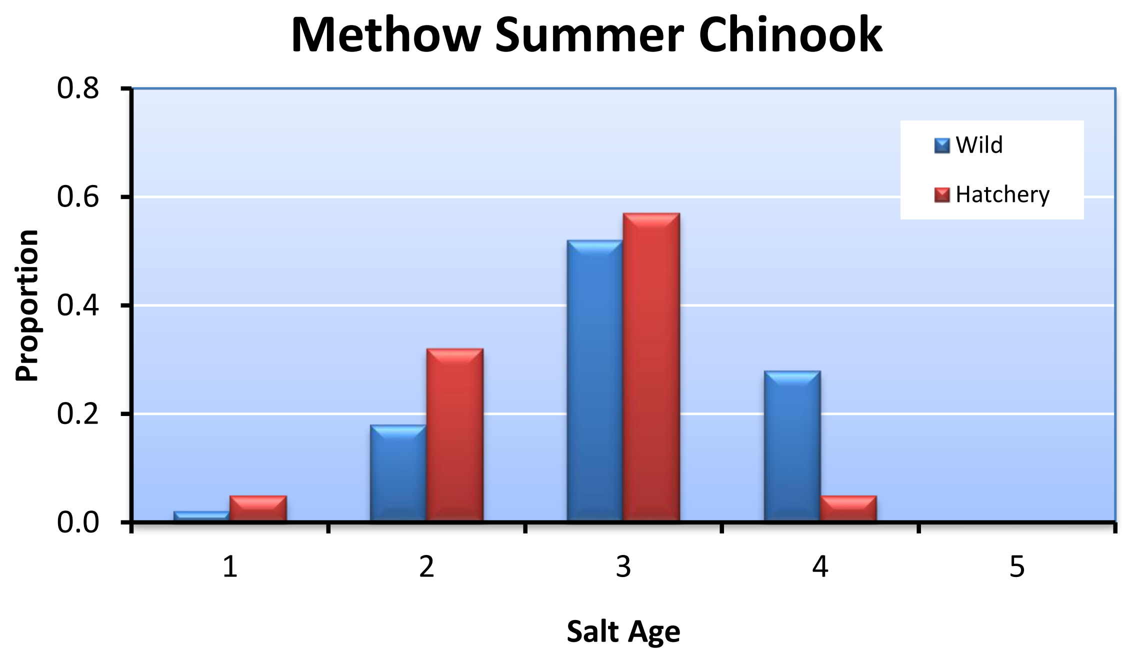


Figure 9.11. Proportions of wild and hatchery summer Chinook of different salt (ocean) ages sampled at broodstock collection sites and on spawning grounds in the Methow River for the combined years 1993-2019.

Size at Maturity

On average, hatchery summer Chinook were about 5 cm smaller than wild summer Chinook sampled in the Methow River basin (Table 9.26). This is likely because a higher percentage of wild fish returned as salt age-4 fish than did hatchery fish. Future analyses will compare sizes of hatchery and wild fish of the same age groups and sex.

Table 9.26. Mean lengths (POH; cm) and variability statistics for wild and hatchery summer Chinook sampled in the Methow River basin, 1993-2019; SD = 1 standard deviation.

Survey year	Origin	Sample size	Summer Chinook length (POH; cm)			
			Mean	SD	Minimum	Maximum
1993[a]	Wild	41	74	9	51	89
	Hatchery	24	62	8	36	80
1994[a]	Wild	112	69	8	35	87
	Hatchery	114	67	5	43	77
1995	Wild	62	74	6	52	88
	Hatchery	56	73	7	46	85
1996	Wild	64	70	11	34	91
	Hatchery	23	72	7	58	85
1997	Wild	62	76	9	35	90
	Hatchery	16	68	15	33	87
1998	Wild	196	67	10	38	97

Survey year	Origin	Sample size	Summer Chinook length (POH; cm)			
			Mean	SD	Minimum	Maximum
	Hatchery	123	63	10	37	87
1999	Wild	292	66	8	43	99
	Hatchery	212	66	7	26	89
2000	Wild	288	74	8	37	89
	Hatchery	109	68	12	24	87
2001	Wild	328	67	10	29	86
	Hatchery	529	63	10	31	87
2002	Wild	1,075	70	8	37	94
	Hatchery	739	67	9	33	87
2003	Wild	538	71	8	35	88
	Hatchery	410	69	8	35	89
2004	Wild	435	73	7	38	89
	Hatchery	142	65	12	34	85
2005	Wild	437	69	8	45	86
	Hatchery	229	64	9	36	79
2006	Wild	438	73	7	35	92
	Hatchery	149	69	8	38	91
2007	Wild	249	72	11	33	89
	Hatchery	219	69	9	22	84
2008	Wild	384	69	8	30	90
	Hatchery	210	63	15	23	86
2009	Wild	363	71	9	32	88
	Hatchery	228	63	12	30	83
2010	Wild	296	69	8	33	90
	Hatchery	280	62	9	39	81
2011	Wild	280	70	9	31	89
	Hatchery	278	64	11	26	82
2012	Wild	355	68	8	36	85
	Hatchery	273	59	9	21	81
2013	Wild	559	65	9	31	89
	Hatchery	613	66	8	27	83
2014	Wild	438	67	7	31	88
	Hatchery	49	60	10	35	76
2015	Wild	588	66	8	38	87
	Hatchery	136	59	8	38	79
2016	Wild	384	68	6	46	84
	Hatchery	203	66	7	37	83
2017	Wild	306	70	7	47	88

Survey year	Origin	Sample size	Summer Chinook length (POH; cm)			
			Mean	SD	Minimum	Maximum
	Hatchery	114	63	8	30	78
2018	Wild	158	67	8	35	91
	Hatchery	169	63	7	39	78
2019	Wild	96	68	7	44	87
	Hatchery	276	67	9	37	81
Pooled	***Wild***	***8,824***	***70***	***8***	***29***	***99***
	Hatchery	***5,923***	***65***	***9***	***21***	***91***

[a] These years include sizes reported in annual reports. The data contained in the WDFW database do not include all these data.

Contribution to Fisheries

Most of the harvest on hatchery-origin Methow summer Chinook occurred in the Ocean (Table 9.27). Ocean harvest has made up 13% to 99% of all hatchery-origin Methow summer Chinook harvested. Brood year 2011 provided the largest harvest, while brood years 1996 and 1999 provided the lowest.

Table 9.27. Estimated number and percent (in parentheses) of hatchery-origin Methow summer Chinook captured in different fisheries, brood years 1989-2013.

Brood year	Ocean fisheries	Columbia River Fisheries			Total	Percent of the brood year escapement harvested[a]
		Tribal	Commercial (Zones 1-5)	Recreational (sport)		
1989	1,043 (52)	884 (44)	0 (0)	66 (3)	1,993	58.9
1990	55 (57)	41 (43)	0 (0)	0 (0)	96	25.4
1991	12 (20)	49 (80)	0 (0)	0 (0)	61	32.8
1992	17 (55)	14 (45)	0 (0)	0 (0)	31	22.3
1993	29 (58)	17 (34)	4 (8)	0 (0)	50	37.9
1994	153 (81)	34 (18)	1 (1)	1 (1)	189	26.4
1995	77 (99)	0 (0)	1 (1)	0 (0)	78	33.6
1996	12 (92)	1 (8)	0 (0)	0 (0)	13	17.6
1997	215 (88)	7 (3)	0 (0)	21 (9)	243	37.6
1998	1,765 (83)	101 (5)	14 (1)	234 (11)	2,114	54.8
1999	2 (13)	13 (87)	0 (0)	0 (0)	15	45.5
2000	366 (71)	88 (17)	27 (5)	33 (6)	514	66.7
2001	326 (52)	97 (15)	43 (7)	160 (26)	626	67.0
2002	271 (48)	96 (17)	61 (11)	137 (24)	565	62.9
2003	58 (58)	17 (17)	7 (7)	18 (18)	100	43.1
2004	133 (49)	55 (20)	16 (6)	68 (25)	272	54.5
2005	298 (54)	137 (25)	50 (9)	65 (12)	550	57.2
2006	1,128 (48)	811 (34)	100 (4)	314 (13)	2,353	62.0
2007	205 (56)	94 (25)	16 (4)	54 (15)	369	72.8

Brood year	Ocean fisheries	Columbia River Fisheries			Total	Percent of the brood year escapement harvested[a]
		Tribal	Commercial (Zones 1-5)	Recreational (sport)		
2008	1,231 (48)	531 (21)	65 (3)	716 (28)	2,543	56.6
2009	318 (39)	258 (32)	28 (3)	209 (26)	813	75.6
2010	530 (43)	481 (39)	26 (2)	207 (17)	1,244	69.9
2011	1578 (46)	988 (29)	136 (4)	725 (21)	3,427	72.5
2012	133 (57)	55 (24)	0 (0)	46 (20)	234	58.8
2013	178 (34)	218 (41)	0 (0)	134 (25)	530	55.8
Average	***406 (56)***	***203 (29)***	***23 (3)***	***128 (12)***	***761***	***50.7***
Median	***205 (54)***	***88 (25)***	***7 (2)***	***54 (12)***	***369***	***55.8***

[a] Percent of brood year escapement harvested = Total brood year harvest / (Total brood year harvest + ∑Hatchery collection + ∑escapement) * 100. In other words, this indicates the percentage of all detected CWTs that ended up in harvest.

Straying

Stray rates were determined by examining CWTs recovered on spawning grounds within and outside the Methow River basin. Targets for strays based on return year (recovery year) within the Upper Columbia River basin (Priest Rapids Dam to Chief Joseph Dam) should be less than 10% and targets for strays outside the upper Columbia River should be less than 5%.

Within the Upper Columbia summer Chinook population, few hatchery-origin Methow summer Chinook have strayed into basins outside the Methow (Table 9.28). Although hatchery-origin Methow summer Chinook have strayed into the Wenatchee River basin, Okanogan River basin, Entiat River basin, Chelan tailrace, and Hanford Reach, on average, they have made up less than 1% of the spawning escapements within those areas.

Hatchery-origin Methow summer Chinook have also strayed into areas outside the Upper Columbia population. Tagged hatchery summer Chinook from the Methow have been detected in Noble Creek in the Coos River watershed, at Big Canyon Trap (for the Wallowa Hatchery), and at Spring Creek, Lyons Ferry, and Marblemount hatcheries. However, few Methow summer Chinook have strayed into each of these locations.

Table 9.28. Number and percent of spawning escapements within other non-target basins that consisted of hatchery-origin Methow summer Chinook, return years 1994-2018. For example, for return year 2002, 0.4% of the summer Chinook escapement in the Okanogan River basin consisted of hatchery-origin Methow summer Chinook. Percent strays should be less than 10%.

Return year	Wenatchee		Okanogan		Chelan		Entiat		Hanford Reach	
	Number	%	Number	%	Number	%	Number	%	Number	%
1994	0	0	72	1.8	-	-	-	-	-	-
1995	0	0.0	9	0.3	-	-	-	-	-	-
1996	0	0.0	0	0.0	-	-	-	-	-	-
1997	0	0.0	0	0.0	-	-	-	-	-	-
1998	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1999	0	0.0	9	0.2	0	0.0	0	0.0	7	0.0
2000	0	0.0	3	0.1	0	0.0	0	0.0	0	0.0

Return year	Wenatchee		Okanogan		Chelan		Entiat		Hanford Reach	
	Number	%	Number	%	Number	%	Number	%	Number	%
2001	0	0.0	0	0.0	0	0.0	0	0.0	7	0.0
2002	0	0.0	54	0.4	0	0.0	0	0.0	0	0.0
2003	0	0.0	1	0.0	6	1.4	0	0.0	0	0.0
2004	0	0.0	7	0.1	3	0.7	0	0.0	0	0.0
2005	0	0.0	24	0.3	0	0.0	0	0.0	0	0.0
2006	0	0.0	12	0.1	0	0.0	0	0.0	0	0.0
2007	0	0.0	17	0.4	2	1.1	3	2.1	0	0.0
2008	0	0.0	12	0.2	0	0.0	0	0.0	0	0.0
2009	0	0.0	14	0.2	0	0.0	0	0.0	0	0.0
2010	6	0.1	44	0.7	22	2.0	0	0.0	0	0.0
2011	0	0.0	45	0.5	8	0.6	0	0.0	0	0.0
2012	0	0.0	31	0.4	0	0.0	0	0.0	0	0.0
2013	0	0.0	10	0.1	0	0.0	0	0.0	0	0.0
2014	0	0.0	15	0.1	0	0.0	0	0.0	0	0.0
2015	0	0.0	40	0.3	4	0.3	0	0.0	0	0.0
2016	0	0.0	20	0.2	0	0.0	0	0.0	0	0.0
2017	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2018	0	0.0	5	0.1	0	0.0	0	0.0	0	0.0
Average	***0***	***0.0***	***18***	***0.3***	***2***	***0.3***	***0***	***0.1***	***1***	***0.0***
Median	***0***	***0.0***	***12***	***0.2***	***0***	***0.0***	***0***	***0.0***	***0***	***0.0***

Based on brood year analyses, on average, 3.2% of the hatchery-origin Methow summer Chinook spawners strayed into non-target streams (Table 9.29). Depending on brood year, percent strays into non-target spawning areas have ranged from 0-12%. In addition, on average, about 7% of hatchery-origin Methow summer Chinook broodstock have been included in non-target hatchery programs.

Table 9.29. Number and percent of hatchery-origin Methow summer Chinook spawners (HOS) that home to the target stream or stray into non-target streams, and the number and percent of hatchery-origin summer Chinook broodstock (HOB) collected for the target hatchery or that were collected for non-target hatcheries, brood years 1989-2013.

Brood year	Hatchery-origin spawner (HOS)				Hatchery-origin broodstock (HOB)			
	Homing		Straying		Broodstock Collection			
	Target stream[1]		Non-target streams[2]		Target hatchery[3]		Non-target hatcheries[4]	
	Number	%	Number	%	Number	%	Number	%
1989	773	55.7	81	5.8	459	33	76	5.5
1990	199	70.6	0	0.0	81	28.7	2	0.7
1991	82	65.6	0	0.0	43	34.4	0	0.0
1992	68	63.0	0	0.0	40	37.0	0	0.0

Brood year	Hatchery-origin spawner (HOS)				Hatchery-origin broodstock (HOB)			
	Homing		Straying		Broodstock Collection			
	Target stream[1]		Non-target streams[2]		Target hatchery[3]		Non-target hatcheries[4]	
	Number	%	Number	%	Number	%	Number	%
1993	54	65.9	6	7.3	22	26.8	0	0.0
1994	419	79.7	13	2.5	94	17.9	0	0.0
1995	126	81.8	0	0.0	28	18.2	0	0.0
1996	57	93.4	0	0.0	4	6.6	0	0.0
1997	379	93.8	18	4.5	7	1.7	0	0.0
1998	1653	94.7	60	3.4	32	1.8	0	0.0
1999	18	100.0	0	0.0	0	0.0	0	0.0
2000	239	93.0	14	5.4	4	1.6	0	0.0
2001	272	88.3	29	9.4	6	1.9	1	0.3
2002	315	94.6	14	4.2	4	1.2	0	0.0
2003	131	99.2	0	0.0	1	0.8	0	0.0
2004	194	85.5	27	11.9	6	2.6	0	0.0
2005	373	90.5	23	5.6	13	3.2	3	0.7
2006	1317	91.3	109	7.6	15	1.0	2	0.1
2007	134	97.1	0	0.0	2	1.4	2	1.4
2008	1886	96.8	25	1.3	15	0.8	23	1.2
2009	182	69.2	0	0.0	14	5.3	67	25.5
2010	223	41.7	42	7.9	9	1.7	261	48.8
2011	775	59.7	47	3.6	79	6.1	398	30.6
2012	98	59.8	0	0.0	4	2.4	62	37.8
2013	328	78.1	2	0.5	19	4.5	71	16.9
Average	***412***	***80.4***	***20***	***3.2***	***40***	***9.6***	***39***	***6.8***
Median	***223***	***85.5***	***13***	***2.5***	***14***	***2.6***	***0***	***0.0***

[1] Target stream includes hatchery-origin summer Chinook that spawned in the Methow River basin.

[2] Non-target streams include hatchery-origin summer Chinook that spawned outside the Methow River basin.

[3] Target hatchery includes broodstock collection at Wells Dam.

[4] Non-target hatcheries include broodstock collections that may be strays or intercepted summer Chinook used in hatchery programs other than the Methow summer Chinook hatchery program. During the last four years, Chief Joseph Hatchery has intercepted most of these fish. Small numbers were intercepted by Eastbank and Marblemount hatcheries.

Genetics

Genetic studies were conducted to investigate relationships among temporally replicated collections of summer Chinook from the Wenatchee River, Methow River, and Okanogan River in the upper Columbia River basin (Kassler et al. 2011; the entire report is appended as Appendix P). A total of 2,416 summer Chinook were collected from tributaries in the upper Columbia River basin. Two collections of natural-origin summer Chinook from 1993 (prior to the supplementation program) were taken from the Wenatchee River basin (N = 139) and compared to collections of hatchery and natural-origin Chinook from 2006 and 2008 (N = 380). Two pre-supplementation collections from the Methow River (1991 and 1993) were compared to supplementation collections from 2006 and 2008 (N = 362). Three pre-supplementation collections from the Okanogan River Basin (1991, 1992, and 1993) were compared with supplementation collections from 2006 and 2008 (N = 669). A collection of natural-origin summer Chinook from the Chelan River was also analyzed (N = 70). Additionally, hatchery collections from Eastbank Hatchery (Wenatchee and Methow/Okanogan stock; N = 221) and Wells Hatchery (N = 294) were analyzed and compared to the in-river collections. Summer Chinook data (provided by the USFWS) from the Entiat River (N = 190) were used for comparison. Lastly, data from eight collections of fall Chinook (N = 2,408) were compared to the collections of summer Chinook. Samples of natural and hatchery-origin summer Chinook were analyzed and compared to determine if the supplementation programs have affected the genetic structure of these populations. The study also calculated the effective number of breeders for collection locations of natural and hatchery-origin summer Chinook from 1993 and 2008.

In general, population differentiation was not observed among the temporally replicated collection locations. A single collection from the Okanogan River (1993) was the only collection showing statistically significant differences. The effective number of breeders was not statistically different from the early collection in 1993 in comparison to the late collection in 2008. Overall, these analyses revealed a lack of differentiation among the temporal replicates from the same locations and among the collection from different locations, suggesting the populations have been homogenized or that there has been substantial gene flow among populations. Additional comparisons among summer-run and fall-run Chinook populations in the upper Columbia River were conducted to determine if there was any differentiation between Chinook with different run timing. These analyses revealed pairwise F_{ST} values that were less than 0.01 for the collections of summer Chinook to collections of fall Chinook from Hanford Reach, lower Yakima River, Priest Rapids, and Umatilla. Collections of fall Chinook from Crab Creek, Lyons Ferry Hatchery, Marion Drain, and Snake River had pairwise F_{ST} values that were higher in comparison to the collections of summer Chinook. The consensus clustering analysis did not provide good statistical support to the groupings but did show relationships among collections based on geographic proximity. Overall the summer and fall run Chinook that have historically been spawned together were not differentiated while fall Chinook from greater geographic distances were differentiated.

It is important to note that no new information will be reported on genetics until the next comprehensive report (data collected through 2018).

Proportionate Natural Influence

Another method for assessing the genetic risk of a supplementation program is to determine the influence of the hatchery and natural environments on the adaptation of the composite population. This is estimated by the proportion of natural-origin fish in the hatchery broodstock (pNOB) and the proportion of hatchery-origin fish in the natural spawning escapement (pHOS). We calculated Proportionate Natural Influence (PNI) by iterating Ford's (2002) equations 5 and 6 to equilibrium, using a heritability of 0.3 and a selection strength of three standard deviations. The larger the PNI value, the greater the strength of selection in the natural environment relative to that of the hatchery environment. For the natural environment to dominate selection, PNI should be greater than 0.50, and integrated populations should have a PNI of at least 0.67 (HSRG/WDFW/NWIFC 2004).

For brood years 1993-2003, the PNI values were generally less than 0.67 (Table 9.30). However, since brood year 2003, PNI has generally been greater than 0.67; brood year 2019 had a PNI value of 0.58.

Table 9.30. Proportionate Natural Influence (PNI) values for the Methow summer Chinook supplementation program for brood years 1989-2019. NOS = number of natural-origin Chinook on the spawning grounds; HOS = number of hatchery-origin Chinook on the spawning grounds; NOB = number of natural-origin Chinook collected for broodstock; and HOB = number of hatchery-origin Chinook included in hatchery broodstock.

Brood year	Spawners			Broodstock			PNI[a]
	NOS	HOS	pHOS	NOB	HOB	pNOB	
1989	492	0	0.00	1,297	312	0.81	1.00
1990	1,421	0	0.00	828	206	0.80	1.00
1991	566	0	0.00	924	314	0.75	1.00
1992	460	0	0.00	297	406	0.42	1.00
1993	314	194	0.38	681	388	0.64	0.64
1994	596	489	0.45	341	244	0.58	0.58
1995	596	618	0.51	173	240	0.42	0.47
1996	435	180	0.29	290	223	0.57	0.67
1997	529	168	0.24	198	264	0.43	0.71
1998	436	239	0.35	153	211	0.42	0.56
1999	573	413	0.42	224	289	0.44	0.53
2000	861	339	0.28	164	339	0.33	0.56
2001	1,122	1,646	0.59	91	266	0.25	0.32
2002	2,572	2,058	0.44	247	241	0.51	0.55
2003	2,307	1,623	0.41	381	101	0.79	0.67
2004	1,622	567	0.26	506	16	0.97	0.79
2005	1,672	889	0.35	391	9	0.98	0.74
2006	1,675	1,058	0.39	500	10	0.98	0.72
2007	660	704	0.52	456	17	0.96	0.66
2008	1,194	753	0.39	404	41	0.91	0.71
2009	1,042	716	0.41	507	0	1.00	0.72
2010	1,326	1,166	0.47	484	8	0.98	0.68
2011	1,503	1,414	0.48	467	26	0.95	0.67
2012	1,593	1,354	0.46	98	1	0.99	0.69
2013	1,693	1,890	0.53	97	4	0.96	0.65
2014	1,451	174	0.11	96	0	1.00	0.90
2015	3,138	814	0.21	97	1	0.99	0.83
2016	1,464	777	0.35	103	0	1.00	0.75
2017	1,042	366	0.26	111	0	1.00	0.80
2018	675	692	0.51	130	1	0.99	0.67
2019	479	1,159	0.71	116	5	0.96	0.58

Brood year	Spawners			Broodstock			PNI[a]
	NOS	HOS	pHOS	NOB	HOB	pNOB	
Average	***1,145***	***725***	***0.35***	***350***	***135***	***0.77***	***0.70***
Median	***1,042***	***692***	***0.39***	***290***	***41***	***0.91***	***0.69***

[a] PNI was calculated previously using PNI approximate equation 11 (HSRG 2009; their Appendix A). All PNI values presented here were recalculated by iterating Ford's (2002) equations 5 and 6 to equilibrium using a heritability of 0.3 and a selection strength of three standard deviations. C. Busack, NOAA Fisheries, 21 March 2016, provided the model for calculating PNI.

Post-Release Survival and Travel Time

We used PIT-tagged fish to estimate survival rates and travel time (arithmetic mean days) of hatchery summer Chinook from the Methow River release site to McNary Dam, and smolt to adult ratios (SARs) from release to detection at Bonneville Dam (Table 9.31).[44] Over the eight brood years for which PIT-tagged hatchery fish were released, survival rates from the Methow River to McNary Dam ranged from 0.485 to 0.775; SARs from release to detection at Bonneville Dam ranged from 0.001 to 0.016. Average travel time from the Methow River to McNary Dam ranged from 17 to 55 days.

Table 9.31. Total number of Methow hatchery summer Chinook released with PIT tags, their survival and travel times (mean days) to McNary Dam, and smolt-to-adult (SAR) ratios for brood years 2008-2017. Standard errors are shown in parentheses. NA = not available (i.e., not all the fish from the release groups have returned to the Columbia River).

Brood year	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
2008	10,094	0.747 (0.055)	39.1 (13.0)	0.016 (0.001)
2009	5,020	0.485 (0.037)	30.2 (11.1)	0.002 (0.001)
2010	0	--	--	--
2011	0	--	--	--
2012	9,801	0.545 (0.046)	17.0 (8.1)	0.001 (0.000)
2013	9,825	0.558 (0.101)	54.5 (8.3)	0.005 (0.001)
2014	4,992	0.624 (0.053)	24.5 (8.1)	0.012 (0.002)
2015	5,064	0.775 (0.088)	23.8 (9.8)	NA
2016	4,424	0.609 (0.068)	24.3 (7.7)	NA
2017	5,034	0.557 (0.114)	36.7 (14.1)	NA

Natural and Hatchery Replacement Rates

Natural replacement rates (NRR) were calculated as the ratio of natural-origin recruits (NOR) to the parent spawning population (spawning escapement). Natural-origin recruits are naturally produced (wild) fish that survive to contribute to harvest (directly or indirectly), to broodstock, and to spawning grounds. We do not account for fish that died in route to the spawning grounds

[44] It is important to point out that because of fish size differences among rearing tanks or raceways, fish PIT tagged in one tank or raceway may not represent untagged fish rearing in other tanks or raceways.

(migration mortality) or died just before spawning (pre-spawn mortality) (see Appendix B in Hillman et al. 2012). We calculated NORs with and without harvest. NORs without harvest include all returning fish that either returned to the basin or were collected as wild broodstock. NORs with harvest include all fish harvested and are based on brood year harvest rates from the hatchery program. For brood years 1989-2013, NRR for summer Chinook in the Methow averaged 1.04 (range, 0.09-4.90) if harvested fish were not included in the estimate and 2.09 (range, 0.16-9.78) if harvested fish were included in the estimate (Table 9.32). NRRs for more recent brood years will be calculated as soon as all tag recoveries and sampling rates have been loaded into the database.

Hatchery replacement rates (HRR) are the hatchery adult-to-adult returns and were calculated as the ratio of hatchery-origin recruits (HOR) to the parent broodstock collected. These rates should be greater than the NRRs and greater than or equal to 3.0 (the calculated target value in Hillman et al. 2019). The target value of 3.0 includes harvest. HRRs exceeded NRRs in 17 out of the 25 years of data, regardless if harvest was or was not included in the estimate (Table 9.32). Hatchery replacement rates for Methow summer Chinook have exceeded the estimated target value of 3.0 in 14 of the 25 years of data.

Table 9.32. Broodstock collected, spawning escapements, natural and hatchery-origin recruits (NOR and HOR), and natural and hatchery replacement rates (NRR and HRR; with and without harvest) for wild summer Chinook in the Methow River basin, brood years 1989-2013.

Brood year	Broodstock Collected	Spawning Escapement	Harvest not included				Harvest included			
			HOR	NOR	HRR	NRR	HOR	NOR	HRR	NRR
1989	202	492	1,389	631	6.88	1.28	3,382	1,532	16.74	3.11
1990	202	1,421	282	978	1.40	0.69	378	1,318	1.87	0.93
1991	266	566	125	287	0.47	0.51	186	429	0.70	0.76
1992	214	460	108	612	0.50	1.33	139	790	0.65	1.72
1993	234	508	82	430	0.35	0.85	132	701	0.56	1.38
1994	260	1,085	526	542	2.02	0.50	715	738	2.75	0.68
1995	242	1,214	154	1,200	0.64	0.99	232	1,807	0.96	1.49
1996	220	615	61	445	0.28	0.72	74	541	0.34	0.88
1997	209	697	404	1,493	1.93	2.14	647	2,315	3.10	3.32
1998	235	675	1,745	3,308	7.43	4.90	3,859	6,603	16.42	9.78
1999	222	986	18	2,862	0.08	2.90	33	5,251	0.15	5.33
2000	222	1,200	257	800	1.16	0.67	771	2,286	3.47	1.91
2001	223	2,768	308	2,574	1.38	0.93	934	6,435	4.19	2.32
2002	222	4,630	333	924	1.50	0.20	898	2,504	4.05	0.54
2003	224	3,930	132	354	0.59	0.09	232	622	1.04	0.16
2004	223	2,189	227	1,544	1.02	0.71	499	3,401	2.24	1.55
2005	225	2,561	412	1,123	1.83	0.44	963	2,496	4.28	0.97
2006	236	2,733	1,443	1,706	6.11	0.62	3,796	3,842	16.08	1.41
2007	209	1,364	138	1,509	0.66	1.11	507	3,992	2.43	2.93
2008	184	1,947	1,949	1,501	10.59	0.77	4,493	2,575	24.42	1.32
2009	223	1,758	263	1,542	1.18	0.88	1,076	4,047	4.83	2.30

Brood year	Broodstock Collected	Spawning Escapement	Harvest not included				Harvest included			
			HOR	NOR	HRR	NRR	HOR	NOR	HRR	NRR
2010	210	2,492	535	2,719	2.55	1.09	1,779	8,857	8.47	3.55
2011	222	2,917	1,299	2,184	5.85	0.75	4,726	5,673	21.29	1.94
2012	128	2,947	164	2,284	1.28	0.78	398	4,550	3.11	1.54
2013	102	3,583	420	671	4.12	0.19	950	1,194	9.31	0.33
Average	***214***	***1,830***	***511***	***1,369***	***2.47***	***1.04***	***1,272***	***2,980***	***6.14***	***2.09***
Median	***222***	***1,421***	***282***	***1,200***	***1.38***	***0.77***	***715***	***2,496***	***3.11***	***1.54***

Smolt-to-Adult Survivals

Smolt-to-adult survival ratios (SARs) were calculated as the number of hatchery adult recaptures divided by the number of tagged hatchery smolts released. Here, SARs were based on CWT returns. For the available brood years, SARs have ranged from 0.00008 to 0.01888 for hatchery summer Chinook in the Methow River basin (Table 9.33).

Table 9.33. Smolt-to-adult ratios (SARs) for Methow summer Chinook, brood years 1989-2013.

Brood year	Number of tagged smolts released[a]	Estimated adult captures[b]	SAR
1989	358,237	2,871	0.00801
1990	371,483	361	0.00097
1991	377,097	130	0.00034
1992	392,636	138	0.00035
1993	200,345	62	0.00031
1994	400,488	710	0.00177
1995	344,974	229	0.00066
1996	289,880	73	0.00025
1997	380,430	643	0.00169
1998	202,559	3,825	0.01888
1999	422,473	33	0.00008
2000	334,337	770	0.00230
2001	246,159	930	0.00378
2002	310,846	895	0.00288
2003	353,495	232	0.00066
2004	394,490	496	0.00126
2005	262,496	961	0.00366
2006	417,795	3,788	0.00907
2007	426,188	506	0.00119
2008	373,234	4,260	0.01141
2009	497,944	1,071	0.00215

Brood year	Number of tagged smolts released[a]	Estimated adult captures[b]	SAR
2010	428,458	1,758	0.00410
2011	424,124	4,643	0.01095
2012	197,391	398	0.00202
2013	188,834	945	0.00500
Average	***343,856***	***1,229***	***0.00375***
Median	***371,483***	***710***	***0.00202***

[a] Includes all tag codes and CWT released fish (CWT + Ad Clip fish and CWT-only fish).
[b] Includes estimated recoveries (spawning ground, hatcheries, harvest, etc.) and observed recoveries if estimated recoveries were unavailable.

9.8 ESA/HCP Compliance

Broodstock Collection

Summer Chinook adults collected at Wells Dam are used primarily for the Methow supplementation programs. On an as needed basis, adults collected at Wells Dam may be used to augment adult collections for the Okanogan summer Chinook supplementation program. Per the 2017 broodstock collection protocol, natural-origin (adipose fin present) adults were targeted for collection between 1 July and 15 September at the West Ladder of Wells Dam for the Methow summer Chinook program. Actual collections occurred between 3 July and 13 September and totaled 118 summer Chinook. ESA Permit 1347 provides authorization to collect Methow and Okanogan summer Chinook at Wells Dam three days per week and up to 16 hours per day from July through November. During 2017, broodstock collection activities were accomplished within the allowable trapping days authorized under ESA Permit 1347.

Collection of Methow summer Chinook broodstock at Wells Dam occurred concurrently with collection of summer steelhead for the Wells steelhead program authorized under ESA Section 10 Permit 1395. Encounters with steelhead and spring Chinook during Methow summer Chinook broodstock collections did not result in takes that were outside those authorized in Permit 1347 and in Permit 1395 for the Wells Steelhead program. Steelhead encountered during summer Chinook collections that were not required for steelhead broodstock were passed at the trap site and were not physically handled. Any spring Chinook encountered during summer Chinook broodstock activities were also passed without handling. No Chinook were collected at Wells Dam for the 2017 Okanogan summer Chinook program.

Hatchery Rearing and Release

The 2017 brood Methow summer Chinook reared throughout their juvenile life-stages at Eastbank Fish Hatchery and the Carlton Acclimation Pond without incident (see Section 9.2). The 2017 brood smolt release totaled 143,594 summer Chinook, representing 71.8% of the 200,000-production objective and was within with the 10% overage allowable in ESA Section 10 Permit 1347.

Hatchery Effluent Monitoring

Per ESA Permit Numbers 1347, 18118, 18120, 18121, and 18583, permit holders shall monitor and report hatchery effluents in compliance with applicable National Pollution Discharge

Elimination Systems (NPDES) (EPA 1999) permit limitations. There were no NPDES violations reported at Eastbank Hatchery or at the Carton Acclimation Facility during the period 1 January through 31 December 2019. NPDES monitoring and reporting for PUD Hatchery Programs during 2019 are provided in Appendix G.

Spawning Surveys

Summer Chinook spawning ground surveys conducted in the Methow River basin during 2019 were consistent with ESA Section 10 Permit No. 1347. Because of the difficulty of quantifying the level of take associated with spawning ground surveys, the Permit does not specify a take level associated with these activities, even though it does authorize implementation of spawning ground surveys. Therefore, no take levels are reported. However, to minimize potential effects to established redds, wading was restricted to the extent practical, and extreme caution was used to avoid established redds when wading was required.

SECTION 10: OKANOGAN/SIMILKAMEEN SUMMER CHINOOK

The goal of summer Chinook salmon supplementation in the Okanogan Basin is to use artificial production to replace adult production lost because of mortality at Wells, Rocky Reach, and Rock Island dams, while not reducing the natural production or long-term fitness of summer Chinook in the basin. The Rock Island Fish Hatchery Complex began operation in 1989 under funding from Chelan PUD. The Complex operated originally through the Rock Island Settlement Agreement, but since 2004 has operated under the Anadromous Fish Agreement and Habitat Conservation Plans.

Before 2012, adult summer Chinook were collected for broodstock from the run-at-large at Wells Dam. Since then, the Colville Tribes collect broodstock using purse seines in the Okanogan and Columbia rivers. The goal was to collect up to 334 adult summer Chinook for the Okanogan program. Broodstock collection occurred from about 7 July through 15 September with trapping occurring no more than 16 hours per day, three days a week. If natural-origin broodstock collection fell short of expectation, hatchery-origin adults could be collected to make up the difference.

Before 2012, adult summer Chinook were spawned and reared at Eastbank Fish Hatchery. Juvenile summer Chinook were transferred from the hatchery to Similkameen Acclimation Pond in October. In addition, since 2005, about 20% (100,000) of the juveniles were transferred to Bonaparte Pond. Chinook were released from the ponds in April to early May.

Prior to 2012, the production goal for the Okanogan summer Chinook supplementation program was to release 576,000 yearling smolts into the Similkameen and Okanogan rivers at ten fish per pound. Beginning with the 2012 brood, the revised production goal is to release 166,569 yearling smolts into the rivers. Targets for fork length and weight are 176 mm (CV = 9.0) and 45.4 g, respectively. Over 90% of these fish are marked with CWTs. In addition, since 2009, juvenile summer Chinook have been PIT tagged annually.

The Colville Tribes began monitoring the Okanogan/Similkameen summer Chinook program in 2013. Their monitoring results are published in annual reports to Bonneville Power Administration (BPA). The purpose of retaining this section is to provide readers with monitoring data collected with Chelan PUD funding through brood year 2012. Thus, this section tracks the status and life histories of summer Chinook up to and including brood year 2012. Results from monitoring brood year 2013 and beyond will be included in annual reports to BPA.

10.1 Broodstock Sampling

Summer Chinook broodstock for the Okanogan/Similkameen and Methow programs were typically collected at the East and West Ladders of Wells Dam. In 2012, purse seines were used to collect broodstock at the mouth of the Okanogan River. In 2012, a total of 81 summer Chinook (79 wild Chinook and two hatchery Chinook)[45] were spawned for the Okanogan program. Refer

[45] It is important to point out that some summer Chinook were used for both the Methow and Okanogan programs in 2012 because of the availability of ripe adults at the time of spawning. In addition, some eyed-eggs were split between the two programs

to Section 9.1 for information on the origin, age and length, sex ratios, and fecundity of summer Chinook broodstock collected at Wells Dam before 2013.

10.2 Hatchery Rearing

In this section, we describe the hatchery rearing of the Okanogan summer Chinook program through brood year 2012. The Colville Tribes began operating the program in 2013. Information on rearing history since brood year 2012 can be found in annual reports prepared by the Colville Tribes and submitted to BPA.

Rearing History

Number of eggs taken

Based on the unfertilized egg-to-release survival standard of 81%, a total of 711,111 eggs were required to meet the program release goal of 576,000 smolts through the 2011 brood year. An evaluation of the program in 2012 determined that 205,134 eggs were needed to meet the revised release goal of 166,569 smolts. This revised goal began with brood year 2012. From 1989 through 2012, the egg take goal was reached in 13 of those years (Table 10.1).

Table 10.1. Numbers of eggs taken from summer Chinook broodstock for the Okanogan program during 1989-2012. From 1989-2011, broodstock were collected at Wells Dam. In 2012, broodstock were collected in purse seines in the Okanogan River.

Return year	Number of eggs taken
1989	724,200
1990	696,144
1991	879,892
1992	729,389
1993	797,234
1994	893,086
1995	736,500
1996	672,000
1997	601,744
1998	584,018
1999	725,589
2000	645,403
2001	418,907
2002	718,599
2003	710,521
2004	805,814
2005	452,928
2006	757,350
2007	824,703
2008	662,668
2009	840,902
2010	726,979

Return year	Number of eggs taken
2011	683,419
Average (1989-2011)	***708,173***
Median (1989-2011)	***724,200***
2012	201,295
Average (2012)	***201,295***
Median (2012)	***201,295***

Number of acclimation days

Summer Chinook were released volitionally from Similkameen Pond as yearling smolts. Transfer dates, release dates, and the number of acclimation days for Okanogan summer Chinook are shown in Table 10.2.

Table 10.2. Number of days Okanogan summer Chinook broods were acclimated at Similkameen and Bonaparte ponds, brood years 1989-2012.

Brood year	Release year	Rearing facility	Transfer date	Release date	Number of days
1989	1991	Similkameen	29-Oct	7-May	190
1990	1992	Similkameen	5-Nov	25-Apr	171
1991	1993	Similkameen	1-Nov	9-Apr	159
1992	1994	Similkameen	2-Nov	1-Apr	150
			26-Feb	1-Apr	34
1993	1995	Similkameen	24-Oct	1-Apr	159
			24-Feb	1-Apr	36
1994	1996	Similkameen	30-Oct	6-Apr	158
			14-Mar	6-Apr	23
1995	1997	Similkameen	1-Oct	1-Apr	182
1996	1998	Similkameen	10-Oct	15-Mar	156
1997	1999	Similkameen	7-Oct	19-Apr	194
1998	2000	Similkameen	5-Oct	19-Apr	196
1999	2001	Similkameen	5-Oct	18-Apr	195
2000	2002	Similkameen	10-Oct	8-Apr	180
2001	2003	Similkameen	1-Oct	29-Apr	210
2002	2004	Similkameen	9-Nov	23-Apr	165
2003	2005	Similkameen	19-Oct	28-Apr	191
2004	2006	Similkameen	26-Oct	23-Apr	179
2005	2007	Bonaparte	6-Nov	11-Apr	156
		Similkameen	25-Oct	18-Apr – 9-May	179-200

Brood year	Release year	Rearing facility	Transfer date	Release date	Number of days
2006	2008	Similkameen	15-17-Oct	16-Apr – 7-May	182-205
2007	2009	Bonaparte	3-4-Nov	10-22-Apr	157-170
		Similkameen	20-24-Oct	14-Apr – 9-May	172-201
2008	2010	Bonaparte	2-4-Nov	19-Apr – 5-May	167-185
		Similkameen	26-28-Oct	19-Apr – 14-May	176-201
2009	2011	Bonaparte	8-9-Nov	12-Apr	155-156
		Similkameen	25-27-Oct	13-Apr – 5-May	169-193
2010	2012	Bonaparte	No program	No program	No program
		Similkameen	25-27 Oct	16-Apr – 7-May	173-196
2011	2013	Bonaparte	No program	No program	No program
		Similkameen	23-26 Oct	16-Apr – 8-May	175-197
2012	2014	Bonaparte	No program	No program	No program
		Similkameen	28-30 Oct	15 Apr – 5 May	167-189

Release Information

Numbers released

The 2012 Okanogan summer Chinook program achieved 68.4% of the 166,569 target goal with about 114,000 fish being released volitionally into the Similkameen River (Table 10.3).

Table 10.3. Numbers of Okanogan summer Chinook smolts released from the Similkameen and Bonaparte ponds, brood years 1989-2012; NA = not available. For brood years 1998-2012, the release target was 576,000 smolts. Since brood year 2013, the release target for Okanogan summer Chinook is 114,000 smolts.

Brood year	Release year	Rearing facility	CWT mark rate	Number of smolts released
1989	1991	Similkameen	0.5732	352,600
1990	1992	Similkameen	0.6800	540,000
1991	1993	Similkameen	0.5335	675,500
1992	1994	Similkameen	0.9819	548,182
1993	1995	Similkameen	0.6470	586,000
1994	1996	Similkameen	0.4176	536,299
1995	1997	Similkameen	0.9785	587,000
1996	1998	Similkameen	0.9769	507,913
1997	1999	Similkameen	0.9711	589,591
1998	2000	Similkameen	0.9825	293,191
1999	2001	Similkameen	0.9689	630,463
2000	2002	Similkameen	0.9928	532,453
2001	2003	Similkameen	0.9877	26,642

Brood year	Release year	Rearing facility	CWT mark rate	Number of smolts released
2002	2004	Similkameen	0.9204	388,589
2003	2005	Similkameen	0.9929	579,019
2004	2006	Similkameen	0.9425	703,359
2005	2007	Bonaparte	0	0 (assumed)
		Similkameen	0.9862	275,919
2006	2008	Similkameen	0.9878	604,035
2007	2009	Bonaparte	0.9920	102,099
		Similkameen	0.9914	513,039
2008	2010	Bonaparte	0.9947	175,729
		Similkameen	0.9947	343,628
2009	2011	Bonaparte	0.9981	151,382
		Similkameen	0.9953	524,521
2010	2012	Similkameen	0.9886	617,950
2011	2013	Similkameen	0.9956	627,978
Average (1989-2011)		***Bonaparte***	***0.7462***	***143,070***
		Similkameen	***0.8907***	***503,647***
Median (1989-2011)		***Bonaparte***	***0.9819***	***540,000***
		Similkameen	***0.9934***	***151,382***
2012	2014	Bonaparte	No program	No program
		Similkameen	0.9939	114,000
Average (2012-present)		***Bonaparte***	***No program***	***No program***
		Similkameen	***0.9939***	***114,000***
Median (2012-present)		***Bonaparte***	***No program***	***No program***
		Similkameen	***0.9939***	***114,000***

Numbers tagged

The 2012 brood Okanogan summer Chinook from the Similkameen facility were 99.4% CWT and adipose fin-clipped (Table 10.3). Table 10.4 summarizes the number of hatchery summer Chinook that have been PIT-tagged and released into the Okanogan River basin. No fish from the 2012 brood year were PIT tagged.

Table 10.4. Summary of PIT-tagging activities for Okanogan hatchery summer Chinook, brood years 2008-2011.

Brood year	Release year	Number of fish tagged	Number of tagged fish that died	Number of tags shed	Number of tagged fish released
2008	2010	5,700 (high density)	1,169	0	4,531
		5,700 (low density)	1,407	0	4,293
2009	2011	5,100	11	0	5,089
2010	2012	0	0	0	0

Brood year	Release year	Number of fish tagged	Number of tagged fish that died	Number of tags shed	Number of tagged fish released
2011	2013	5,100	64	0	5,036

Fish size and condition at release

Size at release of the Similkameen population was 73.3% and 56.8% of the fork length and weight targets, respectively. The CV for fork length exceeded the target by 18.9% (Table 10.5). There was no Bonaparte program for the 2014 release year.

Table 10.5. Mean lengths (FL, mm), weight (g and fish/pound), and coefficient of variation (CV) of Okanogan summer Chinook smolts released from the hatchery, brood years 1989-2012. Size targets are provided in the last row of the table.

Brood year	Release year	Fork length (mm)		Mean weight	
		Mean	CV	Grams (g)	Fish/pound
1989	1991	-	-	41.3	11
1990	1992	143	9.5	37.8	12
1991	1993	125	15.5	22.4	20
1992	1994	120	15.4	20.7	22
1993	1995	132	-	23.2	20
1994	1996	136	16.0	29.6	15
1995	1997	137	8.2	32.8	14
1996	1998	127	12.8	26.2	17
1997	1999	144	9.9	36.0	13
1998	2000	148	5.9	41.0	11
1999	2001	141	15.7	35.4	13
2000	2002	121	13.4	20.4	22
2001	2003	132	8.2	25.7	18
2002	2004	119	13.4	20.8	22
2003	2005	133	10.6	28.9	16
2004	2006	132	9.9	29.8	15
2005	2007	132	9.6	25.9	18
2006	2008	120	12.3	20.9	22
2007	2009	124	12.6	21.9	21
2008	2010	140	12.3	35.1	13
2009	2011	132	11.6	24.7	18
2010	2012	125	10.1	23.2	20
2011	2013	132	9.5	27.9	16
2012	2014	129	7.3	25.8	18
Average		***131***	***11.4***	***28.2***	***17***
Median		***132***	***11.1***	***26.1***	***18***
Targets		***176***	***9.0***	***45.4***	***10***

Survival Estimates

Overall survival of Okanogan summer Chinook from green (unfertilized) egg to release was above the standard set for the program (Table 10.6). Low survival can be attributed to high mortality after ponding through release because of external fungus. Currently, it is unknown if gamete viability is sex biased or is uniform between sexes and more influenced by between-year environmental variations.

Table 10.6. Hatchery life-stage survival rates (%) for Okanogan summer Chinook, brood years 1989-2012. Survival standards or targets are provided in the last row of the table.

Brood year	Rearing facility	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
		Female	Male							
1989[a]	Similkameen	89.8	99.5	89.9	96.7	99.7	99.4	73.3	57.4	48.7
1990[a]	Similkameen	93.9	99.0	84.9	97.1	81.2	80.6	97.7	98.6	77.6
1991[a]	Similkameen	93.1	95.5	88.2	97.1	99.4	99.1	98.4	97.1	76.8
1992[a]	Similkameen	96.9	99.0	87.0	98.0	99.9	99.9	91.7	92.6	75.2
1993[a]	Similkameen	82.2	99.4	85.4	97.6	99.8	99.5	92.0	90.2	73.5
1994	Similkameen	96.1	90.0	86.6	100.0	98.1	97.4	73.1	89.8	60.1
1995	Similkameen	91.9	96.2	98.2	84.1	96.5	96.2	92.7	98.2	79.7
1996	Similkameen	95.4	98.1	83.2	100.0	97.7	96.9	86.5	92.5	75.6
1997	Similkameen	91.9	94.6	86.1	98.4	98.7	98.3	98.8	99.4	98.0
1998	Similkameen	84.0	96.2	54.1	98.0	99.4	98.9	96.6	99.6	50.2
1999	Similkameen	98.8	98.7	92.9	96.9	98.0	97.6	96.9	99.0	86.9
2000	Similkameen	90.5	96.9	89.2	98.5	98.2	98.0	93.6	97.2	82.5
2001	Similkameen	96.2	92.3	89.1	97.6	99.7	99.5	7.4	11.9	6.4
2002	Similkameen	97.1	98.1	89.8	98.0	99.7	99.5	51.6	52.2	54.1
2003	Similkameen	96.7	97.5	86.8	97.6	99.3	98.5	98.0	98.8	81.5
2004	Similkameen	93.6	98.2	84.0	97.6	99.6	99.3	97.8	98.8	80.2
	Bonaparte	93.6	98.2	84.0	97.6	99.6	99.3	97.9	98.9	80.3
2005	Similkameen	97.0	89.6	88.0	99.5	99.5	99.0	93.5	94.6	81.8
	Bonaparte	97.0	89.6	88.0	99.5	99.5	99.0	0.0	0.0	0.0
2006	Similkameen	92.9	89.5	86.3	98.3	99.6	99.3	94.1	95.5	79.8
2007	Similkameen	92.6	99.6	80.8	99.1	99.5	99.1	97.0	98.1	77.7
	Bonaparte	92.6	99.6	80.8	99.1	99.5	99.1	95.6	96.7	76.6
2008	Similkameen	97.9	99.6	91.2	96.8	99.7	99.3	89.8	90.5	79.3
	Bonaparte	97.9	99.6	91.2	96.8	99.7	99.3	86.9	87.8	76.7
2009[b]	Similkameen	93.6	93.5	91.0	98.2	99.7	99.5	97.8	98.6	87.4
	Bonaparte	93.6	93.5	91.0	98.2	99.7	99.5	74.8	75.3	66.8
2010	Similkameen	96.5	100.0	91.2	99.9	97.4	97.1	93.3	96.3	85.0
2011	Similkameen	100.0	90.2	95.9	98.3	99.8	99.1	97.8	98.8	92.2
2012	Similkameen	100.0	100.0	85.1	98.6	99.7	99.3	70.6	71.2	59.3
Mean	***Similkameen***	***94.1***	***96.3***	***86.9***	***97.6***	***98.3***	***97.9***	***86.7***	***88.2***	***72.9***
	Bonaparte	***94.9***	***96.1***	***87.0***	***98.2***	***99.6***	***99.2***	***71.0***	***71.7***	***60.1***
Median	***Similkameen***	***94.7***	***97.8***	***87.5***	***98.0***	***99.5***	***99.1***	***93.6***	***96.7***	***78.5***
	Bonaparte	***93.6***	***98.2***	***88.0***	***98.2***	***99.6***	***99.3***	***86.9***	***87.8***	***76.6***
Standard		***90.0***	***85.0***	***92.0***	***98.0***	***97.0***	***93.0***	***90.0***	***95.0***	***81.0***

[a] Survival rates were calculated from the aggregate population collected at Wells Fish Hatchery volunteer channel and left- and right-ladder traps at Wells Dam.

[b]Survival rates were calculated from aggregate collections at Wells east fish ladder for the Methow and Okanogan/Similkameen programs. About 59% of the total fish collected were used to estimate survival rates.

10.3 Disease Monitoring

Results of adult broodstock bacterial kidney disease (BKD) monitoring for brood years 1997 through 2012 are shown in Table 10.7.

Table 10.7. Proportion of bacterial kidney disease (BKD) titer groups for the Methow/Okanogan summer Chinook broodstock, brood years 1997-2012. Also included are the proportions to be reared at either 0.125 fish per pound or 0.060 fish per pound.

Brood year[a]	Optical density values by titer group				Proportion at rearing densities (fish per pound, fpp)[b]	
	Very Low (≤ 0.099)	Low (0.1-0.199)	Moderate (0.2-0.449)	High (≥ 0.450)	≤ 0.125 fpp (<0.119)	≤ 0.060 fpp (>0.120)
1997	0.6267	0.1333	0.0622	0.1778	0.6844	0.3156
1998	0.9632	0.0184	0.0123	0.0061	0.9816	0.0184
1999	0.9444	0.0198	0.0238	0.0119	0.9643	0.0357
2000	0.7476	0.0952	0.0238	0.1333	0.8000	0.2000
2001	0.9801	0.0199	0.0000	0.0000	1.0000	0.0000
2002	0.9567	0.0130	0.0130	0.0173	0.9740	0.0260
2003	0.9620	0.0127	0.0169	0.0084	0.9747	0.0253
2004	0.9585	0.0151	0.0075	0.0189	0.9736	0.0264
2005	0.9884	0.0000	0.0000	0.0116	0.9884	0.0116
2006	0.9962	0.0038	0.0000	0.0000	0.9962	0.0038
2007	0.9202	0.0266	0.0152	0.0380	0.9354	0.0646
2008	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000
2009	0.9891	0.0073	0.0037	0.0000	0.9927	0.0073
2010	0.9960	0.0040	0.0000	0.0000	1.0000	0.0000
2011	0.9766	0.0140	0.0000	0.0093	0.9860	0.0140
2012	0.9341	0.0440	0.0110	0.0110	0.9780	0.0220
Average	***0.9542***	***0.0267***	***0.0118***	***0.0277***	***0.9518***	***0.0482***
Median	***0.9632***	***0.0146***	***0.0093***	***0.0102***	***0.9798***	***0.0202***

[a] Individual ELISA samples were not collected before the 1997 brood.

[b] ELISA values from broodstock BKD testing dictate what density the progeny of the broodstock are reared. Progeny of broodstock with high ELISA values are reared at lower density.

10.4 Spawning Surveys

Surveys for Okanogan/Similkameen summer Chinook redds were conducted from late September to mid-November in the Okanogan and Similkameen rivers. Total redd counts (not peak counts) were conducted in the rivers.

Redd Counts

During the survey period 1989 through 2018, the number of summer Chinook redds in the Okanogan River basin averaged 2,211 and ranged from 110 to 6,025 (Table 10.8).

Table 10.8. Total number of redds counted in the Okanogan River basin, 1989-2018. The Colville Tribes provided data for survey years 2013 through 2018.

Survey year	Number of summer Chinook redds		
	Okanogan River	Similkameen River	Total count
1989	151	370	521
1990	99	147	246
1991	64	91	155
1992	53	57	110
1993	162	288	450
1994	375	777	1,152
1995	267	616	883
1996	116	419	535
1997	158	486	644
1998	88	276	364
1999	369	1,275	1,644
2000	549	993	1,542
2001	1,108	1,540	2,648
2002	2,667	3,358	6,025
2003	1,035	378	1,413
2004	1,327	1,660	2,987
2005	1,611	1,423	3,034
2006	2,592	1,666	4,258
2007	1,301	707	2,008
2008	1,146	1,000	2,146
2009	1,672	1,298	2,970
2010	1,011	1,107	2,118
2011	1,714	1,409	3,123
2012	1,613	1,066	2,679
2013	2,267	1,280	3,547
2014	2,231	2,022	4,253
2015	2,379	1,897	4,276
2016	3,486	1,790	5,276
2017	2,434	787	3,221
2018	1,554	558	2,112
Average	***1,187***	***1,025***	***2,211***
Median	***1,127***	***997***	***2,115***

* Reach-expanded aerial counts.

Spawning Escapement

Spawning escapement for Okanogan/Similkameen summer Chinook was calculated as the total number of redds times the fish per redd ratio estimated from fish sampled at Wells Dam.[46] During the survey period 1989 through 2018, the summer Chinook spawning escapement within the Okanogan River basin averaged 5,861 and ranged from 473 to 13,857 (Table 10.9).

Table 10.9. Spawning escapements for summer Chinook in the Okanogan and Similkameen rivers for return years 1989-2018. The Colville Tribes provided data for return years 2013 through 2018.

Return year	Fish/Redd	Spawning escapement		
		Okanogan	Similkameen	Total
1989*	3.30	498	1,221	1,719
1990*	3.40	337	500	837
1991*	3.70	237	337	574
1992*	4.30	228	245	473
1993*	3.30	535	950	1,485
1994*	3.50	1,313	2,720	4,033
1995*	3.40	908	2,094	3,002
1996*	3.40	394	1,425	1,819
1997*	3.40	537	1,652	2,189
1998	3.00	264	828	1,092
1999	2.20	812	2,805	3,617
2000	2.40	1,318	2,383	3,701
2001	4.10	4,543	6,314	10,857
2002	2.30	6,134	7,723	13,857
2003	2.42	2,505	915	3,420
2004	2.25	2,986	3,735	6,721
2005	2.93	4,720	4,169	8,889
2006	2.02	5,236	3,365	8,601
2007	2.20	2,862	1,555	4,417
2008	3.25	3,725	3,250	6,975
2009	2.54	4,247	3,297	7,544
2010	2.81	2,841	3,111	5,952
2011	3.10	5,313	4,368	9,681
2012	3.07	4,952	3,273	8,225
2013	2.31	5,237	2,957	8,194
2014	2.86	6,381	5,783	12,164
2015	3.21	7,637	6,089	13,726
2016	2.01	7,007	3,598	10,605
2017	2.04	4,963	1,605	6,568
2018	2.30	3,576	1,284	4,860

[46] Expansion factor = (1 + (number of males/number of females)).

Return year	Fish/Redd	Spawning escapement		
		Okanogan	Similkameen	Total
Average	***2.90***	***3,076***	***2,786***	***5,861***
Median	***2.97***	***2,924***	***2,763***	***5,406***

* Spawning escapement was calculated using the "Modified Meekin Method" (i.e., 3.1 x jack multiplier).

10.5 Carcass Surveys

Surveys for summer Chinook carcasses were conducted during late September to mid-November in the Okanogan and Similkameen rivers.

Number sampled

During the survey period 1993 through 2018, the number of summer Chinook carcasses sampled in the Okanogan River basin averaged 1,356 and ranged from 115 to 3,293 (Table 10.10). In all years, most were sampled in the upper Okanogan River and lower Similkameen River (Table 10.10).

Table 10.10. Numbers of summer Chinook carcasses sampled within each survey reach in the Okanogan River basin, 1993-2018. Reach codes are described in Table 2.11. The Colville Tribes provided data for survey years 2013 through 2018.

Survey year	Number of summer Chinook carcasses								
	Okanogan						Similkameen		Total
	O-1	O-2	O-3	O-4	O-5	O-6	S-1	S-2	
1993[a]	0	2	3	0	23	13	73	1	115
1994[b]	0	4	4	0	27	5	318	60	418
1995	0	0	2	0	30	0	239	15	286
1996	0	0	0	2	5	2	226	0	235
1997	0	0	2	0	9	3	225	1	240
1998	0	1	8	1	7	7	340	4	368
1999	0	0	3	2	23	53	766	48	895
2000	0	2	20	15	47	16	727	41	868
2001	0	26	75	10	127	112	1,141	105	1,596
2002	10	32	83	35	204	572	1,265	259	2,460
2003[c]	0	0	28	0	17	243	596	381	1,265
2004	0	4	31	24	146	283	1,392	298	2,178
2005	0	8	93	37	371	434	731	276	1,950
2006	4	3	31	16	120	291	508	106	1,079
2007	2	0	55	1	453	519	658	29	1,717
2008	4	10	40	36	248	665	859	157	2,019
2009	2	7	31	32	348	500	703	150	1,773
2010	3	10	30	42	241	352	627	148	1,453
2011	0	0	55	14	361	478	753	114	1,775
2012	1	0	56	15	256	537	495	54	1,414

Survey year	Number of summer Chinook carcasses								
	Okanogan						Similkameen		Total
	O-1	O-2	O-3	O-4	O-5	O-6	S-1	S-2	
2013[d]	0	0	30	9	52	432	380	7	910
2014	0	2	79	54	275	783	770	489	2,452
2015	0	10	61	11	283	994	1,702	232	3,293
2016	0	12	14	11	230	1,075	1,214	199	2,755
2017	0	8	9	16	60	628	453	27	1,201
2018	0	0	78	8	134	190	131	6	547
Average	***1***	***5***	***35***	***15***	***158***	***353***	***665***	***123***	***1,356***
Median	***0***	***2***	***31***	***11***	***131***	***322***	***643***	***83***	***1,340***

[a] 25 additional carcasses were sampled on the Similkameen and 46 on the Okanogan without any reach designation.
[b] One additional carcass was sampled on the Similkameen without any reach designation.
[c] 793 carcasses were sampled on the Similkameen before initiation of spawning (pre-spawn mortality) and an additional 40 carcasses were sampled on the Okanogan. The cause of the high mortality (*Ichthyophthirius multifilis* and *Flavobacterium columnarae*) was exacerbated by high river temperatures.
[d] In 2013, the Colville Tribes combined survey reaches O-3 and O-4, and S-1 and S-2. Carcass totals in these reaches were re-apportioned based on redd counts within each reach.

Carcass Distribution and Origin

Based on the available data (1991-2018), most fish, regardless of origin, were found in Reach 1 on the Similkameen River (Driscoll Channel to Oroville Bridge) (Table 10.11). However, a slightly larger percentage of hatchery fish were found in reaches on the Similkameen River than were wild fish (Figure 10.1). In contrast, a larger percentage of wild fish were found in reaches on the Okanogan River.

Table 10.11. Numbers of wild and hatchery summer Chinook carcasses sampled within different reaches in the Okanogan River basin, 1993-2018.

Survey year	Origin	Survey reach								Total
		O-1	O-2	O-3	O-4	O-5	O-6	S-1	S-2	
1993	Wild	0	0	3	0	13	4	48	1	69
	Hatchery	0	2	0	0	10	9	25	0	46
1994	Wild	0	0	1	0	7	1	113	22	144
	Hatchery	0	4	3	0	20	4	205	38	274
1995	Wild	0	0	1	0	10	0	66	4	81
	Hatchery	0	0	1	0	20	0	173	11	205
1996	Wild	0	0	0	1	3	1	53	0	58
	Hatchery	0	0	0	1	2	1	173	0	177
1997	Wild	0	0	1	0	0	3	83	0	87
	Hatchery	0	0	1	0	9	0	142	1	153
1998	Wild	0	1	3	1	6	5	162	4	182
	Hatchery	0	0	5	0	1	2	178	0	186
1999	Wild	0	0	0	0	9	23	293	9	334
	Hatchery	0	0	3	2	14	30	473	39	561
2000	Wild	0	0	8	8	24	11	189	4	244

Survey year	Origin	Survey reach								Total
		O-1	O-2	O-3	O-4	O-5	O-6	S-1	S-2	
	Hatchery	0	2	12	7	23	5	538	37	624
2001	Wild	0	10	23	5	67	42	390	54	591
	Hatchery	0	16	52	5	60	70	751	51	1,005
2002	Wild	6	14	20	10	81	212	340	72	755
	Hatchery	4	18	63	25	123	360	925	187	1,705
2003	Wild	0	0	13	0	12	152	231	124	532
	Hatchery	0	0	15	0	5	91	365	257	733
2004	Wild	0	2	19	19	108	225	1,125	260	1,758
	Hatchery	0	2	12	5	38	58	267	38	420
2005	Wild	0	5	51	21	256	364	531	176	1,404
	Hatchery	0	3	42	16	115	70	200	100	546
2006	Wild	2	2	22	10	105	247	370	73	831
	Hatchery	2	1	9	6	15	44	138	33	248
2007	Wild	1	0	30	1	284	322	405	20	1,063
	Hatchery	1	0	25	0	169	197	253	9	654
2008	Wild	2	1	14	11	107	324	347	41	847
	Hatchery	2	9	26	25	141	341	512	116	1,172
2009	Wild	2	3	13	14	189	347	330	75	973
	Hatchery	0	4	18	18	159	153	373	75	800
2010	Wild	1	5	19	18	154	180	329	69	775
	Hatchery	2	5	11	24	87	172	296	79	676
2011	Wild	0	0	21	4	201	362	216	19	823
	Hatchery	0	0	34	10	160	116	537	95	952
2012	Wild	0	0	18	9	133	427	206	23	816
	Hatchery	1	0	38	6	123	110	288	31	597
2013	Wild	0	0	22	7	37	352	191	4	613
	Hatchery	0	0	8	2	15	80	188	4	297
2014	Wild	0	1	60	47	233	716	641	425	2,123
	Hatchery	1	0	19	7	42	67	129	64	329
2015	Wild	0	5	39	9	209	931	1,186	176	2,555
	Hatchery	0	5	22	2	74	63	516	56	738
2016	Wild	0	6	13	7	186	1,019	819	121	2,171
	Hatchery	0	6	1	4	44	56	395	78	584
2017	Wild	0	4	4	11	50	562	347	19	997
	Hatchery	0	4	5	5	10	66	106	8	204
2018	Wild	0	0	38	7	85	157	83	4	374
	Hatchery	0	0	40	1	49	33	48	2	173
Average	***Wild***	***1***	***2***	***18***	***8***	***99***	***269***	***350***	***69***	***815***
	Hatchery	***1***	***3***	***18***	***7***	***59***	***85***	***315***	***54***	***541***
Median	***Wild***	***0***	***1***	***16***	***7***	***83***	***219***	***311***	***23***	***765***
	Hatchery	***0***	***2***	***12***	***5***	***40***	***65***	***260***	***38***	***554***

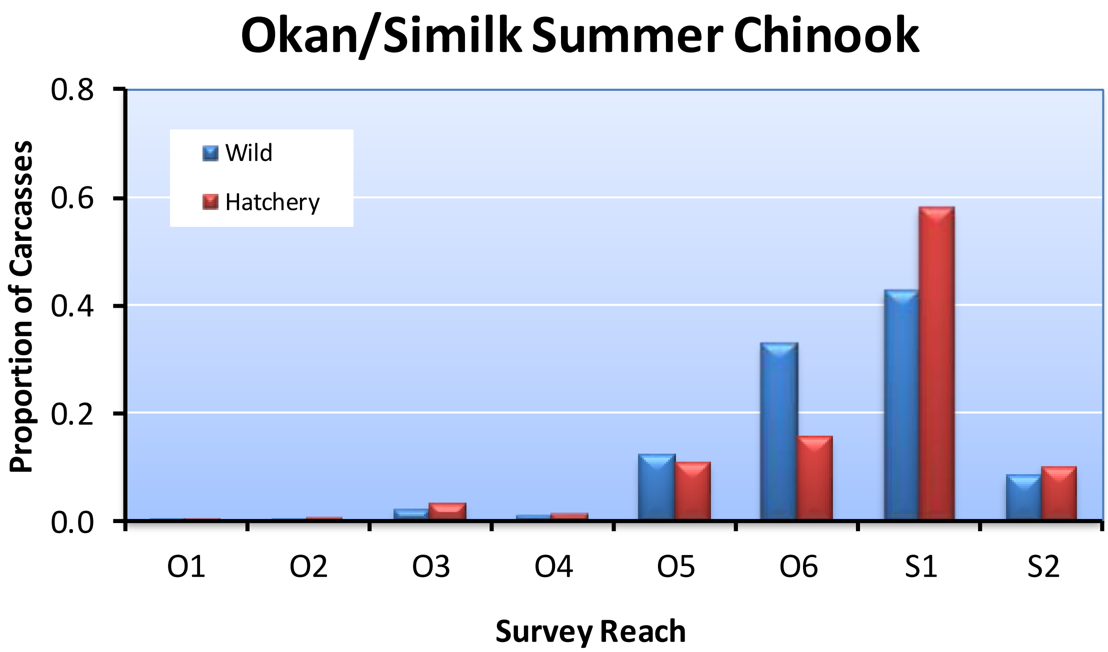


Figure 10.1. Distribution of wild and hatchery produced carcasses in different reaches in the Okanogan River basin, 1993-2018. Reach codes are described in Table 2.11.

10.6 Life History Monitoring

Life history characteristics of Okanogan/Similkameen summer Chinook were assessed by examining carcasses on spawning grounds and fish collected or examined at broodstock collection sites, and by reviewing tagging data and fisheries statistics.

Migration Timing

Migration timing of hatchery and wild Methow/Okanogan summer Chinook was determined from broodstock data collected at Wells Dam. Counting of summer/fall Chinook at Wells Dam occurs from 29 June to 15 November. Broodstock collection at the Dam occurs from early July (week 27) to mid-September (week 37) (see Table 2.1). Based on broodstock sampling in 2018, wild summer Chinook arrived at Wells Dam earlier than hatchery summer Chinook (Table 10.12). This was true throughout most of the migration period. In contrast, there was little difference in migration timing between wild and hatchery summer Chinook when data were pooled for the 2007-2018 survey period.

Table 10.12. The week that 10%, 50% (median), and 90% of the wild and hatchery summer Chinook salmon passed Wells Dam, 2007-2018. The average week is also provided. Migration timing is based on collection of summer Chinook broodstock at Wells Dam.

Survey year	Origin	Methow/Okanogan Summer Chinook Migration Time (week)				Sample size
		10 Percentile	50 Percentile	90 Percentile	Mean	
2007	Wild	27	30	34	30	485
	Hatchery	27	30	33	30	433
2008	Wild	28	30	34	30	542
	Hatchery	28	30	36	31	884
2009	Wild	27	29	34	30	585
	Hatchery	27	29	33	29	708
2010	Wild	27	29	33	29	377
	Hatchery	27	29	32	29	801
2011	Wild	30	32	36	32	516
	Hatchery	30	32	35	33	1223
2012	Wild	28	30	34	31	192
	Hatchery	28	31	34	31	591
2013	Wild	27	30	33	30	229
	Hatchery	27	30	33	30	282
2014	Wild	27	31	40	32	316
	Hatchery	27	30	35	30	208
2015	Wild	26	28	30	28	217
	Hatchery	27	28	31	29	164
2016	Wild	26	29	39	30	314
	Hatchery	25	28	34	29	251
2017	Wild	27	30	35	30	228
	Hatchery	28	31	35	31	236
2018	Wild	25	29	34	29	232
	Hatchery	26	28	33	29	760
Average	***Wild***	***27***	***30***	***35***	***30***	***353***
	Hatchery	***27***	***30***	***34***	***30***	***545***
Median	***Wild***	***27***	***30***	***34***	***30***	***315***
	Hatchery	***27***	***30***	***34***	***30***	***512***

Age at Maturity

Because hatchery summer Chinook are released after one year of rearing and natural-origin summer Chinook migrate primarily as age-0 fish, total ages will differ between hatchery and natural-origin Chinook (see Hillman et al. 2011). Therefore, in this section, we evaluated age at maturity by comparing differences in salt (ocean) ages between the two groups.

Most of the wild and hatchery summer Chinook sampled during the period 1993-2018 in the Okanogan River basin were salt age-3 fish (Table 10.13; Figure 10.2). A higher percentage of salt age-4 wild Chinook returned to the basin than did salt age-4 hatchery Chinook. In contrast, a higher proportion of salt age-1 and 2 hatchery fish returned than did salt age-1 and 2 wild fish. Thus, a higher percentage of wild fish returned at an older age than did hatchery fish.

Table 10.13. Proportions of wild and hatchery summer Chinook of different salt (ocean) ages sampled on spawning grounds in the Okanogan River basin, 1993-2018.

Sample year	Origin	Salt age					Sample size
		1	2	3	4	5	
1993	Wild	0.00	0.21	0.70	0.10	0.00	63
	Hatchery	0.00	0.98	0.02	0.00	0.00	44
1994	Wild	0.02	0.13	0.54	0.31	0.00	134
	Hatchery	0.02	0.09	0.89	0.00	0.00	290
1995	Wild	0.00	0.19	0.59	0.22	0.00	68
	Hatchery	0.01	0.15	0.36	0.49	0.00	200
1996	Wild	0.03	0.28	0.61	0.08	0.00	36
	Hatchery	0.02	0.22	0.56	0.20	0.01	174
1997	Wild	0.04	0.27	0.53	0.15	0.00	73
	Hatchery	0.00	0.02	0.87	0.11	0.00	148
1998	Wild	0.02	0.35	0.52	0.11	0.00	151
	Hatchery	0.05	0.50	0.23	0.22	0.00	185
1999	Wild	0.00	0.20	0.64	0.16	0.00	268
	Hatchery	0.00	0.12	0.85	0.02	0.00	552
2000	Wild	0.03	0.15	0.62	0.20	0.00	216
	Hatchery	0.12	0.02	0.76	0.10	0.00	545
2001	Wild	0.02	0.18	0.76	0.04	0.00	531
	Hatchery	0.05	0.88	0.02	0.05	0.00	1,005
2002	Wild	0.02	0.15	0.62	0.21	0.00	692
	Hatchery	0.01	0.19	0.80	0.01	0.00	1,681
2003	Wild	0.03	0.18	0.63	0.17	0.00	477
	Hatchery	0.03	0.06	0.79	0.12	0.00	653
2004	Wild	0.01	0.17	0.26	0.55	0.00	1,528
	Hatchery	0.01	0.32	0.45	0.23	0.00	382
2005	Wild	0.00	0.12	0.79	0.08	0.01	1,281
	Hatchery	0.02	0.06	0.77	0.15	0.00	530
2006	Wild	0.00	0.02	0.53	0.45	0.00	830
	Hatchery	0.05	0.18	0.24	0.53	0.00	139
2007	Wild	0.02	0.07	0.12	0.78	0.02	1,061
	Hatchery	0.22	0.30	0.42	0.05	0.01	559
2008	Wild	0.01	0.32	0.63	0.04	0.01	846

Sample year	Origin	Salt age					Sample size
		1	2	3	4	5	
	Hatchery	0.02	0.60	0.36	0.02	0.00	1,108
2009	Wild	0.01	0.03	0.81	0.15	0.00	926
	Hatchery	0.05	0.05	0.86	0.03	0.00	783
2010	Wild	0.00	0.16	0.45	0.39	0.00	708
	Hatchery	0.02	0.65	0.27	0.06	0.00	619
2011	Wild	0.01	0.07	0.82	0.10	0.00	787
	Hatchery[a]	0.16	0.08	0.76	0.00	0.00	873
2012	Wild	0.02	0.23	0.41	0.34	0.00	750
	Hatchery	0.05	0.55	0.35	0.05	0.00	532
2013	Wild	0.01	0.17	0.75	0.07	0.00	520
	Hatchery	0.03	0.21	0.74	0.02	0.00	252
2014	Wild	0.02	0.08	0.76	0.14	0.00	1,892
	Hatchery	0.18	0.26	0.55	0.02	0.00	300
2015	Wild	0.00	0.40	0.34	0.25	0.00	2,167
	Hatchery	0.03	0.68	0.26	0.02	0.00	549
2016	Wild	0.00	0.03	0.76	0.21	0.00	1,979
	Hatchery	0.02	0.06	0.87	0.04	0.00	1,255
2017	Wild	0.00	0.02	0.37	0.60	0.00	993
	Hatchery	0.01	0.28	0.40	0.31	0.00	137
2018	Wild	0.01	0.11	0.53	0.35	0.00	260
	Hatchery	0.00	0.51	0.45	0.04	0.00	142
Average	***Wild***	***0.01***	***0.15***	***0.56***	***0.28***	***0.00***	***739***
	Hatchery	***0.05***	***0.30***	***0.59***	***0.07***	***0.00***	***524***
Median	***Wild***	***0.01***	***0.12***	***0.70***	***0.18***	***0.00***	***700***
	Hatchery	***0.04***	***0.24***	***0.63***	***0.10***	***0.00***	***531***

[a] There was one salt age-6 hatchery fish that was not included in this table.

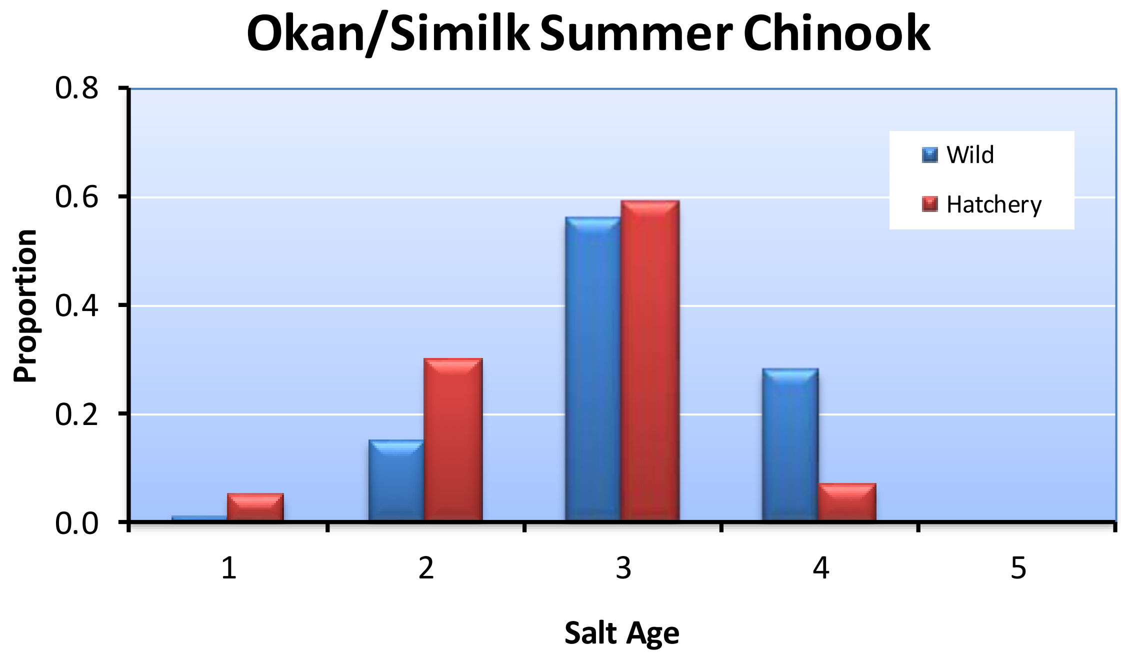


Figure 10.2. Proportions of wild and hatchery summer Chinook of different salt (ocean) ages sampled at broodstock collection sites and on spawning grounds in the Okanogan River basin for the combined years 1993-2018.

Size at Maturity

For the period 1993 through 2018, on average, hatchery summer Chinook were about 2 cm smaller than wild summer Chinook sampled in the Okanogan River basin (Table 10.14). This is likely because a higher percentage of wild fish returned as salt age-4 fish than did hatchery fish.

Table 10.14. Mean lengths (POH; cm) and variability statistics for wild and hatchery summer Chinook sampled in the Okanogan River basin, 1993-2018; SD = 1 standard deviation.

Sample year	Origin	Sample size	Summer Chinook length (POH; cm)			
			Mean	SD	Minimum	Maximum
1993[a]	Wild	69	73	7	52	90
	Hatchery	59	62	6	47	75
1994	Wild	136	71	7	40	86
	Hatchery	268	69	8	30	84
1995	Wild	81	75	6	54	87
	Hatchery	201	73	8	39	87
1996	Wild	22	68	14	22	85
	Hatchery	26	75	8	60	88
1997	Wild	87	70	7	44	84
	Hatchery	148	74	6	48	88
1998	Wild	182	70	8	45	94
	Hatchery	186	65	12	30	87

Sample year	Origin	Sample size	Summer Chinook length (POH; cm)			
			Mean	SD	Minimum	Maximum
1999	Wild	333	73	7	56	91
	Hatchery	559	71	7	23	84
2000	Wild	241	70	10	32	86
	Hatchery	624	69	12	24	92
2001	Wild	578	67	9	26	86
	Hatchery	997	61	8	32	90
2002	Wild	755	69	9	28	91
	Hatchery	1705	70	8	33	87
2003	Wild	532	68	9	30	93
	Hatchery	733	69	10	26	90
2004	Wild	1756	71	10	33	94
	Hatchery	417	66	9	41	92
2005	Wild	1403	66	7	41	99
	Hatchery	546	68	8	31	85
2006	Wild	831	72	6	31	91
	Hatchery	248	71	9	33	87
2007	Wild	1063	75	9	27	99
	Hatchery	654	64	13	30	87
2008	Wild	847	65	9	29	86
	Hatchery	1172	65	8	32	89
2009	Wild	973	70	7	28	89
	Hatchery	799	70	9	35	86
2010	Wild	775	71	9	43	90
	Hatchery	676	64	10	22	87
2011	Wild	823	68	7	29	89
	Hatchery	952	66	11	26	86
2012	Wild	816	67	10	27	93
	Hatchery	597	63	9	23	86
2013	Wild	642	67	8	23	87
	Hatchery	267	71	8	36	88
2014	Wild	2,134	68	8	30	83
	Hatchery	318	64	13	30	89
2015	Wild	2,572	60	9	24	87
	Hatchery	720	58	8	23	78
2016	Wild	2,171	66	6	28	92
	Hatchery	584	67	6	37	86
2017	Wild	997	71	8	30	96
	Hatchery	204	68	9	25	92

Sample year	Origin	Sample size	Summer Chinook length (POH; cm)			
			Mean	SD	Minimum	Maximum
2018	Wild	374	71	8	30	96
	Hatchery	173	68	9	25	92
Pooled	***Wild***	***21,193***	***69***	***8***	***22***	***99***
	Hatchery	***13,833***	***67***	***9***	***22***	***92***

[a] This year includes sizes reported in the annual report. The data contained in the WDFW database do not include all these data.

Contribution to Fisheries

Most of the harvest on hatchery-origin Okanogan/Similkameen summer Chinook occurred in the Ocean (Table 10.15). Ocean harvest has made up 36-100% of all hatchery-origin Okanogan/Similkameen summer Chinook harvested. Brood year 2011 provided the largest harvest, while brood year 1996 provided the lowest.

Table 10.15. Estimated number and percent (in parentheses) of hatchery-origin Okanogan/Similkameen summer Chinook captured in different fisheries, brood years 1989-2012.

Brood year	Ocean fisheries	Columbia River Fisheries			Total	Percent of brood year escapement harvested[a]
		Tribal	Commercial (Zones 1-5)	Recreational (sport)		
1989	2,360 (80)	553 (19)	0 (0)	53 (2)	2,966	39.8
1990	355 (89)	34 (8)	0 (0)	12 (3)	401	28.2
1991	220 (86)	37 (14)	0 (0)	0 (0)	257	14.0
1992	422 (91)	28 (6)	2 (0)	10 (2)	462	20.0
1993	24 (80)	6 (20)	0 (0)	0 (0)	30	25.6
1994	372 (92)	23 (6)	2 (0)	7 (2)	404	26.1
1995	643 (93)	9 (1)	12 (2)	25 (4)	689	23.8
1996	6 (100)	0 (0)	0 (0)	0 (0)	6	18.2
1997	6,483 (92)	136 (2)	36 (1)	424 (6)	7,079	37.1
1998	4,414 (89)	251 (5)	45 (1)	223 (5)	4,933	62.8
1999	1,359 (68)	224 (11)	31 (2)	384 (19)	1,998	70.0
2000	3,139 (69)	533 (12)	222 (5)	675 (15)	4,559	67.1
2001	184 (58)	81 (25)	31 (10)	23 (7)	319	74.9
2002	706 (56)	200 (16)	90 (7)	258 (21)	1,254	63.2
2003	711 (38)	568 (30)	130 (7)	466 (25)	1,875	53.3
2004	3,153 (39)	2,162 (26)	694 (8)	2,168 (27)	8,177	60.9
2005	470 (46)	306 (30)	79 (8)	167 (16)	1,022	61.1
2006	3,136 (37)	3,352 (40)	469 (6)	1,419 (17)	8,376	61.0
2007	1,549 (44)	992 (28)	67 (2)	905 (26)	3,513	70.8
2008	4,226 (38)	2,576 (23)	218 (2)	3,969 (36)	10,989	73.5
2009	2,005 (36)	2,155 (39)	207 (4)	1,138 (21)	5,505	77.2
2010	3,193 (38)	3,933 (46)	247 (3)	1,110 (13)	8,483	79.0
2011	5,801 (40)	5,812 (40)	456 (3)	2,598 (18)	14,667	78.0

Brood year	Ocean fisheries	Columbia River Fisheries			Total	Percent of brood year escapement harvested[a]
		Tribal	Commercial (Zones 1-5)	Recreational (sport)		
2012	771 (35)	827 (37)	13 (1)	619 (28)	2,230	78.4
Average	***1,904 (51)***	***1,033 (27)***	***127 (3)***	***694 (18)***	***3,758***	***53***
Median	***1,065 (63)***	***279 (20)***	***41 (2)***	***321 (14)***	***2,114***	***61***

[a] Percent of brood year escapement harvested = Total brood year harvest / (Total brood year harvest + ∑Hatchery collection + ∑escapement) * 100. In other words, this indicates the percentage of all detected CWTs that ended up in harvest.

Straying

Stray rates were determined by examining CWTs recovered on spawning grounds within and outside the Okanogan River basin. Targets for strays based on return year (recovery year) within the upper Columbia River basin (Priest Rapids Dam to Chief Joseph Dam) should be less than 10% and targets for strays outside the upper Columbia River should be less than 5%.

Within the Upper Columbia River summer Chinook population, few hatchery-origin Okanogan summer Chinook have strayed into basins outside the Okanogan (Table 10.16). Although hatchery-origin Okanogan summer Chinook have strayed into other spawning areas, they usually made up less than 10% of the spawning escapement within those areas. The Chelan tailrace has received the largest number of Okanogan strays.

Hatchery-origin Okanogan summer Chinook have also strayed into areas outside the Upper Columbia population. Tagged hatchery summer Chinook from the Okanogan have been detected in the White Salmon River, Klickitat River, Tucannon River, at Lower Granite Dam on the Snake River, at Three Mile Dam on the Umatilla River, at Pelton Dam on the Deschutes River, and at Tumwater Falls, Lyons Ferry, and Bonneville hatcheries. However, few Okanogan summer Chinook have strayed into each of these locations.

Table 10.16. Number and percent of spawning escapements within other non-target basins that consisted of hatchery-origin Okanogan summer Chinook, return years 1994-2017. For example, for return year 2002, 1% of the summer Chinook spawning escapement in the Entiat Basin consisted of hatchery-origin Okanogan summer Chinook. Percent strays should be less than 10%.

Return year	Wenatchee		Methow		Chelan		Entiat		Hanford Reach	
	Number	%	Number	%	Number	%	Number	%	Number	%
1994	0	0.0	0	0.0	-	-	-	-	-	-
1995	0	0.0	0	0.0	-	-	-	-	-	-
1996	0	0.0	0	0.0	-	-	-	-	-	-
1997	0	0.0	0	0.0	-	-	-	-	-	-
1998	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1999	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2000	0	0.0	6	0.5	30	4.5	0	0.0	3	0.0
2001	12	0.1	0	0.0	10	1.0	0	0.0	0	0.0
2002	0	0.0	3	0.1	4	0.7	5	1.0	0	0.0
2003	0	0.0	8	0.2	22	5.3	14	2.0	0	0.0
2004	0	0.0	0	0.0	5	1.2	0	0.0	0	0.0

Return year	Wenatchee		Methow		Chelan		Entiat		Hanford Reach	
	Number	%	Number	%	Number	%	Number	%	Number	%
2005	5	0.1	27	1.1	36	6.9	7	1.9	8	0.0
2006	0	0.0	5	0.2	4	1.0	7	1.8	0	0.0
2007	0	0.0	3	0.2	4	2.1	0	0.0	0	0.0
2008	0	0.0	9	0.5	46	9.3	4	1.9	0	0.0
2009	15	0.2	3	0.2	11	1.8	18	9.9	0	0.0
2010	6	0.1	0	0.0	33	3.0	0	0.0	0	0.0
2011	0	0.0	0	0.0	46	3.6	0	0.0	0	0.0
2012	7	0.1	5	0.2	19	1.5	0	0.0	0	0.0
2013	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2014	0	0.0	3	0.2	8	0.7	0	0.0	0	0.0
2015	4	0.1	5	0.1	4	0.3	0	0.0	0	0.0
2016	0	0.0	4	0.2	4	0.4	0	0.0	0	0.0
2017	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2018	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Average	**2**	**0.0**	**3**	**0.1**	**14**	**2.1**	**3**	**0.9**	**1**	**0.0**
Median	**0**	**0.0**	**0**	**0.0**	**5**	**1.0**	**0**	**0.0**	**0**	**0.0**

Based on brood year analyses, on average, about 1% of the hatchery-origin Okanogan summer Chinook spawners strayed into non-target streams (Table 10.17). Depending on brood year, percent strays into non-target spawning areas have ranged from 0-4%. In addition, on average, 0.2% of hatchery-origin Okanogan summer Chinook broodstock have been included in non-target hatchery programs.

Table 10.17. Number and percent of hatchery-origin Okanogan summer Chinook spawners (HOS) that home to the target stream or stray into non-target streams, and the number and percent of hatchery-origin summer Chinook broodstock (HOB) collected for the target hatchery or that were collected for non-target hatcheries, brood years 1989-2012.

Brood year	Hatchery-origin spawner (HOS)				Hatchery-origin broodstock (HOB)			
	Homing		Straying		Broodstock Collection			
	Target stream[1]		Non-target streams[2]		Target hatchery[3]		Non-target hatcheries[4]	
	Number	%	Number	%	Number	%	Number	%
1989	3,132	69.7	2	0.0	1,328	29.6	31	0.7
1990	729	71.4	0	0.0	291	28.5	1	0.1
1991	1,125	71.3	0	0.0	453	28.7	0	0.0
1992	1,264	68.5	8	0.4	572	31.0	1	0.1
1993	54	62.1	0	0.0	32	36.8	1	1.1
1994	924	80.8	16	1.4	203	17.7	1	0.1
1995	1,883	85.4	50	2.3	271	12.3	0	0.0
1996	27	100.0	0	0.0	0	0.0	0	0.0

Brood year	Hatchery-origin spawner (HOS)				Hatchery-origin broodstock (HOB)			
	Homing		Straying		Broodstock Collection			
	Target stream[1]		Non-target streams[2]		Target hatchery[3]		Non-target hatcheries[4]	
	Number	%	Number	%	Number	%	Number	%
1997	11,659	97.1	34	0.3	309	2.6	3	0.0
1998	2,784	95.4	31	1.1	102	3.5	2	0.1
1999	828	96.7	10	1.2	18	2.1	0	0.0
2000	2,091	93.6	99	4.4	29	1.3	15	0.7
2001	105	98.1	0	0.0	2	1.9	0	0.0
2002	702	96.2	11	1.5	17	2.3	0	0.0
2003	1,580	96.2	16	1.0	47	2.9	0	0.0
2004	4,947	94.4	85	1.6	206	3.9	2	0.0
2005	606	93.2	22	3.4	22	3.4	0	0.0
2006	5,220	97.6	68	1.3	60	1.1	0	0.0
2007	1,396	96.4	10	0.7	42	2.9	0	0.0
2008	3,600	90.8	23	0.6	337	8.5	4	0.1
2009	993	61.1	11	0.7	621	38.2	1	0.1
2010	924	40.9	9	0.4	1,314	58.2	10	0.4
2011	2,805	67.8	13	0.3	1,295	31.3	25	0.6
2012	445	72.5	0	0.0	168	27.4	1	0.2
Average	**2,076**	**83.2**	**22**	**0.9**	**322**	**15.7**	**4**	**0.2**
Median	**1,195**	**92.0**	**11**	**0.7**	**186**	**6.2**	**1**	**0.1**

[1] Target stream includes hatchery-origin summer Chinook that spawned in the Okanogan River basin.

[2] Non-target streams include hatchery-origin summer Chinook that spawned outside the Okanogan River basin.

[3] Target hatchery includes broodstock collection at Wells Dam.

[4] Non-target hatcheries include broodstock collections that may be strays or intercepted summer Chinook used in hatchery programs other than the Okanogan summer Chinook hatchery program.

Genetics

Genetic studies were conducted to investigate relationships among temporally replicated collections of summer Chinook from the Wenatchee River, Methow River, and Okanogan River in the upper Columbia River basin (Kassler et al. 2011; the entire report is appended as Appendix P). A total of 2,416 summer Chinook were collected from tributaries in the upper Columbia River basin. Two collections of natural-origin summer Chinook from 1993 (prior to the supplementation program) were taken from the Wenatchee River basin (N = 139) and compared to collections of hatchery and natural-origin Chinook from 2006 and 2008 (N = 380). Two pre-supplementation collections from the Methow River (1991 and 1993) were compared to supplementation collections from 2006 and 2008 (N = 362). Three pre-supplementation collections from the Okanogan River Basin (1991, 1992, and 1993) were compared with supplementation collections from 2006 and 2008 (N = 669). A collection of natural-origin summer Chinook from the Chelan River was also analyzed (N = 70). Additionally, hatchery collections from Eastbank Hatchery (Wenatchee and Methow/Okanogan stock; N = 221) and Wells Hatchery (N = 294) were analyzed and compared to the in-river collections. Summer Chinook data (provided by the USFWS) from the Entiat River (N = 190) were used for comparison. Lastly, data from eight collections of fall Chinook (N = 2,408) were compared to the collections of summer Chinook. Samples of natural and hatchery-origin summer Chinook were analyzed and compared to determine if the supplementation programs have affected the genetic structure of these populations. The study also calculated the effective number of breeders for collection locations of natural and hatchery-origin summer Chinook from 1993 and 2008.

In general, population differentiation was not observed among the temporally replicated collection locations. A single collection from the Okanogan River (1993) was the only collection showing statistically significant differences. The effective number of breeders was not statistically different from the early collection in 1993 in comparison to the late collection in 2008. Overall, these analyses revealed a lack of differentiation among the temporal replicates from the same locations and among the collection from different locations, suggesting the populations have been homogenized or that there has been substantial gene flow among populations. Additional comparisons among summer-run and fall-run Chinook populations in the upper Columbia River were conducted to determine if there was any differentiation between Chinook with different run timing. These analyses revealed pairwise F_{ST} values that were less than 0.01 for the collections of summer Chinook to collections of fall Chinook from Hanford Reach, lower Yakima River, Priest Rapids, and Umatilla. Collections of fall Chinook from Crab Creek, Lyons Ferry Hatchery, Marion Drain, and Snake River had pairwise F_{ST} values that were higher in comparison to the collections of summer Chinook. The consensus clustering analysis did not provide good statistical support to the groupings but did show relationships among collections based on geographic proximity. Overall the summer and fall run Chinook that have historically been spawned together were not differentiated while fall Chinook from greater geographic distances were differentiated.

It is important to note that no new information will be reported on genetics until the next comprehensive report (data collected through 2018).

Proportionate Natural Influence

Another method for assessing the genetic risk of a supplementation program is to determine the influence of the hatchery and natural environments on the adaptation of the composite population. This is estimated by the proportion of natural-origin fish in the hatchery broodstock (pNOB) and the proportion of hatchery-origin fish in the natural spawning escapement (pHOS). We calculated Proportionate Natural Influence (PNI) by iterating Ford's (2002) equations 5 and 6 to equilibrium, using a heritability of 0.3 and a selection strength of three standard deviations. The larger the PNI value, the greater the strength of selection in the natural environment relative to that of the hatchery environment. For the natural environment to dominate selection, PNI should be greater than 0.50, and integrated populations should have a PNI of at least 0.67 (HSRG/WDFW/NWIFC 2004).

For brood years 1993-2003, the PNI values were less than 0.67 (Table 10.18). However, since brood year 2003, PNI has generally been greater than 0.67, save 2008 and 2011. PNI results reported here end with brood year 2012. Beginning with brood year 2013, the Colville Confederated Tribes report PNI values for Okanogan summer Chinook in their annual reports to BPA.

Table 10.18. Proportionate Natural Influence (PNI) values for the Okanogan/Similkameen summer Chinook supplementation program for brood years 1989-2012. NOS = number of natural-origin Chinook on the spawning grounds; HOS = number of hatchery-origin Chinook on the spawning grounds; NOB = number of natural-origin Chinook collected for broodstock; and HOB = number of hatchery-origin Chinook included in hatchery broodstock.

Brood year	Spawners			Broodstock			PNI[a]
	NOS	HOS	pHOS	NOB	HOB	pNOB	
1989	1,719	0	0	1,297	312	0.81	1.00
1990	837	0	0	828	206	0.80	1.00
1991	574	0	0	924	314	0.75	1.00
1992	473	0	0	297	406	0.42	1.00
1993	915	570	0.38	681	388	0.64	0.64
1994	1,323	2,710	0.67	341	244	0.58	0.48
1995	979	2,023	0.67	173	240	0.42	0.40
1996	568	1,251	0.69	287	155	0.65	0.50
1997	862	1,327	0.61	197	265	0.43	0.43
1998	600	492	0.45	153	211	0.42	0.50
1999	1,274	2,343	0.65	224	289	0.44	0.42
2000	1,174	2,527	0.68	164	337	0.33	0.35
2001	4,306	6,551	0.6	12	345	0.03	0.09
2002	4,346	9,511	0.69	247	241	0.51	0.44
2003	1,933	1,487	0.43	381	101	0.79	0.66
2004	5,309	1,412	0.21	506	16	0.97	0.83
2005	6,441	2,448	0.28	391	9	0.98	0.78
2006	5,507	3,094	0.36	500	10	0.98	0.74
2007	2,983	1,434	0.32	456	17	0.96	0.76
2008	2,998	3,977	0.57	359	86	0.81	0.60
2009	4,204	3,340	0.44	503	4	0.99	0.70
2010	3,189	2,763	0.46	484	8	0.98	0.69
2011	4,642	5,039	0.52	467	26	0.95	0.65
2012	4,494	3,731	0.45	79	2	0.98	0.69
Average	***2,569***	***2,418***	***0.42***	***415***	***176***	***0.69***	***0.64***
Median	***1,826***	***2,183***	***0.45***	***370***	***209***	***0.77***	***0.66***

[a] PNI was calculated previously using PNI approximate equation 11 (HSRG 2009; their Appendix A). All PNI values presented here were recalculated by iterating Ford's (2002) equations 5 and 6 to equilibrium using a heritability of 0.3 and a selection strength of three standard deviations. C. Busack, NOAA Fisheries, 21 March 2016, provided the model for calculating PNI.

Post-Release Survival and Travel Time

We used PIT-tagged fish to estimate survival rates and travel times (arithmetic mean days) of hatchery summer Chinook from the Similkameen River release site to McNary Dam, and smolt to adult ratios (SARs) from release to detection at Bonneville Dam (Table 10.19).[47] Over the three brood years for which PIT-tagged hatchery fish were released, survival rates from the Similkameen River to McNary Dam ranged from 0.432 to 0.720; SARs from release to detection at Bonneville Dam ranged from 0.016 to 0.031. Average travel time from the Similkameen River to McNary Dam ranged from 41 to 44 days. Although there is only one year in which low densities were compared to high densities (brood year 2008), there was little difference in survival rates and travel times between the two groups (Table 10.19).

Table 10.19. Total number of Okanogan hatchery summer Chinook released with PIT tags, their survival and travel times (mean days) to McNary Dam, and smolt-to-adult (SAR) ratios for brood years 2008-2011. Standard errors are shown in parentheses. NA = not available (i.e., not all the fish from the release groups have returned to the Columbia River).

Brood year	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
2008	4,531 (high density)	0.445 (0.061)	44.0 (10.2)	0.028 (0.002)
	4,293 (low density)	0.432 (0.050)	41.4 (9.7)	0.030 (0.003)
2009	5,089	0.720 (0.102)	41.5 (10.1)	0.016 (0.002)
2010	0	--	--	--
2011	5,036	0.683 (0.064)	41.9 (12.3)	0.031 (0.002)

Natural and Hatchery Replacement Rates

Natural replacement rates (NRR) were calculated as the ratio of natural-origin recruits (NOR) to the parent spawning population (spawning escapement). Natural-origin recruits are naturally produced (wild) fish that survive to contribute to harvest (directly or indirectly), to broodstock, and to spawning grounds. We do not account for fish that died in route to the spawning grounds (migration mortality) or died just before spawning (pre-spawn mortality) (see Appendix B in Hillman et al. 2012). We calculated NORs with and without harvest. NORs without harvest include all returning fish that either returned to the basin or were collected as wild broodstock. NORs with harvest include all fish harvested and are based on brood year harvest rates from the hatchery program. For brood years 1989-2012, NRR for summer Chinook in the Okanogan averaged 1.07 (range, 0.17-3.82) if harvested fish were not included in the estimate and 2.36 (range, 0.32-9.83) if harvested fish were included in the estimate (Table 10.20). Beginning with brood year 2013, the Colville Confederated Tribes report NRRs for Okanogan summer Chinook in their annual reports to BPA.

Hatchery replacement rates (HRR) are the hatchery adult-to-adult returns and were calculated as the ratio of hatchery-origin recruits (HOR) to the parent broodstock collected. These rates should be greater than the NRRs and greater than or equal to 8.6 (the calculated target value in Hillman et al. 2019). The target value of 8.6 includes harvest. HRRs exceeded NRRs in 21 of the 24 years of data, regardless if harvest was or was not included in the estimate (Table 10.20). Hatchery replacement rates for Okanogan summer Chinook have exceeded the estimated target value of 8.6

[47] It is important to point out that because of fish size differences among rearing tanks or raceways, fish PIT tagged in one tank or raceway may not represent untagged fish rearing in other tanks or raceways.

in 13 of the 24 years (brood years 1989-2012). Beginning with brood year 2013, the Colville Confederated Tribes report HRRs for Okanogan summer Chinook in their annual reports to BPA.

Table 10.20. Broodstock collected, spawning escapements, natural and hatchery-origin recruits (NOR and HOR), and natural and hatchery replacement rates (NRR and HRR; with and without harvest) for wild summer Chinook in the Okanogan River basin, brood years 1989-2012. Beginning with brood year 2013, the Colville Confederated Tribes report productivity values for Okanogan summer Chinook in their annual reports to BPA.

Brood year	Broodstock Collected	Spawning Escapement	Harvest not included				Harvest included			
			HOR	NOR	HRR	NRR	HOR	NOR	HRR	NRR
1989	304	1,719	4,493	2,146	14.78	1.25	7,459	3,577	24.54	2.08
1990	288	837	1,021	1,477	3.55	1.76	1,422	2,063	4.94	2.46
1991	364	574	1,578	629	4.34	1.10	1,835	728	5.04	1.27
1992	304	473	1,845	752	6.07	1.59	2,307	942	7.59	1.99
1993	328	1,485	87	1,003	0.27	0.68	117	1,348	0.36	0.91
1994	302	4,033	1,144	2,168	3.79	0.54	1,548	2,942	5.13	0.73
1995	385	3,002	2,204	959	5.72	0.32	2,893	1,262	7.51	0.42
1996	330	1,819	27	466	0.08	0.26	33	574	0.10	0.32
1997	313	2,189	12,005	4,363	38.35	1.99	19,084	6,807	60.97	3.11
1998	352	1,092	2,919	4,166	8.29	3.82	7,852	10,737	22.31	9.83
1999	333	3,617	856	6,641	2.57	1.84	2,854	16,080	8.57	4.45
2000	334	3,701	2,234	1,716	6.69	0.46	6,793	4,727	20.34	1.28
2001	335	10,857	107	8,959	0.32	0.83	426	35,836	1.27	3.30
2002	333	13,857	730	6,077	2.19	0.44	1,984	16,559	5.96	1.19
2003	337	3,420	1,643	566	4.88	0.17	3,518	1,215	10.44	0.36
2004	335	6,721	5,240	3,119	15.64	0.46	13,417	7,977	40.05	1.19
2005	338	8,889	650	6,177	1.92	0.69	1,672	14,707	4.95	1.65
2006	355	8,601	5,348	2,421	15.06	0.28	13,724	5,206	38.66	0.61
2007	314	4,417	1,448	6,241	4.61	1.41	4,961	13,993	15.80	3.17
2008	276	6,975	3,964	2,702	14.36	0.39	14,953	5,537	54.18	0.79
2009	335	7,544	1,626	7,074	4.85	0.94	7,131	19,541	21.29	2.59
2010	301	5,952	2,257	12,236	7.50	2.06	10,740	41,338	35.68	6.95
2011	306	9,681	4,138	6,418	13.52	0.66	18,805	19,870	61.45	2.05
2012	94	8,225	614	15,343	6.53	1.87	2,844	31,570	30.26	3.84
Average	***317***	***4,987***	***2,424***	***4,326***	***7.75***	***1.07***	***6,182***	***11,047***	***20.31***	***2.36***
Median	***332***	***3,867***	***1,635***	***2,911***	***5.30***	***0.76***	***3,206***	***6,172***	***13.12***	***1.82***

Smolt-to-Adult Survivals

Smolt-to-adult survival ratios (SARs) were calculated as the number of hatchery adult recaptures divided by the number of tagged hatchery smolts released. Here, SARs were based on CWT returns. For brood years 1989-2012, SARs have ranged from 0.00007 to 0.03243 for hatchery summer Chinook in the Okanogan River basin (Table 10.21). Beginning with brood year 2013, the Colville Confederated Tribes report SARs for Okanogan summer Chinook in their annual reports to BPA.

Table 10.21. Smolt-to-adult ratios (SARs) for Okanogan/Similkameen summer Chinook, brood years 1989-2012. Beginning with brood year 2013, the Colville Confederated Tribes report SARs for Okanogan summer Chinook in their annual reports to BPA.

Brood year	Number of tagged smolts released[a]	Estimated adult captures[b]	SAR
1989	202,125	4,293	0.02124
1990	367,207	972	0.00265
1991	360,380	975	0.00271
1992	537,190	2,282	0.00425
1993	379,139	117	0.00031
1994	217,818	1,526	0.00701
1995	574,197	2,842	0.00495
1996	487,776	32	0.00007
1997	572,531	18,570	0.03243
1998	287,948	7,742	0.02689
1999	610,868	2,782	0.00455
2000	528,639	6,765	0.01280
2001	26,315	424	0.01611
2002	245,997	1,979	0.00804
2003	574,908	3,503	0.00609
2004	676,222	12,960	0.01917
2005	273,512	1,662	0.00608
2006	597,276	13,605	0.02278
2007	610,379	4,943	0.00810
2008	516,533	14,894	0.02883
2009	522,295	7,119	0.01363
2010	610,927	10,666	0.01746
2011	625,234	18,757	0.03000
2012	113,305	2,834	0.02501
Average	***438,280***	***5,927***	***0.01338***
Median	***519,414***	***3,173***	***0.01045***

[a] Includes all tag codes and CWT released fish (CWT + Ad Clip fish and CWT-only fish).
[b] Includes estimated recoveries (spawning ground, hatcheries, harvest, etc.) and observed recoveries if estimated recoveries were unavailable.

10.7 ESA/HCP Compliance

Broodstock Collection

Direct and/or indirect take of ESA-listed species during broodstock collection for the Okanogan summer Chinook outside of Wells Dam is covered by permits held by the Colville Tribes.

Hatchery Rearing and Release

Activities associated with the spawning, rearing, and release of Okanogan summer Chinook that could result in either direct or incidental take of listed species is covered under ESA permits held by the Colville Tribes.

Hatchery Effluent Monitoring

Per ESA Permits 1347, 1395, 18118, 18120, 18121, and 18583, permit holders shall monitor and report hatchery effluents in compliance with applicable National Pollution Discharge Elimination Systems (NPDES) (EPA 1999) permit limitations. There were no NPDES violations reported at the Similkameen Acclimation Facility during the period 1 January through 31 December 2019. NPDES monitoring and reporting for PUD Hatchery Programs during 2019 are provided in Appendix G. NPDES reporting for Okanogan summer Chinook only covers the Similkameen Acclimation Facility and only during the time fish are present.

SECTION 11: CHELAN FALLS SUMMER CHINOOK

The Chelan Falls summer Chinook program (formerly the Turtle Rock program) included the production of 200,000 fish for No Net Impact (NNI) compensation for passage mortalities associated with Rocky Reach Dam and a 400,000 subyearling/yearling program for compensation for lost spawning habitat as a result of the construction of Rocky Reach Dam. In 2011, as part of the periodic recalculation of NNI for Rocky Reach Dam (inundation), the previous 200,000 NNI program was reduced to 176,000 fish. This reduced the combined Chelan Falls summer Chinook production from 600,000 to 576,000 beginning with the 2012 brood.

Before 2012, broodstock were collected at the Wells Dam volunteer trap (WDVT). Summer Chinook were spawned at Wells Fish Hatchery and fertilized eggs were then transferred to Eastbank Fish Hatchery for hatching and rearing. In 2012, adults were collected at the WDVT and then transferred to Eastbank Fish Hatchery for spawning, hatching, and rearing. Beginning in 2013, broodstock collection was initiated at the Eastbank Fish Hatchery Outfall. With returns to the Outfall diminishing, a pilot broodstock collection program was initiated in 2016 at the outlet structure of the water conveyance canal for the Chelan Tailrace Pump Station (Chelan Falls Canal Trap) and continued through 2018. Concurrently, while collection of broodstock from the Chelan Falls Canal Trap was evaluated, the Entiat National Fish Hatchery and WDVT were used as backup broodstock collection sites. Beginning in 2019, a weir was installed in the habitat channel adjacent to the conveyance canal as another pilot location for broodstock collection. The WDVT was used once again as a backup to this pilot effort.

The original program consisted of both subyearling (normal and accelerated groups) and yearling releases. Subyearlings were transferred to Turtle Rock Fish Hatchery for acclimation in May. These fish were released in June after about 30 days of acclimation on Columbia River water. The goal of this program was to release 1,620,000 subyearling summer Chinook (810,000 normal and 810,000 accelerated subyearlings) into the Columbia River at 40 fish per pound. Targets for fork length and weight were 112 mm (CV = 9.0) and 11.4 g, respectively. Over 50% of both subyearling groups were marked with CWTs. In 2010, the subyearling program was converted to a 400,000-yearling program.

The goal of the yearling program was to release 200,000 summer Chinook smolts into the Columbia River from Turtle Rock Fish Hatchery at 10 fish per pound. Targets for fork length and weight were 176 mm (CV = 9.0) and 45.4 g, respectively. Beginning with the 2006 brood year, yearling summer Chinook were acclimated at both Turtle Rock Fish Hatchery and the Chelan River net pens. With the conversion of the subyearling program to a yearling program and the reduction of the NNI component to 176,000, the current goal is to release 576,000 yearling summer Chinook smolts (176,000 from the NNI program plus 400,000 from the converted subyearling program). Beginning in 2012, the 576,000 yearlings are acclimated overwinter at the Chelan Falls Acclimation Facility on Chelan River water. In 2012, the Turtle Rock program officially became the Chelan Falls summer Chinook program and all fish were overwinter-acclimated at the Chelan Falls Acclimation Facility.

Over 90% of yearling summer Chinook have been marked with CWTs and all are ad-clipped. In addition, juvenile summer Chinook were PIT tagged within each of the circular and standard raceways.

11.1 Broodstock Sampling

Before 2013, broodstock for the program were collected at the WDVT. Refer to Snow et al. (2012) for information related to adults collected for those programs. Beginning in 2013, broodstock collection for the Chelan Falls program was piloted at the Eastbank Hatchery Outfall (EBO). With diminishing returns to the EBO, the Chelan Falls Canal trap was piloted between 2016 through 2018, with backup trapping locations at the Entiat National Fish Hatchery and WDVT. Beginning in 2019, a weir was installed in the Chelan River area (which included seining upstream from the wier to capture escaped fish), with the WDVT used as a backup collection location. This section focuses on results from sampling broodstock from 2013 to present.

Origin of Broodstock

Broodstock collected in 2013-2019 consisted entirely of hatchery-origin summer Chinook (Table 11.1).

Table 11.1. Numbers of wild and hatchery summer Chinook collected for broodstock, numbers that died before spawning, and numbers of Chinook spawned for the Chelan Falls summer Chinook program during 2013-2019. Unknown-origin fish (i.e., undetermined by scale analysis, no CWT or fin clips, and no additional hatchery marks) were considered naturally produced. Mortality includes fish that died of natural causes typically near the end of spawning and were not needed for the program and surplus fish killed at spawning.

Brood year	Wild summer Chinook					Hatchery summer Chinook					Total number spawned
	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	
2013[c]	-	-	-	-	-	318	4	0	314	0	314
2014[c]	-	-	-	-	-	331	19	15	297	0	297
2015[cd]	-	-	-	-	-	351	17	14[b]	320	0	320
2016[ce]	-	-	-	-	-	350	5	1	344	0	344
2017[fe]	-	-	-	-	-	351	10	0	341	0	341
2018[fg]	2	0	0	2	0	387	5	4	378	0	380
2019[hg]	-	-	-	-	-	591	14	148[i]	429	0	429
Average	-	-	-	-	-	***394***	***11***	***26***	***346***	***0***	***346***
Median	-	-	-	-	-	***351***	***10***	***4***	***341***	***0***	***341***

[a] Pre-spawn loss represents the number of fish that died during the holding period before spawning. Mortality is the number of fish that were surplused following spawning.
[b] There was an additional 85 fish surplused that were excess from collections at Chief Joseph Fish Hatchery and were not included in mortality estimates.
[c] Broodstock collected from Eastbank Fish Hatchery outfall
[d] Broodstock collected from Chief Joe Fish Hatchery adult fish ladder
[e] Broodstock collected from Entiat National Fish Hatchery
[f] Broodstock collected from Chelan Falls Canal Trap
[g] Broodstock collected from Wells Dam Volunteer Trap
[h] Broodstock collected from Chelan River Weir
[i] Represents surplused adults not intended to be used for the Chelan Falls Program but could be used for the Yakama Summer Chinook program.

Age/Length Data

Ages of summer Chinook broodstock were determined from analysis of scales and/or CWTs. Broodstock collected from the 2017 return consisted primarily of age-4 and 5 hatchery-origin Chinook (96.9%). Age-3 hatchery-origin Chinook made up 3.1% of the broodstock (Table 11.2).

Broodstock collected from the 2018 return consisted primarily of age-4 and 5 hatchery-origin Chinook (99.7%). Age-6 hatchery-origin Chinook made up 0.3% of the broodstock. There were two natural-origin Chinook broodstock but only one had a useable scale age (Table 11.2).

Broodstock collected from the 2019 return consisted primarily of age-4 and 5 hatchery-origin Chinook (98.9%). Age-6 hatchery-origin Chinook made up 0.9% of the broodstock. There were no natural-origin Chinook broodstock. (Table 11.2).

Table 11.2. Percent of hatchery and wild summer Chinook of different ages (total age) collected from broodstock for the Chelan Falls summer Chinook program, 2013-2019.

Return Year	Origin	Total age				
		2	3	4	5	6
2013	Wild	--	--	--	--	--
	Hatchery	0.0	0.0	37.0	62.0	1.0
2014	Wild	--	--	--	--	--
	Hatchery	0.0	0.0	37.0	62.0	1.0
2015	Wild	--	--	--	--	--
	Hatchery	0.0	2.3	53.8	43.5	0.3
2016	Wild	--	--	--	--	--
	Hatchery	0.0	0.0	35.4	64.0	0.7
2017	Wild	--	--	--	--	--
	Hatchery	0.0	0.0	47.5	49.4	3.1
2018	Wild	0.0	0.0	0.0	100.0	0.0
	Hatchery	0.0	0.0	54.7	45.0	0.3
2019	Wild	0.0	0.0	0.0	0.0	0.0
	Hatchery	0.0	0.2	35.9	63.0	0.9
Average	***Wild***	***0.0***	***0.0***	***0.0***	***50.0***	***0.0***
	Hatchery	***0.0***	***0.4***	***43.0***	***55.6***	***1.0***
Median	***Wild***	***0.0***	***0.0***	***0.0***	***50.0***	***0.0***
	Hatchery	***0.0***	***0.0***	***37.0***	***62.0***	***0.9***

Mean lengths of hatchery-origin summer Chinook of a given age differed little among return years 2013-2019 (Table 11.3).

Table 11.3. Mean fork length (cm) at age (total age) of hatchery and wild summer Chinook collected from broodstock for the Chelan Falls program, 2013-2019; N = sample size and SD = 1 standard deviation.

Return year	Origin	Summer Chinook fork length (cm)														
		Age-2			Age-3			Age-4			Age-5			Age-6		
		Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD
2013	Wild	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-
	Hatchery	-	0	-	-	0	-	77	99	6	91	196	5	-	0	-
2014	Wild	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-
	Hatchery	-	0	-	-	0	-	78	114	6	90	191	5	95	3	6
2015	Wild	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-
	Hatchery	-	0	-	70	7	3	78	162	5	87	131	6	107	1	-
2016	Wild	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-
	Hatchery	-	0	-	-	0	-	77	104	5	88	188	6	89	2	8
2017	Wild	-	0	-	-	0	-	-	-	-	-	0	-	-	0	-
	Hatchery	-	0	-	-	0	-	75	154	5	88	160	6	89	10	7
2018	Wild	-	0	-	-	0	-	-	0	-	95	1	-	-	0	-
	Hatchery	-	0	-	-	0	-	77	180	5	87	148	6	95	1	-
2019	Wild	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-
	Hatchery	-	0	-	65	1	-	78	193	6	89	339	8	86	5	11
Average	***Wild***	***-***	***0***	***-***	***-***	***0***	***-***	***-***	***0***	***-***	***95***	***0.1***	***-***	***-***	***0***	***-***
	Hatchery	***-***	***0***	***-***	***68***	***1***	***3***	***77***	***144***	***5***	***89***	***193***	***6***	***94***	***3***	***8***

Sex Ratios

Male summer Chinook in the 2017 broodstock made up about 49.9% of the adults collected, resulting in an overall male to female ratio of 0.99:1.00 (Table 11.4.). In 2018, males made up about 50.1% of the adults collected, resulting in an overall male to female ratio of 1.01:1.00 (Table 11.4). In 2019, males made up about 50% of the adults collected, resulting in an overall male to female ratio of 0.98:1.00 (Table 11.4). The ratio for 2018 broodstock was above the assumed 1:1 ratio goal in the broodstock protocols. The ratio for 2017 and 2019 broodstock was below the assumed 1:1 ratio goal in the broodstock protocols.

Table 11.4. Numbers of male and female wild and hatchery summer Chinook collected for broodstock at for the Chelan Falls program, 2013-2019. Ratios of males to females are also provided.

Return year	Number of wild summer Chinook			Number of hatchery summer Chinook			Total M/F ratio
	Males (M)	Females (F)	M/F	Males (M)	Females (F)	M/F	
2013	-	-	-	160	158	1.01:1.00	1.01:1.00
2014	-	-	-	168	163	1.03:1.00	1.03:1.00
2015	-	-	-	149	175	0.85:1.00	0.85:1.00
2016	-	-	-	177	173	1.02:1.00	1.02:1.00
2017	-	-	-	175	176	0.99:1.00	0.99:1.00
2018	0	2	0.00:1.00	196	193	1.02:1.00	1.01:1.00
2019	-	-	-	293	298	0.98:1.00	0.98:1.00

Return year	Number of wild summer Chinook			Number of hatchery summer Chinook			Total M/F ratio
	Males (M)	Females (F)	M/F	Males (M)	Females (F)	M/F	
Total	-	***2***	***0.00:1.00***	***1,318***	***1,336***	***0.99:1.00***	***0.99:1.00***

Fecundity

Fecundities for the 2017, 2018, and 2019 summer Chinook broodstock averaged 3,779, 3,906, and 4,292 eggs per female, respectively (Table 11.5). These values are close to the overall average of 4,051 eggs per female. Mean observed fecundities for the 2017 and 2018 returns were below the expected fecundities of 4,072, and 4,024 assumed in the broodstock protocols, respectively. Mean observed fecundities in 2019 were above the 3,827 eggs per female assumed in the broodstock protocols.

Table 11.5. Mean fecundity of wild, hatchery, and all female summer Chinook collected for broodstock for the Chelan Falls program, 2013-2019; NA = not available.

Return year	Mean fecundity		
	Wild	Hatchery	Total
2013	-	4,462	4,462
2014	-	4,275	4,275
2015	-	3,597	3,597
2016	-	4,008	4,008
2017	-	3,823	3,823
2018	4,568	3,899	3,906
2019	-	4,292	4,292
Average	***4,568***	***4,051***	***4,052***
Median	***4,568***	***4,008***	***4,008***

To estimate fecundities by length, weight, and age[48], hatchery staff collected fecundity, fork length, weight, and age data from summer Chinook females during the spawning of 2013 through 2019 broodstock (complete data for all variables are available for years 2014-2019). For the available brood years, we developed age/fecundity, fork length/fecundity, weight/fecundity, fork length/mean egg mass, and fork length/gamete (skein) mass relationships for hatchery-origin summer Chinook. Wild Chinook are not included in broodstock for the Chelan Falls program. Hatchery staff randomly sampled about fifty females.

On average, mean fecundities for hatchery-origin age-4 and age-5 Chinook were 3,791 and 4,421 eggs, respectively (Table 11.6).

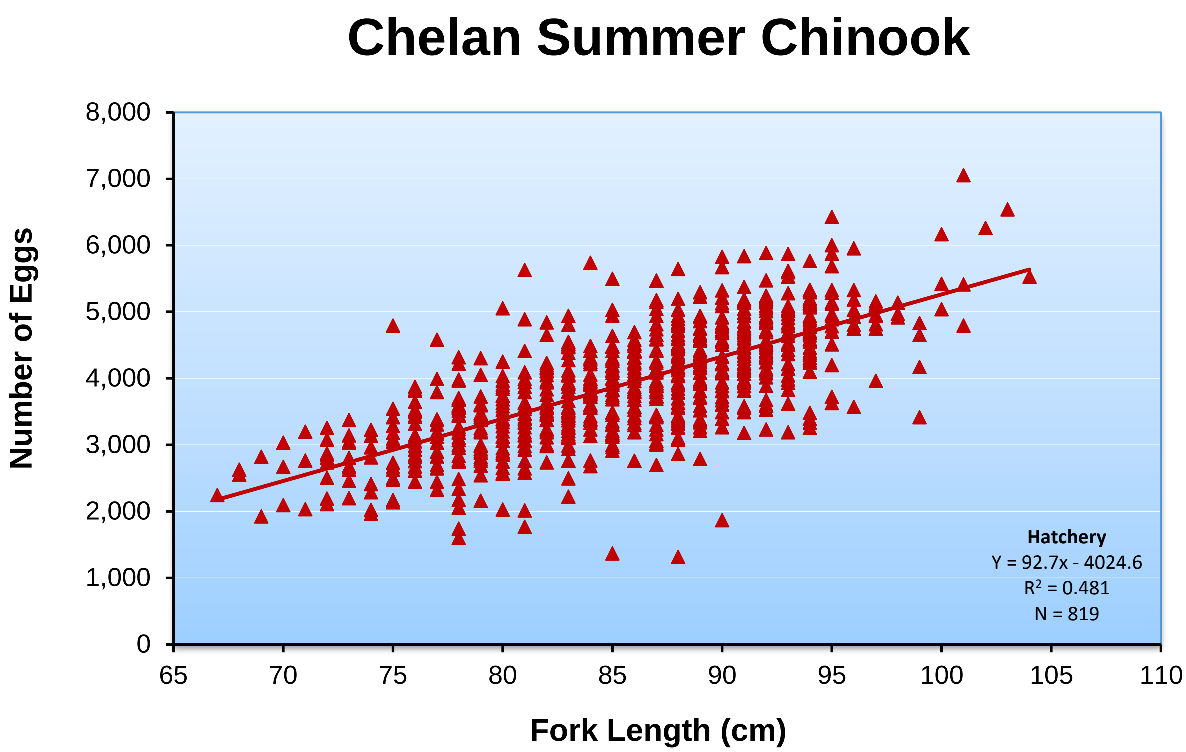
[48] Although age-fecundity relationships are not specific hypotheses tested within the Monitoring and Evaluation Plan (Hillman et al. 2019), we include them here for descriptive purposes.

Table 11.6. Mean fecundity by age (total age) for hatchery summer Chinook collected from broodstock for the Chelan River program, brood years 2013-2019; N = sample size and SD = 1 standard deviation.

Brood year	Origin	Summer Chinook fecundity											
		Age 3			Age 4			Age 5			Age 6		
		Mean	N	SD	Mean	N	SD	Mean	N	SD	Mean	N	SD
2013[a]	Wild	-	0	-	-	0	-	-	0	-	-	0	-
	Hatchery	-	0	-	3,354	16	524	4,593	130	906	-	0	-
2014[a]	Wild	-	0	-	-	0	-	-	0	-	-	0	-
	Hatchery	-	0	-	3,934	9	642	4,301	119	772	5,601	2	2,055
2015[ac]	Wild	-	0	-	-	0	-	-	0	-	-	0	-
	Hatchery	2,919	3	193	3,351	57	740	3,809	85	894	-	0	-
2016[ac]	Wild	-	0	-	-	0	-	-	0	-	-	0	-
	Hatchery	-	0	-	3,509	21	679	4,071	123	759	4,037	2	1,079
2017[cd]	Wild	-	0	-	-	0	-	-	0	-	-	0	-
	Hatchery	-	0	-	3,391	45	660	3,908	108	839	-	0	-
2018[de]	Wild	-	0	-	-	0	-	4,495	1	-	-	0	-
	Hatchery	-	0	-	3,506	57	561	4,054	95	779	5,142	1	-
2019	Wild	-	0	-	-	0	-	-	0	-	-	0	-
	Hatchery	-	0	-	3,791	39	800	4,421	208	823	4,480	4	1,124
Average	***Wild***	***-***	***0***	***-***	***-***	***0***	***-***	***-***	***0***	***-***	***-***	***0***	***-***
	Hatchery	***2,919***	***0.4***	***193***	***3,548***	***35***	***658***	***4,165***	***124***	***825***	***4,815***	***1***	***1,419***

[a] Broodstock collected from Eastbank Fish Hatchery outfall
[b] Broodstock collected from Chief Joe Fish Hatchery adult fish ladder
[c] Broodstock collected from Entiat National Fish hatchery
[d] Broodstock collected from Chelan Falls Canal Trap
[e] Broodstock collected from Wells Dam Volunteer Trap

We pooled fecundity data from brood years 2014 through 2019 (only brood years with complete data for all variables) to increase the number of samples for a given fork length. The linear relationships between fork length and fecundity, mean egg weight, and total egg (skein) weight for hatchery-origin females are shown in Figures 11.1, 11.2, and 11.3. All fecundity variables increase linearly with fork length.



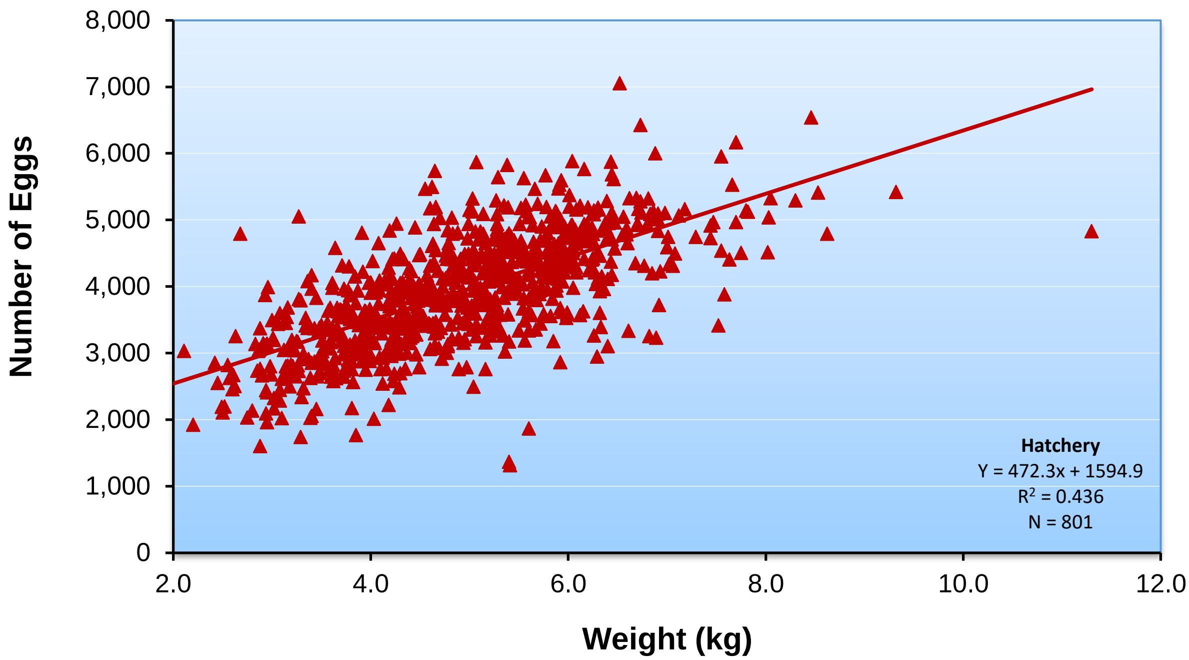


Figure 10.1. Relationships between fecundity and fork length (top figure) and fecundity and weight (bottom figure) for hatchery-origin summer Chinook for return years 2014-2019.

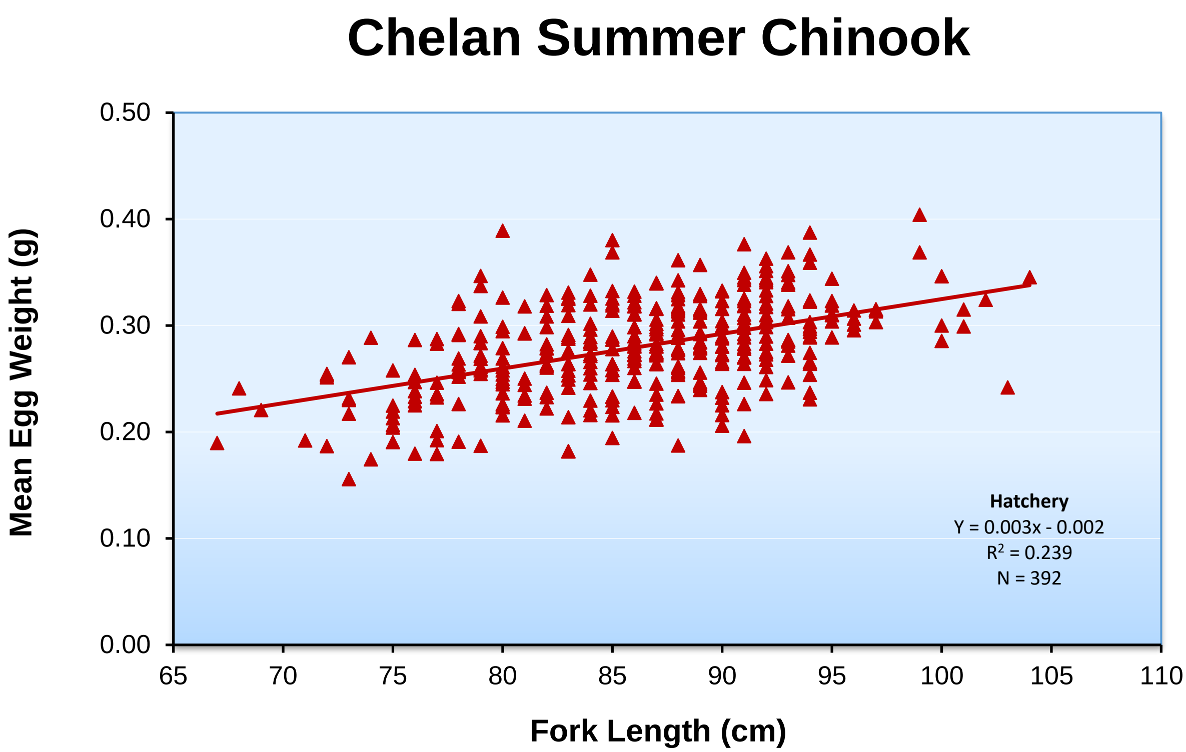


Figure 10.2. Relationships between mean egg weight and fork length for hatchery-origin summer Chinook for return years 2014-2019.

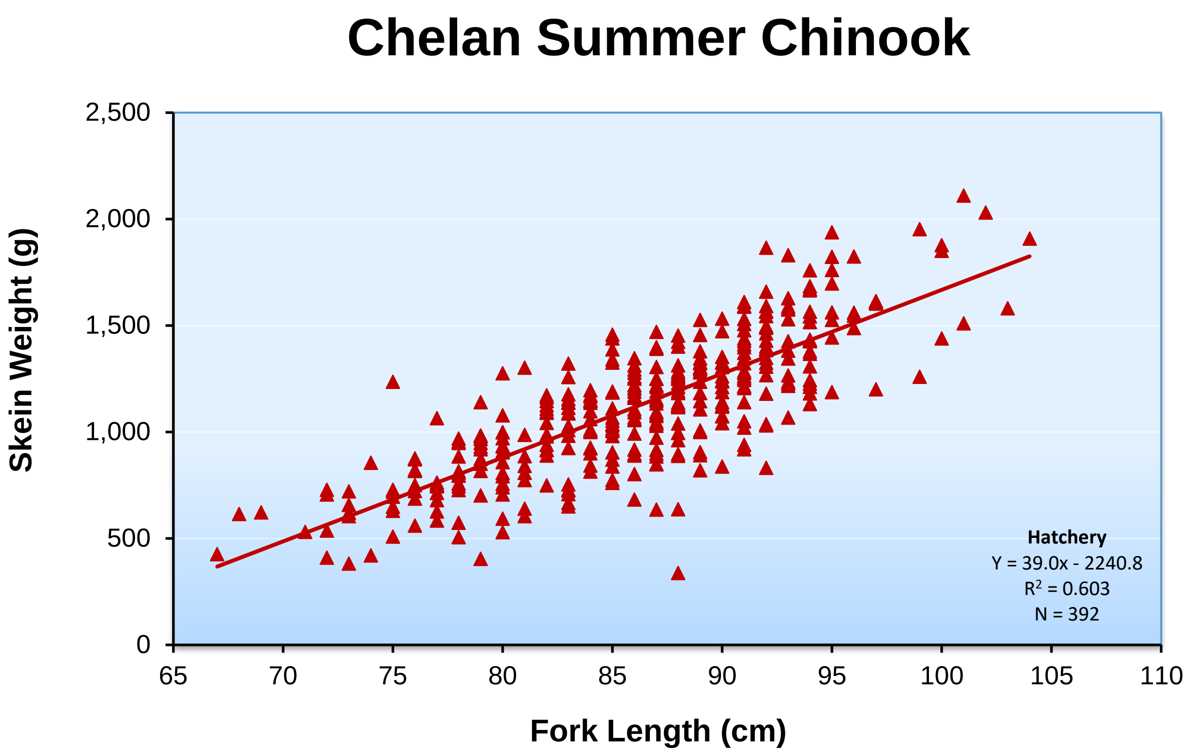


Figure 10.3. Relationships between skein weight and fork length for hatchery-origin summer Chinook for return years 2014-2019.

11.2 Hatchery Rearing

Rearing History

Number of eggs taken

Based on the unfertilized egg-to-release standard of 81%, a total of 688,995 eggs were needed to meet the program goal of 576,000 smolts for brood years 2012 and 2013. An evaluation of the program in 2014 concluded that 696,493 eggs were needed to attain the 576,000 smolts. From 2013-2019, the egg take goal has been achieved three times (Table 11.7).

Table 11.7. Numbers of eggs taken from summer Chinook broodstock for the Chelan Falls program, 2013-2019.

Brood year	Number of eggs taken
2013	696,131
2014	618,092
2015	573,144
2016	680,448
2017	634,843
2018	745,798
2019[a]	1,245,751

Brood year	Number of eggs taken
Average	***742,030***
Median	***680,448***

[a] In 2019, 780,419 eggs were retained for the program, while another 465,332 were surplused. The surplused eggs include excess adults retained for the Yakama Summer Chinook Program as well as progeny culled because of high ELISA results.

Number of acclimation days

Rearing of the 2017 brood Chelan Falls summer Chinook was similar to previous years with fish being held on well water at Eastbank Hatchery until transfer to the Chelan Falls Acclimation Facility for overwinter acclimation. This was the seventh year that the entire program was transferred to the Chelan Falls Acclimation Facility for overwinter acclimation on Chelan River water. Transfer occurred from 5 to 8 November 2018. A forced release took place on 5 April 2019 after 157-160 days of acclimation (Table 11.8).

Table 11.8. Number of days Chelan summer Chinook were acclimated at Chelan Falls Acclimation Facility, brood years 2013-2017.

Brood year	Release year	Transfer date	Release date	Number of days
2013	2015	3-6 Nov	15 Apr	160-163
2014	2016	2-4-Nov	15-18-Apr	163-168
2015	2017	1-3 Nov	17 Apr	165-167
2016	2018	31 Oct -1 Nov	16 Apr	166-167
2017	2019	5-8 Nov	15 Apr	157-160

Release Information

Numbers released

The subyearling Turtle Rock summer Chinook program was discontinued in 2010; however, releases of subyearling Chinook in past years are shown in Tables 11.9 and 11.10. Production from the subyearling programs was converted to the yearling program.

Table 11.9. Numbers of Turtle Rock summer Chinook subyearlings released from the hatchery, brood years 1995-2009. The release target for Turtle Rock summer Chinook subyearlings was 810,000 fish.

Brood year	Release year	CWT mark rate	Number of subyearlings released
1995	1996	0.1873	1,074,600
1996	1997	0.9653	385,215
1997	1998	0.9780	508,060
1998	1999	0.6453	301,777
1999	2000	0.9748	369,026
2000	2001	0.3678	604,892
2001	2002	0.9871	214,059

Brood year	Release year	CWT mark rate	Number of subyearlings released
2002	2003	0.3070	656,399
2003	2004	0.4138	491,480
2004	2005	0.4591	411,707
2005	2006	0.4337	490,074
2006	2007	0.3388	538,392
2007	2008	0.4385	439,806
2008	2009	0.6355	309,003
2009	2010	NA	713,130
Average		***0.6111***	***500,508***
Median		***0.4488***	***490.074***

Table 11.10. Numbers of Turtle Rock summer Chinook accelerated subyearlings released from the hatchery, brood years 1995-2008. The release target for Turtle Rock summer Chinook accelerated subyearlings was 810,000 fish.

Brood year	Release year	CWT mark rate	Number of subyearlings released
1995	1996	0.9834	169,000
1996	1997	0.4163	477,300
1997	1998	0.3767	521,480
1998	1999	0.6033	307,571
1999	2000	0.9556	347,946
2000	2001	0.4331	449,329
2001	2002	0.4086	480,584
2002	2003	0.5492	364,461
2003	2004	0.6414	289,696
2004	2005	0.5471	364,453
2005	2006	0.9783	457,340
2006	2007	0.5510	342,273
2007	2008	0.4745	392,024
2008	2009	0.5295	372,320
Average		***0.6034***	***381,127***
Median		***0.5482***	***368,391***

The 2017 yearling summer Chinook program achieved 97.8% of the 576,000 goal with about 528,567 fish being released from the Chelan River Acclimation Ponds (Table 11.11).

Table 11.11. Numbers of Turtle Rock/Chelan Falls summer Chinook yearling smolts released from the hatchery, brood years 1995-2017. The release target for Turtle Rock summer Chinook was 200,000 smolts for the period before brood year 2010. The current release target is 600,000 smolts. CWT marking rates were adjusted for tag loss before the fish were released.

Brood year	Release year	Acclimation facility	CWT mark rate	Number of smolts released
1995	1997	Turtle Rock	0.9688	150,000
1996	1998	Turtle Rock	0.9582	202,727
1997	1999	Turtle Rock	0.9800	202,989
1998	2000	Turtle Rock	0.9337	217,797
1999	2001	Turtle Rock	0.9824	285,707
2000	2002	Turtle Rock	0.9941	279,969
2001	2003	Turtle Rock	0.9824	203,279
2002	2004	Turtle Rock	0.9799	195,851
2003	2005	Turtle Rock	0.9258	215,366
2004	2006	Turtle Rock	0.9578	206,734
2005	2007	Chelan	0.9810	204,644
2006	2008	Chelan	0.9752	99,271
		Turtle Rock	0.9752	43,943
2007	2009	Chelan Falls	0.9426	112,604
		Turtle Rock	0.9426	61,003
2008	2010	Chelan Falls	0.9818	200,999
		Turtle Rock	0.9818	252,762
2009	2011	Chelan Falls[a]	-	190,449
		Turtle Rock	0.9721	250,667
Average (1995-2009)		***Chelan Falls***	***0.9665***	***137,625***
		Turtle Rock	***0.9745***	***233,429***
Median (1995-2009)		***Chelan Falls***	***0.9737***	***205,007***
		Turtle Rock	***0.9781***	***190,449***
2010	2012	Chelan Falls	0.9702	563,824
2011	2013	Chelan Falls	0.9859	582,460
2012	2014	Chelan Falls	0.9879	566,188
2013	2015	Chelan Falls	0.9917	599,584
2014	2016	Chelan Falls	0.9901	465,450
2015	2017	Chelan Falls	0.9864	442,063
2016	2018	Chelan Falls	0.9941	600,894
2017	2019	Chelan Falls	0.9707	528,567
Average (2010-present)		***Chelan Falls***	***0.9846***	***543,629***
Median (2010-present)		***Chelan Falls***	***0.9871***	***565,006***

[a] No CWT mark rate was provided because of the early release of this group.

Numbers tagged

Brood year 2017 yearling Chinook were 97.1% CWT[49] and 86.4% adipose fin-clipped.

On 23-27 September 2019, a total of 10,496 Chelan River summer Chinook from the 2018 brood were PIT tagged at Eastbank Hatchery. These were PIT tagged and released into raceway #10. Fish were not fed during PIT tagging or for two days before and after tagging. Fish averaged 92 mm in length and 9.0 g at time of tagging.

The number of yearling summer Chinook that have been PIT-tagged and released from the Turtle Rock/Chelan Falls Program are shown in Table 11.12. During the period 2009-2019, the number of fish tagged and released has ranged from 2,360 to 11,082.

Table 11.12. Summary of PIT-tagging activities for Turtle Rock/Chelan Falls yearling summer Chinook, brood years 2007-2017; fpp = fish per pound.

Brood year	Release year	Raceway/Program	Number of fish tagged	Number of tagged fish that died	Number of tags shed	Number of tagged fish released
2007	2009	Circular Reuse	10,104	128	1	9,975
		Standard	10,102	162	3	9,937
2008	2010	Circular Reuse	11,102	20	0	11,082
		Standard	11,100	28	2	11,070
2009	2011	Turtle Rock	5,051	106	0	4,945
		Chelan Net Pens	5,050	2	0	5,048
2010	2012	Chelan Falls	4,200	10	0	4,186
2011	2013	Chelan Falls	4,101	26	0	4,075
2012	2014	Chelan Falls (small)	2,500	17	0	4,983
		Chelan Falls (large)	5,000	40	0	4,960
2013	2015	Chelan Falls (small)	5,000	41	0	4,959
		Chelan Falls (large)	5,000	37	0	4,963
2014	2016	Chelan Falls (18 fpp)	2,500	5	0	2,495
		Chelan Falls (22 fpp)	2,500	19	0	2,481
		Chelan Falls (10 fpp)	2,500	22	0	2,478
		Chelan Falls (13 fpp)	2,500	140	0	2,360
2015	2017	Chelan Falls	10,103	597	0	9,506
2016	2018	Chelan Falls	10,500	82	0	10,418
2017	2019	Chelan Falls	10,499	100	0	10,399

49 Sixty days after tagging, taggers conduct a quality control procedure, which includes collecting a sample of tagged fish and scanning for tag retention. Thus, the number of tagged fish released is adjusted for tag loss.

Fish size and condition at release

Although the subyearling summer Chinook program was discontinued, sizes of subyearlings released from Turtle Rock Hatchery before 2010 are shown in Tables 11.13 and 11.14.

Table 11.13. Mean lengths (FL, mm), weight (g and fish/pound), and coefficient of variation (CV) of Turtle Rock summer Chinook subyearlings released from the hatchery, brood years 1995-2009. Size targets are provided in the last row of the table.

Brood year	Release year	Fork length (mm)		Mean weight	
		Mean	CV	Grams (g)	Fish/pound
1995	1996	102	6.3	12.6	36
1996	1997	87	8.0	7.4	62
1997	1998	98	6.2	10.2	45
1998	1999	96	6.3	10.7	43
1999	2000	90	9.0	9.8	46
2000	2001	100	7.1	11.3	40
2001	2002	104	7.2	13.4	34
2002	2003	97	7.3	11.8	39
2003	2004	101	8.0	12.0	43
2004	2005	100	7.8	11.4	40
2005	2006	100	6.5	12.5	36
2006	2007	95	7.2	9.5	48
2007	2008	79	7.4	5.6	81
2008	2009	86	7.9	7.9	57
2009[a]	2010	89	7.1	7.0	65
Average		***95***	***7.3***	***10.2***	***48***
Targets		***112***	***9.0***	***11.4***	***40***

[a] Pre-release growth sample was conducted using pond mortalities.

Table 11.14. Mean lengths (FL, mm), weight (g and fish/pound), and coefficient of variation (CV) of Turtle Rock summer Chinook accelerated subyearlings released from the hatchery, brood years 1995-2008. Size targets are provided in the last row of the table.

Brood year	Release year	Fork length (mm)		Mean weight	
		Mean	CV	Grams (g)	Fish/pound
1995	1996	129	7.1	27.3	17
1996	1997	107	6.5	15.6	29
1997	1998	117	6.0	18.9	24
1998	1999	119	8.0	18.9	24
1999	2000	114	6.7	19.0	24
2000	2001	111	7.0	16.8	27
2001	2002	117	8.4	19.5	23
2002	2003	116	11.3	21.2	21

Brood year	Release year	Fork length (mm)		Mean weight	
		Mean	CV	Grams (g)	Fish/pound
2003	2004	113	14.9	17.0	30
2004	2005	117	11.3	20.1	23
2005	2006	119	9.1	22.2	21
2006	2007	118	8.3	19.1	24
2007	2008	95	7.7	10.0	45
2008[a]	2009	97	8.6	10.6	43
Average		***114***	***8.6***	***18.3***	***27***
Targets		***112***	***9.0***	***11.4***	***40***

[a] The 2008 brood year was the last year of the accelerated subyearling program.

Size at release of the brood year 2017 yearling summer Chinook was just over the fish per pound target for the Chelan Falls group. This group exceeded the target CV for length (Table 11.15).

Table 11.15. Mean lengths (FL, mm), weight (g and fish/pound), and coefficient of variation (CV) of Turtle Rock/Chelan summer Chinook yearling releases, brood years 1995-2017. Size targets are provided in the last row of the table.

Brood year	Release year	Acclimation facility	Fork length (mm)		Mean weight	
			Mean	CV	Grams (g)	Fish/pound
1995	1997	Turtle Rock	-	-	-	-
1996	1998	Turtle Rock	166	14.2	60.9	7
1997	1999	Turtle Rock	198	4.6	91.3	5
1998	2000	Turtle Rock	161	11.9	53.9	8
1999	2001	Turtle Rock	164	18.6	59.0	8
2000	2002	Turtle Rock	170	15.3	59.0	8
2001	2003	Turtle Rock	154	22.3	48.6	9
2002	2004	Turtle Rock	157	16.7	44.0	12
2003	2005	Turtle Rock	173	13.8	54.7	8
2004	2006	Turtle Rock	176	20.6	45.3	7
2005	2007	Turtle Rock	158	11.0	43.5	10
2006	2008	Chelan Nets	172	14.5	58.4	8
		Turtle Rock	157	25.8	54.1	8
2007	2009	Chelan Nets	153	18.8	45.7	10
		Turtle Rock	167	14.6	49.3	9
2008	2010	Chelan Nets	146	22.9	40.6	11
		Turtle Rock	172	15.9	58.5	8
2009	2011	Chelan Nets	158	15.1	46.6	10
		Turtle Rock	174	17.5	59.3	8
2010	2012	Chelan Falls	132	27.4	33.2	14
2011	2013	Chelan Falls	148	18.6	42.6	11
2012	2014	Chelan Falls	129	17.1	24.5	19

Brood year	Release year	Acclimation facility	Fork length (mm)		Mean weight	
			Mean	CV	Grams (g)	Fish/pound
2013	2015	Chelan Falls	137	9.8	26.8	17
2014	2016	Chelan Falls	141	13.5	31.5	14
2015	2017	Chelan Falls	142	14.0	33.8	13
2016	2018	Chelan Falls	145	13.5	38.6	12
2017	2019	Chelan Falls	146	12.1	38.5	12
Average			***158***	***16.2***	***47.8***	***10***
Targets[a]			***161***	***9.0***	***45.4***	***13***

[a] For size-target studies, fish per pound (fpp) targets for brood year 2012 were 10, 13, 18, 22 fpp.

Survival Estimates

Normal subyearling releases

Overall survival of the normal subyearling Turtle Rock summer Chinook program from green egg to release was below the standard set for the program (Table 11.16). Lower than expected survival at ponding and post-ponding reduced the overall program performance. This program was discontinued in 2010.

Table 11.16. Hatchery life-stage survival rates (%) for Turtle Rock subyearling (zero program) summer Chinook, brood years 2004-2009. Survival standards or targets are provided in the last row of the table.

Brood year	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
2004	NA	NA	93.5	74.4	93.9	91.4	90.8	99.7	63.1
2005	NA	NA	94.4	87.9	85	84.8	84.2	99.4	69.8
2006	NA	NA	97.8	87.9	85.0	84.8	84.2	99.4	72.4
2007	NA	NA	92.7	84.9	88.5	86.7	84.8	99.6	66.7
2008	NA	NA	78.8	95.0	80.7	79.3	79.9	99.8	59.8
2009	NA	NA	95.0	89.4	89.5	89.2	79.7	89.5	67.7
Average	***NA***	***NA***	***92.0***	***86.6***	***87.1***	***86.0***	***83.9***	***97.9***	***66.6***
Median	***NA***	***NA***	***94.0***	***87.9***	***86.8***	***85.8***	***84.2***	***99.5***	***67.2***
Standard	***90.0***	***85.0***	***92.0***	***98.0***	***97.0***	***93.0***	***90.0***	***95.0***	***81.0***

Accelerated subyearling releases

Overall survival of the accelerated subyearling Turtle Rock summer Chinook program from green egg to release was below the standard set for the program (Table 11.17). Lower than expected survival in post-ponding reduced the overall program performance. This program was discontinued in 2010.

Table 11.17. Hatchery life-stage survival rates (%) for Turtle Rock subyearling (accelerated program) summer Chinook, brood years 2004-2009. Survival standards or targets are provided in the last row of the table.

Brood year	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
2004	NA	NA	92.5	98.3	93.4	92.4	90.0	97.8	81.8
2005	NA	NA	93.8	94.6	83.7	83.4	81.7	98.8	72.5
2006	NA	NA	86.1	94.6	83.7	83.4	81.7	98.8	66.5
2007	NA	NA	93.4	95.4	78.4	77.5	76.3	98.9	67.9
2008[a]	NA	NA	93.4	95.0	79.8	78.8	78.2	99.3	67.1
Average	***NA***	***NA***	***91.8***	***95.6***	***83.8***	***83.1***	***81.6***	***98.7***	***71.2***
Median	***NA***	***NA***	***93.4***	***95.0***	***83.7***	***83.4***	***81.7***	***98.8***	***67.9***
Standard	***90.0***	***85.0***	***92.0***	***98.0***	***97.0***	***93.0***	***90.0***	***95.0***	***81.0***

[a] The 2008 brood year was the last year of the accelerated subyearling program.

Yearling releases

Overall survival of the 2017 brood yearling Chelan Falls summer Chinook program from green egg to release was above the standard set for the program (Table 11.18). Survival was above the standard set for the program at all stages with the exception of unfertilized egg to eyed egg and eyed-egg to ponding.

Table 11.18. Hatchery life-stage survival rates (%) for Turtle Rock/Chelan Falls yearling summer Chinook, brood years 2004-2017. Survival standards or targets are provided in the last row of the table.

Brood year	Collection to spawning		Un-fertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Un-fertilized egg-release
	Female	Male							
2004	NA	NA	92.9	97.7	96.8	96.4	95.5	99.6	86.7
2005	NA	NA	89.1	97.5	98.1	97.8	96.6	99.1	83.9
2006	NA	NA	86.2	78.8	97.6	97.1	95.2	98.7	64.8
2007 (Turtle Rock)	NA	NA	80.3	97.6	98.8	98.2	95.4	99.1	74.8
2007 (Chelan Falls)	NA	NA	80.3	97.6	98.8	98.2	94.9	97.1	74.4
2008 (Turtle Rock)	NA	NA	93.5	98.0	99.4	97.2	95.9	98.8	87.8
2008 (Chelan Falls)	NA	NA	93.5	98.0	97.6	98.7	96.4	99.3	88.2
2009 (Turtle Rock)	NA	NA	90.8	96.8	99.7	99.0	97.2	98.1	85.5
2009 (Chelan Falls)	NA	NA	90.9	96.9	99.8	99.0	96.7	97.7	85.2
2010 (Chelan Falls)	NA	NA	94.8	97.7	99.4	95.2	92.4	97.6	85.5
2011 (Chelan Falls)	NA	NA	90.0	99.4	91.7	98.2	83.4	85.2	74.6
2012 (Chelan Falls)	NA	NA	93.5	98.5	99.8	99.3	95.9	96.7	88.3
2013 (Chelan Falls)	100.0	98.1	90.6	96.5	99.5	98.9	98.5	99.7	86.1
2014 (Chelan Falls)	89.6	98.8	83.6	96.3	99.6	98.8	97.0	98.3	78.1
2015 (Chelan Falls)	95.5	97.7	85.6	97.1	99.3	98.9	93.6	95.0	77.7
2016 (Chelan Falls)	98.3	98.9	92.7	96.9	99.8	99.6	98.4	99.0	88.3

Brood year	Collection to spawning		Un-fertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Un-fertilized egg-release
	Female	Male							
2017 (Chelan Falls)	95.5	98.9	91.3	97.7	99.7	99.4	98.0	99.0	87.5
Average (Chelan)	***95.8***	***98.5***	***89.4***	***96.4***	***98.6***	***98.2***	***95.4***	***97.5***	***82.2***
Median (Chelan)	***95.5***	***98.8***	***90.8***	***97.6***	***99.4***	***98.7***	***95.9***	***98.7***	***85.5***
Standard	***90.0***	***85.0***	***92.0***	***98.0***	***97.0***	***93.0***	***90.0***	***95.0***	***81.0***

11.3 Spawning Surveys

Surveys for summer Chinook redds in the Chelan River were conducted from late September to late-November 2019. Total redd counts were conducted in the river (see Appendix Q for more details).

Redd Counts

A total of 509 summer Chinook redds were counted in the Chelan River in 2019 (Table 11.19). This was higher than the overall average of 327 redds.

Table 11.19. Total number of redds counted in the Chelan River, 2000-2019.

Survey year	Total redd count
2000	196
2001	240
2002	253
2003	173
2004	185
2005	179
2006	208
2007	86
2008	153
2009	246
2010	398
2011	413
2012	426
2013	729
2014	400
2015	448
2016	448
2017	421
2018	420
2019	509
Average	***327***
Median	***326***

Redd Distribution

Summer Chinook redds were not evenly distributed among the four sampling areas within the Chelan River. Most redds (43%) were located in the Chelan Tailrace (Table 11.20). Fewer summer Chinook spawned in the Habitat Channel (28%), Habitat Pool (17%), and Columbia Tailrace (13%).

Table 11.20. Total number of summer Chinook redds counted in different survey areas within the Chelan River during September through early November 2019.

Survey area	Total redd count	Percent
Chelan Tailrace	217	43
Columbia Tailrace	66	13
Habitat Channel	141	28
Habitat Pool	85	17
Totals	***509***	***100***

Spawn Timing

Spawning in 2019 began the first week of October, peaked mid-October, and ended mid-November. Peak spawning occurred in all four sections of the Chelan River during mid-October (Figure 11.4).

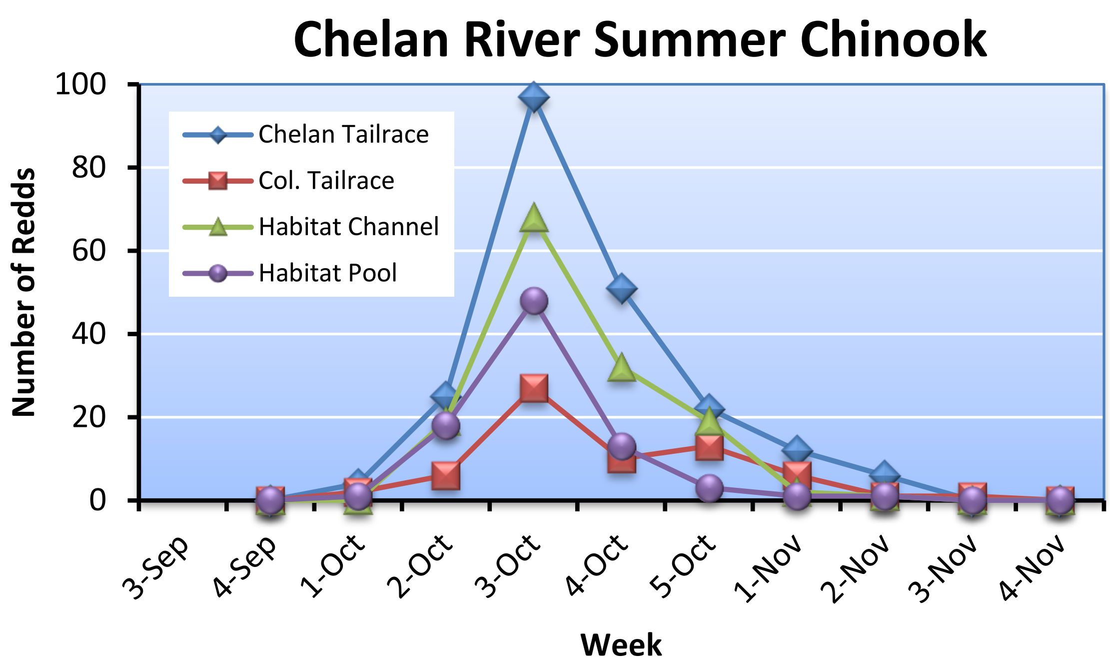


Figure 11.4. Number of new summer Chinook redds counted during different weeks within different sections of the Chelan River, September through November 2019.

Spawning Escapement

Spawning escapement for summer Chinook in the Chelan River was calculated as the total number of redds times the fish per redd ratio estimated from fish sampled at Wells Dam.[50] The estimated fish per redd ratio for Methow summer Chinook in 2018 was 2.32. Multiplying this ratio by the number of redds counted in the Chelan River resulted in a total spawning escapement of 1,181 summer Chinook (Table 11.21).

Table 11.21. Spawning escapements for summer Chinook in the Chelan River for return years 2000-2019.

Return year	Fish/Redd	Redds	Total spawning escapement
2000	2.40	196	470
2001	4.10	240	984
2002	2.30	253	582
2003	2.42	173	419
2004	2.25	185	416
2005	2.93	179	524
2006	2.02	208	420
2007	2.20	86	189
2008	3.25	153	497
2009	2.54	246	625
2010	2.81	398	1,118
2011	3.10	413	1,280
2012	3.07	426	1,308
2013	2.31	729	1,684
2014	2.75	400	1,100
2015	3.21	448	1,438
2016	2.01	448	900
2017	2.04	421	859
2018	2.30	420	966
2019	2.32	509	1,181
Average	***2.62***	***327***	***848***
Median	***2.41***	***326***	***880***

11.4 Carcass Surveys

Surveys for summer Chinook carcasses within the Chelan River were conducted during late September to mid-November 2019 (see Appendix Q for more details).

50 Expansion factor = (1 + (number of males/number of females)).

Number sampled

A total of 271 summer Chinook carcasses were sampled during September through late-November in the Chelan River (Table 11.22). This was higher than the overall average of 187 carcasses sampled since 2000.

Table 11.22. Numbers of summer Chinook carcasses sampled within each survey area within the Chelan River, 2000-2019; ND = no data.

Survey year	Number of summer Chinook carcasses				
	Chelan Tailrace	Columbia Tailrace	Habitat Channel	Habitat Pool	Total
2000	ND	ND	ND	ND	**48**
2001	ND	ND	ND	ND	**101**
2002	ND	ND	ND	ND	**145**
2003	ND	ND	ND	ND	**168**
2004	ND	ND	ND	ND	**159**
2005	ND	ND	ND	ND	**103**
2006	ND	ND	ND	ND	**107**
2007	ND	ND	ND	ND	**106**
2008	ND	ND	ND	ND	**132**
2009	ND	ND	ND	ND	**51**
2010	ND	ND	ND	ND	**106**
2011	ND	ND	ND	ND	**201**
2012	ND	ND	ND	ND	**317**
2013	50	120	157	28	**355**
2014	171	82	50	6	**309**
2015	49	255	41	18	**363**
2016	27	128	64	34	**253**
2017	27	124	58	22	**231**
2018	47	94	39	33	**213**
2019	27	138	72	34	**271**
Average	***57***	***134***	***69***	***25***	***187***
Median	***47***	***124***	***58***	***28***	***164***

Carcass Distribution and Origin

In 2019, hatchery and wild summer Chinook carcasses were not distributed equally among the survey areas within the Chelan River (Table 11.23; Figure 11.5). A larger percentage of hatchery and wild carcasses occurred in the Columbia Tailrace and Habitat Channel than in the Chelan Tailrace and Habitat Pool. There was a larger sample size of hatchery than wild summer Chinook carcasses in the Chelan River in 2019.

Table 11.23. Numbers of wild and hatchery summer Chinook carcasses sampled within different survey areas on the Chelan River, 2000-2019; ND = no data.

Survey year	Origin	Survey reach				Total
		Chelan Tailrace	Columbia Tailrace	Habitat Channel	Habitat Pool	
2000	Wild	ND	ND	ND	ND	**17**
	Hatchery	ND	ND	ND	ND	**31**
2001	Wild	ND	ND	ND	ND	**26**
	Hatchery	ND	ND	ND	ND	**75**
2002	Wild	ND	ND	ND	ND	**37**
	Hatchery	ND	ND	ND	ND	**108**
2003	Wild	ND	ND	ND	ND	**33**
	Hatchery	ND	ND	ND	ND	**135**
2004	Wild	ND	ND	ND	ND	**91**
	Hatchery	ND	ND	ND	ND	**68**
2005	Wild	ND	ND	ND	ND	**42**
	Hatchery	ND	ND	ND	ND	**61**
2006	Wild	ND	ND	ND	ND	**69**
	Hatchery	ND	ND	ND	ND	**38**
2007	Wild	ND	ND	ND	ND	**35**
	Hatchery	ND	ND	ND	ND	**71**
2008	Wild	ND	ND	ND	ND	**69**
	Hatchery	ND	ND	ND	ND	**63**
2009	Wild	ND	ND	ND	ND	**2**
	Hatchery	ND	ND	ND	ND	**49**
2010	Wild	ND	ND	ND	ND	**46**
	Hatchery	ND	ND	ND	ND	**60**
2011	Wild	ND	ND	ND	ND	**89**
	Hatchery	ND	ND	ND	ND	**112**
2012	Wild	ND	ND	ND	ND	**64**
	Hatchery	ND	ND	ND	ND	**253**
2013	Wild	18	55	51	6	**130**
	Hatchery	23	65	106	22	**225**
2014	Wild	32	142	18	1	**193**
	Hatchery	17	113	23	17	**170**
2015	Wild	35	137	11	0	**183**
	Hatchery	21	117	23	21	**180**
2016	Wild	15	63	26	7	**111**
	Hatchery	12	65	38	27	**142**
2017	Wild	14	58	22	7	**101**
	Hatchery	13	66	36	15	**130**
2018	Wild	24	52	15	9	**100**
	Hatchery	23	42	24	24	**113**
2019	Wild	4	38	8	2	**52**

Survey year	Origin	Survey reach				Total
		Chelan Tailrace	Columbia Tailrace	Habitat Channel	Habitat Pool	
	Hatchery	22	97	61	31	**211**
Average	***Wild***	***20***	***78***	***22***	***5***	***124***
	Hatchery	***19***	***81***	***44***	***22***	***167***
Median	***Wild***	***18***	***58***	***18***	***6***	***111***
	Hatchery	***21***	***66***	***36***	***22***	***170***

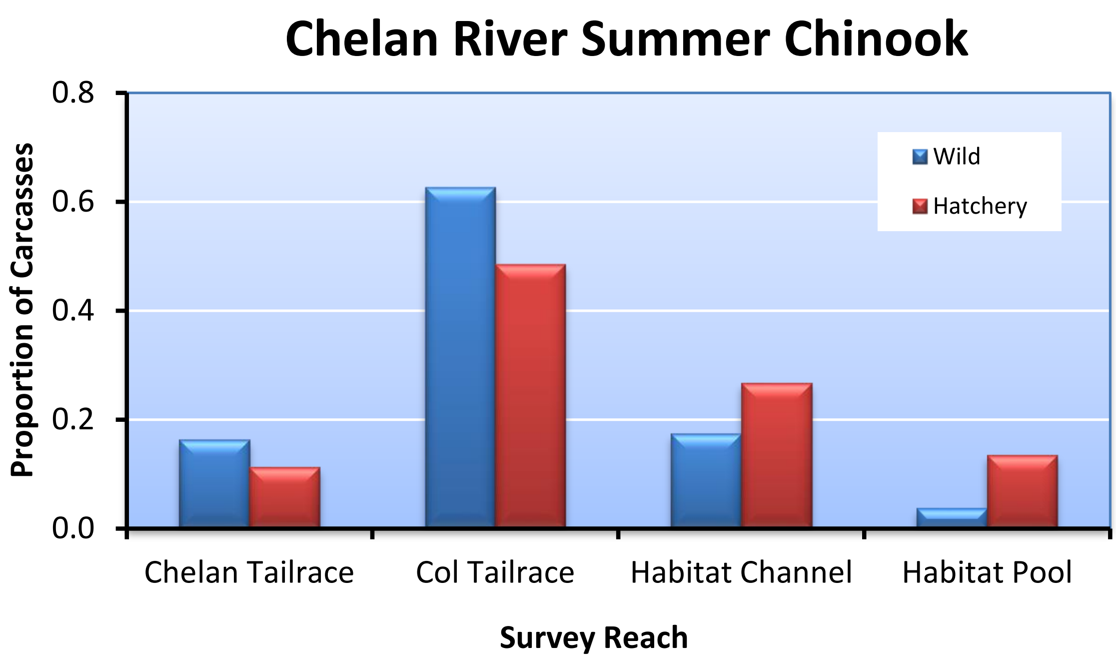


Figure 11.5. Average distribution of wild and hatchery produced carcasses in different survey areas within the Chelan River, 2013-2019.

Sampling Rate

Overall, 23% of the total spawning escapement of summer Chinook in the Chelan River was sampled in 2019 (Table 11.24). Sampling rates among survey reaches varied from 5 to 91%.

Table 11.24. Number of redds and carcasses, total spawning escapement, and sampling rates for summer Chinook in the Chelan River, 2019.

Survey reach	Total number of redds	Total number of carcasses	Total spawning escapement	Sampling rate
Chelan Tailrace	217	27	499	0.05
Columbia Tailrace	66	138	152	0.91
Habitat Channel	141	72	324	0.22
Habitat Pool	85	34	196	0.17

Survey reach	Total number of redds	Total number of carcasses	Total spawning escapement	Sampling rate
Total	***509***	***271***	***1,171***	***0.23***

Length Data

Mean lengths (POH, cm) of male and female summer Chinook carcasses sampled during surveys on the Chelan River in 2019 are provided in Table 11.25. The average size of males and females sampled in the Chelan River were 63 cm and 67 cm, respectively.

Table 11.25. Mean lengths (postorbital-to-hypural length; cm) and standard deviations (in parentheses) of male and female summer Chinook carcasses sampled in different areas on the Chelan River, 2019.

Stream/watershed	Mean length (cm)	
	Male	Female
Chelan Tailrace	65.0 (9.9)	67.4 (5.7)
Columbia Tailrace	63.4 (9.0)	67.4 (4.7)
Habitat Channel	61.7 (7.4)	68.1 (4.8)
Habitat Pool	61.6 (9.6)	66.0 (6.1)
Total	***62.7 (8.6)***	***67.4 (5.0)***

11.5 Life History Monitoring

Life history characteristics of Chelan Falls and Turtle Rock summer Chinook were assessed by examining carcasses on spawning grounds and by reviewing tagging data and fisheries statistics.

Contribution to Fisheries

Normal subyearling releases

Most of the harvest on Turtle Rock summer Chinook (normal subyearling releases) occurred in the Ocean (10-100% of the fish harvested; Table 11.26). Brood years 1995 and 2006 provided the largest total harvests, while brood year 1997 and 1998 provided the lowest. The subyearling hatchery program was discontinued after brood year 2009.

Table 11.26. Estimated number and percent (in parentheses) of Turtle Rock summer Chinook (normal subyearling releases) captured in different fisheries, brood years 1995-2009.

Brood year	Ocean fisheries	Columbia River Fisheries			Total	Percent of brood year escapement harvested[a]
		Tribal	Commercial (Zones 1-5)	Recreational (sport)		
1995	688 (84)	106 (13)	11 (1)	16 (2)	821	75.5
1996	71 (80)	0 (0)	5 (6)	13 (14)	89	47.3
1997	11 (100)	0 (0)	0 (0)	0 (0)	11	61.1
1998	21 (100)	0 (0)	0 (0)	0 (0)	21	46.7
1999	184 (64)	26 (9)	4 (1)	75 (26)	289	75.9
2000	36 (55)	8 (12)	8 (12)	14 (21)	66	86.8

Brood year	Ocean fisheries	Columbia River Fisheries			Total	Percent of brood year escapement harvested[a]
		Tribal	Commercial (Zones 1-5)	Recreational (sport)		
2001	162 (63)	30 (12)	20 (8)	44 (17)	256	78.0
2002	23 (20)	33 (29)	3 (3)	56 (49)	115	92.0
2003	9 (10)	55 (61)	2 (2)	24 (27)	90	76.9
2004	42 (37)	29 (25)	2 (2)	42 (37)	115	61.2
2005	100 (38)	95 (36)	24 (9)	44 (17)	263	75.1
2006	305 (41)	288 (38)	53 (7)	104 (14)	750	73.6
2007	110 (34)	91 (28)	20 (6)	104 (32)	325	66.3
2008	42 (31)	32 (24)	4 (3)	56 (42)	134	87.0
2009	82 (36)	89 (39)	6 (3)	52 (23)	229	72.9
Average	***126 (53)***	***59 (22)***	***11 (4)***	***43 (21)***	***238***	***71.8***
Median	***71 (41)***	***32 (24)***	***5 (3)***	***44 (21)***	***134***	***75.1***

[a] Percent of brood year escapement harvested = Total brood year harvest / (Total brood year harvest + ∑Hatchery collection + ∑escapement) * 100. In other words, this indicates the percentage of all detected CWTs that ended up in harvest.

Accelerated subyearling releases

Most of the harvest on Turtle Rock summer Chinook (accelerated subyearling releases) occurred in ocean fisheries (Table 11.27). Ocean harvest has made up 0% to 100% of all Turtle Rock summer Chinook harvested. Brood year 1999 provided the largest total harvest, while brood years 1995, 1997, 2002, and 2003 provided the lowest. This program was discontinued after brood year 2008.

Table 11.27. Estimated number and percent (in parentheses) of Turtle Rock summer Chinook (accelerated subyearling releases) captured in different fisheries, brood years 1995-2008.

Brood year	Ocean fisheries	Columbia River Fisheries			Total	Percent of brood year escapement harvested[a]
		Tribal	Commercial (Zones 1-5)	Recreational (sport)		
1995	3 (100)	0 (0)	0 (0)	0 (0)	3	23.1
1996	77 (89)	5 (6)	5 (6)	0 (0)	87	46.0
1997	3 (100)	0 (0)	0 (0)	0 (0)	3	33.3
1998	102 (95)	2 (2)	3 (3)	0 (0)	107	89.9
1999	1,026 (76)	142 (10)	12 (1)	178 (13)	1,358	84.2
2000	117 (100)	0 (0)	0 (0)	0 (0)	117	79.6
2001	205 (59)	49 (14)	13 (4)	80 (23)	347	84.4
2002	9 (100)	0 (0)	0 (0)	0 (0)	9	75.0
2003	0 (0)	0 (0)	0 (0)	0 (0)	0	0.0
2004	50 (30)	79 (47)	6 (4)	34 (20)	169	66.5
2005	65 (59)	12 (11)	26 (24)	7 (6)	110	52.6
2006	130 (43)	113 (37)	16 (5)	43 (14)	302	57.2
2007	169 (41)	168 (41)	15 (4)	59 (14)	411	93.0
2008	20 (54)	2 (5)	4 (11)	11 (30)	37	3.4

Brood year	Ocean fisheries	Columbia River Fisheries			Total	Percent of brood year escapement harvested[a]
		Tribal	Commercial (Zones 1-5)	Recreational (sport)		
Average	***141 (68)***	***41 (12)***	***7 (4)***	***29 (9)***	***219***	***56.3***
Median	***71 (67)***	***4 (6)***	***5 (3)***	***4 (3)***	***109***	***61.9***

[a] Percent of brood year escapement harvested = Total brood year harvest / (Total brood year harvest + ∑Hatchery collection + ∑escapement) * 100. In other words, this indicates the percentage of all detected CWTs that ended up in harvest.

Yearling releases

Most of the harvest on Turtle Rock/Chelan Falls summer Chinook (yearling releases) occurred in ocean fisheries (Table 11.28). Ocean harvest has made up 32% to 95% of all Turtle Rock/Chelan Falls summer Chinook harvested. Brood year 2010 provided the largest harvest, while brood year 1995 provided the lowest.

Table 11.28. Estimated number and percent (in parentheses) of Turtle Rock/Chelan Falls summer Chinook (yearling releases) captured in different fisheries, brood years 1995-2013.

Brood year	Ocean fisheries	Columbia River Fisheries			Total	Percent of brood year escapement harvested[a]
		Tribal	Commercial (Zones 1-5)	Recreational (sport)		
1995	456 (75)	51 (8)	31 (5)	70 (12)	608	57.0
1996	771 (95)	14 (2)	2 (0)	21 (3)	808	50.2
1997	2,835 (91)	61 (2)	27 (1)	176 (6)	3,099	63.4
1998	4,284 (90)	224 (5)	16 (0)	230 (5)	4,754	82.2
1999	1,658 (73)	233 (10)	7 (0)	383 (17)	2,281	84.3
2000	1,214 (72)	147 (9)	54 (3)	273 (16)	1,688	82.8
2001	1,952 (59)	453 (14)	178 (5)	729 (22)	3,312	83.2
2002	1,018 (50)	384 (19)	102 (5)	537 (26)	2,041	78.5
2003	758 (46)	449 (27)	70 (4)	378 (23)	1,655	73.4
2004	827 (39)	560 (26)	127 (6)	605 (29)	2,119	80.7
2005	500 (44)	303 (27)	123 (11)	206 (18)	1,132	69.1
2006	1,163 (39)	880 (30)	231 (8)	688 (23)	2,962	73.6
2007	753 (48)	398 (25)	67 (4)	349 (23)	1,567	77.8
2008	3,697 (50)	1,243 (17)	248 (3)	2,168 (30)	7,356	78.9
2009	1,698 (46)	1,106 (30)	122 (3)	743 (22)	3,669	75.4
2010	4,173 (44)	3,414 (36)	409 (4)	1,547 (16)	9,543	78.7
2011	3,374 (45)	2,403 (32)	309 (4)	1,445 (19)	7,531	71.5
2012	1,939 (40)	1,805 (37)	56 (1)	1,073 (22)	4,873	70.2
2013	1,067 (32)	1,295 (39)	19 (1)	943 (28)	3,324	69.9
Average	***1,793 (57)***	***812 (21)***	***116 (4)***	***665 (19)***	***3,386***	***73.7***
Median	***1,214 (48)***	***449 (25)***	***70 (4)***	***546 (21)***	***2,962***	***75.4***

[a] Percent of brood year escapement harvested = Total brood year harvest / (Total brood year harvest + ∑Hatchery collection + ∑escapement) * 100. In other words, this indicates the percentage of all detected CWTs that ended up in harvest.

Straying

Normal subyearling releases

Assessment of straying was based on evaluating the location of CWT recoveries. There were 17 tag codes used to differentiate Turtle Rock/Chelan normal subyearling releases by brood year, release type, and location. There was one subyearling group released into the Chelan River in 2010 (brood year 2009). There were also six non-associated releases.[51] All tag codes, except brood year 2009, recovered in the Chelan River or other tributaries in the Upper Columbia were considered strays.

Rates of Turtle Rock summer Chinook (normal subyearling releases) straying into spawning areas in the upper basin have been low. Although Turtle Rock summer Chinook have strayed into other spawning areas, they made up less than 10% of the spawning escapement within those areas (Table 11.29). The Chelan tailrace has received the largest number of Turtle Rock strays. This hatchery program was discontinued after brood year 2009.

Table 11.29. Number (No.) and percent of spawning escapements within other non-target basins that consisted of Turtle Rock summer Chinook (normal subyearling releases), return years 1998-2015. For example, for return year 2003, 0.6% of the summer Chinook spawning escapement in the Okanogan River basin consisted of Turtle Rock summer Chinook. Percent strays should be less than 10%.

Return year	Wenatchee		Methow		Okanogan		Chelan		Entiat		Hanford Reach	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1998	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1999	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2000	8	0.1	3	0.3	13	0.4	63	13.4	0	0.0	0	0.0
2001	0	0.0	5	0.2	13	0.1	0	0.0	0	0.0	0	0.0
2002	0	0.0	0	0.0	13	0.1	0	0.0	0	0.0	0	0.0
2003	7	0.1	7	0.2	19	0.6	6	1.4	0	0.0	0	0.0
2004	5	0.0	4	0.2	13	0.2	6	1.4	0	0.0	0	0.0
2005	5	0.1	0	0.0	5	0.1	0	0.0	2	0.5	0	0.0
2006	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2007	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2008	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2009	0	0.0	16	0.9	0	0.0	2	0.3	9	3.6	0	0.0
2010	0	0.0	26	1.0	0	0.0	0	0.0	14	3.2	0	0.0
2011	0	0.0	14	0.5	0	0.0	34	2.7	0	0.0	0	0.0
2012	0	0.0	0	0.0	0	0.0	0	0.0	8	0.9	0	0.0
2013	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2014	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2015	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Average	***1***	***0.0***	***4***	***0.2***	***4***	***0.1***	***6***	***1.1***	***2***	***0.5***	***0***	***0.0***
Median	***0***	***0.0***	***0***	***0.0***	***0***	***0.0***	***0***	***0.0***	***0***	***0.0***	***0***	***0.0***

51 Non-associated releases are release groups not containing any coded-wire tagged fish.

Based on brood year analyses, on average, about 29% of the hatchery-origin Turtle Rock summer Chinook (normal subyearling releases) spawners strayed into non-target streams (Table 11.30). Depending on brood year, percent strays into non-target spawning areas have ranged from 0-100%. In addition, on average, about 2% of hatchery-origin Turtle Rock summer Chinook (normal subyearling releases) broodstock have been included in non-target hatchery programs.

Table 11.30. Number and percent of hatchery-origin Turtle Rock summer Chinook (normal subyearling releases) spawners (HOS) that home to the target stream or stray into non-target streams, and the number and percent of hatchery-origin summer Chinook broodstock (HOB) collected for the target hatchery or that were collected for non-target hatcheries, brood years 1995-2009.

Brood year	Hatchery-origin spawner (HOS)				Hatchery-origin broodstock (HOB)			
	Homing		Straying		Broodstock Collection			
	Target stream[1]		Non-target streams[2]		Target hatchery[3]		Non-target hatcheries[4]	
	Number	%	Number	%	Number	%	Number	%
1995	-	-	64	24.1	197	74.1	5	1.9
1996	-	-	44	44.4	54	54.5	1	1.0
1997	-	-	5	71.4	2	28.6	0	0.0
1998	-	-	24	100.0	0	0.0	0	0.0
1999	-	-	52	56.5	40	43.5	0	0.0
2000	-	-	5	50.0	5	50.0	0	0.0
2001	-	-	16	22.2	56	77.8	0	0.0
2002	-	-	0	0.0	10	100.0	0	0.0
2003	-	-	0	0.0	27	100.0	0	0.0
2004	-	-	2	2.7	71	97.3	0	0.0
2005	-	-	7	8.0	80	92.0	0	0.0
2006	-	-	72	26.8	194	72.1	3	1.1
2007	-	-	34	20.6	113	68.5	18	10.9
2008	-	-	0	0.0	16	80.0	4	20.0
2009	27	42.2	8	12.5	29	45.3	0	0.0
Average	***27***	***42.2***	***22***	***29.3***	***60***	***65.6***	***2***	***2.3***
Median	***27***	***42.2***	***8***	***22.2***	***40***	***72.1***	***0***	***0.0***

[1] Target stream includes hatchery-origin summer Chinook that spawned in the Chelan River. Before 2009, there was no target stream because fish were release directly into the Columbia River.
[2] Non-target streams include hatchery-origin summer Chinook that spawned outside the Chelan River.
[3] Target hatchery includes broodstock collection at Wells Dam and Wells Hatchery.
[4] Non-target hatcheries include broodstock collections that may be strays or intercepted summer Chinook used in hatchery programs other than the Chelan River/Turtle Rock summer Chinook hatchery program.

Accelerated subyearling releases

Assessment of straying was based on evaluating the location of CWT recoveries. There were 16 tag codes used to differentiate Turtle Rock accelerated subyearling releases by brood year and release type. There were also four non-associated releases. All tag codes recovered in the Chelan River or other tributaries in the Upper Columbia were considered strays.

Rates of Turtle Rock summer Chinook (accelerated subyearling releases) straying into spawning areas in the upper basin have been low. Although Turtle Rock summer Chinook have strayed into other spawning areas, they made up less than 10% of the spawning escapement within those areas (Table 11.31). The Chelan tailrace, Entiat Basin, and Methow River basin have received the largest numbers of Turtle Rock strays. This hatchery program was discontinued after brood year 2008.

Table 11.31. Number (No.) and percent of spawning escapements within other non-target basins that consisted of Turtle Rock summer Chinook (accelerated subyearling releases), return years 1998-2014. For example, for return year 2001, 0.2% of the summer Chinook spawning escapement in the Methow River basin consisted of Turtle Rock summer Chinook. Percent strays should be less than 10%.

Return year	Wenatchee		Methow		Okanogan		Chelan		Entiat		Hanford Reach	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1998	3	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1999	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2000	7	0.1	0	0.0	0	0.0	24	3.6	0	0.0	0	0.0
2001	0	0.0	12	0.4	31	0.3	0	0.0	0	0.0	0	0.0
2002	0	0.0	5	0.1	0	0.0	0	0.0	0	0.0	0	0.0
2003	0	0.0	45	1.1	0	0.0	22	5.3	13	1.9	16	0.0
2004	0	0.0	7	0.3	0	0.0	14	3.3	0	0.0	18	0.0
2005	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2006	0	0.0	0	0.0	0	0.0	0	0.0	7	1.3	0	0.0
2007	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2008	0	0.0	7	0.4	0	0.0	27	5.4	0	0.0	0	0.0
2009	19	0.2	0	0.0	0	0.0	2	0.3	0	0.0	0	0.0
2010	0	0.0	19	0.8	0	0.0	0	0.0	10	2.3	0	0.0
2011	17	0.2	10	0.3	10	0.1	0	0.0	15	3.2	0	0.0
2012	0	0.0	0	0.0	0	0.0	0	0.0	8	0.9	0	0.0
2013	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2014	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Average	***3***	***0.0***	***6***	***0.2***	***2***	***0.0***	***5***	***1.1***	***3***	***0.6***	***2***	***0.0***
Median	***0***	***0.0***	***0***	***0.0***	***0***	***0.0***	***0***	***0.0***	***0***	***0.0***	***0***	***0.0***

Based on brood year analyses, on average, about 29.5% of the hatchery-origin Turtle Rock summer Chinook (accelerated subyearling releases) spawners strayed into non-target streams (Table 11.32). Depending on brood year, percent strays into non-target spawning areas have ranged from 0-83%. In addition, on average, about 1.3% of hatchery-origin Turtle Rock summer Chinook (normal subyearling releases) broodstock have been included in non-target hatchery programs.

Table 11.32. Number and percent of hatchery-origin Turtle Rock summer Chinook (accelerated subyearling releases) spawners (HOS) that home to the target stream or stray into non-target streams, and the number and percent of hatchery-origin summer Chinook broodstock (HOB) collected for the target hatchery or that were collected for non-target hatcheries, brood years 1995-2008.

Brood year	Hatchery-origin spawner (HOS)				Hatchery-origin broodstock (HOB)			
	Homing		Straying		Broodstock Collection			
	Target stream[1]		Non-target streams[2]		Target hatchery[3]		Non-target hatcheries[4]	
	Number	%	Number	%	Number	%	Number	%
1995	-	-	3	30.0	7	70.0	0	0.0
1996	-	-	69	67.6	33	32.4	0	0.0
1997	-	-	0	0.0	6	100.0	0	0.0
1998	-	-	10	83.3	2	16.7	0	0.0
1999	-	-	117	45.9	138	54.1	0	0.0
2000	-	-	18	60.0	12	40.0	0	0.0
2001	-	-	7	10.9	57	89.1	0	0.0
2002	-	-	0	0.0	0	0.0	0	0.0
2003	-	-	0	0.0	3	100.0	0	0.0
2004	-	-	29	24.4	90	75.6	0	0.0
2005	-	-	19	22.4	64	75.3	2	2.4
2006	-	-	7	7.1	88	88.9	4	4.0
2007	-	-	81	35.8	133	61.9	12	5.3
2008	-	-	8	25.8	21	84.0	2	6.5
Average	**-**	**-**	***26***	***29.5***	***47***	***63.4***	***1***	***1.3***
Median	**-**	**-**	***9***	***25.1***	***27***	***72.7***	***0***	***0.0***

[1] There was no target stream because fish were release directly into the Columbia River.

[2] Non-target streams include hatchery-origin summer Chinook that spawned outside the Chelan River.

[3] Target hatchery includes broodstock collection at Wells Dam and Wells Hatchery.

[4] Non-target hatcheries include broodstock collections that may be strays or intercepted summer Chinook used in hatchery programs other than the Chelan River/Turtle Rock summer Chinook hatchery program.

Yearling releases

Assessment of straying was based on evaluating the location of CWT recoveries. Yearlings have been released in the Columbia River and in the Chelan River. There were 16 tag codes used to differentiate Turtle Rock yearling releases by brood year, release type, and location. All these fish were released into the Columbia River and therefore any tag recoveries in the Chelan River or other tributaries were considered strays. In contrast, there were 21 tag codes[52] used to differentiate Chelan River yearling releases by brood year, release type, and location (there were four non-

52 The Regional Mark Information System (RMIS) indicates that one tag code was released into Lake Chelan. Interestingly, some of these fish have been reported in ocean and Columbia River fisheries.

associated releases). All these fish were released into the Chelan River and therefore any tag recoveries in tributaries other than the Chelan River were considered strays.

Rates of Turtle Rock/Chelan Falls summer Chinook (yearling releases) straying into spawning areas within the Upper Columbia Summer Chinook population have varied widely depending on spawning area. Most of these fish strayed to spawning areas within the Methow River basin, Entiat River basin, and Chelan tailrace (Turtle Rock released fish). On average, Turtle Rock summer Chinook have made up 4-13% of the spawning escapement within those basins (Table 11.33). Relatively few, on average, have strayed to spawning areas in Wenatchee River basin, Okanogan River basin, and the Hanford Reach (i.e., they made up less than 1% of the spawning escapement in these areas). In contrast, Chelan Falls summer Chinook have made up less than 2.5% of the spawning escapements within basins in the Upper Columbia (Table 11.33).

A few Turtle Rock/Chelan Falls summer Chinook have also strayed into areas outside the Upper Columbia population. Tagged Turtle Rock/Chelan Falls hatchery summer Chinook have been detected in the Umatilla River, at Lower Granite Dam on the Snake River, in Sand Hollow Creek, and at Tumwater Falls, Lyons Ferry, and Forks Creek hatcheries.

Table 11.33. Number (No.) and percent of spawning escapements within non-target basins that consisted of Turtle Rock/Chelan Falls summer Chinook (yearling releases), return years 1998-2018. For example, for return year 2003, 4.3% of the summer Chinook spawning escapement in the Methow River basin consisted of Turtle Rock summer Chinook. Percent strays should be less than 10%.

Return year	Wenatchee		Methow		Okanogan		Chelan[a]		Entiat		Hanford Reach	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1998	0	0.0	2	0.3	0	0.0	0	0.0	0	0.0	0	0.0
1999	3	0.1	2	0.2	0	0.0	0	0.0	0	0.0	0	0.0
2000	18	0.3	57	4.8	167	4.5	73	15.5	0	0.0	10	0.0
2001	109	1.0	523	18.9	334	3.1	316	32.1	0	0.0	7	0.0
2002	92	0.6	437	9.4	194	1.4	191	32.8	136	27.1	0	0.0
2003	64	0.5	170	4.3	14	0.4	165	39.4	180	26.0	9	0.0
2004	10	0.1	55	2.5	116	1.7	75	18.0	0	0.0	0	0.0
2005	5	0.1	73	2.9	78	0.9	88	16.8	46	12.5	0	0.0
2006	0	0.0	100	3.7	25	0.3	64	15.2	30	7.5	0	0.0
2007	0	0.0	65	4.8	31	0.7	40	21.2	58	40.8	19	0.1
2008	18	0.3	72	3.7	60	0.9	110	22.1	46	21.4	0	0.0
2009	8	0.1	95	5.4	32	0.4	5	0.8	18	9.9	0	0.0
2010	12	0.2	105	4.2	111	1.9	0	0.0	30	11.5	0	0.0
2011	8	0.1	88	3.0	35	0.4	15	1.2	12	4.1	0	0.0
2012	21	0.2	33	1.1	43	0.5	110	8.4	29	4.5	0	0.0
2013	0	0.0	128	3.6	20	0.2	14	0.8	0	0.0	0	0.0
2014	7	0.1	20	1.2	23	0.2	16	1.5	18	3.0	0	0.0
Average[b]	***22***	***0.2***	***119***	***4.4***	***75***	***1.0***	***75***	***13.3***	***35***	***9.9***	***3***	***0.0***
Median[b]	***8***	***0.1***	***73***	***3.7***	***35***	***0.5***	***64***	***15.2***	***18***	***4.5***	***0***	***0.0***
2015	0	0.0	177	4.5	15	0.1	--	--	6	1.6	0	0.0

Return year	Wenatchee		Methow		Okanogan		Chelan[a]		Entiat		Hanford Reach	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
2016	0	0.0	44	2.0	17	0.2	--	--	1	0.2	0	0.0
2017	6	0.1	4	0.3	0	0.0	--	--	1	0.2	0	0.0
2018	15	0.4	24	1.8	3	0.1	--	--	18	3.7	0	0.0
Average[c]	***5***	***0.1***	***62***	***2.1***	***9***	***0.1***	***--***	***--***	***7***	***1.4***	***0***	***0.0***
Median[c]	***3***	***0.0***	***34***	***1.9***	***9***	***0.1***	***--***	***--***	***4***	***0.9***	***0***	***0.0***

[a] The last release of Turtle Rock Hatchery yearlings occurred in 2011 (brood year 2009). These fish were collected at Wells Dam and reared at the Turtle Rock Hatchery. Brood year 2005 (released in 2007) was the first release group acclimated to the Chelan River as the program transitioned (BYs 2005-2009) to Chelan Falls. Fish acclimated to the Chelan River are not counted as strays to the Chelan River. By return year 2015, all Turtle Rock Hatchery raised summer Chinook (age-6 fish) will be accounted for in adult returns.

[b] Summary statistics during the period when Turtle Rock Hatchery Chinook were returning to the river (1998-2014).

[c] Summary statistics when only Chelan Falls summer Chinook returned to the river (2015-present).

Based on brood year analyses since 2005, on average, about 12% of the hatchery-origin Turtle Rock/Chelan Falls summer Chinook (yearling releases) spawners strayed into non-target streams (Table 11.34). Depending on brood year, percent strays into non-target spawning areas have ranged from 1-29%. In addition, on average, about 29% of hatchery-origin Turtle Rock/Chelan Falls summer Chinook (yearling releases) broodstock have been included in non-target hatchery programs.

Table 11.34. Number and percent of hatchery-origin Turtle Rock/Chelan Falls summer Chinook (yearling releases) spawners (HOS) that home to the target stream or stray into non-target streams, and the number and percent of hatchery-origin summer Chinook broodstock (HOB) collected for the target hatchery or that were collected for non-target hatcheries, brood years 1995-2013.

Brood year	Hatchery-origin spawner (HOS)				Hatchery-origin broodstock (HOB)			
	Homing		Straying		Broodstock Collection			
	Target stream[a]		Non-target streams[b]		Target hatchery[c]		Non-target hatcheries[d]	
	Number	%	Number	%	Number	%	Number	%
1995	-	-	278	60.7	180	39.3	0	0.0
1996	-	-	583	72.8	218	27.2	0	0.0
1997	-	-	1531	85.6	254	14.2	3	0.2
1998	-	-	864	83.8	166	16.1	1	0.1
1999	-	-	243	57.3	181	42.7	0	0.0
2000	-	-	249	70.9	102	29.1	0	0.0
2001	-	-	279	41.8	389	58.2	0	0.0
2002	-	-	254	45.5	303	54.3	1	0.2
2003	-	-	225	37.6	373	62.3	1	0.2
2004	-	-	219	43.2	287	56.6	1	0.2
Average[e]	***-***	***-***	***473***	***59.9***	***245***	***40.0***	***1***	***0.1***
Median[e]	***-***	***-***	***266***	***59.0***	***236***	***41.0***	***1***	***0.0***
2005	149	29.4	144	28.5	202	39.9	11	2.2
2006	429	40.3	223	21.0	376	35.3	36	3.4

Brood year	Hatchery-origin spawner (HOS)				Hatchery-origin broodstock (HOB)			
	Homing		Straying		Broodstock Collection			
	Target stream[a]		Non-target streams[b]		Target hatchery[c]		Non-target hatcheries[d]	
	Number	%	Number	%	Number	%	Number	%
2007	121	27.1	69	15.4	218	48.8	39	8.7
2008	775	39.3	326	16.5	736	37.3	135	6.8
2009	96	8.0	91	7.6	877	73.3	133	11.1
2010	606	23.5	211	8.2	430	16.7	1,329	51.6
2011	453	15.1	98	3.3	356	11.9	2,092	69.8
2012	287	13.9	25	1.2	433	20.9	1,326	64.0
2013	368	25.8	20	1.4	431	30.2	610	42.7
Average[f]	***365***	***24.7***	***134***	***11.5***	***451***	***34.9***	***635***	***28.9***
Median[f]	***368***	***25.8***	***98***	***8.2***	***430***	***35.3***	***135***	***11.1***

[a] Target stream includes hatchery-origin summer Chinook that spawned in the Chelan River. Before 2005, there was no target stream because juvenile summer Chinook salmon were released directly into the Columbia River. Turtle Rock hatchery releases of subyearling (last BY 2009), accelerated subyearling (last BY 2008), and yearling (last BY 2009) summer Chinook salmon to the Columbia River were discontinued with BY 2009.
[b] Non-target streams include hatchery-origin summer Chinook that spawned outside the Chelan River.
[c] Target hatchery includes broodstock collection at Wells Dam, Wells Hatchery, Eastbank Hatchery outfall, and the Chelan River.
[d] Non-target hatcheries include broodstock collections that may be strays or intercepted summer Chinook used in hatchery programs other than the Chelan River/Turtle Rock summer Chinook hatchery program.
[e] Summary information on straying was provided from brood years 1995-2004 because all production of summer Chinook for this program occurred at Turtle Rock hatchery with fish released directly to the Columbia River.
[f] In 2005, the hatchery program transitioned to production at Chelan Falls; although, some production still occurred at Turtle Rock Hatchery until BY 2009. The summary information provided from 2005 to present is a mix of the transition period (BY 2005-2009) and from 2009 to present.

Post-Release Survival and Travel Time

We used PIT-tagged fish to estimate survival rates and travel times (arithmetic mean days) of hatchery summer Chinook from the Turtle Rock/Chelan River release sites to McNary Dam, and smolt to adult ratios (SARs) from release to detection at Bonneville Dam (Table 11.35).[53] Over the 11 brood years for which PIT-tagged hatchery fish were released, survival rates from the release sites to McNary Dam ranged from 0.423 to 0.904; SARs from release to detection at Bonneville Dam ranged from 0.008 to 0.028. Average travel times from release sites to McNary Dam ranged from 15 to 33 days.

Much of the variation in survival rates and travel time among brood years resulted from releases of different experimental groups (Table 11.35). For example, brood years 2007 and 2008 were each split into two experimental groups (Circular Reuse group and Standard Raceway group). For both brood years, survival from the release site to McNary Dam and SARs were greater for the Circular Reuse fish than for the Standard Raceway fish. For both brood years, travel time from release to McNary Dam appeared to be longer for the Standard Raceway fish than for the Circular Reuse fish.

[53] It is important to point out that because of fish size differences among rearing tanks or raceways, fish PIT tagged in one tank or raceway may not represent untagged fish rearing in other tanks or raceways.

Another evaluation was conducted with brood years 2012 and 2013 (Table 11.35). These brood years were split into different treatment groups based on fish size (e.g., small fish and large fish). In general, larger fish had higher survivals (both survival to McNary Dam and SARs) and shorter travel times than did smaller fish.

The study conducted with brood year 2014 summer Chinook evaluated the effects of four different size classes of fish (10 fpp, 13 fpp, 18 fpp, and 22 fpp) on survival and travel times. This work showed a gradient effect with progressively larger fish having higher survivals to McNary Dam, higher SARs, and shorter travel times to McNary Dam than smaller fish (Table 11.35).

Table 11.35. Total number of Turtle Rock/Chelan Falls yearling summer Chinook released with PIT tags, their survival and travel times (mean days) to McNary Dam, and smolt-to-adult (SAR) ratios for brood years 2007-2017. Standard errors are shown in parentheses. NA = not available (i.e., not all the fish from the release groups have returned to the Columbia River); fpp = fish per pound.

Brood year	Raceway/Program	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam	SAR to Bonneville Dam
2007	Circular Reuse	9,975	0.722 (0.036)	22.4 (8.6)	0.017 (0.001)
	Standard	9,937	0.550 (0.034)	28.4 (11.6)	0.010 (0.001)
2008	Circular Reuse	11,082	0.631 (0.040)	26.5 (9.8)	0.028 (0.002)
	Standard	11,070	0.581 (0.038)	27.9 (18.7)	0.025 (0.001)
2009	Turtle Rock	4,945	0.603 (0.061)	15.4 (8.6)	0.018 (0.002)
	Chelan Net Pens	5,048	0.616 (0.059)	19.5 (10.2)	0.012 (0.002)
2010	Chelan Falls	4,186	0.655 (0.050)	22.5 (12.1)	0.025 (0.002)
2011*	Chelan Falls	4,075	0.552 (0.054)	27.2 (11.5)	0.016 (0.002)
2012	Chelan Falls (Small Fish)	4,983	0.590 (0.049)	25.0 (11.2)	0.011 (0.001)
	Chelan Falls (Big Fish)	4,960	0.579 (0.043)	24.4 (10.1)	0.012 (0.002)
2013	Chelan Falls (Small Fish)	4,958	0.423 (0.068)	33.0 (13.6)	0.008 (0.001)
	Chelan Falls (Big Fish)	4,963	0.760 (0.175)	28.6 (12.4)	0.014 (0.002)
2014	Chelan Falls (10 fpp)	2,478	0.798 (0.077)	16.4 (5.9)	0.023 (0.003)
	Chelan Falls (13 fpp)	2,360	0.672 (0.074)	16.1 (5.6)	0.019 (0.003)
	Chelan Falls (18 fpp)	2,495	0.637 (0.064)	18.7 (7.8)	0.019 (0.003)
	Chelan Falls (22 fpp)	2,481	0.449 (0.049)	20.6 (9.6)	0.012 (0.002)
2015	Chelan Falls	9,506	0.747 (0.063)	16.9 (7.4)	NA
2016	Chelan Falls	10,418	0.810 (0.064)	23.1 (9.7)	NA
2017	Chelan Falls	10,399	0.904 (0.112)	24.2 (9.4)	NA

* Brood year 2011 experienced high mortality due to fungus, bacterial cold-water disease, bacterial gill disease, and erythrocytic inclusion body syndrome during April 2013.

Smolt-to-Adult Survivals

Subyearling-to-adult and smolt-to-adult survival ratios (SARs) were calculated as the number of hatchery adult recaptures divided by the number of tagged hatchery subyearling or yearling Chinook released. For these analyses, SARs were based on CWT returns.

Normal subyearling releases

For the available brood years, SARs for normal subyearling-released Chinook have ranged from 0.000036 to 0.001886 (Table 11.36). This hatchery program was discontinued after brood year 2009.

Table 11.36. Subyearling-to-adult ratios (SARs) for Turtle Rock normal subyearling-released summer Chinook, brood years 1995-2009.

Brood year	Number released[a]	Estimated adult captures[b]	SAR
1995	201,230	204	0.001014
1996	371,848	187	0.000503
1997	496,904	18	0.000036
1998	194,723	28	0.000144
1999	197,793	203	0.001026
2000	222,460	28	0.000126
2001	211,306	328	0.001552
2002	200,163	38	0.000190
2003	203,410	49	0.000241
2004	198,019	91	0.000460
2005	197,135	143	0.000725
2006	188,250	355	0.001886
2007	194,437	216	0.001111
2008	152,993	77	0.000503
2009	341,928	133	0.000389
Average	***238,173***	***140***	***0.000660***
Median	***200,163***	***133***	***0.000503***

[a] Includes all tag codes and CWT released fish (CWT + Ad Clip fish and CWT-only fish).
[b] Includes estimated recoveries (spawning ground, hatcheries, harvest, etc.) and observed recoveries if estimated recoveries were unavailable.

Accelerated subyearling releases

For the available brood years, SARs for accelerated subyearling-released Chinook have ranged from 0.000011 to 0.004614 (Table 11.37). This hatchery program was discontinued after brood year 2008.

Table 11.37. Subyearling-to-adult ratios (SARs) for Turtle Rock accelerated subyearling-released summer Chinook, brood years 1995-2008.

Brood year	Number released[a]	Estimated adult captures[b]	SAR
1995	166,203	13	0.000078
1996	198,720	79	0.000398
1997	196,459	3	0.000015
1998	185,551	72	0.000388
1999	192,665	889	0.004614
2000	194,603	63	0.000324
2001	196,355	169	0.000861
2002	200,165	5	0.000025
2003	185,834	2	0.000011
2004	203,255	159	0.000782
2005	192,045	82	0.000427
2006	186,324	217	0.001165
2007	188,328	309	0.001641
2008	197,136	35	0.000178
Average	***191,689***	***150***	***0.000779***
Median	***193,634***	***76***	***0.000393***

[a] Includes all tag codes and CWT released fish (CWT + Ad Clip fish and CWT-only fish).
[b] Includes estimated recoveries (spawning ground, hatcheries, harvest, etc.) and observed recoveries if estimated recoveries were unavailable.

Yearling releases

For the available brood years since 2004, SARs for yearling-released Chinook have ranged from 0.007972 to 0.028164 (Table 11.38).

Table 11.38. Smolt-to-adult ratios (SARs) for Turtle Rock/Chelan Falls yearling-released summer Chinook, brood years 1995-2013.

Brood year	Number released[a]	Estimated adult captures[b]	SAR
1995	145,318	1,047	0.007205
1996	194,251	1,558	0.008021
1997	198,924	4,813	0.024195
1998	215,646	5,764	0.026729
1999	280,683	2,673	0.009523
2000	278,308	2,038	0.007323
2001	199,694	3,937	0.019715
2002	192,234	2,570	0.013369
2003	199,386	2,100	0.010532

Brood year	Number released[a]	Estimated adult captures[b]	SAR
2004	202,682	2,594	0.012798
Average[c]	***210,713***	***2,909***	***0.013941***
Median[c]	***199,540***	***2,582***	***0.011665***
2005	202,329	1,630	0.008056
2006	142,699	4,019	0.028164
2007	161,071	1,904	0.011821
2008	447,155	9,258	0.020704
2009	423,565	4,769	0.011259
2010	547,205	11,796	0.021557
2011	580,057	10,504	0.018109
2012	559,350	6,896	0.012329
2013	594,604	4,740	0.007972
Average[d]	***406,448***	***6,168***	***0.015552***
Median[d]	***447,155***	***4,769***	***0.012329***

[a] Includes all tag codes and CWT released fish (CWT + Ad Clip fish and CWT-only fish).
[b] Includes estimated recoveries (spawning ground, hatcheries, harvest, etc.) and observed recoveries if estimated recoveries were unavailable.
[c] Summary statistics for yearling Turtle Rock summer Chinook released into the Columbia River (brood years 1995-2004).
[d] Summary statistics for yearling Turtle Rock/Chelan River summer Chinook released into the Chelan River (brood years 2005 to present).

11.6 ESA/HCP Compliance

Broodstock Collection

The 2017 brood Chelan Falls (formerly Turtle Rock) summer Chinook program was supported through adult collections at the Eastbank outfall and surplus adults from Entiat National Fish Hatchery. During 2017, broodstock collections were consistent with the 2017 Upper Columbia River Salmon and Steelhead Broodstock Objectives and site-based broodstock collection protocols as required in ESA permit 1347. The 2017 collection target totaled 358 summer Chinook. Actual 2017 broodstock spawned was 429 adults.

Hatchery Rearing and Release

The brood year 2017 release totaled 528,629 yearling fish. These releases represented 91.8% of the 576,000 Rocky Reach HCP and ESA Section 10 Permit 1347 production for the Chelan Falls yearling summer Chinook production.

Hatchery Effluent Monitoring

Per ESA Permit Numbers 1347, 18118, 18120, 18121, and 18583, permit holders shall monitor and report hatchery effluents in compliance with applicable National Pollution Discharge Elimination Systems (NPDES) (EPA 1999) permit limitations. There were no NPDES violations reported at Eastbank Hatchery or the Chelan Falls Acclimation Facility during the period 1 January through 31 December 2019. NPDES monitoring and reporting for Chelan PUD Hatchery Programs during 2019 are provided in Appendix G.

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SECTION 13: APPENDICES

Appendix A

Juvenile Production Targets, Marking Methods, Release Locations, Release Sizes, and Release Types for Hatchery Fish Releases in 2019

Appendix A. Brood year juvenile production targets, marking methods, release locations, release size, and release type. Table is from Appendix B in Tonseth (2017).

Brood Year	Production Group	Program Size	Marks/Tags[3]	Additional Tags	Release Location	Release Year	Release Size (fpp)	Release Type
Summer Chinook								
2017	Methow SUC 1+ (GPUD)	200,000	Ad +CWT	5,000 PIT minimum	Methow River at CAF	2019	13-18	Forced
2017	Wells SUC 0+ (DPUD)	480,000	Ad + CWT	3K-5K PIT	Columbia R. at Wells Dam	2018	50	Forced
2017	Wells SUC 1+ (DPUD)	320,000	Ad + CWT		Columbia R. at Wells Dam	2019	10	Volitional
2017	Chelan Falls SUC 1+ (CPUD)	576,000	Ad + CWT	10,000 PIT	Columbia R. at CFAF	2019	13	Forced
2017	Wenatchee SUC 1+ (CPUD/GPUD)	500,001	Ad + CWT	5,000 PIT minimum	Wenatchee R. at DAF	2019	15-18	Volitional
2017	CJH SUS 1+	500,000	Ad + 100K CWT	5,000 PIT	CJH	2019	10	Volitional
2017	CJH SUS 0+	400,000	Ad + 100K CWT	5,000 PIT	CJH	2018	50	Volitional
2017	Okanogan SUS 1+	266,666	Ad + CWT	5,000 PIT	Omak Pond	2019	10	Volitional
2017	Okanogan SUS 1+	266,666	Ad + CWT		Riverside Pond	2019	10	Volitional
2017	Okanogan SUS 1+	266,666	Ad + CWT		Similkameen Pond	2019	10	Volitional
2017	Okanogan SUS 0+	300,000	Ad + CWT	5,000 PIT	Omak Pond	2018	50	Forced
Spring Chinook								
2017	Methow SPC (PUD)	108,249	CWT only	5,000 PIT	Methow R. at MFH	2019	15	Volitional
2017	Methow SPC (PUD)	25,000[1]	CWT only	7,000 PIT	Methow R. at GWP (YN)	2019	15	Volitional
2017	Methow SPC (PUD)	60,516	CWT only	5,000	Chewuch R. at CAF	2019	15	Volitional
2017	Twisp SPC (PUD)	30,000	CWT only	5,000 PIT	Twisp R. at TAF	2019	15	Volitional
2017	Methow SPC (USFWS)	400,000	Ad + CWT	20,000 PIT	Methow River at WNFH	2019	17	Forced (2-day)
2017	Okanogan SPC[4] (CCT)	200,000	CWT only	5,000 PIT	Okanogan R. at Tonasket Pond	2019	15	Volitional

Brood Year	Production Group	Program Size	Marks/Tags[3]	Additional Tags	Release Location	Release Year	Release Size (fpp)	Release Type
2017	Chief Joe SPC[5] (CCT)	700,000	Ad + 200K CWT	5,000 PIT	Columbia R. at CJH	2019	15	Forced
2017	Chiwawa R. SPC (CPUD) (conservation)	144,026	CWT only	5,000 PIT minimum	Chiwawa River at CPD	2019	18	Short term volitional
2017	Nason Cr. SPC (GPUD) (conservation)	125,000	CWT body tag	5,000 PIT	Nason Cr. at NAF	2019	18	Forced
2017	Nason Cr. SPC (GPUD) (safety net)	98,670	Ad + CWT		Nason Cr. at NAF[9]	2019	18	Forced
Fall Chinook								
2017	Priest Rapids FAC 0+ (ACOE)	1.7M	Ad + Oto	Approximately 43,000 spread across the fish released from PRH	Columbia River at PRH	2018	50	Forced
2017	Priest Rapids FAC 0+ (GPUD)	600,000	Ad+CWT+Oto		Columbia River at PRH	2018	50	Forced
2017	Priest Rapids FAC 0+ (GPUD)	600,000	CWT + Oto		Columbia River at PRH	2018	50	Forced
2017	Priest Rapids FAC 0+ (GPUD)	1M[2]	Ad + Oto		Columbia River at PRH	2018	50	Forced
2017	Priest Rapids FAC 0+ (GPUD)	3.4M	Oto only		Columbia River at PRH	2018	50	Forced
2017	Ringold Springs FAC 0+ (ACOE)	3.5M	Ad + Oto		Columbia River at RSH	2018	50	Forced
Steelhead								
2018	Wenatchee Mixed (HxH/WxW) (CPUD)	66,771	Ad + CWT (HxH) CWT only (WxW)	Estimated 5,400 PIT[7]	Nason Cr. direct release	2019	6	Forced/Volitional
2018	Wenatchee Mixed (HxH/WxW) (CPUD)	53,170	Ad + CWT (HxH) CWT only (WxW)	Estimated 4,300 PIT[7]	Chiwawa R. direct release	2019	6	Forced/Volitional
2018	Wenatchee Mixed (HxH/WxW) (CPUD)	102,359	Ad + CWT (HxH) CWT only (WxW)	Estimated 8,278 PIT[7]	Wenatchee R. direct release	2019	6	Forced/Volitional

Brood Year	Production Group	Program Size	Marks/Tags[3]	Additional Tags	Release Location	Release Year	Release Size (fpp)	Release Type
2018	Wenatchee HxH (CPUD)	25,000	Ad + CWT	Estimated 2,022 PIT[7]	Wenatchee R. at BBP	2019	6	Volitional
2018	Twisp Conservation (DPUD)[11]	48,000	CWT only	TBD	Twisp River at Buttermilk Bridge/TBD	2019	6	Direct Plant
2018	Wells HxH (DPUD)	100,000	Ad only	5,000 PIT	Methow River at MFH	2019	6	Volitional
2018	Wells HxH (DPUD)	160,000	Ad only	5,000 PIT	Columbia R. at Wells Dam	2019	6	Volitional
2018	MetComp WxW (USFWS)	200,000	Ad + CWT	20,000 PIT	Methow R. at WNFH or other locations TBD	2019	4-6	Volitional/Direct Plant
2018	Okanogan HxH/HxW (CCT/GPUD)	Up to 100K [6]	Ad /CWT snout	Up to 20,000 PIT [7,9]	Okanogan/Similkameen Omak, Salmon, Wildhorse Ck, other tribs. (TBD)	2019	5-8	Volitional capture Wells; dropped planted in Salmon Creek, Similkameen R., and possibly other tributaries, TBD by fall of 2018.
2018	Okanogan WxW (CCT/GPUD)	Up to 100K [6]	Body and snout CWT[8]	Up to 20,000 PIT [7,9]	Okanogan/Similkameen Omak, Salmon, Wildhorse Ck, other tribs. (TBD)	2019	5-8	Volitional from St. Mary's pond. The numbers going to Omak Creek and other tributaries will be determined by fall of 2018.

[1] Release of fish at the Goat Wall Pond remote acclimation site operated by the YN is conditional upon HC and HSC approval.
[2] Externally marking of this group is presently funded by WDFW. Marking of this 1M fish is contingent on *US v. Oregon* Policy Committee approval for 2017.
[3] Presently all CWT's are applied to the snout.
[4] The Okanogan SPC program derives its juveniles from a 200K transfer of Methow SPC from WNFH as part of a reintroduction effort. Fish are released into the Okanogan Basin.
[5] The Chief Joe Hatchery SPC program presently receives surplus adults from the Leavenworth NFH. Juveniles are released on station from CJH.
[6] Total Okanogan release not to exceed 100K + 10%.
[7] PIT number s to each release site are estimated and not actual.
[8] The Okanogan steelhead HGMP and NOAA's BiOp for the TRMP state that WxW progeny will receive a unique internal tag (CWT or PIT) and/or receive an alternative fin clip. At this time, CCT does not intend to use an alternative fin clip until/unless a high proportion of the released fish have WxW parents and there is an acceptable survival risk/benefit of the alternative fin clip.
[9] Total PIT tag release in the Okanogan 20,000
[10] Beginning with the 2017 brood, adult returns from the Nason conservation program will be utilized to meet the Nason safety net program and will receive a supplemental body tag (blank wire either at the base of the adipose or the caudal peduncle) in addition to the adipose clip.
[11] With the recent detection inbreeding depression effects in the Twisp conservation program, parties are currently working on developing a new plan for the program. Once developed and agreed to, this table will be updated to reflect any changes.

Appendix B

Abundance and Total Numbers of Chinook Salmon and Trout in the Chiwawa River basin, Washington

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December 30, 2019

TO: HCP Hatchery Committee

FROM: Tracy Hillman

Subject: Abundance and Total Numbers of Chinook Salmon and Trout in the Chiwawa River basin, Washington

The Chelan County Public Utility District (PUD) hatchery program is operated through a habitat conservation plan (HCP) that was incorporated into the PUD's license in 2004. The HCP directed the signatories to develop a monitoring and evaluation plan within one year of the effective date. This resulted in the development of the Conceptual Approach to Monitoring and Evaluating the Chelan County Public Utility District Hatchery Programs (Murdoch and Peven 2005). In 2017, the Hatchery Committees updated the hatchery monitoring and evaluation plan (Hillman et al. 2017).[1] This study helped the Hatchery Committees determine if it is meeting Objective 2 in the updated monitoring and evaluation plan.

Objective 2: *Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.*

We estimated densities and total numbers of age-0 spring Chinook salmon *Oncorhynchus tshawytscha*, trout *Oncorhynchus* sp., and char *Salvelinus* sp. in the Chiwawa River basin, Washington, in August 2018. This was the 26th and last year of a study to assess the freshwater productivity (juveniles/redd) of Chinook salmon in the Chiwawa River basin. We used landscape classification to stratify streams in the basin that supported juvenile Chinook salmon (Hillman and Miller 2004). Classification "explained" most of the variability in fish numbers caused by geology, land type, valley bottom type, stream state condition, and habitat type. We identified ten reaches on the lower 31 miles (50 km) of the Chiwawa River and one reach in each of Phelps, Rock, Chikamin, Big Meadow, Alder, Brush, Clear, Y, and Unnamed[2] creeks (Figure 1). Each reach consisted of several combinations of state-type and habitat-type strata. We used classification to find reference areas for reaches in the Chiwawa River. We matched Reach 3 and Reach 8 of the

[1] The hatchery monitoring and evaluation plan has since been updated; however, the final year of Chinook salmon parr sampling occurred in 2018 under the 2017 hatchery monitoring and evaluation plan.

[2] Unnamed tributary that drains the eastside of Chiwawa Ridge. Its confluence with the Chiwawa River is about 1 mile (1.6 km) downstream from the mouth of Phelps Creek.

Chiwawa River with a moderately-confined section of Nason Creek (RM 0.62-1.70) and an unconfined area of the Little Wenatchee River (RM 4.39-8.55), respectively (Hillman and Miller 2004). Because of the supplementation program in Nason Creek, the use of Nason Creek as a reference for the Chiwawa River was discontinued. Following methods described in Hillman and Miller (2004), we used underwater observations to estimate numbers of fish in 201 randomly selected sites.

During sampling in August 2018, discharge in the Chiwawa River averaged 181 cubic feet per second (cfs) and ranged from 118-309 cfs (Figure 2). Stream temperatures during the study period ranged from 9.0 to 16.0^{o}C. Fish species observed in the Chiwawa River basin and reference areas during the 1992-2018 survey period[3] included: spring Chinook salmon, coho salmon *O. kisutch*, sockeye salmon *O. nerka*, steelhead/rainbow trout *O. mykiss* (hatchery rainbow were present only in 1992 and 1993), cutthroat trout *O. clarki lewisi*, bull trout *S. confluentus*, brook trout *S. fontinalis*, mountain whitefish *Prosopium williamsoni*, dace *Rhinichthys* sp., northern pikeminnow *Ptychocheilus oregonensis*, suckers *Catostomus* sp., and sculpin *Cottus* sp. The age-0 spring Chinook that we observed in the Chiwawa River basin during the 2018 survey were produced from 222 redds counted in the fall of 2017 (Hillman et al. 2018). Assuming a mean fecundity of 4,615 eggs per female Chinook (from females collected for broodstock), and that no female produced more than one redd (Murdoch et al. 2009), we estimated that the Chiwawa River basin was seeded with 1,024,530 eggs in 2017 (Appendix A).

In 2018, riffles made up the largest fraction of habitat types in reaches of the Chiwawa River basin (53% of the total stream surface area) (Table 1). Pools (23%), glides (7%), and multiple channels (17%) constituted the remaining 47% of the stream surface area. We found woody debris associated with most multiple-channel habitat.

Chinook Salmon Abundance

Chinook salmon were the most abundant salmonid in the Chiwawa River basin. We estimated, based on surface area, that age-0 Chinook salmon numbered 83,729 (±10% of the estimated total) in the Chiwawa River basin in August 2018 (Table 2). Extrapolating based on volume of habitat types, age-0 Chinook numbered 83,273 (±9%) in the Chiwawa River basin. About 6% of the juvenile Chinook were in tributaries to the Chiwawa River. During the 1992-2018 surveys, numbers of age-0 Chinook ranged from 5,815 to 149,563 in the Chiwawa River basin (Figure 3; Appendix A and B). Most of the difference in juvenile numbers among years resulted from different seeding (stock) levels (Figure 4). Numbers of Chinook redds in the Chiwawa River basin during 1992-2018 ranged from 13 to 1,078, resulting in seeding levels of 66,248 to 4,984,672 eggs (Appendix A).

As in most years, age-0 Chinook in 2018 were distributed contagiously among reaches in the Chiwawa River (Table 2). In the Chiwawa River, densities of age-0 Chinook were highest in the upper reaches (Reaches 7-10). The highest densities in the Chiwawa River basin were in tributaries to the Chiwawa River (Table 2). Age-0 Chinook were most abundant in multiple channels and pools, and least abundant in glides and riffles. We found the majority of the Chinook associated

[3] The study period 1992-2018 includes only 26 years of sampling because there was no sampling in 2000.

with woody debris in multiple channels (multiple channel use index = 2.82)[4]. These sites (multiple channels) made up 17% of the total surface area of the Chiwawa River basin, but they provided habitat for 44% of all the age-0 Chinook in the basin in 2018 (Appendix C). In contrast, riffles made up 53% of the total surface area, but provided habitat for only 8% of all age-0 Chinook in the Chiwawa River basin (riffle use index = 0.23). Pools made up 23% of the total surface area and provided habitat for 47% of all age-0 Chinook in the basin (pool use index = 1.62). Few Chinook used glides that lacked woody debris (glide use index = 0.24).

As noted earlier, we assumed that the Chiwawa River was seeded with 1,024,530 Chinook eggs (222 redds times 4,615 eggs/female) in fall, 2017, and that at least 83,729 of those survived to August 2018. This means that the egg-to-parr survival was at least 8.2% (95% confidence bound 7.3-9.0%). During 1992-2018, egg-to-parr survival averaged 8.0% (range 2.7-19.1%) in the Chiwawa River basin (Appendix A). This survival rate comports with those from other streams. For example, Mullan et al. (1992) estimated an egg-to-parr survival rate of 9.8% for spring Chinook salmon in Icicle Creek, a tributary of the Wenatchee River. Using a Beverton and Holt model, Hubble (1993) estimated that egg-to-parr survival of Chinook in the Chewuck River, a tributary to the Methow River, ranged between 13% and 32%, depending on percent seeding level in the basin. Kiefer and Forster (1991) estimated a mean egg-to-parr survival rate of 5.5% (range 5.1-6.7%) for naturally-spawning spring Chinook salmon in the entire upper Salmon River. They also noted that egg-to-parr survival of natural spawners and adult outplants in the headwater streams of the upper Salmon River averaged 24.4% (range 16.1-32.0%). Petrosky (1990) reported an egg-to-parr survival range of 1.2-29.0% for Chinook in the upper Salmon River, Idaho. Konopacky et al. (1986) estimated egg-to-parr survival of Chinook in Bear Valley Creek, Idaho, as 8.1-9.4%. Work by Richards and Cernera (1987) in Bear Valley Creek indicated an egg-to-parr survival of 2.1%.

Mean densities of age-0 Chinook salmon in one reach on the Chiwawa River were not consistently greater than those in a corresponding reference area (Little Wenatchee River) (Figure 5). Mean densities of age-0 Chinook in pools and riffles were greater in the Chiwawa River than in the reference area, while mean densities of age-0 Chinook in glides and multiple channels were greater in the reference area than in the Chiwawa River. Within both the Chiwawa River and its reference area, pools and multiple channels consistently had the highest densities of age-0 Chinook.

We estimated a total of 739 (±36% of the estimated total) age-1+ Chinook salmon in the Chiwawa River basin in August 2018 (Table 3). In August 1992-2018, numbers of age-1+ Chinook ranged from 5 to 967 in the Chiwawa River basin (Figure 3; Appendix B). These fish occurred throughout the Chiwawa River. We found relatively few age-1+ Chinook in tributaries. Age-1+ Chinook were most abundant in multiple channels and pools.

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[4] The habitat use index was calculated as follows: Multiple channel use = ($parr_{mc}/parr_t$) / ($area_{mc}/area_t$), where parr $_{mc}$ = the number of parr counted in multiple channel habitat, $parr_t$ = the total number of parr counted within all habitat types, $area_{mc}$ = the area of multiple channel habitat within the sampling frame, and $area_t$ = the total area of the sampling frame. A multiple channel use index value of 1 would indicate that parr were uniformly distributed among habitat types and exhibited no preference for multiple habitat types. Values greater than 1 indicate use of multiple channels to a greater extent than the average, while scores between 0 and 1 indicate below-average use of multiple channel habitat.

Juvenile Chinook Salmon Productivity (Fish/Redd)

Freshwater productivity of juvenile Chinook salmon was estimated as the number of parr (age-0 Chinook) per redd in the Chiwawa River basin. Theoretically, the relationship between number of parr and redds can be explained mathematically provided the relationship between the two parameters goes through the origin, increases monotonically at low spawning levels, and shows some level of density dependence at high spawning levels. We identified four alternative hypotheses that may explain the relationship between spawning level (redds) and numbers of age-0 Chinook:

1. The first hypothesis assumed that the number of juveniles increases constantly toward an asymptote as the number of redds increases. After the asymptote is reached, the number of juveniles neither increases nor decreases. The asymptote represents the maximum number of juveniles the system can support (i.e., carrying capacity for the system). This hypothesis was modeled with a Beverton-Holt curve that took the form:

$$\boldsymbol{J = \frac{(\alpha R)}{(\beta + R)}}$$

   where $\boldsymbol{J}$ is the number of juvenile (age-0) Chinook, $\boldsymbol{R}$ is the number or redds, $\boldsymbol{\alpha}$ is the maximum number of juveniles produced, and $\boldsymbol{\beta}$ is the number of redds needed to produce (on average) juveniles equal to one-half the maximum number of juveniles.

2. The second hypothesis, like the first, assumed that the number of juveniles increases toward an asymptote (carrying capacity) as the number of redds increases. After the carrying capacity is reached, the number of juveniles neither increases nor decreases. The carrying capacity represents the maximum number of juveniles the system can support. This hypothesis was modeled with a smooth hockey stick function that took the form:

$$\boldsymbol{J = J_{\infty}\left(1 - e^{-\left(\frac{\alpha}{J_{\infty}}\right)R}\right)}$$

   where $\boldsymbol{J}$ and $\boldsymbol{R}$ are as above, $\boldsymbol{\alpha}$ is the slope at the origin of the spawner-recruitment curve, and $\boldsymbol{J_{\infty}}$ is the carrying capacity of juveniles.

3. The third hypothesis assumed that the number of juveniles increases to a maximum and then declines as the number or redds increases. In this case, mortality rate of juveniles (or eggs) is proportional to the initial number of redds. Higher mortality rate is associated with density-dependent growth coupled with size-dependent predation. This hypothesis was modeled with a Ricker curve that took the form:

$$\boldsymbol{J = \alpha R e^{-\beta R}}$$

   where $\boldsymbol{J}$ and $\boldsymbol{R}$ are as above, $\boldsymbol{\alpha}$ is the number of juveniles per redd at low spawning levels, and $\boldsymbol{\beta}$ describes how quickly the juveniles per redd drop as the number of redds increases.

4. The fourth hypothesis, like the first, assumed that the number of juveniles increases constantly, but unlike the first, the number of juveniles does not reach an asymptote. Rather, the number of juveniles increases indefinitely, but at a slowing rate of increase. This hypothesis was modeled with both a Cushing curve and a Gamma function. The

Cushing curve took the form:

$$\boldsymbol{J = \alpha R^{\gamma}}$$

where $\boldsymbol{J}$ and $\boldsymbol{R}$ are as above, $\boldsymbol{\alpha}$ is the number of juveniles per redd at low spawning levels, and $\boldsymbol{\gamma}$ describes the level of density dependence at high spawning levels. The Gamma function is a three-parameter model that has the form:

$$\boldsymbol{J = \alpha R^{\gamma} e^{-\beta R}}.$$

This is an un-normalized gamma function that is similar to the Cushing curve when $\beta = 0$.

We used Akaike's Information Criterion for small sample size (AIC_c) to determine which model(s) best explained the productivity of juvenile Chinook in the Chiwawa River basin. AIC_c was estimated as:

$$\boldsymbol{AIC_c = -2log\left(\pounds(\theta|data)\right) + 2K + \left(\frac{2K(K+1)}{n-K-1}\right)}$$

where $\boldsymbol{log(\pounds(\theta|data))}$ is the maximum likelihood estimate, $\boldsymbol{K}$ is the number of estimable parameters (structural parameters plus the residual variance parameter), and $\boldsymbol{n}$ is the sample size (Burnham and Anderson 2002). We used least-squares methods to estimate $\boldsymbol{log(\pounds(\theta|data))}$, which was calculated as $\boldsymbol{log(\sigma^2)}$, where $\boldsymbol{\sigma^2}$ = residual sum of squares divided by the sample size ($\boldsymbol{\sigma^2 = RSS/n}$). AIC_c assesses model fit in relation to model complexity (number of parameters). The model with the smallest AIC_c value represents the "best approximating" model within the model set. Remaining models were ranked relative to the best model using AIC_c difference scores (**ΔAIC_c**), Akaike weights ($\boldsymbol{w_i}$), and evidence ratios. Models with **ΔAIC_c** values less than 2 indicate that there is substantial support for these models as being the best-fitting models within the set (Burnham and Anderson 2002). Models with values greater than 2 have less support. Akaike weights are probabilities estimating the strength of the evidence supporting a particular model as being the best model within the model set. Models with small $\boldsymbol{w_i}$ values are less plausible as competing models (Burnham and Anderson 2002). If no single model could be specified as the best model, a "best subset" of competing models was identified using (1) AIC_c differences to indicate the level of empirical support each model had as being the best model, (2) evidence ratios based on Akaike weights to indicate the relative probability that any model is the best model, and (3) coefficients of determination (R^2) assessing the explanatory power of each model.

The use of AIC_c indicated that the Beverton-Holt model best approximated the information in the juveniles/redd data (Table 4; Figure 6). The estimated structural parameters for this model were:

$$Juveniles = \frac{(153{,}414 \times Redds)}{(192 + Redds)}$$

where the bootstrap estimated standard errors for the two parameters were 17,099 and 55, respectively. The adjusted $R^2 = 0.84$.

The second-best model was the smooth hockey stick model, which was 1.78 AIC_c units from the best model (Table 4; Figure 6). The estimated parameters for this model were:

$$LN(Juveniles) = 11.7 + LN\left(1 - e^{-\left(\frac{714.7}{116,438}\right)Redds}\right)$$

where the bootstrap estimated standard errors of the two parameters were 0.08 and 128, respectively, and the $R^2 = 0.83$. The AIC_c difference scores, Akaike weights, and evidence ratios indicated that there was substantial support for both the Beverton-Holt and smooth hockey stick models (Table 4). There was less support for the remaining models (Ricker, Gamma[5], and Cushing), which were > 2 AIC_c units from the best models. This was further supported by the fact that, relative to the best models, the remaining models had evidence ratios greater than 20.

Because there was substantial support for both the Beverton-Holt and smooth hockey stick models, we used model averaging to compute a weighted estimate of the predicted values (productivity and population capacity[6]) (Burnham and Anderson 2002). Model averaging estimated a population capacity of 142,654 parr and an intrinsic productivity of 774 parr per spawner.

Although the Beverton-Holt, smooth hockey stick, and Ricker models have different biological assumptions, they all indicated a density-dependent relationship between spawning levels (redds) and juvenile Chinook production in the Chiwawa River basin. This was not only evident in the best approximating models, but there was also a significant negative relationship between juveniles per redd and numbers of redds in the Chiwawa River basin (Figure 7). Although data at high seeding levels are lacking, the Beverton-Holt model estimates the population capacity of juvenile Chinook in the Chiwawa River basin at about 153,414 parr. This equates to about 1,280 Chinook parr per hectare. In contrast, the smooth hockey stick model, which fit the data as well as the Beverton-Holt model, estimates the population carrying capacity for juvenile Chinook at about 116,438 parr. This equates to about 971 Chinook parr per hectare. As noted above, model averaging estimates the population capacity at 142,654, which equates to 1,190 Chinook parr per hectare. As a comparison, Thorson et al. (2013) estimated the carrying capacity for 15 populations of juvenile Chinook in the Snake River metapopulation as 5,000 juveniles per hectare. However, those authors noted that the estimate could be biased because of imperfect detectability and estimates of spawning numbers.

Steelhead/Rainbow Abundance

Based on stream surface area, we estimated a total of 11,854 (±12% of the estimated total) age-0 steelhead/rainbow (<4 in) in reaches of the Chiwawa River basin in August 2018 (Table 5). During the 1992-2018 survey period, numbers of age-0 steelhead/rainbow ranged from 1,410 to 45,727 in the Chiwawa River basin (Figure 8; Appendix B). In 1992-2018, numbers of age-0 steelhead/rainbow varied among reaches but were typically highest in the lower reaches of the Chiwawa River. In all years they most often used riffle and multiple channel habitats in the Chiwawa River, although we also found them associated with woody debris in pool and glide habitat. In tributaries, they were generally most abundant in small pools. Those that we observed

[5] The γ parameter in the Gamma model was greater than 0, which means that this model is nearly identical to the Ricker model.

[6] In these analyses, we are calculating "population" carrying capacity (*K*), which is defined as the maximum equilibrium population size estimated with population models. This should not be confused with "habitat" carrying capacity (*C*), which is defined as the maximum population of a given species that a particular environment can sustain.

in riffles selected stations in quiet water behind small and large boulders or occupied stations in quiet water along the stream margin. In pool and multiple-channel habitats, we found age-0 steelhead/rainbow using the same kinds of habitat as age-0 Chinook salmon.

We estimated that 3,151 (±17% of the estimated total) age-1+ steelhead/rainbow (4-8 in) lived in reaches of the Chiwawa River basin in August 2018 (Table 6). During the survey period 1992-2018, numbers of age-1+ steelhead/rainbow ranged from 754 to 22,130 (Figure 8; Appendix B). In most years, we found these fish in nearly all reaches, but they were typically most numerous in lower reaches of the Chiwawa River. We observed age-1+ steelhead/rainbow mostly in pool, riffle, and multiple-channel habitats. Those that we observed in pools were usually in deeper water than age-0 steelhead/rainbow and Chinook. Like age-0 steelhead/rainbow, age-1+ steelhead/rainbow selected stations in quiet water behind boulders in riffles, but we generally did not find the two age groups together. Age-1+ steelhead/rainbow appeared to use deeper and faster water than did age-0 steelhead/rainbow.

We estimated that steelhead/rainbow larger than 8 inches numbered 19 (±68% of the estimated total) in the Chiwawa River basin in August 2018 (Table 7). During the period 1992-2018, steelhead/rainbow numbers ranged from 8 to 1,869 (Appendix B). Steelhead/rainbow larger than 8 inches were generally most abundant in the lower Chiwawa River; however, in 1992 and 1993, they were most abundant near campgrounds in Reaches 8, 9, and 10 (these were mostly hatchery rainbow trout planted near the campgrounds). We found very few in tributaries. Most of the steelhead/rainbow larger than 8 inches used deep pools (>5 feet), and occupied stations near the bottom at the upstream end of pools.

Bull Trout Abundance

We estimated, based on surface area that at least 256 (±16% of the estimated total) juvenile (2-8 in) bull trout lived in reaches of the Chiwawa River basin in August 2018 (Table 8). We found most of these fish in the upper-most reaches of the Chiwawa River and in Rock, Chikamin, and Phelps creeks. During 1992-2018, numbers of juvenile bull trout ranged from 79 to 505 (Figure 9; Appendix B). These estimates and those for adult bull trout are incomplete because we did not sample the entire range of bull trout in all tributaries. That is, we did not extend our surveys into the headwaters of the Chiwawa River because there were no juvenile Chinook there. Areas beyond the distribution of juvenile Chinook salmon are known to support bull trout, steelhead/rainbow, and cutthroat trout (USFS 1993). In addition, our estimates of bull trout abundance were based on daytime snorkel surveys, which may underestimate the actual abundance of bull trout.[7] Several studies (e.g., Goetz 1994; Thurow and Schill 1996; Hillman and Chapman 1996; Bonar et al. 1997) have found bull trout population estimates based on nighttime snorkeling to be in some cases more accurate than daytime snorkeling, especially for juvenile bull trout. Our estimates of adult bull trout numbers may be more accurate than those for juveniles.

In all years, we found most juvenile bull trout in the upstream reaches of the Chiwawa River. In 2018, they occurred primarily in Reaches 9-10 on the Chiwawa River. We found the majority of

[7] Because there are no estimates for probability of detecting bull trout with daytime underwater observation methods in the Chiwawa River basin, we could not adjust bull trout numbers based on detectability. Therefore, the numbers reported in this report likely underestimate the "true" number of bull trout in the survey area.

these fish in multiple channels, pools, and riffles, and few in glides. They consistently occupied stations close to the stream bottom over rubble and small boulder substrate or near woody debris. This is similar to the observation of Pratt (1984) in the upper Flathead River Basin in Montana. She found that juvenile bull trout lay close to instream cover and that they tended to conceal themselves. Consequently, she found it difficult to estimate accurately their numbers. Although this implies that we underestimated numbers of juvenile bull trout in the Chiwawa River, the relative distribution of juvenile bull trout is valid if we assume that we saw the same fraction of juveniles in all reaches (i.e., detection probability was the same across survey sites).

We estimated a total of 1,380 (±10% of the estimated total) adult (>8 in) bull trout in reaches of the Chiwawa River basin in August 2018 (Table 9). This was the second highest number of adult bull trout that we recorded during the more than 20-year survey period. During 1992-2018, numbers of adult bull trout ranged from 76 to 2,286 (Figure 9; Appendix B). As with juvenile bull trout, we found most of the adult bull trout upstream from Reach 6; although they were found in all reaches on the Chiwawa River. We found few adult bull trout in tributaries of the Chiwawa River. Adult bull trout primarily used pools and multiple channel habitat, although most of the smaller adults (<10 in) used riffles.

Abundance of Other Salmonids

In August 2018, we estimated that at least 208 brook trout, an exotic species closely related to the bull trout, occurred in the Chiwawa River, Chikamin Creek, Big Meadow Creek, Minnow Creek, and in the Little Wenatchee River survey areas. In both the Chiwawa and Little Wenatchee rivers, brook trout usually used multiple channels and pools. Few appeared to be bull trout/brook trout hybrids. In Chikamin, Minnow, and Big Meadow creeks, brook trout were most abundant in pools. Brook trout lengths ranged from 2-12 inches.

At least 432 westslope cutthroat trout occurred in the Chiwawa River, Phelps Creek, Rock Creek, and Little Wenatchee River survey areas in August 2018. These fish most often occurred in pools and multiple channel habitats. They ranged in size from 2-23 inches. Few juvenile coho salmon were observed in the lower Chiwawa River.

We observed both juvenile and adult mountain whitefish in the Chiwawa River, Phelps Creek, Rock Creek, and the Little Wenatchee River survey areas. In sum, at least 6,419 adult and 1,917 juvenile whitefish lived in these streams in August 2018. Most were in the mainstem Chiwawa River; few whitefish occurred in tributaries to the Chiwawa River.

Conclusion

This was the 26th and final year of a study to monitor trends in juvenile spring Chinook production in the Chiwawa River basin. As shown in Figure 3, numbers of juvenile Chinook salmon in the Chiwawa River basin have fluctuated widely over the 26-year period. Numbers of juveniles in 2001, 2002, and 2009-2017 were some of the highest recorded, while numbers in the mid-1990s were some of the lowest. Interestingly, the highest spawning escapements (highest redd numbers) resulted in the lowest egg-parr survival rates (Appendix A). This is supported by the fact that the best approximating models clearly demonstrated a density-dependent relationship between seeding levels and juvenile production. Indeed, there was a significant negative relationship between parr per redd and numbers of redds in the Chiwawa River basin. This is an important observation because some of the hypotheses in the revised monitoring and evaluation plan (Hillman et al. 2013) are only valid when the supplemented population is below its carrying capacity.

The best fitting stock-recruitment models indicate that the population capacity of the Chiwawa River basin is between 116,000 to 153,000 spring Chinook parr. This equates to an overall density of about 971-1,280 parr per hectare. These densities can be achieved with about 488 redds. Assuming a female Chinook produces only one redd (Murdoch et al. 2009), a spawning escapement of about 488 females is needed to fill the capacity of the Chiwawa River basin.

The proportion of hatchery-origin spawners (pHOS) within the Chiwawa River basin during the survey period has ranged from 0 to 100%. Thus, some of the variation in juvenile productivity may be related to pHOS. Although there appeared to be a negative relationship between juvenile productivity (parr/redd) and pHOS, the correlation was not significant (Figure 10). In addition, there was no relationship between juvenile productivity and pHOS after the effects of spawning escapement were removed from the analysis (Figure 10). This suggests that spawning escapement has a larger effect on juvenile productivity than does the presence of hatchery spawners.

The presence of density dependence in the early life stages of spring Chinook is not surprising. Rarely does density dependence appear in numbers of adult spring Chinook or on their spawning grounds. The Chiwawa River basin appears to have plenty of spawning habitat, as indicated by the large numbers of spawners and redds widely distributed throughout the basin during high spawning escapements. However, those large spawning escapements did not translate into large numbers of juveniles or smolts. Thus, density-dependent regulation appears to occur sometime during the early life stages of the fish, likely at the fry or early parr stage. It is possible that physical habitat (space) during higher flows when fry are emerging may limit juvenile Chinook production in the basin. Low nutrient levels and its effects on food webs may also be a limiting factor in the basin. If spawning escapements remain relatively high, marine-derived nutrients should increase in the basin, resulting in more food for juvenile Chinook salmon.

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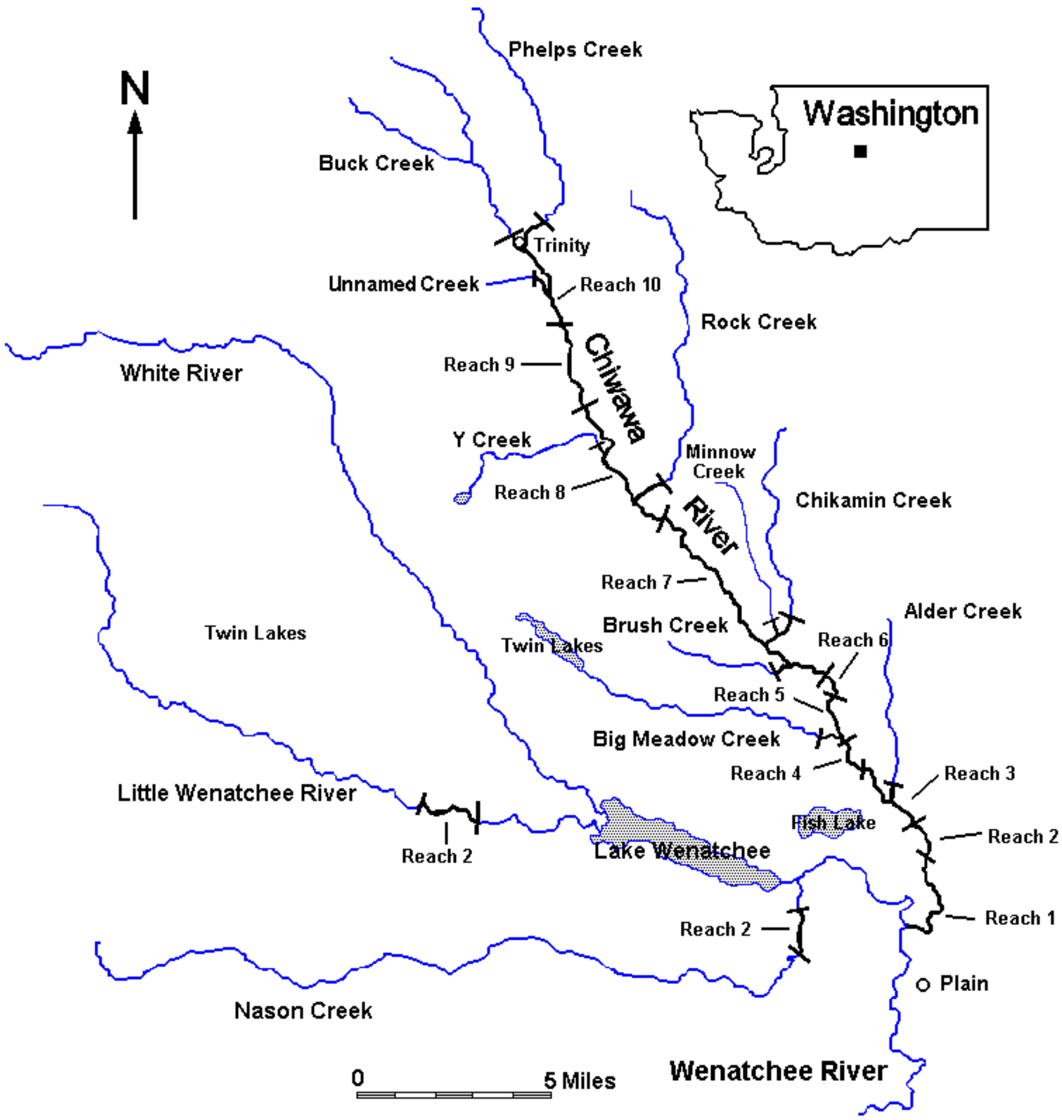


Figure 1. Location of study reaches on the Chiwawa River, and Chikamin, Rock, Big Meadow, Unnamed, Alder, Brush and Phelps creeks, Chelan County, Washington. Reach 2 on Nason Creek and Reach 2 on the Little Wenatchee River were matched with Reaches 3 and 8 on the Chiwawa River, respectively. Nason Creek is no longer used as a reference.

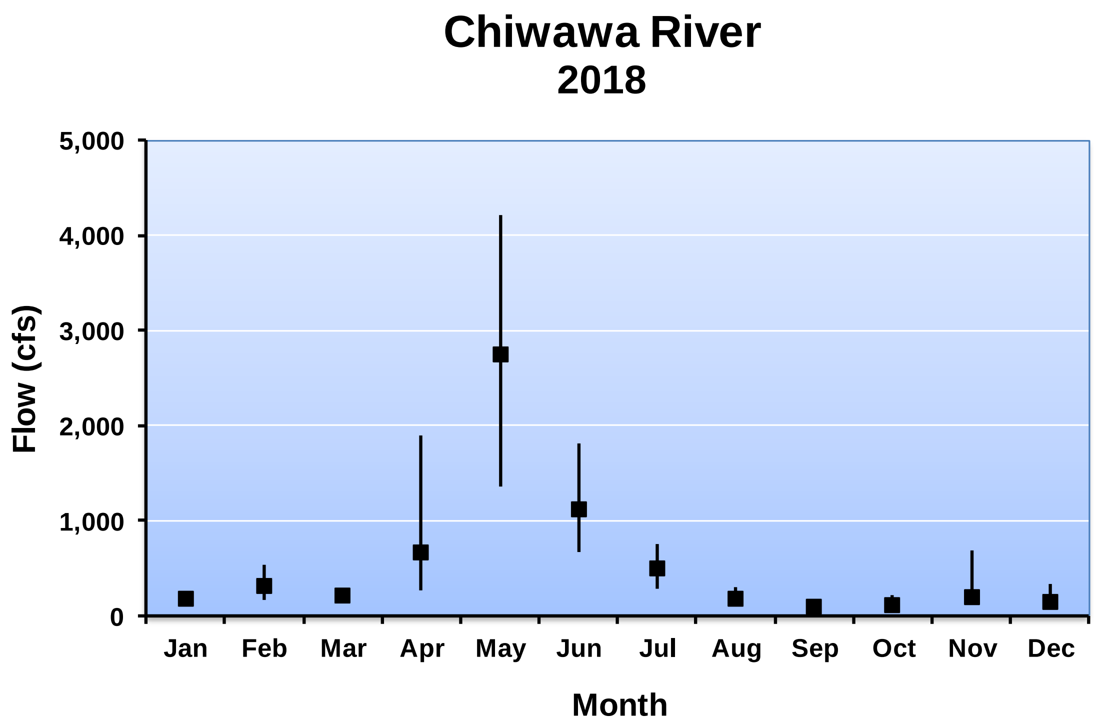


Figure 2. Mean, minimum, and maximum monthly flows in the Chiwawa River for 2018.

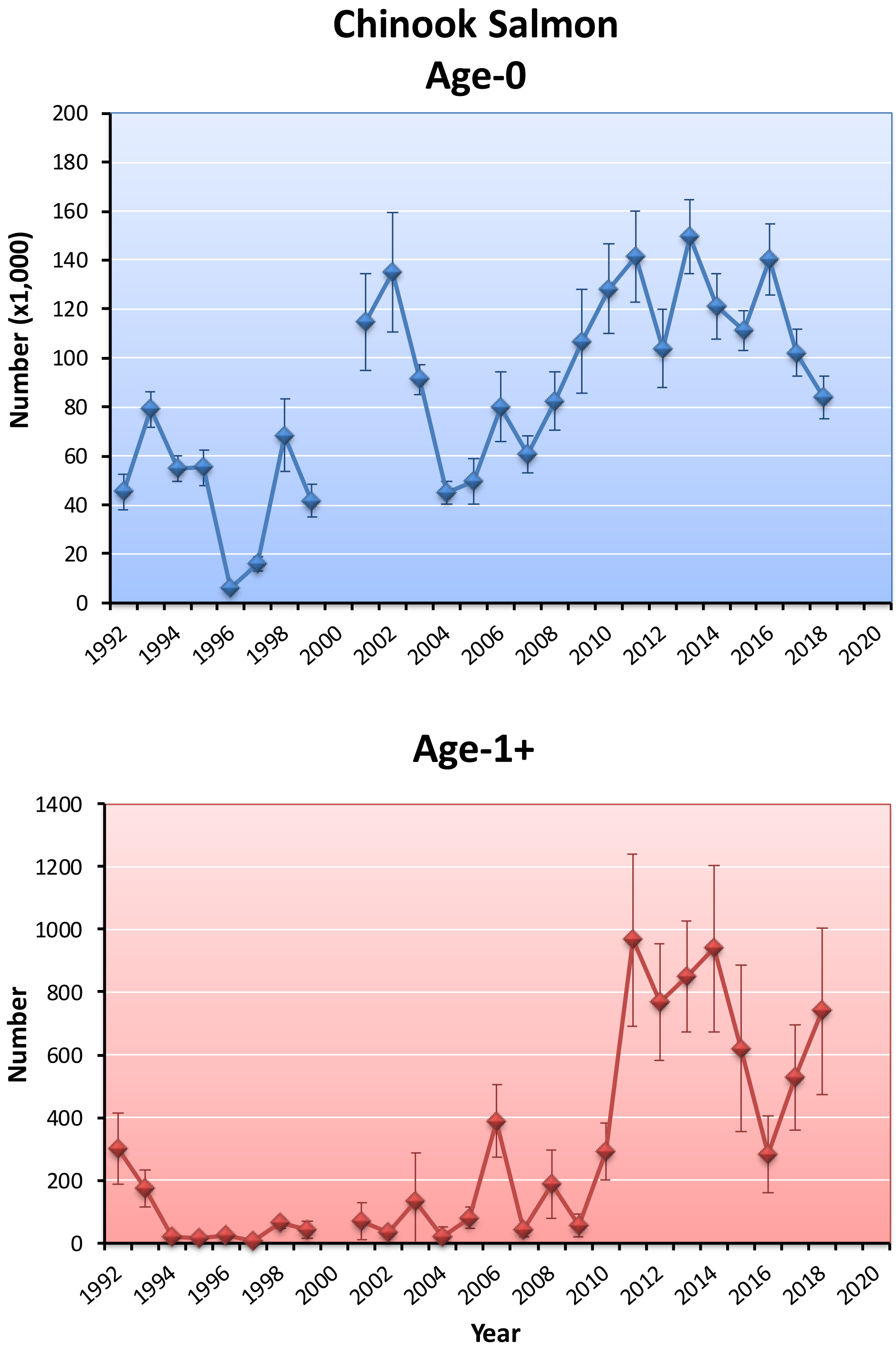


Figure 3. Numbers of age-0 and age-1+ Chinook salmon within the Chiwawa River basin in August 1992-2018. Vertical bars indicate 95% confidence bounds.

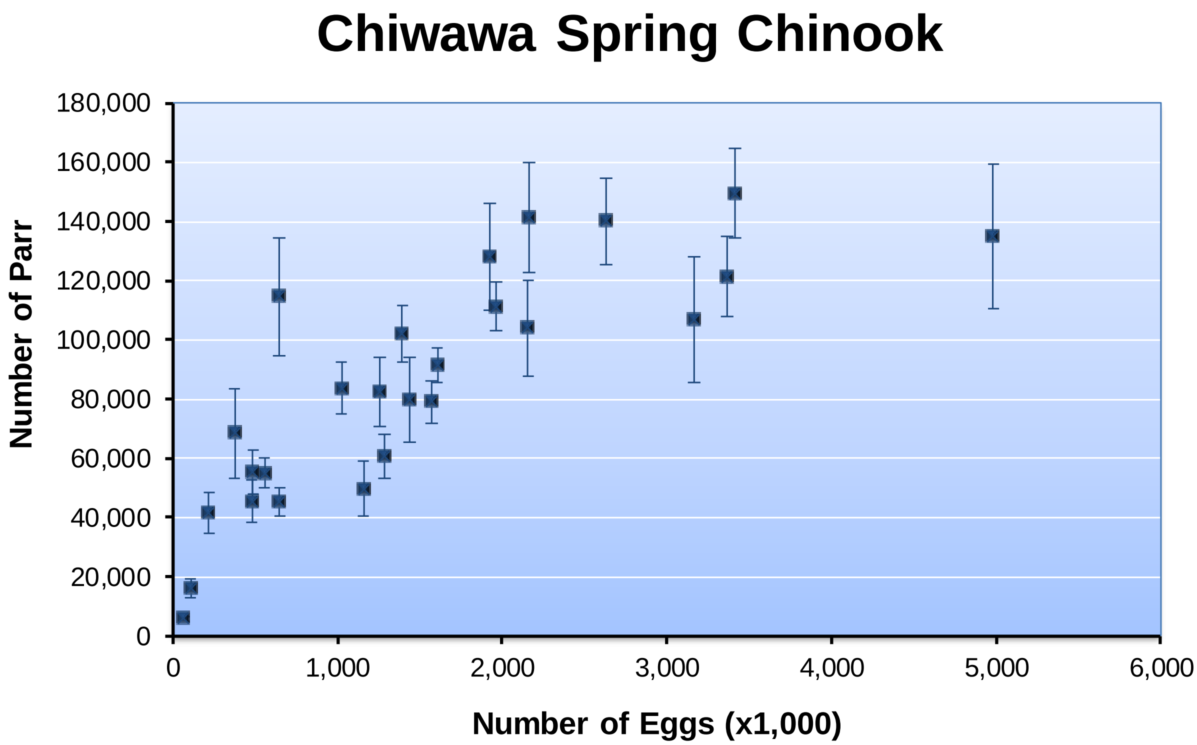


Figure 4. Relationship between total number of Chinook salmon parr counted during the summer (based on fish/ha) and number of eggs deposited in the Chiwawa River basin, 1992-2018. Vertical bars indicate 95% confidence bounds.

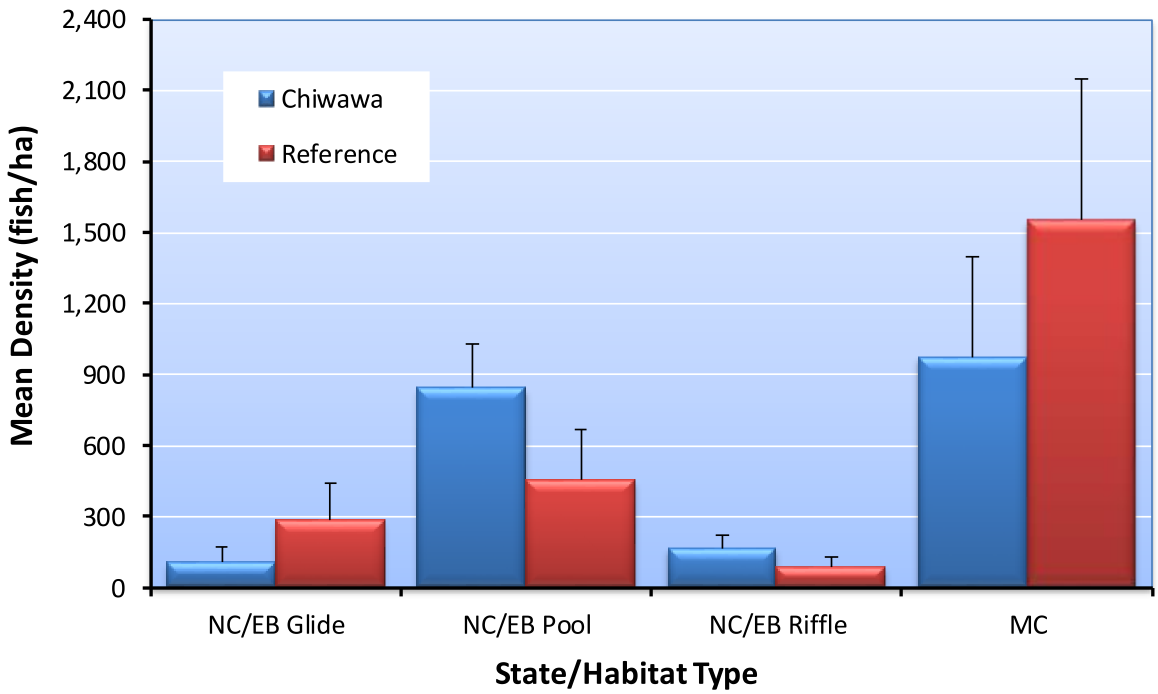


Figure 5. Comparison of the means (95% CI) of age-0 Chinook salmon densities (fish/ha) within state/habitat types in Reach 8 of the Chiwawa River and their matched reference areas on the Little Wenatchee River. There was no sampling in 2000 and no sampling in reference areas in 1992.

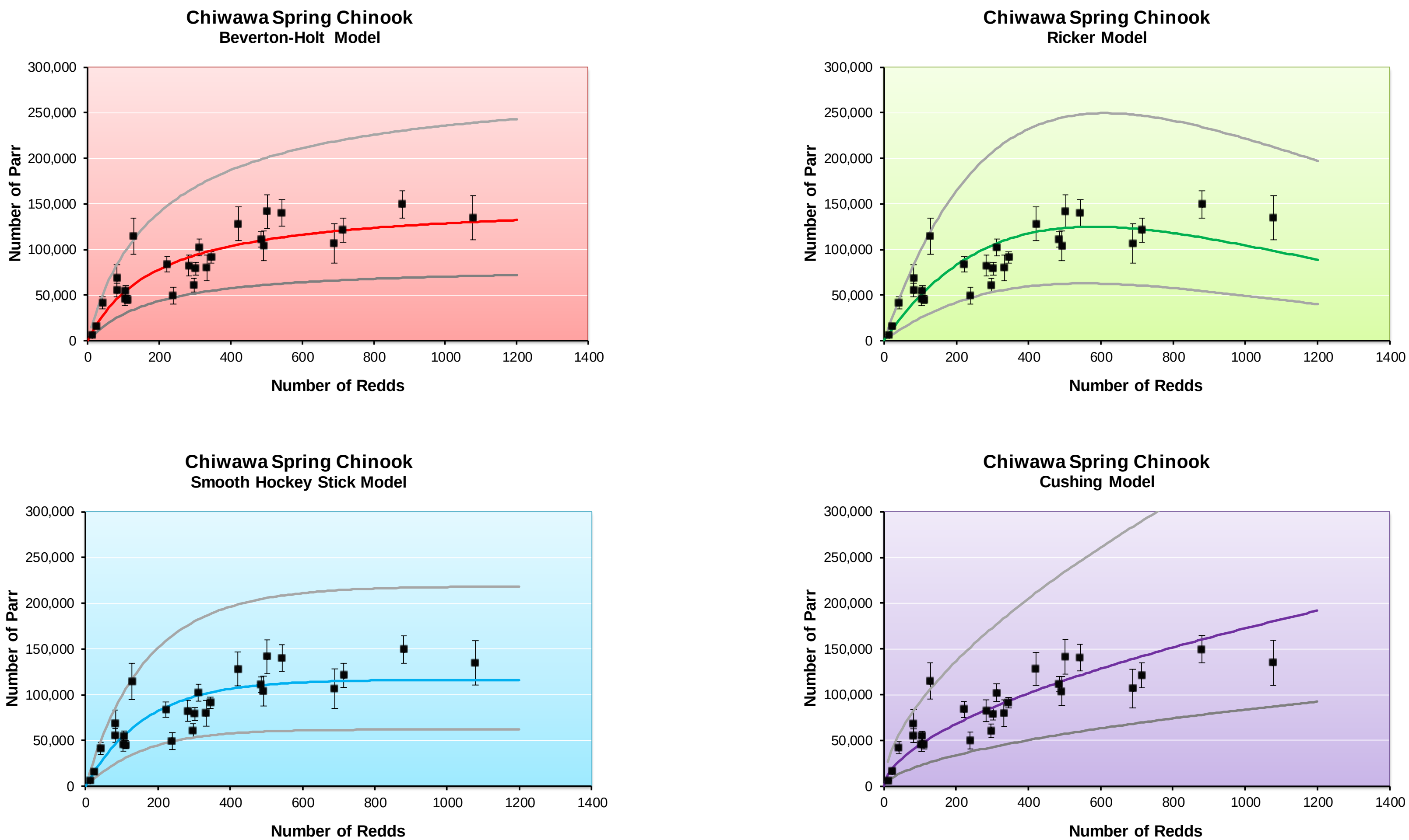


Figure 6. Relationship between numbers of juvenile (age-0) Chinook and redds in the Chiwawa River basin, 1992-2018 (no sampling occurred in 2000). Figures show the fit of the Beverton-Holt model, smooth hockey stick, Ricker model, and the Cushing model to the data. Gray lines indicate the upper and lower 95% C.B.

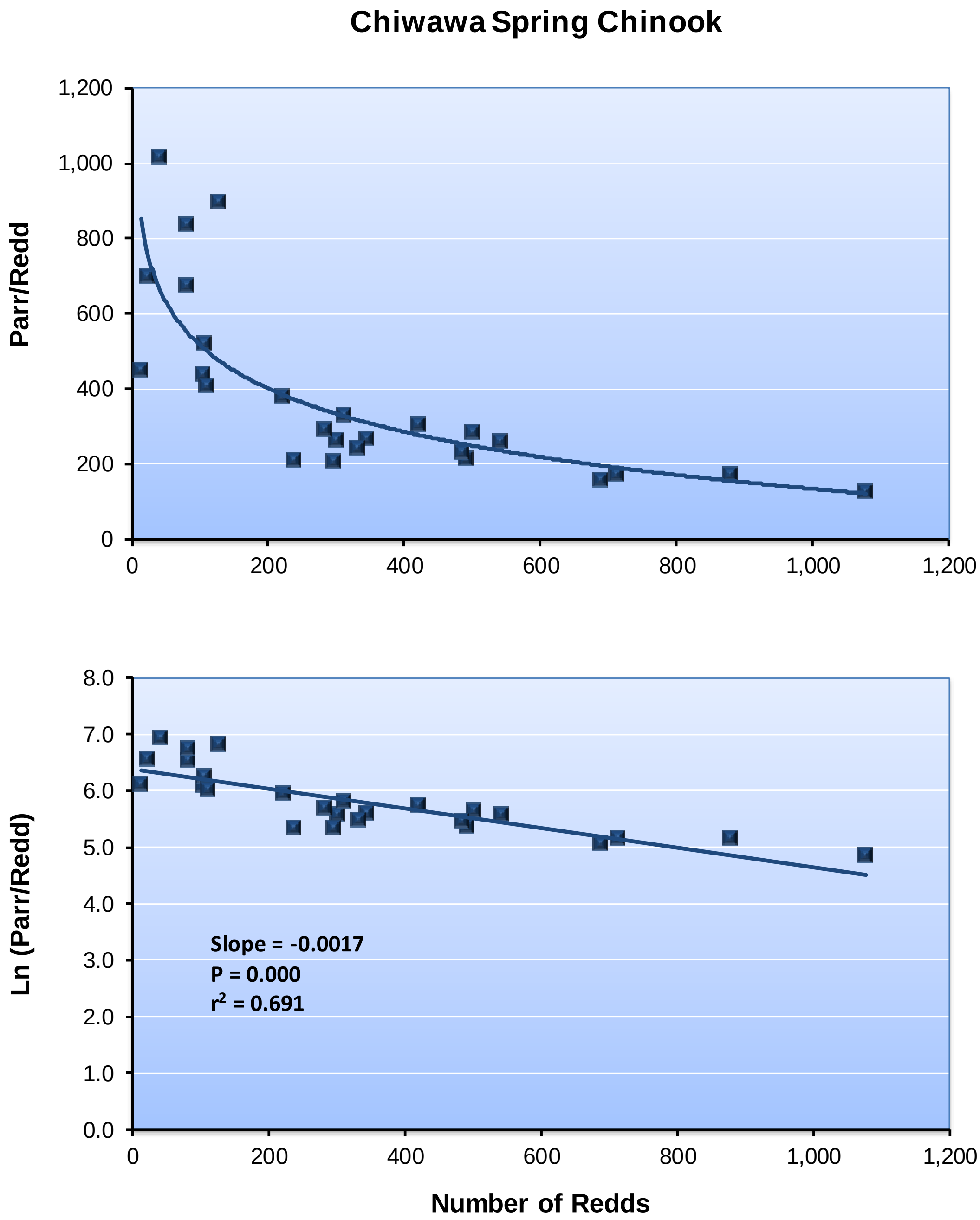


Figure 7. Relationship between parr/redd and numbers of redds (top figure) and natural log parr/redd and numbers of redds (bottom figure) in the Chiwawa River basin, 1992-2018. No sampling was conducted in 2000. Estimates for 1993-2018 included the Chiwawa River and its tributaries; the 1992 estimate included only the Chiwawa River. The linear relationship LN(P/R) = 6.3728 – 0.0017(Redds) was significant with P = 0.000; r^2 = 0.691.

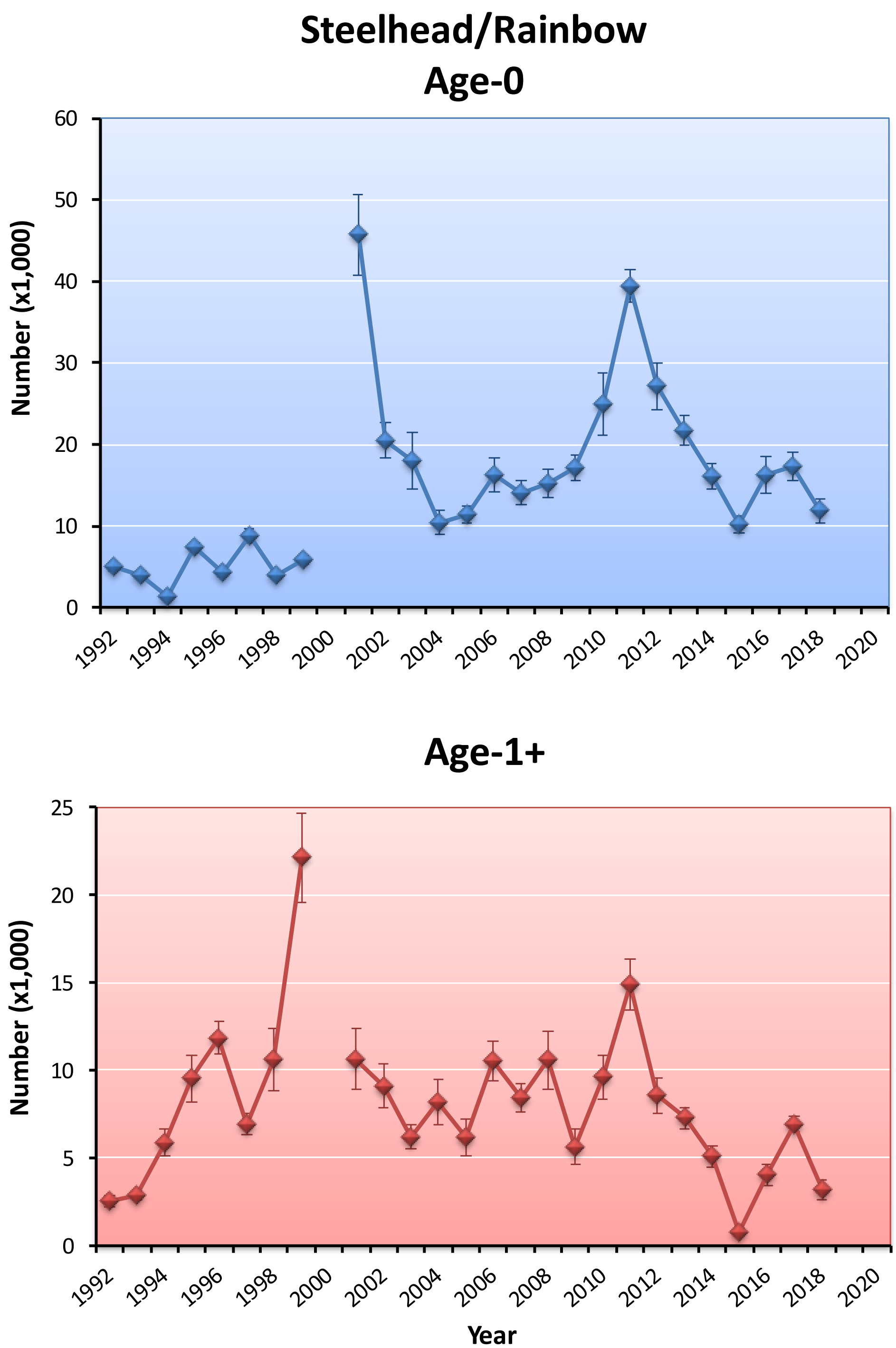
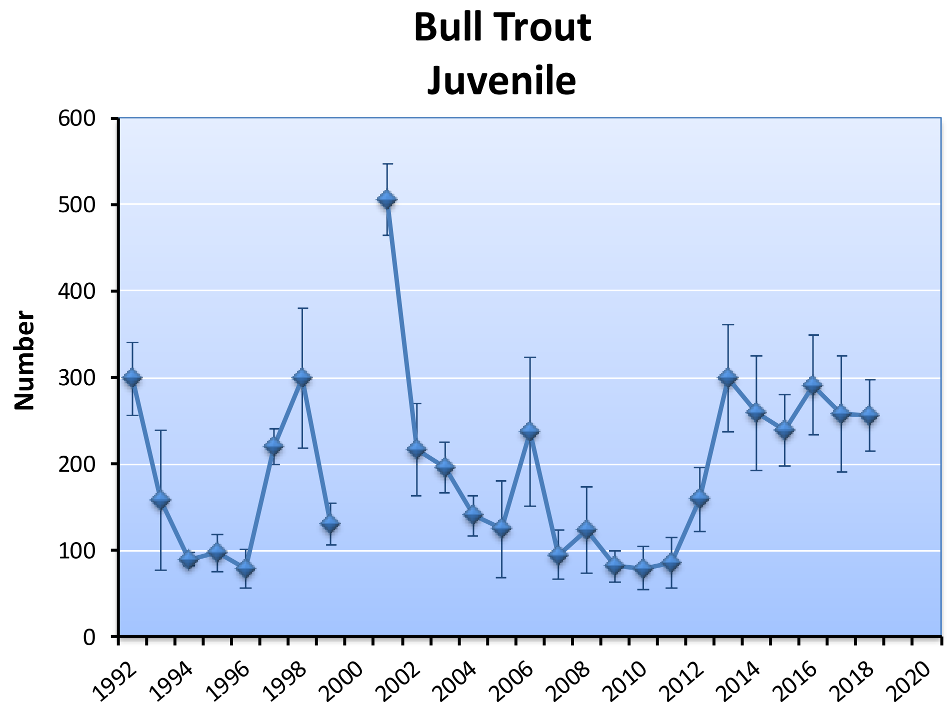


Figure 8. Numbers of age-0 (<4 in) and age-1+ (4-8 in) steelhead/rainbow within the Chiwawa River basin in August 1992-2018. Vertical bars indicate 95% confidence bounds.



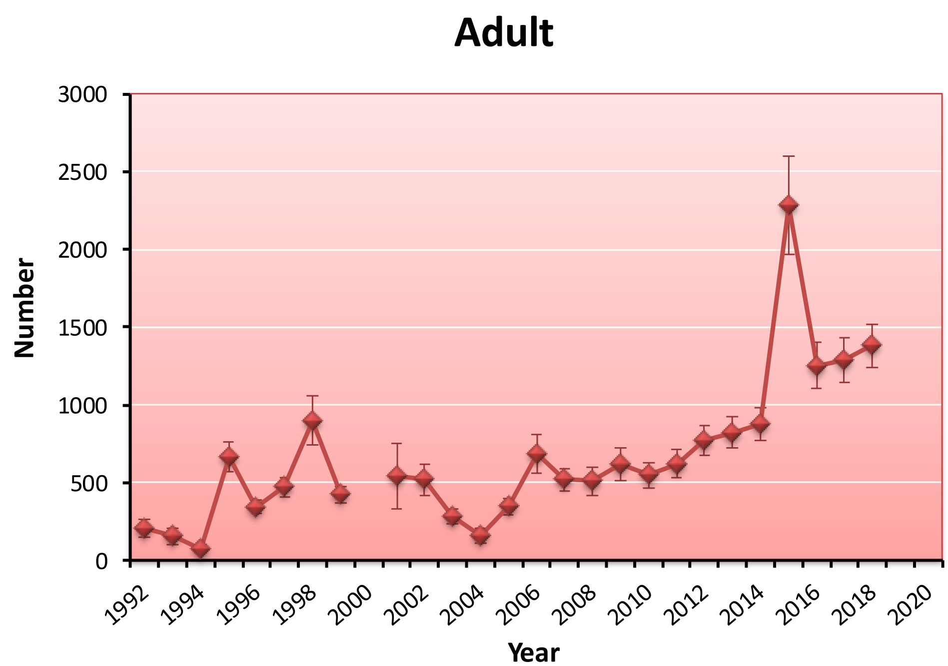


Figure 9. Numbers of juvenile (2-8 inches) and adult (>8 inches) bull trout within the Chiwawa River basin in August 1992-2018. Vertical bars indicate 95% confidence bounds.

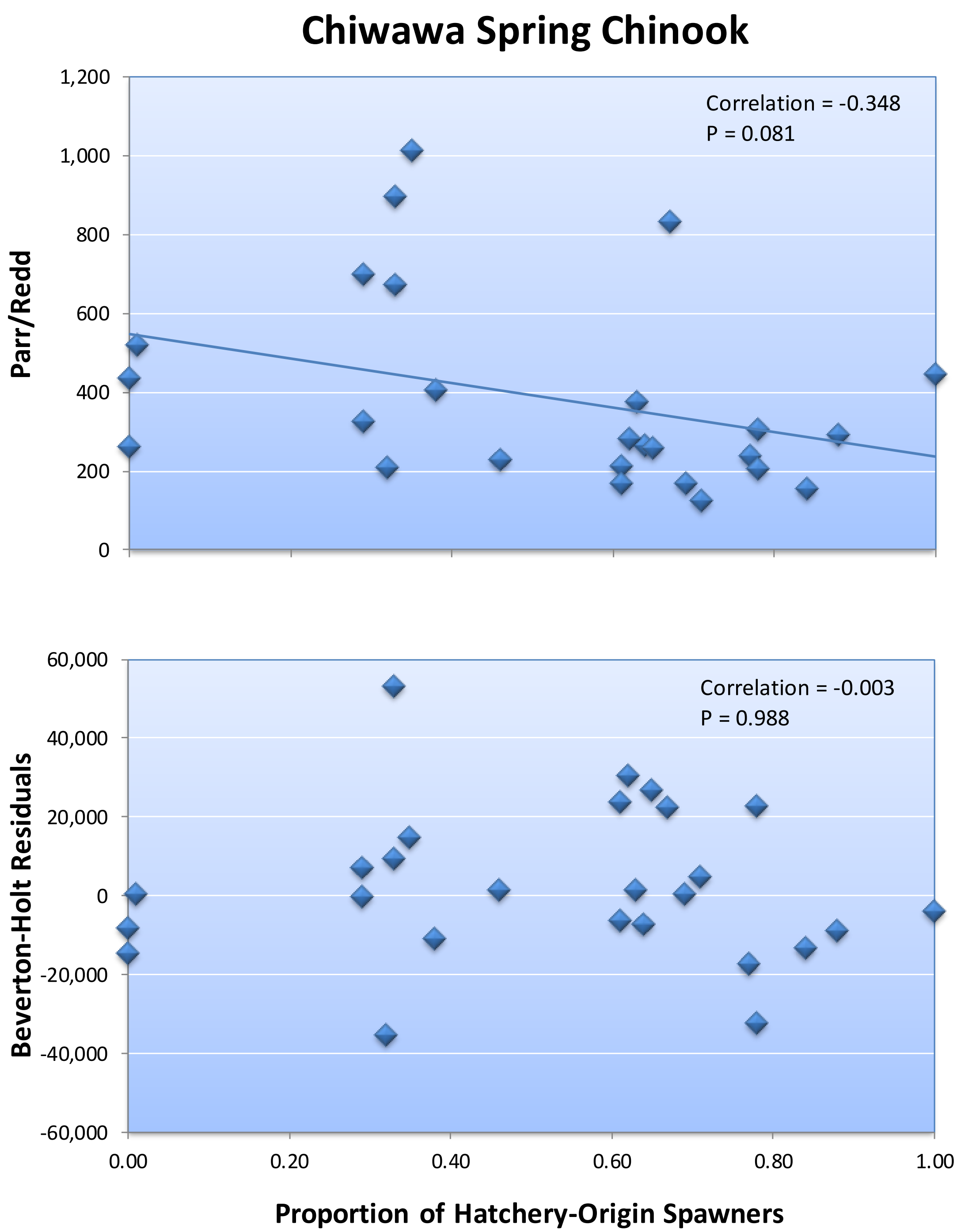


Figure 10. Relationship between juvenile productivity (parr/redd) and the proportion of hatchery-origin spawners (pHOS) (top figure) and the relationship between the residuals from the Beverton-Holt stock/recruitment relationship and pHOS (bottom figure).

Table 1. Description, location (river mile), and area (hectares) of land-class strata (reaches) used by age-0 Chinook salmon in the Chiwawa River basin, 2018. Reaches were classified according to geologic district, land-type association, valley-bottom type, stream state-type, and habitat type within the Cascade Ecoregion; MCV = moderately confined valley, CC = confined canyon, UCV = unconfined valley, NC = natural channel, EB = eroded banks, S = straight, G = glide, P = pool, R = riffle, and MC = multiple channel. See Hillman and Miller (2004) for definitions of stream state codes.

Reach	RM	Gradient	Geologic district	Landtype association	Valley bottom type	Stream state type	Habitat type	Area (ha)	
								Total	Sample
Chiwawa River									
1	0.00-3.77	0.007	Glacial Drift over Chumstick Formation	Glacial Valley	MCV Alluvial	NC/EB	G	0.58	0.58
						NC/EB	P	1.36	1.04
						NC/EB	R	16.22	1.73
2	3.77-5.51	0.010	Glacial Drift over Chumstick Formation	Glacial Canyon	CC Fluvial	NC/EB	G	0.31	0.31
						NC/EB	P	0.65	0.23
						NC/EB	R	6.90	0.62
3	5.51-7.88	0.009	Glacial Drift over Chumstick Formation	Glacial Valley	MCV Alluvial	NC/S	R	5.17	0.74
						NC/EB	G	0.13	0.13
						NC/EB	R	4.35	0.58
						MC	MC	0.27	0.27
4	7.88-8.90	0.007	Glacial Drift over Chumstick Formation	Glacial Canyon	CC Fluvial	NC/EB	P	0.37	0.26
						NC/EB	R	2.62	0.39
						MC	MC	0.45	0.45
5	8.90-10.83	0.011	Glacial Drift over Chumstick Formation	Glacial Valley	MCV Alluvial	NC/EB	P	0.12	0.12
						NC/EB	R	8.58	0.95
6	10.83-11.80	0.008	Glacial Drift over Chumstick Formation	Glacial Canyon	CC Fluvial	NC/EB	P	0.41	0.41
						NC/EB	R	3.69	1.04
						MC	MC	0.33	0.33
7	11.80-20.03	0.001	Glacial Drift over Chumstick Formation	Glacial Valley	UCV Alluvial	NC	G	1.71	0.92
						NC	P	5.65	0.53
						NC	R	0.87	0.33
						NC/EB	G	2.43	1.31
						NC/EB	P	6.33	1.64
						NC/EB	R	4.43	0.51
						MC	MC	4.11	1.89
8	20.03-25.42	0.003	Glacial Drift over Swakane Gneiss	Glacial Valley	UCV Alluvial	NC/EB	G	2.78	1.08
						NC/EB	P	7.46	1.74
						NC/EB	R	5.30	1.36
						EB	P	0.20	0.20
						EB	R	0.28	0.28
						MC	MC	6.79	2.99
9	25.42-28.81	0.007	Glacial Drift over Swakane Gneiss	Glacial Valley	MCV Alluvial	NC	P	3.73	0.49
						NC	R	2.58	0.62
						MC	MC	3.14	0.52
10	28.81-31.11	0.011	Pre-upper Jurassic Gneiss	Glacial Valley	MCV Alluvial	NC	P	0.63	0.37
						NC	R	2.40	0.75
						MC	MC	4.23	0.34

Table 1. Concluded.

Reach	RM	Gradient	Geologic district	Landtype association	Valley bottom type	Stream state type	Habitat type	Area (ha)	
								Total	Sampled
Trinity Side Channel									
10b	0.00-0.75	0.011	Pre-upper Jurassic Gneiss	Glacial Valley	MCV Alluvial	NC	P	0.38	0.03
						NC	R	0.19	0.04
						NC	MC	0.14	0.14
Phelps Creek									
1	0.00-0.35	0.043	Pre-upper Jurassic Gneiss	Glacial Valley	MCV Alluvial	NC	R	0.00	0.00
						NC	MC	0.05	0.05
Chikamin Creek[1]									
1	0.00-0.94	0.013	Glacial Drift over Chumstick Formation	Glacial Valley	UCV Alluvial	NC	G	0.07	0.07
						NC	P	0.23	0.07
						NC	R	0.32	0.10
						MC	MC	0.12	0.12
Rock Creek									
1	0.00-0.73	0.020	Glacial Drift over Swakane Gneiss	Glacial Valley	UCV Alluvial	NC	G	0.00	0.00
						NC	P	0.19	0.07
						NC	R	0.29	0.06
						MC	MC	0.06	0.06
Unnamed Creek									
1	0.00-0.05		Pre-upper Jurassic Gneiss	Glacial Valley	MCV Alluvial	NC	P	0.01	0.01
						NC	R	0.00	0.00
Big Meadow Creek									
1	0.00-0.35	0.025	Glacial Drift over Chumstick Formation	Glacial Valley	MCV Alluvial	NC	G	0.00	0.00
						NC	P	0.09	0.02
						NC	R	0.12	0.03
						NC	MC	0.05	0.05
Alder Creek									
1	0.00-0.01		Glacial Drift over Chumstick Formation	Glacial Valley	MCV Alluvial	NC	P	0.002	0.002
						NC	R	0.006	0.006
Brush Creek									
1	0.00-0.01		Glacial Drift over Chumstick Formation	Glacial Valley	UCV Alluvial	NC	P	0.003	0.003
						NC	R	0.004	0.004
Clear Creek									
1	0.00-0.05		Glacial Drift over Chumstick Formation	Glacial Valley	UCV Alluvial	NC	P	0.001	0.001
						NC	R	0.005	0.005
Y Creek									
1	0.00-0.05		Glacial Drift over Swakane Gneiss	Glacial Valley	UCV Alluvial	NC	P	0.000	0.000
						NC	R	0.000	0.000

[1] Includes the lower 0.2 miles of Minnow Creek.

Table 2. Estimated mean densities (fish/hectare and fish/m^3), total numbers, 95% confidence bounds on total numbers, and error of the estimated total number of age-0 Chinook salmon in reaches in the Chiwawa River basin, Washington, August 2018.

Reach	Mean density		Surface area (ha)			Volume (m^3)		
	Fish/ha	Fish/m^3	Total No.	95% C.B.	± Error	Total No.	95% C.B.	± Error
Chiwawa River								
1	121.5	0.038	2,207	±283	0.13	2,213	±325	0.15
2	239.6	0.054	1,883	±938	0.50	1,746	±1,007	0.58
3	104.2	0.031	1,034	±24	0.02	1,239	±24	0.02
4	298.8	0.065	1,028	±91	0.09	1,122	±105	0.09
5	34.0	0.008	296	±18	0.06	267	±26	0.10
6	138.4	0.040	613	±27	0.04	582	±40	0.07
7	1,219.8	0.208	31,142	±7,432	0.24	33,231	±4,808	0.14
8	606.0	0.099	13,823	±3,297	0.24	12,118	±5,061	0.42
9	870.7	0.163	8,228	±1,862	0.23	8,800	±1,334	0.15
10	2,282.9	0.622	18,195	±2,391	0.13	17,271	±2,657	0.15
Phelps Creek								
1	1,460.0	0.908	73	±0	0.00	73	±0	0.00
Chikamin Creek[1]								
1	2,695.9	1.255	1,995	±417	0.21	1,954	±263	0.13
Rock Creek								
1	3,764.8	1.174	2,033	±403	0.20	1,657	±804	0.49
Unnamed Creek								
1	1,545.5	0.370	17	±0	0.00	17	±0	0.00
Big Meadow Creek								
1	3,969.0	1.768	1,024	±359	0.35	845	±513	0.61
Alder Creek								
1	4,000.0	4.638	32	±0	0.00	32	±0	0.00
Brush Creek								
1	13,571.4	12.338	95	±0	0.00	95	±0	0.00
Clear Creek								
1	1,833.3	2.076	11	±0	0.00	11	±0	0.00
Y Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Grand Total	**698.4**	**0.148**	**83,729**	**±8,760**	**0.10**	**83,273**	**±7,726**	**0.09**

[1] Includes lower 0.2 miles of Minnow Creek.

Table 3. Estimated mean densities (fish/hectare and fish/m^3), total numbers, 95% confidence bounds on total numbers, and error of the estimated total number of age-1+ Chinook salmon in reaches in the Chiwawa River basin, Washington, August 2018.

Reach	Mean density		Surface area (ha)			Volume (m^3)		
	Fish/ha	Fish/m^3	Total No.	95% C.B.	± Error	Total No.	95% C.B.	± Error
Chiwawa River								
1	2.5	0.001	45	±16	0.36	47	±26	0.55
2	7.8	0.002	61	±10	0.16	55	±15	0.27
3	0.0	0.000	0	±0	0.00	0	±0	0.00
4	7.3	0.002	25	±0	0.00	26	±0	0.00
5	0.0	0.000	0	±0	0.00	0	±0	0.00
6	2.5	0.001	11	±0	0.00	10	±0	0.00
7	9.1	0.002	233	±160	0.69	256	±166	0.65
8	10.3	0.002	234	±194	0.83	209	±267	1.28
9	12.4	0.002	117	±82	0.70	129	±85	0.66
10	1.6	0.001	13	±12	0.92	13	±15	1.15
Phelps Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Chikamin Creek[1]								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Rock Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Unnamed Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Big Meadow Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Alder Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Brush Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Clear Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Y Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Grand Total	**6.2**	**0.001**	**739**	**±266**	**0.36**	**745**	**±327**	**0.44**

[1] Includes lower 0.2 miles of Minnow Creek.

Table 4. Summary of the five productivity models of juvenile (age-0) Chinook salmon in the Chiwawa River basin. Models are shown, including the number of parameters (*K*), AIC_c values, AIC_c difference scores (Δ_i), the likelihood of the model given the data ($\pounds(g_i|x)$), Akaike weights (w_i), and adjusted R^2 values. The sample size (*n*) for all models was 26. Models describe the relationship between juvenile Chinook numbers (dependent variable) and redd numbers (independent variable).

Model	K^a	AIC_c	Δ_i	$\pounds(g_i\|x)$	w_i	*Adj* R^2
Beverton-Holt	3	-146.089	0.000	1.000	0.677	0.844
Smooth Hockey Stick	3	-144.313	1.776	0.411	0.278	0.833
Gamma[b]	4	-139.358	6.731	0.035	0.023	0.810
Ricker	3	-138.419	7.670	0.022	0.015	0.790
Cushing	3	-136.971	9.118	0.010	0.007	0.778

[a] ***K*** is the number of structural parameters in the model plus 1 for σ^2.
[b] The γ parameter in the Gamma model was greater than 0, which means that this model is nearly identical to the Ricker model.

Table 5. Estimated mean densities (fish/hectare and fish/m^3), total numbers, 95% confidence bounds on total numbers, and error of the estimated total number of age-0 (<4 in) steelhead/rainbow in reaches in the Chiwawa River basin, Washington, August 2018.

Reach	Mean density		Surface area (ha)			Volume (m^3)		
	Fish/ha	**Fish/m^3**	**Total No.**	**95% C.B.**	**± Error**	**Total No.**	**95% C.B.**	**± Error**
Chiwawa River								
1	71.5	0.022	1,299	±251	0.19	1,271	±257	0.20
2	149.9	0.038	1,178	±179	0.15	1,218	±174	0.14
3	83.8	0.024	831	±74	0.09	965	±65	0.07
4	229.4	0.056	789	±160	0.20	970	±154	0.16
5	128.3	0.031	1,116	±47	0.04	993	±49	0.05
6	80.6	0.021	357	±36	0.10	315	±36	0.11
7	81.7	0.015	2,085	±1,064	0.51	2,334	±1,034	0.44
8	0.0	0.000	0	±0	0.00	0	±0	0.00
9	0.0	0.000	0	±0	0.00	0	±0	0.00
10	0.0	0.000	0	±0	0.00	0	±0	0.00
Phelps Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Chikamin Creek[1]								
1	1,381.1	0.650	1,022	±402	0.39	1,013	±368	0.36
Rock Creek								
1	3,100.0	1.0.18	1,674	±710	0.42	1,437	±1,021	0.71
Unnamed Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Big Meadow Creek								
1	5,376.0	2.438	1,387	±420	0.30	1,165	±684	0.59
Alder Creek								
1	2,500.0	2.899	20	±0	0.00	20	±0	0.00
Brush Creek								
1	11,142.9	10.130	78	±0	0.00	78	±0	0.00
Clear Creek								
1	3,000.0	3.396	18	±0	0.00	18	±0	0.00
Y Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Grand Total	**98.9**	**0.021**	**11,854**	**±1,450**	**0.12**	**11,797**	**±1,686**	**0.14**

[1] Includes lower 0.2 miles of Minnow Creek.

Table 6. Estimated mean densities (fish/hectare and fish/m^3), total numbers, 95% confidence bounds on total numbers, and error of the estimated total number of age-1+ (4-8 in) steelhead/rainbow in reaches in the Chiwawa River basin, Washington, August 2018.

Reach	Mean density		Surface area (ha)			Volume (m^3)		
	Fish/ha	Fish/m^3	Total No.	95% C.B.	± Error	Total No.	95% C.B.	± Error
Chiwawa River								
1	47.6	0.015	865	±150	0.17	853	±160	0.19
2	95.8	0.024	753	±298	0.40	764	±300	0.39
3	26.7	0.008	265	±32	0.12	335	±32	0.10
4	24.4	0.005	84	±31	0.37	83	±17	0.20
5	26.6	0.006	231	±42	0.18	204	±45	0.22
6	33.4	0.009	148	±53	0.36	130	±56	0.43
7	16.9	0.003	432	±391	0.91	496	±414	0.83
8	0.0	0.000	0	±0	0.00	0	±0	0.00
9	0.0	0.000	0	±0	0.00	0	±0	0.00
10	0.0	0.000	0	±0	0.00	0	±0	0.00
Phelps Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Chikamin Creek[1]								
1	89.2	0.040	66	±53	0.80	63	±48	0.76
Rock Creek								
1	118.5	0.037	64	±86	1.34	52	±91	1.75
Unnamed Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Big Meadow Creek								
1	941.9	0.439	243	±147	0.60	210	±185	0.88
Alder Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Brush Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Clear Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Y Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Grand Total	**26.3**	**0.006**	**3,151**	**±550**	**0.17**	**3,190**	**±581**	**0.18**

[1] Includes lower 0.2 miles of Minnow Creek.

Table 7. Estimated mean densities (fish/hectare and fish/m^3), total numbers, 95% confidence bounds on total numbers, and error of the estimated total number of steelhead/rainbow larger than 8 inches in reaches in the Chiwawa River basin, Washington, August 2018.

Reach	Mean density		Surface area (ha)			Volume (m^3)		
	Fish/ha	Fish/m^3	Total No.	95% C.B.	± Error	Total No.	95% C.B.	± Error
Chiwawa River								
1	0.1	0.000	1	±2	2.00	1	±3	3.00
2	0.4	0.000	3	±3	1.00	3	±4	1.33
3	0.2	0.000	2	±0	0.00	2	±0	0.00
4	0.0	0.000	0	±0	0.00	0	±0	0.00
5	0.0	0.000	0	±0	0.00	0	±0	0.00
6	0.0	0.000	0	±0	0.00	0	±0	0.00
7	0.5	0.000	13	±13	1.00	16	±13	0.81
8	0.0	0.000	0	±0	0.00	0	±0	0.00
9	0.0	0.000	0	±0	0.00	0	±0	0.00
10	0.0	0.000	0	±0	0.00	0	±0	0.00
Phelps Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Chikamin Creek[1]								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Rock Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Unnamed Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Big Meadow Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Alder Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Brush Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Clear Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Y Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Grand Total	**0.2**	**0.000**	**19**	**±13**	**0.68**	**22**	**±14**	**0.64**

[1] Includes lower 0.2 miles of Minnow Creek.

Table 8. Estimated mean densities (fish/hectare and fish/m^3), total numbers, 95% confidence bounds on total numbers, and error of the estimated total number of juvenile bull trout (2-8 in) in reaches in the Chiwawa River basin, Washington, August 2018.

Reach	Mean density		Surface area (ha)			Volume (m^3)		
	Fish/ha	Fish/m^3	Total No.	95% C.B.	± Error	Total No.	95% C.B.	± Error
Chiwawa River								
1	0.1	0.000	1	±3	3.00	1	±3	3.00
2	0.0	0.000	0	±0	0.00	0	±0	0.00
3	0.0	0.000	0	±0	0.00	0	±0	0.00
4	0.0	0.000	0	±0	0.00	0	±0	0.00
5	0.0	0.000	0	±0	0.00	0	±0	0.00
6	0.0	0.000	0	±0	0.00	0	±0	0.00
7	0.0	0.000	0	±0	0.00	0	±0	0.00
8	0.0	0.000	0	±0	0.00	0	±0	0.00
9	6.7	0.001	63	±21	0.33	65	±46	0.71
10	13.8	0.006	110	±19	0.17	163	±28	0.17
Phelps Creek								
1	420.0	0.261	21	±13	0.62	21	±10	0.48
Chikamin Creek[1]								
1	14.9	0.008	11	±26	2.36	12	±36	3.00
Rock Creek								
1	92.6	0.030	50	±0	0.00	42	±0	0.00
Unnamed Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Big Meadow Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Alder Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Brush Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Clear Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Y Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Grand Total	**2.1**	**0.001**	**256**	**±41**	**0.16**	**304**	**±65**	**0.21**

[1] Includes lower 0.2 miles of Minnow Creek.

Table 9. Estimated mean densities (fish/hectare and fish/m^3), total numbers, 95% confidence bounds on total numbers, and error of the estimated total number of adult bull trout (>8 in) in reaches in the Chiwawa River basin, Washington, August 2018.

Reach	Mean density		Surface area (ha)			Volume (m^3)		
	Fish/ha	Fish/m^3	Total No.	95% C.B.	± Error	Total No.	95% C.B.	± Error
Chiwawa River								
1	1.0	0.000	18	±10	0.56	18	±26	1.44
2	3.6	0.001	28	±6	0.21	26	±26	1.00
3	0.9	0.000	9	±0	0.00	8	±0	0.00
4	2.3	0.001	8	±4	0.50	9	±5	0.56
5	2.1	0.001	18	±0	0.00	16	±0	0.00
6	1.1	0.000	5	±0	0.00	4	±0	0.00
7	11.5	0.002	294	±61	0.21	320	±144	0.45
8	9.8	0.002	224	±93	0.42	209	±169	0.81
9	28.6	0.005	270	±34	0.13	280	±89	0.32
10	62.2	0.015	496	±79	0.16	427	±80	0.19
Phelps Creek								
1	80.0	0.050	4	±0	0.00	4	±0	0.00
Chikamin Creek[1]								
1	4.1	0.002	3	±6	2.00	3	±6	2.00
Rock Creek								
1	5.6	0.001	3	±5	1.67	2	±5	2.50
Unnamed Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Big Meadow Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Alder Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Brush Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Clear Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Y Creek								
1	0.0	0.000	0	±0	0.00	0	±0	0.00
Grand Total	**11.5**	**0.002**	**1,380**	**±141**	**0.10**	**1,326**	**±256**	**0.19**

[1] Includes lower 0.2 miles of Minnow Creek.

APPENDIX A. Numbers of redds, eggs, age-0 Chinook salmon, parr per redd, and percent egg-to-parr survival in the Chiwawa River basin, brood years 1991-2017; NS = not sampled. Numbers of eggs were calculated as the number of redds times the mean fecundity of females collected for broodstock.

Brood Year	Chinook Salmon			Parr/Redd	Egg-to-parr survival (%)
	Redds	Eggs	Age-0 (parr)		
1991	104	478,400	45,483	437	9.5
1992	302	1,570,098	79,113	262	5.0
1993	106	556,394	55,056	519	9.9
1994	82	485,686	55,240	674	11.4
1995	13	66,248	5,815	447	8.8
1996	23	106,835	16,066	699	15.0
1997	82	374,740	68,415	834	18.3
1998	41	218,325	41,629	1,015	19.1
1999	34	166,090	NS	NS	NS
2000	128	642,944	114,617	895	17.8
2001	1,078	4,984,672	134,874	125	2.7
2002	345	1,605,630	91,278	265	5.7
2003	111	648,684	45,177	407	7.0
2004	241	1,156,559	49,631	206	4.3
2005	332	1,436,564	79,902	241	5.6
2006	297	1,284,228	60,752	205	4.7
2007	283	1,256,803	82,351	291	6.6
2008	689	3,163,888	106,705	155	3.4
2009	421	1,925,233	128,220	305	6.7
2010	502	2,165,628	141,510	282	6.5
2011	492	2,157,420	103,940	211	4.8
2012	880	3,716,240	149,563	185	4.4
2013	714	3,367,224	121,240	170	3.6
2014	485	1,961,825	111,224	229	5.7
2015	543	2,631,921	140,172	258	5.3
2016	312	1,393,704	102,106	327	7.3
2017	222	1,024,530	83,729	377	8.2
Average	**328**	**1,501,723**	**85,146**	**385**	**8.0**

APPENDIX B. Estimated numbers of salmonids (based on fish/ha) in the Chiwawa River basin, Washington, 1992-2018; NS = not sampled.

Survey year	Chinook salmon		Steelhead/Rainbow			Bull trout		Cutthroat trout
	Age-0	Age-1+	Age-0	Age-1+	>8 in[1]	2-8 in	>8 in	
1992[2]	45,483	563	4,927	2,533	1,869	299	208	NS
1993	79,113	174	4,004	2,860	768	158	156	NS
1994	55,056	18	1,410	5,856	67	90	76	NS
1995	55,241	13	7,357	9,517	140	97	664	NS
1996	5,815	22	4,245	11,849	78	79	343	NS
1997	16,066	5	8,823	6,905	48	220	472	56
1998	68,415	63	3,921	10,585	78	300	900	93
1999	41,629	41	5,838	22,130	33	130	423	80
2000	NS	NS	NS	NS	NS	NS	NS	NS
2001	114,617	69	45,727	10,623	420	505	542	108
2002	134,874	32	20,521	9,090	181	217	521	111
2003	91,278	134	18,020	6,179	49	196	282	52
2004	45,177	21	10,380	8,190	8	140	157	22
2005	49,631	79	11,463	6,188	48	125	346	23
2006	79,902	388	16,245	10,533	50	238	686	68
2007	60,752	41	14,073	8,448	77	95	520	47
2008	82,351	189	15,230	10,576	144	124	510	109
2009	106,705	54	17,179	5,629	85	82	618	128
2010	128,220	291	25,018	9,616	63	79	547	252
2011	141,510	967	39,446	14,903	65	86	621	240
2012	103,940	767	27,134	8,576	65	159	768	188
2013	149,563	852	21,682	7,253	76	299	820	358
2014	121,240	939	16,083	5,084	87	259	875	761
2015	111,224	620	10,208	754	18	239	2,286	292
2016	140,172	282	16,244	4,031	14	291	1,254	544
2017	102,106	526	17,296	6,923	20	258	1,284	562
2018	83,729	739	11,854	3,151	19	256	1,380	432

[1]During 1992-1993, numbers of steelhead/rainbow greater than 8 inches included both hatchery and wild rainbow trout. Thereafter, only wild trout were observed.
[2]Only the Chiwawa River was sampled in 1992. No tributaries were sampled in that year.

APPENDIX C. Proportion of total habitat available, fraction of all age-0 Chinook within each habitat type, and densities (fish/ha) and numbers of age-0 Chinook within each habitat type in the Chiwawa River basin, survey years 1992-2018; NS = not sampled.

Habitat	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Proportion of total habitat available											
Glide	0.10	0.09	0.10	0.10	0.10	0.09	0.09	0.09	NS	0.07	0.08
Pool	0.19	0.19	0.21	0.18	0.18	0.17	0.16	0.17	NS	0.15	0.16
Riffle	0.61	0.61	0.57	0.59	0.57	0.57	0.58	0.55	NS	0.49	0.48
M. Chan	0.10	0.11	0.12	0.14	0.14	0.17	0.17	0.19	NS	0.29	0.28
Fraction of all age-0 Chinook within habitat types											
Glide	0.07	0.03	0.02	0.01	0.02	0.01	0.01	0.01	NS	0.03	0.01
Pool	0.30	0.28	0.22	0.21	0.30	0.16	0.17	0.14	NS	0.23	0.24
Riffle	0.19	0.16	0.12	0.11	0.43	0.23	0.08	0.11	NS	0.18	0.15
M. Chan	0.45	0.53	0.64	0.67	0.24	0.60	0.74	0.74	NS	0.57	0.60
Densities of age-0 Chinook within habitat types (fish/ha)											
Glide	254	251	93	55	11	12	78	13	NS	351	187
Pool	584	1,049	619	541	82	122	607	257	NS	1,392	1,468
Riffle	116	188	124	91	38	52	79	62	NS	336	300
M. Chan	1,710	3,408	2,985	2,328	84	449	2,620	1,201	NS	1,820	2,069
Number of age-0 Chinook within habitat types											
Glide	2,967	2,458	857	623	137	130	837	157	NS	3,231	1,931
Pool	13,468	21,814	12,131	11,294	1,755	2,553	11,454	5,933	NS	25,890	32,612
Riffle	8,531	12,616	6,698	6,197	2,525	3,699	5,392	4,626	NS	20,629	19,754
M. Chan	20,517	42,225	35,370	36,965	1,396	9,682	50,728	30,912	NS	64,866	80,576

APPENDIX C. Continued.

Habitat	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Proportion of total habitat available											
Glide	0.07	0.07	0.08	0.08	0.07	0.09	0.08	0.08	0.08	0.07	0.07
Pool	0.17	0.16	0.16	0.16	0.17	0.23	0.22	0.23	0.18	0.23	0.23
Riffle	0.49	0.50	0.47	0.47	0.47	0.51	0.54	0.53	0.57	0.53	0.53
M. Chan	0.26	0.27	0.29	0.30	0.29	0.17	0.15	0.16	0.17	0.17	0.17
Fraction of all age-0 Chinook within habitat types											
Glide	0.02	0.01	0.01	0.03	0.02	0.03	0.02	0.02	0.04	0.01	0.02
Pool	0.23	0.07	0.19	0.31	0.46	0.40	0.36	0.34	0.34	0.41	0.37
Riffle	0.15	0.14	0.07	0.12	0.12	0.11	0.11	0.11	0.19	0.15	0.13
M. Chan	0.60	0.77	0.73	0.54	0.40	0.45	0.51	0.53	0.43	0.43	0.48
Densities of age-0 Chinook within habitat types (fish/ha)											
Glide	200	58	49	237	113	238	230	286	526	173	321
Pool	951	155	492	1,240	1,211	1,210	1,453	1,436	1,805	1,360	1,890
Riffle	216	101	60	166	118	156	175	200	330	221	281
M. Chan	1,626	1,008	1,057	1,147	603	1,872	2,993	3,293	2,515	2,061	3,190
Number of age-0 Chinook within habitat types											
Glide	1,884	540	442	2,498	1,120	2,668	2,371	3,164	6,122	1,535	2,822
Pool	21,091	3,183	9,626	26,754	28,851	34,314	39,382	44,765	48,846	42,209	55,651
Riffle	13,783	6,501	3,367	10,753	7,809	9,773	11,558	14,446	27,883	15,418	19,619
M. Chan	54,519	34,952	36,196	46,580	25,409	38,275	55,607	69,609	61,944	44,779	73,057

APPENDIX C. Concluded.

Habitat	2014	2015	2016	2017	2018	Mean
Proportion of total habitat available						
Glide	0.07	0.07	0.06	0.07	0.07	**0.08**
Pool	0.22	0.24	0.24	0.23	0.23	**0.19**
Riffle	0.54	0.53	0.54	0.54	0.53	**0.53**
M. Chan	0.17	0.16	0.16	0.16	0.17	**0.20**
Fraction of all age-0 Chinook within habitat types						
Glide	0.01	0.01	0.01	0.01	0.01	**0.02**
Pool	0.37	0.31	0.35	0.43	0.47	**0.31**
Riffle	0.11	0.05	0.08	0.12	0.08	**0.13**
M. Chan	0.51	0.63	0.56	0.44	0.44	**0.54**
Densities of age-0 Chinook within habitat types (fish/ha)						
Glide	133	66	114	146	119	**169**
Pool	1,569	1,300	1,628	1,446	1,417	**1,097**
Riffle	190	98	168	170	94	**163**
M. Chan	2,957	3,768	3,789	2,121	1,887	**1,930**
Number of age-0 Chinook within habitat types						
Glide	1,120	518	931	1,333	1,025	**1,670**
Pool	44,321	34,993	49,103	43,697	40,121	**27,147**
Riffle	13,085	6,017	11,550	11,840	6,097	**10,776**
M. Chan	62,713	69,969	78,589	45,234	37,819	**46,480**

Appendix C

Fish Trapping at the Chiwawa and Lower Wenatchee Rotary Smolt Traps during 2019

Monitoring Juvenile Salmonids in the Wenatchee River Basin:

Activities in the Chiwawa River and Lower Wenatchee River during 2019

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April 28, 2020

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INTRODUCTION

Background

Monitoring and Evaluation

Productivity indicators in the freshwater environment provide data essential to inform evolving salmon and steelhead hatchery programs. In the Wenatchee River subbasin, the Juvenile Monitoring Component of the Monitoring and Evaluation Plan for PUD Hatchery Programs gather data directed at informing these productivity indicators (see Hillman et al. 2013). More specifically, this data directly addresses Objective 2 of the monitoring and evaluation framework:

"Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks."

Objectives

The Washington Department of Fish and Wildlife monitors juvenile salmonids in the Wenatchee River basin with the primary objective of estimating: natural productivity, migration timing, and age with size at migration. This has occurred at the tributary level (Chiwawa River since 1991) and population level (Wenatchee River since 1997). Target species include spring Chinook salmon *Oncorhynchus tshawytscha* and summer steelhead *O. mykiss* in the Chiwawa River, and is expanded to include sockeye salmon *O. nerka* and summer Chinook salmon *O. tshawytscha* in the mainstem Wenatchee River.

Monitoring has primarily been conducted with rotary smolt traps that capture emigrating salmonids from spring through fall. In an effort to reduce biases in emigrant estimates, and to improve understanding of survival and movement during non-trapping periods (December through February), WDFW began remote sampling spring Chinook salmon in the Chiwawa River Basin in 2012 and Nason Creek Basin in 2013.

Study Area

Chiwawa River

The Chiwawa River is a fourth-order river draining a 474-km^2 basin and has a mean annual discharge of 14.4 cubic meters per second (m^3/s); contributing about 15% of the mean annual discharge of the Wenatchee River. The Chiwawa basin is dominated by the snow melt cycle with peak discharge occurring May through July with occasional fall freshets (Figure 1). The Chiwawa River originates in the North Cascades and flows southeast for 60 km before joining the Wenatchee River. This confluence with the Wenatchee River is approximately 9 km downstream of Lake Wenatchee and 76 km upstream of the Columbia River (Figure 2). The Chiwawa River basin is relatively natural, with 96% managed as part of the Wenatchee National Forest and the upper 32% designated wilderness.

Precipitation in the basin varies between 76 cm near the confluence and 356 cm at the peaks, while elevations range from 573 to 2,768 m. The river is dynamic with generally shallow pool riffle segments as it meanders through a U-shaped valley formed by ancient glaciers in the region. Gradients remain well under 1% for the majority of the river.

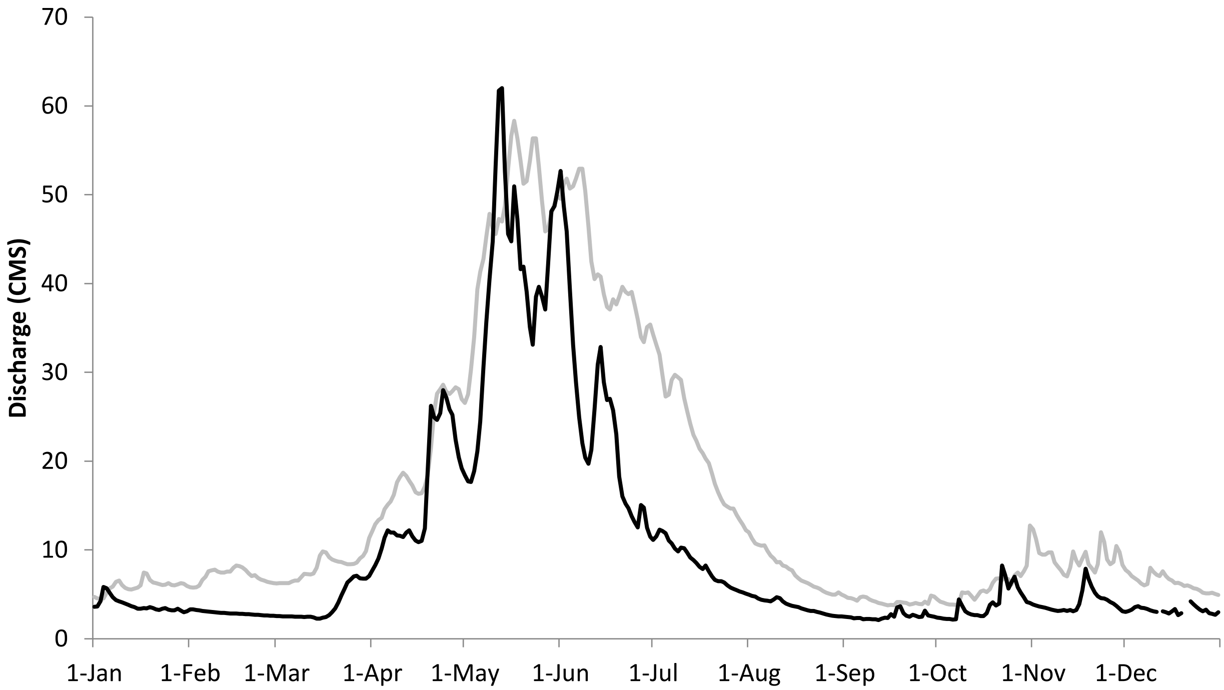

Figure 11. Discharge of the Chiwawa River at Plain, USGS gauge # 12456500. Black line represents 2019 discharge and grey line represents mean discharge from 2009-2018.

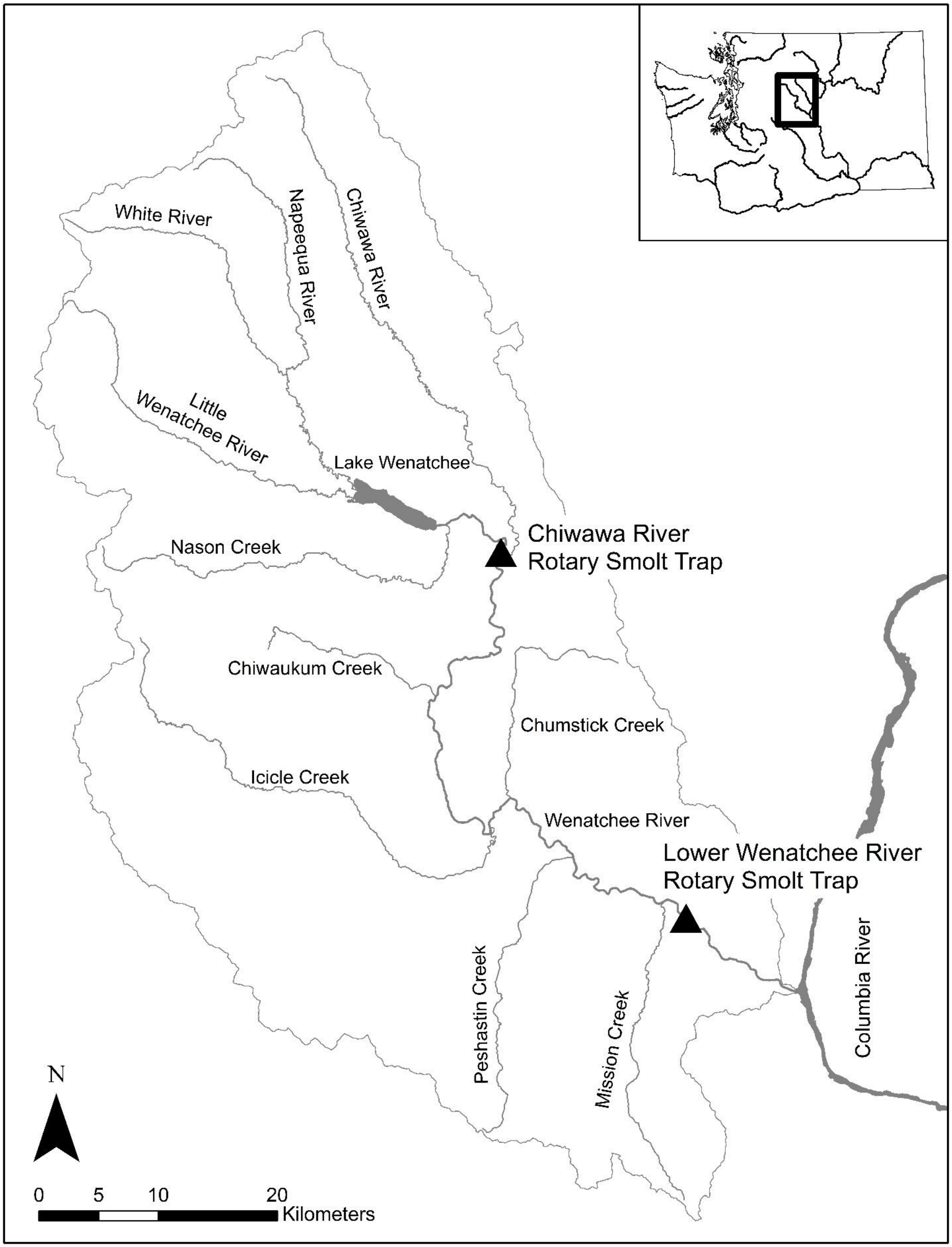

Figure 2. Wenatchee River basin (with rotary smolt trap locations).

Wenatchee River

The Wenatchee River is a fourth-order river draining a 3,437-km^2 basin and has a mean annual discharge of 91.4 m^3/s. The hydrograph is dominated by the snow melt cycle with peak discharge occurring May through July with occasional fall freshets (Figure 3). The mainstem originates at the outlet of Lake Wenatchee and flows southeast 84.5 km before joining the Columbia River, 753 km upstream of the Pacific Ocean (Figure 2). While most of the lowlands (17%) are private, the majority (83%) of basin is public land.

Precipitation in the basin varies from 22 cm near the Columbia River confluence to 381 cm at the crest of the Cascade Mountains with elevations ranging from 237 to 2,768 m. The Wenatchee River has a relatively low gradient except from rkm 40 – 64 where the river flows through a bedrock canyon (Tumwater Canyon) and has a gradient of approximately 9.8 meters per kilometer.

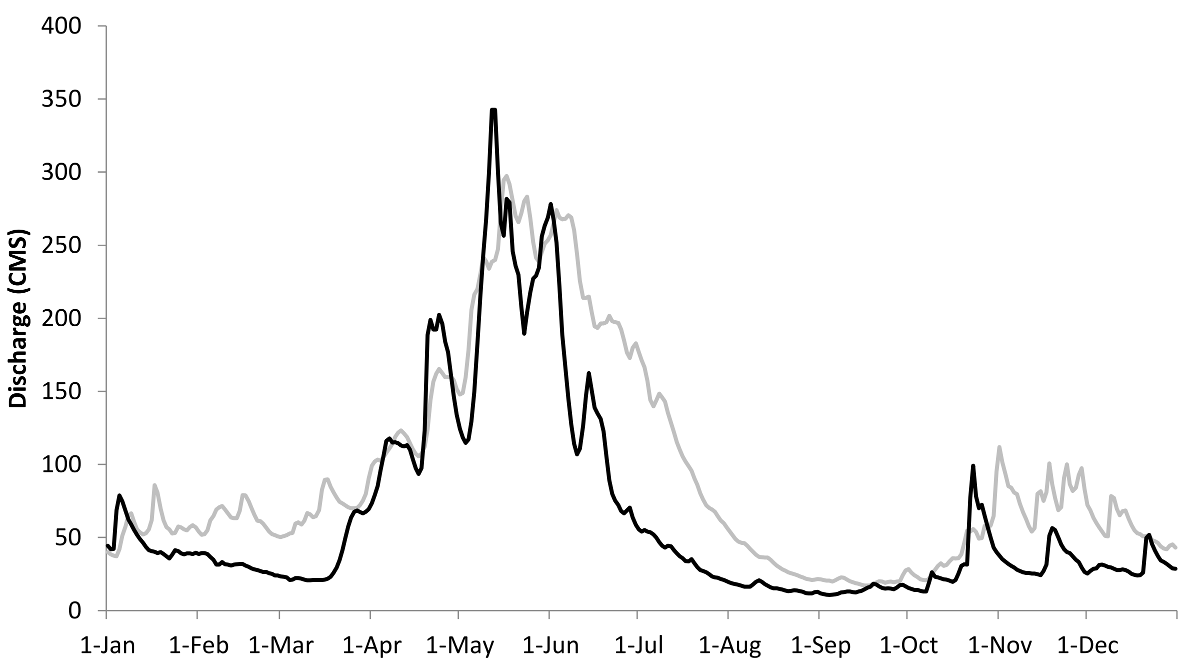

Figure 12. Discharge of the Wenatchee River at Monitor, USGS gauge # 12462500. Black line represents 2019 discharge and grey line represents mean discharge from 2009-2018.

METHODS

Rotary Smolt Traps

Trap Operations

The Chiwawa River trap consists of a single 2.4 m cone and has been operating since 1991 at its current location, 0.6 km upstream from the confluence with the Wenatchee River. Trap operations usually begin in March and continue until environmental conditions suspend operations in late fall. The Lower Wenatchee trap consists of two 2.4 m cones and has been operating in its current location (rkm 12.5) since 2013. Trap operations usually begin in early February and continue until fall, when river conditions force its removal.

Operational procedures and techniques follow the standardized basin-wide monitoring plan developed by the Upper Columbia Regional Technical Team for the Upper Columbia Salmon Recovery Board (UCSRB; Hillman 2004), which was adapted from Murdoch and Petersen (2000). The traps remain in operation 24 hours a day unless environmental conditions (high/low flow, extreme temperature, and high debris), hatchery releases, mechanical failure or human recreational activities halt operations. During periods of high recreational activities in the spring and summer the Lower Wenatchee trap is pulled during daylight hours to minimize human danger.

Fish Sampling

At a minimum of once a day, all fish collected at the traps were identified to genus or species, enumerated, weighed, and fork length (FL) measured. All salmonids were classified as hatchery, wild, or unknown and visually classified as fry, parr, transitional, or smolt. All hatchery salmonids in the basin are marked (adipose fin-clip, coded-wire tags, or Passive Integrated Transponder (PIT)). Target species (≥ 65 mm FL) were tagged using 12.5 mm FDX PIT tags and all PIT tagging information was uploaded to a regional PIT tag database (PTAGIS) maintained by the Pacific States Marine Fisheries Commission.

A combination of length, time of year, and trap location was used to determine race (spring or summer) of captured juvenile Chinook salmon. All Chinook salmon captured in the Chiwawa River trap were considered spring Chinook salmon, regardless of size since summer Chinook salmon spawning has not been documented upstream of the trap. All yearling (age-1) Chinook salmon captured at the Lower Wenatchee River trap during the spring migration period were considered spring Chinook salmon because spring Chinook salmon are yearling migrants and summer Chinook salmon are typically subyearling migrants. All subyearling fry and parr (age-0) Chinook salmon captured at the Lower Wenatchee River trap during spring were considered summer Chinook salmon.

Mark–Recapture Trials

Groups of marked juveniles were released during a range of stream discharges in order to determine trapping efficiencies under the varied flow regime. Natural origin fish were marked with a PIT tag if ≥65 mm FL or stained with Bismarck Brown dye if <65 mm FL, and hatchery origin fish were marked using a caudal fin clip. All marked fish were released evenly upstream on both sides of the river and most releases occurred between 1800 hours and 2100 hours. Marked fish from the Lower Wenatchee River trap were transported and released 14.5 km upstream of the trap site while fish from the

Chiwawa River trap were released 2.6 km upstream. Each trial was conducted over a four-day (96 hour) period to allow time for passage or capture. Target mark group sizes were based on historical data, location and species, ranging from 100 to over 500 individual fish. See appendix D for mark-recapture trails.

Emigrant Estimates

All emigration estimates were calculated using estimated daily trap efficiency derived from the regression formula using trap efficiency (dependent variable) and discharge (independent variable). Trap efficiency models used a modified Bailey estimator (recaptures + 1) in the calculation of efficiency as a method of bias correction. If a significant relationship ($R^2 > 0.5$ and $P < 0.05$) could not be found a pooled trap efficiency estimate was used. Estimates of emigrating spring Chinook salmon were calculated with and without fry (<50mm FL) due to the uncertainty that these fish were actively migrating to the ocean (UCRTT, 2001). See appendices A and B for detailed equations and information on how the point estimate, variance, and standard error were calculated.

During minor breaks in operation (less than seven days), the number of individual fish collected was estimated. This estimate was calculated using the mean number of fish captured two days prior and two days after the break in operation. For major breaks in operations (greater than seven days), an estimate based on historical run timing was developed. This estimate of daily capture was incorporated into the overall emigration estimate.

Egg-to-emigrant Survival

The estimated total egg deposition (d) was calculated by multiplying the mean fecundity (f) of the brood spawners by the total number of redds (r) found during surveys (Hillman et al. 2015). Egg-to-emigrant survival (s) was calculated by dividing total emigrants (e) by estimated egg deposition (d).

Backpack Electrofishing

Sampling Procedure

From 2012 to present, WDFW has had a goal of PIT tagging 3,000 juvenile spring Chinook salmon each year. In order to representatively tag the population throughout all reaches, the number of fish tagged in each reach was based on the reach specific abundance encountered during snorkeling surveys in late summer. See Appendix C for further explanation.

Detections and Calculations

Detections occur at PIT tag interrogation sites in and out of the basin as well as rotary smolt traps downstream of the sampling reaches. Calculations of non-trapping emigrant estimates are based on a flow-detection efficiency regression developed using mark-groups previously released to test smolt trap efficiencies. The total number of tagged fish (t) divided by the estimated total parr abundance (p), as based off of standard snorkeling techniques (Hillman et al. 2013), resulted in an overall tag rate (t_i). See Appendix C for further explanation.

RESULTS

Rotary Smolt Traps – Chiwawa

Trap Operation

The Chiwawa Trap operated between 19 March and 27 November 2019. During the trapping period, the trap was inoperable for 12 days due to high or low river discharge, debris, major hatchery releases, and mechanical issues. Throughout the trapping season the trap operated in two positions, the upper position and low flow position.

Fish Sampling

A total of 31,698 individual fish were collected, with wild spring Chinook salmon and steelhead comprising 59% and 5% of the total catch, respectively. Additionally, 3,151 hatchery spring Chinook salmon and 3,822 hatchery steelhead were collected. Throughout the sampling period 15,387 PIT tags were deployed into wild spring Chinook salmon and steelhead (14,174 and 1,213 respectively). Spring Chinook salmon mortality for the season totaled 9 yearling, 72 subyearling parr, and 6 fry (0.06%, 0.51%, and 0.04%, respectively). Mortality of steelhead throughout the season totaled 10 (0.82%). The mean fork length (SD) of captured yearling and subyearling spring Chinook salmon (fry excluded) was 94.2 (7.1) mm and 76.5 (10.1) mm, respectively (Table 1).

Table 11. Mean fork length (mm) and weight (g) of spring Chinook salmon captured in the Chiwawa rotary smolt trap during 2019.

	Yearling transitional/smolts			Subyearling parr		
	Mean	SD	*N*	Mean	SD	*N*
Fork length	94.2	7.1	4,712	76.5	10.1	11,417
Weight	9.2	2.3	4,144	4.7	1.9	7,322

Yearling Spring Chinook Salmon (Brood Year 2017)

Wild yearling spring Chinook salmon were primarily captured in April (Figure 4). A total of 4,730 yearling Chinook salmon were captured and an estimated 4,794 would have been captured if the trap had operated without interruption. Four mark/recapture efficiency trials using PIT tags were conducted producing a mean trap efficiency of 16.4%. When combined with mark/recapture trials from 2016, 2017 and 2018 a significant relationship between trap efficiency and river flow ($R^2 = 0.54$; $P < 0.05$) was developed. The total number of wild yearling Chinook salmon emigrating from the Chiwawa River in 2019 was estimated at 39,015 (±6,825; 95% CI). Smolt survival (SE) to McNary of those tagged fish was 37.8% (6%) using the Cormack-Jolly-Seber estimator.

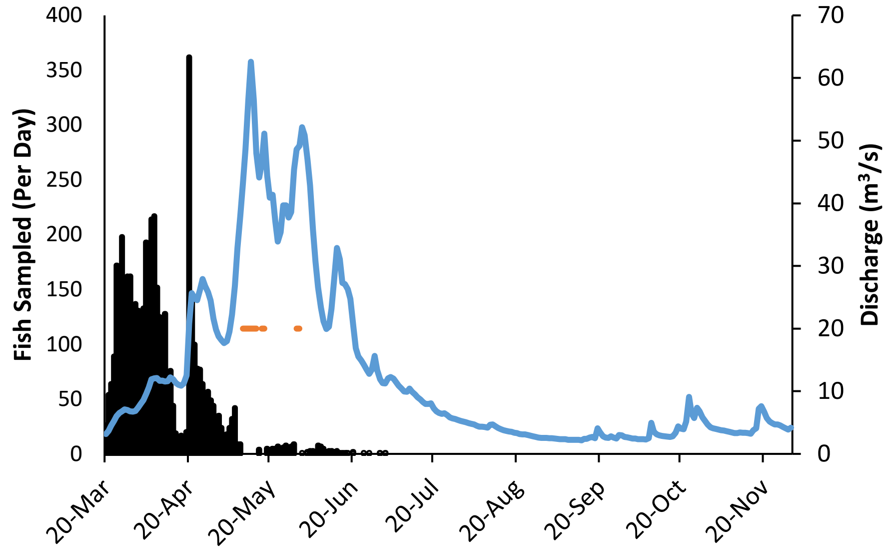

Figure 13. Daily catch of yearling spring Chinook salmon at the Chiwawa rotary smolt trap. Blue line indicates river discharge and red horizontal line indicates non-trapping period.

Subyearling Spring Chinook Salmon (Brood Year 2018)

Wild subyearling spring Chinook salmon were captured throughout the sampling period, with peak catches of parr in October and peak catches of fry in May and June (Figures 5 and 6, respectively). A total of 11,641 subyearling parr and 2,329 fry were captured with an estimated 11,786 subyearling parr and 3,230 fry had the trap operated without interruption. Two mark/recapture efficiency trials were conducted at the upper cone position with a mean trap efficiency of 12.4%. There were also seven mark/recapture efficiency trails conducted at the new low flow cone position with a mean trap efficiency of 19.4%. Combining with 2016, 2017, and 2018 trials, a significant regression model was developed for the upper cone position (R^2 = 0.58, P < 0.05). Using the seven 2019 trials, a significant regression model was developed for the low flow position (R^2 = 0.72, P < 0.05). Based on capture efficiencies, the total number of wild subyearling (fry and parr) Chinook salmon from the Chiwawa River basin was 109,275 (±28,841; 95% CI). Removing fry from the estimate, a total of 68,038 (±20,716; 95% CI) subyearling parr emigrated from the Chiwawa River basin in 2019.

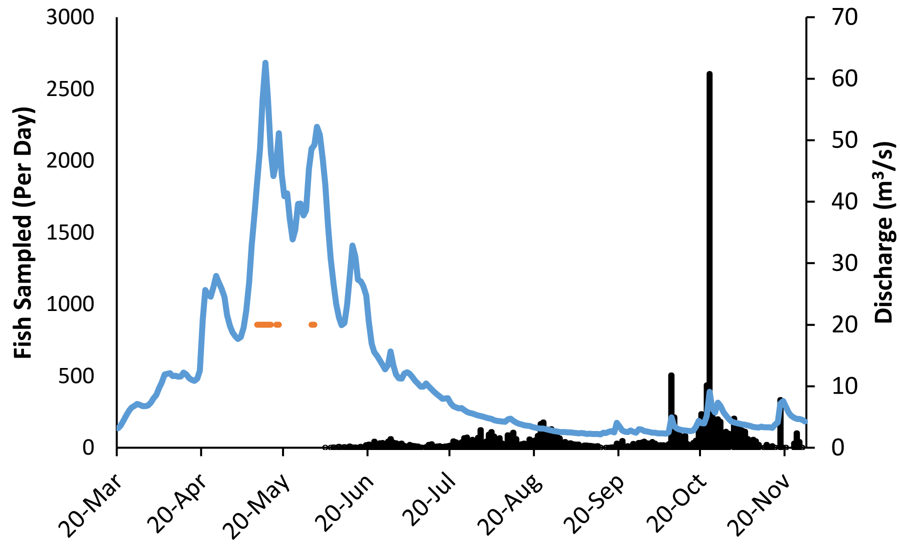

Figure 14. Daily catch of wild spring Chinook salmon subyearling parr at the Chiwawa rotary smolt trap. Blue line indicates river discharge and red horizontal line indicates non-trapping period.

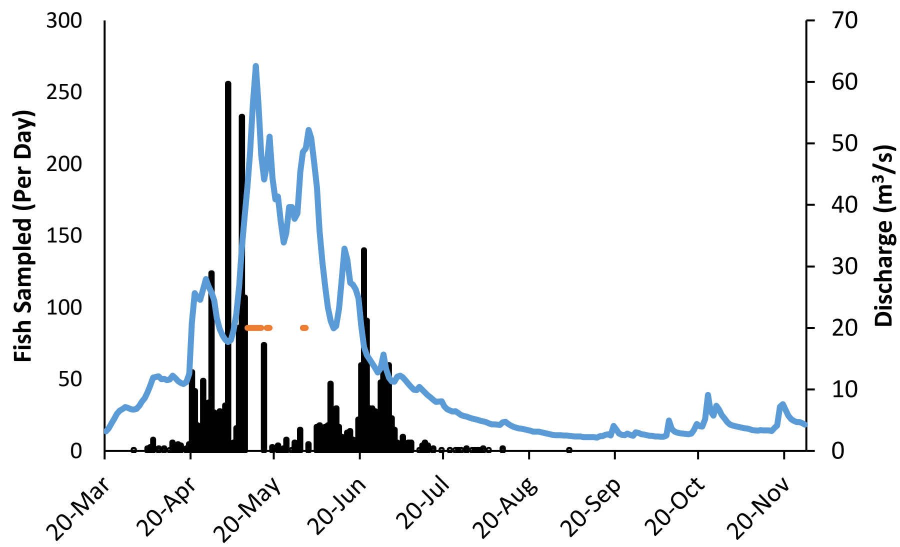

Figure 15. Daily catch of wild spring Chinook salmon fry at the Chiwawa rotary smolt trap. Blue line indicates river discharge and red horizontal line indicates non-trapping period.

Summer Steelhead

During the trapping period, 196 steelhead transitional/smolts and 1,284 steelhead/rainbow parr and 38 steelhead/rainbow fry were captured. While collections occurred in moderate numbers throughout the year, peak collections occurred during April and October (Figure 7). The mean fork length (SD) of steelhead parr and transitional/smolts captured was 79.9 (20.6) and 164.3 (25.3) mm, respectively (Table 2). Using the 5 trails from 2019, along with a single trial from 2018 and 2017, a significant regression model was developed for steelhead (R^2 = 0.78, P < 0.05). Based on capture efficiencies, the total number of wild steelhead emigrating from the Chiwawa River basin was 28,512

(±3,360; 95% CI). Removing fry from the estimate, a total of 28,062 (±3,354; 95%) steelhead emigrated from the Chiwawa River basin in 2019.

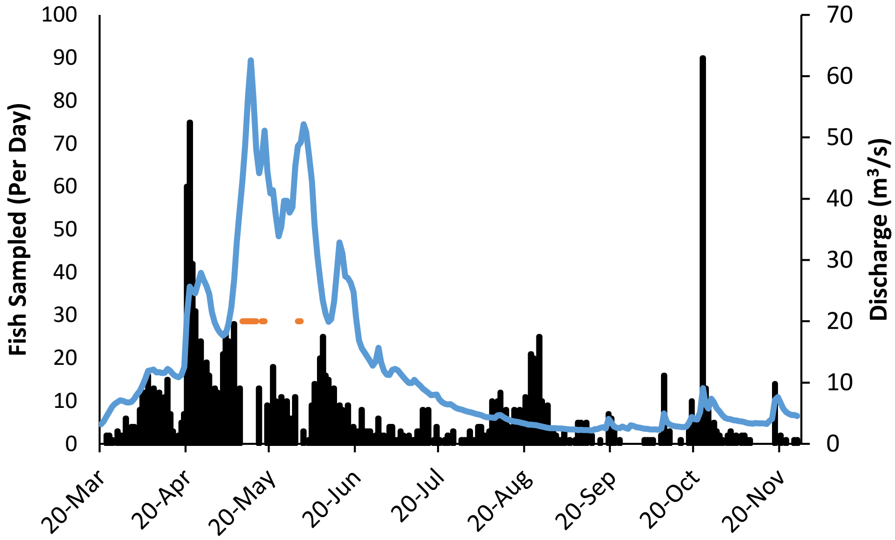

Figure 16. Daily catch of all wild steelhead at the Chiwawa rotary smolt trap. Blue line indicates river discharge and red horizontal line indicates non-trapping period.

Table 12. Mean fork length (mm) and weight (g) of steelhead/rainbow captured in the Chiwawa rotary smolt trap during 2019.

	Transitional/smolts			Parr		
	Mean	SD	*N*	Mean	SD	*N*
Fork length	164.3	25.3	194	79.9	20.6	1,277
Weight	46.7	19.9	192	6.5	6.5	1,151

Egg-to-emigrant Survival

For BY 2018, 331 redds were counted in the Chiwawa River Basin with an estimated 1,378,946 eggs being deposited. A total of 79,740 emigrants were estimated resulting in an egg-to-emigrant survival of 7.8% (Table 3). This is up from a five-year moving average of 6.4%.

Table 13. Estimated egg deposition and egg-to-emigrant survival rates for Chiwawa River spring Chinook salmon.

Brood Year	Number of redds	Estimated egg deposition	Estimated number				Egg-to-emigrant survival (%)
			Sub-yearling	Non trapping	Yearling	Total emigrants	
1992	302	1,570,098	25,818		39,723	65,541	4.2
1993	106	556,394	14,036		8,662	22,698	4.1
1994	82	485,686	8,595		16,472	25,067	5.2

1995	13	66,248	2,121		3,830	5,951	9.0
1996	23	106,835	3,708		15,475	19,183	18.0
1997	82	374,740	16,228		28,334	44,562	11.9
1998	41	218,325	2,855		23,068	25,923	11.9
1999	34	166,090	4,988		10,661	15,649	9.4
2000	128	642,944	14,854		40,831	55,685	8.7
2001	1,078	4,984,672	459,784		86,482	546,266	11.0
2002	345	1,605,630	93,331		90,948	184,279	11.5
2003	111	648,684	16,881		16,755	33,637	5.2
2004	241	1,156,559	44,079		72,080	116,158	10.0
2005	333	1,440,891	108,595		69,064	177,659	12.3
2006	297	1,284,228	62,922		45,050	107,972	8.4
2007	283	1,256,803	60,196		25,809	86,006	6.9
2008	689	3,163,888	85,161		35,023	120,184	3.8
2009	421	1,925,233	30,996		30,959	61,955	3.2
2010[a]	502	2,165,628	53,619		47,511	101,130	4.7
2011[a]	492	2,157,420	67,982	3,665	37,185	108,832	5.0
2012[a]	880	3,716,240	49,774	25,305	34,334	109,413	2.9
2013[a]	714	3,367,224	73,695	NA	39,396	113,091	3.4
2014[a]	485	1,961,825	77,510	NA	46,615	124,125	6.3
2015[a]	543	2,631,921	80,543	5,976	53,344	139,863	5.3
2016[a]	312	1,393,704	95,063	4,305	31,300	130,668	9.4
2017[a]	222	1,024,530	37,810	2,915	39,015	79,740	7.8
2018[a]	331	1,378,946	68,038	--	--	--	--
2019[a]	229	945,541	--	--	--	--	--

[a]calculated with Bailey model

Non-target Taxa

Bull trout (*Salvelinus confluentus*) also comprised a large proportion of incidental species captured. During the trapping period 185 bull trout (34 ≥ 300 mm FL and 151 <300 mm FL) were captured. Additionally, 90 westslope cutthroat trout (*O. clarki lewisi*), and 2 Eastern brook trout (*S. fontinalis*) were collected. Overall, 151 bull trout and 85 westslope cutthroat trout were released with PIT tags. In addition, 37 (12 ≥ 300 mm FL and 25 <300 mm FL) mountain whitefish (*Prosopium williamsoni*) were released with PIT tags. Monthly and annual totals of all fish captured are presented in Appendix E and Appendix F, respectively.

Rotary Smolt Traps – Lower Wenatchee

Trap Operation

The Lower Wenatchee Trap operated between 19 February and 23 July 2019. During that time, the trap was inoperable for 16 days because of high and low river discharge, ice, debris, elevated river temperature, large hatchery releases, and mechanical issues. Extreme river temperatures and low flows resulted in trapping operations being suspended for the season on 23 July. At the beginning of the season the trap operated in the low flow position until 26 March. It then operated in the lower position until 5 July when it was switched back into the low flow position for the remainder of the season.

Fish Sampling

A total of 89,265 individual fish were collected, with wild summer Chinook salmon comprising 32% of the total catch. Additionally, 1,485 wild yearling spring Chinook salmon, 36,104 hatchery yearling Chinook salmon, 1,096 wild sockeye salmon, 221 wild steelhead, and 1,918 hatchery steelhead were captured. Throughout the sampling period 1,289 wild yearling spring Chinook salmon, 1,062 wild sockeye salmon, and 185 wild steelhead were marked with a PIT tag. Mortality for the season totaled 2 wild yearling spring Chinook salmon, 167 subyearling summer Chinook salmon, 5 sockeye salmon, and 1 wild steelhead (0.1%, 0.6%, 0.5%, and 0.5%, respectively).

Yearling Spring Chinook Salmon (Brood Year 2017)

Wild yearling spring Chinook salmon were primarily captured in April (Figure 8). Throughout the trapping period 1,485 spring Chinook salmon were collected and an estimated 1,586 would have been collected had the trap operated without interruption. A combination of 2015, 2017, 2018, and 2019 trials were used to develop a significant relationship between discharge and trap efficiency (R^2 = 0.80, $P < 0.02$). This model was used to calculate an emigrant estimate of 101,793 (±19,396; 95% CI). Smolt survival (SE) to McNary of those tagged fish was 46.1% (12%) using the Cormack-Jolly-Seber estimator. The mean fork length (SD) of captured yearling Chinook salmon was 99.5 (9.0) mm (Table 4).

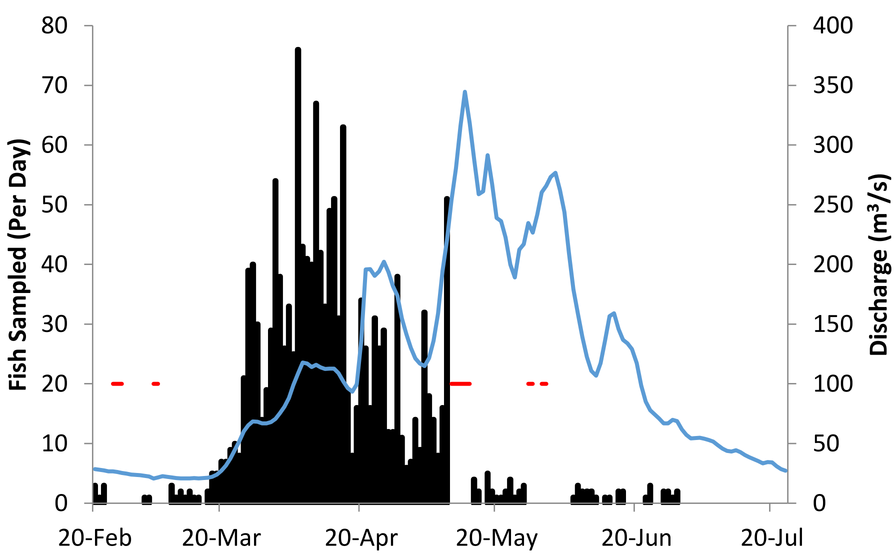

Figure 17. Daily capture of wild yearling spring Chinook salmon at the Lower Wenatchee rotary smolt trap. Blue line indicates river discharge and red horizontal line indicates non-trapping period.

Table 14. Mean fork length (mm) and weight (g) for wild yearling spring Chinook salmon sampled at the Lower Wenatchee rotary trap during 2019.

	Mean	SD	N
Fork length	99.5	9.0	1,446
Weight	10.5	3.0	1,434

Wild Subyearling Summer Chinook Salmon (Brood Year 2018)

Wild subyearling summer Chinook salmon dominated the catch (32%) with 28,534 fish being processed. Most were collected in June (Figure 9). An estimated 33,502 would have been captured had the trap operated without interruption. Over the season, four mark/recapture efficiency trials were carried out using Bismarck Brown dye. When combined with trials from 2018 a significant discharge efficiency relationship was developed (R^2 = 0.70, P < 0.02) and an emigrant estimate of 2,439,434 (±534,405; 95% CI) was calculated. The mean fork length (SD) for captured subyearling parr and fry summer Chinook salmon was 67.6 (11.6) and 41.9 (3.6), respectively (Table 5). Two summer Chinook salmon were PIT tagged.

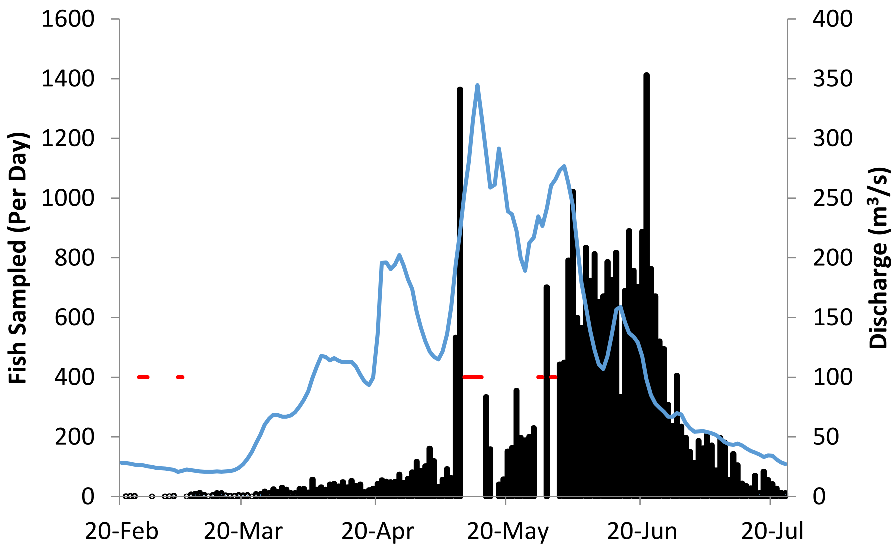

Figure 18. Daily capture of wild summer Chinook salmon at the Lower Wenatchee rotary smolt trap. Blue line indicates river discharge and red horizontal line indicates non-trapping period.

Table 15. Mean fork length (mm) and weight (g) of subyearling summer Chinook salmon sampled at the Lower Wenatchee rotary smolt trap during 2019.

	Parr			Fry		
	Mean	SD	N	Mean	SD	N
Fork length	67.6	11.6	1,401	41.9	3.6	989
Weight	3.8	2.0	1,393	0.7	0.3	964

Wild Sockeye Salmon

A total of 1,096 juvenile sockeye salmon were collected in the 2019 season and an estimated 1,108 had the trap operated without interruption. The majority of these fish (89%) were collected in April (Figure 10). Due to low numbers of fish being sampling no mark/recapture efficiency trials were conducted. No significant model could be calculated ($R^2 = 0.34$, $P > 0.061$) so a pooled model was created. Using this pooled model, the number of juvenile sockeye emigrants was estimated to be 192,705 (±1,449,588; 95% CI). Smolt survival (SE) to McNary of those tagged fish was 64.8% (14%) using the Cormack-Jolly-Seber estimator. In 2019, most were Age 1+ (94.4%), with the remaining Age 2+ (5.0%) and Age 0+ (0.6%) (Table 6). Mean fork length (SD) for captured sockeye salmon was 92.2 (9.1) mm (Table 7).

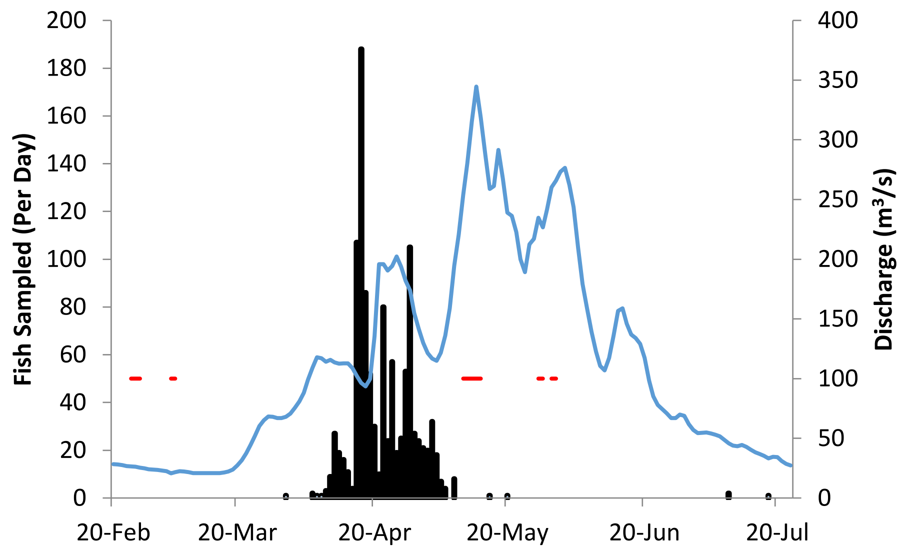

Figure 19. Daily capture of wild sockeye salmon at the Lower Wenatchee rotary smolt trap. Blue line indicates river discharge and red horizontal line indicates non-trapping period.

Table 16. Age structure and estimated number of wild sockeye salmon smolts that emigrated from the Wenatchee basin in 2013-2019.

Run year	Proportion of Wild Smolts				Total Wild Smolts
	Age 0+	Age 1+	Age 2+	Age 3+	
2013	0.008	0.919	0.073	0.000	873,096
2014	0.003	0.948	0.049	0.000	1,275,027
2015	0.003	0.777	0.220	0.000	1,065,614
2016	0.046	0.895	0.059	0.000	208,250
2017	0.053	0.868	0.079	0.000	121,825
2018	0.001	0.989	0.010	0.000	1,806,164
2019	0.006	0.944	0.049	0.000	192,705

Table 17. Mean fork length (mm) and weight (g) of wild sockeye salmon smolts sampled at the Lower Wenatchee rotary smolt trap during 2019.

	Mean	SD	N
Fork length	92.2	9.1	1,076
Weight	6.9	2.3	1,073

Wild Summer Steelhead

Capture of wild steelhead at the Lower Wenatchee site for all life stages was low, totaling 221 fry, parr, and smolts combined and an estimated 245 collected had the trap operated without interruption. Peak catches of steelhead occurred in April (Figure 11). Due to the lack of fish no mark/recapture trials were conducted, and no significant relationship could be determined. Thus, a combination of three trials from 2014 and 2016 were used to produce a pooled efficiency of 0.028. This pooled estimated was used to produce an emigrant estimate of 8,050 (±81,137; 95% CI) parr and smolt steelhead (excludes fry). If fry are included, the emigrant population was estimated to be 8,924 (± 89,944; 95% CI). Mean length (SD) of transitional/smolts and parr was 165.8 (22.0) and 99.7 (25.1) mm, respectively (Table 8).

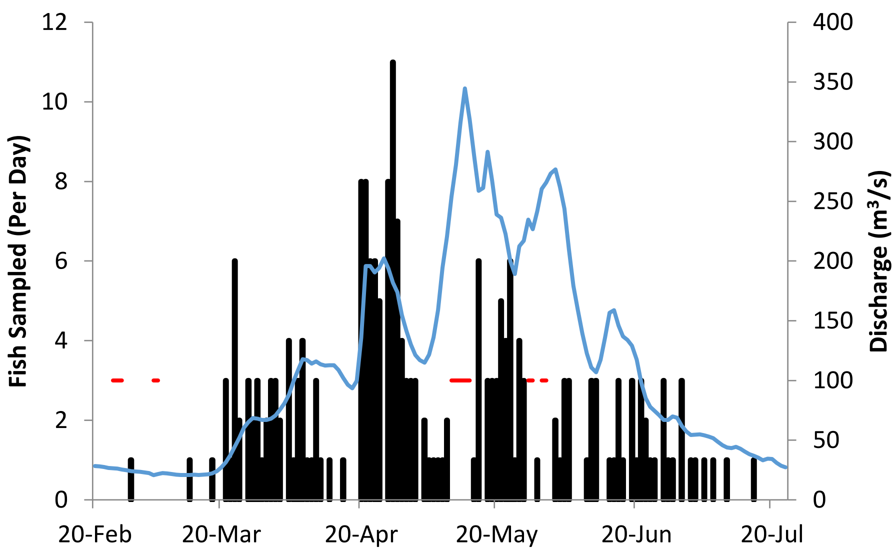

Figure 20. Daily capture of wild steelhead at the Lower Wenatchee rotary smolt trap. Blue line indicates river discharge and red horizontal line indicates non-trapping period.

Table 18. Mean fork length (mm) and weight (g) of wild steelhead sampled at the Lower Wenatchee rotary smolt trap during 2019.

	Transitional/Smolt			Parr			Fry		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Fork length	165.8	22.0	123	99.7	25.1	69	32.2	5.5	18
Weight	46.4	20.4	123	11.9	10.5	69	0.4	0.2	15

Survival

For BY 2017, 430 spring Chinook salmon redds were surveyed in the Wenatchee Basin producing an estimated 1,984,450 eggs. An estimate of 101,793 emigrants results in an estimated egg-to-emigrant survival of 5.13%. This is up from the four-year moving average of 2.01% (Table 9).

Table 19. Estimated egg deposition and egg-to-smolt survival rates for Wenatchee Basin spring Chinook salmon.

Brood Year	Number of redds	Estimated egg deposition	Estimated number	
			Total emigrants	Egg-to-emigrant survival (%)
2000	350	1,758,050	76,643	4.36
2001	1,876	8,674,624	243,516	2.81
2002	1,139	5,300,906	165,116	3.11
2003	323	1,887,612	70,738	3.75
2004	555	2,663,445	55,619	2.09
2005	829	3,587,083	302,116	8.42
2006	588	2,542,512	85,558	3.37
2007	466	2,069,506	60,219	2.91
2008	1,411	6,479,312	82,137	1.27
2009	733	--	--	--
2010	968	--	--	--
2011	872	3,823,720	89,917	2.35
2012	1,704	7,195,992	67,973	0.94
2013	1,159	5,465,844	58,595	1.07
2014	969	3,919,605	36,752	0.94
2015	1,047	5,071,668	130,426	2.57
2016	638	2,849,946	99,045	3.48
2017	430	1,984,450	101,793	5.13
2018	549	2,287,134	-	-

For BY 2018, 1,498 summer Chinook salmon redds were surveyed in the Wenatchee Basin, 98.5% being upstream of the Lower Wenatchee smolt trap. After extrapolating by the proportion of redds above the trap a total emigrant population of 2,477,473 was estimated resulting in an egg-to-emigrant survival of 38.5%. This is down from the five-year moving average of 63.4% (Table 10).

Table 20. Estimated egg deposition and egg-to-emigrant survival rates for Wenatchee Basin summer Chinook salmon.

Brood year	Peak total redd expansion	Estimated egg deposition	Redds above trap / total redds	Estimated number		
				Trap estimate	Total emigrants	Egg-to-emigrant survival (%)
1999	2,738	13,654,406	0.988	9,572,392	9,687,261	70.9
2000	2,540	13,820,140	0.983	1,299,476	1,321,567	9.6
2001	3,550	18,094,350	0.987	8,229,920	8,336,909	46.1
2002	6,836	37,488,624	0.977	13,167,855	13,470,716	35.9
2003	5,268	28,241,748	0.996	20,336,968	20,418,316	72.3
2004	4,874	26,207,498	0.989	14,764,141	14,926,547	57.0
2005	3,538	17,877,514	0.993	11,612,939	11,694,230	65.4
2006	8,896	45,663,168	0.979	9,397,044	9,594,382	21.0
2007	1,970	10,076,550	0.983	4,470,672	4,546,673	45.1
2008	2,800	14,302,400	0.978	4,309,496	4,404,305	30.8
2009	3,441	18,206,331	0.983	6,695,977	6,809,809	37.4
2010	3,261	16,184,343	0.957	--	--	--
2011	3,078	15,122,214	0.958	--	--	--
2012	2,504	12,021,704	0.930	9,333,214	10,034,508	83.5
2013	3,241	16,162,867	0.947	11,936,928	12,605,925	78.0
2014	3,447	16,556,904	0.959	14,157,778	14,763,064	89.2
2015	1,819	9,062,258	0.958	4,023,310	4,199,697	46.3
2016	2,715	12,008,445	0.958	7,593,243	7,926,141	66.0
2017	3,860	16,833,460	0.925	5,823,795	6,298,641	37.4
2018	1,498	6,438,404	0.985	2,439,434	2,477,473	38.5

Non-target Taxa

Five bull trout were collected at the Lower Wenatchee Trap. All bull trout and an additional 2 mountain whitefish received a PIT tag. Monthly and annual totals of all fish captured are presented in Appendix G and Appendix H, respectively.

Backpack Electrofishing

Fish Sampling

Between 1 October and 14 November 2019, WDFW personnel sampled the Chiwawa River. During this sampling, 3,448 subyearling Chinook salmon were collected of which 3,309 received a PIT tag. The greatest concentration of juvenile Chinook salmon occurred between rkm 21 and 40 which had a mean sample rate of 1 Chinook salmon collected for every 18 seconds of sampling. Over the sampling period 9 Chinook salmon died resulting in a mortality rate of 0.3%. Additionally, 559 juvenile bull trout and 24 coho salmon were collected, none of which received a PIT tag. Highest catch rates for bull trout were around rkm 47, and there was no bull trout or coho salmon mortality. There was 1 lamprey ammocoete collected and released as well.

Between 3 September and 13 November 2019, WDFW personnel sampled Nason Creek with assistance from Yakima Nation Fisheries. During this sampling, 3,447 subyearling Chinook salmon were collected of which 3,212 received a PIT tag. The greatest concentration of juvenile Chinook salmon occurred between rkm 6 and 17 which had a mean sample rate of 1 Chinook salmon collected for every 9 seconds of sampling. Over the sampling period 86 Chinook salmon died resulting in a mortality rate of 2.5%. A total of 8 juvenile bull trout were collected, none of which received a PIT tag. There was no bull trout mortality. Additionally, there were 327 coho salmon captured and 262 received a PIT tag. There was no coho salmon mortality. A total of 54 lamprey ammocoetes were also collected and released unharmed.

Detections and Calculations

Of the subyearling Chinook salmon remotely tagged in the Chiwawa basin the prior year, there were 35 detections during the non-trapping season (4 December 2018 through 19 March 2019) at the lower Chiwawa PIT tag antenna array (Table 11). These detections were used in a significant flow efficiency model (R^2 = 0.79; P > 0.001) to produce a non-trapping emigration estimate for the Chiwawa basin of 2,915 (± 769; 95% CI).

Table 11. Number of remotely sampled subyearling spring Chinook salmon in Chiwawa River and Nason Creek.

Sample location and year	Collected	PIT tagged	Caught at smolt trap in fall of year tagged	Detected at stream's downstream PIT tag antenna array during non trapping season	Caught at smolt trap in spring of following year	Survival to McNary
Chiwawa 2019	3,448	3,309	158	17	--	--
Chiwawa 2018	3,800	3,737	226	35	141	14.4%
Chiwawa 2017	2,740	2,703	114	11	69	18.7%
Chiwawa 2016	1,829	1,772	38	25	65	18.3%
Chiwawa 2015	1,103	1,052	32	3	26	13.8%
Chiwawa 2014	1,083	1,033	17	16	46	5.2%
Nason 2019	3,447	3,212	20	--	--	--
Nason 2018	2,648	2,524	36	74	17	12.9%
Nason 2017	3,401	3,242	63	34	12	12.9%
Nason 2016	828	802	9	26	11	12.4%
Nason 2015	1,153	1,087	5	0	0	19.1%
Nason 2014	1,908	1,816	27	12	4	5.3%

DISCUSSION

Chiwawa River Rotary Smolt Trap

Over the last 5 years, the Chiwawa River smolt trap has usually been installed early March and in 2019 it was installed 19 March. During the trapping season of 19 March – 27 November the trap was inoperable for 12 days. Eleven of the inoperable days occurred during spring runoff when discharge was elevated. Current operable discharges are between 2.4 m^3/s and 50 m^3/s.

Significant discharge efficiency models were obtained for all target species and life-stages (wild spring Chinook salmon yearling and subyearling, as well as wild steelhead) at the Chiwawa trap. This is the first time a significant discharge efficiency model could be developed for wild steelhead. We will continue to prioritize the development of this model and expand the range of flows for which it provides resolution. The 2019 field season represented the third year we operated the cone in the low flow position. We will continue to develop and improve our low-flow model for target species.

Lower Wenatchee River Rotary Smolt Trap

Historically, the smolt trap on the mainstem Wenatchee River has moved location numerous times due to poor trap efficiencies of target species and environmental factors causing abbreviated trapping seasons. At the Lower Wenatchee site, the smolt trap has been able to operate into September in 2013, and October in 2014. This marks a relatively large increase in operational length over the old site (located 2.5 km downstream) which had an average trap removal date of 14 August. However, since 2014 low river discharge and elevated water temperatures throughout the summer and early fall have hindered the trapping season. In 2017, 2018 and 2019 the trap was removed in late July or early August.

In 2018, the Lower Wenatchee smolt trap's pontoons were replaced with longer, wider, and deeper pontoons which increased buoyancy and improved trap function at elevated river discharge. This has increased the range of discharges at which the trap can safely operate. Currently, the trap can operate between discharges of 28.3 and 382.3 m^3/s.

Significant discharge efficiency models were obtained for two of the four target species (wild spring Chinook salmon and summer Chinook salmon) at the Lower Wenatchee trap during the 2019 trapping season. The discharge efficiency model for sockeye salmon was not significant and all efforts will be made to reestablish a significant model in 2020. Collections of wild steelhead continue to be inadequate for conducting mark–recapture trials. In 2020, we will continue to look for ways to improve our efficiency models for steelhead.

Backpack Electrofishing

Remote sampling was initiated in 2012 with the goal of releasing 3,000 PIT tagged subyearling spring Chinook salmon to produce an emigrant estimate during the non-trapping winter season when the smolt traps are removed due to environmental conditions. In 2019, we were able to release 3,309 tagged Chinook salmon in the Chiwawa River, marking the second consecutive year that we were able to exceed our goal of 3,000 Chinook salmon tags. We will continue to refine and adapt our techniques to insure the best estimates are calculated, and we will also continue to monitor and evaluate bull trout, coho salmon and lamprey encounters while conducting our electrofishing surveys.

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APPENDICES

Appendix A. Peterson Population and Variance Equations.

Trap efficiency was calculated using the following formula:

Trap efficiency = $E_i = R / Mi,$

Where E_i is the trap efficiency during time period *i*; M_i is the number of marked fish released during time period *i*; and R_i is the number of marked fish recaptured during time period *i*. The number of fish captured was expanded by the estimated daily trap efficiency (*e*) to estimate the daily number of fish migrating past the trap using the following formula:

Estimated daily migration = $\hat{N}_i = C_i / \hat{e}_i$

where N_i is the estimated number of fish passing the trap during time period *i*; C_i is the number of unmarked fish captured during time period *i;* and e_i is the estimated trap efficiency for time period *i* based on the regression equation.

The variance for the total daily number of fish migrating past the trap was calculated using the following formulas:

Variance of daily migration estimate = $$\mathrm{var}\left[\hat{N}_i\right] = \hat{N}_i^2 \frac{\mathrm{MSE}\left(1 + \frac{1}{n} + \frac{\left(X_i - \overline{X}\right)^2}{(n-1)s_X^2}\right)}{\hat{e}_i^2}$$

where X_i is the discharge for time period *i*, and *n* is the sample size. If a relationship between discharge and trap efficiency was not present (i.e., $P < 0.05$; $R^2 > 0.5$), a pooled trap efficiency was used to estimate daily emigration:

Pooled trap efficiency = $e_p = \sum R / \sum M$

The daily emigration estimate was calculated using the formula:

Daily emigration estimate = $\hat{N}_i = C_i / e_p$

The variance for daily emigration estimates using the pooled trap efficiency was calculated using the formula:

Variance for daily emigration estimate = $$\mathrm{var}\left[\hat{N}_i\right] = \hat{N}_i^2 \frac{e_p(1 - e_p)/\sum M}{e_p^2}$$

The total emigration estimate and confidence interval was calculated using the following formulas:

Total emigration estimate = $\sum \hat{N}_i$

95% confidence interval = $1.96 \times \sqrt{\sum \mathrm{var}} \left[\hat{N}_i \right]$

Appendix B. Bailey Population and Variance Equations.

Trap efficiency was calculated using the following formula:

Trap efficiency = *E_i =R+1 / Mi,*

Estimated daily emigration = $\hat{N}_i = \dfrac{C_i + 1}{\hat{e}_i}$

The variance of the total population abundance was calculated as follows:

$$Var\left(\sum_{i=1}^{n} \hat{N}_i\right) = \underbrace{\sum_i Var\left(\frac{(C_i + 1)}{\hat{e}_i}\right)}_{Part\ A} + \underbrace{\sum_i \sum_j Cov\left(\frac{(C_i + 1)}{\hat{e}_i}, \frac{(C_j + 1)}{\hat{e}_j}\right)}_{Part\ B}$$

Part A is the variance of the daily estimates where C_i is the number of fish caught in period *i*, e_i is the estimated trap efficiency for period *i*, and *Cov* is the between day covariance for days that the same linear model is used (part B). For a more details and derivation of Peterson and Bailey estimation methods see Murdoch et al. (2012).

Appendix C. Emigration during non-trapping periods.

A flow-efficiency regression model was developed for the lower Chiwawa River PIT tag interrogation site (CHL) using the same mark/recapture trials used for estimating efficiency at the smolt trap. This CHL model was used to calculate emigration outside of the trapping period by incorporating the tag rate into the Bailey estimator.

$$\text{Estimated daily emigration} = \left(\hat{N}_i = \frac{C_i + 1}{\hat{e}_i}\right) \Big/ t_i$$

Where t_i is equal to the tag rate = $t_i = \frac{t}{p}$

Appendix D: Mark–Recapture groups used for developing emigrant estimates.

Model	Date	Cone Position	Number Released	Number Recaptured	Bailey's Efficiency (%)	Discharge (m^3/s)
Lower Wenatchee River rotary smolt trap						
Wild Yearling Spring Chinook Salmon	17-Apr-15	Lower	2,045	82	4.06	63.1
	23-Mar-17	Lower	191	3	2.09	106.2
	1-Apr-17	Lower	409	3	0.98	115.6
	6-Apr-17	Lower	231	1	0.87	141.6
	10-Apr-18	Lower	685	15	2.34	111.5
	13-Apr-18	Lower	496	12	2.62	116.4
	26-Mar-19	Lower	381	10	2.89	66.5
	3-Apr-19	Lower	458	12	2.84	82.7
	10-Apr-19	Lower	452	5	1.33	115.9
Wild Sockeye Salmon	31-Mar-14	Lower	322	1	0.62	83.1
	4-Apr-14	Lower	599	2	0.50	81.7
	7-Apr-14	Lower	633	2	0.47	99.6
	16-Apr-14	Lower	591	3	0.68	126.2
	19-Apr-14	Lower	385	4	1.30	130.4
	23-Apr-14	Lower	504	2	0.60	125.5
	27-Apr-13	Lower	565	6	1.24	141.6
	12-Apr-15	Lower	540	2	0.56	73.9
	16-Apr-18	Lower	398	1	0.50	129.9
	19-Apr-18	Lower	456	5	1.32	120.3
	22-Apr-18	Lower	401	3	1.00	110.5
Wild Subyearling Summer Chinook Salmon	29-May-18	Lower	1001	3	0.40	302.9
	2-Jun-18	Lower	1175	15	1.36	182.2
	6-Jun-18	Lower	941	11	1.28	168.4
	12-Jun-18	Lower	1026	14	1.46	139.0
	6-Jul-18	Lower	587	11	2.04	89.2
	4-Jun-19	Lower	1118	18	1.70	229.9
	9-Jun-19	Lower	1131	30	2.74	118.0
	18-Jun-19	Lower	1033	30	3.00	131.3
	24-Jun-19	Lower	601	23	3.99	73.8
Wild Summer Steelhead	12-May-14	Lower	126	6	5.56	181.8
	13-May-14	Lower	347	11	3.46	180.5
	28-Apr-16	Lower	146	0	0.68	218.1
Chiwawa River rotary smolt trap						

Model	Date	Cone Position	Number Released	Number Recaptured	Bailey’s Efficiency (%)	Discharge (m^3/s)
Wild Yearling Spring Chinook Salmon	6-Mar-16	Upper	132	15	12.1	14.7
	9-Mar-16	Upper	106	12	12.3	15.8
	12-Mar-16	Upper	126	14	11.9	15.1
	2-Apr-16	Upper	178	11	6.7	23.8
	4-Apr-16	Upper	240	13	5.8	34.4
	24-Mar-17	Upper	150	20	14	8.1
	28-Mar-17	Upper	150	31	21.3	7.8
	30-Mar-17	Upper	149	21	14.8	9.3
	16-Apr-17	Upper	123	8	7.3	15.0
	21-Apr-17	Upper	269	20	7.8	17.6
	26-Apr-17	Upper	212	28	13.7	21.8
	29-Apr-17	Upper	164	22	14	22.7
	6-Apr-18	Low Flow	159	38	24.5	14.6
	10-Apr-18	Upper	154	18	12.3	9.0
	27-Mar-19	Low Flow	120	19	16.7	7.1
	4-Apr-19	Upper	126	20	16.7	9.8
	8-Apr-19	Upper	152	20	13.8	12.2
Wild Subyearling Spring Chinook Salmon	16-Jun-16	Upper	265	21	7.9	17.6
	26-Jun-16	Upper	241	32	13.3	17.7
	1-Jul-16	Upper	326	34	10.4	24.9
	7-Jul-16	Upper	246	34	13.8	14.5
	11-Jul-16	Upper	80	13	16.3	14.0
	27-Jul-16	Upper	101	22	21.8	12.1
	4-Aug-16	Upper	209	96	45.9	8.2
	10-Aug-16	Upper	162	51	31.5	6.5
	12-Oct-16	Upper	199	73	36.7	5.7
	17-Oct-16	Upper	185	37	20	10.9
	28-Oct-16	Upper	200	22	11	16.8
	4-Nov-16	Upper	156	17	10.9	11.8
	12-Jul-17	Upper	113	16	15	21.5
	1-Aug-17	Upper	138	32	23.9	8.7
	9-Aug-17	Upper	94	14	16	7.0
	15-Aug-17	Upper	100	40	41	5.7
	6-Nov-18	Upper	98	20	21.4	8.4
	23-Jun-19	Upper	120	14	12.5	14.8
	28-Jun-19	Upper	131	17	13.7	14.1

Model	Date	Cone Position	Number Released	Number Recaptured	Bailey's Efficiency (%)	Discharge (m^3/s)
Wild Subyearling Spring Chinook Salmon	24-Jul-19	Low Flow	110	11	10.9	6.4
	29-Jul-19	Low Flow	152	32	21.7	5.3
	3-Aug-19	Low Flow	156	30	19.9	4.8
	10-Aug-19	Low Flow	118	18	16.1	4.6
	18-Aug-19	Low Flow	73	15	21.9	3.5
	28-Aug-19	Low Flow	78	20	26.9	2.6
	5-Sep-19	Low Flow	62	19	32.3	2.3
Wild Subyearling Spring Chinook Non Trapping Period	24-Mar-17	Low Flow	150	3	2.7	8.1
	25-Mar-17	Low Flow	128	5	4.7	8.1
	28-Mar-17	Low Flow	150	8	6.0	7.8
	30-Mar-17	Low Flow	149	12	8.7	9.3
	6-Apr-18	Low Flow	159	4	3.1	9.0
	19-Aug-18	Low Flow	118	24	21.2	4.5
	20-Oct-18	Low Flow	108	30	28.7	2.5
	6-Nov-18	Low Flow	98	3	4.1	8.4
	27-Mar-19	Low Flow	120	23	20.0	7.1
	24-Jul-19	Low Flow	61	6	11.5	6.4
	29-Jul-19	Low Flow	87	28	33.3	5.3
	3-Aug-19	Low Flow	79	26	34.2	4.8
	10-Aug-19	Low Flow	67	17	26.9	4.6
	18-Aug-19	Low Flow	73	20	28.8	3.5
	28-Aug-19	Low Flow	78	44	57.7	2.6
	5-Sep-19	Low Flow	62	35	58.1	2.3

Appendix E. Monthly collection information for the Chiwawa River smolt trap.

	2019												
Species/Origin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Chinook salmon													
Wild													
Yearling	--	--	1,437	2,966	273	53	1	0	0	0	0	--	4,730
Subyearling (non-fry)	--	--	0	0	0	458	933	2,209	579	5,920	1,542	--	11,641
Subyearling fry	--	--	1	470	864	887	99	7	1	0	0	--	2,329
Hatchery yearling	--	--	0	3,150	1	0	0	0	0	0	0	--	3,151
Steelhead													
Wild													
Smolt	--	--	0	108	26	7	12	33	7	2	1	--	196
Parr	--	--	23	350	245	211	21	184	38	179	32	--	1,283
Fry	--	--	0	0	0	0	31	7	0	0	0	--	38
Hatchery	--	--	0	27	3,739	34	4	10	3	1	4	--	3,822
Coho salmon													
Wild													
Smolt	--	--	0	0	0	0	0	0	0	0	0	--	0
Parr	--	--	0	0	0	0	0	0	0	3	4	--	7
Fry	--	--	0	0	0	1	0	0	0	0	0	--	1
Bull trout													
Juvenile	--	--	5	16	10	15	1	12	15	50	27	--	151
Adult	--	--	0	0	0	0	1	6	15	8	4	--	34
Westslope cutthroat trout	--	--	0	2	3	8	23	41	11	2	0	--	90
Eastern brook trout	--	--	0	0	0	0	0	0	0	2	0	--	2
Rainbow trout	--	--	0	0	0	0	0	1	0	0	0	--	1
Mountain whitefish	--	--	22	14	2	13	218	1,656	478	7	30	--	2,440
Longnose dace	--	--	4	90	90	834	210	68	37	47	28	--	1,408
Sculpin spp.	--	--	2	8	5	21	62	16	2	19	12	--	147
Dace spp.	--	--	0	17	0	0	0	2	0	0	0	--	19
Northern pikeminnow	--	--	0	0	0	0	69	88	40	0	0	--	197
Lamprey spp.	--	--	0	0	0	0	0	0	0	0	0	--	0
Sucker spp.	--	--	0	0	0	1	2	4	0	2	1	--	10
Redside shiner	--	--	0	0	0	0	0	0	0	0	0	--	0
Yellow perch	--	--	0	0	1	0	0	0	0	0	0	--	1

Appendix F. Annual collection information from the Chiwawa River smolt trap.

Species origin	2019	2018	2017	2016	2015
Chinook salmon					
Wild					
Yearling	*4,730*	*3,539*	5,824	2,807	6,350
Subyearling	*13,970*	*7,948*	12,938	16,393	31,152
Hatchery	*3,151*	*9,750*	4,518	2,525	7,162
Steelhead					
Wild					
Smolt	*196*	*147*	244	195	259
Parr and Fry	*1,321*	*379*	837	1,522	3,004
Hatchery	*3,822*	*379*	3,907	1,518	3,151
Coho salmon					
Wild					
Smolt	*0*	*0*	0	0	0
Parr and fry	*8*	*1*	0	3	38
Hatchery	*0*	*0*	0	0	0
Bull trout					
Juvenile	151	215	259	103	266
Adult	34	71	78	15	32
Westslope cutthroat trout	90	78	61	43	72
Eastern brook trout	2	4	1	3	8
Mountain whitefish	2,440	2,500	745	883	5,544
Longnose dace	1,408	2,252	861	979	2,663
Northern pikeminnow	197	63	58	69	331
Sculpin spp.	147	96	130	94	225
Sucker spp.	10	4	7	3	30
Dace spp.	19	1	28	16	NA
Redside shiner	0	1	0	0	13
Rainbow Trout	1	5	0	0	NA
Yellow perch	1	0	0	1	0

Appendix G. Monthly collection information for the Lower Wenatchee River smolt trap.

	2019												
Species/Origin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Chinook salmon													
Wild													
Yearling	--	7	258	996	196	28	0	--	--	--	--	--	1,485
Subyearling (non-fry)	--	0	0	5	181	9,823	2,148	--	--	--	--	--	12,157
Subyearling fry	--	9	267	1,326	5,132	9,593	50	--	--	--	--	--	16,377
Hatchery yearling	--	1	0	35,636	460	7	0	--	--	--	--	--	36,104
Steelhead													
Wild													
Smolt	--	0	11	65	45	4	0	--	--	--	--	--	125
Parr	--	1	17	26	9	18	1	--	--	--	--	--	72
Fry	--	0	0	0	0	19	5	--	--	--	--	--	24
Hatchery	--	0	0	12	1,849	57	0	--	--	--	--	--	1,918
Sockeye salmon													
Wild													
Smolt	--	0	0	974	112	0	3	--	--	--	--	--	1,089
Fry	--	0	1	6	0	0	0	--	--	--	--	--	7
Coho salmon													
Wild													
Smolt	--	1	6	61	24	6	0	--	--	--	--	--	98
Parr	--	0	3	20	4	221	37	--	--	--	--	--	285
Fry	--	0	0	0	1	256	2	--	--	--	--	--	259
Hatchery	--	0	0	14,134	2,948	108	0	--	--	--	--	--	17,190
Bull trout													
Juvenile	--	0	0	2	2	0	0	--	--	--	--	--	4
Adult	--	0	0	1	0	0	0	--	--	--	--	--	1
Westslope cutthroat trout	--	0	0	0	0	0	0	--	--	--	--	--	0
Eastern brook trout	--	0	0	0	0	0	0	--	--	--	--	--	0
Mountain whitefish	--	0	0	0	6	22	17	--	--	--	--	--	45
Lamprey spp.	--	2	116	202	142	473	107	--	--	--	--	--	1,042
Northern pikeminnow	--	0	1	2	2	58	11	--	--	--	--	--	74
Sucker spp.	--	0	2	11	17	35	12	--	--	--	--	--	77
Dace spp.	--	1	1	2	8	25	16	--	--	--	--	--	53
Longnose dace	--	2	36	20	11	164	219	--	--	--	--	--	452
Redside shiner	--	0	0	0	3	36	184	--	--	--	--	--	223
Sculpin spp.	--	2	5	7	4	8	22	--	--	--	--	--	48
Fathead minnow	--	0	0	0	0	0	0	--	--	--	--	--	0
Chiselmouth	--	0	0	1	0	0	5	--	--	--	--	--	6
3-Spine stickleback	--	0	0	1	0	47	0	--	--	--	--	--	48
Peamouth	--	0	0	0	0	0	0	--	--	--	--	--	0
Bullhead spp.	--	0	0	0	1	0	1	--	--	--	--	--	2

Appendix H. Annual collection information from the Lower Wenatchee River smolt trap.

Species/Origin	2019	2018	2017	2016	2015
Chinook salmon					
Wild					
Yearling	*1,485*	*1,418*	1,332	610	1,559
Subyearling	*28,534*	*47,283*	46,801	27,407	252,293
Hatchery	*36,104*	*51,068*	12,132	7,701	9,920
Steelhead					
Wild					
Smolt	*125*	*208*	52	88	231
Parr and fry	*96*	*37*	111	329	100
Hatchery	*1,918*	*349*	337	259	2,288
Sockeye salmon					
Wild	*1,096*	*10,331*	1,046	1,346	4,178
Hatchery	*0*	*0*	0	0	0
Coho salmon					
Wild					
Smolt	*98*	*97*	17	10	22
Fry and parr	*544*	*1,434*	685	135	4,972
Hatchery	*17,190*	*25,851*	3,724	219	6,566
Unknown	*0*	*0*	15	2,630	143
Bull trout					
Juvenile	4	0	0	0	0
Adult	1	0	0	0	0
Westslope cutthroat trout	0	0	0	0	1
Mountain whitefish	45	26	8	15	9
Lamprey spp.	1,042	753	1,307	1,497	283
Longnose dace	452	269	244	163	242
Sculpin spp.	48	25	51	56	52
Sucker spp.	77	77	192	269	51
Redside shiner	223	345	98	189	19
3-Spine stickleback	48	3	6	2	13
Dace spp.	53	25	40	133	NA
Fathead minnow	0	8	1	9	NA
Northern pikeminnow	74	75	83	552	12
Chiselmouth	6	1	7	66	6
Bullhead	2	1	0	0	NA
Peamouth	0	0	0	0	3

Appendix D

Summary of PIT-tagging Activities in the Wenatchee Basin, 2019

Appendix D. Numbers of fish captured, recaptured, PIT tagged, trap and handle mortality, shed tags, and total fish with tags released in the Wenatchee River basin from February through November 2019.

Sampling Location	Species and Life Stage	Number collected	Number of recaptures	Number tagged	Number died	Shed tags	Total tags released	Percent mortality
Chiwawa Trap	Wild Subyearling Chinook	13,970	247	9,634	78	0	9,634	0.56
	Wild Yearling Chinook	4,730	91	4,540	9	0	4,540	0.19
	Wild Steelhead/Rainbow	1,517	41	1,213	10	1	1,213	0.66
	Hatchery Steelhead/Rainbow	3,822	1	1	4	0	1	0.10
	Wild Coho	8	0	4	0	0	4	0.00
	Total	**24,047**	**380**	**15,392**	**101**	**1**	**15,392**	**0.30**
Chiwawa Remote (Electrofishing)	Wild Subyearling Chinook	3,448	67	3,309	9	1	3,309	0.26
	Wild Yearling Chinook	0	0	0	0	0	0	0.00
	Wild Steelhead/Rainbow	0	0	0	0	0	0	0.00
	Hatchery Steelhead/Rainbow	0	0	0	0	0	0	0.00
	Wild Coho	24	0	0	0	0	0	0.00
	Total	**3,472**	**67**	**3,309**	**9**	**1**	**3,309**	**0.26**
Nason Creek Trap	Wild Subyearling Chinook	1,759	20	959	25	0	959	1.42
	Wild Yearling Chinook	296	18	269	2	0	269	0.68
	Wild Steelhead/Rainbow	542	0	320	4	0	320	0.74
	Hatchery Steelhead/Rainbow	723	0	0	0	0	0	0.00
	Wild Coho	0	0	0	0	0	0	0.00
	Total	**3,320**	**38**	**1,548**	**31**	**0**	**1,548**	**0.94**
Nason Creek Remote (Electrofishing)	Wild Subyearling Chinook	3,447	76	3,212	86	0	3,212	2.49
	Wild Yearling Chinook	0	0	0	0	0	0	0.00
	Wild Steelhead/Rainbow	0	0	0	0	0	0	0.00
	Hatchery Steelhead/Rainbow	0	0	0	0	0	0	0.00
	Wild Coho	327	2	262	0	0	262	0.00
	Total	**3,774**	**78**	**3,474**	**86**	**0**	**3,474**	**2.49**
White River Trap	Wild Subyearling Chinook	372	1	332	6	0	332	1.61
	Wild Yearling Chinook	119	1	103	9	0	103	7.56
	Wild Steelhead/Rainbow	4	0	4	0	0	4	0.00
	Hatchery Steelhead/Rainbow	0	0	0	0	0	0	0.00
	Wild Coho	0	0	0	0	0	0	0.00
	Total	**495**	**2**	**439**	**15**	**0**	**439**	**3.03**
Lower Wenatchee Trap	Wild Subyearling Chinook	28,534	101	2	167	0	2	0.59
	Wild Yearling Chinook	1,485	4	1,289	2	0	1,289	0.13
	Wild Steelhead/Rainbow	221	0	185	1	0	185	0.45
	Hatchery Steelhead/Rainbow	1,918	0	1	0	0	1	0.00
	Wild Coho	642	0	4	0	0	4	0.00
	Hatchery Coho	17,190	0	0	11	0	0	0.06
	Wild Sockeye	1,096	1	1,062	5	0	1,062	0.46

Sampling Location	Species and Life Stage	Number collected	Number of recaptures	Number tagged	Number died	Shed tags	Total tags released	Percent mortality
	Total	**51,086**	**106**	**2,543**	**186**	**0**	**2,543**	**0.36**
Total:	***Wild Subyearling Chinook***	***51,530***	***512***	***17,448***	***371***	***1***	***17,448***	**0.72**
	Wild Yearling Chinook	***6,630***	***114***	***6,201***	***22***	***0***	***6,201***	**0.33**
	Wild Steelhead/Rainbow	***2,284***	***41***	***1,722***	***15***	***1***	***1,722***	**0.66**
	Hatchery Steelhead/Rainbow	***6,463***	***1***	***2***	***4***	***0***	***2***	**0.06**
	Wild Coho	***1001***	***2***	***270***	***0***	***0***	***270***	**0.00**
	Hatchery Coho	***17,190***	***0***	***0***	***11***	***0***	***0***	**0.06**
	Wild Sockeye	***1,096***	***1***	***1,062***	***5***	***0***	***1,062***	**0.46**
Grand Total:		***86,194***	***671***	***26,705***	***428***	***2***	***26,705***	**0.50**

Appendix E

Wenatchee Steelhead Spawning Escapement Estimates, 2019

Estimates of Wenatchee Steelhead Redds in 2019

Kevin See[1,*]

June 04, 2020

Abstract

This report contains estimates of total steelhead redds in the Wenatchee, after accounting for observer bias. It also includes estimates of spawners, as well as pre-spawn mortality.

Contents

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1 Introduction

Redd counts are an established method to provide an index of adult spawners (Gallagher et al. 2007). In the Wenatchee subbasin, index reaches are surveyed weekly during the steelhead spawning season (Mar 11, 2019 - Jun 03, 2019) and non-index reaches are surveyed once during the peak spawning period. The goal of this work is to:

1. Predict observer net error, using the model described in Murdoch et al. (2018).
2. Use estimates of observer net error rates and the mean survey interval to estimate the number of redds in each index reach, using a Gaussian area under the curve (GAUC) technique described in Millar et al. (2012) and Murdoch et al. (2018).
3. Estimate the total number of redds in the non-index reaches by adjusting the observed counts with the estimated net error where possible.
4. Sum the total number of estimated redds for the entire Wenatchee subbasin.

2 Methods

2.1 Net Error Model

The net error (NE) for a reach i is defined as

$$NE_i = \frac{F_i}{V_i}$$

where F_i is the number of redds the surveyor reported and V_i is the true number of redds in the reach. Therefore, if we have an estimate of net error ($\hat{NE}_i$), we can calculate the true number of redds based on that estimate and the number of redds the surveyor reported:

$$V_i = \frac{F_i}{\hat{NE}_i} \tag{1}$$

The model for observer net error is fully described in Murdoch et al. (2018). It uses covariates of the log of observer experience, mean discharge, the observed redd density and mean thalweg CV as a proxy for channel complexity. After normalizing these covariates, the model coefficients are shown in Table 1. The response, net error, is scaled such that estimates of net error less than 1 suggest more errors of omission, while estimates greater than 1 suggest more errors of commission. An estimate of net error equal to one would indicate the observed count equals the true number of redds.

Table 1: Net error model covariates and coefficients.

Covariate	Estimate	Std. Error
(Intercept)	0.682	0.039
Obs. Redd Density	0.277	0.053
Mean Thalweg CV	-0.169	0.043
Mean Discharge	0.116	0.048
Log Surveyor Exp.	0.115	0.042

2.2 Data

Redd counts were conducted on a nearly weekly basis for index reaches, and once during the peak spawning period for non-index reaches. The covariates in the observer error model of Murdoch et al. (2018) were collected during each survey. The covariate of mean thalweg CV was calculated based on all measurements taken within a reach across years (assuming this covariate does not vary through time within a reach). They were compared with the covariates contained in the model data set, as well as the estimates of net error (Figure 1).

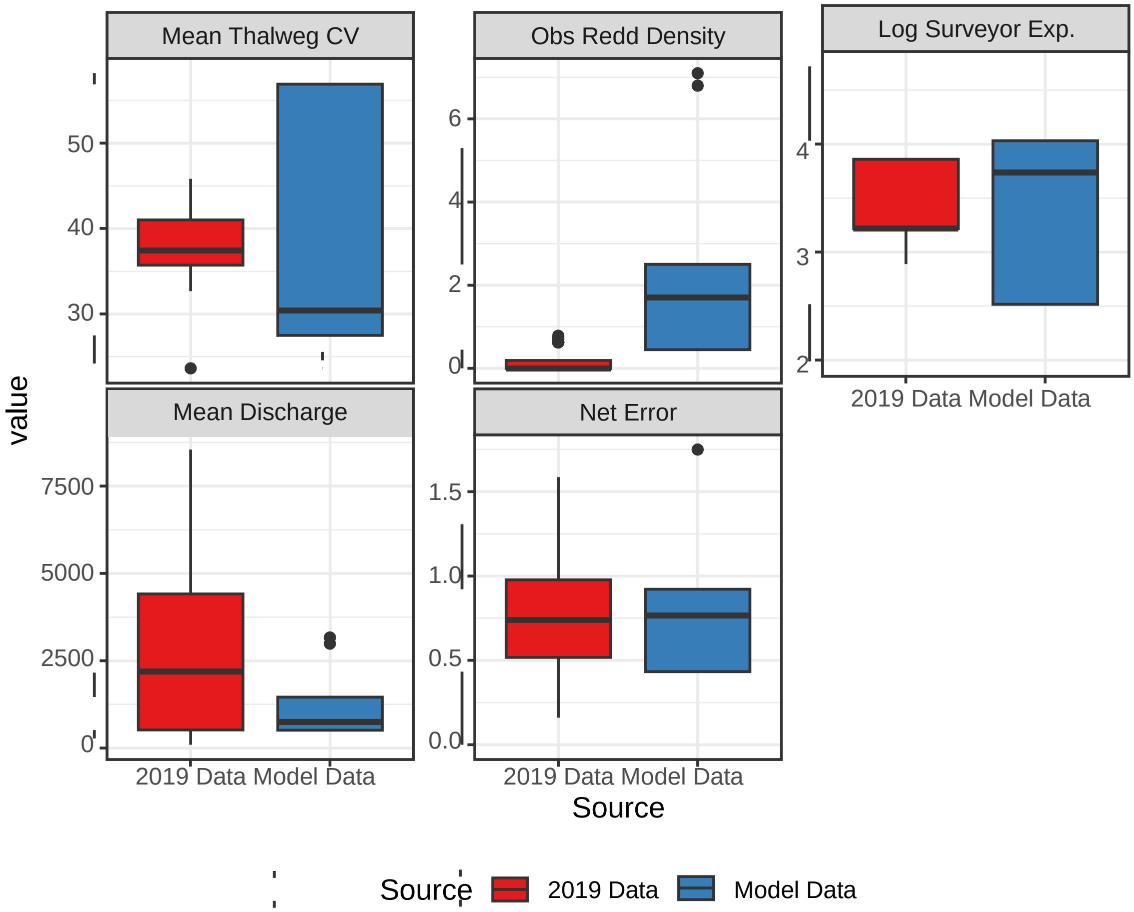

Figure 1: Net error covariate values from the original study the predicted reaches in this report.

Those covariates in the observer error model were collected during each survey in 2019, and predictions of net error were made for each survey. From these survey specific estimates of net error, a mean and standard error of net error was calculated for each reach. The standard deviation was calculated by taking the square root of the sum of the squared standard errors for all predictions within a reach.

2.3 Estimating Redds

Use of the GAUC methodology was limited to index reaches with a minimum of two redds and at least three weeks with at least one new redd found. For those reaches, we used the method described in Millar et al. (2012) and Murdoch et al. (2018). The GAUC model was developed with spawner counts in mind. As it is usually infeasible to mark every individual spawner, only total spawner counts can be used, and an estimate of average stream life must be utilized to translate total spawner days to total unique spawners. However, in adapting this for redd surveys, we note that individual redds can be marked, and therefore the GAUC model can be fit to new redds only. The equivalent of stream life thus the difference between survey numbers which can be fixed at 1. We applied the average net error from all the surveys when redds were visible, so as to not bias the estimate from early weeks when no redds were found, and the observed redd density was zero.

For non-index reaches, which were surveyed only once during peak spawning, the estimate of total redds was calculated by dividing the observed redds by the estimate of net error associated with that survey (Eq.

Table 2: Known number of fish removed at dams or due to harvest, by origin.

Source	Hatchery	Natural
Dryden	41	31
Harvest	0	0
Tumwater	26	26

(1)). This assumes that no redds were washed out before the non-index survey, and that no new redds appeared after that survey. As the number of redds observed in the non-index reaches ranged from 0 to 2, any violation of this assumption should not affect the overall estimates very much. Any index reaches that did not meet the thresholds described above were treated as non-index reaches, and the total observed redds in those reaches were divided by the mean estimate of net error for each reach.

When summing reach-scale estimates to obtain estimates at the stream scale, an attempt was made to incorporate the fact that the reaches within a stream are not independent. Estimates of correlation between the reaches within a stream were made based on weekly observed redds. This method may not be perfect, since spawners could use certain reaches preferentially at different times in the season, but it may be the best we can do. Because correlations are often quite high between reaches, this is a better alternative than to naively assume the standard errors between reaches are independent of one another. These correlation estimates were combined with estimates of standard error at the reach scale to calculate a covariance matrix for the reaches within each stream, which was used when summing estimates of total redds to estimate the standard error at the stream scale. Failure to incorporate the correlations between reaches would result in an underestimate of standard error at the stream scales. Different streams (and therefore reaches in different streams) were assumed to be independent.

2.4 Estimating Spawners

Estimates of escapement to various tributaries in the Wenatchee were made using a branching patch-occupancy model (Waterhouse, L. et al., *in review*) based on PIT tag observations of fish tagged at Priest Rapids dam. All fish that escaped to the various tributaries were assumed to be spawners (i.e. pre-spawn mortality only occurs in the mainstem).

To convert estimates of redds in mainstem areas into estimates of natural and hatchery spawners, the estimates of redds were multiplied by a fish per redd (FpR) estimate and then by the proportion of hatchery or wild fish. The fish per redd estimate was based on PIT tags from the branching patch-occupancy model observed to move into the lower or upper Wenatchee (below or above Tumwater Dam), but not into tributaries upstream of Tumwater. FpR was calculated as the ratio of male to female fish, plus 1. Reaches W1 - W7 are below Tumwater, while reaches W8 - W10 are above Tumwater. Similarly, the proportion of hatchery and natural origin fish was calculated from the same group of PIT tags for areas above and below Tumwater.

2.5 Pre-spawn Mortality

After translating estimates of redds to estimates of spawners by origin, we can then compare the spawner estimates to escapement estimates made using PIT tags and estimate a pre-spawn mortality rate. Taking the total PIT-tag based escapement estimate, by origin, to the Wenatchee, we then subtract any fish removed at Tumwater or Dryden for broodstock or surplus, as well as any deaths due to harvest (Table 2), and then subtract the total estimate of spawners, including the tributaries, to provide an estimate of how many fish succumbed to pre-spawn mortality. Dividing that number by the total escapement estimate provides an estimate of the pre-spawn mortality rate, by origin across the entire Wenatchee population.

We can also compare estimates of escapement to the mainstem lower Wenatchee (after subtracting the fish removed at Dryden) and to the upper mainstem above Tumwater (after subtracting the fish removed at Tumwater) to total estimates of spawners in mainstem areas below and above Tumwater dam. This allows us to estimate pre-spawn mortality in the mainstem above and below Tumwater, by origin. Using this approach, it is unclear which area deaths due to harvest should apply to, which is a moot point in years when there was no harvest.

If any group had a higher estimate of spawners compared to escapement, we fixed our pre-spawn mortality estimate at 0, reflecting a very low level of pre-spawn mortality. There is uncertainty in both the escapement and spawner estimates, which could explain why these types of scenarios could arise.

Table 3: Estimates of mean net error and redds for each reach.

River	Reach	Type	Net Error	Net Error CV	Observed Redds	Estimated Redds	Std. Err. Redds	Redds CV
Chiwawa	C1	Index	1	0	0	0	0	-
Nason	N1	Index	1	0	0	0	0	-
Peshastin	P1	Index	1	0	1	1	0	0
Wenatchee	W1	Non-Index	1	0	0	0	0	-
Wenatchee	W2	Index	1	0	0	0	0	-
Wenatchee	W3	Non-Index	1	0	0	0	0	-
Wenatchee	W4	Non-Index	1	0	0	0	0	-
Wenatchee	W5	Non-Index	1	0	0	0	0	-
Wenatchee	W6	Non-Index	1	0	0	0	0	-
Wenatchee	W6	Index	0.95	0.181	5	5	2.5	0.5
Wenatchee	W8	Non-Index	1	0	0	0	0	-
Wenatchee	W8	Index	0.727	0.203	1	1	0.3	0.279
Wenatchee	W9	Non-Index	0.916	0.185	1	1	0.2	0.202
Wenatchee	W9	Index	0.923	0.195	18	19	6.5	0.343
Wenatchee	W10	Non-Index	1	0	2	2	0	0
Wenatchee	W10	Index	0.709	0.186	25	35	9.6	0.273

Table 4: Estimate of redds for each stream

River	Location	Index	# Reaches	Observed Redds	Estimated Redds	Std. Err. Redds	Redds CV
Chiwawa	Tributaries	Y	1	0	0	0	-
Nason	Tributaries	Y	1	0	0	0	-
Peshastin	Tributaries	Y	1	1	1	0	0
Wenatchee	Above Tumwater	N	3	3	3	0.202	0.1
Wenatchee	Above Tumwater	Y	3	44	55	15.354	0.3
Wenatchee	Below Tumwater	N	5	0	0	0	-
Wenatchee	Below Tumwater	Y	2	5	5	2.499	0.5
Total	**-**	**-**	**16**	**53**	**64**	**15.558**	**0.2**

3 Results

3.1 Redd estimates

The estimated net error, observed redds and estimates of redds at the reach scale are shown in Table 3. Plots of the new redds and the GAUC fit to those data are shown in Figure 2. The results are summarized at the stream and population scale in Table 4.

3.2 Spawner Estimates

Demographic data about sex and origin were derived from the PIT tags detected within each area (Table @ref{tab:pit-tag-tab}).

Parameter estimates for fish / redd and proportion hatchery based on this PIT tag data are shown in Table 6.

Combining PIT tag-based estimates of spawners in the tributaries with adjusted redd-based estimates of spawners in the mainstem areas, Table 7 shows all of them, broken down by area and origin.

3.3 Pre-spawn Mortality

The estimates of overall pre-spawn mortality within the Wenatchee population, by origin, are shown in Table 8. The estimates when split into the mainstream areas above and below Tumwater dam, are displayed in Table 9.

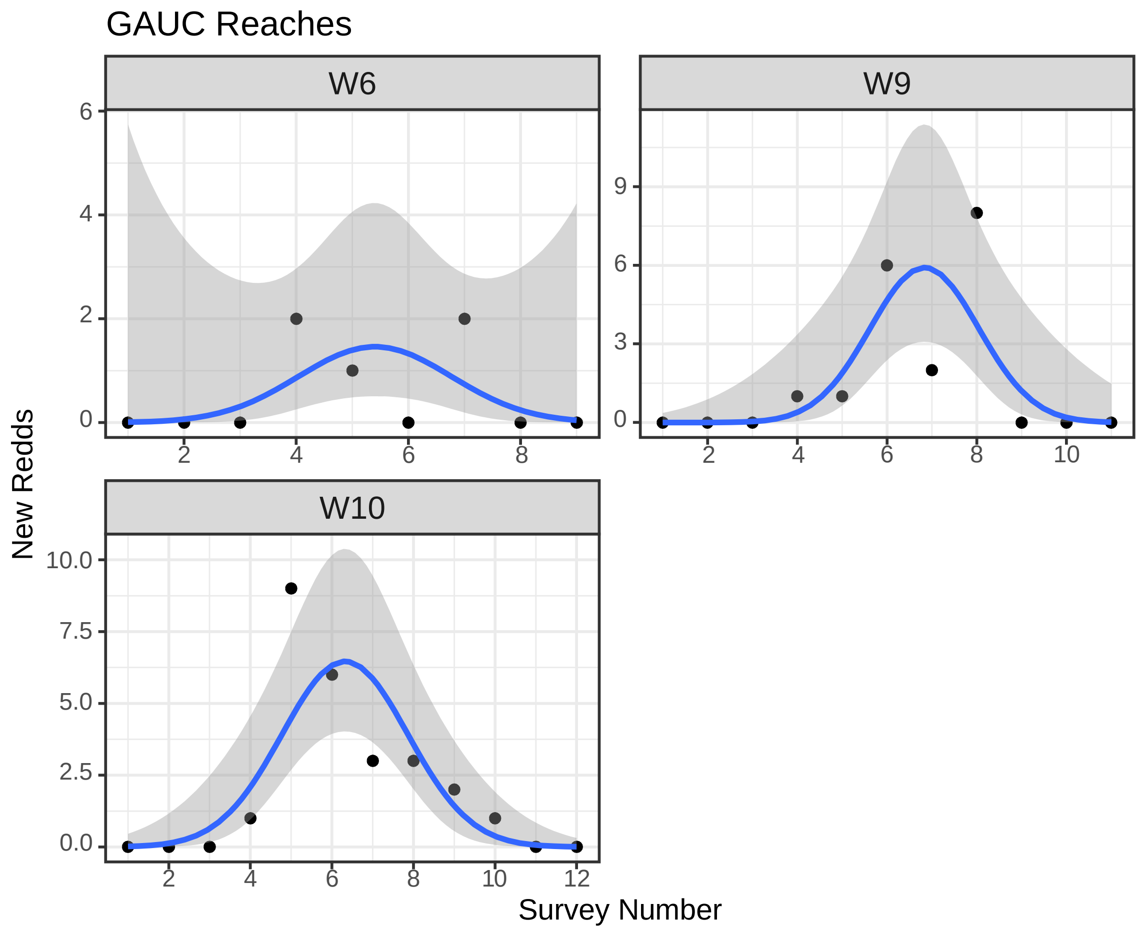

Figure 2: Plots of observed redd counts (black dots) through time for each qualifying index reach, and the fitted curve from the GAUC model (blue line) with associated uncertainty (gray).

Table 5: Number of PIT tags detected in each area by sex and origin.

Location	Sex	Origin	n tags
Below TUM	F	H	15
Below TUM	F	W	7
Below TUM	M	H	6
Below TUM	M	W	7
TUM bb	F	H	2
TUM bb	F	W	6
TUM bb	M	H	2
TUM bb	M	W	3
Tribs above TUM	F	H	8
Tribs above TUM	F	W	5
Tribs above TUM	M	H	5
Tribs above TUM	M	W	2

Table 6: Fish per redd and hatchery / natural origin proportion estimates.

Area	Fish / redd	FpR Std. Error	Prop. Hatchery	Prop Std. Error
Below TUM	1.591	0.151	0.600	0.083
Mainstem above TUM	1.625	0.259	0.308	0.128

Table 7: Estimates (CV) of spawners by area and origin.

Area	Type	Natural	Hatchery
W1	Non-Index	0 (-)	0 (-)
W2	Index	0 (-)	0 (-)
W3	Non-Index	0 (-)	0 (-)
W4	Non-Index	0 (-)	0 (-)
W5	Non-Index	0 (-)	0 (-)
W6	Index	3 (0.55)	5 (0.53)
W6	Non-Index	0 (-)	0 (-)
W8	Index	1 (0.37)	1 (0.53)
W8	Non-Index	0 (-)	0 (-)
W9	Index	21 (0.42)	10 (0.56)
W9	Non-Index	1 (0.32)	1 (0.49)
W10	Index	39 (0.37)	18 (0.52)
W10	Non-Index	2 (0.24)	1 (0.45)
Icicle	Trib	12 (0.6)	25 (0.4)
Peshastin	Trib	48 (0.31)	9 (0.67)
Mission	Trib	13 (0.61)	9 (0.74)
Chumstick	Trib	9 (0.74)	10 (0.76)
Chiwaukum	Trib	0 (-)	0 (-)
Chiwawa	Trib	23 (0.4)	51 (0.31)
Nason	Trib	16 (0.51)	17 (0.49)
Little Wenatchee	Trib	0 (-)	0 (-)
White River	Trib	0 (-)	0 (-)
Total	**-**	**188 (0.43)**	**157 (0.46)**

Table 8: Wenatchee pre-spawn mortality estimates. Includes estimates (standard error) of escapement, spawners, pre-spawn mortality, and standard error of this rate, separated by origin.

Origin	Escapement	Spawners	Pre-spawn Mortality	SE
Natural	134 (29)	189 (29)	0	0.372
Hatchery	143 (31)	155 (26)	0	0.295

Table 9: Wenatchee pre-spawn mortality estimates. Includes estimates (standard error) of escapement, spawners, pre-spawn mortality, and the standard error of this rate, separated by origin and mainstem areas above and below Tumwater dam.

Origin	Area	Escapement	Spawners	Pre-spawn Mortality	SE
Natural	Above Tumwater	20 (13)	65 (17)	0.000	2.344
Hatchery	Above Tumwater	1 (11)	29 (11)	0.000	323.573
Natural	Below Tumwater	0 (12)	3 (2)	0.000	0.818
Hatchery	Below Tumwater	22 (17)	5 (3)	0.783	0.205

4 Discussion

Most of the covariates collected in 2019 were within the range of those in the model data set from Murdoch et al. (2018), leading to estimates of net error in a very similar range to the model dataset (Figure 1). However, most reaches did not meet the minimum thresholds of number of observed redds or number of weeks with at least one new redd observed, so we used the GAUC method in only three reaches.

The estimates of high pre-spawn mortality in the lower mainstem of the Wenatchee for hatchery fish could be accurate, but it should be noted that many of the redd surveys failed to observe a single redd in many of the reaches (Table 3). Without any observed redds, any estimate of net error is moot, as the adjusted redd estimate will still be zero. So, if all the redds were missed in some of those reaches, the estimate of total spawners in the lower mainstem should be higher, leading to a lower estimate of pre-spawn mortality. It is unclear whether that actually occurred, or if there were actually no redds this year in those reaches.

Most of the estimates of pre-spawn mortality were zero this year, due to higher estimates of spawners compared to escapement, at least after removals had been accounted for. In some cases, there were overlapping confidence intervals between spawners and escapement, so not too much should be made of that fact, and we interpret that as at least very low levels of pre-spawn mortality, perhaps even none. However, the natural-origin estimates of spawners, either in the Wenatchee as a whole (Table 8) or split between above and below Tumwater (Table 9), were much higher than estimates of natural-origin escapement. It is unclear exactly why that is, but we do note that the net error in reach W10 above Tumwater is quite low, and a number of redds were spotted there, leading to high levels of estimated redds and therefore spawners.

5 Acknowledgements

The data for this report was collected by Washington Department of Fish and Wildlife. Development of the observer error model was done in collaboration with Andrew Murdoch, WDFW.

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Appendix F

Genetic Diversity of Wenatchee Summer Steelhead

Examining the Genetic Structure of Wenatchee Basin Steelhead and Evaluating the Effects of the Supplementation Program

Developed for

Chelan County PUD

and the

Rock Island Habitat Conservation Plan Hatchery Committee

Developed by
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17 January 2012

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Executive Summary

In 1997, Wenatchee River summer steelhead, as part of the upper Columbia River evolutionarily significant unit (ESU), were listed as threatened under the Endangered Species Act (ESA). To address concerns about effects of hatchery supplementation, the hatchery program for hatchery produced (HOR) summer steelhead to be planted in the Wenatchee River changed from using mixed ancestry broodstock collected in the Columbia River to using Wenatchee River broodstock collected in the Wenatchee River. Three monitoring and evaluation (M&E) indicators were developed to measure the genetic effects of hatchery production on wild fish populations. To address these indicators, temporal collections of tissue samples from Wenatchee River hatchery-produced (HOR) and natural origin (NOR) adults captured and sampled at Dryden and Tumwater dams and from NOR juveniles from three Wenatchee River tributaries and the Entiat River were surveyed for genetic variation with 132 genetic (SNPs) markers. Peshastin Creek (a Wenatchee River tributary) and the Entiat River served as no-hatchery-outplant controls, meaning they have stopped receiving HOR juvenile outplants. As per the M&E plan, we interrogated these data for the presence or absence of spatial and temporal trends in allele frequencies, genetic distances, and effective population size.

Allele frequencies – Changes to the summer steelhead hatchery supplementation program had no detectable effect on genetic diversity of wild populations. On average, HOR adults had higher minor allele frequencies (MAF) than NOR adults, which may simply reflect the mixed ancestry of HOR adults. Both HOR and NOR adults had MAF similar to juveniles collected in spawning tributaries and in the Entiat River. There was no temporal trend in allele frequencies or observed heterozygosity in adult or juvenile collections and allele frequencies in control populations were no different than those still receiving hatchery outplants. This suggests that the hatchery program has had little effect on allele frequencies since broodstock sources changed in 1998.

Genetic distances – As intended, interbreeding of Wenatchee River HOR and NOR adults reduced the genetic differences between Wells Hatchery HOR adults and Wenatchee River NOR adults observed in the first few years after changing the broodstock collection protocol. Though there were detectable genetic differences between HOR and HOR adults, the magnitude of that difference declined over time. HOR adults were genetically quite different from NOR adults and juveniles based on pair-wise F_{ST} and principal components analysis (PCA), most likely because of the much smaller effective population size (N_b) in the hatchery population (see below). Pair-wise F_{ST} estimates and genetic distances between HOR and NOR adults collected the same year declined over time suggesting that the interbreeding of HOR and NOR adults in the hatchery (and presumably in the wild) is slowly homogenizing Wenatchee River summer steelhead. Analyses using brood year (the year fish were hatched, determined using scale-based age estimates) were inconclusive because of limitations of the data.

Effective population size (N_b) – Although the effective population size of the Wenatchee River hatchery summer steelhead program was consistently small, it does not appear to have caused a reduction in the effective population size of wild populations. On average, estimates of N_b were much lower and varied less for HOR adults than for NOR adults and juveniles. Estimates of N_b for HOR adults declined from the earliest brood years to a stable new low value after broodstock practices were changed in 1997. There was no indication that this had any effect on N_b in NOR adults and juveniles; N_b estimates for NOR adults and juveniles were, on average, higher and varied considerably over the time period covered by our dataset (1998 – 2010) and showed no temporal trend.

Introduction

The National Marine Fisheries Service (NMFS) recognizes 15 Evolutionary Significant Units (ESU) for west coast steelhead (*Oncorhynchus mykiss*). The Upper Columbia ESU, which contains steelhead in the Wenatchee Basin, was listed as endangered under the Endangered Species Act (ESA) in 1997. Included in this listing were the Wells hatchery steelhead (program initiated in the late 1960s) that originated from a mixed group of native steelhead and are considered to be genetically similar to natural spawning populations above Wells Dam. Juvenile steelhead from Wells Fish Hatchery was the primary stock released into the Wenatchee River (Murdoch et al. 2003). The 1998 steelhead status review identified several areas of concern for this ESU including the risk of genetic homogenization due to hatchery practices and the high proportion (65% for the Wenatchee River) of hatchery fish present on the spawning grounds (Good et al. 2005). The Biological Review Team (BRT) further identified the relationship between the resident and anadromous forms of *O. mykiss* and possible changes in the population structure ('genetic heritage of the naturally spawning fish') in the basin as two areas requiring additional study. Furthermore, the West Coast Steelhead BRT (2003) recommended that stocks in the Wenatchee, Entiat, and Methow rivers, within the Upper Columbia ESU, be managed as separate populations.

A review of the presence of resident *O. mykiss* in the Upper Columbia ESU (Good et al. 2005) shows that rainbow trout are relatively abundant in upper Columbia River tributaries currently accessible to steelhead as well as in upriver tributaries unavailable to anadromous access by Chief Joseph and Grand Coulee dams (Kostow 2003). U.S. Fish and Wildlife Service (USFWS) biologists surveyed the abundance of trout and steelhead juveniles in the Wenatchee, Entiat, and Methow river drainages in the mid-1980s and found adult trout (defined as those with fork length > 20 cm) in all basins (Mullan et al. 1992). The results also supported the hypothesis that resident *O. mykiss* are more abundant in tributary or mainstem areas upstream of the areas used by steelhead for rearing. No samples of rainbow trout from the Wenatchee were available for this study.

In addition to the mixed ancestry Wells Hatchery steelhead, Skamania Hatchery (Washougal River steelhead ancestry) steelhead were also released into the Wenatchee River basin for several years in the late 1980s (L. Brown, Washington Dept. of Fish and Wildlife [WDFW], personal communication). In 1996, broodstock for the Wenatchee River steelhead program were collected from Priest Rapids Dam and Dryden (rkm 24.9) and Tumwater (rkm 52.6) dams on the Wenatchee River. Because of the ESA listing, broodstock collection after 1996 was restricted to the Wenatchee River in an effort to develop a localized broodstock (Murdoch et al. 2003). Thus, starting in 1998, all juvenile steelhead released into the Wenatchee River and Wenatchee River tributaries were offspring of only Wenatchee River captured broodstock.

In response to the need for evaluation of the supplementation program, both a monitoring and evaluation plan (Murdoch and Peven 2005) and the associated analytical framework (Hays et al. 2006) were developed for the Habitat Conservation Plans Hatchery Committee through the joint effort of the fishery co-managers (Confederated Tribes of the Colville Reservation [CCT], NMFS, USFWS, WDFW, and Yakama Nation [YN]) and Chelan County, Douglas County, and Grant County Public Utility Districts (PUD). These reports outline 10 objectives to be applied to various species assessing the impacts of hatchery operations mitigating the operation of Rock Island and Rocky Reach Dams. This report pertains to Wenatchee River basin steelhead (*O. mykiss*) and the steelhead supplementation program as addressed by objective 3, specifically the first three evaluation indicators.

> **Objective 3:** Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program. Additionally, determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.

3.1 Allele Frequency

3.2 Genetic Distances Between Populations

3.3 Effective Spawning Population

To address these evaluation indicators the WDFW Molecular Genetics Lab (MGL) obtained pertinent tissue collections and samples, surveyed genetic variation with SNP markers using our standard laboratory protocols, and calculated the relevant genetic metrics and statistics. We used collections from both the Entiat River and Wenatchee River basins. Both have received hatchery plants from non-local stocks [i.e. Entiat was stocked with both Wenatchee and Wells program juveniles averaging 12K and 18K respectively during 1995-2001, and Wenatchee received on average 177K juveniles from the Wells program during 1995-2001; (Good et al. 2005)], and both have all or some part of the basin designated as natural production "reference" drainage – no hatchery outplanting (i.e., the entire Entiat Basin, and Peshastin Creek in the Wenatchee River basin) (Good et al. 2005).

Materials and methods

Sample collections

To address objectives 3.1 through 3.3, we obtained samples from hatchery (HOR, adipose fin clipped) and natural origin (NOR, adipose fin intact) adult summer steelhead captured at Dryden or Tumwater diversion dams in the summer and fall of 1997 through 2009 (excepting 2004 and 2005; Table 1). All or some fraction of these fish was later used as hatchery broodstock the calendar year following the sampling year. In order to keep things simple we have reported years as the spawning year, i.e., the calendar year the fish were spawned, not the calendar year they were captured.

To address objective 3.2, it was necessary to have samples from natural origin fish from each of the spawning populations in the basin. It is difficult to obtain adult samples from known spawning populations due to the life history and behavior of steelhead, without tributary weirs or some other blocking method of collection. The NOR adult samples used as broodstock collected from Dryden and Tumwater Dams were a mixed collection representing all of the spawning populations located upstream. Therefore to determine population substructure within the basin we obtained collections of juvenile fish from smolt traps located within tributaries representing three major populations in the basin and from the Entiat River (Chiwawa River, Nason Creek, and Peshastin Creek; Table 2). We also obtained two collections of juvenile fish caught in a smolt trap in the lower Wenatchee River. These, like the NOR adult collections, were a mixed collection presumably representing all populations located upstream. Fin tissue was taken from each fish and preserved in 95% ethanol.

Sample processing

Fin tissue samples were processed for 1468 HOR and NOR adult steelhead broodstock (Table 1) and for 1542 juvenile *O. mykiss* from the Wenatchee and Entiat Rivers (Table 2). Samples were genotyped at 152 single nucleotide polymorphism loci (SNPs, Tables 3, 4). We originally proposed to use microsatellites, but WDFW MGL and other regional genetic laboratories (Columbia River Inter-Tribal Fish Commission [CRITFC], Idaho Fish and Game [IDFG], USFWS) are moving toward using SNPs and they provide the same kinds of information with faster processing. Twenty SNP loci were developed to discriminate among trout species; 14 distinguish *O. mykiss* from coastal cutthroat trout (*O. clarkii clarkii*) and westslope cutthroat (*O. clarkii lewisi*), and 6 distinguish steelhead and coastal cutthroat from westslope cutthroat (Table 4). The remaining 132 SNP loci were developed to be used for population structure, parentage assignment, or other population genetic studies of *O. mykiss* (Table 3). These markers comprised the current standard set of SNP markers used for genetic studies of *O. mykiss* at WDFW MGL.

We used Qiagen DNEasy ® kits (Qiagen Inc., Valencia, CA), following the recommended protocol for animal tissues, to extract and isolate DNA from fin tissue. SNP genotypes were obtained through PCR and visualization on Fluidigm EP1 integrated fluidic circuits (chips). Protocols followed Fluidigm's recommendations for TaqMan SNP assays as follows: Samples were pre-amplified by Specific Target Amplification (STA) following Fluidigm's recommended protocol with one modification. The 152 assays were pooled to a concentration of 0.2X and mixed with 2X Qiagen Multiplexing Kit (Qiagen, Inc., Valencia CA), instead of TaqMan PreAmp Master Mix (Applied Biosystems), to a volume of 3.75µl, to which 1.25µl of unquantified sample DNA was added for a total reaction volume of 5µl. Pre-amp PCR was conducted on a MJ Research or Applied Biosystems thermal cycler using the following profile: 95°C for 15 min followed by 14 cycles of 95°C for 15 sec and 60°C for 4 minutes. Post-PCR reactions were diluted with 20µl dH_2O to a final volume of 25µl.

Specific SNP locus PCRs were conducted on the Fluidigm chips. Assay loading mixture contained 1X Assay Loading Reagent (Fluidigm), 2.5X ROX Reference Dye (Invetrogen) and 10X custom TaqMan Assay (Applied Biosystems); sample loading mixture contains 1X TaqMan Universal PCR Master Mix (Applied Biosystems), 0.05X AmpliTaq Gold DNA polymerase (Applied Biosystems), 1X GT sampling loading reagent (Fluidigm) and 2.1 µL template DNA. Four µL assay loading mix and 5 µL sample loading mix were pipetted onto the chip and loaded by the IFC loader (Fluidigm). PCR was conducted on a Fluidigm thermal cycler using a two step profile. Initial mix thermal profile was 70°C for 30min, 25°C for 5 min, 52.3° for 10 sec, 50.1°C for 1 min 50sec, 98°C for 5 sec, 96°C for 9 min 55 sec, 96°C for 15 sec, 58.6°C for 8 sec, and 60.1°C for 43 sec. Amplification thermal profile was 40 cycles of 58.6°C for 10 sec, 96°C for 5 sec, 58.6°C for 8 sec and 60.1°C for 43 sec with a final hold at 20°C.

The SNP assays were visualized on the Fluidigm EP1 machine using the BioMark data collection software and analyzed using Fluidigm SNP genotyping analysis software. To ensure all SNP markers were being scored accurately and consistently, all data were scored by two researchers and scores of each researcher were compared. Disputed scores were called missing data (i.e., no genotype).

Evaluation of loci

A two-tailed exact test of Hardy–Weinberg equilibrium (HWE) was performed for each locus in each collection or population using the Markov Chain method implemented in GENEPOP v4.1 (dememorization number 1000, 100 batches, 1000 iterations per batch; Raymond and Rousset 1995; Rousset 2008). Significance of probability values was adjusted for multiple tests using false discovery rate (Verhoeven et al. 2005). F_{IS}, a measure of the fractional reduction in heterozygosity due to inbreeding in individuals within a subpopulation and an additional indicator of scoring issues, was calculated according to Weir and Cockerham (1984) using GENEPOP v4.1. Allele frequencies were calculated using CONVERT v1.0 (Glaubitz 2004). Expected and observed heterozygosities were calculated using GDA v1.1 (Lewis and Zaykin 2001).

Allele frequencies, genetic distances and population differentiation

To evaluate Q1 of Objective 3.1 and 3.2, we evaluated trends and patterns in allele frequencies, genetic distances and population differentiation. To test for temporal patterns in allele frequencies, we compared sample or spawn year to two diversity metrics, allele frequency and observed heterozygosity, from each adult and juvenile collection. Each SNP locus had only one or two alleles, so we used the minor allele frequency (MAF) of each SNP locus for each adult collection and averaged across loci. We also calculated the average observed heterozygosity (Ho) for each SNP locus within each adult and juvenile collection. We examined the presence or absence of a temporal trend in average allele frequency and observed heterozygosity with logistic regression analysis in R (R Development Core Team 2009).

To partition genetic variance into temporal, spatial (juvenile) and origin (adult) fractions, we performed hierarchical analysis of molecular variance (AMOVA) using ARLEQUIN v3.0 (Excoffier et al. 2005) with 1,000 permutations. We performed this analysis separately for juvenile and adult collections. Juveniles were grouped by sampling location (tributary) and adults were grouped by origin (HOR or NOR). To estimate the magnitude of genetic differences among temporal and spatial collections we calculated pairwise F_{ST} estimates among collections using FSTAT (Goudet 1995) with 1000 permutations. Statistical significance was adjusted using false discovery rate (Verhoeven et al. 2005).

To evaluate the temporal changes in genetic relationships, we compared spawn year to within spawn year pairwise F_{ST} estimates between NOR and NOR adults using beta regression (Simas and Rocha 2010). We used beta regression because the dependent variable was bound by zero and one but not binomial. Analysis was performed in R (package "betareg", Cribari-Neto and Zeileis 2010), with a loglog link.

We used principal component analyses (PCA) to explore the relationship between the covariation among the SNP loci within each collection and genetic differentiation between HOR and NOR collections, and to determine if the degree of differentiation has changed with time. Since each SNP is represented by only two alleles, only one allele per SNP is necessary to fully describe the covariation among all SNPs. We used MATLAB® scripts (2007a, The Mathworks, Natlick, MA) to calculate the principal components from SNP allele frequencies using only the major allele (1-MAF) for each SNP. We defined the major allele as the allele with the higher mean frequency across all collections, regardless of its status within any individual collection. We conducted three PCA analyses using: (1) all adult samples, aggregated based on origin (HOR versus NOR) and spawn year (i.e., the year the adult fish were used as broodstock) (N = 1437, 22 collections), (2) same as #1, but with the addition of all juvenile samples (N = 2938, 37 collections), and (3) only those adults samples with available age information (Mike Hughes, WDFW, personal communication) aggregated based on origin, and spawn year or brood year (i.e., the year the fish were hatched) (N = 1313, 20 spawn-year or 25 brood-year collections).

Molecular differentiation between HOR and NOR adults within a year was calculated based on principal component scores using Euclidian distances. We calculated pair-wise Euclidian distances between HOR and NOR fish within a spawn year or brood year using the first three principal components, and standardized each distance by subtracting from it the mean Euclidian distance calculated across all pair-wise distances. We used Mahalanobis distances to calculate the variation among HOR and NOR collections (calculated separately), again using the first three principal components. Here, we calculated Mahalanobis distances as the Euclidian distances between each collection and the centroid of all collections (HOR and NOR combined), but the Euclidian distances are scaled based on the dispersion of collections around the centroid (i.e., the variance). Euclidian and Mahalanobis distances were calculated using MATLAB scripts.

Effective spawning population

To evaluate Q1 of Objective 3.3, we estimated N_e using the single-sample linkage disequilibrium methods implemented in the program LDNE (Waples and Do 2008). This method requires that you input the P_{crit} value, the minimum frequency at which alleles were included in the analysis, since results can be biased depending on this setting (Waples and Do 2010). SNP markers typically have only one or two alleles; if one of two alleles is excluded based on its frequency in the collection it essentially excludes the locus, reducing the overall dataset. Therefore, we used P_{crit} values ranging from 0.1 to 0.001 to evaluate whether trends in N_e changed given which loci were used. Confidence intervals were calculated using a jackknife procedure.

We calculated an estimate of N_e for all adult and juvenile collections individually. However, the intention of an integrated hatchery program such as the Wenatchee River steelhead hatchery program is that HOR and NOR fish are integrated and progress as a single population through intentional interbreeding in the hatchery and presumed natural interbreeding in the wild. Thus, we also combined annual HOR and NOR collections to calculate an overall N_e estimate as has been done in other genetic monitoring and evaluation analyses (e.g., Small et al. 2007, [Chinook salmon, *O. tshawytscha*]).

Estimates of N_e from linkage refer to the generations that produced the sample. To calculate the ratio of effective population size to census size (N_e/N), we obtained the number of fish spawned in the hatchery (1993 through 2006, i.e., those that produced the adipose fin clipped adults that returned to spawn in the Wenatchee River 1998 through 2010) and the estimated escapement of fish spawning naturally (HOR and NOR separately) for the same time period. Estimates of census population size in spawning tributaries was obtained by multiplying the fraction of redds counted within tributaries (Chad Herring ,WDFW, unpublished data) by the total Wenatchee River census population estimate (Andrew Murdoch, WDFW, unpublished data). To calculate N_e/N, we performed two analyses. First, for adults, we assumed a five year generation time for natural origin adults and a four year generation time for hatchery origin adults and divided the N_e estimate by the census population estimate from four or five years earlier. For juveniles, we assumed an age at outmigration of two years and divided the N_e estimates by the estimate of census population size for the appropriate tributary. Second, we used available adult age data to parse individuals into cohorts originating in brood years (rather than spawn years) and then used LDNE to estimate N_e from cohort collections. We performed both analyses to make full use of all available data; age data were not available for many adults, and because of variable survival and sampling not all cohorts had sufficient numbers of HOR and NOR adults. According to Luikart et al. (2010), estimates produced using linkage disequilibrium should be interpreted as something between effective population size (N_e) and the effective number of breeders (N_b). Using cohorts, the estimate produced by LDNE is clearly an estimate of N_b rather than N_e. In order to keep things simple, we have referred to all estimates as N_b.

Results and Discussion

Collections and samples received

From 1468 samples from HOR and NOR adult steelhead broodstock, 1437 produced sufficient genetic data for further analysis (Table 1). From 1542 samples from NOR juvenile steelhead from Wenatchee River tributaries and the Entiat River, 1501 produced sufficient genetic data for further analysis and were genetically identified as *O. mykiss* (Table 2). Samples genetically identified as *O. clarki* (2 samples from the Chiwawa River, 1 from the Entiat River) or *O. clarki*/*O. mykiss* hybrids (4 – lower Wenatchee River, 4 – Nason Creek, 4 – Chiwawa River, and 1 – Entiat River) were omitted from further analysis.

Evaluation of loci

Three loci showed deviations from HWE in 10 or more of 37 Wenatchee steelhead collections before correcting for multiple tests (AOmy016, AOmy051, AOmy252, Table A1) indicating possible scoring issues. These loci were omitted from further analysis. Nine of the remaining loci were monomorphic or nearly monomorphic in all collections (average MAF < 0.1, AOmy023, AOmy028, AOmy123, AOmy129, AOmy132, AOmy209, AOmy229, AOmy270, AOmy271, Table A1) contributing little or nothing to analytical power. These loci were also omitted from further analysis. No genetic data was available for collection 10FD due to poor PCR amplification at locus AOmy213 for the entire collection. AOmy213 had a relatively low MAF in most collections so rather than re-processing this collection at this locus or running different sets of loci for different tests, we omitted this locus from further analysis. Only six tests of deviation from HWE were significant after correcting for 4348 tests using false discovery rate. Two of these tests were in loci already omitted. The remaining four tests were spread among the remaining loci, indicating no more loci needed to be omitted from further analysis.

Objective 3.1, 3.2 – Allele frequencies and Genetic distances

Allele frequencies

Average MAF of SNP loci ranged from 0.00 to 0.60 in HOR adult collections and from 0.00 to 0.61 in NOR adult collections (Table A1). Observed heterozygosity ranged from 0.00 to 0.75 in HOR adult collections and from 0.01 to 0.67 in NOR adult collections. Juvenile collections produced similar ranges of MAF and Ho (Table A1). Average MAF and Ho of HOR adult collections appeared to be greater than those of natural origin collections. However, logistic regression analysis indicated there was no significant temporal trend in either diversity statistic (Figure 1). Similarly, there was no consistent temporal trend in MAF or Ho of juvenile collections (Figure 2). Both the Chiwawa River and Nason Creek, the two tributaries that currently still receive hatchery juvenile outplants, both appeared to have declining allele frequencies, but neither was statistically significant ($P > 0.90$). However, the power to detect significant trends was limited by the small sample sizes (n = 3 sample years).

Analysis of Molecular Variance

Analysis of molecular variance (AMOVA) of adult collections (i.e., temporal and origin structure) indicated most of the genetic variance was among individuals or among individuals within populations (99.04%). Most of the remaining variance was temporal variation within hatchery and natural origin groups (0.61%) with the remaining variation from origin (0.35%). AMOVA of juvenile collections (i.e., spatial structure) indicated most of the genetic variance was among individuals (98.44%) or among individuals within populations (0.94%). Most of the remaining variance existed among temporal collections within tributary collections (0.37%) with the smallest fraction as among tributary variance (0.24%). Thus, overall, there was more variability among years than among tributaries or origins, but no trend in the temporal variability.

Pair-wise F_{ST} *estimates*

HOR adults were genetically different that NOR adults as estimated by F_{ST} (full pair-wise table in Table A2, all pair-wise F_{ST} estimates with P-values ≤ 0.05 before correcting for multiple tests were significantly different from zero after correcting for multiple tests using false discovery rate). On average, HOR adult collections were as different from one another (mean F_{ST} = 0.011) as they were from NOR adult collections among years (mean F_{ST} = 0.009) or from NOR adult collections within years (mean F_{ST} = 0.010). Among year comparisons of NOR adult collections were, on average, nearly an order of magnitude lower (mean = 0.002). These patterns held whether spawn year or brood year (data not shown) was used to group individuals. Over time, within spawn year pair-wise F_{ST} estimates between HOR and NOR adults declined over time (β = -0.014, P = 0.0185; Figure 3), suggesting that the integration of hatchery and wild fish is slowly genetically homogenizing the groups. That relationship disappeared when adults were grouped by brood year (i.e., comparing fish produced the same year) and all brood years were used (β = -0.009, P = 0.615, data not shown). However, when the dataset was restricted to just those brood years when all typical (age at maturation frequency among all years > 0.10) age classes were present in the dataset (HOR = age 3, 4; NOR = age 4, 5, 6; brood years 1996-1998, 2004-2005) a non-significant (P = 0.278) negative relationship (β = -0.12) of F_{ST} and brood year was apparent. When the data were further restricted to just the years after the hatchery program changed to only collecting broodstock in the Wenatchee River (brood years 1998, 2004-2005), the slope was also negative (β = -0.09), but the relationship was not statistically significant (P = 0.962).

Within tributary among sample year pair-wise comparisons of juvenile collections were, on average, only very slightly smaller than comparisons among tributaries (0.005 vs. 0.006, respectively, Table 5, all pair-wise F_{ST} estimates with P-values ≤ 0.05 before correcting for multiple tests were significantly different from zero after correcting for multiple tests using false discovery rate). Nason Creek and Peshastin Creek on average showed higher among sample year F_{ST} estimates (0.010 and 0.007, respectively) than the Chiwawa or Entiat Rivers (0.004 and 0.002, respectively). The pair-wise comparison of the two collections of lower Wenatchee River smolts, presumably a mix of Chiwawa, Nason, Peshastin smolts and smolts from other spawning tributaries, was an order of magnitude smaller (F_{ST} = 0.0002), and not significantly different than zero (Table 5). There was no temporal trend in pair-wise comparisons of juvenile collections. However with, at most, four annual collections, detecting any temporal trend was unlikely. We also had no collections from years prior to 1998 (the first year of new hatchery program broodstock collecting protocols) with which to compare contemporary data, nor could we find any reports or papers containing pre-hatchery-program-change genetic comparisons among Wenatchee River tributary populations, making it impossible to determine whether or not changing the hatchery program has had any effect at all on population structure. However, these data will be useful for future studies.

Principal Components

Each principal component analysis (Figures 4, 5) indicated that the genetic structure among HOR collections differed from that among NOR collections, and that this difference has decreased with time. When adult fish were aggregated based on origin and spawn-year, there was a clear differentiation between HOR and NOR adult collections along PC 1, and a separation among HOR collections, differentiating the early spawn-years (1998 – 2003) from the later spawn-years (2004 – 2010) along PC 2 and PC 3, respectively (Figure 4). The pair-wise genetic distances between HOR and NOR collections from the same spawn year (i.e., the HOR and NOR fish used as broodstock within the same year) decreased from the largest distance in 1998 to small distances in 2009 and 2010, although the smallest distance occurred in 2004 (Figure 4, top right). That is, within hatchery broodstock, the genetic difference between HOR and NOR fish decreased, on average, from 1998 to 2010, and the decrease appeared to be a mutual convergence of NOR fish shifting right along PC 1 and HOR fish shifting downward along PC 2 and PC 3. This increasing similarity in adult fish mirrored that seen in within year pair-wise F_{ST} estimates between HOR and NOR adults which also declined over time (Figure 3).

Overall, there was considerably more genetic variation among the HOR collections than there was among the NOR collections with average Mahalanobis distances (distance between each collection and the overall centroid [0,0,0]) among the HOR and NOR collections being 4.2 and 1.5, respectively. Since each NOR collection was generally composed of 3-4 brood-years, while HOR collections rarely were composed of more than two brood-years, we attributed the lower year-to-year genetic variability of the NOR broodstock to the greater homogenizing effect of including four or more brood-years compared with only two brood years for the HOR broodstock.

Including the 15 juvenile collections, along with the 22 adult collections, did not materially alter the principal component structure (Figure 6), although the total genetic variation accounted for by the three principal components decreased from 44% using only the adults to 33% when juveniles were included. For the most-part, the juvenile fish appeared intermediate between HOR and NOR fish, but there was greater overlap in principal component scores (and therefore greater genetic similarity) of the juvenile and NOR collections, than of the juvenile and HOR collections. The average Euclidian distance between the juvenile and HOR collections was 0.49, compared to 0.23 between the juvenile and NOR collections, which was no different than 0.23 and 0.22 for the within juvenile and NOR collections, respectively.

By using the available adult age data, we were able to compare the genetic differentiation among the same set of fish when they are aggregated by origin (hatchery versus natural) and brood-year (year fish were hatched) with aggregates based on origin and spawn-year (year adult fish were spawned). A brood-year analysis compares within a year the genetic diversity generated from hatchery broodstock with that naturally produced in the spawning grounds. A spawn-year analysis compares the HOR and NOR genetic diversity that was mixed among cohorts of the parental generations. The same basic pattern of genetic structure that we have seen in spawn-year analyses (Figure 4, Figure 6, and the right side of Figure 5) also occurred in the brood-year analysis (left side of Figure 5). That is, from Figure 5 we saw (1) that HOR and NOR fish were differentiated from each other; (2) there was considerably more genetic variation (temporal variation) among the hatchery-origin collections than there was among the natural-origin collections (for brood-year, Mahalanobis distances = 5.18 and 0.75, respectively; for spawn-year, Mahalanobis distances = 4.25 and 1.25, respectively), and (3) that the genetic distances between HOR and NOR collections were lower in the more recent brood- and spawn-years, than in the earlier brood- and spawn-years (Figure 7; $R^2 = 0.41$ or 41%, $P < 0.05$). This indicated that the HOR and NOR fish used as broodstock in 2010 were more similar to each other than they were at the inception of the new hatchery program.

The relationship between genetic distance and brood-year was not the same as the relationship between genetic distance and spawn-year. For brood-year, although the slope was negative (i.e., trending downward or decreased differentiation with time) and the two most-recent brood years (2005-2006) showed relatively small HOR and NOR adult differentiation, the negative slope was not significantly different from zero and the regression accounted for only 7% of the variation. This was likely the result of insufficient sampling of certain age classes from many brood years (especially from NOR adults) due to two un-processed sample years (2005 and 2006).

Objective 3.3 – Effective spawning population

There was no difference in the temporal trends in estimates of N_b with P_{crit} set from 0.1 to 0.001 (Figure 8, data not shown for all collections), so we have reported only results with $P_{crit} = 0.001$, i.e., the full genetic dataset. Using either spawn-year or brood year, estimates of NOR adult N_b were higher and varied more than those of HOR adults (Figures 9, 10), concordant with the PCA analysis. Estimates for HOR adults ranged from 17 to 174 (by spawn year, mean = 65) or from 6 to 130 (by brood year, mean = 39). Estimates for NOR adults ranged from 36 to 982 (by spawn year, mean = 405) or from 59 to 2966 (by brood year, mean = 645). Many N_b estimates for NOR adults had confidence intervals extending to infinity on the upper bound. This reflected the difficulty in obtaining precise estimates of N_b for large populations (Waples and Do 2010).

Estimates of N_b for HOR steelhead dropped by approximately half from 1994, when broodstock were still collected at Wells Hatchery, to 1998, when the program used Wenatchee River trapped adults only, suggesting an effect of changing broodstock collection practices, which began in 1997 (Figures 8, 9). Since 1997, the hatchery population N_b remained at a relatively stable lower level (Figures 8, 9, and 10). There was no obvious change in N_b for NOR steelhead since 1993; the N_b estimate for 1993 was the largest, however the confidence interval overlapped estimates from many other years. The temporal trend in N_b estimates from combined collections mirrored those of the HOR collections alone, though estimates using combined collections were slightly larger (Figure 11).

As with N_b estimates, estimates of the ratio of N_b/N for NOR adults varied more than those of HOR adults (Figures 12, 13). However, using spawn year, i.e., mixtures of cohorts, the average N_b/N ratio for HOR adults was equal to that of NOR adults (mean $N_b/N = 0.26$), whereas when using brood year, the average N_b/N ratio for NOR adults was double that of HOR adults (NOR average =0.40, HOR average = 0.20). This is likely a consequence of the homogenizing effect of mixed cohorts. Estimates of N_b for HOR adults using spawn year were close to those estimated using brood year because of the lower diversity in age at maturation, whereas for NOR, grouping by brood year produces different estimates than when grouping by spawn year because of higher diversity in age at maturation. Regardless of which estimate was used, there was no temporal trend in N_b/N for either NOR or HOR adults.

Summary

On average, HOR adults had higher minor allele frequencies (MAF) than NOR adults, and both had similar MAF as juveniles collected in spawning tributaries and in the Entiat River. There was no temporal trend in allele frequencies or observed heterozygosity in adult or juvenile collections and allele frequencies in control populations were no different than those still receiving hatchery outplants suggesting that the hatchery program has had little effect on allele frequencies since 1998.

HOR adults were genetically quite different from NOR adults and juveniles based on pair-wise F_{ST} and principal components analysis (PCA), most likely because of the much smaller effective population size (N_b) in the hatchery population. Pair-wise F_{ST} estimates and genetic distances between HOR and NOR adults collected the same year declined over time suggesting that the interbreeding of HOR and NOR adults in the hatchery (and presumably in the wild) is slowly homogenizing Wenatchee River summer steelhead. Analyses using brood year (the year fish were hatched, determined using scale-based age estimates) were inconclusive because of limitations of the data.

On average, estimates of N_b were much lower and varied less for HOR adults than for NOR adults and juveniles. Estimates of N_b for HOR adults declined from the earliest brood years to a stable new low value after broodstock practices were changed in 1997. There was no indication that this had any effect on N_b in NOR adults and juveniles; N_b estimates for NOR adults and juveniles were, on average, higher and varied considerably over the time period covered by our dataset (1998 – 2010) and showed no temporal trend. Small N_b sizes increase the risk of loss of genetic diversity due to inbreeding and random effects (genetic drift). The N_b of the hatchery component of the population may be increased by spawning more families, using specific mating designs, and minimizing variance in reproductive success. However, given the apparent lack of effects overall, changes to the hatchery protocol may not be necessary.

Overall, hatchery practices appear to have had little effect on natural origin Wenatchee summer steelhead neutral genetic diversity or N_b. We cannot accurately assess their effects on population structure at this time. However, it is interesting to note that when juvenile collections are analyzed separately from adult collections, Peshastin Creek, which has received fewer hatchery outplants in the past and is currently a refuge from hatchery outplants, is genetically different than other tributaries and the Entiat River (data not shown). On the other hand, the Entiat River, which is also a refuge from hatchery outplants and is not a tributary of the Wenatchee River, is genetically very similar to Nason Creek and the Chiwawa River, both Wenatchee River tributaries. This suggests, though it does not conclude, that within basin population structure may have existed before summer steelhead hatchery production began in the upper Columbia River and that the population structure was eliminated by hatchery influence long before 1998.

Acknowledgements

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Figures

Figure 1. Observed average minor allele frequencies (MAF) and observed heterozygosities (Ho) of 119 SNP loci from 11 annual collections of hatchery-produced (HOR) and natural origin (NOR) adult steelhead from the Wenatchee River. Trend lines are from a logistic regression. Note the X axis does not cross the Y axis at the origin. Neither the slopes nor the intercepts were statistically significant.

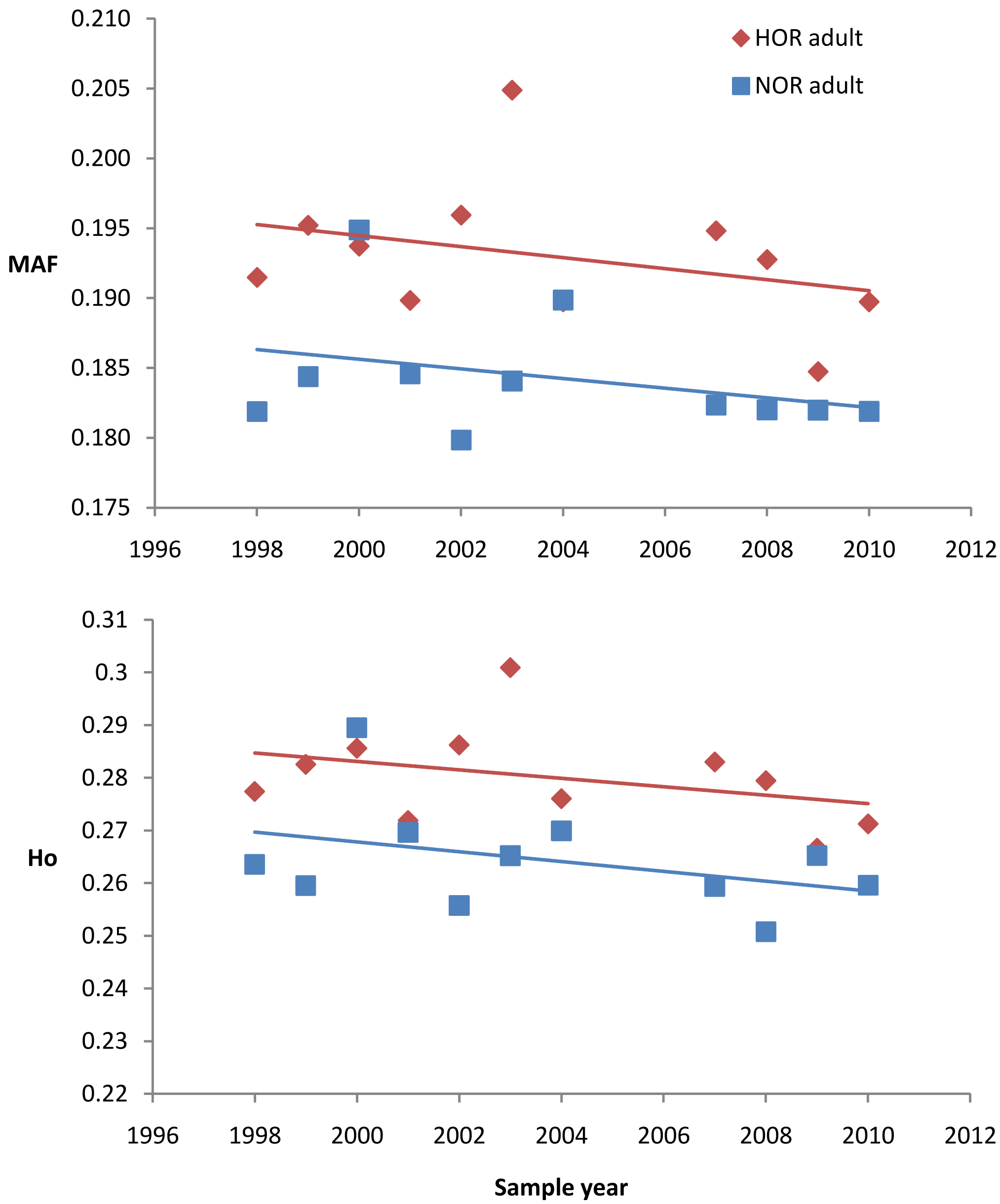


Figure 2. Observed average minor allele frequencies (MAF) and observed heterozygosities (Ho) of 119 SNP loci from 15 collections of natural origin juvenile steelhead from Wenatchee River tributaries, the lower Wenatchee River and the Entiat River. There were no consistent temporal trends in MAF or Ho in these collections.

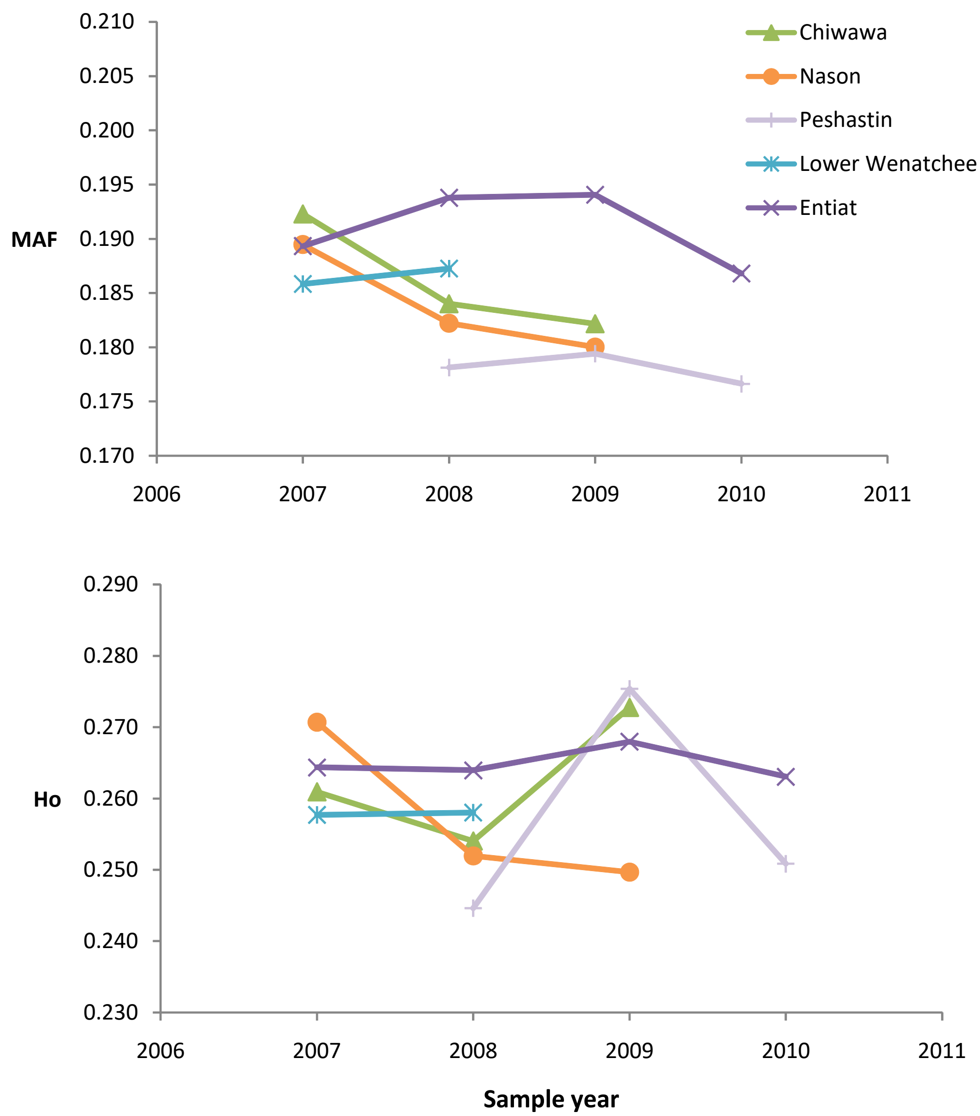


Figure 3. The relationship of time with pairwise F_{ST} estimates between hatchery-produced (adipose fin clipped) and natural origin (unclipped) adults of the same sample year. The line is the prediction based on beta regression.

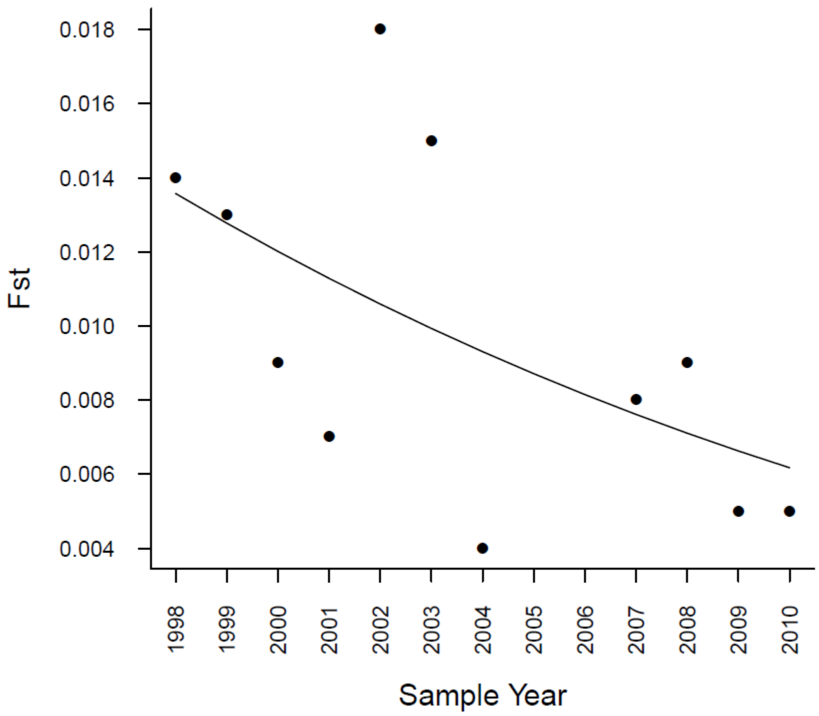


Figure 4. Principal component (PC) 1 versus 2 (top left), PC 1 versus 3 (bottom left), and PC 2 versus 3 (bottom right) based on an analysis using all adults aggregated into origin and spawn-year collections. Natural-origin spawn-years are shown in italicized typeface. The percentage within the label of each axis convey the percent of total genetic variance that is accounted for by that axis. Taken together, the three principal components account for 44% of the total SNP variation. Top right shows pairwise Euclidian distances versus spawn-year, with zero distance equal to average distance across all pairwise distances. Blue line is least-squares fit with $R^2 = 0.45$.

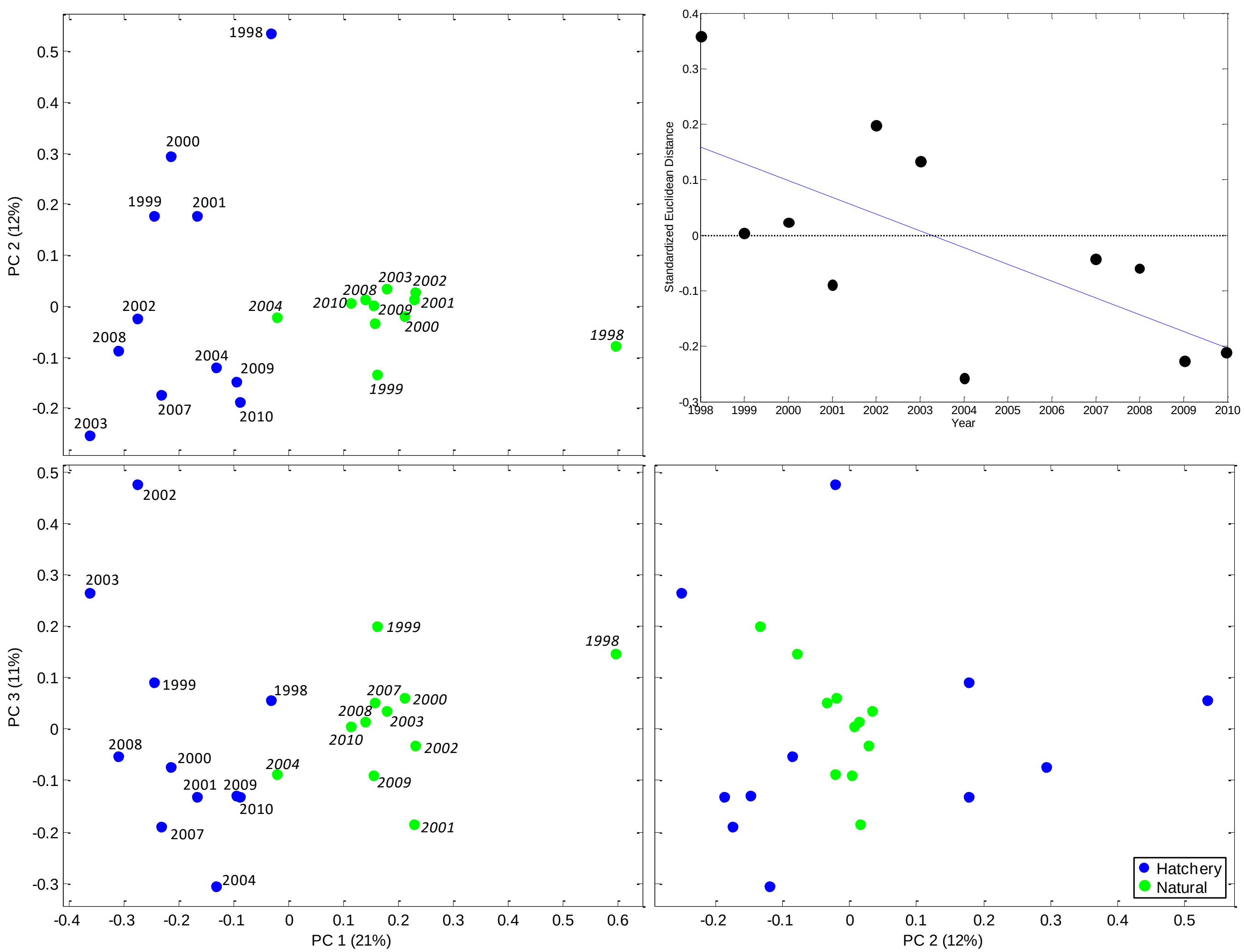


Figure 5. Principal components (PC) 1 versus 2 (top) and 3 (bottom) for adults aggregated into brood-year (BY; left) and spawn-year (SY; right). Spawn-year analysis is the same as in Figure x1, except fewer individuals per collection were included (see methods). Note that for the SY analysis here PC 2 and 3 are similar to PC 3 and 2, respectively, in Figure x1. Only BY1995 (earliest year with paired hatchery-natural data), BY2000 (extreme PC 1 score), and BY2006 (latest year with paired hatchery-natural data) are labeled. Hatchery- and natural-origin individuals from BY1995, BY2000, and BY2006, returned to spawn (spawn-year) in 1999 (hatchery)/1999-2001 (natural), 2003-2004 (hatchery)/2004 and 2007 (natural), and 2009-2010 (hatchery)/2010 (natural), respectively. These years are labeled in the upper right figure. Only 4 year-old BY 2006 natural-origin fish are represented in the SY 2010 collection.

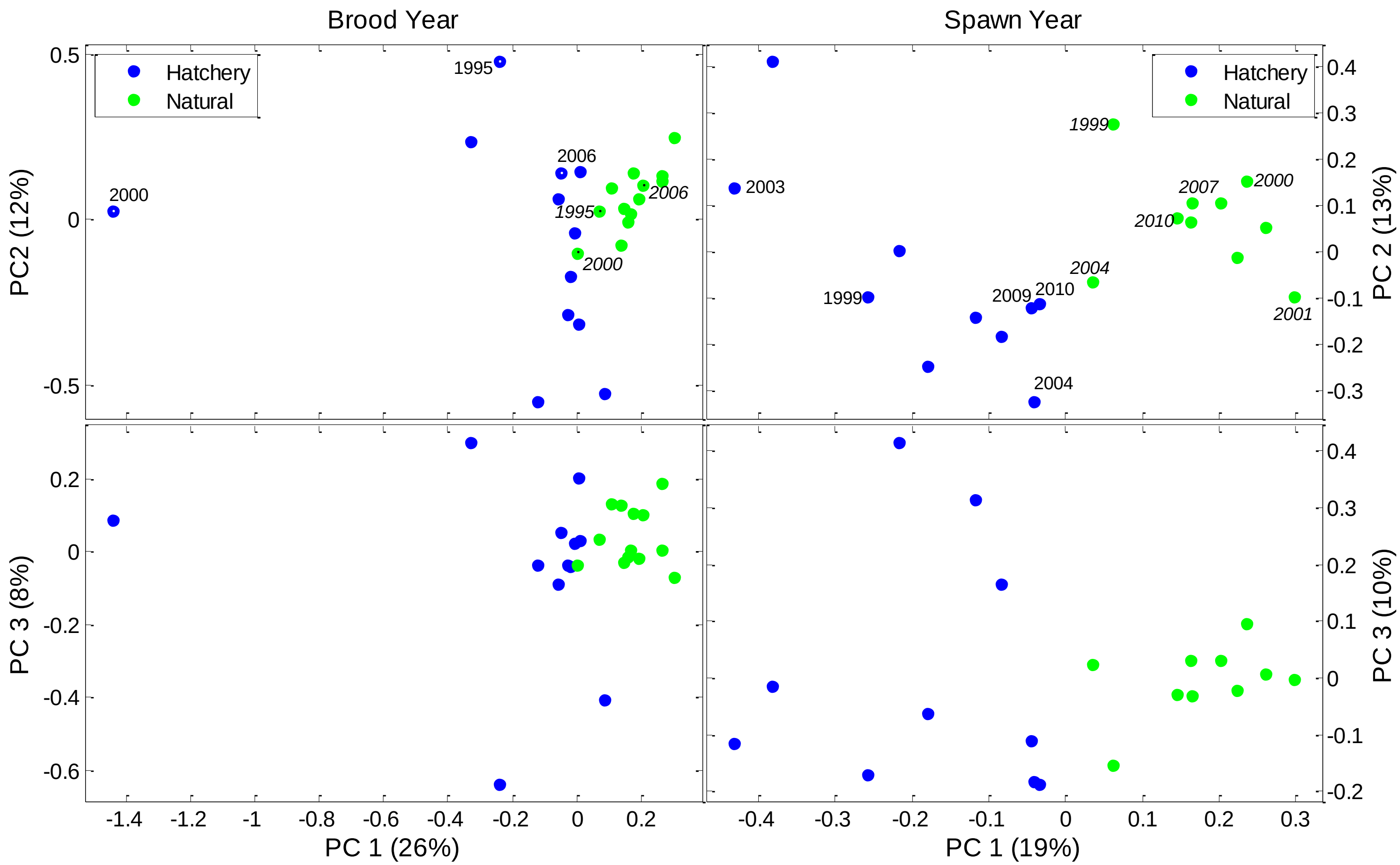


Figure 6. Principal component (PC) 1 versus 2 (top) and PC 1 versus 3 (bottom) based on an analysis using all adult and juvenile fish aggregated into age (juvenile versus adult), origin (hatchery versus adult) and spawn-year collections.

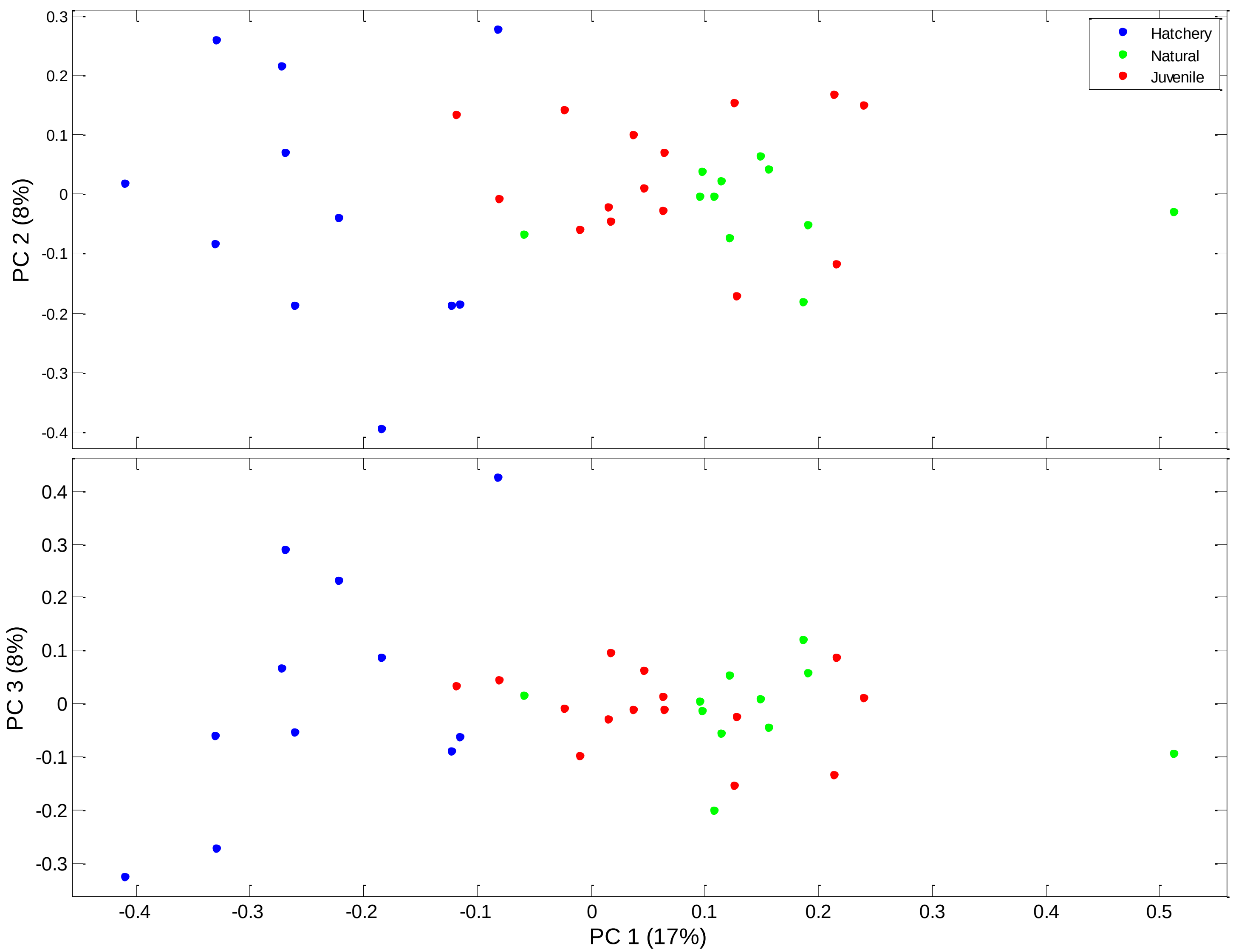


Figure 7. Pairwise Euclidian distances versus brood-year (top) and spawn-year (bottom), with zero distance equal to average distance across all pairwise distances. Blue lines are least-squares fits, which is not significant (slope = 0) for brood-year, but significant (slope > 0) for spawn-year.

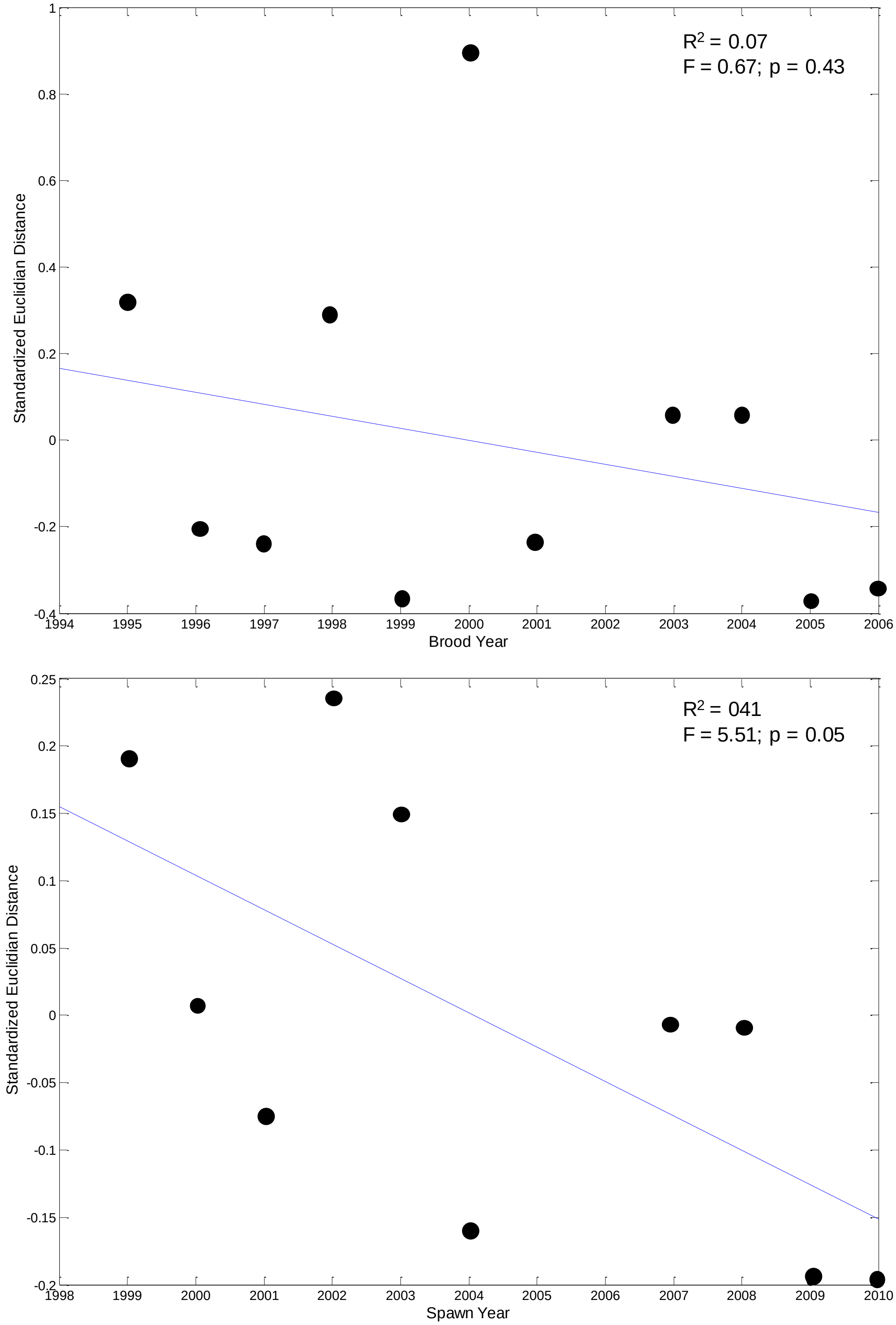


Figure 8. Effective population size estimates (N_b) from Wenatchee River adult hatchery-produced steelhead annual collections calculated using single sample methods implemented in the program LDNE (Waples and Do 2008). Each line connects annual estimates of N_b estimated with a different value of P_{crit}, the smallest allelic proportion allowed during analysis. With SNP data, omitting an allele omits the locus. Estimates of N_b changed very little when P_{crit} varied from 0.1 to 0.001. Setting P_{crit} = 0.001 forced the use of all available loci.

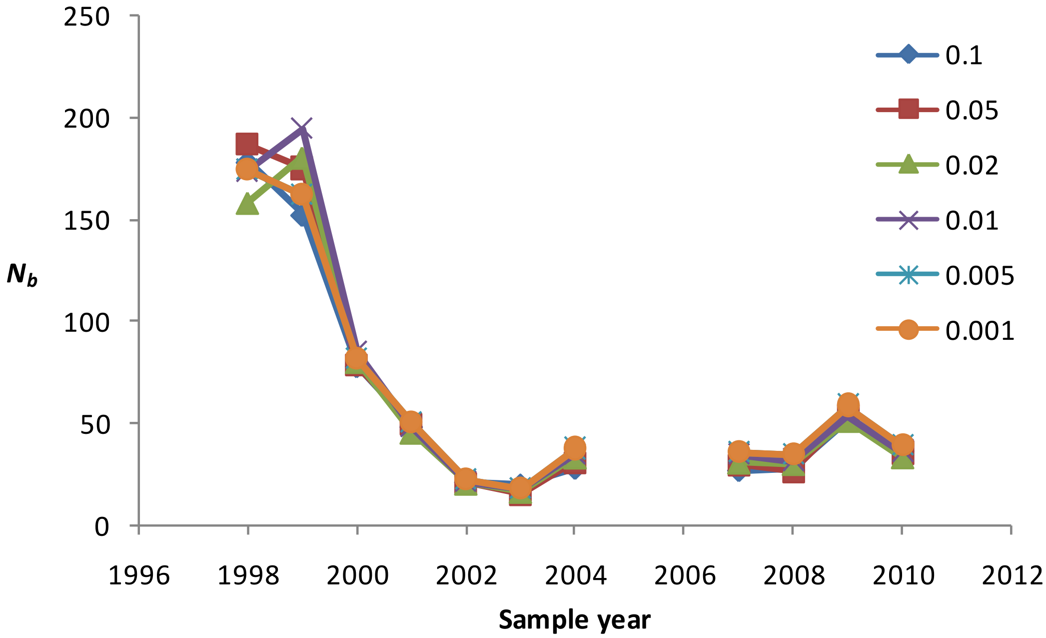


Figure 9. Estimates of Wenatchee River steelhead effective number of breeders (N_b) estimated using the single sample methods incorporated in the program LDNE (Waples and Do 2008). Estimates of N_b refer to parental (and even grantparental) generations. N_b data were plotted against their estimated parental brood year. We assumed a 5 year generation time for natural origin adults (NOR), a 4 year generation time for hatchery-produced adults (HOR) and an age of smolt outmigration of age 2 for smolt collections from Wenatchee River tributaries (Chiwawa River, Nason Creek, Peshastin Creek), the lower Wenatchee River, and the Entiat River. Bars represent the 95% confidence interval estimated by jackknife procedure. Bars that exceed the upper limit of the Y axis are labeled with the upper bound (Inf. = infinity).

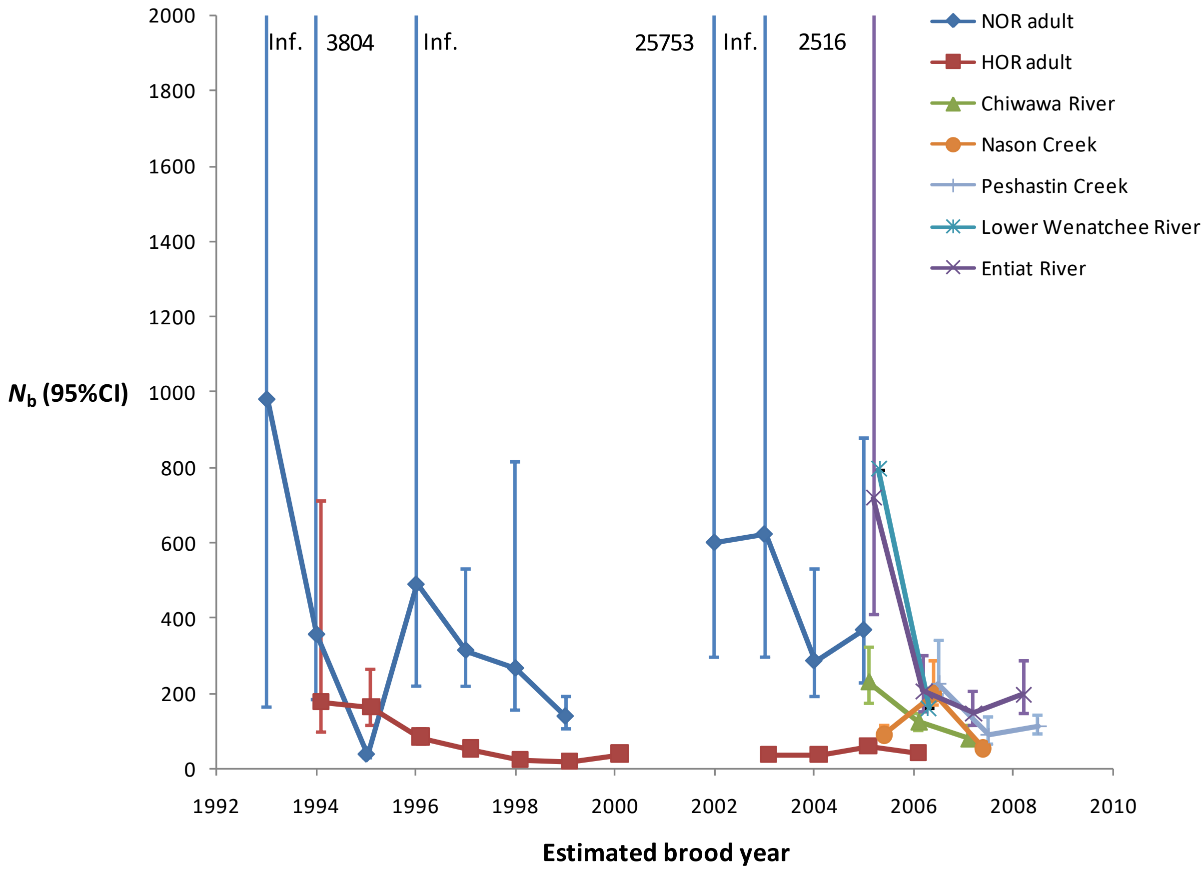


Figure 10. Estimates of N_b for collections of hatchery-produced (HOR) and natural origin (NOR) Wenatchee River summer steelhead grouped by brood year rather than spawn year. Brood year was estimated using scale-based age data. Error bars that extend past the top of the chart are all bounded by infinity.

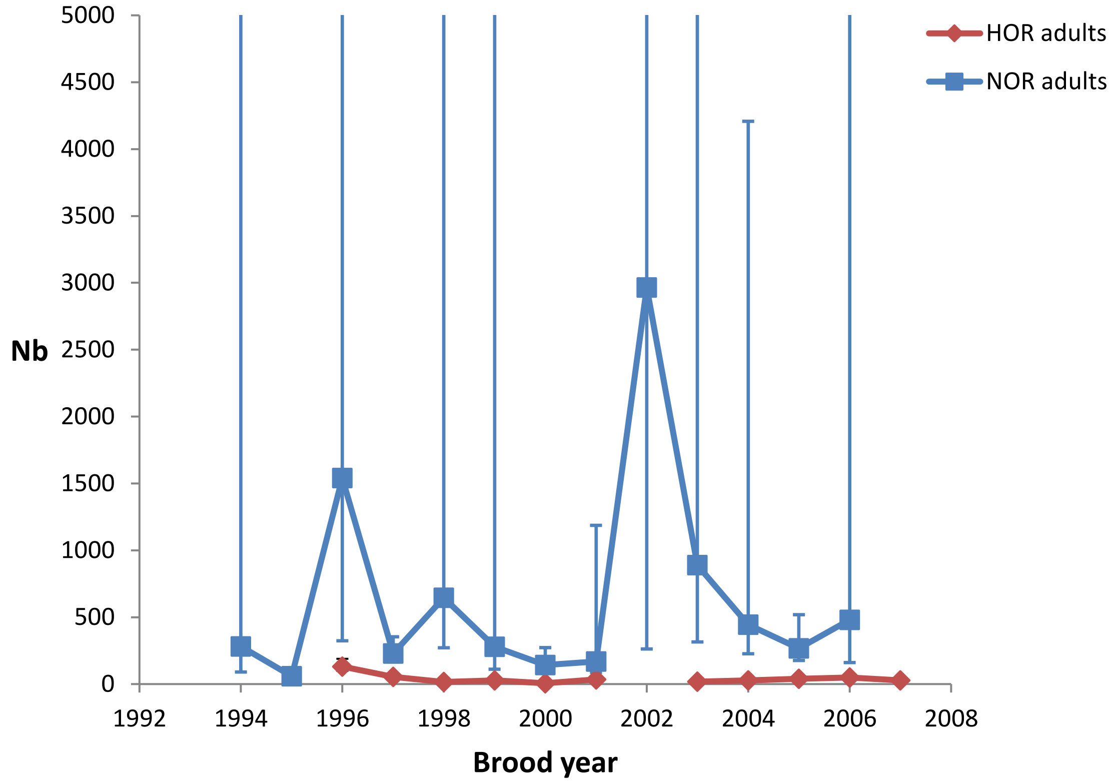


Figure 11. Estimates of N_b for combined annual adult hatchery-produced (HOR) and natural origin (NOR) steelhead and for HOR adults alone. The temporal patterns are similar, though estimates from combined collections are larger than those from HOR collections alone.

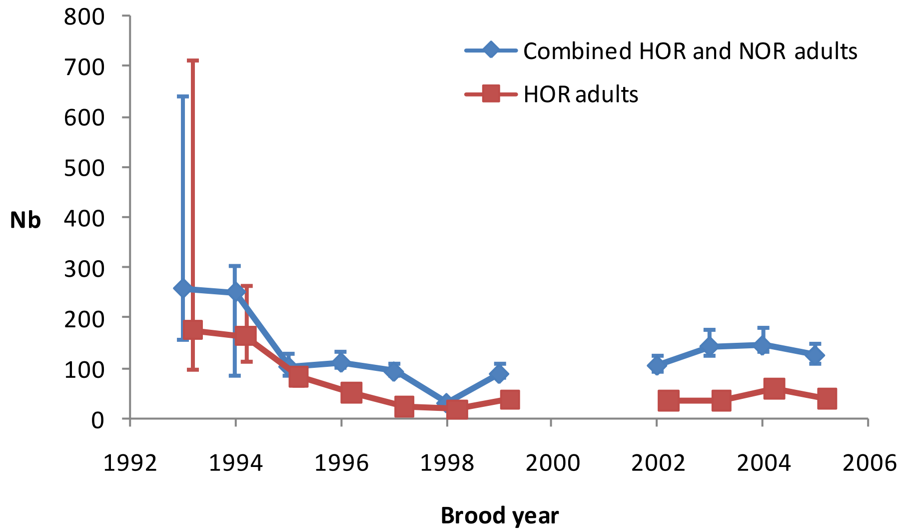


Figure 12. N_b/N ratios for hatchery-produced (HOR) and natural origin (NOR) adult Wenatchee River summer steelhead grouped by spawn year. The average N_b/N ratios are not different, though in later years NOR adults appear to have lower N_b/N ratios.

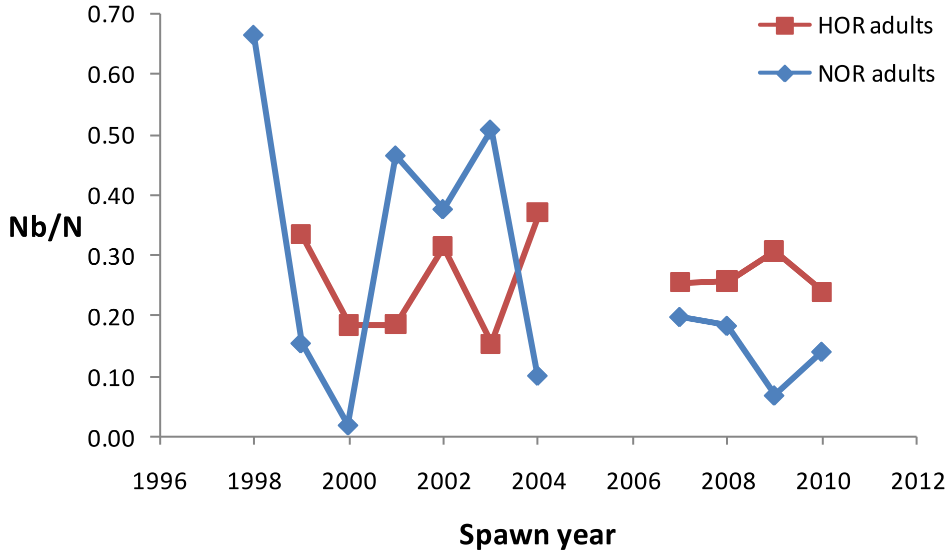
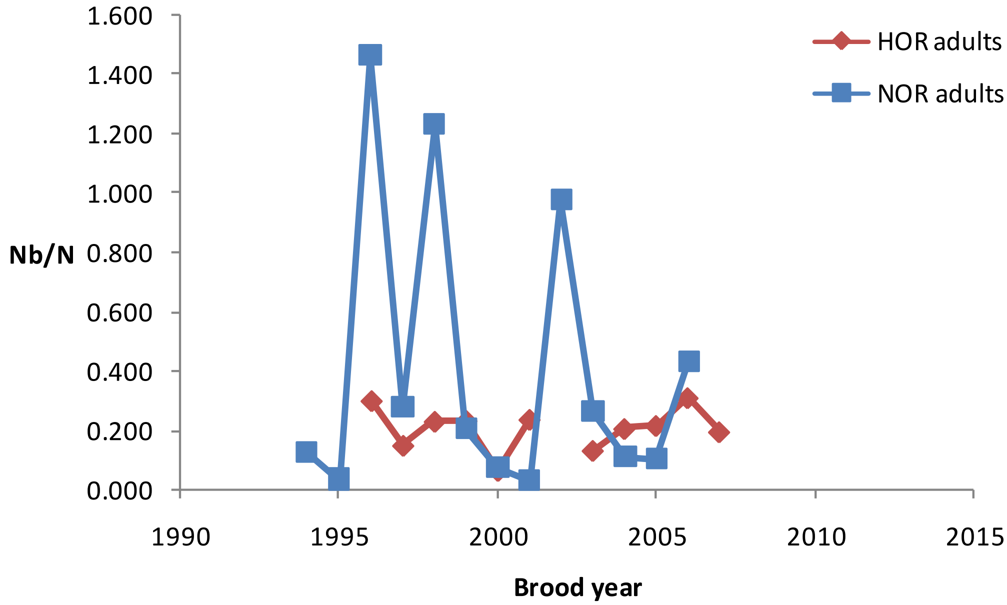


Figure 13. N_b/N ratios for hatchery-produced (HOR) and natural origin (NOR) adult Wenatchee River summer steelhead collections with individuals grouped in brood years rather than spawn years. Individual brood year was estimated using scale-based age data.



Tables

Table 1. Samples of adult steelhead collected for Wenatchee Program broodstock and used for genetic monitoring and evaluation.

Origin	Sampling Location	Year spawned	WDFW Collection code	Samples (N)	Unused Samples[a]
Hatchery	Dryden/Tumwater Dams	1998	98AE	32	4
		1999	98LJ	62	2
		2000	99NE	60	5
		2001	00DQ	99	1
		2002	01MS	64	
		2003	02NP	89	
		2004	03KW	61	
		2007	06CW	64	1
		2008	08AG	56	
		2009	09AV	74	
		2010	10FE	76	1
			Total	737	14
Natural	Dryden/Tumwater Dams	1998	98AF	30	5
		1999	99AA	51	1
		2000	99ND	33	3
		2001	00DP	50	
		2002	01MR	95	
		2003	02NO	50	
		2004	03KV	71	3
		2007	06CX	74	
		2008	08AF	74	1
		2009	09AU	82	2
		2010	10FD	90	2
			Total	700	17

[a]Samples were not used if they had incomplete (≤ 80% or 95 of 119 loci) or duplicate genotypes.

Table 2. Samples of natural origin juvenile steelhead and rainbow trout collected from four Wenatchee basin rivers or creeks and the Entiat River.

Sampling Location	Collection Year	WDFW Collection Code	Samples (N)	Unused samples[a]
Chiwawa River	2007	07AO	127	5
	2008	08CG	143	1
	2009	09NF	35	2
Entiat River	2007	07AL	134	4
	2008	08CI	82	4
	2009	09NC	74	1
	2010	10OX	82	1
Lower Wenatchee River	2007	07AM	139	5
	2008	08CE	98	2
Nason Creek	2007	07AN	81	4
	2008	08CF	133	6
	2009	09NG	103	2
Peshastin Creek	2008	08CH	142	2
	2009	09NE	34	1
	2010	10OY	94	1
		Total	1501	41

[a]Samples were not used if they were genetically identified as cutthroat trout or cutthroat/rainbow trout hybrids, or if they had incomplete (≤ 80% or 95 of 119 loci) or duplicate genotypes.

Table 3. List of 132 general use, diploid single nucleotide polymorphic (SNP) loci genotyped in Wenatchee River basin and Entiat River steelhead.

WDFW Name	Locus Name	Allele 1	Allele 2	Reference
AOmy005	Omy_aspAT-123	T	C	(Campbell et al. 2009)
AOmy014	Omy_e1-147	G	T	(Sprowles et al. 2006)
AOmy015	Omy_gdh-271	C	T	(Campbell et al. 2009)
AOmy016	Omy_GH1P1_2	C	T	(Aguilar and Garza 2008)
AOmy021	Omy_LDHB-2_e5	T	C	(Aguilar and Garza 2008)
AOmy023	Omy_MYC_2	T	C	(Aguilar and Garza 2008)
AOmy027	Omy_nkef-241	C	A	(Campbell et al. 2009)
AOmy028	Omy_nramp-146	G	A	(Campbell et al. 2009)
AOmy047	Omy_u07-79-166	G	T	WDFW - S. Young unpubl.
AOmy051	Omy_121713-115	T	A	(Abadía-Cardoso et al. 2011)
AOmy056	Omy_128693-455	T	C	(Abadía-Cardoso et al. 2011)
AOmy059	Omy_187760-385	A	T	(Abadía-Cardoso et al. 2011)
AOmy061	Omy_96222-125	T	C	(Abadía-Cardoso et al. 2011)
AOmy062	Omy_97077-73	T	A	(Abadía-Cardoso et al. 2011)
AOmy063	Omy_97660-230	C	G	(Abadía-Cardoso et al. 2011)
AOmy065	Omy_97954-618	C	T	(Abadía-Cardoso et al. 2011)
AOmy067	Omy_aromat-280	A	T	WSU - J. DeKoning unpubl.
AOmy068	Omy_arp-630	G	A	(Campbell et al. 2009)
AOmy071	Omy_cd59-206	C	T	WSU - J. DeKoning unpubl.
AOmy073	Omy_colla1-525	C	T	WSU - J. DeKoning unpubl.
AOmy079	Omy_g12-82	T	C	WSU - J. DeKoning unpubl.
AOmy081	Omy_gh-475	C	T	(Campbell et al. 2009)
AOmy082	Omy_gsdf-291	T	C	WSU - J. DeKoning unpubl.
AOmy089	Omy_hsp90BA-193	C	T	(Campbell and Narum 2009)
AOmy094	Omy_inos-97	C	A	WSU - J. DeKoning unpubl.
AOmy095	Omy_mapK3-103	A	T	CRITFC - N. Campbell unpubl.
AOmy096	Omy_mcsf-268	T	C	WSU - J. DeKoning unpubl.
AOmy100	Omy_nach-200	A	T	WSU - J. DeKoning unpubl.

AOmy107	Omy_Ots249-227	C	T	(Campbell et al. 2009)
AOmy108	Omy_oxct-85	A	T	WSU - J. DeKoning unpubl.
AOmy110	Omy_star-206	A	G	WSU - J. DeKoning unpubl.
AOmy111	Omy_stat3-273	G	Deletion	WSU - J. DeKoning unpubl.
AOmy113	Omy_tlr3-377	C	T	WSU - J. DeKoning unpubl.
AOmy117	Omy_u09-52-284	T	G	WDFW - S. Young unpubl.
AOmy118	Omy_u09-53-469	T	C	WDFW - S. Young unpubl.
AOmy120	Omy_u09-54.311	C	T	WDFW - S. Young unpubl.
AOmy123	Omy_u09-55-233	A	G	WDFW - S. Young unpubl.
AOmy125	Omy_u09-56-119	T	C	WDFW - S. Young unpubl.
AOmy129	Omy_BAMBI4.238	T	C	WDFW - S. Young unpubl.
AOmy132	Omy_G3PD_2.246	C	T	WDFW - S. Young unpubl.
AOmy134	Omy_Il-1b-028	T	C	WDFW - S. Young unpubl.
AOmy137	Omy_u09-61.043	A	T	WDFW - S. Young unpubl.
AOmy151	Omy_p53-262	T	A	CRITFC - N. Campbell unpubl.
AOmy173	BH2VHSVip10	C	T	Pascal & Hansen unpubl.
AOmy174	OMS00003	T	G	(Sánchez et al. 2009)
AOmy176	OMS00013	A	G	(Sánchez et al. 2009)
AOmy177	OMS00018	T	G	(Sánchez et al. 2009)
AOmy179	OMS00041	G	C	(Sánchez et al. 2009)
AOmy181	OMS00052	T	G	(Sánchez et al. 2009)
AOmy182	OMS00053	T	C	(Sánchez et al. 2009)
AOmy183	OMS00056	T	C	(Sánchez et al. 2009)
AOmy184	OMS00057	T	G	(Sánchez et al. 2009)
AOmy185	OMS00061	T	C	(Sánchez et al. 2009)
AOmy186	OMS00062	T	C	(Sánchez et al. 2009)
AOmy187	OMS00064	T	G	(Sánchez et al. 2009)
AOmy189	OMS00071	A	G	(Sánchez et al. 2009)
AOmy190	OMS00072	A	G	(Sánchez et al. 2009)
AOmy191	OMS00078	T	C	(Sánchez et al. 2009)
AOmy192	OMS00087	A	G	(Sánchez et al. 2009)

AOmy193	OMS00089	A	G	(Sánchez et al. 2009)
AOmy194	OMS00090	T	C	(Sánchez et al. 2009)
AOmy195	OMS00092	A	C	(Sánchez et al. 2009)
AOmy196	OMS00094	T	G	(Sánchez et al. 2009)
AOmy197	OMS00103	A	T	(Sánchez et al. 2009)
AOmy198	OMS00105	T	G	(Sánchez et al. 2009)
AOmy199	OMS00112	A	T	(Sánchez et al. 2009)
AOmy200	OMS00116	T	A	(Sánchez et al. 2009)
AOmy201	OMS00118	T	G	(Sánchez et al. 2009)
AOmy202	OMS00119	A	T	(Sánchez et al. 2009)
AOmy203	OMS00120	A	G	(Sánchez et al. 2009)
AOmy204	OMS00121	T	C	(Sánchez et al. 2009)
AOmy205	OMS00127	T	G	(Sánchez et al. 2009)
AOmy206	OMS00128	T	G	(Sánchez et al. 2009)
AOmy207	OMS00132	A	T	(Sánchez et al. 2009)
AOmy208	OMS00133	A	G	(Sánchez et al. 2009)
AOmy209	OMS00134	A	G	(Sánchez et al. 2009)
AOmy210	OMS00153	T	G	(Sánchez et al. 2009)
AOmy211	OMS00154	A	T	(Sánchez et al. 2009)
AOmy212	OMS00156	A	T	(Sánchez et al. 2009)
AOmy213	OMS00164	T	G	(Sánchez et al. 2009)
AOmy215	OMS00175	T	C	(Sánchez et al. 2009)
AOmy216	OMS00176	T	G	(Sánchez et al. 2009)
AOmy218	OMS00180	T	G	(Sánchez et al. 2009)
AOmy220	Omy_1004	A	T	(Hansen et al. 2011)
AOmy221	Omy_101554-306	T	C	(Abadía-Cardoso et al. 2011)
AOmy222	Omy_101832-195	A	C	(Abadía-Cardoso et al. 2011)
AOmy223	Omy_101993-189	A	T	(Abadía-Cardoso et al. 2011)
AOmy225	Omy_102505-102	A	G	(Abadía-Cardoso et al. 2011)
AOmy226	Omy_102867-443	T	G	(Abadía-Cardoso et al. 2011)
AOmy227	Omy_103705-558	T	C	(Abadía-Cardoso et al. 2011)

AOmy228	Omy_104519-624	T	C	(Abadía-Cardoso et al. 2011)
AOmy229	Omy_104569-114	A	C	(Abadía-Cardoso et al. 2011)
AOmy230	Omy_105075-162	T	G	(Abadía-Cardoso et al. 2011)
AOmy231	Omy_105385-406	T	C	(Abadía-Cardoso et al. 2011)
AOmy232	Omy_105714-265	C	T	(Abadía-Cardoso et al. 2011)
AOmy233	Omy_107031-704	C	T	(Abadía-Cardoso et al. 2011)
AOmy234	Omy_107285-69	C	G	(Abadía-Cardoso et al. 2011)
AOmy235	Omy_107336-170	C	G	(Abadía-Cardoso et al. 2011)
AOmy238	Omy_108007-193	A	G	(Abadía-Cardoso et al. 2011)
AOmy239	Omy_109243-222	A	C	(Abadía-Cardoso et al. 2011)
AOmy240	Omy_109525-403	A	G	(Abadía-Cardoso et al. 2011)
AOmy241	Omy_110064-419	T	G	(Abadía-Cardoso et al. 2011)
AOmy242	Omy_110078-294	A	G	(Abadía-Cardoso et al. 2011)
AOmy243	Omy_110362-585	G	A	(Abadía-Cardoso et al. 2011)
AOmy244	Omy_110689-148	A	C	(Abadía-Cardoso et al. 2011)
AOmy245	Omy_111005-159	C	T	(Abadía-Cardoso et al. 2011)
AOmy246	Omy_111084-526	A	C	(Abadía-Cardoso et al. 2011)
AOmy247	Omy_111383-51	C	T	(Abadía-Cardoso et al. 2011)
AOmy248	Omy_111666-301	T	A	(Abadía-Cardoso et al. 2011)
AOmy249	Omy_112301-202	T	G	(Abadía-Cardoso et al. 2011)
AOmy250	Omy_112820-82	G	A	(Abadía-Cardoso et al. 2011)
AOmy252	Omy_114976-223	T	G	(Abadía-Cardoso et al. 2011)
AOmy253	Omy_116733-349	C	T	(Abadía-Cardoso et al. 2011)
AOmy254	Omy_116938-264	A	G	(Abadía-Cardoso et al. 2011)
AOmy255	Omy_117259-96	T	C	(Abadía-Cardoso et al. 2011)
AOmy256	Omy_117286-374	A	T	(Abadía-Cardoso et al. 2011)
AOmy257	Omy_117370-400	A	G	(Abadía-Cardoso et al. 2011)
AOmy258	Omy_117540-259	T	G	(Abadía-Cardoso et al. 2011)
AOmy260	Omy_117815-81	C	T	(Abadía-Cardoso et al. 2011)
AOmy261	Omy_118175-396	T	A	(Abadía-Cardoso et al. 2011)
AOmy262	Omy_118205-116	A	G	(Abadía-Cardoso et al. 2011)

AOmy263	Omy_118654-91	A	G	(Abadía-Cardoso et al. 2011)
AOmy265	Omy_120255-332	A	T	(Abadía-Cardoso et al. 2011)
AOmy266	Omy_128996-481	T	G	(Abadía-Cardoso et al. 2011)
AOmy267	Omy_129870-756	C	T	(Abadía-Cardoso et al. 2011)
AOmy268	Omy_131460-646	C	T	(Abadía-Cardoso et al. 2011)
AOmy269	Omy_98683-165	A	C	(Abadía-Cardoso et al. 2011)
AOmy270	Omy_cyp17-153	C	T	WSU - J. DeKoning unpubl.
AOmy271	Omy_ftzf1-217	A	T	WSU - J. DeKoning unpubl.
AOmy272	Omy_GHSR-121	T	C	CRITFC - N. Campbell unpubl.
AOmy273	Omy_metA-161	T	G	CRITFC - N. Campbell unpubl.
AOmy274	Omy_UBA3b	A	T	(Hansen et al. 2011)

Primer and probe sequences for unpublished loci available by request.

Table 4. List of 20 species identification single nucleotide polymorphic (SNP) loci genotyped in Wenatchee River basin and Entiat River steelhead.

		Expected genotype			
WDFW Name	Locus Name	*O. mykiss*	*O. clarkii clarkii*	*O. clarkii lewisi*	Reference
ASpI001	Ocl_Okerca	T	C	C	(McGlauflin et al. 2010)
ASpI002	Ocl_Oku202	A	C	C	(McGlauflin et al. 2010)
ASpI003	Ocl_Oku211	G	T	T	(McGlauflin et al. 2010)
ASpI004	Ocl_Oku216	C	C	A	(McGlauflin et al. 2010)
ASpI005	Ocl_Oku217	C	C	A	(McGlauflin et al. 2010)
ASpI006	Ocl_SsaHM5	A	A	G	(McGlauflin et al. 2010)
ASpI007	Ocl_u800	T	C	C	(McGlauflin et al. 2010)
ASpI008	Ocl_u801	A	T	T	(McGlauflin et al. 2010)
ASpI009	Ocl_u802	C	C	T	(McGlauflin et al. 2010)
ASpI010	Ocl_u803	C	T	T	(McGlauflin et al. 2010)
ASpI011	Ocl_u804	G	G	C	(McGlauflin et al. 2010)
ASpI012	Omy_B9_228	A	A	C	(Finger et al. 2009)
ASpI013	Omy_CTDL1_243	C	A	A	(Finger et al. 2009)
ASpI014	Omy_F5_136	C	G	G	(Finger et al. 2009)
ASpI016	Omy_myclarp404-111	T	G	G	CRITFC - S. Narum - unpubl.
ASpI017	Omy_myclgh1043-156	C	T	T	CRITFC - S. Narum - unpubl.
ASpI018	Omy_Omyclmk436-96	A	C	C	CRITFC - S. Narum - unpubl.
ASpI019	Omy_RAG11_280	T	A	A	(Sprowles et al. 2006)
ASpI020	Omy_URO_302	T	C	C	(Finger et al. 2009)
ASpI021	Omy_BAC-F5.238	C	G	G	WDFW - S. Young unpubl.

Primer and probe sequences for unpublished loci available by request.

Table 5. Pairwise F_{ST} estimates for collections from Wenatchee River tributaries and the Entiat River (below diagonal) and associated bootstrap estimated *P*-values (above diagonal).

		Chiwawa River			Nason Creek			Peshastin Creek			Lower Wenatchee River		Entiat River			
Population	Year	2007	2008	2009	2007	2008	2009	2008	2009	2010	2007	2008	2007	2008	2009	2010
Chiwawa	2007		**0.000**	**0.003**	**0.000**	**0.000**	**0.000**	**0.000**	**0.002**	**0.000**	**0.001**	**0.001**	**0.000**	**0.001**	**0.000**	**0.000**
River	2008	0.004		**0.004**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
	2009	0.004	0.003		**0.000**	**0.001**	0.061	**0.000**	**0.001**	**0.000**	0.086	**0.050**	**0.022**	0.108	**0.005**	**0.045**
Nason	2007	0.011	0.010	0.007		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Creek	2008	0.007	0.007	0.005	0.009		**0.003**	**0.000**	**0.002**	**0.000**	0.079	**0.000**	**0.001**	**0.000**	**0.000**	**0.000**
	2009	0.007	0.007	0.003	0.014	0.006		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Peshastin	2008	0.010	0.011	0.008	0.013	0.010	0.013		**0.001**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Creek	2009	0.005	0.005	0.006	0.010	0.007	0.008	0.003		**0.002**	**0.002**	**0.047**	**0.028**	**0.004**	**0.005**	**0.001**
	2010	0.010	0.011	0.008	0.015	0.008	0.011	0.003	0.003		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Lower Wenatchee	2007	0.003	0.003	0.000	0.005	0.008	0.007	0.009	0.010	0.008		0.112	**0.020**	**0.012**	**0.002**	**0.017**
River	2008	0.002	0.005	0.002	0.003	0.004	0.005	0.007	0.009	0.006	0.000		**0.049**	0.459	**0.047**	**0.002**
Entiat	2007	0.005	0.006	0.002	0.005	0.006	0.005	0.005	0.007	0.006	0.001	0.002		0.451	0.173	**0.000**
River	2008	0.004	0.004	0.000	0.007	0.005	0.007	0.008	0.009	0.011	0.002	0.001	0.000		0.644	**0.002**
	2009	0.005	0.006	0.002	0.003	-0.001	0.003	0.002	0.003	0.004	0.003	0.002	0.002	0.000		**0.028**
	2010	0.005	0.006	0.003	0.006	0.004	0.006	0.006	0.008	0.009	0.002	0.003	0.003	0.003	0.002	

P-values in bold were significant at $\alpha = 0.05$ after correcting for multiple tests using false discovery rate.

Appendix G

NPDES Hatchery Effluent Monitoring, 2019

NPDES COMPLIANCE SUMMARY

WDFW operated facilities requiring discharge reports include Chelan Hatchery, Chelan Falls Hatchery, Eastbank Hatchery, Chiwawa Ponds, Similkameen Hatchery, Dryden Acclimation Pond, and Priest Rapids Hatchery. Not included in the request are facilities that are no longer operated under WDFW including Wells Hatchery, Methow Hatchery, the Twisp/Chewuch acclimation facilities and the Carlton Acclimation Pond.

Below are tables detailing NPDES discharge data for Washington Department of Fish and Wildlife (WDFW) operated facilities in the upper Columbia River. The monitoring period is for 1 January 2019 through 31 December 2019.

There were no violations reported at the NPDES permitted facilities during the period 1 January 2019 through 31 December 2019.

NPDES MONITORING FOR WDFW FACILITIES.

WDFW hatcheries monitor discharge in accordance with the National Pollutant Discharge Elimination System (NPDES) Upland Fin Fish Hatching and Rearing General Permit. The permit is administered by the Washington Department of Ecology under jurisdiction of the United States Environmental Protection Agency. The current permit was issued on 1 April 2016 and expires on 31 March 2021.

Facilities are exempted from sampling during any month that pounds of fish on hand fall below 20,000 lbs and pounds of feed used fall below 5,000 lbs, with the exception of offline settling basin discharges, which are monitored once per month when ponds are in use and discharging to receiving waters. Inactive permitted facilities retain a permit but are not required to monitor discharges because pounds of fish and pounds of feed remain below monitoring guidelines set by the permit.

Sampling at facilities covered under the current NPDES General Permit include the following parameters:

FLOW	Measured in millions of gallons per day (MGD) discharge.
SS EFF	Average net settleable solids in the hatchery effluent, measured in ml/L.
TSS COMP	Average net total suspended solids, composite sample (6 x/day) of the hatchery effluent, measured in mg/L.
TSS MAX	Maximum daily net total suspended solids, composite sample (6 x/day) of the hatchery effluent, measured in mg/L.
FLOW PA	Average gallons per day into the pollution abatement (PA) pond.
SS PA	Maximum settleable solids in the PA pond discharge, measured in ml/L.
TSS PA	Maximum total suspended solids in the PA pond discharge, effluent grab measured in mg/L.
SS DD	Settleable solids discharged during drawdown for fish release. One sample per pond drawdown, measured in ml/L.

Eastbank Hatchery										
NPDES Permit Number WAG13-5011										
		FLOW	SS EFF	TSS COMP	TSS MAX	FLOW PA	SS PA	TSS PA	Lbs of Fish	Lbs of Feed
2019	JAN	22.26	0	0.4	0.4	5000	0	32.6	20446	3908.22
	FEB	25.85	0	0.8	0.8	6000	0	42.8	25896	4107.7
	MAR	29.08	0	0	0	11000	0	13.6	31460	5167.85
	APR	21.9	0	0.2	0.2	10000	0	6.6	21123	2299.5
	MAY	19.39	0	1	1	10000	0	11.4	11914.5	4316.27
	JUN	20.68	0	0	0	7000	0.1	18.4	18575.3	5436.96
	JUL	25.01	0	2.4	2.4	8000	0	9.4	20886.3	4944.1
	AUG	28.4	0	4.6	4.8	10000	0	26	22687	5906.2
	SEP	27.01	0	0	0	9000	0.1	25	34521.5	10194.1
	OCT	26.2	0	0	0	7000	0	15.6	45321	9506.5
	NOV	23.11	0	0	0	6000	0	15.2	47116	7077.5
	DEC	18.86	0	1.2	1.2	5000	0	18.6	31865	3022.5

Chiwawa Ponds - Chiwawa River									
NPDES Permit Number WAG13-5015									
		FLOW	SS EFF	TSS COMP	TSS MAX	Lbs of Fish	Lbs of Fee	SS DD	TSS DD
2019	JAN	3.87	0	-0.2	-0.2	8375	354		
	FEB	3.74	0	0.2	0.2	8800	98		
	MAR	3.7	0	0.2	0.2	8500	260		
	APR	3.2	0	0	0	9855	2860	0.03	1.3
	MAY	No Monitoring				0	0		
	JUN	No Monitoring				0	0		
	JUL	No Monitoring				0	0		
	AUG	No Monitoring				0	0		
	SEP	3.7	0	-0.2	-0.2	5975	616		
	OCT	3.6	0	0.2	0.2	5950	1144		
	NOV	3.56	0	0.1	0.2	7555	854		
	DEC	3.38	0	0	0	7561	242		

Chiwawa Ponds - Wenatchee River									
NPDES Permit Number WAG13-5015									
		FLOW	SS EFF	TSS COMP	TSS MAX	Lbs of Fish	Lbs of Fee	SS DD	TSS DD
2019	JAN	6.7	0	0.8	0.8	19333	430		
	FEB	6.67	0	-0.8	-0.8	14876	484		
	MAR	4.37	0	0	0	16330	1470		
	APR	1.8	0	0.4	0.4	19525	2167	0.03	4.2
	MAY	2.3	0	1.8	3	212	67		
	JUN	3.13	0	0	0	243	59		
	JUL	No Monitoring				0	0		
	AUG	No Monitoring				0	0		
	SEP	No Monitoring				0	0		
	OCT	No Monitoring				0	0		
	NOV	7.04	0	0.2	0.2	2400	364		
	DEC	6.97	0	0.2	0.2	11885	956		

Similkameen Hatchery									
NPDES Permit Number WAG13-5007									
		FLOW	SS EFF	TSS COMP	TSS MAX	Lbs of Fish	Lbs of Fee	SS DD	TSS DD
2019	JAN	7.2	0	0.4	0.4	8826	0		
	FEB	7.2	0	0.4	0.4	8976	22		
	MAR	8.35	0.025	-0.6	-0.6	7352	1964		
	APR	8	0.08	1	1	13427	3740	0.3	49
	MAY	No Monitoring				0	0		
	JUN	No Monitoring				0	0		
	JUL	No Monitoring				0	0		
	AUG	No Monitoring				0	0		
	SEP	No Monitoring				0	0		
	OCT	7.37	0	-1	-1	8500	484		
	NOV	7.37	0	1.6	1.6	8428	572		
	DEC	7.2	0	0	0.2	8500	88		

Chelan Hatchery												
NPDES Permit Number WAG13-5006												
		FLOW	SS EFF	TSS COMP	TSS MAX	FLOW PA	SS PA	TSS PA	Lbs of Fish	Lbs of Feed		
2019	JAN	4.48	0	0.4	0.4	68000	0.01	1.4	14694	2613		
	FEB	5.37	0	0.3	0.4	68000	0.01	1.4	19341	7011		
	MAR	6.33	0	0.6	0.6	68000	0	8.2	2428	4295		
	APR	6.6	0	-0.8	-0.8	68000	0	3.2	29545	1766		
	MAY	3.6	0	0	0	68000	0	5.8	4380	1140		
	JUN	5.2	0	0.8	0.8	68000	0	4	4320	839		
	JUL	6.16	0	1.6	1.6	68000	0	1.6	8222	2904.28		
	AUG	5.58	0	0.3	0.6	68000	0.01	6.4	15127	2744.5		
	SEP	8.16	0	0.6	0.6	68000	0.01	6.4	27899	12507		
	OCT	7.35	0.01	1	1	68000	0.01	1	26012	9739		
	NOV	8.84	0	-0.6	-0.6	68000	0.01	2.6	45317	6001		
	DEC	5.6	0.01	0.2	0.2	68000	0.01	1.2	22681	6337		

Chelan Falls Hatchery												
NPDES Permit Number WAG13-7019												
		FLOW	SS EFF	TSS COMP	TSS MAX	FLOW PA	SS PA	TSS PA	Lbs of Fish	Lbs of Feed		
2019	JAN	6.4	0	-0.2	-0.2	857	0.01	0.6	36136	4620		
	FEB	6.5	0.01	-1.8	-1.8	857	0.01	0.8	35191	4928		
	MAR	6.9	0	-4.2	-4.2	857	0	0	44186	6428		
	APR	6.9	0	3.2	3.2	857	0	0.4	46937	4460		
	MAY	No Monitoring							0	0		
	JUN	No Monitoring							0	0		
	JUL	No Monitoring							0	0		
	AUG	No Monitoring							0	0		
	SEP	No Monitoring							0	0		
	OCT	No Monitoring							0	0		
	NOV	6.91	0.01	-0.2	-0.2	857	0.01	0.4	26359	2112		
	DEC	7.5	0	0	0	857	0.01	0.4	29019	4092		

Dryden Acclimation Pond												
NPDES Permit Number WAG13-5014												
		FLOW	SS EFF	TSS COMP	TSS MAX	Lbs of Fish	Lbs of Fee	SS DD	TSS DD			
	JAN	No Monitoring				0	0					
	FEB	No Monitoring				0	0					
	MAR	No Monitoring				0	0					
	APR	8.3	0	-0.2	-0.2	29447	1452	0	0.8			
	MAY	No Monitoring				0	0					
	JUN	No Monitoring				0	0					
	JUL	No Monitoring				0	0					
	AUG	No Monitoring				0	0					
	SEP	No Monitoring				0	0					
	OCT	No Monitoring				0	0					
	NOV	No Monitoring				0	0					
	DEC	No Monitoring				0	0					

Priest Rapids												
NPDES Permit Number WAG13-7013												
		FLOW	SS EFF	TSS COMP	TSS MAX	FLOW PA	SS PA	TSS PA	Lbs of Fish	Lbs of Feed	SS DD	TSS DD
2019	JAN	13.3	0	1.4	1.4		**	**	7275	0		
	FEB	19.8	0	4	4		**	**	8659	1028		
	MAR	20.7	0	0	0		**	**	15814	8083		
	APR	25.2	0	0.4	0.4		0	46.8	42982	21691.5		
	MAY	35.38	0	0.4	0.4		0	54.6	99883	45708.2		
	JUN	21.24	0	1.4	1.4		0	48	76127	16646		
	JUL	No Monitoring							0	0		
	AUG	No Monitoring							0	0		
	SEP	No Monitoring							0	0		
	OCT	No Monitoring							0	0		
	NOV	No Monitoring							0	0		
	DEC	38.05	0	0.2	0.2		**	**	7469	0		
		**PA pond - No discharge this month										

Appendix H

Steelhead Stock Assessment at Priest Rapids Dam, 2017-2018

Priest Rapids Dam 2017-2018 Adult Upper Columbia River Steelhead Run-Cycle Stock Assessment Report

Introduction

Upper Columbia River (UCR) steelhead stock assessment sampling at Priest Rapids Dam (PRD) in 2017 was authorized through the Endangered Species Act (ESA) Section 10(a)(1)(A) Permit 18583 and extension of Section 10(a)(1)(A) Permit 1395 (NMFS 2003). Permit authorizations include interception and biological sampling of up to 15% of the UCR steelhead passing PRD to determine upriver population size, estimate hatchery to wild ratios, determine age class contribution, and evaluate the need for managing hatchery steelhead consistent with ESA recovery objectives, which include fully seeding spawning habitat with naturally produced UCR steelhead supplemented with artificially propagated enhancement steelhead (NMFS 2003; NMFS 2017).

Stock Assessment

The 2017 steelhead sampling at Priest Rapids Dam began 10 July and concluded 1 November. Sampling consisted of operating the Priest Rapids Off-Ladder Trap (OLAFT), located on the left bank Priest Rapids Dam, 8 hours per day, up to three days per week, for a total of 58 sampling days. Steelhead were trapped, handled, and released in accordance with Section 2.1 and 2.2.1 of the National Marine Fisheries Service (NMFS) Biological Opinion for ESA Permit 1395 (NMFS 2003) and Section 2.9.4 of the National Marine Fisheries Service Biological Opinion for ESA Permit 18583 (NMFS 2017). The cumulative sample rate attained during 2017 totaled 21.2%.

The Washington Department of Fish and Wildlife (WDFW) sampled 1,231 steelhead from the 2017/2018 run-cycle passing PRD, totaling 5,804 steelhead, for an overall sampling rate of 21.2%. Of the 1,231 steelhead sampled, 815 (66.2%) were hatchery origin and 416 (33.8%) were natural origin. The estimated 2017-2018 run-cycle total wild steelhead return was 1,962, representing 65.9% of the 1986-2016 average and about 48.8% of the most recent 5-year average (Table 1).

Based on scales, external marks, and external and internal tags, 815 hatchery-origin steelhead were sampled at Priest Rapids Dam during the 2017 return cycle and included an estimated, 14.1% Wenatchee hatchery-origin steelhead and 70.7% "above Wells Dam" hatchery-origin steelhead[1] (Table 2), while 4.2% of the hatchery-origin steelhead sampled could not be assigned to a specific hatchery program. Ringold FH origin steelhead represented about 11.0% of the hatchery sample (Table 2).

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[1] Defined as "above Wells Dam" because some hatchery-origin, adipose-clipped steelhead released into the Methow and Okanogan rivers from the Wells FH and Winthrop NFH have the same marks and are indistinguishable from one another.

Table 1. Priest Rapids Dam adult steelhead returns and stock composition, 1974-2016.

Run-cycle[1]	Hatchery	Wild	Wild percent	Total run
1974				2,950
1975				2,560
1976				9,490
1977				9,630
1978				4,510
1979				8,710
1980				8,290
1981				9,110
1982				10,770
1983				32,000
1984				26,200
1985				34,010
1986	20,022	2,342	10.5	22,364
1987	9,955	4,058	29.0	14,013
1988	7,530	2,670	26.2	10,200
1989	8,033	2,685	25.1	10,718
1990	6,252	1,585	20.2	7,837
1991	11,169	2,799	20.0	13,968
1992	12,102	1,618	11.8	13,720
1993	4,538	890	16.4	5,428
1994	5,880	855	12.7	6,735
1995	3,377	993	22.7	4,370
1996	7,757	843	9.8	8,600
1997	8,157	785	8.8	8,942
1998	4,919	928	15.9	5,847
1999	6,903	1,374	16.6	8,277
2000	9,023	2,341	20.6	11,364
2001	24,362	5,715	19.0	30,077
2002	12,884	2,983	18.8	15,867
2003	14,890	2,837	16.0	17,729
2004	15,670	2,985	16.0	18,655
2005	10,352	3,127	23.2	13,479
2006	8,738	1,677	16.1	10,415
2007	12,160	3,097	20.3	15,257
2008	13,528	3,030	18.3	16,558
2009	32,557	7,439	18.6	39,996
2010	18,784	7,647	28.9	26,431
2011	15,910	4,896	23.5	20,806
2012	13,908	3,284	19.1	17,192
2013	10,415	4,657	30.9	15,072
2014	13,836	5,930	30.0	19,766
2015	9,583	4,720	33.0	14,303
2016	4,991	1,516	23.3	6,507
1986-2016 average	**11,554**	**2,978**	**20.0**	**14,532**
2012-2016 average	***10,547***	***4,021***	***27.3***	***14,568***

[1] A return cycle is the combined total of steelhead passing PRD from 1 June – 30 November during year (x), plus steelhead passing PRD between 15 April and 31 May on year (x+1).

Table 2. Origin classification of steelhead sampled at Priest Rapids Dam, 10 July – 1 November 2017.

Steelhead Origin																			
Wild			Hatchery																
			Wenatchee			Above Wells						Ringold		Unk. Hat.					
Criteria			Criteria			Criteria						Criteria		Criteria			Total	Total	Total
NS	NM	Tot	CWT	AD+CWT	Total	AD+CWT	CWT	AD	LV	PED	Total	AD+RV	Total	SD	NM	Total	Wild	Hatchery	Total
x	x	416	x		63	x					125	x	90	x	x	34	416	815	1,231
				x	52		x				20								
								x			422								
									x		2								
										x	7								
Total		**416**			**115**						**576**		**90**			**34**	**416**	**815**	**1,231**
%Hatchery					**14.1**						**70.7**		**11.0**			**4.2**			
%Total		**33.8**			**9.3**						**46.8**		**7.3**			**2.8**	**33.8**	**66.2**	

Reconciliation of saltwater age of wild and hatchery steelhead sampled at Priest Rapids Dam during 2017 was accomplished through scale sample analysis. Salt-age analysis of the 2017-2018 UCR steelhead run-cycle provides an estimated hatchery-origin return dominated by 1- salt and 2-salt age composition of 97.7% and 8.1%, respectively (Table 3). Natural-origin steelhead salt ages were 83.6% and 15.9% for salt ages 1 and 2, respectively. Three-salt age fish represented approximately 0.3% of the combined hatchery/wild sample (Table 3).

Table 3. Salt-water age composition of 2017 – 2018 return cycle Upper Columbia River steelhead sampled at Priest Rapids Dam, corrected by scale age/origin determination.

	Origin					
	Hatchery		Wild		Combined	
Salt-age	***N***	**%**	***N***	**%**	***N***	**%**
1-salt	743	91.7%	316	83.6%	1,059	89.1%
2-salt	66	8.1%	60	15.9%	126	10.6%
3-salt	1	0.1%	2	0.5%	3	0.3%
4-salt	0	0.0%	0	0.0%	0	0.0%
Total	**810**		**378**		**1,188**	

Freshwater residency of naturally produced Upper Columbia River steelhead present in the 2017-2018 run cycle were dominated by age-2 freshwater fish (73.5%) and was similar to the 1986-2016 average of 74.2% (Table 4).

Table 4. 2017 return year freshwater age of wild Upper Columbia River steelhead sampled at Priest Rapids Dam during steelhead stock assessment activities, compared to July – November 1986-2016 average.

Freshwater age	**2017-2018 run cycle**		**1986-2016 proportion**	
	N	**%**	***N***	**%**
1.x	29	7.8%	624	7.6%
2.x	275	73.5%	6,120	74.2%
3.x	62	16.6%	1,426	17.3%
4.x	8	2.1%	74	0.9%
5.x	0	0.0%	3	0.0%
Total	**374**		**8,247**	

Wild and hatchery-origin steelhead exhibited similar saltwater growth in the 2016 run-cycle. Wild 1and 2-salt adults were slightly larger than their hatchery cohorts (Table 5). Age-1and 2-salt wild and hatchery steelhead observed in the 2017-2018 adult run-cycle return past PRD were comparable in size (although slightly smaller for age-2 hatchery and slightly larger for age-1 wild adults) to the 1986-2016 run-cycle average (Table 5).

Table 5. Average fork length of 1-salt and 2-salt, Upper Columbia River steelhead sampled at Priest Rapids Dam during July – November 2017 and the period between 1986-2016.

Salt age	Average fork length (cm)			
	2017-2018 run cycle		1986-2016 run cycle	
	Wild	Hatchery	Wild	Hatchery
x.1	61.3	59.5	59.5	58.4
x.2	71.5	68.2	71.8	70.9

Appendix I

Bull Trout (*Salvelinus confluentus*) Take Associated with the Wenatchee Batch Biological Opinion for the Wenatchee River Sub-basin Hatchery Programs, 2019

2019 Annual USFWS Report of Incidental Take of Bull Trout (*Salvelinus confluentus*), Associated with Chelan and Grant County PUD Hatchery Programs in Wenatchee River Subbasin

Introduction

Implementation of Wenatchee River sub-basin spring and summer Chinook and summer steelhead hatchery programs, monitoring and evaluation, and adult management activities in 2019 was authorized through Endangered Species Act (ESA) Section 10(a)(1)(A) Permits 18118 (Nason Creek spring Chinook; NMFS 2015), 18120 (White River spring Chinook; NMFS 2015), 18121 (Chiwawa spring Chinook; NMFS 2015), and 18583 (Wenatchee summer steelhead; NMFS 2017) and extension of Section 10(a)(1)(B) Permit 1347 (Wenatchee summer Chinook) NMFS 2003). Additionally, incidental take of bull trout (*Salvelinus confluentus*) associated with these programs and activities is detailed in the Section 7 consultation Biological Opinion (BiOp) with the United States Fish and Wildlife Service (USFWS) No. 01EWFW00-2013-F-0444.

Permit authorizations include broodstock collection, juvenile releases, nutrient enhancement, juvenile smolt trapping, adult management, and monitoring and evaluation activities. Hatchery programs and their related activities covered under these permits are:

- Chiwawa River Spring Chinook (Chelan County PUD)
- Nason Creek Spring Chinook (Grant County PUD)
- White River Spring Chinook (Grant County PUD)
- Wenatchee River Summer Chinook (Grant and Chelan County PUDs)
- Wenatchee River Summer Steelhead (Chelan County PUD)

Reasonable and Prudent Measures Related to Bull Trout Impacts

Under the terms and conditions for bull trout, the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize and monitor the impacts of take of bull trout likely to be caused by the proposed implementation of the hatchery programs and related activities:

RPM 1. Minimize incidental take resulting from operation of the Chiwawa Weir for spring Chinook salmon broodstock collection or any other activity.

RPM 2. Minimize incidental take resulting from tangle netting for spring Chinook salmon broodstock collection in Nason Creek.

RPM 3. Minimize incidental take due to adverse ecological interactions associated with smolt releases and residualism.

RPM 4. Minimize incidental take associated with nutrient enhancement.

RPM 5. Minimize incidental take associated with monitoring, research, and evaluation activities for all programs.

RPM 6. Minimize potential for incidental take through effective implementation of adaptive management.

Reporting Requirements

In order to monitor the impacts of implementation of the reasonable and prudent measures, an annual report shall be prepared describing the progress of the proposed Project and impacts to the bull trout (50 CFR § 402.14(I)(3)). The report shall be submitted to the Central Washington Field Office. The annual reporting required shall list and describe the following information relative to each RPM above (with the exception of RPM 6, which is a compendium of the previous five years activities):

1) Regarding RPM 1:

a) Narrative description of any adjustments to Chiwawa Weir operations relative to planned operations for broodstock collection at this facility, especially measures that change the schedule of weir operation. This includes deviations, if any, from the broodstock collection activities described in the Broodstock Collection Protocol for the reporting year.
b) Schedule of operation, including:
   i) Seasonal period of operation (start date, end date, total days of operation).
   ii) Daily periods of operation (clock time and total hours of operation).
   iii) Maximum water temperature during each day of operation.
c) Total number of bull trout encountered, segregated into numbers of adult, sub-adult, and juvenile life stages, by day of operation. Specify the criteria used to segregate by life stage.
d) For bull trout captured when water temperature is greater than 15^{o} C, a qualitative description of their condition and behavior upon release. Evaluate the relationship of water temperature at time of capture and bull trout condition at release, stratifying capture temperature into two classes: (1) water temperature greater than 18^{o} C and (2) water temperature greater than 15^{o} C, but less than 18^{o} C.
e) If a bull trout mortality occurs:
   i) A detailed description of the circumstances surrounding the mortality.
   ii) A detailed description of alternative or additional measures implemented to reduce risk of additional mortalities.

2) Regarding RPM 2:

f) Specific locations where reconnaissance snorkels and tangle netting occurred.
g) The netting schedule (dates and hours-per-location of net sets) and number of personnel participating for each set.
h) Number of bull trout observed during snorkeling and captured during netting, segregated into adult, sub-adult, and juvenile life stages.
i) For captured bull trout, a qualitative description of their condition and behavior upon release.

3) Regarding RPM 3:

j) Narrative description of estimated migration speed and conversion rates at downstream monitoring locations, with a qualitative comparison of performance to long-term values.

4) Regarding RPM 4:
   k) List or map displaying where carcasses were distributed within bull trout spawning areas, the approximate number of carcasses distributed by site, and when carcasses were placed.

5) Regarding RPM 5:
   a) Numbers of bull trout captured by smolt trap and by date, stratified by life stage (juvenile, sub-adult, and adult). Specify the criteria used to segregate by life stage.
   b) Numbers of injuries and mortalities observed, and narrative description of circumstances surrounding mortalities.
   c) A narrative description of adaptive management adjustments to trap operations and their apparent efficacy in minimizing trapping-related adverse effects to bull trout.
   d) A detailed description of any electrofishing activities that encounter bull trout which includes:
      i) Purpose of the electrofishing activity.
      ii) Protocol used (reference) and deviations, if any, from the referenced protocol.
      iii) Water temperature and conductivity.
      iv) Number of bull trout encountered by life stage. Specify the criteria used to segregate by life stage, and if electroshocking occurs where resident bull trout may be present, segregate resident from migratory bull trout and specify criteria used.
      v) A qualitative description of bull trout condition and behavior upon release.
      vi) Narrative description of circumstances surrounding mortalities.

6) Regarding RPM 6:
   a) Every five years, provide a cumulative report focused on the components of this program for which five-year average incidental take limits have been specified.
   b) The primary purposes of the five-year summaries are to help the Service determine if adjustments to this incidental take statement and the accompanying biological opinion are needed and to inform future adaptive management of the hatchery programs.
   c) To accomplish these objectives, the report should focus on:
      i) How successfully programs could be implemented while conforming to incidental take limits,
      ii) Incidental take exceedances if any,
      iii) Recommendations for addressing incidental take exceedances, especially new or enhanced conservation measures, or rationale for an increased take limit, including relevant new information.
      iv) Issues (especially recurring issues) that were encountered, and
      v) The relative effectiveness of conservation measures and terms and conditions.

7) Deviations from the proposed Project description, other than those specified in 1-6 above, if any, for all five hatchery programs.

8) Implementation of any conservation recommendations.

Results

RPM 1:

Chiwawa Weir operations detailed in the 2019 Broodstock Collection Protocols approved by the HCP Hatchery Committees and the PRCC Hatchery Subcommittee established a 24 hour up/24 hour down schedule from about June 1 through August 15 not to exceed 20 cumulative trapping days and/or 93 bull trout encounters (WDFW 2019). On June 25, in response to high bull trout numbers and very few adult spring Chinook being encountered at the Chiwawa weir, Chelan PUD and the WDFW petitioned the USFWS to extend the allowable bull trout encounters from 93 to 116 (10% of the five-year estimated mean bull trout spawners in the Chiwawa subbasin). The USFWS and the HCP HCs approved the request with no extension in the number of trapping days available.

A total of 118 bull trout were trapped during five days of trapping (Table 1). All bull trout were removed from the trap daily with a subsample PIT tagged by WDFW staff. All bull trout where then loaded into a transport truck and hauled/released into the Chiwawa River about 10 km upstream of the weir near Big Meadow Creek. All fish appeared healthy and dispersed immediately. No known mortalities related to trapping, handling, hauling, and release occurred.

Table 1. Bull trout encounters by date during spring Chinook broodstock collections at the Chiwawa Weir in 2019.

Date	Max Daily Water Temp (ºC)	Number Captured[2]			Mortalities			Comments
		Juvenile	Sub-adult	Adult	Juvenile	Sub-adult	Adult	
6/12	12.0	0	0	21	0	0	0	
6/14	10.0	0	0	66	0	0	0	Weir scan only/Passed 60 non-PIT tagged bull trout
6/27	8.0	0	0	4	0	0	0	
7/01	9.5	0	0	19	0	0	0	
7/03	9.5	0	0	8	0	0	0	
Total	**9.8[1]**	**0**	**0**	**118**	**0**	**0**	**0**	

[1] Average of maximum daily water temperature.
[2] All fish were sampled by WDFW staff for fork, POH, DNA, and PIT tagged if not previously tagged.

RPM 2:

In 2019, no tangle netting for spring Chinook broodstock for the Nason Creek program in Nason Creek occurred.

RPM 3:

Estimates of post-release survival and travel times (mean travel days) for the Nason Creek and Chiwawa River spring Chinook, Wenatchee summer Chinook, and Wenatchee summer steelhead hatchery programs can be found in the 2019 annual report for Monitoring and Evaluation of the Chelan and Grant PUDs Hatchery Programs (Hillman et al. 2020).

RPM 4:

No nutrient enhancement or natural area carcass distributions covered by this permit were conducted in 2019.

RPM 5:

In 2019, juvenile smolt traps were operated in Nason Creek, the White River, the Chiwawa River, and in the lower Wenatchee River by the Yakama Nation (Nason and White) and the Washington Department of Fish and Wildlife (Chiwawa and lower Wenatchee). A total of 220 bull trout were collected in 2019. Of the smolt traps operating, 2.3%, 0.0%, 13.6%, and 84.1% were caught in Lower Wenatchee, Nason Creek, White River, and Chiwawa River traps, respectively (Table 2). All bull trout were allowed to recover and released immediately downstream of trap locations. One adult mortality was observed at the Chiwawa River smolt trap and based on its condition, it likely died somewhere upstream and washed downstream to the trap.

Table 2. Summary of bull trout encountered at Wenatchee River sub-basin smolt traps funded by Chelan and/or Grant PUDs in 2019.

Trap Location	Number Trapped			Mortalities			Ave. Max Daily Water Temp (ºC)
	Juvenile	Sub-adult	Adult	Juvenile	Sub-adult	Adult	
Lower Wenatchee	4	0	1	0	0	0	8.0
Nason Creek	0	0	0	0	0	0	--
White River	29	0	1	0	0	0	12.2
Chiwawa River	151	0	34	0	0	1	6.3
Total	**184**	**0**	**36**	**0**	**0**	**1**	--

Of the 220 bull trout collected in 2019, lengths were taken from 186 of them (5 at the Lower Wenatchee Trap, 25 at the White River Trap, and 157 at the Chiwawa River Trap; Table 3). Of the fish sampled, 170 (91.4%) were ≤300 mm with 2.7% (N = 5) >500 mm.

Collection dates and individual lengths of bull trout collected are available in Appendix 1.

Table 3. Number of bull trout by size range in 100-mm increments collected at Wenatchee River sub-basin smolt traps in 2019.

Trap location	Number within length range						No data
	≤ 100	101 ≤ 200	201 ≤ 300	301 ≤ 400	401 ≤ 500	>500	
Lower Wenatchee	0	4	0	1	0	0	0
Nason Creek	0	0	0	0	0	0	0
White River	21	1	1	0	0	1	6
Chiwawa River	1	85	57	5	5	4	28
Total	**22**	**90**	**58**	**6**	**5**	**5**	**34**

In addition to juvenile smolt trapping, electrofishing activities were conducted in Nason Creek and the Chiwawa River in an effort to collect and PIT-tag juvenile spring Chinook to evaluate overwinter movement and survival of spring Chinook within the Wenatchee River sub-basin.

Electrofishing activities occurred between 1 October and 14 November in the Chiwawa River and between 3 September and 13 November in Nason Creek. A total of eight juvenile bull trout were collected in Nason Creek and 559 in the Chiwawa River (Table 4). No mortalities occurred and all fish were released unharmed within the reach they were collected. No bull trout were sampled or tagged during these activities. Daily catch by location including shocker settings, water temperatures, waypoints, etc. can be found in Appendix 2.

Table 4. Number of bull trout encountered during 2019 electrofishing activities in the Wenatchee River sub-basin.

Tributary	Number	Mortality	Shocker Settings		Total shocking seconds	Min/Max Water Temp (ºC)
			Ave volts	Ave frequency		
Nason Creek	8	0	375	30	65,142	3.0 – 16.0
Chiwawa River	559	0	375	30	92,662	0.5 – 7.0
Total	**567**	**0**	**--**	**--**	**157,804**	--

All backpack electrofishing activities and equipment were consistent with NMFS' June 2000 Backpack Electrofishing Guidelines.

RPM 6:

Not applicable for 2019. The first five-year summary report will be in 2023.

RPM 7:

No deviations in the proposed project descriptions occurred in 2019.

RPM 8:

For 2019, no Conservation Recommendations identified in the Biological Opinion were implemented.

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Appendix 1

Juvenile Smolt Trapping Bull Trout Encounters in the Wenatchee River Sub-basin in 2019

Table 1. Collection dates and lengths of adult and juvenile bull trout encountered at Wenatchee River sub-basin smolt traps funded by Chelan and Grant PUDs in 2019.

Trap Location	Date	Number Trapped[1]			Fork Length (mm)	Mortalities	Max daily Water Temp (ºC)
		Juvenile	Sub-Adult	Adult			
Lower Wenatchee	4-Apr	X			134	0	6.0
Lower Wenatchee	7-Apr			X	340	0	6.0
Lower Wenatchee	21-Apr	X			139	0	8.0
Lower Wenatchee	7-May	X			132	0	9.5
Lower Wenatchee	9-May	X			140	0	10.5
Chiwawa River	24-Mar	X			230	0	4.0
Chiwawa River	27-Mar	X			157	0	3.5
Chiwawa River	27-Mar	X			205	0	3.5
Chiwawa River	28-Mar	X			179	0	5.0
Chiwawa River	31-Mar	X			167	0	4.0
Chiwawa River	3-Apr	X			174	0	6.0
Chiwawa River	5-Apr	X			177	0	4.5
Chiwawa River	6-Apr	X			192	0	3.0
Chiwawa River	7-Apr	X			166	0	3.5
Chiwawa River	7-Apr	X			198	0	3.5
Chiwawa River	7-Apr	X			152	0	3.5
Chiwawa River	7-Apr	X			182	0	3.5
Chiwawa River	14-Apr	X			149	0	4.0
Chiwawa River	15-Apr	X			135	0	3.5
Chiwawa River	19-Apr	X			148	0	6.0
Chiwawa River	22-Apr	X			166	0	6.5
Chiwawa River	24-Apr	X			178	0	7.0
Chiwawa River	24-Apr	X			173	0	7.0
Chiwawa River	25-Apr	X			152	0	5.0
Chiwawa River	27-Apr	X			102	0	7.0
Chiwawa River	27-Apr	X			96	0	7.0
Chiwawa River	9-May	X			135	0	7.5
Chiwawa River	16-May	X			148	0	7.0
Chiwawa River	19-May	X			139	0	7.0
Chiwawa River	19-May	X			168	0	7.0

Trap Location	Date	Number Trapped[1]			Fork Length (mm)	Mortalities	Max daily Water Temp (ºC)
		Juvenile	Sub-Adult	Adult			
Chiwawa River	20-May	X			130	0	7.0
Chiwawa River	22-May	X			132	0	7.0
Chiwawa River	22-May	X			165	0	7.0
Chiwawa River	22-May	X			169	0	7.0
Chiwawa River	26-May	X			175	0	7.0
Chiwawa River	28-May	X			145	0	8.5
Chiwawa River	3-Jun	X			154	0	9.5
Chiwawa River	3-Jun	X			177	0	9.5
Chiwawa River	7-Jun	X			108	0	9.0
Chiwawa River	8-Jun	X			180	0	9.5
Chiwawa River	8-Jun	X			169	0	9.5
Chiwawa River	8-Jun	X			164	0	9.5
Chiwawa River	9-Jun	X			185	0	9.0
Chiwawa River	10-Jun	X			149	0	10.5
Chiwawa River	10-Jun	X			150	0	10.5
Chiwawa River	12-Jun	X			162	0	12.0
Chiwawa River	13-Jun	X			175	0	15.0
Chiwawa River	14-Jun	X			195	0	10.0
Chiwawa River	15-Jun	X			146	0	12.5
Chiwawa River	18-Jun	X			161	0	9.0
Chiwawa River	30-Jun	X			170	0	9.0
Chiwawa River	11-Jul			X[3]	500	0	12.0
Chiwawa River	30-Jul	X			228	0	13.0
Chiwawa River	6-Aug			X	365	0	13.0
Chiwawa River	8-Aug	X			272	0	14.5
Chiwawa River	12-Aug	X			229	0	12.0
Chiwawa River	21-Aug	X			218	0	13.0
Chiwawa River	22-Aug	X			213	0	10.0
Chiwawa River	23-Aug			X	NDC	0	10.0
Chiwawa River	25-Aug	X			223	0	10.0
Chiwawa River	26-Aug	X			225	0	10.5
Chiwawa River	27-Aug	X			257	0	10.5
Chiwawa River	27-Aug	X			235	0	10.5
Chiwawa River	28-Aug	X			NDC	0	10.0
Chiwawa River	28-Aug	X			222	0	10.0
Chiwawa River	28-Aug	X			270	0	10.0
Chiwawa River	29-Aug	X			292	0	10.0
Chiwawa River	29-Aug			X	440	0	10.0

Trap Location	Date	Number Trapped[1]			Fork Length (mm)	Mortalities	Max daily Water Temp (ºC)
		Juvenile	Sub-Adult	Adult			
Chiwawa River	29-Aug			X	575	0	10.0
Chiwawa River	31-Aug			X	390	0	11.0
Chiwawa River	31-Aug			X	303	0	11.0
Chiwawa River	1-Sep	X			252	0	12.5
Chiwawa River	3-Sep	X			NDC	0	12.0
Chiwawa River	3-Sep	X			NDC	0	12.0
Chiwawa River	3-Sep	X			NDC	0	12.0
Chiwawa River	5-Sep			X	NDC	0	10.5
Chiwawa River	5-Sep	X			NDC	0	10.5
Chiwawa River	5-Sep	X			NDC	0	10.5
Chiwawa River	7-Sep			X	305	0	10.5
Chiwawa River	9-Sep	X			218	0	12.0
Chiwawa River	11-Sep	X			226	0	7.5
Chiwawa River	12-Sep	X			231	0	8.0
Chiwawa River	13-Sep	X			229	0	9.0
Chiwawa River	16-Sep	X			237	0	7.0
Chiwawa River	23-Sep	X			236	0	7.0
Chiwawa River	24-Sep			X	NDC	0	9.0
Chiwawa River	26-Sep			X	445	0	7.5
Chiwawa River	26-Sep	X			209	0	7.5
Chiwawa River	27-Sep			X	NDC	0	6.5
Chiwawa River	27-Sep			X	NDC	0	6.5
Chiwawa River	27-Sep			X	NDC	0	6.5
Chiwawa River	28-Sep	X			279	0	4.5
Chiwawa River	28-Sep			X	450	0	4.5
Chiwawa River	28-Sep			X	470	0	4.5
Chiwawa River	29-Sep			X	NDC	0	4.0
Chiwawa River	29-Sep			X	NDC	0	4.0
Chiwawa River	29-Sep			X	NDC	0	4.0
Chiwawa River	29-Sep			X	NDC	0	4.0
Chiwawa River	29-Sep			X	NDC	0	4.0
Chiwawa River	29-Sep	X			251	0	4.0
Chiwawa River	30-Sep			X	520	0	2.5
Chiwawa River	1-Oct			X	NDC	0	2.5
Chiwawa River	1-Oct			X	NDC	0	2.5
Chiwawa River	2-Oct	X			204	0	2.5
Chiwawa River	2-Oct			X	515	0	2.5
Chiwawa River	3-Oct			X	NDC	0	2.5

Trap Location	Date	Number Trapped[1]			Fork Length (mm)	Mortalities	Max daily Water Temp (ºC)
		Juvenile	Sub-Adult	Adult			
Chiwawa River	4-Oct			X	390	0	4.0
Chiwawa River	4-Oct	X			108	0	4.0
Chiwawa River	5-Oct	X			227	0	5.0
Chiwawa River	5-Oct	X			288	0	5.0
Chiwawa River	7-Oct			X	640	0	3.5
Chiwawa River	7-Oct	X			224	0	3.5
Chiwawa River	7-Oct	X			218	0	3.5
Chiwawa River	7-Oct	X			154	0	3.5
Chiwawa River	8-Oct			X	NDC	0	3.5
Chiwawa River	8-Oct			X	NDC	0	3.5
Chiwawa River	10-Oct	X			195	0	0.5
Chiwawa River	14-Oct	X			199	0	0.5
Chiwawa River	19-Oct	X			205	0	4.0
Chiwawa River	19-Oct	X			180	0	4.0
Chiwawa River	19-Oct	X			234	0	4.0
Chiwawa River	19-Oct	X			198	0	4.0
Chiwawa River	19-Oct	X			239	0	4.0
Chiwawa River	19-Oct	X			258	0	4.0
Chiwawa River	19-Oct	X			190	0	4.0
Chiwawa River	19-Oct	X			227	0	4.0
Chiwawa River	19-Oct	X			194	0	4.0
Chiwawa River	19-Oct	X			215	0	4.0
Chiwawa River	20-Oct	X			NDC	0	2.0
Chiwawa River	20-Oct	X			183	0	2.0
Chiwawa River	20-Oct	X[4]			202	0	2.0
Chiwawa River	20-Oct	X			199	0	2.0
Chiwawa River	21-Oct	X			196	0	2.0
Chiwawa River	21-Oct	X			184	0	2.0
Chiwawa River	21-Oct	X			195	0	2.0
Chiwawa River	21-Oct	X			225	0	2.0
Chiwawa River	21-Oct	X			245	0	2.0
Chiwawa River	22-Oct	X			202	0	3.0
Chiwawa River	22-Oct	X			201	0	3.0
Chiwawa River	23-Oct	X			217	0	3.0
Chiwawa River	23-Oct	X			191	0	3.0
Chiwawa River	23-Oct	X			200	0	3.0
Chiwawa River	23-Oct	X			180	0	3.0
Chiwawa River	23-Oct	X			228	0	3.0

Trap Location	Date	Number Trapped[1]			Fork Length (mm)	Mortalities	Max daily Water Temp (ºC)
		Juvenile	Sub-Adult	Adult			
Chiwawa River	23-Oct	X			230	0	3.0
Chiwawa River	23-Oct	X			207	0	3.0
Chiwawa River	23-Oct	X			213	0	3.0
Chiwawa River	23-Oct	X			192	0	3.0
Chiwawa River	23-Oct	X			212	0	3.0
Chiwawa River	23-Oct	X			175	0	3.0
Chiwawa River	24-Oct	X			231	0	3.5
Chiwawa River	24-Oct	X			188	0	3.5
Chiwawa River	24-Oct	X			209	0	3.5
Chiwawa River	24-Oct	X			174	0	3.5
Chiwawa River	24-Oct	X			213	0	3.5
Chiwawa River	25-Oct	X			164	0	3.0
Chiwawa River	25-Oct	X			185	0	3.0
Chiwawa River	26-Oct	X			179	0	4.0
Chiwawa River	27-Oct	X			210	0	1.0
Chiwawa River	1-Nov	X			210	0	0.5
Chiwawa River	1-Nov	X			182	0	0.5
Chiwawa River	3-Nov	X			178	0	0.5
Chiwawa River	3-Nov	X			210	0	0.5
Chiwawa River	3-Nov	X			205	0	0.5
Chiwawa River	4-Nov	X			NDC	0	0.5
Chiwawa River	4-Nov	X			165	0	0.5
Chiwawa River	5-Nov	X			122	0	0.5
Chiwawa River	5-Nov	X			160	0	0.5
Chiwawa River	6-Nov	X			118	0	0.5
Chiwawa River	8-Nov			X	NDC	0	0.5
Chiwawa River	8-Nov	X			174	0	0.5
Chiwawa River	8-Nov	X			196	0	0.5
Chiwawa River	9-Nov	X			196	0	0.5
Chiwawa River	10-Nov			X	NDC	0	4.0
Chiwawa River	10-Nov	X			109	0	4.0
Chiwawa River	10-Nov	X			195	0	4.0
Chiwawa River	12-Nov			X	NDC	1	0.5
Chiwawa River	14-Nov	X			165	0	1.0
Chiwawa River	14-Nov	X			212	0	1.0
Chiwawa River	15-Nov	X			215	0	1.0
Chiwawa River	18-Nov	X			199	0	1.0
Chiwawa River	18-Nov	X			190	0	1.0

Trap Location	Date	Number Trapped[1]			Fork Length (mm)	Mortalities	Max daily Water Temp (ºC)
		Juvenile	Sub-Adult	Adult			
Chiwawa River	18-Nov	X			224	0	1.0
Chiwawa River	18-Nov	X			222	0	1.0
Chiwawa River	18-Nov	X			178	0	1.0
Chiwawa River	18-Nov	X			186	0	1.0
Chiwawa River	18-Nov	X			172	0	1.0
Chiwawa River	18-Nov	X			162	0	1.0
Chiwawa River	18-Nov	X			189	0	1.0
Chiwawa River	24-Nov			X	NDC	0	1.0
White River	25-Apr	X			NDC	0	6.3
White River	1-May	X			NDC	0	7.6
White River	27-May	X			NDC	0	9.4
White River	16-Jun	X			NDC	0	12.5
White River	19-Jun	X			NDC	0	10.0
White River	22-Jun	X			35	0	11.3
White River	4-Jul	X			40	0	13.2
White River	28-Jul	X			56	0	14.7
White River	28-Jul	X			54	0	14.7
White River	29-Jul	X			56	0	15.5
White River	29-Jul	X			136	0	15.5
White River	30-Jul	X			60	0	15.8
White River	30-Jul	X			55	0	15.8
White River	31-Jul	X			53	0	15.9
White River	3-Aug	X			54	0	15.1
White River	3-Aug	X			56	0	15.1
White River	4-Aug	X			50	0	15.6
White River	5-Aug	X			57	0	16.2
White River	5-Aug	X			59	0	16.2
White River	8-Aug	X			63	0	16.1
White River	8-Aug	X			59	0	16.1
White River	8-Aug	X			62	0	16.1
White River	8-Aug	X			63	0	16.1
White River	9-Aug	X			60	0	15.0
White River	10-Aug	X			64	0	15.1
White River	10-Aug	X			63	0	15.1
White River	10-Aug	X			60	0	15.1
White River	12-Oct			X	600	0	4.8
White River	31-Oct	X			222	0	2.1

Trap Location	Date	Number Trapped[1]			Fork Length (mm)	Mortalities	Max daily Water Temp (ºC)
		Juvenile	Sub-Adult	Adult			
White River	31-Oct	X			NDC	0	2.1

[1] Bull trout are only classified as juvenile or adult; X=1 fish.
[2] NDC = No data collected.
[3] Bull trout was recaptured on 29 Aug at a water temperature of 10 ºC.
[4] Bull trout was recaptured on 23 Oct at a water temperature of 3 ºC.

Appendix 2

Electrofishing Bull Trout Encounters in the Wenatchee River Sub-basin in 2019

Table 1. Electrofishing duration by location and bull trout encounters in the Nason Creek in 2019.

Date	Reach	Bull Trout			Shocker Settings			Release GPS Waypoints		Temps		Additional Notes
		Caught	Tagged	Morts	Volts	Frequency	Shocker Seconds	Latitude	Longitude	Tagging	Release	
3-Sep-19	N3A	1	0	0	300		1,634	47.776880	-120.920684	13.0	13.0	
3-Sep-19	N3B	2	0	0	375	30	3,189	47.777349	-120.894956	15.0	15.0	
4-Sep-19	N3C	0	0	0	300		3,248	47.784035	-120.87599	16.0	16.0	
4-Sep-19	N3D	0	0	0	375	30	2,769	47.786827	-120.858891	15.0	15.0	
5-Sep-19	N3E	0	0	0	300		1,542	47.783504	-120.846186	14.0	14.0	
23-Sep-19	N3B Extra	1	0	0	375	30	1,393	47.778544	-120.88459	9.5	9.5	
24-Sep-19	N3D Extra	0	0	0	300		1,540	47.787123	-120.853498	11.0	11.0	
	N3 Total	4	0	0			15,315					
5-Sep-19	N2A	0	0	0	375	30	2,985	47.776022	-120.828997	16.0	16.0	Did not finish entire section
9-Sep-19	N2B	0	0	0	300		1,836	47.773683	-120.8212710	14.0	14.0	
10-Sep-19	N2C	0	0	0	375	30	2,001	47.764983	-120.790049	12.0	12.0	Did not finish entire section
11-Sep-19	N2D	0	0	0	300		2,244	47.767783	-120.785233	14.0	14.0	Did not finish entire section
12-Sep-19	N2E	0	0	0	300		1,042	47.767539	-120.771572	14.0	14.0	
9-Sep-19	N2A Cont.	1	0	0	375	30	1,997	47.7800200	-120.8380020	12.0	12.0	Finished out rest of section
11-Sep-19	N2C Cont.	0	0	0	375	30	2,343	47.7676020	-120.7773370	14.0	14.0	Finished out rest of section
12-Sep-19	N2D Cont.	0	0	0	300		880	47.7650650	-120.7891430	11.0	11.0	Finished out rest of section
24-Sep-19	N2E Extra	1	0	0	375	30	5,018	47.7677690	-120.7710320	12.5	12.5	Shocking for Aqua SHR
25-Sep-19	N2E Extra x2	0	0	0	375	30	4,194	47.7663440	-120.7813580	12.0	12.0	Shocking for Aqua SHR
7-Nov-19	N2E Extra x3	0	0	0	375	30	4,427	47.7663440	-120.7813580	3.0	3.0	Shocking for Aqua SHR

Date	Reach	Bull Trout			Shocker Settings			Release GPS Waypoints		Temps		Additional Notes
		Caught	Tagged	Morts	Volts	Frequency	Shocker Seconds	Latitude	Longitude	Tagging	Release	
13-Nov-19	N2E Extra x4	1	0	0	375	30	5,456	47.7677690	-120.7710320	4.0	4.0	Shocking for Aqua SHR
	N2 Total	3	0	0			34,423					
16-Sep-19	N1A	0	0	0	300		1,540	47.767696	-120.758700	12.0	12.0	
16-Sep-19	N1B	1	0	0	300		3,219	47.763927	-120.747497	12.5	12.5	
17-Sep-19	N1C	0	0	0	300		1,640	47.7625050	-120.7334790	11.0	11.0	
17-Sep-19	N1D	0	0	0	375	30	1,393	47.771125	-120.721606	12.0	12.0	
18-Sep-19	N1E	0	0	0	300		1,560	47.7817780	-120.7177410	13.0	13.0	
19-Sep-19	N1F	0	0	0	375	30	3,161	47.796319	-120.714618	12.0	12.0	Did not finish entire section
26-Sep-19	N1F Extra	0	0	0	375	30	2,227	47.800986	-120.716944	12.0	12.0	
26-Sep-19	N1B Extra	0	0	0	375	30	664	47.760683	-120.734811	13.5	13.5	
	N1 Total	1	0	0			15,404					

4 Sept - 26 Sept (15 days)	**8**	**0**	**0**	**65,142**

Table 2. Electrofishing duration by location and bull trout encounters in the Chiwawa River in 2019.

Date	Reach	Bull Trout			Shocker Seconds			Release Location		Temps		Additional Notes
		Caught	Tagged	Morts	Volts	Amps	Shocker Seconds	Latitude	Longitude	Tagging	Release	
16-Oct-19	Alpine Meadows Down	48	0	0	375	30	1893	48.045538	-120.835577	1	1	
17-Oct-19	Alpine Meadows Up	54	0	0	375	30	3108	48.052592	-120.839253	2	2	
21-Oct-19	Phelps	35	0	0	375	30	2534	48.067353	-120.8476	2	2	
	Chiwawa 10 - Alpine Meadows	137	0	0			7535					
14-Oct-19	Beginning of C9	38	0	0	375	30	2252	48.009355	-120.823302	0.5	0.5	
15-Oct-19	Below "19 Mile Down"	43	0	0	375	30	3083	48.012775	-120.822632	0.5	0.5	
	Chiwawa 9 - 19Mile CG	81	0	0			5335					
3-Oct-19	Atkinson Up	47	0	0	375	30	3284	48.000803	-120.818798	7	7	
7-Oct-19	Riverbend Down	19	0	0	375	30	1910	47.958499	-120.78206	7	7	
8-Oct-19	Riverbend	53	0	0	375	30	3097	47.959946	-120.787674	6	6	
10-Oct-19	Above Riverbend	25	0	0	375	30	4153	47.959487	-120.792816	0.5	0.5	
10-Oct-19	Above Rock Creek	17	0	0	375	30	3489	47.97027	-120.802824	0.5	0.5	
14-Oct-19	End of C8	30	0	0	375	30	1763	48.00706	-120.820781	0.5	0.5	
31-Oct-19	Riverbend Down Recap Run	39	0	0	375	30	3367	47.960838	-120.783911	2	2	
31-Oct-19	Riverbend Up Recap Run	10	0	0	320	30	4356	47.959789	-120.793143	2	2	
6-Nov-19	Above Rock Creek Recap Run	34	0	0	375	30	3471	47.97027	-120.802824	1	1	
	Chiwawa 8 – Riverbend-Atkinson	274	0	0			28890					
1-Oct-19	Log Jam Upstream	14	0	0	375	30	3344	47.937885	-120.758273	7	7	
2-Oct-19	Above Log Jam/Below Finner	23	0	0	375	30	3984	47.946797	-120.767029	6	6	
28-Oct-19	Log Jam Upstream Recap Run	15	0	0	375	30	4051	47.936839	-120.755754	0.5	0.5	
29-Oct-19	Above Log Jam/Below Finner Recap Run	7	0	0	375	30	2474	47.940718	-120.761405	0.5	0.5	
6-Nov-19	Huckleberry Ford Up and Down	2	0	0	350	30	4814	47.897248	-120.713699	3	3	

Date	Reach	Bull Trout			Shocker Seconds			Release Location		Temps		Additional Notes
		Caught	Tagged	Morts	Volts	Amps	Shocker Seconds	Latitude	Longitude	Tagging	Release	
	Chiwawa 7 - Upstream Grouse	61	0	0			18667					
5-Nov-19	Grouse Creek	1	0	0	375	30	3328	47.894239	-120.697781	3	3	
	Chiwawa 6 - Grouse Hike in	1	0	0			3328					
24-Oct-19	Meadow Creek	3	0	0	375	30	4283	47.867426	-120.694673	5	5	Plus a small section of the mainstem
	Chiwawa 5 - Meadow CG	3	0	0			4283					
30-Oct-19	C4 Old Road Up	0	0	0	375	30	3348	47.8538	-120.682591	0	0	
	Chiwawa 4	0	0	0			3348					
4-Nov-19	Below Hatchery Release Bridge	0	0	0	375	30	6589	47.840639	-120.666327	3	3	Shocking with Aqua for SHR
14-Nov-19	C3 Start Up	1	0	0	375	30	4096	47.834006	-120.65274	4	4	Shocking with Aqua for SHR
	Chiwawa 3 - 2nd bridge	1	0	0			10685					
13-Nov-19	C2 Forest Road	0	0	0	350	30	3722	47.823212	-120.643424	3	3	
	Chiwawa 2	0	0	0			3722					
11-Nov-19	C1 Forest Service Road 6121	1	0	0	375	30	3810	47.809865	-120.647177	3.5	3.5	
12-Nov-19	Mark Group Bridge	0	0	0	375	30	3059	47.796924	-120.638581	2	2	
	Chiwawa 1 - Town	1	0	0			6869					

Chiwawa Total Oct1 – Nov14	**559**	**0**	**0**	**92,662**

Appendix J

Wenatchee Sockeye Salmon Spawning Escapement, 2019

PUBLIC UTILITY DISTRICT NUMBER 1 OF CHELAN COUNTY
Natural Resource Division
Fish and Wildlife Department
327 N. Wenatchee Ave., Wenatchee WA 98801 (509) 663-8121

March 30, 2020

To: HCP Hatchery Committee

From: Catherine Willard and Scott Hopkins

Subject: 2019 Wenatchee Sockeye Mark/Recapture-Based Sockeye Escapement Estimates to Tributaries

Introduction

In 2019, the Chelan County Public Utility District (District) estimated sockeye escapement to tributaries based on mark-recapture methodology. The purpose of this document is to report the spawning escapement estimates for the Little Wenatchee and White River subbasins. This information is used to track and/or estimate viable salmonid population parameters (VSP): abundance, productivity, spatial structure, and diversity (McElhaney et al. 2000).

Methods

Mark-Recapture Method:

Detection efficiencies of the in-stream arrays were calculated for the Little Wenatchee River and White River in 2019. The in-stream arrays include a series of upstream and downstream coils (Figure 1). Combined, these coils represented the upstream and downstream detection arrays, respectively. Overall detection efficiency P_{all} of the arrays was calculated based on observed detection probabilities of individual arrays:

$$P_{all} = 1 - \left(1 - P_{array\ 1}\right)\left(1 - P_{array\ 2}\right)$$

where the probability of missing a fish on both the upstream P_{array1} and downstream P_{array2} arrays were combined for an overall efficiency P_{all} (Connolly et al. 2008).

Adult sockeye salmon were tagged at adult fishways within the Columbia River and at Tumwater Dam. Additionally, adult returns that were PIT tagged as juveniles were used in the analyses. Total passage of adult sockeye salmon through Tumwater Dam was obtained from Columbia River Data Access in Real Time (DART 2019). Resulting tag files were queried in PTAGIS (2019), providing detection histories for each study fish.

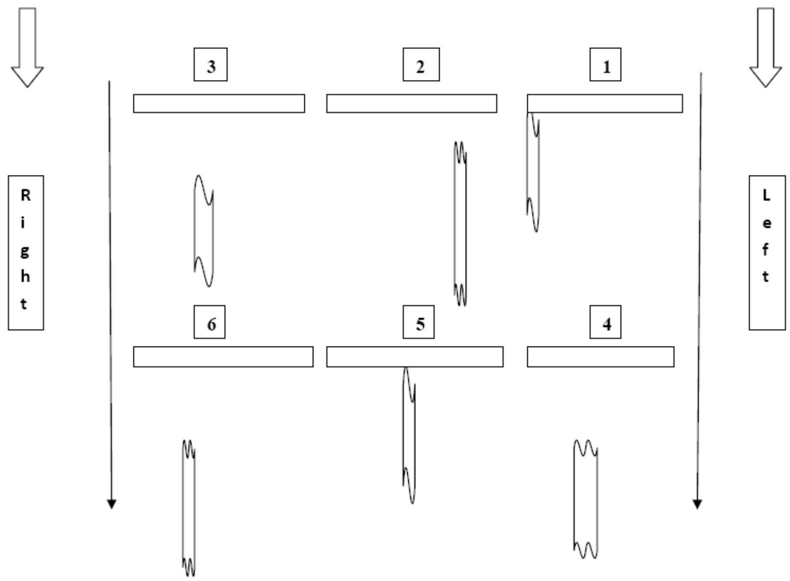

Figure 1. Schematic of a PIT array configuration.

Resulting data from passage at Tumwater Dam, mark and recapture using PIT tags, and detection efficiency estimates can provide estimation of escapement to spawning tributaries. Assumptions include: (1) the study population is "closed," i.e., no individuals die or emigrate between the initial mark and subsequent recaptures; (2) tags are not lost and detections are correctly identified; (3) all individuals have the same probability of being detected, and (4) the number of recapture events are proportional to the total population. Lastly, it was assumed that PIT-tagging efforts at Tumwater have negligible influence on fish behavior and tagged individuals behave similarly to untagged individuals. The resulting escapement rate, adjusted for detection efficiency, was then applied to the total population as such:

$$Escapement = \left(\frac{\left(\frac{Obs_{LWN}}{Eff_{LWN}} + \frac{Obs_{WTL}}{Eff_{WTL}} \right)}{PITs_{TUM}} \right) \times Counts_{TUM}$$

where the PIT tag detections (*Obs*) at the Little Wenatchee (*LWN*) and White River (WTL) were adjusted for detection efficiency (*Eff*), compared to the number released (*PITs*) at Tumwater Dam (*TUM*), and the resulting proportion was applied to the population observed (*Counts*) passing Tumwater Dam.

Results

Sockeye Salmon Mark-Recapture Method

Fishway enumeration at Tumwater Dam indicated that 11,007 adult sockeye salmon passed the facility during the 2019 migration, which was an insufficient return to open a recreational fishery in Lake Wenatchee for 2019. PIT tags were implanted in 750 fish at Tumwater and 174 fish were PIT tagged before passing Tumwater; 60 fish were subsequently detected at the Little Wenatchee PIT-tag array and 705 fish were subsequently detected at the White River PIT-tag array (Table 1). Based on the recapture of PIT-tagged adult sockeye and assigned detection efficiencies, the total estimated escapement to the Little Wenatchee River was 715 adult sockeye and to the White River was 8,542 adult sockeye (Table 2).

Table 1. Number of adult sockeye salmon PIT tagged, released, and detected upstream of Tumwater Dam in 2009 through 2019, and mark/recapture based tributary escapement estimates. Obs. = observed, D.E. = detection efficiency, Est = estimated (Obs./D.E.), and NA = not available.

Year	**Number of PIT-tagged adults detected or tagged at Tumwater**[1]	**White River**			**Little Wenatchee River**			**Chiwawa River Obs.**	**Nason Creek Obs.**
		Obs.	***D.E. (p_{all})***	***Est***	**Obs.**	***D.E. (p_{all})***	***Est***		
2009	1,085	381	0.406	*939*	38	0.971	*39*	37	7
2010	1,164	571	0.900[2]	*635*	67	1.000	*67*	3	1
2011	484	40	NA[3]	*NA*	84	--	*0*	0	0
2012	1,154	410	0.943	*435*	74	0.987	*75*	0	0
2013	719	152	NA[3]	*NA*	55	0.818	*67*	0	0
2014	1,729	848	0.999	*848*	76	1.000	*76*	0	3
2015[4]	950	371	0.999	*371*	50	1.000	*50*	69	4
2016	1,420	743	0.994	*748*	130	1.000	*130*	2	1
2017	778	600	0.998	*601*	68	1.000	*68*	8	0
2018[5]	549	405	0.990	*409*	35	0.915	*38*	3	0
2019[6]	924	705	0.983	*717*	60	1.000	*60*	12	0

[1] Also includes fish detected downstream of release point (fallbacks).
[2] Detection efficiency p_{all} = 0.406 in 2009 was assigned from 2010 data.
[3] Technical difficulties with the White River PIT array prevented the calculation of detection efficiency and a mark-recapture based escapement estimate.
[4] In 2015, 45 sockeye salmon were detected in Chiwaukum Creek.
[5] In 2018, 2 sockeye salmon were detected in Chiwaukum Creek.
[6] In 2019, 1 sockeye salmon was detected in Chiwaukum Creek.

Table 2. Estimated escapement of adult sockeye salmon to Little Wenatchee and White rivers based on mark-recapture events, in-stream detection efficiency, and adult enumeration at Tumwater Dam, 2009-2019.

Year	Tumwater count	Recreational harvest	Little Wenatchee	White River	Combined	Escapement
2009	16,034	2,285	576	13,876	14,452	0.901
2010	35,821	4,129	2,062	19,542	21,604	0.603
2011[1]	18,634	0	2,431	14,582	17,013	0.913
2012	66,520	12,107	4,607	23,866	28,473	0.428
2013[1]	29,015	6,262	2,426	14,294	16,720	0.576
2014	99,898	16,281	4,319	49,021	53,340	0.534
2015	51,435	7,916	2,707	20,097	22,804	0.443
2016	73,697	14,630	6,747	38,802	45,549	0.618
2017	23,854	0	2,085	18,436	20,521	0.860
2018	13,975	0	974	10,411	11,384	0.815
2019	11,007	0	715	8,542	9,257	0.841
Average	**39,990**	**5,783**	**2,695**	**21,043**	**23,738**	**0.685**

[1] Escapement was calculated using AUC counts for the Little Wenatchee River and a linear regression relationship to the Little Wenatchee River for the White River.

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Appendix K

Genetic Diversity of Wenatchee Sockeye Salmon

Assessing the Genetic Diversity of Lake Wenatchee Sockeye Salmon And Evaluating The Effectiveness Of Its Supportive Hatchery Supplementation Program

Developed for

Chelan County PUD

and the

Habitat Conservation Plan's Hatchery Committee

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Executive Summary

Nine spawning populations of sockeye (*Oncorhynchus nerka*) salmon have been identified in Washington, including stocks in the Lake Wenatchee basin (SaSI 5800) (Washington Department of Fisheries et al. 1993). Lake Wenatchee sockeye are classified as an Evolutionary Significant Unit (ESU), and consists of sockeye salmon that spawn primarily in tributaries above Lake Wenatchee (the White River, Napeequa River, and Little Wenatchee Rivers). Since 1990, the Wenatchee Sockeye Program has released juveniles into Lake Wenatchee to supplement natural production of sockeye salmon in the basin. The program's broodstock are predominantly natural-origin sockeye adults returning to the Wenatchee River captured at Tumwater Dam (Rkm 52.0), where a net-pen system is used to house both maturing adults and juveniles prior to release into Lake Wenatchee to over-winter.

Previous genetic studies have generally found a lack of concordance between population genetic relationships and their geographic distributions. These studies indicate that the nearest geographic neighbors of sockeye salmon populations are not necessarily the most genetically similar. Specifically for the Columbia River Basin, sockeye from Lake Wenatchee, Okanogan River, and Redfish Lake may be more closely related to a population from outside the Columbia River (depending on marker used) then to each other.

In this study we investigated the temporal and spatial genetic structure of Lake Wenatchee sockeye collections, without regard to sockeye populations outside of the Lake Wenatchee area. Our primary objective here was to determine if the Wenatchee Sockeye Program affected the natural Lake Wenatchee sockeye population. More specifically, we were tasked to determine if the genetic composition of Lake Wenatchee sockeye population had been altered by a supplementation program that was based on the artificial propagation of a small subset of that population. Using microsatellite DNA allele frequencies, we investigated population differentiation between temporally replicated collections of natural-origin Lake Wenatchee sockeye and program broodstock. We analyzed thirteen collections of Lake Wenatchee sockeye (Table 1), eight temporally replicated collections of natural-origin Lake Wenatchee sockeye (N=786) and five temporally replicated collections of Wenatchee Sockeye Program broodstock (N=248). Paired natural – broodstock collections were available from years 2000, 2001, 2004, 2006, and 2007.

Conclusions

We observed that allele frequency distributions were consistent over time, irrespective of collection origin, resulting in small and statistically insignificant measures of genetic differentiation among collections. We interpreted these results to indicate no year-to-year differences in allele frequencies among natural-origin or broodstock collections. Furthermore, there were no observed difference between pre- and post-supplementation collections. Therefore, we accepted our null hypothesis that the allele frequencies of the broodstock collections equaled the allele frequencies of the natural collections, which

equaled the allele frequency of the donor population. Given the small differences in genetic composition among collections, the genetic model for estimating N_e produced estimates with extremely large variances, preventing the observation of any trend in N_e.

Introduction

A report titled "Conceptual Approach to Monitoring and Evaluating the Chelan County Public Utility District Hatchery Programs" was prepared July 2005 by Andrew Murdoch and Chuck Peven for the Chelan PUD Habitat Conservation Plan's Hatchery Committee. This report outlined 10 objectives to be applied to various species assessing the impact (positive or negative) of hatchery operations mitigating the operation of Rock Island Dam. This current study pertains only to Lake Wenatchee sockeye and objective 3:

> *Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program. Additionally, determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.*

In order to evaluate cause and effect of hatchery supplementation, WDFW Molecular Genetics Lab surveyed genetic variation of Lake Wenatchee sockeye. The conceptual approach for this project follows that of a parallel study regarding the Wenatchee River spring Chinook supplementation program (Blankenship et al. 2007). We determined the genetic diversity present in the Lake Wenatchee sockeye population by analyzing temporally replicated collections spanning 1989 – 2007, which included collections from before and following the inception of the Wenatchee Sockeye Program. Documenting the genetic composition of the Lake Wenatchee sockeye population is necessary to assess the effect of the hatchery program on the Lake Wenatchee population. In addition, this work provides a genetic baseline for future projects requiring genetic data. See study objectives below for specific details about how this project addresses Murdoch and Peven (2005) objective 3.

Lake Wenatchee Sockeye Salmon

Nine spawning populations of sockeye (*Oncorhynchus nerka*) salmon have been identified in Washington (Washington Department of Fisheries et al. 1993): 1) Baker

River, 2) Ozette Lake, 3) Lake Pleasant, 4) Quinault Lake, and 5) Okanogan River (classified as native stock); 6) Cedar River (classified as non-native stock); 7) Lake Wenatchee, classified as mixed stock); 8) Lake Washington/Lake Sammamish tributaries; and 9) Lake Washington beach spawners (classified as unknown origin). Chapman et al. (1995) listed four additional spawning aggregations of sockeye salmon that appear consistently in Columbia River tributaries: the Methow, Entiat, and Similkameen Rivers; and Icicle Creek in the Wenatchee River drainage.

Located in north central Washington, the Wenatchee River basin drains a portion of the eastern slope of the Cascade Mountains, including high mountainous regions of the Cascade crest. The headwater area of the Wenatchee River is Lake Wenatchee, a typical low productivity oligotrophic or ultra-oligotrophic sockeye salmon nursery lake (Allen and Meekin 1980, Mullan 1986, Chapman et al. 1995). Sockeye salmon bound for Lake Wenatchee enter the Columbia River in April and May and arrive at Lake Wenatchee in late July to early August (Chapman et al. 1995; Washington Department of Fisheries et al. 1993). The run timing of Lake Wenatchee sockeye salmon, classified as an Evolutionary Significant Unit (ESU), appears to have become earlier by 6 - 30 days during the past 70 years (Chapman et al. 1995; Quinn and Adams 1996). Additionally, scale pattern analysis suggests Wenatchee sockeye migrate past Bonneville Dam earlier than the sockeye bound for the Okanogan River (Fryer and Schwartzberg 1994). The Wenatchee population spawns from mid-September through October in the Little Wenatchee, White, and Napeequa Rivers above Lake Wenatchee (Washington Department of Fisheries et al. 1993), peaking in late September (Chapman et al. 1995). Limited beach spawning is believed to occur in Lake Wenatchee (L. Lavoy pers. com.; Mullan 1986), although Gangmark and Fulton (1952) reported two lakeshore seepage areas in Lake Wenatchee that were used by spawning sockeye salmon. Sockeye salmon fry enter Lake Wenatchee between March and May (Dawson et al. 1973), and typically rear in the lake for one year before leaving as smolts (Gustafson et al. 1997; Peven 1987).

Both the physical properties of the habitat and ecological/biological factors of the sockeye populations differ between the Lake Wenatchee ESU and the geographically proximate Okanogan ESU. For example: 1) Different limnology is encountered by sockeye salmon in Lakes Wenatchee and Osoyoos; 2) Lake Wenatchee sockeye predominantly return at ages four and five (a near absence of 3-year-olds), where a large percentage of 3-year-olds return to the Okanogan population; and 3) the apparent one month separation in juvenile outmigration-timing between Okanogan- and Wenatchee-origin fish (Gustafson et al. 1997 and references therein).

Sockeye Artificial Propagation In Lake Wenatchee

The construction of Grand Coulee Dam completely blocked fish passage to the upper Columbia River, and 85% of sockeye salmon passing Rock Island Dam between 1935 and 1936 were estimated to be from natural stocks bound for areas up-river to Grand Coulee Dam (Mullan 1986; Washington Department of Fisheries et al. 1938). To compensate for loss of habitat resulting from Grand Coulee Dam, the federal government initiated the Grand Coulee Fish-Maintenance Project (GCFMP) in 1939 to maintain fish runs in the Columbia River above Rock Island Dam. Between 1939 and 1943, all sockeye salmon entering the mid-Columbia River were trapped at Rock Island Dam, and over 32,000 mixed Lake Wenatchee, Okanogan River, and Arrow Lake adult sockeye salmon were released into Lake Wenatchee (Gustafson et al. 1997 Appendix Table D-2). In addition to adult relocation, between 1941 and 1969 over 52.8 million fry descended from original spawners collected at Rock Island and Bonneville Dams, were released into Lake Wenatchee (Gustafson et al. 1997 Appendix Table D-2).

No releases of artificially-reared sockeye salmon occurred in the Wenatchee watershed during the years 1970 to 1989 (Gustafson et al. 1997 Appendix Table D-2). Since 1990, the Wenatchee Sockeye Program has released juveniles into Lake Wenatchee to supplement natural production of sockeye salmon in the basin. Sockeye adults returning to the Wenatchee River are captured at Tumwater Dam (Rkm 52.0) and transferred to Lake Wenatchee net pens until mature. The Wenatchee Sockeye Program goals are 260 adults with an equal sex ratio, <10% hatchery-origin returns (identified by coded wire tags), and the adults removed for broodstock account for <10% of the run size. Fish are spawned at Lake Wenatchee and their gametes are taken to Rock Island Fish Hatchery

Complex (i.e., Eastbank) for fertilization and incubation. Fry are returned to the Lake Wenatchee net -pens after they are large enough to be coded wire tagged, and are housed in the pens until fall (one year after spawning), when they are liberated into the lake to over-winter. For brood years 1991 – 2004 an average of 218,683 (std. dev. = 71,090) pen-reared Lake Wenatchee-origin juvenile sockeye salmon have been released yearly into Lake Wenatchee.

Previous Genetic Studies

Protein (allozyme) variation – Surveying genetic variation at 12 allozyme loci, Utter et al. (1984) reported moderate population structure among 16 sockeye collections from southeast Alaska through the Columbia River Basin, including Okanogan and Wenatchee stocks, with an apparent genetic association between upper Fraser River and Columbia River sockeye salmon. Winans et al. (1996) surveyed variation at 55 allozyme loci for 25 sockeye salmon and two kokanee collections from 21 sites in Washington, Idaho, and British Columbia, and reported the lowest level of allozyme variability of any species of Pacific salmon and a highest level of inter-population differentiation. Furthermore, these authors reported that there was no clear relationship between geographic and genetic differentiation among the populations within there study. Other studies corroborate the results of Winans et al. (1996), finding a lack of discernible geographic patterning for sockeye salmon populations in British Columbia, Alaska, and Kamchatka (Varnavskaya et al. 1994, Wood et al. 1994, Wood 1995). These studies indicate that the nearest geographic neighbors of sockeye salmon populations are not necessarily the most genetically similar, which contrasts with the other Pacific salmon species that exhibit concordance between geographic and genetic differentiation (Utter et al. 1989, Winans et al. 1994, Shaklee et al. 1991). As part of the comprehensive status review of west coast sockeye salmon (Gustafson et al. 1997), NMFS biologists collected new allozyme genetic information for 17 sockeye salmon populations and one kokanee population in Washington and combined these data for analysis with the existing Pacific Northwest sockeye salmon and kokanee data from Winans et al. (1996). Results of the updated study were consistent with Winans et al. (1996), with no clear concordance between geographic and genetic distances. Sockeye salmon from Lake Wenatchee, Redfish Lake, Ozette Lake, and Lake Pleasant are very distinct from other collections in the study, and Columbia River populations were not necessarily most closely related to each other. Gustafson et al. (1997) also examined between-year variability within a collection location and found low levels of statistical significance among the five Lake Wenatchee collections included in the study (For 10 pair-wise comparisons using sum-G test, five were statistically significant). Lake Wenatchee brood year 1987 accounted for three of the significant comparisons, which were driven by unusually high frequencies of two allozyme alleles (ALAT*95 and ALAT*108) (Winans et al. 1996). Nevertheless, Gustafson et al. (1997) conclude that, in general, temporal variation at a locale was considerably less than between-locale variation.

Nucleic acid variation - Beacham et al. (1995) reported levels of variation in nuclear DNA of *O. nerka* using minisatellite probes. They analyzed 10 collections, including a sample from Lake Wenatchee. Cluster analysis showed the Lake Wenatchee sample was different from all the other collections, including those from the Columbia River. Using a similar molecular technique, Thorgaard et al. (1995) examined the use of multi-locus DNA fingerprinting (i.e., banding patterns) to discriminate among 14 sockeye salmon and kokanee populations. Dendrograms based on analysis of banding patterns produced different genetic affinity groups depending on the probes used. While none of the five DNA probes showed a close relationship between Lake Wenatchee and Okanogan River sockeye salmon, if information from all probes were combined, *O. nerka* from Redfish Lake, Wenatchee, and Okanogan were separate from kokanee of Oregon and Idaho and a sockeye salmon sample from the mid-Fraser River.

Study Objective

We documented temporal variation in genetic diversity (i.e., heterozygosity and allelic diversity), and investigated population differentiation between temporally replicated collections of natural-origin Lake Wenatchee sockeye and program broodstock, using microsatellite DNA allele frequencies. Temporally replicated collections from the same location can also be used to estimate effective population size (N_e). If populations are "ideal", the census size of a population is equal to the "genetic size" of the population.

Yet, numerous factors lower the "genetic size" below census, such as, non-equal sex ratios, changes in population size, and variance in the numbers of offspring produced from parent pairs. N_e is thought to be between 0.10 and 0.33 of the estimated census size (Bartley et al. 1992; RS Waples pers. comm.), although numerous observations differ from this general rule. N_e can be calculated directly from demographic data, or inferred from observed differences in genetic variance over time. Essentially, when calculated from genetic data, N_e is the estimated size of an "ideal" population that accounts for the genetic diversity changes observed, irrespective of abundance.

We will address the hypotheses associated with Objective 3 in Murdock and Peven (2005) using the following four specific tasks:

Task 1 - Document the observed genetic diversity.

Task 2 - Test for population differentiation among Lake Wenatchee collections and the associated supplementation program.

Task 2 was designed to address two hypotheses listed as part of Objective 3 in Murdoch and Peven (2005):

- Ho: Allele frequency $_{\text{Hatchery}}$ = Allele frequency $_{\text{Naturally produced}}$ = Allele frequency $_{\text{Donor pop}}$.
- Ho: Genetic distance between subpopulations $_{\text{Year x}}$ = Genetic distance between subpopulations $_{\text{Year y}}$

Murdoch and Peven (2005) proposed these two hypotheses to help evaluate supplementation programs through a "Conceptual Process" (Figure 5 in Murdoch and Peven 2005). There are two components to the first hypothesis, which must be considered separately for Lake Wenatchee sockeye. The first component involves comparisons between natural-origin populations from Lake Wenatchee to determine if there have been changes in allele frequencies through time starting with the donor population. Documenting a change does not necessarily indicate that the supplementation program has directly affected the natural-origin fish, as additional tests would be necessary to support that hypothesis. The intent of the second component is to determine if the hatchery produced populations have the same genetic composition as the naturally produced populations.

Task 3 - Calculate N_e using the temporal method for multiple samples from the same location to document trend.

Task 4 - Compare N_e estimates with trend in census size for Lake Wenatchee sockeye.

Methods and Materials

Sampling

Thirteen collections of Lake Wenatchee sockeye were analyzed, eight temporally replicated collections of natural Lake Wenatchee sockeye (N=786) and five temporally replicated collections of Wenatchee Sockeye Program broodstock (N=248) (Table 1). Paired natural – broodstock collections were available from years 2000, 2001, 2004, 2006, and 2007 (Table 1). All collections were made at Tumwater Dam on the Wenatchee River. Note that collections classified as broodstock were predominantly natural-origin sockeye. A majority of the genetic samples were from dried scales. The tissue collections from 2006 and 2007 were fin clips stored immediately in ethanol after collection. DNA was extracted from stored tissue using Nucleospin 96 Tissue following the manufacturer's standard protocol (Macherey-Nagel, Easton, PA, U.S.A.).

Laboratory Analysis

Polymerase chain reaction (PCR) amplification was performed using 17 fluorescently end-labeled microsatellite marker loci, *One* 2 (Scribner et al 1996) *One* 100, 101, 102, 105, 108, 110, 114, and 115 (Olsen et al. 2000), *Omm* 1130, 1135, 1139, 1142, 1070, and 1085 (Rexroad et al. 2001), *Ots* 3M (Banks et al. 1999) and *Ots* 103 (Small et al. 1998). PCR reaction volumes were 10 μL, with the reaction variables being 2 μL 5x PCR buffer (Promega), 0.6 μL $MgCl_2$ (1.5 mM) (Promega), 0.2 μL 10 mM dNTP mix (Promega), and 0.1 μL *Go Taq* DNA polymerase (Promega). Loci were amplified as part of multiplexed sets, so primer molarities and annealing temperatures varied. Multiplex one had an annealing temperature of 55°C, and used 0.09 Molar (M) *One* 108, 0.06 M *One* 110, and 0.11 M *One* 100. Multiplex two had an annealing temperature of 53°C, and used 0.08 M *One* 102, 0.1 M *One* 114, and 0.05 M *One* 115. Multiplex three had an annealing temperature of 55°C, and used 0.08 M *One* 105 and 0.07 M *Ots* 103. Multiplex four had an annealing temperature of 53°C, and used 0.09 M *Omm* 1135 and 0.08 M *Omm* 1139. Multiplex five had an annealing temperature of 60°C, and used 0.2 M *Omm* 1085, 0.09 M *Omm* 1070, and 0.05 M *Ots* 3M. Multiplex six had an annealing temperature of 48°C, and used 0.06 M *One* 2, 0.08 M *Omm* 1142, and 0.08 M *Omm* 1130. *One* 101 was run in isolation with a primer molarity of 0.06. Thermal cycling was conducted on either PTC200 (MJ Research) or GeneAmp 9700 thermal cyclers as follows: 94°C (2 min); 30 cycles of 94°C for 15 sec., 30 sec. annealing, and 72°C for 1 min.; a final 72°C extension and then a 10°C hold. PCR products were visualized by denaturing polyacrylamide gel electrophoresis on an ABI 3730 automated capillary analyzer (Applied Biosystems). Fragment analysis was completed using GeneMapper 3.7 (Applied Biosystems).

Genetic data analysis

Assessing within collection genetic diversity - Heterozygosity measurements were reported using Nei's (1987) unbiased gene diversity formula (i.e., expected heterozygosity) and Hedrick's (1983) formula for observed heterozygosity. Both tests were implemented using the microsatellite toolkit (Park 2001). For each locus and collection FSTAT version 2.9.3.2 (Goudet 1995) was used to assess Hardy-Weinberg equilibrium, where deviations from the neutral expectation of random associations among alleles were calculated using a randomization procedure. Alleles were randomized among individuals within collections (4160 randomizations for this dataset) and the F_{IS} (Weir and Cockerham 1984) calculated for the randomized datasets were compared to the observed F_{IS} to obtain an unbiased estimation of the probability that the null hypothesis was true. The 5% nominal level of statistical significance was adjusted for multiple tests (Rice 1989). Genotypic linkage disequilibrium was calculated following Weir (1979) using GENETIX version 4.05 (Belkhir et al. 1996). Statistical significance of linkage disequilibrium results was assessed using a permutation procedure implemented in GENETIX for each locus by locus combination within each collection.

Assessing among collection genetic differentiation - The temporal stability of allele frequencies was assessed by the randomization chi-square test implemented in FSTAT version 2.9.3.2 (Goudet 1995). Multi-locus genotypes were randomized between collections. The G-statistic for observed data was compared to G-statistic distributions from randomized datasets (i.e., null distribution of no differentiation between collections). Population differentiation was also investigated using pairwise estimates of F_{ST}. Multi-locus estimates of pairwise F_{ST}, estimated by a "weighted" analysis of variance (Weir and Cockerham, 1984), were calculated using GENETIX version 4.05 (Belkhir et al.1996). F_{ST} was used to quantify population structure, the deviation from statistical expectations (i.e., excess homozygosity) due to non-random mating between populations. To determine if the observed F_{ST} estimate was consistent with statistically expectations of no population structure, a permutation test was implemented in GENETIX (1000 permutations).

Effective population size (N_e) – Estimates of the effective population size were obtained using a multi-collection temporal method (Waples 1990a). The temporal method assumes that cohorts are used, but we did not decompose the collection year samples into their respective cohorts using age data. Therefore, N_e estimates that pertain to individual year classes of breeders are not valid; however the harmonic mean over all samples will estimate an N_e that pertains to the time period from which the collections are derived. Comparing samples from years *i* and *j*, Waples' (1990a) temporal method estimates the effective number of breeders ($\hat{N}_{b(i,j)}$) according to:

$$\hat{N}_{b(i,j)} = \frac{b}{2(\hat{F} - 1/\tilde{S}_{i,j})}$$

The standardized variance in allele frequency ($\hat{F}$) is calculated according to Pollack (1983). The parameter b is calculated analytically from age structure information and the number of years between samples (Tajima 1992). The age-at-maturity information required to calculate b was obtained from ecological data (Hillman et al. 2007). The harmonic mean of sample sizes from years *i* and *j* is $\tilde{S}_{i,j}$. The harmonic mean over all pairwise estimates of $\hat{N}_{b(i,j)}$ is $\tilde{N}_b$. SALMONNb (Waples et al. 2007) was used to calculate $\tilde{N}_b$.

Results and Discussion

In this section we combine our presentation and interpretations of the genetic analyses. Additionally, this section is organized based on the task list presented in the study plan.

Task 1 - Document the observed genetic diversity.

Substantial genetic diversity was observed over all Lake Wenatchee sockeye collections analyzed (Table 1), with heterozygosity estimates over all loci having a mean of 0.79. Genetic diversity was consistent with expected Hardy-Weinberg random mating genotypic proportions for all collections. The F_{IS} observed for each collection was not statistically significant given the distribution of F_{IS} generated using a randomization procedure. Additionally, there were no statistically significant associations observed between alleles across loci (i.e., linkage equilibrium) (data not shown). We concluded from these results that the genetic data from each collection was consistent with statistical expectations for random association of alleles within and between loci. In other words, each collection represents samples from a single gene pool (i.e., populations), and the genetic diversity observed has no detectable technical artifacts or evidence of natural selection.

Task 2 - Test for differentiation among Lake Wenatchee collections and the associated supplementation program.

We explicitly tested the hypothesis of no significant differentiation within natural-origin or broodstock collections from Lake Wenatchee using a randomization chi-square test. The null hypothesis for these tests was that the allele frequencies from two different populations were drawn from the same underlying distribution. We show the results for the pairwise comparisons among eight temporally replicated natural-origin collections from Lake Wenatchee (28 pairwise tests), and report all tests were non-significant (Table 2A). Similarly, for five temporally replicated broodstock collections, 10 of 10 pairwise tests were non-significant (Table 2B). We also tested if natural-origin and broodstock collections were differentiated from each other over time, and report that 40 of 40 tests were non-significant (Table 2C). The nominal level of statistical significance ($\alpha = 0.05$) was adjusted for multiple comparisons using strict Bonferroni correction (Rice 1989). Yet, there are perhaps slight differences between paired natural-broodstock collections. Note that the p-values for comparisons regarding 2006 and 2007 paired collections are lower than for comparisons regarding 2000, 2001, and 2004. The small sample sizes for broodstock collections in 2006 and 2007 may not have been random samples from the Lake Wenatchee sockeye population.

Given the consistencies observed for allele frequency distributions over time, metrics of population structure were expected to be small. This was the case, as the estimated F_{ST} over all thirteen collections was 0.0003. This observed value fell within the distribution of F_{ST} values expected if there were no population structure present (permutation test p-value 0.12). Analysis of the paired natural-broodstock collections corroborated this result. Pairwise estimates of F_{ST} were 0.000 for years 2000, 2001, 2004, and 2007, and 0.002 for 2006. All five estimates were non-significant. Essentially, all 13 sockeye collections could be considered samples from the same population. Given these results, it is valid to combine all collections for statistical analysis. Therefore, we did not calculate genetic distances among any collections, as it is inappropriate to estimate distances that are effectively zero.

Conclusions

We interpret these data to indicate that there appears to be no significant year-to-year differences in allele frequencies among natural-origin or broodstock collections, nor are there observed differences between collections pre- and post-supplementation. As a result, we accept the null hypothesis that the allele frequencies of the broodstock collections equal the allele frequencies of the natural collections, which equals the allele frequency of the donor population. Furthermore, the observed genetic variance that can be attributed to among collection differences was negligible.

Task 3 - Calculate N_e using the temporal method for multiple samples from the same location to document trend.

The fundamental parameter for inferring N_e using genetic data is the standardized variance in allele frequency ($\hat{F}$) (Pollack 1983). Methods estimate N_e from observed changes in $\hat{F}$ over temporally replicated collections from the same location. Yet, as previously shown, there were no statistically significant differences detected in allele frequencies. The underlying model for estimating N_e produced estimates with extremely large variances, given small temporal differences in $\hat{F}$, which rendered any trend in N_e unobservable. Table 3 shows N_e estimates calculated using temporally replicated natural collections.

Task 4 - Compare N_e estimates with trend in census size for Lake Wenatchee sockeye.

See Task 3

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Table 1 Lake Wenatchee sockeye collections analyzed. MNA is the mean number of alleles per locus, Hz is unbiased heterozygosity, Obs Hz is observed heterozygosity, and HW is the p-value of the null hypothesis of random association of alleles (i.e., Hardy – Weinberg equilibrium). For reference, the nominal level of statistical significance at $\alpha = 0.05$ is 0.0002 after correction for multiple tests.

Year	Collection Code	Tissue Type	Source	N	MNA	Hz	Obs Hz	HW
1989	89[1]	Scales	Natural	96	14.35	0.792	0.791	0.424
1990	90[1]	Scales	Natural	96	13.19	0.793	0.779	0.131
2000	00AAE	Scales	Broodstock	96	12.31	0.787	0.776	0.213
2000	00[1]	Scales	Natural	96	11.76	0.801	0.826	0.868
2001	01AAS	Scales	Broodstock	53	9.47	0.788	0.793	0.392
2001	01[1]	Scales	Natural	96	14.35	0.786	0.794	0.456
2002	02[1]	Scales	Natural	96	14.53	0.794	0.777	0.780
2004	04[1]	Scales	Natural	96	14.65	0.798	0.803	0.704
2004	04AAV	Scales	Broodstock	43	14.35	0.796	0.795	0.051
2006	06CN	Tissue	Broodstock	38	14.59	0.793	0.785	0.688
2006	06CO	Tissue	Natural	96	14.53	0.806	0.803	0.408
2007	07EE	Tissue	Broodstock	18	14.00	0.790	0.790	0.221
2007	07EF	Tissue	Natural	96	14.35	0.789	0.800	0.347

[1] Samples taken from scale cards provided by Jeff Fryer (CRITFC)

Table 2 Allelic differentiation for Lake Wenatchee sockeye collections. A single analysis tested (pairwise) the allelic differentiation between all thirteen collections; however p-values for G-statistics are partitioned in the table by A) natural-origin, B) broodstock, and C) natural versus broodstock. Underlined values are for paired natural-broodstock collections from the same year. For reference, the nominal level of statistical significance at α = 0.05 is 0.0006 after correction for multiple tests. No significant values were observed.

A) Natural-Origin Collections

	89	90	00	01	02	04	06CO	07EF
89		0.257	0.359	0.531	0.331	0.127	0.031	0.263
90			0.953	0.148	0.753	0.903	0.077	0.283
00				0.328	0.527	0.607	0.604	0.400
01					0.209	0.081	0.127	0.093
02						0.085	0.707	0.235
04							0.312	0.577
06CO								0.435
07EF								

B) Broodstock Collections

	00AAE	01AAS	04AAV	06CN	07EE
00AAE		0.189	0.090	0.008	0.058
01AAS			0.122	0.020	0.116
04AAV				0.008	0.031
06CN					0.326
07EE					

C) Natural vs. Broodstock

	89	90	00	01	02	04	06CO	07EF
00AAE	0.027	0.309	0.572	0.018	0.041	0.012	0.093	0.040
01AAS	0.115	0.471	0.160	0.219	0.519	0.049	0.654	0.133
04AAV	0.136	0.219	0.210	0.423	0.208	0.328	0.037	0.153
06CN	0.029	0.004	0.053	0.007	0.022	0.004	0.019	0.001
07EE	0.099	0.229	0.053	0.015	0.093	0.178	0.090	0.037

Table 3 Estimation of N_e for temporally replicated natural-original sockeye collections. Above the diagonal are pairwise estimates of N_e, where negative values mean sampling variance can account for genetic variance observed (i.e., genetic drift unnecessary). Below the diagonal are variances for pairwise estimates of N_e. Absent variance values (denoted by **-**) were too large for SalmonNb to display.

Collection	89	90	00	01	02	04	06CO	07EF
89		-3936.6	-1414	-2636.3	671.4	1871.1	1066.1	1951.2
90	2.59E+09		-1490.3	3649.1	-31144	-6808.4	817.6	93190.2
00	1.40E+09	4.45E+09		-592.2	-6842.2	-667.1	-1736.9	-1350.1
01	1.21E+09	1.47E+09	2.33E+09		977.1	6160.4	387.8	2531.5
02	1.91E+09	1.33E+09	1.16E+09	2.29E+09		1495.6	-848.5	3213.6
04	2.21E+09	3.62E+09	4.08E+09	1.27E+09	1.14E+09		896.6	2155.3
06CO	1.34E+09	1.39E+09	1.73E+09	**-**	4.51E+09	1.2E+09		3278.6
07EF	2.15E+09	1.51E+09	1.18E+09	1.68E+09	**-**	1.36E+09	2.65E+09	

Appendix L

Wenatchee Spring Chinook Redd Estimates, 2019

Estimates of Wenatchee Spring Chinook Redds in 2019

Kevin See[1,*]

February 19, 2020

Abstract

This report contains estimates of total spring Chinook redds in the Wenatchee subbasin, after accounting for observer bias.

Contents

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Table 1: Net error model covariates and coefficients.

Covariate	Estimate	Std. Error
(Intercept)	-0.122	0.016
Less than 1 Season Experience	-0.271	0.061
Mean Thalweg CV	-0.060	0.016
Obs. Redd Density	0.042	0.017

1 Introduction

Redd counts are an established method to provide an index of adult spawners (Gallagher et al. 2007). In the Wenatchee subbasins, reaches are surveyed weekly during the spring Chinook spawning season (Jul 24, 2019 - Sep 28, 2019). The goal of this work is to:

1. Predict observer net error, using the model described in Murdoch et al. (2019).
2. Use estimates of observer net error rates to estimate the number of redds in each reach, using the methods described in Murdoch et al. (2019).
3. Sum the total number of estimated redds by stream and for the entire Wenatchee subbasin.

2 Methods

2.1 Net Error Model

The net error (NE) for a reach i is defined as

$$NE_i = \frac{E_i - M_i}{V_i}$$

where E_i is the number of features erroneously called as redds, M_i is the number of actual redds missed by the surveyor, and V_i is the true number of redds in the reach. Therefore, if we have an estimate of net error ($\hat{NE_i}$), we can calcultate the true number of redds based on that estimqte and the number of redds the surveyor reported, F_i:

$$V_i = \frac{F_i}{\hat{NE_i} + 1} \tag{1}$$

The model for observer net error is fully described in Murdoch et al. (2019). It uses covariates of the observer experience (rookie or experienced), mean discharge, the observed redd density and mean thalweg CV as a proxy for channel complexity. After normalizing these covariates, the model coefficients are shown in Table 1. The response, net error, is scaled such that estimates of net error less than 0 suggest more errors of omission, while estimates greater than 0 suggest more errors of commission. An estimate of net error equal to zero would indicate the observed count equals the true number of redds.

2.2 Data

Redd counts were conducted on a nearly weekly basis for index reaches, and once during the peak spawning period for non-index reaches. The covariates in the observer error model of Murdoch et al. (2019) were collected during each survey. They were compared with the covariates contained in the model data set, as well as the estimates of net error (Figure 1).

Because each reach was surveyed by the same surveyor(s) each week, the experience level remained constant through the season, as did the mean thalweg CV. The observed redd density was calculated by taking the

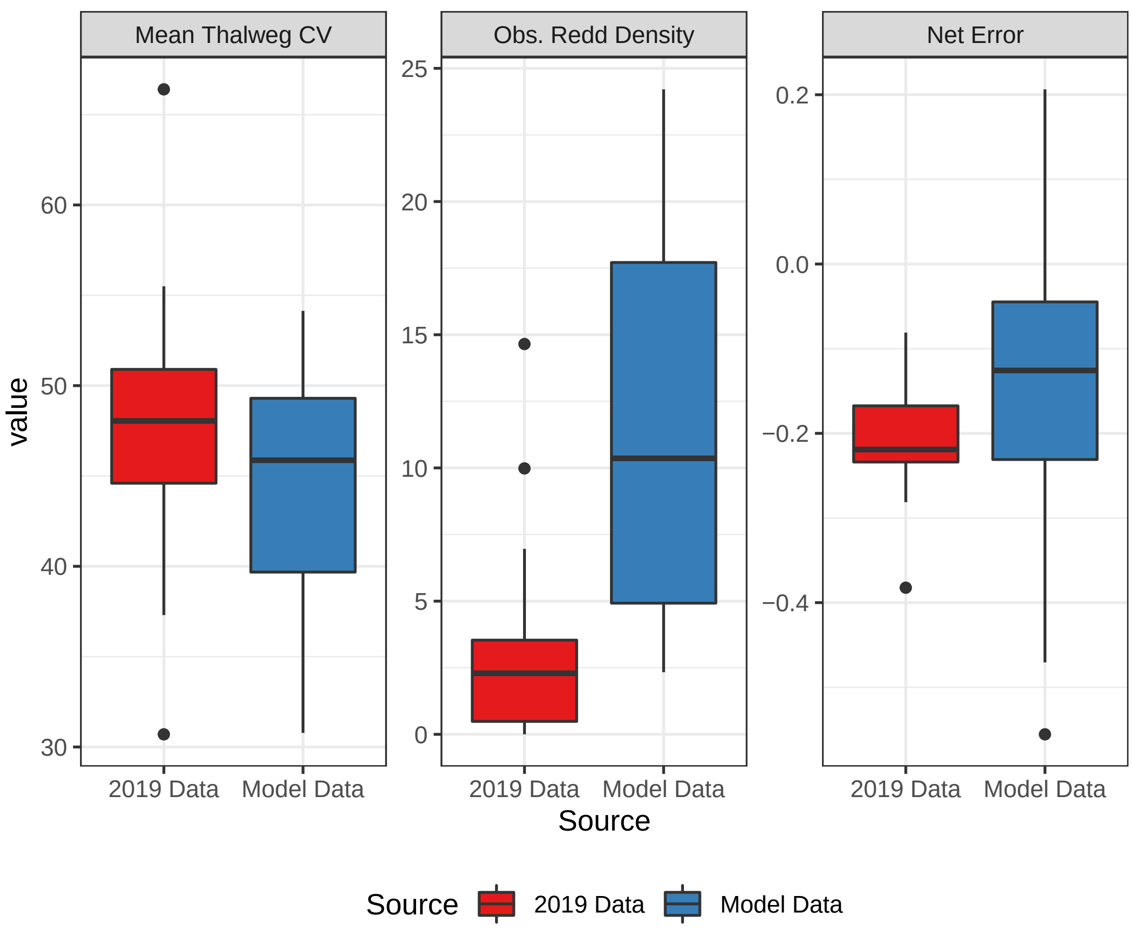

Figure 1: Net error covariate values from the original study the predicted reaches in this report.

total number of new redds found through the entire season, and dividing by the reach length. From these covariates, predictions of net error and a its standard error could be made.

2.3 Estimating Redds

Estimates of total redds were made for each reach where an estimate of net error was available, following equation (1). The observer error model was not used for minor spawning tributaries because observer error was assumed to tend toward zero because of the characteristics of minor tributaries: relatively small size ($<$ 10 m width), low discharge ($<$ 5 CFS) and shallow water depth ($<$0.2 m), which were outside the range of the data set used to develop the observer error model. Redd counts in the minor spawning areas were assumed to be without error and were added to the respective estimated number of redds in each major spawning stream. As the number of redds observed in the minor reaches ranged from 0 to 3, any violoation of this assumption should not affect the overall estimates very much.

When summing reach-scale estimates to obtain estimates at the stream scale, an attempt was made to incorporate the fact that the reaches within a stream are not independent. Estimates of correlation between the reaches within a stream were made based on weekly observed redds. This method may not be perfect, since spawners could use certain reaches preferentially at different times in the season, but it may be the best we can do. Because correlations are often quite high between reaches, this is a better alternative than to naively assume the standard errors between reaches are independent of one another. These correlation estimates were combined withestimates of standard error at the reach scale to calculate a covariance matrix for the reaches within each stream, which was used when summing estimates of total redds to estimate the standard error at the stream scale. Failure to incorporate the correlations between reaches would result in an underestimate of standard error at the stream scales. Different streams (and therefore reaches in different streams) were assumed to be independent.

3 Results

3.1 Net Error

Net error was estimated for as many reaches as possible. The variability within and between streams is shown in Figure 2.

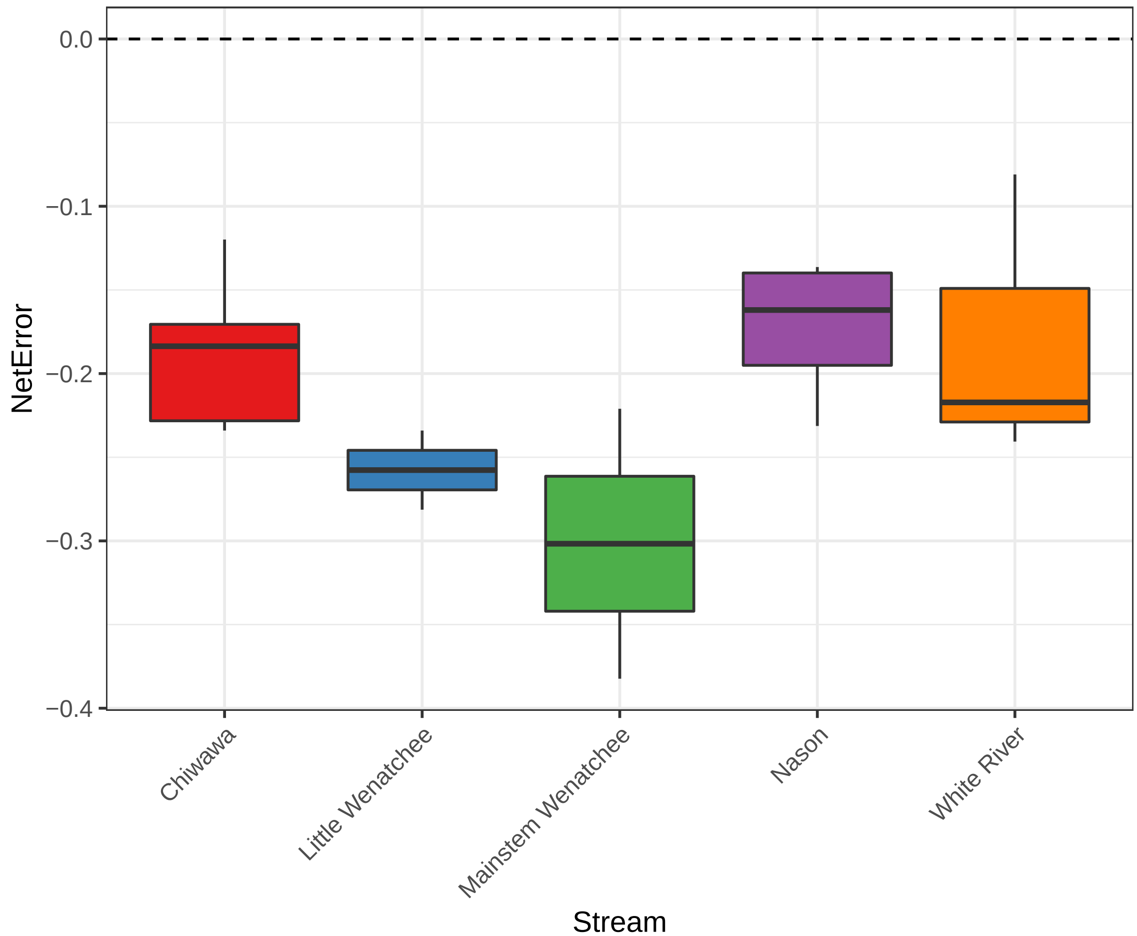

Figure 2: Boxplots showing predicted net error of reaches within each stream. Dashed line shows no error.

3.2 Redd estimates

Redds were estimated at the reach scale using the estimate of net error whenever possible. For a few small tributary reaches, no estimates of observer error were made and instread the small number of observed redds was assumed to be observed without error. The estimated net error, observed redds and estimates of redds at the reach scale are shown in Table 2. The results are summarized at the stream and population scale in Table 3.

4 Discussion

We were able to estimate observer net error, and correct for it, in 18 of the reaches surveyed in 2019. All of the surveyors had more than one season of experience on the spawning grounds conducting redd surveys, so the impact of rookie observers from the observer error model (Murdoch et al. 2019) was not necessary. The observed redd densities were lower in 2019 compared to the model data set in Murdoch et al. (2019), but the estimates of net error were in a very similar range to the model dataset (Figure 1). Every reach with an

Table 2: Estimates of mean net error and redds for each reach.

Stream	Reach	Type	Net Error	Net Error CV	Observed Redds	Estimated Redds	Redds CV
Chiwaukum	U1	Minor	0	-	0	0	-
Chiwawa	C1	Major	-0.12	-0.235	53	60	0.032
Chiwawa	C2	Major	-0.164	-0.129	121	145	0.025
Chiwawa	C3	Major	-0.184	-0.16	5	6	0.037
Chiwawa	C4	Major	-0.177	-0.151	13	16	0.032
Chiwawa	C5	Major	-0.234	-0.147	17	22	0.045
Chiwawa	C6	Major	-0.223	-0.151	15	19	0.044
Chiwawa	C7	Major	-0.233	-0.158	2	3	0.042
Chiwawa	K1	Minor	0	-	2	2	0
Chiwawa	PH1	Minor	0	-	0	0	-
Chiwawa	R1	Minor	0	-	1	1	0
Icicle	I1	Minor	0	-	0	0	-
Icicle	I2	Minor	0	-	1	1	0
Icicle	I3	Minor	0	-	0	0	-
Little Wenatchee	L2	Major	-0.234	-0.162	1	1	0.065
Little Wenatchee	L3	Major	-0.281	-0.16	9	13	0.06
Mainstem Wenatchee	W10	Major	-0.221	-0.162	7	9	0.046
Mainstem Wenatchee	W9	Major	-0.382	-0.179	1	2	0.09
Nason	N1	Major	-0.183	-0.161	14	17	0.036
Nason	N2	Major	-0.231	-0.143	37	48	0.043
Nason	N3	Major	-0.141	-0.133	107	125	0.022
Nason	N4	Major	-0.136	-0.123	39	45	0.019
Peshastin	D1	Minor	0	-	0	0	-
Peshastin	P1	Minor	0	-	0	0	-
Peshastin	P2	Minor	0	-	0	0	-
White River	H2	Major	-0.217	-0.165	0	0	-
White River	H3	Major	-0.241	-0.149	12	16	0.047
White River	H4	Major	-0.081	-0.477	0	0	-
White River	Q1	Minor	0	-	3	3	0
White River	T1	Minor	0	-	0	0	-

Table 3: Estimate of redds for each stream

Stream	Observed Redds	Mean Net Error	Estimated Redds	Std. Error Redds	Redds CV
Chiwaukum	0	-	0	0	-
Chiwawa	229	-0.191	274	7.1	0.026
Icicle	1	-	1	0	0
Little Wenatchee	10	-0.258	14	0.8	0.058
Mainstem Wenatchee	8	-0.302	11	0.5	0.045
Nason	197	-0.173	235	5.9	0.025
Peshastin	0	-	0	0	-
White River	15	-0.18	19	0.7	0.039
Total	**460**	**-**	**554**	**9.3**	**0.017**

estimated net error had an estimate of less than 0, suggesting there were always more redds missed (omission error) than false IDs (commission error).

5 Acknowledgements

The data for this report was collected by Washington Department of Fish and Wildlife. Development of the observer error model was done in collaboration with Andrew Murdoch, WDFW.

6 References

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Murdoch, A. R., C. H. Frady, M. S. Hughes, and K. E. See. 2019. Estimating population size and observation bias for spring Chinook Salmon. Conservation Science and Practice 1(11):e120.

Appendix M

Genetic Diversity of Chiwawa River Spring Chinook Salmon

Assessing the Genetic Diversity of Natural Chiwawa River Spring Chinook Salmon and Evaluating the Effectiveness of its Supportive Hatchery Supplementation Program

Developed for

Chelan County PUD

and the

Habitat Conservation Plan's Hatchery Committee

Developed by
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March 30, 2007

Table of Contents

Executive Summary

The main objective of this study was to determine the potential impacts of the Chiwawa River Supplementation Program on natural spring Chinook in the upper Wenatchee system. We did this by investigating population differentiation between temporally replicated Chiwawa River natural and hatchery samples from the Wenatchee River watershed using microsatellite DNA allele frequencies and the statistical assignment of individual fish to specific populations. Additionally, to assess the genetic effect of the hatchery program, we investigated the relationship between census and effective population sizes using collections obtained before and after the supplementation program. In this summary, we briefly describe the salient results contained within this report; however, each "Task" within the Results/Discussion section below contains extended coverage for each topic along with an expanded interpretation of each result.

Overall, we observed substantial genetic diversity within collections, with heterozygosities equal to roughly 80%, over thirteen microsatellite markers. Microsatellite allele frequencies among temporally replicated collections from the same population (i.e., location) were variable, resulting in significant genetic differentiation among these collections. However, these difference are likely the result of salmon life history in this area, as four-year-old Chinook comprise a majority of returns each year. That is, the genetic tests are detecting the differences of contributing parents from each cohort, rather than a hatchery effect.

Analysis of Chiwawa River Collections

To assess the multiple competing hypotheses regarding population differentiation within and among Chiwawa River collections, we found it necessary to organized the Chiwawa genetic data into three data sets: (1) fish origin (hatchery versus natural), (2) spawning location (hatchery broodstock versus in-river (natural) spawners), and (3) four "treatment" groups (1. hatchery-origin hatchery broodstock, 2. hatchery-origin natural spawner, 3. natural-origin natural spawner, and 4. natural-origin hatchery broodstock). We conducted separate analyses using each of the three data sets, with each analysis touching on some aspect of the components necessary to move through the Conceptual Process outlined by Murdoch and Peven (2005).

Origin Dataset – We report that allele frequencies within and between natural- and hatchery-origin collections are significantly different, but there does not appear to be a robust signal indicating that the recent natural-origin collections have diverged greatly from the pre- or early post-supplementation collections. Genetic drift will occur in all populations, but does not appear to be a major factor affecting allele frequencies within the Chiwawa collections.

Spawning Location Dataset – There are significant allele frequency differences within and between hatchery broodstock and natural spawner collections. However, in recent years the allele frequency differences between the hatchery broodstock and natural spawner collections have declined. Furthermore, based on linkage disequilibrium, there is a genetic signal that is consistent with increasing homogenization of allele frequencies within hatchery broodstock collections, but a similar homogenization within the natural spawner collection is not apparent. These data suggest that there exists consistent year-to-year variation in allele frequencies among hatchery and natural spawning collections, but there is a trend toward homogenization of the allele frequencies of the natural- and hatchery-origin fish that compose the hatchery broodstock.

Four Treatment dataset – Although there are signals of allelic differentiation among Chiwawa River collections, there are no robust signs that these collections are substantially different from each other. We used two different analyses to measure the degree of genetic variation that exists among individuals and collections within the Chiwawa River. First, we conducted a principal component analysis using all Chiwawa samples with complete genotypes (i.e., no missing alleles from any locus). Although the first two principal component axes account for only 10.5% of the total molecular variance, a substantially greater portion of that variance is among individual fish, regardless of their identity, rather than among hatchery and natural collections. The variances in principal component scores among individuals are 11 and 13 times greater than the variance in scores among collections.

Secondly, using an Analysis of Molecular Variance (AMOVA), we were able to determine how best to group populations, with "best" being defined as that grouping that accounts for the greatest proportion of among group (i.e., population) variance. Furthermore, by partitioning molecular variance into different hierarchical components, we are able to determine what level accounts for the majority of the molecular variance. The AMOVA results clearly show that nearly all molecular variation, no matter how the data are organized, resides within a collection. The percentage of total molecular variance occurring within collections ranged from 99.68% to 99.74%. These results indicate that the significant differences among collections of Chiwawa fish account for less than one percent of the total molecular variance, and these differences cannot be attributed to fish origin or spawning location.

Effective Population Size (N_e)

The contemporary estimate of N_e calculated using genetic data combined for Chiwawa natural-origin spawners (NOS) and hatchery-origin spawners (HOS) Chinook is N_e=386.8, which is slightly larger than the pre-hatchery N_e we estimated using demographic data from 1989 – 1992. Additionally, the N_e /N ratio calculated using 386.8 for N_e and the arithmetic mean yearly census of NOS and HOS Chinook from 1989 – 2005 for N is 0.40. These results suggest the N_e has not declined during the period of Chiwawa Hatchery Supplementation Program operation.

Analysis Of Upper Wenatchee Tributary Collections

We compared genetic data for spring Chinook collected from the major spawning aggregates of the Wenatchee River. We observed significant differences in allele frequencies among temporally replicated collections within populations, and among populations within the upper Wenatchee. However, these differences account for a very small portion of the overall molecular variance, and these populations overall are very similar to each other. Of all the populations within the Wenatchee River, the White River appears to be the most distinct. Yet, this distinction is more a matter of detail than of large significance, as the median F_{ST} between White River collections and all other collections (except the Little Wenatchee collection; see Results/Discussion) is less than 1.5% among population variance. We consider the implications of these results in the Conclusion section that follows the Results/Discussion section. Additionally, there is no evidence that the Chiwawa River Supplementation Program has changed the allele frequencies in the Nason Creek and White River populations, despite the presence of hatchery-origin fish in both these systems.

Introduction

Murdoch and Peven (2005) outlined 10 objectives to assess the impact (positive or negative) of hatchery operations mitigating the operation of Rock Island Dam. Two objectives relate to monitoring the genetic integrity of populations:

Objective 3: Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program. Additionally, determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.

Objective 5: Determine if the stray rate of hatchery fish is below the acceptable levels to maintain genetic variation between stocks.

This study addresses Objective 3 (above), and documents analyses and results WDFW completed for populations of spring Chinook (*Oncorhynchus tshawytscha*) in the Wenatchee River watershed. This study was not intended to specifically address Objective 5 (above); however, genetic data provide results relevant to Objective 5. The critical component of Objective 3 is to determine if hatchery supplementation has effected change. Furthermore, change in this context means altering census size and/or genetic marker allele frequencies; we did not attempt to measure changes in fitness. Perhaps a more meaningful rewording of Objective 3 is, "Did the hatchery supplementation program succeed at increasing the census size of a target population while leaving genetic integrity intact?" In order to evaluate cause and effect of hatchery supplementation, we surveyed and compared genetic variation in samples collected before and after potential effects from the Chiwawa Hatchery Supplementation Program. Samples were acquired from the primary spawning aggregates in the upper Wenatchee River watershed: Nason Creek, Little Wenatchee River, White River, and Chiwawa River. Hatchery samples were acquired from programs that could potentially affect genetic composition of Wenatchee stocks, the integrated Chiwawa River stock (local stock), Leavenworth National Fish Hatchery spring Chinook (Carson Stock – non local), and Entiat NFH (Carson Stock – non local). Additionally, the genetic markers used were the Genetic Analysis of Pacific Salmonids (GAPS) (Seeb et al. in review) standardized microsatellites, so all data from the Wenatchee study will be available for inclusion in the GAPS Chinook coastwide microsatellite baseline.

History of Artificial Propagation

Artificial propagation in the upper Columbia River began in 1899 when hatcheries were constructed on the Wenatchee and Methow rivers (Mullan 1987). These initial operations were small, with the Tumwater Hatchery on the Wenatchee River releasing several hundred thousand fry, and the Methow River hatchery producing few Chinook salmon before it was closed in 1913 (Craig and Suomela 1941, Nelson and Bodle 1990). The Leavenworth State Hatchery operated in the Wenatchee River Basin between 1913 and 1931 using eggs from non-native stocks (Willamette River spring-run and lower Columbia Chinook hatchery fall-run). These early attempts at hatchery production were largely unsuccessful for spring-run Chinook (WDF 1934). Between 1931 and 1939, no Chinook salmon hatcheries were in operation above Rock Island Dam (Rkm 730).

In 1938, the last salmon was allowed to pass upstream through the uncompleted Grand Coulee Dam (Rkm 959). To mitigate the loss of habitat, adult Chinook salmon were trapped, under the auspices of the Grand Coulee Fish Maintenance Project (GCFMP), at Rock Island Dam beginning in May 1939, and relocated into three of the remaining accessible tributaries to the upper Columbia River: the Wenatchee, Entiat, and Methow Rivers. GCFMP transfers continued through the autumn of 1943. Spring- and summer/fall-run fish were differentiated at Rock Island Dam based on a 9 July cutoff date for Chinook arrivals at Rock Island Dam (Fish and Hanavan 1948). Spring-run adults collected at Rock Island Dam (pre 9 July fish) were either transported to Nason Creek on the Wenatchee River to spawn naturally (1939-43), or to the newly constructed Leavenworth NFH (1940) for holding and subsequent spawning (1940-43). Eggs were incubated on site or transferred to the Entiat NFH (1941) and Winthrop NFH (1941). In 1944 spring-run adults were allowed to freely pass Rock Island Dam. The GCFMP did not differentiate among late-run stocks (post 9 July fish) passing Rock Island Dam. Late-run offspring reared at the Leavenworth NFH, Entiat NFH, and Winthrop NFHs were an amalgamation of summer and fall upper Columbia River populations (Fish and Hanavan 1948). Late-run fish were transplanted into the upper and lower Wenatchee, Methow, and Entiat Rivers.

After 1943, the Winthrop NFH continued to use local spring-run Chinook for hatchery production, while the other NFHs largely focused on summer-run Chinook salmon. Renewed emphasis on spring run production in the mid-1970s saw the inclusion of local and non-local eggs (Carson NFH stock, Klickitat River stock, and Cowlitz River stock) to the NFHs. In the early 1980s, imports of non-native eggs were reduced significantly, and thereafter the Leavenworth, Entiat, and Winthrop NFHs have relied on adults returning to their facilities for their egg needs (Chapman et al. 1995). Regarding late-run Chinook, due to the variety of methods employed to collect broodstock at dams, hatcheries, or the result of juvenile introductions into various areas, Chinook populations and runs (i.e., summer and fall) have been mixed considerably in the upper Columbia system over the past five decades (reviewed in Chapman et al. 1994).

Washington Department of Fish and Wildlife (WDFW) operates two facilities producing spring-run Chinook, the Methow Fish Hatchery (MFH) owned by Douglas County PUD that began operation in 1992 and Eastbank Fish Hatchery (EFH) owned by Chelan County PUD that began operation in 1989. Both programs were designed to implement supplementation (supportive breeding) programs for naturally spawning populations on the Methow and Wenatchee Rivers, respectively (Chapman et al. 1995). As part of the Rock Island Mitigation Agreement between Chelan County Public Utility District and the fishery management parties (RISPA 1989), a supplementation (supportive breeding) program was initiated in 1989 on the Chiwawa River to mitigate smolt mortality resulting from the operation of Rock Island Hydroelectric Project. EFH uses broodstock collected at a weir on the Chiwawa River, although in recent years hatchery fish have been collected at Tumwater Dam. Similarly, the MFHC uses returning adults collected at weirs on the Methow River and its tributaries, the Twisp and Chewuch Rivers (Chapman et al. 1995; Bugert 1998). Although low run size and trap efficiency has resulted in most broodstock being collected from the hatchery outfall or in some years Wells Dam, progeny produced from these programs are reared at and released from satellite sites on the tributaries where the adults were collected. Numerous other facilities have reared spring-run Chinook salmon on an intermittent basis.

Previous Genetic Studies – Population differentiation

Waples et al. (1991a) examined 21 polymorphic allozyme loci in samples from 44 populations of Chinook salmon in the Columbia River Basin. These authors reported three major clusters of Columbia River Basin Chinook salmon: 1) Snake River spring- and summer-run Chinook salmon, and mid and upper Columbia River spring-run Chinook salmon, 2) Willamette River spring-run Chinook salmon, 3) mid and upper Columbia River fall- and summer-run Chinook salmon, Snake River fall-run Chinook salmon, and lower Columbia River fall- and spring-run Chinook salmon. Utter et al. (1995) examined allele frequency variability at 36 allozyme loci in samples of 16 upper Columbia River Chinook populations. Utter et al. (1995) indicated that spring-run populations were distinct from summer- and fall-run populations, where the average genetic distance between spring-run and late-run Chinook were about eight times the average of genetic distances between samples within each group. Additionally, allele frequency differences among spring-run populations were considerably greater than that among summer- and fall-run populations in the upper Columbia River. Utter et al. (1995) also reported hatchery populations of spring-run Chinook salmon were genetically distinct from natural spring-run populations, but hatchery populations of fall-run Chinook salmon were not genetically distinct from natural fall-run populations.

As part of an evaluation of the relative reproductive success for the Chiwawa River supplementation program, Murdoch et al. (2006), used eleven microsatellite loci to assess population differentiation among spring Chinook salmon population samples in the upper Wenatchee River. Murdoch et al. (2006) reported a >99% accuracy of correctly identifying spring-run and fall-run Chinook from the Wenatchee River. They also reported slight, but significantly different genetic variation among wild spring populations and between wild and hatchery stocks. Yet, since the spring-run populations are genetically similar, identifying individuals genetically from the upper tributaries of the Wenatchee River was difficult. This result is exemplified in their individual assignment results, where < 8% of spring-run individuals, hatchery or wild, were correctly assigned using their criterion of an LOD (log of odds) score greater than 2. Murdoch et al. (2006) also reported contemporary natural spring Chinook show heterozygote deficit and low linkage disequilibrium (LD), while contemporary hatchery spring Chinook show heterozygote excess and high LD.

Williamson et al. (submitted) have continued the work of Murdoch et al. (2006) by analyzing Chiwawa River demographic data from 1989 – 2005 to estimate the proportions of recruits that were produced by Chinook with hatchery or wild origin. In an "ideal" population, the genetic size (i.e., effective size or N_e) and the census size are equal; however various demographic factors such as unequal sex ratios and variance in reproductive success among individuals reduces the genetic size below the census size. It is generally thought that the genetic size is approximately 10-33% the census size (Bartley et al. 1992; RS Waples pers. comm.), although values have been reported outside this range (Araki et al. 2007; Arden and Kapuscinski 2003; Heath et al. 2002). Despite being difficult to estimate, the effective population size in many respects is a more important parameter to know than census size, because N_e determines how genetic diversity is distributed within populations and how the forces of evolution (i.e., forces that change genetic diversity over time) will affect the genetic variation present.

Williamson et al. (submitted) used demographic data to 1) investigate the effect of unequal sex ratio on genetic diversity, 2) investigate the effect of variation in reproductive success on genetic diversity, 3) investigate the effect of fluctuations in population size on genetic diversity, and 4) estimate the effective population size, using the inbreeding method (Ryman and Laikre 1991). Most importantly, they use demographic data from 1989 – 2000 to assess the impact of the Chiwawa Hatchery Supplementation Program on the effective population size of natural-origin Chiwawa River spring Chinook. They estimate that the N_e of naturally spawning Chiwawa Chinook (i.e., both hatchery- and wild-origin fish on the spawning grounds) from 1989 –

1992 was N_e = 2683 and in 1997 – 2000 was N_e = 989. They compare spawning ground N_e to estimates calculated from combined broodstock and naturally spawning Chinook demographic data. The combined inbreeding N_e estimate from 1989 – 1992 was N_e = 147 and in 1997 – 2000 was N_e = 490. Williamson et al. (submitted) argue that since the combined N_e estimate is lower than the naturally spawning estimate, the supplementation program has had a negative impact on the Chiwawa River N_e.

Williamson et al. (submitted) also present genetic data for Chinook recovered on spawning grounds in upper Wenatchee River tributaries in 2004 and 2005. These genetic data are derived from the Murdoch et al. (2006) study. They compare samples collected from Chiwawa River (i.e., hatchery and wild), White River, Nason Creek, and Leavenworth Hatchery. Additionally, they include a 1994 Chiwawa River wild smolt sample for comparison with the 2004 brood year. Williamson et al. (submitted) report statistically significant genetic differentiation among Chiwawa River, White River and Nason Creek. Additionally, they report that the 1994 and 2004 Chiwawa River wild samples are not statistically different, but the 2004 Chiwawa wild and hatchery collections are statistically different.

Study Objectives

This study investigated within and among population genetic diversity to assess the effect of the Chiwawa Hatchery's supplemental program on the natural Chiwawa River spring Chinook population. Differences among temporal population samples, the census size, heterozygosity, and allelic diversity were documented. We investigated population differentiation between the Chiwawa River natural and hatchery samples, and among all temporally replicated samples from the Wenatchee River watershed using microsatellite DNA allele frequencies and the statistical assignment of individual fish to specific populations. To assess the genetic effect of the hatchery program, correlation between census and effective population sizes were investigated using temporally replicated samples obtained before and after the supplementation program operation. To address the hypotheses associated with Objective 3 in Murdock and Peven (2005) we developed eleven specific "Tasks" (Blankenship and Murdoch 2006), to which we analyzed specific genetic data. We present the results from these analyses specific to each individual Task.

Methods and Materials

Tissue collection and DNA extraction

We analyzed thirty-two population collections of adult spring Chinook salmon (*Oncorhynchus tshawytscha*) obtained from the Wenatchee River between 1989 and 2006 (Table 1). Nine collections of natural Chinook adults from the Chiwawa River (n=501), and nine collections of Chiwawa Hatchery Chinook (n=595) were collected at a weir located in the lower Chiwawa River. The 1993 and 1994 Chiwawa Hatchery samples are smolt samples from the 1991 and 1992 hatchery brood years, respectively. Additional samples were collected from upper Wenatchee River tributaries, White River, Little Wenatchee River, and Nason Creek. Six collections of natural White River Chinook (n=179), one collection from the Little Wenatchee (n=19), and six collections from Nason Creek (n=268) were obtained. Single collections were obtained for Chinook spawning in the mainstem Wenatchee River and Leavenworth National Fish Hatchery. An additional out-of-basin collection from Entiat River was also included in the analysis. Samples collected in 1992 or earlier are scale samples. All other samples were either fin clips or operculum punches, stored immediately in ethanol after collection. DNA was extracted from stored tissue using Nucleospin 96 Tissue following the manufacturer's standard protocol (Macherey-Nagel, Easton, PA, U.S.A.).

Laboratory analysis

We performed polymerase chain reaction (PCR) amplification on each fish sample using the 13 fluorescently end-labeled microsatellite marker loci standardized as part of the GAPS project (Seeb et al. in review). GAPS genetic loci are: *Ogo*2, *Ogo*4 (Olsen et al. 1998); *Oki*100 (unpublished); *Omm*1080 (Rexroad et al. 2001); *Ots*201b (unpublished); *Ots*208b, *Ots*211, *Ots*212, and *Ots*213 (Grieg et al. 2003); *Ots*3M, *Ots*9 (Banks et al.

1999); *Ots*G474 (Williamson et al. 2002); *Ssa*408 (Cairney et al. 2000). PCR reaction volumes were 10 μL, and contained 1 μL 10x PCR buffer (Promega), 1.0 μL MgCl2 (1.5 mM final) (Promega), 0.2 μL 10 mM dNTP mix (Promega), and 0.1 units/mL Taq DNA polymerase (Promega). Loci were amplified as part of multiplexed sets, so primer molarities and annealing temperatures varied. Multiplex one had an annealing temperature of 50°C, and used 0.37 Molar (M) *Oki*100, 0.35 M *Ots*201b, and 0.20 M *Ots*208b, and 0.20 M *Ssa*408. Multiplex two had an annealing temperature of 63°C, and used 0.10 M *Ogo*2, and 0.25 M of a non-GAPS locus (*Ssa* 197). Multiplex three had an annealing temperature of 56°C, and used 0.18 M *Ogo*4, 0.18 M *Ots*213, and 0.16 M *Ots*G474. Multiplex four had an annealing temperature of 53°C, and used 0.26 M *Omm*1080, and 0.12 M *Ots*3M. Multiplex five had an annealing temperature of 60°C, and used 0.30 M *Ots*212, 0.20 M *Ots*211, and 0.10 M *Ots*9. Thermal cycling was conducted on either a PTC200 thermal cycler (MJ Research) or GeneAmp 9700 (Applied Biosystems) as follows: 95°C (2 min); 30 cycles of 95°C for 30 sec., 30 sec. annealing, and 72°C for 30 sec.; a final 72°C extension and then a 10°C hold. PCR products were visualized by electrophoresis on an ABI 3730 automated capillary analyzer (Applied Biosystems). Fragment analysis was completed using GeneMapper 3.7 (Applied Biosystems). Standardization of genetic data to GAPS allele standards was conducted following Seeb et al. (in review).

Genetic data analysis

Assessing within population genetic diversity - Heterozygosity measurements are reported using Nei's (1987) unbiased gene diversity formula (i.e., expected heterozygosity) and Hedrick's (1983) formula for observed heterozygosity. Both tests are implemented using the microsatellite toolkit (Park 2001). We used GENEPOP version 3.4 (Raymond and Rousset 1995) to assess Hardy-Weinberg equilibrium (HWE), where deviations from the neutral expectation of random associations among alleles are calculated using a Markov chain method (5000 iterations in this study) to obtain unbiased estimates of Fisher's exact test. Global estimates of F_{IS} according to Weir and Cockerham (1984) were calculated using GENEPOP version 3.4. Genotypic linkage disequilibrium was calculated following Weir (1979) using GENEPOP version 3.4.

Linkage results for population collections are reported as the proportion of pairwise (locus by locus) tests that are significant (alpha = 0.01). Linkage disequilibrium is considered statistically significant if more than 5% of the pairwise tests based on permutation are significant for a collection.

Within- and among-population genetic differentiation – The temporal stability of allele frequencies within populations, and pairwise differences in allele frequencies among populations were assessed using several different procedures. First, we tested for differences in allele frequencies among populations defined in Table 1 using a randomization chi-square test implemented in GENEPOP version 3.4 (Raymond and Rousset 1995). This procedure tests for differences between pairs of populations where alleles are randomized between the populations (i.e., genic test). The null hypothesis for this test is that the allele frequency distributions between two populations are the same. A low p-value should be interpreted as the allele frequency distributions being compared are unlikely to be samples drawn from the same underlying distribution.

Second, to graphically describe allele frequency differences among populations we conducted a nonmetric multidimensional scaling analysis using allele-sharing distance matrices from two different data sets. Pairwise allele-sharing distances are calculated as 1 – (mean over all loci of the sums of the minima of the relative frequencies of each allele common to a pair of populations). To calculate the allele-sharing distances for each pair of populations we used PowerMarker v3.25 (Liu and Muse 2005). Nonmetric multidimensional scaling is a technique designed to construct an n-dimensional "map" of populations, given a set of pairwise distances between populations (Manly 1986). The output from this analysis is a set of coordinates along n-axes, with the coordinates specific to the number of n-dimensions selected. To simplify our analysis we selected a 2-dimensional analysis to represent the relative positions of each population in a typical bivariate plot. The goodness of fit between the original allele-sharing distances and the pairwise distances between all populations along the 2-dimensional plot is measured by a "stress" statistic. Kruskal (in Rohlf 2002) developed a five-tier guide for evaluating stress levels, ranging from a perfect fit (stress=0) to a poor fit (stress=0.40). We conducted the nonmetric multidimensional scaling analysis for one data set containing Chiwawa natural- and hatchery-origin collections, and another data set containing Chiwawa broodstock and in-river spawner collections. We used the mdscale module in MATLAB R2006b (The Mathworks 2006) to generate the nonmetric multidimensional scaling coordinates.

We examined the geographic and temporal structure of populations in the upper Wenatchee (Chiwawa River, Nason Creek, and White River, only) using a series of analyses of molecular variance (AMOVAs). Here, we defined an AMOVA as an analysis of variance of allele frequencies, as originally designed by Cockerham (1969), but implemented in Arlequin v2.1 (Schneider et al. 2000). These analyses permit populations to be aggregated into groups, and molecular variance is then partitioned into within collections, among collections, but within groups, and among group components. With this approach, we were able to determine how best to group populations, with "best" being defined as that grouping that accounts for the greatest proportion of among group variance. Furthermore, by partitioning molecular variance into three different hierarchical components, we are able to determine what level accounts for the majority of the molecular variance.

Finally, we explored the partitioning of molecular variance between among-individuals and among-populations using a principal component analysis and multi-locus estimates of pairwise F_{ST}, estimated by a "weighted" analysis of variance (Weir and Cockerham, 1984). Principal component analysis is a data-reduction technique whereby the correlation structure among variables can be used to combine variables into a series of multivariate components, with each original variable receiving a weighted value for each component based on its correlation with that component. Here, we used a program written by Warheit in MATLAB R2006b (The Mathworks 2006) that treats each allele for each locus as a single variable (13 loci = 26 alleles or variables), and these 26 "variables" were arranged into 26 components, with each component accounting for a decreasing amount of molecular variance. Estimates of F_{ST} were calculated using GENETIX version 4.05 (Belkhir et al.1996). To determine if the F_{ST} estimates were statistically different from random (i.e., no structure), 1000 permutations were implemented in GENETIX version 4.05 (Belkhir et al.1996).

Effective population size (N_e) – Estimates of the effective population size were obtained using two methods, a multi-collection temporal method (Waples 1990), and a single-collection method (Waples 2006) using linkage disequilibrium data. The temporal method assumes that cohorts are used, but we did not decompose the collection year samples into their respective cohorts using age data. Therefore, N_e estimates that pertain to individual year classes of breeders are not valid; however the harmonic mean over all samples will estimate the contemporary N_e. Comparing samples from years *i* and *j*, Waples' (1990) temporal method estimates the effective number of breeders ($\hat{N}_{b(i,j)}$) according to:

$$\hat{N}_{b(i,j)} = \frac{b}{2(\hat{F} - 1/\hat{S}_{i,j})}$$

The standardized variance in allele frequency ($\hat{F}$) is calculated according to Pollack (1983). The parameter b is calculated analytically from age structure information and the number of years between samples (Tajima 1992). The age-at-maturity information required to calculate b was obtained from Murdoch et al. (2006) for this analysis. They observed for Chiwawa Hatchery Chinook that 8.6% matured at age 2, 4% at age 3, 87% at age 4, and 0.4% at age 5. For Chiwawa natural Chinook, Murdoch et al. (2006) observed that 1.8% matured at age 3, 81.6% at age 4, and 16.7% at age 5. The harmonic mean of sample sizes from years *i* and *j* is $\tilde{S}_{i,j}$. Over all pairwise comparisons the harmonic mean of all $\hat{N}_{b(i,j)}$ is $\tilde{N}_b$, the contemporary estimate of the effective population size (N_e). SALMONNb (Waples et al. 2007) was used to calculate $\tilde{N}_b$. As suggested by authors, alleles with a frequency below 0.05 were excluded from the analysis to reduce potential bias.

The method of Waples (2006) uses linkage disequilibrium (i.e., mean squared correlation of allele frequencies at different gene loci) as a means of estimating effective population size (N_e) from a single sample. While this method is biased in some cases where N_e /N ratio is less the 0.1 and the sample size is less than the true N_e, it has been shown to produce comparable results to the temporal method. Burrows' delta method is used to estimate LD, and a bias corrected estimate of N_e is calculated after eliminating alleles with frequency less than 0.05. This test was implemented using LDN$_e$ (Do and Waples unpublished). In age-structured species, N_e estimates based on LD are best interpreted as the effective number of breeders (N_b) that produced the sample (Waples 2006). N_b should be multiplied by the mean generation length (i.e., 4 in this case) to obtain an overall estimate of N_e based on an N_b estimate. We analyzed collections categorized by spawning location (i.e., hatchery broodstock or in-river) and did not analyze collections categorized by origin (i.e., hatchery or natural). Waples' (2006) method estimates N_e from observed LD, therefore the corresponding N_e estimates for the hatchery collections would be low and the estimates for the natural collections would be high. Yet, since the supplementation program is integrated, and hatchery fish can spawn naturally, we feel it inappropriate to analyze the hatchery and natural samples as if they were separate, which would essentially partition all the LD into the hatchery samples.

Each collection has an N_b estimate and an associated confidence interval. If the confidence interval includes infinity, it means that sampling error accounts for all the LD observed (i.e., empirical LD is less than expected LD). The usual interpretation is that there is no evidence for any disequilibrium caused by genetic drift in a finite number of parents. Since the LD method estimates the number of breeders that contributed to the sample being analyzed, in order to calculate an N_e /N ratio, the appropriate census size must be used. The census size used to derive a ratio was the estimate four years prior to the collection analyzed using LD, which assumed a strict four-year-old lifecycle, although the observed proportion of four-year-olds was approximately 85% each year. The census numbers (Table 2) used to calculate the ratios for Chiwawa broodstock and in-river spawners were combined NOS (natural-origin spawners) and HOS (hatchery-origin spawners) census estimates.

Individual assignment – A population baseline file was constructed containing all 1704 individual Chinook from 34 population collections (Table 1; Chiwawa origin data set plus all samples from other populations). All individuals in the baseline had geneotypes that included nine or more loci. Individual Chinook were assigned to their most likely population of origin based on the partial Bayesian criteria of Rannala and Mountain (1997), using a "jack-knife" procedure, where each individual to be assigned was removed from the baseline prior to the calculation of population likelihoods. This procedure was implemented in a program written by Warheit in MATLAB R2006b (The Mathworks 2006). Two assignment criteria were used, 1) the population with the largest posterior probability for an individual was the "most-likely" population of origin (i.e., all individuals assigned to a collection), and 2) an assignment was consider valid only if the posterior probability was greater than or equal to 0.9. Please note that while the analysis used 34 population collections to assign Rannala and Mountain likelihoods for each individual, these likelihoods were aggregated based on "population" (i.e., Chiwawa, Nason, White, and so on) and posterior probabilities were calculated for population location, rather than individual collections.

Results and Discussion

In this section we combine our presentation and interpretations of the genetic analyses. Additionally, this section will be organized based on the task list presented in the study plan. Overall conclusions are provided following this section.

Task 1: Determine trend in census size for Chiwawa River spring Chinook.

Census data from 1989 – 2005 are provided in Table 2 for the Chiwawa Hatchery broodstock and spring Chinook present in the Chiwawa River. The demographic data for naturally spawning Chinook are based on redd sampling and carcass surveys, while broodstock data are based on Chiwawa hatchery records. As the supplementation program is integrated by design, we also present the proportion of natural-origin broodstock (pNOB) incorporated into the hatchery, in addition to the number of natural-origin (NOS) and hatchery-origin (HOS) spawners present in Chiwawa River. The census size fluctuated yearly, and a general reduction in census size was observed in the mid to late 1990's. This trend was apparent in both the broodstock and in the river. The arithmetic mean census size from 1989 – 2005 for the Chiwawa Hatchery (i.e., broodstock) was N=87.5 per year. The arithmetic mean census size from 1989 – 2005 for the Chiwawa River (i.e., NOS and HOS combined) was N=961.9 per year. For collection years when adult Chiwawa hatchery-origin fish would have been absent in the Chiwawa River (1989 – 1992), the arithmetic mean of natural Chiwawa Chinook census size is N=962.7. We will use this number as the baseline census size to assess if census size has changed. We used two different values for the contemporary census size in the Chiwawa River, NOS only and NOS + HOS. Additionally, we used collection years 2002 – 2005 for the contemporary NOS and HOS estimates, as these are the most recent data and the number of years included for estimation is the same as the pre-hatchery estimate above (i.e., four years). For NOS only, the arithmetic mean census size from 2002 – 2005 was N=536.0. For total census size (i.e., NOS and HOS combined), the arithmetic mean census size from 2002 – 2005 was N=1324.0. For the demographic data presented here, the contemporary census size is larger than the census estimate derived from the years prior to hatchery operation.

<u>Task 2:</u> Document the observed genetic diversity.

Genetic Diversity Categorized By Origin

For Chiwawa River collections categorized by origin (Table 1A), substantial genetic diversity was observed, with heterozygosity estimates over all loci, having a mean of 0.80. Genetic diversity was consistent with expected Hardy-Weinberg random mating genotypic proportions for ten of the eighteen collections. Eight of the nine Chiwawa natural collections were consistent with HWE, and two of nine Chiwawa Hatchery collections were consistent with HWE. F_{IS} is observed to be slight for all Chiwawa population collections, suggesting individuals within collections do not show excessive homozygosity.

The deviations from HWE observed were generally associated with hatchery collections. The two smolt collections (i.e., 1993 and 1994) showed significant deviations from HWE, which may be a function of non-random hatchery practices involving the contributing natural-origin parental broodstocks (i.e., 1991 and 1992 cohort). Deviations from HWE in the remaining hatchery collections may be the result of few individuals being represented in the broodstock (see below).

Additionally, linkage disequilibrium (LD) was also common for Chiwawa hatchery-origin collections and minimal for Chiwawa natural-origin collections. The random association of alleles between loci (i.e., linkage equilibrium) is expected under ideal conditions. LD is observed when particular genotypes are encountered more than expected by chance. Laboratory artifacts (e.g. null alleles) or physical linkage of loci on the same chromosome can cause LD, but the LD we observed was not associated with certain locus combinations, which you would expect if either artifacts or physical linkage were the cause of LD. LD was observed for seven of the nine hatchery-origin collections. As with the deviations from HWE, the high LD in the 1993 and 1994 hatchery-origin collections may be a result of non-random hatchery practices. The substantial LD observed in the hatchery-origin adult collections (collection years 2000, 2001, 2004, and 2006) might be the result of small parental broodstock sizes contributing to those returning adults. During the mid 1990's, the Chiwawa broodstock size was low, with zero individuals collected in 1995 and 1999; so fewer individuals would be contributing to the hatchery adult returns than the natural. This idea is corroborated by the lower LD observed for the 2005 hatchery-origin collection, which had a contributing parental broodstock size in 2001 (i.e., the major contributing parental generation) approximately eight times as large as the previous few collection years (Table 2). LD reappears in the 2006 Chiwawa hatchery-origin collection, which had a contributing parental broodstock size (i.e., for the most-part, the 2002 hatchery brood year) five times lower (Table 2) than that of the 2005 collection.

While seven of nine hatchery-origin collections showed significant LD, only one natural origin collection showed LD, and for this collection, only 10% of the loci-pairs were in disequilibrium (Table 1). The fact that LD predominated in the hatchery samples, suggests that variance in reproductive success (i.e., overrepresentation of particular parents) is higher in the hatchery-origin than in natural-origin collections.

Genetic Diversity Categorized By Spawning Location

For upper Wenatchee River collections categorized by spawning location (Table 1B), substantial genetic diversity was observed, with heterozygosity estimates over all loci, having a mean of 0.79 and ranging from a low of 0.69 (1993 White River) to 0.85 (1993 Little Wenatchee). Genetic diversity was consistent with HWE for nineteen of twenty-nine population collections. For the collections that departed from HWE, seven were from the Chiwawa River, one was from Leavenworth Hatchery, one was the Wenatchee mainstem collection of hatchery-origin – naturally spawning fish, and one was from the White River. F_{IS} is observed to be slight for all population collections except the 1993 White River collection (10% heterozygote deficit) (Table 1B). Collections deviating with HWE generally correlated with collections having high LD. Twelve population collections showed a proportion of pairwise linkage disequilibrium tests (across all loci) greater than 5% (Table 1B), eight of which were Chiwawa collections.

Starting in 1996, spawning location collections are composed of both natural- and hatchery-origin samples. The LD seen in the later spawning location collections may be caused by an admixing effect (i.e., mixing two populations), where random mating has not had the chance to freely associate alleles into genotypes. Interestingly, there appears to be a trend of reducing LD through time within the broodstock collections (Table 1B), which suggests that a “homogenizing” effect is taking place within the Chiwawa River. This observation is discussed more fully in Task 3 below.

<u>Task 3:</u> Test for population differentiation among collections within the Chiwawa River and associated supplementation program.

Introduction

Task 3 was designed to address two hypotheses listed as part of Objective 3 in Murdoch and Peven (2005):

- Ho: Allele frequency $_{\text{Hatchery}}$ = Allele frequency $_{\text{Naturally produced}}$ = Allele frequency $_{\text{Donor pop}}$.
- Ho: Genetic distance between subpopulations $_{\text{Year x}}$ = Genetic distance between subpopulations $_{\text{Year y}}$

Murdoch and Peven (2005) proposed these two hypotheses to help evaluate the Chiwawa supplementation program through the "Conceptual Process" (Figure 5 in Murdoch and Peven 2005; repeated here as Figure 1). There are two components to the first hypothesis, which must be considered separately. The first component involves comparisons between natural-origin populations in the Chiwawa to determine if there have been changes in allele frequencies or genetic distances, through time starting with the donor population. Documenting a change does not necessarily indicate that the supplementation program has directly affected the natural origin fish, as additional tests would be necessary to support that hypothesis. The intent of the second component is to determine if the hatchery produced populations have the same genetic composition as the naturally produced populations.

Although on the surface these two components and their associated comparisons may appear simple, from a hypothesis-testing perspective the analyses are complicated by the fact that natural-origin fish may have had hatchery-origin parents, and hatchery-origin fish may have had natural-origin parents. As such, we organized the Chiwawa genetic data into three data sets: (1) fish origin (hatchery versus natural), (2) spawning location (hatchery broodstock versus in-river (natural) spawners), and (3) four "treatment" groups (1. hatchery-origin hatchery broodstock, 2. hatchery-origin natural spawner, 3. natural-origin natural spawner, and 4. natural-origin hatchery broodstock). We conducted separate analyses using each of the three data sets, with each analysis touching on some aspect of the components necessary to move through the Conceptual Process (Figure 1).

Hatchery- Versus Natural-Origin

We address the following questions with the origin data set:

1. Are there changes in allele frequencies and allele sharing distances in the natural-origin collections from pre-supplementation to today?
2. Are there changes in allele frequencies and allele sharing distances in the hatchery-origin collections from early supplementation to today?
3. Are there significant differences in allele frequencies and large allele sharing distances between hatchery- and natural-origin adults from a collection year, and has this pattern changed through time?

Genic Differentiation Tests – We explicitly tested the hypothesis of no significant differentiation within natural- or hatchery-origin collections from the Chiwawa River using a randomization chi-square test. We show the results for the pairwise comparisons among natural-origin collections from the Chiwawa River populations in the first block of the second page of Table 3. Ten of the 36 (28%) pairwise comparisons have highly significant allele frequency differences, while only 12 of the 36 comparisons (33%) showed no significant differences. Eight of these 12 comparisons involved the 1996 collection, which included only eight samples and therefore provided little power to differentiate allele frequencies. If we exclude the 1996 collection, only 14% of the pairwise comparisons showed no significant differences, and here all but one of these comparisons involved the 1989 collection. The 1989 collection appeared to be the least differentiated collection in the natural-origin data set in that all pairwise comparisons were either not significant, or only mildly significant at the nominal critical value. No comparisons involving the 1989 collection were significant using a Bonferroni-corrected critical value, and 1989 is the only natural-origin collection in our data set that can be classified as “pre-supplementation.”

We can interpret these results to indicate that although there appears to be significant year-to-year differences in allele frequencies among post-supplementation collections, the allele frequencies between each post-supplementation collection and the 1989 pre-supplementation collection are not greatly different. However, the level of differentiation does increase from the early post-supplementation years to the more recent years (2001, 2004-2006), although the statistical level of this significance never exceeds the Bonferroni-corrected critical value. Finally, sample sizes were also small for the 1989 collection (n = 36) and we cannot eliminate a reduction in power as a contributing factor for the lack of significance for these tests.

As with the hatchery-origin collections, most pairwise comparisons of allele frequencies between hatchery-origin samples were significant (Table 3, first page, upper block). Out of the 36 pairwise comparisons, all but three are significant at some level, and most comparisons are highly significant. Similar to the natural-origin analysis, the non-significant results were limited to comparisons involving the 1996, which included only eight samples.

As a result of this analysis *we reject the hypothesis that there was no significant differentiation among natural- or hatchery-origin collections from the Chiwawa River*. Furthermore, the allele frequencies of the hatchery-origin collections are significantly different from those of natural-origin collections (Table 3, first page, second block). For those fish collected in the same year, allele frequencies are significantly different between hatchery- and natural-origin collections, although in 2005 the level of significance was below the Bonferroni critical value (Table 3). The next step is to examine the pattern of allelic differentiation to discover first if there is a trend among the data, and second, if this trend suggests that the allele frequency differences among Chiwawa River natural-origin fish collections has been affected by the hatchery-origin fish.

Allele-sharing and Nonmetric Multidimensional Scaling – We constructed a pairwise allele-sharing distance matrix for all hatchery- and natural-origin collections from the Chiwawa River and subjected this matrix to a nonmetric multidimensional scaling analysis, restricting the analysis to two dimensions (Figure 2). The stress statistic for this analysis is 0.09, a value Kruskal (in Rohlf 2002) listed as a good to excellent fit between the actual allele-sharing distances and the Euclidean (straight-line) distances in the plot.

In other words, Figure 2 is a good visual representation of the allele sharing distance matrix; collections with a high percentage of alleles shared will be closer to each other than collections with a lower percentage of alleles shared.

With the exception of the two outlier years (1996 and 1998) the Chiwawa natural-origin collections form a tight cluster indicating an overall common set of shared alleles among these collections. Even if we ignore the 1996 and 1998 hatchery-origin collections, there appears to be a greater variance in shared alleles among the Chiwawa hatchery-origin collections than the natural-origin collections (Figure 2). In fact, the median percentage of alleles shared among the Chiwawa natural-origin collections is 76% compared with 69% alleles shared among the Chiwawa hatchery-origin collections.

Also, there appears to be a convergence in allele sharing distances (i.e., a decrease in allele frequency differences) between the hatchery- and natural-origin fish from the late 1980s/early 1990s to 2006. The series of red arrows in Figure 2 represent the progression of change in hatchery-origin allele sharing distances from 1996 (first adult hatchery origin fish in our analysis) to 2006 and this progression is decidedly in the direction of the natural-origin cluster. However, the most recent natural-origin collections (2001, 2004-2006) appear to have pulled closer to the hatchery-origin collections, compared with the 1989 natural-origin collection (note the close proximity of the 2000 and 1989 natural-origin collections). Nevertheless, the cluster of natural-origin collections adjacent to the hatchery-origin collections in Figure 2 also includes the 1993 natural-origin collection. Qualitatively, it appears that the initial hatchery-origin and natural-origin collections were more different from each other in terms of the percentage of shared alleles than are the most recent hatchery- and natural-origin collections. This may have been a result of a non-random sample of natural-origin fish that was used as broodstock in the initial years of the supplementation program (see discussion in Task 2 concerning deviations from HWE and linkage disequilibrium).

That being said, we do need to emphasize that Figure 2 is dominated by five outlier collections (two each from the 1996 and 1998 collections, and the 1994 smolt collection).

The 1996 and 1998 collections are characterized by small samples sizes, and the 1994 smolt collection has nearly all pairs of loci in linkage disequilibrium (Table 1). If we eliminate these five outlier groups, both the hatchery- and natural-origin collections form a relatively tight cluster. Excluding the five outliers, the median percentage of shared alleles among all pairwise combinations of Chiwawa hatchery versus Chiwawa natural collections is 76%. This compares with a median pairwise percentage of 79% among only Chiwawa natural-origin collections. That is, there are nearly as many alleles shared between the hatchery-origin and natural-origin collections as there are among the natural-origin collections themselves. There is also a narrowing of differences between natural- and hatchery-origin fish from the same collection years from 1993 (76% shared alleles) through 2006 (83% shared alleles).

If allelic differentiation among collections is a function of genetic drift, we would expect a positive correlation between the number of years between two collections and the allele sharing distance. That is, if genetic drift is the primary cause of allele frequency differences between two collections, the greater the number of years between the two collections the larger the allele-sharing distance. For both the natural- and hatchery-origin collections we examined the relationship between the number of years between a pair of collections and the collections' allele-sharing distance (Figure 3). Although the relationship between time interval and allele distance appears to be a positive function in the natural collections, the slope of the regression line is 0.0017, and is not significantly different from zero. Furthermore, the correlation coefficient (r^2) equals 0.1068, which means that the time interval between collections accounts for only 10% of the pairwise differences in allelic distance. The hatchery-origin collections do show a significantly positive slope (0.0037; $p = 0.0254$) and a regression coefficient nearly three times greater than that for the natural-origin collections. However, the correlation coefficient is still relatively small ($r^2 = 0.3290$), indicating that the time interval between collections accounts for one-third of the pairwise differences in allelic distance. The results suggest that if genetic drift is a factor in allelic differentiation between collections, it is only a minor factor, and appears to have affected the hatchery-origin collections more than the natural-origin collections.

If four-year-old fish dominate each collection year, we would expect a closer relationship among collections that are spaced at intervals of four years. The average percentage of alleles shared between two natural-origin collections that are separated by four years or a multiple of four years is 81%, compared with 78% for natural-origin collections separated by years that are not divisible by four. Likewise, for hatchery-origin collections the average percentage of alleles shared is 80% and 75% for collections separated by years divisible and not divisible by four, respectively. Although the percent differences described above are relatively small, they are consistent with the idea that allelic differences between collections are a function of year-to-year variability among different cohorts of four year-old fish.

Summary – The allele frequencies within and between natural- and hatchery-origin collections are significantly different, but there does not appear to be a robust signal indicating that the recent natural-origin collections have diverged greatly from the pre- or early post-supplementation collections. Genetic drift will occur in all populations, but does not appear to be a major factor with the Chiwawa collections. We propose that the differences among collections are a function of differences in allele frequencies among cohorts of the four year-old fish that dominate each collection.

Hatchery Broodstock Versus Natural (In-River) Spawners

We address the following questions with the spawner data set:

1. Are there changes in allele frequencies and allele sharing distances in the natural spawning collections from pre-supplementation to today?
2. Are there changes in allele frequencies and allele sharing distances in the hatchery broodstock collections from early supplementation to today?
3. Are there significant differences in allele frequencies and large allele sharing distances between hatchery and natural spawning adults from a collection year, and has this pattern changed through time?

Genic Differentiation Tests – For the most part there are significant differences in allele frequencies among collections for both the hatchery broodstock and natural spawners (Table 4), and these differences are consistent with the origin data set (Table 3). There are four collection years with paired samples (2001, 2004-2006) where we can compare allele frequency differences between the hatchery broodstock and natural spawners, within the same year. The 2001 hatchery broodstock and natural spawner collections have significantly different allele frequencies, but the level of significance decreased from 2001 to 2004, and become non-significant in 2005 and 2006 (Table 4). This indicates that by 2005, the hatchery broodstock and natural spawners collections were effectively sampling from the same population of fish. Additionally, the percentage of alleles shared between the hatchery broodstock and the natural spawners increased from 76% in 2001 to 86% in 2006 (allele sharing distance matrix, not shown). From this analysis, we conclude that although there are year-to-year differences in allele frequencies within the natural and hatchery spawner collections, *there appears to be a convergence of allele frequencies within collection-year, between the natural and hatchery spawner populations*.

Linkage Disequilibrium – Linkage disequilibrium is the correlation of alleles between two loci, and can occur for several reasons. If two loci are physically linked on the same chromosome, than alleles from each of these loci should be correlated. However, linkage between two loci can occur as a result of population bottlenecks, small population sizes, and natural selection. If any of these conditions had occurred or were occurring within the Chiwawa River system, we would expect to find substantial linkage disequilibrium in many or perhaps all Chiwawa collections. However, many Chiwawa collections, especially the natural-origin collections, do not show linkage disequilibrium (Table 1), and it would appear that the linkage disequilibrium within certain Chiwawa collections is not a function of the processes listed above. Linkage disequilibrium can also result if the collection is composed of an admixture. That is, if two or more reproductively isolated populations are combined into a single collection, the collection will show linkage disequilibrium. Each broodstock and natural spawning collection is composed of natural- and hatchery-origin fish. If these hatchery- and natural-origin fish are drawn from the same population, the spawning collections should not show substantial linkage disequilibrium. However, if the hatchery- and natural-origin fish are from different populations (i.e., full hatchery – natural integration has not been achieved), the spawning collections should show substantial linkage disequilibrium.

There are only three Chiwawa spawning collections that are not composed of both hatchery- and natural-origin samples: 1989 (natural-origin, natural spawner), 1993 (natural-origin, hatchery broodstock), and 2001 (natural-origin, natural spawner). Of the 10 spawning collections with both hatchery- and natural-origin fish, seven show significant linkage disequilibrium. Two of the three collections that did not show linkage disequilibrium are the 1996 and 1998 hatchery broodstock collections, which are composed of only seven natural- and six hatchery-origin fish, and two natural- and 19 hatchery-origin fish, respectively. Within the hatchery broodstock collections with linkage disequilibrium, the percent of loci pairs showing linkage decreased from 32% in 2000 to 13% in 2001 and 2004, to only 1% and 5% in 2005 and 2006, respectively (Table 1). If the homogenization of allele frequencies of natural- and hatchery-origin fish was increasing from 2000 to 2006, we would expect a decrease in linkage disequilibrium among the broodstock collections. This is what occurred within the hatchery broodstock collections, but did not occur within the natural spawner collections, where the percent of loci pairs showing linkage was 18% in 2004, 6% in 2005, and 10% in 2006 (Table 1). Furthermore, the 2001 natural spawner collection, with no hatchery-origin component showed linkage disequilibrium with 9% of loci pairs.

There is no correlation between percent of loci pairs showing linkage disequilibrium and percent of broodstock composed of hatchery-origin fish ($r^2 = 0.0045$). Furthermore, the natural spawner and hatchery broodstock collections were each composed of roughly the same average percentage of hatchery-origin fish (57% and 53%, respectively). If the decrease in linkage disequilibrium among the hatchery broodstock collections from 2000 to 2006 was a result of a homogenization of allele frequencies of natural- and hatchery-origin fish in the broodstock, the same degree of homogenization did not occur within the natural spawner collections. This would occur if natural- and hatchery-origin fish spawning within the river remain segregated, either by habitat or by fish behavior.

Summary – As with the origin data set, there are significant allele frequency differences within and between hatchery broodstock and natural spawner collections. However, in recent years the allele frequency differences between the hatchery broodstock and natural spawner collections has declined. Furthermore, based on linkage disequilibrium, there is a genetic signal that is consistent with increasing homogenization of allele frequencies within hatchery broodstock collections, but a similar homogenization within the natural spawner collection is not apparent. These data suggest that there exists consistent year-to-year variation in allele frequencies among hatchery and natural spawning collections, but there is a trend toward homogenization of the allele frequencies of the natural- and hatchery-origin fish that compose the hatchery broodstock.

Four Treatment Groups

Analyses of genetic differences between hatchery (broodstock) and natural spawner collections is confounded by the fact that each these two groups are composed of fish of natural- and hatchery-origin. To understand the effects of hatchery supplementation on *natural-origin fish that spawn naturally*, we needed to divide the Chiwawa data set into four mutually exclusive groups: (1) hatchery-origin hatchery broodstock, (2) hatchery-origin natural spawner, (3) natural-origin hatchery broodstock, and (4) natural-origin natural spawner, with each group consisting of multiple collection years, for a total of 25 different groups.

Allele-sharing and Nonmetric Multidimensional Scaling –As with previous analyses discussed above, we constructed a pairwise allele-sharing distance matrix for all collections from each of these treatment groups and subjected this matrix to a nonmetric multidimensional scaling analysis, restricting the analysis to two dimensions. Figure 4 shows that five outlier groups dominate the allele-sharing distances within this data set. These outlier groups are also present in Figure 2, as discussed above, and Figure 2 and 4 resemble each other because the same fish are included in each analysis. The difference between Figures 2 and 4 is that in Figure 4 the fish are grouped into collection year and the four treatment groups, rather than collection year and two treatment groups (hatchery- versus natural-origin).

Figure 4 does not provide useful resolution of the groups within the polygon, because the outlier groups dominate the allele sharing distances. We removed the five outlier groups from Figure 4, recalculated the allele sharing distances and subjected this new matrix to a multidimensional scaling analysis (Figure 5). Figure 5 shows separation among the 2001, 2004-2006 collections, but this separation does not necessarily indicate that within-year collections are more similar to each other than any collection is to a collection from another year. For example, the 2006 natural-origin natural spawner and the 2005 natural-origin hatchery broodstock collections share 81% alleles, while the 2006 natural-origin natural spawner and 2006 hatchery-origin hatchery broodstock collections share 75% alleles. There does not appear to be any discernable pattern of change in allele-sharing distance among the collections relevant to pre- or post-supplementation. Although the 1989 pre-supplementation natural-origin collection appears distinct (Figure 5), the 1993 natural-origin hatchery broodstock collection appears quite similar to the 2005 and 2006 natural-origin collections (Figure 5). The 1993 natural-origin hatchery broodstock collection, although not technically pre-supplementation, is composed of fish whose ancestry cannot be traced to any Chiwawa hatchery fish. Therefore, there is no clear pattern of allele sharing change from pre-supplementation to recent collections.

There does appear to be some change in the average percentage of alleles shared within the 2001 to 2006 collections, with an increase from 74% in 2001 and 2004 to 78% and 79% in 2005 and 2006, respectively. The results provided by this analysis are consistent with the results presented in the origin and spawner data sets. That is, there are allele frequency and allele sharing differences among the collections, but analyses do not strongly suggest that these differences are a function of the supplementation program. Furthermore, there is also a weak signal that the hatchery and natural collections within the most recent years are more similar to each other than in the previous years.

Overall Genetic Variance – Although there are signals of allelic differentiation among Chiwawa River collections, there are no robust signs that these collections are substantially different from each other. We used two different analyses to measure the degree of genetic variation that exists among individuals and collections within the Chiwawa River. First, we conducted a principal component analysis using all Chiwawa samples with complete genotypes (i.e., no missing alleles from any locus). Although the first two principal component axes account for only 10.5% of the total molecular variance, a substantially greater portion of that variance is among individual fish, regardless of their identity, rather than among hatchery and natural collections (Figure 6). The variances in principal component scores among individuals are 11 and 13 times greater than the variance in scores among collections, along the first and second axes, respectively.

Second, we conducted a series of analyses of molecular variance (AMOVA) to ascertain the percentage of molecular variance that could be attributed to differences among collections. We organized these analyses to test also for differences in the hierarchical structure of the data. That is, we tested for differences among collections using the following framework:

- No organizational structure – all 25 origin-spawner collections considered separately
- Origin-spawner collections organized into 10 collection year groups
- Origin-spawner collections organized into 2 breeding location groups (hatchery versus natural)
- Origin-spawner collections organized into 2 origin groups (hatchery versus natural)
- Origin-spawner collections organized into the 4 origin-spawner groups

It is clear from this analysis that nearly all molecular variation, no matter how the data are organized, resides within a collection (Table 5). The percentage of total molecular variance occurring within collections ranged from 99.68% to 99.74%. The among group variance component was limited to less than 0.26% and in all organizational structures, except “no structure,” the among group percentage was not significantly greater than zero. Furthermore, none of the organizational structures provided better resolution than “no structure” in terms of accounting for molecular variance within the data set. *These results indicate that if there are significant differences among collections of Chiwawa fish, these differences account for less than one percent of the total molecular variance, and these differences cannot be attributed to fish origin or spawning location.*

Summary and Conclusions

We reject the null hypothesis that the allele frequencies of the hatchery collections equal the allele frequencies of the natural collections, which equals the allele frequency of the donor population. Furthermore, because the allele-sharing distances are not consistent within and among collections years, we also reject the second stated hypothesis discussed above. However, there is an extremely small amount of genetic variance that can be attributed to among collection differences. The allelic differentiation that does exist among collections does not appear to be a function of fish origin, spawning location, genetic drift, or collection year. Figure 5 and related statistics does suggest that hatchery and natural collections in 2005 and 2006 are more similar to each other than previous years’ collections, and this would be expected in a successful integrated hatchery supplementation program.

Since each of these collection years are generally composed of four-year-old fish, the differentiation among these collections for the most part is differentiation among specific cohorts. The slightly greater percentage of alleles shared among collections that are separated in time by multiples of four years, compared with collections that are not separated in time as such, suggests that cohort differences may be the most important factor accounting for differences in allele frequencies among collections.

<u>Task 4:</u> Develop a model of genetic drift.

See Task 3

Task 5: Analyze spring Chinook population samples from the Chiwawa River and Chiwawa Hatchery from multiple generations.

See Task 3

Task 6: Analyze among population differences for upper Wenatchee spring Chinook.

Supplementation of the Chiwawa River spring Chinook population may affect populations within the Wenatchee River watershed other than the Chiwawa River stock. If the stray rate for Chiwawa hatchery-origin fish is greater than that for natural-origin fish, an increase in gene flow from the Chiwawa population into other populations may result. If this gene flow is high enough, Chiwawa River fish may alter the genetic structure of these other populations. Records from field observations indicate that hatchery-origin fish are present in all major spawning aggregates (A.R Murdoch, unpublished data), and these fish are successfully reproducing (Blankenship et al 2006). The intent of this task is to investigate if there have been changes to the genetic structure of the spring Chinook stocks within upper Wenatchee tributaries during the past 15-20 years, and if changes have occurred, are they a function of the Chiwawa River Supplementation Program? Therefore, we ask the following two questions:

1. Are allele frequencies within populations in the upper Wenatchee stable through time? That is, is there significant allelic differentiation among collections within upper Wenatchee populations?
2. Are the recent collections from the upper Wenatchee populations more similar to the Chiwawa population than earlier collections from the same populations?

For this task we analyzed natural spawning collections from the White River (natural-origin), Little Wenatchee River (natural-origin), Nason Creek (natural-origin), and

Wenatchee mainstem (hatchery-origin), and hatchery collections from Leavenworth NFH and Entiat River NFH (Table 1). We also included in the analysis the natural- and hatchery-origin collections from the Chiwawa River. There are no repeated collections from Leavenworth, Entiat, Little Wenatchee, and Wenatchee mainstem (Table 1), so for many of the analyses we have limited our discussion to the Chiwawa River, White River, and Nason Creek collections. Furthermore, genetic structure of the Little Wenatchee collection, which consisted of only 19 samples, was unexpectedly quite different from the other collections. For example, the F_{ST} statistic measures the percent of total molecular variation that can be attributed to differences between populations. The median F_{ST} for all pairwise combinations of collections from all populations, except Little Wenatchee (33 populations, 528 individual F_{ST} statistics) equals 0.010 (1%), with a range of 0.000 to 0.037 (Table 6). The median F_{ST} for the Little Wenatchee paired with all other collections (33 individual F_{ST} statistics) equals 0.106 (10.6%), with a range of 0.074 to 0.121. The ten-fold increase in the F_{ST} statistic indicates that either the Little Wenatchee spring Chinook is unique among the upper Wenatchee River stocks, or this 1993 collection is somehow aberrant. Therefore, we exclude the Little Wenatchee collection from many other analyses.

Population Differentiation – Table 3 provides the levels of significance for all pairwise genic differentiation tests. Most between-collection comparisons are highly significant, with no pattern of increasing or decreasing differentiation with time, and no differences when comparisons are made with Chiwawa hatchery- versus Chiwawa natural-origin fish. For example, excluding the outlier 1996 and 1998 Chiwawa hatchery- and natural-origin collections, Nason Creek showed highly significant allele frequency differences between the Chiwawa hatchery- and natural-origin collections at 100% and 86% of the comparisons, respectively. The same comparisons with the White River produced 100% and 93% highly significant allele frequency comparisons, respectively. Allele frequencies between Nason Creek and White River were likewise differentiated from each other.

The collection allele frequencies within the upper Wenatchee system are significantly different, and these differences do not appear to change as a function of time (Table 3). Nason Creek shows greater within-population year-to-year variation in allele frequencies than does the White River, with 47% of the pairwise comparisons showing highly significant differences, compared with only 13% for the White River. However, the 2005 and 2006 collections from the White River appear to be somewhat more differentiated from not only each other, but from the earlier collections from the White River.

Despite the high degree of temporal and spatial structure suggested by the genic differentiation tests, as described above for within-Chiwawa analysis (Task 3), most of the genetic variation within this data set occurs within populations, rather than between populations (Table 6). The F_{ST} values for most population comparisons are between 0.01 and 0.02, indicating 1% to 2% among-population variance, with the remaining 98% to 99% variance occurring within populations. The White River shows the highest median F_{ST} among the natural-origin collections, equal to 0.014, compared with 0.009 for both the Nason Creek and Chiwawa natural-origin collections. The median F_{ST} for the Chiwawa hatchery-origin collections (0.012) was higher than that for the Chiwawa natural-origin collections.

Table 7 summarizes the information from the F_{ST} analyses, under five different temporal and spatial scenarios. Under all scenarios, over 99% of the molecular variance is within populations. There is significantly greater spatial structure among populations ("Origin") in 2005 and 2006 than from 1989 to 1996. That is, there appears to be more spatial structure among the Chiwawa hatchery-origin, Chiwawa natural-origin, White River, and Nason Creek now, than in 1989 to 1996, despite the potential homogenizing and cumulative effect of hatchery strays. However, we stress that the amount of molecular variance associated with the among population differences, despite being significantly greater than 0.00%, is limited to only 0.43%.

Allele-sharing and Nonmetric Multidimensional Scaling – As in the Chiwawa River data discussed above, we constructed an allele-sharing distance matrix and then subjected that matrix to a multidimensional scaling analysis (Figure 7). Consistent with all previously discussed multidimensional scaling analyses, the 1996 and 1998 adult, and the 1994 smolt collections are outliers. There is clear separation between the White River collections and all other natural-origin and Chiwawa hatchery-origin collections, indicating that there are more alleles shared among the Nason Creek and Chiwawa collections, than with the White River collections. Furthermore, there is a slight separation between the Chiwawa natural-origin natural spawner collections and Nason Creek collections, suggesting different groups of shared alleles between these populations. There is more variation in the allele-sharing distances among collections involved with the Chiwawa hatchery (origin or broodstock) than any of the natural-origin collections, even if we exclude the 1994, 1996, and 1998 collections. This suggests that there is more year-to-year variation in the composition of hatchery-origin and hatchery broodstock than within natural-origin populations throughout the upper Wenatchee. All Wenatchee mainstem fish are hatchery-origin, and if these fish are from the Chiwawa Supplementation Program (rather than from Leavenworth), it is not unexpected that this collection would be plotted within the Chiwawa polygon (Figure 7).

Assignment of Individual to Populations – Finally, we conducted individual assignment tests whereby we assigned each individual fish to a population, based on a procedure developed by Rannala and Mountain (1997) (Table 8 and 9). Individual fish may be correctly assigned to the population from which they were collected, or incorrectly assigned to a different population. Incorrect assignments may occur if the fish is an actual migrant (i.e., source population different from population where collected), or because the genotype for that fish matches more closely with a population different from its source. If there are many individuals from a population incorrectly assigned to populations other than its source population, that original population is either unreal (i.e., an admixture), or there is considerable gene flow between that population and other populations. Furthermore, in assigning individuals to populations, we can either accept the assignment with the highest probability, regardless of how low that probability may be, or we can establish a more stringent criterion, such as to not accept an assignment unless the posterior probability is equal to or greater than 0.90. This value is roughly equal to having the likelihood of the most-likely population equal to 10 times that of the second most-likely population.

We provide a summary of the assignments in Tables 8 and 9. On average, nearly 50% of the fish are assigned incorrectly if we accept all assignments (Table 8), but the incorrect assignment rate drops to roughly 10% when we accept only those assignments with probabilities greater than 0.90. However, with this more stringent criterion, nearly 64% of the fish go unassigned. These results indicate that the allele frequency distributions for these populations are very similar, and it would be very difficult to assign an individual fish of unknown origin to the correct population. If all fish are assigned, there is a 50% chance, overall, of a correct assignment. If you accept only those assignment with the 0.90 criterion, nearly two-thirds of the fish would be unassigned, but there is a 90% chance of correctly assigning those fish that are indeed assigned.

Of all the populations in the data set, there are fewer errors associated with assigning fish to the White River. If all fish are assigned (Table 8), 72% of those fish assigned to the White River, are actually from the White River (115 fish out of a total of 159 fish assigned to the White River). This compares to a rate of only 52% and 53% for Nason Creek and Chiwawa natural-origin, respectively, and 60% for the Chiwawa hatchery-origin collections. With the 0.90 criterion (Table 9), 89% of the fish assigned to the White River, are actually from the White River, compared with 70% and 65% for Nason Creek and Chiwawa natural origin, respectively, and 81% for the Chiwawa hatchery origin.

When all fish are assigned, most of the incorrectly assigned fish from Nason Creek and White River are assigned to Chiwawa River, at roughly equal frequencies to the hatchery- and natural-origin populations. Incorrectly assigned fish to other populations occur at a slightly higher rate in Nason Creek than in the White River. However, when only those fish meeting the 0.90 criterion are assigned (Table 9), incorrectly assigned fish from Nason Creek are distributed among White and Chiwawa Rivers, as well as Leavenworth NFH, and the Entiat NFH. Mis-assignment to the Chiwawa hatchery-origin was the highest among the Nason Creek collections, equal to nearly 14%. This contrasts with the White River where mis-assignments do not exceed 7% anywhere, and there is a roughly even distribution of mis-assignments among Nason Creek and Chiwawa River collections.

Summary and Conclusions – There is little geographic or temporal structure among populations within the upper Wenatchee systems. Among population molecular variance is limited to 1% or less. The little variance that can be attributed to among populations indicates that the White River is more differentiated from the Chiwawa and Nason populations than these populations are from each other. Furthermore, although we cannot rule out a hatchery effect on the Nason Creek and White River populations, there is no indication there has been any temporal changes in allele frequencies within these populations that can be attributed directly to the Chiwawa River Supplementation Program. In fact, Table 7 weakly suggests that there is more differentiation among these populations now, than there was before or at the early stages of Chiwawa supplementation.

Therefore, returning to our two original questions, there are significant differences in allele frequencies among collections within populations, and among populations within the upper Wenatchee spring Chinook stocks. However, these differences account for a very small portion of the overall molecular variance, and these populations overall are very similar to each other. There is no evidence that the Chiwawa River Supplementation Program has changed the allele frequencies in the Nason Creek and White River populations, despite the presence of hatchery-origin fish in both these systems. Finally, of all the populations within the Wenatchee River, the White River appears to be the most distinct. Yet, this distinction is more a matter of detail than of large significance, as the median F_{ST} between White River collections and all other collections (except the Little Wenatchee) is less than 1.5% among population variance.

<u>Task 7:</u> Calculate the inbreeding effective population size using demographic data for each sample year, and document the ratio of census to effective size.

This analysis was completed by Williamson et al. (submitted).

<u>Task 8:</u> Calculate LD N_b using genetic data for each sample year, and document the ratio of census to effective size.

We report N_e estimated for the Chiwawa River collections based on the bias correction method of Waples (2006) implemented in LDNe (Do and Waples unpublished). N_e estimates based on LD are best interpreted as the effective number of breeders (N_b) that produced the sample (Waples 2006).

For collections categorized by spawning location (i.e., hatchery broodstock or natural), estimates of N_b are shown in Table 10. Considering the hatchery broodstock, N_b estimates range from 30.4 (1996) to 274.3 (2005). To obtain N_e /N ratios, the N_b estimate is multiplied by four (i.e., mean generation length) and divided by the total in river (i.e., NOS [natural-origin spawners] plus HOS [hatchery-origin spawners]) census data from four years prior (i.e., major cohort; see Table 2). The observed N_e /N ratios for the broodstock collections range from 11% to 54% of the census estimate, excluding the 2000 collection which is 106%. A ratio greater than one is possible under special circumstances, and certain artificial mating schemes within hatcheries can inflate N_e above N; yet, it is unknown if this is the case for this collection. While no direct comparisons are possible, the N_b estimates reported by Williamson et al. (submitted) for Chiwawa broodstock collections from 2000 – 2003 are similar in magnitude to our estimates. For Chiwawa natural spawner collections, the N_b estimates range from 5.2 (1989) to 231.5 (2005), with observed N_e /N ratios of 22% - 48% of the census estimate.

<u>Task 9:</u> Calculate N_b using the temporal method for multiple samples from the same location.

Estimates of effective number of breeders (N_b) derived from Waples' (1990) temporal method are shown in Tables 11-13. Eight collection years were used for the Chiwawa broodstock collections (Table 11). The harmonic mean of all pairwise estimates of N_b ($\tilde{N}_b$) was 269.4. This estimate is the contemporary N_e for Chiwawa broodstock collections. For the five collection years of Chiwawa in-river spawners (Table 12), the estimated $\tilde{N}_b$ = 224.2. This estimate is the contemporary N_e for Chiwawa River natural spawner collections. Since the Chiwawa Supplementation Program is integrated by design, we also performed another estimation of N_e using composite hatchery and natural samples. There are paired samples from 2004-2006. We combined genetic data for hatchery (HOS) and natural (NOS) origin fish from 2004 – 2006 to create a single Chiwawa River natural spawner sample for each year. The three composite samples from 2004 – 2006 were then analyzed using the temporal method (Table 13), resulting in a $\tilde{N}_b$ = 386.8. This estimate is the contemporary N_e for Chiwawa River.

Williamson et al. (submitted) estimated N_e using Waples' (1990) temporal method for Chinook captured in 2004 and 2005, and used age data to decompose brood years into consecutive cohorts from 2000 – 2003. They report for Chiwawa broodstock a $\tilde{N}_b$ = 50.4. This estimate is not similar to our Chiwawa broodstock estimate. However, if we analyze the hatchery-origin Chinook only, our estimate is $\tilde{N}_b$ = 80.1 for collection years 1989 – 2006 (data not shown). Williamson et al. (submitted) report for Chiwawa naturally spawning Chinook a $\tilde{N}_b$ = 242.7, which is slightly higher than our estimate for in-river spawners from 1989 – 2006, but lower than our estimate from combined NOS and HOS Chinook from 2004 – 2006 collection years.

Task 10: **Use available data and the Ryman-Laikre and Wang-Ryman models to determine the expected change of N_e for natural spring Chinook salmon in the Wenatchee River due to hatchery operation.**

N_e is generally thought to be between 0.10 and 0.33 of the estimated census size (Bartley et al. 1992; RS Waples pers. comm.). We used this range to generate an estimate of N_e for Chiwawa natural spawners prior to hatchery operation. For brood years 1989 – 1992, the arithmetic mean census size was N=962.7 (Table 2), resulting in an estimated N_e ranging from 96.3 – 317.7. The contemporary estimate of N_e calculated using genetic data for the Chiwawa in-river spawners is N_e=224.2 (Table 12), falling in the middle of the pre-hatchery range. The N_e /N ratio calculated using 224.2 and the arithmetic census of NOS Chinook from 1989 – 2005 is 0.42. A more appropriate contemporary N_e to compare with the pre-hatchery estimate (i.e., 96.3 – 317.7) is the combined NOS and HOS estimate from natural spawners, since the supplementation program is integrated. As discussed above, the contemporary estimate of N_e calculated using genetic data for Chiwawa NOS and HOS Chinook is N_e=386.8 (Table 13), which is slightly larger than the pre-hatchery range, suggesting the N_e has not declined during the period of hatchery operation. The N_e /N ratio calculated using 386.8 and the arithmetic census of NOS and HOS Chinook from 1989 – 2005 is 0.40. These results suggest the Chiwawa Hatchery Supplementation Program has not resulted in a smaller N_e for the natural spawners from the Chiwawa River.

Williamson et al. (submitted) argued that since their combined (i.e., broodstock and natural) N_e estimate was lower than the naturally spawning estimate, the supplementation program likely had a negative impact on the Chiwawa River N_e. We disagree with this interpretation of these data. Since the natural spawning component is mixed hatchery and natural ancestry, the N_e estimates from natural spawning data are the results that bear on possible hatchery impacts. The census data show the population declined in the mid 1990's and rebounded by 2000 (Table 2). This trend is reflected in the N_e results, as shown above, and Williamson et al. (submitted) clearly show in their Table 4 the N_e was lower in 2000 (N_e = 989) than it was in 1992 (N_e = 2683). Yet, the important comparison they make in our view was the natural spawning N_e versus the natural only component N_e (i.e., hypothetically excluding hatchery program). Williamson et al. (submitted) report the 1989 – 1992 N_e estimated from naturally spawning Chinook (i.e., NOS and HOS integrated) was essentially the same as the natural only component estimate, 2683 and 2776, respectively. This result is not surprising since no HOS fish were present between 1989 – 1992. They also report that the 1997 – 2000 N_e estimated from naturally spawning Chinook (i.e., NOS and HOS integrated) was N_e =989, while the natural-origin estimate of N_e in 1997 – 2000 was N_e = 629. Since the natural-origin estimate of 629 is lower than 989, the N_e estimate from all in-river spawners, we argue that their analysis of demographic data show the N_e estimated from naturally spawning Chinook (i.e., NOS and HOS integrated) is larger only if the hatchery Chinook in the river are ignored.

Task 11: Use individual assignment methods to determine the power of self-assignment for upper Wenatchee River tributaries.

See "Assignment of Individual to Populations" in Task 6

Conclusions

Has the Chiwawa Hatchery Supplementation Program succeeded at increasing the census size of the target population while leaving genetic integrity intact? This is an important question, as hatcheries can impact natural populations by reducing overall genetic diversity (Ryman and Laikre 1991), reducing the fitness of the natural populations through relaxation of selection or inadvertent positive selection of traits advantageous in the hatchery (Ford 2002; Lynch and O'Hely 2001), and by reducing the reproductive success of natural populations (McLean et al. 2003). The census data presented here show that the current natural spawning census size is similar to the pre-supplementation census size. Despite large numbers of hatchery-origin fish on the Chiwawa River spawning grounds, the genetic diversity of the natural-origin collections appear unaffected by the supplementation program; heterozygosities are high, and contemporary N_e is similar (perhaps slightly higher) than pre-supplementation N_e. We did find significant year-to-year differences in allele frequencies in both the origin and spawner datasets, but these differences do not appear to be related to fish origin, spawning area, or genetic drift. However, we do suggest that cohort differences may be the most important factor accounting for differences in allele frequencies among collections.

The main objective of this study was to determine the potential impacts of the hatchery program on natural spring Chinook in the upper Wenatchee system. We did this by analyzing temporally replicated collections from the Chiwawa River, and by comparing genetic diversity prior to the presumed effect of the Chiwawa Hatchery Supplementation Program, with contemporary collections. We report that the genetic diversity present in the Chiwawa River is unchanged (allowing for differences among cohorts) from 1989 – 2006, and the contemporary estimate of the effective population size (N_e) using genetic data is approximately the same as the N_e estimate extrapolated from 1989 – 1992 census data (i.e., pre-hatchery collection years). We observed substantial genetic diversity, with heterozygosities ~80% over thirteen microsatellite markers. Yet, temporal variation in allele frequencies was the norm among temporal collections from the same populations (i.e., location). The genetic differentiation of replicated collections from the same population is likely the result of salmon life history in this area, as four-year-old Chinook comprise a majority of returns each year. The genetic tests are detecting the differences of contributing parents for each cohort. An important point related to the temporal variation, is that the hatchery broodstock is composed in part of the natural origin Chinook from the Chiwawa River. When we compared the genetic data (within a collection year) for Chinook brought into the hatchery as broodstock with the Chinook that remained in the river (years 2001, 2004 – 2006), there was a trend of decreasing statistical differences in allele frequencies from 2001 to 2004, and no differences were detected for 2005 and 2006. While the replicated collections may have detectable differences in allele frequencies, those differences reflect actual differences in cohorts, not the result of hatchery operations, and the hatchery broodstock collection method captures the differences in returning Chiwawa River spring adults each year. We conclude from these results that the genetic diversity of natural spring Chiwawa Chinook has been maintained during the Chiwawa Hatchery Supplementation Program.

We observe slight, but statistically significant population differentiation between Chiwawa River, White River, and Nason Creek collections. Murdoch et al (2006) and Williamson et al. (submitted) also observed population differentiation between Chiwawa River, White River, and Nason Creek collections. Yet, 99.3% of the genetic variation observed was within samples, very little variance could be attributed to population differences (i.e., population structure). The AMOVA analysis and poor individual assignment results suggest the occurrence of gene flow among Wenatchee River locations or a very recent divergence of these groups. While Murdoch et al. 2006 did not perform an AMOVA analysis, their F_{ST} results provide comparable data to our among-population results. Murdoch et al. 2006 report F_{ST} ranging from 2%-3% for pairwise comparisons between of Chiwawa, White, and Nason River collections. Since F_{ST} is an estimate of among-sample variance, these results also imply a majority of the genetic variance (i.e., 97%-98%) resides within collections. To provide further context for the magnitude of these variance estimates, we present the among-group data from Murdoch et al. 2006 comparing summer-run and spring-run Chinook from the Wenatchee River. They report that approximately 91% of observed genetic variance is within-collection for comparisons between collections of summer- and spring-run Chinook. Ultimately, the information provided by this and other reports will be incorporated into the management process for Wenatchee River Chinook. However, we would like to emphasize that the application of these genetic data to management is more about the goals related to the distribution of genetic diversity in the future than specific data values reported. If Chinook are collected at Tumwater Dam instead of within the upper Wenatchee River tributaries, a vast majority of the genetic variation present in the basin would be captured, although any differences among tributaries would be mixed. Alternatively, management policies could be crafted to promote and maintain the among-group genetic diversity that genetic studies consistently observe to be non-zero within the Wenatchee River.

We agree with Murdoch et al. (2006) that it appears hatchery Chinook are not contributing to reproduction in proportion to their abundance. Additionally, if the total census size (i.e., NOS and HOS combined) within the Chiwawa River does not continue to increase, genetic diversity may decline within this system, given the smaller N_e within the hatchery-origin collections compared with the natural-origin collections.

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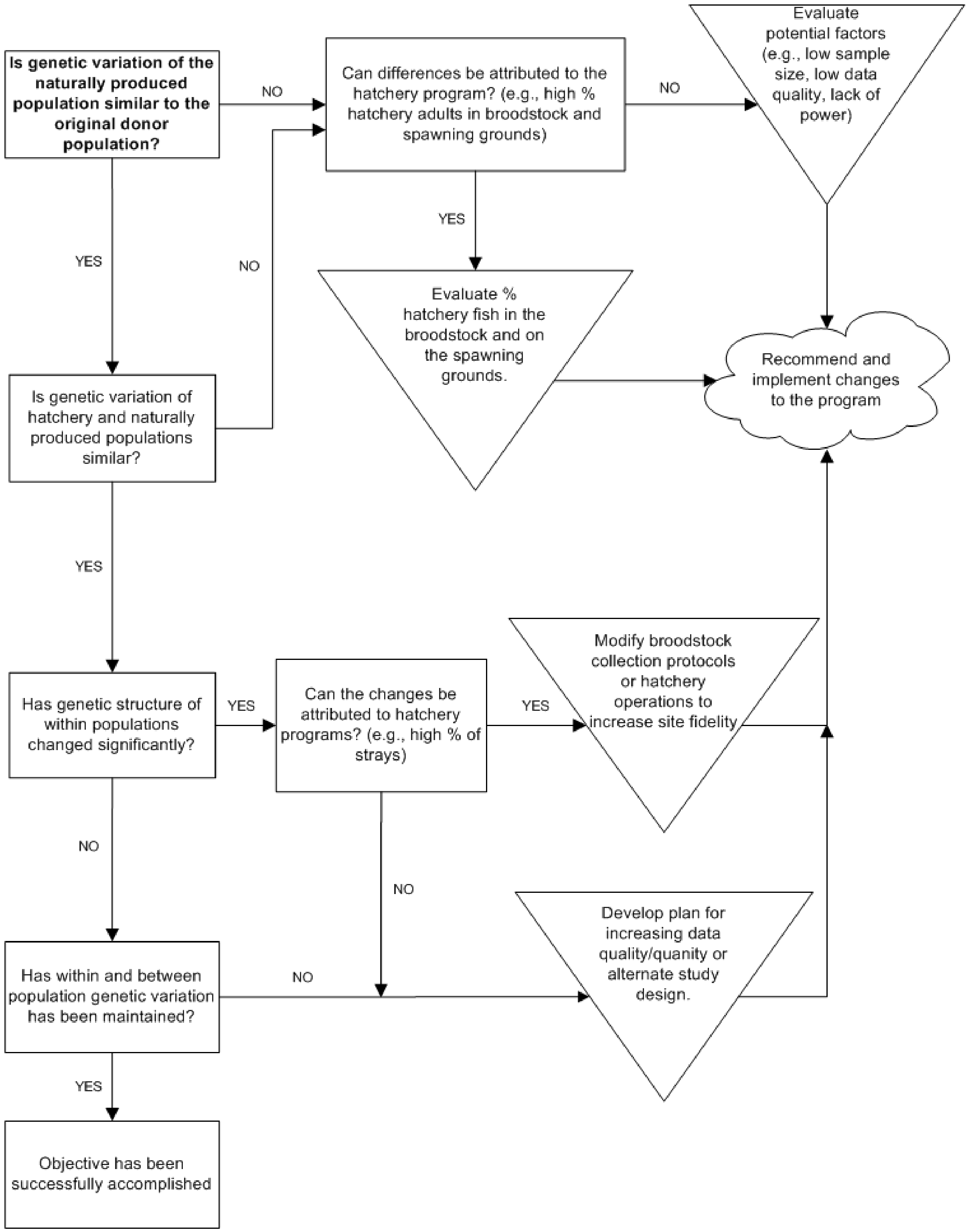

Figure 1. Conceptual process for evaluating potential changes in genetic variation in the Chiwawa naturally produced populations as a result of the supplementation hatchery programs (From Murdoch and Peven 2005).

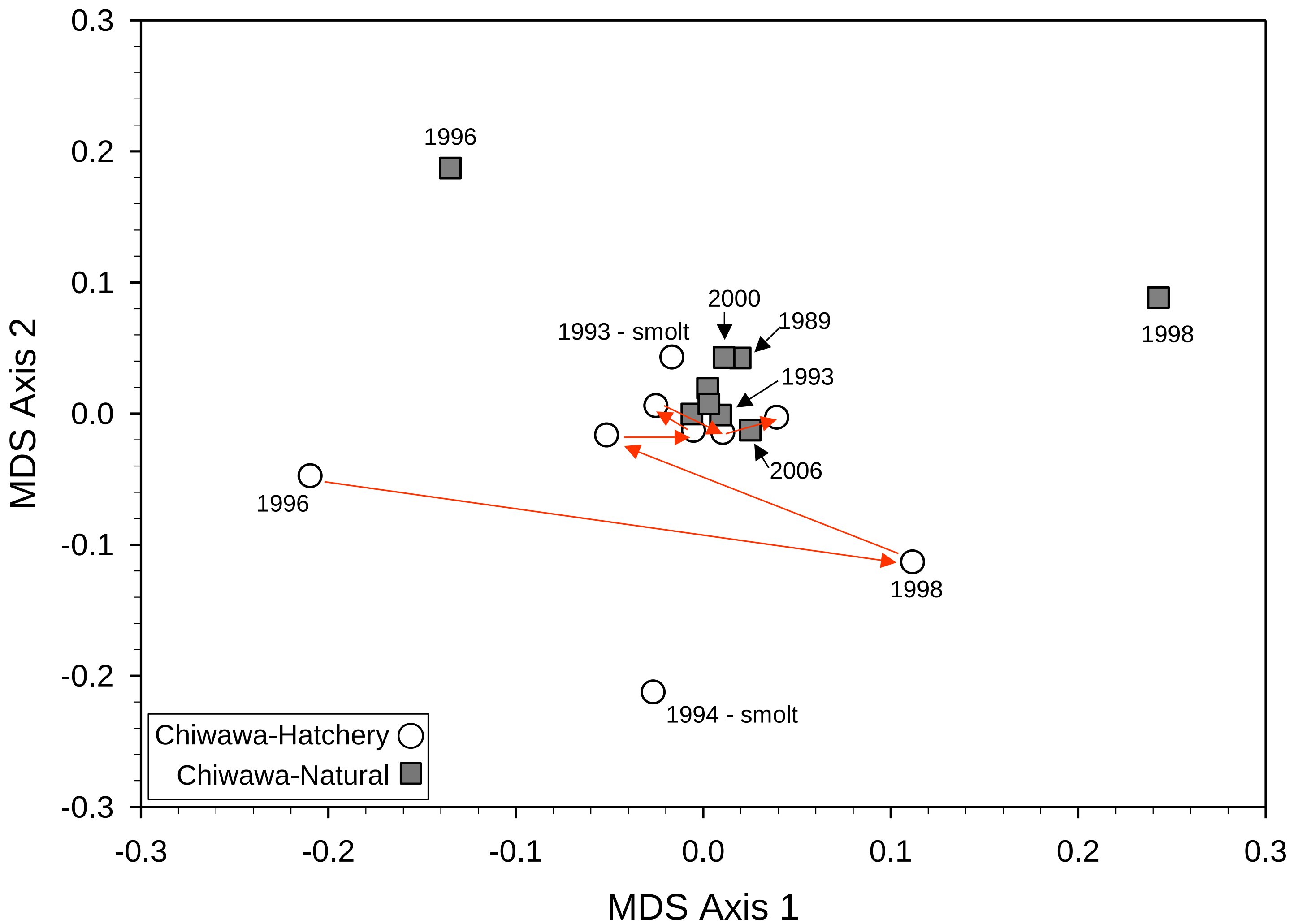

Figure 2. Multidimensional scaling plot from an allele-sharing distance matrix calculated from the Chiwawa data set organized by fish origin (i.e., hatchery versus natural). The red arrows connect consecutive hatchery-origin collections starting with the first adult collection (1996) and ending with the 2006 collection (see Table 1 for collection years).

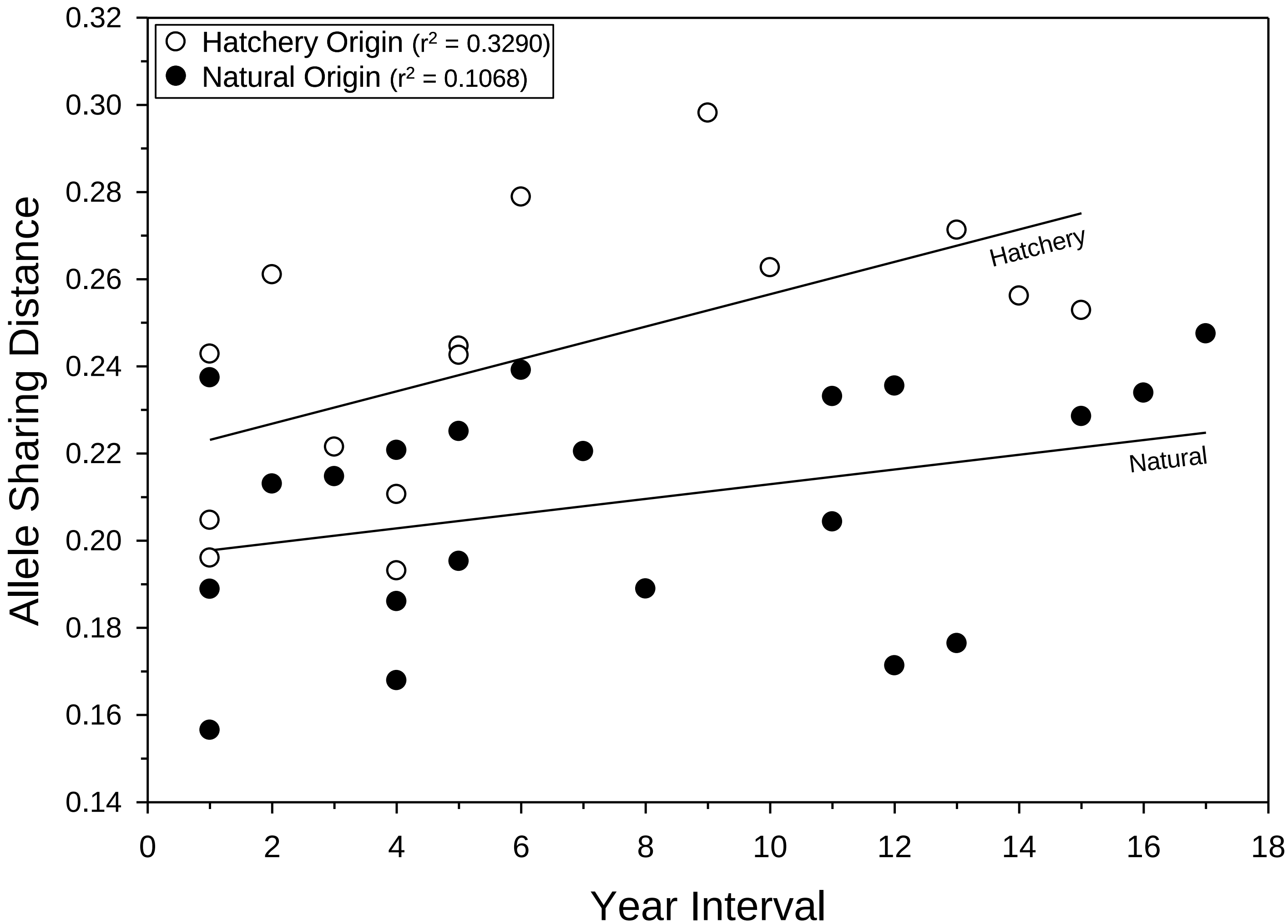

Figure 3. Relationships between the time interval in years and allele sharing distances, with each circle representing the pairwise relationship between two Chiwawa collections. Separate regression lines for the natural- and hatchery-origin collections. The slope for the natural-origin collection is not significantly different from zero (p=0.1483), while the slope for hatchery-origin collection is significantly greater than zero (p=0.0254) indicating a positive relationship between time interval and allele sharing distance.

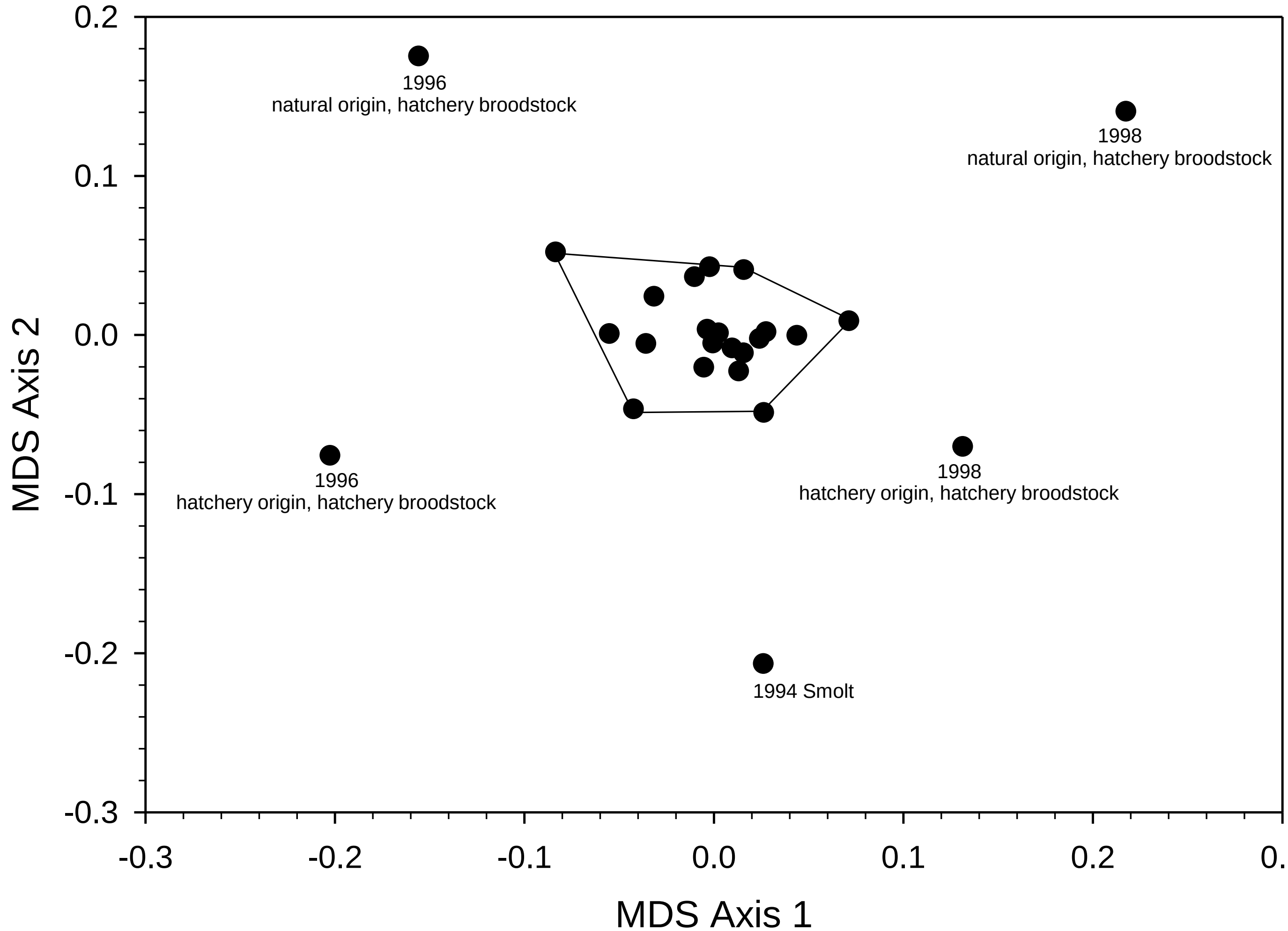

Figure 4. Multidimensional scaling plot from an allele-sharing distance matrix calculated from the Chiwawa data set organized by four treatment groups, as discussed in the text. Each circle represents a single collection within each of the four treatment groups, and the polygon encloses all groups that are not outliers. Each outlier group is specifically labeled.

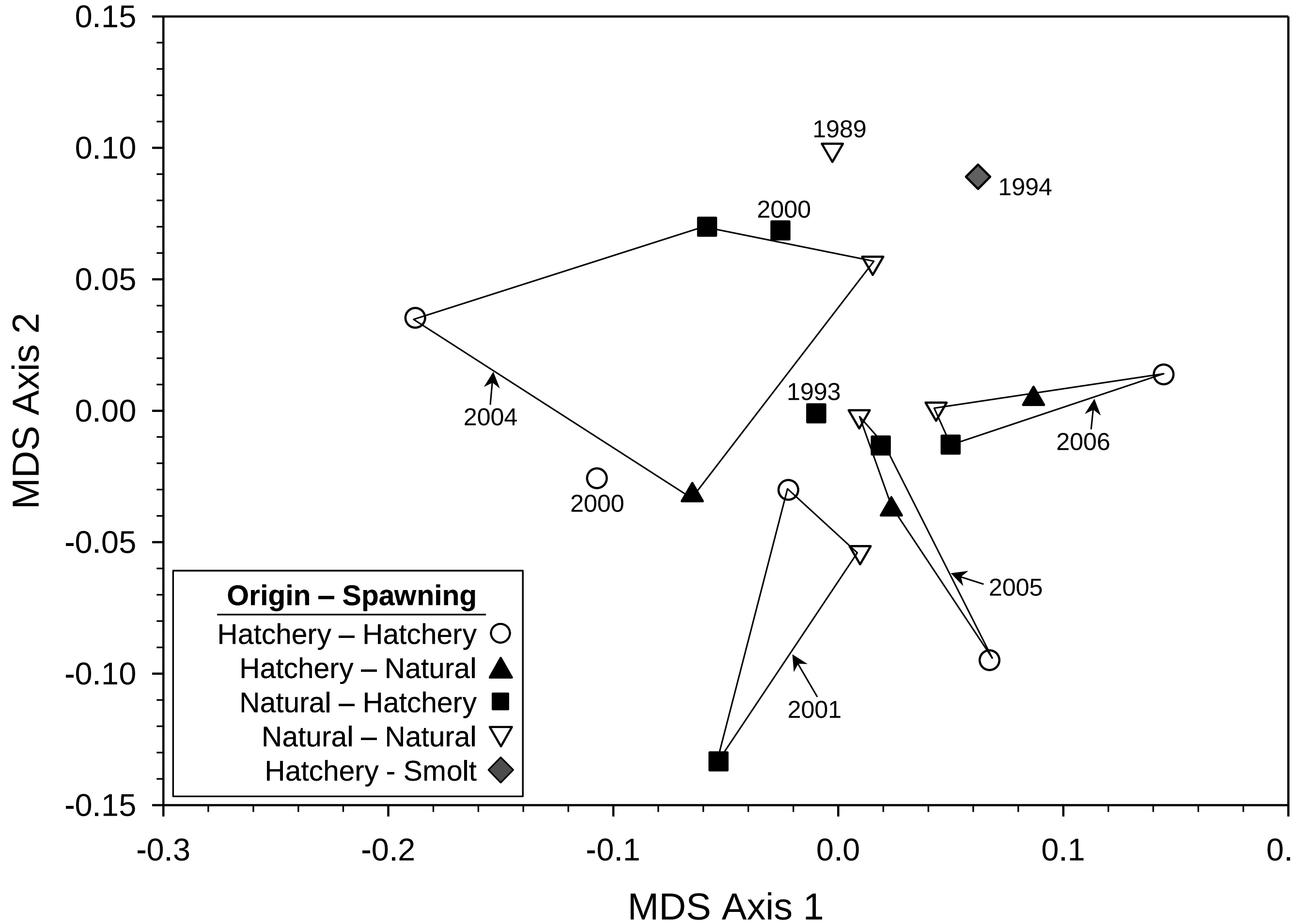

Figure 5. As in Figure 4, but allele-sharing distance matrix recalculated without the five outlier groups shown in Figure 4. Polygons group together treatment groups from the same collection year. Dates associated with symbols also refer to collection year. Collection years 2004-2006 included all four treatment groups, while collection year 2001 did not include a hatchery-origin natural spawner group. Legend is read as follows: Open circles refer to hatchery-origin hatchery spawner group, while filled box refers to natural-origin hatchery spawner group, and so on.

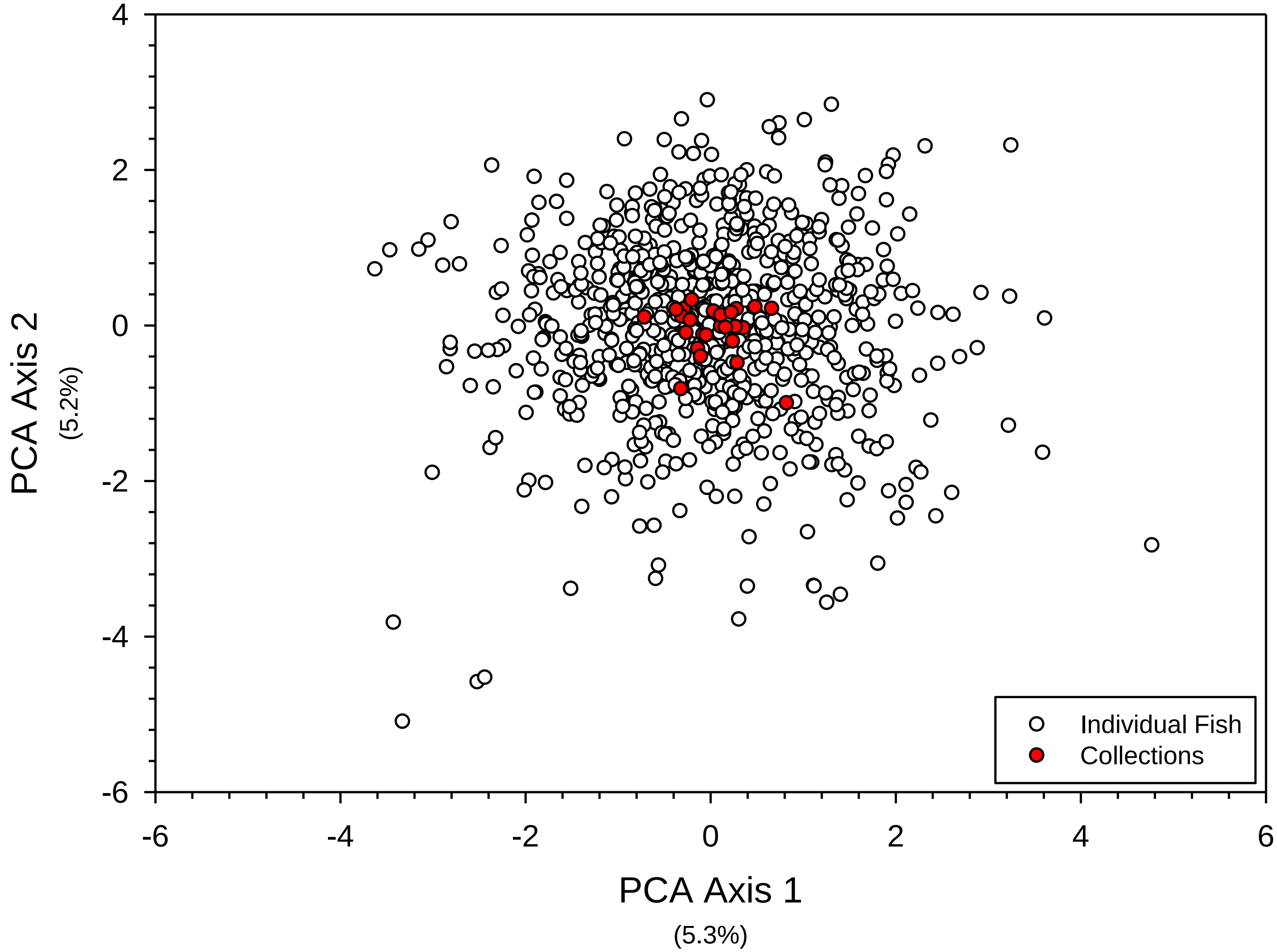

Figure 6. Principal component (PC) analysis of individual fish from the Chiwawa River. Only fish with complete microsatellite genotypes were included in the analysis (n = 757). Open circles are the PC scores for individual fish, and the filled circles are the centroids (bivariate means) for each of the 25 groups discussed in the text. PC axes 1 and 2 account for only 10.5% of the total molecular variance.

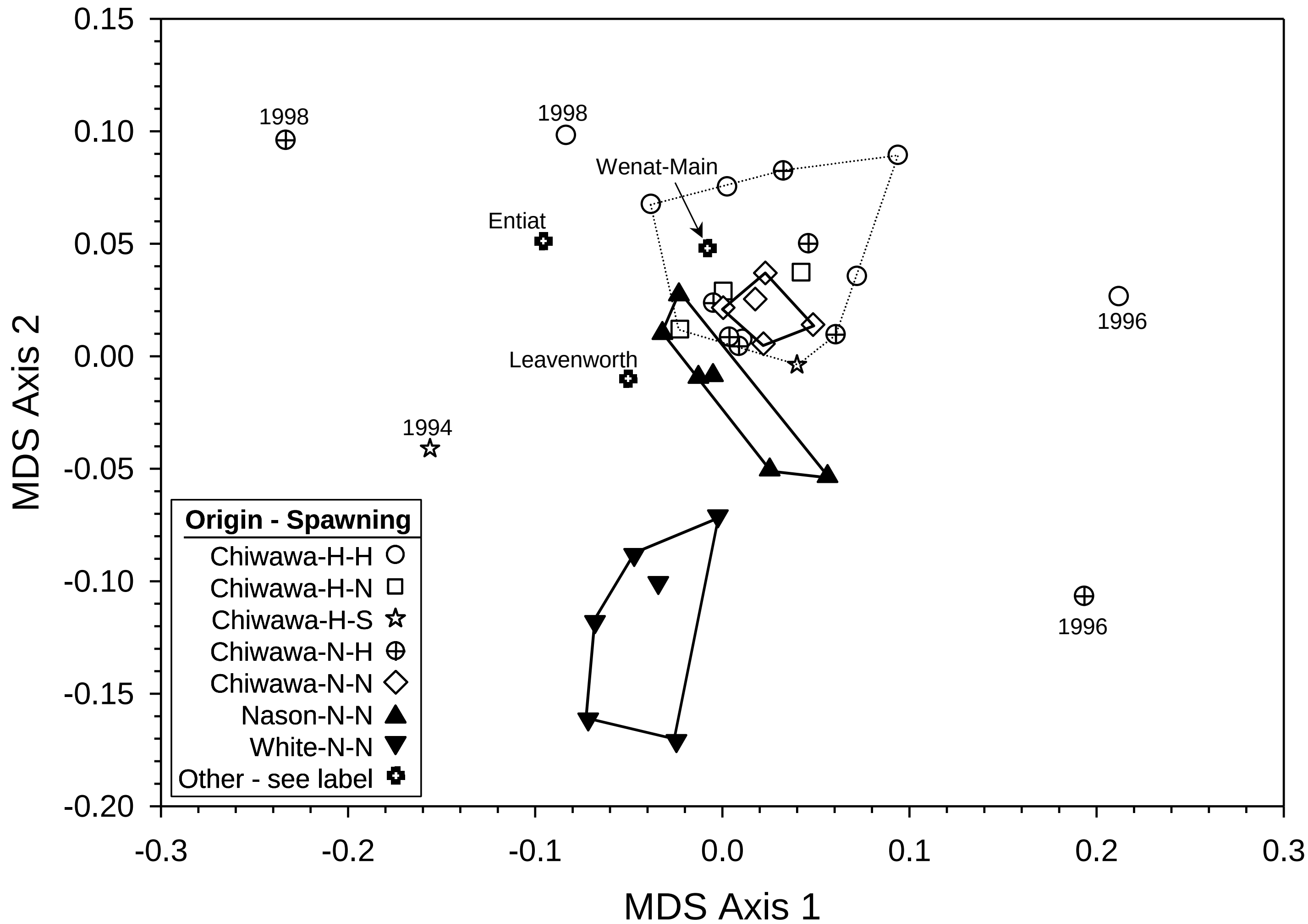

Figure 7. Multidimensional scaling plot from an allele-sharing distance matrix calculated from the Chiwawa origin data set and all other non-Chiwawa collections, except Little Wenatchee River. Legend is read with abbreviations beginning with origin and then spawning location. H=hatchery, N=natural, and S=smolts. Polygons with solid lines enclose the natural-origin natural spawner collections from each population (i.e., river). The polygon with the dotted lines enclose all Chiwawa collections, except for the five outlier collections, as discussed in text.

Table 1 Summary of within population genetic data. Chiwawa collection data are summarized in A) by origin of the sample (i.e., clipped vs. non-clipped). All collection data are summarized in B) by spawning location (i.e., hatchery broodstock or on spawning grounds). Hz is heterozygosity, HWE is the statistical significance of deviations from Hardy-Weinberg expectations (* = 0.05, ** = 0.01, and *** = 0.001), LD is the proportion of pairwise locus tests (across all populations) exhibiting linkage disequilibrium (bolded values are statistically significant), and the last column is mean number of alleles per locus.

Collection	Sample size	Gene Diversity	Observed Hz	HWE	F_{IS}	LD	Mean # Alleles
A) Origin							
1993 Chiwawa Hatchery	95	0.77	0.79	***	-0.02	**0.86**	14.00
1994 Chiwawa Hatchery	95	0.76	0.77	***	-0.01	**0.91**	11.38
1996 Chiwawa Hatchery	8	0.75	0.81	-	-0.01	0.00	8.23
1998 Chiwawa Hatchery	27	0.81	0.82	-	0.00	0.04	12.62
2000 Chiwawa Hatchery	43	0.75	0.78	***	-0.01	**0.19**	12.46
2001 Chiwawa Hatchery	69	0.77	0.80	***	-0.02	**0.14**	15.31
2004 Chiwawa Hatchery	72	0.77	0.77	***	0.01	**0.45**	15.92
2005 Chiwawa Hatchery	91	0.79	0.82	*	-0.03	**0.05**	16.15
2006 Chiwawa Hatchery	95	0.80	0.84	***	-0.05	**0.49**	15.85
1989 Chiwawa Natural	36	0.76	0.78	-	0.01	0.00	12.77
1993 Chiwawa Natural	62	0.78	0.81	-	-0.02	0.04	15.85
1996 Chiwawa Natural	8	0.72	0.78	-	-0.02	0.00	7.54
1998 Chiwawa Natural	10	0.78	0.84	-	0.00	0.00	8.23
2000 Chiwawa Natural	39	0.78	0.79	***	0.00	**0.10**	14.00
2001 Chiwawa Natural	75	0.78	0.80	-	-0.03	0.03	15.31
2004 Chiwawa Natural	85	0.78	0.77	-	0.02	0.01	15.77
2005 Chiwawa Natural	90	0.79	0.79	-	0.01	0.01	16.15
2006 Chiwawa Natural	96	0.80	0.81	-	-0.01	0.01	16.46

Table 1 Within population genetic data analysis summary continued.

Collection	Sample size	Gene Diversity	Observed Hz	HW	F_{IS}	LD	Mean # Alleles
B) Spawning Location							
1993 Chiwawa Broodstock	62	0.78	0.81	-	-0.02	0.00	15.85
1996 Chiwawa Broodstock	16	0.75	0.79	-	-0.02	0.00	10.92
1998 Chiwawa Broodstock	37	0.82	0.83	-	0.00	0.01	14.38
2000 Chiwawa Broodstock	82	0.78	0.78	***	0.00	**0.32**	15.62
2001 Chiwawa Broodstock	89	0.78	0.80	*	-0.02	**0.13**	15.77
2004 Chiwawa Broodstock	61	0.77	0.76	*	0.02	**0.13**	14.92
2005 Chiwawa Broodstock	75	0.79	0.78	*	0.02	0.01	15.85
2006 Chiwawa Broodstock	89	0.80	0.83	-	-0.03	**0.05**	16.46
1989 Chiwawa River	36	0.76	0.78	-	0.01	0.00	12.77
2001 Chiwawa River	55	0.78	0.80	-	-0.02	**0.09**	14.00
2004 Chiwawa River	96	0.78	0.78	*	0.01	**0.18**	17.23
2005 Chiwawa River	106	0.79	0.82	*	-0.02	**0.06**	16.69
2006 Chiwawa River	102	0.80	0.83	***	-0.03	**0.10**	16.77
1989 White River	48	0.75	0.75	-	0.01	0.01	12.85
1991 White River	19	0.76	0.76	-	0.03	0.00	10.92
1992 White River	22	0.75	0.79	-	-0.02	0.01	11.00
1993 White River	21	0.75	0.69	*	0.10	0.00	10.15
2005 White River	29	0.75	0.77	-	-0.01	0.03	12.23
2006 White River	40	0.76	0.76	-	0.01	0.04	13.38

Table 1 Within population genetic data analysis summary continued.

Collection	Sample size	Gene Diversity	Observed Hz	HW	F_{IS}	LD	Mean # Alleles
1993 Little Wenatchee R.	19	0.84	0.85	-	0.02	0.00	11.23
1993 Nason Creek	45	0.78	0.80	-	-0.01	0.01	13.77
2000 Nason Creek	51	0.76	0.78	-	-0.02	**0.13**	13.92
2001 Nason Creek	41	0.79	0.81	-	-0.01	**0.08**	14.23
2004 Nason Creek	38	0.76	0.76	-	0.02	0.03	13.23
2005 Nason Creek	45	0.78	0.82	-	-0.04	0.03	14.92
2006 Nason Creek	48	0.80	0.82	-	-0.01	0.00	15.77
2001 Wenatchee River	32	0.79	0.80	*	0.00	0.04	12.85
2000 Leavenworth NFH	73	0.80	0.82	*	-0.02	**0.15**	16.23
1997 Entiat NFH	37	0.81	0.83	-	-0.01	**0.06**	14.38

Table 2 Demographic data for Chiwawa Hatchery and Chiwawa natural spring Chinook salmon. BS is census size of hatchery broodstock, pNOB is the proportion of hatchery broodstock of natural origin, NOS is the census size of natural-origin spawners present in Chiwawa River, HOS is the census size of hatchery-origin spawners present in Chiwawa River, Total is NOS and HOS combined, and pNOS is the proportion of spawners present in Chiwawa River of natural origin.

	Hatchery		In River			
Brood Year	BS	pNOB	NOS	HOS	Total	pNOS
1989	28	1	1392	0	1392	1.00
1990	18	1	775	0	775	1.00
1991	32	1	585	0	585	1.00
1992	78	1	1099	0	1099	1.00
1993	94	1	677	491	1168	0.58
1994	11	0.64	190	90	280	0.68
1995	0	0	8	50	58	0.14
1996	18	0.44	131	51	182	0.72
1997	111	0.29	210	179	389	0.54
1998	47	0.28	134	45	178	0.75
1999	0	0	119	13	132	0.90
2000	30	0.3	378	310	688	0.55
2001	371	0.3	1280	2850	4130	0.31
2002	71	0.28	694	919	1613	0.43
2003	94	0.44	380	223	603	0.63
2004	215	0.39	820	788	1608	0.51
2005	270	0.33	250	1222	1472	0.17

Table 3 Levels of significance for pairwise tests of genic differentiation among all hatchery- and natural-origin collections used in this analysis. HS = highly significant (P < 0.000095; the Bonferroni corrected p-value for an alpha = 0.05); * = P < 0.05 (nominal critical value for most statistical test); - = P > 0.05 (not significant). A significant result between pairs of populations indicates that the allele frequencies between the pair are significantly different. Results are read by comparing the collections along the rows to collections along columns. The top block for each section is a symmetric matrix, as it compares collections within the same group.

		Chiwawa – Hatchery Origin								
		1993	1994	1996	1998	2000	2001	2004	2005	2006
Chiwawa – Hat. Origin	1993		HS	*	HS	HS	HS	HS	HS	HS
	1994	HS		HS	HS	HS	HS	HS	HS	HS
	1996	*	HS		*	-	*	-	-	*
	1998	HS	HS	*		HS	HS	HS	HS	HS
	2000	HS	HS	-	HS		HS	*	HS	HS
	2001	HS	HS	*	HS	HS		HS	*	HS
	2004	HS	HS	-	HS	*	HS		HS	HS
	2005	HS	HS	-	HS	HS	*	HS		HS
	2006	HS	HS	*	HS	HS	HS	HS	HS	
Chiwawa – Natural Origin	1989	HS	HS	-	HS	HS	*	HS	HS	HS
	1993	HS	HS	-	HS	HS	-	HS	*	HS
	1996	*	HS	-	*	-	-	-	-	-
	1998	HS	HS	-	-	HS	*	*	*	-
	2000	HS	HS	-	HS	HS	HS	*	HS	HS
	2001	HS	HS	-	HS	HS	HS	HS	*	HS
	2004	HS	HS	-	HS	HS	HS	HS	HS	HS
	2005	HS	HS	-	HS	HS	*	HS	*	HS
	2006	HS	HS	-	*	HS	HS	HS	HS	HS
Nason	1996	HS	HS	-	HS	HS	HS	HS	HS	HS
	2000	HS	HS	*	HS	HS	HS	HS	HS	HS
	2001	HS	HS	-	HS	HS	HS	HS	HS	HS
	2004	HS	HS	-	HS	HS	HS	HS	HS	HS
	2005	HS	HS	-	HS	HS	HS	HS	HS	HS
	2006	HS	HS	-	*	HS	HS	HS	HS	HS
White	1989	HS	HS	HS	HS	HS	HS	HS	HS	HS
	1991	HS	HS	-	HS	HS	HS	HS	HS	HS
	1992	HS	HS	*	HS	HS	HS	HS	HS	HS
	1993	HS	HS	*	HS	HS	HS	HS	HS	HS
	2005	HS	HS	-	HS	HS	HS	HS	HS	HS
	2006	HS	HS	HS	HS	HS	HS	HS	HS	HS
Other	Wen-M	HS	HS	*	HS	HS	*	*	-	HS
	Leaven	HS	HS	*	HS	HS	HS	HS	HS	HS
	Entiat	HS	HS	*	HS	HS	HS	HS	HS	HS

Table 3 (con't)

		Chiwawa – Natural Origin								
		1989	**1993**	**1996**	**1998**	**2000**	**2001**	**2004**	**2005**	**2006**
Chiwawa – Natural Origin	**1989**		-	-	-	-	*	*	*	*
	1993	-		-	*	*	*	HS	*	HS
	1996	-	-		-	-	-	-	-	-
	1998	-	*	-		*	*	HS	*	*
	2000	-	*	-	*		HS	-	HS	HS
	2001	*	*	-	*	HS		HS	*	HS
	2004	*	HS	-	HS	-	HS		HS	HS
	2005	*	*	-	*	HS	*	HS		*
	2006	*	HS	-	*	HS	HS	HS	*	
Nason	**1996**	*	*	-	*	*	HS	HS	HS	HS
	2000	HS	HS	HS	HS	HS	HS	HS	HS	HS
	2001	HS	*	-	*	HS	HS	HS	HS	HS
	2004	HS	HS	-	HS	HS	HS	HS	HS	HS
	2005	*	*	-	*	HS	HS	HS	HS	HS
	2006	HS	HS	-	-	HS	HS	HS	HS	HS
White	**1989**	HS	HS	*	HS	HS	HS	HS	HS	HS
	1991	HS	HS	*	-	HS	HS	HS	HS	HS
	1992	HS	HS	-	*	HS	HS	HS	HS	HS
	1993	HS	*	-	*	HS	HS	HS	HS	HS
	2005	HS	*	*	*	HS	HS	HS	*	HS
	2006	HS	HS	*	HS	HS	HS	HS	HS	HS
Other	**Wen-M**	*	-	-	-	*	*	HS	*	*
	Leaven	HS	HS	*	*	HS	HS	HS	HS	HS
	Entiat	HS	HS	*	HS	HS	HS	HS	HS	HS

Table 3 (con't)

		Nason					
		1996	**2000**	**2001**	**2004**	**2005**	**2006**
Nason	**1996**		HS	-	HS	-	*
	2000	HS		HS	HS	HS	HS
	2001	-	HS		*	-	*
	2004	HS	HS	*		*	HS
	2005	-	HS	-	*		-
	2006	*	HS	*	HS	-	
White	**1989**	HS	HS	HS	HS	HS	HS
	1991	*	HS	HS	HS	*	*
	1992	HS	HS	HS	HS	HS	HS
	1993	*	HS	HS	HS	HS	HS
	2005	*	HS	HS	HS	HS	HS
	2006	HS	HS	HS	HS	HS	HS
Other	**Wen-M**	HS	HS	HS	HS	*	HS
	Leaven	HS	HS	HS	HS	HS	HS
	Entiat	HS	HS	HS	HS	HS	HS

Table 3 (con't)

		White						Other		
		1989	**1991**	**1992**	**1993**	**2005**	**2006**	**Wen-M 2001**	**Leaven 2000**	**Entiat 1997**
White	**1989**		-	*	-	HS	HS	HS	HS	HS
	1991	-		-	-	*	*	*	HS	HS
	1992	*	-		-	*	*	HS	HS	HS
	1993	-	-	-		*	*	HS	HS	HS
	2005	HS	*	*	*		*	HS	HS	HS
	2006	HS	*	*	*	*		HS	HS	HS
Other	**Wen-M**	HS	*	HS	HS	HS	HS		HS	HS
	Leaven	HS	HS	HS	HS	HS	HS	HS		HS
	Entiat	HS	HS	HS	HS	HS	HS	HS	HS	

Table 4 Probabilities (above diagonal) and levels of significance (below diagonal) for pairwise tests of genic differentiation among all Chiwawa hatchery broodstock and Chiwawa natural spawner collections used in this analysis. HS = highly significant (P < 0.000476; the Bonferroni corrected p-value for an alpha = 0.05); * = P < 0.05 (nominal critical value for most statistical test); - = P > 0.05 (considered not significant). A significant result between pairs of populations indicates that the allele frequencies between the pair are significantly different. Pairwise comparisons between the hatchery broodstock and natural spawner collections from 2001, 2004, 2005, and 2006, respectively, are highlighted.

		Smolt		Hatchery Broodstock								Natural Spawners				
		1993	1994	1993	1996	1998	2000	2001	2004	2005	2006	1989	2001	2004	2005	2006
Smolt	1993		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	1994	HS		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hatchery Broodstock	1993	HS	HS		0.9155	0.0000	0.0073	0.3647	0.0003	0.0694	0.0000	0.2220	0.0039	0.0008	0.0095	0.0000
	1996	HS	HS	-		0.0151	0.8388	0.0452	0.4916	0.3189	0.0716	0.5591	0.0759	0.8101	0.2364	0.0786
	1998	HS	HS	HS	*		0.0000	0.0000	0.0000	0.0000	0.0043	0.0000	0.0000	0.0000	0.0000	0.0005
	2000	HS	HS	*	-	HS		0.0000	0.4720	0.0000	0.0000	0.0036	0.0000	0.0712	0.0000	0.0000
	2001	HS	HS	-	*	HS	HS		0.0000	0.0059	0.0000	0.0003	0.0000	0.0000	0.0126	0.0000
	2004	HS	HS	*	-	HS	-	HS		0.0000	0.0000	0.0001	0.0000	0.0012	0.0000	0.0000
	2005	HS	HS	-	-	HS	HS	*	HS		0.0005	0.0024	0.0137	0.0025	0.7782	0.0018
	2006	HS	HS	HS	-	*	HS	HS	HS	*		0.0000	0.0000	0.0000	0.0000	0.5770
Natural Spawners	1989	HS	HS	-	-	HS	*	*	HS	*	HS		0.0023	0.0317	0.0000	0.0003
	2001	HS	HS	*	-	HS	HS	HS	HS	*	HS	*		0.0000	0.2641	0.0000
	2004	HS	HS	*	-	HS	-	HS	*	*	HS	*	HS		0.0000	0.0000
	2005	HS	HS	*	-	HS	HS	*	HS	-	HS	HS	-	HS		0.0000
	2006	HS	HS	HS	-	*	HS	HS	HS	*	-	*	HS	HS	HS	

Table 5 Analysis of molecular variance (AMOVA) for the Chiwawa collections, showing the partition of molecular variance into (1) within collections, (2) among collections but within group, and (3) among group components. Each column in the table represents a separate analysis testing for differences under a different spatial or temporal hypothesis. The different analyses are grouped together in a single table for comparisons. The values within the table are percentages and the parenthetical values are P-values, or probabilities, associated with that percentage. P-values greater than 0.05 indicate that the percentage is not significantly different from zero. For example, when collections are organized by hatchery- versus natural-origin ("Origin" – fourth column), 0.11% of the molecular variance is attributed to among group (i.e., hatchery- versus natural-origin), which is not significantly different from zero. No collections (first column) indicates no organization or grouping among all collections, and the among-group percentage is equal to the F_{ST} for the entire data set.

	No Structure	Collection Year	Spawning Location	Origin	Origin-Spawning Location
Among Groups	0.26 (0.00)	0.20 (0.43)	0.05 (0.48)	0.11 (0.15)	0.11 (0.06)
Among collections - Within groups	-	0.08 (0.003)	0.24 (0.00)	0.21 (0.00)	0.18 (0.06)
Within collections	99.74 (0.00)	99.72 (0.00)	99.71 (0.00)	99.68 (0.00)	99.71 (0.00)

Table 6 F_{ST} values for all pairwise combinations of populations. Each F_{ST} is the median value for all pairwise combinations of collections within each population (the number of collections within each population is shown parenthetically next to each population name on each row). For example, the F_{ST} for the Chiwawa hatchery versus the White River (0.019) is the median value of 54 pairwise comparisons. The bold values along the center diagonal are the median F_{ST} values within each collection. For those populations with only one collection, the diagonal value was set at 0.000.

	Chiwawa-Hatchery	Chiwawa-Natural	Entiat	Leaven-worth	Nason	Wenatchee-main	White	Little Wenatchee
Chiwawa-Hatchery (9)	**0.013**	0.008	0.016	0.012	0.011	0.005	0.019	0.111
Chiwawa-Natural (9)		**0.003**	0.012	0.011	0.007	0.003	0.014	0.105
Entiat (1)			**0.000**	0.005	0.010	0.008	0.019	0.078
Leavenworth (1)				**0.000**	0.007	0.008	0.014	0.092
Nason (6)					**0.006**	0.008	0.015	0.099
Wenatchee-main (1)						**0.000**	0.012	0.098
White (6)							**0.005**	0.113
Little Wenatchee (1)								**0.000**

Table 7 As in Table 5, except data includes Chiwawa hatchery- and natural-origin, Nason Creek, and White River collections

	All Years	All Years	1989-1996	2005-2006	2005-2006
	No Structure	Origin	Origin	Origin	Collection Year
Among Groups	0.28 (0.00)	0.33 (0.00)	-0.07 (0.67)	0.43 (0.01)	-0.06 (0.57)
Among Collections - Within groups	-	0.04 (0.00)	0.22 (0.00)	0.25 (0.00)	0.64 (0.00)
Within Collections	99.72	99.63	99.85	99.32	99.41

Table 8 Individual assignment results reported are the numbers of individuals assigned to each population using the partial Bayesian criteria of Rannala and Mountain (1997) and a “jack-knife” procedure (see Methods). The population with the highest posterior probability is considered the stock of origin (i.e., no unassigned individuals). Individuals from each population are assigned to specific populations (along rows). Bold values indicate correct assignment back to population of origin. Individuals assigned to a population are read down columns. For example, of the 595 individuals from Chiwawa hatchery origin, 134 individuals were assigned to Chiwawa natural origin (reading across). Of the 511 individuals assigned to Chiwawa natural origin (reading down), 60 were from Nason Creek.

Population	Total	Unassigned	1	2	3	4	5	6	7	8
1) Chiwawa Hatchery	595	0	**371**	134	2	16	0	45	15	12
2) Chiwawa Natural	501	0	156	**269**	4	5	0	42	9	16
3) Entiat	37	0	4	5	**13**	8	0	6	1	0
4) Leavenworth	73	0	9	8	3	**33**	0	17	0	3
5) Little Wenatchee	19	0	0	0	0	0	**19**	0	0	0
6) Nason	268	0	49	60	5	11	0	**131**	1	11
7) Wenatchee Mainstem	32	0	12	9	0	1	0	2	**6**	2
8) White	179	0	22	26	0	2	0	13	1	**115**
TOTAL	1704	0	623	511	27	76	19	256	33	159

Table 9 As in Table 8, except the posterior probability from the partial Bayesian criteria of Rannala and Mountain (1997) must be 0.90 or greater, to be assigned to a population. Those individuals with posterior probabilities less than 0.90 are unassigned.

Aggregate	Total	Unassigned	1	2	3	4	5	6	7	8
1) Chiwawa Hatchery	595	332	**214**	31	1	4	0	10	3	0
2) Chiwawa Natural	501	375	30	**82**	0	1	0	5	2	6
3) Entiat	37	24	1	1	**5**	4	0	2	0	0
4) Leavenworth	73	51	0	1	1	**19**	0	1	0	0
5) Little Wenatchee	19	2	0	0	0	0	**17**	0	0	0
6) Nason	268	188	11	6	2	5	0	**53**	0	3
7) Wenatchee Mainstem	32	23	4	3	0	0	0	0	**2**	0
8) White	179	92	4	3	0	1	0	5	1	**73**
TOTAL	1704	1087	264	127	9	34	17	76	8	82

Table 10 Estimates of N_e based on bias correction method of Waples (2006) implemented in LDNe (Do and Waples unpublished). Collections are categorized by spawning location. Sample size is the harmonic mean of the sample size, 95% CI is the confidence interval calculated using Waples' (2006) equation 12, and Major Cohort assumes that each collection is 100% four-year-olds.

	Sample size	Estimated N_b	95% CI	Major Cohort	Census	N_e/N
1993 Chiwawa Broodstock	58.4	103.1	77.0 - 149.7	1989	1392	0.30
1996 Chiwawa Broodstock	15.5	30.4	19.6 - 58.1	1992	1099	0.11
1998 Chiwawa Broodstock	33.4	37.7	29.8 - 49.7	1994	280	0.54
2000 Chiwawa Broodstock	77.8	48.4	41.4 - 57.2	1996	182	1.06
2001 Chiwawa Broodstock	80.4	49.6	42.2 - 59.2	1997	389	0.51
2004 Chiwawa Broodstock	56.6	48.1	39.0 - 60.9	2000	688	0.28
2005 Chiwawa Broodstock	73	274.3	148.9 - 1131.8	2001	4130	0.27
2006 Chiwawa Broodstock	88.4	198.3	136.1 - 340.5	2002	1613	0.49
1989 Chiwawa River	26.6	5.2	3.9 - 6.3	1985		
2001 Chiwawa River	46.7	38.6	31.0 - 49.3	1997	389	0.40
2004 Chiwawa River	88.5	82.6	67.3 - 104.4	2000	688	0.48
2005 Chiwawa River	104.2	231.5	161.8 - 382.7	2001	4130	0.22
2006 Chiwawa River	101.1	107.3	87.2 - 136	2002	1613	0.27

Table 11 Summary of output from program SALMONNb and data for eight Chiwawa broodstock collections from Wenatchee River. For each pairwise comparison of samples *i* and *j*, $\tilde{S}$ is the harmonic mean sample size, *n* is the number of independent alleles used in the comparison, $\hat{N}_{b(i,j)}$ are the pairwise estimates of N_b, and Var [$\hat{N}_{b(i,j)}$] is the variance of $\hat{N}_{b(i,j)}$. $\tilde{N}_b$ is the harmonic mean of the $\hat{N}_{b(i,j)}$. Alleles with a frequency below 0.05 were excluded from the analysis to reduce potential bias.

Year	1993	1996	1998	2000	2001	2004	2005	2006
Pairwise $\tilde{S}$ (above diagonal) and *n* (below diagonal):								
1993	-	24.5	42.5	66.4	67.2	57.2	64.6	70.3
1996	82	-	21.2	25.8	26.0	24.4	25.6	26.4
1998	80	81	-	46.7	47.2	42.0	45.8	48.4
2000	80	82	84	-	78.6	65.2	75.1	82.7
2001	73	77	81	76	-	66.0	76.2	84.2
2004	77	81	75	76	78	-	63.5	69.0
2005	71	75	82	73	73	69	-	80.0
2006	81	80	84	75	74	75	72	-
Pairwise $\hat{N}_{b(i,j)}$ (above diagonal) and Var [$\hat{N}_{b(i,j)}$] (below diagonal):								
1993	-	-742.7	406.9	1240.8	-5432.0	829.8	808.9	729.0
1996	22491.2	-	110.4	-1786.5	765.9	162.8	824.7	382.7
1998	10910.4	67299.1	-	101.8	237.1	69.6	307.0	140.0
2000	6910.0	742895.8	19122.7	-	490.6	1498.2	706.9	201.6
2001	49318.3	21402.8	9754.2	6126.6	-	307.8	82.0	362.5
2004	8338.4	257267.7	24283.0	145043.4	7095.7	-	269.7	140.1
2005	31511.8	22242.5	10015.8	6596.6	114931.1	8240.4	-	599.6
2006	6223.8	43935.2	73518.7	10152.5	5885.3	12827.0	6370.8	-

$\tilde{N}_b$ = 269.4

Table 12 Summary of output from program SALMONNb and data for five Chiwawa in-river spawner collections from Wenatchee River. For each pairwise comparison of samples *i* and *j*, $\tilde{S}$ is the harmonic mean sample size, *n* is the number of independent alleles used in the comparison, $\hat{N}_{b(i,j)}$ are the pairwise estimates of N_b, and Var [$\hat{N}_{b(i,j)}$] is the variance of $\hat{N}_{b(i,j)}$. $\tilde{N}_b$ is the harmonic mean of the $\hat{N}_{b(i,j)}$. Alleles with a frequency below 0.05 were excluded from the analysis to reduce potential bias.

Year	1989	2001	2004	2005	2006
Pairwise $\tilde{S}$ (above diagonal) and *n* (below diagonal):					
1989	-	33.3	40.2	41.7	42.2
2001	72	-	60.5	63.9	63.3
2004	72	77	-	95.3	94.0
2005	69	72	75	-	102.5
2006	76	76	77	78	-
Pairwise $\hat{N}_{b(i,j)}$ (above diagonal) and Var [$\hat{N}_{b(i,j)}$] (below diagonal):					
1989	-	118.4	299.0	143.3	165.3
2001	40378.8	-	181.7	-1537.3	153.5
2004	10455.2	7265.5	-	387.1	329.4
2005	20923.6	68660.6	5040.7	-	356.8
2006	16227.2	8886.9	3802.0	4522.8	-

$\tilde{N}_b$ = 224.2

Table 13 Summary of output from program SALMONNb and data for three brood years that combined Chiwawa natural- and hatchery-origin samples from Wenatchee River. For each pairwise comparison of samples *i* and *j*, $\tilde{S}$ is the harmonic mean sample size, *n* is the number of independent alleles used in the comparison, $\hat{N}_{b(i,j)}$ are the pairwise estimates of N_b, and Var [$\hat{N}_{b(i,j)}$] is the variance of $\hat{N}_{b(i,j)}$. $\tilde{N}_b$ is the harmonic mean of the $\hat{N}_{b(i,j)}$. Alleles with a frequency below 0.05 were excluded from the analysis to reduce potential bias.

Year	2004	2005	2006
Pairwise $\tilde{S}$ (above diagonal) and *n* (below diagonal):			
2004	-	162	164.3
2005	77	-	188.2
2006	76	75	-
Pairwise $\hat{N}_{b(i,j)}$ (above diagonal) and Var [$\hat{N}_{b(i,j)}$] (below diagonal):			
2004	-	611.3	210.8
2005	9351.5	-	727.5
2006	14965.5	8673.9	-

$\tilde{N}_b = 386.8$

Appendix N

Fish Trapping at the Nason Creek Smolt Trap, 2019

Population Estimates for Juvenile Salmonids in Nason Creek, WA

2019 Annual Report

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Project No. 1996-040-00

ABSTRACT

In 2019, Yakama Nation Fisheries Resource Management (YNFRM) monitored emigration of Endangered Species Act (ESA) - listed Upper Columbia River (UCR) spring Chinook salmon, UCR summer steelhead, and naturally spawned coho salmon juveniles in Nason Creek. This report summarizes the resulting juvenile abundance and freshwater survival estimates for each of these species. Fish were captured using a 1.5m rotary smolt trap between March 1 and November 27, 2019. Target catch included 2,055 wild spring Chinook salmon and 542 wild summer steelhead of varying age classes. There were no natural-origin coho captured. Daily fish abundances for spring Chinook and steelhead were expanded by stream discharge-to-trap efficiency regressions or pooled estimates. We estimated that 27,690 ± 14,634 brood-year (BY) 2017 wild spring Chinook parr and smolts emigrated from Nason Creek. We subsequently estimated that within Nason Creek, BY2017 spring Chinook had an egg-to-emigrant survival of 8.8%. Additionally, we estimated that 24,157 ± 30,806 BY2016 wild steelhead parr and smolts emigrated from Nason Creek.

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ACKNOWLEDGEMENTS

This project is part of a basin-wide monitoring program requiring close coordination between multiple agencies and contractors. We greatly appreciate the hard work of the Yakama Nation Fisheries Resource Management (YNFRM) crew members including Matthew Clubb, Jamie Hallman, Kushiah Yazzie, and Tim Jeffris who maintained and operated the trap during all hours including nights/weekends and through challenging weather conditions. We would like to also thank the Wenatchee River Ranger District (U.S. Forest Service), Mr. Duane Bolser for providing use of the trapping site and accommodating the needs of this project, and Peter Graf and Rolland O'Connar (Grant County PUD) for administering contracting and funding. Finally, thank you to Mike Hughes, Mclain Johnson, Andrew Murdoch, Ben Truscott, and Joshua Williams (Washington Department of Fish and Wildlife), and Tracy Hillman (BioAnalysts, Inc.) for shared data and smolt trap methodologies.

1.0 INTRODUCTION

Beginning in the fall of 2004, Yakama Nation Fisheries Resource Management (YNFRM) began operating a rotary smolt trap in Nason Creek for nine months per year. Prior to 2004, the smolt trap was operated on a limited basis solely for hatchery coho predation studies. This project is a cost share between the YNFRM's Mid-Columbia Coho Reintroduction Program (MCCRP) and Grant County PUD's Hatchery Monitoring Plan. Trap operations were conducted in compliance with ESA consultation specifically to address abundance and productivity of spring Chinook, steelhead trout, and coho salmon in Nason Creek.

Within this document we will report:

> 1) Juvenile abundance and productivity of spring Chinook salmon (tkwínat) *Oncorhynchus tshawytscha*, steelhead trout (shúshaynsh) *Oncorhynchus mykiss* and coho salmon (súnx) *Oncorhynchus kisutch* in Nason Creek.
>
> 2) Emigration timing of spring Chinook salmon, steelhead trout and coho salmon emigrating from Nason Creek.

The data presented will be directly used to address Objective 2 in the Monitoring and Evaluation Plan for PUD Hatchery Programs (Hillman et al. 2015) on a 5-year analytic cycle:

> **Objective 2: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks (Hillman et al. 2013).**

1.1 Watershed Description

The Nason Creek watershed drains 26,547 ha of alpine glaciated landscape where high precipitation and moderate rain on snow recurrence controls the hydrology and aquatic communities. Nason Creek originates near the Cascade crest at Stevens Pass and flows east for approximately 37 river kilometers (rkm) until joining the Wenatchee River at rkm 86.3 just below Lake Wenatchee. There are 26.4 rkm along the mainstem accessible to anadromous fish in Nason Creek. The smolt trap is located downstream from the majority of spring Chinook and steelhead spawning grounds (Figure 1). Private land ownership comprises 21,165 ha (79.7%) of the watershed while 5,180 ha (19.5%) are federal and 194 ha (0.1%) are state owned (USFS et al. 1996).

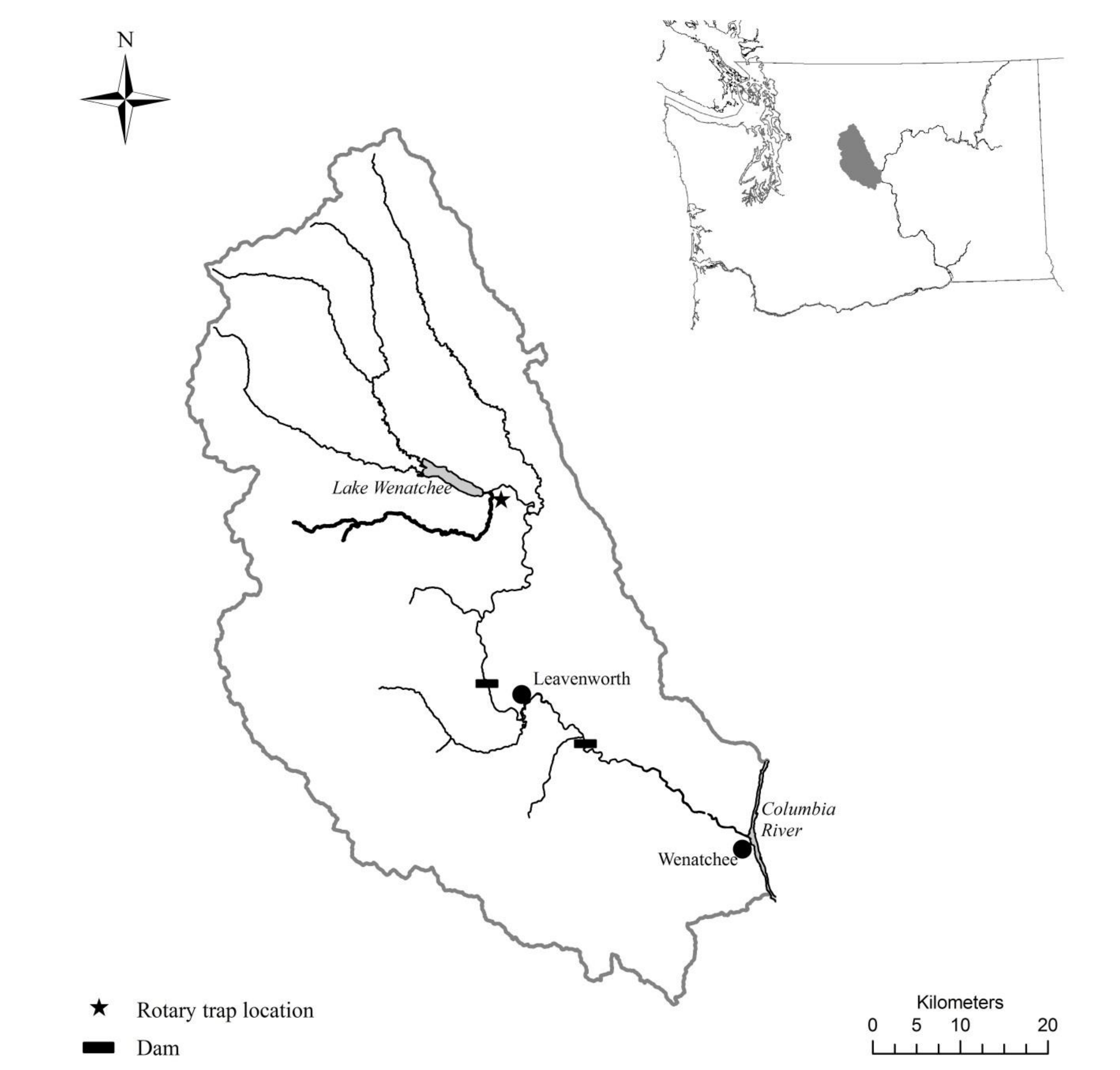


Figure 1. Map of Wenatchee River Subbasin with the Nason Creek rotary trap location.

The channel morphology of the lower 25 rkm of Nason Creek has been impacted by development of highways, railroads, power lines, and residential development resulting in channel confinement and reduced side-channel habitat. The present condition is a low gradient (< 1.1%), low sinuosity (1:2 to 2:0 channel-to-valley length ratio) and depositional channel (USFS et al. 1996). Peak runoff typically occurs in May and June with occasional high water produced by rain on snow events in October and November.

In 2019, mean daily discharge for Nason Creek was 7.0 m^3/s (247 cfs; Figure 2). The timing of spring runoff was typical of the tributary, with the onset ocurring in mid-March, and a peak flow of 41.6 m^3/s on May 12. The seasonal water temperature regime was also typical in 2019 (Figure 3).

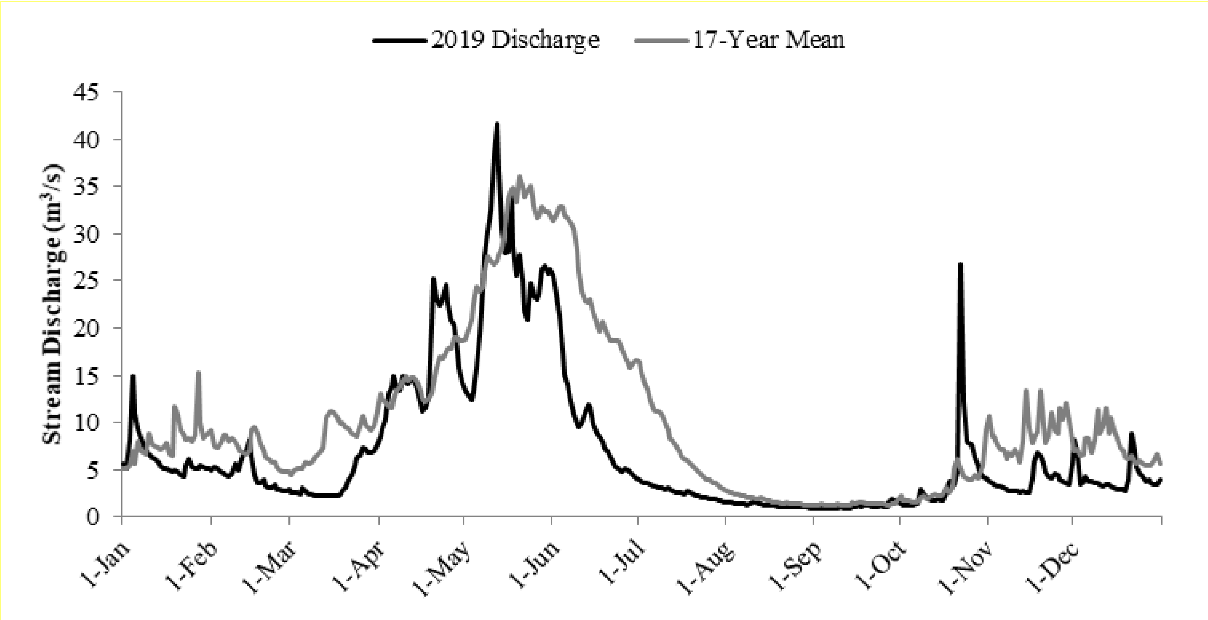


Figure 2. Mean daily stream discharge at the Nason Creek WDOE stream monitoring station in 2019.

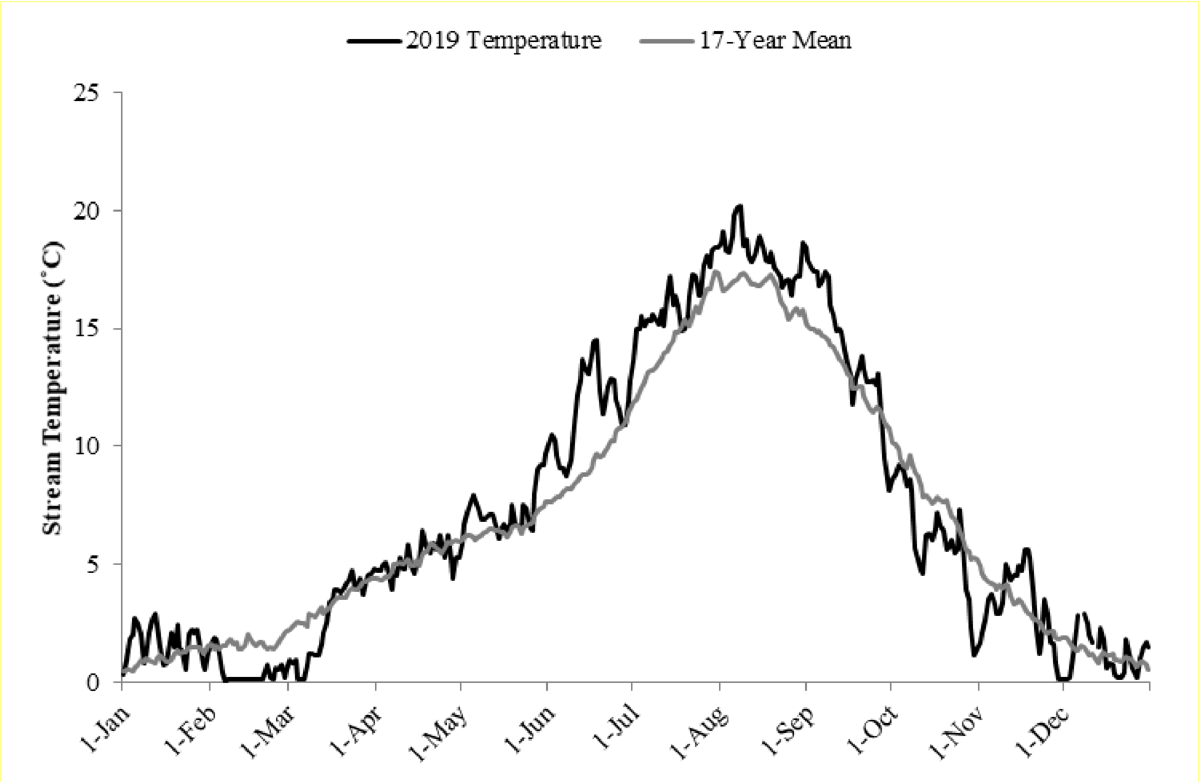


Figure 3. Mean daily stream discharge at the Nason Creek WDOE stream monitoring station in 2019.

2.0 METHODS

2.1 Trapping Equipment and Operation

The smolt trap was operated continually 24 hours per day, 7 days per week when conditions permitted. During spring snowmelt, operations occurred only during hours of darkness in order to minimize trap damage and capture mortality, while retaining the ability to sample during periods of peak fish movement.

On a daily basis, fish were removed from the primary collection box and retained in separate shore-anchored holding boxes until removed for efficiencies trials. A rotating drum-screen constantly removed small debris from the live box to avoid fish injury. All changes/modifications to the trap as well as periods of stoppage were noted.

2.2 Biological Sampling

Trap operating procedures and techniques followed a standardized basin-wide monitoring plan developed by the Upper Columbia Regional Technical Team (RTT) for the Upper Columbia Salmon Recovery Board (UCSRB; Hillman 2004), which was adapted from Murdoch and Petersen (2000).

All fish were enumerated by species and size class. Fish to be sampled were anesthetized in a solution of MS-222, weighed with an electronic scale and measured in a wetted trough-type measuring board. Anesthetized fish received air through aquarium bubblers and were allowed to fully recover before being either released downstream of the trap or used in efficiency trials. Fork length (FL) and weight were recorded for all fish except when large numbers of fry or non-target species were collected; a sub-sample of 25 fish were measured and weighed while the remaining fish were tallied. Weight was measured to the nearest 0.1 gram and FL to the nearest millimeter. We used these data to calculate a Fulton-type condition factor (K-factor) using the formula:

$$K = (W/L^3) \text{ x } 100{,}000$$

where K = Fulton-type condition metric;
W = weight in grams;
L = fork length in millimeters;
And 100,000 is a scaling constant.

Scale samples were collected from steelhead measuring ≥ 60 mm FL so that age and brood year could be assigned. Samples were collected according to the needs and protocols set by Washington Department of Fish and Wildlife (WDFW), who conducted the analysis and provided YNFRM with results. Tissue samples were collected from spring Chinook and steelhead for DNA analysis. Samples from spring Chinook and steelhead were retained for reproductive success analyses conducted by WDFW and National Marine Fisheries Service (NMFS). All target salmonids were classified as either natural or hatchery origin by physical appearance, presence/absence of coded wire tags (CWTs), or post-orbital elastomer tags. Developmental stages were visually classified as fry, parr, transitional, or smolt. Fry were defined as newly emerged fish with or without a visible yolk sac and a FL measuring < 50 mm.

Age-0 coho and spring Chinook salmon captured before July 1 were considered 'fry' and were excluded from subyearling population estimates because of the uncertainity that these fish were actively migrating (UCRTT, 2001).

2.3 PIT Tagging

All natural origin Chinook, steelhead and coho measuring ≥ 60 mm were PIT tagged. Once anesthetized, each fish was examined for external wounds or descaling, then scanned for the presence of a previously implanted PIT tag. If a tag was not detected, a pre-loaded 12mm Digital Angel 134.2 kHz type TX 1411ST PIT tag was inserted into the body cavity using a Biomark MK-25 Rapid Implant Gun. Each unique tag code was electronically recorded along with date of tag implantation, date of fish release, tagging personnel, FL, weight, and anesthetic bath temperature. Data were entered using P4 software and submitted to the PIT Tag Information System (PTAGIS). PIT tagging methods were consistent with methodologies described in the PIT Tag Marking Procedures Manual (CBFWA 1999) as well as in 2008 ISEMP protocols (Tussing 2008).

After marking and sampling, fish were held for a minimum of 24-hours in holding boxes at the trap to; a) ensure complete recovery, b) assess tagging mortality, and c) determine a PIT tag shed rate. Mark groups were released by hand 0.8 rkm above the trap at nautical twilight. At each release, fish were distributed evenly along river-left, and river-right banks in pools and other protected areas. Fish that were not used in mark-recapture trials were released downstream from the trap.

2.4 Mark-Recapture Trials

Groups of marked juveniles were released during a range of stream discharges in order to determine the trapping efficiency. PIT tags were the only method of marking used in 2018. These releases followed the protocols described in Hillman (2004), in which the author suggests a minimum sample size of 100 fish for each mark-recapture trial. Although 100 fish/trial represented the ideal mark group, low abundance of fish often required mark-recapture trials be completed with smaller sample sizes. To achieve the largest marked group possible, we combined catch over a maximum of 72 hours. Fish being held for mark-recapture trials were kept in auxiliary live boxes attached to the end of each pontoon or floating holding boxed anchored to the stream bank. A pre-season, minimum mark group size for each species/life stage was initially determined based on past regression models. During periods of high abundance, minimum trial sizes could be raised to a more robust mark group with the intention of strengthening existing regression models. Current minimum mark group size for inclusion in flow efficiency models is 50 fish.

Each mark-recapture trial was conducted over a three-day (72 hour) period to allow time for passage or capture. Completed trials were only considered invalid if an interruption to trapping occurred or proper pre-release procedures were not followed. Trials resulting in zero recaptures were included in the efficiency regression (if determined valid once vetted through release/recapture protocols) as allowed by the new method of observed trap efficiency calculation. The model used (Bailey) employs use of recaptures +1 in the calculation of efficiency as a mode of bias correction. As a result, even trials yeilding no recaptures can be included in regression modeling (See equation 3 in **2.5.1 Estimate of Abundance**).

In the event that low juvenile abundance could not provide any opportunities for efficiency trials, releases were performed to allow for a pooled estimate. These releases did not have a minimum size and were released at equal intervals across the migratory period. Pooled estimates at the Nason Creek trap were utilized as an alternative method of estimation prior to the development of a viable regression model.

2.5 Data Analysis

2.5.1 Estimate of Abundance During Smolt Trapping

Seasonal juvenile migration, N, was estimated as the sum of daily migrations, N_i, i.e., $N = \sum_i N_i$, and daily migration was calculated from catch and efficiency:

$$\hat{N}_i = \frac{C_i}{\hat{e}_i}, \qquad \textbf{(1)}$$

where C_i = number of fish caught in period *I*;

$\hat{e}_i$ = trap efficiency estimated from the flow-efficiency relationship, $\sin^2(b_0 + b_1 flow_i)$,

where b_0 is estimated intercept and b_1 is the estimated slope of the regression.

The regression parameters b_0 and b_1 are estimated using linear regression for the model:

$$\arcsin\left(\sqrt{e_k^{obs}}\right) = \beta_0 + \beta_1 flow_k + \varepsilon, \qquad \textbf{(2)}$$

where e_k^{obs} = observed trap efficiency of Eq. 2 for trapping period *k*;

β_0 = intercept of the regression model;

β_1 = slope parameter;

ε = error with mean 0 and variance σ^2.

In Equation 2, the observed trap efficiency, e_k^{obs}, is calculated as follows,

$$e_k^{obs} = \frac{r_k + 1}{m}. \qquad \textbf{(3)}$$

The estimated variance of seasonal migration is calculated from daily estimates as:

$$Var\left(\sum_{i=1}^{n} \hat{N}_i\right) = \underbrace{\sum_i Var(N_i)}_{Part\ A} + \underbrace{\sum_i \sum_j Cov(N_i, N_j)}_{Part\ B}$$

or, **(4)**

$$Var\left(\sum_{i=1}^{n} \hat{N}_i\right) = \underbrace{\sum_i Var\left(\frac{(C_i + 1)}{\hat{e}_i}\right)}_{Part\ A} + \underbrace{\sum_i \sum_j Cov\left(\frac{(C_i + 1)}{\hat{e}_i}, \frac{(C_j + 1)}{\hat{e}_j}\right)}_{Part\ B}$$

Part A of equation 4 is the variance of daily estimates. Part B is the between-day covariance. Note that the between-day covariance exists only for days that use the same trap efficiency model. If, for example, day 1 is estimated with one trap efficiency model, and day 2 estimated from a different model, then there is no covariance between day 1 and day 2. The full expression for the estimated variance:

$$\begin{aligned}\widehat{Var}\left(\sum_{i=1}^{n} \hat{N}_i\right) &= \underbrace{\sum_i \hat{N}_i^2 \left(\frac{N_i \hat{e}_i (1 - \hat{e}_i)}{(C^i + 1)^2} + \frac{4(1 - \hat{e}_i)}{\hat{e}_i} \widehat{Var}(b_0 + b_1 flow_i)\right)}_{Part\ A} \\ &\quad + \underbrace{\sum_i \sum_j 4\left(\hat{N}_i (1 - \hat{e}_i)\right)\left(\hat{N}_j (1 - \hat{e}_j)\right) \cdot \left[\widehat{Var}(b_0) + flow_i flow_j \widehat{Var}(b_1)\right]}_{Part\ B}\end{aligned}$$

where $\hat{Var}(b_0 + b_1 flow_i) = M\hat{S}E\left(1 + \frac{1}{n} + \frac{\left(flow_i - \overline{flow}\right)^2}{(n-1)s_{flow}^2}\right)$, and $\hat{Var}(b_0)$ and $\hat{Var}(b_1)$ are

obtained from regression results. In Excel, the standard error (SE) of the coefficients is provided. The variance is calculated as the square of the standard error, SE^2.

In cases when there was no significant flow-efficiency relationship (i.e., low correlation), then a pooled, or average trap efficiency will suffice for the stratum. The estimator is calculated as follows:

$$\hat{\bar{e}} = \frac{\sum_{j=1}^{k} r_j}{\sum_{j=1}^{k} m_j}$$

where $\hat{\bar{e}}$ = the average or pooled trap efficiency for the stratum;

m_j = the number of smolts marked and released in efficiency trial j for the stratum;

r_j = the number of smolts recaptured out of m_j marked fish in efficiency trial j.

Abundance for a trapping period is estimated as:

$$\hat{N}_i^{pooled} = \frac{C_i}{\hat{\bar{e}}},$$

,and total stratum abundance is:

$$N^{pooled} = \sum_i \hat{N}_i^{pooled}.$$

The variance of seasonal abundance takes into account the variability in catch numbers that are a result of binomial sampling (Part A), the pooled variance of trap efficiency, $\hat{\bar{e}}$ (Part B), and the covariance in daily estimates that arises from using a common estimate of efficiency across all trapping days (Part C):

$$Var\left(\sum_{i=1}^{n} \hat{N}_i^{pooled}\right) = \underbrace{\left(\sum_i \frac{\hat{N}_i(1-\hat{\bar{e}})}{\hat{\bar{e}}}\right)}_{Part\ A} + \underbrace{\frac{Var(\hat{\bar{e}})}{\hat{\bar{e}}^2}\sum_i \hat{N}_i^2}_{Part\ B} + \underbrace{\frac{Var(\hat{\bar{e}})}{\hat{\bar{e}}^2}\sum_i\sum_j \hat{N}_i\hat{N}_j}_{Part\ C}$$

The Part B and Part C terms are combined in the calculation as a new Part B:

$$Var\left(\sum_{i=1}^{n} \hat{N}_i^{pooled}\right) = \left(\sum_i \frac{\hat{N}_i(1-\hat{\bar{e}})}{\hat{\bar{e}}}\right) + \frac{Var(\hat{\bar{e}})}{\hat{\bar{e}}^2}\left[\sum_i \hat{N}_i^2 + \sum_i\sum_j \hat{N}_i\hat{N}_j\right]$$

The variance of $\hat{\hat{e}}$ is calculated as:

$$V\hat{a}r\left(\hat{\hat{e}}\right) = V\hat{a}r\left(\frac{\sum_{k=1}^{n} r_k}{\sum_{k=1}^{n} m_k}\right) = \frac{\sum_{k=1}^{n}\left(r_k - \hat{\hat{e}}_k m_k\right)^2}{\overline{m}^2 n(n-1)}$$

where $\overline{m}$ is the average release size across all efficiency trial, $\frac{\sum_{k=1}^{n} m_k}{n}$.

Confidence intervals were calculated using the following formulas:

95% confidence interval = $1.96 \times \sqrt{\sum \mathrm{var}\left[\hat{N}_i\right]}$

The single M-R estimator of abundance carries a set of well documented assumptions (Everhart and Youngs 1981; Seber 1982),

1. The population is closed to mortality.
2. The probability of capturing a marked or unmarked fish is equal.
3. Marked fish were randomly dispersed in the population prior to recapture.
4. Marking does not affect probabilities of capture.
5. Marks were not lost between the time of release and recapture.
6. All marks are reported upon recapture.
7. The number of fish in the trap, C, is fully enumerated and known without error.

2.5.2 Estimate of Abundace During Trap Stoppages and Suspended Operations

Daily catch during stoppages of seven days or less was estimated by averaging catch three days prior to, and after the discreet non-trapping event and then applying that value to the consecutive days without operation. This method was used for all target species.

For periods of suspended trapping longer than seven days, a methodology developed and currently employed by local WDFW smolt trap operators was used (J. Williams, personal communication, March 8, 2017). This method uses historic run-timing to determine the proportion of the entire emigrant estimate missed during the period of suspended trapping. Once determined, the estimated percentage can be used with in-year data to extrapolate how many fish were missed. This method was used exclusively during the fall migratory period, when low summer flows commonly result in extended stoppages. Because steelhead are considered non-migratory during this period, this type of estimate was only applied to spring Chinook subyearlings.

2.5.3 Estimate of Abundance During The Winter Non-Trapping Period

An estimate of spring Chinook emigration during the non-trapping period (December 1 through February 28) was calculated using remote-tagged spring Chinook parr and the lower Nason Creek PIT tag array (NAL). A flow-detection efficiency regression was developed using mark-groups previously released to test the efficiency of the smolt trap. Daily spring Chinook detections at the NAL array and the developed regression were then applied to the Bailey estimator, as was peformed with daily trap abundance data (See equation **2.5.1 Estimate of Abundance**). Tag rate determined at the Nason Creek smolt trap was used to account for unmarked emmigrants passing the NAL array.

Tag rate, t_i, was calculated as:

$$t_i = \frac{t}{p}$$

where t = total smolt trap recaptures subsequent to the tagging effort;
p = total catch at the smolt trap.

Daily abundace during the non-trapping period is calculated as:

$$\hat{N}_i = \left(\frac{C_i}{\hat{e}_i}\right) \Big/ t_i \,,$$

where C_i = number of fish caught in period I;
$\hat{e}_i$ = trap efficiency estimated from the flow-efficiency relationship, $\sin^2(b_0 + b_1 flow_i)$;
t_i = tag rate.

2.5.4 Production and Survival

Production estimates by age class were summed to produce a total emigration estimate. For spring Chinook and coho, estimates of fall-migrating parr were added to subsequent spring smolt estimates to generate a single brood year estimate. For steelhead, a single brood year was deemed completely emigrated from Nason Creek after three consecutive years of outmigration. Age 4+ steelhead smolts have been previously identified via scale analysis, but are extremely uncommon. Pending eventual scale analysis, steelhead captured in 2019 were aged via an age-length histogram built upon previously analyzed scale samples. For all three species, egg-to-emigrant estimates were calculated by dividing estimated emigrants by approximated egg deposition during a spawning brood (average fecundity used to determine egg deposition derived from WDFW Chiwawa broodstock spawning). The number of emigrants-per-redd for each brood year was calculated by dividing the total emigrant estimate by the number of redds counted during spawning ground surveys.

3.0 RESULTS

3.1 Dates of Operation

The Nason Creek smolt trap was operated between March 1 and November 27 and operated in its fixed position for the entirety of the trapping season. In total, the trap was operated for 155 days (Table 1). The primary cause of un-trapped days was a prolonged period (82 days) of intentional pulling due to base flow conditions (~ ≤50 cfs).

Table 1. Summary of Nason Creek rotary trap operation in 2019.

Date of Trap Operations	Trap Status	Description	Days
March 1 to June 30	Operating	Continuous data collection	94
	Interrupted	Interrupted by debris	4
	Pulled	Intentionally pulled due to high flow, low flow, or heavy debris load	24
July 1 to November 30	Operating	Continuous data collection	61
	Interrupted	Interrupted by debris	4
	Pulled	Intentionally pulled due to high flow, low flow, or heavy debris load	88

3.2 Daily Captures and Biological Sampling

3.2.1 Spring Chinook Yearlings (BY2017)

Between March 1 and June 30, a total of 296 wild Chinook yearlings were captured (Figure 4). The majority of smolts were captured in April and May, with a peak catch of 20 yearling smolts occurring on April 1 and 4. Mean FL and weight for Chinook yearlings was 97 mm (n = 294; SD = 6.9) and 10.1 g (n = 294; SD = 2.1; Table 2), respectively. Tissue samples were collected from 283 fish for an ongoing, parental-based DNA analysis by WDFW. A total of 2 yearling Chinook mortalities were incurred in 2019.

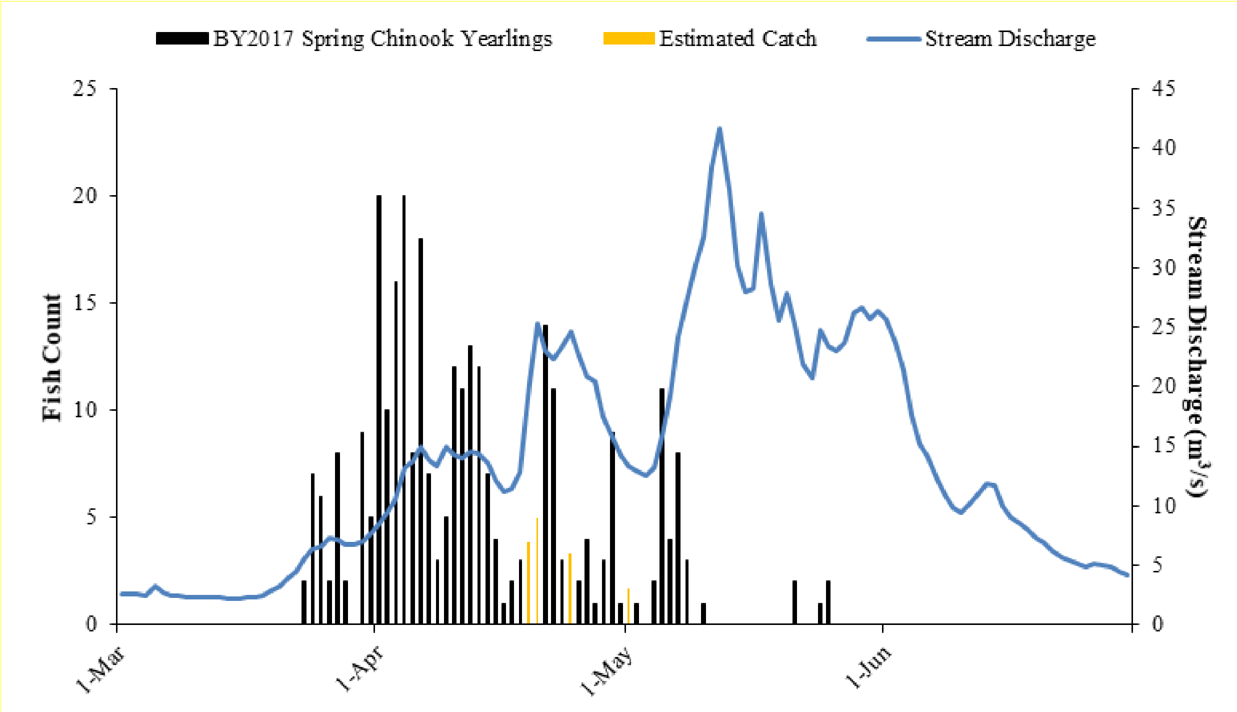


Figure 4. Daily catch of BY2017 spring Chinook yearlings with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2019.

Table 2. Summary of length and weight sampling of juvenile spring Chinook captured at the Nason Creek rotary trap in 2019.

Brood Year	Origin/Species/Stage	Fork Length (mm)			Weight (g)			K-Factor
		Mean	*n*	SD	Mean	*n*	SD	
2017	Wild Spring Chinook Yearling Smolt	97	294	6.9	10.1	294	2.1	1.08
2018	Wild Spring Chinook Subyearling Fry	39	456	4.6	0.6	456	0.5	0.88
2018	Wild Spring Chinook Subyearling Parr	75	1,249	12.2	4.8	1,249	2.1	1.05
2017	Hatchery Spring Chinook Yearling Smolt	117	193	10.7	18.0	193	5.3	1.12

3.2.2 Spring Chinook Subyearlings (BY2018)

A total of 1,249 wild spring Chinook subyearling parr (FL ≥ 50 mm) and 510 subyearling fry (FL < 50 mm) were captured in 2019 (Figure 5). The majority of parr movement was documented in October and November following the first fall freshets. Mean FL and weight among subyearling parr was 75 mm (*n* = 1,249; *SD* = 12.2) and 4.8 g (*n* = 1,249; *SD* = 2.1), respectively. We estimate that an additional 185 Chinook subyearling parr would have been captured during short stoppages (≤7 days) had the trap run without interruption. Daily catch estimates were not made during the period of suspended trapping; total emigrant estimates for this period will be included in section 3.4.2. Tissue samples were collected from 991 fish for an ongoing, parental-based DNA analysis by WDFW. A total of 9 subyearling Chinook fry and 16 parr mortalities occurred in 2019. All incidental mortality was attributed to trapping.

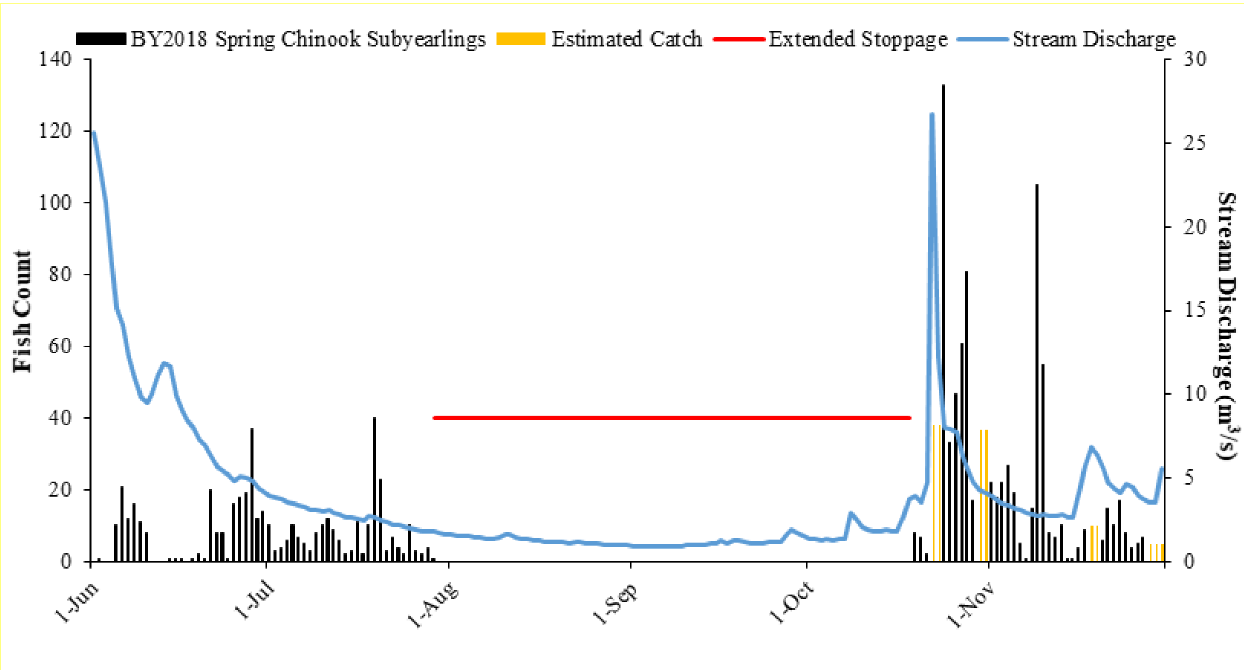


Figure 5. Daily catch of BY2018 spring Chinook subyearling parr with mean daily stream discharge at the Nason Creek rotary trap, June 1 to November 27, 2019. Estimates of fish passage during extended trap interruptions are not depicted.

3.2.3 Hatchery Spring Chinook Smolts (BY2017)

In April, 231,859 hatchery spring Chinook smolts were released directly from the Grant County Public Utility District (GCPUD) Nason Creek Acclimation Facility located at rkm17.3. Subsequently, a total of 2,898 smolts were captured with a mean FL and weight of 117 mm (*n* =193; *SD* = 10.7) and 18.0 g (*n* =193; *SD* = 5.3), respectively (Figure 6). Hatchery spring Chinook were not captured at the smolt trap beyond June 28, with majority of catch occurring immediately after initial release. Only 1 hatchery spring Chinook mortality was incurred.

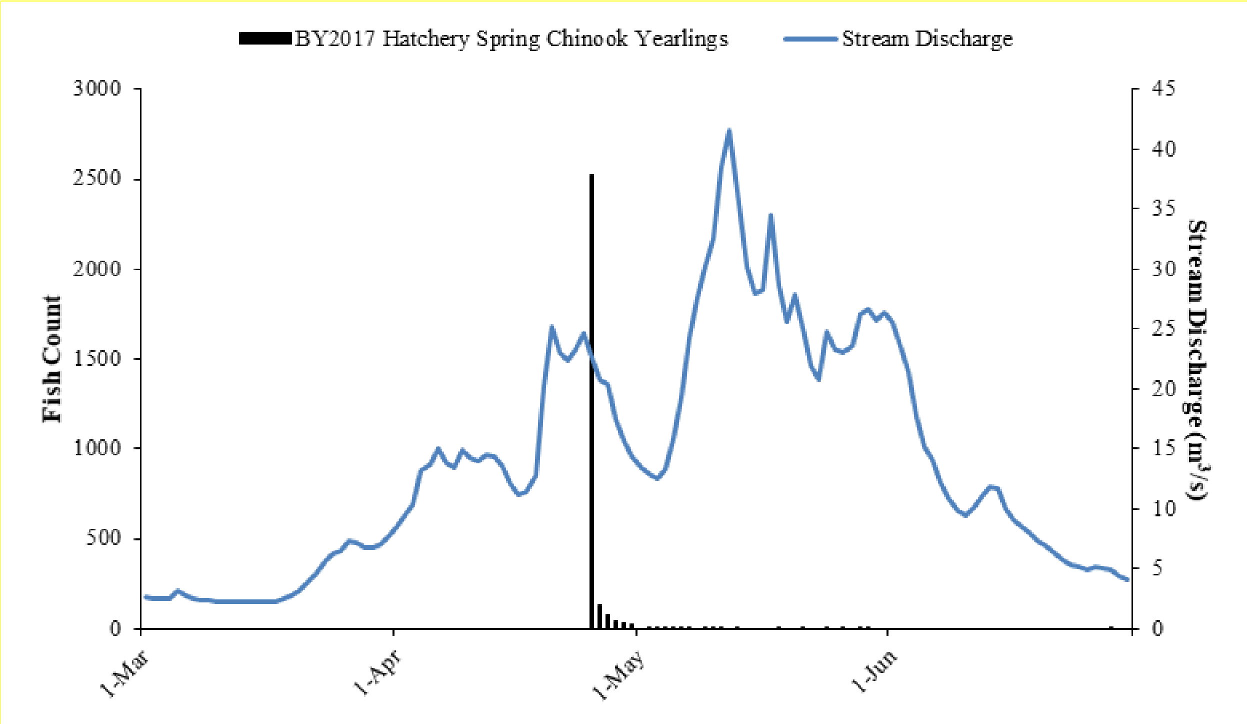


Figure 6. Daily catch of BY2017 hatchery spring Chinook smolts with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2019.

3.2.4 Summer Steelhead

A total of 542 wild summer steelhead juveniles were captured throughout the season from March 1 to November 27, with a peak catch of 71 juveniles on July 12 (Figures 7 & 8). Histogram analysis of known steelhead ages sampled from 2005 to 2016 allowed us to estimate ages of fish captured in 2019 using FL. We estimated that of the total steelhead captured, 244 were young-of-the-year (BY2019), 277 were age-1 (BY2018), and 21 were age-2 (BY2017). No age-3 (BY2016) steelhead were captured. Subyearling steelhead had a mean FL of 54 mm (n = 79; SD = 21.3), and a mean weight of 2.6 g (n = 70; SD = 2.0). The majority of steelhead juveniles captured during the spring emigration were age-1 parr. Mean FL and weight of age-1 fish was 87 mm (n = 277; SD = 13.0; Table 3) and 7.5 g (n = 277; SD = 3.6), respectively. Age-2 steelhead were caught primarily in the spring, with only one fish being captured after July 31. Mean FL and weight of age-2 fish was 144 mm (n = 21; SD = 16.5) and 31.1 g (n = 21; SD = 11.2), respectively. Mean FL and weight of age-3 fish was 190 mm (n = 2; SD = 0.7) and 56.6 g (n = 2; SD = 6.1), respectively. Scales were taken from a sub-sample (n = 86) of steelhead with FL $\geq$ 60 mm to be used for future age analyses. A total of 4 mortalities were incurred.

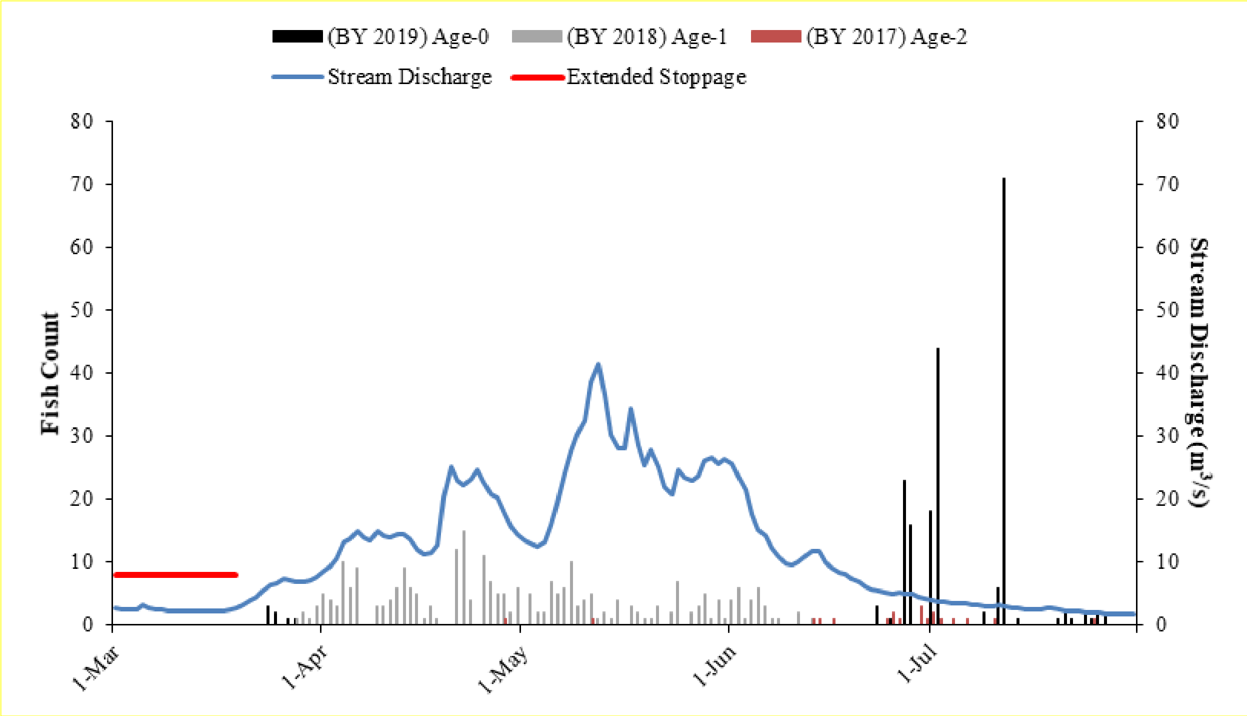


Figure 7. Daily catch of wild summer steelhead with mean daily stream discharge at the Nason Creek rotary trap, March 1 to July 31, 2019. Estimates of fish passage during trap interruptions are not depicted.

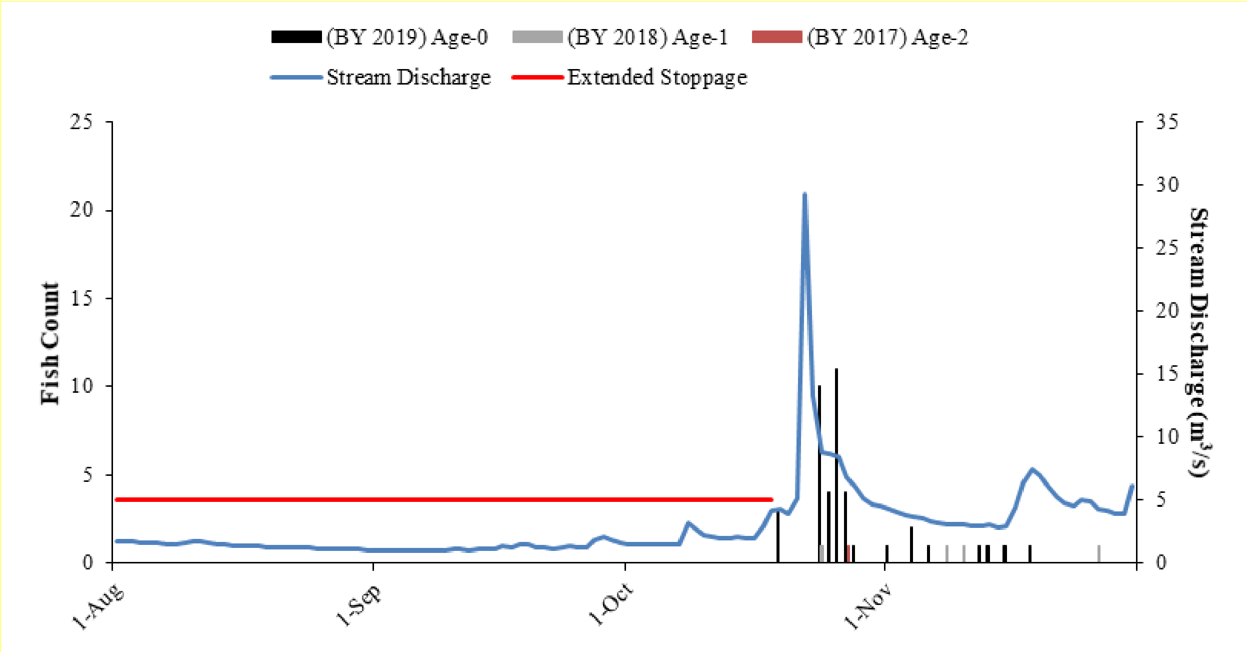


Figure 8. Daily catch of wild summer steelhead with mean daily stream discharge at the Nason Creek rotary trap, August 1 to November 27, 2019. Estimates of fish passage during trap interruptions are not depicted.

Table 3. Summary of length, weight and condition factor by age class of wild summer steelhead emigrants and hatchery steelhead captured at the Nason Creek rotary trap in 2019.

Brood Year	Origin/Species/Stage	Fork Length (mm)			Weight (g)			K-Factor
		Mean	*n*	SD	Mean	*n*	SD	
2019	Wild Summer Steelhead (Age-0)	54	79	21.3	2.6	70	2.0	1.02
2018	Wild Summer Steelhead (Age-1)	87	277	13.0	7.5	277	3.6	1.07
2017	Wild Summer Steelhead (Age-2)	144	21	16.5	31.1	21	11.2	1.00
2016	Wild Summer Steelhead (Age-3)	—	—	—	—	—	—	—
2018	Hatch. Summer Steelhead Smolt	161	375	13.9	40.0	375	10.6	0.94

3.2.5 Hatchery Steelhead Smolts (BY2018)

During April and May, WDFW directly planted a total of 66,983 hatchery summer steelhead smolts into Nason Creek above the smolt trap (C. Moran, personal communication, April 24, 2019). Subsequently, a total of 723 hatchery steelhead were captured at the smolt trap with a mean FL and weight of 161 mm (n =375; SD = 13.9) and 40.0 g (n = 375; SD = 10.6), respectively (Figure 9). Hatchery origin was determined by the presence of coded wire tags (CWT). There were no hatchery-origin steelhead trapping mortalities (See section 3.7 ESA Compliance).

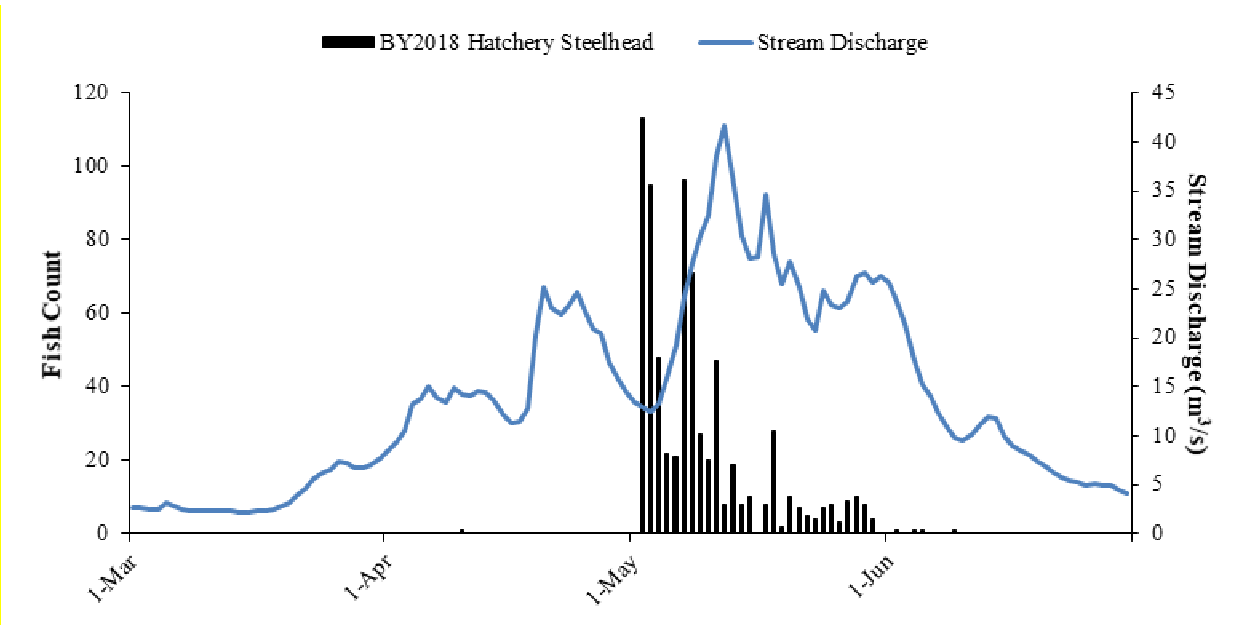


Figure 9. Daily catch of BY2018 hatchery steelhead smolt with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2019.

3.2.6 Bull Trout

No bull trout were collected at the Nason creek trap in 2019.

3.2.7 Coho Yearlings (BY2017)

There were no BY2017 naturally-produced coho smolts captured at the Nason Creek smolt trap in 2019.

3.2.8 Coho Subyearlings (BY2018)

There were no BY2018 naturally-produced coho fry or parr captured at the Nason Creek smolt trap in 2019.

3.2.9 Hatchery Coho Smolts (BY2017)

A total of 269,867 hatchery coho were released into Nason Creek above the trap in spring of 2019. All hatchery coho released were acclimated in natural ponds adjacent to Nason Creek and reared to smolt stage prior to volitional release. Between March 1 and June 30, a total of 2,733 hatchery coho were captured at the trap (Figure 10). Mean FL was 134 mm (n = 664; SD = 9.7) and mean weight was 26.1 g (n = 664; SD = 8.8; Table 2). A peak daily catch of 498 hatchery coho smolts occurred on May 8 following volitional release into Nason Creek. No trapping mortalities were incurred. Hatchery coho emigration data at the Nason Creek trap assists the MCCRP by providing size-at-emigration, emigration timing and duration of residence in Nason Creek.

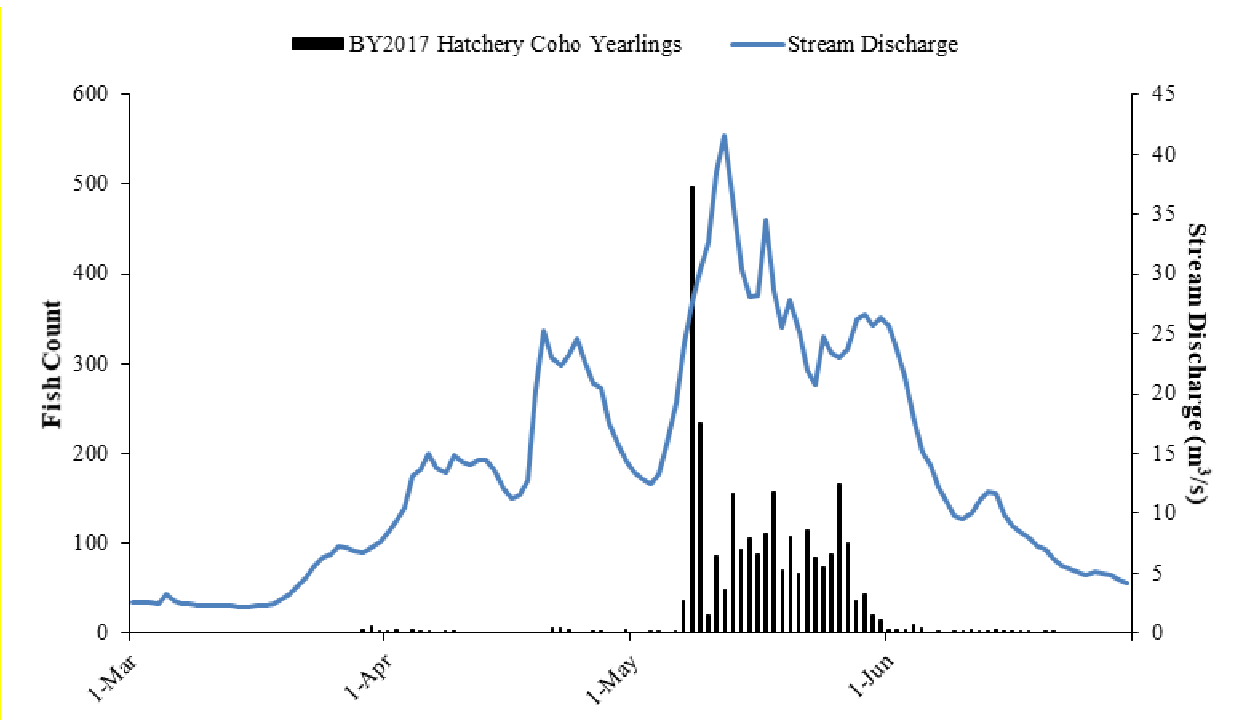


Figure 10. Daily catch of BY2017 hatchery coho smolt with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2019.

3.3 Remote Spring Chinook Tagging and Non-Trapping Estimates

3.3.1 BY2017 Parr

YN FRM and WDFW personnel PIT tagged and released a total of 2,524 BY2017 spring Chinook parr between September 4 and November 15, 2018 (Table 4). The total surveyed area included Nason Creek from rkm 0.8 to 26.1. All collections were performed via backpack electrofisher. Equal capture effort (measured in electrofisher seconds used) was applied across all reaches.

Table 4. Remote parr tagging results, BY2013 -2018.

Brood Year	Mark Year	Total Marked	Estimated Tag Rate	Detections at NAL		Non-Trapping Estimate
				Total	Non-Trapping Period	
2013	2014	1,821	3.8%	311	13	6,823
2014	2015	1,214	2.0%	100	2	1,443
2015	2016	802	2.8%	60	26	4,407
2016	2017	3,242	5.3%	245	10	1,114
2017	2018	2,524	6.0%	365	77	5,739
2018	2019	3,291	—	—	—	—

Between October 1, 2018 and March 31, 2019, a total of 365 re-sights of the remote tagged spring Chinook were documented at the NAL array (Figure 11). Of these detections, 77 were during the winter non-trapping period. Antenna operation during this period was continuous, with no losses in coverage or periods of inactivity. The upstream gauge was inactive during the majority of the non-trapping period, which did not allow concurrent measurement of discharge. Measurement of gauge height was continuous during this period, and acted as a surrogate measurement.

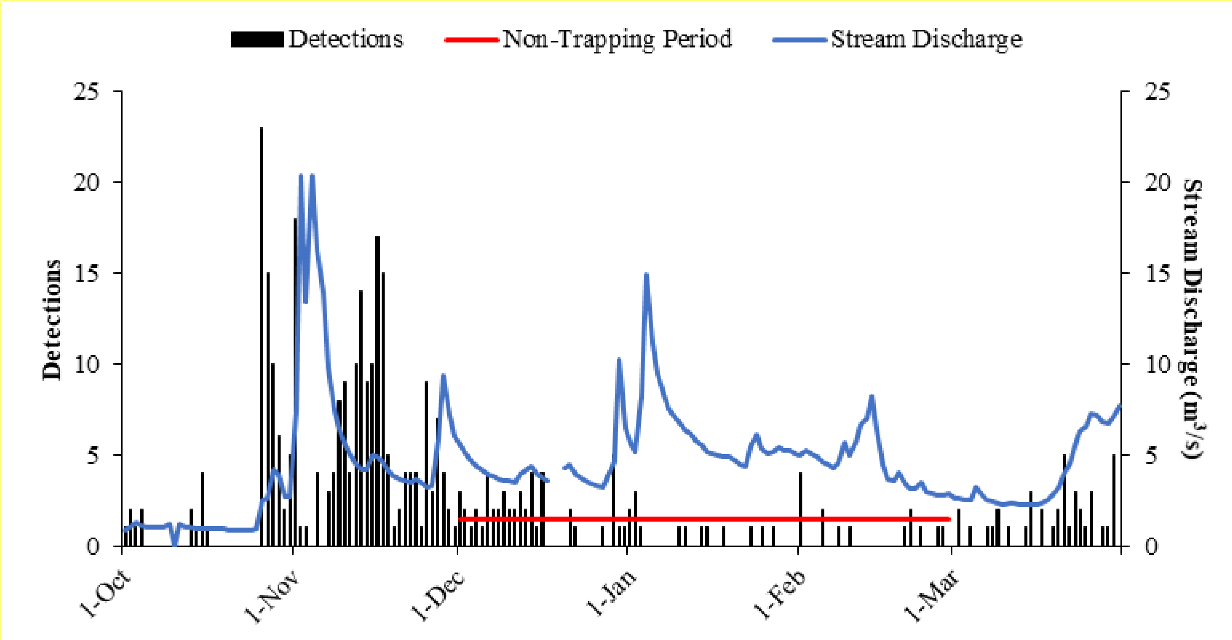


Figure 11. Daily detections of remote-tagged BY2017 spring Chinook at the lower Nason Creek PIT tag antenna array (NAL) from October 1 2018 to March 31 2019.

Subsequent to the remote tagging effort, 53 remote-tagged BY2017 spring Chinook were recaptured at the Nason Creek smolt trap. Total spring Chinook catch at the smolt trap was 887 emigrants during the same period. The pooled tag rate for remote-tagged spring Chinook captured at the Nason smolt trap was 6.0%. Parr emmigration during the non-trapping period was estimated using a flow-efficiency regression ($r^2 = 0.61$; $p = 0.0002$) based on detections at the NAL PIT tag array. We estimated that 5,793 (± 1,257; 95% CI) BY2017 spring Chinook emigrated out of Nason Creek during the non-trapping period (Table 4).

3.3.2 BY2018 Parr

During remote tagging efforts in the fall of 2019, 3,291 spring Chinook were PIT tagged by YNFRM and WDFW personnel (Table 4). Because tag rate cannot be estimated until the completion of the BY2018 emigrant estimate in the spring/summer of 2019, an estimate of emigration during the non-trapping period will not be reported until the following report.

3.4 Trap Efficiency Calibration and Population Estimates

3.4.1 Spring Chinook Yearlings (BY2017)

Infrequent releases, low abundance, and a lack of recaptures did not allow a flow-efficiency model to be used on BY2017 yearling emigrants. In order to produce an estimate, a pooled efficiency (7.1%) composed of spring Chinook yearling releases in 2019 was used (Table 5). We recognize the sub-optimal nature of this estimation methodology, and will recalculate the estimates using linear regression analysis as soon as feasible. We estimated a total of 4,494 (± 14,383; 95% CI) BY2017 spring Chinook yearlings emigrated in spring of 2019 (Table 6). Combined with the non-trapping estimate of 5,793 (± 1,257; 95% CI) emigrants, and a BY2017 subyearling estimate of 17,403 (± 2,356; 95% CI), we estimated that a total of 27,690 (± 14,634; 95% CI) BY2017 spring Chinook juveniles emigrated from Nason Creek.

Table 5. Trap efficiency trials conducted with BY2017 wild spring Chinook yearlings.

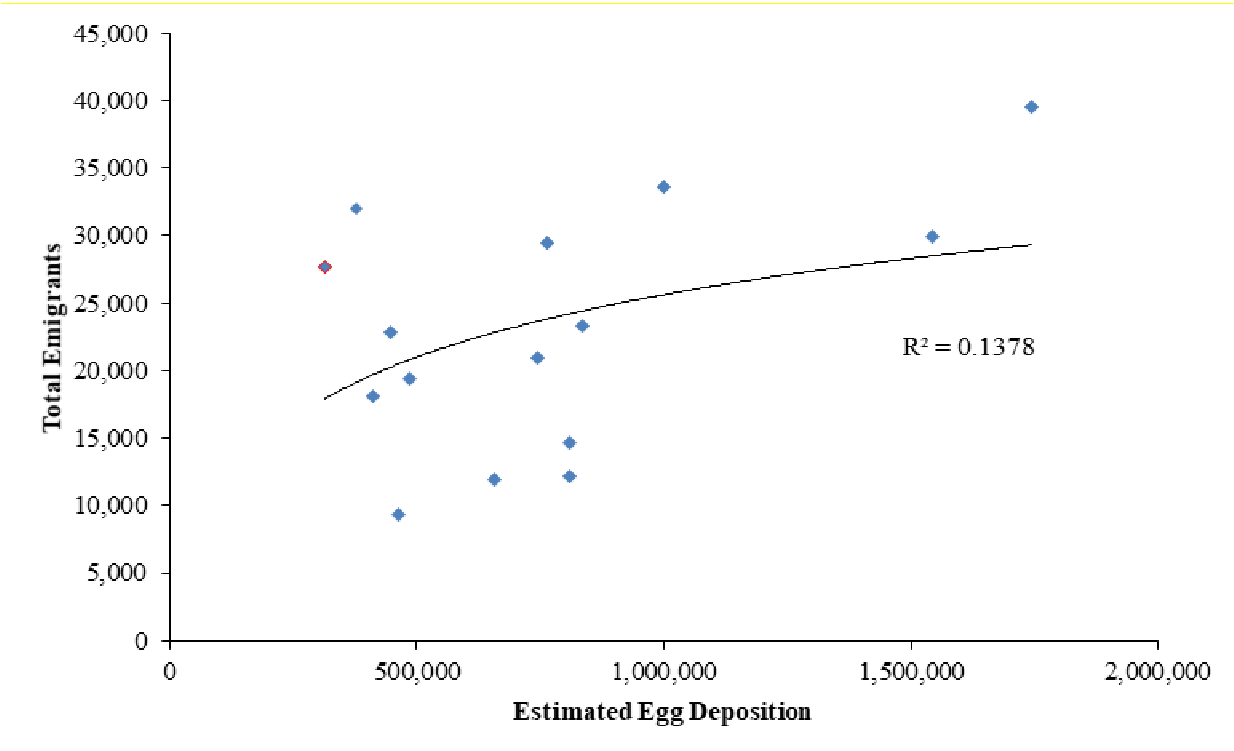
Origin/Species/Stage	Age	Date	Marked	Recaptured	Discharge (m^3/s)
Wild Chinook Yearlings	1+	3/27/2019	20	2	7
Wild Chinook Yearlings	1+	3/31/2019	16	5	8
Wild Chinook Yearlings	1+	4/4/2019	64	2	13
Wild Chinook Yearlings	1+	4/12/2019	38	1	14
Wild Chinook Yearlings	1+	4/16/2019	20	1	11
Wild Chinook Yearlings	1+	4/28/2019	10	2	17
Wild Chinook Yearlings	1+	5/2/2019	9	0	12
Wild Chinook Yearlings	1+	5/6/2019	16	2	17
Wild Chinook Yearlings	1+	5/10/2019	12	0	33
Wild Chinook Yearlings	1+	5/23/2019	2	0	20
Wild Chinook Yearlings	1+	5/27/2019	3	0	21
Total			**210**	**15**	

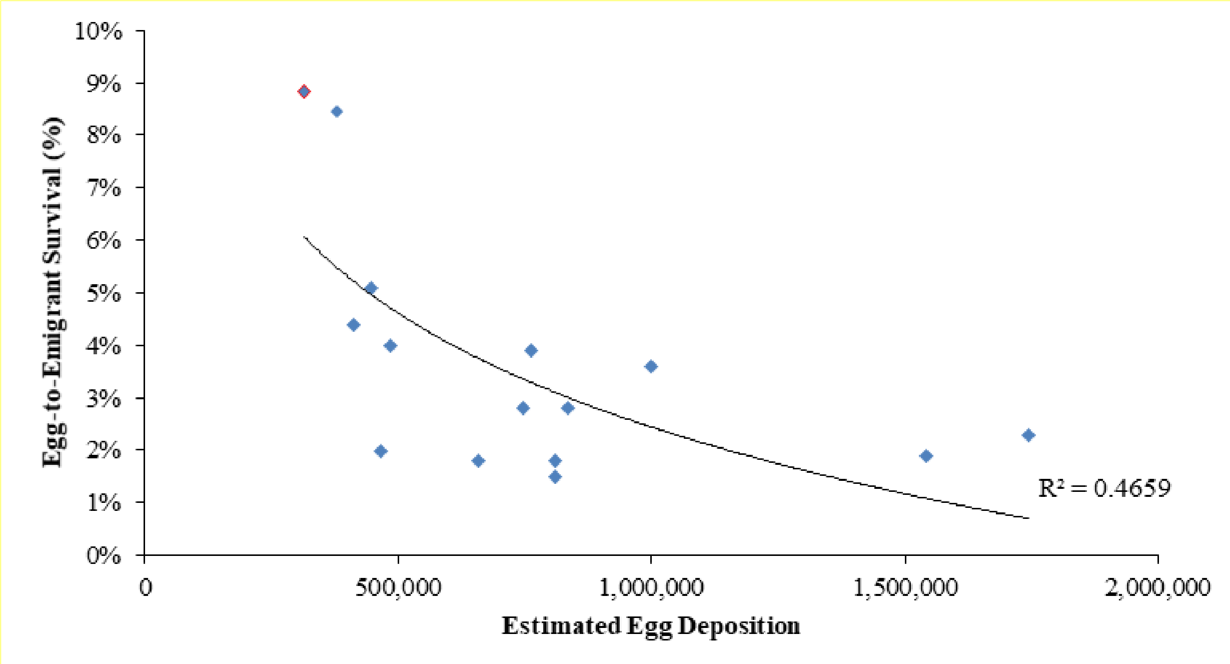
Table 6. Estimated egg-to-emigrant survival and smolts-per-redd production for Nason Creek spring Chinook salmon.

Brood Year	No. Redds	Fecundity[a]	Est. Egg Deposition	No. of Emigrants				Egg-to-Emigrant	Emigrants per Redd
				Age-0[b]	Non Trap[d]	Age-1	Total ± 95% CI		
2002	294	4,654	1,368,276	—	—	4,683	—	—	—
2003	83	5,844	485,052	13,067	—	6,358	19,425 ± 1,993	4.0%	234
2004	169	4,799	811,031	12,111	—	2,597	14,708 ± 2,938	1.8%	87
2005	193	4,327	835,111	14,565	—	8,696	23,261 ± 5,440	2.8%	121
2006	152	4,324	657,248	4,144	—	7,798	11,942 ± 1,744	1.8%	79
2007	101	4,441	448,541	17,097	—	5,679	22,776 ± 2,983	5.1%	226
2008	336	4,592	1,542,912	26,284	—	3,611	29,895 ± 7,244	1.9%	89
2009	167	4,573	763,691	27,720	—	1,705	29,425 ± 12,777	3.9%	176
2010	188	4,314	811,032	8,685	—	3,535	12,220 ± 1,972	1.5%	65
2011	170	4,385	745,450	18,457	—	2,422	20,879 ± 3,887	2.8%	123
2012	413	4,223	1,744,099	34,961	—	4,561	39,522 ± 6,395	2.3%	96
2013	212	4,716	999,792	19,834	6,823	6,992[e]	33,649 ± 34,185	3.6%	168
2014	115	4,045	465,175	6,916	1,443	930[e]	9,289 ± 5,227	2.0%	81
2015	85	4,847	411,995	6,405	4,407	7,247[e]	18,058 ± 10,345	4.4%	212
2016	85	4,467	379,695	25,809	1,114	5,082[e]	32,005 ± 5,508	8.4%	377
2017	68	4,615	313,820	17,403	5,793	4,494[e]	27,690 ± 14,634	8.8%	407

Brood Year	No. Redds	Fecundity[a]	Est. Egg Deposition	No. of Emigrants				Egg-to-Emigrant	Emigrants per Redd
				Age-0[b]	Non Trap[d]	Age-1	Total ± 95% CI		
2018	90	4,166	374,940	29,530	—	—	—	—	—
Avg.[c]	172	4,549	773,992	17,687	—	4,780	22,983	3.7%	169

[a] Data provided by Hillman et al. 2019.
[b] Does not include subyearling fry prior to July 1.
[c] 15-year average of complete brood data, BY2003-2017.
[d] Estimated emigration during the winter non-trapping period (December 1 – February 28).
[e] Pooled estimate





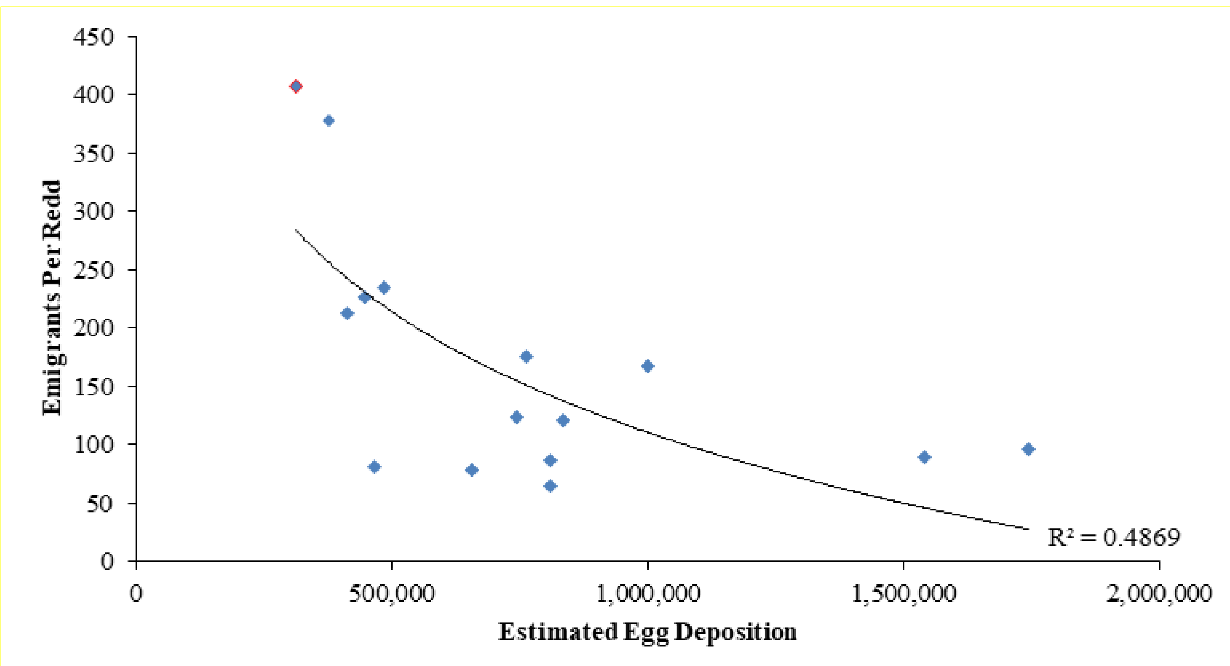


Figure 12. Relationships between estimated egg deposition and total emigrants produced, egg-to-emigrant survival, and emigrants per redd for Nason Creek spring Chinook, BY 2003 to 2017. *BY2017 denoted by red border.

3.4.2 Spring Chinook Subyearlings (BY2018)

A linear regression model was developed using subyearling mark groups released in the fall 2014, 2016, 2017, 2018 and 2019. The resulting regression (r^2 = 0.14; p = 0.053) was below the desired level of statistical significance. However, this was attributed to an outlier value resulting from a single efficiency trial on October 31, 2017 (Appendix C). Without this single outlier, the regression proved significant (r^2 = 0.43; p = 0.001). We decided to use the regression (including the outlier) due to the small actual effect of the outlier. Using this model, we estimated that a total of 29,530 (± 3,587; 95% CI) BY2017 spring Chinook emigrated past the trap in the fall of 2019.

Table 7. Efficiency trials conducted with BY2018 wild spring Chinook subyearlings.

Origin/Species/Stage	Age	Date	Marked	Recaptured	Discharge (m^3/s)
Wild Chinook Subyearlings	0	7/4/2019	14	0	3
Wild Chinook Subyearlings	0	7/8/2019	21	1	3
Wild Chinook Subyearlings	0	7/12/2019	31	1	3
Wild Chinook Subyearlings	0	7/16/2019	20	1	2
Wild Chinook Subyearlings	0	7/20/2019	72	8	2
Wild Chinook Subyearlings	0	7/24/2019	12	0	2
Wild Chinook Subyearlings	0	10/31/2019	94	17	4
Wild Chinook Subyearlings	0	11/4/2019	61	5	3
Wild Chinook Subyearlings	0	11/8/2019	38	2	3
Wild Chinook Subyearlings	0	11/12/2019	173	13	3
Wild Chinook Subyearlings	0	11/16/2019	14	2	5
Wild Chinook Subyearlings	0	11/20/2019	13	1	6
Wild Chinook Subyearlings	0	11/24/2019	48	8	4
Total			**611**	**59**	

3.4.3 Summer Steelhead

Releases of PIT-tagged steelhead were performed every four days at the established release location (Table 8). Because a viable flow-efficiency regression could not be obtained, a pooled estimate was used. In a total of 20 separate trials, 220 wild summer steelhead were released upstream with 9 recaptures (4.1%). Estimates of age-0 fry and parr were not made due to insufficient evidence that active migration is occurring at this young age. Previous attempts at the old location to build a model based on young-of-the-year steelhead parr in the fall have yielded weak flow-efficiency relationships; further suggesting that age-0 parr catch is the result of displacement rather than active migration. We estimated that 5,306 (± 9,761; 95% CI) BY2018 age-1 and 489 (± 968; 95% CI) BY2017 age-2, emigrated past the trap in 2019 (Table 9). We estimated total (age 1-3) BY2016 emigration to be 24,157 (± 30,806; 95% CI). All pooled estimates will be recalculated upon development of a species-specific flow-efficiency model.

Table 8. Efficiency trials conducted with wild summer steelhead juveniles.

Origin/Species/Stage	Date	Marked	Recaptured	Discharge (m^3/s)
Wild Steelhead Parr/Smolt	3/27/2019	6	0	7
Wild Steelhead Parr/Smolt	3/31/2019	6	0	N/A
Wild Steelhead Parr/Smolt	4/4/2019	20	1	13

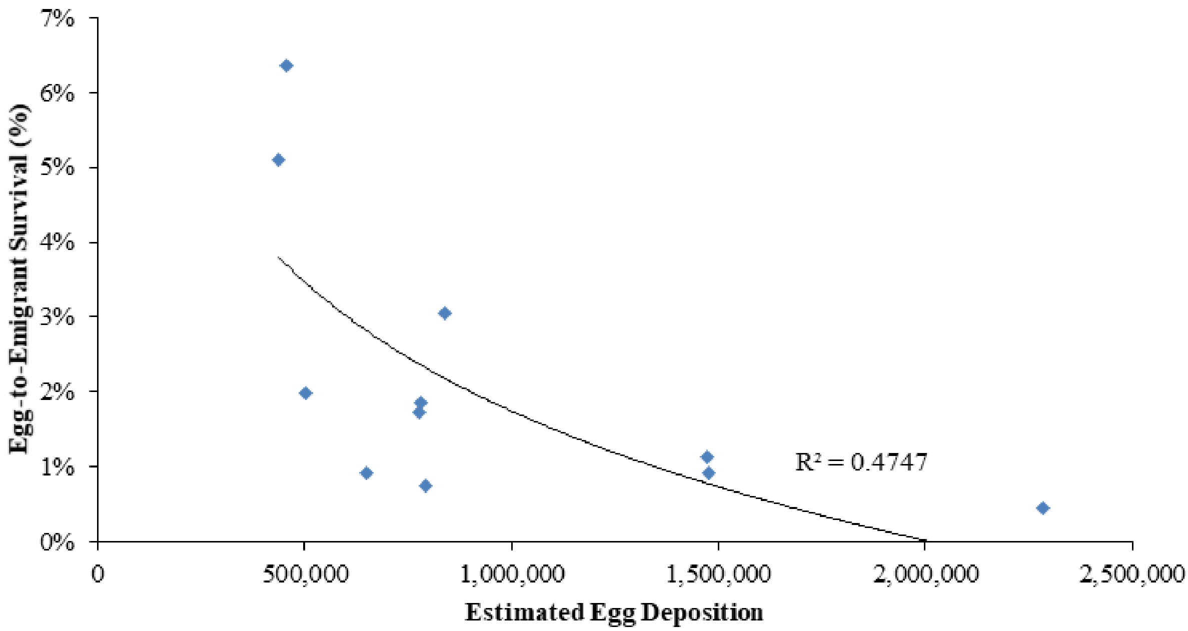
Origin/Species/Stage	Date	Marked	Recaptured	Discharge (m^3/s)
Wild Steelhead Parr/Smolt	4/12/2019	15	1	14
Wild Steelhead Parr/Smolt	4/16/2019	21	1	11
Wild Steelhead Parr/Smolt	4/28/2019	29	0	17
Wild Steelhead Parr/Smolt	5/2/2019	11	1	12
Wild Steelhead Parr/Smolt	5/6/2019	15	0	17
Wild Steelhead Parr/Smolt	5/10/2019	21	2	33
Wild Steelhead Parr/Smolt	5/14/2019	10	0	28
Wild Steelhead Parr/Smolt	5/19/2019	6	0	24
Wild Steelhead Parr/Smolt	5/23/2019	6	0	20
Wild Steelhead Parr/Smolt	5/27/2019	12	2	21
Wild Steelhead Parr/Smolt	5/31/2019	11	0	23
Wild Steelhead Parr/Smolt	6/4/2019	14	1	17
Wild Steelhead Parr/Smolt	6/8/2019	8	0	11
Wild Steelhead Parr/Smolt	6/12/2019	2	0	11
Wild Steelhead Parr/Smolt	6/16/2019	4	0	9
Wild Steelhead Parr/Smolt	6/27/2019	2	0	5
Wild Steelhead Parr/Smolt	7/12/2019	1	0	3
Total		**220**	**9**	

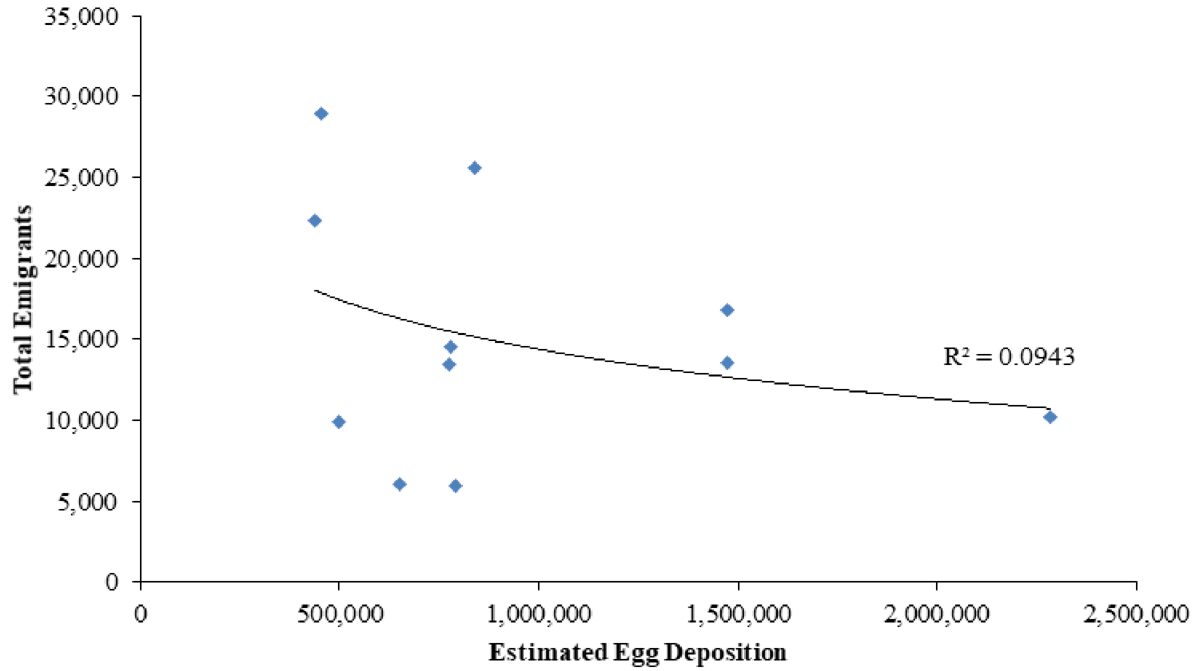
Table 9. Estimated egg-to-emigrant survival and emigrants-per-redd production for Nason Creek summer steelhead.

Brood Year	No. of Redds	Fecundity[a]	Est. Egg Deposition	No. of Emigrants				Egg-to-Emigrant	Emigrants per Redd
				1+	2+	3+	Total ± 95%CI		
2001	27	5,951	160,677	DNOT	DNOT	846	—	—	—
2002	80	5,776	462,080	DNOT	2,475	0	—	—	—
2003	121	6,561	793,881	4,906	1,054	27	5,987 ± 1,193	0.80%	49
2004	127	5,118	649,986	5,107	906	22	6,035 ± 885	0.90%	48
2005	412	5,545	2,284,540	7,416	2,502	298	10,216 ± 2,147	0.40%	25
2006	77	5,688	437,976	19,609	2,673	37	22,319 ± 5,722	5.10%	290
2007	78	5,840	455,520	26,518	2,325	117	28,960 ± 7,739	6.40%	371
2008	88	5,693	500,984	8,782	1,164	0	9,946 ± 2,382	2.00%	113
2009	126	6,199	781,074	13,606	608	312	14,526 ± 2,868	1.90%	115
2010	270	5,458	1,473,660	12,767	3,999	0	16,776 ± 3,885	1.10%	62
2011	235	6,276	1,474,860	13,109	482	0	13,591 ± 3,525	0.90%	58
2012	158	5,309	838,822	24,637	813	116[c]	25,566 ± 6,020	3.00%	162
2013	135	5,749	—	11,837	1,508[c]	72[c]	13,417 ± 9,133	1.73%	99
2014	—	5,831	—	22,504[c]	1,224[c]	0	23,728 ± 124,628	—	—
2015	—	6,220	—	19,872[c]	1,391[c]	208[c]	21,471 ± 56,663	—	—
2016	—	5,392	—	20,829[c]	3,328[c]	0	24,157 ± 30,806	—	—
2017	—	6,656	—	28,080[c]	489[c]	—	—	—	—

Brood Year	No. of Redds	Fecundity[a]	Est. Egg Deposition	No. of Emigrants				Egg-to-Emigrant	Emigrants per Redd
				1+	2+	3+	Total ± 95%CI		
2018	—	5,145	—	5,036[c]	—	—	—	—	—
Avg[b]	166	5,800	951,731	15,288	1,684	124	16,902	2.2%	127

[a] Data provided by Hillman et al. 2019
[b] 14-year average of complete brood estimates, BY2003-2016
[c] Pooled estimate





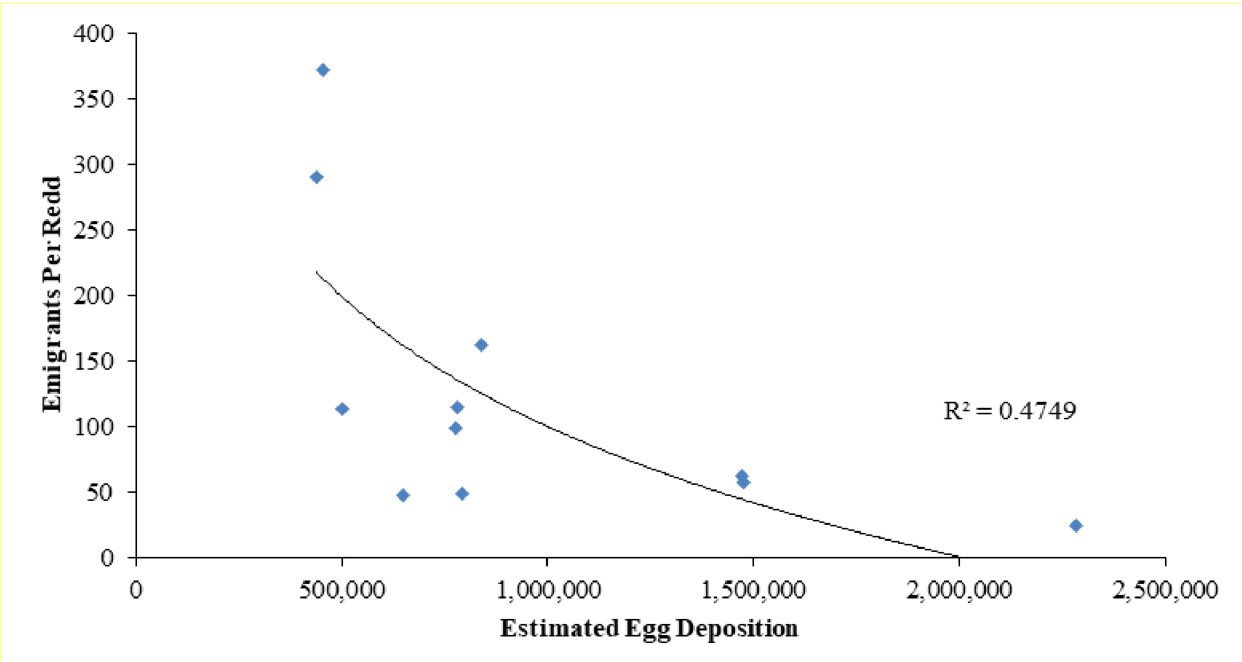


Figure 13. Relationships between estimated egg deposition and total emigrants produced, egg-to-emigrant survival, and emigrants per redd for Nason Creek summer Steelhead, BY 2003 to 2013.

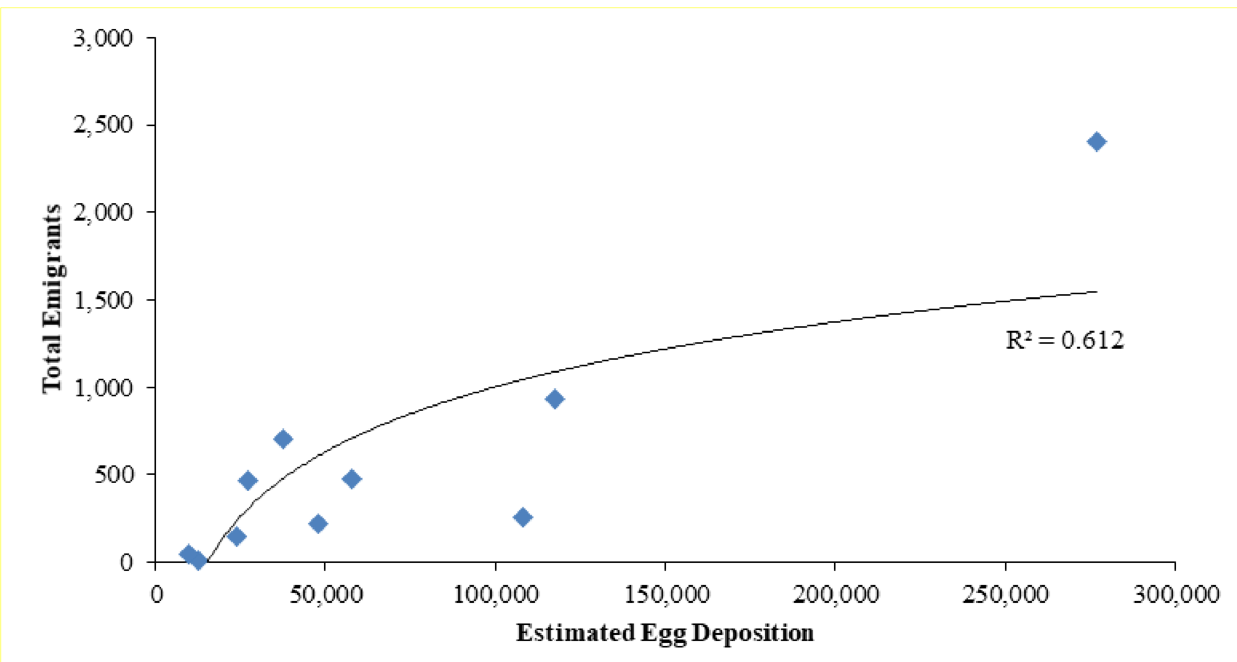
3.4.4 Coho Yearlings (BY2017)

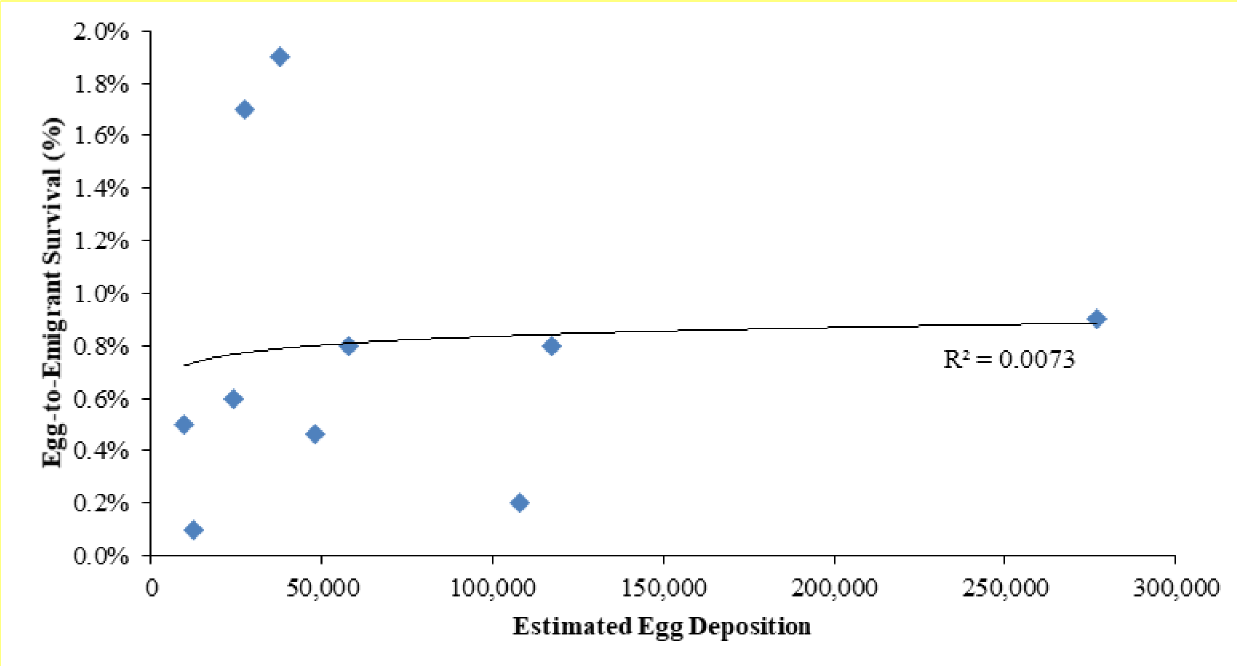
Due to lack of BY2017 naturally-produced coho catch, we concluded that there were no emigrants from Nason in 2019 (Table 10).

Table 10. Estimated egg-to-emigrant survival and smolts-per-redd production for Nason Creek coho salmon.

Brood Year	No. of Redds	Fecundity	Est. Egg Deposition	No. of Emigrants			Egg-to-Emigrant	Emigrants per Redd
				Age-0[a]	Age-1	Total ± 95% CI		
2003	6	2,458	14,748	DNOT	394	—	—	—
2004	35	3,084	107,940	204	56	260 ± 155	0.2%	7
2005	41	2,866	117,506	27	910	937 ± 347	0.8%	23
2006	4	3,126	12,504	7	0	7 ± 10	0.1%	2
2007	10	2,406	24,060	14	136	150 ± 104	0.6%	15
2008	3	3,275	9,825	50	0	50 ± 57	0.5%	17
2009	14	2,691	37,674	471	237	708 ± 478	1.9%	51
2010	8	3,411	27,288	27	437	464 ± 231	1.7%	58
2011	89	3,114	277,146	1,018	1,387	2,405 ± 612	0.9%	27
2012	21	2,752	57,792	46	434	480 ± 237	0.8%	23
2013	0	—	0	91	91[c]	182 ± 714	—	—
2014	16	2,992	47,872	131[c]	92[c]	223 ± 514	0.5%	14
2015	0	—	0	0	0	0	—	—
2016	0	—	0	0	0	0	—	—
2017	0	2,241	—	0	0	0	—	—
2018	1	2,841	2,841	0	—	—	—	—
Avg.[b]	16	2,808	46,075	139	278	419	0.8%	24

[a] Does not include subyearling fry prior to July 1.
[b] 14-year average of complete brood data, BY2004-2017.
[c] Pooled estimate





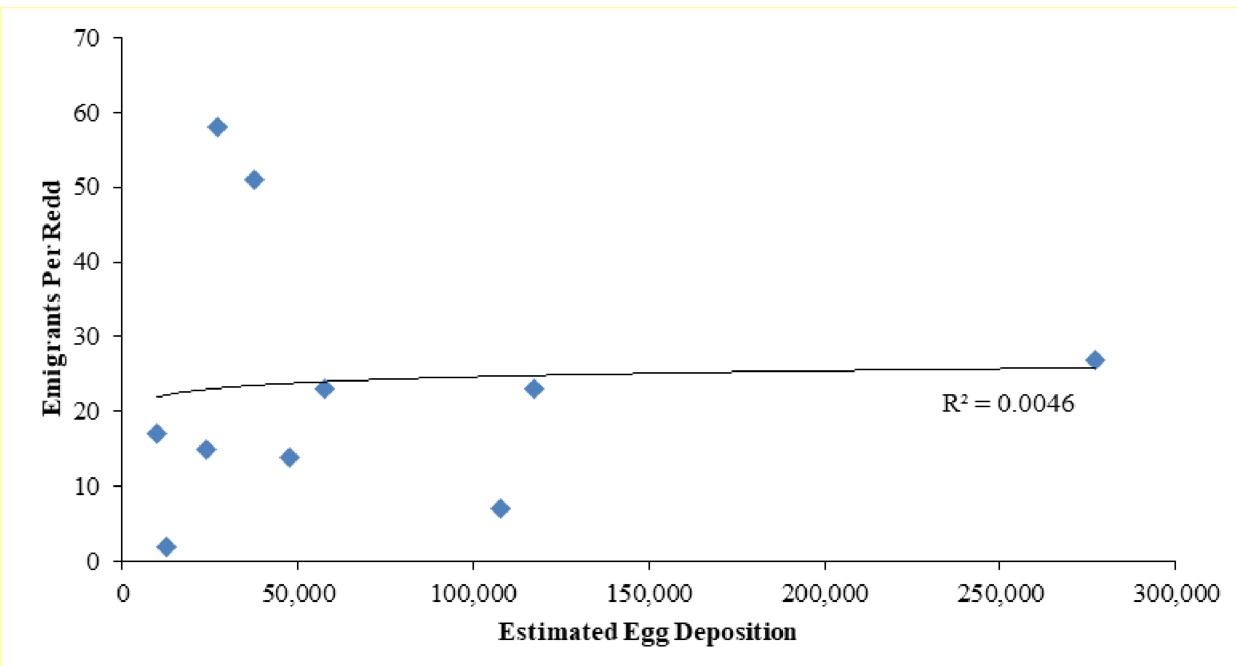


Figure 14. Relationships between estimated egg deposition and total emigrants produced, egg-to-emigrant survival, and emigrants per redd for Nason Creek natural-produced coho, BY 2003 to 2014.

3.4.5 Coho Subyearlings (BY2018)

Due to lack of BY2018 naturally-produced coho catch, we concluded that there were no emigrants from Nason Creek in 2019.

3.5 PIT Tagging

Total fish PIT tagged included 1,218 wild spring Chinook and 320 steelhead (Table 11). All tagging files were submitted to the PTAGIS database. There were no shed tags recovered after the 24-72 hr. post-tagging holding period.

Table 11. Number of PIT tagged Chinook and steelhead with shed rates at the Nason Creek rotary trap in 2019.

Brood Year	Species/Stage	Total Catch	Total PIT Tagged	Percent Tagged	Percent Tags Shed
2017	Spring Chinook Yearlings	296	269	90.9%	0.0%
2018	Spring Chinook Subyearlings	1,759	949	54.0%	0.0%
*	Summer Steelhead	542	320	59.0%	0.0%

* Brood year unknown

3.6 Incidental Species

Along with wild spring Chinook, wild steelhead/rainbow trout, and naturally produced coho, other resident fish species captured at the Nason Creek rotary trap and included in Table 12 are: cutthroat trout (*Oncorhynchus clarki lewisi*), longnose dace (*Rhinichthys cataractae*), mountain whitefish (*Prosopium williamsoni*), northern pikeminnow (*Ptychocheilus oregonensis*), redside shiner (*Richardsonius balteatus*), sculpin (*Cottus sp.*), and sucker (*Catostomus sp.*).

Table 12. Summary of length and weight sampling of incidental species captured at the Nason Creek rotary trap in 2019.

Species	Total Count	Length (mm)			Weight (g)		
		Mean	N	SD	Mean	N	SD
Cutthroat Trout	1	100	1	—	9.2	1	—
Longnose Dace	137	57	134	24.1	3.5	130	5.0
Mountain Whitefish	80	51	79	28.6	3.4	71	12.7
Northern Pikeminnow	6	118	6	46.5	24.0	6	30.6
Redside Shiner	23	51	19	50.9	3.5	16	4.4
Sculpin	86	87	86	37.7	13.7	86	16.6
Sucker	86	79	86	29.3	8.4	85	15.3

3.7 ESA Compliance

The Nason Creek smolt trap was operated under consultation by NMFS and USFWS. Total numbers of UCR spring Chinook and UCR summer steelhead that were captured or handled (indirect take) at the trap were less than the maximum permitted (20%) for each species. The maximum lethal take threshold of 2% was not exceeded for any species (Table 13).

Table 13. Summary of ESA species and coho salmon mortality at the Nason Creek rotary trap.

Species/Stage/Brood Year	Total Collected	Total Mortality	% Mortality
Spring Chinook Yearling (BY2016)	296	2	0.7%
Spring Chinook Subyearling (BY 2017)	1,759	25	1.4%
Total Wild Spring Chinook	**2,055**	**27**	**1.3%**
Total Hatchery Spring Chinook	**2,898**	**1**	**0.0%**
Steelhead Age-0 (BY2019)	244	3	1.2%
Steelhead Age-1 (BY2018)	277	1	0.4%
Steelhead Age-2 (BY2017)	21	0	0.0%
Total Wild Summer Steelhead	**542**	**4**	**0.7%**
Total Hatchery Summer Steelhead	**723**	**0**	**0.0%**
Total Bull Trout	**0**	**0**	**—**

4.0 DISCUSSION

Trap Operation

Operation in 2019 marked the fifth full year of trapping at the Bolser location. Attempts to characterize a "normal" operational year at the new site are ongoing, and largely inconclusive due to anomalous flow trends during the 2015 through 2019 trapping years. After 2015 and 2016 trap operations were affected by a strong El Niño event, 2017 and 2018 again saw decreased trap deployment, this time due to precipitation levels markedly below the ten-year mean. The 2019 trapping season again experienced long periods of operation interruption with the trap being pulled for 112 days due to high or low flows. In these five years, the trap saw a minimum of 62 days at discharges below 1.4 m^3/s (50 cfs); the approximate lowest discharge required to ensure consistent trap rotation. Though we assume that uninterrupted trap operation is unlikely in a tributary that can fall below 0.6 m^3/s (20 cfs), such long periods of trap stoppage were unexpected. In contrast, 2014 was the only summer sampled in the new location in which temperature, flow, and precipitation trends were near average for the tributary. Days below the 1.4 m^3/s minimum operational flow were limited to 20, and were sporadically distributed instead of a single prolonged period of discontinued trapping. Given the anomalous weather patterns and resulting low-flow conditions in the past three years of operation, 2014 is likely the best indicator of what we can expect given average conditions. In the absence of such anomalous weather patterns, we can expect to see improved trap operation in the coming years.

Spring Chinook

The BY2017 spring Chinook emigrant estimate was above average, despite the lowest estimated egg deposition on record. It is suspected that the low rearing denisities resulted in above-averarage in-stream survival and the highest estimated egg-to-emigrant ratio (8.8%) on record. Though high survival of BY2017 subyearlings is apparent, we can only speculate as to the cause. We hypothesize that improved survival may be due in-part to natural habitat alterations occurring in the past four years, including a major flood in November 2015 that resulting in significant alterations to channel morphology and LWD throughout the tributary. This pattern of high BY2017 spring Chinook egg-to-emigrant ratio was also observed in the nearby White and Chiwawa Rivers, which both had below-average egg deposition and estimated egg-to-emigrant ratios that were well above-average (Fig. 14).

With the second lowest egg desposition on record, we might have expected BY2018 subyearling estimates to be below average. However, the BY2018 subyearling estimate was well above average. With that said, the BY2018 egg-to-emigrant ratio is already at 7.9% without including forthcoming yearling estimates, which would tie for the third highest on record. Conclusions about BY2018 will be made after BY2018 yearling estimates are calculated at the conclusion of the 2020 trapping season.

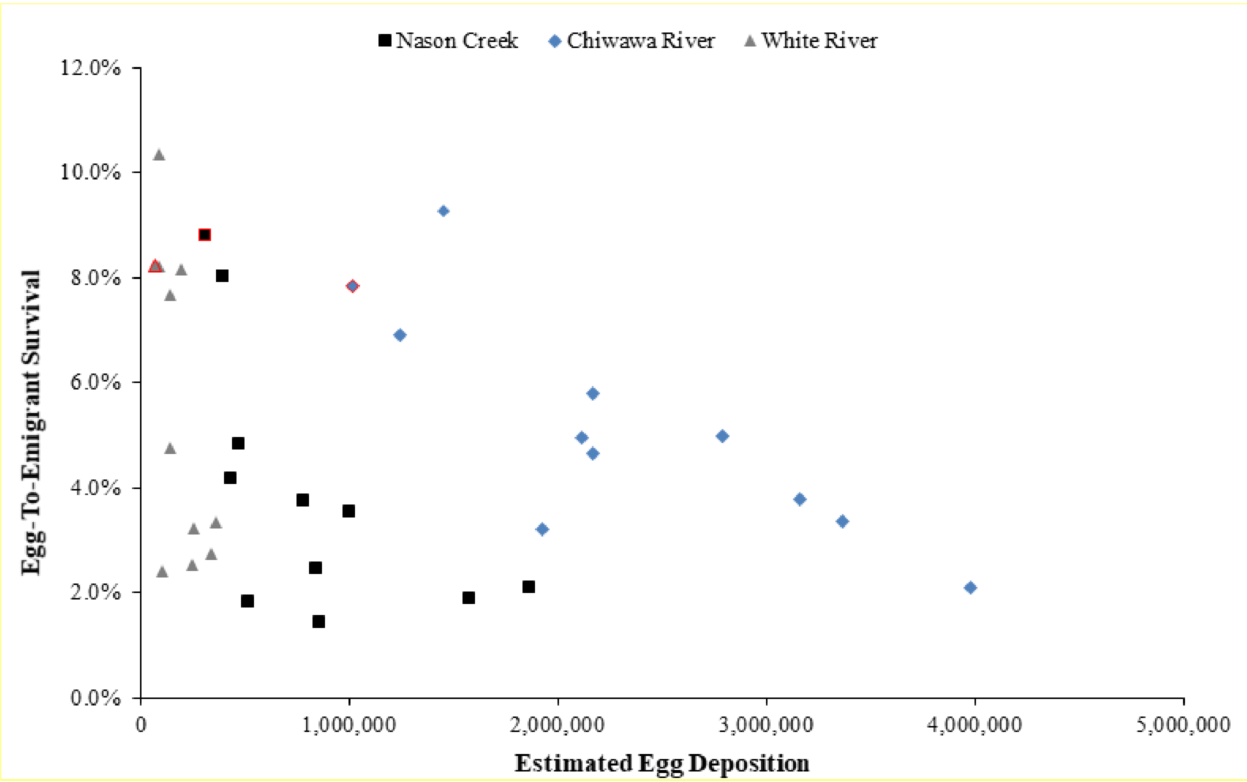


Figure 15. Comparisons of White R., Nason Cr., and Chiwawa River egg-to-emigrant survivals, BY2007-2017. *BY2017 denoted by red border.

Summer Steelhead

The BY2016 steelhead emigrant total was above average. As in previous years, the overwhelming majority (86.2%) of BY2016 juveniles emigrated from Nason Creek at age-1. Pooled estimates were used to produce all steelhead estimates in 2019. As with Chinook yearlings, we note the caveat that eventual recalculation using a flow efficiency regression may yield different results. Further examination of the success of this completed brood migration should be performed upon recalculation of emigrant estimates.

Initial BY2017 emigrant estimates both suggest above-average juvenile abundances based on the age classes collected so far. Although redd counts were not conducted at Nason Creek beyond 2013, for BY2017, based on age-1 emigrant estimates alone, egg-to-emigrant survival appears likely to be well-above average. High initial survival rates likely achieved in BY2017 summer steelhead may be due to changing habitat conditions resulting from significant high water events in the past three years. A conclusion about BY2017 will be made after the 2020 trapping season. Initial age-1 estimates for BY2018 steelhead are the second lowest on record. A conclusion about BY2018 will be made after the 2021 trapping season.

Coho

The MCCRP is currently in 'Broodstock Develop Phase 2' (BDP2; YNFRM 2018). In an effort to promote the long-range upriver adaptation of the stock, BDP2 prioritizes adult coho collected at Tumwater Dam. The emphasis placed on Tumwater Dam for adult collections combined with low adult coho returns in 2017 resulted in few coho escaping to spawning habitats upstream of Tumwater Dam (such as Nason Creek). In 2017, adult passage upstream of Tumwater Dam was limited to 3 adults. The lack of juveniles captured at the smolt trap in 2019 were a reflection of this low passage. In 2018, a total of 337 adult coho were passed upstream of Tumwater dam, providing potential for naturally-produced smolts in Nason Creek in 2020. We expect increased escapement to spawning habitats upstream of Tumwater Dam when biological targets for Broodstock Development Phase 2 have been met and the project transitions to the Natural Production Phases (YNFRM 2018).

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APPENDIX A. Daily Stream Discharge

Date	Stream Discharge (m^3/s)	Water Temperature (˚C)
1/1/2019	5.7	0.5
1/2/2019	5.1	0.5
1/3/2019	8.2	0.5
1/4/2019	14.9	0.5
1/5/2019	11.1	0.6
1/6/2019	9.4	0.8
1/7/2019	8.3	0.9
1/8/2019	7.6	0.9
1/9/2019	7.2	1.0
1/10/2019	6.7	0.9
1/11/2019	6.4	0.9
1/12/2019	6.1	0.8
1/13/2019	5.8	1.0
1/14/2019	5.5	1.1
1/15/2019	5.2	1.0
1/16/2019	5.1	0.9
1/17/2019	5.0	0.9
1/18/2019	4.9	0.9
1/19/2019	4.9	1.2
1/20/2019	4.8	1.3
1/21/2019	4.5	1.2
1/22/2019	4.4	1.3
1/23/2019	5.4	1.3
1/24/2019	6.1	1.5
1/25/2019	5.3	1.4
1/26/2019	5.1	1.4
1/27/2019	5.2	1.5
1/28/2019	5.4	1.5
1/29/2019	5.3	1.2
1/30/2019	5.2	1.3
1/31/2019	5.1	1.5
2/1/2019	5.0	1.6
2/2/2019	5.3	1.4
2/3/2019	5.1	1.6
2/4/2019	4.9	1.4
2/5/2019	4.6	1.5
2/6/2019	4.5	1.5
2/7/2019	4.3	1.7
2/8/2019	4.6	1.8
2/9/2019	5.7	1.6
2/10/2019	5.0	1.7
2/11/2019	5.7	1.4
2/12/2019	6.7	1.4
2/13/2019	7.0	1.6
2/14/2019	8.2	2.0
2/15/2019	6.4	1.9
2/16/2019	4.4	1.7
2/17/2019	3.7	1.5
2/18/2019	3.6	1.7
2/19/2019	4.0	1.7
2/20/2019	3.4	1.6
2/21/2019	3.1	1.4
2/22/2019	3.1	1.5
2/23/2019	3.5	1.4
2/24/2019	3.0	1.5
2/25/2019	2.9	1.7
2/26/2019	2.8	1.9
2/27/2019	2.8	2.1
2/28/2019	2.9	2.2
3/1/2019	2.6	2.2
3/2/2019	2.6	2.3
3/3/2019	2.5	2.5
3/4/2019	2.5	2.6
3/5/2019	3.2	2.5
3/6/2019	2.8	2.5
3/7/2019	2.5	2.4
3/8/2019	2.4	2.9
3/9/2019	2.3	2.8
3/10/2019	2.3	2.7
3/11/2019	2.3	3.0
3/12/2019	2.3	3.2
3/13/2019	2.3	2.9
3/14/2019	2.2	3.1
3/15/2019	2.2	3.2
3/16/2019	2.3	3.4
3/17/2019	2.3	3.5
3/18/2019	2.5	3.6
3/19/2019	2.8	3.6
3/20/2019	3.2	3.6
3/21/2019	3.9	3.6
3/22/2019	4.5	3.8

3/23/2019	5.5	4.0	5/5/2019	15.9	6.1
3/24/2019	6.3	3.9	5/6/2019	19.3	6.0
3/25/2019	6.6	3.9	5/7/2019	24.2	6.2
3/26/2019	7.3	4.1	5/8/2019	27.6	6.2
3/27/2019	7.2	4.2	5/9/2019	30.3	6.3
3/28/2019	6.8	4.2	5/10/2019	32.6	6.4
3/29/2019	6.8	4.3	5/11/2019	38.5	6.5
3/30/2019	7.1	4.4	5/12/2019	41.6	6.5
3/31/2019	7.7	4.4	5/13/2019	36.5	6.4
4/1/2019	8.5	4.4	5/14/2019	30.3	6.4
4/2/2019	9.4	4.3	5/15/2019	28.0	6.4
4/3/2019	10.4	4.3	5/16/2019	28.2	6.4
4/4/2019	13.2	4.5	5/17/2019	34.5	6.2
4/5/2019	13.7	4.5	5/18/2019	28.6	6.3
4/6/2019	15.0	4.7	5/19/2019	25.5	6.5
4/7/2019	13.8	5.0	5/20/2019	27.8	6.6
4/8/2019	13.4	5.0	5/21/2019	25.1	6.6
4/9/2019	14.9	5.1	5/22/2019	21.9	6.3
4/10/2019	14.3	5.0	5/23/2019	20.8	6.6
4/11/2019	14.0	5.1	5/24/2019	24.8	6.6
4/12/2019	14.5	5.2	5/25/2019	23.4	6.7
4/13/2019	14.4	4.9	5/26/2019	23.0	6.8
4/14/2019	13.6	4.9	5/27/2019	23.6	7.1
4/15/2019	12.1	5.1	5/28/2019	26.2	7.3
4/16/2019	11.2	5.0	5/29/2019	26.6	7.4
4/17/2019	11.5	5.4	5/30/2019	25.7	7.5
4/18/2019	12.8	5.5	5/31/2019	26.3	7.6
4/19/2019	20.3	5.6	6/1/2019	25.6	7.7
4/20/2019	25.2	5.9	6/2/2019	23.6	7.7
4/21/2019	23.0	5.8	6/3/2019	21.4	7.8
4/22/2019	22.3	5.7	6/4/2019	17.7	7.8
4/23/2019	23.3	5.6	6/5/2019	15.2	7.9
4/24/2019	24.6	5.5	6/6/2019	14.1	8.1
4/25/2019	22.6	5.7	6/7/2019	12.2	8.2
4/26/2019	20.8	5.9	6/8/2019	11.0	8.2
4/27/2019	20.4	5.9	6/9/2019	9.9	8.2
4/28/2019	17.5	5.9	6/10/2019	9.5	8.4
4/29/2019	15.7	6.0	6/11/2019	10.1	8.6
4/30/2019	14.3	5.9	6/12/2019	11.1	8.8
5/1/2019	13.4	6.0	6/13/2019	11.9	8.8
5/2/2019	12.9	6.2	6/14/2019	11.7	8.8
5/3/2019	12.5	6.2	6/15/2019	9.9	8.8
5/4/2019	13.3	6.2	6/16/2019	9.0	9.1

6/17/2019	8.5	9.4	7/30/2019	1.7	17.4
6/18/2019	8.0	9.7	7/31/2019	1.7	17.3
6/19/2019	7.3	9.5	8/1/2019	1.6	16.9
6/20/2019	6.9	9.6	8/2/2019	1.6	16.6
6/21/2019	6.3	9.8	8/3/2019	1.6	16.7
6/22/2019	5.7	10.0	8/4/2019	1.5	16.8
6/23/2019	5.4	10.2	8/5/2019	1.5	17.0
6/24/2019	5.2	10.3	8/6/2019	1.4	17.0
6/25/2019	4.9	10.6	8/7/2019	1.4	17.1
6/26/2019	5.2	10.8	8/8/2019	1.3	17.2
6/27/2019	5.0	10.8	8/9/2019	1.5	17.3
6/28/2019	4.9	11.1	8/10/2019	1.6	17.2
6/29/2019	4.4	11.4	8/11/2019	1.6	17.1
6/30/2019	4.2	11.6	8/12/2019	1.5	16.8
7/1/2019	4.0	11.9	8/13/2019	1.4	16.9
7/2/2019	3.8	12.0	8/14/2019	1.3	16.8
7/3/2019	3.7	12.3	8/15/2019	1.3	16.8
7/4/2019	3.6	12.5	8/16/2019	1.2	16.9
7/5/2019	3.5	12.7	8/17/2019	1.2	17.1
7/6/2019	3.4	13.1	8/18/2019	1.2	17.2
7/7/2019	3.3	13.2	8/19/2019	1.2	17.3
7/8/2019	3.1	13.2	8/20/2019	1.1	17.0
7/9/2019	3.1	13.4	8/21/2019	1.1	16.7
7/10/2019	3.0	13.6	8/22/2019	1.2	16.2
7/11/2019	3.1	13.8	8/23/2019	1.2	16.0
7/12/2019	2.9	13.9	8/24/2019	1.1	15.8
7/13/2019	2.8	14.1	8/25/2019	1.1	15.4
7/14/2019	2.6	14.3	8/26/2019	1.1	15.6
7/15/2019	2.6	14.5	8/27/2019	1.0	15.7
7/16/2019	2.6	14.8	8/28/2019	1.0	15.8
7/17/2019	2.5	14.8	8/29/2019	1.0	15.6
7/18/2019	2.8	15.0	8/30/2019	1.0	15.8
7/19/2019	2.7	15.4	8/31/2019	1.0	15.2
7/20/2019	2.5	15.2	9/1/2019	0.9	15.1
7/21/2019	2.3	15.1	9/2/2019	0.9	15.0
7/22/2019	2.2	15.5	9/3/2019	0.9	15.0
7/23/2019	2.2	15.9	9/4/2019	0.9	14.8
7/24/2019	2.1	15.7	9/5/2019	0.9	14.9
7/25/2019	2.0	15.9	9/6/2019	0.9	14.7
7/26/2019	2.0	16.4	9/7/2019	0.9	14.7
7/27/2019	1.9	16.7	9/8/2019	0.9	14.5
7/28/2019	1.9	16.7	9/9/2019	0.9	14.3
7/29/2019	1.8	16.9	9/10/2019	1.0	14.2

9/11/2019	1.0	13.9	10/24/2019	8.0	6.7
9/12/2019	1.0	13.7	10/25/2019	7.9	6.4
9/13/2019	1.0	13.6	10/26/2019	7.8	6.1
9/14/2019	1.1	13.4	10/27/2019	6.3	5.6
9/15/2019	1.1	13.1	10/28/2019	5.5	5.5
9/16/2019	1.2	12.9	10/29/2019	4.8	5.2
9/17/2019	1.1	12.4	10/30/2019	4.2	5.3
9/18/2019	1.3	12.5	10/31/2019	4.1	5.2
9/19/2019	1.3	12.5	11/1/2019	3.9	4.9
9/20/2019	1.2	12.5	11/2/2019	3.7	4.6
9/21/2019	1.1	12.1	11/3/2019	3.5	4.4
9/22/2019	1.1	11.8	11/4/2019	3.4	4.3
9/23/2019	1.1	11.6	11/5/2019	3.2	4.2
9/24/2019	1.2	11.4	11/6/2019	3.1	4.1
9/25/2019	1.2	11.6	11/7/2019	2.9	3.9
9/26/2019	1.1	11.7	11/8/2019	2.8	4.1
9/27/2019	1.7	11.4	11/9/2019	2.8	4.0
9/28/2019	1.9	11.1	11/10/2019	2.8	4.1
9/29/2019	1.7	10.9	11/11/2019	2.7	4.1
9/30/2019	1.5	10.8	11/12/2019	2.7	3.6
10/1/2019	1.4	10.2	11/13/2019	2.8	3.3
10/2/2019	1.3	10.1	11/14/2019	2.6	3.4
10/3/2019	1.3	9.9	11/15/2019	2.7	3.5
10/4/2019	1.3	9.5	11/16/2019	4.1	3.4
10/5/2019	1.3	9.2	11/17/2019	5.8	3.1
10/6/2019	1.4	9.1	11/18/2019	6.9	2.9
10/7/2019	1.4	9.6	11/19/2019	6.4	2.9
10/8/2019	2.9	9.3	11/20/2019	5.6	2.7
10/9/2019	2.5	8.9	11/21/2019	4.8	2.6
10/10/2019	2.1	8.7	11/22/2019	4.4	2.5
10/11/2019	1.9	8.3	11/23/2019	4.1	2.4
10/12/2019	1.8	7.8	11/24/2019	4.6	2.2
10/13/2019	1.8	7.9	11/25/2019	4.5	2.1
10/14/2019	1.9	7.8	11/26/2019	4.0	2.2
10/15/2019	1.8	7.6	11/27/2019	3.8	2.1
10/16/2019	1.8	7.7	11/28/2019	3.6	1.9
10/17/2019	2.7	7.8	11/29/2019	3.5	1.8
10/18/2019	3.8	7.7	11/30/2019	5.6	1.9
10/19/2019	3.9	7.6	12/1/2019	8.3	1.9
10/20/2019	3.5	7.7	12/2/2019	6.9	1.9
10/21/2019	4.8	7.5	12/3/2019	3.5	1.7
10/22/2019	26.8	7.0	12/4/2019	3.8	1.5
10/23/2019	12.2	6.9	12/5/2019	4.4	1.3

12/6/2019	3.7	1.3
12/7/2019	3.7	1.5
12/8/2019	3.7	1.5
12/9/2019	3.7	1.3
12/10/2019	3.5	1.1
12/11/2019	3.4	1.2
12/12/2019	3.4	1.0
12/13/2019	3.5	0.8
12/14/2019	3.3	1.0
12/15/2019	3.2	1.3
12/16/2019	3.0	1.1
12/17/2019	3.0	1.1
12/18/2019	2.9	1.2
12/19/2019	2.9	0.9
12/20/2019	3.9	0.9
12/21/2019	8.8	0.9
12/22/2019	7.0	1.0
12/23/2019	5.2	1.1
12/24/2019	4.6	1.0
12/25/2019	4.2	1.0
12/26/2019	3.9	0.7
12/27/2019	3.9	0.7
12/28/2019	3.7	0.8
12/29/2019	3.5	0.8
12/30/2019	3.4	0.8
12/31/2019	4.0	0.5

APPENDIX B. Daily Trap Operations

Date	Trap Status	Comments
3/1/2019	Pulled	Low flow
3/2/2019	Pulled	Low flow
3/3/2019	Pulled	Low flow
3/4/2019	Pulled	Low flow
3/5/2019	Pulled	Low flow
3/6/2019	Pulled	Low flow
3/7/2019	Pulled	Low flow
3/8/2019	Pulled	Low flow
3/9/2019	Pulled	Low flow
3/10/2019	Pulled	Low flow
3/11/2019	Pulled	Low flow
3/12/2019	Pulled	Low flow
3/13/2019	Pulled	Low flow
3/14/2019	Pulled	Low flow
3/15/2019	Pulled	Low flow
3/16/2019	Pulled	Low flow
3/17/2019	Pulled	Low flow
3/18/2019	Pulled	Low flow
3/19/2019	Pulled	Low flow
3/20/2019	Opp.	
3/21/2019	Opp.	
3/22/2019	Opp.	
3/23/2019	Opp.	
3/24/2019	Opp.	
3/25/2019	Opp.	
3/26/2019	Opp.	
3/27/2019	Opp.	
3/28/2019	Opp.	
3/29/2019	Opp.	
3/30/2019	Opp.	
3/31/2019	Opp.	
4/1/2019	Opp.	
4/2/2019	Opp.	
4/3/2019	Opp.	
4/4/2019	Opp.	
4/5/2019	Opp.	
4/6/2019	Opp.	
4/7/2019	Opp.	
4/8/2019	Stopped	Debris
4/9/2019	Opp.	
4/10/2019	Opp.	
4/11/2019	Opp.	
4/12/2019	Opp.	
4/13/2019	Opp.	
4/14/2019	Opp.	
4/15/2019	Opp.	
4/16/2019	Opp.	
4/17/2019	Opp.	
4/18/2019	Pulled	High flow
4/19/2019	Pulled	High flow
4/20/2019	Pulled	High flow
4/21/2019	Opp.	
4/22/2019	Opp.	
4/23/2019	Opp.	
4/24/2019	Pulled	
4/25/2019	Opp.	
4/26/2019	Opp.	
4/27/2019	Opp.	
4/28/2019	Opp.	
4/29/2019	Opp.	
4/30/2019	Opp.	
5/1/2019	Pulled	32H release
5/2/2019	Opp.	
5/3/2019	Opp.	
5/4/2019	Opp.	
5/5/2019	Opp.	
5/6/2019	Stopped	Debris
5/7/2019	Opp.	
5/8/2019	Opp.	
5/9/2019	Opp.	
5/10/2019	Opp.	
5/11/2019	Opp.	
5/12/2019	Stopped	Debris
5/13/2019	Opp.	
5/14/2019	Opp.	
5/15/2019	Opp.	
5/16/2019	Opp.	
5/17/2019	Opp.	
5/18/2019	Opp.	
5/19/2019	Opp.	

5/20/2019	Opp.	
5/21/2019	Opp.	
5/22/2019	Opp.	
5/23/2019	Opp.	
5/24/2019	Opp.	
5/25/2019	Opp.	
5/26/2019	Opp.	
5/27/2019	Opp.	
5/28/2019	Opp.	
5/29/2019	Opp.	
5/30/2019	Opp.	
5/31/2019	Opp.	
6/1/2019	Stopped	Debris
6/2/2019	Opp.	
6/3/2019	Opp.	
6/4/2019	Opp.	
6/5/2019	Opp.	
6/6/2019	Opp.	
6/7/2019	Opp.	
6/8/2019	Opp.	
6/9/2019	Opp.	
6/10/2019	Opp.	
6/11/2019	Opp.	
6/12/2019	Opp.	
6/13/2019	Opp.	
6/14/2019	Opp.	
6/15/2019	Opp.	
6/16/2019	Opp.	
6/17/2019	Opp.	
6/18/2019	Opp.	
6/19/2019	Opp.	
6/20/2019	Opp.	
6/21/2019	Opp.	
6/22/2019	Opp.	
6/23/2019	Opp.	
6/24/2019	Opp.	
6/25/2019	Opp.	
6/26/2019	Opp.	
6/27/2019	Opp.	
6/28/2019	Opp.	
6/29/2019	Opp.	
6/30/2019	Opp.	
7/1/2019	Opp.	
7/2/2019	Opp.	
7/3/2019	Opp.	
7/4/2019	Opp.	
7/5/2019	Opp.	
7/6/2019	Opp.	
7/7/2019	Opp.	
7/8/2019	Opp.	
7/9/2019	Opp.	
7/10/2019	Opp.	
7/11/2019	Opp.	
7/12/2019	Opp.	
7/13/2019	Opp.	
7/14/2019	Opp.	
7/15/2019	Opp.	
7/16/2019	Opp.	
7/17/2019	Opp.	
7/18/2019	Opp.	
7/19/2019	Opp.	
7/20/2019	Opp.	
7/21/2019	Opp.	
7/22/2019	Opp.	
7/23/2019	Opp.	
7/24/2019	Opp.	
7/25/2019	Opp.	
7/26/2019	Opp.	
7/27/2019	Opp.	
7/28/2019	Opp.	
7/29/2019	Pulled	Low flow
7/30/2019	Pulled	Low flow
7/31/2019	Pulled	Low flow
8/1/2019	Pulled	Low flow
8/2/2019	Pulled	Low flow
8/3/2019	Pulled	Low flow
8/4/2019	Pulled	Low flow
8/5/2019	Pulled	Low flow
8/6/2019	Pulled	Low flow
8/7/2019	Pulled	Low flow
8/8/2019	Pulled	Low flow
8/9/2019	Pulled	Low flow
8/10/2019	Pulled	Low flow
8/11/2019	Pulled	Low flow
8/12/2019	Pulled	Low flow
8/13/2019	Pulled	Low flow

8/14/2019	Pulled	Low flow
8/15/2019	Pulled	Low flow
8/16/2019	Pulled	Low flow
8/17/2019	Pulled	Low flow
8/18/2019	Pulled	Low flow
8/19/2019	Pulled	Low flow
8/20/2019	Pulled	Low flow
8/21/2019	Pulled	Low flow
8/22/2019	Pulled	Low flow
8/23/2019	Pulled	Low flow
8/24/2019	Pulled	Low flow
8/25/2019	Pulled	Low flow
8/26/2019	Pulled	Low flow
8/27/2019	Pulled	Low flow
8/28/2019	Pulled	Low flow
8/29/2019	Pulled	Low flow
8/30/2019	Pulled	Low flow
8/31/2019	Pulled	Low flow
9/1/2019	Pulled	Low flow
9/2/2019	Pulled	Low flow
9/3/2019	Pulled	Low flow
9/4/2019	Pulled	Low flow
9/5/2019	Pulled	Low flow
9/6/2019	Pulled	Low flow
9/7/2019	Pulled	Low flow
9/8/2019	Pulled	Low flow
9/9/2019	Pulled	Low flow
9/10/2019	Pulled	Low flow
9/11/2019	Pulled	Low flow
9/12/2019	Pulled	Low flow
9/13/2019	Pulled	Low flow
9/14/2019	Pulled	Low flow
9/15/2019	Pulled	Low flow
9/16/2019	Pulled	Low flow
9/17/2019	Pulled	Low flow
9/18/2019	Pulled	Low flow
9/19/2019	Pulled	Low flow
9/20/2019	Pulled	Low flow
9/21/2019	Pulled	Low flow
9/22/2019	Pulled	Low flow
9/23/2019	Pulled	Low flow
9/24/2019	Pulled	Low flow
9/25/2019	Pulled	Low flow

9/26/2019	Pulled	Low flow
9/27/2019	Pulled	Low flow
9/28/2019	Pulled	Low flow
9/29/2019	Pulled	Low flow
9/30/2019	Pulled	Low flow
10/1/2019	Pulled	Low flow
10/2/2019	Pulled	Low flow
10/3/2019	Pulled	Low flow
10/4/2019	Pulled	Low flow
10/5/2019	Pulled	Low flow
10/6/2019	Pulled	Low flow
10/7/2019	Pulled	Low flow
10/8/2019	Pulled	Low flow
10/9/2019	Pulled	Low flow
10/10/2019	Pulled	Low flow
10/11/2019	Pulled	Low flow
10/12/2019	Pulled	Low flow
10/13/2019	Pulled	Low flow
10/14/2019	Pulled	Low flow
10/15/2019	Pulled	Low flow
10/16/2019	Pulled	Low flow
10/17/2019	Pulled	Low flow
10/18/2019	Pulled	Low flow
10/19/2019	Opp.	
10/20/2019	Opp.	
10/21/2019	Opp.	
10/22/2019	Stopped	Debris
10/23/2019	Pulled	Wind
10/24/2019	Opp.	
10/25/2019	Opp.	
10/26/2019	Stopped	Debris
10/27/2019	Opp.	
10/28/2019	Opp.	
10/29/2019	Opp.	
10/30/2019	Stopped	Frozen
10/31/2019	Pulled	Low temps
11/1/2019	Opp.	
11/2/2019	Opp.	
11/3/2019	Opp.	
11/4/2019	Opp.	
11/5/2019	Opp.	
11/6/2019	Opp.	
11/7/2019	Opp.	

11/8/2019	Opp.	
11/9/2019	Opp.	
11/10/2019	Opp.	
11/11/2019	Opp.	
11/12/2019	Opp.	
11/13/2019	Opp.	
11/14/2019	Opp.	
11/15/2019	Opp.	
11/16/2019	Opp.	
11/17/2019	Opp.	
11/18/2019	Stopped	Debris
11/19/2019	Pulled	High flow
11/20/2019	Opp.	
11/21/2019	Opp.	
11/22/2019	Opp.	
11/23/2019	Opp.	
11/24/2019	Opp.	
11/25/2019	Opp.	
11/26/2019	Opp.	
11/27/2019	Opp.	
11/28/2019	Pulled	
11/29/2019	Pulled	
11/30/2019	Pulled	

APPENDIX C. Regression Models

Model: Chinook Yearlings (Spring ’06-’14) Back Position, (r^2 = 0.15; p = 0.03)

Origin/Species/Stage	Age	Date	Trap Position	Mark	Recap	Trap Efficiency (R+1) / M	ASIN Transform	Discharge (m^3/s)
Wild Chinook Smolt	1+	3/31/2007	Back	40	2	0.08	0.28	24.6
Wild Chinook Smolt	1+	4/6/2006	Back	42	9	0.24	0.51	7.5
Wild Chinook Smolt	1+	4/14/2010	Back	42	4	0.12	0.35	4.9
Wild Chinook Smolt	1+	3/31/2012	Back	43	5	0.14	0.38	7.1
Wild Chinook Smolt	1+	4/3/2007	Back	46	1	0.04	0.21	18.6
Wild Chinook Smolt	1+	4/19/2012	Back	48	7	0.17	0.42	12.3
Wild Chinook Smolt	1+	4/10/2007	Back	53	4	0.09	0.31	27.4
Wild Chinook Smolt	1+	4/21/2009	Back	53	0	0.02	0.14	20.7
Wild Chinook Smolt	1+	4/13/2012	Back	53	4	0.09	0.31	10.1
Wild Chinook Smolt	1+	4/16/2012	Back	53	7	0.15	0.40	12.5
Wild Chinook Smolt	1+	4/24/2008	Back	57	8	0.16	0.41	5.9
Wild Chinook Smolt	1+	4/23/2012	Back	58	1	0.03	0.19	39.1
Wild Chinook Smolt	1+	4/24/2006	Back	59	3	0.07	0.26	10.4
Wild Chinook Smolt	1+	3/23/2007	Back	59	7	0.14	0.38	24.8
Wild Chinook Smolt	1+	3/17/2007	Back	64	7	0.13	0.36	26.5
Wild Chinook Smolt	1+	4/18/2010	Back	67	2	0.05	0.21	9.3
Wild Chinook Smolt	1+	4/17/2008	Back	72	13	0.19	0.46	7.8
Wild Chinook Smolt	1+	4/3/2006	Back	81	10	0.14	0.38	5.3
Wild Chinook Smolt	1+	3/20/2007	Back	91	13	0.15	0.40	34.8
Wild Chinook Smolt	1+	5/1/2008	Back	102	16	0.17	0.42	8.9
Wild Chinook Smolt	1+	4/28/2008	Back	127	19	0.16	0.41	7.7
Wild Chinook Smolt	1+	4/14/2008	Back	195	40	0.21	0.48	9.3
Wild Chinook Smolt	1+	3/9/2014	Back	65	4	0.08	0.28	27.1
Wild Chinook Smolt	1+	3/13/2014	Back	67	9	0.15	0.40	16.0

Model: Chinook Subyearling (Fall ’06-’13) Back Position, (r^2 = 0.55; p = 0.001)

Origin/Species/Stage	Age	Date	Trap Position	Mark	Recap	Trap Efficiency (R+1) / M	ASIN Transform	Discharge (m^3/s)
Wild Chinook Parr	0	10/26/2006	Back	183	50	0.28	0.56	1.4
Wild Chinook Parr	0	10/30/2006	Back	168	52	0.32	0.60	1.8
Wild Chinook Parr	0	11/1/2010	Back	254	42	0.17	0.42	5.6
Wild Chinook Parr	0	11/4/2010	Back	287	49	0.17	0.43	6.1
Wild Chinook Parr	0	11/7/2010	Back	168	32	0.20	0.46	6.8

Origin/Species/Stage	Age	Date	Trap Position	Mark	Recap	Trap Efficiency (R+1) / M	ASIN Transform	Discharge (m^3/s)
Wild Chinook Parr	0	11/13/2010	Back	185	35	0.19	0.46	3.7
Wild Chinook Parr	0	11/3/2012	Back	201	25	0.13	0.37	11.4
Wild Chinook Parr	0	11/7/2012	Back	233	27	0.12	0.35	11.2
Wild Chinook Parr	0	11/11/2012	Back	328	87	0.27	0.54	6.1
Wild Chinook Parr	0	11/15/2012	Back	195	34	0.18	0.44	6.0
Wild Chinook Parr	0	9/30/2013	Back	171	12	0.08	0.28	15.3
Wild Chinook Parr	0	10/2/2013	Back	213	43	0.21	0.47	9.3
Wild Chinook Parr	0	10/3/2013	Back	181	41	0.23	0.50	8.4
Wild Chinook Parr	0	10/7/2013	Back	242	31	0.13	0.37	6.6
Wild Chinook Parr	0	10/9/2013	Back	203	40	0.20	0.47	8.6
Wild Chinook Parr	0	11/27/2013	Back	241	55	0.23	0.50	5.2

Model: Chinook Subyearling (Fall ’06-’13) Forward Position, ($r^2 = 0.16$; $p = 0.02$)

Origin/Species/Stage	Age	Date	Trap Position	Mark	Recap	Trap Efficiency (R+1) / M	ASIN Transform	Discharge (m^3/s)
Wild Chinook Parr	0	7/13/2006	Back	52	8	0.17	0.43	4.8
Wild Chinook Parr	0	7/17/2006	Back	138	15	0.12	0.35	3.7
Wild Chinook Parr	0	7/20/2006	Back	74	5	0.08	0.29	3.2
Wild Chinook Parr	0	7/28/2006	Back	54	5	0.11	0.34	2.6
Wild Chinook Parr	0	7/31/2006	Back	99	7	0.08	0.29	2.2
Wild Chinook Parr	0	9/18/2006	Back	55	10	0.20	0.46	1.3
Wild Chinook Parr	0	7/31/2008	Back	60	15	0.27	0.54	3.4
Wild Chinook Parr	0	8/12/2008	Back	103	2	0.03	0.17	2.4
Wild Chinook Parr	0	8/22/2008	Back	75	11	0.16	0.41	2.7
Wild Chinook Parr	0	8/28/2008	Back	72	7	0.11	0.34	2.3
Wild Chinook Parr	0	10/9/2008	Back	110	22	0.21	0.48	1.8
Wild Chinook Parr	0	10/27/2008	Back	51	12	0.26	0.53	1.6
Wild Chinook Parr	0	10/30/2008	Back	84	15	0.19	0.45	1.5
Wild Chinook Parr	0	11/6/2008	Back	78	8	0.12	0.35	2.2
Wild Chinook Parr	0	11/10/2008	Back	88	0	0.01	0.11	8.7
Wild Chinook Parr	0	7/14/2009	Back	86	2	0.04	0.19	5.5
Wild Chinook Parr	0	7/15/2009	Back	105	4	0.05	0.22	5.1
Wild Chinook Parr	0	7/17/2009	Back	122	8	0.07	0.28	4.4
Wild Chinook Parr	0	7/20/2009	Back	89	2	0.03	0.19	3.8
Wild Chinook Parr	0	8/17/2009	Back	73	1	0.03	0.17	1.6
Wild Chinook Parr	0	9/10/2009	Back	56	7	0.14	0.39	1.7
Wild Chinook Parr	0	8/8/2010	Back	58	1	0.03	0.19	2.4
Wild Chinook Parr	0	8/11/2010	Back	114	8	0.08	0.29	2.2

Origin/Species/Stage	Age	Date	Trap Position	Mark	Recap	Trap Efficiency (R+1) / M	ASIN Transform	Discharge (m^3/s)
Wild Chinook Parr	0	9/11/2010	Back	68	9	0.15	0.39	2.1
Wild Chinook Parr	0	10/12/2010	Back	216	42	0.20	0.46	3.6
Wild Chinook Parr	0	10/15/2010	Back	192	37	0.20	0.46	2.7
Wild Chinook Parr	0	10/18/2010	Back	193	36	0.19	0.45	2.3
Wild Chinook Parr	0	10/22/2010	Back	92	18	0.21	0.47	2.0
Wild Chinook Parr	0	10/25/2010	Back	60	7	0.13	0.37	2.2
Wild Chinook Parr	0	10/29/2010	Back	127	0	0.01	0.09	2.7
Wild Chinook Parr	0	8/19/2011	Back	106	5	0.06	0.24	3.5

Model: Chinook Subyearling (Fall ’14-’19) Bolser Site (r^2 = 0.14; p = 0.053)

Origin/Species/Stage	Age	Date	Trap Position	Mark	Recap	Trap Efficiency (R+1)/M	ASIN Transform	Discharge (m^3/s)
Wild Chinook Parr	0	7/14/2014	1	89	7	0.09	0.30	9.3
Wild Chinook Parr	0	7/21/2014	1	74	4	0.07	0.26	5.6
Wild Chinook Parr	0	7/27/2014	1	72	4	0.07	0.27	4.4
Wild Chinook Parr	0	10/24/2014	1	53	4	0.09	0.31	6.3
Wild Chinook Parr	0	10/27/2014	1	71	3	0.06	0.24	6.8
Wild Chinook Parr	0	10/30/2014	1	70	5	0.09	0.30	9.6
Wild Chinook Parr	0	11/1/2014	1	96	6	0.07	0.27	9.6
Wild Chinook Parr	0	10/24/2016	1	59	6	0.12	0.35	8.0
Wild Chinook Parr	0	11/1/2016	1	68	8	0.13	0.37	11.3
Wild Chinook Parr	0	11/15/2016	1	69	11	0.17	0.43	15.1
Wild Chinook Parr	0	7/17/2017	1	71	3	0.06	0.24	3.7
Wild Chinook Parr	0	10/23/2017	1	183	25	0.14	0.39	13.5
Wild Chinook Parr	0	10/27/2017	1	248	24	0.10	0.32	7.5
Wild Chinook Parr	0	10/31/2017	1	114	24	0.22	0.49	4.8
Wild Chinook Parr	0	11/12/2017	1	115	6	0.06	0.25	2.7
Wild Chinook Parr	0	11/27/2017	1	100	11	0.12	0.35	18.4
Wild Chinook Parr	0	11/7/2018	1	119	15	0.13	0.38	9.8
Wild Chinook Parr	0	11/15/2018	1	121	7	0.07	0.26	5.0
Wild Chinook Parr	0	11/19/2018	1	64	8	0.14	0.38	3.9
Wild Chinook Parr	0	11/4/2019	1	61	5	0.10	0.32	3.4
Wild Chinook Parr	0	11/12/2019	1	173	13	0.08	0.29	2.7

Model: Summer Steelhead Back Position (’07-’14), (r^2 = 0.35; p = 2.90E-05)

Origin/Species/Stage	Age	Date	Trap Position	Mark	Recap	Trap Efficiency (R+1) / M	ASIN Transform	Discharge (m^3/s)
Wild Steelhead Parr/Smolt	1+	3/20/2007	Back	55	1	0.04	0.19	34.8
Wild Steelhead Parr/Smolt	1+	3/31/2007	Back	56	4	0.09	0.30	24.6
Wild Steelhead Parr/Smolt	1+	4/10/2007	Back	60	8	0.15	0.40	27.4
Wild Steelhead Parr/Smolt	1+	5/1/2007	Back	52	2	0.06	0.24	22.2
Wild Steelhead Parr/Smolt	1+	6/9/2007	Back	71	9	0.14	0.38	23.8
Wild Steelhead Parr/Smolt	1+	6/12/2007	Back	65	8	0.14	0.38	19.9
Wild Steelhead Parr/Smolt	1+	6/14/2007	Back	61	5	0.10	0.32	19.5
Wild Steelhead Parr/Smolt	1+	6/21/2007	Back	67	4	0.07	0.28	21.3
Wild Steelhead Parr/Smolt	1+	4/14/2008	Back	149	46	0.32	0.60	9.3
Wild Steelhead Parr/Smolt	1+	4/17/2008	Back	75	3	0.05	0.23	7.8
Wild Steelhead Parr/Smolt	1+	4/28/2008	Back	74	11	0.16	0.41	7.7
Wild Steelhead Parr/Smolt	1+	5/1/2008	Back	176	29	0.17	0.43	8.9
Wild Steelhead Parr/Smolt	1+	5/12/2008	Back	55	8	0.16	0.42	18.8
Wild Steelhead Parr/Smolt	1+	5/15/2008	Back	57	1	0.04	0.19	39.4
Wild Steelhead Parr/Smolt	1+	6/9/2008	Back	142	20	0.15	0.39	26.6
Wild Steelhead Parr/Smolt	1+	6/12/2008	Back	83	10	0.13	0.37	23.3
Wild Steelhead Parr/Smolt	1+	6/16/2008	Back	81	8	0.11	0.34	32.3
Wild Steelhead Parr/Smolt	1+	4/20/2010	Back	121	11	0.10	0.32	19.1
Wild Steelhead Parr/Smolt	1+	4/22/2010	Back	121	10	0.09	0.31	20.6
Wild Steelhead Parr/Smolt	1+	6/20/2010	Back	128	11	0.09	0.31	26.2
Wild Steelhead Parr/Smolt	1+	4/5/2011	Back	52	1	0.04	0.20	21.5
Wild Steelhead Parr/Smolt	1+	5/22/2011	Back	84	3	0.05	0.22	43.6
Wild Steelhead Parr/Smolt	1+	6/12/2012	Back	69	5	0.09	0.30	33.1
Wild Steelhead Parr/Smolt	1+	7/26/2012	Back	63	4	0.08	0.29	7.9
Wild Steelhead Parr/Smolt	1+	4/22/2013	Back	66	6	0.11	0.33	14.7
Wild Steelhead Parr/Smolt	1+	4/26/2013	Back	50	2	0.06	0.25	18.2
Wild Steelhead Parr/Smolt	1+	4/30/2013	Back	54	2	0.06	0.24	22.0
Wild Steelhead Parr/Smolt	1+	5/8/2013	Back	62	0	0.02	0.13	61.4
Wild Steelhead Parr/Smolt	1+	5/19/2013	Back	122	15	0.13	0.37	32.0
Wild Steelhead Parr/Smolt	1+	5/22/2013	Back	58	4	0.09	0.30	30.6
Wild Steelhead Parr/Smolt	1+	5/26/2013	Back	79	3	0.05	0.23	20.5
Wild Steelhead Parr/Smolt	1+	5/30/2013	Back	92	7	0.09	0.30	24.0
Wild Steelhead Parr/Smolt	1+	6/3/2013	Back	71	6	0.10	0.32	27.2
Wild Steelhead Parr/Smolt	1+	6/7/2013	Back	94	4	0.05	0.23	40.2
Wild Steelhead Parr/Smolt	1+	6/13/2013	Back	64	2	0.05	0.22	21.1
Wild Steelhead Parr/Smolt	1+	6/17/2013	Back	115	5	0.05	0.23	25.0
Wild Steelhead Parr/Smolt	1+	6/29/2013	Back	60	12	0.22	0.48	20.7
Wild Steelhead Parr/Smolt	1+	7/7/2013	Back	75	9	0.13	0.37	9.2
Wild Steelhead Parr/Smolt	1+	5/5/2014	Back	55	3	0.07	0.27	35.7
Wild Steelhead Parr/Smolt	1+	5/20/2014	Back	57	0	0.02	0.13	42.2

Origin/Species/Stage	Age	Date	Trap Position	Mark	Recap	Trap Efficiency (R+1) / M	ASIN Transform	Discharge (m^3/s)
Wild Steelhead Parr/Smolt	1+	6/3/2014	Back	75	1	0.03	0.16	45.6

Model: 2013 Summer Steelhead Back Position (In-yr.), (r^2 = 0.15; p = 0.05)

Origin/Species/Stage	Age	Date	Trap Position	Mark	Recap	Trap Efficiency (R+1) / M	ASIN Transform	Discharge (m^3/s)
Wild Chinook Smolt	1+	3/31/2007	Back	40	2	0.08	0.28	24.6
Wild Chinook Smolt	1+	4/6/2006	Back	42	9	0.24	0.51	7.5
Wild Chinook Smolt	1+	4/14/2010	Back	42	4	0.12	0.35	4.9
Wild Chinook Smolt	1+	3/31/2012	Back	43	5	0.14	0.38	7.1
Wild Chinook Smolt	1+	4/3/2007	Back	46	1	0.04	0.21	18.6
Wild Chinook Smolt	1+	4/19/2012	Back	48	7	0.17	0.42	12.3
Wild Chinook Smolt	1+	4/10/2007	Back	53	4	0.09	0.31	27.4
Wild Chinook Smolt	1+	4/21/2009	Back	53	0	0.02	0.14	20.7
Wild Chinook Smolt	1+	4/13/2012	Back	53	4	0.09	0.31	10.1
Wild Chinook Smolt	1+	4/16/2012	Back	53	7	0.15	0.40	12.5
Wild Chinook Smolt	1+	4/24/2008	Back	57	8	0.16	0.41	5.9
Wild Chinook Smolt	1+	4/23/2012	Back	58	1	0.03	0.19	39.1
Wild Chinook Smolt	1+	4/24/2006	Back	59	3	0.07	0.26	10.4
Wild Chinook Smolt	1+	3/23/2007	Back	59	7	0.14	0.38	24.8
Wild Chinook Smolt	1+	3/17/2007	Back	64	7	0.13	0.36	26.5
Wild Chinook Smolt	1+	4/18/2010	Back	67	2	0.05	0.21	9.3
Wild Chinook Smolt	1+	4/17/2008	Back	72	13	0.19	0.46	7.8
Wild Chinook Smolt	1+	4/3/2006	Back	81	10	0.14	0.38	5.3
Wild Chinook Smolt	1+	3/20/2007	Back	91	13	0.15	0.40	34.8
Wild Chinook Smolt	1+	5/1/2008	Back	102	16	0.17	0.42	8.9
Wild Chinook Smolt	1+	4/28/2008	Back	127	19	0.16	0.41	7.7
Wild Chinook Smolt	1+	4/14/2008	Back	195	40	0.21	0.48	9.3
Wild Chinook Smolt	1+	3/9/2014	Back	65	4	0.08	0.28	27.1
Wild Chinook Smolt	1+	3/13/2014	Back	67	9	0.15	0.40	16.0

Model: Spring Chinook 2010-2014 Non-Trapping Period Array (NAL) – Full Antenna Function, ($r^2 = 0.61$; $p = 0.0002$)

Origin/Species/Stage	Age	Date	Mark	Detections	Trap Efficiency (R+1) / M	ASIN Transform	Discharge (m^3/s)
Wild Chinook Parr	0	11/4/2010	254	95	0.38	0.66	6.3
Wild Chinook Parr	0	11/7/2010	287	70	0.25	0.52	7.0
Wild Chinook Parr	0	11/10/2010	168	74	0.45	0.73	4.8
Wild Chinook Parr	0	11/13/2010	74	41	0.57	0.85	4.0
Wild Chinook Parr	0	11/18/2010	185	22	0.12	0.36	7.9
Wild Chinook Parr	0	11/3/2012	201	21	0.11	0.34	10.9
Wild Chinook Parr	0	11/7/2012	233	31	0.14	0.38	10.7
Wild Chinook Parr	0	11/11/2012	328	66	0.20	0.47	6.3
Wild Chinook Parr	0	11/15/2012	195	68	0.35	0.64	6.2
Wild Chinook Parr	0	11/4/2013	130	51	0.40	0.68	3.7
Wild Chinook Parr	0	11/8/2013	106	39	0.38	0.66	4.2
Wild Chinook Parr	0	3/9/2014	65	4	0.08	0.28	24.9
Wild Chinook Parr	0	3/13/2014	67	5	0.09	0.30	15.3
Wild Chinook Parr	0	11/4/2014	114	5	0.05	0.23	10.5
Wild Chinook Parr	0	11/1/2014	96	5	0.06	0.25	16.5
Wild Chinook Parr	0	11/10/2014	78	8	0.12	0.35	11.3

Model: Spring Chinook 2010-2014 Non-Trapping Period Array (NAL) – Partial Antenna Function, ($r^2 = 0.38$; $p = 0.007$)

Origin/Species/Stage	Age	Date	Mark	Detections	Trap Efficiency (R+1)/M	ASIN Transform	Discharge
Wild Chinook Parr	0	11/4/2010	254	39	0.16	0.41	6.3
Wild Chinook Parr	0	11/7/2010	287	16	0.06	0.25	7.0
Wild Chinook Parr	0	11/10/2010	168	34	0.21	0.47	4.8
Wild Chinook Parr	0	11/13/2010	74	17	0.24	0.52	4.0
Wild Chinook Parr	0	11/18/2010	185	8	0.05	0.22	7.9
Wild Chinook Parr	0	11/3/2012	201	7	0.04	0.20	10.9
Wild Chinook Parr	0	11/7/2012	233	8	0.04	0.20	10.7
Wild Chinook Parr	0	11/11/2012	328	24	0.08	0.28	6.3
Wild Chinook Parr	0	11/15/2012	195	30	0.16	0.41	6.2
Wild Chinook Parr	0	11/4/2013	130	40	0.32	0.60	3.7
Wild Chinook Parr	0	11/8/2013	106	30	0.29	0.57	4.2
Wild Chinook Parr	0	3/9/2014	65	1	0.03	0.18	24.9

Origin/Species/Stage	Age	Date	Mark	Detections	Trap Efficiency (R+1)/M	ASIN Transform	Discharge
Wild Chinook Parr	0	3/13/2014	67	5	0.09	0.30	15.3
Wild Chinook Parr	0	11/1/2014	96	1	0.02	0.15	10.5
Wild Chinook Parr	0	11/4/2014	114	4	0.04	0.21	16.5
Wild Chinook Parr	0	11/10/2014	78	3	0.05	0.23	11.3

APPENDIX D. Historical Morphometric Data

Spring Chinook (2004-2019)

Trap Year	Brood Year	Origin/Species/Stage	Fork Length (mm)			Weight (g)			K-factor
			Mean	n	SD	Mean	n	SD	
2004	2002	Wild Chinook Yearling Smolt	93.4	336	12.4	9	337	5	1.1
2004	2003	Wild Chinook Subyearling Fry	39.5	82	5.1	0.6	79	0.3	1.0
2004	2003	Wild Chinook Subyearling Parr	82.4	792	7.9	6.1	702	2.7	1.1
2005	2003	Wild Chinook Yearling Smolt	93.6	278	7.9	8.7	276	2.1	1.1
2005	2004	Wild Chinook Subyearling Fry	42.1	107	5.6	0.7	102	0.4	0.9
2005	2004	Wild Chinook Subyearling Parr	75.9	924	9.6	4.9	890	3.8	1.1
2006	2004	Wild Chinook Yearling Smolt	91.2	363	7.1	7.5	362	1.8	1.0
2006	2005	Wild Chinook Subyearling Fry	—	—	—	—	—	—	—
2006	2005	Wild Chinook Subyearling Parr	72.9	1,428	9.6	3.9	1,428	2.3	1.0
2007	2005	Wild Chinook Yearling Smolt	89	676	8.2	8	675	6.1	1.1
2007	2006	Wild Chinook Subyearling Fry	39	24	3.7	0.6	24	0.5	1.0
2007	2006	Wild Chinook Subyearling Parr	79.5	686	13.8	6.1	685	2.6	1.2
2008	2006	Wild Chinook Yearling Smolt	96.1	904	6.6	9.5	904	2.1	1.1
2008	2007	Wild Chinook Subyearling Fry	42.8	127	4.6	0.8	127	0.4	1.0
2008	2007	Wild Chinook Subyearling Parr	75.8	2,049	12.5	5.2	2,049	2.4	1.2
2009	2007	Wild Chinook Yearling Smolt	94.4	198	8.9	9.2	198	2.5	1.1
2009	2008	Wild Chinook Subyearling Fry	44.8	82	4.8	0.9	82	0.6	1.0
2009	2008	Wild Chinook Subyearling Parr	70.1	2,333	12	4.2	2,333	2	1.2
2010	2008	Wild Chinook Yearling Smolt	96.9	366	7.3	10.2	366	2.3	1.1
2010	2009	Wild Chinook Subyearling Fry	41.8	30	5	1.3	8	0.2	1.8
2010	2009	Wild Chinook Subyearling Parr	80.7	3,021	10.7	6.2	3,021	2.3	1.2
2011	2009	Wild Chinook Yearling Smolt	89.1	152	9.9	7.7	152	1.8	1.1
2011	2010	Wild Chinook Subyearling Fry	39.8	217	6.6	0.6	217	0.5	1.0
2011	2010	Wild Chinook Subyearling Parr	73.4	1,046	13.1	4.9	1,046	2.5	1.2
2012	2010	Wild Chinook Yearling Smolt	93.3	368	7	9.2	368	2.2	1.1
2012	2011	Wild Chinook Subyearling Fry	42.7	48	9.1	0.9	48	0.6	1.2
2012	2011	Wild Chinook Subyearling Parr	77.9	2,160	10.7	5.3	2,160	1.9	1.1
2013	2011	Wild Chinook Yearling Smolt	90.6	239	75	7.9	239	2.1	1.1
2013	2012	Wild Chinook Subyearling Fry	45.6	1,824	6.8	1	1,803	0.6	1.1
2013	2012	Wild Chinook Subyearling Parr	70	4,422	11.4	3.8	4,409	1.7	1.1
2014	2012	Wild Chinook Yearling Smolt	89.5	464	6.9	7.5	464	1.8	1.0
2014	2013	Wild Chinook Subyearling Fry	40.1	677	5.2	0.9	221	0.5	1.4
2014	2013	Wild Chinook Subyearling Parr	69.1	1,549	12.3	3.8	1,547	2.3	1.2
2015	2013	Wild Chinook Yearling Smolt	93	152	7	8.4	152	2.2	1.0
2015	2014	Wild Chinook Subyearling Fry	45	338	9.9	1	338	0.9	0.9

Trap Year	Brood Year	Origin/Species/Stage	Fork Length (mm)			Weight (g)			K-factor
			Mean	n	SD	Mean	n	SD	
2015	2014	Wild Chinook Subyearling Parr	84	210	8	6.5	209	1.7	1.1
2015	2013	Hatchery Chinook Yearling Smolt	136	284	12.3	29.5	284	8.8	1.1
2016	2014	Wild Chinook Yearling Smolt	96	61	5.5	9.0	61	1.7	1.0
2016	2015	Wild Chinook Subyearling Fry	38	285	3.0	0.5	285	0.2	0.8
2016	2015	Wild Chinook Subyearling Parr	85	491	12.7	6.9	490	2.5	1.1
2016	2014	Hatchery Chinook Yearling Smolt	119	87	13.5	19.6	87	7.6	1.1
2017	2015	Wild Chinook Yearling Smolt	96	357	6.6	9.8	357	2.1	1.1
2017	2016	Wild Chinook Subyearling Fry	38	557	3.9	0.5	557	0.3	0.9
2017	2016	Wild Chinook Subyearling Parr	74	1,864	12.3	4.7	1,863	2.1	1.1
2017	2015	Hatchery Chinook Yearling Smolt	115	143	10.3	18.4	143	5.4	1.2
2018	2016	Wild Chinook Yearling Smolt	95	301	6.8	9.5	301	2.1	1.1
2018	2017	Wild Chinook Subyearling Fry	43	834	8.7	0.9	834	0.9	0.9
2018	2017	Wild Chinook Subyearling Parr	83	710	12.1	6.5	710	2.4	1.1
2018	2016	Hatchery Chinook Yearling Smolt	119	87	10.3	19.3	87	5.4	1.1
2019	2017	Wild Chinook Yearling Smolt	97	294	6.9	10.1	294	2.1	1.1
2019	2018	Wild Chinook Subyearling Fry	39	456	4.6	0.6	456	0.5	0.9
2019	2018	Wild Chinook Subyearling Parr	75	1,249	12.2	4.8	1,249	2.1	1.1
2019	2017	Hatchery Chinook Yearling Smolt	117	193	10.7	18.0	193	5.3	1.1

Summer Steelhead (2004-2019)

Trap Year	Brood Year	Age	Origin/Species	Fork Length (mm)			Weight (g)			K-factor
				Mean	n	SD	Mean	n	SD	
2004	2004	0	Wild Summer Steelhead	67	358	10	3.5	279	1.5	1.2
2004	2003	1	Wild Summer Steelhead	101.7	394	23.2	13.2	366	27.3	1.3
2004	2002	2	Wild Summer Steelhead	161.6	146	19.8	43.4	141	15.5	1.0
2004	2001	3	Wild Summer Steelhead	201.6	43	11.2	76	43	21.2	0.9
2004	2003	1	Hat. Summer Steelhead	182.8	523	22.4	62.1	497	21.2	1.0
2005	2005	0	Wild Summer Steelhead	54.1	649	15.7	2.2	616	3.2	1.4
2005	2004	1	Wild Summer Steelhead	93.6	585	25.6	10.8	575	10.1	1.3
2005	2003	2	Wild Summer Steelhead	153.5	103	21.2	38.1	102	16.4	1.1
2005	2002	3	Wild Summer Steelhead	144	1	—	43.2	1	—	1.4
2005	2004	1	Hat. Summer Steelhead	188.2	343	21.2	66	343	24	1.0
2006	2006	0	Wild Summer Steelhead	66.3	180	5.8	2.5	180	1	0.9
2006	2005	1	Wild Summer Steelhead	85.2	877	18.7	6.7	877	6.6	1.1
2006	2004	2	Wild Summer Steelhead	155.9	106	26.8	36.1	105	13.5	1.0
2006	2003	3	Wild Summer Steelhead	197	2	—	73.5	2	—	1.0

Trap Year	Brood Year	Age	Origin/Species	Fork Length (mm)			Weight (g)			K-factor
				Mean	n	SD	Mean	n	SD	
2006	2005	1	Hat. Summer Steelhead	—	—	—	—	—	—	—
2007	2007	0	Wild Summer Steelhead	54.2	329	11.7	2	328	1.4	1.3
2007	2006	1	Wild Summer Steelhead	82.7	1,330	16.8	7.2	1,329	6.3	1.3
2007	2005	2	Wild Summer Steelhead	143.8	102	20.6	31.4	102	11.9	1.1
2007	2004	3	Wild Summer Steelhead	143	1	—	26.8	1	—	0.9
2007	2006	1	Hat. Summer Steelhead	149.3	3	47	33.1	3	29.1	1.0
2008	2008	0	Wild Summer Steelhead	52.9	930	11.1	1.7	930	1.2	1.1
2008	2007	1	Wild Summer Steelhead	84.5	1,876	17.1	7.4	1,874	6.6	1.2
2008	2006	2	Wild Summer Steelhead	149.9	122	22.9	36	122	15.5	1.1
2008	2005	3	Wild Summer Steelhead	180.3	13	18.9	57.4	13	16.4	1.0
2008	2007	1	Hat. Summer Steelhead	179.4	389	16.5	55.9	388	14.8	1.0
2009	2009	0	Wild Summer Steelhead	55.6	843	10.5	2.2	688	1.1	1.3
2009	2008	1	Wild Summer Steelhead	82.6	452	18.6	7.1	447	5.5	1.3
2009	2007	2	Wild Summer Steelhead	156.9	72	22	40.9	72	15.5	1.1
2009	2006	3	Wild Summer Steelhead	195	3	5	73	3	6.7	1.0
2009	2008	1	Hat. Summer Steelhead	183.1	280	16.7	60.8	280	18.2	1.0
2010	2010	0	Wild Summer Steelhead	55	1,287	11.1	2.5	917	1.3	1.5
2010	2009	1	Wild Summer Steelhead	89.8	1,079	19.1	9	1,072	7.1	1.2
2010	2008	2	Wild Summer Steelhead	144.9	87	25.1	35	87	17.4	1.2
2010	2007	3	Wild Summer Steelhead	184	8	12.2	61.9	8	10.2	1.0
2010	2009	1	Hat. Summer Steelhead	183.5	531	19.5	61.3	526	19.6	1.0
2011	2011	0	Wild Summer Steelhead	43.5	1,093	10.1	1.1	783	0.9	1.3
2011	2010	1	Wild Summer Steelhead	75.7	818	18.5	5.5	811	5.7	1.3
2011	2009	2	Wild Summer Steelhead	144.8	27	41.3	42.1	27	62.1	1.4
2011	2008	3	Wild Summer Steelhead	—	—	—	—	—	—	—
2011	2010	1	Hat. Summer Steelhead	180.7	464	17	59.1	464	17.6	1.0
2012	2012	0	Wild Summer Steelhead	55.1	589	14.2	2.6	402	1.2	1.6
2012	2011	1	Wild Summer Steelhead	84.7	747	17.4	7.6	741	5.7	1.3
2012	2010	2	Wild Summer Steelhead	127.1	132	27	23.7	132	14.5	1.2
2012	2009	3	Wild Summer Steelhead	161	4	32	40.5	4	15.6	1.0
2012	2011	1	Hat. Summer Steelhead	154.8	318	20.9	37.7	318	14	1.0
2013	2013	0	Wild Summer Steelhead	56.1	878	11.3	2.1	777	1.1	1.2
2013	2012	1	Wild Summer Steelhead	44.5	1,777	14.7	5.4	1,772	4.2	1.2
2013	2011	2	Wild Summer Steelhead	144.7	21	15.7	36.1	21	10.2	1
2013	2010	3	Wild Summer Steelhead	—	—	—	—	—	—	—
2013	2012	1	Hat. Summer Steelhead	166.2	365	21.4	49.2	363	18.2	1.1
2014	2014	0	Wild Summer Steelhead	49.6	490	12.8	1.7	389	1.1	1.4
2014	2013	1	Wild Summer Steelhead	82.2	745	13.6	6.3	745	3.5	1.1

Trap Year	Brood Year	Age	Origin/Species	Fork Length (mm)			Weight (g)			K-factor
				Mean	n	SD	Mean	n	SD	
2014	2012	2	Wild Summer Steelhead	145.1	30	16.5	33	30	13.4	1.1
2014	2011	3	Wild Summer Steelhead	—	—	—	—	—	—	—
2014	2013	1	Hat. Summer Steelhead	173.4	632	18.7	52.6	633	15.9	1.0
2015	2015	0	Wild Summer Steelhead	70	182	15.5	4.3	176	2	1.1
2015	2014	1	Wild Summer Steelhead	88	233	20.2	8.3	233	6.7	1.0
2015	2013	2	Wild Summer Steelhead	149	14	13.5	33.7	14	8.2	1.0
2015	2012	3	Wild Summer Steelhead	191	1	—	73.8	1	—	1.1
2015	2014	1	Hat. Summer Steelhead	175	273	15.2	51.3	273	12.5	0.9
2016	2016	0	Wild Summer Steelhead	56	674	16.4	2.4	617	1.8	1.0
2016	2015	1	Wild Summer Steelhead	87	278	21.5	8.3	278	5.9	1.1
2016	2014	2	Wild Summer Steelhead	143	19	17.4	31.1	19	9.6	1.0
2016	2013	3	Wild Summer Steelhead	202	1	—	90.1	1	—	1.1
2016	2015	1	Hat. Summer Steelhead	175	95	15.5	55.1	95	16.2	1.0
2017	2017	0	Wild Summer Steelhead	54	370	17.6	2.5	306	1.5	1.0
2017	2016	1	Wild Summer Steelhead	88	1,109	14.5	8.1	1,108	4.4	1.0
2017	2015	2	Wild Summer Steelhead	150	74	15.8	35.6	74	11.0	1.0
2017	2014	3	Wild Summer Steelhead	—	—	—	—	—	—	—
2017	2016	1	Hat. Summer Steelhead	167	497	19.2	48.3	497	17.8	1.0
2018	2018	0	Wild Summer Steelhead	45	221	21.7	1.8	214	2.1	0.9
2018	2017	1	Wild Summer Steelhead	87	426	15.1	7.8	426	4.4	1.1
2018	2016	2	Wild Summer Steelhead	150	50	16.2	34.9	50	11.0	1.0
2018	2015	3	Wild Summer Steelhead	190	2	0.7	56.6	2	6.1	0.8
2018	2017	1	Hat. Summer Steelhead	158	279	17.0	39.8	280	12.9	1.0
2019	2019	0	Wild Summer Steelhead	54	79	21.3	2.6	70	2.0	1.0
2019	2018	1	Wild Summer Steelhead	87	277	13.0	7.5	277	3.6	1.1
2019	2017	2	Wild Summer Steelhead	144	21	16.5	31.1	21	11.2	1.0
2019	2016	3	Wild Summer Steelhead	—	—	—	—	—	—	—
2019	2017	1	Hat. Summer Steelhead	161	375	13.9	40.0	375	10.6	0.9

Coho (2007-2019)

Trap Year	Brood Year	Origin/Species/Stage	Fork Length (mm)			Weight (g)			K-factor
			Mean	n	SD	Mean	n	SD	
2004	2002	Nat. Or. Coho Yearling Smolt	—	—	—	—	—	—	—
2004	2003	Nat. Or. Coho Subyearling Fry	—	—	—	—	—	—	—
2004	2003	Nat. Or. Coho Subyearling Parr	—	—	—	—	—	—	—
2004	2002	Hatchery Coho Yearling Smolt	136.6	847	12.8	27.4	820	7.5	1.1
2005	2003	Nat. Or. Coho Yearling Smolt	114.4	17	8.8	16.2	17	3.6	1.1
2005	2004	Nat. Or. Coho Subyearling Fry	49.1	9	10.4	1.3	9	0.8	1.1
2005	2004	Nat. Or. Coho Subyearling Parr	76.7	9	12.8	4.9	9	2.7	1.1
2005	2003	Hatchery Coho Yearling Smolt	137.3	689	11.3	28.6	690	7.2	1.1
2006	2004	Nat. Or. Coho Yearling Smolt	—	—	—	—	—	—	—
2006	2005	Nat. Or. Coho Subyearling Fry	—	—	—	—	—	—	—
2006	2005	Nat. Or. Coho Subyearling Parr	71	4	13.6	3.8	4	2.9	1.1
2006	2004	Hatchery Coho Yearling Smolt	—	—	—	—	—	—	—
2007	2005	Nat. Or. Coho Yearling Smolt	92.9	36	12.5	8.7	36	4	1.1
2007	2006	Nat. Or. Coho Subyearling Fry	—	—	—	—	—	—	—
2007	2006	Nat. Or. Coho Subyearling Parr	83	1	—	6.2	1	—	1.1
2007	2005	Hatchery Coho Yearling Smolt	116	2	—	16.8	2	—	1.1
2008	2006	Nat. Or. Coho Yearling Smolt	—	—	—	—	—	—	—
2008	2007	Nat. Or. Coho Subyearling Fry	—	—	—	—	—	—	—
2008	2007	Nat. Or. Coho Subyearling Parr	87	1	—	6.4	1	—	1.0
2008	2006	Hatchery Coho Yearling Smolt	130.2	843	10.4	23.6	843	6.2	1.1
2009	2007	Nat. Or. Coho Yearling Smolt	103	4	9.7	11.7	4	3.4	1.1
2009	2008	Nat. Or. Coho Subyearling Fry	—	—	—	—	—	—	—
2009	2008	Nat. Or. Coho Subyearling Parr	79.6	5	20.1	6.6	5	4.8	1.3
2009	2007	Hatchery Coho Yearling Smolt	135.3	625	8.9	26.2	579	5.2	1.1
2010	2008	Nat. Or. Coho Yearling Smolt	—	—	—	—	—	—	—
2010	2009	Nat. Or. Coho Subyearling Fry	48	2	—	1.3	2	—	1.2
2010	2009	Nat. Or. Coho Subyearling Parr	83.6	27	8.6	6.7	27	2.4	1.1
2010	2008	Hatchery Coho Yearling Smolt	130	1,051	10.1	23.8	1,049	5.3	1.1
2011	2009	Nat. Or. Coho Yearling Smolt	100.2	14	12.7	11.3	14	3.9	1.1
2011	2010	Nat. Or. Coho Subyearling Fry	—	—	—	—	—	—	—
2011	2010	Nat. Or. Coho Subyearling Parr	64.7	3	10.8	3	3	1.5	1.1
2011	2009	Hatchery Coho Yearling Smolt	124.6	969	8.6	21	969	4.8	1.1
2012	2010	Nat. Or. Coho Yearling Smolt	102.1	17	9.1	11.9	17	3	1.1
2012	2011	Nat. Or. Coho Subyearling Fry	36	1	—	—	—	—	—
2012	2011	Nat. Or. Coho Subyearling Parr	78.4	84	9.3	5	84	2.1	1
2012	2010	Hatchery Coho Yearling Smolt	126.2	1,684	7.6	21.5	1,684	5.5	1.1
2013	2011	Nat. Or. Coho Yearling Smolt	97	81	10	10	81	3.1	1.1
2013	2012	Nat. Or. Coho Subyearling Fry	47.3	3	1	1	3	1	0.9

Trap Year	Brood Year	Origin/Species/Stage	Fork Length (mm)			Weight (g)			K-factor
			Mean	n	SD	Mean	n	SD	
2013	2012	Nat. Or. Coho Subyearling Parr	87.8	4	3.8	6.6	4	1	1.0
2013	2011	Hatchery Coho Yearling Smolt	130.1	982	8.5	23.3	977	4.9	1.1
2014	2012	Nat. Or. Coho Yearling Smolt	96.3	20	9.8	9.9	20	3	1.1
2014	2013	Nat. Or. Coho Subyearling Fry	36	1	—	—	—	—	—
2014	2013	Nat. Or. Coho Subyearling Parr	73	3	22.5	5.9	3	4.7	1.5
2014	2012	Hatchery Coho Yearling Smolt	127	1,203	9.7	21.7	1,207	5.0	1.1
2015	2013	Nat. Or. Coho Yearling Smolt	109	2	4.9	12.0	2	0.1	0.9
2015	2014	Nat. Or. Coho Subyearling Fry	47	7	13.7	1.4	7	1.5	0.9
2015	2014	Nat. Or. Coho Subyearling Parr	69	3	7	4.0	3	1.3	1.2
2015	2013	Hatchery Coho Yearling Smolt	131	952	9.9	23.3	952	4.8	1.0
2016	2014	Nat. Or. Coho Yearling Smolt	100	6	15.8	11.1	6	5.5	1.0
2016	2015	Nat. Or. Coho Subyearling Fry	—	—	—	—	—	—	—
2016	2015	Nat. Or. Coho Subyearling Parr	—	—	—	—	—	—	—
2016	2014	Hatchery Coho Yearling Smolt	134	302	8.4	24.8	301	5.0	1.0
2017	2015	Nat. Or. Coho Yearling Smolt	—	—	—	—	—	—	—
2017	2016	Nat. Or. Coho Subyearling Fry	—	—	—	—	—	—	—
2017	2016	Nat. Or. Coho Subyearling Parr	—	—	—	—	—	—	—
2017	2015	Hatchery Coho Yearling Smolt	122	548	8.0	20.1	548	4.1	1.1
2018	2016	Nat. Or. Coho Yearling Smolt	—	—	—	—	—	—	—
2018	2017	Nat. Or. Coho Subyearling Fry	—	—	—	—	—	—	—
2018	2017	Nat. Or. Coho Subyearling Parr	—	—	—	—	—	—	—
2018	2016	Hatchery Coho Yearling Smolt	131	258	8.5	24.7	258	5.1	1.1
2019	2017	Nat. Or. Coho Yearling Smolt	—	—	—	—	—	—	—
2019	2018	Nat. Or. Coho Subyearling Fry	—	—	—	—	—	—	—
2019	2018	Nat. Or. Coho Subyearling Parr	—	—	—	—	—	—	—
2019	2017	Hatchery Coho Yearling Smolt	134	664	9.7	26.1	664	8.8	1.1

Appendix O

Fish Trapping at the White River Smolt Trap during 2019

Population Estimates for Juvenile Spring Chinook Salmon in White River, WA

2019 Annual Report

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ABSTRACT

In 2007, Yakama Nation Fisheries Resource Management began monitoring emigration of Endangered Species Act (ESA) - listed Upper Columbia River (UCR) spring Chinook salmon in the White River to provide abundance and freshwater survival estimates. This report summarizes data collected between March 1 and November 27, 2019. We used 1.5 m, and 2.4 m rotary screw traps to collect 491 juvenile spring Chinook; 34 fry, 338 subyearling parr, 115 yearling smolts, and 4 precocial parr. Daily counts at the trap were expanded via regression analysis derived from mark-recapture trials. We estimated that 3,401 (± 4,435; 95% CI) BY2017 wild spring Chinook smolts and 3,541 (± 2,392; 95% CI) BY2018 wild spring Chinook parr emigrated past the White River trap in 2019. Combined with data collected in 2018, this gives us a total estimate of 5,709 (± 4,468; 95% CI) BY2017 emigrants. Using spring Chinook spawning ground data collected by Washington Department of Fish and Wildlife (WDFW) in 2017, we estimated egg-to-emigrant survival of BY2016 spring Chinook to be 8.2% (381 smolts-per-redd).

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ACKNOWLEDGEMENTS

This project is part of a basin-wide monitoring program requiring close coordination between multiple agencies and contractors. We greatly appreciate the hard work of the Yakama Nation FRM crew members including Matthew Clubb, Jamie Hallman, Tim Jeffris, and Kushiah Yazzie who maintained and operated the trap during all hours including nights/weekends and inclement weather conditions. Also, thank you to Peter Graf and Rolland O'Connor (Grant County PUD) for administering contracting and funding as well as Mclain Johnson, Andrew Murdoch, and Josh Williams (WDFW) for data sharing and collaboration on smolt trap methodologies.

1.0 INTRODUCTION

White River spring Chinook salmon (tkwínat) *Oncorhynchus tshawytscha* are part of the Upper Columbia River (UCR) spring Chinook salmon Evolutionarily Significant Unit (ESU), which was listed as endangered under the Endangered Species Act (ESA) in 1999. Due to critically low abundance, a captive broodstock program was operated in the White River between 1997 and 2015 as a risk aversion measure. Determining freshwater productivity of spring Chinook salmon in the White River is an essential component of the overall population monitoring, and will help contribute to the body of knowledge needed to evaluate if further supplementation in the White River is warranted.

In the fall of 2005, Washington State Department of Fish and Wildlife (WDFW) began smolt trapping in the lower White River in order to provide an estimate of juvenile spring Chinook salmon production. No trapping was conducted in 2006 as there was a transition between trap operators. In 2007, Public Utility District No. 2 of Grant County (GCPUD) contracted with Yakama Nation Fisheries (YNF) to operate a rotary trap in the White River. This document reports data collected between March 1 and November 27, 2019, and provides emigration estimates for spring Chinook salmon yearlings (BY2017) and subyearlings (BY2018) during that time period. Fish trap operations were conducted in compliance with ESA consultation specifically to address abundance and productivity of spring Chinook salmon in the White River.

Within this document, we will report:

1) Juvenile abundance and productivity of spring Chinook salmon in the White River.

2) Emigration timing of spring Chinook salmon emigrating from the White River.

1.1 Watershed Description

The White River drainage encompasses 40,451 ha originating in alpine glaciers and perennial snow fields (Figure 1; USFS 2004). Elevation within the drainage varies from 569 m at the surface of Lake Wenatchee to 2,614 m at Clark Mountain (Andonaegui 2001). As one of two primary tributaries to Lake Wenatchee, the White River flows in a south-easterly direction for 42.9 rkm before emptying into the lake. Precipitation ranges from 79 cm at the mouth to more than 356 cm in the head waters (Andonaegui 2001). Due to its glacial origins, peak runoff for the White River typically occurs between April and July with occasional high flows caused by rain-on-snow events in the fall and winter months. Water temperatures in this watershed tend to be cooler than other tributaries to the upper Wenatchee River subbasin. As of September 2002, Washington State Department of Ecology (WDOE) began operating a stream monitoring station at rkm 9.9. Operation of this station by WDOE is currently maintained with funding provided by GCPUD. In 2019, daily mean stream discharge ranged from 3.2 m^3/s (113 cfs) to 99.6 m^3/s (3,517 cfs) while mean daily stream temperatures ranged from 0.0°C to 15.1°C (Figs. 2 & 3). Discharge and temperature data provided by WDOE should be considered provisional and are presented in Appendix A.

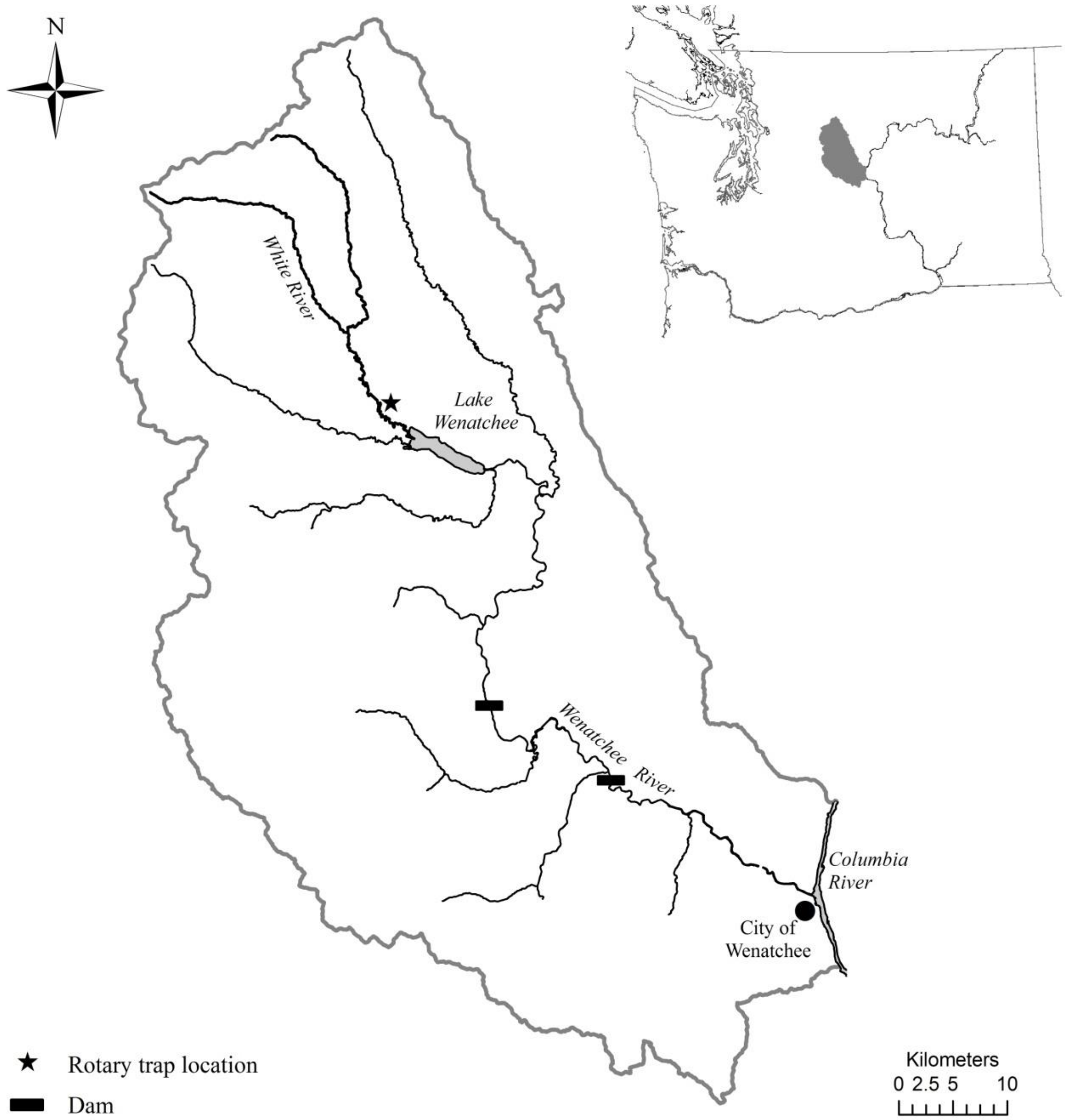


Figure 1. Map of the Wenatchee River subbasin with White River rotary trap location.

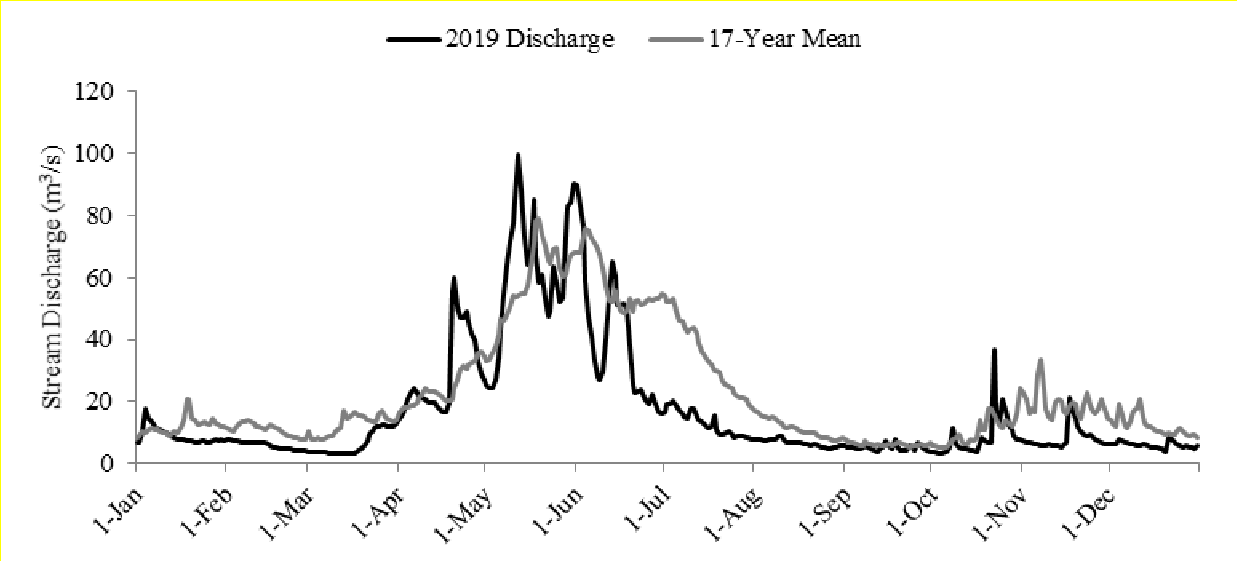


Figure 2. Mean daily stream discharge at the White River DOE stream monitoring station at Sears Creek Bridge, 2019.

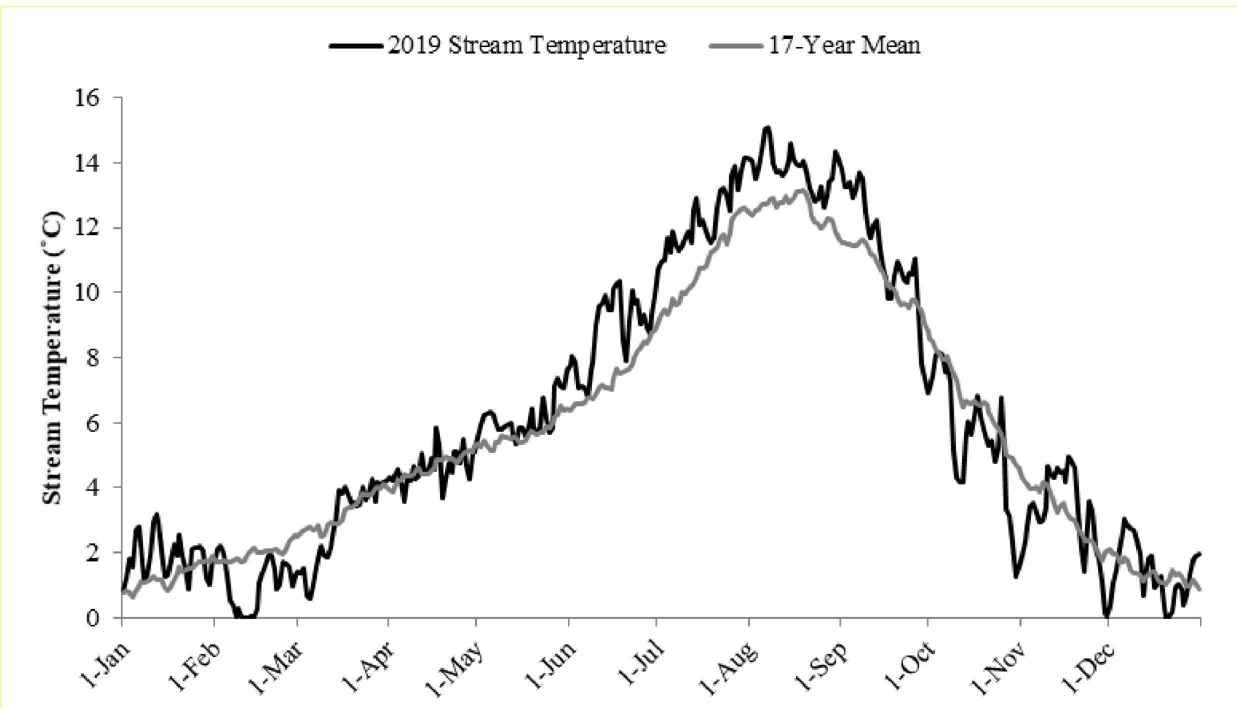


Figure 3. Mean daily water temperatures at the White River DOE stream monitoring station at Sears Creek Bridge, 2019.

The White River drainage has had minimal riparian harvest from the 1950's to the present on federally owned land. Turn of the century settlement and land clearing activities have impacted the riparian reserve network up to the Napeequa confluence, yet, riparian areas in the mainstem below Panther Creek remain in fair condition (USFS 2004). In the remainder of the watershed, woody debris recruitment, shade, aquatic habitat connectivity, and riparian vegetation appear to be in good condition. Current habitat concerns pertaining to the development of homes and vacation retreats on private lands do exist. Bank armoring (Rip-rap), channel constriction, and stream degradation are considered minor in the watershed. Public ownership comprises 78% of the drainage area; more than half of public land is located within the Glacier Peak Wilderness. The remaining 22% of the drainage is in private ownership (USFS 2004).

Downstream of White River Falls are key spawning grounds for spring Chinook salmon (tkwínat) *Oncorhynchus tshawytscha*, sockeye salmon (kálux) *O. nerka*, and bull trout *Salvelinus confluentus*. Two large tributaries to the White River, Napeequa River and Panther Creek, are also known to support populations of anadromous salmonids (Mullen et al. 1992). For a complete list of known fish species encountered in the White River see Section 3.4 (Incidental Species).

2.0 METHODS

2.1 Trapping Equipment and Operation

Throughout the duration of the trapping season, a 1.5m diameter cone rotary trap (Trap-A) was operated at a fixed position along the river-right bank. This trapping regime employed a single trap position across all flows since 2013. Additionally, a 2.4m diameter rotary trap (Trap B) was installed along the river-left bank to be operated concurrently with Trap-A. Trap-B was installed for the sole purpose of catching additional spring Chinook parr and smolts for tagging and efficiency trials used to build the flow-efficiency model of Trap-A. Both traps were suspended from a single 1/2” 6x37 IWRC galvanized (26,500 lb. breaking strength, 5,300 lb. working-load limit) wire-rope highline anchored to two large western red cedar (*Thuja plicata*) trees on opposing banks. Both traps were affixed to the highline with 13/32” nylon-coated wire rope (9,800 lb. breaking-strength/1,960 lb. working-load limit) and a heavy duty pulley. Each pulley could be moved laterally along the highline with a system of 7/32” nylon-coated wire rope (2,000 lb. breaking-strength/400 lb. working-load limit) positioning cables controlled by hand-powered winches on the river-left bank. For a detailed explanation of the use of Trap B, see the original pilot proposal in Appendix E.

Trap-A acted as the primary trap upon which the flow-efficiency relationship was based i.e., daily catch was integral to producing emigrant estimates. Because of this, we attempted to operate Trap-A 24 hours per day, 7 days per week at all flows. During spring runoff, operations only occurred during hours of darkness to minimize trap damage and fish mortality, while enabling collection during hours of peak migration. Trap-B was operated as channel depth and discharge level permitted. A record of daily trap operations is provided in Appendix B.

During all ranges of river discharge, fish were removed daily. Additional trap checks were necessary during periods of high discharge and/or debris accumulation. Debris in the live-box was removed continually by a rotating drum screen driven by the force of the rotating cone.

2.2 Biological Sampling

Trap operating procedures and techniques followed a standardized, basin-wide monitoring plan developed by the Upper Columbia Regional Technical Team (UCRTT) for the Upper Columbia Salmon Recovery Board (UCSRB; Hillman 2004), which was adapted from Murdoch & Petersen (2000).

Captured fish were transferred from the rotary trap’s live box using covered five-gallon plastic buckets to a stream-side portable sampling station. Fish were anesthetized in a solution of tricaine methanesulfonate (MS-222) to facilitate sampling and reduce handling stress. Fork length (FL) and weight were recorded for all fish, except large numbers of sockeye fry. For these fish, a daily subsample of 25 individuals was measured while the remaining fish were enumerated and released. Weight was measured to the nearest 0.1g with a portable digital scale while FL was recorded to the nearest 1.0 mm using a trough-type measuring board. These data were used to calculate a Fulton-type condition factor (K-factor) for each target species using the formula:

$$K = (W/L^3) \times 100{,}000$$

where K = Fulton-type condition metric;
W = weight in grams;
L = fork length in millimeters;
And 100,000 is a scaling constant.

Portable aerators were used to oxygenate holding water during sampling. All fish were allowed to fully recover from anesthesia before being released. Developmental stages (fry, parr, transitional or smolt) were visually identified and assigned to each individual sampled. Transitional juveniles were identified as having both parr and smolt characteristics; visible parr marks, semi-transparent fin coloration along with silvery coloration throughout body. Smolts were identified by a strong silvery coloration over entire body and faint or absent parr marks. Fry were defined as newly emerged fish with or without a visible yolk sac and a FL measuring < 50 mm. Age-0 spring Chinook salmon captured before July 1 were considered 'fry' and excluded from population estimates due to the inconclusive nature of their movement (i.e. active emigration or local distribution in-stream). Age-0 spring Chinook salmon captured after 1 July were considered subyearling emigrants and included in the population estimate (UCRTT, 2001).

Tissue samples (caudal clip) were taken from spring Chinook salmon and applied to blotter sheets. Samples were provided to WDFW for reproductive success analysis. Scale samples were also collected from all steelhead captured. Scale samples were submitted to WDFW for age analysis. Bull trout tissue or scale samples were not collected in 2019.

During periods when the trap operations were suspended (e.g. - high discharge, high debris and/or mechanical problems), passage estimates were generated to account for emigrants during these time periods. This estimate was calculated using the average number of fish captured three days prior and three days after the break in operation (Hillman et al., 2013; Snow et al., 2013).

2.3 Mark-Recapture Trials

Groups of marked spring Chinook salmon were used for trap efficiency trials. Fish were marked by insertion of a Passive Integrated Transponder (PIT) tag into the abdominal cavity. Ideally, marked groups of fish were released over a broad range of stream discharges in order to determine a trap efficiency-discharge relationship. (See **2.4 Data Analysis**). Mark-recapture (M-R) trials followed the protocol described in Hillman (2004). Although the protocol suggests a minimum sample size of 100 fish for each mark-group, limited abundance of juvenile emigrants from the White River required efficiency trials be completed with smaller sample sizes. YN's continued goal is to increase individual mark-group sizes, when possible, to meet the standard described above. Current minimum mark group size is 50 fish.

Number of wild fish included in a marked group was maximized by combining catches from three days of trapping. Fish were held up to 72 hours prior to release in holding boxes located on the river-left bank. Fish to be used in efficiency trials were then transported in five gallon buckets ~1.0 rkm upstream to the release location at Sears Creek Bridge (rkm 10.3). All mark groups are released by hand at nautical twilight.

Each M-R trial was conducted over a three-day (72 hour) period to allow time for passage or capture. Completed trials were only considered invalid if an interruption to trapping occurred or proper pre-release procedures were not followed. Trials resulting in zero recaptures were included in the efficiency regression as allowed by the new method of observed trap efficiency calculation (See equation 3 in **2.4.1 Estimate of Abundance**).

2.3.1 Marking and PIT tagging

All spring Chinook and summer steelhead juveniles with FL ≥ 60mm were PIT tagged unless the health of a specimen was in question. Once anesthetized, each fish was examined for external wounds or descaling and scanned for the presence of a previously implanted PIT tag. If a tag was not detected, a pre-loaded 12mm Digital Angel 134.2 kHz type TX 1411ST PIT tag was inserted into the body cavity using a Biomark MK-25 Rapid Implant Gun. Each unique tag code was electronically recorded with an appropriate tagging date, release date, tagging personnel and biological data. These data were entered into P**3** and submitted to the PIT Tag Information System (PTAGIS) at the end of each month. Tagging methods were consistent with methodology described in the PIT Tag Marking Procedures Manual (CBFWA 1999) as well as with 2008 ISEMP protocols (Tussing 2008).

Tagged fish were held for a minimum of 24-hours to a) ensure complete recovery, b) assess tagging mortality and c) determine tag-shed rate. Fish that were not to be used in an efficiency trial were released downstream of the smolt trap.

2.4 Data Analysis

2.4.1 Estimate of Abundance

Seasonal juvenile migration, N, was estimated as the sum of daily migrations, N_i, i.e., $N = \sum_i N_i$, and daily migration was calculated from catch and efficiency:

$$\hat{N}_i = \frac{C_i}{\hat{e}_i}, \tag{1}$$

where C_i = number of fish caught in period *I*;

$\hat{e}_i$ = trap efficiency estimated from the flow-efficiency relationship, $\sin^2\left(b_0 + b_1 flow_i\right)$,

where b_0 is estimated intercept and b_1 is the estimated slope of the regression.

The regression parameters b_0 and b_1 are estimated using linear regression for the model:

$$\arcsin\left(\sqrt{e_k^{obs}}\right) = \beta_0 + \beta_1\, flow_k + \varepsilon\,, \qquad \textbf{(2)}$$

where e_k^{obs} = observed trap efficiency of Eq. 2 for trapping period k;

β_0 = intercept of the regression model;

β_1 = slope parameter;

ε = error with mean 0 and variance σ^2.

In Equation 2, the observed trap efficiency, e_k^{obs}, is calculated as follows,

$$e_k^{obs} = \frac{r_k + 1}{m}. \qquad \textbf{(3)}$$

The estimated variance of seasonal migration is calculated from daily estimates as:

$$Var\left(\sum_{i=1}^{n} \widehat{N}_i\right) = \underbrace{\sum_i Var(N_i)}_{Part\ A} + \underbrace{\sum_i \sum_j Cov(N_i\,, N_j)}_{Part\ B}$$

or, **(4)**

$$Var\left(\sum_{i=1}^{n} \widehat{N}_i\right) = \underbrace{\sum_i Var\left(\frac{(C_i + 1)}{\hat{e}_i}\right)}_{Part\ A} + \underbrace{\sum_i \sum_j Cov\left(\frac{(C_i + 1)}{\hat{e}_i}, \frac{(C_j + 1)}{\hat{e}_j}\right)}_{Part\ B}$$

Part A of equation 4 is the variance of daily estimates. Part B is the between-day covariance. Note that the between-day covariance exists only for days that use the same trap efficiency model. If, for example, day 1 is estimated with one trap efficiency model, and day 2 estimated from a different model, then there is no covariance between day 1 and day 2. The full expression for the estimated variance:

$$\widehat{Var}\left(\sum_{i=1}^{n}\widehat{N}_i\right) = \underbrace{\sum_i \widehat{N}_i^2\left(\frac{N_i\hat{e}_i(1-\hat{e}_i)}{(C^i+1)^2} + \frac{4(1-\hat{e}_i)}{\hat{e}_i}\widehat{Var}(b_0+b_1flow_i)\right)}_{Part\ A}$$
$$+\underbrace{\sum_i\sum_j 4\left(\widehat{N}_i(1-\hat{e}_i)\right)\left(\widehat{N}_j(1-\hat{e}_j)\right)\cdot\left[\widehat{Var}(b_0)+flow_iflow_j\widehat{Var}(b_1)\right]}_{Part\ B}$$

where $V\hat{a}r(b_0+b_1 flow_i) = M\hat{S}E\left(1+\frac{1}{n}+\frac{\left(flow_i-\overline{flow}\right)^2}{(n-1)s_{flow}^2}\right)$, and $V\hat{a}r(b_0)$ and $V\hat{a}r(b_1)$ are

obtained from regression results. In Excel, the standard error (SE) of the coefficients is provided. The variance is calculated as the square of the standard error, SE^2.

In cases when there was no significant flow-efficiency relationship (i.e., low correlation), then a pooled, or average trap efficiency will suffice for the stratum. The estimator is calculated as follows:

$$\hat{\bar{e}} = \frac{\sum_{j=1}^{k} r_j}{\sum_{j=1}^{k} m_j}$$

where $\hat{\bar{e}}$ = the average or pooled trap efficiency for the stratum;

m_j = the number of smolts marked and released in efficiency trial *j* for the stratum;

r_j = the number of smolts recaptured out of m_j marked fish in efficiency trial *j*.

Abundance for a trapping period is estimated as:

$$\hat{N}_i^{pooled} = \frac{C_i}{\hat{\bar{e}}},$$

and total stratum abundance is:

$$N^{pooled} = \sum_i \hat{N}_i^{pooled}.$$

The variance of seasonal abundance takes into account the variability in catch numbers that are a result of binomial sampling (Part A), the pooled variance of trap efficiency, $\hat{\hat{e}}$ (Part B), and the covariance in daily estimates that arises from using a common estimate of efficiency across all trapping days (Part C):

$$Var\left(\sum_{i=1}^{n}\hat{N}_i^{pooled}\right)=\underbrace{\left(\sum_i\frac{\hat{N}_i(1-\hat{\hat{e}})}{\hat{\hat{e}}}\right)}_{Part\ A}+\underbrace{\frac{Var(\hat{\hat{e}})}{\hat{\hat{e}}^2}\sum_i\hat{N}_i^2}_{Part\ B}+\underbrace{\frac{Var(\hat{\hat{e}})}{\hat{\hat{e}}^2}\sum_i\sum_j\hat{N}_i\hat{N}_j}_{Part\ C}$$

The Part B and Part C terms are combined in the calculation as a new Part B:

$$Var\left(\sum_{i=1}^{n}\hat{N}_i^{pooled}\right)=\left(\sum_i\frac{\hat{N}_i(1-\hat{\hat{e}})}{\hat{\hat{e}}}\right)+\frac{Var(\hat{\hat{e}})}{\hat{\hat{e}}^2}\left[\sum_i\hat{N}_i^2+\sum_i\sum_j\hat{N}_i\hat{N}_j\right]$$

The variance of $\hat{\hat{e}}$ is calculated as:

$$V\hat{a}r\left(\hat{\hat{e}}\right)=V\hat{a}r\left(\frac{\sum_{k=1}^{n}r_k}{\sum_{k=1}^{n}m_k}\right)=\frac{\sum_{k=1}^{n}\left(r_k-\hat{\hat{e}}_k m_k\right)^2}{\overline{m}^2 n(n-1)}$$

where $\overline{m}$ is the average release size across all efficiency trial, $\frac{\sum_{k=1}^{n}m_k}{n}$.

Confidence intervals were calculated using the following formulas:

95% confidence interval = $1.96\times\sqrt{\sum \mathrm{var}\left[\hat{N}_i\right]}$

The single M-R estimator of abundance carries a set of well documented assumptions (Everhart and Youngs 1981; Seber 1982),

1. The population is closed to mortality.
2. The probability of capturing a marked or unmarked fish is equal.
3. Marked fish were randomly dispersed in the population prior to recapture.

4. Marking does not affect probabilities of capture.
5. Marks were not lost between the time of release and recapture.
6. All marks are reported upon recapture.
7. The number of fish in the trap, C, is fully enumerated and known without error.

3.0 RESULTS

3.1 Dates of Operation

Trap-A was operated between March 1 and November 27. During this period, it was run 24 hours per day, 7 days per week barring inoperable environmental conditions (i.e. heavy debris loads or high discharge). Trap-A was not operational for a total of 26 days (Table 1).

Table 1. Summary of Trap A operation, 2019.

Trap Status	Description	Days
Operating	Continuous data collection	246
Interrupted	Unexpected interruption by debris, etc.	8
Pulled	Intentionally pulled to protect the trap during high flows	18

Trap-B was operated between March 1 and November 27. During this period, it was operated 24 hours per day, 7 days per week barring inoperable environmental conditions (i.e. insufficient channel depth or high discharge). Trap-B was not operational for a total of 105 days (Table 2).

Table 2. Summary of Trap B operation, 2019.

Trap Status	Description	Days
Operating	Continuous data collection	167
Interrupted	Unexpected interruption by debris, etc.	7
Pulled	Intentionally pulled due to grounding, or to protect the trap during high flows	98

3.2 Daily Captures and Biological Sampling

3.2.1 Wild Spring Chinook Yearlings (BY 2017)

A total of 104 wild yearling Chinook smolts were collected at Trap A between March 1 and June 30 (Figure 4). Mean FL was 103 mm (*n* = 101; *SD* = 6.6) and mean weight was 12.0 g (*n* = 101; *SD* = 2.2; Table 2). A total of 95 spring Chinook smolts were implanted with PIT tags and had tissue samples taken. There were 9 BY2017 mortalities and 2 injured spring Chinook that did not receive PIT tags. An additional 11 yearling Chinook smolts were caught at Trap B (Figure 5) with a mean length of 100 mm (*n*=11; SD=7.0) and a mean weight of 11.3 g (*n* = 11; SD = 2.3). Additionally, 4 wild spring Chinook precocial parr were captured at Trap A following the smolt migration. Mean FL for precocial parr was 145 mm (*n* = 4; *SD* = 3.7) and mean weight was 32.6 g (*n* = 4; *SD* = 5.9).

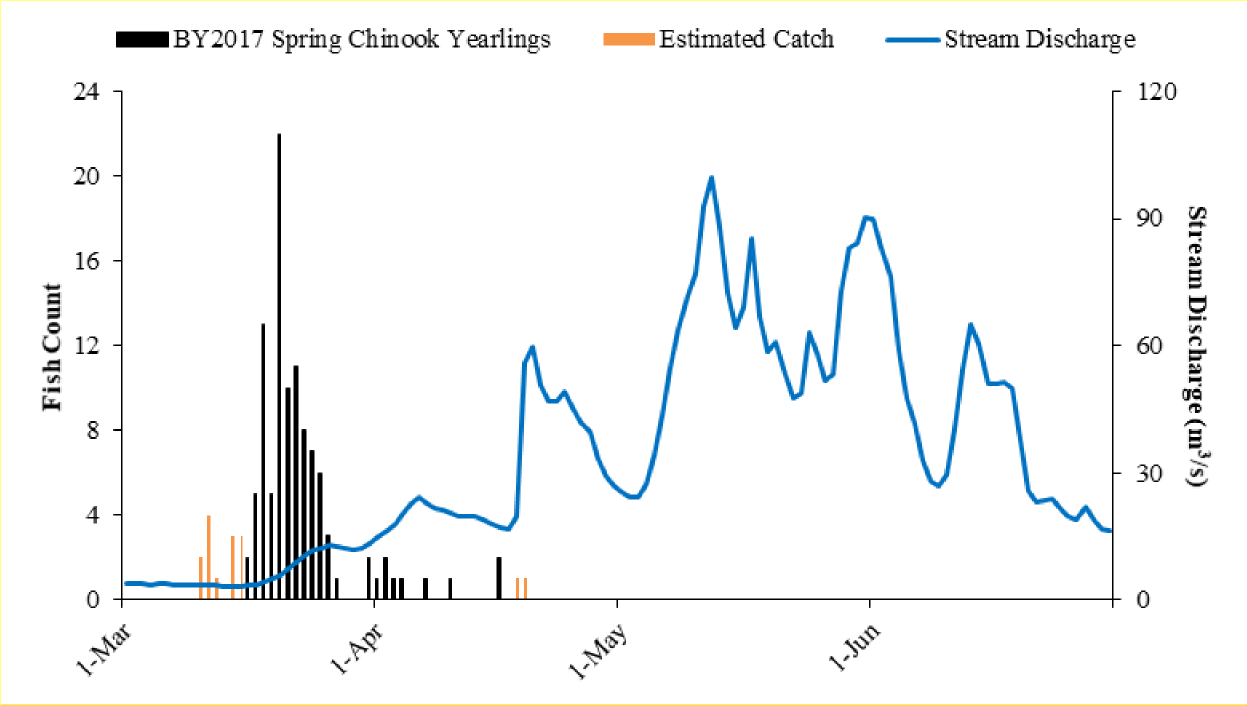


Figure 4. Daily catch of yearling spring Chinook smolt with mean daily stream discharge at the White River rotary Trap A, March 1 to June 30, 2019.

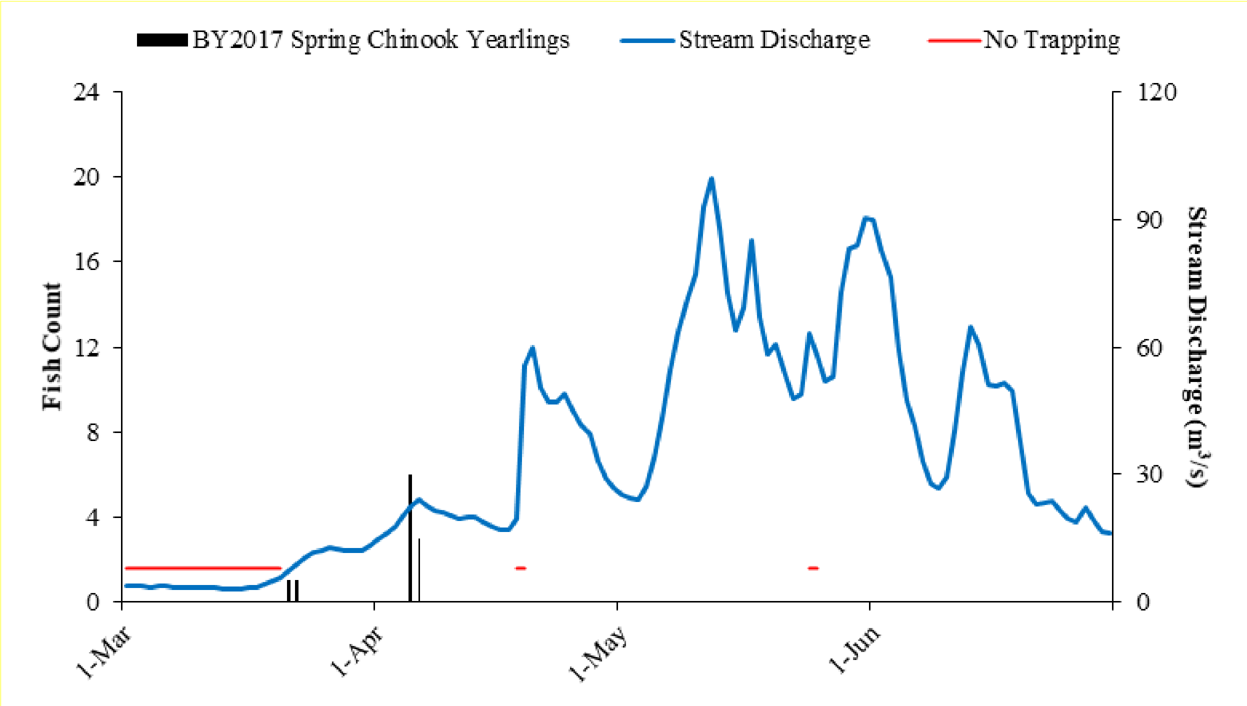


Figure 5. Daily catch of yearling spring Chinook smolt with mean daily stream discharge at the White River rotary Trap B, March 1 to June 30, 2019.

3.2.2 Wild Spring Chinook Subyearlings (BY2018)

Subyearling spring Chinook catch at Trap A included 12 fry (FL<50 mm) and 302 parr (FL≥50 mm) (Figure 6). Chinook fry captured at Trap A had a mean FL of 43 mm (*n* = 12; *SD* = 9.6) and a mean weight of 0.9 g (*n* = 12; *SD* = 0.7). Parr captured at Trap A had a mean FL of 86 mm (*n* = 301; *SD* = 9.4) and a mean weight of 7.4 g (*n* = 301; *SD* = 2.3). An additional 22 fry (no measurements taken) and 36 parr with a mean FL of 85 mm (*n* = 36; *SD* = 7.4) and a mean weight of 6.8 g (*n* = 36; *SD* = 1.6) were captured at Trap B (Figure 7). There were 6 BY2018 spring Chinook mortalities incurred throughout trap operations.

Table 3. Summary of length and weight sampling of juvenile spring Chinook captured at the White River rotary Trap A, 2019.

Brood Year	Origin/Species/Stage	Fork Length (mm)			Weight (g)			K-factor
		Mean	n	SD	Mean	n	SD	
2017	Wild Yearling Smolt	103	101	6.6	12.0	101	2.2	1.10
2017	Wild Precocial Parr	100	11	7.0	11.3	11	2.3	1.13
2018	Wild Subyearling Fry	43	12	9.6	0.9	12	0.7	0.96
2018	Wild Subyearling Parr	86	301	9.4	7.4	301	2.3	1.11

Table 4. Summary of length and weight sampling of juvenile spring Chinook captured at the White River rotary Trap B, 2019.

Brood Year	Origin/Species/Stage	Fork Length (mm)			Weight (g)			K-factor
		Mean	n	SD	Mean	n	SD	
2017	Wild Yearling Smolt	100	11	7.0	11.3	11	2.3	1.13
2017	Wild Precocial Parr	—	—	—	—	—	—	—
2018	Wild Subyearling Fry	—	—	—	—	—	—	—
2018	Wild Subyearling Parr	85	36	7.4	6.8	36	1.6	1.08

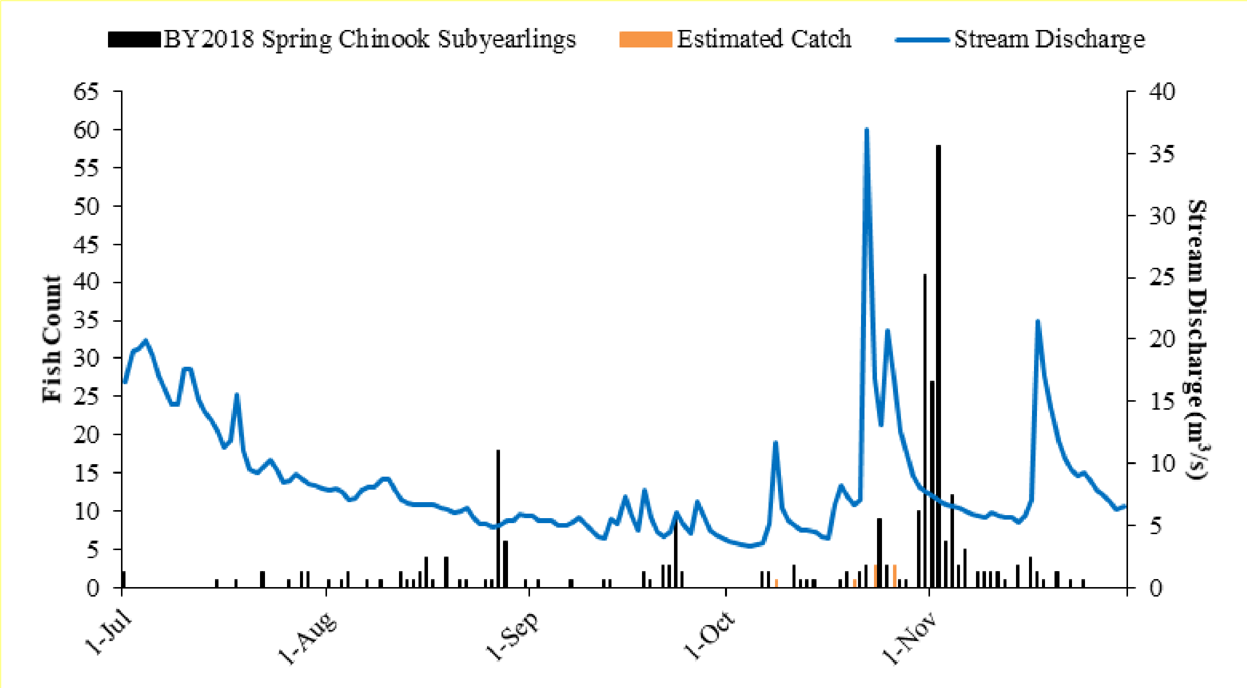


Figure 6. Trap A wild subyearling spring Chinook daily catch with mean daily stream discharge at the White River rotary trap, July 1 to November 27, 2019.

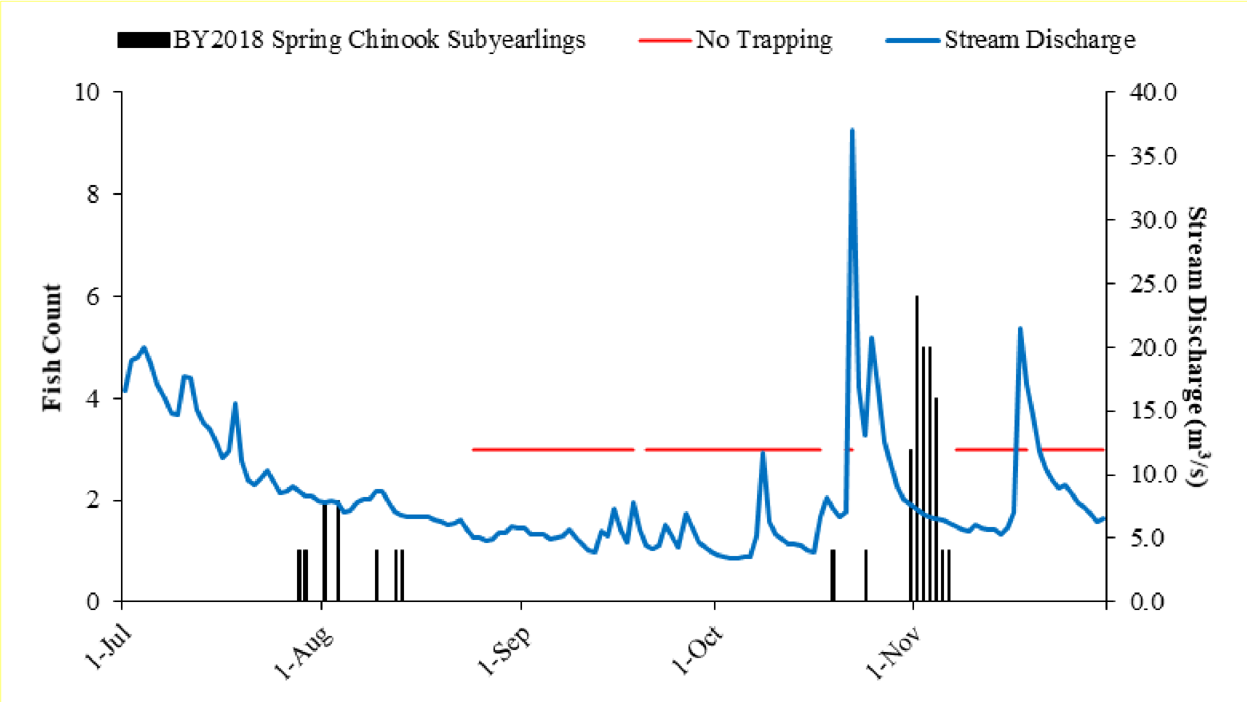


Figure 7. Trap B wild subyearling spring Chinook daily catch with mean daily stream discharge at the White River rotary trap, July 1 to November 27, 2019.

3.3 Trap Efficiency Calibration and Population Estimates

3.3.1 Wild Spring Chinook Yearlings (BY 2017)

Only one BY2017 efficiency trial was performed in 2019, however, it was not used in our flow-efficiency regression as the trap was stopped by a debris blockage during the trial. A composite regression model using previous years' (2008-2018) efficiency trials showed a statistically significant ($r^2 = 0.61$; $p = 0.0004$) flow-efficiency relationship, and was used to calculate yearling abundance. Use of a single spring trapping position allowed this regression to be applied to all yearling Chinook captured in 2019. Weighting of this regression via an R script (provided by WDFW) did not affect calculation parameters greatly and yielded the same r-square and *p*-values. In the fall of 2018, we estimated that 1,679 (± 537; 95% CI) BY2017 subyearlings emigrated past the trap. In the spring of 2019 we estimated that 3,401 (± 4,435; 95% CI) BY2017 yearlings emigrated past the trap. Combining the two estimates, total BY2017 wild spring Chinook emigrants was 5,079 (± 4,468; 95% CI; Table 5).

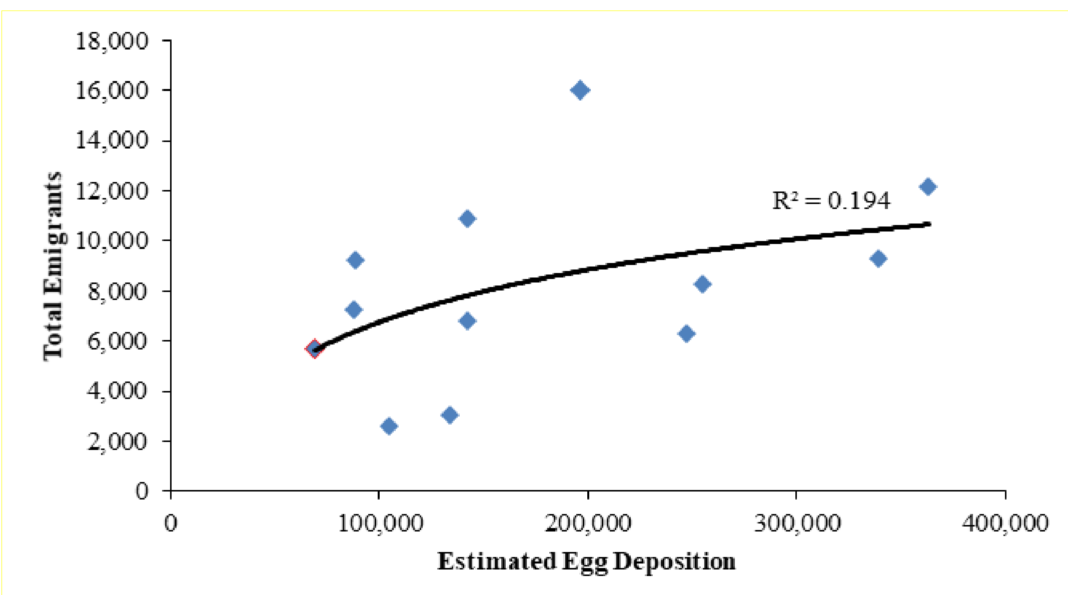
3.3.2 Wild Spring Chinook Subyearling (BY 2018)

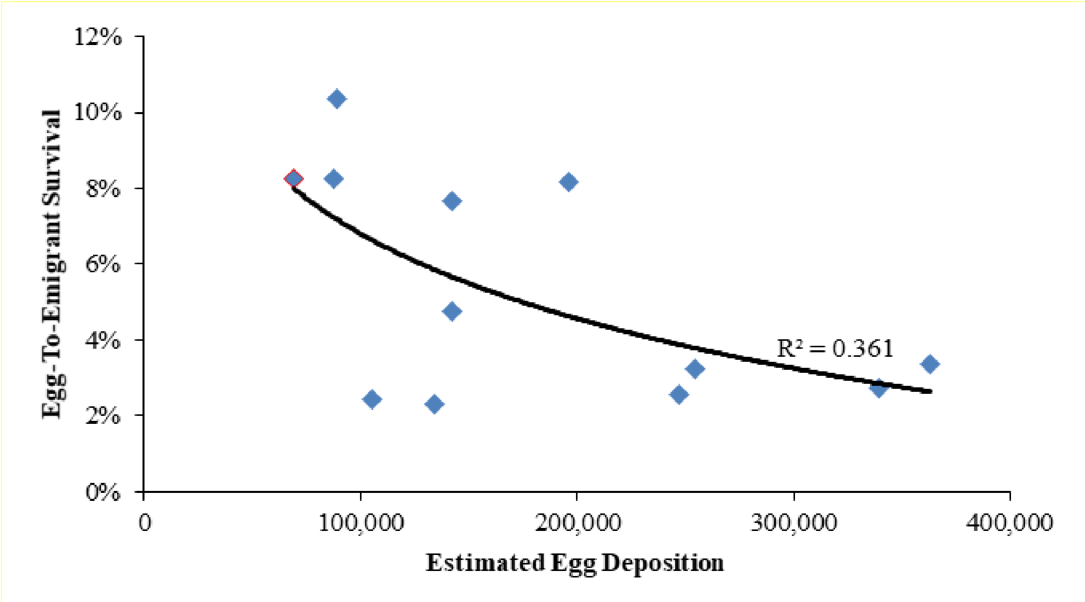
One BY2018 efficiency trial was performed in 2019, however, it was not used in our flow-efficiency regression as the trap was stopped by a debris blockage during the trial. Test releases used to initially measure the combined efficacy of the two traps in tandem (see section 3.6) did not contribute to the existing flow-efficiency model because of their small sizes and redundancies in flows tested. The existing composite regression model used data from 2009-2018 to build a flow-efficiency relationship. The weighted regression was not significant ($r^2 = 0.14$; $p = 0.074$) at our accepted limit ($\alpha = 0.05$). However, after comparison with a pooled method and considerations of the pooled estimate limitations, we decided to use the regression model despite its slightly higher *p*-value. This single regression was the only model required to estimate total subyearling migration due to the fact only one fall trapping position was used. We estimated that 3,541 (± 2,392; 95% CI) BY2018 spring Chinook subyearling parr moved past the trap in 2019 (Table 5).

Table 5. Estimated egg-to-emigrant survival and emigrants per redd for White River spring Chinook.

Brood Year	No. of Redds[a]	Fecundity[b]	No. of Eggs	No. of Emigrants			Egg-to Emigrant	Emigrants per Redd
				Age-0[c]	Age-1	Total ± 95% CI		
2005	86	4,327	372,122	DNOT[d]	4,856	—	—	—
2006	31	4,324	134,044	874	2,202	3,076 ± 2,543	2.3%	99
2007	20	4,441	88,820	2,710	6,493	9,203 ± 3,803	10.4%	460
2008	31	4,592	142,352	5,913	4,981	10,894 ± 3,919	7.7%	351
2009	54	4,573	246,942	2,819	3,476	6,295 ± 4,724	2.5%	117
2010	33	4,314	142,362	1,922	4,853	6,755 ± 3,880	4.8%	205
2011	20	4,385	87,700	4,197	3,027	7,244 ± 5,292	8.2%	361
2012	86	4,223	363,178	3,814	8,357	12,171 ± 11,616	3.4%	142
2013	54	4,716	254,664	2,457	5,787	8,244 ± 7,837	3.2%	153
2014	26	4,045	105,170	1,957	580	2,537 ± 1,944	2.4%	98
2015	70	4,847	339,290	2,436	6,848	9,284 ± 8,948	2.7%	133
2016	44	4,467	196,548	4,851	11,170	16,201 ± 13,779	8.2%	364
2017	15	4,615	69,225	1,679	3,401	5,709 ± 4,468	8.2%	381
2018	20	4,166	83,320	3,541	—	—	—	—
Avg	**42**	**4,431**	**187,553**	**3,013**	**5,219**	**8,119 ± 3,783**	**5.3%**	**239**

[a] Number of complete redds in White River (Hillman et al. 2019)
[b] Mean annual fecundity of spring Chinook broodstock at Chiwawa River Hatchery
[c] Estimate is based on capture of parr collected during summer/fall and does not include fry captured prior to July1
[d] Did not operate trap; no production estimates were made





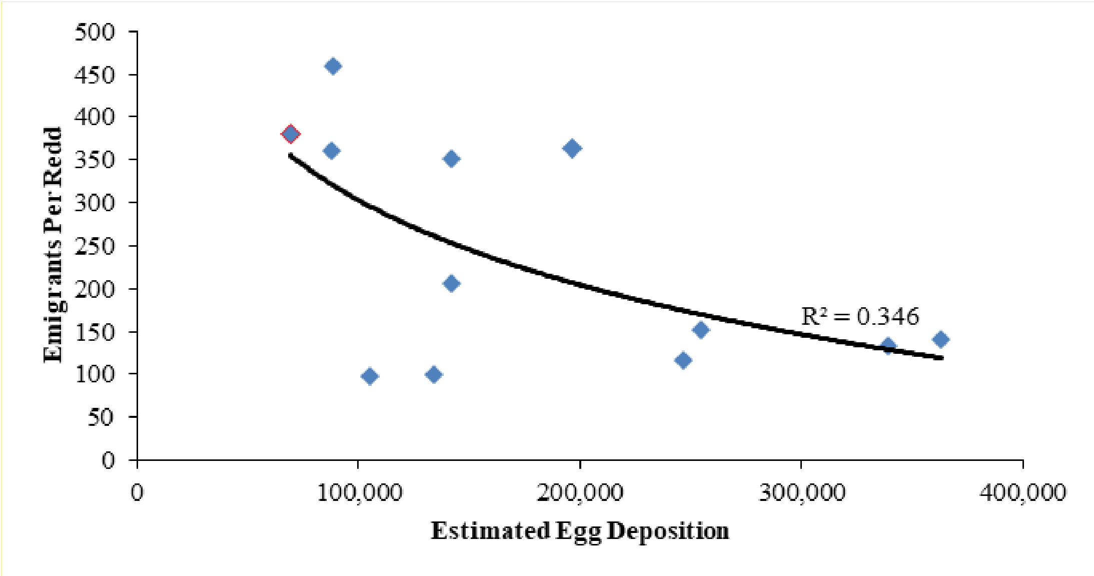


Figure 8. Relationships between estimated egg deposition and total emigrants produced, egg-to-emigrant survival, and emigrants per redd for White River spring Chinook, BY 2006 to 2017. *BY2017 values denoted by red border.

3.4 PIT Tagging

A total of 455 spring Chinook and 4 steelhead were PIT tagged (Table 5). The post-tagging observational hold time of a minimum of 24 hours yielded no shed tags. There were no tagging mortalities (Table 6).

Table 6. Number of PIT tagged spring Chinook and steelhead with shed rates at the White River rotary trap, 2019.

Brood Year	Species/Stage	Total Catch	Total PIT Tagged	Percent Tagged	Percent Tags Shed
2017	Spring Chinook Yearlings	119	103	86.6%	0.0%
2018	Spring Chinook Subyearlings	372	332	89.2%	0.0%
*	Summer Steelhead	4	4	100.0%	0.0%

* Brood year unknown

3.5 Incidental Species

Incidental species were enumerated and sampled for length and weight (Table 7). Incidental species included: bull trout, longnose dace *Rhinichthys cataractae*, mountain whitefish *Prosopium williamsoni*, northern pikeminnow *Ptychocheilus oregonensis*, steelhead/rainbow trout (shúshaynsh) *Oncorhynchus mykiss*, redside shiner *Richardsonius balteatus*, sculpin *Cottus sp.*, sockeye salmon, sucker *Catostomus sp.*, and westslope cutthroat *Oncorhynchus clarkii lewisi*.

Table 7. Summary of length and weight sampling of incidental species captured at the White River rotary trap, 2019.

Species	Total Count	Fork Length (mm)			Weight (g)		
		Mean	*n*	SD	Mean	*n*	SD
Bull Trout	30	89	24	115	8.0	21	23.6
Longnose Dace	17	62	7	30	7.4	4	5.6
Mountain Whitefish	262	61	187	28	4.0	154	7.8
Northern Pikeminnow	23	167	12	48	67.3	11	64.6
Rainbow Trout/Steelhead Parr	4	125	4	52	21.9	4	20.6
Redside Shiner	45	68	26	20	5.7	20	4.0
Sculpin	209	53	108	22	3.6	72	4.7
Sockeye Fry	1,679	28	398	1	—	—	—
Sockeye Parr	4	66	2	21	3.1	2	2.5
Sockeye (Kokanee)	2	224	2	20	119.8	2	21.5
Sucker	37	158	21	91	94.4	18	84.3
Westslope Cutthroat	12	199	10	14	85.5	9	46.4

3.6 ESA Compliance

A total of 15 spring Chinook mortalities were incurred in 2019, all due to trap stoppages (Table 8). The total lethal take exceed the maximum allowed 2% in 2019. All fish handled were inspected prior to tagging or further sampling for any sign of injury or stress warranting immediate release.

Table 8. Summary of White River ESA listed species catch and mortality, 2019.

Species/Stage	Total Catch	Total Mortality	Total % Mortality
Yearling Chinook Smolt	115	9	6.1%
Chinook Precocial Parr	4	0	0.0%
Subyearling Chinook Parr	338	6	1.8%
Subyearling Chinook Fry	34	0	0.0%
Total Wild Spring Chinook	**491**	**15**	**3.1%**
Bull Trout	30	0	0.0%
Steelhead/Rainbow Trout	4	0	0.0%

Maximum allowable incidental (handling) take for wild spring Chinook was 20% annually. To ensure that the addition of Trap B did not push us beyond this limit, multiple test efficiency trails were performed to gauge the combined efficiency of both traps. Although both trials met the minimum sample size (50) for inclusion in the flow-efficiency regression, debris stopped the trap during both trials, making them invalid. In total, the test yielded no trials resulting in a combined efficiency of over 20% (Table 9). Mean combined efficiency for the two trials was 2.7% at a mean discharge of 8.0 m^3/s (283 cfs). Although efficiencies would have been higher if the traps had not stopped during the trials, efficiencies would still likely have been well below the 20% threshold. Though test trials could only be performed at a relatively low range of discharges, based on existing flow-efficiency models we conclude that combined efficiency would also diminish at higher flows.

Table 9. Test combined efficiency trials, 2019.

Release Date	Discharge (m^3/s)	Marked	Recaptured			Combined Efficiency
			Trap A	Trap B	Total	
3/22/2019	9.1	50	0	0	0	0.0%
11/2/2019	6.9	132	7	0	7	5.3%

4.0 DISCUSSION

In contrast with 2018, the use of the second trap (Trap B) was relatively ineffective in catching juvenile spring Chinook for use in efficiency trials in 2019. Use of a second trap did not drastically increase the number of subyearling Chinook parr (302 caught in Trap A vs. 36 caught in Trap B), or the number of yearling Chinook smolts caught (104 caught in Trap A vs. 11 caught in Trap B). For the second time since 2012, our desired mark group size of ≥ 50 yearlings was reached during a 72-hour period. Unfortunately, the trap was stopped by debris during the trial, rendering it unusable for our regression-efficiency model. We will continue to conduct efficiency trials in the coming years, when sample sizes allow, to improve our estimation of Chinook emigrants.

The lowest on-recorded White River spawner success rate, observed in 2017, resulted in well below-average BY2017 emigrant estimates. However, egg-to-emigrant ratios and emigrants per redd for BY2017 were the highest on record. It is suspected that density-dependent effects cause an inverse relationship between in-stream survival and egg deposition (Figure 9). Low juvenile densities, combined with above-average rearing conditions are likely responsible for relatively high egg-to-emigrant survival of BY2017 Chinook. High in-stream survival as seen in the White River's population was mirrored in the nearby Nason Creek, where redd counts in 2017 were below average, but egg-to-emigrant ratios were high. BY2017 egg-to-emigrant estimates for the Chiwawa River were also above average. Age-class composition of BY2017 Chinook was typical with more than double the number of smolts leaving as yearlings than subyearlings.

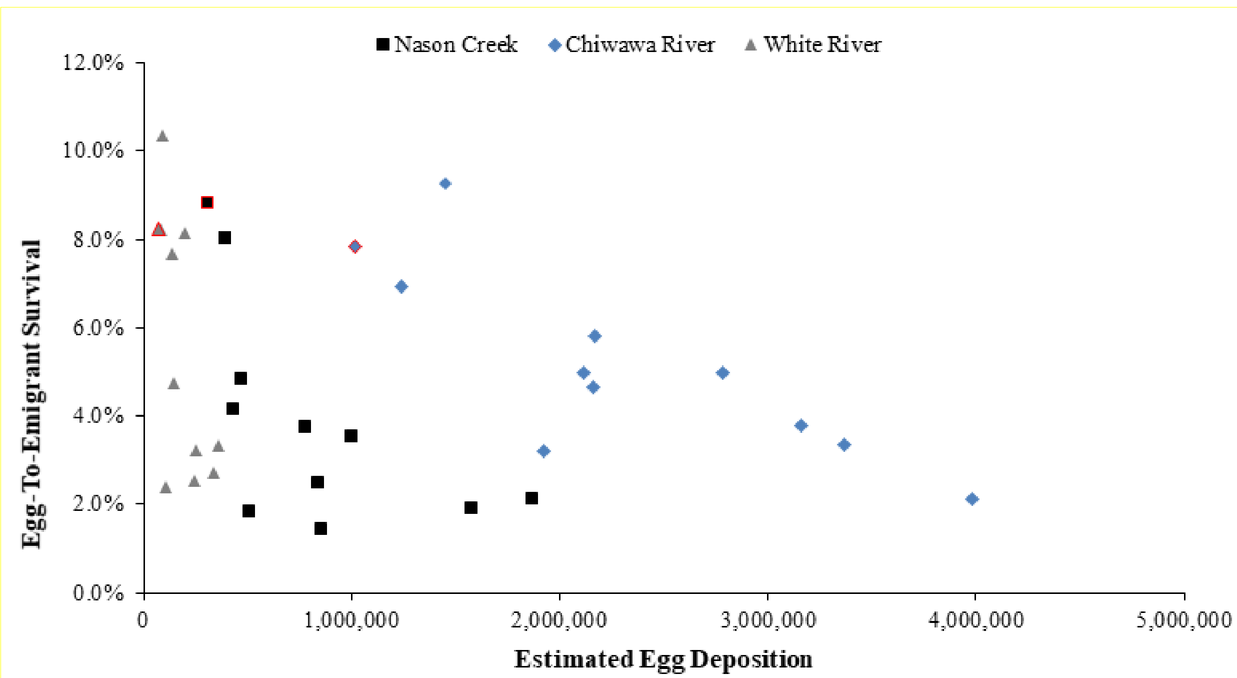


Figure 9. Comparisons of White R., Nason Cr., and Chiwawa River egg-to-emigrant survivals, BY2007-2017. *BY2017 denoted by red border.

BY2018 subyearling emigrant estimates were slightly above-average despite below-average egg deposition. Despite this, egg-to-emigrant ratio of BY2018 is already nearly average (4.5%), despite not having included forthcoming estimates for BY2018 yearlings. This indicates that in-stream survival for BY2018 Chinook was relatively high, likely due to lower densities of conspecifics. Additionally, relatively stable flows in late 2018 and early 2019 may have resulted in less redd scouring, and thus higher egg-to-emigrant ratios. Final conclusions about BY2018 Chinook will be made at the conclusion of the 2020 trapping season, when yearling estimates have been made.

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APPENDIX A: White River Temperature and Discharge Data

Date	Stream Discharge (m^3/s)	Water Temperature (˚C)
3/1/2019	3.9	1.4
3/2/2019	3.9	1.4
3/3/2019	3.8	1.5
3/4/2019	3.6	0.7
3/5/2019	3.7	0.6
3/6/2019	3.7	1.0
3/7/2019	3.5	1.6
3/8/2019	3.4	1.8
3/9/2019	3.4	2.2
3/10/2019	3.3	1.9
3/11/2019	3.3	1.9
3/12/2019	3.3	2.1
3/13/2019	3.2	2.8
3/14/2019	3.2	2.9
3/15/2019	3.2	3.9
3/16/2019	3.3	3.8
3/17/2019	3.4	4.0
3/18/2019	4.1	3.8
3/19/2019	4.8	3.5
3/20/2019	5.9	3.6
3/21/2019	7.5	3.4
3/22/2019	9.2	3.5
3/23/2019	10.5	4.0
3/24/2019	11.8	3.6
3/25/2019	12.0	3.8
3/26/2019	12.7	4.2
3/27/2019	12.6	3.6
3/28/2019	12.2	4.2
3/29/2019	11.9	4.1
3/30/2019	12.2	4.2
3/31/2019	13.1	4.2
4/1/2019	14.7	4.3
4/2/2019	16.2	4.2
4/3/2019	17.8	4.4
4/4/2019	20.5	4.5
4/5/2019	22.7	4.2
4/6/2019	24.1	3.6
4/7/2019	22.7	4.3
4/8/2019	21.6	4.2
4/9/2019	21.2	4.6
4/10/2019	20.5	4.3
4/11/2019	19.7	4.3
4/12/2019	19.9	5.0
4/13/2019	19.9	4.4
4/14/2019	18.8	4.5
4/15/2019	17.7	4.9
4/16/2019	16.9	4.5
4/17/2019	16.9	5.8
4/18/2019	19.8	5.3
4/19/2019	55.8	3.7
4/20/2019	59.8	4.2
4/21/2019	50.6	4.8
4/22/2019	47.0	4.5
4/23/2019	47.0	5.1
4/24/2019	49.1	5.1
4/25/2019	45.2	4.7
4/26/2019	41.8	5.5
4/27/2019	39.6	4.7
4/28/2019	33.1	4.3
4/29/2019	29.1	5.1
4/30/2019	26.7	5.1
5/1/2019	25.3	5.6
5/2/2019	24.4	5.9
5/3/2019	24.1	6.2
5/4/2019	27.1	6.3
5/5/2019	33.9	6.3
5/6/2019	43.3	6.2
5/7/2019	54.8	6.0
5/8/2019	63.7	5.8
5/9/2019	71.7	5.8
5/10/2019	77.1	5.9
5/11/2019	92.9	5.9
5/12/2019	99.6	6.0
5/13/2019	88.0	5.6
5/14/2019	72.5	5.4
5/15/2019	64.0	5.8
5/16/2019	69.3	5.8
5/17/2019	85.2	5.6
5/18/2019	67.0	5.9
5/19/2019	58.5	6.4

5/20/2019	60.6	5.8	7/4/2019	20.0	11.7
5/21/2019	53.3	5.7	7/5/2019	18.8	11.2
5/22/2019	47.7	5.9	7/6/2019	17.1	11.9
5/23/2019	48.8	6.8	7/7/2019	15.9	11.5
5/24/2019	63.2	6.2	7/8/2019	14.8	11.3
5/25/2019	58.1	5.7	7/9/2019	14.8	11.4
5/26/2019	51.9	5.8	7/10/2019	17.7	11.7
5/27/2019	53.1	7.1	7/11/2019	17.6	11.9
5/28/2019	73.0	7.4	7/12/2019	15.1	11.5
5/29/2019	83.0	7.1	7/13/2019	14.1	12.5
5/30/2019	84.1	7.1	7/14/2019	13.5	12.9
5/31/2019	90.2	7.6	7/15/2019	12.6	12.1
6/1/2019	89.8	7.8	7/16/2019	11.4	12.2
6/2/2019	82.9	8.0	7/17/2019	11.8	11.9
6/3/2019	76.4	7.9	7/18/2019	15.5	11.6
6/4/2019	59.0	7.1	7/19/2019	11.0	11.5
6/5/2019	47.6	7.1	7/20/2019	9.5	11.7
6/6/2019	41.5	7.1	7/21/2019	9.2	12.6
6/7/2019	33.0	6.8	7/22/2019	9.7	13.2
6/8/2019	28.1	7.6	7/23/2019	10.3	13.2
6/9/2019	26.9	7.9	7/24/2019	9.5	13.0
6/10/2019	29.3	9.0	7/25/2019	8.5	12.5
6/11/2019	40.5	9.6	7/26/2019	8.7	13.6
6/12/2019	54.3	9.7	7/27/2019	9.1	13.9
6/13/2019	64.8	9.9	7/28/2019	8.7	13.1
6/14/2019	60.6	9.5	7/29/2019	8.4	13.8
6/15/2019	51.2	9.5	7/30/2019	8.3	14.2
6/16/2019	50.9	10.1	7/31/2019	8.0	14.2
6/17/2019	51.5	10.2	8/1/2019	7.8	14.1
6/18/2019	49.9	10.4	8/2/2019	8.0	14.0
6/19/2019	37.8	8.5	8/3/2019	7.8	13.5
6/20/2019	25.6	7.9	8/4/2019	7.1	13.9
6/21/2019	23.0	9.1	8/5/2019	7.2	14.4
6/22/2019	23.4	10.1	8/6/2019	7.8	15.0
6/23/2019	23.7	9.7	8/7/2019	8.1	15.1
6/24/2019	21.4	9.8	8/8/2019	8.1	14.9
6/25/2019	19.8	9.0	8/9/2019	8.7	14.0
6/26/2019	19.1	9.3	8/10/2019	8.7	13.7
6/27/2019	22.1	8.9	8/11/2019	7.8	13.7
6/28/2019	19.1	8.7	8/12/2019	7.1	13.6
6/29/2019	16.6	9.3	8/13/2019	6.9	13.7
6/30/2019	16.2	9.9	8/14/2019	6.7	14.1
7/1/2019	16.6	10.7	8/15/2019	6.7	14.6
7/2/2019	19.0	11.0	8/16/2019	6.7	14.1
7/3/2019	19.3	11.0	8/17/2019	6.7	13.9

8/18/2019	6.4	13.9	10/2/2019	3.5	7.4
8/19/2019	6.3	14.0	10/3/2019	3.4	8.1
8/20/2019	6.0	13.7	10/4/2019	3.4	8.2
8/21/2019	6.2	13.2	10/5/2019	3.5	8.1
8/22/2019	6.5	13.1	10/6/2019	3.5	7.6
8/23/2019	5.7	12.8	10/7/2019	5.2	7.8
8/24/2019	5.1	12.9	10/8/2019	11.6	7.3
8/25/2019	5.1	13.3	10/9/2019	6.4	5.2
8/26/2019	4.8	12.6	10/10/2019	5.4	4.3
8/27/2019	4.9	13.0	10/11/2019	5.0	4.2
8/28/2019	5.4	13.4	10/12/2019	4.6	4.2
8/29/2019	5.4	13.5	10/13/2019	4.6	5.7
8/30/2019	5.9	14.4	10/14/2019	4.4	6.1
8/31/2019	5.8	14.1	10/15/2019	4.1	5.6
9/1/2019	5.8	13.8	10/16/2019	4.0	6.2
9/2/2019	5.3	13.3	10/17/2019	6.6	6.8
9/3/2019	5.3	13.3	10/18/2019	8.2	6.2
9/4/2019	5.4	13.4	10/19/2019	7.3	5.8
9/5/2019	5.0	12.9	10/20/2019	6.6	5.4
9/6/2019	5.0	13.2	10/21/2019	7.1	5.3
9/7/2019	5.2	13.7	10/22/2019	36.9	5.5
9/8/2019	5.6	13.5	10/23/2019	16.9	4.8
9/9/2019	5.1	12.4	10/24/2019	13.1	5.2
9/10/2019	4.6	11.9	10/25/2019	20.7	6.8
9/11/2019	4.1	11.7	10/26/2019	16.9	4.9
9/12/2019	3.9	12.1	10/27/2019	12.5	3.3
9/13/2019	5.5	12.2	10/28/2019	10.8	3.1
9/14/2019	5.2	11.3	10/29/2019	9.0	2.3
9/15/2019	7.3	10.8	10/30/2019	8.0	1.3
9/16/2019	5.7	10.4	10/31/2019	7.7	1.6
9/17/2019	4.6	9.8	11/1/2019	7.3	1.9
9/18/2019	7.9	9.8	11/2/2019	6.9	2.3
9/19/2019	5.7	10.5	11/3/2019	6.7	2.8
9/20/2019	4.5	10.9	11/4/2019	6.6	3.4
9/21/2019	4.2	10.7	11/5/2019	6.4	3.5
9/22/2019	4.4	10.4	11/6/2019	6.2	3.2
9/23/2019	6.0	10.3	11/7/2019	5.9	2.9
9/24/2019	5.2	10.6	11/8/2019	5.7	3.0
9/25/2019	4.3	10.6	11/9/2019	5.6	3.4
9/26/2019	6.9	11.1	11/10/2019	6.1	4.6
9/27/2019	5.8	9.4	11/11/2019	5.8	4.4
9/28/2019	4.7	7.8	11/12/2019	5.7	4.3
9/29/2019	4.3	7.4	11/13/2019	5.7	4.6
9/30/2019	3.9	6.9	11/14/2019	5.3	4.5
10/1/2019	3.7	7.0	11/15/2019	5.8	4.5

11/16/2019	7.1	4.2	11/24/2019	9.2	3.6
11/17/2019	21.5	5.0	11/25/2019	8.5	3.3
11/18/2019	17.0	4.8	11/26/2019	7.8	2.2
11/19/2019	14.6	4.6	11/27/2019	7.4	1.8
11/20/2019	11.8	3.3	11/28/2019	6.9	1.1
11/21/2019	10.4	2.1	11/29/2019	6.3	0.2
11/22/2019	9.5	1.4	11/30/2019	6.5	0.0
11/23/2019	9.0	2.2			

APPENDIX B: Daily Trap Operation Status

Date	Trap A Status	Trap B Status	Comments
3/1/2019	Pulled	Pulled	Low flow
3/2/2019	Pulled	Pulled	Low flow
3/3/2019	Pulled	Pulled	Low flow
3/4/2019	Pulled	Pulled	Low flow
3/5/2019	Pulled	Pulled	Low flow
3/6/2019	Pulled	Pulled	Low flow
3/7/2019	Pulled	Pulled	Low flow
3/8/2019	Pulled	Pulled	Low flow
3/9/2019	Pulled	Pulled	Low flow
3/10/2019	Pulled	Pulled	Low flow
3/11/2019	Pulled	Pulled	Low flow
3/12/2019	Pulled	Pulled	Low flow
3/13/2019	Pulled	Pulled	Low flow
3/14/2019	Pulled	Pulled	Low flow
3/15/2019	Pulled	Pulled	Started for season
3/16/2019	Op.	Pulled	
3/17/2019	Op.	Pulled	
3/18/2019	Op.	Pulled	
3/19/2019	Op.	Pulled	
3/20/2019	Op.	Pulled	
3/21/2019	Op.	Op.	
3/22/2019	Stopped	Op.	Debris
3/23/2019	Op.	Op.	
3/24/2019	Op.	Op.	
3/25/2019	Stopped	Op.	Equip. malfunction
3/26/2019	Op.	Op.	
3/27/2019	Op.	Op.	
3/28/2019	Op.	Op.	
3/29/2019	Op.	Op.	
3/30/2019	Op.	Op.	
3/31/2019	Op.	Op.	
4/1/2019	Stopped	Op.	Debris
4/2/2019	Op.	Op.	
4/3/2019	Op.	Op.	
4/4/2019	Op.	Op.	
4/5/2019	Stopped	Op.	Debris
4/6/2019	Op.	Op.	
4/7/2019	Op.	Op.	
4/8/2019	Op.	Op.	
4/9/2019	Op.	Op.	
4/10/2019	Op.	Op.	
4/11/2019	Op.	Op.	
4/12/2019	Op.	Op.	
4/13/2019	Op.	Op.	
4/14/2019	Op.	Op.	
4/15/2019	Op.	Op.	
4/16/2019	Op.	Op.	
4/17/2019	Op.	Op.	
4/18/2019	Pulled	Pulled	Pulled
4/19/2019	Pulled	Pulled	Pulled
4/20/2019	Op.	Op.	
4/21/2019	Op.	Op.	
4/22/2019	Op.	Stopped	Debris
4/23/2019	Op.	Op.	
4/24/2019	Op.	Op.	
4/25/2019	Op.	Op.	
4/26/2019	Op.	Op.	
4/27/2019	Op.	Op.	
4/28/2019	Op.	Op.	
4/29/2019	Op.	Op.	
4/30/2019	Op.	Op.	
5/1/2019	Op.	Op.	
5/2/2019	Op.	Op.	
5/3/2019	Op.	Op.	
5/4/2019	Op.	Op.	
5/5/2019	Op.	Op.	
5/6/2019	Op.	Op.	
5/7/2019	Op.	Op.	
5/8/2019	Op.	Op.	
5/9/2019	Op.	Op.	
5/10/2019	Op.	Op.	
5/11/2019	Op.	Op.	
5/12/2019	Op.	Op.	
5/13/2019	Op.	Op.	
5/14/2019	Op.	Op.	
5/15/2019	Op.	Stopped	Debris
5/16/2019	Op.	Op.	
5/17/2019	Op.	Op.	
5/18/2019	Op.	Op.	
5/19/2019	Op.	Op.	
5/20/2019	Op.	Op.	
5/21/2019	Op.	Op.	
5/22/2019	Op.	Op.	
5/23/2019	Op.	Op.	

5/24/2019	Op.	Stopped	Debris	7/8/2019	Op.	Op.
5/25/2019	Op.	Stopped	Debris	7/9/2019	Op.	Op.
5/26/2019	Op.	Op.		7/10/2019	Op.	Op.
5/27/2019	Op.	Op.		7/11/2019	Op.	Op.
5/28/2019	Op.	Op.		7/12/2019	Op.	Op.
5/29/2019	Op.	Stopped	Debris	7/13/2019	Op.	Op.
5/30/2019	Op.	Op.		7/14/2019	Op.	Op.
5/31/2019	Op.	Op.		7/15/2019	Op.	Op.
6/1/2019	Op.	Op.		7/16/2019	Op.	Op.
6/2/2019	Op.	Op.		7/17/2019	Op.	Op.
6/3/2019	Op.	Op.		7/18/2019	Op.	Op.
6/4/2019	Op.	Op.		7/19/2019	Op.	Op.
6/5/2019	Op.	Op.		7/20/2019	Op.	Op.
6/6/2019	Op.	Op.		7/21/2019	Op.	Op.
6/7/2019	Op.	Op.		7/22/2019	Op.	Op.
6/8/2019	Op.	Op.		7/23/2019	Op.	Op.
6/9/2019	Op.	Op.		7/24/2019	Op.	Op.
6/10/2019	Op.	Op.		7/25/2019	Op.	Op.
6/11/2019	Op.	Op.		7/26/2019	Op.	Op.
6/12/2019	Op.	Op.		7/27/2019	Op.	Op.
6/13/2019	Op.	Op.		7/28/2019	Op.	Op.
6/14/2019	Op.	Op.		7/29/2019	Op.	Op.
6/15/2019	Op.	Op.		7/30/2019	Op.	Op.
6/16/2019	Op.	Op.		7/31/2019	Op.	Op.
6/17/2019	Op.	Op.		8/1/2019	Op.	Op.
6/18/2019	Op.	Stopped	Debris	8/2/2019	Op.	Op.
6/19/2019	Op.	Op.		8/3/2019	Op.	Op.
6/20/2019	Op.	Op.		8/4/2019	Op.	Op.
6/21/2019	Op.	Op.		8/5/2019	Op.	Op.
6/22/2019	Op.	Op.		8/6/2019	Op.	Op.
6/23/2019	Op.	Op.		8/7/2019	Op.	Op.
6/24/2019	Op.	Op.		8/8/2019	Op.	Op.
6/25/2019	Op.	Op.		8/9/2019	Op.	Op.
6/26/2019	Op.	Op.		8/10/2019	Op.	Op.
6/27/2019	Op.	Op.		8/11/2019	Op.	Op.
6/28/2019	Op.	Op.		8/12/2019	Op.	Op.
6/29/2019	Op.	Op.		8/13/2019	Op.	Op.
6/30/2019	Op.	Op.		8/14/2019	Op.	Op.
7/1/2019	Op.	Op.		8/15/2019	Op.	Op.
7/2/2019	Op.	Op.		8/16/2019	Op.	Op.
7/3/2019	Op.	Op.		8/17/2019	Op.	Op.
7/4/2019	Op.	Op.		8/18/2019	Op.	Op.
7/5/2019	Op.	Op.		8/19/2019	Op.	Op.
7/6/2019	Op.	Op.		8/20/2019	Op.	Op.
7/7/2019	Op.	Op.		8/21/2019	Op.	Op.

8/22/2019	Op.	Op.		10/6/2019	Op.	Pulled	Low flow
8/23/2019	Op.	Op.		10/7/2019	Op.	Pulled	Low flow
8/24/2019	Op.	Pulled	Low flow	10/8/2019	Stopped	Pulled	Debris/Low flow
8/25/2019	Op.	Pulled	Low flow	10/9/2019	Op.	Pulled	Low flow
8/26/2019	Op.	Pulled	Low flow	10/10/2019	Op.	Pulled	Low flow
8/27/2019	Op.	Pulled	Low flow	10/11/2019	Op.	Pulled	Low flow
8/28/2019	Op.	Pulled	Low flow	10/12/2019	Op.	Pulled	Low flow
8/29/2019	Op.	Pulled	Low flow	10/13/2019	Op.	Pulled	Low flow
8/30/2019	Op.	Pulled	Low flow	10/14/2019	Op.	Pulled	Low flow
8/31/2019	Op.	Pulled	Low flow	10/15/2019	Op.	Pulled	Low flow
9/1/2019	Op.	Pulled	Low flow	10/16/2019	Op.	Pulled	Low flow
9/2/2019	Op.	Pulled	Low flow	10/17/2019	Op.	Pulled	Low flow
9/3/2019	Op.	Pulled	Low flow	10/18/2019	Op.	Op.	
9/4/2019	Op.	Pulled	Low flow	10/19/2019	Op.	Op.	
9/5/2019	Op.	Pulled	Low flow	10/20/2019	Stopped	Op.	Debris
9/6/2019	Op.	Pulled	Low flow	10/21/2019	Op.	Pulled	Low flow
9/7/2019	Op.	Pulled	Low flow	10/22/2019	Op.	Pulled	Low flow
9/8/2019	Op.	Pulled	Low flow	10/23/2019	Stopped	Op.	Debris
9/9/2019	Op.	Pulled	Low flow	10/24/2019	Op.	Op.	
9/10/2019	Op.	Pulled	Low flow	10/25/2019	Op.	Op.	
9/11/2019	Op.	Pulled	Low flow	10/26/2019	Stopped	Stopped	Debris
9/12/2019	Op.	Pulled	Low flow	10/27/2019	Op.	Op.	
9/13/2019	Op.	Pulled	Low flow	10/28/2019	Op.	Op.	
9/14/2019	Op.	Pulled	Low flow	10/29/2019	Op.	Op.	
9/15/2019	Op.	Pulled	Low flow	10/30/2019	Op.	Op.	
9/16/2019	Op.	Pulled	Low flow	10/31/2019	Op.	Op.	
9/17/2019	Op.	Pulled	Low flow	11/1/2019	Op.	Op.	
9/18/2019	Op.	Pulled	Low flow	11/2/2019	Op.	Op.	
9/19/2019	Op.	Op.		11/3/2019	Op.	Op.	
9/20/2019	Op.	Pulled	Low flow	11/4/2019	Op.	Op.	
9/21/2019	Op.	Pulled	Low flow	11/5/2019	Op.	Op.	
9/22/2019	Op.	Pulled	Low flow	11/6/2019	Op.	Op.	
9/23/2019	Op.	Pulled	Low flow	11/7/2019	Op.	Pulled	Low flow
9/24/2019	Op.	Pulled	Low flow	11/8/2019	Op.	Pulled	Low flow
9/25/2019	Op.	Pulled	Low flow	11/9/2019	Op.	Pulled	Low flow
9/26/2019	Op.	Pulled	Low flow	11/10/2019	Op.	Pulled	Low flow
9/27/2019	Op.	Pulled	Low flow	11/11/2019	Op.	Pulled	Low flow
9/28/2019	Op.	Pulled	Low flow	11/12/2019	Op.	Pulled	Low flow
9/29/2019	Op.	Pulled	Low flow	11/13/2019	Op.	Pulled	Low flow
9/30/2019	Op.	Pulled	Low flow	11/14/2019	Op.	Pulled	Low flow
10/1/2019	Op.	Pulled	Low flow	11/15/2019	Op.	Pulled	Low flow
10/2/2019	Op.	Pulled	Low flow	11/16/2019	Op.	Pulled	Low flow
10/3/2019	Op.	Pulled	Low flow	11/17/2019	Op.	Pulled	Low flow
10/4/2019	Op.	Pulled	Low flow	11/18/2019	Op.	Pulled	Low flow
10/5/2019	Op.	Pulled	Low flow	11/19/2019	Op.	Op.	

11/20/2019	Op.	Pulled	Low flow
11/21/2019	Op.	Pulled	Low flow
11/22/2019	Op.	Pulled	Low flow
11/23/2019	Op.	Pulled	Low flow
11/24/2019	Op.	Pulled	Low flow
11/25/2019	Op.	Pulled	Low flow
11/26/2019	Op.	Pulled	Low flow
11/27/2019	Pulled	Pulled	Low flow
11/28/2019	Pulled	Pulled	
11/29/2019	Pulled	Pulled	
11/30/2019	Pulled	Pulled	

APPENDIX C: Regression Models

Model: Chinook Yearlings (Spring ’08-’15) Back Position, (r^2=0.609; p = 0.0004)

Origin/Species/Stage	Date	Marked	Recaptured	Trap Efficiency	ASIN Transform	Discharge (m^3/s)
Wild Chinook Yearlings	4/10/2008	25	2	0.120	0.354	6
Wild Chinook Yearlings	3/26/2009	24	5	0.250	0.524	5
Wild Chinook Yearlings	3/30/2009	34	4	0.147	0.394	5
Wild Chinook Yearlings	4/2/2009	37	10	0.297	0.577	6
Wild Chinook Yearlings	4/5/2009	59	15	0.271	0.548	6
Wild Chinook Yearlings	4/10/2009	36	3	0.111	0.34	11
Wild Chinook Yearlings	3/12/2010	25	1	0.080	0.287	8
Wild Chinook Yearlings	3/16/2010	30	5	0.200	0.464	8
Wild Chinook Yearlings	3/20/2010	21	1	0.095	0.314	8
Wild Chinook Yearlings	4/5/2010	37	1	0.054	0.235	10
Wild Chinook Yearlings	4/9/2010	31	4	0.161	0.413	9
Wild Chinook Yearlings	4/12/2010	58	4	0.086	0.298	8
Wild Chinook Yearlings	4/16/2010	73	2	0.041	0.204	11
Wild Chinook Yearlings	4/14/2012	48	1	0.042	0.206	15
Wild Chinook Yearlings	4/9/2018	50	0	0.020	0.142	20

Model: Chinook Subyearlings (Fall ’09-’15) Back Position, (r^2=0.143; p = 0.074)

Origin/Species/Stage	Date	Marked	Recaptured	Trap Efficiency	ASIN Transform	Discharge (m^3/s)
Wild Chinook Subyearlings	8/20/2009	20	2	15.00%	0.398	9
Wild Chinook Subyearlings	8/29/2009	34	4	14.71%	0.394	7
Wild Chinook Subyearlings	10/7/2009	22	2	13.64%	0.378	3
Wild Chinook Subyearlings	10/16/2009	34	6	20.59%	0.471	4
Wild Chinook Subyearlings	11/17/2009	35	3	11.43%	0.345	11
Wild Chinook Subyearlings	11/23/2009	21	0	4.76%	0.22	9
Wild Chinook Subyearlings	11/21/2011	39	2	7.69%	0.281	5
Wild Chinook Subyearlings	10/4/2012	33	5	18.18%	0.441	4
Wild Chinook Subyearlings	10/24/2012	87	6	8.05%	0.288	8
Wild Chinook Subyearlings	10/28/2012	36	1	5.56%	0.238	21
Wild Chinook Subyearlings	10/31/2013	46	7	17.39%	0.43	8
Wild Chinook Subyearlings	11/6/2013	38	9	26.32%	0.539	7
Wild Chinook Subyearlings	11/9/2013	40	6	17.50%	0.432	7
Wild Chinook Subyearlings	11/13/2013	29	2	10.34%	0.327	12
Wild Chinook Subyearlings	11/23/2013	25	3	16.00%	0.412	12
Wild Chinook Subyearlings	11/27/2013	24	0	4.17%	0.206	10
Wild Chinook Subyearlings	9/17/2015	39	4	12.82%	0.366	3

Appendix D. Historical Morphometric Data

Spring Chinook (Trap A 2007-2018)

Trap Year	Brood Year	Origin/Species/Stage	Fork Length (mm)			Weight (g)			K-factor
			Mean	n	SD	Mean	n	SD	
2007	2005	Wild Yearling Smolt	93	173	8.5	8.6	173	2.2	1.1
2007	2005	Wild Yearling Precocial Parr	123	4	7.2	22.2	4	5.8	1.2
2007	2005	Hatchery Yearling Smolt*	76	208	17.9	5.4	203	4.2	1.2
2007	2005	Hatchery Yearling Precocial Parr	98	20	8.7	11.1	19	2.2	1.2
2007	2006	Wild Subyearling Fry	35	7	1.6	—	—	—	—
2007	2006	Wild Subyearling Parr	95	33	12.4	9.8	33	4.1	1.1
2008	2006	Wild Yearling Smolt	100	105	12.3	12.5	105	13.5	1.2
2008	2006	Wild Yearling Precocial Parr	126	9	8.4	22.8	9	4.1	1.1
2008	2006	Hatchery Yearling Smolt	117	229	12.7	18.7	228	9.8	1.2
2008	2006	Hatchery Yearling Precocial Parr	155	2	15.6	47.6	2	12.6	1.3
2008	2007	Wild Subyearling Fry	41	10	4.4	—	—	—	—
2008	2007	Wild Subyearling Parr	95	202	9.1	9.4	202	2.5	1.1
2009	2007	Wild Yearling Smolt	104	275	6.4	12.5	274	2.6	1.1
2009	2007	Wild Yearling Precocial Parr	134	5	7.0	28.5	2	2.7	1.2
2009	2007	Hatchery Yearling Precocial Parr	188	2	17.7	81.9	2	27.1	1.2
2009	2008	Wild Subyearling Fry	38	13	2.1	—	—	—	—
2009	2008	Wild Subyearling Parr	85	507	11.8	7.2	499	2.7	1.2
2010	2008	Wild Yearling Smolt	96	345	7.1	11.2	345	2.4	1.3
2010	2008	Wild Yearling Precocial Parr	130	15	10.3	26.4	15	6.6	1.2
2010	2009	Wild Subyearling Fry	40	31	3.6	—	—	—	—
2010	2009	Wild Subyearling Parr	87	166	12.6	7.7	166	3.0	1.2
2011	2009	Wild Yearling Smolt	99	64	7.7	11.3	64	2.8	1.2
2011	2009	Wild Yearling Precocial Parr	137	1	—	32.3	1	—	1.3
2011	2009	Hatchery Yearling Smolt	127	46	10.6	24.3	46	6.5	1.2
2011	2010	Wild Subyearling Fry	37	26	2.5	—	—	—	—
2011	2010	Wild Subyearling Parr	91	159	13.0	9.2	159	7.1	1.2
2012	2010	Wild Yearling Smolt	98	182	7.9	10.9	179	2.8	1.2
2012	2010	Wild Yearling Precocial Parr	123	13	12.7	22.4	13	6.5	1.2
2012	2011	Hatchery Subyearling Fry	84	29	4.4	6.5	2	2.3	1.1
2012	2011	Hatchery Subyearling Parr	110	25	7.4	14.6	25	3.3	1.1
2012	2011	Wild Subyearling Fry	35	18	2.7	—	—	—	—
2012	2011	Wild Subyearling Parr	91	315	10.1	8.8	288	2.8	1.2
2013	2011	Wild Yearling Smolt	103	20	7.0	12.3	20	3.0	1.1
2013	2011	Wild Yearling Precocial Parr	111	2	0.7	13.5	2	3.0	1.0
2013	2011	Hatchery Yearling Precocial Parr	155	4	17.4	43.4	4	17.8	1.2
2013	2012	Wild Subyearling Fry	40	77	8.1	—	—	—	—
2013	2012	Wild Subyearling Parr	84	445	12.3	6.7	444	4.7	1.1

Trap Year	Brood Year	Origin/Species/Stage	Fork Length (mm)			Weight (g)			K-factor
			Mean	n	SD	Mean	n	SD	
2014	2012	Wild Yearling Smolt	94	43	7.0	9.4	43	2.2	1.1
2014	2012	Wild Yearling Precocial Parr	127	7	13.0	23.2	7	7.4	1.1
2014	2013	Wild Subyearling Fry	40	22	3.8	—	—	—	—
2014	2013	Wild Subyearling Parr	86	185	14.1	7.5	185	3.3	1.2
2015	2013	Wild Yearling Smolt	103	32	6.8	13.0	31	2.8	1.1
2015	2013	Wild Yearling Precocial Parr	145	2	13.4	35.2	2	11.4	1.1
2015	2014	Wild Subyearling Fry	38	11	3.3	0.5	10	0.2	0.9
2015	2014	Wild Subyearling Parr	96	151	7.5	10.4	148	6.3	1.2
2016	2014	Wild Yearling Smolt	106	3	1.5	12.4	3	0.3	1.1
2016	2015	Wild Subyearling Fry	38	50	3.0	0.46	49	0.3	0.8
2016	2015	Wild Subyearling Parr	89	147	10.7	8.29	147	2.8	1.1
2017	2015	Wild Yearling Smolt	98	41	6.6	10.7	35	2.3	1.1
2017	2015	Wild Yearling Precocial Parr	140	20	11.7	30.1	20	7.2	1.1
2017	2016	Wild Subyearling Fry	38	47	3.4	0.4	47	0.2	0.8
2017	2016	Wild Subyearling Parr	86	530	10.1	7.1	516	7.1	1.1
2018	2016	Wild Yearling Smolt	98	114	7.0	10.6	112	2.2	1.11
2018	2016	Wild Yearling Precocial Parr	147	8	22.1	37.8	8	14.3	1.15
2018	2017	Wild Subyearling Fry	43	4	4.8	0.7	4	0.2	0.89
2018	2017	Wild Subyearling Parr	95	94	8.4	9.3	94	2.3	1.08
2019	2017	Wild Yearling Smolt	103	101	6.6	12.0	101	2.2	1.10
2019	2017	Wild Precocial Parr	100	11	7.0	11.3	11	2.3	1.13
2019	2018	Wild Subyearling Fry	43	12	9.6	0.9	12	0.7	0.96
2019	2018	Wild Subyearling Parr	86	301	9.4	7.4	301	2.3	1.11

[a] Includes residualized non-precocial smolts caught after June 30
[b] “Fry” classification based on age despite FL ≥ 50mm

Appendix E: White River Smolt Trap Proposal for Pilot 2.4-Meter Trap Addition

White River Smolt Trap

Proposal for Pilot 2.4-Meter Trap Addition

July 2017

Prepared by:

Bryan R. Ishida

CONTENTS

LIST OF FIGURES

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1.0 INTRODUCTION

Established in 2005 to target juvenile Upper Columbia River (UCR) spring Chinook (*Oncorhynchus tshawytscha*), operation of the White River smolt trap has undergone several changes to facilitate development of a flow-efficiency model capable of producing accurate abundance estimates. Early trapping strategies included switching operations between a high-water position at an upstream highline cable, and a low-flow position at a lower highline cable. In the upstream high-water position, 1.5 m (5 ft.) and 2.4 m (8 ft.) traps were separately operated to accommodate a range of flows. However, operation of two trap sizes and two trap positions created the need for multiple flow-efficiency models to produce a single population estimate. Low catch in some trap positions did not allow marked group releases to develop needed flow-efficiency models, making catch expansion impossible. By 2013, the decision was made to abandon the use of multiple trap positions and instead run the smaller 1.5 m trap continuously in a fixed position off of the downstream highline. The use of a single, fixed position provided the ability to simplify abundance estimates to two models (yearling and subyearling) which could be applied across years. Though the single trap and single positon provided a much simpler, and more effective means of producing population estimates, the smaller trap has low efficiency at higher flows. Low catch at the current trap limits our ability to further develop the models needed to produce accurate population estimates. Recently, annual yearling and subyearling abundances have dropped markedly (Table 1). Given the low return of natural-origin adults in 2017 and the discontinuation of GCPUD's hatchery supplementation program in 2015, further development of the flow-efficiency models will be challenging unless catch at the current position can be increased or supplemented.

Table 10. Summary of natural-origin spring Chinook captured at the White River Smolt Trap, 2007-2016.

Capture Year	Yearlings	Sub-Yearlings
2007	172	47
2008	102	229
2009	286	543
2010	372	249
2011	65	251
2012	204	335
2013	22	522
2014	50	212
2015	35	162
2016	3	198
Average	**131**	**275**

Regarding potential changes to trap operation for the purpose of increasing catch, GCPUD has specified the following goals (R. O'Connor, personal communication, June 14, 2017):

1) Preservation of the long term dataset that has been established with the 5' trap

2) Collection of more fish for PIT tagging

3) Preservation of the current budget

The following proposal describes a pilot study in which the feasibility and effectiveness of a tandem-trap configuration at the current location is assessed. Data and results will be reviewed by YN and GCPUD at a later point to determine if the goals can effectively be met and further use of a second trap is warranted.

2.0 PROPOSED ACTION

To supplement the catch of the current 1.5 m trap (Trap-A), we propose the simultaneous operation of a 2.4 m diameter trap (Trap-B). Trap-B will operate with the sole purpose of catching additional spring Chinook parr and smolts for tagging and efficiency trials used to build the flow-efficiency model of Trap-A. Not limited to a single trapping position, Trap-B will be free to be moved in order to optimize channel depth and velocity. Operation of Trap-B can be discontinued during low flow, high flow, and/or heavy debris load conditions without loss of daily emigrant estimates given continued operation of Trap-A.

2.1 Rigging/location

The location of Trap-B will not affect the ability of Trap-A to collect fish in its current position i.e., fish captured in Trap-B will be those which would have otherwise passed Trap-A during outmigration. To ensure this, Trap-B will be suspended off of the same river-spanning cable as Trap-A, with the opening of its cone in line with, or slightly downstream of that of Trap-A (Figure 1). Initial changes to the positioning of Trap-A as a result of the installation of Trap-B will be compensated for via the adjustment of positioning and lead cables.

Figure 10. Current location of Trap-A, and proposed location of Trap-B at rkm 9 of the White River.

Trap-B will be positioned along the river-left bank as shown in Figure 1. The river-left location will provide easy access to the trap for personnel, and an adjacent eddy that can be used as a haven during periods of high flow. The river-left side of the channel is also the deepest section of the river transect, aside from the location of Trap-A and the river-right bank eddy (Figure 2). Because Trap-B will be situated in a shallower location and using a larger cone, we anticipate that it will not be able to operate at the base flows in which Trap-A can run. Based on the latest low-flow transect (2016), it does appear that Trap-B will maintain cone clearance to discharges as low as 154 cfs, although it is unclear if water velocity will be sufficient to turn the cone. However, base, or near-base flow operation is not of major concern given that supplemented catch is needed particularly at mid, to high-water discharges when Trap-A is least efficient.

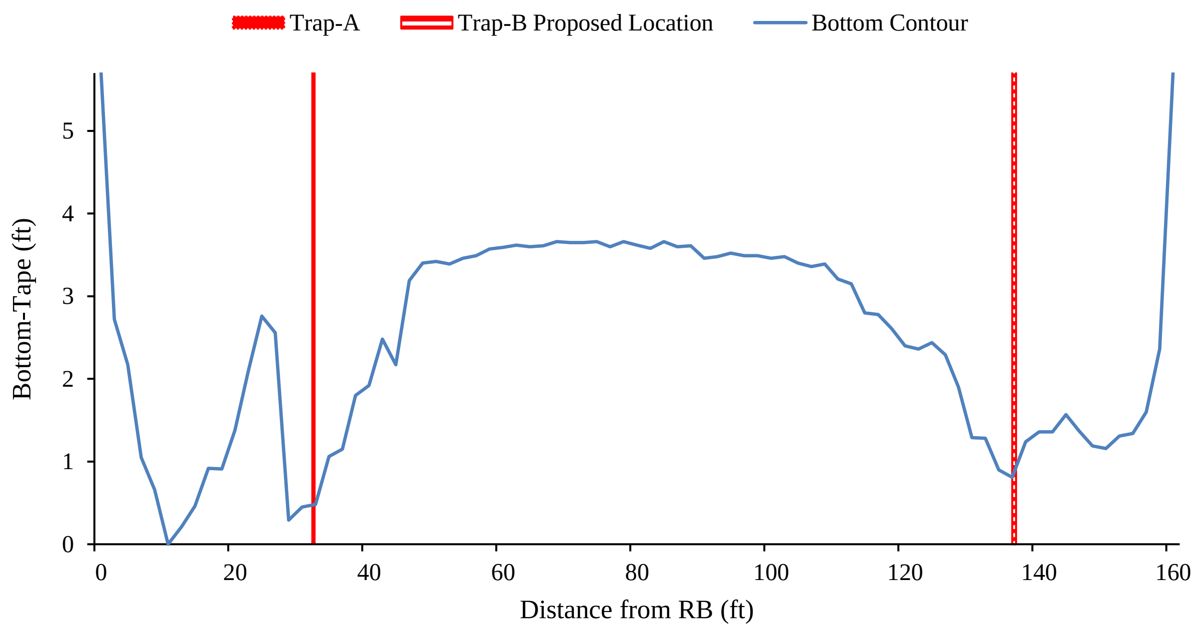

Figure 11. White River transect showing the current position of Trap-A, and the proposed position of Trap-B. Measurement taken on 9/8/2016 at 154 cfs.

Trap-B will be held in place by a rigging configuration similar to that of the Nason Creek smolt trap (Figure 3). This system of rigging will include two side anchors attaching the fore and aft of the starboard pontoon to the river-left bank in addition to the main lead cables attached to the highline. Lateral anchoring points will allow the inclusion of a break-away point located in between the main pulley and the leads. In the unlikely event that the force of debris on Trap-B begins to threaten the integrity of the highline and its anchors, the breakaway point will give way, transferring the load of the trap onto the lateral anchors. With the shift in anchor point(s), the trap will be drawn into an eddy on the river-left bank, alleviating pressure on the trap. A safety cable attached to the aft of the port pontoon will provide a secondary failsafe. In the event that both the highline connection and lateral anchors are pulled, the secondary safety will assume the load, swinging the trap around to a downstream-facing position, clearing the debris blockage and again drawing the trap back to the river-left bank. Lateral movement of the trap within the channel will be made using two positioning cables attached to separate hand winches located below the highline anchor point.

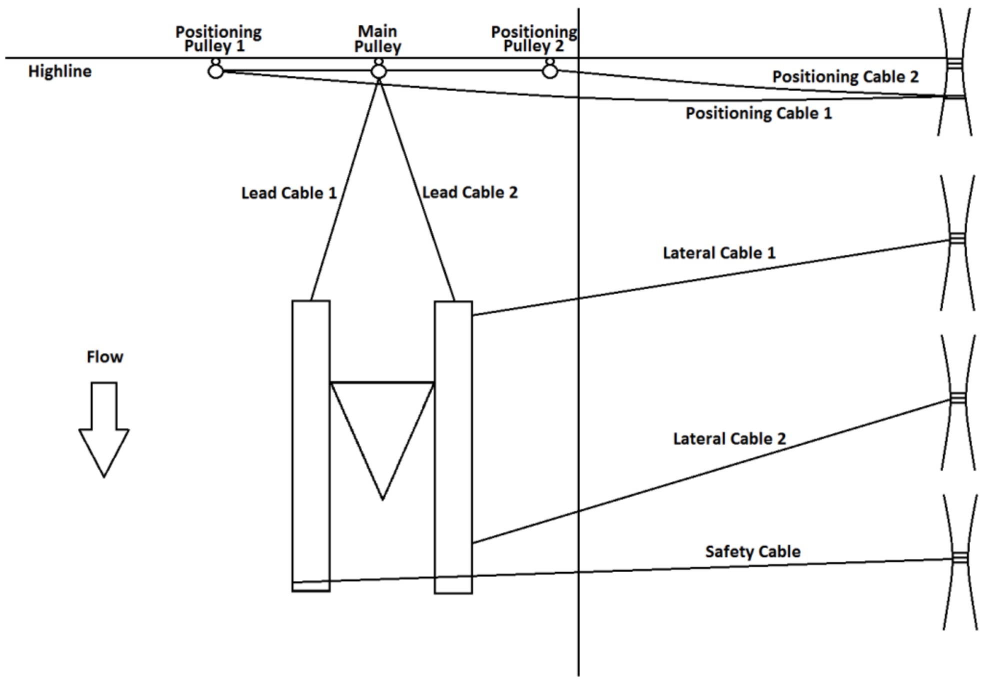

Figure 12. Rigging system to be used to secure Trap-B on the White River.

The current highline cable is made of 1/2” 6x37 IWRC galvanized wire rope (26,500 lb. breaking strength, 5,300 lb. working-load limit). The lateral, safety, and lead cables will all be 13/32” nylon-coated wire rope (9,800 lb. breaking-strength/1,960 lb. working-load limit). Both positioning cables will be made of 7/32” nylon-coated wire rope (2,000 lb. breaking-strength/400 lb. working-load limit). The break-away point will be a single locking shackle (maximum capacity 1,500 – 2,000 lbs.). All live trees used as anchor points will be protected by a layer of untreated 2”x4” wood “tree savers”, preventing direct contact between cables and the tree and distributing pressure across a greater surface area. With the exception of the highline cable, all rigging will be removed at the end of the season.

2.2 Target Operational Periods

The secondary trap will be most useful during periods in which active emigrant movement is elevated, yet coinciding with diminishing trap efficiency as a result of increasing discharge (Figure 4). Namely, this includes the initial-onset periods of spring (mid-March to mid-May) and fall freshets (mid-October to late-November). High-flow operations will be limited to avoid undue risk to the trap and fish captured. Trap-B will not be operated if any risk of damage is foreseen, including periods of rapid increase in discharge and/or sustained debris load. When trapping is suspended due to high flow, Trap-B will be pulled into the river-left eddy and secured to the bank with all tension off of the lead cables. We will attempt to run Trap-B at the lowest discharge possible.

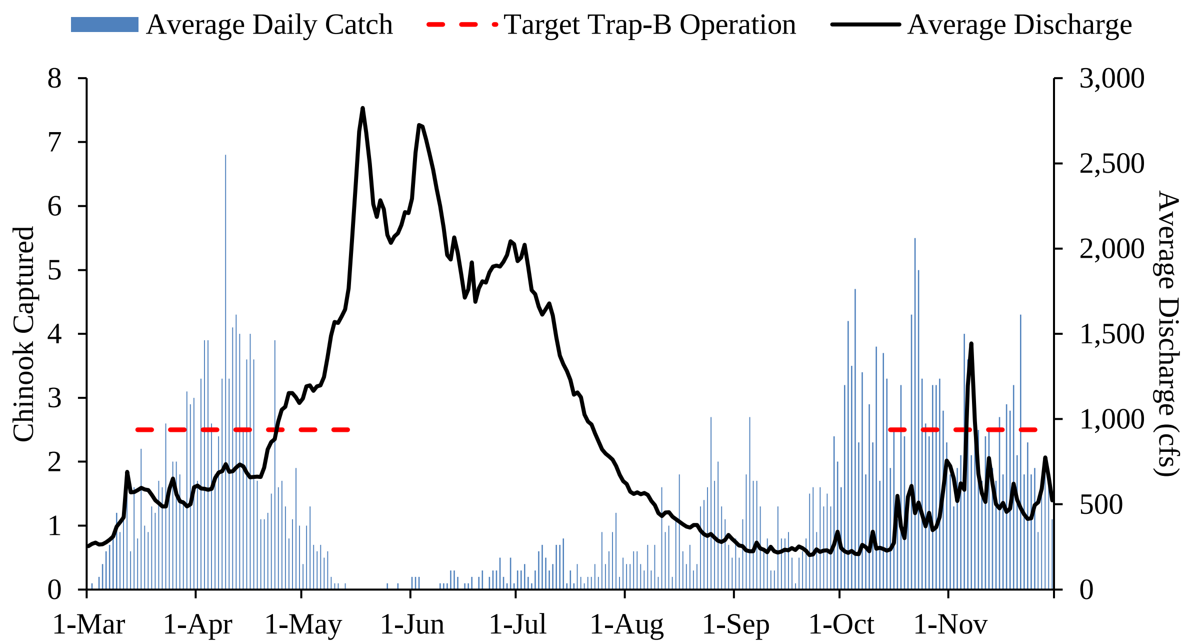

Figure 13. Average daily catch and discharge (2007-2016) with target periods of Trap-B operation.

2.3 Daily Operation and Sampling

YN personnel will sample Trap-B daily when it is running. All non ESA-listed species will be released immediately off of the trap. Non-target ESA-listed species will be quantified, scanned for PIT tags, and released off of the trap without further handling or anesthetization. Spring Chinook juveniles will be the only specimens retained for sampling in aerated five-gallon buckets. Spring Chinook will be sampled using the same protocol as Trap-A, though kept separate in a different P4 tagging file. All spring Chinook with fork lengths ≥ 60mm will be tagged. Tagged fish will be held in holding boxes along the river-left bank until the next mark group release, or release on-site if the minimum mark-group size is not achieved. Efficiency trials will continue to be performed at the Sears Creek Bridge located approximately 2 rkm upstream of the trap location. Trap-B will be operated during the three-day recapture period following each release to determine the combined efficiencies of both traps so that we can ensure we do not exceed the annual handling take for ESA listed spring Chinook (see section 3.3). All trapping, and tagging-caused mortalities of ESA-listed species will be quantified and applied to the take.

3.0 PERMITTING/TAKE LIMITS

3.1 WDFW Land Use Permit #140152A

The current WDFW-issued Land Use Permit (LUP; expiration date February 15, 2020), limits and manages the use of WDFW-owned land adjacent to the smolt trap including impacts on the river bank and trees used as anchor points. It does not regulate how the traps are operated or how many fish are handled. Because both traps will share the same existing access point, no additional impact to the bank and surrounding riparian vegetation will occur. No additional highline or other river-spanning cables/ropes will be needed. The aforementioned break-away system will minimize excessive stress on the highline and its existing tree anchors. Two or three additional tree anchors will be established along the river left bank to secure the lateral and safety cables. The additional anchor points established will not be load-bearing unless a break-away occurs; daily stress on the side anchor points will be minimal. In total, the addition of Trap-B will have a less of an impact than the previously-approved use of two alternating trapping sites, which included two highline cables.

3.2 WDFW Hydraulic Project Approval #2015-2-25+01

The current WDFW Hydraulic Project Approval (HPA; expiration date March 3, 2020) also regards the use of the area around the trap, and does not refer to take limits. Trap-B will not cause any additional disturbance of the bank, riparian vegetation, streambed, or large woody debris within the channel. With the exception of establishing two, to three non-load bearing anchors on the river left bank, impacts on the surrounding environment will remain unchanged after the introduction of Trap-B. All HPA requirements as related to the prohibition of petroleum-based chemicals, motorized tools and equipment, and other substances/practices that may be harmful to the environment will be strictly adhered to in the operation of Trap-B. The operation of a second trap as proposed will be less impactful to the riparian area than the operation of two traps in different positions.

3.3 NMFS Section 7 Biological Opinion #NMFS-WCR-2015-3778

The NMFS Section 7 Biological Opinion (BO) currently specifies the maximum annual total (non-lethal) and lethal take for wild and UCR hatchery-origin spring Chinook and UCR summer steelhead (*Oncorhynchus mykiss*) at the White River Trap. Section 2.8.1.3 of the BO sets an annual total take of "20% of spring-run Chinook salmon and steelhead out-Migrants." Lethal take is specified as: "2% of fish handled," for both species. Because the limitations set on the White River in the BO are based on take percentages and not effort, the operation of the second smolt trap will not violate its terms given continued adherence to the established limits. All take associated by Trap-B will be counted against the single permit, with no extra allowances provided by the change in trapping regime. Non-lethal take will continue to be assessed as a function of mean trap efficiency, with the combined efficiency of both traps representing the total percentage of the out-migrants sampled during tandem-operation.

Because the primary use of Trap-B is to supplement catch during periods in which efficiency of Trap-A is low (>5%), the chance that the 20% threshold is exceeded with the addition of the second trap above approximately 500 cfs is unlikely. Though combined trap efficiency at low flows may approach 20%, annual take will likely be much lower given the bulk of emigration is at higher flows. We have no reason to believe that Trap-B will increase the total lethal take beyond the permitted limit. If anything, lethal take incurred by Trap-B will be less than that of Trap-A considering that it will not be run during periods in which mortalities often occur: extreme low and extreme high flows.

3.4 USFWS Section 10 Permit # TE-022743-6

The White River currently operates under Grant County's USFWS Section 10 permit (expiration date October 27, 2021), which establishes the guidelines associated with the handling of bull trout (*Salvelinus confluentus*). The lethal take maximum as described in the terms and conditions is set as "five individuals, of all life stage, per calendar year." As with the NMFS BO, we do not perceive this as precluding the use of the secondary smolt trap as long as the maximum take is not exceeded in the total catch of both traps. Bull trout captured in Trap-B will be released off the trap with minimal handling and no exposure to anesthetic.

Annual bull trout catch on the white river is relatively low, especially in recent years (Table 2). In the past ten years of operation, we have not had a single bull trout mortality of any kind (trapping or handling). Though possible that Trap-B may capture bull trout, mortalities will be unlikely; especially given the policy of minimal handling.

Table 11. Bull trout catch at the White River smolt trap, 2007-2016.

Capture Year	FL < 50 mm	FL ≥ 50 mm
2007	1	6
2008	24	21
2009	19	27
2010	68	11
2011	46	8
2012	49	16
2013	19	9
2014	11	2
2015	1	8
2016	0	5
Average	**24**	**11**

4.0 BUDGET

We intend to operate Trap-B within the general confines of the current budget (Table 3). All major equipment and rigging are currently on-hand from previous operation at the upper cable. Because the two traps will be in the same vicinity, increase to the daily workload will only be associated with the actual removal, and work-up of fish collected (which would be the same if we were catching target numbers of fish in one trap). Travel times, daily set-up/break-down, data processing, report preparation, and mark-group release procedures will remain virtually the same. We expect that any future increases in the budget will be due to operating costs which are subject to inflation (i.e. wage rates, indirect, GSA vehicle rates, changes in costs of supplies). Such increases would still occur in the absence of Trap-B.

Appendix P

Genetic Diversity of Upper Columbia River Summer Chinook Salmon

Genetic Structure of upper Columbia River Summer Chinook and Evaluation of the Effects of Supplementation Programs

by

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February 2011

Abstract

We investigated genetic relationships among temporally replicated collections of summer Chinook from the Wenatchee River, Methow River, and Okanogan River in the upper Columbia River basin. Samples from the Eastbank Hatchery – Wenatchee stock, Eastbank Hatchery – MEOK stock, and Wells Hatchery were also included in the analysis. Samples of natural- and hatchery-origin summer Chinook were analyzed and compared to determine if the supplementation program has had any impacts to the genetic structure of these populations. We also calculated the effective number of breeders for collection locations of natural- and hatchery-origin summer Chinook from 1993 and 2008. In general, population differentiation was not observed among the temporally replicated collection locations. A single collection from the Okanogan River (1993) was the only collection showing statistically significant differences. The effective number of breeders was not statistically different from the early collection in 1993 in comparison to the late collection in 2008. Overall, these analyses revealed a lack of differentiation among the temporal replicates from the same locations and among the collection from different locations, suggesting the populations have been homogenized or that there has been substantial gene flow among populations. Additional comparisons among summer-run and fall-run Chinook populations in the upper Columbia River were conducted to determine if there was any differentiation between Chinook with different run timing. These analyses revealed pairwise F_{ST} values that were less than 0.01 for the collections of summer Chinook to collections of fall Chinook from Hanford Reach, lower Yakima River, Priest Rapids, and Umatilla. Collections of fall Chinook from Crab Creek, Lyons Ferry Hatchery, Marion Drain, and Snake River had pairwise F_{ST} values that were higher in comparison to the collections of summer Chinook. The consensus clustering analysis did not provide good statistical support to the groupings, but did show relationships among collections based on geographic proximity. Overall the summer and fall run Chinook that have historically been

spawned together were not differentiated while fall Chinook from greater geographic distances were differentiated.

Introduction

The National Marine Fisheries Service (NMFS) recognizes 15 Evolutionary Significant Units (ESU) for Chinook salmon (*Oncorhynchus tshawytscha*) (Myers et al. 1998). The summer Chinook from the upper Columbia River are included in the Upper Columbia River Summer- and Fall-Run ESU, which encompasses all late-run (summer and fall), ocean-type Chinook salmon from the mainstem Columbia River and its tributaries (excluding the Snake River) between Chief Joseph and McNary Dams (Waknitz et al. 1995). Waknitz et al. (1995) concluded that due to high total abundance this ESU was not likely to become at risk from extinction. Yet, a majority of natural spawning activity was in the vicinity of Hanford Reach, and it was unclear whether natural production was self-sustaining given the vast summer Chinook artificial propagation efforts (Waknitz et al. 1995). Additionally, the Biological Review Team expressed concern about potential consequences to genetic and life-history traits from an increasing contribution of hatchery fish to total spawning escapement (Waknitz et al. 1995).

Artificial propagation of ocean-type Chinook from the middle/upper Columbia has been continuous since the implementation of the Grand Coulee Fish Maintenance Project (GCFMP) in 1939 (Myers et al. 1998). The US Fish and Wildlife Service established three hatchery programs for summer/fall Chinook during the GCFMP, Leavenworth NFH, Entiat NFH, and Winthrop NFH. The Washington Department of Fisheries (now Washington Department of Fish and Wildlife) followed with hatchery programs at Rocky Reach (1964), Wells Dam (1967), Priest Rapids (1974), and Eastbank (1990) facilities. Currently, only Leavenworth NFH and Winthrop NFH are not producing summer/fall Chinook. Entiat NFH has resumed production of summer/fall Chinook (Wells FH Stock) in 2009 and released their first yearling summer Chinook smolts in 2010. Since

1941, over 200 million ocean-type Chinook salmon have been released into the middle Columbia River Basin (Myers et al. 1998). Initially, the hatchery programs differentiated between early returning fish (i.e., stream-type) and later returning fish (i.e., ocean-type), but no distinction was made regarding the “summer” and “fall” components of the ocean-type stocks (Waknitz et al. 1995). Therefore, all Chinook salmon now migrating above Rock Island Dam descend from not only a mixture between different stocks from the basin, but also a mixture between the endemic summer and fall life histories. While hatchery protocols have been modified of late to maintain discreet summer and fall Chinook hatchery stocks (Utter et al. 1995; see also HGMP), physical evidence and genetic data suggests that summer and fall Chinook may have become homogenized. During the 1970’s and 80’s, given coded-wire tag recoveries, summer-run Chinook originating from above Rock Island Dam were believed to have spawned extensively with Hanford Reach and Priest Rapids Hatchery fish (Chapman 1994). Stuehrenberg et al. (1995) reported that 10% of their radio tagged summer Chinook were occupying typical fall-run spawning habitat on the mainstem Columbia river, and 25% of fall fish released from Priest Rapids were recovered as summers at (or above) Wells Hatchery. Genetic data reported by Marshall et al. (1995) and Waknitz et al. (1995) corroborate these observations, as genetic distances observed between summer and fall Chinook within the Upper Columbia River Summer- and Fall-Run ESU were essentially zero.

In response to the need for evaluation of the supplementation hatchery programs, both a monitoring and evaluation plan (DCPUD 2005; Murdoch and Peven 2005) and the associated analytical framework (Hays et al. 2006) were developed for the Habitat Conservation Plan’s Hatchery Committee through the joint effort of the fishery co-managers (CCT, NMFS, USFWS, WDFW, and YN) and Chelan County and Douglas County PUDs. These reports outline 10 objectives to be applied to various species assessing the impacts of hatchery operations mitigating the operation of Wells, Rocky Reach, and Rock Island hydroelectric projects. The present monitoring and evaluation study plan differs in scope from previous monitoring and evaluation projects proposed by WDFW Molecular Genetics Lab, in that it does not investigate a single watershed, but instead will encompass all summer Chinook stocks from the upper Columbia River including the three supplementation (Wenatchee, Methow, and Okanogan) and the harvest augmentation program (Wells summer Chinook). The objectives of this study were to determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery programs.

Materials and Methods

Collections

A total of 2,416 summer Chinook were collected from tributaries in the upper Columbia River basin and were analyzed (Table 1). Two collections of natural-origin summer Chinook from 1993 (prior to the supplementation program) were taken from the Wenatchee River Basin and were compared to collections of hatchery and natural-origin from 2006 and 2008 that were post-supplementation. Two pre-supplementation collections from the Methow River (1991 and 1993) were compared to post-supplementation collections from 2006 and 2008. Three pre-supplementation collections from the Okanogan River Basin (1991, 1992, and 1993) were compared with post-supplementation collections from 2006 and 2008. A collection of natural-origin summer Chinook from the Chelan River was also analyzed. Additionally, hatchery collections from Eastbank Hatchery (Wenatchee and MEOK stock) and Wells Hatchery were analyzed and compared to the in-river collections. Summer Chinook data (provided by the USFWS) from the Entiat River was also used for comparison. Lastly, data from eight collections of fall Chinook was compared to the collections of summer Chinook.

Laboratory Analyses

All laboratory analyses were conducted at the WDFW Genetics Laboratory in Olympia, Washington. Genomic DNA was extracted by digesting a small piece of fin tissue using the nucleospin tissue kits obtained from Macherey-Nagel following the recommended conditions in the user manual. Extracted DNA was eluted with a final volume of 100 µL.

Genotype information was generated using thirteen microsatellite markers following standard laboratory protocols and analysis methods. Descriptions of the loci assessed in this study and polymerase chain reaction (PCR) conditions are given in Table 2. PCR reactions were run with a thermal profile consisting of: denaturation at 95ºC for 3 min, denaturation at 95ºC for 15 sec, anneal for 30 sec at the appropriate temperature for each locus (Table 2), extension at 72ºC for 1 min, repeat cycle (steps 2-4), final extension at 72ºC for 30 minutes. PCR products were then processed with an ABI-3730 DNA Analyzer. Genotypes were visualized with a known size standard (GS500LIZ 3730) using GENEMAPPER 3.7 software. Alleles were binned in GENEMAPPER using the standardized allele sizes established for the Chinook GAPS dataset (Seeb et al. 2007).

Within-collection Statistical Analyses

Allele frequencies were calculated with CONVERT (version 1.3, Glaubitz 2003). Hardy-Weinberg proportions for all loci within each collection were calculated using GENEPOP (version 3.4, Raymond and Rousset 1995). Heterozygosity (observed and expected) was computed for each collection group using GDA (Lewis and Zaykin 2001).

Allelic richness and F_{IS} (Weir and Cockerham 1984) inbreeding coefficient were calculated using FSTAT (version 2.9.3.2, Goudet 2001). Linkage disequilibrium for each pair of loci in each collection was calculated using GENEPOP v 3.4 (10,000 dememorizations, 100 batches, and 5,000 iterations per batch). Pairwise estimates of genetic differentiation between collection groups were calculated using GENEPOP (version 3.4, Raymond and Rousset 1995). Statistical significance for the tests of Hardy-Weinberg proportions, linkage disequilibrium, and genotypic differentiation was evaluated using a Bonferroni correction of p-values to account for multiple, simultaneous tests (Rice 1989).

Between-collection Statistical Analyses

Pairwise F_{ST} estimates were computed to examine population structure among collections using GENETIX (version 4.03, Belkhir et al. 2001). This estimate uses allelic frequency data and departures from expected heterozygosity to assess differences between pairs of populations.

We used PHYLIP (version 3.5c, Felsenstein 1993) to calculate Cavalli-Sforza and Edwards (1967) pairwise chord distances between collections. Bootstrap calculations were performed using SEQBOOT followed by calculations of genetic distance using GENDIST. The NEIGHBOR-JOINING method of Saitou and Nei (1987) was used to generate the dendrograms and CONSENSE to generate a final consensus tree from the 1,000 replicates. The dendrogram generated in PHYLIP was plotted as an unrooted radial tree using TREEVIEW (version 1.6.6, Page 1996).

Effective Number of Breeders

The effective number of breeders (N_b) was estimated for pre- and post-supplementation program collections (where possible) to investigate whether hatchery programs had affected that genetic metric over the operational period. Wang (2009) derived an equation for effective size (N_e) as a function of the frequency of nested full-sib and half-sib families in a random collection of individuals.

$$\frac{1}{N_e} = \frac{1+3\alpha}{4}(Q_1 + Q_2 + 2Q_3) - \frac{\alpha}{2}\left(\frac{1}{N_1} + \frac{1}{N_2}\right) \qquad \text{(equation 10)}$$

Where α is a measure of the deviation of genotype frequencies from Hardy-Weinberg expectation (equivalent to Wright's (1969) F_{IS}), Q_i are the probabilities that a pair of offspring are paternal half sibs, maternal half sibs, or full sibs, respectively, and N_1 and N_2 are the number of male and female parents that generation, respectively. Genetic parameters (i.e., sibship distributions) were estimated for summer Chinook collections using algorithms implemented in COLONY (Jones and Wang 2009). To be clear, Wang's (2009) method as implemented here will estimate N_b, given multi-locus genotypes from each collection were partitioned by brood year for this analysis. To obtain an estimate of N_e each N_b value must be multiplied by the mean generation time of that population.

Results

Collections

A total of 2,350 individuals from 32 collections of temporally replicated samples (six locations) were analyzed (Table 1). Temporally replicated collections of hatchery and natural-origin samples were from the Wenatchee, Methow, and Okanogan Rivers. Temporally replicated hatchery-origin summer Chinook were from Wells Hatchery, Eastbank Hatchery - Wenatchee stock, and Eastbank Hatchery - Methow/Okanogan (MEOK) stock. A total of 232 of those individuals were excluded from any analyses because they failed to amplify at nine or more loci. Data for remaining 2,118 individuals were analyzed to assess differences between temporally replicated natural- and hatchery-origin summer Chinook for each location and to compare the differences among the different collection locations. Summer Chinook data from the temporally replicated collection locations were then combined and compared to fall Chinook data from the GAPS v.3.0 dataset.

Statistical Analyses

The population statistics (Hardy-Weinberg equilibrium and F_{IS}) calculated for each of the 32 temporally replicated collection locations were consistent with neutral expectations (i.e., no associations among alleles). Three collections did have a single locus that did not meet expectations (Wenatchee hatchery-origin 2006, Wells hatchery 2006, and Okanogan hatchery-origin 2009). Based on these results we suggest the collections represented randomly breeding groups and were not comprised of mixtures of individuals from different genetic source populations.

Population differentiation was assessed for each of the temporally replicated collections from within each location (Table 3). This analysis revealed the only significant difference observed within a collection location pertained to the collection from 1993 Okanogan River natural-origin samples. Because of the significant difference of this collection to the other temporal replicates it was not included in further analyses.

Given the absence of genetic differentiation observed among the temporally replicated collections, the 32 collections from the Wenatchee, Methow, and Okanogan River were combined to form three location-specific collections for analysis. Population differentiation metrics were compared among the composite Wenatchee, Methow, and Okanogan collections and eight other location-specific collections (11 locations total). Comparing all collections, there were a total of 39 significant genic test comparisons out of a total 496 (Table 4). Thirty-eight of the 39 statistically significant pairwise differences pertained to the Okanogan River and 2006 Wells Hatchery collections (Table 4). F_{ST} results are described further below.

Within-collection genetic metrics were estimated for the 11 location-specific collections of summer Chinook from the upper Columbia River, in addition to eight collections of fall Chinook (Table 1). The population statistics (Hardy-Weinberg equilibrium and F_{IS}) calculated for these collections of summer and fall

Chinook were also consistent with neutral expectations. The collection from Lyons Ferry Hatchery had one locus that did not meet expectations and the collections from Crab Creek and Marion Drain both had three loci that did not meet expectations.

The hatchery collections in general had a higher percentage of significantly linked loci; however the observed genetic diversity were similar for the natural and hatchery-origin collections. Analysis of allelic richness was based on 11 individuals per collection, the minimum number of individuals across all collections with complete multilocus genotypes. The largest number of linked loci occurred in the Crab Creek, Entiat River, and Okanogan natural-origin collections. Allelic richness was on average lower in the collections of summer Chinook (10.7) collections in comparison to the collections of fall Chinook (11.0).

Pairwise F_{ST} (Table 4) estimates revealed low levels of differentiation, where all observed F_{ST} values between the collections of summer Chinook were lower than 0.0096. There were 15 out of 28 comparisons between collections of summer Chinook that were significantly different from zero and occurred primarily from comparisons of the Okanogan River (hatchery and natural-origin) and Wells Hatchery to all other collections. The collection of Eastbank Hatchery – MEOK stock was differentiated from the Wenatchee River natural-origin and Entiat River collections. The collection from the Chelan River had a small sample size of 23 individuals and only differentiated from the Eastbank Hatchery – MEOK stock. F_{ST} estimates regarding pairwise comparisons between each of four fall Chinook collection locations (Crab Creek, Lyons Ferry Hatchery, Marion Drain, and Snake River) to all other collections were significantly different from zero (Table 5). Pairwise comparisons for three other fall Chinook collections (Hanford Reach, lower Yakima River, and Umatilla River) to the collections of summer Chinook were significantly different from zero (Table 6). The only fall Chinook collection that was not significantly differentiated from all of the summer Chinook was Priest Rapids.

The relative genetic relationships among the test groups were assessed using the consensus clustering analysis (Figure 1). Statistical support for the dendrogram topology (i.e., tree shape) was low regarding the branching that separated the collections of summer Chinook from the upper Columbia River. The collections of fall Chinook; however were supported with bootstrap support over 76% with the exception of three collections (lower Yakima River, Crab Creek, and Umatilla River). In other words, 760 of the 1000 bootstrap replicates supported the placement of the node separating summer and fall collections. The collection from the Chelan River had bootstrap support of 68%; however the sample size for that collections was small (N = 23). Even though the bootstrap support was low among the collections of summer Chinook there was concordance between geography and genetic distance.

Where comparisons were possible between pre- and post-supplementation program collections, the effective number of breeders (N_b) estimated to have comprised those collections were slightly lower for contemporary (2008) collections; however in all cases the 95% confidence intervals overlapped between historical and contemporary collections, suggesting statistical equivalency. Regarding Wenatchee River collections, the point estimates of N_b ranged from 134 (08FU) to 190 (93DD), where all collections had overlapping confidence intervals (Table 7). The upper bound of the 1989 brood year for collection 93DD was very large, suggesting the sample size was insufficient for properly inferring the sibship distribution within the collection. Comparing the Okanogan natural collections 93ED and 08GA, the estimated N_b were 142 (CI 102 – 203) and 127 (CI 92 – 180), respectively. For the Eastbank Hatchery MEOK stock comparisons, the N_b estimated for the 93DF collection was 171 (CI 129 – 229), as compared to the 166 (CI 126 – 226) estimated for collection 08MO. In all cases, the estimated N_b can be converted to effective population size (N_e) by multiplying the estimate by the mean generation time.

Discussion

The collections of summer Chinook populations from the upper Columbia River are of interest because census sizes are reduced below historic levels and are the subject of mitigation and supplementation hatchery programs. Concern over the impacts of hatchery supplementation programs on the genetic integrity of natural-origin populations led to our primary objective, which was to evaluate genetic metrics for temporally replicated collections of summer Chinook in the upper Columbia River pre and post hatchery supplementation. A similar analysis by Kassler and Dean (2010) was conducted on spring Chinook in the Tucannon River to evaluate the effects of a supplementation and captive brood program on natural-origin stocks. Additionally, upper Columbia River spring Chinook supplementation programs (Blankenship et al. 2007; Small et al. 2007), spring and fall Chinook populations in the Yakima Basin (Kassler et al. 2008), and a potentially unique population of fall Chinook in Crab Creek (Small et al. 2010) have been evaluated. In the present analysis of summer Chinook populations, collections of pre- and post- supplementation summer Chinook were collected from the Wenatchee River, Methow River, and Okanogan River Basins and analyzed to determine if the genetic profile has changed as a result of the supplementation program. Analysis was then conducted on the collections of summer run to compare the fall run Chinook collections in the upper Columbia River basin.

Allozyme analyses of these three summer run Chinook stocks in the upper Columbia River have identified that each stock was distinct, with a closer relationship detected between the Wenatchee and Methow Rivers (WDF and WDW 1993, Marshall 2002). Wenatchee summer Chinook are thought to be a mixture of native summer Chinook and Chinook from the Grand Coulee Fish Maintenance Project (GCFMP). The goal of the GCFMP project between 1939 and 1943 was to trap migrating Chinook salmon at Rock Island dam (75 miles below Grand Coulee) and homogenize the populations, which reduced the genetic uniqueness of the distinct tributary populations present in the upper Columbia River.

We found allele frequencies for individual temporally replicated hatchery- and natural-origin collection locations of adult summer Chinook were not significantly different from that expected of a single underlying population, except for one collection (1993 Okanogan natural-origin; Table 3). This collection was differentiated to the Okanogan collections in 2006 and 2008; however it was not differentiated from the collection in 1992. The Okanogan collection from 1992 was also not differentiated to any other collection; therefore the difference in the collection from Okanogan 1993 was likely not an indication of genetic change from pre supplementation to post supplementation. The collection was however dropped from further analyses so as to not confuse interpretation of results. The lack of allelic differentiation observed among the temporally replicated collections was interpreted as the genetic metrics from each location in the early 1990's did not differ from the samples collected in 2008. Spanning a few generations, allele frequencies are not expected to change for large populations at genetic equilibrium. In contrast, changes in allele frequencies of small populations may occur due to the stochastic sampling of genes from one generation to the next (i.e., genetic drift).

A second round of analyses was conducted to evaluate the genetic relationships of the summer run collections (temporal collections were combined) with data from the Entiat River, Chelan River, and eight collections of fall Chinook. Assessment of the relationship between the summer run collections in comparison to each other provided very little evidence of genetic differentiation between these collections. While population differentiation did show some significant differences between the Okanogan River and Wells Hatchery collections, all of the pairwise F_{ST} values were below 0.003. Meaning that a very small proportion of the observed genetic variation could be attributed to restrictions in gene flow (i.e., population structure)

The comparison of the hatchery-origin collections revealed a lack of differentiation between the Eastbank Hatchery – Wenatchee stock, Eastbank Hatchery – MEOK stock, and the Wells Hatchery (with exception of the 2006 collection). The genetic similarity or low level of genetic differentiation among these stocks suggests that there has been an integration of natural- and hatchery-origin summer Chinook in the upper Columbia River or a lack of ancestral genetic difference. The difference of the 2006 Wells Hatchery collection to the other collections is most likely a result of sampling effect because of the lack of differentiation among the stocks in the basin. If the 2006 collection had been mixed from different sources of summer Chinook there would not be a detectable level of differentiation as was seen with the 2006 sample.

The analyses to compare summer and fall Chinook collections provided some understanding on the genetic relationships of Chinook with different run timings in the upper Columbia River basin. Historically, the hatchery programs in the upper Columbia River were separated into groups of the early returning fish (i.e., stream-type) and later returning fish (i.e., ocean-type), but the programs did not sort individuals identified as “summer” or “fall” stocks (Waknitz et al. 1995). Now all Chinook salmon that are migrating above Rock Island Dam descend from a mixture of different stocks from the upper Columbia River basin, but also a mixture between the endemic summer and fall life histories.

Small et al. (2010) conducted an analysis on summer run and fall run Chinook in the upper Columbia River and concluded that Crab Creek Chinook in the upper Columbia River were genetically distinct to all other fall and summer run Chinook stocks that were analyzed. They did note a departure from Hardy Weinberg expectation as a result of a null allele at the microsatellite locus *Ogo-4* and a higher linkage disequilibrium value due to the inclusion of family groups in one of their samples. Kassler et al. (2008) found differentiation among spring and fall Chinook populations in the Yakima River.

The tests of pairwise F_{ST} indicated a very low level of genetic differentiation (less than one percent difference) between collections of summer-run Chinook and fall-run Chinook. The range of pairwise F_{ST} values for comparisons between the summer run and fall run collections was 0.0016 – 0.0248. The larger values from the range were associated to the collections from Crab Creek, Lyons Ferry Hatchery, and Marion Drain. Studies by Kassler et al. (2008) and Small et al. (2010) have documented differences among the populations of these collections to others within the upper Columbia River basin. The low pairwise F_{ST} values between Priest Rapids and Hanford Reach collections and the summer run collections were not surprising because summer-run Chinook originating from above Rock Island Dam were believed to have spawned extensively with Hanford Reach and Priest Rapids Hatchery fish during the 1970's and 80's (Chapman 1994). The lack of differentiation among the summer and fall stocks in the Columbia River was also identified by Utter et al. (1995) and the HGMP where they state physical evidence and genetic data suggests that summer and fall Chinook may have become homogenized.

Despite low levels of statistical bootstrap support for dendrogram topology (i.e., tree shape), there was concordance observed between geographic location and the genetic relationships among the summer and fall Chinook populations. The collections from the Okanogan (hatchery and natural-origin) did separate out with collections from Wells Dam Hatchery, Entiat River, and Eastbank Hatchery – MEOK stock, and were next to a group of the Methow and Wenatchee collections. The fall Chinook populations are also separated to the summer collections and the position of all but three of these collections (lower Yakima River, Crab Creek, and Umatilla River) were statistically supported. The geographic proximity of the fall collections seemed to follow the observed pattern in this dendrogram. The relationship of the Snake River and Lyons Ferry Hatchery in proximity to the collection from Marion Drain was not surprising while the relationship between Priest Rapids and Hanford Reach was easily a result of the stocking practices of fall Chinook in the 1970 and 1980's.

A secondary objective of this study was to determine if the effective population size of upper Columbia River summer Chinook populations had changed over time due to supplementation efforts. We observed that the number of effective breeders in the collections from 1993 and 2008 has not changed thus providing reason to believe that the genetic diversity of summer Chinook in the upper Columbia River has not been altered through the supplementation program.

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Table 1. Samples of adult hatchery- and natural-origin summer and fall Chinook that were analyzed from the upper Columbia River. Total number of individuals that were analyzed / individuals with data for 9 or more loci that were included in the analysis. Collection statistics (allelic richness, linkage disequilibrium (before and after Bonferroni correction), F_{IS}, heterozygosity (H_O and H_E)) and p-values for deviations from Hardy-Weinberg equilibrium (HWE). P-values were defined as significant after implementation of Bonferroni correction for multiple tests (Rice 1989).

WDFW GSI code[a]	Collection location	N =	Allelic Richness[b]	Linkage Disequilibrium[c]	F_{IS} (p-value)[d]	H_O	H_E
93DD	Wenatchee River upstream of Tumwater Dam - natural origin	51 / 45					
93DE	Wenatchee River downstream of Tumwater Dam - natural origin	88 / 88					
06CQ	Wenatchee River upstream of Tumwater Dam - natural origin	95 / 86					
06CR	Wenatchee River downstream of Tumwater Dam - natural origin	95 / 82					
08FV	Wenatchee River upstream of Tumwater Dam - natural origin	95 / 82					
08FW	Wenatchee River downstream of Tumwater Dam - natural origin	95 / 87					
	Wenatchee River - Natural origin combined	**519 / 470**	**10.7**	**17 / 4**	**0.001 (0.403)**	**0.8504**	**0.8513**
06CP	Wenatchee River - hatchery origin	95 / 70					
08FU	Wenatchee River - hatchery origin	95 / 83					
	Wenatchee River - Hatchery origin combined	**190 / 153**	**10.6**	**18 / 6**	**0.018 (0.013)**	**0.8409**	**0.8561**
93EC	Methow River - natural origin	27 / 27					
06CT	Methow River - natural origin	95 / 90					
08FY	Methow River - natural origin	95 / 88					
09CO	Methow River - natural origin	91 / 80					
	Methow River - Natural origin combined	**308 / 285**	**10.7**	**4 / 1**	**0.006 (0.160)**	**0.8506**	**0.8554**
06CS	Methow River - hatchery origin	14 / 8					
08FX	Methow River - hatchery origin	21 / 18					
09CP	Methow River - hatchery origin	19 / 18					
	Methow River - Hatchery origin combined	**54 / 44**	**10.8**	**11 / 2**	**-0.003 (0.593)**	**0.8553**	**0.8523**

Table 1 continued.

92FM	Okanogan River - natural origin	49 / 46					
93ED*	Okanogan River - natural origin	103 / 87					
06CV	Okanogan River - natural origin	95 / 88					
08GA	Okanogan River - natural origin	95 / 92					
09CN	Okanogan River - natural origin	133 / 126					
	Okanogan River - Natural origin combined	**475 / 439**	**10.8**	**9 / 4**	**0.003 (0.304)**	**0.8563**	**0.8596**
* - not included in the combined dataset							
06CU	Okanogan River - hatchery origin	58 / 49					
08FZ	Okanogan River - hatchery origin	19 / 18					
09CM	Okanogan River - hatchery origin	117 / 107					
	Okanogan River - hatchery origin combined	**194 / 174**	**10.8**	**31 / 10**	**-0.011 (0.920)**	**0.8678**	**0.8586**
91FL	Wells Hatchery	68 / 42					
92FK	Wells Hatchery	25 / 23					
93DG	Wells Hatchery	11 / 9					
06DM	Wells Hatchery	95 / 91					
08HY	Wells Hatchery	95 / 91					
	Wells Hatchery combined	**294 / 256**	**10.7**	**8 / 3**	**-0.001 (0.529)**	**0.8670**	**0.8665**
08MN	**Eastbank Hatchery - Wenatchee River stock**	**95 / 90**	**10.7**	**6 / 1**	**0.020 (0.024)**	**0.8326**	**0.8498**
92FO	Eastbank Hatchery - Methow / Okanogan (MEOK) stock	36 / 33					
93DF	Eastbank Hatchery - Methow / Okanogan (MEOK) stock	90 / 86					
08MO	Eastbank Hatchery - Methow / Okanogan (MEOK) stock	95 / 88					
	Eastbank Hatchery - MEOK stock combined	**221 / 207**	**10.7**	**2 / 0**	**-0.005 (0.782)**	**0.8647**	**0.8604**
		2,350 / 2,118					

Table 1 continued.

06KN	**Chelan River**	**70 / 23**	**10.3**	**11 / 0**	**0.027 (0.118)**	**0.8334**	**0.8556**
Data provided by USFWS							
	Entiat River - summer Chinook	**190**	**10.9**	**33 / 10**	**0.008 (0.119)**	**0.8553**	**0.8625**
Data from Small et al. (2010)							
08EH	Crab Creek	108					
09AZ	Crab Creek	291					
	Crab Creek	**399**	**10.5**	**35 / 14**	**0.018 (0.000)**	**0.8519**	**0.8676**
GAPS v.3.0 data							
	Priest Rapids Hatchery - fall Chinook	**81**	**11.1**	**3 / 2**	**0.015 (0.079)**	**0.8591**	**0.8723**
	Hanford Reach - fall Chinook	**220**	**11.3**	**4 / 0**	**0.010 (0.068)**	**0.8661**	**0.8746**
	Umatilla - fall Chinook	**96**	**11.2**	**17 / 6**	**-0.003 (0.623)**	**0.8719**	**0.8693**
	lower Yakima River - fall Chinook	**103**	**11.0**	**3 / 1**	**0.000 (0.511)**	**0.8724**	**0.8721**
	Marion Drain - fall Chinook	**190**	**10.8**	**9 / 4**	**0.022 (0.001)**	**0.8586**	**0.8782**
	Lyons Ferry Hatchery - fall Chinook	**186**	**10.6**	**7 / 4**	**0.013 (0.033)**	**0.8527**	**0.8641**
	Snake River - fall Chinook	**521**	**11.1**	**0 / 0**	**-0.001 (0.634)**	**0.8720**	**0.8708**
		NA / 2,009					

[a] - Year that samples were collected is identifed by the two numbers in the WDFW GSI code

[b] - based on a minimum of 11 diploid individuals

[c] - adjusted alpha p-value = 0.0006

[d] - adjusted alpha p-value = 0.0002

Table 2. PCR conditions and microsatellite locus information (number alleles/locus and allele size range) for multiplexed loci used for the analysis of Chinook. Also included are the observed and expected heterozygosity (H_o and H_e) for each locus.

PCR Conditions			Locus statistics		Heterozygosity		
Poolplex	Locus	Dye Label	# Alleles/ Locus	Allele Size Range (bp)	H_o	H_e	References
Ots-M	*Ots-201b*	blue	49	137 - 334	0.9474	0.9544	Unpublished
	Ots-208b	yellow	56	154 - 378	0.9523	0.9672	Greig et al. 2003
	Ssa-408	red	32	184 - 308	0.9177	0.9214	Cairney et al. 2000
Ots-N	*Ogo-2*	red	22	206 - 260	0.8526	0.8673	Olsen et al. 1998
Ots-O	*Ogo-4*	blue	20	128 - 170	0.6694	0.7028	Olsen et al. 1998
	Ots-213	yellow	45	178 - 370	0.9430	0.9525	Greig et al. 2003
	Ots-G474	red	16	152 - 212	0.6816	0.6838	Williamson et al. 2002
Ots-R	*Ots-3M*	blue	15	128 - 158	0.7854	0.7938	Banks et al. 1999
	Omm-1080	green	54	162 - 374	0.9517	0.9670	Rexroad et al. 2001
Ots-S	*Ots-9*	red	9	99 - 115	0.6531	0.6543	Banks et al. 1999
	Ots-212	blue	33	123 - 251	0.9205	0.9360	Greig et al. 2003
Ots-T	*Oki-100*	blue	50	164 - 361	0.9500	0.9567	Unpublished
	Ots-211	red	34	188 - 327	0.9325	0.9414	Greig et al. 2003

Table 3. Tests of population differentiation for temporal collections of summer Chinook from natural and hatchery-origin populations in the upper Columbia River. P-values that are highlighted grey are significantly different after Bonferroni correction (Rice 1989). Adjusted alpha p-value was 0.0001 . The H and W in the collection identifier is for wild or hatchery-origin and the two digit number identifes the year samples were collected.

Wenatchee River

	WenW93U	WenW93D	WenH06	WenW06U	WenW06D	WenH08	WenW08U	WenW08D
WenW93U	****							
WenW93D	0.0162	****						
WenH06	0.0033	0.0102	****					
WenW06U	0.3039	0.1642	0.4795	****				
WenW06D	0.0261	0.0160	0.0678	0.5300	****			
WenH08	0.1126	0.0708	0.0073	0.4359	0.0893	****		
WenW08U	0.2115	0.1148	0.4191	0.7243	0.3830	0.8856	****	
WenW08D	0.1915	0.0014	0.7047	0.4928	0.1671	0.7755	0.7665	****

D - collection was downstream of Tumwater Dam; U - collection was upstream of Tumwater Dam

Methow River

	MetW93	MetH06	MetW06	MetH08	MetW08	MetW09	MetH09
MetW93	****						
MetH06	0.3962	****					
MetW06	0.5481	0.4688	****				
MetH08	0.1408	0.1192	0.2052	****			
MetW08	0.8219	0.8937	0.6156	0.3779	****		
MetW09	0.2564	0.4282	0.2502	0.0328	0.7309	****	
MetH09	0.1543	0.5678	0.0547	0.0017	0.0098	0.0073	****

Okanogan River

	OkanW92	OkanW93	OkanH06	OkanW06	OkanH08	OkanW08	OkanH09	OkanW09
OkanW92	****							
OkanW93	0.0066	****						
OkanH06	0.0193	0.0000	****					
OkanW06	0.2843	0.0082	0.0031	****				
OkanH08	0.1290	0.1106	0.0652	0.7329	****			
OkanW08	0.0106	0.0029	0.0082	0.4075	0.7396	****		
OkanH09	0.0187	0.0001	0.0094	0.0551	0.2214	0.0281	****	
OkanW09	0.0527	0.0000	0.0024	0.7130	0.0262	0.0065	0.0002	****

Table 3 continued.

Wells Dam Hatchery

	Wells91	Wells92	Wells93	Wells06	Wells08
Wells91	****				
Wells92	0.5863	****			
Wells93	0.0490	0.0784	****		
Wells06	0.0089	0.0100	0.0542	****	
Wells08	0.0819	0.1088	0.2552	0.0256	****

Eastbank Hatchery - Wenatchee and MEOK stocks

	EBHWen08	EBHME92	EBHME93	EBHME08
EBHWen08	****			
EBHME92	0.8681	****		
EBHME93	0.0251	0.8661	****	
EBHME08	0.0086	0.9563	0.1895	****

Table 4. F_{ST} pairwise comparisons and genotypic tests of differentiation for hatchery- and natural-origin summer Chinook from the upper Columbia River. Above the diagonol are the F_{ST} values and below are p-values for the test of genotypic differentiation. Non-significant p-values for the result of the genotypic differentiation test are in bold type and F_{ST} values that are not significantly different from zero are in bold type.

	Wenatchee Hatchery	Wenatchee Natural	Methow Hatchery	Methow Natural	Okanogan Hatchery	Okanogan Natural	Wells Hatchery	Eastbank Wenatchee stock	Eastbank MEOK stock	Entiat River	Chelan River
Wenatchee Hatchery	****	**0.0000**	**0.0011**	**0.0000**	**0.0013**	**0.0010**	0.0015	**0.0004**	**0.0007**	**0.0004**	**0.0072**
Wenatchee Natural	**0.4351**	****	**0.0016**	**0.0000**	0.0014	0.0016	0.0024	**0.0006**	0.0012	0.0009	**0.0068**
Methow Hatchery	**0.3800**	**0.0205**	****	**0.0012**	0.0029	**0.0008**	**0.0027**	**0.0014**	**0.0022**	**0.0019**	**0.0078**
Methow Natural	**0.2237**	**0.6566**	**0.1502**	****	**0.0011**	0.0011	0.0013	**0.0007**	**0.0007**	**0.0008**	**0.0053**
Okanogan Hatchery	0.0001	0.0000	**0.0364**	**0.0008**	****	**0.0010**	**0.0014**	0.0029	**0.0000**	**0.0007**	**0.0055**
Okanogan Natural	0.0000	0.0000	**0.1755**	0.0000	**0.0003**	****	0.0016	0.0023	**0.0005**	**0.0008**	**0.0049**
Wells Hatchery	0.0000	0.0000	**0.0129**	0.0000	0.0000	0.0000	****	0.0036	**0.0006**	**0.0008**	**0.0041**
Eastbank Wenatchee	**0.5261**	**0.4102**	**0.1215**	**0.8404**	**0.0015**	0.0000	0.0000	****	**0.0018**	0.0030	0.0096
Eastbank MEOK stock	**0.0485**	0.0000	**0.4246**	**0.0009**	**0.5786**	**0.0051**	0.0000	**0.0065**	****	**0.0005**	**0.0039**
Entiat River	**0.0565**	0.0000	**0.1795**	**0.0044**	**0.0005**	0.0000	**0.0032**	**0.0039**	**0.0042**	****	**0.0052**
Chelan River	**0.0091**	**0.0026**	**0.0182**	**0.0156**	**0.0048**	**0.0030**	**0.0066**	**0.0059**	**0.0493**	**0.0617**	****

Table 5. F_{ST} pairwise comparisons and genotypic tests of differentiation for fall Chinook. Above the diagonol are the F_{ST} values and below are p-values for the test of genotypic differentiation. Non-significant p-values for the result of the genotypic differentiation test are in bold type and F_{ST} values that are not significantly different from zero are in bold type.

	Crab Creek	Hanford Reach Fall	Lyons Ferry Hatchery Fall	lower Yakima River Fall	Marion Drain Fall	Priest Rapids Fall	Umatilla River Fall	Snake River Fall
Crab Creek	****	0.0087	0.0134	0.0079	0.0143	0.0107	0.0073	0.0097
Hanford Reach Fall	0.0000	****	0.0077	**0.0000**	0.0064	**0.0000**	**0.0000**	0.0022
Lyons Ferry Hatchery Fall	0.0000	0.0000	****	0.0063	0.0074	0.0092	0.0062	0.0029
lower Yakima River Fall	0.0000	**0.4140**	0.0000	****	0.0054	**0.0000**	**0.0000**	0.0018
Marion Drain Fall	0.0000	0.0000	0.0000	0.0000	****	0.0067	0.0061	0.0060
Priest Rapids Fall	0.0000	**0.0695**	0.0000	**0.0083**	0.0000	****	**0.0000**	0.0027
Umatilla River Fall	0.0000	**0.4879**	0.0000	**0.4896**	0.0000	**0.2539**	****	0.0011
Snake River Fall	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	****

Table 6. F_{ST} pairwise comparisons and genotypic tests of differentiation for hatchery- and natural-origin summer Chinook from the upper Columbia River and fall Chinook. Above the diagonol are the F_{ST} values and below are p-values for the test of genotypic differentiation. Non-significant p-values for the result of the genotypic differentiation test are in bold type and F_{ST} values that are not significantly different from zero are in bold type.

Population Differentiation

	Wenatchee Hatchery	Wenatchee Natural	Methow Hatchery	Methow Natural	Okanogan Hatchery	Okanogan Natural	Wells Hatchery	Eastbank Wenatchee stock	Eastbank MEOK stock	Entiat River	Chelan River
Crab Creek	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hanford Reach Fall	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0349**
Lyons Ferry Hatchery Fall	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
lower Yakima River Fall	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0074**
Marion Drain Fall	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Priest Rapids Fall	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0642**
Umatilla River Fall	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0579**
Snake River Fall	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 6 continued.

Pairwise F_{ST}

	Crab Creek	Hanford Reach Fall	Ferry Hatchery	Yakima River	Marion Drain Fall	Priest Rapids Fall	Umatilla River Fall	Snake River Fall
Wenatchee Hatchery	0.0158	0.0054	0.0180	0.0056	0.0153	**0.0025**	0.0053	0.0103
Wenatchee Natural	0.0162	0.0059	0.0185	0.0063	0.0157	0.0030	0.0059	0.0102
Methow Hatchery	0.0191	0.0104	0.0248	0.0095	0.0220	0.0069	0.0107	0.0165
Methow Natural	0.0148	0.0057	0.0182	0.0051	0.0148	0.0033	0.0055	0.0101
Okanogan Hatchery	0.0146	0.0041	0.0166	0.0042	0.0151	**0.0016**	0.0041	0.0082
Okanogan Natural	0.0163	0.0064	0.0187	0.0062	0.0170	0.0035	0.0068	0.0113
Wells Hatchery	0.0120	0.0051	0.0135	0.0044	0.0120	0.0028	0.0046	0.0077
Wenatchee stock	0.0184	0.0073	0.0203	0.0074	0.0167	0.0047	0.0084	0.0128
Eastbank MEOK stock	0.0128	0.0036	0.0143	0.0038	0.0135	**0.0019**	0.0038	0.0079
Entiat River	0.0147	0.0059	0.0176	0.0057	0.0156	0.0028	0.0056	0.0100
Chelan River	0.0074	**0.0046**	0.0110	**0.0040**	0.0160	**0.0047**	**0.0035**	0.0072

Table 7. Effective number of breeders per brood year with the largest number of samples of summer Chinook in the upper Columbia River. Brood years with sample size less than 19 individuals (shown in bold type) were not analyzed with exception of the 2008 Wells Hatchery collection. A comparison could not be made between an early and late collection from Wells Hatchery.

WDFW Code	Collection Location	Sample Size	Nb =	CI95(L) =	CI95(U) =
93DD[A]	Wenatchee Natural - upstream	23 / 19	152 / 190	77 / 87	616 / 2,147,483,647
08FV	Wenatchee Natural - upstream	56	162	112	249
93DE[A]	Wenatchee Natural - downstream	39 / 34	145 / 152	94 / 95	256 / 302
08FW	Wenatchee Natural - downstream	67	140	105	199
08FU	Wenatchee Hatchery	60	134	90	213
93EC[A]	Methow Natural	**10 / 15**	---	---	---
08FY	Methow Natural	62	150	106	218
08FX	Methow Hatchery	**9**	---	---	---
93ED	Okanogan Natural	69	142	102	203
08GA	Okanogan Natural	59	127	92	180
08FZ	Okanogan Hatchery	**16**	---	---	---
93DG	Wells Hatchery	**6**	---	---	---
08HY[B]	Wells Hatchery	24 / 39	---	---	---
08MN	Eastbank Hatchery - Wenatchee	88	190	144	263
93DF	Eastbank Hatchery - MEOK	84	171	129	229
08MO	Eastbank Hatchery - MEOK	88	166	126	226

[A] - calculations were made for samples from brood year 1988 / brood year 1989

[B] - samples were collected from brood year 2003 / brood year 2004

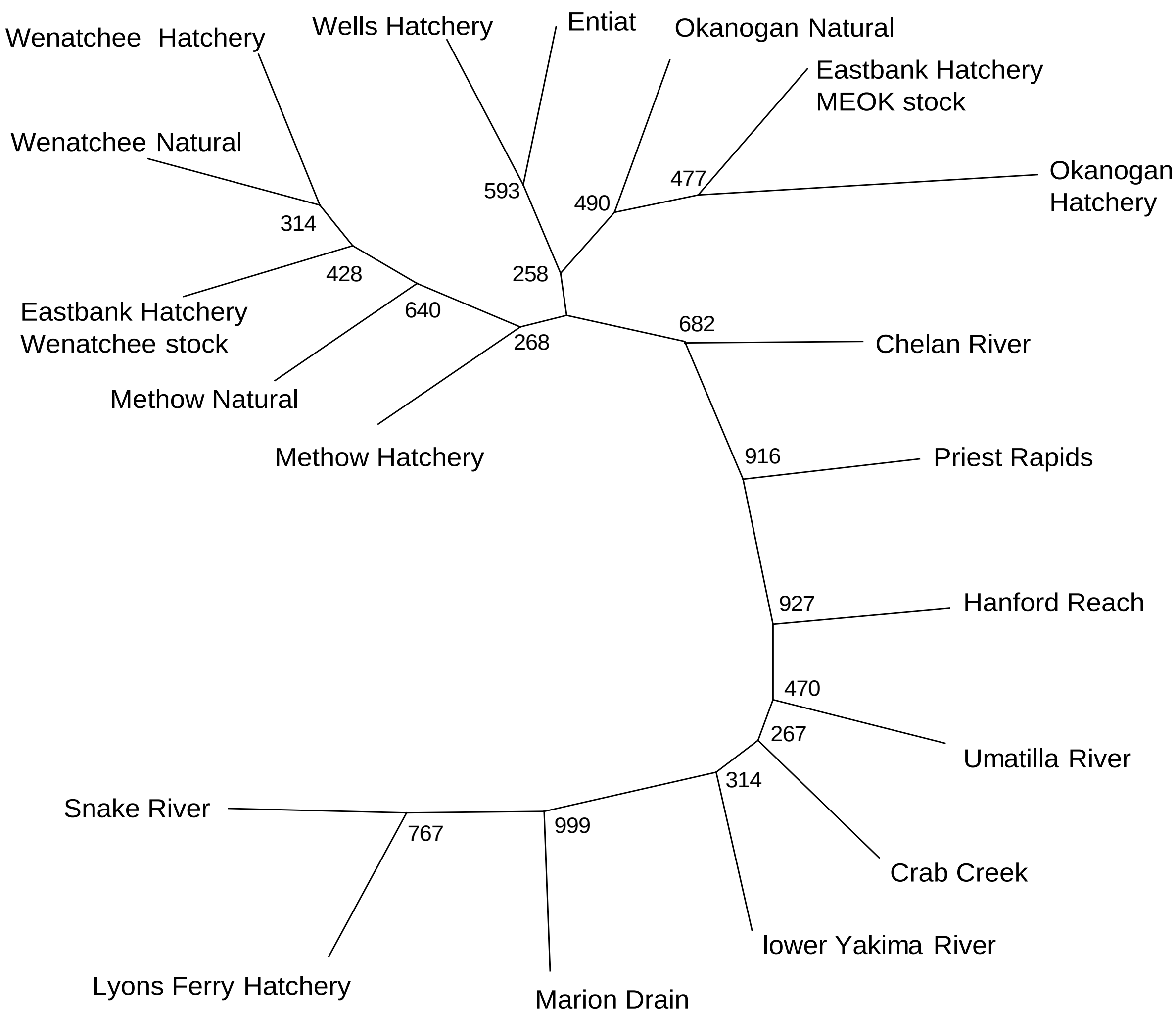

Figure 1. Relationship of natural- and hatchery-origin Chinook collections from the upper Columbia River basin using Cavalli-Sforza and Edwards (1967) chord distance. Bootstrap values are shown at each node.

Appendix Q

Summer Chinook Spawning Ground Surveys in the Methow River Basin and Chelan River, 2019

BioAnalysts, Inc.℠

4725 North Cloverdale Road, Ste. 102
Boise ID 83713

February 1, 2020

To: Chelan and Grant Public Utility Districts

From: Denny Snyder and Mark Miller

Re: 2019 Summer Chinook Spawning Ground Surveys in the Methow Basin and Chelan River.

The purpose of this memo is to provide information on the supplemented natural spawning population of summer Chinook in the Methow and Chelan River basins. This work is part of a larger effort focused on monitoring and evaluating Grant and Chelan PUDs' hatchery supplementation programs. The tasks and objectives associated with implementing Grant and Chelan PUDs' Hatchery M&E Plan for 2019 are outlined in Hillman et al. (2017), *Chelan County PUD Hatchery Monitoring and Evaluation Implementation Plan 2019*, and *Grant County PUD Hatchery Monitoring and Evaluation Implementation Plan for Spring and Summer Chinook in the Wenatchee Basin and Summer Chinook in the Methow Basin 2019*.

METHODS

Spawning ground surveys were conducted by foot and raft beginning the third week of September and ending late-November. Observers floated or walked through sampling reaches and recorded the location and numbers of redds each week (see Figures 1 and 2). Observers recorded the date and redd location with a unique colored icon for each week using an Apple I-Pad.

To maintain consistency, at least one observer surveyed the same stream reach on successive dates. In areas where numerous summer Chinook spawned, we created polygons within the I-pads to help identify the number of redds in these areas. Polygons were bound by noticeable landmarks along the banks (e.g., bridges or trees) or at stream habitat boundaries (e.g., transitions between pools and riffles). The number of redds were then recorded in the corresponding polygon in the map. When possible, observers estimated the number of redds in a large disturbed area by counting females that defended redds. We assumed that the area or territory defended by a female was one redd.

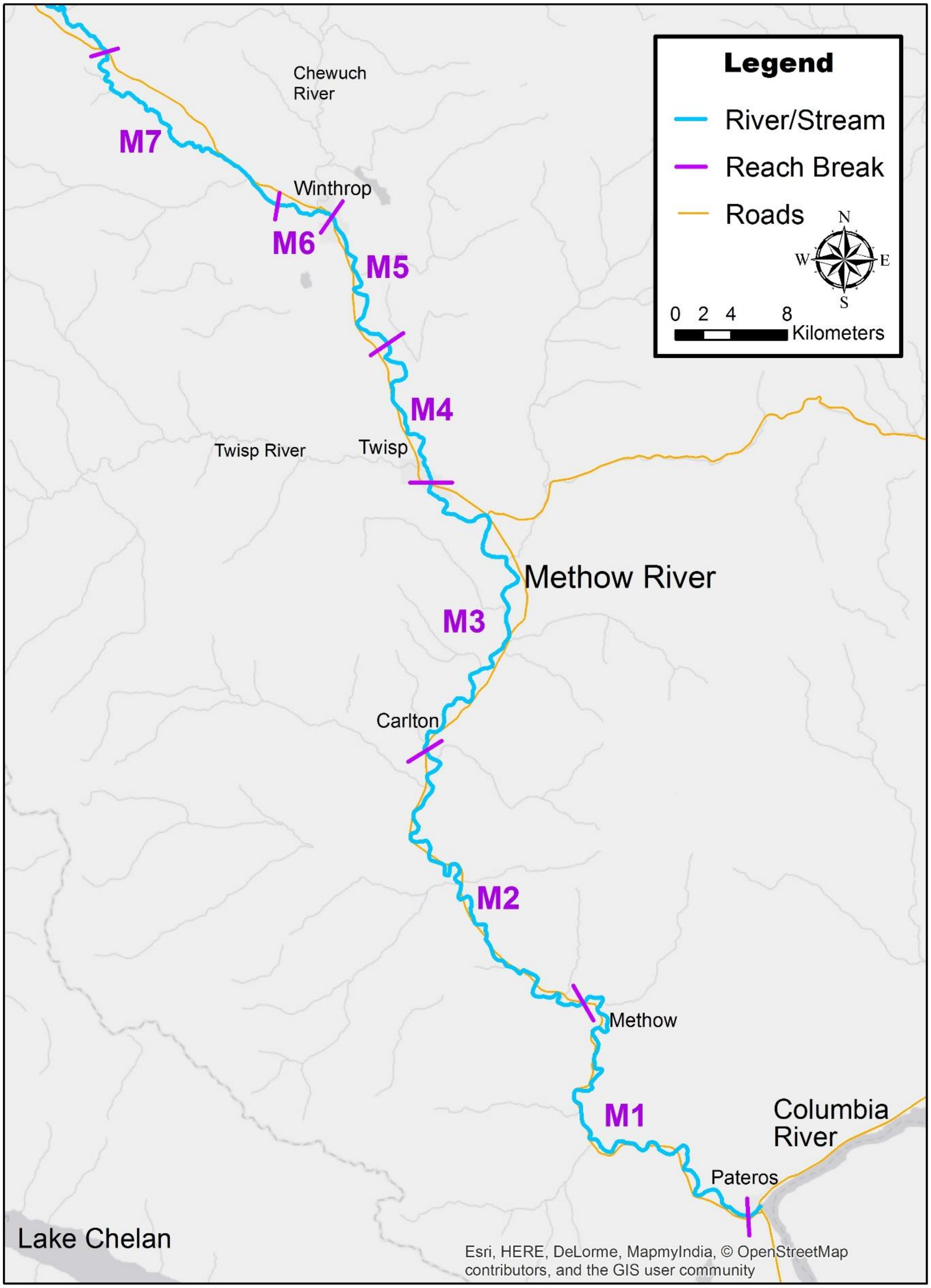

Figure 1. Summer Chinook survey reaches on the Methow River, 2019.

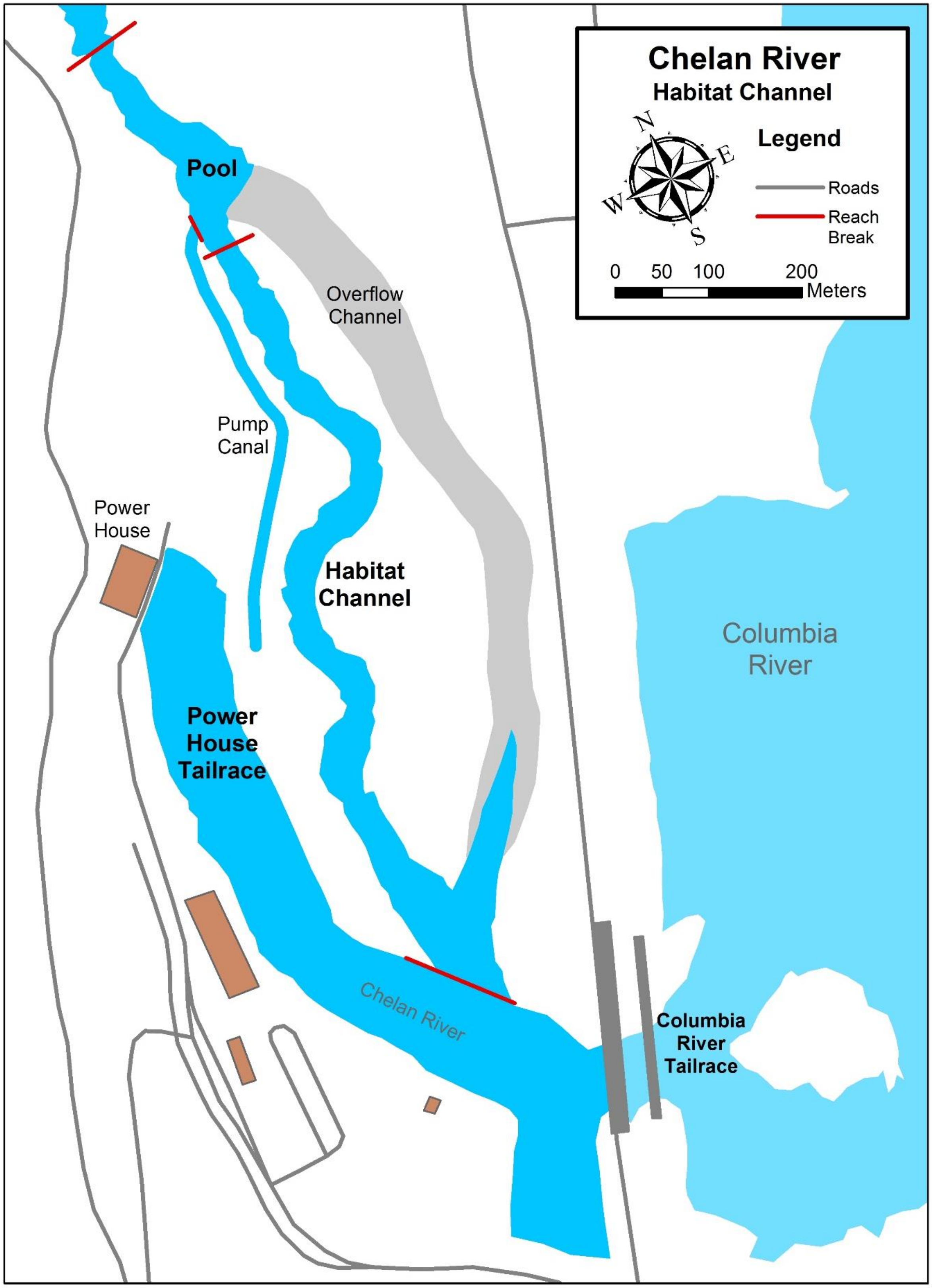

Figure 2. Summer Chinook survey areas on the Chelan River, 2019.

Spawning escapement was estimated as the number of redds times the sex ratio observed at Wells Dam during broodstock collection. Carcasses of summer Chinook were sampled to describe the spawning population. Biological data collection included: scale samples for age analysis, length measurements (POH and FKL), sex, egg voidance, marks, and presence of PIT tags. These data will be used to assess length-at-age, size-at-age, egg voidance, origin (hatchery or naturally produced), and stray rates. No DNA samples were collected on summer Chinook this year. In this report, we only report the number of redds counted in the Okanogan Basin.

RESULTS

Methow

There were 706 summer Chinook redds counted within seven reaches on the Methow River (Table 1). Most redds (89%) were located in reaches from the mouth of the river to the town of Twisp (M1-M3). We estimate, based on expansion of redd counts using the sex-ratio observed at Wells Dam during broodstock collection, that 1,638 summer Chinook (706 redds x 2.32 fish/redd) spawned in the Methow River in 2019.

Table 1. Number of summer Chinook redds observed each week within the Methow River, 2019. Dashes (--) indicate that no survey occurred.

Reach	Location (Rkm)	Sep	Oct				Nov				Total	Percent
		22-28	29-5	6-12	13-19	20-26	27-2	3-9	10-16	17-23		
		39	40	41	42	43	44	45	46	47		
Methow River												
M1	0.0-23.8	--	9	45	70	47	37	8	4	--	220	31.2
M2	23.8-43.8	0	17	49	126	26	12	0	0	--	230	32.6
M3	43.8-63.7	2	7	60	82	26	1	0	0	--	178	25.2
M4	63.7-72.3	0	5	9	8	0	0	--	--	--	22	3.1
M5	72.3-80.1	0	3	19	20	0	0	--	--	--	42	5.9
M6	80.1-83.0	0	0	0	0	1	0	--	--	--	1	0.1
M7	83.0-96.1	4	0	4	5	0	--	--	--	--	13	1.8
	Total:	**6**	**41**	**186**	**311**	**100**	**50**	**8**	**4**	**0**	**706**	**100.0**

Time of spawning was assessed as the number of new redds counted each week in the Methow River. Spawning began the last week of September, peaked in mid-October, and ended the second week of November (Figure 3). Stream temperatures in the Methow River varied from 10.0-12.0°C in September when spawning began. Spawning peaked the third week of October in Reaches M1-M3, M5 and M7, while peak spawning occurred in reach M4 the second week of October. Spawning continued in reach M1 and M2 into the first two weeks of November (Table 1). This was the fourteenth highest redd count observed in the last 28 years for the Methow River (Appendix A).

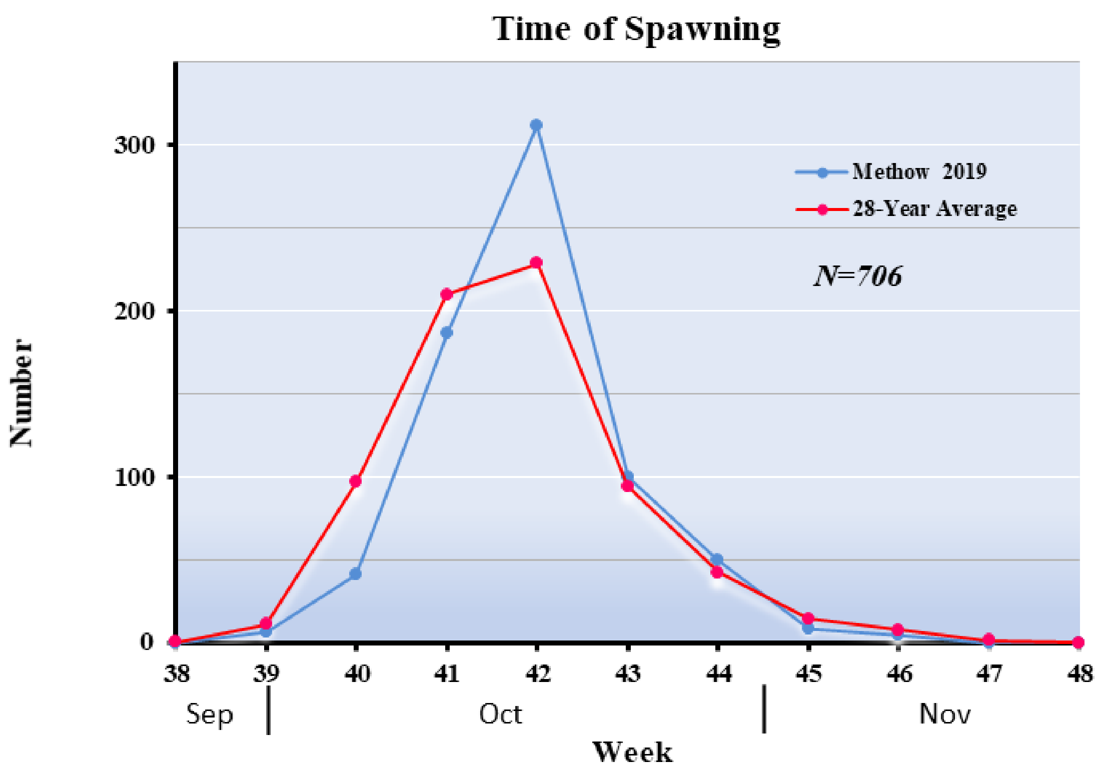

Figure 3. Number of new redds counted each week from late September to mid-November in the Methow River, 2019. The figure shows the beginning, peak, and end of spawning for summer Chinook in the Methow River compared to a 28-year average (1991-2018).

There were 378 summer Chinook salmon carcasses sampled within five reaches on the Methow River (Table 2). No carcasses were found in reaches M-6 and M-7. Twenty-three percent of the fish returning to the Methow River were sampled based on the estimated escapement of 1,638 summer Chinook. Ad-clipped hatchery fish made up 69% and naturally produced fish (adipose fin present) made up 31% of the fish sampled (Table 2).

Table 2. Number and percent of hatchery (ad-clipped) and naturally produced (ad-present) summer Chinook sampled in the Methow River, 2019.

Reach	Location (Rkm)	Ad-Clipped Hatchery				Naturally Produced				Reach Total
		Male	Female	Total	Percent	Male	Female	Total	Percent	
M1	0.0-23.8	65	46	111	73.2	17	14	31	21.8	**142**
M2	23.8-43.8	43	57	100	71.4	24	16	40	28.6	**140**
M3	43.8-63.7	8	32	40	58	10	19	29	42	**69**
M4	63.7-72.3	1	2	3	75	1	0	1	25	**4**
M5	72.3-80.1	0	2	2	13.3	3	10	13	86.7	**15**
M6	80.1-83.0	0	0	0	0.0	0	0	0	0.0	**0**
M7	83.0-96.1	0	0	0	0.0	0	0	0	0.0	**0**
Total		**117**	**139**	**256**	**69**	**55**	**59**	**114**	**31**	**370**

Most (94%) of the ad-clipped hatchery fish were located in reaches M1-M3, while naturally produced fish were sampled within M1-M5 survey reaches (Figure 4). Female summer Chinook accounted for 53% of the fish sampled in 2019 (Table 2). Five Coho salmon carcasses were sampled while conducting Chinook surveys. All Coho data were provided to the Yakama Nation.

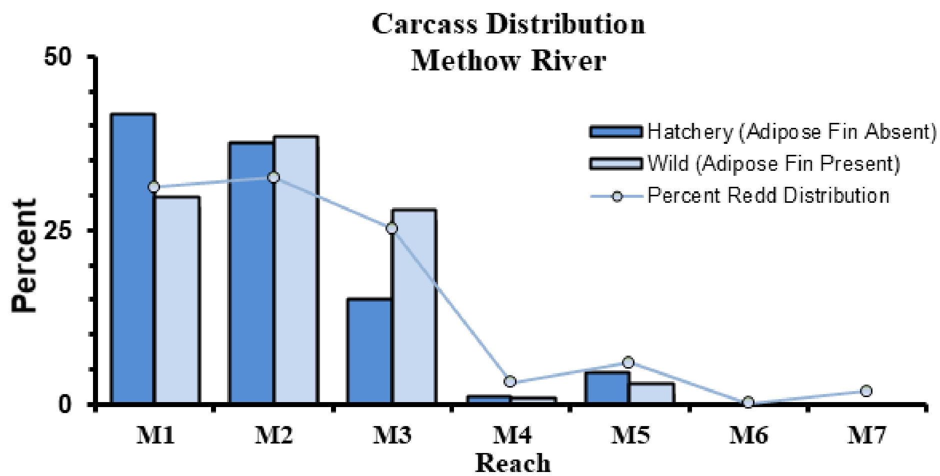

Figure 4. Percent distribution of ad-clipped hatchery and naturally produced fish plotted against the percent distribution of redds observed in reaches on the Methow River, 2019.

Egg voidance was assessed by sampling female carcasses. Based on 192 sampled female carcasses, average egg voidance was 98%. A total of 202 females were sampled; however, 10 carcasses had been scavenged/damaged and were not able to be assessed for egg voidance. Two females (1%) died before spawning (i.e., they retained all their eggs).

Chelan River

We counted 509 redds in the Chelan River in 2019. This is the 2nd highest redd count observed for summer Chinook in the Chelan River since 2000. The majority of spawning occurred in the Powerhouse Tailrace (43%), Habitat Channel (28%), and in the Pool (17%) (Table 3). We estimate, based on expansion of redd counts using the sex-ratio observed at Wells Dam during broodstock collection, that 1,181 summer Chinook (509 redds x 2.32 fish/redd) spawned in the Chelan River in 2019.

Table 3. Number of summer Chinook redds observed each week within the Chelan and Columbia rivers, 2019. Dashes (--) indicate that no survey occurred.

Reach	Location (Rkm)	Sep	Oct					Nov				Dec	Total	Percent
		22-28	29-5	6-12	13-19	20-26	27-2	3-9	10-16	17-23	24-30	1-7		
		39	40	41	42	43	44	45	46	47	48	49		
Powerhouse Tailrace		--	4	25	97	51	22	12	6	0	--	--	217	42.6
Columbia R. Tailrace		--	2	6	27	10	13	6	1	1	--	--	66	13.0
Pool		--	1	18	48	13	3	1	1	0	--	--	85	16.7
Habitat Channel		--	0	19	68	32	19	2	1	0	--	--	141	27.7
Total:		**0**	**7**	**68**	**240**	**106**	**57**	**21**	**9**	**1**	**0**	**0**	**509**	**100.00**

Time of spawning was assessed as the number of new redds counted each week in the Chelan River. Spawning activity began the first week of October and peaked two weeks later (Figure 5). Spawning ended the third week of November. An exceptionally high redd count in 2013 (792 redds) and late spawning in 2014 currently influence the average time of spawning.

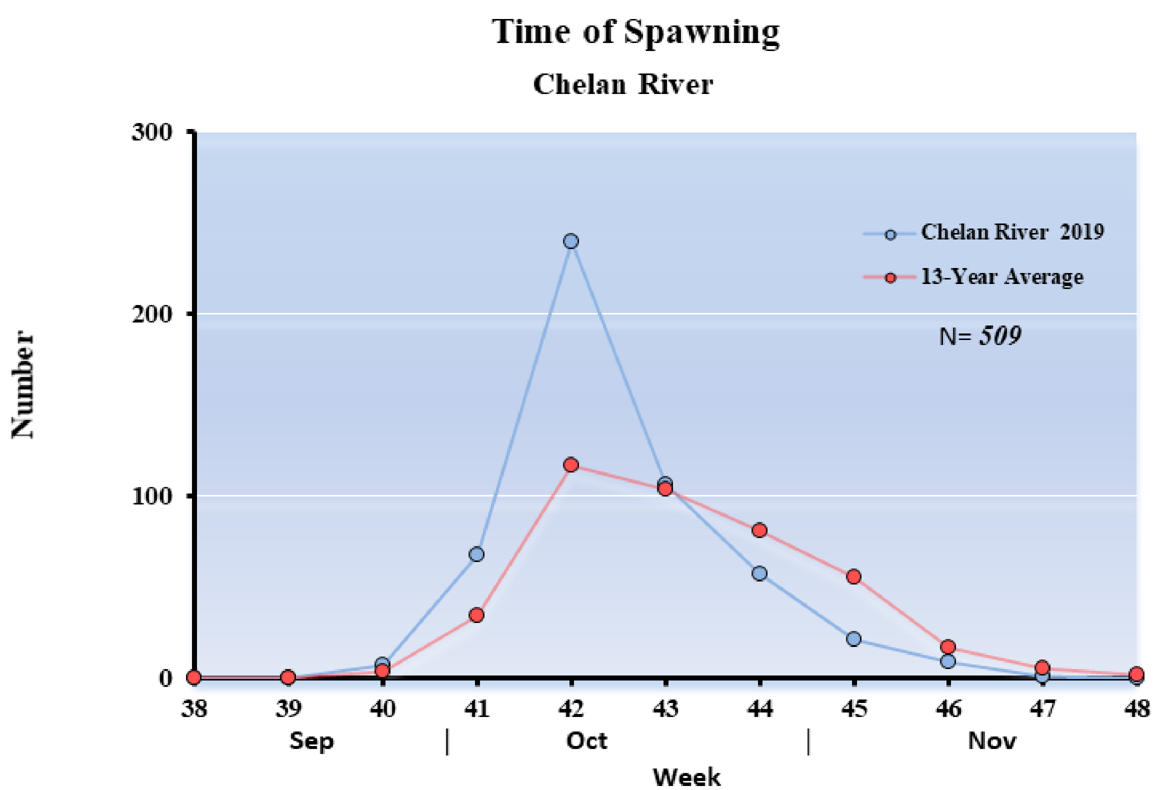

Figure 5. Number of new summer Chinook redds counted each week in the Chelan River from late September to mid-November. The figure displays the beginning, peak, and end of spawning for summer Chinook in the Chelan River in 2019 compared to a 13-year average (2006-2018).

There were 271 summer Chinook carcasses sampled in the Chelan River (Table 4). Twenty-three percent of the summer Chinook spawning in the Chelan River were sampled based on the estimated spawning escapement of 1,181 fish. Based on the absence of their adipose fin, hatchery fish made up 75% of the fish examined and naturally produced (ad-present) fish made up 25% of the fish examined. Females made up 76% of the carcasses examined (Table 4).

Table 4. Number and percent of hatchery (ad-clipped) and naturally produced (ad-present) summer Chinook collected in the Chelan River, 2019.

Reach	Location (Rkm)	Ad-Clipped Hatchery				Naturally Produced				Reach Total
		Male	Female	Total	Percent	Male	Female	Total	Percent	
Powerhouse Tailrace		5	15	20	74.1	1	6	7	25.9	**27**
Columbia R. Tailrace		19	71	90	65.2	8	40	48	34.8	**138**
Pool		10	22	32	94.1	0	2	2	5.9	**34**
Habitat Channel		18	43	61	84.7	3	8	11	15.3	**72**
Total		**52**	**151**	**203**	**74.9**	**12**	**56**	**68**	**25.1**	**271**

The distribution of ad-clipped hatchery fish and naturally produced fish varied within the Chelan River (Figure 6). A disproportionate number of fish (compared to redd counts) were sampled in the Columbia River Tailrace. This likely occurs because carcasses drifted from upstream spawning areas and settled in the Columbia River Tailrace. A higher percentage of hatchery fish were sampled in the Habitat Channel (85%) and Pool (94%) than were natural-origin fish. Hatchery fish abundance (75%) this year was higher than in the past four years, which ranged from 49%-56%.

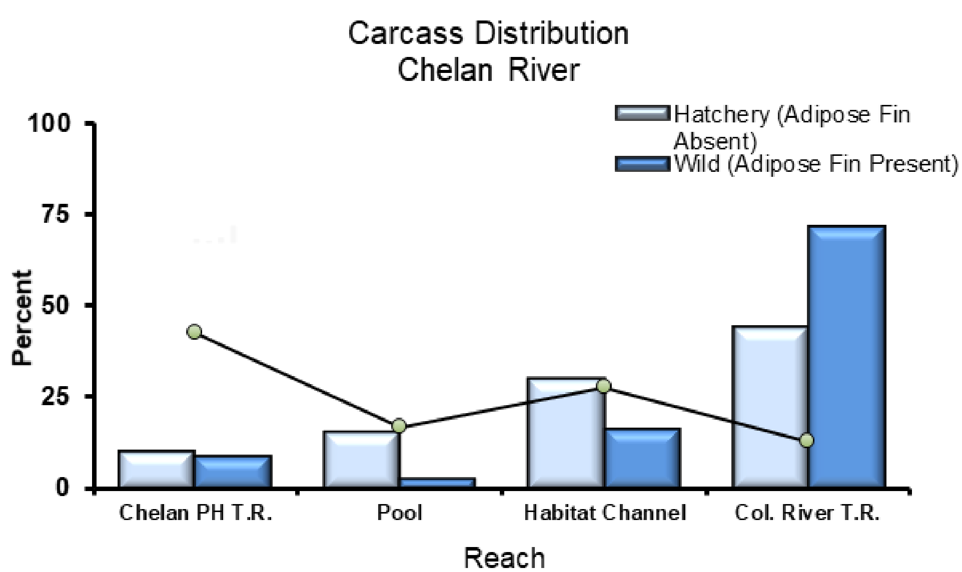

Figure 6. Percent distribution of ad-clipped hatchery and naturally produced fish plotted against the percent distribution of redds observed in reaches on the Chelan River, 2019.

Mean egg voidance assessed from 198 female carcasses was 91%. Egg voidance from nine females could not be determined and seven females (3%) died before spawning.

Four Coho were sampled in 2019 (one in the Columbia River tailrace, one in the Powerhouse Tailrace, and two in the Habitat Channel). A total of eight Coho redds were counted in 2019, with five in the pool, one each in the Powerhouse Tailrace, Habitat Channel, and Columbia River Tailrace. Coho carcass data were given to the Yakama Nation.

Okanogan Basin

In 2019, CCT conducted summer Chinook surveys in the Okanogan River basin. A total of 2,371 redds were counted in the Okanogan Basin (1,638 in the Okanogan River and 733 in the Similkameen River) (Personal Communication, Andrea Pearl, CCT).

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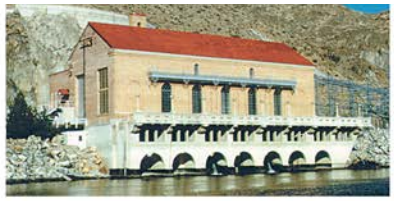
Appendix A. Historical aerial and ground redd counts of summer Chinook in the Methow, Chelan, Okanogan, and Similkameen rivers, 1956-2016.

Year	Methow		Okanogan		Similkameen		Chelan	
	Aerial	Ground	Aerial	Ground	Aerial	Ground	Aerial	Ground
1956	109	--	37	--	30	--	--	--
1957	451	--	53	--	30	--	--	--
1958	335	--	94	--	31	--	--	--
1959	130	--	50	--	23	--	--	--
1960	194	--	29	--	--	--	--	--
1961	120	--	--	--	--	--	--	--
1962	678	--	--	--	17	--	--	--
1963	298	--	9	--	51	--	--	--
1964	795	--	112	--	67	--	--	--
1965	562	--	109	--	154	--	--	--
1966	1,275	--	389	--	77	--	--	--
1967	733	--	149	--	107	--	--	--
1968	659	--	232	--	83	--	--	--
1969	329	--	103	--	357	--	--	--
1970	705	--	656	--	210	--	--	--
1971	562	--	310	--	55	--	--	--
1972	325	--	182	--	64	--	--	--
1973	366	--	138	--	130	--	--	--
1974	223	--	112	--	201	--	--	--
1975	432	--	273	--	184	--	--	--
1976	191	--	107	--	139	--	--	--
1977	365	--	276	--	268	--	--	--
1978	507	--	195	--	268	--	--	--
1979	622	--	173	--	138	--	--	--
1980	345	--	118	--	172	--	--	--
1981	195	--	55	--	121	--	--	--
1982	142	--	23	--	56	--	--	--
1983	65	--	36	--	57	--	--	--
1984	162	--	235	--	301	--	--	--
1985	164	--	138	--	309	--	--	--
1986	169	--	197	--	300	--	--	--
1987	211	--	201	--	164	--	--	--
1988	123	--	113	--	191	--	--	--
1989	126	--	134	--	221	370	--	--
1990	229	--	88	47	94	147	--	--
1991	--	153	55	64	68	91	--	--
1992	--	107	35	53	48	57	--	--
1993	--	154	144	162	152	288	--	--
1994	--	310	372	375	463	777	--	--
1995	--	357	260	267	337	616	--	--

Year	Methow		Okanogan		Similkameen		Chelan	
	Aerial	Ground	Aerial	Ground	Aerial	Ground	Aerial	Ground
1996	--	181	100	116	252	419	--	--
1997	--	205	149	158	297	486	--	--
1998	--	225	75	88	238	276	--	--
1999	--	448	222	369	903	1,275	--	--
2000	--	500	384	549	549	993	--	196
2001	--	675	883	1,108	865	1,540	--	240
2002	--	2,013	1,958	2,667	2,000	3,358	--	253
2003	--	1,624	1,099	1,035	103	378	--	173
2004	--	973	1,310	1,327	2,127	1,660	--	185
2005	--	874	1,084	1,611	1,111	1,423	--	179
2006	--	1,353	1,857	2,592	1,337	1,666	--	208
2007	--	620	1,265	1,301	523	707	--	86
2008	--	599	1,019	1,146	673	1,000	--	153
2009	--	692	1,109	1,672	907	1,298	--	246
2010	--	887	688	1,011	642	1,107	--	398
2011	--	941	1,203	1,714	1,047	1,409	--	413
2012	--	960	1,170	1,613	762	1,066	--	426
2013	--	1,551	NA	2,267	NA	1,280	--	729
2014	--	591	NA	2,231	NA	2,022	--	400
2015	--	1,231	NA	4,276[1]	NA	--	--	448
2016	--	1,115	729	2757	141	1649	--	448
2017	--	690	--	--	--	--	--	421
2018	--	594	--	1554	--	558	--	420

1. The redd count is for the entire Okanogan Basin (Similkameen + Okanogan rivers).

Appendix Q
2020 Annual Financial Report for this Plan Species Account

PUBLIC UTILITY DISTRICT NO. 1 of CHELAN COUNTY
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MEMORANDUM

DATE: **January 22, 2021**

TO: **Becky Gallaher**
Alene Underwood

FROM: **Debbie Litchfield**
Treasurer/Director – Treasury

RE: **Rock Island Hydro Project Habitat Conservation Plan**
2020 Annual Financial Report, Plan Species Account

In accordance with Section 7.4.3 of the Rock Island Habitat Conservation Plan, attached is the 2020 year end annual financial report of the Plan Species Account activity completed by Chelan County Public Utility District No. 1.

Chelan County PUD
Rock Island Hydroelectric Project
Habitat Conservation Plan
Plan Species Cash Account Activity
Annual Financial Report Per Section 7.4.3
Reporting Year:
2020

Beginning Balance:	**1/1/2020**		**$ 7,880,320.82**
Transfers In:			
Rock Island Funding		804,280.00	
Interest Earnings		37,930.06	
Total Transfers In			842,210.06
Transfers Out:			
Payments		(1,742,461.30)	
Bank Service Fees		(6.50)	
Total Transfers Out			(1,742,467.80)
Ending Balance:	**12/31/2020**		**$ 6,980,063.08**

The Plan Species Account was established per the Rock Island Habitat Conservation Plan, Section 7.4.
Interest earnings shall remain in the Account in accordance with Appendix E, Section 7.4.1.