ANNUAL REPORT
CALENDAR YEAR 2015
ACTIVITIES UNDER THE ANADROMOUS FISH AGREEMENT AND HABITAT CONSERVATION PLAN
ROCK ISLAND HYDROELECTRIC PROJECT
FERC LICENSE NO. 943

Prepared for
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1 INTRODUCTION

On June 21, 2004, the Federal Energy Regulatory Commission (FERC) approved an Anadromous Fish Agreement and Habitat Conservation Plan (HCP) for the Rock Island Hydroelectric Project (Rock Island – FERC License No. 943) 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 species addressed in the plan (Plan Species) and their habitats. This document fulfills Article 413(a) of the FERC Project license issued on January 1, 1989[1], and Section 4.8 of the HCP, which requires annual reporting of progress toward achieving the No Net Impact (NNI) goal. Responsibilities toward achieving the NNI goal are described in Section 3 of the HCP and also in a 10-year Comprehensive Report assessing overall status of NNI, 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 of the Wells, Rocky Reach, and Rock Island hydroelectric projects) meet as combined Coordinating Committees, Hatchery Committees, and Tributary Committees groups to expedite the process of overseeing and guiding HCP implementation. Minutes from the 2015 monthly meetings are compiled in Appendices A (Coordinating Committees), B (Hatchery Committees), and C (Tributary Committees). Appendix E lists members of the Rock Island HCP Committees. In addition, the Policy Committees provides a forum for resolution of disputes that are either elevated to or arise in the Coordinating Committees and remain unresolved. The Policy Committees did not meet in 2015 for the purpose of dispute resolution. However, the Policy Committees convened in 2015 to discuss the selection of new HCP Committees Chairpersons, as the Chairperson serving the HCP Policy, Coordinating, and Hatchery Committees since 2004 retired in spring 2015, as further discussed in Section 3.3 and Appendix D. The Coordinating Committee for the Rock Island HCP oversaw the preparation of this 12th Annual Report for calendar year 2015, which covers the period from January 1 to December 31, 2015. (The first 11 Annual Reports covered January 1 to December 31, 2004 through 2014, respectively.)

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[1] 46 FERC, paragraph 61,033 (1989)

2 PROGRESS TOWARD MEETING NO NET IMPACT

The Rock Island 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 three elements: 1) project passage survival; 2) hatchery production; and 3) funding a Plan Species Account for tributary restoration. Survival standards and measures established in the HCP include: 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 2015, Chelan PUD has met or exceeded all requirements for NNI under the Rock Island HCP for spring migrant HCP Plan Species (spring Chinook salmon [*Oncorhynchus tshawytscha*], steelhead [*O. mykiss*], and sockeye salmon [*O. nerka*]). Project survival standards have been exceeded for steelhead, yearling Chinook salmon, and sockeye salmon since 2010. Yearling Chinook salmon, sockeye salmon, and steelhead are currently designated Phase III (Standards Achieved). For subyearling summer/fall Chinook salmon (a summer migrant and a 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[2]) and will continue to be compensated through the Tributary Conservation and Hatchery Compensation Plans at levels consistent with direction 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. Coho salmon (*O. kisutch*) also are currently classified as Phase III (Additional Juvenile Studies[3]) and are compensated at levels indicated by the HCP to achieve NNI through Tributary Conservation and Hatchery Compensation Plans as the species is being reintroduced to the Upper Columbia River.

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[2] The current phase designation will be re-evaluated in 2016.

[3] The current phase designation will be re-evaluated in 2017.

Recalculated NNI production levels were agreed upon in 2011, and implementation began with the 2014 release year and will continue for the next 10 years (release years 2014 through 2023). Chelan PUD has funded the Tributary Conservation Plan at the level agreed to in the HCP ($485,200 in 1998 dollars) and will continue to do so for the duration of the HCP (Section 2.3; Table 1).

Table 1
Rock Island HCP NNI Progress for Plan Species (2015)

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 (Additional Studies)	Yes	Yes	Yes

Notes:
ESA = Endangered Species Act
HCP = Habitat Conservation Plan
NNI = No Net Impact

The remainder of this section of the report summarizes decisions and agreements reached by the Rock Island HCP Coordinating, Hatchery, and Tributary Committees in 2015 in support of achieving and maintaining NNI. This summary is followed by individual sections that summarize achievements, actions, and activities in 2015 that are specific to the areas of project survival and dam operations, hatchery compensation, and funding of tributary habitat protection and restoration projects.

Throughout 2015, the HCP Coordinating, Hatchery, and Tributary Committees reached agreement on numerous issues during meetings, all of which were documented in the meeting minutes, with many described in stand-alone statements of agreement (SOAs). These agreements, along with approvals for funding of habitat projects by the Rock Island HCP Tributary Committee, are summarized in Table 2 and discussed in the remainder of this report.

Table 2
Summary of 2015 Decisions for Rock Island Habitat Conservation Plan

Date	Agreement	HCP Committee	Reference
February 12, 2015	Approved the tributary portion of the revised 2015 Rocky Reach and Rock Island HCP Action Plans	Tributary	Appendix C and Appendix G
February 18, 2015	Approved the hatchery portion of the 2015 Rocky Reach and Rock Island HCP Action Plans	Hatchery	Appendix B and Appendix G
February 18, 2015	Approved the Wenatchee Spring Chinook Permit Re-initiation Letter to NMFS from the HCP Hatchery Committees and PRCC HSC, on condition that no substantive revisions are made following the 1-week review period	Hatchery	Appendix B and Appendix Q
February 18, 2015	Agreed that Mike Schiewe will submit the Wenatchee Spring Chinook Permit Re-initiation Letter to NMFS on behalf of the HCP Hatchery Committees and PRCC HSC	Hatchery	Appendix B
February 24, 2015	Approved the 2015 Rocky Reach and Rock Island HCP Action Plans	Coordinating	Appendix A and Appendix G
February 24, 2015	Approved the 2015 Rocky Reach and Rock Island Spill Plan, contingent on incorporating edits as discussed	Coordinating	Appendix A and Appendix I
February 24, 2015	Approved the 2015 Rock Island Bypass Monitoring Plan, contingent on incorporating edits as discussed	Coordinating	Appendix A and Appendix H
March 18, 2015	Approved the 2015 Steelhead Release Plan	Hatchery	Appendix B and Appendix N

Date	Agreement	HCP Committee	Reference
March 18, 2015	Unanimously agreed to revisit the results of M&E in the Methow Basin to date and develop an adaptive management plan to improve the performance of the Methow Hatchery Programs	Hatchery	Appendix B
March 18, 2015	Agreed to reconvene the HETT to finalize the Hatchery M&E Plan appendices	Hatchery	Appendix B
March 18, 2015	Agreed for Chelan PUD to continue their Summer Chinook Size Target Study for an additional year	Hatchery	Appendix B
March 24, 2015	Agreed to provide McLain Johnson read-only access to the final document library on the HCP Hatchery Committees Extranet site and add Johnson to the HCP Hatchery Committees email distribution list	Coordinating	Appendix A
March 27-31, 2015	Approved, via email, the Final SOA "Regarding Timeline for Review of 'Evaluation of Hatchery Programs Funded by Douglas County PUD 5-Year Report 2006-2010,'" as revised, as follows: Chelan PUD, NMFS, USFWS, WDFW, CCT, and YN approved March 27, 2015; and Douglas PUD approved March 31, 2015	Hatchery	Appendix B and Appendix F
April 8-10, 2015	Approved, via email, the Final 2015 Broodstock Collection Protocols, as follows: Chelan PUD, NMFS, WDFW, and CCT approved April 8, 2015; Douglas PUD and YN approved April 9, 2015; and USFWS approved April 10, 2015	Hatchery	Appendix B and Appendix L
May 20, 2015	Supported the proposed Methow Spring Chinook Review of Five-Year Annual Report Plan Outline	Hatchery	Appendix B
June 11, 2015	Approved CCFEG's budget amendment request for the Twisp-to-Carlton Reach Assessment Project	Tributary	Appendix C
June 11, 2015	Elected to fund CCFEG's White River Floodplain Connection (RM 3.4) Project	Tributary	Appendix C
June 17, 2015	Agreed to change the deadline for Chelan PUD to provide their draft Hatchery M&E Annual Implementation Plan to the HCP Hatchery Committees for review from July 1 (as previously agreed to on December 12, 2012) to August 1 of the year preceding the proposed M&E activities, so long as there are no significant changes requiring HCP Hatchery Committees discussion	Hatchery	Appendix B

Date	Agreement	HCP Committee	Reference
June 17, 2015	Agreed to Chelan PUD's proposed Hatchery M&E Annual Report schedule to provide the HCP Hatchery Committees with a draft Hatchery M&E Annual Report for a 30-day review by June 15, with the final report due to NMFS by September 1	Hatchery	Appendix B
June 17, 2015	Agreed to convene joint sessions with the PRCC HSC when there are agenda items applicable to and which require participation from the HCP Hatchery Committees and PRCC HSC, with the conditions that: 1) any items requiring Committees decision (i.e., Decision Items) will be discussed to the extent necessary and voted on separately in the respective Committees; 2) prior to joint sessions, it will be made clear at the onset of the discussion that the item is a joint discussion and all Parties are welcome to speak freely; and 3) following joint sessions, the PRCC HSC will be provided with the joint section(s) of the draft meeting minutes for review, as well as the opportunity to comment on the joint discussions, and with the final minutes for their respective administrative records	Hatchery	Appendix B
July 9, 2015	Approved Trout Unlimited's funding request for the Icicle Creek – Boulder Field – Wild Fish to Wilderness Project	Tributary	Appendix C
August 28, 2015	Approved the 2016 Chelan PUD Hatchery M&E Implementation Plan	Hatchery	Appendix B and Appendix O
August 28, 2015	Agreed that the 60-day review period for HCP Plans may be shortened to 30 days when approved by the HCP Hatchery Committees	Hatchery	Appendix B
October 21-22, 2015	Agreed to WDFW's proposal to release excess HxH-origin steelhead into lakes (non-anadromous waters) in the Methow and Okanogan basins *(Note: YN provided agreement via email on October 22, 2015)*	Hatchery	Appendix B
November 12, 2015	Approved Trout Unlimited's change-of-scope request for the MVID Instream Flow Improvement Project	Tributary	Appendix C
November 12, 2015	Elected to contribute funding to WDFW's Peshastin Creek RM 105 PIT-tag Detection Site	Tributary	Appendix C
November 18, 2015	Approved the WDFW and University of Idaho study proposal titled, "Supplemental Radio-Tagging of Summer Steelhead"	Hatchery	Appendix B

Date	Agreement	HCP Committee	Reference
November 18, 2015	Agreed to adopt the three-population gene flow model for calculating PNI *(Note: CCT provided agreement via email on December 10, 2015)*	Hatchery	Appendix B
December 16, 2015	Approved using the 20th percentile method for calculating HRR targets (harvest not included) *(Note: Grant PUD approved via email on December 17, 2015, and NMFS approved via phone call with Tracy Hillman on December 22, 2015)*	Hatchery	Appendix B

Notes:
CCFEG = Cascade Columbia Fisheries Enhancement Group
CCT = Colville Confederated Tribes
HCP = Habitat Conservation Plan(s)
HETT = Hatchery Evaluation Technical Team
HRR = hatchery replacement rate
HxH = hatchery-by-hatchery
MVID = Methow Valley Irrigation District
M&E = monitoring and evaluation
NMFS = National Marine Fisheries Service
PIT = passive integrated transponder
PNI = proportionate natural influence
PRCC HSC = Priest Rapids Coordinating Committee Hatchery Sub-Committee
RM = river mile
SOA = statement of agreement
USFWS = U.S. Fish and Wildlife Service
WDFW = Washington Department of Fish and Wildlife
YN = Yakama Nation

2.1 Project Survival and Dam Operations

2.1.1 Status of Phase Designations for Current Plan Species

Following 3 years of valid juvenile survival studies and completion of 3 years of adult passage survival estimates, Rock Island is in Phase III Standards Achieved for 91% combined adult and juvenile survival. This standard is in place for steelhead, spring Chinook salmon, and sockeye salmon.

Section 5.3.3 of the HCP allows for reduced spill if survival standards for juvenile migration have been exceeded and an additional 1 to 3 years of testing confirms achievement of the survival standards under the new spill operations. Beginning in 2007 and continuing in 2008, 2009, and 2010, Chelan PUD tested juvenile survival at Rock Island Dam under a 10%

spill condition during the spring juvenile migration period. Current phase designations for all Rock Island Plan Species under conditions of 10% spill are summarized in Table 3.

Table 3
Phase Designations for Rock Island Habitat Conservation Plan Under Conditions of 10% Spill

Plan Species	Project Survival[1] (%)	Phase Designation	SOA Date
Okanogan and Wenatchee Rivers Sockeye Salmon	93.27	Phase III (Standards Achieved)	December 15, 2009
UCR Steelhead	96.75	Phase III (Standards Achieved)	November 16, 2010
UCR Yearling Chinook Salmon	93.75	Phase III (Standards Achieved)	November 16, 2010

Notes:
1 Juvenile project survival achieved (standard is 93%)
SOA = statement of agreement
UCR = Upper Columbia River

In April 2013, information was reviewed on the status of tag technology and life-history attributes of subyearling summer Chinook salmon in the Mid-Columbia. Based on this information and review, the Rock Island HCP Coordinating Committee agreed that empirical estimates of juvenile project survival are not currently feasible. As a result, on June 25, 2013, the Rock Island HCP Coordinating Committee approved an SOA maintaining subyearling summer Chinook salmon in Phase III (Additional Juvenile Studies) for 3 years (May 2016). The SOA stipulated additional assessments of improvements in tag technology and study methods to evaluate survival study feasibility by 2016. The first assessment will take place in late spring/early summer 2016.

2.1.2 Assessment of Project Survival

The HCP requires that Chelan PUD shall work toward 91% combined adult and juvenile project survival at Rock Island Dam achieved by project-improvement measures implemented within the geographic area of the project. Progress toward this objective is described in Sections 2.1.2.1 through 2.1.2.4.

2.1.2.1 Adult Passage Monitoring

2.1.2.1.1 Rock Island Project

When the HCP was signed in 2002, it was acknowledged there was no scientifically rigorous method for the Rock Island 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 (such as mortality from natural causes, injuries and delayed mortality resulting from passage at downstream projects, and marine mammal predation, harvest, or other types of non-project-specific mortality). Section 5.2 of the HCP states that given the inability to differentiate between the sources of adult mortality, initial compliance with the combined adult and juvenile survival standard would be based on the measurement of 93% juvenile project survival or 95% juvenile 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 Rock Island Project (dam and reservoir) for spring Chinook salmon, steelhead, and sockeye salmon, even though unknown harvest mortality remained in the survival estimates for steelhead and sockeye salmon. 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 spring Chinook salmon and steelhead, adults destined for the Methow and Okanogan river systems were used for the survival evaluation. For sockeye salmon, adults originating from the Wenatchee and Okanogan river systems were evaluated. The 3-year arithmetic mean survival rates at Rock Island Project for adult spring Chinook salmon, steelhead, and sockeye salmon were 99.89%, 99.31%, and 98.37%, respectively (Table 4.) Chelan PUD will re-evaluate adult passage survival at Rock Island in 10-year intervals, as required.

Table 4 details HCP juvenile, adult, and combined survival rates at the Rock Island and Rocky Reach projects. Adult conversion rates were calculated from adult passage data for the years 2010 through 2012.[4]

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[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.

Table 4
Habitat Conservation Plan Juvenile, Adult, and Combined 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%).

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 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).

2.1.2.1.2 Wanapum Dam Emergency Reservoir Drawdown

In February 2014, in response to the discovery of a fracture in Wanapum Dam (Section 2.1.3.1.2), Grant PUD steadily drew down the Wanapum Reservoir approximately 26 feet to an operating range of 543 to 545 feet. Subsequently, Chelan PUD implemented adult fish passage and monitoring and evaluation (M&E) measures at Rock Island Dam, as outlined in the Rock Island Interim Fish Passage Plan (RI IFPP[5]). Adult fish passage measures involved installing three 30-foot-long denil structures to allow fish passage at lower tailwater elevations at two of the three ladder entrances (left bank and right bank; Section 2.1.3.2). Juvenile fish passage measures included minor modifications to juvenile spill shaping. During implementation of the RI IFPP, forebay elevations remained within the normal operating range to avoid impacts to the juvenile spill program and maintain adult

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[5] Contains critical energy infrastructure information (CEII)-designated material in accordance with the CEII procedures found in 18 CFR § 388.113(c), and is not for public distribution.

ladder exit criteria on all three adult fishways. No significant fish passage delays were observed at Rock Island Dam while the Wanapum Reservoir was drawn down to the 543- to 545-foot operating elevation.

By December 2014, an elevation of 561.8 feet was achieved in the Wanapum Reservoir (i.e., intermediate pool raise). At this elevation, all denil structures at Rock Island Dam were completely submerged. However, Chelan PUD still continued to closely monitor fish passage at Rock Island Dam, because the Wanapum Reservoir was still drawn down below the normal operating elevation. In April 2015, the Wanapum Reservoir was back to normal operating conditions. No significant fish-passage delays were observed at Rock Island Dam during the Wanapum Reservoir drawdown. Rock Island Dam was restored to its normal condition during the 2015/2016 winter maintenance outage, including removal of the denil structures (see Section 2.1.3.2).

2.1.2.2 Valid Study Flow Duration Curve Update

The Rock Island HCP, Section 13.24, requires that as part of the 2013 comprehensive review, and every 10 years thereafter, the Rock Island Coordinating Committee shall 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 day average outflow. In 2013, efforts began to update the Flow Duration Curve, as required by the Rock Island HCP. 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 is 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 and expand the dataset used for the summer period to include data from June 1 through August 15, as opposed to the former definition of July 1 through August 15 for the summer 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 (Section 2.1.3.1.3). The final updated Flow Duration Curves will now be completed in 2016.

2.1.2.3 2015 Survival Studies

2.1.2.3.1 Yearling Chinook Salmon

No yearling Chinook salmon survival studies were conducted in 2015 at the Rock Island Project.

2.1.2.3.2 Subyearling Chinook Salmon

Since 2010, Chelan PUD has been compiling information on PIT-tag detections of subyearling Chinook salmon at Rock Island Dam to increase the understanding of subyearling life histories in the mainstem Columbia River upstream of Rock Island Dam. As discussed in Section 2.1.1 above, in April 2013, data were presented regarding the status of tag technology and life-history attributes for subyearling summer Chinook salmon in the Mid-Columbia. The Rock Island HCP Coordinating Committee agreed that, based on this information, an empirical estimate of subyearling project passage survival is not currently feasible. In June 2013, the Rock Island HCP Coordinating Committee approved an SOA maintaining subyearling summer Chinook salmon in Phase III (Additional Juvenile Studies) for up to 3 years (June 2016) and agreed to conduct annual assessments of improvements in tag technology and study design to evaluate survival study feasibility by 2016.

2.1.2.4 2016 Planned Survival Studies

There are no planned Rock Island juvenile salmonid project survival studies for 2016. Chelan PUD has achieved a Phase III (Standards Achieved) designation for yearling Chinook salmon, sockeye salmon, and steelhead at the Rock Island Project (Section 2.1.1). Subyearling Chinook salmon project survival status is pending development of suitable technology and is currently designated Phase III (Additional Juvenile Studies). The Rock Island HCP Coordinating Committee agreed to annually assess improvements in tag technology and study design to evaluate subyearling Chinook salmon survival study feasibility (Section 2.1.1). All designations will be re-evaluated at 10-year intervals, as required.

2.1.3 Project Operations and Improvements

This section summarizes project operations and progress toward maintaining the juvenile project survival standards at Rock Island Dam in 2015. Actions in 2015 were guided by the 2015 Rocky Reach and Rock Island HCP Action Plans (Appendix G), as approved by the Rocky Reach and Rock Island HCP Coordinating Committees on February 24, 2015 (Appendix A).

2.1.3.1 Operations

2.1.3.1.1 Juvenile Fish Spill Operations

In February 2015, the Rock Island and Rocky Reach HCP Coordinating Committees approved the 2015 Rock Island Bypass Monitoring Plan (Appendix H) and the *2015 Fish Spill Plan Rock Island and Rocky Reach Dams* (Appendix I). In 2015, the Rock Island bypass system operated from April 1 through August 31, 2015, which covered the normal bypass operating period for the outmigration of juvenile salmon and steelhead at Rock Island Dam.

Spring fish spill at Rock Island Dam for yearling Chinook salmon, steelhead, and sockeye salmon began on April 16, 2015, at 0001 hours and continued uninterrupted for 46 days through midnight on May 31, 2015. The target spill level for the duration of the spring spill period in 2015 was 10% of the estimated daily average river flow, as specified and approved in the Rock Island Fish Spill Plan. Actual spill for this 46-day period averaged 10.29% of the total river flow. The Columbia River average flow through Rock Island Dam during the spill period was 108,333 cubic feet per second (cfs), and the daily average spill was 11,144 cfs. Spill at Rock Island was provided for 99.6% of the steelhead outmigration, 76.6% of the sockeye salmon outmigration, and 99.4% of the yearling Chinook salmon outmigration. Spring spill was started slightly late for sockeye salmon, which resulted in it being the only species where 95% or more spill coverage was not provided due to an uncharacteristic decrease in juvenile sockeye salmon counts after spring spill was initiated.

Summer fish spill at Rock Island Dam for subyearling Chinook salmon began at 20% of daily average flow on June 1, 2015, at 0001 hours, immediately following completion of spring spill at 10%. Spill continued uninterrupted for 72 days at a spill target of 20% of the estimated daily average river flow. Spill ended on August 11, 2015, at 2400 hours. Actual spill for the 72-day period averaged 19.86% of the total river flow. The Columbia River average flow rate past Rock Island Dam during the spill period was 102,557 cfs, and the daily average spill rate was 20,370 cfs. Summer spill at Rock Island Dam covered 99.2% of the subyearling Chinook salmon outmigration past Rock Island Dam. Complete Rock Island Dam 2015 fish spill operations results are summarized in the 2015 Rocky Reach and Rock Island Fish Spill Report (Appendix J).

2.1.3.1.2 Wanapum Dam Emergency Reservoir Drawdown

On February 27, 2014, Chelan PUD was notified by Grant PUD that a 65-foot-long by 2-inch-wide horizontal fracture was discovered in one of the spillway piers of Wanapum Dam, a Grant PUD-owned hydroproject located on the Columbia River approximately 36 river miles (RMs) downstream from Chelan PUD's Rock Island Dam. The fracture (later determined to be primarily caused by a mathematical error during the pre-construction design of Wanapum Dam) was located on the upstream side of Wanapum Dam Spillway Pier Monolith No. 4 at an elevation of approximately 485 feet (Wanapum normal operations are at an elevation of 571.5 feet). Grant PUD, FERC, and an independent Board of Consultants (convened by Grant PUD, including experts in engineering geology, geotechnical engineering, and structural engineering), conducted modeling efforts that indicated that 545 feet was the reservoir water elevation that needed to be reached to stabilize Wanapum Dam Spillway Pier Monolith No. 4. Based on these results, Grant PUD steadily drew down the Wanapum Reservoir approximately 26 feet to an operating range of 543 to 545 feet, which was achieved on March 4, 2014.

Chelan PUD, in close coordination with CH2M HILL (under contract with Chelan PUD), the U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS), developed the RI IFPP, which outlined adult fish passage and M&E measures and juvenile fish passage and spill planning. Adult fish passage measures involved installing three 30-foot-long denil structures to allow fish passage at lower tailwater elevations at two of the three ladder entrances (left bank and right bank; Section 2.1.3.2). Juvenile fish passage measures included minor modifications to juvenile spill shaping. Chelan PUD filed the RI IFPP with FERC on March 21, and on March 26, 2014, FERC issued to Chelan PUD the FERC Order approving the plan.

In June 2014, installation of the denil structures, as outlined in the FERC-approved RI IFPP, was completed at the right and left bank fish ladders at Rock Island Dam. The denil structures were installed at an elevation of 559 feet to use in the event that the tailwater elevation dropped below that point. When tailwater elevations were above 559 feet, the denil structures were submerged, and fish passed Rock Island Dam via the regular fish passage routes. Once tailwater elevations dropped below 559 feet and the denil structures were in use, a minimum river flow of 45 thousand cubic feet per second (kcfs) needed to be managed to maintain a tailwater elevation to keep the denil structures in operation (the invert of the denil structures was designed for 38 kcfs). Fishway attendants were on station 24 hours per day, 7 days per week monitoring the fishways to ensure they were in tune with changing river elevations. The attendants were trained to optimize conditions for use of the denils, as needed. In October 2014, modifications were completed to the middle adult fishway side-entrances at Rock Island Dam to provide an additional fish passage route into the middle fishway at low tailwater elevations. Chelan PUD closely monitored fish passage throughout the 2014 migration season, and no significant delays were observed (Section 2.1.2.1.2).

In November 2014, refilling the Wanapum Reservoir began, and in December 2014, an elevation of 561.8 feet was achieved (i.e., intermediate pool raise). At this elevation, all denil structures at Rock Island Dam were completely submerged. In 2015, refilling the Wanapum Reservoir continued, and in April 2015, the reservoir was back to normal operating conditions. Fish passage during the 2015 migration season was via the normal passage routes at Rock Island Dam. In August 2015, FERC approved the RI IFPP Biological Assessment (BA), which included removal of the denil structures and other actions to restore Rock Island Dam to its normal condition, as further described in Section 2.1.3.2.

Following the discovery of the fracture in Wanapum Dam, Chelan PUD submitted to FERC monthly RI IFPP progress reports documenting progress of the implementation of the RI IFPP. In March 2015, considering the current status and progress of the repairs at Wanapum Dam, FERC agreed that the January 2015 report (Appendix K) would be the final monthly report filed. Chelan PUD also provided updates on the situation at Wanapum Dam at each HCP Coordinating Committees meeting from March 2014 to April 2015, with the final update in August 2015 (Appendix A). On June 12, 2015, Chelan PUD filed the draft BA with FERC. In FERC's letter dated September 11, 2015, FERC requested concurrence from NMFS and USFWS with FERC's BA (adopted Chelan PUD's draft BA). USFWS responded on October 16, 2015, that a "likely to adversely affect" determination was appropriate. Chelan PUD notified the USFWS on December 10, 2015, of its schedule to remove the denil structures during the 2015/2016 adult fishway winter maintenance outage.

2.1.3.1.3 Pikeminnow Predator Control

In 2015, northern pikeminnow (*Ptychocheilus oregonensis*) predator-control work continued 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. The contract was extended to overlap with the 2015 U.S. Department of Agriculture (USDA) effort. The USDA hook-and-line angling program commenced during the peak of juvenile salmonid migration. The total combined harvest of pikeminnow in 2015 from Rocky Reach and Rock Island reservoirs was 89,611 fish. Harvest numbers from the various control efforts in 2015 were as follows: USDA hook-and-line angling – 59,730 fish; Columbia Research long-line angling – 26,790 fish; East Wenatchee Rotary Club pikeminnow derby – 2,427 fish; and angling by Chelan PUD Fish and Wildlife personnel – 664 fish. As in 2014, Chelan PUD once again provided contract funding for the annual East Wenatchee Rotary Club Pikeminnow Derby in 2015. A report summarizing results of the 2015 removal effort is expected sometime in early 2016.

2.1.3.1.4 Tumwater Fishway Repairs

On February 17, 2015, Tumwater Dam was temporarily taken out of service for needed repairs. On February 18, 2015, members of the Rocky Reach Fish Forum also conducted a rapid assessment for lamprey (*Entosphenus tridentatus*) passage. Chelan PUD coordinated the ladder outages with steelhead trapping activities conducted by the Washington Department of Fish and Wildlife (WDFW). Chelan PUD and WDFW discussed the needed repairs (see Section 2.1.3.2), and together recommended completing all repairs consecutively to avoid the need for multiple dewaters and fish rescues. There was no fish passage throughout the duration of the repairs. Construction was completed and the ladder rewatered by March 4, 2015. These activities were also discussed with the HCP Hatchery Committees (see Section 2.2.2.12).

2.1.3.2 Improvements and Maintenance

Facility improvements and maintenance at the Rock Island Project in 2015 that had the potential to affect Plan Species are described in this section.

Auxiliary Water System Picket-Barrier Repairs

In 2013, a bowed vane was discovered in the auxiliary water system picket-barrier on the right ladder at Rock Island Dam. During the 2013/2014 winter maintenance outage, as a temporary fix, the weaker areas were reinforced with a bracket riveted to the bowed picket-vane to prevent fish from passing through the bowed area. During the 2014/2015 winter maintenance outage, a full inspection of the auxiliary water system picket-barrier leads was conducted. The inspection results showed the structural integrity of the picket-barrier as a whole is sound and not in need of replacement, and annual inspections will continue.

Wanapum Dam Emergency Reservoir Drawdown Repairs

In 2014, in response to the drawdown of the Wanapum Reservoir (see Section 2.1.3.1.2), Chelan PUD installed adult fish passage structures at Rock Island Dam, as outlined in the FERC-approved RI IFPP. The denil structures installed at the right bank (tailrace entrance and left powerhouse entrance) and left bank adult fishways comprised two 30-foot-long sections with a rest box in the middle. The right bank extensions had two denils (6-foot-wide total) at each entrance designed for an attraction flow of 90 cfs; the left bank extension is a single denil (3 feet wide) designed for 55 cfs. Each ladder extension had a lamprey passage way (18 inches wide by 8 inches high, with 4 inches of water flow) installed on the side of the denil, which follows the same slope and contour as the denil. These extensions provided passage down to a tailwater elevation of 547 feet. Regarding the center ladder at Rock Island Dam, reliability of function, inability to securely install modifications, and low incidence of fish use at this ladder precluded any initial attempt to make modifications at this entrance; however, in October 2014, the Rock Island HCP Coordinating Committee approved excavating concrete from the middle adult fishway side-entrances at Rock Island Dam to provide an additional fish passage route into the middle fishway at low tailwater elevations, and the modification was completed on October 8, 2014. In August 2015, FERC approved the RI IFPP BA, which included removal of the denil structures and refilling of concrete in the middle adult fishway side-entrances. This was completed during the 2015/2016 winter maintenance outage at Rock Island Dam.

Right Bank Adult Fishway PIT-tag Antenna

In 2014, it came to Chelan PUD's attention that PIT-tagged sockeye salmon passing via the Rock Island Dam right bank adult fishway were not being detected. Biomark tested the right bank PIT-tag antenna and it registered 100% noise (meaning no detections were occurring). A temporary PIT-tag antenna was installed upstream of the count window, about 5 feet from the fishway exit, which comprised a combination half- and full-duplex antennas. Biomark fabricated a new combination half- and full-duplex PIT-tag antenna array to install upstream of the count window, which is a much quieter location than at Powerhouse 2. The new combination two-antenna array was permanently installed during the 2014/2015 winter maintenance period at Rock Island Dam.

Trash Boom Repair

During the 2014/2015 winter maintenance outage, the trash boom located above the exit of the right fish ladder at Rock Island Dam was repaired. The trash boom was damaged in 2014, when the forebay elevation was dropped in response to the Wanapum Dam repair. Repairs included replacing and strengthening the mount that secures the trash boom to the shoreline.

Left Bank Fish Ladder Entrance Gate Operators

During the 2014/2015 winter maintenance outage, new operators for the entrance gates were installed, as the previous infrastructure was old and worn.

Tumwater Fishway Repairs

On February 17, 2015, Tumwater Dam was temporarily taken out of service for needed repairs (see Section 2.1.3.1.4). Repairs included: 1) fixing spalled concrete, along with measures to ensure the concrete cured correctly; 2) installing a replacement PIT-tag antenna; and 3) making a revision to the attraction water foot screens to meet NMFS criteria (i.e., fixed a gap between the screens that did not meet passage criteria). Chelan PUD and WDFW discussed the needed repairs, and together recommended completing all repairs consecutively to avoid the need for multiple unwaters and fish rescues. Construction was completed and the ladder rewatered by March 4, 2015.

Rock Island Turbine Units B5 to B8 Continued Rehabilitation

In 2003, FERC approved the rehabilitation of Rock Island Dam Powerhouse 1 Units B5 through B10. Turbine Units B9 and B10 were rehabilitated in 2008 and 2012, respectively. The rehabilitation effort was then paused to observe how the rehabilitated units performed. Testing indicated that rehabilitated Units B9 and B10 are performing better than expected (higher efficiency). The rehabilitation effort is now ready to move forward again, with Unit B6 to be completed first in 2017, followed by B5 in 2018, B7 in 2019, and B8 in 2020.

2.2 Hatchery Compensation

Section 8.1 of the Rock Island 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 2015, Chelan PUD continued funding and provided capacity for hatchery production consistent with meeting NNI, and will continue to do so through 2016. Recalculated hatchery production values required to meet NNI through 2023 were approved by the Rock Island 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 Rock Island Project in 2015 included the release of 2,919,019 juvenile salmonids (combined Rock Island and Rocky Reach hatchery compensation; Table 5).

To improve coordination, a representative from Grant PUD is invited to the monthly HCP Hatchery Committees meetings. The Grant PUD representative and the Priest Rapids Coordinating Committee Hatchery Sub-Committee (PRCC HSC) facilitator also receive meeting announcements, final agendas, and meeting minutes. Furthermore, in June 2015, the HCP Hatchery Committees agreed to convene joint sessions of the HCP Hatchery Committees and PRCC HSC when discussing agenda items applicable to and requiring participation from both Committees (see Section 2.2.2.17). This practice benefits the HCP Hatchery Committees through increased coordination and sharing of expertise. The Grant

PUD representative has 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.

2.2.1 Hatchery Production Summary

Table 5 summarizes and compares HCP hatchery production objectives and actual 2015 smolt releases.

Table 5
2015 Production Level Objectives and Smolt Releases for Rock Island Habitat Conservation Plan Hatchery Programs

Species	Program	Final Rearing Site	Rock Island Production Level Objectives (2014 to 2023)[a]	Total Releases for Rock Island in 2014 (Number of fish)
Spring Chinook Salmon	Chiwawa (Wenatchee)	Chiwawa	144,026	147,480 smolts
Summer/Fall Chinook Salmon	Wenatchee	Dryden Pond	318,000	470,570[b] smolts
Steelhead	Wenatchee	Chiwawa Hatchery[c]	247,300[e]	236,636 smolts
Sockeye Salmon	Okanogan	Kl cp'elk' stim Hatchery	591,050[e]	1,764,223 fry
Spring Chinook Salmon	Okanogan	CJH	115,000 (12.81% of CJH production)	91,144 smolts
Summer Chinook Salmon	Okanogan	CJH/Omak Pond	94,570 (13.51% of CJH production	92,006’ sub-yearlings
Summer Chinook Salmon	Okanogan	Similkameen	166,569 (12.81% of CJH production)	116,966 yearlings

Notes:

a As specified in the Rocky Reach and Rock Island HCP Hatchery Committees Statement of Agreement Chelan PUD Hatchery Compensation, Release Years 2014-2023, approved December 14, 2011.

b Includes Grant PUD production obligations.

c Includes releases from Blackbird Island Pond.

d Steelhead production at Chiwawa Hatchery includes Rock Island and Rocky Reach obligations.

e Combined with the Rocky Reach HCP, the Okanogan sockeye salmon production requirement totals 591,050 fish (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 Okanogan Skaha Lake sockeye salmon reintroduction program until otherwise determined by the HCP Hatchery Committees.

CJH = Chief Joseph Hatchery
HCP = Habitat Conservation Plan

2.2.2 Hatchery Planning and Implementation

Sections 2.2.2.1 through 2.2.2.17 detail 2015 actions that are relevant to planning for hatchery operations supporting the HCP.

2.2.2.1 2015 Broodstock Collection Protocols

In February 2015, the HCP Hatchery Committees began their review of the draft 2015 Broodstock Collection Protocols (for Chinook salmon and steelhead). The revised draft protocols were approved, via email, as follows: Chelan PUD, NMFS, WDFW, and the Colville Confederated Tribes (CCT) approved April 8, 2015; Douglas PUD and the Yakama Nation (YN) approved April 9, 2015; and USFWS approved April 10, 2015. The Final 2015 Broodstock Collection Protocols (Appendix L) were distributed to the HCP Hatchery Committees on April 14, 2015, and implemented at program hatcheries throughout 2015. In-season revisions were made as needed in coordination with the HCP Hatchery Committees. As in previous years, the 2015 Broodstock Collection Protocols were intended to guide the collection of salmon and steelhead broodstock in the Methow River, Wenatchee River, and Columbia River basins. The protocols are consistent with previously defined program objectives such as program operational intent (i.e., conservation and/or harvest augmentation) and mitigation production levels (i.e., HCPs), and they comply with ESA permit provisions.

2.2.2.1.1 Brood Year 2015 Chelan Falls Summer Chinook Salmon

In August 2015, WDFW notified the HCP Hatchery Committees that a Chelan Falls alternate brood source needed to be pursued because Eastbank Hatchery outfall collections were not meeting expectations. The CCT were able to support brood collection to backfill shortfalls. Fish collected at Eastbank Hatchery were prioritized over the ones collected at Chief Joseph Dam.

2.2.2.2 Post-release Performance of Chinook Salmon and Steelhead Reared in Partial Water Reuse Circular Vessels Versus Traditional Flow-through Raceways

In January 2015, Chelan PUD presented to the HCP Hatchery Committees results from studies conducted by Chelan PUD and Grant PUD comparing the health and performance of summer Chinook salmon and steelhead that were reared in partial water reuse vessels (recirculating aquaculture systems; RASs) versus raceways (flow-through; FT) at Eastbank Fish Hatchery and Chiwawa Acclimation Facility, in addition to comparing performance of summer Chinook salmon reared in single-pass circular vessels at Chelan Falls as compared with fish reared in FT raceways at the Entiat National Fish Hatchery. The purpose of this study was to investigate lower-water-use rearing methods (i.e., RASs/circular vessels) versus traditional methods (i.e., FT). In summary, for summer Chinook salmon, the study found equal or better survival and quality of fish and improved age structure for adult returns among fish reared in RASs versus FTs. For steelhead, the study results were mixed, but indicated that partial water reuse is promising for steelhead but difficult to determine a rearing vessel effect due to the presence of several confounding variables and no identifiable covariates. The *Comprehensive Summary of Partial Water Reuse and Circular Pond Rearing Systems at Chelan PUD Hatcheries* (Appendix M), which includes documents representing more than 8 years of study design, implementation, and evaluation of partial water reuse systems as compared with standard FT raceway hatchery rearing vessels, as well as performance of circular rearing ponds without partial water reuse, was distributed to the HCP Hatchery Committees on February 24, 2015.

2.2.2.3 Brood Year 2015 Wenatchee Steelhead Release Plan

In 2015, Chelan PUD was required to produce 247,300 steelhead smolts for release into the Wenatchee River Basin as part of the Rock Island and Rocky Reach HCP requirements. In February 2015, Chelan PUD and WDFW presented to the HCP Hatchery Committees a Draft Brood Year (BY) 2014 Wenatchee Steelhead Release Plan. Release strategy objectives included evaluating best hatchery management practices for hatchery releases to optimize homing fidelity, minimize residualism, maximize out-migration survival, and minimize negative ecological interactions. The plan implemented a paired release design by vessel type, brood origin, and release sites, and also a detailed M&E plan. The Final BY 2014

Wenatchee Steelhead Release Plan (Appendix N) was approved by the Rock Island and Rocky Reach HCP Hatchery Committees on March 18, 2015, and was implemented in April and May 2015.

2.2.2.4 Hatchery Monitoring and Evaluation Plan Implementation

Hatchery Monitoring and Evaluation Plan

Since 2013, Chelan PUD hatchery programs have been operated in accordance with the *Monitoring and Evaluation Plan for PUD Programs 2013 Update* and the Chelan PUD Hatchery M&E Implementation Plan, titled *Chelan County PUD Hatchery M&E Work Plan*, prepared annually to describe the M&E activities for the next calendar year. In September 2014, the Chelan PUD 2015 Hatchery M&E Implementation Plan was finalized following a 30-day HCP Hatchery Committees review period, and was appended to the 2014 Rocky Reach HCP Annual Report.

On June 17, 2015, the Rock Island and Rocky Reach HCP Hatchery Committees agreed to change the deadline for Chelan PUD to provide their draft Hatchery M&E Annual Implementation Plan to the HCP Hatchery Committees for review from July 1 to August 1 of the year preceding the proposed M&E activities, so long as there are no significant changes requiring HCP Hatchery Committees discussion. As such, the Rock Island and Rocky Reach HCP Hatchery Committees approved the Chelan PUD 2016 Hatchery M&E Implementation Plan (Appendix O) on August 28, 2015, following a 60-day HCP Hatchery Committees review period.

Hatchery Monitoring and Evaluation Plan Report

In June 2015, the Chelan PUD 2014 Hatchery M&E Plan Report, titled *Monitoring and Evaluation of the Chelan and Grant County PUDs Hatchery Programs 2014 Annual Report,* that documented M&E activities in 2014 (Appendix P) was finalized following a 60-day HCP Hatchery Committees review period. On June 17, 2015, the Rock Island and Rocky Reach HCP Hatchery Committees agreed to Chelan PUD's proposed Hatchery M&E Annual Report schedule to provide the HCP Hatchery Committees with a draft Hatchery M&E Annual Report for a 30-day review by June 15, with the final report due to NMFS by September 1.

As such, a similar report documenting 2015 M&E activities of natural production and hatchery operations will be available in September 2016.

2.2.2.5 Hatchery Monitoring and Evaluation Plan Appendices

In January 2015, while discussing where to append the memorandum clarifying standardized methods for Hatchery M&E Plan Objective 8.3, Fecundity at Size (see Section 2.2.2.11), the HCP Hatchery Committees recognized that the Hatchery M&E Plan Appendices had not yet been finalized. In March 2015, the HCP Hatchery Committees agreed to reconvene the Hatchery Evaluation Technical Team (HETT) to finalize the appendices. The HETT first reconvened in April 2015, and discussed a plan for completing the appendices, which are living documents, subject to change as more data become available. Appendices were split up among HETT members to complete by varying dates. Appendix 1, which addresses carrying capacity, seemed to be the most onerous in terms of work remaining to be done.

In July 2015, Douglas PUD shared a presentation with the HCP Hatchery Committees on estimating carrying capacity, which reviewed methods for estimating carrying capacity, including estimates based on habitat capacity, smolt estimates, and stock-recruit relationships. The presentation demonstrated the many ways to calculate carrying capacity, and the HETT indicated they are currently discussing which method is preferred with regard to completing Hatchery M&E Plan Appendix 1. Finalizing the Hatchery M&E Plan Appendices will continue into 2016.

2.2.2.6 Review of the Five-Year Hatchery Monitoring and Evaluation Report

In March 2015, while working toward approving an Interlocal Agreement between Chelan PUD and Douglas PUD to rear Chelan PUD's Methow spring Chinook salmon production at the Methow Fish Hatchery, the HCP Hatchery Committees unanimously agreed on the need to revisit the results of M&E in the Methow Basin to date, and develop an adaptive management plan to improve the performance of the Methow Hatchery Programs. The HCP Hatchery Committees also approved an SOA titled, *Regarding Timeline for Review of 'Evaluation of Hatchery Programs Funded by Douglas County PUD 5-Year Report 2006-2010,'* (Appendix F), which outlined specific actions to accomplish within 1 year of approval of the SOA.

In April 2015, the HCP Hatchery Committees agreed to review the Five-Year Hatchery M&E Report by species and basin, starting with spring Chinook salmon in the Methow Basin, and moving forward program-by-program (e.g., Methow, Twisp, and Chewuch). In May 2015, a Methow Spring Chinook Salmon Review of Five-Year Annual Report Plan Outline (Appendix B; May 20, 2015, meeting minutes) was distributed, which divided Hatchery M&E Plan objectives into groups to be reviewed during subsequent HCP Hatchery Committees meetings. The HCP Hatchery Committees began reviewing Hatchery M&E Plan objectives for Methow Spring Chinook Salmon, as described in the outline, documenting which objectives are not meeting targets, flagging items to revisit, and, where applicable, developing recommendations or documenting reasons for not revisiting objectives. During this review, Objectives 2, 4, 5, 6, and 7 were flagged for further discussion. Review of all objectives for Methow spring Chinook salmon was complete by August 2015, and in September 2015, the HCP Hatchery Committees reviewed and prioritized the flagged objectives. In October 2015, the HCP Hatchery Committees began a process of addressing flagged objectives, including convening the HETT to further discuss certain flagged objectives and make recommendations to the HCP Hatchery Committees. Review of Hatchery M&E Plan objectives for Methow spring Chinook salmon will continue into 2016, along with the complete review of the Five-Year Hatchery M&E Report.

2.2.2.7 Okanogan Sockeye Salmon Mitigation

In 2015, Chelan PUD provided a tenth year of funding for a portion of the Okanagan Nation Alliance's 12-year Skaha 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 also contributed to the construction of the new Kl cp'elk' stim Sockeye Salmon Hatchery in Penticton, British Columbia, which was completed in September 2014. 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 Okanagan Nation Alliance release. The hatchery was designed to support up to an 8-million-egg program; however, initial plumbing constructed can accommodate 5 million eggs.

2.2.2.8 Hatchery and Genetic Management Plans

Chiwawa Spring Chinook Salmon

On July 3, 2013, NMFS issued a new Permit No. 18121 jointly to WDFW, Chelan PUD, and the YN (as an authorized agent of Chelan PUD) for operation of the Chiwawa spring Chinook salmon hatchery program.

On November 28, 2012, NMFS requested formal consultation with USFWS under Section 7(a)(2) of the ESA on the proposed permitting of the Chiwawa Spring Chinook Salmon Program and Wenatchee Steelhead Program. A partial draft Biological Opinion (BiOp) was distributed by USFWS on December 23, 2014. Several coordination meetings were held throughout 2015 among Chelan PUD, NMFS, USFWS, the YN, WDFW, the CCT, and Grant and Douglas PUDs. Consultation is still ongoing, and a complete BiOp is anticipated to be issued by USFWS in 2016.

Wenatchee Steelhead

On June 30, 2014, after more than 4 years of consultation, the initial draft Wenatchee Steelhead BiOp was completed. The BiOp was revised several times in 2014 and 2015, and a final BiOp and new Section 10(a)(1)(A) permit are anticipated in 2016, once consultation is completed between NMFS and USFWS.

On November 28, 2012, NMFS requested formal consultation with USFWS under Section 7(a)(2) of the ESA on the proposed permitting of the Chiwawa Spring Chinook Salmon, Wenatchee Steelhead, and Wenatchee Summer Chinook Programs. A partial draft BiOp was distributed by USFWS on December 23, 2014. Several coordination meetings were held throughout 2015 among Chelan PUD, NMFS, USFWS, the YN, WDFW, the CCT, and Grant and Douglas PUDs. Consultation is still ongoing, and a complete BiOp is anticipated to be issued by USFWS in 2016.

Wenatchee Summer Chinook Salmon

In May 2013, NMFS requested that Chelan PUD and other Permit No. 1347 permit holders submit letter applications for extension of permit 1347. NMFS indicated that a 10-year extension of the existing Permit No. 1347 was feasible. Chelan PUD submitted an extension request letter on August 27, 2013. Subsequently, on September 20, 2013, Chelan PUD received a letter from NMFS indicating that the existing ESA permits would be extended during consultation, until consultations were completed and a determination made on the new permits. In 2014, NMFS indicated that, due to higher priority permitting of programs rearing ESA-listed species, permitting of summer and fall Chinook salmon programs would not be addressed until spring 2015. In 2015, permitting of summer and fall Chinook salmon programs was postponed because parties agreed this program was the lowest priority for completing consultation.

2.2.2.8.1 Spring Chinook Salmon Broodstock Compositing in the Wenatchee Basin

Since 2007, a variety of approaches have been tried to collect tributary-specific spring Chinook salmon broodstock in the Wenatchee Basin; however, none have proven satisfactory in accomplishing this for the Nason Creek Hatchery Program (Grant PUD). In February 2014, the YN formally proposed to the PRCC HSC a composite broodstock approach to collect Chiwawa broodstock at the Chiwawa Weir and known Chiwawa origin (based on PIT-tags) at Tumwater Dam. Nason Creek broodstock would be collected at Tumwater Dam and include known Nason Creek fish (based on PIT-tags) and fish that were not from the White or Little Wenatchee rivers (determined by genetics). During discussion of the proposal, NMFS indicated that the proposal could not be authorized under the current BiOp and permits, and the BiOp would have to be amended, fully evaluating effects of this change. In September 2014, NMFS indicated they would prepare a supplemental Wenatchee Spring Chinook Salmon BiOp; however, a final decision would need to be deferred until USFWS completed their bull trout (*Salvelinus confluentus*) consultation. In January 2015, NMFS distributed a draft Wenatchee Spring Chinook Re-initiation BiOp, and directed WDFW to implement the 2015 Broodstock Collection Protocols based on having the BiOp completed. Also in January 2015, NMFS requested a letter (as a formality) from Chelan PUD and Grant PUD acknowledging that this new preferred broodstock collection strategy was not previously analyzed in the BiOp, and will ultimately lead to re-initiation of consultation, signed by the PRCC HSC and HCP Hatchery Committees (Appendix Q). This letter was provided to NMFS, as requested, on March 6, 2015. NMFS provided the Final Wenatchee Spring Chinook Re-initiation BiOp on May 29, 2015.

2.2.2.9 Wenatchee Steelhead Reproductive Success Study

The Rock Island 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 measureable biological characteristics.

In September 2015, WDFW and NMFS presented to the HCP Hatchery Committees the results of the Wenatchee Steelhead RRS Study (Appendix B; September 16, 2015, meeting minutes). 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. Hatchery-by-hatchery (HxH broodstock) male and female fish had the lowest RRS. Hatchery-by-wild (HxW broodstock) male and female fish had a RRS between those of HxH broodstock and wild-by-wild (WxW) broodstock. WxW 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. A final report documenting the study results is expected in 2016.

2.2.2.10 Dryden Overwintering Feasibility Study/Wenatchee River Total Maximum Daily Load

In 2011, Chelan PUD agreed to assess the feasibility of modifying the Dryden Acclimation Facility to accommodate overwinter rearing, as memorialized in the SOA titled *Chelan PUD Hatchery Compensation, Release Years 2014-2023*, approved by the Rocky Reach and Rock Island HCP Hatchery Committees on December 14, 2011. Concurrent with this effort, Chelan PUD is evaluating ways to meet the Washington State Department of Ecology's addendum to the Wenatchee Total Maximum Daily Load (TMDL) establishing a modified phosphorus target not to exceed 743 micrograms per liter for the entire Wenatchee River, effective in 2018.

In July 2012, Chelan PUD committed to conduct specific actions toward assessing the feasibility of converting the Dryden Acclimation Facility to an overwinter facility in conjunction with determining how best to meet TMDL requirements for phosphorous discharge by 2018. Based on the proposed schedule for implementing these actions, Chelan PUD expected to have all the information needed to make a decision by 2015.

In March 2015, the HCP Hatchery Committees agreed for Chelan PUD to continue their Wenatchee and Chelan Falls Summer Chinook Size Target Study for 1 additional year in order to obtain additional data to better inform a long-term decision. This study is intended to contribute information about the performance of hatchery fish released at a smaller size, which may help Chelan PUD meet the phosphorus TMDL targets at the facility (see Section 2.2.2.10.2). Adding an additional year of testing, however, postponed making a final decision for another year. The last several years of data and analyses will continue to be examined in 2016, and it will be determined whether or not it is feasible to convert the Dryden Acclimation Facility to an overwinter facility at that time.

2.2.2.10.1 Dryden Water Quality Monitoring

In 2015, Chelan PUD implemented the fourth year of water quality monitoring at the Dryden Acclimation Facility to help inform the ongoing evaluation of the feasibility for meeting phosphorus TMDL requirements (see Section 2.2.2.10). Water quality monitoring at the Dryden Acclimation Facility will continue in 2016.

2.2.2.10.2 Summer Chinook Salmon Size Target Study

In 2015, Chelan PUD conducted the third year of the Wenatchee and Chelan Falls Summer Chinook Size Targets Study with the NOAA's Northwest Fisheries Science Center to help inform the feasibility of converting the Dryden Acclimation Facility to an overwinter facility in conjunction with determining how best to meet TMDL requirements (see Section 2.2.2.10). During the first year of this study (BY 2012), there were challenges reaching the specific size targets. During the second year of this study (BY 2013), size targets were generally met, and preliminary results showed differences as a result of rearing vessel and/or release size in juvenile performance for Wenatchee summer Chinook salmon and no difference in juvenile performance between the four size-at-release targets. In 2015, the

HCP Hatchery Committees agreed for Chelan PUD to conduct a third year of the study (BY 2014) to attempt to replicate success from the BY 2013 study. Results from the BY 2014 study will be available in 2016.

2.2.2.11 Hatchery Monitoring and Evaluation Plan Objective 8.3, Fecundity at Size

In January 2014, WDFW requested input from the HCP Hatchery Committees on the protocol for measuring gonadal mass and on options for when to take the measurements (taking the measurement at the eyed-egg stage or taking the measurement before the eggs are fertilized, at the green-egg stage). The appropriate sample sizes required for listed versus unlisted programs were also discussed. The HCP Hatchery Committees came to conclusions regarding how to calculate and measure fecundity at size; however, additional discussion was needed to resolve the sample size question. In February 2014, WDFW distributed a memorandum describing standardized methods for Hatchery M&E Plan Objective 8.3, Fecundity at Size, and in December 2014, WDFW provided a revised memorandum to append to the Hatchery M&E Plan (see Section 2.2.2.5).

2.2.2.12 Tumwater Fishway Repairs

On February 17, 2015, Tumwater Dam was temporarily taken out of service for needed repairs. There was no fish passage throughout the duration of the repairs. Construction was completed and the ladder rewatered by March 4, 2015. These activities were also discussed with the HCP Coordinating Committees (see Section 2.1.3.1.4 and Section 2.1.3.2).

2.2.2.13 Spring Chinook Salmon Spawning Ground Surveys

Beginning in July 2015, spring Chinook salmon spawning ground surveys were conducted in the Chiwawa River (including Rock and Chikamin creeks), Nason Creek, Icicle Creek, Peshastin Creek (including Ingalls Creek), the Upper Wenatchee River, the Little Wenatchee River, and the White River (including the Napeequa River and Panther Creek). Surveys in the Chiwawa River basin were interrupted because of local wildfires in the area. Access to the upper Chiwawa River basin was available again in September 2015.

2.2.2.14 Supplemental Radio-tagging of Summer Steelhead

In November 2015, the HCP Hatchery Committees received a proposal from WDFW and the University of Idaho to PIT-tag and radio-tag summer steelhead collected at Tumwater Dam and the Twisp Weir. WDFW and University of Idaho were trying to tag up to 500 summer steelhead at Priest Rapids Dam; however, due to lower than expected return rates in 2015, only 400 summer steelhead were tagged. There are now 100 tags left, and WDFW and University of Idaho suggested tagging at Tumwater Dam and the Twisp Weir could provide additional information on parameters such as estimating stray rates and estimating overwinter survival, among other things. The HCP Hatchery Committees approved the proposal, which will likely be conducted during spring 2016.

2.2.2.15 Water Rights and Drought Planning

The Washington State Legislature establishes minimum flows or levels on streams for the purpose of protecting various aquatic, wildlife, and recreational resources. In 2015, contingency actions were implemented at the Chiwawa Acclimation Facility in anticipation of a low-flow year and potential drought. In September 2015, Chelan PUD provided updates on other Chelan PUD-owned facilities, as described below.

Chiwawa Acclimation Facility

On May 21, 2015, Chelan PUD filled the Chiwawa Ponds earlier than usual in anticipation of a low-water situation in 2015. Filling the ponds during higher river flow avoided the need for filling the ponds during periods of river flow outside instream flow requirements and non-consumptive water-use restrictions. There were no fish on station at the time of filling. In September 2015, 46% of the minimum instream flow requirements were being met at the Chiwawa Ponds; however, having expected this, the ponds were already filled and a maintenance flow had been running. Fish arrived onsite in mid-October 2015, and operation of the facility was not affected by minimum instream flow requirements.

Similkameen Acclimation Facility

In September 2015, 75% of the minimum instream flow requirements were being met at Similkameen Pond; thus, the ponds were filled from the south well supply. Fish arrived onsite in mid-October 2015.

Chelan Falls Acclimation Facility

In 2015, the Chelan Falls Ponds were not subject to minimum instream flow requirements. Fish arrived onsite in November 2015.

2.2.2.16 Tumwater Dam Stakeholder Meeting

In December 2015, the HCP Hatchery Committees were informed that the Cascade Columbia Fisheries Enhancement Group (CCFEG) is launching a process to engage stakeholders in a discussion about the current and future uses of Tumwater Dam including potential removal of the dam. The CCFEG is proposing to facilitate a conversation regarding removal of the dam to help benefit habitat restoration in Lake Jolanda and improve fish passage. Chelan PUD indicated no official position at this time; however, they noted their primary concern and obligation is meeting the requirements of the Rocky Reach and Rock Island HCPs. Currently, Chelan PUD has hatchery production and adult management obligations, which require operations at Tumwater Dam. These discussions will continue in 2016.

2.2.2.17 Joint Sessions with the Priest Rapids Coordinating Committee Hatchery Sub-Committee

In June 2015, the HCP Hatchery Committees received a request from the PRCC HSC that the HCP Hatchery Committees and PRCC HSC convene joint sessions when discussing agenda items applicable to and requiring participation from the HCP Hatchery Committees and PRCC HSC. The HCP Hatchery Committees agreed to convene joint sessions with the PRCC HSC when there are agenda items applicable to and which require participation from the HCP Hatchery Committees and PRCC HSC, with the conditions that: 1) any items requiring Committees decision (i.e., Decision Items) will be discussed to the extent necessary and voted on separately in the respective Committees; 2) prior to joint sessions, it will be made clear at the onset of the discussion that the item is a joint discussion and all Parties are welcome to speak freely; and 3) following joint sessions, the PRCC HSC will be provided with the joint section(s) of the draft meeting minutes for review, as well as the opportunity to comment on the joint discussions, and with the final minutes for their respective administrative records.

2.2.3 Maintenance and Improvements

Chelan Fish Hatchery Rehabilitation Design

In 2015, design began to rehabilitate the Chelan Fish Hatchery 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. Design will continue into 2016 and 2017 with construction scheduled to start in 2018.

Chiwawa Acclimation Facility Office Rehabilitation Construction

In April 2015, construction was underway to rehabilitate the Chiwawa Acclimation Facility Office Building. Rehabilitation is for the building only, and there will be no program changes. Construction included increasing office space and electrical capacity, and adding sleeping quarters. This project was substantially completed in 2015.

Eastbank Fish Hatchery Office Rehabilitation Construction

In February 2015, construction was underway to rehabilitate the Eastbank Fish Hatchery Office Building. Rehabilitation is for the building only, and there will be no program changes. Construction included increasing office space and storage room. This project was substantially completed in 2015.

2.3 Tributary Committees and Plan Species Accounts

As outlined in the Rock Island HCP, the signatory parties each designated one member to serve on the 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 2015, the HCP Tributary Committees met on six different occasions.

An initial task of the HCP Tributary Committees in 2015 was to review and update their operating procedures that provide a mechanism for decision making. These were initially developed in 2005 and included in that year's annual report (Anchor 2005)[6]. The HCP Tributary Committees also developed Policies and Procedures for soliciting, reviewing, and approving project proposals (Anchor 2005). This document was last reviewed and updated in February 2015. 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 established two complementary funding programs, the General Salmon Habitat Program (GSHP) and the Small Projects Program.

In 2015, the HCP Tributary Committees found no need to modify language in the Policies and Procedures document or in the HCP Tributary Committees Operating Procedures. They did note, however, that Section 6.9 (External Financial Review) in the Policies and Procedures document no longer applies to the Wells Plan Species Account. State auditors will audit the Wells Account annually. The Rocky Reach and Rock Island Plan Species Accounts will be audited every 5 years.

In 2015, National Oceanic and Atmospheric (NOAA) Fisheries submitted a letter to the HCP Coordinating Committees indicating that Justin Yeager will replace Dale Bambrick as NOAA Fisheries representative on the Rock Island HCP Tributary Committee. Dale Bambrick will serve as NOAA Fisheries' designated alternative representative for the Rock Island HCP Tributary Committee.

Dr. Tracy Hillman continued as the Chairperson for the Rock Island HCP Tributary Committee. Dr. Hillman is an Ecological Society of America board-certified senior ecologist and Chief Executive Officer of BioAnalysts, Inc. He has 29 years of experience as an ecologist and has chaired the Rock Island HCP Tributary Committee since 2007.

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[6] Anchor Environmental, L.L.C. 2005. *Annual Report, Calendar Year 2005, of Activities under the Anadromous Fish Agreement and Habitat Conservation Plan.* Rock Island Hydroelectric Project, FERC license no. 943. Prepared for FERC by Anchor Environmental L.L.C. and Public Utility District No. 1 of Chelan County.

2.3.1 Regional Coordination

Similar to the HCP Hatchery Committees and to improve coordination, a representative from Grant PUD and the facilitator of the PRCC Habitat Sub-Committee were invited to the HCP Tributary Committees monthly meetings. In addition, they received meeting announcements, draft agendas, and meeting minutes. This benefits the HCP Tributary Committees through increased coordination and sharing of expertise. The Grant PUD representative and PRCC Habitat Sub-Committee facilitator have no voting authority. The HCP Tributary Committees, through the HCP Coordinating Committees, also invited American Rivers and the Confederated Tribes of the Umatilla Indian Reservation to participate in Committees meetings. Both parties contributed to the development of the HCP, yet elected not to sign the document. Neither of these parties participated in the deliberations of the HCP Tributary Committees in 2015.

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 the 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 SRFB and HCP Tributary Committees are complementary, and annual funding rounds by these funding entities have been coordinated during the last several years.

The Rock Island HCP Tributary Committee coordinated funding of GSHP proposals with the Bonneville Power Administration in July 2015. The purpose, according to Section 2 of the Tributary Fund Policies and Procedures for Funding Projects, was 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 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 Rock Island HCP Tributary Committee appointed the accounting firm Clifton Larson Allen to perform the necessary tasks for fiscal management of the Rock Island 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 Rock Island Plan Species Account on January 1, 2015 was $4,837,822.51; Chelan PUD's annual Rock Island contribution was $711,794.00; interest accrued during 2015 was $7,545.68; funds disbursed for projects in 2015 totaled $213,175.45; $4,185.49 was paid to Clifton Larson Allen and Chelan PUD for account administration during 2015; and $1,000 was paid to the UCSRB for sponsorship of the 2016 Upper Columbia Science Conference, resulting in an ending balance of $5,338,801.25 on December 31, 2015. The 2015 Annual Financial Report for this Plan Species Account is provided in Appendix R.

The Rock Island HCP Tributary Committee delegated signatory authority to the chairperson for processing of payments for invoices approved by the Committee, with the HCP Coordinating Committees Chairperson serving as the alternate. Chelan PUD recognizes the uniqueness of the Rock Island 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 General Salmon Habitat Program

The HCP Tributary Committees established the GSHP as the principle 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 require extensive design, permitting, and public participation to be feasible. 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 provide lesser amounts during a phased project.

In 2014, the HCP Tributary Committees announced that they would accept GSHP applications at any time during the year. They also announced that they would continue to 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 (see Section 2.3.1).

2.3.3.1 2015 General Salmon Habitat Projects

The SRFB announced their 2015 funding cycle in March, with pre-proposal applications due on April 17, 2015, and full proposals due on June 19, 2015. The HCP Tributary Committees received and reviewed eight pre-proposal applications. The HCP Tributary Committees identified six projects that they believed warranted full proposals and dismissed two projects because they were inconsistent with the intent of the Tributary Fund, did not have strong technical merit, or had low benefits per cost.

In June, the HCP Tributary Committees received six full SRFB proposals to the GSHP. All were cost-shares with the SRFB or other funding entities. The HCP Tributary Committees approved funding for three projects. In addition, the HCP Tributary Committees received two full proposals to the GSHP that were not SRFB proposals. The HCP Tributary Committees approved funding for one of these projects. 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 HCP Tributary Committees in 2015

Project Name	Sponsor[1]	Total Cost	Request from T.C.	Plan Species Account[2]
Salmon Recovery Funding Board Applications				
Wenatchee Basin Barrier and Diversion Assessment	CCFEG	\$361,589	\$40,000	Not funded
Lower Wenatchee Instream Flow Enhancement	TU-WWP	\$1,760,759	\$125,000	Not funded
Icicle Creek-Boulder Field-Wild Fish to Wilderness	TU-WWP	\$1,571,189	\$250,000	RI: \$250,000
M2 Right Sugar Acquisition	MSRF	\$122,903	\$18,435	W: \$15,185[3]
Nason Creek Upper White Pine Floodplain Reconnect	CCNRD	\$2,845,107	\$400,000	Not funded
Lower Nason Creek KG Protection	CDLT	\$197,500	\$29,625	RR: \$24,625[4]
General Salmon Habitat Program Applications				
Similkameen River 3.8 RM Habitat Rehabilitation	OCD	\$392,370	\$67,370	RR: \$67,370
Silver Side Channel Revival – Phase I	CCFEG	\$575,435	\$287,718	Not funded

Notes:

1 CCFEG = Cascade Columbia Fisheries Enhancement Group; CCNRD = Chelan County Natural Resources Department; CDLT = Chelan-Douglas Land Trust; OCD = Okanogan Conservation District; MSRF = Methow Salmon Recovery Foundation; TU-WWP = Trout Unlimited – Washington Water Project.

2 RI = Rock Island Plan Species Account; RR = Rocky Reach Plan Species Account; W = Wells Plan Species Account.

3 The Wells HCP Tributary Committee will order and pay for the appraisal and review. Because the sponsor asked for \$3,250 for appraisal and review, the Wells HCP Tributary Committee subtracted this amount from the Wells HCP Tributary Committee request. Thus, the amount the Wells HCP Tributary Committee will pay the sponsor for this project is \$15,185 (\$18,435 minus \$3,250).

4 The Rocky Reach HCP Tributary Committee will order and pay for the appraisal and review. Because the sponsor asked for \$5,000 for appraisal and review, the Committee subtracted this amount from the Rocky Reach HCP Tributary Committee request. Thus, the amount the Rocky Reach Committee will pay the sponsor for this project is \$24,625 (\$29,625 minus \$5,000).

RM = river mile

In 2015, the Rock Island HCP Tributary Committee agreed to fund the following GSHP project:

- **Icicle Creek – Boulder Field – Wild Fish to Wilderness Project for the amount of \$250,000 (with cost-share the, total cost of the project was \$1,571,189) –** This project will enhance fish passage at the Boulder Field (RM 5.6) on Icicle Creek and thereby provide access to more than 23 miles of high-quality habitat. This will be accomplished by creating a 160-foot fishway (14% slope, step-pool channel) along the left bank. This project is likely to have a large positive effect on abundance, productivity, and spatial structure of Plan Species.

2.3.3.2 Modifications to General Salmon Habitat Program Contracts

In 2015, the Rock Island HCP Tributary Committee received the following requests from sponsors asking for modifications to GSHP projects funded by the Committee:

- In April, the CCFEG asked the Rock Island HCP Tributary Committee for a scope change on the Wenatchee Nutrient Assessment – Treatment Design Project. The sponsor asked to change the scope of the project from a 4-year effort to a 2-year effort, with the expectation that the sponsor will secure necessary funding to extend the project to the original 4-year period. The Rock Island HCP Tributary Committee elected not to support the change in scope. The Committee noted that if the sponsor is unable to secure the additional funds needed to complete the 4-year project, the project may fail to demonstrate any treatment effects. That is, with only 2 years of data, it is unlikely that the sponsor will be able to determine if nutrient enhancement is a cost-effective method for boosting fish survival and productivity within the Chiwawa River basin. The Committee encouraged the sponsor to secure additional funds and the necessary permits.
- In June, the CCFEG asked the Rock Island HCP Tributary Committee for a budget amendment on the Twisp-to-Carlton Reach Assessment Project. In order to complete the assessment, the sponsor asked to move $3,585.76 from Sponsor Salaries and Benefits and $4,108.62 from Indirect, Overhead, and Administration to Professional Services. Thus, the budget for Professional Services would increase from $30,000.00 to $37,694.38. The total budget amount will not change as a result of this budget amendment. The Rock Island HCP Tributary Committee approved the budget amendment.
- In November, Trout Unlimited – Washington Water Project (TU-WWP) asked the Wells, Rocky Reach, and Rock Island HCP Tributary Committees for a scope change on the Methow Valley Irrigation District Instream Flow Improvement Project. TU-WWP requested a scope change that includes tree removal along the abandoned west-side ditch and also provides the sponsor with the opportunity to negotiate buy-

outs of liability with the few larger landowners for dead trees. This change will help TU-WWP remain within budget as they near completion of the project. The Wells, Rocky Reach, and Rock Island HCP Tributary Committees approved the scope change.

2.3.4 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.

2.3.4.1 2015 Small Projects

In 2015, the HCP Tributary Committees received four requests for funding under the Small Projects Program. The HCP Tributary Committees approved funding for two projects. Table 7 identifies the projects, sponsors, total cost of the projects, amount requested from Tributary Funds, and which Plan Species Accounts supported the projects.

Table 7

Projects Reviewed by the HCP Tributary Committees under the Small Projects Program in 2015

Project Name	Sponsor[1]	Total Cost	Request from T.C.	Plan Species Account[2]
Permitting Nutrient Enhancement in the Chiwawa River	CCFEG	$40,250	$40,250	Not funded
White River Floodplain Connection (RM 3.4)	CCFEG	$35,500	$35,500	RI: $35,500
Bank Stabilization at Shingle Dam Removal Site	ONA	$14,013	$14,013	Not funded
Peshastin Creek RM 10.5 PIT-tag Detection Site	WDFW	$66,859	$36,256	RI: $32,269[3]

Notes:

1 CCFEG = Cascade Columbia Fisheries Enhancement Group; ONA = Okanagan Nation Alliance; WDFW = Washington Department of Fish and Wildlife

2 RI = Rock Island Plan Species Account

3 The Rock Island HCP Tributary Committee was unable to fund the full amount requested from WDFW because the Policies and Procedures for the HCP Tributary Committees require that indirect costs cannot exceed 15% of the total cost. Thus, the Rock Island HCP Tributary Committee contributed only $4,209 for WDFW indirect costs ($28,060 x 0.15 = $4,209), not the $8,196 requested by the project sponsor.

PIT = passive integrated transponder
RM = river mile
T.C. = Tributary Committees

In 2015, the Rock Island HCP Tributary Committee agreed to fund the following Small Projects:

- **White River Floodplain Connection (RM 3.4) Project for the amount of $35,500 (no cost-share) –** This project will remove a culvert that limits floodplain connectivity along the lower White River. This project will improve fish access to a side channel and a large (40-acre) wetland.
- **Peshastin Creek RM 10.5 PIT-tag Detection Site Project for the amount of $32,269 (with cost-share, the total cost of the project was $66,859) –** This project will install a permanent instream PIT-tag detection site in Peshastin Creek just upstream from the Ruby Creek slide. The site will be used to evaluate steelhead passage at the Ruby Creek slide before and after restoration, help manage suction dredging, and help to better understand movement and distribution of bull trout and steelhead.

2.3.4.2 Modifications to Small Project Contracts

In 2015, the Rock Island HCP Tributary Committee received no requests from sponsors asking for modifications to Small Projects funded by the Committee.

2.3.5 Tributary Assessment Program

In 2015, at the request of the HCP Tributary Committees, the Okanagan Nation Alliance submitted proposals for the following monitoring projects:

1. **Penticton Channel Monitoring Spawning Platforms –** The objective of this study is to monitor the effects of the proposed spawning platforms as adaptive management for designing and construction of more platforms. This work will focus 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 will occur

throughout a 5-year period (2014 to 2018). The amount requested from the HCP Tributary Committees during the 5-year period was $53,738 (with cost-share, the total cost of the monitoring project during the 5-year period was $168,863).

2. **ORRI Phase II Effectiveness Monitoring** – The objective of this study is to monitor the effects (i.e., channel, hydraulic, and biological responses) of the Okanagan River Restoration Initiative (ORRI)-Phase II restoration work and to continue to monitor the long-term effects of Phase I and Vertical Drop Structure 13 restoration. Monitoring will include all activities associated with channel and hydraulic responses, and aquatic biological responses (save macrophytes and macroinvertebrates). Monitoring will occur during a 5-year period (2014 to 2018). The amount requested from the HCP Tributary Committees during the 5-year period was $69,578 (with cost-share, the total cost of the monitoring project during the 5-year period was $175,600).

The Rocky Reach HCP Tributary Committee approved funding for the Penticton Channel Monitoring Spawning Platforms, and the Wells HCP Tributary Committee approved funding for the ORRI Phase II Effectiveness Monitoring Project. The Rock Island HCP Tributary Committee did not fund any monitoring proposals in 2014.

In November 2015, the HCP Tributary Committees received the following annual monitoring reports from the Okanagan Nation Alliance:

- Dunn, M., K. Alex, C. Rivard-Sirois, and J. Enns, 2015. *Aquatic Monitoring 2014 for the Penticton Channel salmon spawning restoration work*. Prepared for the Habitat Conservation Committee. Prepared by Okanagan Nation Alliance Fisheries Department, Westbank, British Columbia.
- Machin, D., K. Alex, C. Louie, C. Mathieu, and C. Rivard-Sirois, 2015. *Aquatic monitoring of the Okanagan River Restoration Initiative (ORRI) – Post-construction 2014.* Prepared by Okanagan Nation Alliance Fisheries Department. Westbank, British Columbia.

3 HABITAT CONSERVATION PLAN ADMINISTRATION

3.1 Mid-Columbia Habitat Conservation Plan Forums

In 2005 and 2006, Mid-Columbia Forums (Forums) were held as a means of communicating and coordinating with the non-signatories and other interested parties on the implementation of the HCPs. Non-signatory parties at the time of the 2006 meeting included the Confederated Tribes of the Umatilla Reservation and American Rivers. As in 2007 through 2014, these parties were invited by letter in 2015 to attend a Forum, 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 Tributary Committees and Hatchery Committees processes. The non-signatory parties again indicated no interest in attending a Forum in 2015.

3.2 Mid-Columbia Habitat Conservation Plan Extranet Sites

In 2013, the HCP Coordinating Committees discussed transitioning HCP file sharing from the historically used file transfer protocol (FTP) site to a more user-friendly platform. One of the primary purposes for transitioning to a new filing system was to facilitate a more efficient process for retrieving historical documents. In May 2013, Douglas PUD presented to the HCP Coordinating Committees an overview of their new SharePoint system (i.e., HCP Extranet site), as a potential option for Douglas and Chelan PUDs' new HCP document repository. The HCP Coordinating Committees raised no concerns with the proposed SharePoint repository, and Douglas PUD proceeded with the development of the repository. Douglas PUD unveiled the respective HCP Hatchery Committees Extranet site and HCP Coordinating Committees site with presentations to the HCP Hatchery Committees on January 15, 2014, and to the HCP Coordinating Committees on January 28, 2014. During 2014 and 2015, the process of transferring all historical HCP files from the former FTP site to the new HCP Extranet sites was underway and is expected to be complete by early 2016. The HCP Tributary Committees Extranet site will also be available by early 2016.

3.3 Mid-Columbia Habitat Conservation Plan Committees Chairperson

In September 2014, the HCP Chairperson of the Coordinating and Hatchery Committees announced to the respective Committees plans to retire at the end of April 2015. The Chairperson of the HCP Coordinating Committees also serves as the Chairperson of the HCP Policy Committees; therefore, discussions began regarding selecting new Chairpersons for the HCP Policy, Coordinating, and Hatchery Committees—a process last visited 10 years ago when the HCPs were signed in 2004. A timeline was established to allow the new Chairperson(s) time to shadow the current Chairperson prior to April 2015, which translated into interviews in December 2014, final decisions in January 2015, and contracting by February 2015. HCP Coordinating and Hatchery Committees' representatives were asked to nominate qualified candidates to fill the respective Committees' Chairperson positions, and the HCP Policy and Coordinating Committees agreed to convene to discuss details of the selection process. HCP signatory representatives were identified to select the Chairpersons for the HCP Hatchery and Coordinating Committees, which included the HCP Policy Committees representative for the YN, NMFS, Chelan PUD, and Douglas PUD, and the HCP Coordinating Committees representative for the CCT, USFWS, and WDFW. A ranking system was also approved for narrowing the HCP Chairperson candidate lists to a short list for interviews, where each Party ranked the candidates first to last for filling the Chairperson positions. Reviews of the sum of those rankings, along with further discussion, determined the interview lists. The HCP Policy and Coordinating Committees compiled interview questions developed by each HCP signatory, and in December 2014, all candidates were interviewed for the HCP Coordinating and Hatchery Committees Chairperson positions.

On January 14, 2015, the HCP Policy and Coordinating Committees unanimously approved Dr. John Ferguson as the HCP Policy and Coordinating Committees Chairperson and Dr. Tracy Hillman as the HCP Hatchery Committees Chairperson (Dr. Hillman has also been the HCP Tributary Committees Chairperson since 2007). In April 2015, Dr. Michael Schiewe retired as HCP Chairperson of the HCP Coordinating and Hatchery Committees. In May 2015, Dr. Ferguson assumed responsibility as Chairperson of the HCP Coordinating Committees and Dr. Hillman assumed responsibility as Chairpersons of the HCP Hatchery and Tributary Committees.

3.4 Habitat Conservation Plan Related Reports and Miscellaneous Documents Published in Calendar Year 2015

The following is a list of reports released in 2015 that are related to the implementation of the Rock Island HCP:

- Hillman, T., C. Willard, M. Johnson, C. Moran, M. Tonseth, A. Murdoch, B. Ishida, C. Kamphaus, T. Pearsons, and P. Graf, 2015. *Monitoring and Evaluation of the Chelan and Grant County PUDs Hatchery Programs: 2014 Annual Report*. Prepared for HCP Hatchery Committees and the PRCC Hatchery Sub-Committee. June 2015.
- Keller, L., 2015. Public Utility District No. 1 of Chelan County. *Rock Island Dam Smolt Monitoring and Gas Bubble Trauma Evaluation Plan 2015*. February 2015.
- Mosey, T., 2015. *Final 2015 Fish Spill Plan: Rock Island and Rocky Reach Dams*. Public Utility District No. 1 of Chelan County. February 2015.
- National Marine Fisheries Service, 2015. *Biological Opinion – Reinitiation of the Issuance of Three Section 10(a)(1)(A) Permits for the Upper Columbia River, Chiwawa River, Nason Creek, and White River Spring Chinook Salmon Hatchery Programs.* NMFS Consultation Number: NWR-2013-9707. Operated by the Public Utility District No. 1 of Chelan County, Public Utility District No. 2 of Grant County, and Washington Department of Fish and Wildlife. May 2015.
- National Oceanic and Atmospheric Administration, 2015. *Scientific Research/Enhancement, Permit Number 1821 (amended).* National Marine Fisheries Service Section 10(A)(1)(A) Permit for Takes of Endangered/ Threatened Species. Issued to the Operation, monitoring, and evaluation of the Chiwawa River spring Chinook salmon hatchery program. May 2015.
- Public Utility District No. 1 of Chelan County, 2015. *Final 2015 Rocky Reach and Rock Island HCP Action Plan.* February 2015.
- Public Utility District No. 1 of Chelan County, 2015. *Interim Fish Passage Plan*. Rock Island Hydroelectric Project. FERC No. 943. Revised March 2015.
- Public Utility District No. 1 of Chelan County, 2015. *Rocky Reach and Rock Island HCPs Draft 2015 Fish Spill Report*. 2015 Chelan PUD Fish Spill Programs. Fall 2015.
- Schiewe, M. and E. McManus, 2015. *New Preferred Broodstock Collection Strategy for Wenatchee spring Chinook Hatchery Supplementation Programs under Section 10(a)(1)(A) Permits 18118 and 18121 and associated Biological Opinion.* Re-initiation

Letter to NMFS Sustainable Fisheries Division from the HCP Hatchery Committees and PRCC HSC. March 5, 2015.

- Tonseth, M., 2014. *Final 2015 Upper Columbia River Salmon and Steelhead Broodstock Objectives and Site-Based Broodstock Collection Protocols*. Washington Department of Fish and Wildlife Wenatchee Research Office. April 2015.
- Underwood, A., and C. Willard, 2015. *Chelan County PUD Hatchery Monitoring and Evaluation Implementation Plan 2016.* July 2015.
- Underwood, A., and C. Willard, 2015. *Comprehensive Summary of Partial Water Reuse and Circular Pond Rearing Systems at Chelan PUD Hatcheries*. Public Utility District No. 1 of Chelan County. February 2015.
- Washington Department of Fish and Wildlife, 2015. *2015 Wenatchee Steelhead Release Plan (Brood Year 2014).* WDFW Fish Program – Science Division Supplementation Research Team. February 18, 2015.

APPENDIX A
HABITAT CONSERVATION PLAN COORDINATING COMMITTEES 2015 MEETING MINUTES AND CONFERENCE CALL MINUTES

ANCHOR QEA

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FINAL MEMORANDUM

To: Wells, Rocky Reach, and Rock Island HCPs Coordinating Committees
Date: February 25, 2015
From: Michael Schiewe, Chair
Cc: Kristi Geris
Re: Final Minutes of the January 27, 2015 HCPs Coordinating Committees Meeting

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Coordinating Committees met at the Radisson Gateway Hotel, in SeaTac, Washington, on Tuesday, January 27, 2015, from 9:30 am to 12:00 pm. Attendees are listed in Attachment A of these meeting minutes.

ACTION ITEM SUMMARY

Documents for review by Tuesday, February 10, 2015	Distributed
Draft 2015 Wells Bypass Operating Plan/Gas Abatement Plan (Item II-D)	1/9/2015
Draft 2014 Wells Post-Season Bypass Report and Revised Draft Wells Passage-Dates Analysis (Item II-B)	1/16/2015
Draft 2015 Rocky Reach and Rock Island Spill Plan (Item III-C)	1/23/2015
Draft 2015 Rocky Reach Juvenile Fish Bypass System Operations Plan (Item III-D)	1/23/2015
Draft 2015 Rock Island Bypass Monitoring Plan (Item III-D)	1/23/2015
Revised Draft 2015 Wells HCP Action Plan (Item II-C)	1/27/2015
Draft 2015 Rocky Reach and Rock Island HCP Action Plan (Item III-B)	1/27/2015

- Douglas PUD will provide the revised draft 2015 Wells HCP Action Plan to Kristi Geris for distribution to the Coordinating Committees (Item II-C). *(Note: Tom Kahler provided the revised draft plan to Geris following the meeting on January 27, 2015, which Geris distributed to the Coordinating Committees that same day.)*
- Chelan PUD will provide the Colville Confederated Tribes' (CCT's) comments on the draft Rocky Reach Total Dissolved Gas (TDG): Step One, Year Five Compliance Report to Kristi Geris for distribution to the Coordinating Committees (Item III-A). *(Note: the CCT's comments, along with Chelan PUD's response, were included in Appendix A of the final report that was provided by Marcie Steinmetz [Chelan PUD]*

on January 30, 2015, and distributed to the Coordinating Committees by Geris that same day.)

- Kristi Geris will coordinate with Alene Underwood (Chelan PUD HCP Hatchery Committees Representative) regarding distributing the draft 2015 Rocky Reach and Rock Island HCP Action Plan to the HCP Hatchery Committees (Item III-B). *(Note: Geris distributed the draft plan to the HCP Hatchery Committees following the meeting on January 27, 2015, per Underwood's direction.)*
- The U.S. Fish and Wildlife Service (USFWS) will provide Chelan PUD with fork lengths of Entiat subyearling Chinook salmon (Item III-C). *(Note: Jim Craig provided these lengths to Lance Keller and the Coordinating Committees Technical Representatives following the meeting on January 27, 2015.)*
- Chelan PUD will provide the draft 2014 Rocky Reach and Rock Island Juvenile Bypass Study Plan Reports for review, which will include 2013 data (Item III-D).
- Lance Keller will coordinate with the Chelan PUD HCP Hatchery Committees representatives regarding Tumwater fishway repairs (Item III-F).

DECISION SUMMARY

- The Coordinating Committees representatives present approved the Rocky Reach TDG: Step One, Year Five Compliance Report (Item III-A).

AGREEMENTS

- There were no agreements discussed during today's meeting.

REVIEW ITEMS

- Kristi Geris sent an email to the Coordinating Committees on January 9, 2015, notifying them that the draft 2015 Wells Gas Abatement Plan (GAP)/Bypass Operating Plan (BOP) was available for review. Edits and comments on the draft plan are due to Tom Kahler and Andrew Gingerich (Douglas PUD) by Tuesday, February 10, 2015 (Item II-D).

- Kristi Geris sent an email to the Coordinating Committees on January 16, 2015, notifying them that the draft 2014 Wells Post-Season Bypass Report, including a revised draft 2014 Wells Passage-Dates Analysis, was available for review. Edits and comments on the draft report are due to Douglas PUD by Tuesday, February 10, 2015 (Item II-B).
- Kristi Geris sent an email to the Coordinating Committees on January 23, 2015, notifying them that the draft 2015 Rocky Reach and Rock Island Spill Plan was available for review. Edits and comments on the draft plan are due to Chelan PUD by Tuesday, February 10, 2015 (Item III-C).
- Kristi Geris sent an email to the Coordinating Committees on January 23, 2015, notifying them that the draft 2015 Rocky Reach Juvenile Fish Bypass System Operations Plan was available for review. Edits and comments on the draft plan are due to Chelan PUD by Tuesday, February 10, 2015 (Item III-D).
- Kristi Geris sent an email to the Coordinating Committees on January 23, 2015, notifying them that the draft 2015 Rock Island Bypass Monitoring Plan was available for review. Edits and comments on the draft plan are due to Chelan PUD by Tuesday, February 10, 2015 (Item III-D).
- Kristi Geris sent an email to the Coordinating Committees on January 27, 2015, notifying them that the revised draft 2015 Wells HCP Action Plan was available for review. Edits and comments on the draft plan are due to Douglas PUD by Tuesday, February 10, 2015 (Item II-C).
- Kristi Geris sent an email to the Coordinating Committees on January 27, 2015, notifying them that the draft 2015 Rocky Reach and Rock Island HCP Action Plan was available for review. Edits and comments on the draft plan are due to Chelan PUD by Tuesday, February 10, 2015 (Item III-B).
- Kristi Geris sent an email to the Coordinating Committees on February 9, 2015, notifying them that the draft 2014 Wells HCP Annual Report was available for review, with edits and comments due to her by Monday, March 9, 2015.
- Kristi Geris sent an email to the Wells HCP Coordinating Committee on February 19, 2015, notifying them that the draft 2015 Broodstock Collection Protocols was available for review, with edits and comments due to Mike Tonseth by Friday, March 6, 2015.

- Kristi Geris sent an email to the Coordinating Committees on February 19, 2015, notifying them that the draft 2014 Rocky Reach and Rock Island HCP Annual Reports were available for review, with edits and comments due to her by Wednesday, March 18, 2015.

DOCUMENTS FINALIZED

- The final Rocky Reach TDG: Step One, Year Five Compliance Report was distributed to the Coordinating Committees by Kristi Geris on January 30, 2015 (Item III-A).

I. Welcome

A. Review Agenda (Mike Schiewe)

Mike Schiewe welcomed the Coordinating Committees and asked for any additions or other changes to the agenda. The following additions were requested:

- Lance Keller added an update on Rocky Reach Dam and Rock Island Dam adult fishway annual maintenance.
- Tom Kahler added updates on: 1) the 2014 Wells Plan Species Account Annual Report; and 2) modifications to the low-level side entrance at the Wells Dam adult fishway.

B. Meeting Minutes Approval (Mike Schiewe)

The Coordinating Committees reviewed the revised draft joint HCP Policy and Coordinating Committees November 6, 2014 conference call minutes. Kristi Geris said that all comments and revisions received from members of the Committees were incorporated in the revised minutes, and that there were no outstanding edits or questions to discuss. Coordinating Committees members present approved the joint HCP Policy and Coordinating Committees November 6, 2014 conference call minutes, as revised.

The Coordinating Committees reviewed the revised draft November 18, 2014 conference call minutes. Geris said that all comments and revisions received from members of the Committees were incorporated in the revised minutes. She noted one clarification that was added to the revised minutes after they were distributed to the Coordinating Committees, regarding Chelan PUD's discussion of the draft Rocky Reach TDG Year Five Report. She said that Steve Hays (Chelan PUD) later clarified via email that Figures 2-3 and 2-4 in the draft report (i.e., daily passage counts of Chinook and sockeye salmon, respectively, at Rocky Reach Dam with spill pattern in effect that day) do not account for fish that "entered" the ladders (opposed to "passed through" the ladders, as previously reported) and did not pass the count window. Hays further explained that fish could have entered the fishway, but would not have been counted until they passed through the counting window. Thus, the count data are not a perfect temporal match to the spill pattern in effect at the time an individual fish may have found the entrance and entered the fishway. However, because it is believed that the majority of fish pass through the fishway on the same day that they enter, the comparison is considered useful, just not exact. Coordinating Committees members present approved the November 18, 2014 conference call minutes, as revised.

C. Last Meeting Action Items (Mike Schiewe)

Action items from the Coordinating Committees conference call on November 18, 2014, and follow-up discussions were as follows: *(Note: italicized item numbers below correspond to agenda items from the November 18, 2014 meeting.)*

- *Anchor QEA will coordinate with USFWS to resolve the last pending item from the Coordinating Committees revised draft October 28, 2014 conference call minutes; once resolved Kristi Geris will finalize the minutes and distribute them to the Coordinating Committees (Item I-B).*
  Geris obtained clarification from Jim Craig on November 21, 2014, and distributed the final October 28, 2014 conference call minutes that same day.
- *Kristi Geris will contact Julene McGregor (Douglas PUD Information System Staff) to request read-only access to the final document library on the HCP Hatchery Committees Extranet site for Peter Graf (Grant PUD), as approved by the Coordinating Committees (Item I-D).*
  Geris sent an email to McGregor on November 18, 2014, requesting access for Graf, as discussed.
- *Chelan PUD will provide 2013 and 2014 adipose (ad)-present steelhead fish passage data for Rock Island and Rocky Reach dams to Kristi Geris for distribution to the Coordinating Committees (Item II-A).*

Lance Keller provided these data to Geris on January 23, 2015, which Geris distributed to the Coordinating Committees that same day.

- *Chelan PUD will request from the Washington State Department of Ecology (Ecology) an extension of the review period for the draft Rocky Reach TDG Year Five Report from 30 to 60 days, and will notify the Coordinating Committees whether the extension is granted (Item II-D).*
  Ecology granted the extended review period with a new comment deadline of January 15, 2015, as distributed to the Coordinating Committees by Kristi Geris on November 26, 2014. This will be discussed further during today's meeting.
- *Coordinating Committees representatives will provide initial comments on the draft Rocky Reach TDG Year Five Report to Chelan PUD prior to the next Coordinating Committees meeting on December 16, 2014 (Item II-D).*
  This will be discussed during today's meeting.
- *Douglas PUD will provide the draft 2014 Wells Post-Season Bypass Report for review to Kristi Geris for distribution to the Coordinating Committees (Item III-C).*
  Douglas PUD provided the draft report, along with a revised draft Wells Passage-Dates Analysis, to Geris on January 16, 2015, which Geris distributed to the Coordinating Committees that same day. This will be discussed further during today's meeting.
- *The next Coordinating Committees meeting will be on December 16, 2014, and will be held by conference call (Item V-A).*
  This meeting was canceled.

II. Douglas PUD

A. Methow River Coho Salmon Phase Designation Statement of Agreement (Tom Kahler)

Tom Kahler said that Douglas PUD and the Yakama Nation (YN) are still working to reach agreement on language in the revised draft Methow River Coho Salmon Phase Designation Statement of Agreement (SOA), which was last distributed to the Coordinating Committees by Kristi Geris on November 7, 2014. Kahler said that they have been meeting regularly and hope to reach agreement by the next Coordinating Committees meeting on February 24, 2015. Kirk Truscott asked what issues were causing the delays, and Kahler replied that there is no trouble with the substance of the SOA, just the wording. Kahler further explained that the primary issue for both parties is certainty; the wording in the current draft apparently does not provide the degree of certainty that the YN desires.

B. Draft 2014 Wells Post-Season Bypass Report and Revised Draft Wells Passage-Dates Analysis (Tom Kahler)

Tom Kahler said that Douglas PUD drafts a Wells Post-Season Bypass Report each year. Also, beginning in 2011, Drs. John Skalski and Richard Townsend of Columbia Basin Research have developed a Wells Passage-Dates Analysis summarizing the performance of Wells Dam bypass operations for the current year. Kahler recalled that the draft 2014 Wells Passage-Dates Analysis, which was distributed to the Coordinating Committees by Kristi Geris on November 18, 2014, showed low passage compliance for yearling Chinook salmon in 2014; this prompted additional analyses to determine the basis for the low compliance.

Kahler said that a draft 2014 Wells Post-Season Bypass Report and a revised draft 2014 Wells Passage-Dates Analysis (in redline strikeout; Attachment B) were distributed to the Coordinating Committees by Geris on January 16, 2015. Kahler said that the revised analysis incorporated comments received from the CCT regarding Omak releases, as well as the results of the additional analyses of yearling Chinook salmon passage data. He said that an analysis of passive integrated transponder (PIT)-tag data revealed that the early detections at Rocky Reach Dam consisted of both hatchery and wild fish originating from below Wells Dam, primarily from the Entiat River. He handed out graphs depicting yearling Chinook salmon PIT-tag detection data at Rocky Reach Dam from 2010 through 2014 (Attachment C), which Geris distributed electronically to the Coordinating Committees following the meeting on January 27, 2014. Kahler said that he used these PIT-tag data to modify the draft 2014 Wells Passage-Dates Analysis, as reflected in Attachment B. He noted the revisions made to Table 3 in Attachment B to reflect the exclusion of below-Wells Chinook salmon from the analysis, which resulted in bypass passage for 98.03% of yearling Chinook salmon versus the previously reported 80.65%, which included Chinook salmon originating below Wells Dam.

Kahler also raised a question about the accuracy of the estimated 5-day average travel time between Rocky Reach Dam and Wells Dam that has been used in these annual analyses of yearling Chinook salmon passage; Kahler said this is based on estimates from a 2010 survival verification study. He said that Douglas PUD is now investigating the possibility of installing a PIT-tag detection system in Wells Spillway 2, which would eliminate the need to rely on travel times estimated using only Rocky Reach Dam detections. Only spillways 2 and 10 are designed with flap gates for top spill, which may also be able to accommodate antennas for PIT-tag detection. He said that in the past, fyke net data showed that most fish pass Wells Dam via Spillway 2, providing an ideal situation for monitoring bypass effectiveness. He said that the flap gate in Spillway 2 is about 17 feet wide by about 8 feet tall. He said that Douglas PUD and Biomark plan to meet in February to discuss the feasibility of installing PIT-tag antennae equipment in the flap gate.

Jim Craig asked if they anticipate issues with interference from the metal gate, and Kahler replied that it was unknown, but new antenna technology has minimized such interference. Kahler added that velocity through the spillway is about 15 to 17 feet per second, which should by itself not be an issue. The detection system in the Rocky Reach Juvenile Fish Bypass System (RRJFBS) has similar velocities, and that system has performed well. He also added that Douglas PUD and Chelan PUD plan to update the readers at the RRJFBS, which have almost 100% detection for single fish; however, only about 80% for multiple fish passing at the same time. The updated readers planned for the RRJFBS are the same technology that may be applied to the detection system in Spillway 2 at Wells Dam. He said that evaluating the feasibly of this system is included in the draft 2015 Wells HCP Action Plan; if it is feasible, Douglas PUD would like to have the system in place by the 2016 bypass season.

Mike Schiewe asked about the 2012 data, which indicated all fish passing Rocky Reach Dam in about 2 days, as depicted in the 2012 yearling Chinook salmon PIT-tag detection data at Rocky Reach Dam (Attachment C). Kahler speculated that hatchery releases over a narrow window dominated the rest of the curve. Jeff Korth noted that 2012 was the first summer releases out of the Entiat River.

Kahler requested that Coordinating Committees representatives submit edits and comments on the draft 2014 Wells Post-Season Bypass Report and revised draft 2014 Wells Passage-

Dates Analysis to him by Tuesday, February 10, 2015. He noted that Figure 1a in Attachment B will be updated to include the curve resulting from the exclusion of below-Wells yearling Chinook salmon from the analysis.

C. *Draft 2015 Wells HCP Action Plan (Tom Kahler)*

Tom Kahler said that a draft 2014 Wells HCP Action Plan was distributed to the Coordinating Committees by Kristi Geris on January 16, 2015; however, since that time, the draft plan has been revised. Kahler handed out a revised draft 2015 Wells HCP Action Plan, which he said he would provide to Geris to distribute electronically to the Coordinating Committees. He said that regarding the Coordinating Committees section of the draft plan, revisions included a minor title change and an additional date under the Pikeminnow Control Program. *(Note: Kahler provided the revised draft plan to Geris following the meeting on January 27, 2015, which Geris distributed to the Coordinating Committees that same day.)*

Mike Schiewe explained that this plan is developed at the beginning of each year, and includes activities for all three HCP Committees. He said that the plan is also reviewed and approved by all three HCP Committees. He added that the plan is not a requirement of the HCPs; rather, it is intended for managing in-house activities. Kahler requested that Coordinating Committees representatives submit edits and comments on the revised draft 2015 Wells HCP Action Plan to him by Tuesday, February 10, 2015. He said that Douglas PUD will request approval of the draft plan during the next Coordinating Committees meeting on February 24, 2015.

D. *Draft 2015 Wells Bypass Operating Plan/Gas Abatement Plan (Tom Kahler)*

Tom Kahler said that the draft 2015 Wells GAP/BOP was distributed to the Coordinating Committees by Kristi Geris on January 9, 2015. Kahler said that approval of the draft plan is needed no later than the next Coordinating Committees meeting on February 24, 2015, in order to meet a deadline for submission to the Federal Energy Regulatory Commission (FERC). He said that the draft plan, a requirement of the Wells Hydroelectric Project Clean Water Act Section 401 Certification, is developed by Andrew Gingerich, Douglas PUD Aquatic Settlement Work Group (SWG) Technical Representative. Kahler said that the draft

2015 plan is essentially the same as the 2014 plan, including the section about Spillbays 4 and 7. He further explained that in 2014, concentrated spill was met using Spillbays 5 and 4 because unit 7 was being rebuilt. He said that unit 7 has now been in operation for several weeks and appears to be running well; however, the Spill Playbook is still written to allow concentrated spill through Spillbays 4, 5, and 6 in case there are issues with unit 7.

Mike Schiewe said that the draft plan will be up for approval during the next Aquatic SWG meeting on February 11, 2015. He said that Pat Irle, formerly the Ecology Aquatic SWG Technical Representative, has typically played a key role in the review of this plan. Schiewe said, however, that Irle has recently left Ecology, but Charlie McKinney (Ecology) indicated that Ecology is aware of the FERC deadline and still plans a rigorous review of the plan. Kahler requested that Coordinating Committees representatives submit edits and comments on the draft 2015 Wells GAP/BOP to him by Tuesday, February 10, 2015. He said that Douglas PUD will request approval of the draft plan during the next Coordinating Committees meeting on February 24, 2015.

E. 2014 Wells Plan Species Account Annual Report (Tom Kahler)

Tom Kahler said that the 2014 Wells Plan Species Account Annual Report was distributed to the Coordinating Committees by Kristi Geris on January 22, 2015. Kahler said that at the beginning of 2014, the Wells Plan Species Account balance was $1,096,267.79. He said that 2014 contributions (including interest) totaled $256,160.21, and disbursements totaled $30,837.63, resulting in an ending balance of $1,321,590.37. He said that Douglas PUD contributions in January 2015 totaled an additional $258.455.33, which will be deposited in the Wells Tributary Account.

F. Modifications to the Low-Level Side Entrance at the Wells Dam Adult Fishway (Tom Kahler)

Tom Kahler said that in early-December 2014, the east fishway at Wells Dam was dewatered for the annual winter maintenance, which included reopening the low-level side entrance to improve lamprey passage at Wells Dam. He said that when the low-level side entrance was opened, it was discovered that the area behind the entrance was full of silt. He said that it was determined that the silt would need to be removed before the “lamprey box” was installed, and the most efficient way to remove the silt was to re-water the ladder and suction out the silt, and then dewater again to install the lamprey box. Therefore, he said the plan now is to: 1) re-water the east fishway so that divers can suction out the silt, and then return the fishway back into service; 2) dewater the west fishway to perform routine maintenance and suction the silt out of the low-level entrance, and install the lamprey box, and then return the fishway back into service; and 3) dewater the east fishway again and install the lamprey box. Kahler said that Douglas PUD is trying to schedule these activities so that the divers can conduct their work in a single mobilization. He said that the materials for the lamprey boxes are expected onsite this week. He recalled that these modifications need to be installed prior to Douglas PUD's Aquatic SWG radio-telemetry lamprey study scheduled for this summer. He said that the second dewatering of the east fishway will likely take place in late-February, and that hopefully these modifications can be completed without needing to extend the winter outage season. He added that during these activities, at least one fish ladder will remain open at Wells Dam. Jim Craig asked if the silt will need to be routinely flushed out of the area. Kahler replied that the lamprey box was redesigned to flush silt through drain holes in both corners of the steel plate.

III. Chelan PUD

A. Draft Rocky Reach Total Dissolved Gas: Step One, Year Five Compliance Report (Lance Keller)

Lance Keller said that the draft Rocky Reach TDG: Step One, Year Five Compliance Report was distributed to the Coordinating Committees by Kristi Geris on November 17, 2014, with comments and edits due to Chelan PUD by December 16, 2014. Keller said that comments were received from the CCT, which were incorporated into the draft report. Jeff Korth asked if the CCT's comments were distributed to the Coordinating Committees, and Keller said that Chelan PUD will provide the CCT's comments on the draft report to Geris for distribution to the Coordinating Committees. Keller added that the CCT's comments did not significantly change any aspect of the report. Kirk Truscott also added that Marcie Steinmetz contacted him regarding his comments, and he was confident they were addressed in the draft report. The Coordinating Committees representatives present approved the Rocky Reach TDG: Step One, Year Five Compliance Report. *(Note: the CCT's comments, along with Chelan PUD's response, were included in Appendix A of the final report [Attachment D] that was provided by Steinmetz on January 30, 2015, and distributed to the Coordinating Committees by Geris that same day.)*

B. Draft 2015 Rocky Reach and Rock Island HCP Action Plan (Lance Keller)

Lance Keller said that the draft 2015 Rocky Reach and Rock Island HCP Action Plan was distributed to the Coordinating Committees by Kristi Geris prior to the meeting on January 27, 2015. Keller said that the Coordinating Committees portion of the draft plan is the same as last year's, with the exception of the extended September bypass operations, which were completed. He requested that Coordinating Committees representatives submit edits and comments on the draft 2015 Rocky Reach and Rock Island HCP Action Plan to him by Tuesday, February 10, 2015. He said that Chelan PUD will request approval of the draft plan during the next Coordinating Committees meeting on February 24, 2015.

Geris indicated that she will coordinate with Alene Underwood regarding distributing the draft plan to the HCP Hatchery Committees. *(Note: Geris distributed the draft plan to the HCP Hatchery Committees following the meeting on January 27, 2015, per Underwood's direction.)*

C. Draft 2015 Rocky Reach and Rock Island Spill Plan (Lance Keller)

Lance Keller said that the draft 2015 Rocky Reach and Rock Island Spill Plan was distributed to the Coordinating Committees by Kristi Geris on January 23, 2015. Keller said that Thad Mosey, Chelan PUD Spill Coordinator, developed the draft plan using last year's plan as a template. Keller recalled that last year, the Coordinating Committees approved this same plan; however, because of the emergency drawdown of the Wanapum Reservoir, both Rocky Reach and Rock Island dams were operated under the Interim Fish Passage Plan (IFPP). He said that based on the current status and progress of the repairs at Wanapum Dam, Chelan PUD is confident that in 2015, Rocky Reach and Rock Island dams will be operated under the 2015 Rocky Reach and Rock Island Spill Plan.

Jim Craig noted that the fork lengths for subyearling Chinook salmon that were reported in the draft plan seemed large (i.e., 76 to 150 millimeters [mm]); he said that fork lengths of subyearling Chinook salmon obtained from the Entiat River screw traps only averaged about 50 to 60 mm. He added that he will provide Chelan PUD with these Entiat subyearling

Chinook salmon data. *(Note: Craig provided these lengths to Keller and the Coordinating Committees Technical Representatives following the meeting on January 27, 2015.)*

Keller requested that Coordinating Committees representatives submit edits and comments on the draft 2015 Rocky Reach and Rock Island Spill Plan to him by Tuesday, February 10, 2015. He said that Chelan PUD will request approval of the draft plan during the next Coordinating Committees meeting on February 24, 2015.

D. Draft 2015 Rocky Reach and Rock Island Juvenile Bypass Study Plans (Lance Keller)

Lance Keller said that the draft 2015 Rocky Reach Juvenile Fish Bypass System Operations Plan and draft 2015 Rock Island Bypass Monitoring Plan were distributed to the Coordinating Committees by Kristi Geris on January 23, 2015. Keller said that the plans are the same as last year's, with the exception of the extended September bypass operations. He added that Chelan PUD will also soon provide the draft 2014 Rocky Reach and Rock Island Juvenile Bypass Study Plan Reports for review (which will include 2013 data). He requested that Coordinating Committees representatives submit edits and comments on the draft 2015 Rocky Reach Juvenile Fish Bypass System Operations Plan and draft 2015 Rock Island Bypass Monitoring Plan to him by Tuesday, February 10, 2015. He said that Chelan PUD will request approval of the draft plans during the next Coordinating Committees meeting on February 24, 2015.

E. Rocky Reach Dam and Rock Island Dam Adult Fishway Annual Maintenance (Lance Keller)

Lance Keller reviewed 2014/2015 winter maintenance activities at Rocky Reach and Rock Island dams, as follows:

Rocky Reach Dam

Keller said that on January 9, 2015, the adult fishway at Rocky Reach Dam was taken offline for annual maintenance. He said that a fish rescue was performed and routine inspections are underway. He said that the fishway is scheduled to be back online by March 1, 2015.

Rock Island Dam

Keller said that on December 1, 2014, annual maintenance began at Rock Island Dam. He said that at least one fishway will be available throughout all maintenance activities, and all Rock Island Dam fishways are scheduled to be back online by March 1, 2015.

Right Ladder

Keller said that on December 1, 2014, the right fish ladder at Rock Island Dam was taken offline for annual maintenance. He added that this year, the right ladder was scheduled for a comprehensive inspection and maintenance. He said that maintenance activities included repairs to an attraction water pump and a full inspection of the auxiliary water system picket-barrier leads. He said that all ladder maintenance is now complete; however, the ladder is still offline as maintenance staff are waiting for reduced river flow to repair the trash boom above the exit of the ladder that was damaged when the forebay elevation was dropped in response to the Wanapum Dam repair. He said that a temporary PIT-tag antenna array has been installed upstream of the count window, and is now undergoing tuning and testing. He recalled that the temporary array was installed at this upstream location to help mitigate noise issues experienced with the existing array.

Center Ladder

Keller said that on December 29, 2014, the center fish ladder at Rock Island Dam was taken offline for annual maintenance. He said that routine maintenance was performed, including a more in-depth inspection of the valves in the lower fishway to inspect for cracks or other damage that may have occurred during the low tailwater elevations experienced in December 2014. He said that the center ladder was re-watered on January 9, 2015.

Left Ladder

Keller said that on January 12, 2015, the left fish ladder at Rock Island Dam was taken offline for annual maintenance. He said that the ladder is still offline; however, it is expected to be re-watered by the end of this week. He said that major maintenance activities included installing new operators for the entrance gates, as the previous infrastructure was old and worn. He said that the installation is now complete, and all that remains is cleaning up.

F. Tumwater Fishway Repairs (Lance Keller)

Lance Keller said that Tumwater Dam will be temporarily taken out of service for needed repairs. He said that Chelan PUD is coordinating these efforts with steelhead trapping activities conducted by the Washington Department of Fish and Wildlife (WDFW), Wenatchee District Office. He said that on February 17, 2015, the fish ladder at Tumwater Dam will be dewatered; on February 18, 2015, members of the Rocky Reach Fish Forum will conduct a rapid assessment for lamprey passage. He said that construction is scheduled to be complete and the ladder rewatered by March 4, 2015. He said that Chelan PUD discussed the needed repairs with McClain Johnson (WDFW, Wenatchee District Office), and together they recommended completing all repairs at once to avoid the need for multiple fish rescues. Keller said that the repairs include: 1) fixing spalled concrete, which require measures to ensure that the concrete cures correctly; 2) installing a PIT-tag antenna, which is already onsite and ready for installation; and 3) making a revision to the attraction water foot screens to meet National Marine Fisheries Service (NMFS) criteria (i.e., fixing a gap between the screens that do not currently meet passage criteria). Jeff Korth asked if the HCP Hatchery Committees are aware of the planned outage, and Mike Schiewe said that this has not yet been discussed within the HCP Hatchery Committees. Keller said that he will coordinate with the Chelan PUD HCP Hatchery Committees representatives regarding these repairs.

G. Wanapum Drawdown Update (Lance Keller)

Lance Keller said that the Chelan PUD Rock Island IFPP January Report was distributed to the Coordinating Committees by Kristi Geris on December 31, 2014. Keller said that considering the current status and progress of the repairs at Wanapum Dam, Chelan PUD proposed to FERC that the January report will be the last monthly report filed. Keller said that if the Coordinating Committees have questions at any time, to please contact him. He said that all fishways currently not out for maintenance are currently open and the current tailwater elevation is at approximately 567.9 feet, which is approximately 8 feet above the fishway sills. He added that the side walls of the rest boxes are at about 564.0 feet. He said that the Wanapum Dam headwater is at approximately 560.2 feet, and added that Wanapum Dam operates at up to approximately 561.8 feet. He said that river flow past Rock Island Dam is approximately 146,400 cubic feet per second (146.4 kcfs), which translates to a headwater elevation of approximately 612.9 feet.

Jim Craig asked about plans for removal of the denil structures, and Keller replied that Chelan PUD plans to leave the structures in place for the 2015 passage season in case they are needed. Keller added that, assuming the full Wanapum pool raise goes well, Chelan PUD plans to remove the structures during the 2015/2016 winter maintenance period. He said that once the denils are removed, they will likely go to the boneyard (opposed to being scrapped). Jeff Korth asked if there is concern regarding the long-term stability of the denil structures and leaving them permanently in place. Keller said that leaving the structures permanently in place would require re-consultation, and Scott Carlon further explained that this would be considered a structural change to the project, which would reopen the license.

IV. HCP Hatchery and Tributary Committees Update (Mike Schiewe)

Mike Schiewe said that the HCP Tributary Committees did not meet in January 2015, and plan to meet next on February 12, 2015.

Schiewe updated the Coordinating Committees on actions and discussions that occurred at the last HCP Hatchery Committees meeting on January 21, 2015, which—due to several shared agenda items—was a joint meeting of the HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Sub Committee, as follows:

- *Draft Wells 2015 HCP Action Plan:* The draft action plan was circulated by Douglas PUD, as discussed during today's meeting.
- *Methow Sharing Agreement:* Chelan PUD announced that they are nearing agreement on a sharing arrangement with Douglas PUD to return to meeting their Methow spring Chinook salmon production obligation at Methow Fish Hatchery (FH). Recall that last year, Chelan PUD was looking to develop a program that included: 1) adult collection at the Rocky Reach Trap (which worked to a limited extent, but not as well as hoped), and tangle netting efforts to collect broodstock for 2015; 2) incubation and early rearing at Eastbank FH; and 3) acclimation at Carlton Pond, with the intention of acclimating fish in the Chewuch. This new sharing agreement, if finalized, will allow a return to a program that was in place previously, with brood collection at Wells Dam, and rearing at Methow FH. This was seen as good news for most everyone; however, the YN expressed interest in seeing

acclimation at Carlton Pond continue for a few years. Jeff Korth asked if these are all conservation fish, and Schiewe replied that they are.

- *YN Kelt Reconditioning Project Request for Sampling at Wells Dam:* This was a proposal for new sampling at Wells Dam as part of an evaluation of kelt reconditioning. The sampling is looking to compare reproduction-related phenotypic characteristics between reconditioned kelts and first-time steelhead spawners in the Upper Columbia. The sampling will include measurement of lipid content and obtaining blood samples to determine concentrations of vitellogenin and estradiol. This sampling was suggested by the Independent Scientific Review Panel during their review of the YN's Kelt Reconditioning Program. Sampling will occur in coordination with existing sampling conducted by WDFW (i.e., no new trapping).
- *Methow and Wenatchee Spring Chinook Production Status Update:* Regarding Methow spring Chinook salmon production, there are approximately 37,000 surplus progeny on hand in excess of 110% of the Methow spring Chinook salmon production goal, including both Grant PUD and Douglas PUD production. The surplus fish were a result of low incidence of bacterial kidney disease in broodstock and high survival through the eyed egg stage. WDFW is looking into how to use the excess fish, including possibly incorporating them with the CCT's production. Kirk Truscott said that WDFW and the CCT are trying to determine whether the excess fish can be accommodated from a facility standpoint in the Okanagan reintroduction program, consistent with the CCT's Section 10j permit. The YN is also discussing internally whether they can help put the surplus fish to use. Jeff Korth asked about the brood origin of the surplus fish, and Truscott said that they are hatchery-by-wild (HxW). Truscott added that because of factorial mating, the hatchery component is already accounted for in the hatchery population. Tom Kahler also clarified that the overage is at Methow FH; however, if those fish are used, then the overage will be the hatchery-by-hatchery (HxH) production at Eastbank FH. Schiewe noted that if a new sharing agreement is signed, those fish could become part of Chelan PUD's production.

  Regarding Wenatchee spring Chinook salmon production, the Nason Creek program currently has about 37,000 eyed eggs, which are expected to yield about 27% of the conservation program. In contrast, the Chiwawa program has about 141,000 eyed eggs, which are expected to yield about 95% of the conservation program. The addition of approximately 201,000 smolts from the safety net program is expected to bring the Wenatchee spring Chinook salmon program total to about 371,000 smolts, which is 101% of the combined program. Thus, the program is slightly over production as a whole; however, the program is under production for the conservation component.

- *Re-initiation of Spring Chinook Biological Opinion (BiOp):* NMFS has made a preliminary decision on a preferred alternative to collect Wenatchee basin spring Chinook salmon broodstock at Tumwater Dam and the Chiwawa Weir beginning with brood year (BY) 2015. Chelan PUD and Grant PUD drafted a letter to NMFS indicating that this new preferred alternative was not previously analyzed in the BiOp, and will ultimately lead to re-initiation of consultation.
- *PRESENTATION: Circular Pond Rearing at Eastbank FH and Chiwawa Facility:* Chelan PUD provided a presentation highlighting the results of studies conducted by Chelan PUD to compare the health and performance of summer Chinook salmon and steelhead that were reared in partial water reuse vessels versus raceways. Post-release data have shown benefits for fish reared in partial water reuse vessels, including: 1) no significant health issues observed to date; 2) faster migration times; 3) high estimated survival; and 4) higher growth on same rations. A final report is expected to be available by next month. Schiewe recalled the lengthy process to obtain HCP Hatchery Committees approval of this study because the technology had not yet been widely tested; however, he noted that it seems that the technology has caught up. Jim Craig noted that this technology is also being considered for Leavenworth National Fish Hatchery.
- *YN Upper Methow Spring Chinook Acclimation – Draft Proposal and SOA:* In October 2014, the YN first proposed expanded acclimation in the Upper Methow River. During the meeting in November 2014, Douglas PUD introduced the idea of incorporating adaptive management into these types of studies and developing metrics of success to measure progress and support decision-making. The adaptive management concept was initially well-received during the meeting in November; however, during last week's meeting, the YN expressed reservations about the

suggested changes to their proposal. The current YN draft proposes acclimation of 25,000 BY 2014 Methow spring Chinook salmon at the Goat Wall acclimation site in 2016.

V. HCP Committees Administration

A. Next Meetings (Mike Schiewe)

The next scheduled Coordinating Committees meeting is on February 24, 2015, to be held in person at the Radisson Hotel in SeaTac, Washington. The March 24 and April 28, 2015 meetings will be held either by conference call or in person at the Radisson Hotel in SeaTac, Washington, as is yet to be determined.

List of Attachments

Attachment A	List of Attendees
Attachment B	Revised Draft 2014 Wells Passage-Dates Analysis (in redline strikeout)
Attachment C	Yearling Chinook Salmon PIT-Tag Detection Data at Rocky Reach Dam from 2010 to 2014
Attachment D	Final Rocky Reach TDG: Step One, Year Five Compliance Report

Attachment A
List of Attendees

Name	Organization
Mike Schiewe	Anchor QEA, LLC
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Lance Keller*	Chelan PUD
Tom Kahler*	Douglas PUD
Jim Craig*	U.S. Fish and Wildlife Service
Scott Carlon*	National Marine Fisheries Service
Jeff Korth*	Washington Department of Fish and Wildlife
Kirk Truscott*†	Colville Confederated Tribes

Note:
* = Denotes Coordinating Committees member or alternate
† = Joined by phone

Attachment B

Analysis of Proportion of Outmigration Affected by Bypass Operations at Wells Dam in 2014

Prepared for:

Public Utility District No. 1 of Douglas County
1151 Valley Mall Parkway
East Wenatchee, Washington 98802 - 4497

Prepared by:

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18 November 2014

Introduction

Outmigration has been monitored at the juvenile sampling facility at Rocky Reach Dam for four stocks of salmonids (yearling and subyearling Chinook salmon, steelhead, and sockeye salmon) from 2005 onward. Coho salmon were added in 2013, using the detections at Rocky Reach Bypass of PIT-tagged fish. The proportions of each stock covered by the bypass operations at Wells Dam can be estimated using ~~the historical~~ daily counts at Rocky Reach Dam, and adding the travel time from Wells to Rocky Reach ~~D~~dams. Table 1 has the average travel times based on Douglas PUD's 2010 PIT-tag study for yearling Chinook salmon, and acoustic-tag studies for steelhead and sockeye salmon. Due to a dearth of PIT-tag or acoustic-tag studies performed with subyearling Chinook and coho salmon, travel time was assumed to be 2 days.

Table 1: Average travel times from Wells tailrace to Rocky Reach Dam.

Stock	Travel time
Yearling Chinook salmon	5 days
Subyearling Chinook salmon	2 days
Steelhead	2 days
Sockeye salmon	2 days
Coho salmon	2 days

This year, monitoring was extended 11 days at Rocky Reach under its Habitat Conservation Plan 10-year requirement. Estimates of daily passage reflect the additional daily monitoring. Plots of the annual cumulative proportion of the outmigration for spring migrants (yearling Chinook, steelhead, sockeye, and coho), and the subyearling Chinook in the summer had fairly consistent start and end dates at Rocky Reach (Figure 1). The timing of bypass operations for the spring outmigration at Wells from 2004 through 2011 was from 00:00 ~~12~~ April 12th through ~~–~~ 24:00 ~~13~~ June 13th of each year for the "spring" spill season, and from 00:00 ~~14~~ June 14th through ~~–~~ 24:00 ~~26~~ August 26th for the "summer" spill season. For 2012 and beyond, the Wells Habitat Conservation Plan (HCP) Coordinating Committee approved the modification of the timing of bypass operations at Wells Dam as follows: bypass operations commenced at 00:00 on April 9th and continued through 24:00 on August 19th. This current timing of bypass operations will continue annually, unless modified as a result of future investigations that demonstrate an inadequacy of these dates at providing bypass passage for 95% of the migrations of both spring- and summer-migrating Plan Species at Wells Dam.

Results

The proportions of passage during the Wells bypass operations in 2014 were ~~0.8065 for yearling Chinook salmon, 0.~~99.75% for steelhead, 1.00% for sockeye salmon, ~~0.~~99.99% for coho salmon, ~~and~~ ~~0.~~96.80% for subyearling Chinook salmon, and apparently 80.65% for yearling Chinook salmon. The

2014 results for steelhead, sockeye, coho, and subyearling Chinook salmon were all consistent with historical trends, 2005–2012 (Table 2). The unusually low coverage percentage for yearling Chinook salmon (i.e., ~~0.~~80.65%) was due~~ primarily~~ to the release of 385,000 yearling summer Chinook from the Entiat National Fish Hatchery and an early release~~s~~ of approximately 573,000 yearling summer Chinook from ~~two hatchery programs: the Chief Joseph Hatchery Omak Creek acclimation facility (approximately 44,000 fish), and~~ the Chelan ~~Falls~~ River acclimation facility. Both of these releases occur downstream from Wells Dam, and thus do not represent the yearling Chinook passing Wells Dam~~ (approximately 573,000 fish)~~. ~~Of those, only the Omak Creek releases occurred upstream of Wells Dam; nevertheless, since the assessment of Wells bypass performance relies on Rocky Reach sampling, and we cannot determine from the sampling data whether those fish originated upstream or downstream from Wells Dam--the analysis includes all fish irrespective of origin.~~ Analysis of PIT-tag detections of yearling Chinook at the Rocky Reach Juvenile Fish Bypass indicated similar compliance levels (82.99%) to those from bypass sampling, but also revealed distinct differences in passage-timing distributions for yearling Chinook originating above and below Wells. The dates on which the fifth percentile of the yearling Chinook migration passed Rocky Reach occurred on April 10th for fish originating downstream from Wells and on April 21st for those originating upstream of Wells, corresponding to Wells passage dates of April 5th and April 16th, respectively. Thus, when appropriately including only those fish originating upstream from Wells in the analysis, the April 9th start date for the Wells Bypass in 2014 achieved compliance with the 95% HCP mandate, providing bypass passage to 98.03% of the yearling Chinook migration. ~~Nearly 20% (i.e., 0.1935) of the yearling Chinook run sampled at Rocky Reach apparently passed Wells Dam prior to the beginning of the 9 April bypass operations.~~ For yearling Chinook salmon in 2014, the start of the Wells bypass operations was~~ould have needed to start 3~~ 7 days earlier than necessary to achieve the ≥95% coverage (Table 3). Figure 1 illustrates the sudden, early spike in yearling Chinook salmon migration at Rocky Reach in 2014 that represents the arrival of fish originating from ENFH and the Chelan River, and also shows the curve generated from PIT-tag data including only fish originating above Wells Dam. Finally, for subyearling Chinook salmon ~~T~~the termination of the bypass operation in August 2014 was 4 days later than required to assure ≥95% coverage~~ for subyearling Chinook salmon~~ (Table 4).

To assess the effectiveness of the selected start date for ~~spring~~ bypass operations, Table 3 ~~has~~ compares the start date for bypass operations each year with the date ~~that, with hindsight, the spring~~on which the 5th percentile of the cumulative ~~bypass operations should have started to achieve 95% coverage of the~~ yearling Chinook salmon outmigration passed Wells Dam~~for~~ that year.~~. These dates ranged from 6 April to 3 May. For the three years when yearling Chinook salmon coverage was less than 95%, bypass starting dates should have been 6, 9, and 11 April, instead of 12 April.~~

Similarly, Table 4 compares the actual termination date for bypass operations with the date on which bypass operations covered 95% of the subyearling Chinook salmon outmigration. In each year, an earlier termination of bypass operations would have been possible without jeopardizing the achievement of the HCP standard of providing a bypass route for ≥95% of outmigrating subyearling Chinook salmon. During the ten years analyzed, the 95% HCP standard was achieved 4 to 32 days prior to the actual date on which bypass operations were terminated.

~~Investigation of possible causes for the low coverage percentage for yearling Chinook focused on the timing of hatchery releases, since, as the numerically dominant component of the run, hatchery migrants substantially influence cumulative passage. Initial investigation of available raw counts (unadjusted for spill at Rocky Reach) compared the "wild" (adipose-present [ad+]) and hatchery (adipose-minus [ad-]) components of the run, and it did appear that the outmigration distributions differ for a few of the years (2010-2014). However, the fact remains that the source of both components cannot be directly determined as having come from above Wells Dam or below it.~~

Table 2. Total proportion of each stock's migration affected by bypass operations (spring, summer) at Wells Dam, based on travel times from Wells Dam to Rocky Reach Dam, the cumulative proportion of the annual migration of each stock at Rocky Reach, and the start and stop dates of Wells bypass operations.

	Proportion passed	Annual migration proportion					
Spring Outmigration	**Yearling Chinook Salmon**	2005	2006	2007	2008	2009	2010
	prior to spring Bypass Ops period	0.0528	0.0259	0.0551	0.0025	0.0116	0.0067
	during spring Bypass Ops period	0.9455	0.9559	0.9154	0.9972	0.9827	0.9917
	during summer Bypass Ops period	0.0017	0.0182	0.0296	0.0002	0.0056	0.0016
	after Bypass Ops period	0	0	0	0	0	0
	Total Covered by Bypass Ops	**0.9472**	**0.9741**	**0.9449**	**0.9975**	**0.9884**	**0.9933**
		2011	2012	2013	**2014**		
	prior to spring Bypass Ops period	0.0085	0.0004	0.0171	**0.0197~~35~~**		
	during spring Bypass Ops period	0.9910	0.9996	0.9823	**0.8064**		
	during summer Bypass Ops period	0.0005	0.0001	0.0006	**0.00~~0~~12**		
	after Bypass Ops period	0	0	0	**0**		
	Total Covered by Bypass Ops	**0.9915**	**0.9996***	**0.9829**	**0.9803~~65~~***		
	Steelhead	2005	2006	2007	2008	2009	2010
	prior to spring Bypass Ops period	0.0015	0.0101	0.0066	0.0009	0.0019	0.0045
	during spring Bypass Ops period	0.9903	0.9762	0.9887	0.9901	0.9965	0.9763
	during summer Bypass Ops period	0.0081	0.0137	0.0042	0.0089	0.0016	0.0188
	after Bypass Ops period	0	0	0.0004	0.0001	0	0.0004
	Total Covered by Bypass Ops	**0.9985**	**0.9899**	**0.9930**	**0.9990**	**0.9981**	**0.9951**
		2011	2012	2013	**2014**		
	prior to spring Bypass Ops period	0.0190	0.0014	0.0079	**0.0021**		
	during spring Bypass Ops period	0.9513	0.9885	0.9847	**0.9817**		
	during summer Bypass Ops period	0.0297	0.0101	0.0074	**0.0158**		
	after Bypass Ops period	0	0	0	**0.0004**		
	Total Covered by Bypass Ops	**0.9810**	**0.9986**	**0.9921**	**0.9975**		
	Sockeye Salmon	2005	2006	2007	2008	2009	2010
	prior to spring Bypass Ops period	0	0	0	0	0	0
	during spring Bypass Ops period	0.9983	0.9984	0.9998	0.9972	0.9957	0.9992
	during summer Bypass Ops period	0.0017	0.0016	0.0001	0.0028	0.0043	0.0008
	after Bypass Ops period	0	0	0	0	0	0
	Total Covered by Bypass Ops	**1.0000**	**1.0000**	**0.9999**	**1.0000**	**1.0000**	**1.0000**
		2011	2012	2013	**2014**		
	prior to spring Bypass Ops period	0	0	0	**0**		
	during spring Bypass Ops period	0.9923	0.9995	0.9990	**0.9999**		
	during summer Bypass Ops period	0.0077	0.0005	0.0009	**0.0001**		
	after Bypass Ops period	0	0	0.0001	**0**		
	Total Covered by Bypass Ops	**1.0000**	**1.0000**	**0.9999**	**1.0000**		

***Proportions not summing to 1 are due to round-off error.**

Commented [TK1]: Edited to reflect the exclusion of below-Wells stocks from the analysis.

Table 2. Total proportion of each stock’s migration affected by bypass operations (spring, summer) at Wells Dam (continued).

	Proportion passed	**Annual migration proportion**					
Spring Outmigration	**Coho Salmon**			2013	**2014**		
	prior to spring Bypass Ops period			0	**0.0001**		
	during spring Bypass Ops period			0.9910	**0.9984**		
	during summer Bypass Ops period			0.0090	**0.0015**		
	after Bypass Ops period			0	**0**		
	Total Covered by Bypass Ops			**1.0000**	**0.9999**		
Summer Outmigration	**Subyearling Chinook Salmon**	2005	2006	2007	2008	2009	2010
	prior to spring Bypass Ops period	0	0	0	0	0	0
	during spring Bypass Ops period	0.1937	0.1894	0.2136	0.1266	0.1029	0.5212
	during summer Bypass Ops period	0.8022	0.8077	0.7847	0.8620	0.8882	0.4723
	after Bypass Ops period	0.0041	0.0029	0.0017	0.0113	0.0089	0.0064
	Total Covered by Bypass Ops	**0.9959**	**0.9971**	**0.9983**	**0.9887**	**0.9911**	**0.9936**
		2011	2012	2013	**2014**		
	prior to spring Bypass Ops period	0	0	0	**0**		
	during spring Bypass Ops period	0.5628	0.5871	0.1670	**0.3529**		
	during summer Bypass Ops period	0.4331	0.4059	0.8263	**0.6151**		
	after Bypass Ops period	0.0041	0.0070	0.0067	**0.0320**		
	Total Covered by Bypass Ops	**0.9959**	**0.9930**	**0.9933**	**0.9680**		

Table 3. A~~C~~ comparison of the actual start date for ~~spring~~ bypass operations at Wells Dam each year, versus the date on which the 5th percentile~~start date necessary to have covered at least 95%~~ of the yearling Chinook salmon ~~out~~migration passed Wells Dam that year. Operations are assumed to begin at 00:00 for the date listed. "Proportion bypass ops would have covered" indicates the proportion of the migration that would have been provided a bypass passage route had bypass operations started at 00:00 on the date that the 5th percentile of the migration passed Wells Dam. "Bypass start date was…" indicates whether the bypass start date was earlier or later than the date on which the 5th percentile of the yearling Chinook migration passed Wells Dam, and by how many days.

Migration Year	Actual bypass start ~~D~~date	Cumulative proportion passed before 00:00	Proportion Covered by Bypass Ops	Date on~~by~~ which the ~~first~~ 5th percentile~~%~~ passed	Cumulative proportion passed before 00:00	Proportion b~~B~~ypass ~~O~~ops would have c~~C~~overed ~~this Proportion~~	~~# Days before or after~~Bypass start date was… ~~actual date to get 95%~~
2005	April 12	0.0528	0.9472	April 11	0.0039	0.9961	1 ~~before~~day late
2006	April 12	0.0259	0.9741	April 18	0.0468	0.9532	6 ~~after~~days early
2007	April 12	0.0551	0.9449	April 9	0.0243	0.9757	3 ~~before~~days late
2008	April 12	0.0025	0.9975	May 3	0.0406	0.9594	21 ~~after~~days early
2009	April 12	0.0116	0.9884	April 19	0.0436	0.9564	7 ~~after~~days early
2010	April 12	0.0067	0.9933	April 22	0.0410	0.9590	10 ~~after~~days early
2011	April 12	0.0085	0.9915	April 15	0.0446	0.9554	3 ~~after~~days early
2012	April 9	0.0004	0.9996	April 15	0.0115	0.9885	6 ~~after~~days early
2013	April 9	0.0171	0.9829	April 10	0.0240	0.9760	1 ~~after~~days early
2014	April 9	0.0169~~935~~	0.9803~~65~~	April 16	0.0~~15~~386	0.96~~8~~14~~7~~	~~3 before~~7 days early

Commented [TK2]: Modified to reflect the exclusion of below-Wells Chinook from the analysis

Table 4. A ~~C~~comparison of the actual stop date for ~~summer~~ bypass operations at Wells Dam each year, versus the stop date necessary to have covered at least 95% of the subyearling Chinook salmon outmigration that year. Operations are assumed to end at 24:00 for the date listed.

Migration Year	Actual Stop Date	Cumulative proportion passed by 11:59:59 PM	Date on or before the last 5% passed	Cumulative proportion passed by 11:59:59 PM (Bypass Ops would have Covered this Proportion)	# Days before actual date to get 95%
2005	August 26	0.9959	August 3	0.9525	23
2006	August 26	0.9971	August 2	0.9524	24
2007	August 26	0.9983	August 11	0.9538	15
2008	August 26	0.9887	August 19	0.9502	7
2009	August 26	0.9911	August 22	0.9709	4
2010	August 26	0.9936	August 10	0.9537	16

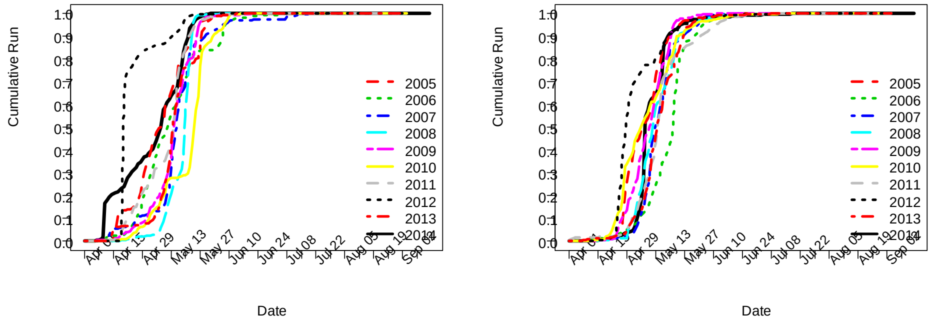
2011	August 26	0.9959	July 25	0.9528	32
2012	August 19	0.9930	July 29	0.9502	22
2013	August 19	0.9933	August 7	0.9592	12
2014	August 19	0.9696	August 15	0.9524	4

Figure 1. Passage dates at Rocky Reach Dam for spring and summer migrating stocks, 2005-2014. Cumulative proportions are based on the expanded counts obtained from sampling daily from 1 April – 31 August (or through 4 September in 2008 and 15 September in 2014).

a. Yearling Chinook Salmon

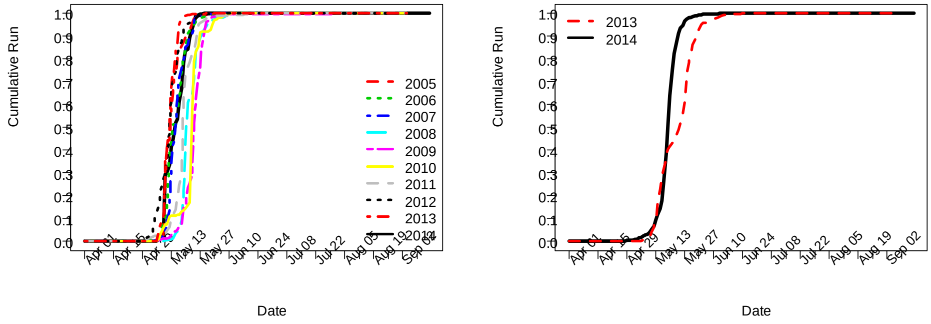
b. Steelhead

Commented [TK3]: Will have Townsend update this graph to include the curve resulting from the exclusion of below-Wells yearling Chinook from the analysis.

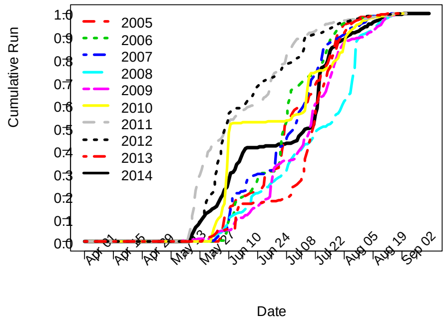


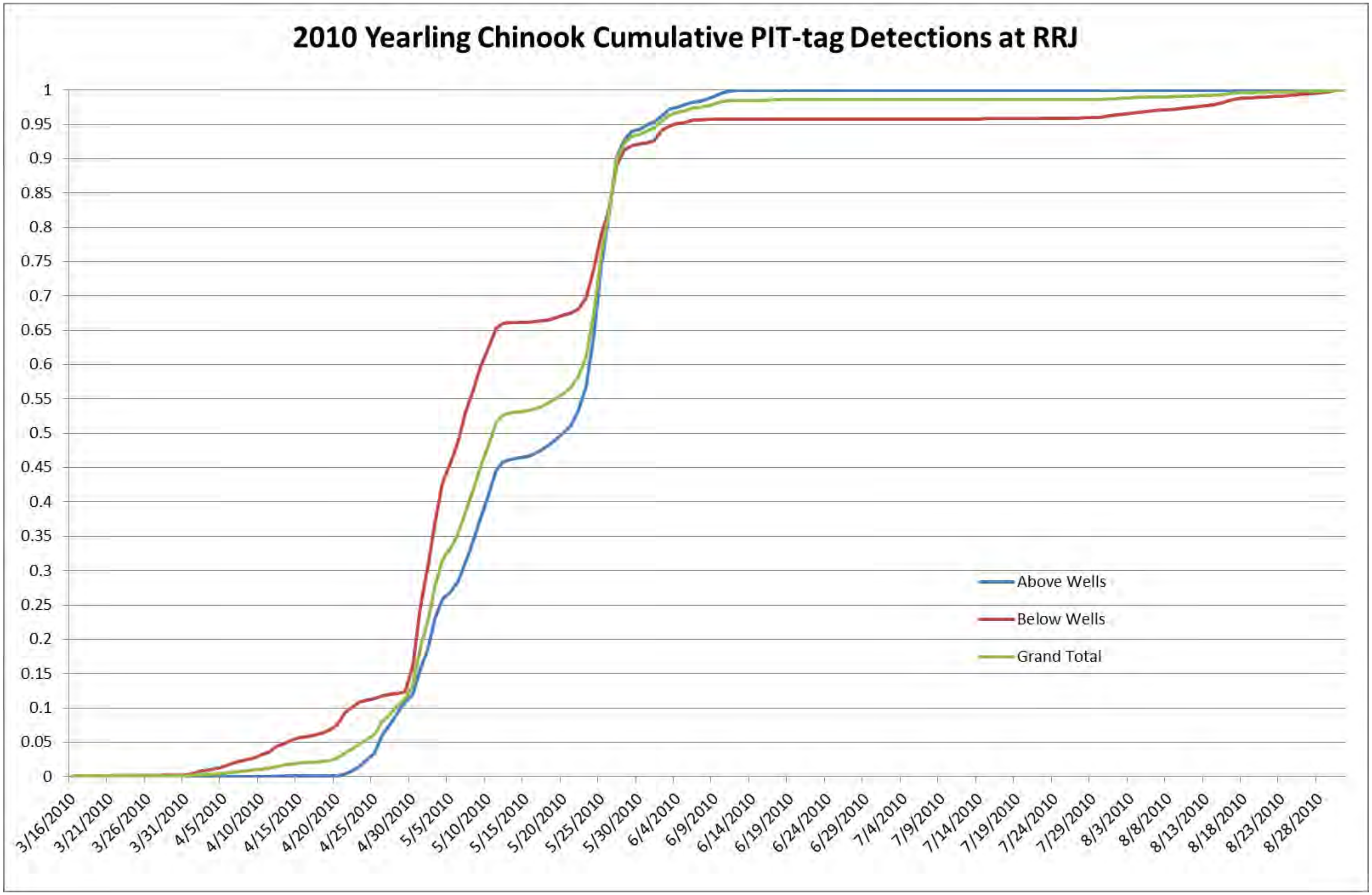
c. Sockeye Salmon

d. Coho Salmon



e. Subyearling Chinook Salmon




2010 Yearling Chinook Cumulative PIT-tag Detections at RRJ
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0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
3/16/2010
3/21/2010
3/26/2010
3/31/2010
4/5/2010
4/10/2010
4/15/2010
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7/24/2010
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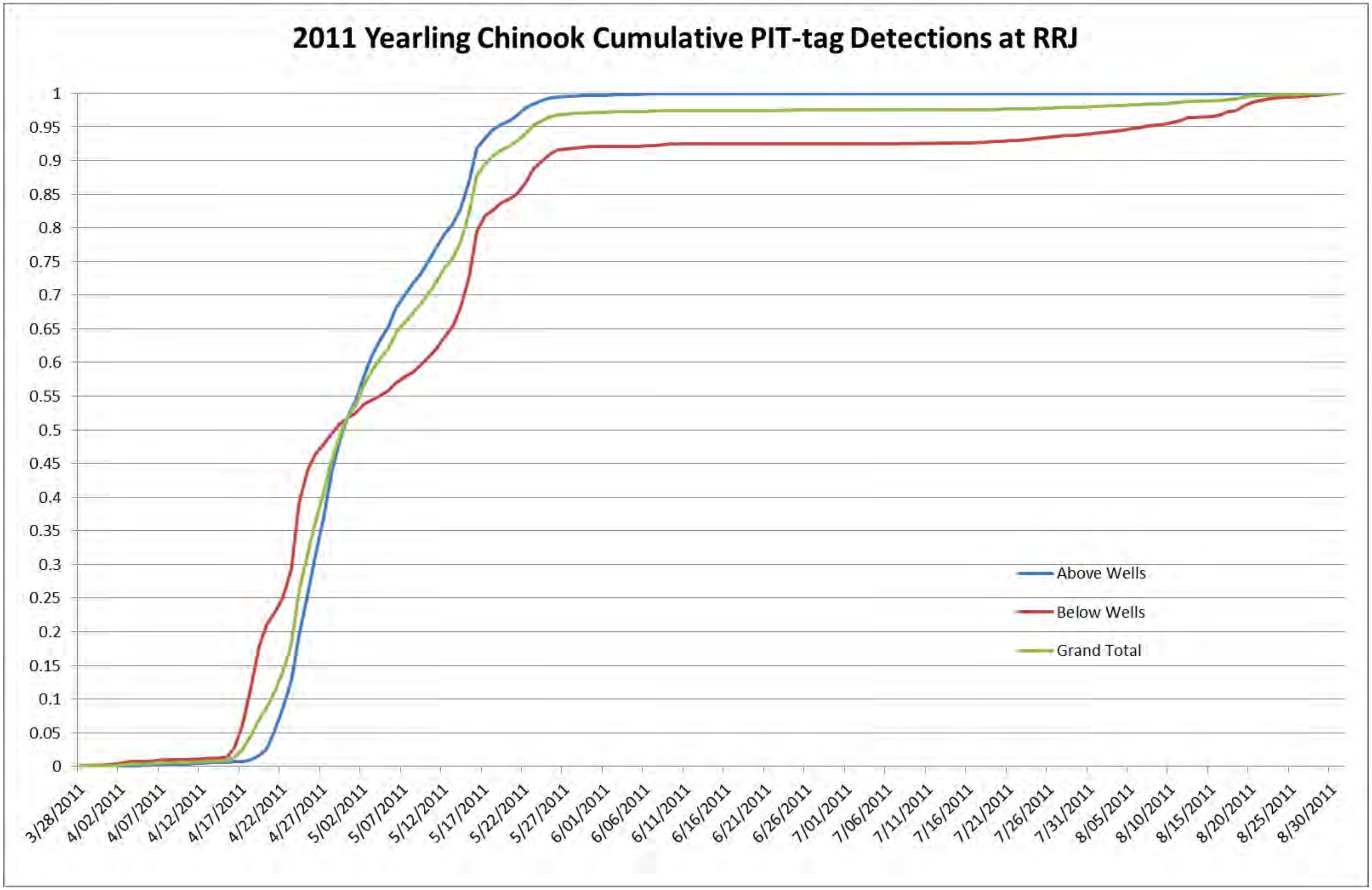
Above Wells
Below Wells
Grand Total


2011 Yearling Chinook Cumulative PIT-tag Detections at RRJ
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0
3/28/2011
4/02/2011
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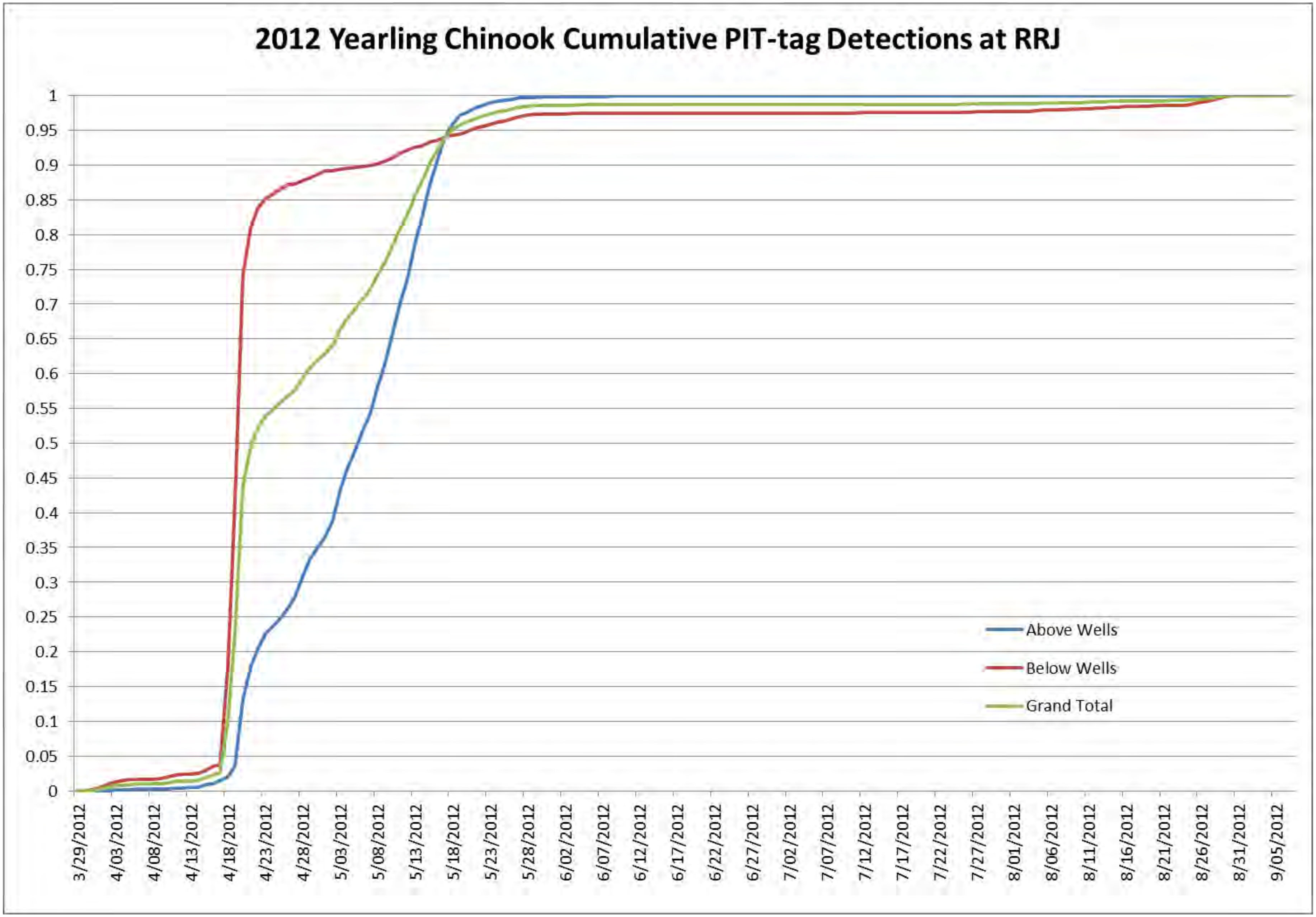
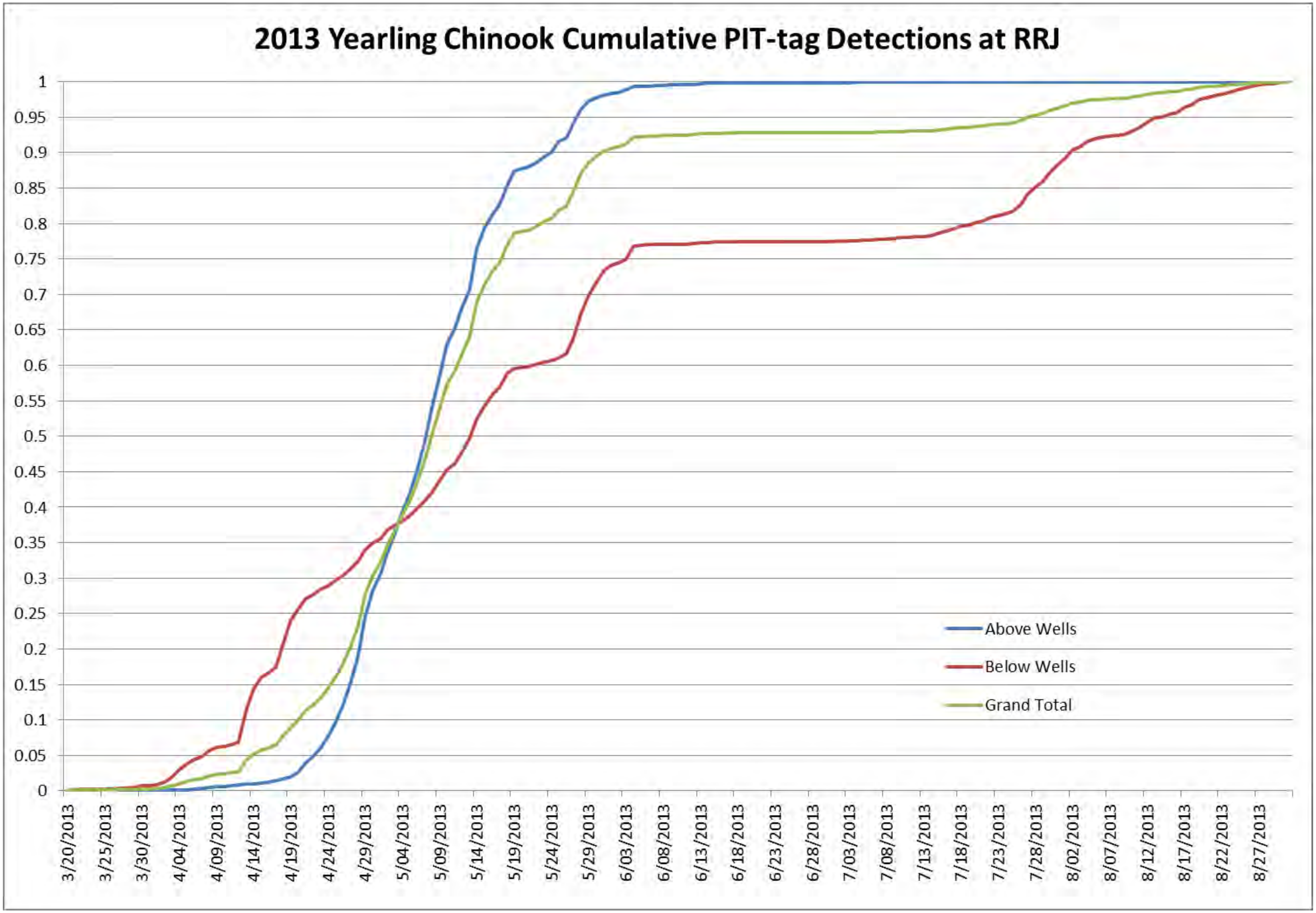
Above Wells
Below Wells
Grand Total

Attachment C




2013 Yearling Chinook Cumulative PIT-tag Detections at RRJ
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0.95
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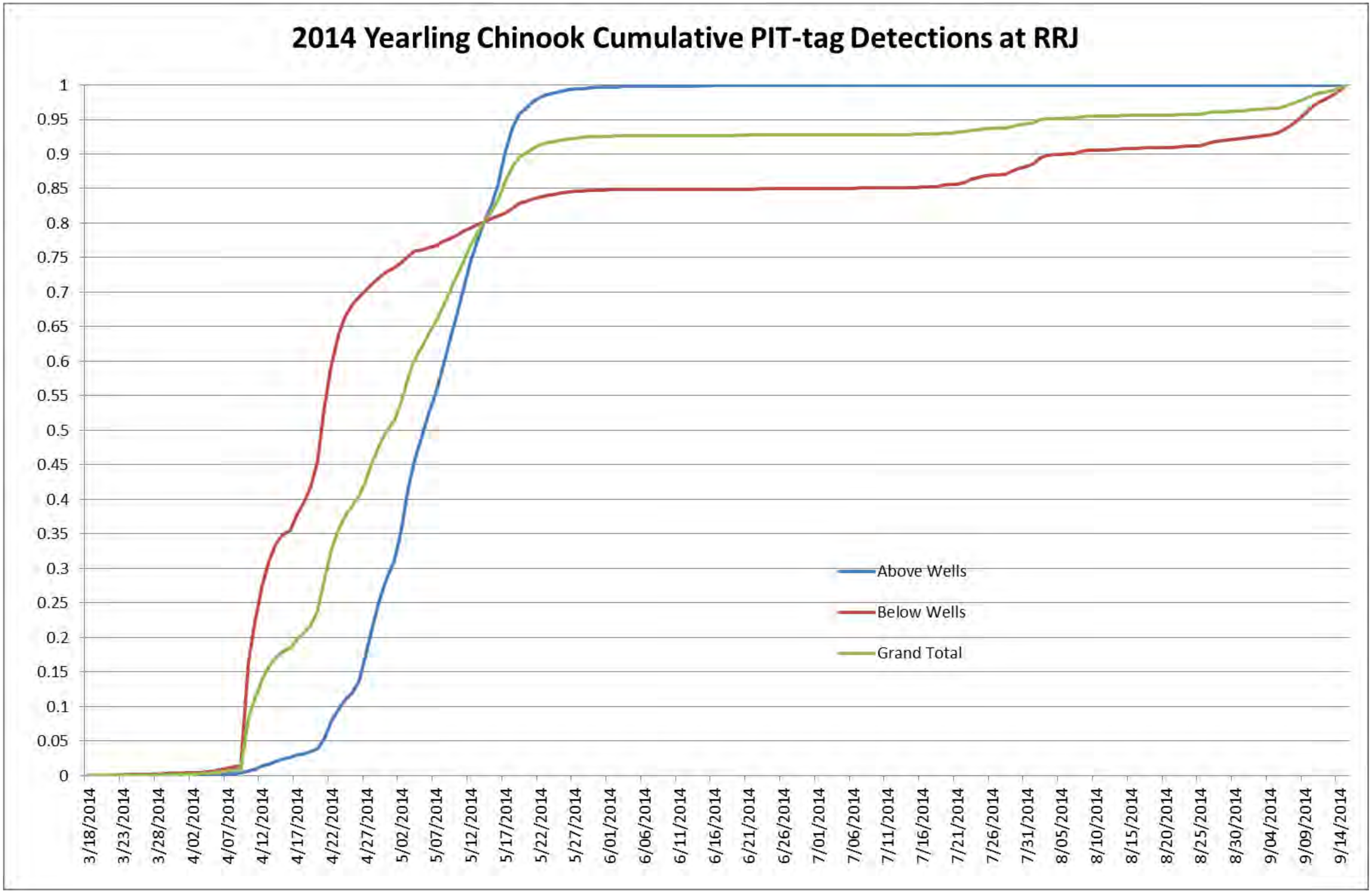
7/28/2013
8/02/2013
8/07/2013
8/12/2013
8/17/2013
8/22/2013
8/27/2013
Above Wells
Below Wells
Grand Total

Attachment C



Attachment D

TOTAL DISSOLVED GAS: STEP ONE, YEAR FIVE COMPLIANCE REPORT

FINAL

ROCKY REACH HYDROELECTRIC PROJECT
FERC Project No. 2145

January 30, 2015

Public Utility District No. 1 of Chelan County
Wenatchee, Washington

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TERMS AND ABBREVIATIONS

401 Certification	water quality certification
7Q10	highest seven consecutive day average flow with a 10-year recurrence frequency
cfs	cubic feet per second
CCT	Confederated Tribes of the Colville Reservation
Chelan PUD	Public Utility District No. 1 of Chelan County
CHJ	Chief Joseph dam
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
FMS	fixed monitoring station
GBT	gas bubble trauma
GCL	Grand Coulee dam
HCP	Habitat Conservation Plan
HCP CC	Habitat Conservation Plan Coordinating Committee
JBS	juvenile bypass system
kcfs	thousand cubic feet per second
NMFS	National Marine Fisheries Service
Project	Rocky Reach Hydroelectric Project
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
Report	Rocky Reach Dam Total Dissolved Gas: Step One, Year 5 Compliance Report
RRFF	Rocky Reach Fish Forum
standards	Washington State water quality standards
TDG	total dissolved gas
USFWS	United States Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WQMP	Water Quality Management Plan

EXECUTIVE SUMMARY

Public Utility District No. 1 of Chelan County (Chelan PUD) owns and operates the Rocky Reach Hydroelectric Project (Project), located on the Columbia River downstream of Wells Dam. The Project is licensed as Project No. 2145 by the Federal Energy Regulatory Commission (FERC) (FERC, 2009).

Chelan PUD is required to manage spill toward meeting water quality criteria for TDG during all flows below seven-day, ten-year frequency flood stage (7Q10) levels, but only to the extent consistent with meeting the passage and survival standards set forth in the Habitat Conservation Plan (HCP) and Anadromous Fish Agreement. Chelan PUD has been implementing the required total dissolved gas (TDG) abatement measures as well as completing annual monitoring and reporting requirements in accordance with its Washington State Department of Ecology (Ecology) 401 Water Quality Certification (401 Certification) (Ecology, 2006) and the Rocky Reach Water Quality Management Plan (WQMP) (Chelan PUD, 2006).

This Total Dissolved Gas: Step One, Year Five Compliance Report (Report), summarizes the results of all TDG studies performed to date and TDG data recorded from 2009 to 2013.

Determination of Compliance, Year 5, Section 5.4(1)(d) of the 401 Certification
Chelan PUD has prepared this report with the intent to satisfy the first step of Section 5.4(1)(d) of the 401 Certification for Ecology's review and conclusions. This report summarizes the results of all TDG studies performed to date, describes whether compliance with the numeric criteria has been attained and discusses the results of Chelan PUD's study on alternative spillway operations.

During the first five years of the License (2009 through 2013), the total number of Rocky Reach Dam TDG exceedances for the fish-spill season varied from zero in 2009 to 27 in 2012. During this same five year period the total number of hourly exceedances for the non-fish spill season varied from zero in 2009 to 61 in 2012.

The information below regarding Rocky Reach Dam's TDG compliance is summarized in a table below. Overall 5 Year Project compliance or percent time below the 120/115 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the fish-spill season was 93.6 percent (86 daily exceedances/1,352 days).

Overall 5 Year Project compliance or percent time below the 125 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the fish-spill season was 100 percent (0 daily exceedances/32,448 hours).

Overall 5 Year Project compliance or percent time below the 110 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the non fish-spill season was 99.5 percent (124 hourly exceedances/26,256 hours).

Rocky Reach tailrace and Rock Island forebay TDG Compliance Years 2009 through 2013		
% time below 120/115%	% time below 125%	% time below 110%
93.6	**100**	**99.5**

Chelan PUD has been effective in their compliance efforts regarding the TDG criterion at the Project by implementing the gas abatement measures identified in the 401 Certification and the WQMP. Although Chelan PUD has not been 100 percent compliant with the TDG standard 100 percent of the time, Chelan PUD will continue to implement the gas abatement measures in accordance with 401 Certification and WQMP. These measures have been successful in reducing TDG within the Rocky Reach tailrace and the Rock Island forebay.

Upon Ecology's review and conclusions of this Report, Chelan PUD shall coordinate and consult with Ecology regarding the next steps required of Section 5.4(1)(d) of the 401 Certification.

TDG Gas Abatement Measure (6), Alternate Spillway Operations, Section 5.4(1)(b)(6) of the 401 Certification

According to Section 5.4(1)(b)(6) of the 401 Certification, Chelan PUD shall study alternative spillway operations using any of gates 2 through 12. In 2011 and 2012, Chelan PUD studied alternative spillway flow distribution patterns, in order to evaluate the potential to reduce total dissolved gas TDG levels, particularly during high spill levels (above 50 kcfs). Generally, all of the three alternative spill patterns studied resulted in lower TDG levels than the standard spill pattern. Of the three alternative patterns, the flat spill pattern (flow distributed evenly between spillway gates) had a slightly better TDG performance than the other two alternative patterns. Chelan PUD has presented these findings to Ecology, the Rocky Reach Fish Forum (RRFF) and Habitat Conservation Plan Coordinating Committee (HCP CC).

Chelan PUD, through the consultation process with Ecology, the RRFF, and the HCP CC, will develop a schedule to make the necessary changes to perform the new spill configuration. This schedule may include but not be limited to; computer automation of spill gates (2015), and/or changes to system operations and monitoring. Chelan PUD will operate the new spill configuration as a pilot or test spill and further evaluate the results for a designated period of time. Chelan PUD shall develop a monitoring schedule to test operations under the new spill configuration. If upon operating under the new spill configuration data show that optimal results are not occurring as previously evaluated, Chelan PUD shall implement adaptive management in coordination with the RRFF and HCP CC.

SECTION 1: INTRODUCTION

The Project, owned and operated by Chelan PUD, is located on the Columbia River in Chelan County, Washington, approximately seven miles upstream of the city of Wenatchee, Washington (Figure 1-1). The Project utilizes the waters of the Columbia River, whose drainage basin extends over substantial portions of northern Washington, Idaho, Montana and into Canada. The Project reservoir (Lake Entiat) extends 43 miles to Douglas County PUD's Wells Dam. The Project consists primarily of an 8,235-acre reservoir; a 2,847-foot-long by 130-foot-high concrete gravity dam spanning the river, including a powerhouse and spillway; an upstream adult fishway, a juvenile fish bypass system, and hatchery facilities.

The FERC issued a new license (License) for the Project on February 19, 2009 (FERC, 2009) authorizing the Chelan PUD to operate the Project for a period of 43 years. The License incorporated the terms of the Rocky Reach Settlement Agreement, which included a comprehensive WQMP (Chelan PUD, 2006), and the terms of the 401 Certification (Ecology, 2006) issued by the Washington Department of Ecology (Ecology) as required by Section 401 of the Clean Water Act (Order 3155).

1.1 Determination of Compliance, Year 5, Section 5.4(1)(d) of the 401 Certification

In accordance with 401 Certification Condition 5.4(1)(d) *Determination of Compliance*, in the fifth year of the effective date of the License, Chelan PUD is required to prepare a report summarizing the results of all TDG studies performed to date, and describing whether compliance with the numeric criteria has been attained. Probable and possible impacts to fish species from such TDG abatement methods will be included in the report. Chelan PUD will also submit a report to Ecology summarizing gas bubble trauma (GBT) monitoring and other relevant information regarding the effects of TDG produced by the Project on aquatic life. Chelan PUD will submit these reports to Ecology, members of RRFF and HCP CC.

In accordance with Section 5.4(1)(d), Chelan PUD submits this Report to Ecology for their review and conclusions. This report summarizing the results of the first five years of TDG monitoring and studies at Rocky Reach Dam, including an evaluation of compliance to date. Chelan PUD has prepared this report with the intent to satisfy the first step of Section 5.4(1)(d) of the 401 Certification.
Chelan PUD has prepared this report with the intent to satisfy the first step of Section 5.4(1)(d) of the 401 Certification for Ecology's review and conclusions. This report summarizes the results of all TDG studies performed to date, describes whether compliance with the numeric criteria has been attained and discusses the results of Chelan PUD's study on alternative spillway operations.

Chelan PUD has prepared this report with the intent to satisfy the first step of Section 5.4(1)(d) of the 401 Certification for Ecology's review and conclusions. This report summarizes the results of all TDG studies performed to date, describes whether compliance with the numeric criteria has been attained and discusses the results of Chelan PUD's study on alternative spillway operations.

During the first five years of the License (2009 through 2013), the total number of Rocky Reach Dam TDG exceedances for the fish-spill season varied from zero in 2009 to 27 in 2012. During this same five year period the total number of hourly exceedances for the non-fish spill season varied from zero in 2009 to 61 in 2012.

The information below regarding Rocky Reach Dam's TDG compliance is summarized in Table 4-1. Overall 5 Year Project compliance or percent time below the 120/115 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the fish-spill season was 93.6 percent (86 daily exceedances/1,352 days).

Overall 5 Year Project compliance or percent time below the 125 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the fish-spill season was 100 percent (0 daily exceedances/32,448 hours).

Overall 5 Year Project compliance or percent time below the 110 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the non fish-spill season was 99.5 percent (124 hourly exceedances/26,256 hours).

Table 1-1: Summary table of TDG Compliance at Rocky Reach Dam

Rocky Reach tailrace and Rock Island forebay TDG Compliance Years 2009 through 2013		
% time below 120/115%	% time below 125%	% time below 110%
93.6	**100**	**99.5**

Chelan PUD has been effective in their compliance efforts regarding the TDG criterion at the Project by implementing the gas abatement measures identified in the 401 Certification and the WQMP. Although Chelan PUD has not been 100 percent compliant with the TDG standard 100 percent of the time, Chelan PUD will continue to implement the gas abatement measures in accordance with 401 Certification and WQMP. These measures have been successful in reducing TDG within the Rocky Reach tailrace and the Rock Island forebay.

Upon Ecology's review and conclusions of this Report, Chelan PUD shall coordinate and consult with Ecology regarding the next steps required of Section 5.4(1)(d) of the 401 Certification.

1.2 TDG Gas Abatement Measure (6), Alternate Spillway Operations, Section 5.4(1)(b)(6) of the 401 Certification

In 2011 and 2012, Chelan PUD studied alternative spillway flow distribution patterns, in order to evaluate the potential to reduce total dissolved gas TDG levels, particularly during high spill levels (above 50 kcfs). Generally, all of the three alternative spill patterns studied resulted in lower TDG levels than the standard spill pattern. Of the three alternative patterns, the flat spill pattern (flow distributed evenly between spillway gates) had a slightly better TDG performance than the other two alternative patterns. Chelan PUD has presented these findings to Ecology, the Rocky Reach Fish Forum (RRFF) and Habitat Conservation Plan Coordinating Committee (HCP CC). Chelan PUD, through the consultation process with Ecology, the RRFF, and the HCP CC, will develop a schedule to make the necessary changes to perform the new spill configuration. This schedule may include but not be limited to; computer automation of spill gates (2015), and/or changes to system operations and monitoring. Chelan PUD will operate the new spill configuration as a pilot or test spill and further evaluate the results for a designated period of time. Chelan PUD shall develop a monitoring schedule to test operations under the new spill configuration. If upon operating under the new spill configuration data show that optimal results are not occurring as previously evaluated, Chelan PUD shall implement adaptive management in coordination with the RRFF and HCP CC.

1.3 Project Description

The Rocky Reach Project (Project) is located on the Columbia River approximately seven miles upstream of the city of Wenatchee. Construction of the dam and powerhouse began in 1956 and the Project was completed and put into production in 1961. The impounding structures are reinforced concrete consisting of a forebay wall section about 460 feet long; a combined intake and powerhouse section 1,088 feet long; a non-overflow center dam spillway that is 740 feet long consisting of 12 bays, each controlled by a

50-foot-wide, 58-foot-high radial gate; and a 2,000-foot sub-surface cutoff consisting of a grout curtain and a compacted impervious barrier limits seepage through a terrace forming the east bank.

The forebay wall consists of concrete gravity blocks of various heights, with a maximum height of 118 feet. The service bay connects the forebay wall to the powerhouse. The powerhouse contains 11 units, each 86 feet wide and about 200 feet long. The Project's FERC authorized installed capacity is 865.76 megawatts.

The Project contains an upstream (adult) fish passage facility consisting of a fish ladder located downstream of the forebay wall with three entrances, and a JBS which began operation in 2003 to provide downstream fish passage for juvenile salmon and steelhead.

The JBS consists of; a surface collection system adjacent to the forebay wall, intake screens and a bypass conduit routed along the downstream side of the powerhouse and spillway; a fish collection facility and an outfall downstream of the Project near the dam's left abutment.

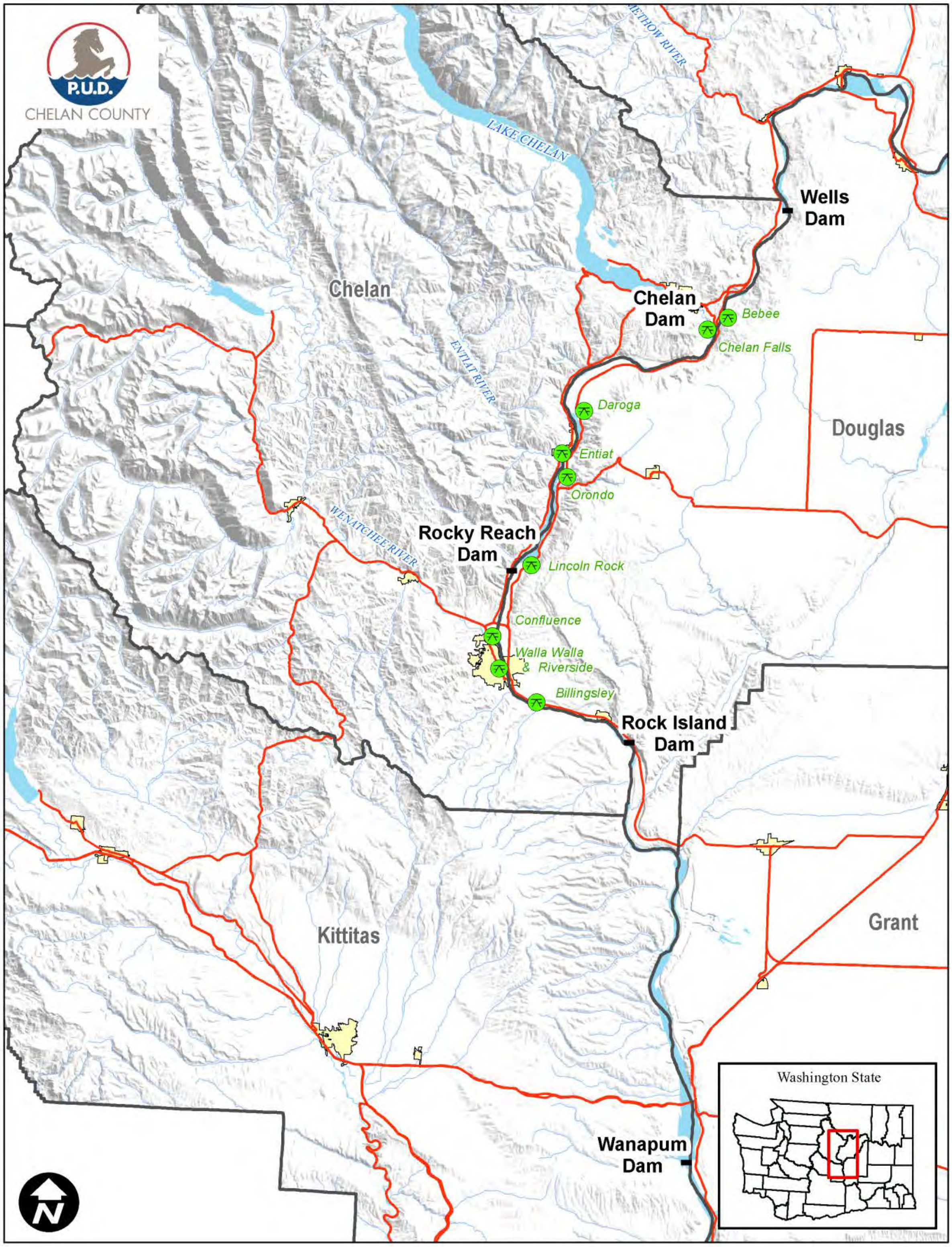

Figure 1-1: Project Location

1.4 Regulatory Framework

The Washington State water quality numeric criteria for TDG (Washington Administrative Code (WAC) 173-201A-200(1)(f)) address standards for the surface waters of Washington State. Under the water quality standards (standards), TDG shall not exceed 110 percent at any point of measurement in any state water body. However, the TDG criteria may be adjusted to aid fish passage over hydroelectric dams when consistent with an Ecology approved GAP. This plan must be accompanied by fisheries management and physical and biological monitoring plans. Ecology may approve, on a per application basis, a temporary exemption to the TDG standard (110 percent) to allow spill for juvenile fish passage on the Columbia and Snake rivers (WAC 173-201A-200(1)(f)(ii)). On the Columbia and Snake rivers, there are three separate standards with regard to the TDG exemption. First, in the tailrace of a dam, TDG shall not exceed 125 percent as measured in any one-hour period. Further, TDG shall not exceed 120 percent in the tailrace of a dam and shall not exceed 115 percent in the forebay of the next dam downstream as measured as an average of the 12 highest consecutive (12C-High) hourly readings in any one day (24-hour period).

It is important to note that the TDG water quality standards identified above are intended to help protect aquatic life designated uses within the Project. This includes Ecology's allowance of higher TDG levels during the fish-spill season, which allow dams to spill water to help meet juvenile salmonid passage performance standards.

Specific passage performance (or survival) standards for the Project are outlined in the HCP for the Rocky Reach Project. Specifically, the HCP provides that Chelan PUD achieve and maintain Combined Adult and Juvenile Project Survival. The Combined Adult Juvenile Survival standard is 91 percent. The ninety-one percent standard is composed of 98 percent adult project passage survival and 93 percent juvenile project survival.

Chelan PUD is currently in Phase III - Standards Achieved (the 91 percent adult-juvenile combined survival standard is achieved) for the spring migrating HCP species; sockeye, spring Chinook, and steelhead. Summer/fall subyearling Chinook are in Phase III - Additional Juvenile Studies, due to limitations on acoustic tag technology for subyearling fish and unpredictable migration behavior of Upper Columbia River subyearling Chinook. Coho, the last Plan species, is in Phase III - Standards Achieved - Interim.

Achieving the survival standards as described above and in addition to meeting TDG numeric criteria as outlined in WAC 173-201A-200(1)(f), are an integral part of meeting the water quality standards (e.g. protection of designated uses) as described in the Project's 401 Certification (Ecology, 2006).

1.4.1 7Q10 Flows

Section 5.4.1(b) of the 401 Certification (Ecology, 2006) and WAC 173-201A-200(f)(i) states that the water quality criteria for TDG shall not apply when the stream flow exceeds 7Q10 flow. The 7Q10 flood flow for the Rocky Reach Project was calculated to be 252 kcfs (Ecology, 2004)

1.4.2 Daily Total Dissolved Gas Compliance Value Calculation Method

Prior to 2008, the method used to calculate the daily TDG compliance value during the fish-spill season was based on the average of the twelve highest hourly values in a twenty-four hour period, starting at 0100 hours and ending at 2359 hours. This method was based on Ecology's 1997 standards. In Ecology's 2006 revision to the standards (which were not approved by the Environmental Protection Agency (EPA), and thus not effective, until 2008) the method for calculating the TDG compliance value was changed. The new method provided that the TDG compliance value be determined by calculating the average of the twelve highest "consecutive" hourly values in a twenty-four hour period. Prior to the 2008 fish-spill season, there were discussion amongst the Columbia and Snake River dam operators on how to properly implement the "rolling average" method, especially as it related to what time the rolling average began. There were concerns related to the addition of the previous day's last eleven hours to the compliance value calculation on the next day.

On May 21, 2008, Ecology requested, via memo, that all Columbia and Snake River dam operators use a rolling average method for calculating the twelve highest consecutive hourly TDG readings in a twenty-four hour period, beginning at 0100 hours, based on Ecology's 2006 revised water quality standards (Ecology, 2008). Using a rolling average method that begins at 0100 hours results in counting the hours 1400 through 2359 twice: in the average calculations on the day they occur and on the next reporting day. As a result, a TDG standard exceedance may be indicated on two separate days based on the same group of hours.

The annual fish-spill season TDG monitoring reports from 2012-2013 Gas Abatement Annual Reports provide examples of how the "rolling average" method could create a TDG exceedance on two separate days based on the same grouping of hourly values during the applicable fish-spill season, and Chelan PUD's method for accounting for those occurrences.

1.4.3 401 Water Quality Certification Condition

The following is the total dissolved gas condition from the 401 Certification (Ecology, 2006) Section 5.4(1)(d).

> **5.4(1)(d) <u>Determination of Compliance</u>**. In Year 5 of the effective date of the New License, Chelan PUD shall prepare a report summarizing the results of all TDG studies performed to date, and describing whether compliance with the numeric criteria has been attained. If Ecology concludes, upon reviewing such report and other applicable information, that the Project complies with the applicable TDG numeric criteria, Ecology, in consultation with Chelan PUD, will determine which measures will be continued for the term of the New License to maintain such compliance. If Ecology concludes that compliance with the TDG numeric criteria has not been attained, Chelan PUD shall prepare a report that evaluates what measures (operational and structural) may be reasonable and feasible to implement to further reduce TDG production at the Project. Probable and possible impacts to fish species from such TDG abatement methods shall be included in the report. Chelan PUD shall also submit a report to Ecology summarizing GBT monitoring and other relevant information regarding the effects of TDG produced by the Project on aquatic life. Chelan PUD shall submit these reports to Ecology, members of the RRFF, and members of the HCP CC.

Chelan PUD has identified several steps within Section 5.4(1)(d) of the 401 Certification. They are as follows:

1. Prepare a report summarizing the results of all TDG studies performed to date, and describing whether compliance with the numeric criteria has been attained,

2. Ecology shall review the report and conclusions regarding the Project's compliance with the TDG numeric criteria,

3. If TDG numeric criteria are met, then Ecology in consultation with Chelan PUD will determine which measures will be continued for the term of the license to maintain compliance,

4. If Ecology concludes that compliance with TDG standards have not been attained, then Chelan PUD shall prepare a report that evaluates what measures (operational and structural) may be reasonable and feasible to implement to further reduce TDG production at the Project. Probable and possible impacts to fish species from such TDG abatement methods shall be included in the report.

5. Chelan PUD shall also submit a report to Ecology summarizing GBT monitoring and other relevant information regarding the effects of TDG produced by the Project on aquatic life.

6. Chelan PUD shall submit these reports to Ecology, members of the Rocky Reach Fish Forum (RRFF), and members of the HCP Coordinating Committee.

Chelan PUD has prepared this report with the intent to satisfy the first step of Section 5.4(1)(d) of the 401 Certification, as identified above. If Ecology concludes that TDG numeric criteria have not been met within five years of the effective date of the new License, further conditions apply. The conditions from Section 5.4(1)(e)-(g) are stated below.

> **(e) <u>Actions if TDG Numeric Criteria Not Achieved</u>**. If compliance with numeric TDG criteria has not been achieved within five years of the effective date of the New License, Ecology will proceed as described below. Such determination shall be based on an analysis of the water quality standard for TDG from the perspective of attainability and biological necessity, as provided in subsections (1) and (2) below:
>
> **(1) <u>Aquatic Life Adversely Affected</u>.** Upon receipt of the section d) reports, Ecology will determine, based on the monitoring data and analysis provided by Chelan PUD, as may be supplemented by the RRFF and/or the HCP Coordinating Committee, whether aquatic life has been adversely affected, or insufficient information exists to conclude that it has not been adversely affected, by TDG resulting from the Project. If Ecology determines an effect has occurred or insufficient information exists, it shall then further determine, in consultation with Chelan PUD and the RRFF, whether additional seasonable and feasible measures exist to further reduce TDG without significant adverse impact to fish species, and, if so, Chelan PUD shall begin implementation, which may include structural modifications. Ecology retains the right to make the final determination with respect to measures it requires to be implemented to reduce TDG subject to FERC approval, when needed. Nothing limits either Ecology's or Chelan PUD's option to evaluate new, additional or previously evaluated alternatives to abate TDG. Ecology may also require Chelan PUD to perform additional engineering studies of TDG abatement structures or operations. Notice should be given to all parties potentially affected by this decision. If structural modifications are necessary and found reasonable and feasible, Chelan PUD shall provide design, construction and final assessment reports to Ecology in a timely manner as determined by Ecology. If it appears to Ecology, based on the information before it, that no reasonable and feasible TDG abatement measures may exist, Ecology will follow the procedures set forth in subsection (g) below in processing a related rule petition that Chelan PUD may file. If the Corps of Engineers requires a 404 permit, Ecology retains its option to issue a separate water quality certification for construction.

(2) <u>Aquatic Life Not Adversely Affected</u>. If Ecology determines, under subsection (1), that aquatic life has not been adversely affected by TDG resulting from ongoing Project operations, Chelan PUD shall consult with Ecology and the RRFF to determine if any additional reasonable and feasible measures may exist to meet the TDG standards. If Chelan PUD concludes that no other additional reasonable and feasible measures exist to reduce TDG, Chelan PUD may petition Ecology to modify the standards as described below

f) Chelan PUD may petition Ecology for a rule change to the TDG standard after Year 10 or sooner, if Chelan PUD believes that it can demonstrate it has done everything reasonable and feasible to attain the TDG numeric criteria at that time. In evaluating whether all reasonable and feasible measures have been done as part of reviewing such petition, Ecology will, among other relevant factors, consider information regarding biological impacts of TDG caused by the Project and the extent to which the Project has achieved the Biological Objectives. However, to be granted, any petition for a rule change must satisfy any additional legal requirements that are applicable.

g) If, in conformance with the above, Chelan PUD petitions Ecology to modify the standards to eliminate any non-compliance with such standards, and files a timely and scientifically robust petition, Ecology will provide a schedule for the evaluation and completion of action on such rulemaking petition. Such schedule shall provide target dates for Ecology's determination of whether to grant or deny the petition, and, if granted, for submission of proposed rule change to EPA. While such petition is pending before Ecology and EPA, no non-compliance orders or penalties for TDG violations shall be issued against Chelan PUD, as long as Chelan PUD continues to operate in accordance with the GAP and this Certification.

SECTION 2: WATER QUALITY MANAGEMENT PLAN ABATEMENT MEASURES

Upon receipt of the License, Chelan PUD has worked toward TDG compliance in accordance with the conditions of the 401 Certification (Ecology, 2006) and the conditions set forth in Section 4 of the WQMP (Chelan PUD, 2006), including implementation of operational TDG abatement measures, as well as development of annual GAPs and monitoring reports.

In accordance with Section 5.4.1(b), Chelan PUD is required to manage spill toward meeting water quality criteria for TDG during all flows below 7Q10 levels, but only to the extent consistent with meeting the passage and survival standards set forth in the HCP. Further TDG abatement measures are discussed below.

2.1 Operational

In general, during the first five-years of the License, there have not been any major non-routine operational changes at Rocky Reach; however, informal contact with Ecology related to involuntary spill (especially during non-fish spill season), power market conditions, or unscheduled turbine outages that had potential to impact TDG levels has occurred throughout the first five years of the TDG compliance. Annual GAPs and Annual Reports have been submitted to Ecology, in accordance with Section 5.4.3 and 5.4.4 of the 401 Certification, which have included Chelan PUD's planned TDG abatement measures, operational plans, monitoring plans, etc.

Chelan PUD implemented the following operational TDG abatement measures during the first five years of License issuance, in accordance with the conditions of the 401 Certification and Section 4 of the WQMP.

2.1.1 Minimize Voluntary Spill

Following over 15 years of testing and prototype operation, Chelan PUD constructed the permanent JBS in 2002 and began operation of that system at Rocky Reach in 2003 to guide migrating fish before they enter the powerhouse and divert them downstream past the dam. The JBS is a key component of the HCP signed by Chelan PUD, the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), Washington Department of Fish and Wildlife (WDFW), and the Confederated Tribes of the Colville Reservation (CCT) to meet HCP juvenile fish survival standards. Results of survival studies have allowed Chelan PUD to greatly reduce spill for fish at Rocky Reach Dam. The JBS is now operated exclusively, for spring migrants; and spill during the summer migration has been reduced to nine percent of the daily average flow. The JBS continues to be the most efficient non-turbine route for fish passage at the Rocky Reach Project.

2.1.2 Manage Voluntary Spill Levels in Real Time

Spillway releases to pass water in excess of turbine capability for load requirements; or for fish passage are controlled by computer. The Project's automated functions are backed up with around-the-clock, on duty plant operators who monitor operations and can over-ride computer control if needed. When the headwater level exceeds operator-set maximum points, gates are automatically opened to pass the excess flow.

During fish passage spill operations, the sequence and amounts of gate opening can also be adjusted to maximize the effectiveness of the water being spilled, both for juvenile passage and adult attraction. Based on the daily spill memo sent by the Chelan PUD Spill Coordinator by 10:00 a.m., the plant operators input into the system the volume of spill, begin time, and end time requested. On occasion the daily spill volumes are revised later in the day based on flows from Grand Coulee and Chief Joseph dams. The computer then determines, based on the program, which gates to open and how far.

Since 2003, the University of Washington has been contracted to provide Chelan PUD with run-timing predictions for spring and summer out migrating salmon and steelhead using the Program RealTime runtime forecasting model. Program RealTime provides daily forecasts and cumulative passage percentiles for steelhead, yearling Chinook, sockeye, and sub yearling Chinook at both Rocky Reach and Rock Island. The program enables the Chelan PUD to better predict the date when a selected percentage of these species will arrive, or when a given percentage of any stock has passed (e.g. the five percent passage point for juvenile sub yearling Chinook at Rocky Reach to trigger summer spill). The program utilizes daily fish counts from the juvenile sampling facility at Rocky Reach and the bypass trap at Rock Island. Estimates of the program's forecast error in daily run projections will be calculated and displayed with the daily predictions at http://www.cbr.washington.edu/analysis/rt.

Spill will be provided for juvenile summer Chinook salmonid passage to cover 95 percent of the run at each both the Rocky Reach and Rock Island Projects in accordance with the criteria set forth in the HCP. Spill levels and durations are correlated with operations necessary for meeting the HCP juvenile survival standards and the specific passage studies designed to measure attainment.

2.1.3 Minimize Spill

Operation of the turbines at the Project is automated, including decisions to start, stop and adjust the output of the 11 generating units to achieve maximum efficiency. The Project's automated functions are backed up with around-the-clock on-duty plant operators who monitor operations and can over-ride computer control if needed.

Turbines are inspected as necessary based on hours operated and other associated stresses. To the extent possible, maintenance of priority units has been scheduled outside of fish passage periods. Because units 1 and 2 provide attraction water flows they are important components of the bypass system; long-term outages of the two units will be avoided during the juvenile passage season.

Additionally, to minimize TDG uptake in the tailrace, Chelan PUD has, to the extent practicable, avoided maintenance outages during the high flow periods. When possible, maintenance has been scheduled based on predicted flows.

Scheduled maintenance of the bypass system has occurred in the off-season, which typically runs from September through March of each year. At this time, the various systems that comprise the Bypass System are inspected.

2.1.4 Participate in the Hourly Coordination Agreement

Chelan PUD operates the Project in a manner to avoid spill as much as possible, while meeting the passage and survival standards set forth in the HCP and Fish Management Plans. When spilling for fish or due to excess inflow or generation needs, the spillway is operated using gate settings that have been shown to limit TDG production and meet fish passage requirements (Schneider and Wilhelms, 2005). These gate settings are consistent with Section 5.4(1)(b) of the 401 Certification, which states "*manage spill toward meeting state water quality criteria for TDG during all flows below 7Q10 levels, but only to the extent consistent with meeting the passage and survival standards set forth in the HCP and Fish Management Plans….*"

Chelan PUD participates in regional coordination meetings regarding Columbia River spill and project operations. These meetings occur prior to and during the fish spill season and include representatives from Natural Resources, Power Marketing, and Hydro Operations staff from Chelan, Douglas, and Grant PUDs, as well as representatives from Bonneville Power Association (BPA) and the USACE. Discussions typically included topics such as:

- Each project's operational limitations, competing regulations, fish studies, and/or other natural resources requirements
- The possibility of shifting generation away from those projects that produce relatively low levels of TDG to those that have the propensity to produce higher TDG levels
- Each project's planned maintenance schedules and how it may limit ability to spill water through spillways and/or pass water through turbine units

2.1.5 Maximize Powerhouse Discharge as Appropriate up to 212 kcfs.

It is important to note that while Chelan PUD attempts to reduce involuntary spill by maximizing powerhouse discharge during periods of high flows, there are other regional constraints that limit the ability to maximize powerhouse flows. These constraints include, but are not limited to:

- Regional renewable energy portfolio standards and federal tax incentives have stimulated investment of variable energy resources. The Pacific Northwest has the highest wind production capacity in the country, which tends to peak during the spring runoff (e.g. higher flow) and lower energy demand periods, which can lead to limited markets for hydroelectric energy, forcing negative pricing and/or involuntary spill.

- Variable market conditions.

2.1.6 Implement Alternative Spillway Operations

Under Section 5.4.1(b)(6) of the 401 Certification, Chelan PUD is required to implement alternative spillway operations, using any of gates 2 through 12, to determine, in consultation with the RRFF and HCP CC, whether TDG levels can be reduced without adverse effects on fish passage. If effective in reducing TDG and not adversely affecting fish passage, Chelan PUD will implement the alternative in coordination and consultation with Ecology, the RRFF and HCP CC.

Chelan PUD has identified four steps or phases necessary in order to complete the condition 5.4.1(b)(6). The identified phases are listed and discussed further below.

Phase 1. Develop and run test scenarios for spill gate configurations, collect data

Phase 2. Analyze the data collected during the test scenarios for TDG reduction

Phase 3. Further analyze the TDG reductions and potential effects on fish passage

Phase 4. If effective in TDG reduction without potentially affecting fish passage, develop an implementation plan in coordination and consultation internally with Chelan PUD operations and externally with the RRFF and the HCP CC

Phase 1. Develop and run test scenarios for spill gate configurations, collect data

Alternative spillway flow distribution patterns were studied in 2011 and 2012 in order to evaluate the potential to reduce TDG levels, particularly during high spill levels (above 50 kcfs). The standard spillway flow pattern, which has been in use for over 20 years, is designed to create a V-shaped pattern of high velocity, aerated water below the spillway that is presumed to lead upstream migrating adult salmon toward the vicinity of the entrances to the upstream passage fishways. However, the margins of the V-shaped pattern tend to distort at spillway flows above 50 kcfs and appear to have less value for enhancing fish guidance to the fishway entrances. The standard spillway pattern confines spill to 7 gates (gates 2 through 8), leaving gates 9 through 12 unused. Studies of TDG levels at other Columbia River basin hydroelectric projects have shown that TDG levels are typically reduced when spillway flows are spread between more gates, thus reducing the flow per gate. The studies in 2011 and 2012 were planned to test three alternative spill patterns during normal operations to see if TDG levels would be reduced by any of these alternate patterns.

Phase 2. Analyze the data collected during the test scenarios for TDG reduction

The results of the 2011 and 2012 studies (Chelan PUD, 2013) were analyzed from the perspective of absolute TDG levels under different spillway flow volumes and the percentage of increase or decrease in TDG levels in the tailrace below the spillway, compared to the ambient TDG arriving at the Rocky Reach Project's forebay. Generally, all of the three alternative spill patterns resulted in lower TDG levels than the standard spill pattern. Of the three alternative patterns, the flat spill pattern (flow distributed evenly between spillway gates) had a slightly better TDG performance than the other two alternative patterns, which attempted to maintain some semblance of the V-shaped turbulence zone desired for adult salmon guidance. The Parametrix (Chelan PUD, 2013b) analysis did not explore whether there was any disruption of fish passage associated with the use of the alternative spill patterns. Also, since both 2011 and 2012 were high flow years, most of the time the spillway flow was greater than 50 kcfs during these tests, thus any effects on fish passage might have been masked due to the overall effects of high spill, regardless of the spill pattern in use. The standard spill pattern is a required operating procedure for upstream salmon passage, thus prior to changing that pattern for the purpose of reducing TDG an analysis of effects on fish passage is needed. Any decision to permanently change the spill pattern would require approval by the RRFF and HCP CC.

Phase 3. Further analyze the TDG reductions and their potential affect on fish passage

Chelan PUD has conducted some further analysis of the 2011 and 2012 spill and TDG data to determine if there is sufficient potential benefit regarding TDG levels to warrant changing the spill pattern for spill volumes of 50 kcfs or less. Chelan PUD began by looking only at the 2011 data set, as this year was more consistent in the duration and frequency of the test of the flattened spill configuration. In addition, the adult salmon passage data for Chinook and sockeye was examined to determine if there were any apparent adverse effects on daily passage rates during the 2011 study. This analysis indicates that there may be a significant reduction in TDG levels for spillway volumes of 40 kcfs or greater if the flat spill pattern were used rather than the standard spill pattern. There were not sufficient data to determine if the flat spill pattern would significantly reduce TDG for spill levels of less than 40 kcfs. This is, for the most part, consistent with the findings of a previous study (Schneider and Wilhelms, 2005) which found little difference in TDG levels generated with either the standard spill pattern or with spill spread evenly between spillway gates 2 through 12 (roughly equivalent to the flat spill pattern tested in 2011). However, the Schneider and Wilhelms study had very limited data for spill levels above 40 kcfs and no data for spill volumes greater than 60 kcfs. Thus, the ability to detect a reduction in TDG levels using the flat spill pattern was limited during this study.

Chelan PUD grouped the 2011 spill and TDG data for the standard spill pattern (FISH) and the flat spill pattern (FLAT) into increments of spillway flow bands of 10 kcfs. For example, all data for spillway flows greater than or equal to 40 kcfs, but less than 50 kcfs, were analyzed for the standard and flat spill patterns. The TDG data during these spill levels was averaged over 10 minute intervals and the percent TDG saturation was plotted for each ten minute average. The forebay TDG level was also averaged over the same interval and plotted. The graphs for the 40 kcfs – 50 kcfs and 50 kcfs – 60 kcfs spill levels are shown in Figures 2-1 and 2-2. These plots of 10 minute intervals indicate that the flat spill pattern may reduce TDG levels slightly compared to the standard spill pattern. However, the plots also show a correlation between TDG levels measured at the tailrace monitoring location and TDG levels measured in the forebay. In theory, if the tailrace monitoring location is only measuring TDG from water that passed through the spillway, as opposed to a mixture of water from both the spillway and the powerhouse, the TDG level in spillway flows should be independent from the forebay TDG level. Since this was not the case, the flow passing by the tailrace monitoring location must be receiving a mixture of powerhouse flows and spillway flows. Since forebay TDG was not consistent for the different time periods when the standard and flat spill patterns were being used, the data could not definitively demonstrate that the flat spill pattern reduced TDG levels over the standard spill pattern. In order to determine whether the flat spill pattern indeed reduces TDG, that pattern would need to be observed over a longer time period than under the daily change in spill pattern that was used during the 2011 and 2012 studies.

The use of different spill patterns did not appear to have any adverse effect on adult salmon passage at the Rocky Reach Project. The two species of salmon with peak migrations during the study were Chinook salmon and sockeye salmon. Plots of daily passage counts for these two species did not demonstrate any apparent delays or failures to find the fishway entrances. The daily passage counts of Chinook and sockeye salmon, with the spill pattern in effect each day, are shown in Figures 2-3 and Figure 2-4. Further study of the flat spill pattern, particularly for spill flows less than 50kcfs where the standard pattern creates a well defined V-shaped pattern, would be needed to evaluate whether adult salmon passage is adversely affected by use of the flat spill pattern.

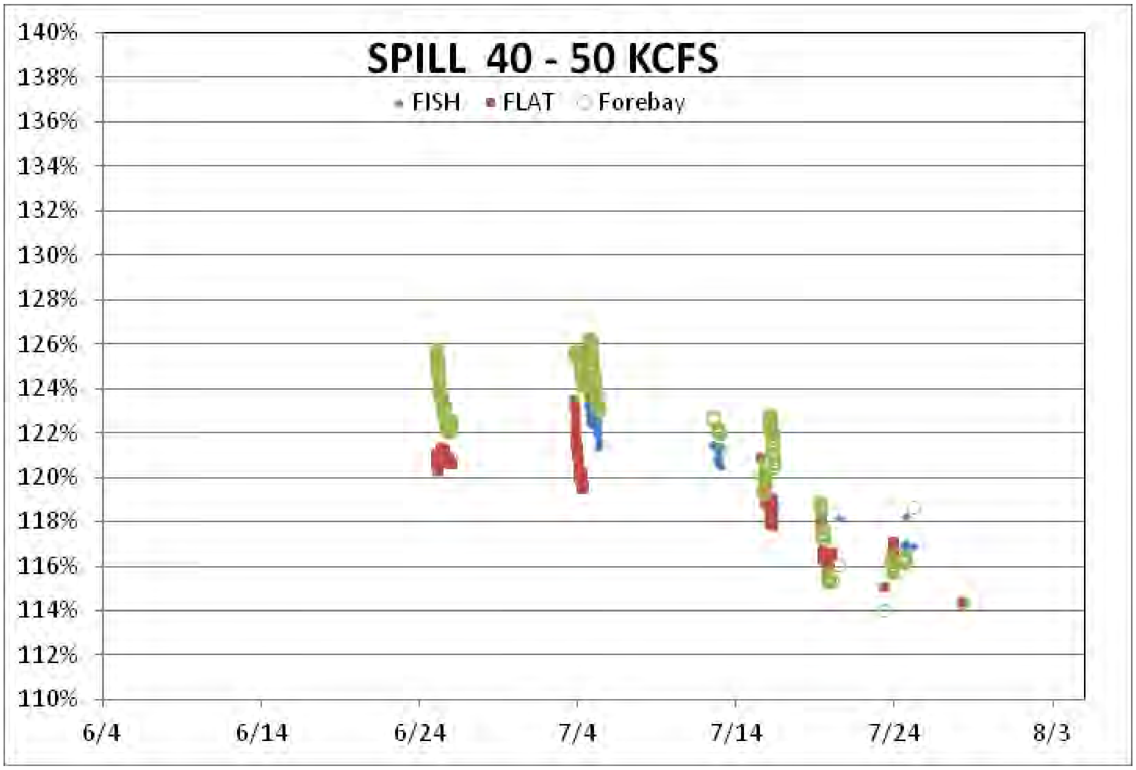

Figure 2-1: TDG levels at the Rocky Reach tailrace monitoring station for spillway flows from 40- 50 kcfs.

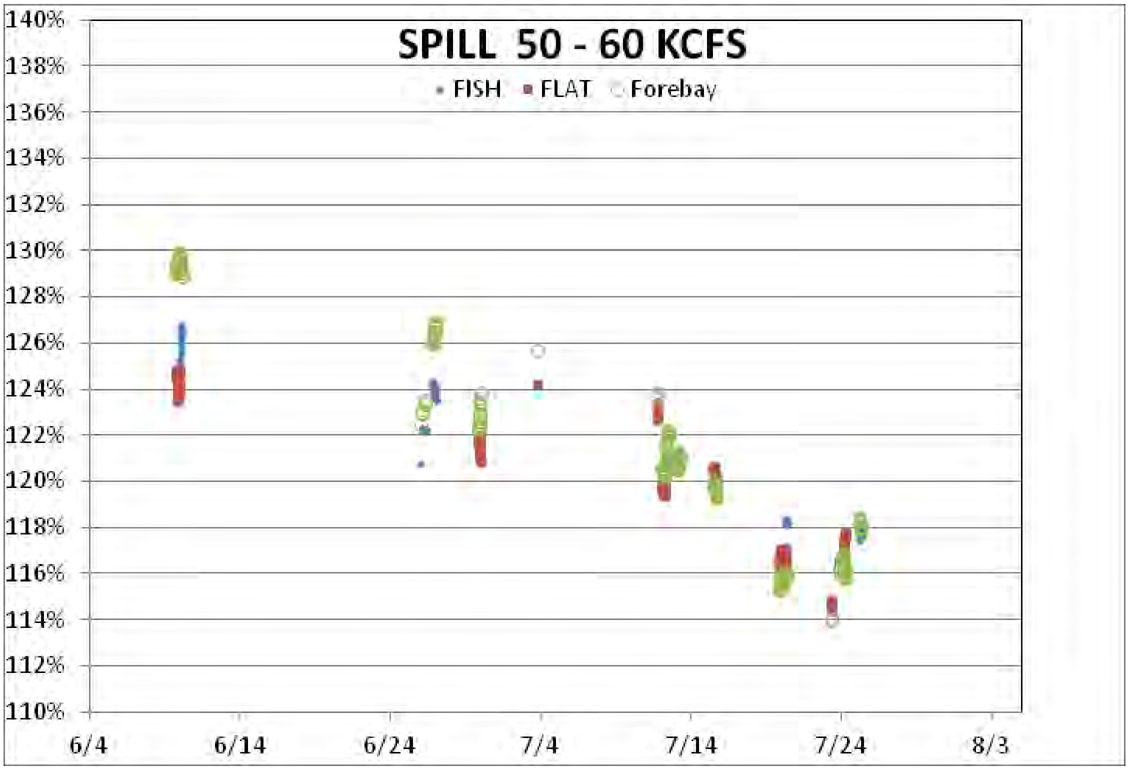

Figure 2-2: TDG levels at the Rocky Reach tailrace monitoring station for spillway flows from 50- 60 kcfs.

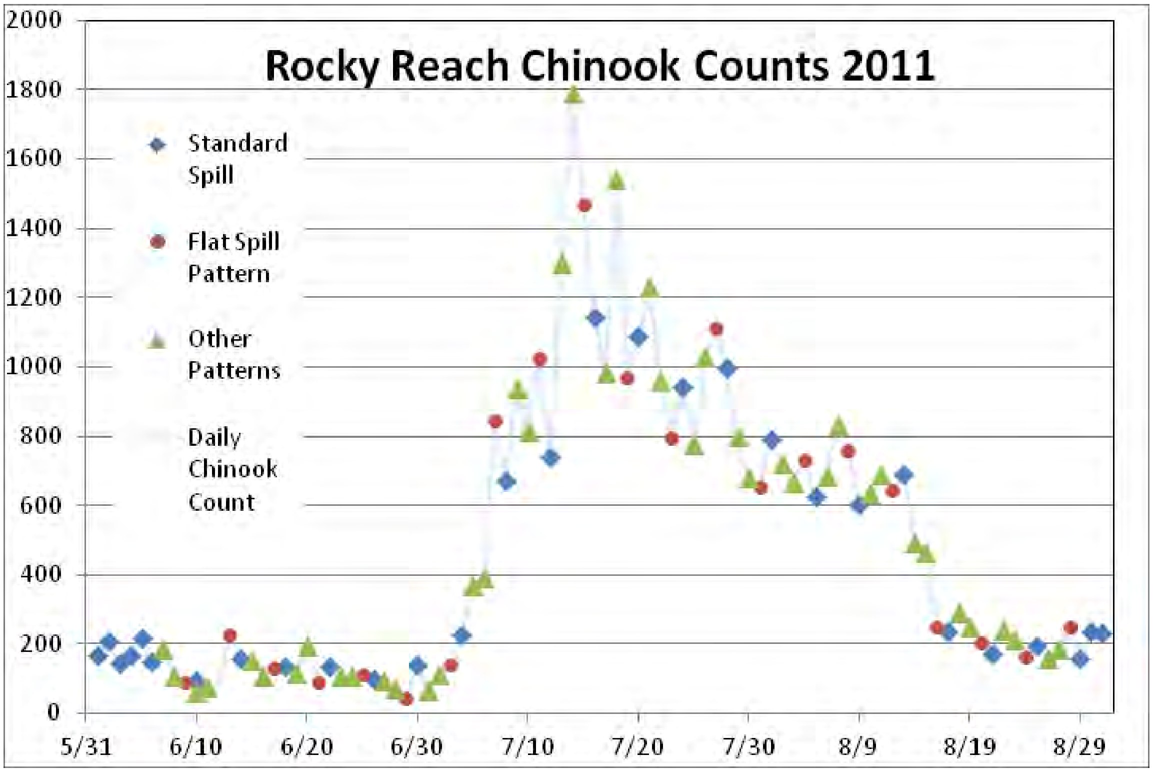

Figure 2-3: Daily passage counts of Chinook salmon at Rocky Reach, with spill pattern in effect that day.

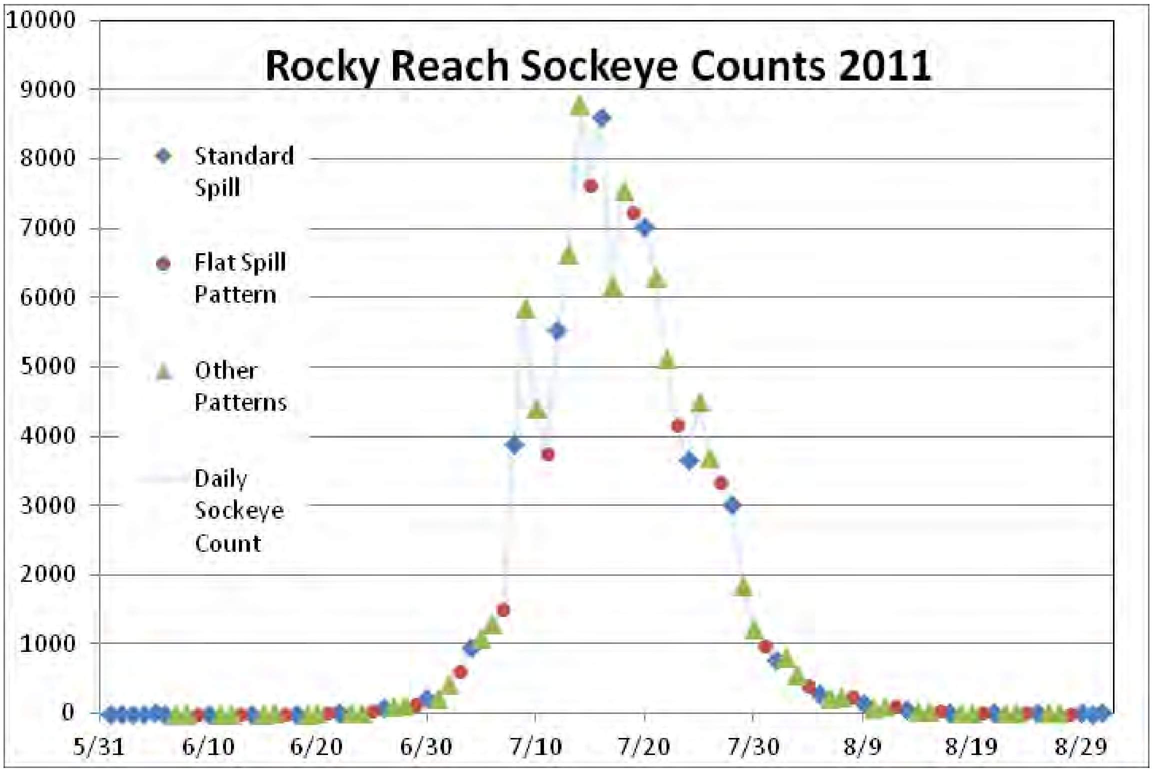

Figure 2-4: Daily passage counts of sockeye salmon at Rocky Reach, with spill pattern in effect that day.

Phase 4. If effective in TDG reduction without potentially affecting fish passage, develop an implementation plan in coordination with various parties

Chelan PUD has presented our findings to Ecology, the RRFF and HCP CC. Through the consultation process with Ecology, the RRFF and HCP CC, Chelan PUD will develop a schedule to make the necessary changes to perform the new spill configuration. This schedule may include, but is not be limited to computer automation of spill gates, changes to system operations, and monitoring. Chelan PUD will operate the new spill configuration as a pilot or test spill and further evaluate the results for a designated period of time. If upon operating under the new spill configuration, data show that optimal results are not occurring as previously evaluated, Chelan PUD will implement adaptive management in coordination with the RRFF and HCP CC.

2.1.7 Total Dissolved Gas Monitoring

In accordance with Section 5.4.1(a) of the 401 Certification (Ecology, 2006), Chelan PUD currently operates and maintains four fixed-site monitoring stations (FMS) that record barometric pressure (millimeters of mercury (mm/hg)), TDG (mm/hg), and temperature (°C). Barometric pressure, TDG, and temperature are recorded at 15 minute intervals, throughout the year in accordance with Chelan PUD's Ecology-approved Quality Assurance Project Plan (QAPP) (Chelan PUD, 2010b).

TDG data enables plant operators to adjust spill volumes to maintain gas levels to reduce the likelihood of exceeding the TDG criteria. These 15-minute intervals are averaged into hourly readings for use in compiling daily and 12-hour averages. All hourly data are forwarded to Chelan PUD headquarters and then onto the USACE Reservoir Control Center and posted at their site on the World Wide Web at www.nwd-wc.usace.army.mil/report/tdg.htm.

The Rock Island forebay FMS is located at a fixed site on the upstream face of Rock Island dam. The Rocky Reach tailrace monitoring station is located approximately one third of a mile downstream of the spillway on the juvenile fish bypass outfall, as required by the 401 Certification (Ecology, 2006). This location was chosen because it was the most feasible location near the end of the aerated zone, which is the compliance point for the Mid-Columbia TDG TMDL. There is not a bridge or other structure downriver of Rock Island Project to which a monitoring station can be attached.

Each Chelan PUD FMS station is equipped with a Hydrolab® Minisonde® 5 enclosed in a submerged conduit. Multi-probes are connected to an automated system that allows Chelan PUD to monitor barometric pressure, TDG, and water temperature on an hourly basis. Probes are maintained and calibrated as outlined in the QAPP. For a complete description of the FMS see the QAPP (Chelan PUD, 2010b).

SECTION 3: DATA SUMMARY

The following sections summarize the hydrological and TDG monitoring results from the 2009 through 2013 time periods. Additional detail can be found in the GAPs, annual reports (GAP Reports) and annual water quality monitoring reports. All of these reports have been submitted to Ecology in accordance with Sections 5.4.3, 5.4.4 and 5.7.8 of the 401 Certification (Ecology, 2006).

3.1 Hydrological

Mean daily discharges for each year from 2009 through 2013 as measured at Rocky Reach Dam are shown in Figure 3-1. In general 2009 and 2010 were the lowest flow years, while 2011 and 2012 were the highest, which corresponded to the highest TDG levels due to the amount of involuntary spill that was required to pass high flows throughout the mid-Columbia River. In 2011 and 2012, the 7Q10 flow was exceeded at Rocky Reach 70 of the 153 days in 2011, and 90 of the 153 days in 2012 of the fish-spill seasons (Chelan PUD, 2011 and 2012).

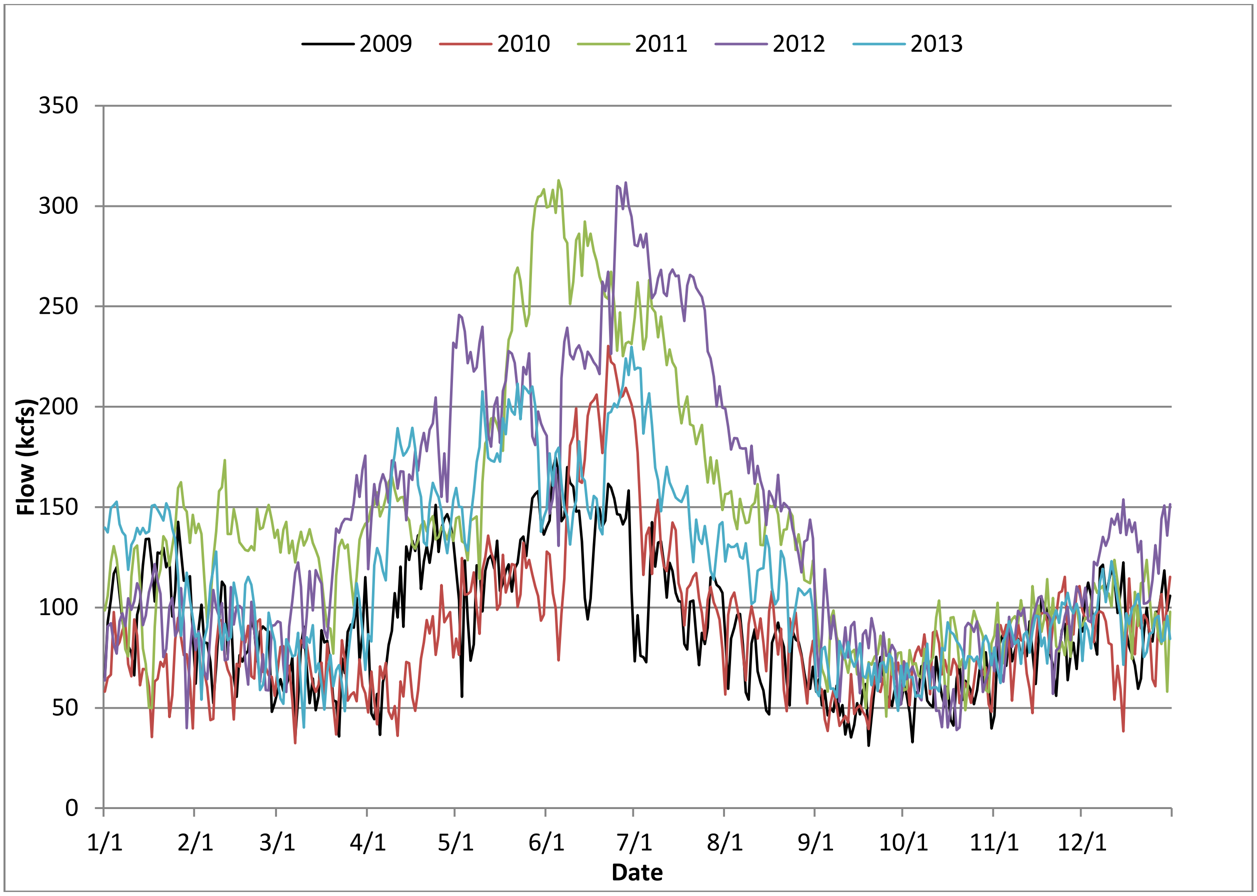

Figure 3-1: Mean daily discharge values as measured at Rocky Reach Dam.

3.2 Gas Bubble Trauma

From 2008-2013, Chelan PUD examined 12,636 smolts for signs of gas bubble trauma (GBT) during the fish spill season (typically between April and August). During the 5-year time period, only 354 showed signs of GBT, or approximately 2.8 percent. The highest percentages of GBT effects occurred between 2011 and 2012, during which the highest flows and highest TDG values occurred as well (Chelan PUD, 2011 and 2012). Table 3-1 provides the summary results of GBT monitoring at Rock Island Dam from 2009 through 2013.

Table 3-1: Number salmon and steelhead smolts examined for external signs of GBT of at Rock Island Dam from 2009-2013.

Year	**Species**	**Number of fish examined**	**Fish with GBT**	
			Number of fish	**%**
2009	Chinook yearling	609	9	1.48%
	Steelhead	677	4	0.59%
	Chinook Sub-yearling	502	1	0.20%
	Total	***1,788***	***14***	***0.78%***
2010	Chinook yearling	603	3	0.50%
	Steelhead	817	1	0.12%
	Chinook Sub-yearling	1,029	0	0.00%
	Total	***2,449***	***4***	***0.16%***
2011	Chinook yearling	927	18	1.94%
	Steelhead	1,022	230	22.50%
	Chinook Sub-yearling	1,351	31	2.29%
	Total	***3,300***	***279***	***8.45%***
2012	Chinook yearling	818	9	1.10%
	Steelhead	586	10	1.71%
	Chinook Sub-yearling	1283	30	2.34%
	Total	***2,687***	***49***	***1.82%***
2012	Chinook yearling	935	5	1.10%
	Steelhead	454	2	1.71%
	Chinook Sub-yearling	1,024	1	2.34%
	Total	***2,413***	***8***	***0.33%***
5-year Total	Chinook yearling	3,892	44	1.13%
	Steelhead	3,555	247	6.95%
	Chinook Sub-yearling	5,189	63	1.21%
	5-year combined Total	***12,636***	***354***	***2.80%***

3.3 Total Dissolved Gas

Table 3-2, summarizes the number of times TDG levels exceeded the current water quality standards from 2009-2013 during the fish-spill season (April through August) at the Rocky Reach Project tailrace and Rock Island Project forebay. Table 3-3, summarizes the same information for the non-fish spill season (January through March and September through December). Chelan PUD did not begin recording data during non fish-spill until September 1, 2011, when Ecology requested that data be collected annually in their comments on the 2011 Annual Gas Abatement Report (Chelan PUD, 2011). Therefore, Table 3-3 begins on September 1, 2011.

Additional detail can be found in the Final Gas Abatement Annual Reports (Chelan PUD, 2009, 2010, 2011, 2012 and 2013), all of which were submitted to Ecology in accordance with Sections 5.4.4 and 5.7.8 of the 401 Certification (Ecology, 2006).

Table 3-2: Number of fish-spill season total dissolved gas exceedances from 2009-2013 for Rocky Reach Dam

Year	**Location**[1]	**Fish-spill (April 1-August 31)**			
		Total	**Total # of days**[2]	**% time below 115% TDG**	**% of hours below 125% TDG**
2009	RRTR	0	153	100	100
	RIFB	0	153	100	100
2010	RRTR	5	152	96.7	100
	RIFB	4	110	96.4	100
2011	RRTR	11	121	90.9	100
	RIFB	9	119	92.4	100
2012	RRTR	27	120	77.5	100
	RIFB	20	118	83.1	100
2013	RRTR	8	153	94.8	100
	RIFB	2	153	98.7	100
5-year Total	RRTR	51	699	**92.7**	100
	RIFB	35	653	**94.6**	100

Notes:

[1] RRTR = Rocky Reach Dam tailrace, RIFB = Rock Island Dam forebay

[2] Based on total number of available days minus days omitted due to the 7Q10 flood flow being exceeded or TDG membrane failures, multi-probe failures, data transmission errors, and/or electrical issues that resulted in communication errors, or other QA/QC issues

Table 3-3: Number of non fish-spill season total dissolved gas exceedances from 2009-2013 for Rocky Reach Dam

Year	Location[1]	Date	Non-Fish Spill January 1-March 31 September 1-December 31		
			Total	**Total # of hours**	**% time below 110%**
2011	RRTR	09/01-12/31	0	2,928	100
	RIFB	09/01-12/31	0	2,928	100
2012	RRTR	01/01-03/31	52	2,184	97.6
		09/01-12/31	0	2,928	100
	Total		**52**	**5,112**	**99.0**
	RIFB	01/01-03/31	61	2,184	33
		09/01-12/31	0	2,928	100
	Total		**61**	**5,112**	**98.8**
2013	RRTR	01/01-03/31	7	2,160	99.7
		09/01-12/31	4	2,928	99.9
	Total		**11**	**5,088**	**99.8**
	RIFB	01/01-03/31	0	2,160	100
		09/01-12/31	0	2,928	100
	Total		**0**	**5,088**	**100**
5-year Totals	RRTR	01/01-03/31	59	4,344	98.6
		09/01-12/31	4	8,784	99.9
	Total		**63**	**13,128**	**99.5**
	RIFB	01/01-03/31	61	4,344	98.6
		09/01-12/31	0	8,784	100
	Total		**61**	**13,128**	**99.5**

Notes:

[1] RRTR = Rocky Reach Dam tailrace, RIFB = Rock Island Dam forebay

[2] Based on total number of available days minus days omitted due to the 7Q10 flood flow being exceeded or TDG membrane failures, multi-probe failures, data transmission errors, and/or electrical issues that resulted in communication errors, or other QA/QC issues

For the fish-spill seasons, the total number of exceedances varied from zero in 2009 (lowest flow year between 2009 and 2012) to 41 in 2012 (highest flow year between 2009 and 2013). Higher mean daily flows as described in Section 3-3 above in 2011 and 2012, created higher incoming TDG levels. Higher flows in excess of 7Q10 values resulted in increased involuntary spill at Rocky Reach Dam, as well as the rest of the mid-Columbia River projects. These exceedances of the water quality criteria did not necessarily result in noncompliance, as many of the forbay exceedances occurred when the upstream dam's forebay exceeded 115 percent, or flows were in excess of 7Q10 values.

During the non fish-spill season, TDG levels were notably higher in the last few days of March in 2012. In a three-day period from March 29 through 31, 2012, there were a combined total of 113 hourly exceedances of the 110 percent criteria, 52 hours in the Rocky Reach tailrace and 61 hours in the Rock

Island forebay. During these three days, a federal operations spillway test occurred at Chief Joseph Dam (CHJ) upstream of Rocky Reach which created unusually high river flows into the Project. Additionally, one of the generating units at Rocky Reach was out with unavoidable maintenance thereby reducing the generation capability. During these three days, CHJ conducted a spillway test requiring the Project to spill at a 60 kcfs level over and above its normal turbine generating flow (J. Taylor, Mid-C Hourly Coordination Coordinator, 2012). The CHJ spill test required Grand Coulee dam (GCL) to increase discharge to maintain CHJ reservoir elevations during the spill test, and non-federal Projects to pre-draft their reservoirs in order minimize system-wide spill from all Mid-Columbia Projects resulting from increased river flows. The spill test increased inflows into all down river dams in the Mid-Columbia. Mean daily total discharge and spill for Grand Coulee, Chief Joseph, Rocky Reach and Rock Island are represented in Figures 3-2 and 3-3 during the periods when the 110 percent exceedances occurred at Rocky Reach tailrace and Rock Island forebay.

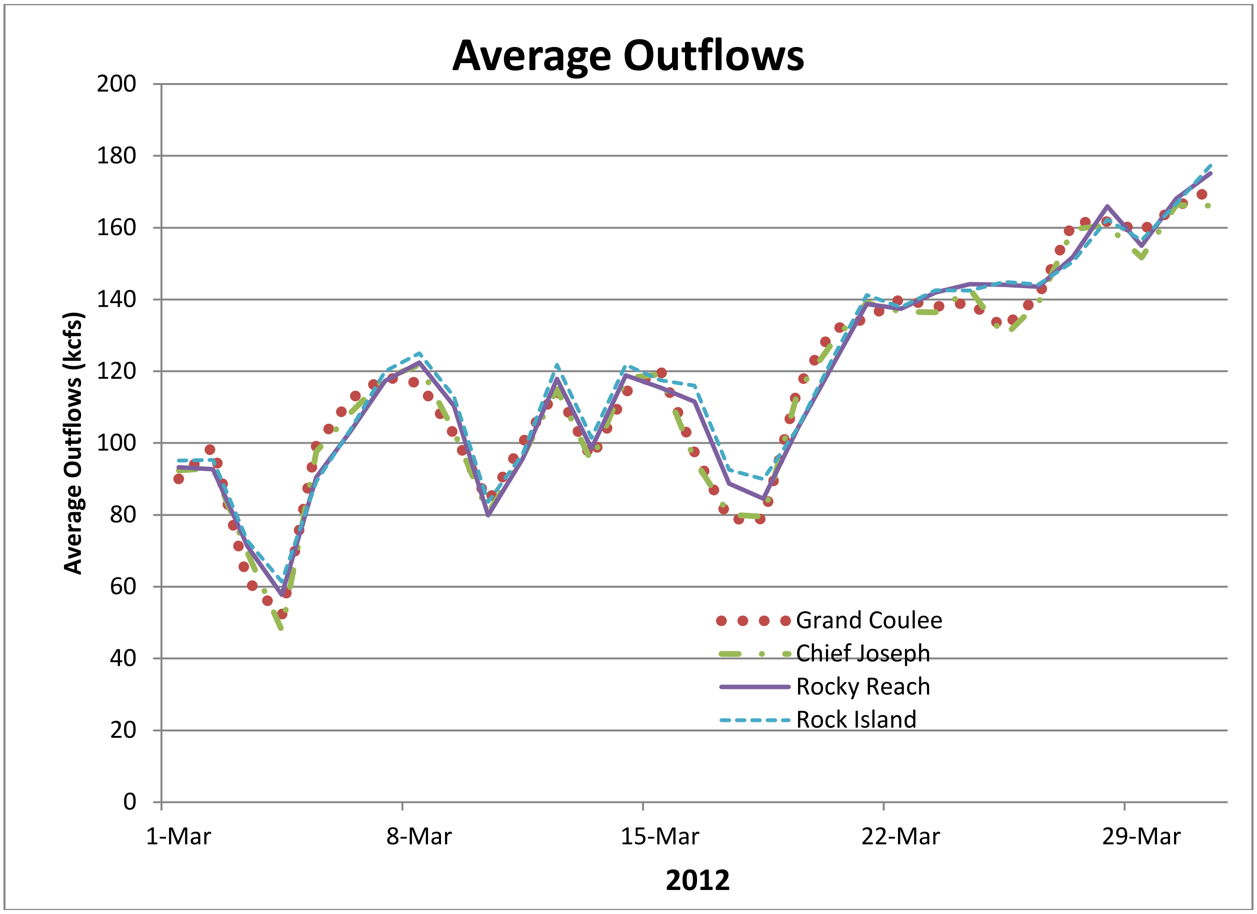

Figure 3-2: Mean daily outflows for Grand Coulee, Chief Joseph, Rocky Reach and Rock Island Dams in March of 2012.

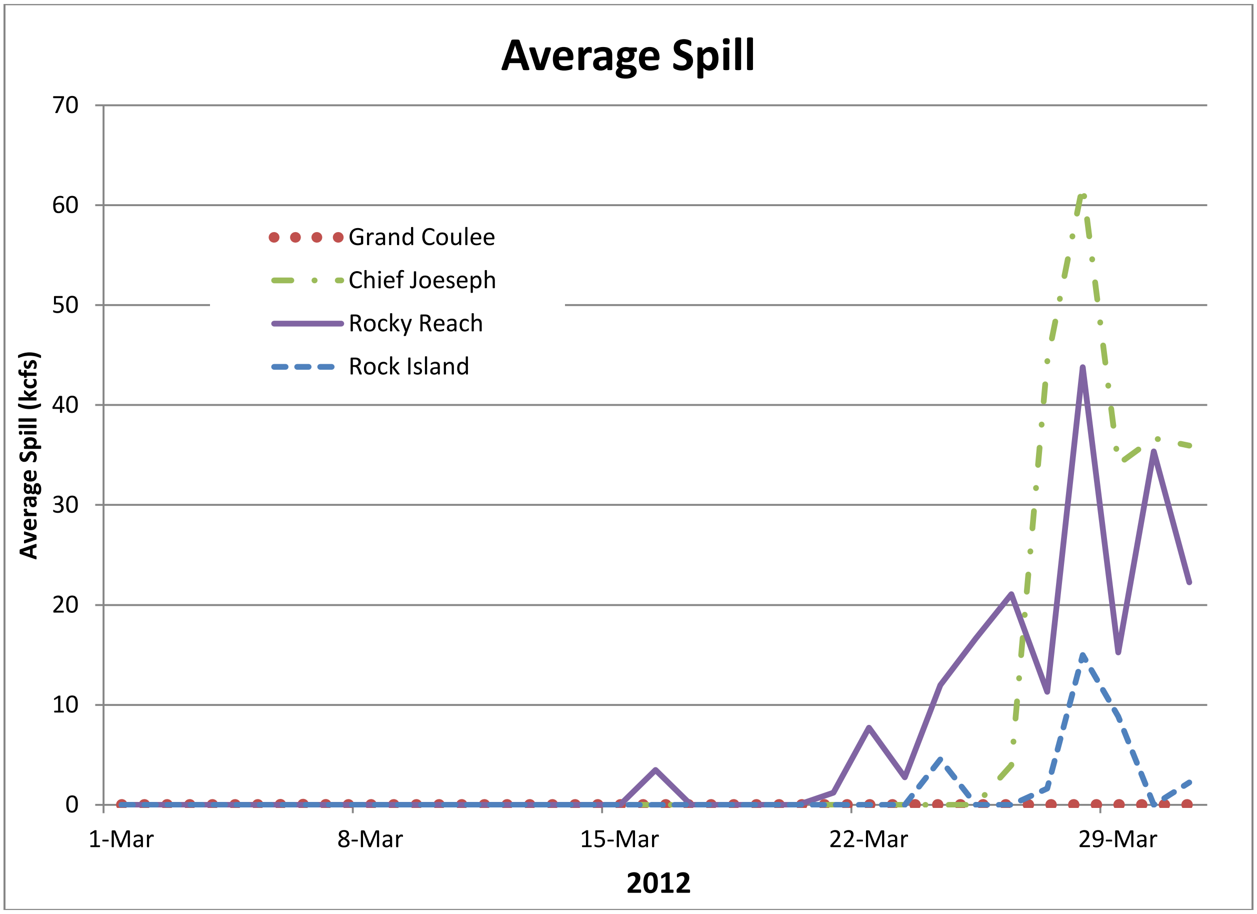

Figure 3-3: Mean daily outflows for Grand Coulee, Chief Joseph, Rocky Reach and Rock Island Dams in March of 2012.

SECTION 4: CONCLUSIONS

4.1 Determination of Compliance, Year 5, Section 5.4(1)(d) of the 401 Certification

Chelan PUD has prepared this report with the intent to satisfy the first step of Section 5.4(1)(d) of the 401 Certification for Ecology's review and conclusions. This report summarizes the results of all TDG studies performed to date, describes whether compliance with the numeric criteria has been attained and discusses the results of Chelan PUD's study on alternative spillway operations.

During the first five years of the License (2009 through 2013), the total number of Rocky Reach Dam TDG exceedances for the fish-spill season varied from zero in 2009 to 27 in 2012. During this same five year period the total number of hourly exceedances for the non-fish spill season varied from zero in 2009 to 61 in 2012.

The information below regarding Rocky Reach Dam's TDG compliance is summarized in Table 4-1. Overall 5 Year Project compliance or percent time below the 120/115 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the fish-spill season was 93.6 percent (86 daily exceedances/1,352 days).

Overall 5 Year Project compliance or percent time below the 125 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the fish-spill season was 100 percent (0 daily exceedances/32,448 hours).

Overall 5 Year Project compliance or percent time below the 110 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the non fish-spill season was 99.5 percent (124 hourly exceedances/26,256 hours).

Table 4-1: Summary table of TDG Compliance at Rocky Reach Dam

Rocky Reach tailrace and Rock Island forebay TDG Compliance Years 2009 through 2013		
% time below 120/115%	% time below 125%	% time below 110%
93.6	**100**	**99.5**

Chelan PUD has been effective in their compliance efforts regarding the TDG criterion at the Project by implementing the gas abatement measures identified in the 401 Certification and the WQMP. Although Chelan PUD has not been 100 percent compliant with the TDG standard 100 percent of the time, Chelan PUD will continue to implement the gas abatement measures in accordance with 401 Certification and WQMP. These measures have been successful in reducing TDG within the Rocky Reach tailrace and the Rock Island forebay.

Upon Ecology's review and conclusions of this Report, Chelan PUD shall coordinate and consult with Ecology regarding the next steps required of Section 5.4(1)(d) of the 401 Certification.

4.2 TDG Gas Abatement Measure (6), Alternate Spillway Operations, Section 5.4(1)(b)(6) of the 401 Certification

According to Section 5.4(1)(b)(6) of the 401 Certification, Chelan PUD shall study alternative spillway operations using any of gates 2 through 12. In 2011 and 2012, Chelan PUD studied alternative spillway flow distribution patterns, in order to evaluate the potential to reduce total dissolved gas TDG levels, particularly during high spill levels (above 50 kcfs). Generally, all of the three alternative spill patterns studied resulted in lower TDG levels than the standard spill pattern. Of the three alternative patterns, the flat spill pattern (flow distributed evenly between spillway gates) had a slightly better TDG performance than the other two alternative patterns. Chelan PUD has presented these findings to Ecology, the Rocky Reach Fish Forum (RRFF) and Habitat Conservation Plan Coordinating Committee (HCP CC).

Chelan PUD, through the consultation process with Ecology, the RRFF, and the HCP CC, will develop a schedule to make the necessary changes to perform the new spill configuration. This schedule may include but not be limited to; computer automation of spill gates (2015), and/or changes to system operations and monitoring. Chelan PUD will operate the new spill configuration as a pilot or test spill and further evaluate the results for a designated period of time. Chelan PUD shall develop a monitoring schedule to test operations under the new spill configuration. If upon operating under the new spill configuration data show that optimal results are not occurring as previously evaluated, Chelan PUD shall implement adaptive management in coordination with the RRFF and HCP CC.

SECTION 5: LIST OF LITERATURE

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APPENDIX A: RESPONSE TO COMMENTS

This Report was submitted for review and consultation to Ecology and the RRFF on October 31, 2014 and the HCP CC on November 25, 2014. Chelan PUD received comments from Ecology and the CCT. Comments received and Chelan PUD's responses to those comments are in the following table.

Additionally, Chelan PUD and Ecology had a conference call on December 15, 2014 to discuss their comments. The following responses to Ecology's comments were agreed upon during that conference call. Present during the call were: Chelan PUD, Michelle Smith and Marcie Steinmetz; Ecology, Chris Coffin, Pat Irle, and Charlie McKinney.

Agency Comments			Chelan PUD Response
Ecology			
1.		According to page 7 of the draft report, the purpose of this report is to comply with Section 5.4(1)(d) of the Clean Water Act Section 401 Water Quality Certification (included in the FERC license), which states that Chelan PUD shall "Prepare a report summarizing the results of all TDG studies performed to date, and describing whether compliance with the numeric criteria has been attained." If this is indeed the purpose of this report, it would be very helpful to have the following additions and changes:	The paragraph 5.4.1(d) contains about 6 steps, all of which need to happen in a successive order, meaning one cannot happen until the others are completed. It is not specific on dates only to state that "In year 5…Chelan PUD shall prepare a report……."
	a.	Could you state the purpose of the report (as described above) in the Executive Summary, the Introduction, and the Conclusions?	The purpose has been clearly stated in each of the three sections.
	b.	In the Executive Summary, Introduction and Conclusions, could you describe the TDG studies performed to date? If there have been none, simply say so and describe why. If it is because studies to improve fish passage were still ongoing, it is fine to say so.	A description of the TDG study (flattened spill configuration) has been added in each section.
	c.	Also, in each of these three sections, please describe whether you believe compliance with the numeric criteria has been achieved. Note that "the numeric criteria" refers to the State water quality standards found in WAC 173-201A. During the conference on December 15, 2014, Ecology asked that a table be added to show compliance in these sections as well.	It has been stated that 100% compliance with the numeric criteria has not been met in each of the three sections with an additional table explaining the compliance.
	d.	It may be helpful to note in the Executive Summary and Introduction (as well as the Conclusions) that the PUD is proposing to implement a study this coming year (2015) to investigate a potential operational change to improve TDG levels.	It has been noted in all sections, that upon the HCP CC recommendation, the process/phased approach of developing an implementation plan for the flattened spill configuration will take place in 2015.

Agency Comments				Chelan PUD Response
	e.		On page 7 of the draft report you state that this report is the first of six steps to comply with Section 5.4(1)(d) of the 401 Certification.	This statement is correct.
		i.	Could you include a brief statement in the Executive Summary, Introduction and Conclusions that describes the steps remaining to ensure compliance with Section 5.4(1)(d). It should be clear that Ecology will review the final (Step 1) report and determine whether the numeric criteria are met.	It has been clearly stated in each section that Ecology will review the report and conclusions and determine whether the numeric criteria have been met.
		ii.	These sections should also include a statement that the PUD will be submitting a second (Step 4) report and third (Step 5) report to Ecology.	It has been stated in each section the process according to the 401 Certification.
		iii.	In the Conclusion, could you provide an estimated time frame for the remaining steps. Note that according to the 401 Certification, these are all to be completed in Year 5.	It has been stated that Chelan PUD will be submitting these reports in a successive order with Ecology approving and making recommendations along each step. These steps will not be completed in Year 5, but a schedule will be developed in consultation with Ecology, the RRFF and the HCP CC.
		iv.	Could you change the title to include the phrase “Step 1” (or something like that)?	The title of the report has been changed to: Total Dissolved Gas: Step One, Year Five Compliance Report.
2.			In Section 3.3, two tables summarize the number of exceedances of TDG standards. The text states that “Higher mean daily flows… created higher incoming TDG levels.” Can you discuss the results in more detail (rather than asking the reader to look back to previous reports). Also, is there a correlation to the proposed TDG study, which focuses on higher flows?	Section 3.3 has been expanded to include more detailed discussion of the results.
3.			In Section 3.3, there is a statement that “Higher flows in excess of 7Q10 values results in increased involuntary spill…” The relevance of the second sentence is unclear, because when flows exceed 7Q10, high TDG levels are not counted as exceedances.	Section 3.3 has been expanded to include more detailed discussion of the results.

Agency Comments			Chelan PUD Response
4.		In Section 4, the text indicates that the RRFF and HCP CC will determine if Flattened Spill is to be implemented, by consensus. Please describe the next steps if the group is unable to reach consensus, or if the water quality standards still are not met.	This section of text has been edited to state “The RRFF and HCP CC will be consulted with to determine if the Flattened Spill configuration will be implemented. If implementation is decided upon, then Chelan PUD will develop a schedule to make the necessary changes to perform the new spill configuration. This schedule may include, but is not limited to computer automation of spill gates, changes to system operations, and monitoring. Chelan PUD will operate the new spill configuration as a pilot or test spill and further evaluate the results for a designated period of time. If upon operating under the new spill configuration, data show that optimal results are not occurring as previously evaluated, Chelan PUD will implement adaptive management in coordination with the RRFF and HCP CC.
Minor Comments (mostly editorial)			
1.		In the Executive Summary, third paragraph, it appears that the numbers need to be checked for accuracy.	The reference to the conditions in the 401 Certification have been verified and corrected.
2.		Could you provide more consistency in terminology and abbreviations throughout the report? The terms that stand out to this reader are;	Consistency in terminology and abbreviations throughout the report have been corrected and verified.
	a.	Abbreviation used for the Clean Water Act 401 Certification. In previous Chelan PUD documents, “401 Certification” was used (which is probably my preference.) If the PUD would like to change its format, that fine. If so, please be consistent. Note that in this document, sometimes WQC is used and elsewhere 401 WQC.	Consistency with the abbreviation of “401 Certification” has been used.
	b.	Another is reference to kcfs or cfs. I personally prefer kcfs. Note that the use of cfs shows up a lot in the discussion in Section 2.1.6	Kcfs has been used where appropriate
	c.	There seems to be inconsistent use of abbreviations and terminology in reference to the juvenile bypass system. JBS? JFB (see Section 2.1)? Bypass system and Bypass System (2.1.3).	JBS has been used consistently throughout the document.
	d.	A couple of places in the text that refer to “effecting fish passage”, which should be “affecting fish passage”.	The proper use of “effect” and “affect” has been corrected in the document.
	e.	Other minor stuff like spelling out TDG, GBT and HCP when these abbreviations are first used.	Abbreviations have been spelled out where they are first used (to include the Executive summary as the first use).

<table>
<tr><th colspan="2">Agency Comments</th><th>Chelan PUD Response</th></tr>
<tr><td colspan="2">CCT</td><td>January 21, 2015, Comments from Kirk Truscott</td></tr>
<tr><td>1.</td><td>Consider adding the adult fishway to this paragraph describing the Project.</td><td>The upstream adult fishway was added to the noted paragraph.</td></tr>
<tr><td>2.</td><td>Figure 3-1 doesn't appear to support this statement. From Figure 3-1, the flows during 2011 Jan. - March period appear to be higher than 2012 and 2013. Additionally, flows in all years during Jan. - March were less than the 7Q10 flow, so why the exceedences? Is it entirely related to flow as stated, or did the power market have an influence as well?</td><td>Upon review of the comments submitted by Kirk Truscott, an error in Table 3-3 was discovered. The error in the table was regarding the total number of days of data recorded for the 110% criteria. The number of days reported were correct, but the 110% TDG criteria is reported in hours, thereby reporting an incorrect % of time below the 110% criteria. The table has been changed to reflect total number of “hours” of data recorded and the % time below 110% corrected to reflect these hours as opposed to days.
In response to the comment, the section has been corrected to describe the appropriate condition that created the 110% exceedances during the January through March time period in 2012 as described below:
During the non fish-spill season, TDG levels were notably higher in the last few days of March in 2012. In a three-day period from March 29 through 31, 2012, there were a combined total of 113 hourly (52 hours Rocky Reach tailrace and 61 Rock Island forebay) exceedances of the 110 percent criteria. During these three days, a federal operations spillway test occurred at Chief Joseph Dam (CHJ) upstream of Rocky Reach which created unusually high river flows into the Project. Additionally, one of the generating units at Rocky Reach was out with unavoidable maintenance thereby reducing the generation capability. During these three days, CHJ conducted a spillway test requiring the Project to spill at a 60 kcfs level over and above its normal turbine generating flow (J. Taylor, Mid-C Hourly Coordination Coordinator, 2012). The CHJ spill test required Grand Coulee dam (GCL) to increase discharge to maintain CHJ reservoir elevations during the spill test, and non-federal Projects to pre-draft their reservoirs in order minimize system-wide spill from all Mid-Columbia Projects resulting from increased river flows. The spill test increased inflows into all down river dams in the Mid-Columbia. Mean daily total discharge and spill for Grand Coulee, Chief Joseph, Rocky Reach and Rock Island are represented in Figures 3-2 and 3-3 during the periods when the 110 percent exceedances occurred at Rocky Reach tailrace and Rock Island forebay.</td></tr>
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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Coordinating Committees	**Date:**	April 6, 2015
From:	Michael Schiewe, Chair		
Cc:	Kristi Geris		
Re:	Final Minutes of the February 24, 2015 HCPs Coordinating Committees Meeting		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Coordinating Committees met at the Radisson Gateway Hotel, in SeaTac, Washington, on Tuesday, February 24, 2015, from 9:30 am to 12:00 pm. Attendees are listed in Attachment A of these meeting minutes.

ACTION ITEM SUMMARY

- Chelan PUD will add language explaining the average fork lengths for subyearling Chinook salmon that are reported in the 2015 Rocky Reach and Rock Island Spill Plan (Item II-B). *(Note: Lance Keller added language, as discussed, and the final plan was distributed to the Coordinating Committees by Kristi Geris on February 27, 2015.)*
- Chelan PUD will consider the feasibility of scanning for coded-wire-tags (CWT) during 2015 bypass monitoring at Rock Island Dam, and will report back to the Coordinating Committees by Tuesday, March 3, 2015 (Item II-C). *(Note: Kirk Truscott indicated via email on March 3, 2015, that based on discussions with Chelan PUD, he is withdrawing his request for CWT assessment as a monitoring component in the 2015 monitoring plan for the Rock Island Bypass, as distributed to the Coordinating Committees by Geris that same day.)*
- Chelan PUD will add language explaining protocols for handling Endangered Species Act (ESA)-listed steelhead kelts if encountered during bypass operations at Rock Island and Rocky Reach dams (Item II-D). *(Note: Keller added language, as discussed, and the final plans were distributed to the Coordinating Committees by Geris on February 27, 2015.)*

- John Ferguson will contact Tracy Hillman regarding monthly Coordinating Committees updates on the HCP Hatchery and Tributary Committees, following the transition of the new HCP Chairpersons in May 2015 (Item V-A). *(Note: Ferguson contacted Hillman, who agreed to call into the monthly Coordinating Committees meetings to provide the HCP Hatchery and Tributary Committees updates in lieu of generating monthly reports to the Coordinating Committees, following the transition of the new HCP Chairpersons in May 2015.)*

DECISION SUMMARY

- The Coordinating Committees representatives present approved the 2015 Rocky Reach and Rock Island HCP Action Plan (Item II-A).
- The Coordinating Committees representatives present approved the 2015 Rocky Reach and Rock Island Spill Plan, contingent on incorporating edits as discussed (Item II-B).
- The Coordinating Committees representatives present approved the 2015 Rock Island Bypass Monitoring Plan, contingent on incorporating edits as discussed (Item II-C).
- The Coordinating Committees representatives present approved the 2015 Rocky Reach Juvenile Fish Bypass System Operations Plan, contingent on incorporating edits as discussed (Item II-D).
- The Coordinating Committees representatives present approved the 2015 Wells HCP Action Plan (Item III-C).
- The Coordinating Committees representatives present approved the 2015 Wells Gas Abatement Plan (GAP)/Bypass Operating Plan (BOP; Item III-D).

AGREEMENTS

- The Coordinating Committees representatives present agreed to extend the 2014/2015 winter maintenance work period at Rocky Reach Dam by 1 week to allow more time to complete required work. Rather than the typical March 1 completion date, the Rocky Reach Fish Ladder will be fully operational by March 8, 2015 (Item II-E).
- Coordinating Committees representatives present agreed to reschedule the April 28 Coordinating Committees meeting to April 21, 2015, to be held either by

conference call or in person at the Radisson Hotel in SeaTac, Washington, as is yet to be determined (Item V-B).

REVIEW ITEMS

- Kristi Geris sent an email to the Coordinating Committees on February 9, 2015, notifying them that the draft 2014 Wells HCP Annual Report was available for review, with edits and comments due to her by Monday, March 9, 2015.
- Geris sent an email to the Wells HCP Coordinating Committee on March 12, 2015, notifying them that the revised draft 2015 Broodstock Collection Protocols were available for review.
- Geris sent an email to the Coordinating Committees on February 19, 2015, notifying them that the draft 2014 Rocky Reach and Rock Island HCP Annual Reports were available for review, with edits and comments due to her by Wednesday, March 18, 2015.
- Geris sent an email to the Coordinating Committees on February 24, 2015, notifying them that a Wells Project Land-use Permit for renewal (No. 651-01) was available for a 30-day review, with edits and comments, or indication of no comments, due to Tom Kahler by Tuesday, March 24, 2015.
- Geris sent an email to the Coordinating Committees on March 3, 2015, notifying them that several Wells Project Land-use Permits for renewal were available for a 60-day review period, with edits and comments, or indication of no comments, due to Kahler by Monday, May 4, 2015.

DOCUMENTS FINALIZED

- Kristi Geris sent an email to the Coordinating Committees on February 19, 2015, notifying them that the 2014 Wells Post-Season Bypass Report and 2014 Wells Passage-Dates Analysis were finalized following a 60-day review period, which ended on February 10, 2015.
- The final 2015 Rocky Reach and Rock Island HCP Action Plan was distributed to the Coordinating Committees by Geris on February 27, 2015 (Item II-A).

- The final 2015 Rocky Reach and Rock Island Spill Plan was distributed to the Coordinating Committees by Geris on February 27, 2015 (Item II-B).
- The final 2015 Rock Island Bypass Monitoring Plan was distributed to the Coordinating Committees by Geris on February 27, 2015 (Item II-C).
- The final 2015 Rocky Reach Juvenile Fish Bypass System Operations Plan was distributed to the Coordinating Committees by Geris on February 27, 2015 (Item II-D).
- The final 2015 Wells HCP Action Plan was distributed to the Coordinating Committees by Geris on February 27, 2015 (Item III-C).
- The final 2015 Wells GAP/BOP was filed with the Federal Energy Regulatory Commission (FERC) on February 26, 2015, and was distributed to the Coordinating Committees by Geris that same day (Item III-D).

I. Welcome

A. Review Agenda (Mike Schiewe)

Mike Schiewe welcomed the Coordinating Committees and asked for any additions or other changes to the agenda. The following revisions were requested:

- Lance Keller added Tumwater Dam Adult Fishway repairs.
- Tom Kahler added: 1) Wells Dam Adult Fishway annual maintenance; 2) passive integrated transponder (PIT)-tag detection in Spillway 2 at Wells Dam; and 3) Wells Project Land-use Permit reviews.
- Schiewe added an administrative update.

B. Meeting Minutes Approval (Mike Schiewe)

The Coordinating Committees reviewed the revised draft January 27, 2015, meeting minutes. Geris said all comments and revisions received from members of the Committees were incorporated in the revised minutes. She said she also added three documents to the review items (the draft 2015 Broodstock Collection Protocols and the draft 2014 Rocky Reach and Rock Island HCP Annual Reports). Coordinating Committees members present approved the January 27, 2015, meeting minutes, as revised.

C. Last Meeting Action Items (Mike Schiewe)

Action items from the Coordinating Committees meeting on January 27, 2015, and follow-up discussions were as follows: *(Note: italicized item numbers below correspond to agenda items from the January 27, 2015, meeting.)*

Documents for review by Tuesday, February 10, 2015	***Distributed***
Draft 2015 Wells Bypass Operating Plan/Gas Abatement Plan (Item II-D)	*1/9/2015*
Draft 2014 Wells Post-Season Bypass Report and Revised Draft Wells Passage-Dates Analysis (Item II-B)	*1/16/2015*
Draft 2015 Rocky Reach and Rock Island Spill Plan (Item III-C)	*1/23/2015*
Draft 2015 Rocky Reach Juvenile Fish Bypass System Operations Plan (Item III-D)	*1/23/2015*
Draft 2015 Rock Island Bypass Monitoring Plan (Item III-D)	*1/23/2015*
Revised Draft 2015 Wells HCP Action Plan (Item II-C)	*1/27/2015*
Draft 2015 Rocky Reach and Rock Island HCP Action Plan (Item III-B)	*1/27/2015*

- *Douglas PUD will provide the revised draft 2015 Wells HCP Action Plan to Kristi Geris for distribution to the Coordinating Committees (Item II-C).*
  Tom Kahler provided the revised draft plan to Geris following the meeting on January 27, 2015, which Geris distributed to the Coordinating Committees that same day. This will be discussed further during today's meeting.
- *Chelan PUD will provide the Colville Confederated Tribes' (CCT's) comments on the draft Rocky Reach Total Dissolved Gas (TDG): Step One, Year Five Compliance Report to Kristi Geris for distribution to the Coordinating Committees (Item III-A).*
  CCT's comments, along with Chelan PUD's response, were included in Appendix A of the final report that was provided by Marcie Steinmetz (Chelan PUD) on January 30, 2015, and distributed to the Coordinating Committees by Geris that same day.
- *Kristi Geris will coordinate with Alene Underwood (Chelan PUD HCP Hatchery Committees Representative) regarding distributing the draft 2015 Rocky Reach and Rock Island HCP Action Plan to the HCP Hatchery Committees (Item III-B).*
  Geris distributed the draft plan to the HCP Hatchery Committees following the meeting on January 27, 2015, per Underwood's direction. This will be discussed further during today's meeting.

- *The U.S. Fish and Wildlife Service (USFWS) will provide Chelan PUD with fork lengths of Entiat subyearling Chinook salmon (Item III-C).*
  Jim Craig provided these lengths to Lance Keller and the Coordinating Committees Technical Representatives following the meeting on January 27, 2015.
- *Chelan PUD will provide the draft 2014 Rocky Reach and Rock Island Juvenile Bypass Study Plan Reports for review, which will include 2013 data (Item III-D).*
  This will be discussed further during today's meeting.
- *Lance Keller will coordinate with the Chelan PUD HCP Hatchery Committees representatives regarding Tumwater fishway repairs (Item III-F).*
  Alene Underwood discussed these repairs with the HCP Hatchery Committees during their last meeting on February 18, 2015. This will be discussed further during today's meeting.

II. Chelan PUD

A. DECISION: Draft 2015 Rocky Reach and Rock Island HCP Action Plan (Lance Keller)

Lance Keller said Kristi Geris sent an email to the Coordinating Committees on January 27, 2015, notifying them that the draft 2015 Rocky Reach and Rock Island HCP Action Plan was available for review. Edits and comments on the draft plan were due to Chelan PUD by Tuesday, February 10, 2015. Keller said the HCP Tributary Committees approved the tributary portion of the draft plan, with one minor edit (i.e., removed the solicitation section). He said the HCP Hatchery Committees also approved the hatchery portion of the draft plan during their meeting last week, and a revised draft plan for approval was distributed to the Coordinating Committees by Geris on February 23, 2015. The Coordinating Committees representatives present approved the 2015 Rocky Reach and Rock Island HCP Action Plan. *(Note: the final plan was distributed to the Coordinating Committees by Geris on February 27 2015.)*

B. DECISION: Draft 2015 Rocky Reach and Rock Island Spill Plan (Lance Keller)

Lance Keller said Kristi Geris sent an email to the Coordinating Committees on January 23, 2015, notifying them that the draft 2015 Rocky Reach and Rock Island Spill Plan was available for review. Edits and comments on the draft plan were due to Chelan PUD by

Tuesday, February 10, 2015. Keller said comments were received from USFWS and the CCT, as follows:

Rocky Reach Summer Spill Operations – subyearling Chinook salmon fork lengths (page 4)
Jim Craig commented that the upper end of the fork length range identified for subyearling Chinook salmon, as reported in the draft plan, seemed large (i.e., 76 to 150 millimeters [mm]). Craig provided average fork length data for adipose (ad)-present subyearling Chinook salmon caught in the rotary screw trap on the lower Entiat River for comparison (i.e., 51.0 to 58.5 mm in June and July). Craig cautioned that the range identified in the draft plan may also include yearling spring Chinook salmon. Keller explained the estimated 1-percentile passage point that triggers summer spill is driven by hatchery releases upstream. He said bypass staff are provided with hatchery release timing information and are also given the freedom to decide whether a fish is a subyearling or not. He said in 2014, the first subyearling observed at the bypass was on May 26, 2014, and average fork lengths ranged from 75 to 109 mm. He said, however, that sometimes larger fish trickle in and the upper range gradually increases. He said he would like to add language explaining the average fork lengths for subyearling Chinook salmon that are reported in the 2015 Rocky Reach and Rock Island Spill Plan. He also noted that PIT-tag detections in the sampling facility and bypass system are used to verify that fish are indeed subyearlings. *(Note: Keller added language, as discussed, and the final plan was distributed to the Coordinating Committees by Geris on February 27, 2015.)*

Table 2 Fish spill percentages and spill shape for the Rocky Reach spill program, 2015 (page 5)
Kirk Truscott asked about data used for diel spill shaping. Keller explained that those data came from prototyping, hydroacoustic, and acoustic studies at Rocky Reach Dam. He added that travel times can be applied to those data to determine spill shaping at Rock Island Dam, as well. Mike Schiewe asked if Truscott's comments required any changes to the draft plan, and Keller said no, that his comments were only for his information.

The Coordinating Committees representatives present approved the 2015 Rocky Reach and Rock Island Spill Plan, contingent on incorporating edits as discussed.

C. DECISION: Draft 2015 Rock Island Bypass Monitoring Plan (Lance Keller)

Lance Keller said Kristi Geris sent an email to the Coordinating Committees on January 23, 2015, notifying them that the draft 2015 Rock Island Bypass Monitoring Plan was available for review. Edits and comments on the draft plan were due to Chelan PUD by Tuesday, February 10, 2015. Keller said comments were received from USFWS and the CCT, as follows:

General Comment

Jim Craig requested that page numbers be added to the document, and Keller said he will add those, as requested.

Bypass Monitoring Requirements (page 2)

Kirk Truscott asked about the feasibility of checking yearling Chinook salmon for presence of CWTs. He said his interest is to determine what portion of the 95% coverage consists of natural-origin recruits (NORs) versus hatchery-origin recruits (HORs). Keller said scanning for presence of CWTs is not in the current protocol, but he said he will discuss this internally and will report back to the Coordinating Committees by Tuesday, March 3, 2015. (*Note: Truscott indicated via email on March 3, 2015, that based on discussions with Chelan PUD, he is withdrawing his request for CWT assessment as a monitoring component in the 2015 monitoring plan for the Rock Island Bypass, as distributed to the Coordinating Committees by Geris that same day.)*

Daily Protocol for Fish Collection (page 6)

Truscott asked about the protocol for steelhead kelts. Keller said last year, Chelan PUD coordinated with the Yakama Nation (YN) who used Rock Island Dam as a collection location for their Kelt Reconditioning Program. He said if kelt were encountered and could be used for the YN's program, the kelt were transferred for reconditioning at Winthrop. If kelt were not retained for the YN program, they were returned into the ladder. Bob Rose said he will contact Keely Murdoch (YN) and ask if the YN plans to coordinate efforts with Chelan PUD in 2015. Keller noted that Chelan PUD and the YN also considered Rocky Reach Dam as a potential kelt collection location; however, it was determined not to be feasible. *(Note: Murdoch indicated via email that the YN and Chelan PUD plan to* *continue coordination in 2015, as distributed to the Coordinating Committees by Geris following the meeting on February 24, 2015.)*

The Coordinating Committees representatives present approved the 2015 Rock Island Bypass Monitoring Plan, contingent on incorporating edits as discussed.

D. DECISION: Draft 2015 Rocky Reach Juvenile Fish Bypass System Operations Plan (Lance Keller)

Lance Keller said Kristi Geris sent an email to the Coordinating Committees on January 23, 2015, notifying them that the draft 2015 Rocky Reach Juvenile Fish Bypass System Operations Plan was available for review. Edits and comments on the draft plan were due to Chelan PUD by Tuesday, February 10, 2015. Keller said comments were received from USFWS and the CCT, as follows:

2015 Evaluation Requirements (page 2)

Kirk Truscott asked about the feasibility of scanning for presence of CWTs. Keller said scanning for CWTs would be more appropriate at Rock Island Dam. Truscott said he was fine with this.

Special Operations (page 3)

Truscott asked about the number of fish used for the marked fish releases. Keller explained that prior to bypass startup, to assess for descaling, 100 fish will be released in the following locations: 1) right/south surface collector entrance upstream of the trash rack; 2) left/north surface collector entrance upstream of the trash rack; 3) Turbine Unit 1 (C1) intake screen; and 4) Turbine Unit 2 (C2) intake screen. He said if any issues are observed, multiple releases will be conducted to pinpoint the locations of the issues. He said, historically, the only issue encountered was when a release pipe for C2 came loose and fish were released into the wall. He said divers were deployed and the issue was fixed.

Table 1 Flow Diagram of Phased Approach and Threshold Values for Conducting Marked-Fish Releases (page 4)

Truscott asked how the descale thresholds were determined. Keller said the descale rates used are the standard rates implemented by the state. These rates are also used in the Smolt Monitoring Program. He added that any slight increase in descale is typically cured by increasing the cleaning intervals of the dewatering screens in the surface collector (i.e., to clear screens of debris).

Special Operations (page 3)

Truscott asked about collection of ESA-listed steelhead kelt. Keller explained that at Rocky Reach Dam, there are adult separator bars where the juveniles fall through and the adults pass above. He said if an adult slips through the bars, they are returned to the adult return flume. Keller said he will add language explaining protocols if ESA-listed steelhead kelt are encountered during bypass operations at Rock Island and Rocky Reach dams. *(Note: Keller added language, as discussed, and the final plans were distributed to the Coordinating Committees by Kristi Geris on February 27, 2015.)*

The Coordinating Committees representatives present approved the 2015 Rocky Reach Juvenile Fish Bypass System Operations Plan, contingent on incorporating edits as discussed.

E. Rocky Reach Dam and Rock Island Dam Adult Fishway Annual Maintenance (Lance Keller)

Lance Keller reviewed 2014/2015 winter maintenance activities at Rocky Reach and Rock Island dams, as follows:

<u>Rock Island Dam</u>

Left Ladder

Keller said on February 6, 2015, the left ladder at Rock Island Dam was brought back in service. He recalled that new operators for the entrance gates were installed, which are now being calibrated.

Right Ladder

Keller said maintenance work is complete on the right ladder at Rock Island Dam, and now maintenance staff are waiting for reduced river flow to repair the trash boom above the exit of the ladder that was damaged when the forebay elevation was dropped in response to the Wanapum Dam repair. He said today, the average river flow past Rock Island Dam is 171,600 cubic feet per second (171.6 kcfs), which is fairly high for this time of year. He added that he will notify the Coordinating Committees when the ladder is back in service.

Rocky Reach Dam

Keller said everything is complete except for one defective valve screw in the attraction water system that needs replacing. He said the ladder is fully watered up, but there will be no attraction water until the new valve screw is installed. He said the part has been ordered and is scheduled to arrive by Friday, February 27, 2015. However, the manufacturer is located in Massachusetts, so there may be delays due to the inclement weather that region is experiencing. He said installation is estimated to require only 1 to 2 days; however, just in case, he said Chelan PUD would like to request a 1-week extension of the maintenance period to complete the installation. The Coordinating Committees representatives present agreed to extend the 2014/2015 winter maintenance work period at Rocky Reach Dam by 1 week to allow time to complete the work. Rather than the typical March 1 start date, the Rocky Reach Fish Ladder will be fully operational on March 8, 2015.

F. Wanapum Drawdown Update (Lance Keller)

Lance Keller said Chelan PUD is currently drafting a Biological Opinion for the Emergency Action, which is proceeding well. He recalled that today's average river flow past Rock Island Dam is 171.6 kcfs, which translates to an average tailrace elevation of 569.9 feet, and an average forebay elevation of 612.9 feet. He said all denils are submerged, and the dam is operating in a generation configuration.

Keller said at Wanapum Dam, the forebay elevation is at about 559.0 feet, which is near the bottom of the operating range. He said repairs are progressing well. Scott Carlon said a full pool raise is expected as early as April 2015. Carlon added that the Board of Consultants and FERC plan to meet in early-March 2015.

G. Tumwater Dam Adult Fishway Repairs (Lance Keller)

Lance Keller said Tumwater Dam was dewatered on February 16, 2015. He said the dewatering effort went well for the most part; however, he said the river is high enough to cause issues with seals on the entrance side of the dam, so water is still in the lower level and is being pumped out. Jim Craig noted that the river level is almost twice as high as what it typically is this time of year. Keller said Biomark is onsite replacing PIT-tag Antenna No. 18. He said members of the Rocky Reach Fish Forum were onsite on February 18, 2015, conducting a rapid assessment for lamprey passage. He said everything is on schedule, and Chelan PUD expects to rewater by March 4, 2015.

III. Douglas PUD

A. Wells Dam Adult Fishway Annual Maintenance (Tom Kahler)

Tom Kahler recalled that in early-December 2014, the east fishway at Wells Dam was taken offline for annual winter maintenance, and when the low-level side entrance was opened in the east fishway, it was discovered the area behind the entrance was full of silt. He said divers were deployed last week to suction out the silt, which took longer than expected; however, now the silt has been suctioned out of the east and west fishways. He recalled the lamprey box will not be installed on the east fishway until after all maintenance is completed on the west fishway. He said all other maintenance on the east fishway is now complete, and the ladder is fully watered and operating. He said the west fishway will be taken offline next week for the routine winter maintenance and installation of the lamprey box. He said the plan is to complete all maintenance on the west fishway and installation of the lamprey box in the east fishway in the next few weeks.

Kirk Truscott asked when the normal maintenance period is for Wells Dam. Kahler said the typical window is from December through March, and permission would be sought if additional time was needed. He added the earliest issue may be with the spring Chinook salmon migration. Truscott noted that the steelhead migration may also arrive by mid-March. Kahler said steelhead typically arrive at Wells Dam more towards mid- to late-April, and he added Douglas PUD will definitely want to avoid an outage in April.

Kahler noted that there were a few issues with obtaining materials for the lamprey boxes; however, all materials are onsite now, and contractors are working on a best approach to install them. Mike Schiewe asked if the worst-case scenario would be not installing a lamprey box in one of the fishways, and Kahler said that is correct. He added that all of the PIT-tag–detection equipment is either installed (readers and reader enclosures) and ready to go, or onsite ready for installation (antennas) once the boxes are installed in the low-level entrances.

B. PIT-Tag Detection in Spillway 2 at Wells Dam (Tom Kahler)

Tom Kahler said tomorrow, Biomark will be onsite at Wells Dam to discuss the feasibility of installing PIT-tag detection in the bypass baffles for Spillway 2. He said Biomark is also upgrading the readers in the Rocky Reach Juvenile Fish Bypass System. Lance Keller added that Chelan PUD is supplying Biomark with fish to test the antennas. Kahler said the PUDs are hoping to get improved detection for multiple fish passing at the same time. Keller also noted that the new readers can all be linked and tuned together.

C. DECISION: Draft 2015 Wells HCP Action Plan (Tom Kahler)

Tom Kahler said Kristi Geris sent an email to the Coordinating Committees on January 27, 2015, notifying them that the revised draft 2015 Wells HCP Action Plan was available for review. Edits and comments on the draft plan were due to Douglas PUD by Tuesday, February 10, 2015. Kahler said the HCP Hatchery Committees approved the hatchery portion of the draft plan during their meeting last week, and the HCP Tributary Committees approved the tributary portion of the draft plan, with one minor edit (i.e., removed the project-solicitation section). The Coordinating Committees representatives present approved the 2015 Wells HCP Action Plan. *(Note: the final plan was distributed to the Coordinating Committees by Geris on February 27, 2015.)*

D. DECISION: Draft 2015 Wells GAP/BOP (Tom Kahler)

Tom Kahler said Kristi Geris sent an email to the Coordinating Committees on January 9, 2015, notifying them that the draft 2015 Wells GAP/BOP was available for review. Edits and comments on the draft plan were due to Kahler and Andrew Gingerich (Douglas PUD) by Tuesday, February 10, 2015. The Coordinating Committees representatives present approved the 2015 Wells GAP/BOP. *(Note: the final plan was filed with FERC on February 26, 2015, and distributed to the Coordinating Committees by Geris that same day.)*

E. Wells Project Land-Use Permit Reviews (Tom Kahler)

Tom Kahler said the Supervisor of the Douglas PUD Lands Department recently notified him that Douglas PUD's new FERC License (issued in 2012) requires all Wells Project land-use permits to be renewed. Kahler said Douglas PUD owns almost all lands around the reservoir, and there are about 120 existing land-use permits that need renewal. He said the Wells HCP also indicates that Douglas PUD needs to consult the Wells Coordinating Committee regarding any land-use action on the reservoir; therefore, he said this serves as notification that large batches of land-use permits will soon be out for review. He said Wells Coordinating Committee members can choose to comment; however, if a member chooses not to comment, Douglas PUD is requesting that the member indicate 'no comment' so Douglas PUD can expedite the 60-day review period and proceed with the issuance process. He said almost all existing permits have been in place for years. He recalled one exception, Mary Bailey, who recently applied to install a new dock in 2014. Jeff Korth asked if WDFW's Lands Supervisor is receiving these permit reviews, as well. Kahler said Korth will likely need to coordinate internally, as appropriate; these are all existing uses that do not require the re-issuance of permits from other resource agencies.

IV. HCP Hatchery and Tributary Committees Update (Mike Schiewe)

Mike Schiewe updated the Coordinating Committees on the following actions and discussions that occurred at the last HCP Tributary Committees meeting on February 12, 2015:

- *Review of Policies and Procedures Documents:* The Tributary Committees reviewed the Policies and Procedures for Funding Projects and the Tributary Committees Operating Procedures. Members had no changes on the documents. National Marine Fisheries Service (NMFS) identified changes in representation—Justin Yeager will become the designated representative, and Dale Bambrick will be the alternate.
- *Salmon Recovery Funding Board and Tributary Committees Funding Schedule:* The Tributary Committees reviewed the funding schedule. Project tours are scheduled for

mid-May, final proposals are due to the Tributary Committees June 19, 2015, and final funding decisions will be made on July 9, 2015.

- *Annual Deposits to the Plan Species Accounts:* The Rock Island, Rocky Reach, and Wells Tributary Committees made contributions at the end of January 2015 ($711,794, $337,199, and $258,455, respectively). As of mid-January 2015, the Rock Island, Rocky Reach, and Wells Tributary Committees accounts contained roughly $5.5 million, $2.5 million, and $1.5 million, respectively.
- *Wells, Rocky Reach, and Rock Island 2015 Draft Action Plans:* the Tributary Committees approved the tributary section on their respective 2015 Action Plans.
- *Meeting Schedule:* the Tributary Committees reviewed their 2015 meeting schedule.
- *Next Steps:* The next meeting of the Tributary Committees will be on Thursday, March 12, 2015, at Grant PUD in Wenatchee, Washington.

Schiewe updated the Coordinating Committees on the following actions and discussions that occurred at the last HCP Hatchery Committees meeting on February 18, 2015:

- *DECISION: Draft 2015 Wells HCP Action Plan:* The Wells Hatchery Committee approved the hatchery portion of the 2015 Wells HCP Action Plan, as revised.
- *DECISION: Draft 2015 Rocky Reach and Rock Island HCP Action Plan:* The Rocky Reach and Rock Island Hatchery Committees approved the hatchery portion of the 2015 Rocky Reach and Rock Island HCP Action Plan, as revised.
- *Chelan PUD Methow Spring Chinook Hatchery Production Obligation:* Chelan PUD reviewed their plan to develop an Interlocal Agreement (ILA) with Douglas PUD to return their Methow spring Chinook salmon program to its former status at Methow Fish Hatchery (FH). It was recalled that about 2 years ago, when Chelan PUD terminated its Methow Hatchery Sharing Agreement with Douglas PUD, Chelan PUD moved Methow spring Chinook salmon brood collection to Rocky Reach Dam, spawning and early-rearing was moved to Eastbank FH, and the Carlton Acclimation Pond was used for final grow out. With this arrangement, the YN were also using some of these fish for testing spring acclimation in the Upper Methow Basin. Now, with the previous arrangements potentially returning, the YN has suggested continuing rearing at Eastbank FH for further evaluation. However, most other Hatchery Committees members did not support rearing at

Eastbank FH (preferring Methow FH). The Hatchery Committees also discussed possibly testing overwinter acclimation at Carlton Pond. Concerns were expressed that overwinter acclimation that low in the system would run counter to the goal of encouraging spawning upstream. A statement of agreement (SOA) for the proposed ILA will be considered for approval at the next meeting.

- *Spring Chinook Permit Re-initiation Letter:* Chelan and Grant PUDs are drafting a letter to NMFS regarding re-consultation on the Wenatchee Spring Chinook Program for brood collection for the Nason Creek and Chiwawa programs. NMFS is already working on consultation for those programs, which needs to be complete by March 2015.
- *Draft 2015 Steelhead Release Plan:* Similar to previous years, Chelan PUD is planning to evaluate homing fidelity, residualism, and out-migration survival among hatchery releases using circular tanks and traditional raceways. In the past, those fish that did not volitionally migrate (non-movers) were transferred to Blackbird Pond for recreational angling or to migrate on their own volition, or were released directly into the Wenatchee River. This year, however, because non-movers are a component of the life history of steelhead, WDFW and Chelan PUD were developing a test of different hatchery-release strategies to gain more information on the non-movers to residualize.
- *NMFS HCP Hatchery Committees Representation:* Lynn Hatcher is retiring in April 2015. Craig Busack has taken over as the NMFS HCP Hatchery Committees Representative, and Hatcher will be the alternate until he retires. NMFS is searching for another representative in order to allow more time for Busack to complete permitting.
- *Surplus Juvenile Methow Spring Chinook Salmon at Methow FH:* There was an overage of about 37,000 Methow spring Chinook salmon; however, the overage was cut in half due to an outbreak of bacterial kidney disease. Mortalities have slowed. A decision regarding the disposition of the remaining surplus fish is still under discussion.
- *Discussion of Hatchery Committees Roles and Responsibilities:* The YN expressed concerns that their role as co-manager may be being overlooked in some cases. The YN were reminded the HCPs that were signed have a section on HCP Hatchery

Committees roles and responsibilities, which indicates that each Party has a vote, and actions affecting HCP mitigation programs require unanimous consent. Although there have been issues the HCP Hatchery Committees have determined not the purview of the Committees, decisions related to implementing the HCP hatchery programs has always been the work of the Committees.

- *YN Upper Methow Spring Chinook Acclimation Proposal:* During previous HCP Hatchery Committees meetings, Douglas PUD proposed a more robust study that incorporated an adaptive management framework and more objective criteria for success, which was initially very well-received. However, concerns were raised about various issues, which after further discussion in between meetings, were mostly resolved. An SOA for this study is now out for approval.

Kirk Truscott said during the last Priest Rapids Coordinating Committee Hatchery Sub-Committee meeting, timing of volitional release, as it relates to the spill season, was discussed. He said, specifically, the discussion focused on the linkage between the onset of smolt behavior (particularly when earlier than usual) and the start of the spill programs, and how that may affect spill programs and meeting passage for 95% of the total migration. He suggested considering the start of bypass operations compared to projected release dates, and evaluate whether there is an impact on meeting passage for 95% of the migration. Schiewe noted that Douglas PUD performed a similar exercise this year by reviewing hatchery releases and how those affected bypass operations at Wells Dam. Truscott questioned whether early releases of HORs have an effect on spill coverage for NORs or other hatchery programs. Tom Kahler asked if there is an effort to coordinate all releases in the Upper Columbia River. Truscott said that might be his recommendation, so one program would not affect all the other programs. Schiewe asked about the proposed path forward, and Truscott said one was not established. Truscott added he plans to continue reviewing this and will bring a proposal forward to the HCP Hatchery Committees. Kahler noted that currently, hatchery staff in the Methow Basin try to get fish in the acclimation ponds when the ponds can remain ice-free, and then hold them until about late-April, which is well after all bypass facilities are already operating. He asked if any particular programs were discussed, and Truscott said some Grant PUD programs were discussed. Kahler said last year, releases from all Methow programs, including Carlton, were plenty late enough to provide full bypass coverage at the lower projects. He asked if the concern was more regarding Wenatchee programs. Truscott said the discussion was more of a general concern, and not necessarily specific to one program.

V. HCP Committees Administration

A. HCP-CC and HCP-HC Distribution List and Extranet Site Access – John Ferguson and Tracy Hillman (Mike Schiewe)

Mike Schiewe said considering the upcoming transition of HCP Chairpersons, the succeeding Chairpersons, John Ferguson and Tracy Hillman, were added to the Coordinating and Hatchery Committees email distribution lists, respectively, and also given access to the respective HCP Extranet Sites. Schiewe also suggested that Hillman start calling into the monthly Coordinating Committees meetings to provide the HCP Hatchery and Tributary Committees updates, following the transition of the new HCP Chairpersons in May 2015. Ferguson agreed to coordinate with Hillman regarding this request. *(Note: Ferguson contacted Hillman, who agreed to call into the monthly Coordinating Committees meetings to provide the HCP Hatchery and Tributary Committees updates in lieu of generating monthly reports to the Coordinating Committees, following the transition of the new HCP Chairpersons in May 2015.)*

B. Next Meetings (Mike Schiewe)

The next scheduled Coordinating Committees meeting is on March 24, 2015, and will be held by conference call.

Coordinating Committees representatives present agreed to reschedule the Coordinating Committees meeting on April 28 to April 21, 2015, to be held either by conference call or in person at the Radisson Hotel in SeaTac, Washington, as is yet to be determined.

Mike Schiewe noted that the Coordinating Committees meeting on May 26, 2015, falls directly after Memorial Day (May 25, 2015), and he recommended considering that meeting to be held either in eastern Washington or by conference call.

List of Attachments

Attachment A	List of Attendees

Attachment A
List of Attendees

Name	Organization
Mike Schiewe	Anchor QEA, LLC
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Lance Keller*	Chelan PUD
Tom Kahler*	Douglas PUD
Jim Craig*	U.S. Fish and Wildlife Service
Scott Carlon*	National Marine Fisheries Service
Jeff Korth*	Washington Department of Fish and Wildlife
Bob Rose*†	Yakama Nation
Kirk Truscott*†	Colville Confederated Tribes

Note:
* = Denotes Coordinating Committees member or alternate
† = Joined by phone

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Coordinating Committees	**Date:**	April 21, 2015
From:	Michael Schiewe, Chair		
Cc:	Kristi Geris		
Re:	Final Minutes of the March 24, 2015 HCPs Coordinating Committees Meeting		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Coordinating Committees met by conference call on Tuesday, March 24, 2015, from 9:30 am to 11:00 am. Attendees are listed in Attachment A of these meeting minutes.

ACTION ITEM SUMMARY

- Wells HCP Coordinating Committee representatives will submit edits and comments, or indication of no comments, on the Wells Project Land-use Permit for renewal (No. 651-01) to Douglas PUD by Tuesday, March 24, 2015 (Item II-C).
- Wells HCP Coordinating Committee representatives will submit edits and comments, or indication of no comments, on the Wells Project Land-use Permits for renewal (105 individual permits) to Douglas PUD by Monday, May 4, 2015 (Item II-C).
- Anchor QEA will provide directions to the Coordinating Committees to the locations of the Wells Project Land-use Permits for renewal that are posted on the HCP Coordinating Committees Extranet Site (Item II-C). *(Note: Kristi Geris sent an email to the Coordinating Committees after the meeting on March 24, 2015, with directions, as discussed.)*
- Douglas PUD will provide an update to the Coordinating Committees when additional information is available on spring Chinook salmon run-timing in the Upper Columbia River and upstream movement of steelhead as it relates to a possible extension of the west fishway outage at Wells Dam (Item II-D).
- Chelan PUD will provide an update via email on the Rocky Reach Juvenile Fish Bypass (RRJFB) pre-season marked fish releases when results are available (Item III-B).

- Kristi Geris will contact Julene McGregor (Douglas PUD Information Systems Staff) to request read-only access to the final document library on the HCP Hatchery Committees Extranet site for McLain Johnson (Washington Department of Fish and Wildlife [WDFW]), as approved by the Coordinating Committees; Geris will also add Johnson to the HCP Hatchery Committees email distribution list (Item IV-A). *(Note: Geris sent an email to McGregor after the meeting on March 24, 2015, requesting access for Johnson, as discussed. Geris also added Johnson to the email distribution list.)*

DECISION SUMMARY

- The Wells HCP Coordinating Committee representatives present approved the 2015 Broodstock Collection Protocols, as revised (Item II-A). *(Note: Jim Craig indicated the U.S. Fish and Wildlife's [USFWS'] approval of the revised draft protocols via email on March 19, 2015.)*
- The Wells HCP Coordinating Committee representatives present approved the Columbia River Inter-Tribal Fish Commission's (CRITFC's) annual request to tag sockeye salmon at Wells Dam in 2015 (Item II-B). *(Note: Jim Craig indicated USFWS' approval of CRITFC's request via email on March 19, 2015.)*
- The Wells HCP Coordinating Committee approved via email extending the current maintenance outage on the Wells Dam west fishway one week (i.e., moved completion date from April 9 to April 16, 2015) to complete needed work, as follows: Douglas PUD, National Marine Fisheries Service (NMFS), USFWS, and the Colville Confederated Tribes (CCT) approved April 7, 2015, and WDFW and the Yakama Nation (YN) approved April 8, 2015.

AGREEMENTS

- Wells HCP Coordinating Committee representatives present agreed to extend the 2014/2015 winter maintenance outage at Wells Dam to April 9, 2015, to allow time to complete required work at the west ladder (Item II-D).
- Coordinating Committees representatives present agreed to provide McLain Johnson read-only access to the final document library on the HCP Hatchery Committees

Extranet site, and add Johnson to the HCP Hatchery Committees email distribution list (Item IV-A).

REVIEW ITEMS

- Kristi Geris sent an email to the Coordinating Committees on February 24, 2015, notifying them that a Wells Project Land-use Permit for renewal (No. 651-01) was available for a 30-day review, with edits and comments, or indication of no comments, due to Tom Kahler by Tuesday, March 24, 2015 (Item II-C).
- Geris sent an email to the Coordinating Committees on March 3, 2015, notifying them several Wells Project Land-use Permits for renewal were available for a 60-day review period, with edits and comments, or indication of no comments, due to Kahler by Monday, May 4, 2015 (Item II-C).

DOCUMENTS FINALIZED

- Kristi Geris sent an email to the Coordinating Committees on March 27, 2015, notifying them that the 2014 Wells HCP Annual Report was finalized following a 30-day review period, which ended on March 9, 2015.
- Kristi Geris sent an email to the Coordinating Committees on April 10, 2015, notifying them that the 2014 Rocky Reach and Rock Island HCP Annual Reports were finalized following a 30-day review period, which ended on March 18, 2015.

I. Welcome

A. Review Agenda (Mike Schiewe)

Mike Schiewe welcomed the Coordinating Committees and asked for any additions or other changes to the agenda. No additions or changes were requested.

B. Meeting Minutes Approval (Mike Schiewe)

The Coordinating Committees reviewed the revised draft February 24, 2015, meeting minutes. Kristi Geris said all comments and revisions received from members of the Committees were incorporated in the revised minutes. Coordinating Committees members present approved the February 24, 2015, meeting minutes, as revised. *(Note: Jim Craig indicated USFWS' approval of the revised draft minutes via email on March 19, 2015.)*

C. Last Meeting Action Items (Mike Schiewe)

Action items from the Coordinating Committees meeting on February 24, 2015, and follow-up discussions, were as follows: *(Note: italicized item numbers below correspond to agenda items from the February 24, 2015, meeting.)*

- *Chelan PUD will add language explaining the average fork lengths for subyearling Chinook salmon that are reported in the 2015 Rocky Reach and Rock Island Spill Plan (Item II-B).*
  Lance Keller added language as discussed, and the final plan was distributed to the Coordinating Committees by Kristi Geris on February 27, 2015.
- *Chelan PUD will consider the feasibility of scanning for coded-wire-tags (CWT) during 2015 bypass monitoring at Rock Island Dam, and will report back to the Coordinating Committees by Tuesday, March 3, 2015 (Item II-C).*
  Kirk Truscott indicated via email on March 3, 2015, that after discussions with Chelan PUD, the CCT was withdrawing the request for CWT assessment as a monitoring component in the 2015 monitoring plan for the Rock Island Bypass, as distributed to the Coordinating Committees by Geris that same day.
- *Chelan PUD will add language explaining protocols for handling Endangered Species Act (ESA)-listed steelhead kelts if encountered during bypass operations at Rock Island and Rocky Reach dams (Item II-D).*
  Keller added language as discussed, and the final plans were distributed to the Coordinating Committees by Geris on February 27, 2015.
- *John Ferguson will contact Tracy Hillman regarding monthly Coordinating Committees updates on the HCP Hatchery and Tributary Committees, after the transition of the new HCP Chairpersons in May 2015 (Item V-A).*
  Ferguson contacted Hillman, who agreed to call into the monthly Coordinating Committees meetings to provide the HCP Hatchery and Tributary Committees updates in lieu of generating monthly reports to the

Coordinating Committees, after the transition of the new HCP Chairpersons in May 2015.

II. Douglas PUD

A. DECISION: 2015 Broodstock Collection Protocols (Tom Kahler)

Tom Kahler recalled the Wells HCP stipulates that "Broodstock Collection Protocols are developed by WDFW and are annually submitted to the Wells HCP Coordinating Committee and NMFS Hydro Program for annual approval prior to trapping at the Dam" Kahler also recalled the Broodstock Collection Protocols Statement of Agreement (SOA), approved by the Coordinating Committees on October 28, 2014 (and approved by the HCP Hatchery Committees on September 17, 2014), delegated NMFS' approval of the annual Broodstock Collection Protocols jointly to the NMFS HCP Hatchery Committees and Coordinating Committees Representatives.

Kahler said the revised draft 2015 Broodstock Collection Protocols for approval, along with minor edits received from the CCT, were distributed to the Coordinating Committees by Kristi Geris prior to today's meeting on March 24, 2015. Kahler said this revised draft incorporates edits and comments received from the HCP Hatchery Committees, which were vetted at their March 18, 2015 meeting. Kahler added the edits were primarily clarifications, and did not change the actions. He also noted that the Methow and Wells programs are largely unchanged from previous versions of the draft protocols. Mike Schiewe added that the revised draft protocols are still under review by the HCP Hatchery Committees; however, the review is now down to minor edits. He said that the final protocols are due to NMFS by April 15, 2015. Because the Coordinating Committees do not meet again before that time, approval of this document needed to be covered during today's meeting.

Kahler explained the requirement for approval of this document is found in the Wells HCP Adult Passage Plan, which addresses trapping that occurs at Douglas PUD facilities as part of the hatchery programs. He noted the Gantt chart on page 34 of the revised draft protocols describing trapping that will occur at Wells Dam in 2015 (except coho salmon), is similar to the chart Douglas PUD submits annually to the Coordinating Committees. He also noted the language in the revised draft protocols that indicates preference to trap only at the west ladder and use the east ladder only if necessary, is similar to last year.

The Wells HCP Coordinating Committee representatives present approved the 2015 Broodstock Collection Protocols, as revised. *(Note: Jim Craig indicated USFWS' approval of the revised draft protocols via email on March 19, 2015.)* Schiewe said the HCP Hatchery Committees will be considering approval of the passage and non-trapping aspects of the revised protocols via email on April 6, 2015.

B. DECISION: CRITFC Request to Tag Sockeye at Wells Dam in 2015 (Tom Kahler)

Tom Kahler said that CRITFC's annual request to tag sockeye salmon at Wells Dam in 2015 (Attachment B) was distributed to the Coordinating Committees by Kristi Geris on March 13, 2015. Kahler said the request is similar to past years' requests. He noted the CRITFC plans to use only the west ladder for trapping, like last year, even though it is not included information in the request. The Wells HCP Coordinating Committee representatives present approved CRITFC's annual request to tag sockeye salmon at Wells Dam in 2015. *(Note: Jim Craig indicated USFWS' approval of CRITFC's request via email on March 19, 2015.)*

C. Douglas PUD Land-Use Permits for Renewal (Tom Kahler)

Tom Kahler recalled that Douglas PUD's new Federal Energy Regulatory Commission License (issued in 2012) requires Douglas PUD to renew all existing Wells Project land-use permits. Additionally, the Wells HCP requires Douglas PUD to notify and consider comments from the Parties to the HCP regarding any applications for land-use permits that affect reservoir habitat. Douglas PUD intends to renew existing land-use permits consistent with the new FERC license, and has notified the HCP Parties and sought their comments via the Wells HCP Coordinating Committee. He said Kristi Geris sent an email to the Coordinating Committee on February 24, 2015, notifying them that a Wells Project Land-use Permit for renewal (No. 651-01) was available for an expedited 30-day review, with edits and comments, or indication of no comments, due to him by today, March 24, 2015. He said a week later, Geris sent an email to the Coordinating Committees on March 3, 2015, notifying them that several Wells Project Land-use Permits for renewal were available for a 60-day review period, with edits and comments, or indication of no comments, due to him by Monday, May 4, 2015. He said if no comments are received on the permit renewal applications, Douglas PUD will proceed with issuance of the renewed permits.

Scott Carlon said he spoke with Justin Yeager, who handles these types of requests for NMFS, and it was decided NMFS will not be commenting on the expedited or other permits for renewal. Carlon asked if these permits have already undergone other agency review (e.g., U.S. Army Corp of Engineers process). Kahler said they have, and added that Douglas PUD does not issue land-use permits until all other permits have been issued under the jurisdiction of other agencies, as applicable. Carlon asked if these permits were established pre-ESA listing. Kahler said he was not sure, but noted that some were very old. Jeff Korth said there may also be no comments from WDFW. He added he provided the permit renewal information to the WDFW Habitat and Lands managers; however, he has not received any comments to date.

Kirk Truscott asked, regarding the large batch of permits for renewal, if Douglas PUD could provide a map showing the locations of those properties. Kahler said Douglas PUD provided a summary letter and Microsoft Excel spreadsheet listing the different permits and their respective details, and then posted the individual permit renewal applications on the HCP Coordinating Committees Extranet Site (100-plus megabytes). Geris said she will provide directions to the Coordinating Committees to the locations of the Wells Project Land-use Permits for renewal that are posted on the HCP Coordinating Committees Extranet Site (Item II-C). *(Note: Geris sent an email to the Coordinating Committees after the meeting on March 24, 2015, with directions, as discussed.)*

Truscott asked if these permits remove lands from the public domain. Kahler clarified all Douglas PUD-owned land is public land. He added, in general, all reservoir shoreline is owned by Douglas PUD; therefore, it is open to public access. He said if property owners post no trespassing signs along the shoreline of the Wells Reservoir, Douglas PUD will contact those land owners to have them remove the signs. He added that anyone is welcome on the Wells Reservoir shoreline, so long as they do not access the adjacent upland private property. Truscott asked if there was a specific elevation that delineates the Wells Project boundary. Kahler said there is, as defined by the emergency flood level; however, the boundary is also related to bank stability and other factors, so the boundary extends upland in areas that are influenced by reservoir action.

The Wells HCP Coordinating Committee representatives agreed to submit edits and comments, or indication of no comments, on the Wells Project Land-use Permit for renewal (No. 651-01) to Douglas PUD by end of day today, Tuesday, March 24, 2015, as well as for the Wells Project Land-use Permits for renewal (105 total) by Monday, May 4, 2015.

D. Wells Dam Low-Level Entrance Update (Tom Kahler)

Tom Kahler said installation of the lamprey boxes at Wells Dam is not complete. He explained assembling the boxes was taking longer than anticipated, and completion is not expected until April 10, 2015. He said, in order to install the lamprey boxes, the winter maintenance outage at Wells Dam may need to be extended. He noted the east ladder is currently fully functional. He said the spring Chinook salmon run is early this year, with more than 480 over Bonneville Dam already (about 1 month ahead of normal). He said steelhead tend to start moving in April; however, Douglas PUD expects they may move early this year as well, because water temperatures are warmer.

Kahler said Douglas PUD is requesting two things: 1) an extension of the normal winter maintenance period into the second week of April (April 9, 2015) to complete west fishway maintenance; and 2) a possible additional extension to complete installation of the lamprey boxes, which may mean operating only one functional ladder through most of April 2015.

Bob Rose asked about the downside of not extending the maintenance period. Kahler said the primary risk would be failure of the vertical diffuser gratings that separate the auxiliary water supply chamber from the collection gallery, which tend to get clogged with debris and need to be cleaned annually. He said during each winter outage, maintenance personnel remove the panels to clear debris. He added that if the panels become clogged, they can fail, allowing fish access to the area behind the grating, which would require shutting down the ladder at a later date to repair them. He said the potential downside of an extension might be delayed passage of early moving steelhead and early-arriving spring Chinook salmon. He said, if there is a need to trap broodstock early, trapping typically takes place at the west ladder, which would be considered.

Scott Carlon asked if installing the lamprey boxes will require the full month of April, and Kahler said this is currently unknown, but could possibly be the case. Mike Schiewe asked how not installing the lamprey boxes will affect the lamprey study proposed this year by the Aquatic Settlement Work Group (SWG). Kahler said detection equipment is already in place so that lamprey could be detected approaching and around the Wells Project; however, there would be no evaluation of passage efficacy or lamprey responses to the low-level entrances. Rose asked if the study would continue for an additional year if installing the lamprey boxes was postponed, and Kahler said he was not certain if there was budget for additional years of study at this time. Schiewe noted the Aquatic SWG does not meet again until April 8, 2015, and he also added there has been no discussion to date regarding a lamprey study extending beyond this year.

Carlon asked if the lamprey box would be installed in the west ladder first because that ladder is currently down for maintenance, and Kahler said that is correct. Kahler added that the exact time required to install the lamprey boxes will not be known until the boxes have arrived (project arrival is April 10, 2015). He suggested the Coordinating Committees first consider approval of a winter outage extension to April 9, 2015, and then revisit the potential additional extension when more information is available. He said Douglas PUD will provide an update to the Coordinating Committees when more information is available on spring Chinook salmon run-timing in the Upper Columbia River and upstream movement of steelhead is available. Wells HCP Coordinating Committee representatives present agreed to extend the 2014/2015 winter maintenance outage at Wells Dam to April 9, 2015, to allow time to complete required work at the west ladder, and delay a decision on an additional outage until new information on run-timing becomes available.

III. Chelan PUD

A. Rocky Reach Dam and Rock Island Dam Adult Fishway Annual Maintenance (Lance Keller)

Lance Keller reviewed 2014/2015 winter maintenance activities at Rocky Reach and Rock Island dams, as follows:

Rock Island Dam

Keller said, on February 27, 2015, an email was sent notifying the Coordinating Committees that as of that afternoon, all three ladders at Rock Island Dam were fully operational. He recalled that the right ladder had still been out of service to repair the trash boom above the exit of the ladder that was damaged when the forebay elevation was dropped in response to the Wanapum Reservoir drawdown; however, crews completed the repairs and reduced river flow allowed the install.

Rocky Reach Dam

Keller recalled that during the last Coordinating Committees meeting on February 24, 2015, Chelan PUD had requested an extension of the maintenance period to March 8, 2015, to allow time to complete the repair of a defective valve stem in the attraction water system (AWS), in which the parts were delayed due to the inclement weather near the manufacturer. He said, when the parts arrived, it was discovered critical parts had been damaged during transit. He said Rocky Reach mechanics manually raised the gate, blocked it in the open position, and established a manual shut-down procedure, should the AWS system need to be shut down mid-season for an emergency. He said, on March 6, 2015, the Rocky Reach adult ladder was returned to service. Kirk Truscott asked what the future plan is for replacing the stem. Keller said that the equipment to properly repair the valve stem will be ordered and on site for repair during the 2015/2016 winter maintenance period. He added the ladder needs to be dewatered to complete the maintenance.

Keller said, regarding Turbine Units 8-11 (C8-11) at Rocky Reach Dam, in-house staff are conducting a more thorough analysis of the large units, and Chelan PUD may ask to convene a Coordinating Committees conference call to discuss the results and recommendations moving forward prior to the next meeting on April 21, 2015.

B. Rocky Reach Juvenile Fish Bypass Pre-Season Marked Fish Releases (Lance Keller)

Lance Keller said the RRJFB pre-season marked fish releases were rescheduled and results are not yet available. He said he will provide an update via email on the releases when results are available.

C. Wanapum Drawdown Update (Lance Keller)

Lance Keller said, as described in emails distributed by Grant PUD, refill of the Wanapum Reservoir is going well. He said currently, the forebay elevation at Wanapum Dam is at 570.1 feet. He said river flow past Rock Island Dam is 164,400 cubic feet per second (164.4 kcfs), which translates to a tailrace elevation of about 573 to 574 feet. He recalled the fishway sills are at an elevation of 559 feet, and the upper resting pool of the denil structures is at an elevation of 564 feet; therefore, he said all denils are well-submerged, and the dam is operating in a generation configuration. He said Chelan PUD is still preparing a draft Emergency Biological Assessment, which will be completed in about a month, and sent to USFWS and NMFS for initial review.

IV. WDFW

A. HCP Hatchery Committees Distribution List and Extranet Access Request – McLain Johnson (Mike Schiewe and Jeff Korth)

Mike Schiewe said McLain Johnson has requested to be added to the Hatchery Committees email distribution list, and also requested access to the HCP Hatchery Committees Extranet Site. Jeff Korth explained Johnson is the lead for the WDFW Science Division in Wenatchee, Washington, and his role is similar to that of Charlie Snow (WDFW) in the Methow. Coordinating Committees representatives present agreed to provide Johnson read-only access to the final document library on the HCP Hatchery Committees Extranet site and add Johnson to the HCP Hatchery Committees email distribution list. Kristi Geris will contact Julene McGregor to request read-only access to the final document library on the HCP Hatchery Committees Extranet site for Johnson, as approved by the Coordinating Committees. Geris will also add Johnson to the HCP Hatchery Committees email distribution list. *(Note: Geris sent an email to McGregor after the meeting on March 24, 2015, requesting access for Johnson, as discussed. Geris also added Johnson to the email distribution list.)*

V. HCP Hatchery and Tributary Committees Update (Mike Schiewe)

Mike Schiewe said the HCP Tributary Committees did not meet in March 2015. The next HCP Tributary Committees meeting will be held on April 9, 2015.

Schiewe updated the Coordinating Committees on the following actions and discussions that occurred at the last HCP Hatchery Committees meeting on March 18, 2015:

- *DECISION/Discussion: Revised Draft 2015 Broodstock Collection Protocols:* The HCP Hatchery Committees reviewed the revised draft protocols, as was discussed during today's meeting. The Committees developed a schedule to submit final revisions by March 26, 2015, vote via email by April 6, 2015, and submit the final draft protocols to NMFS by April 15, 2015. Just as the NMFS HCP Coordinating Committees Representative constitutes NMFS approval of the protocols, the same is true with the NMFS HCP Hatchery Committees Representative. In the past, there was a separate NMFS approval process; however, the HCP Committees worked with NMFS to streamline that process. Mike Tonseth (WDFW HCP Hatchery Committees Representative) was applauded for shepherding this very long and successful pilot year of the expedited schedule and updated protocols template.
- *DECISION: Methow Spring Chinook Hatchery Production SOA:* This SOA formalized Hatchery Committee permission for Chelan PUD to enter into an Interlocal Agreement (ILA) between Chelan PUD and Douglas PUD to move Chelan PUD's 61,000 Methow spring Chinook salmon program back to collection at Wells Dam, and spawning and rearing at Methow Fish Hatchery (FH). The discussion of the SOA turned controversial. Chelan PUD assumed returning their program to Methow FH would simplify logistics by returning spawning and rearing to its previous location. The YN expressed interest in testing alternative rearing arrangements to address what they characterized as a "homing problem" in the Methow. There were a range of opinions by different Hatchery Committees members on the YN proposal, and in end, the YN proposed modifying Chelan PUD's SOA to make it a 1-year agreement (which was a non-started for Chelan PUD and Douglas PUD), and also included language that required Chelan PUD to develop a study plan to address issues in the Methow for implementation in 2016. HCP Hatchery Committees representatives concluded the performance issues in the Methow were

not solely the responsibility of Chelan PUD, and suggested that the full HCP Hatchery Committees should consider addressing these issues. The HCP Hatchery Committees approved Chelan PUD's SOA authorizing the ILA with Douglas PUD, with the exception of the YN. It was emphasized if agreement cannot be reached on the SOA, the fallback would be last year's program, which included broodstock collection via tangle netting in the Chewuch, and spawning and rearing at Eastbank Hatchery, an arrangement that several HCP Hatchery Committees representatives would not support. The YN ultimately proposed a separate SOA calling for a review of the Methow program in 2015, with studies and actions to be implemented starting in 2016. Schiewe said he spoke offline with many of the HCP Hatchery Committees representatives, and most parties are supportive of a formal evaluation of the Methow Program, and adaptive management changes as needed. There is a conference call scheduled for Friday, March 27, 2015 to try to reach resolution. Schiewe said he is encouraging all parties to work collaboratively and on a path forward.

- *DECISION: 2015 Steelhead Release Plan for the Wenatchee Basin:* The HCP Hatchery Committees approved this plan (proposed by Chelan PUD and WDFW). The plan is not a study per se; rather, it is an effort to collect information on way to separate migrant from non-migrant steelhead.
- *Hatchery M&E Appendices Review:* The HCP Hatchery Committees agreed to reconvene the Hatchery Evaluation Technical Team to finalize the pending Hatchery M&E Plan Appendices.
- *Summer Chinook Size Target Study:* The HCP Hatchery Committees approved a 1-year extension of Chelan PUD's and Grant PUD's Summer Chinook Size Target Study that involves early-rearing fish at Eastbank FH and finishing them at Chelan Falls and Dryden Ponds.
- *HGMP Update:* Craig Busack indicated litigation is delaying the permitting process, but that NMFS is still slowly making progress.

VI. HCP Committees Administration

A. Next Meetings (Mike Schiewe)

The next scheduled Coordinating Committees meeting is on April 21, 2015, and will be held by conference call. The May 26 and June 23, 2015 meetings will be held either by conference call or in person at the Radisson Hotel in SeaTac, Washington, as is yet to be determined.

List of Attachments

Attachment A	List of Attendees
Attachment B	CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam in 2015

Attachment A
List of Attendees

Name	Organization
Mike Schiewe	Anchor QEA, LLC
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Lance Keller*	Chelan PUD
Tom Kahler*	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Jeff Korth*	Washington Department of Fish and Wildlife
Bob Rose*	Yakama Nation
Kirk Truscott*	Colville Confederated Tribes

Note:
* = Denotes Coordinating Committees member or alternate

March 13, 2015

Tom Kahler
Public Utility District Number 1 of Douglas County
1151 Valley Mall Parkway
East Wenatchee, Washington 98801

Dear Mr. Kahler:

In 2015, we are planning to once again sample sockeye salmon at Wells Dam. We hope to collect scale samples from up to 800 sockeye, all of which we will PIT tag (if they have not already been tagged). In addition, all fish will be floy tagged and we will acoustic tag up to 100 sockeye salmon. We anticipate sampling from late June through early August and will coordinate sampling activities with Wells Hatchery brood stock collection programs. Sampling personnel may include Dr. Jeff Fryer of CRITFC, Jennifer Miller, Byron Sam, Brooklyn Hudson, and Darin Hathaway of the Colville Tribe, and Kraig Mott, Casey Heemsah, Kory Kuhn, and Terri Benson of the Yakama Nation.

Please contact Dr. Jeff Fryer of our staff if you have any questions. Thank you for your cooperation with this study.

Sincerely,

Babtist P. Lumley
Executive Director

720 Olive Way, Suite 1900
Seattle, Washington 98101
Phone 206.287.9130
Fax 206.287.9131
www.anchorqea.com

FINAL MEMORANDUM

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

Date: June 23, 2015

From: Michael Schiewe, Chair

Cc: Kristi Geris

Re: Final Minutes of the April 21, 2015 HCPs Coordinating Committees Conference Call

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The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Coordinating Committees met by conference call on Tuesday, April 21, 2015, from 9:30 am to 11:30 am. Attendees are listed in Attachment A of these meeting minutes.

ACTION ITEM SUMMARY

- Chelan PUD will provide an updated Rocky Reach Juvenile Fish Bypass (RRJFB) pre-season marked fish release results table, which includes additional notes about the results, to Kristi Geris for distribution to the Coordination Committees (Item II-A).
- Douglas PUD will confirm with the Yakama Nation (YN) their plans to trap summer Chinook salmon for the YN Yakima River Reintroduction at Wells Dam in 2015 and provide a finalized 2015 Douglas PUD Trapping Activities table to Kristi Geris for distribution to the Coordination Committees (Item III-A). *(Note: Tom Kahler confirmed trapping plans with the YN and provided a final table to Geris following the meeting on April 21, 2015, which Geris distributed to the Coordinating Committees the same day.)*
- Scott Carlon will coordinate with Bryan Nordlund (National Marine Fisheries Service [NMFS], retired) and Douglas PUD to discuss concerns Nordlund raised regarding reopening the low-level fishway entrance at Wells Dam, and Douglas PUD will report back to the Coordinating Committees regarding a path forward (Item III-E).
- Wells HCP Coordinating Committee representatives will submit edits and comments, or indication of no comments, on the Wells Project Land-use Permits for renewal (105 total permits) to Douglas PUD by Monday, May 4, 2015 (Item III-F).

- Wells HCP Coordinating Committee representatives will submit edits and comments, or indication of no comments, on the Wells Project Land-use Permits for renewal (Nos. 57A-01, 57HA-01, and 1001-01) to Douglas PUD by Friday, June 19, 2015 (Item III-F).
- Tom Kahler will discuss internally if Wells Project Land-use Permit No. 57A-01 (up for renewal) includes permitting for any new work and report back to the Coordinating Committees (Item III-F).
- John Ferguson will ask Tracy Hillman (BioAnalysts) if he can share with the Coordinating Committees NMFS' presentations titled, *"Ocean Conditions in 2014; Potential Consequences for Salmon,"* and *"Estimation of Survival and Run Timing of Adult Spring/Summer Chinook from the Columbia River Estuary to Bonneville Dam,"* that he recently shared with the HCP Hatchery and Tributary Committees (Item IV).
- **The Coordinating Committees meeting on May 26, 2015, will be held by conference call (Item V-E).**

DECISION SUMMARY

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

AGREEMENTS

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

REVIEW ITEMS

- Kristi Geris sent an email to the Coordinating Committees on March 3, 2015, notifying them that several Wells Project Land-use Permits for renewal were available for a 60-day review period, with edits and comments, or indication of no comments, due to Kahler by Monday, May 4, 2015 (Item III-F).
- Geris sent an email to the Coordinating Committees on April 20, 2015, notifying them that three additional Wells Project Land-use Permits for renewal (Nos. 57A-01, 57HA-01, and 1001-01) were available for a 60-day review period, with edits and

comments, or indication of no comments, due to Kahler by Friday, June 19, 2015 (Item III-F).

- Geris sent an email to the Coordinating Committees on May 5, 2015, notifying them that the draft 2014 Douglas PUD Pikeminnow Program Annual Report is available for a 60-day review period, with edits and comments due to Kahler by Monday July 6, 2015.
- Geris sent an email to the Coordinating Committees on May 12, 2015, notifying them that a Wells Project Land-use Permit Application (Tract 824 Matherly) was available for a 60-day review period, with edits and comments due to Kahler by Monday, July 13, 2015.
- Geris sent an email to the Coordinating Committees on May 14, 2015, notifying them that a Wells Project Land-use Permit Application (Tract 82 Wick) was available for a 60-day review period, with edits and comments due to Kahler by Monday, July 13, 2015.
- Geris sent an email to the Coordinating Committees on June 16, 2015, notifying them that a Wells Project Land-use Permit Application (Permit 1030-01 CCT) was available for a 60-day review period, with edits and comments, or indication of no comments, due to Kahler by Friday, August 14, 2015.
- Geris sent an email to the Coordinating Committees on June 16, 2015, notifying them that a Wells Project Land-use Permit Application (Permit 130-01 Earl and Cartwright) was available for a 60-day review period, with edits and comments, or indication of no comments, due to Kahler by Friday, August 14, 2015.

DOCUMENTS FINALIZED

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda (Mike Schiewe)

Mike Schiewe welcomed the Coordinating Committees and asked for any additions or changes to the agenda. The following revisions were requested:

- Lance Keller added a Twin W Boat Launch notification.

- Tom Kahler added Wells Project Land-Use Permits for renewal.

B. Meeting Minutes Approval (Mike Schiewe)

The Coordinating Committees reviewed the revised draft March 24, 2015, meeting minutes. Kristi Geris said all comments and revisions received from members of the Committees were incorporated in the revised minutes. Coordinating Committees members present approved the March 24, 2015, meeting minutes, as revised.

C. Last Meeting Action Items (Mike Schiewe)

Action items from the Coordinating Committees meeting on March 24, 2015, and follow-up discussions, were as follows: *(Note: italicized item numbers below correspond to agenda items from the March 24, 2015, meeting.)*

- *Wells HCP Coordinating Committee representatives will submit edits and comments, or indication of no comments, on the Wells Project Land-use Permit for renewal (No. 651-01) to Douglas PUD by Tuesday, March 24, 2015 (Item II-C).*
  This will be discussed during today's conference call.
- *Wells HCP Coordinating Committee representatives will submit edits and comments, or indication of no comments, on the Wells Project Land-use Permits for renewal (105 individual permits) to Douglas PUD by Monday, May 4, 2015 (Item II-C).*
  This will be discussed during today's conference call.
- *Anchor QEA will provide directions to the Coordinating Committees to the locations of the Wells Project Land-use Permits for renewal that are posted on the HCP Coordinating Committees Extranet Site (Item II-C).*
  Kristi Geris sent an email to the Coordinating Committees after the meeting on March 24, 2015, with directions, as discussed.
- *Douglas PUD will provide an update to the Coordinating Committees when additional information is available on spring Chinook salmon run-timing in the Upper Columbia River and upstream movement of steelhead as it relates to a possible extension of the west fishway outage at Wells Dam (Item II-D).*
  The Wells HCP Coordinating Committee approved via email extending the current maintenance outage on the Wells Dam west fishway 1 week (i.e., moved completion

date from April 9 to April 16, 2015) to complete needed work, as follows: Douglas PUD, NMFS, U.S. Fish and Wildlife Service (USFWS), and the Colville Confederated Tribes (CCT) approved April 7, 2015, and Washington Department of Fish and Wildlife (WDFW) and the YN approved April 8, 2015. Installation of the lamprey boxes was postponed.

- *Chelan PUD will provide an update via email on the RRJFB pre-season marked fish releases when results are available (Item III-B).*
  Lance Keller provided an update to Kristi Geris on April 17, 2015, which Geris distributed to the Coordinating Committee the same day. This will be further discussed during today's conference call.
- *Kristi Geris will contact Julene McGregor (Douglas PUD Information Systems Staff) to request read-only access to the final document library on the HCP Hatchery Committees Extranet site for McLain Johnson (WDFW), as approved by the Coordinating Committees. Geris will also add Johnson to the HCP Hatchery Committees email distribution list (Item IV-A).*
  Geris sent an email to McGregor after the meeting on March 24, 2015, requesting access for Johnson, as discussed. Geris also added Johnson to the email distribution list.

II. Chelan PUD

A. Rocky Reach Juvenile Fish Bypass Pre-Season Marked Fish Release Results (Lance Keller)

Lance Keller recalled pre-season marked fish releases were conducted at the RRJFB to test the system for possible descaling injury or mortalities prior to the start of the 2015 bypass season, which was scheduled to begin April 1, 2015 at midnight. RRJFB pre-season marked fish release results were distributed to the Coordinating Committees by Kristi Geris on April 17, 2015. Keller explained test fish were clipped to differentiate between release locations, and were recovered at the sampling facility to tally the results.

Keller said, on March 24, 2015, a total of 200 fish were released into the north and south entrance channels located upstream of the trash rack surface collector system. He said 100 of 100 fish released in the south entrance were recovered and were free of descale and injury. He said, however, only 78 of 100 fish released in the north entrance were recovered, all of which were free of descaling injury. He attributed this lower recovery number to the larger size of the test fish, and a high likelihood that the fish escaped before entering the bypass. Jim Craig asked for this explanation to be added to the results table that was distributed on April 17, 2015. Keller said he will provide an updated RRJFB pre-season marked fish release results table, which includes additional notes about the results, to Geris for distribution to the Coordinating Committees.

Keller said, on March 25, 2015, a total of 156 fish were released into vertical barrier screens (VBSs) that were deployed in Turbine Unit 1 (C1) and Turbine Unit 2 (C2). He said 77 of 78 fish released in the VBS in C1 were recovered and were free of descaling injury. He said, however, only 31 of 78 fish released in the VBS in C2 were recovered, all of which were free of descaling injury. He said these low recovery numbers prompted Rocky Reach staff to take C2 offline for an emergency outage, and divers were deployed to inspect the VBS. He said divers discovered the VBS had been deployed in a vertical configuration instead of at an angle, which damaged the center panel of the VBS. He said this issue was corrected on March 30, 2015. After the correction, a total of 100 fish were released in the VBS in C2, and this time 99 of 100 fish were recovered and free of descaling injury. Craig asked if it is known what part of the installation caused the issues with deployment and damage to the system. Keller explained, when the screens have been deployed in the past, the turbine units have either been completely turned off or slowed down to reduce flow. He said that this year, the units were only slowed down, resulting in river flow high enough to cause the VBS to go vertical, damaging the system during deployment. He said to prevent this from happening in the future, he coordinated with Rocky Reach staff to update the protocol to require that the turbine units are completely turned off to achieve proper deployment.

B. Rocky Reach Large Unit Operations (C8-C11) (Lance Keller)

Servo Rod Repairs

Lance Keller recalled, in 2013, while Turbine Unit 10 (C10) at Rocky Reach Dam was offline for maintenance, crews discovered a deep hairline crack in a stainless steel rod that delivers oil to the servo motor, and Turbine Unit 8 (C8), Turbine Unit 9 (C9), and Turbine Unit 11 (C11) all have the same stainless steel rod design as part of the servo motors. Keller said repairs to these units are scheduled to start soon and will continue into 2019.

February 4, 2015 Incident

Keller said, on February 4, 2015, a series of events led to an emergency evacuation of the powerhouse at Rocky Reach Dam. He explained crews were conducting work on C8, which required the wicket gate to be fully opened and head gate to be applied. He said crews were instructed to begin work on C11, so crews initiated re-watering of C8; however, they failed to verify the wicket gate was closed and water entered the unit causing it to spin, which filled the powerhouse with smoke from the brake on the unit and resulted in the evacuation. Keller said the exact sequence of events is being evaluated, and Chelan PUD has contracted a consultant to conduct an in-depth analysis to determine the root cause of the error. He also said new protocols are in place and additional crew training is being implemented. He said the overall damage to C8 is still unknown and an analysis is underway to determine the extent of the damage. He added this incident may result in the need for a few months of additional repair time (in addition to the servo rod repair).

Powerhouse Operation Scheme

Keller explained, per the current powerhouse loading plan at Rocky Reach Dam, the southern-most unit (i.e., C1), which is located closest to the surface collector, is operated first. He said, to increase generation, additional units are brought online, as needed, in sequential order moving upstream. He said, when decreasing generation, the unit shutdown process is conducted in reverse of increasing generation. He said this powerhouse operation scheme was designed to comply with fish-survival standards and preserve collection efficiency. He added that a soft constraint of 12,500 cubic feet per second (12.5 kcfs) is applied to the first two units (C1 and C2) in the powerhouse closest to the surface collector.

Keller said Rocky Reach engineers observed accelerated wear on the northern units (C8, C9, C10, and C11), and speculated this may be due to the frequent starts and stops experienced by those units in the loading sequence. He said Rocky Reach engineers recommended minimizing the starts and stops on these units; therefore, Rocky Reach Operations staff suggested, when the large units come online, they should remain online long enough to complete a proper heat cycle (i.e., enough time to heat up and cool down properly), and the starts/stops that would normally be achieved with C8 through C11 would now be achieved with C7 and C6. Keller said this approach also preserves the current turbine loading sequence, with C1 and C2 remaining as the first on/last off units in the Rocky Reach powerhouse.

Scott Carlon asked if the proposal is to change the order of how the units are prioritized. Keller explained there will still be soft constraints on C1 and C2, and when C8, C9, and C10 are available, those units, along with C11, will be removed from the load sequence to minimize starts and stops. He added that the same loading sequence will be implemented with the first seven units (C1 through Turbine Unit 7 [C7]).

Kirk Truscott asked if C8 through C11 are operating more now than in previous years in which survival studies were conducted. Keller said this may be the case depending on water availability, heat cycles, and available units. He added, approximately 2 years ago, when Chelan PUD was discussing block loading, historical fish passage data were reviewed, which indicated only about 2% of fish passing Rocky Reach Dam use the upper units. Truscott said his concerns are regarding any differences in project survival. Keller said that Rocky Reach Operations staff have been instructed to follow the original loading sequence as close as possible; however, when river flow requires the larger units to start and stop often, staff have been instructed to shift some of that action to C7 to reduce wear and tear on the larger units. He added, annually, the larger units start and stop hundreds of times more than the lower units in the Powerhouse. Truscott asked, with this modified operations scheme, if Chelan PUD expects greater proportions of juvenile fish to pass through C10 and C11. Keller replied that based on approach data, they do not.

C. Wanapum Drawdown Update (Lance Keller)

Lance Keller said conditions are back to normal in the Wanapum Reservoir. He said the draft Emergency Biological Assessment is now undergoing internal review and is on schedule to be submitted to the Federal Energy Regulatory Commission (FERC) by June 12, 2015. He said current river flow past Rock Island Dam is 116.8 kcfs, which translates to a tailrace elevation of 571.4 feet and forebay elevation of 612.9 feet. He said all denil structures are fully submerged and all three fish ladders are available for fish passage.

D. Twin W Boat Launch Notification (Lance Keller)

Lance Keller notified the Coordinating Committees that a permit has been filed to improve a boat launch that is located within the Rocky Reach Reservoir. He explained Twin W is a privately owned parcel of land located approximately 2.5 miles upstream of Sun Cove on the Douglas County side of the Rocky Reach Reservoir. He said improvements will be applied to an existing gravel boat launch and will include building a new articulating boat launch. He added all proper permitting will be required to conduct the work.

III. Douglas PUD

A. Douglas PUD Trapping Activities in 2015 (Tom Kahler)

Tom Kahler said he distributed a draft 2015 Douglas PUD Trapping Activities table prior to the meeting on April 21, 2015. He recalled, in recent years, Douglas PUD has provided a similar table to the Coordinating Committees prior to conducting trapping activities at Douglas PUD facilities. He said the table is a summary of anticipated trapping activities and includes information on location, species, organization conducting the trapping, and timing. He noted, in past years, WDFW trapped summer Chinook salmon at the Wells Outfall for the YN Yakima River Reintroduction; however, this year, Douglas PUD has not yet received a request from the YN to conduct this work. He said he tentatively included this trapping activity in the draft table and will confirm with the YN their plans for trapping in 2015. He said that once confirmed, he will also provide a finalized 2015 Douglas PUD Trapping Activities table to Kristi Geris for distribution to the Coordination Committees. *(Note: Kahler confirmed trapping plans with the YN and provided a final table [Attachment B] to Geris following the meeting on April 21, 2015, which Geris distributed to the Coordinating Committees the same day.)*

Jeff Korth asked if the information in this table was reflected in the 2015 Broodstock Collection Protocols, and Kahler replied it was in the protocols. Kahler also noted the hatched areas and the to-be-determined (TBD) dates, and explained those dates are tentative pending further discussion. He explained that the tentative dates at the Wells Outfall need to be confirmed with Mike Tonseth (WDFW) because Tonseth listed dates in the 2015 Broodstock Collection Protocols that were different from those in past years. Kahler explained the TBD dates are pending further discussion with USFWS regarding developing alternative trapping operations at the Twisp Weir to minimize incidental take of bull trout. Korth asked if this is a new request from USFWS. Kahler replied that it is not, and added that these discussions have been ongoing since last fall. He explained, in 2014, the number of bull trout encountered at the Twisp Weir exceeded the take limit. He added that Greg Mackey (Douglas PUD) and Andrew Gingerich (Douglas PUD) have been working with USFWS on a revised trapping protocol for the Twisp Weir, which is undergoing final review by USFWS before the revised protocols are presented to the HCP Hatchery Committees. Kahler asked Korth if he had particular concerns with the scheduled trapping at the Twisp Weir. Korth replied that he does not at this time, and he asked if Tonseth is aware that these dates are tentative. Kahler said he does not know, and he noted the purpose of this document is only to inform the Coordinating Committees of what trapping is planned for Douglas PUD facilities. He added that this document is not intended to change management or trapping protocols. Mike Schiewe added another benefit of this document is it shows which trapping activities overlap and highlights opportunities to minimize impacts by combining efforts. Kahler agreed, and added that last year, all trapping except of coho was conducted at the west fish ladder only.

B. YN Kelt Study – Proposed Sampling of Maiden Steelhead at Wells Dam (Tom Kahler)

Tom Kahler said proposed protocols for sampling steelhead at Wells Dam and kelts at the Kelt Rehabilitation Facility (Attachment C) were distributed to the Coordinating Committees by Kristi Geris on April 20, 2015. Kahler explained this work is part of the YN's kelt reconditioning effort in the Methow Basin and was requested by the Independent Scientific Review Panel (ISRP). He further explained the ISRP requested that the YN compare phenotypic characteristics between reconditioned kelts and maiden spawners. He said the ISRP also wanted to test fecundity; however, this was not suitable as it involves lethal sampling. He said Attachment C is an alternative approach developed by the YN and does not require sacrificing fish. He said the YN releases reconditioned kelts in September when other spawners are also returning, and sampling needs to take place right before release in order to obtain information on maturation. He also noted Fulton's Condition Factor and fat-meter readings will be used in this evaluation. He said sampling will take place concurrently with WDFW's run composition sampling at Wells Dam (when WDFW will already be sampling fish), and the YN will coordinate on this additional sampling.

Kahler said the purpose of presenting this document is to inform the Coordinating Committees there will be additional handling of these fish (which will be minimal). He added that HCP Hatchery Committees have already reviewed and approved the document.

C. Wells Dam Bypass Operations (Tom Kahler)

Tom Kahler notified the Coordinating Committees that bypass operations at Wells Dam started on April 9, 2015, at 0000 hours.

D. Wells Dam Ladder Maintenance Update (Tom Kahler)

Tom Kahler said, on April 15, 2015, the west fish ladder was brought back into service, which is 1 day earlier than what was approved by the Coordinating Committees.

E. Wells Dam Low-Level Entrance Update (Tom Kahler)

Tom Kahler said, because the lamprey boxes were not installed, the Wells Dam low-level entrances (LLEs) have not been opened for lamprey passage. Kahler said there remains a question of whether or not the unmodified LLEs could function as lamprey entrances without posing a risk to salmon passage. He said postponing the lamprey study is a question for the Aquatic SWG; however, whether the low-level entrance can be used for lamprey passage without the lamprey boxes is a separate issue. He recalled Bryan Nordlund's concern that reopening these entrances would increase the necessary auxiliary water supply (AWS) flow necessary to achieve the required head differential between the collection gallery and the tailrace, which would in turn increase aquatic vegetation build-up on the diffuser grating and potentially cause failure of the grating, or delayed fish passage because fish are attracted to cascading AWS water at the grating. Kahler said, however, the low-level entrances have never been open without the side entrances concurrently open. The LLEs represent only a small fraction of the fishway discharge, relative to either the side or end entrances. He questioned whether there would be any problems with increased AWS flow if only the low-level entrances were open.

Scott Carlon said he thought Nordlund's concern was with salmonids accessing the AWS. Kahler said that is correct; failure of diffuser gratings during migration results in fish access to the AWS chambers. Additionally, when there is debris loading on the diffuser grating and the tailwater drops, the head differential between the AWS chamber and the collection gallery increases and water cascades over the debris. Fish are attracted to the cascades from the diffuser grating instead of the ladder, causing passage delays. He added, however, this behavior was only observed before the baffle was installed at Weir 1 that constrained the flow jet, so it is unknown what the response would be now. He also added that those behaviors were observed when the side entrance was open, which resulted in more AWS flow than now. Carlon asked if the side entrances are open now, and Kahler replied that they are not. Kahler further explained, in the early 1990s, Douglas PUD conducted a radio-telemetry (RT) study with the side entrances at Wells Dam open. He said that they observed fish entering the end entrances, and instead of proceeding to the fish ladder, fish would exit the side entrances and cycle back around, causing passage delays. He said, based on these findings, Douglas PUD decided to close the side entrances and open the end entrances all the way. He said since 2006, baffles have been installed on top of Weir 1 that concentrate flow from the fish ladder to create a stronger flow jet into the collection gallery to attract fish away from the diffuser gratings. Carlon asked if a study would be required to evaluate how fish migrate through this area. Kahler said Nordlund's concerns were all based on observations (i.e., fish were observed nosing at the diffuser gratings). Carlon asked if the low-level entrance was opened this year, if fish could be adequately evaluated migrating through the area. Kahler said this year WDFW is conducting a steelhead RT study at Priest Rapids Dam, so there will be radio-tagged fish in the system; however, he noted tailwater conditions necessary to set up a head differential between the AWS chamber and collection gallery cannot be readily controlled. Carlon said he is not suggesting creating a new study; rather, he is just concerned about evaluating risks.

Kahler said, if there is no major concern with opening the entrances, Douglas PUD will develop a proposal for the Coordinating Committees to consider. Bob Rose asked if monitoring is in place to know whether or not lamprey are using the low-level entrance. Kahler replied RT antennas are installed throughout the entrances in order to achieve effective monitoring of the fishways. He added it is his understanding equipment should be in place to detect which entrances fish are using, how fish behave once inside, and how fish use the collection gallery. Rose said, from a lamprey perspective, it seems useful information can still be collected without installing the lamprey boxes; however, he noted, he is not certain about the risk to salmonids.

Kirk Truscott noted, at some point, there was enough concern to warrant developing the lamprey box. Kahler recalled the intent of the box was to prevent salmon and steelhead from accessing the low-level entrances and to reduce total discharge from those entrances. Truscott asked about potential risk to salmonids without the lamprey box (i.e., passage in the fish ladder). Also, he expressed concern about additional debris loading on the diffuser grating in late-August and September, because of scheduled construction activities in the reservoir that will require low-pool operations, potentially resulting in fish-passage delays at that location. He said, because of the low water year, there may be high water temperatures.

Carlon said he will coordinate with Nordlund and Douglas PUD to discuss concerns Nordlund expressed regarding reopening the low-level fishway entrances at Wells Dam, and Douglas PUD will report back to the Coordinating Committees.

F. Douglas PUD Land-Use Permits for Renewal (Tom Kahler)

Tom Kahler said Kristi Geris sent an email to the Coordinating Committees on April 20, 2015, notifying them that three additional Wells Project Land-use Permits for renewal (Nos. 57A-01, 57HA-01, and 1001-01) were available for a 60-day review period, with edits and comments, or indication of no comments, due to Kahler by Friday, June 19, 2015. Kahler added he believes these may be the last of the permits for renewal. He recalled Douglas PUD is providing these permits for renewal to the Coordinating Committees for an opportunity to comment per Section 5.1 of the Wells HCP. He said he received indication of no comment from WDFW and NMFS, and requested other Coordinating Committees representatives do the same, if applicable. Bob Rose and Jim Craig also provided indication of no comment for the YN and USFWS, respectively.

Jeff Korth said Wells Project Land-use Permit No. 57A-01 appeared to be proposing new work. If this is the case, Korth suggested requiring a caveat statement that new work can only be completed if all applicable permits are obtained and all plans for vegetation and riprap are first approved. Kahler said he does not believe any new work is being proposed.

He added he believes the permits include the original language that was approved in 1987 (i.e., it was new work then, but not now). He said he will inquire internally whether Wells Project Land-use Permit No. 57A-01 for renewal includes permitting for any new work and will report back to the Coordinating Committees.

Kirk Truscott said the CCT's main concern is regarding additional ground disturbance that may result with these activities. Kahler said Douglas PUD monitors the Wells Reservoir throughout the summer, so they are fully aware of activities taking place at these sites. He added the reissuances are just formalities to provide landowners with a current permit for activities already completed. He said additional actions are addressed on a case-by-case basis, as needed. He also recommended contacting Beau Patterson (Douglas PUD) for additional information.

Wells HCP Coordinating Committee representatives will submit edits and comments, or indication of no comments, on the Wells Project Land-use Permits for renewal (105 total permits) to Douglas PUD by Monday, May 4, 2015. Wells HCP Coordinating Committee representatives will also submit edits and comments, or indication of no comments, on the Wells Project Land-use Permits for renewal (Nos. 57A-01, 57HA-01, and 1001-01) to Douglas PUD by Friday, June 19, 2015.

IV. HCP Hatchery and Tributary Committees Update (Mike Schiewe)

Mike Schiewe updated the Coordinating Committees on the following actions and discussions that occurred at the last HCP Tributary Committees meeting on April 9, 2015:

- *Budget Amendment:* The Rocky Reach Tributary Committee approved a budget amendment request from Trout Unlimited on the Clear Creek Fish Passage and Instream Flow Enhancement Project. The request was to move $5,000 from "Excavation/Heavy Equipment Work" to "Sponsor Salaries and Benefits."
- *Scope Change:* The Cascade Columbia Fisheries Enhancement Group (CCFEG) requested a change in the existing scope on the Chiwawa Nutrient Enhancement Project. The request was to change the scope from a 4-year effort to a 2-year effort, with the expectation the sponsor would secure necessary funding. The Rock Island Tributary Committee elected not to support the change in scope at this time, and

requested that the CCFEG complete the following actions: 1) acquire necessary permitting; 2) secure additional funding; and 3) submit a Small Projects Application.

- *Change in Designated Alternative Representation:* This will be covered under Item V-A.
- *SRFB/TC Draft Proposal Schedule:* Draft SRFB/TC proposals are due on April 17, 2015, and will be reviewed on June 11, 2015. Project tours in the Methow and Wenatchee basins are scheduled for May 7 and May 13, 2015, respectively. Final proposals will be delivered on June 19, 2015, and funding decisions will be made on July 9, 2015.
- *Presentations:* Tracy Hillman (BioAnalysts) shared two presentations that were prepared by NMFS and recently presented at the Life-Cycle Modeling Workshop in Seattle, Washington. One presentation was about ocean conditions. It demonstrated that nearshore conditions are not particularly favorable for juvenile salmonids. The other presentation was about California sea lion impacts to the Columbia Estuary, which demonstrated impacts on returning adults are quite significant.
- *Icicle Peshastin Irrigation District Pumpback O&M Costs:* Chelan County Natural Resources Department (CCNRD) asked the Tributary Committees if they would be willing to provide additional O&M funding for the Icicle Peshastin Irrigation District Pumpback Project, and, if so, how much would be provided. The Tributary Committees requested additional information prior to making a funding decision. Jim Craig explained that the CCNRD would like to construct a pump exchange that would enable water to be withdrawn from the Wenatchee River instead of Icicle Creek, and pumped into a canal system to provide water for orchards. He said, however, the Icicle Irrigation District is concerned there will be inadequate funds to run the pumps; therefore, the CCNRD is investigating if funds are available to assist with annual operating costs.
- *Discussions with Chelan-Douglas Land Trust:* The Priest Rapids Coordinating Committee Habitat Subcommittee (PRCC HSC) and representatives from Chelan-Douglas Land Trust (CDLT) joined the Tributary Committees to discuss a liability issue in which CDLT Board Members could be held liable for accidents occurring during habitat restoration projects. The CDLT is working with Washington Land Trusts, the Bonneville Power Administration, and the Washington Department of Natural Resources to find ways to reduce the risk to the Board. Also, David

Morgan (CDLT) provided a brief presentation on the Enlow Acquisition Project on the Entiat River, located near river mile 16 near the Entiat Stillwaters Reach, and includes about 1,300 feet of riverbank. The CDLT was seeking $437,700 for the project, which the PRCC HSC agreed to fund.

- *Next Steps:* The next meeting of the Tributary Committees will be on Thursday, May 14, 2015, at Grant PUD in Wenatchee, Washington.

Schiewe updated the Coordinating Committees on the following actions and discussions that occurred at the last HCP Hatchery Committees meeting on April 15, 2015:

- *Methow Spring Chinook Adult Management for Implementation in 2015:* Greg Mackey presented a first draft of information about potential Methow spring Chinook salmon adult management targets. The information is being revised for review by the Hatchery Committees at their May meeting.
- *Review of Five-Year Hatchery M&E Report:* Greg Mackey, Catherine Willard (Chelan PUD), and Keely Murdoch (YN) are developing a plan for addressing the Methow Basin results in the Five-Year Hatchery M&E Report and newer Methow Basin data. This is the follow-up on the YN Statement of Agreement evaluating Methow programs.
- *HGMP Update:* Progress on permitting has slowed largely due to the ongoing Puget Sound and Elwha River litigation.
- *Presentations:* Tracy Hillman provided the same NMFS presentations to the Hatchery Committees that he presented to the Tributary Committees. Jim Craig asked if Hillman could also share these presentations with the Coordinating Committees. Schiewe said John Ferguson will follow up with Hillman and ask him to share these presentations with the Coordinating Committees.

V. HCP Committees Administration

A. Change in Designated HCP Tributary Committees Alternative Representation (Mike Schiewe)

Mike Schiewe said Justin Yeager will be replacing Dale Bambrick as the NMFS HCP Tributary Committees Representative (Bambrick will continue as the Alternate), and Chas Kyger will be replacing Shane Bickford as the Douglas PUD HCP Tributary Committees Alternate Representative.

B. HCP-CC Extranet Site Read-Only Access – Rosana Sokolowski (Chelan PUD) (Mike Schiewe)

Mike Schiewe notified the Coordinating Committees, as requested by Chelan PUD, Rosana Sokolowski was given read-only access to the HCP Coordinating Committees Extranet site in order to access documents for submittal to FERC.

C. HCP-HC Extranet Site Administrative Access – Larissa Rohrbach (Anchor QEA) (Mike Schiewe)

Mike Schiewe notified the Coordinating Committees Larissa Rohrbach will be supporting the HCP Hatchery Committees Hatchery Evaluation Technical Team and eventually also support the HCP Hatchery Committees; therefore, Rohrbach was given administrative access to the HCP Hatchery Committees Extranet Site.

D. Mike Schiewe's Retirement (Mike Schiewe)

Mike Schiewe said, during the past 12 years, he has appreciated how professional the Coordinating Committees have been in addressing the many challenges of HCP implementation. Schiewe thanked the Coordinating Committees and said he was confident John Ferguson, the new HCP Coordinating Committees Chairperson, will do an outstanding job. The Coordinating Committees representatives present thanked Schiewe for his years of leadership and contributions to the Coordinating Committees and the HCPs.

E. Next Meetings (Mike Schiewe)

The next scheduled Coordinating Committees meeting is on May 26, 2015, and will be held by conference call. The June 23, 2015, meeting will be held by conference call, in eastern Washington, or in person at the Radisson Hotel in SeaTac, Washington, as is yet to be determined. The July 28, 2015, meeting will be held either by conference call or in person at the Radisson Hotel in SeaTac, Washington, as is yet to be determined.

List of Attachments

Attachment A	List of Attendees
Attachment B	2015 Douglas PUD Trapping Activities Table
Attachment C	Proposed Protocols for Sampling Steelhead at Wells Dam and Kelts at the Kelt Rehabilitation Facility

Attachment A
List of Attendees

Name	Organization
Mike Schiewe	Anchor QEA, LLC
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Lance Keller*	Chelan PUD
Tom Kahler*	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Jim Craig*	U.S. Fish and Wildlife Service
Jeff Korth*	Washington Department of Fish and Wildlife
Bob Rose*	Yakama Nation
Kirk Truscott*	Colville Confederated Tribes

Note:
* = Denotes Coordinating Committees member or alternate

2014 Trapping Schedule for Douglas PUD Trapping Facilities

Trapping Location	Species	Program	Trapping Entity	March	April	May	June	July	August	September	October	November
Wells Ladders	Spring Chinook	DPUD Methow/Twisp GSI	WDFW			E & W traps, 3 d/wk, 16-hr/d	▨					
	Summer Chinook	GPUD Carlton	WDFW					W. trap, max 3 d/wk, 16 hr/d	▨			
	Steelhead	DPUD Columbia/Met. safety-net, pHOS; GPUD -Ok; FWS WNFH	WDFW							W(&E?) trap(s), max 3 d/wk, 16-hrs/d (usually 1d/wk)	▨	▨
	Coho	YN Methow Reintroduction	YN/WDFW							▨	E&W, 5 d/wk, 9hr/d; >10/10 7d/wk	▨
	Sockeye	CRITFC Tagging	CRITFC, CCT, YN, WDFW				▨	W. trap, max 3 d/wk, 16-hr/d	▨			
Wells Outfall	Summer Chinook	Douglas Wells	WDFW					Run trap until full each day	▨			
	Summer Chinook	WDFW Chelan Hatchery Lk. Chelan	WDFW					Concurrent with Collection for Wells	▨			
	Summer Chinook	YN Yakima Reintroduction (green eggs)	WDFW					Concurrent with Collection for Wells	▨			
	Summer Chinook	Surplus to Tribes	WDFW					▨	Ditto	▨	▨	
	Steelhead	DPUD Met. safety-net/Columbia, pHOS; GPUD Ok; FWS WNFH	WDFW						Run trap until full each day	▨	▨	
Methow Outfall	Spring Chinook	DPUD Methow, pHOS/FWS WNFH Methow	WDFW			Trap checked multiple times per day	▨	▨	▨			
	Steelhead	DPUD Met. safety-net/Columbia, pHOS	WDFW	▨	Trap checked multiple times per day	▨						
	Coho	YN Methow Reintroduction	YN							▨	Trap checked daily	▨
Twisp Weir	Spring Chinook	DPUD Twisp, pHOS	WDFW			Daily schedule TBD	▨	As necessary for brood collection	▨			
	Steelhead	DPUD Twisp brood, pHOS, and RSS	WDFW	Traps checked multiple times per day	▨	▨						

Attachment C

Phenotypic Characteristics of Reconditioned Steelhead Kelts and First-time Steelhead Spawners in the Upper Columbia

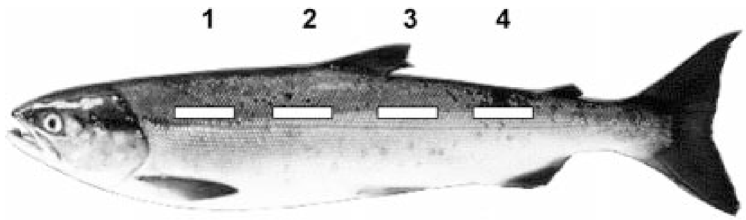
Yakama Nation Fisheries Resource Management
Upper Columbia Kelt Reconditioning Project
March 12, 2015

Purpose: To address ISRP Qualifications comparing reproduction related phenotypic characteristics between reconditioned kelts and first time steelhead spawners in Upper Columbia

Objective: To compare 1) maturation timing, 2) condition factors, 3) available energy stores, 4) PIT tag detection rates (spring), and 5) spring migration timing between reconditioned kelts at the time of release and first time spawners.

Sampling Protocols

Title/Action	**1st Time Spawners (sampling completed by WDFW and YN) from the run-at large at Wells**	**Reconditioned Kelts (all sampling completed by YN) at Kelt facility**
Sample Size	• 25 NOR Females • 25 HOR Females	• 50 to 75 females
Collection	• Trapped using Wells Dam fish ladder during annual run composition sampling (no additional trapping; WDFW)	• Collected during spring months • Held at MSKF until sampling
Time Frame	• First 2 to 3 weeks of September	
Pre-Sampling	• **Will be completed by WDFW staff** • Using standard WDFW procedures • Anesthetized using Aqui-S • Collect length, sex, scales, and mark data	• All fish will be anesthetized using MS222. • Collect length, weight, and mark data
Maturation Timing	**Blood Sampling:** used to measure the levels of maturation hormones in the fishes' plasma and compare maturation timing between reconditioned kelts and maiden spawners. • **Will be completed by YN personnel.** • Besides 25 NOR females sampled at Wells, every other HOR female kept for broodstock (up to 25)will be sampled to facilitate post-sampling mortality comparisons • Place fish on a measuring board. • Insert sterile syringe along the ventral midline between the anal fin and the tail	

<table>
<tr><td></td><td colspan="2">- Draw approximately 2 ml of blood
- Apply gentle pressure to the puncture site to stop blood flow
- The blood samples processed by YN FRM personnel
- Ship samples to a CRITFC Fish Physiologist for analysis</td></tr>
<tr><td>Condition Factors</td><td colspan="2">- Measure fork length (mm) – done by WDFW
- Measure weight (g) – done by YN
- Calculate Fulton’s Condition factor – done by YN</td></tr>
<tr><td>Available Energy Stores</td><td colspan="2">Fatmeter: measurements will allow the project to compare available energy stores between reconditioned kelts and maiden spawners. Muscle lipid readings would be made using a Distell Fish Fatmeter model 692.
- Will be completed by YN personnel
- Besides 25 NOR females sampled at Wells, every other HOR female kept for broodstock (up to 25) will be sampled to facilitate post-sampling mortality comparisons
- Turn on meter and allow 5 minutes to warm up. Cover the charging port with the waterproof cap.
- Place fish left side up.
- Apply the read head of the meter flush to the skin of fish at site 1 and press the read button.
- Hold the read button until the reading stabilizes.
- Release the read button to record the measurement. Be careful not to move the meter when you release the button.
- Move to location 2 and repeat.
- If the readings are more than 1% different the reading should be redone. Record data on datasheet.

 </td></tr>
<tr><td>Recovery/Release</td><td>- Completed by WDFW and YN personnel
- Place fish in recovery tank.
- Release into fish ladder
- Mortality rate of sampled vs unsampled HOR broodstock will be compared</td><td>- Return fish to holding tanks.
- Formalin treatments and feed to be administered until release.</td></tr>
</table>

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Coordinating Committees	**Date:**	August 25, 2015
From:	John Ferguson, Chairman		
Cc:	Kristi Geris		
Re:	Final Minutes of the June 23, 2015 HCPs Coordinating Committees Meeting		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Coordinating Committees met at the Radisson Gateway Hotel, in SeaTac, Washington, on Tuesday, June 23, 2015, from 9:30 a.m. to 12:30 p.m. Attendees are listed in Attachment A of these meeting minutes.

ACTION ITEM SUMMARY

- Chelan PUD will provide an updated Rocky Reach Juvenile Fish Bypass (RRJFB) pre-season marked fish release results table that includes additional notes about the results, as requested, to Kristi Geris for distribution to the Coordinating Committees (Item I-C).
- John Ferguson will coordinate with Brian Burke (National Marine Fisheries Service [NMFS]) about presenting to the Coordinating Committees in the fall 2015 Burke's presentation titled, *"Ocean Conditions in 2014; Potential Consequences for Salmon,"* that Tracy Hillman (BioAnalysts) shared with the HCP Hatchery and Tributary Committees in the spring 2015 (Item I-C).
- Tracy Hillman will provide the most recent progress report on nutrient work in the Yankee Fork Salmon River, as discussed during the HCP Tributary Committees Update, to Kristi Geris for distribution to the Coordinating Committees (Item II). *(Note: Hillman provided the report titled, "Salmon River Basin Nutrient Enhancement: Contract Year 2014-2015 Research, Monitoring, and Evaluation [RME] Annual Progress Report," [Kohler et al. 2015] to Geris following the meeting on June 23, 2015, which Geris distributed to the Coordinating Committees that same day.)*

- Tom Kahler will provide the corrected memorandum outlining the comparison of juvenile survivals of spring Chinook and coho salmon and steelhead released from Winthrop National Fish Hatchery (NFH) to Kristi Geris for distribution to the Coordinating Committees (Item IV-A). *(Note: Kahler provided the corrected memorandum to Geris following the meeting on June 23, 2015, which Geris distributed to the Coordinating Committees that same day.)*
- Tom Kahler will contact Bob Rose regarding obtaining the Yakama Nation's (YN's) expedited approval of Wells Project Land-use Permit Application No. 1030-01 (Colville Confederated Tribes [CCT]; Item IV-B).
- Tom Kahler will provide the Columbia River Inter-Tribal Fish Commission's (CRITFC's) letter outlining proposed scheduling for sockeye salmon sampling at Wells Dam in 2015 to Kristi Geris for distribution to the Coordination Committees (Item III-C). *(Note: Kahler provided CRITFC's schedule to Geris following the meeting on June 23, 2015, which Geris distributed to the Coordinating Committees that same day.)*
- **The Coordinating Committees meeting on July 28, 2015, will be held by conference call (Item VI-B).**

DECISION SUMMARY

- There were no decisions approved during today's meeting.

AGREEMENTS

- The Coordinating Committees representatives present agreed to move the monthly HCP Hatchery and Tributary Committees Update from the end of the meeting to the beginning of the meeting (approximately 9:45 am), in the interest of continuity and scheduling (Item II).

REVIEW ITEMS

- Kristi Geris sent an email to the Coordinating Committees on May 5, 2015, notifying them that the draft 2014 Douglas PUD Pikeminnow Program Annual Report is available for a 60-day review period, with edits and comments due to Tom Kahler by Monday, July 6, 2015.
- Kristi Geris sent an email to the Coordinating Committees on May 12, 2015, notifying them that a Wells Project Land-use Permit Application (Tract 824 Matherly) was available for a 60-day review period, with edits and comments due to Tom Kahler by Monday, July 13, 2015. *(Note: no comments were received from Coordinating Committees members on the proposed land-use actions.)*
- Kristi Geris sent an email to the Coordinating Committees on May 14, 2015, notifying them that a Wells Project Land-use Permit Application (Tract 82 Wick) was available for a 60-day review period, with edits and comments due to Tom Kahler by Monday, July 13, 2015. *(Note: no comments were received from Coordinating Committees members on the proposed land-use actions.)*
- Kristi Geris sent an email to the Coordinating Committees on June 16, 2015, notifying them that a Wells Project Land-use Permit Application (Permit 1030-01 CCT) was available for a 60-day review period, with edits and comments, or indication of no comments, due to Tom Kahler by Friday, August 14, 2015 (Item IV-B).
- Kristi Geris sent an email to the Coordinating Committees on June 16, 2015, notifying them that a Wells Project Land-use Permit Application (Permit 130-01 Earl and Cartwright) was available for a 60-day review period, with edits and comments, or indication of no comments, due to Tom Kahler by Friday, August 14, 2015 (Item IV-B).
- Kristi Geris sent an email to the Coordinating Committees on August 10, 2015, notifying them that two Wells Project Land-use Permit Applications (Permit 716-01 Fry and Permit 828 See) were available for a 60-day review period, with edits and comments, or indication of no comments, due to Tom Kahler by Friday, October 9, 2015.

DOCUMENTS FINALIZED

- The Final Chelan PUD Rock Island Interim Fish Passage Plan (IFPP) Biological Assessment was distributed to the Coordinating Committees by Kristi Geris on June 12, 2015 (Item IV-A).
- Kristi Geris sent an email to the Coordinating Committees on July 7, 2015, notifying them that the 2014 Douglas PUD Pikeminnow Program Annual Report was finalized following a 60-day review period, which ended on July 6, 2015. As noted in the email, no comments were received from Coordinating Committees members on the draft report.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the Coordinating Committees and asked for any additions or changes to the agenda. Tom Kahler added an update on sockeye salmon tagging at Wells Dam.

B. Meeting Minutes Approval (John Ferguson)

The Coordinating Committees reviewed the revised draft April 21, 2015, conference call minutes. Kristi Geris noted the addition of two review items, and said all other comments and revisions received from members of the Committees were incorporated into the revised minutes. Coordinating Committees members present approved the April 21, 2015, conference call minutes, as revised, with the Washington Department of Fish and Wildlife (WDFW) abstaining.

C. Last Meeting Action Items (John Ferguson)

Action items from the Coordinating Committees meeting on April 21, 2015, and follow-up discussions, were as follows *(note: italicized item numbers below correspond to agenda items from the April 21, 2015, meeting):*

- *Chelan PUD will provide an updated RRJFB pre-season marked fish release results table, which includes additional notes about the results, to Kristi Geris for distribution to the Coordination Committees (Item II-A).*

This action item will be carried forward.

- *Douglas PUD will confirm with the YN their plans to trap summer Chinook salmon for the YN Yakima River Reintroduction at Wells Dam in 2015 and provide a finalized 2015 Douglas PUD Trapping Activities table to Kristi Geris for distribution to the Coordination Committees (Item III-A).*

  Tom Kahler confirmed trapping plans with the YN and provided a final table to Geris following the meeting on April 21, 2015, which Geris distributed to the Coordinating Committees the same day.
- *Scott Carlon will coordinate with Bryan Nordlund (NMFS, retired) and Douglas PUD to discuss concerns Nordlund raised regarding reopening the low-level fishway entrance at Wells Dam, and Douglas PUD will report back to the Coordinating Committees regarding a path forward (Item III-E).*

  Carlon said he contacted Nordlund who indicated he believes reopening the low-level fishway entrance at Wells Dam may still be of concern to salmonid passage; however, he did not necessarily advocate reopening or not reopening the entrance. Tom Kahler said Douglas PUD decided to postpone the 2015 Lamprey Study, and, therefore, leave the entrance closed. He added that Douglas PUD hopes to install the lamprey boxes during the 2015/2016 winter maintenance period at Wells Dam.
- *Wells HCP Coordinating Committee representatives will submit edits and comments, or indication of no comments, on the Wells Project Land-use Permits for renewal (105 total permits) to Douglas PUD by Monday, May 4, 2015 (Item III-F).*

  This action item was completed.
- *Wells HCP Coordinating Committee representatives will submit edits and comments, or indication of no comments, on the Wells Project Land-use Permits for renewal (Nos. 57A-01, 57HA-01, and 1001-01) to Douglas PUD by Friday, June 19, 2015 (Item III-F).*

  This action item was completed.
- *Tom Kahler will discuss internally if Wells Project Land-use Permit No. 57A-01 (up for renewal) includes permitting for any new work and report back to the Coordinating Committees (Item III-F).*

Kahler said he followed up with Kirk Truscott (who made this inquiry during the Coordinating Committees conference call on April 21, 2015), indicating that no new work was proposed, and Truscott had no additional comments.

- *John Ferguson will ask Tracy Hillman (BioAnalysts) if he can share with the Coordinating Committees NMFS' presentations titled, "Ocean Conditions in 2014; Potential Consequences for Salmon," and "Estimation of Survival and Run Timing of Adult Spring/Summer Chinook from the Columbia River Estuary to Bonneville Dam," that he recently shared with the HCP Hatchery and Tributary Committees (Item IV).* Ferguson said Hillman suggested that Brian Burke and Michelle Rub (NMFS), co-authors of these presentations, provide the presentations to the Coordinating Committees. Ferguson said Burke is largely unavailable this summer, but agreed to present in the fall 2015, and Rub is presenting today. Ferguson said he will coordinate with Burke about presenting to the Coordinating Committees his presentation titled, *"Ocean Conditions in 2014; Potential Consequences for Salmon,"* in the fall of 2015. Hillman shared this presentation with the HCP Hatchery and Tributary Committees in the spring 2015.
- *The Coordinating Committees meeting on May 26, 2015, will be held by conference call (Item V-E).*
  This meeting was canceled due to lack of agenda items.

II. HCP Hatchery and Tributary Committees Update (John Ferguson and Tracy Hillman)

John Ferguson said because Tracy Hillman is now the Chairman for the HCP Hatchery Committees and HCP Tributary Committees, instead of Hillman providing a written briefing for Ferguson to share with the Coordinating Committees, Hillman plans to call into every meeting to verbally provide the updates himself. Ferguson said that he, Hillman, and Kristi Geris convene by conference call prior to each Coordinating Committees meeting to discuss any potential issues ahead of time. Ferguson proposed a new routine and the Coordinating Committees representatives present agreed to move the monthly HCP Hatchery and Tributary Committees Update from the end of the meeting to the beginning of the meeting (approximately 9:45 am), in the interest of continuity and scheduling.

Hillman updated the Coordinating Committees on the following actions and discussions that occurred at the last HCP Hatchery Committees meeting on June 17, 2015:

- *New Hatchery Committees Support – Sarah Montgomery (Anchor QEA):* Montgomery was introduced to the HCP Hatchery Committees. She will replace Geris as the HCP Hatchery Committees Support Staff in September 2015.
- *YN Kelt Reconditioning Program Update:* The YN provided a presentation on their Upper Columbia Kelt Reconditioning Project, which to date, has been a productive program. Female steelhead are being collected in tributaries in the Methow Basin and in the mainstem Columbia River, cultured for about 9 months, and monitored for maturation and survival. In 2014, total survival was about 76%, and Twisp River-origin kelts appeared to be the most successful among those collected. The YN are evaluating the potential for additional future studies. Lance Keller noted the strict criteria that need to be met for a fish to be retained for the program (e.g., no fungus, no injuries, and minimal fin wear, among others). Tom Kahler said the reconditioned kelts are released during the fall when the run at large is passing through the Mid-Columbia River. Ferguson asked where the reconditioned fish are released. Hillman said those captured in the Methow Basin are released back to the Methow Basin, and those captured at Rock Island Dam are released back to the Columbia River.
- *Methow Spring Chinook Adult Management Update:* The Hatchery Committees approved the Methow Spring Chinook Adult Management Plan on May 20, 2015. The goal of the plan is to reduce percent hatchery-origin spawners (pHOS) on the spawning grounds, specifically in the Methow Basin with regard to spring Chinook salmon. Adult management will be performed to maintain a pHOS of less than or equal to 50% and a proportion of natural-origin fish in hatchery broodstock (pNOB) of greater than 50%. Part of adult management for the Twisp Weir includes the following: 1) removing all adipose (ad)-clipped adults encountered; 2) for Methow Fish Hatchery (FH), achieving a proportionate natural influence (PNI) target based on a sliding scale; and 3) for Winthrop NFH, removing all ad-clipped adults and hatchery-origin age-3 males encountered. This year is a pilot study to inform future years of adult management in the Methow Basin.

- *Methow Basin Spring Chinook Program:* The Hatchery Committees approved the Chelan PUD Methow Spring Chinook Hatchery Production Obligation Statement of Agreement on March 27, 2015, which authorizes the establishment of an Interlocal Agreement (ILA) with Douglas PUD. An ILA to collect Chelan PUD Methow spring Chinook salmon at Wells Dam and hold, spawn, and early-rear the fish at Methow FH is now almost finalized. Additionally, due to the early spring Chinook salmon run this year, the Hatchery Committees agreed to backfill Chelan PUD's brood year (BY) 2015 Methow Spring Chinook Program with hatchery-origin MetComp spring Chinook salmon collected at Methow FH in order to avoid tangle netting in the Chewuch River.
- *2015 Chelan PUD Hatchery Monitoring and Evaluation (M&E) Implementation Plan Schedule:* Chelan PUD proposed changing the deadline to provide their draft Hatchery M&E Annual Implementation Plan to the Hatchery Committees for review from July 1 (as previously agreed to on December 12, 2012) to August 1 of the year preceding the proposed M&E activities, so long as there are no significant changes requiring Hatchery Committees discussion. The Hatchery Committees approved.
- *Revised Chelan PUD Hatchery M&E Annual Report Review/Submission Timeline:* Chelan PUD proposed changing the Hatchery M&E Annual Report scheduling to providing the Hatchery Committees with a draft Hatchery M&E Annual Report for a 30-day review by June 15 (previously June 1), with the final report due to NMFS by September 1 (previously due June 1; NMFS approved the newly proposed September 1 deadline). The Hatchery Committees approved.
- *Hatchery Evaluation Technical Team (HETT) Update:* In April 2015, the Hatchery Committees reconvened the HETT to finalize the appendices to the Hatchery M&E Plan. Currently, draft Appendices 2, 4, 5, and 6 are complete, and draft Appendices 1 and 3 are still outstanding. The goal is to complete all draft appendices and reconvene the HETT to discuss finalizing the appendices by the end of July 2015.
- *Hatchery and Genetic Management Plan (HGMP) Update:* NMFS plans to continue drafting the Methow Spring Chinook HGMP soon. The Wenatchee Steelhead HGMP is in the final stages of development before being sent to National Oceanic and Atmospheric Administration General Counsel review. On a side note, the Washington State Legislature is requiring a Contingency Plan for certain state

facilities/locations due to the drought. The Chelan PUD Chiwawa Acclimation Facility is also preparing for drought, and the Chiwawa ponds are already being filled with water (earlier than usual). Jeff Korth said one big pond and two indoor circulars are being filled. Jim Craig asked if the pond will be aerated throughout the summer. Korth said he was not sure; however, there will be some recirculation and it will be routinely cleaned.

- *Five-Year Hatchery M&E Review Planning – Methow Spring Chinook Objectives 1, 4, 7:* A subgroup of the Hatchery Committees convened to determine how to evaluate the last Five-Year Hatchery M&E Report (2006 to 2010). The path forward includes evaluating each objective and identifying shortcomings by basin and species, starting with Methow spring Chinook salmon. To date, the Hatchery Committees have reviewed Objectives 1, 4, and 7 for Methow spring Chinook salmon. Each objective was discussed in terms of where targets are not being met, and items needing additional discussion were flagged. For the Hatchery Committees meeting on July 15, 2015, Objectives 2 (migration timing, spawn timing, and redd distribution) and 5 (stray rates) will be addressed. As currently scheduled, all objectives for the Methow Spring Chinook Salmon Program will be evaluated through the end of 2015, and then the Hatchery Committees will commence an adaptive management feedback loop.
- *Hatchery Committees Meeting Protocols:* A final draft Hatchery Committees Meeting Protocols was distributed to the Hatchery Committees. The protocols are intended to assist Hillman's transition into the Hatchery Committees Chairman position and help keep future proceedings, such as business as usual.
- *Coordination/Joint Sessions with Priest Rapids Coordinating Committee Hatchery Sub-Committee (PRCC HSC):* The Hatchery Committees agreed to convene joint sessions with the PRCC HSC when there are agenda items applicable to, and which require participation from, the Hatchery Committees and PRCC HSC.
- *Next Meetings:* The next meeting of the Hatchery Committees will be on Wednesday, July 15, 2015, at Douglas PUD Headquarters in East Wenatchee, Washington.

Hillman updated the Coordinating Committees on the following actions and discussions that occurred at the last HCP Tributary Committees meeting on June 15, 2015:

- *General Salmon Habitat Program Draft Proposals:* This year, eight draft proposals requesting HCP funding matches were received during the solicitation of projects for the 2015 funding round of the Washington State Salmon Recovery Funding Board. All projects were reviewed, and it was determined that two did not warrant a full proposal (rejected). Full proposals were solicited from the remaining six projects, one of which has already been funded by other means; so, five full proposals are now expected. The Tributary Committees will review the proposals in July 2015 and will have funding decisions by July or August 2015.
- *General Salmon Habitat Program Application:* The Okanogan Conservation District requested funding for their Similkameen River 3.8 River Mile (RM) Habitat Rehabilitation Project. The purpose of the project is to improve instream habitat and reduce bank erosion within a quarter-mile section of the Similkameen River by installing four flow-deflection structures made of large woody material and planting native species along the bank to accelerate reestablishment of riparian vegetation. This work is intended to improve habitat, primarily for summer Chinook salmon. The Rocky Reach Tributary Committee elected to fund this project with $67,370 from the Rocky Reach Plan Species Account for the project.
- *Small Projects Program Applications:* Two applications were received from the Cascade Columbia Fisheries Enhancement Group. The first application requested funding for “Permitting Nutrient Enhancement in the Chiwawa.” The purpose of the project is to develop a treatment and effectiveness monitoring plan, and obtain permits from the U.S. Forest Service and Washington State Department of Ecology to conduct a 4-year, nutrient-enhancement pilot project in the Chiwawa River. The total cost of the project is $40,250. The sponsor requested $40,250 from HCP Tributary Funds. The Tributary Committees declined to fund the project because the Committees believed the project was too expensive and that their limited funds would be better spent on other restoration projects in the Upper Columbia Basin, as opposed to spending funds on permitting a nutrient-enhancement project that would likely not achieve the objectives of the original project funded in 2013. The second application requested funding for the White River Floodplain Connection Project (RM 3.4). The purpose of the project is to remove a culvert that limits floodplain connectivity along the lower White River, with the intent to improve fish access to a side channel and a 40-acre wetland. The total cost

of the project is $35,500. The sponsor requested funding for the entire project, which the Rock Island Tributary Committee elected to fund. Jeff Korth requested clarification for denying funding for the first application. Hillman said the project was too expensive. He added that the month before, the sponsor only requested $10,000 for the monitoring plan, but when the application was received it was four-times more than originally requested. He said, additionally, the Tributary Committees would rather use limited funds to support process-based restoration projects—not nutrient enhancement projects. He said researchers studying different nutrient enhancement techniques in the Yankee Fork are finding that planting live fish instead of carcasses or analogs provides a bigger boost to ecosystem function. Korth asked about the source of the live fish, and Hillman said he believes they are surplus hatchery-origin fish from the Sawtooth Hatchery. Korth asked if nutrient enhancement efforts would be coordinated with the HCP Tributary and Hatchery Committees. Kirk Truscott noted that there is a specific Adult Management Plan for Wenatchee spring Chinook salmon in the Wenatchee Basin, and adding more adults in the Chiwawa River will be in conflict with pHOS for that basin. Hillman agreed, also noting that HCP Hatchery Committees approval would be needed for this type of action. Tom Kahler noted that the annual releases of over 1,000,000 hatchery spring Chinook salmon into the Methow Basin over the last several decades have not alleviated the limitation of available nutrients in that basin, and have instead likely reduced the production of natural-origin Chinook salmon because of competition and introgression. Jim Craig asked if there is any M&E reporting available on this topic. Hillman said the most recent progress report on nutrient work in the Yankee Fork Salmon River is available on the Bonneville Power Administration website. He added that he will provide this report on nutrient work in the Yankee Fork Salmon River to Geris for distribution to the Coordinating Committees. *(Note: Hillman provided the report titled, "Salmon River Basin Nutrient Enhancement: Contract Year 2014-2015 Research, Monitoring, and Evaluation [RME] Annual Progress Report," [Kohler et al. 2015] to Geris following the meeting on June 23, 2015, which Geris distributed to the Coordinating Committees that same day.)*

- *Tributary Assessment Program Application:* In May, the Okanagan Nation Alliance requested funding to purchase and install a permanent passive integrated transponder (PIT)-tag interrogation system near the mouth of Shingle Creek to monitor recolonization of the stream by steelhead and spring Chinook salmon. The total cost of the project is $42,422, and the sponsor requested $35,867 from HCP Tributary Assessment Funds. The Wells Tributary Committee chose to fund the project contingent on receiving a brief annual report or memorandum that summarizes findings. Hillman recalled that about 1 year ago, the Wells Tributary Committee elected to fund removal of a dam on Shingle Creek, now the creek will be equipped with PIT-tag detection capability. John Ferguson asked about who will be maintaining the PIT-tag detection system. Hillman said the Okanagan Nation Alliance will be tracking these data, and to his understanding, data will be uploaded to the PIT-Tag Information System. Kahler noted that the CCT will maintain the system through their Okanogan Basin M&E Program.

- *Review Middle Entiat 30% Restoration Designs:* The U.S. Bureau of Reclamation requested that the Tributary Committees review 30% designs for restoration actions proposed to be implemented on lands purchased with Plan Species Account funds in the middle segment of the Entiat River. Comments are due today.
- *Next Steps:* The next meeting of the Tributary Committees will be on Thursday, July 9, 2015, at Grant PUD in Wenatchee, Washington.

III. NMFS

A. *PRESENTATION: Estimation of Survival and Run Timing of Adult Spring/Summer Chinook from the Columbia River Estuary to Bonneville Dam (Michelle Rub [NMFS])*

Michelle Rub shared a presentation titled, "Estimation of Survival and Run Timing of Adult Spring/Summer Chinook from the Columbia River Estuary to Bonneville Dam," (Attachment B), which was distributed to the Coordinating Committees by Kristi Geris on June 24, 2015. This presentation included estimates of the numbers of pinnipeds counted in the estuary from 2010 through 2014 and provided an early estimate for 2015—the latter of which is about four times greater than the number estimated in 2014. Based on mark-recapture studies in the estuary since 2010, average annual Chinook salmon survival from release after tagging to Bonneville Dam has ranged from 55 to 90%. Mortality was highest and travel times to Bonneville Dam were slowest for fish tagged in March and April. Upper Columbia River spring Chinook salmon comprised 36% of the early component of the run. The higher mortality and longer travel times coincided with peak numbers of sea lions.

In addition, the average annual survival of Chinook salmon decreased from 2010 to 2014, which correlates with the estimated number of sea lions counted at haul-out locations near Astoria, Oregon. The study also indicated parental-based genetics testing shows promise for evaluating hatchery- and tributary-level information on Chinook salmon survival and movement. The increasing numbers of pinnipeds in the estuary could create survival bottlenecks for selected salmon runs.

IV. Douglas PUD

A. Coho Survival Estimates (Tom Kahler)

Tom Kahler said he previously distributed to individual Coordinating Committees members a corrected comparison of juvenile survivals of spring Chinook salmon, coho salmon, and steelhead released from Winthrop NFH. Kahler recalled that in August 2014, Douglas PUD asked Dr. John Skalski and Dr. Richard Townsend of Columbia Basin Research to run this analysis to help determine whether the surrogacy assumption that coho salmon likely survive passage at Wells Dam at levels similar to other yearling spring migrants is valid. Kahler said Peter Graf (Grant PUD) found an error in one of the tables (which subsequently affected another table), which Dr. Townsend has corrected. For those without a copy on hand, Kahler handed out the corrected memorandum, which also includes 2014 results not included in the August 2014 memorandum. He said he will also provide an electronic version of the corrected memorandum to Kristi Geris for distribution to the Coordinating Committees. *(Note: Kahler provided the corrected memorandum [Attachment C] to Geris following the meeting on June 23, 2015, which Geris distributed to the Coordinating Committees that same day.)*

Kahler noted that Tables 4 and 5 in Attachment C contain corrected ratios, which indicate, in general, spring Chinook salmon survival is expected to exceed coho salmon survival; however, for steelhead, coho salmon survival is higher in 3 out of 5 years and significantly higher in 1 out of 5 years. He said the previous analysis (before the correction) indicated that coho salmon survival was higher than steelhead in only 1 of 5 years. He summarized the data by stating that coho salmon survival appeared to be lower than spring Chinook salmon and higher than steelhead.

Jeff Korth asked, as demonstrated in Table 3 of Attachment C, why some fish appear to be speeding up farther downstream (decreasing travel times). Kahler said Cory Kamphaus (YN) stated that the coho salmon were released before they were ready to volitionally migrate, so they may be spending a lot of time in the Methow before they reach the Columbia River.

Kahler recalled that currently, Douglas PUD is using a survival value for yearling spring migrants based on past Chinook salmon and steelhead studies. He said the Coordinating Committees will eventually need to determine how to establish a coho salmon survival value and what that value will be. He said, however, this discussion will require that all HCP Parties are present, specifically the YN, as he recalled the YN having reservations on approving a Statement of Agreement the last time this was discussed. He said he plans to coordinate with Bob Rose prior to putting this discussion on the agenda. Kahler said the purpose of today's agenda item was merely to provide the memo with corrected table numbers.

John Ferguson asked if the correction affected the reported coho salmon survival. Kahler replied no, that the error did not change survival; it only changed the ratios in Tables 4 and 5 in Attachment C. Jim Craig asked if survival was based on PIT-tag detections, and Kahler said it was. Craig questioned the use of a surrogate if survival was measured directly with coho salmon. Kahler explained that because no survival studies have been conducted for coho salmon, the only survival measurement known for coho salmon is from these single-release comparisons, which are not measurements of Wells Project survival, but rather of Rocky Reach to McNary dams. He recalled that when Douglas PUD and the YN first established a coho salmon agreement, there was no surplus broodstock available for a survival study. Also, they did not want to take a portion of the fish destined to the Methow Basin and release them at the City of Pateros as a survival study group. He said the YN may be willing to do this now if returns remain strong. He added, however, that Douglas PUD cannot conduct a coho salmon survival study until after the Wells Hatchery Modernization is complete, which is scheduled for 2018. He said once the modernization is complete, Douglas PUD already has plans for another survival verification study for yearling spring migrants in 2020, so a potential survival study may not be feasible until around 2021.

B. Wells Project Land-Use Permit Applications – Permit 1030-01 (CCT) and Permit 130-01 (Earp and Cartwright)(Tom Kahler)

Tom Kahler said Kristi Geris sent an email to the Coordinating Committees on June 16, 2015, notifying them that two Wells Project Land-use Permit Applications (Permit 1030-01 CCT and Permit 130-01 Earl and Cartwright) were available for a 60-day review period, with edits and comments, or indication of no comments, due to Kahler by Friday, August 14, 2015. Kahler noted that these are new applications (not re-permitting). He said Permit 130-01 is for an existing orchard located within Tract 130 along the Okanagan River. He said the owners have been using the land for years; however, Douglas PUD has never permitted the action. He said this action is to permit the owners for that activity. He said Permit 1030-01 is for mooring of a CCT fishing vessel that is anchored just offshore of their property. He said this activity has been ongoing, and permitting is just a formality. He added that under this permit, the CCT agreed to keep the access road mowed.

Kahler said there is no urgency with Permit 130-01; however, it would be helpful to expedite review of Permit 1030-01. Coordinating Committees representatives present indicated no comments on Permit 1030-01. Kahler said he will contact Bob Rose regarding obtaining the YN's expedited approval of Wells Project Land-use Permit Application No. 1030-01.

C. Sockeye Tagging at Wells Dam (Tom Kahler)

Tom Kahler said Jeff Fryer (CRITFC) provided Douglas PUD with the schedule for tagging sockeye salmon at Wells Dam in 2015, which started this week. Kahler said the plan is to tag 50 fish this week, including 5 acoustically-tagged and 2 acoustic-plus-temperature-and-depth-tagged fish. He said tagging will continue through July and finish the week of August 2, 2015. He noted that, to date, more than 3,000 sockeye salmon have already passed Wells Dam, and the goal is to tag proportionally throughout the run. He added that he will provide CRITFC's Proposed Scheduling for Sockeye Salmon Sampling at Wells Dam in 2015 to Kristi Geris for distribution to the Coordination Committees (Item III-C). *(Note: Kahler provided CRITFC's schedule [Attachment D] to Geris following the meeting on June 23, 2015, which Geris distributed to the Coordinating Committees that same day.)*

V. Chelan PUD

A. Final Chelan PUD Rock Island IFPP Biological Assessment (Lance Keller)

Lance Keller said the Final Chelan PUD Rock Island IFPP Biological Assessment was distributed to the Coordinating Committees by Kristi Geris on June 12, 2015. Keller said the initial due date to NMFS and USFWS was May 1, 2015; however, Grant PUD and Chelan PUD were able to submit their respective reports on May 6, 2015. Keller said comments were received from Scott Carlon and Steve Lewis (USFWS), which were addressed in the final document. Keller said the only communication received from the Federal Energy Regulatory Commission since the reports were submitted is that they are trying to schedule a conference call with USFWS, Grant PUD, and Chelan PUD to check-in on any updates.

Keller said at Rock Island Dam, the denil structures are still in place. He said that included in the Biological Assessment were plans to remove the denils during the annual winter maintenance period at Rock Island Dam (January to February 2016). He said removal of the denils was planned during the upcoming annual maintenance period in order to avoid additional outages.

VI. HCP Committees Administration

A. HCP Hatchery Committees Distribution Lists and Extranet Site Access – Sarah Montgomery (John Ferguson)

John Ferguson notified the Coordinating Committees that Sarah Montgomery will replace Kristi Geris as the HCP Hatchery Committees Support Staff by September 2015; therefore, Montgomery was added to the HCP Hatchery Committees email distribution lists and given administrative access to the HCP Hatchery Committees Extranet Site.

B. Next Meetings (John Ferguson)

The next scheduled Coordinating Committees meeting is on July 28, 2015, and it will be held by conference call.

The August 25 and September 22, 2015, meetings will be held by conference call, in Eastern Washington, or in person at the Radisson Hotel in SeaTac, Washington, as is yet to be determined.

List of Attachments

Attachment A	List of Attendees
Attachment B	Estimation of Survival and Run Timing of Adult Spring/Summer Chinook from the Columbia River Estuary to Bonneville Dam
Attachment C	Corrected Memorandum Comparing Juvenile Survivals of Spring Chinook Salmon, Coho Salmon, and Steelhead Released from Winthrop NFH
Attachment D	CRITFC's Proposed Scheduling for Sockeye Salmon Sampling at Wells Dam In 2015

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman†	BioAnalysts, Inc.
Lance Keller*	Chelan PUD
Tom Kahler*	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Michelle Rub	National Marine Fisheries Service
Jim Craig*	U.S. Fish and Wildlife Service
Jeff Korth*	Washington Department of Fish and Wildlife
Kirk Truscott*††	Colville Confederated Tribes

Note:
* = Denotes Coordinating Committees member or alternate
† = Joined by phone for the Hatchery and Tributary Committees Update
†† = Joined by phone

Attachment B

NOAA
FISHERIES

Northwest
Fisheries
Science Center

Estimation of survival and run timing of adult spring/summer Chinook salmon from the Columbia River Estuary to Bonneville Dam: a cooperative effort between NOAA Fisheries and Columbia River commercial fishermen

A. Michelle Wargo Rub, Lyle Gilbreath, David Teel, & Benjamin Sandford
NOAA Fisheries Northwest Fisheries Science Center, Seattle, WA 98112

The primary goal of this study is to provide estimates of survival and run timing for spring/summer Chinook salmon returning to the Middle & Upper Columbia and Snake Rivers

Contemporary smolt-to-adult return rates (SARs) for spring/summer Chinook salmon originating above Bonneville Dam (RKM 234) are based on adult returns to Bonneville Dam. As such, any 'natural mortality' (e.g. any mortality not due to fishing) that might have occurred in the estuary or lower river gets attributed to the ocean phase of the salmonid life history.

- mask important stressors that adult fish may encounter within the estuary and lower river
- may underestimate the true benefits of conservation measures implemented at earlier life history stages
- may effect predictions of run size

Natural mortality in the CR estuary and lower river may be significant

- The CR pinniped population has grown steadily since passage of the Marine Mammal Protection Act in 1972
- In 2010 as many as 7k pinnipeds were estimated to reside in the near ocean & CR below Bonneville Dam for all or part of the year including 3k California and Stellar Sea Lions & 4k Harbor Seals
- >90% of the CR population resides in the estuary and lower River
- There is concern that the number of sea lions has increased further in response to recent robust smelt runs.
- In 2013 the number of sea lions identified at haul out sites near Astoria, OR was 5x's that observed during each of the previous three years
- The number of sea lions identified at haul out sites near Astoria in 2014 exceeded those observed during 2013

Commercial tangle–net crew hauling in a Chinook salmon

Custom fabricated PVC tubes

Facilitated safe handling, holding, and transfer of study fish

Adult Chinook salmon being transferred from the commercial fishing vessel to a research vessel using PVC tubes

Study fish were physically restrained in dorsal recumbency for tissue collection and tagging

> 2200 returning spring/summer Chinook salmon have been tagged for this study since 2010

- Willamette River spring Chinook (22%)
- West Cascade tributary spring Chinook (9%)
- Middle and Upper Columbia River spring Chinook (36%)
- Snake River spring/summer Chinook (31%)
- Upper Columbia River summer/fall Chinook (<1%)
- North Oregon Coast Chinook (<1%)

Survival to Bonneville Dam is determined for upriver stocks after adjusting for:

- detection efficiency at Bonneville Dam (98-99%)
- gear associated mortality (12.8%)
- mortality due to harvest (2.5-4 %)

Adjusted Survival for Interior CR stocks

Year	Interior CR Adult Chinook salmon (N)	Dates Sampled	adjusted Survival	95% CI
2010	174	4/14-5/11	90%	(80%-99%)
2011	374	4/1-5/16	85%	(77%-92%)
2012	370	3/23-5/31	83%	(76%-88%)
2013	66	4/19-6/20	73%	
2014	290	3/20-5/13	*55%	(46%-65%)

*Preliminary estimate; assumes harvest of 4%

Survival varied by tagging date

	Adjusted Survival		
Year	Early Season (3/20-4/7)	Middle Season (4/9-5/2)	Late Season (5/3-6/20)
2010	NA	89%	101%
2011	89%	81%	101%
2012	74%	82%	91%
2013	NA	62%	104%
2014	*40%	*63%	*107%

*Preliminary estimate; assumes harvest of 4%

What does this imply?

Year	Spring/summer Chinook returns (N)	mortalities (N)	*sea lions (N)
2010	315,345	35,038	80
2011	221,200	39,035	72
2012	203,100	44,582	109
2013	123,100	55,260	495
2014	~220,000	99,000	616

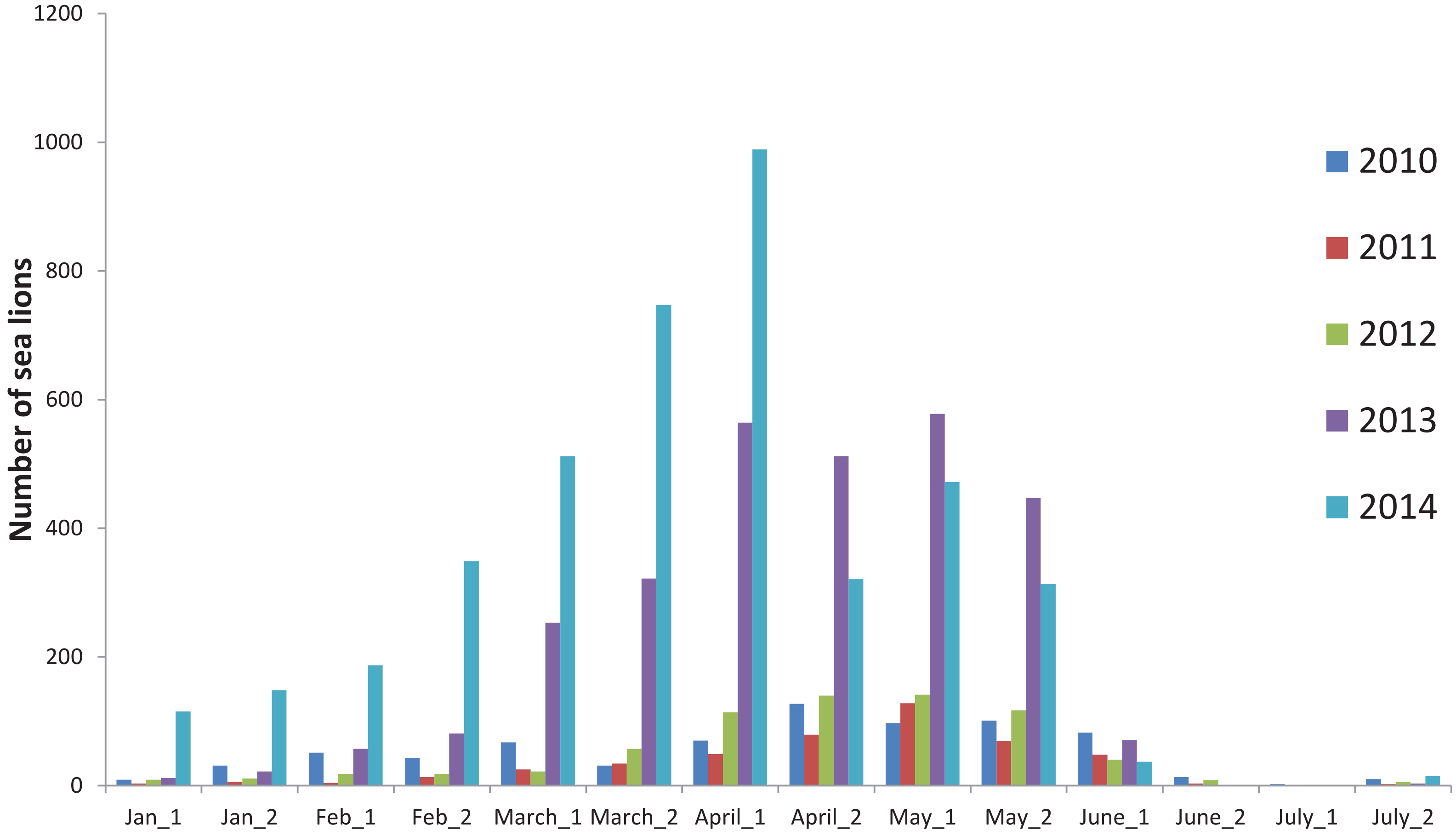
***The average number of sea lions observed at haul out sites near Astoria, OR by ODFW staff for the period March 15-May 15 (M. Tennis, ODFW, pers. comm.).**

Potential additional sources of mortality:

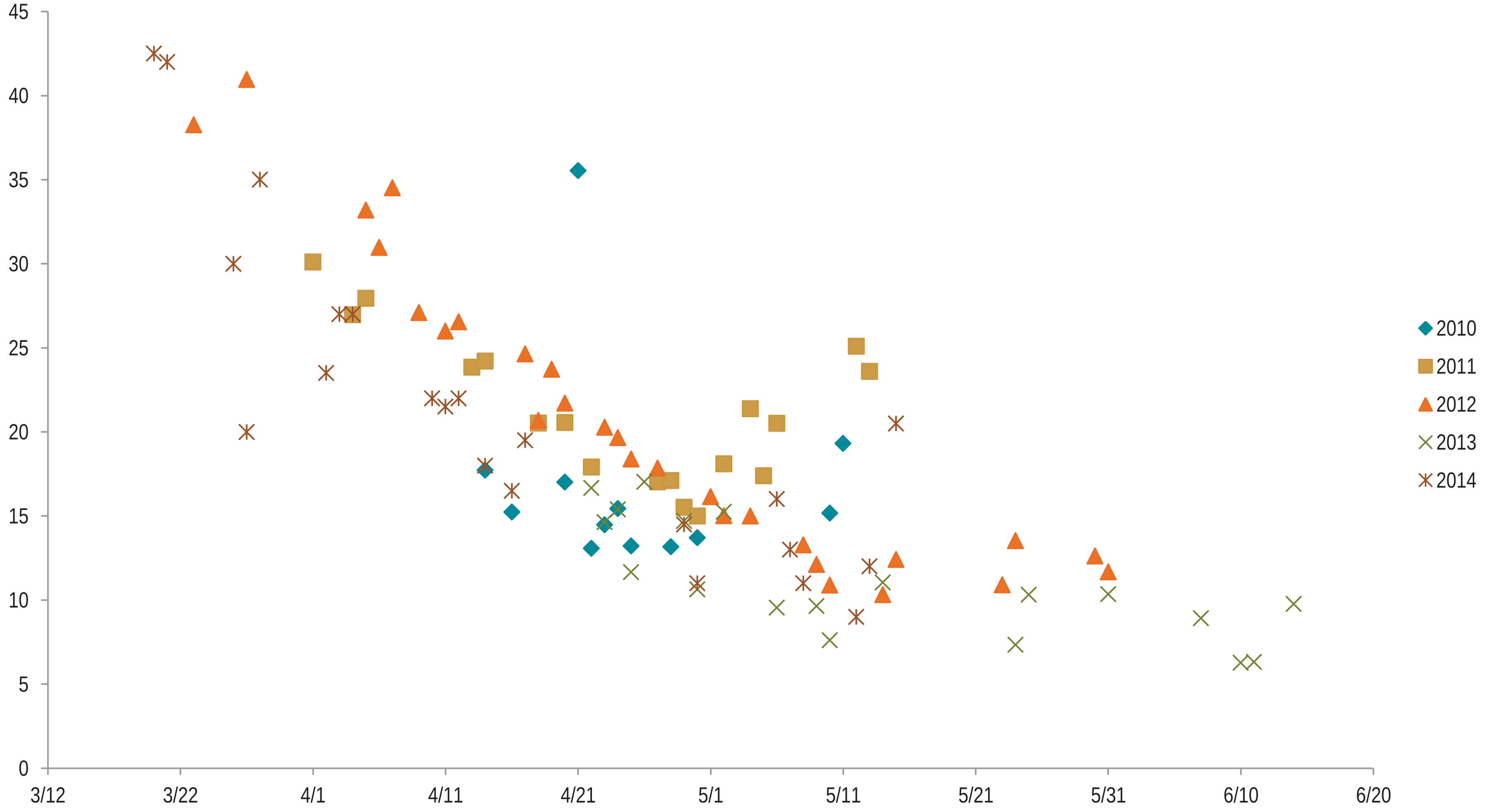
- Straying
- Harvest
- Disease
- Sampling and handling mortality
- Learned behavior

Theoretical estimates of predation = 22.5-57k

Average biweekly number of sea lions hauled out at the East End Mooring Basin near Astoria, OR

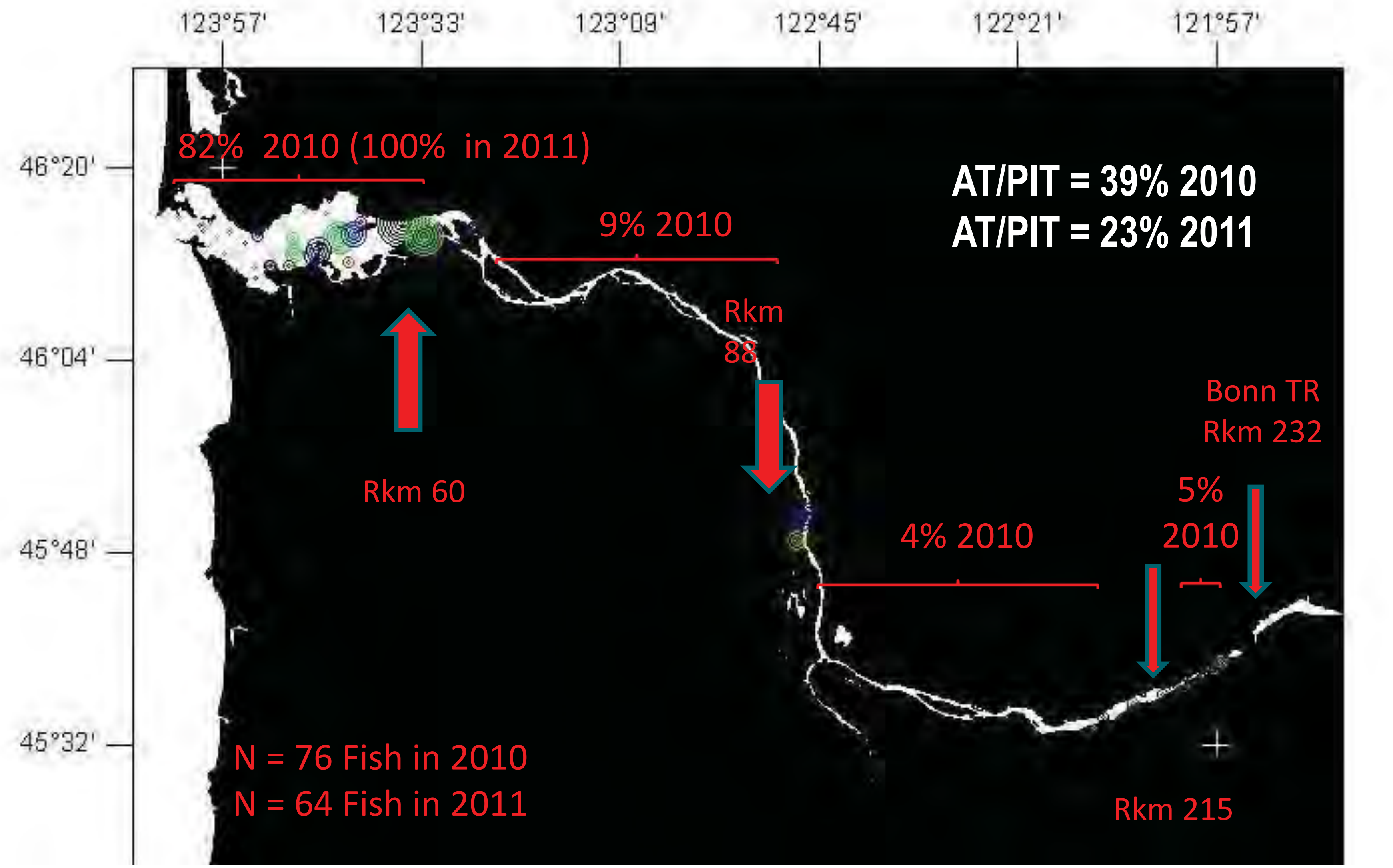


Median Travel Time (d) to Bonneville Dam by release group



Attachment B

Where did mortality occur?



82% 2010 (100% in 2011)

9% 2010

AT/PIT = 39% 2010
AT/PIT = 23% 2011

Rkm 88

Rkm 60

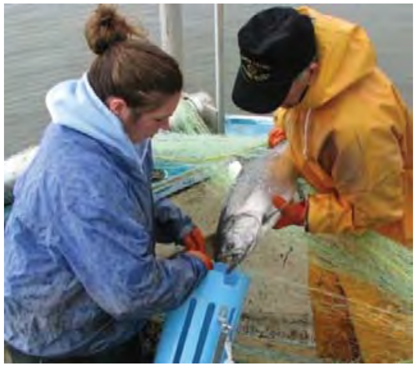
Bonn TR
Rkm 232

5%
2010

4% 2010

N = 76 Fish in 2010
N = 64 Fish in 2011

Rkm 215



+

69 kHz @ 158 dB
re 1µ Pa

=

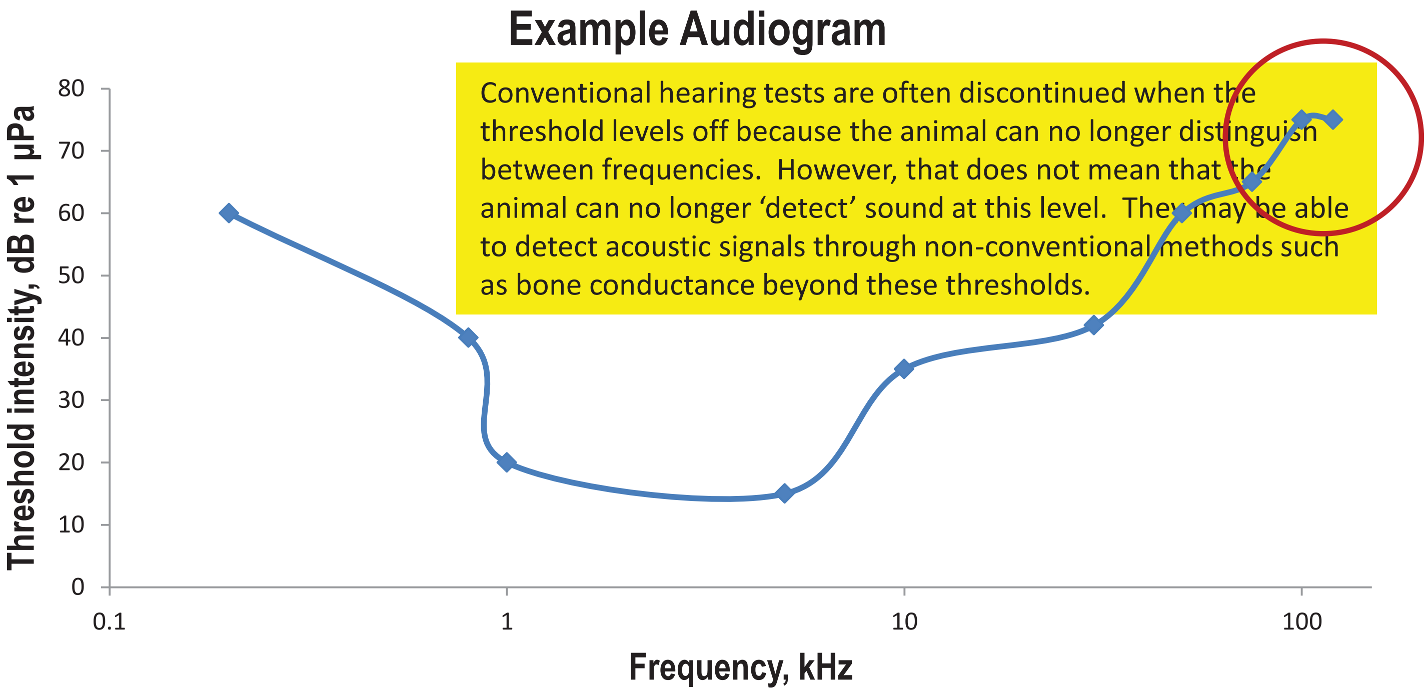
?

Published High-Frequency hearing limits:

100 kHz for Harbor Seals

34kHz for California Sea Lions

Attachment B



Example Audiogram

Conventional hearing tests are often discontinued when the threshold levels off because the animal can no longer distinguish between frequencies. However, that does not mean that the animal can no longer 'detect' sound at this level. They may be able to detect acoustic signals through non-conventional methods such as bone conductance beyond these thresholds.

There are at least three problems with applying hearing thresholds from the published literature to our applications:

1.) studies were conducted on only a few animals

2.) tests were conducted to determine the upper threshold with which animals were able to distinguish between different frequencies, not necessarily the upper hearing limit

3.) tag intensities are well above those which have been tested during conventional hearing tests (e.g. 150 dB re 1µPa compared to 60 dB re 1µPa

Collaborative research conducted between researchers at the NWFSC, the SWFSC, and the Institute of Marine Sciences, Long Marine Laboratory, UCSC

Photo credit:
www.pinnipedlab.ucsc.edu

24yr old male harbor seal Sprouts

Photo credit:
www.pinnipedlab.ucsc.edu

4yr old female CSL Ronin

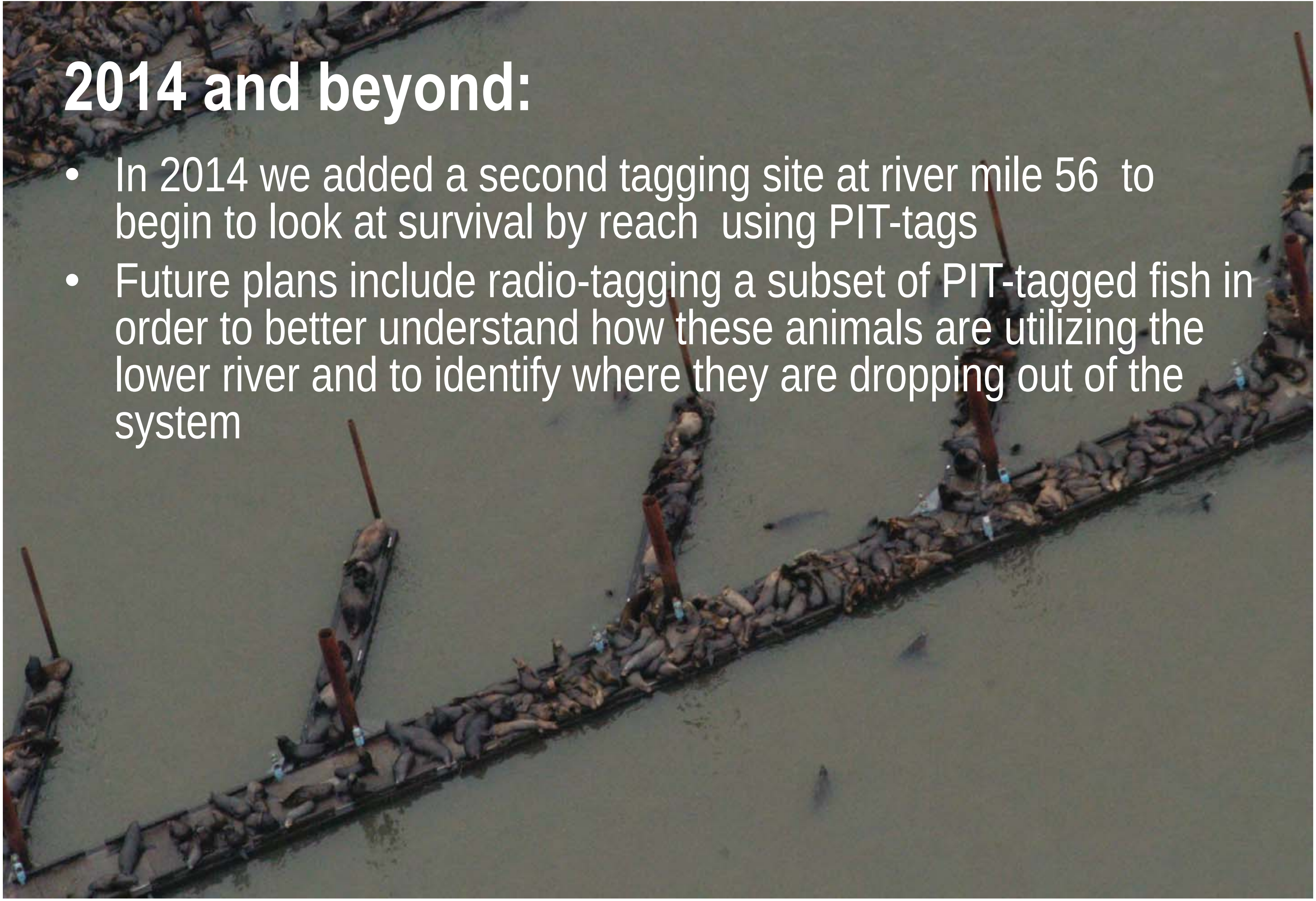
Both Animals were exposed to a 69 kHz pure tone

Harbor seal detected this tone at 106 dB (this was slightly lower (i.e. more sensitive than expected), but within the range of published data)

***Based on this information, the detection range of a Vemco 69 kHz high OP transmitter would be ~900 m in FW**

CSL detected this tone at 112dB (this was 33 dB lower than expected compared to published data)

***Based on this information, the detection range of a Vemco 69 kHz high OP transmitter would be ~350m in FW**



2014 and beyond:

- In 2014 we added a second tagging site at river mile 56 to begin to look at survival by reach using PIT-tags
- Future plans include radio-tagging a subset of PIT-tagged fish in order to better understand how these animals are utilizing the lower river and to identify where they are dropping out of the system

Genetics 2014 and future:

Genotypic Sex	(N)
F	264
M	301
Total	565

Spawn Year	(N)
2008	1
2009	2
2010	133
2011	28
Total	164

PBT Hatchery Assignment	(N)
Clearwater	17
Dworshak	37
Lookingglass	23
LyonsFerry	2
McCall	1
NezPerce	5
Pahsimeroi	2
PowellSatellite	11
RapidRiver	59
Sawtooth	7
Total	164

Summary:

- >2200 fish tagged since 2010
- Average annual survival ranged from 55-90%
- Mortality was highest for fish tagged in late March and April
- Travel time to Bonneville Dam is also longer for fish tagged during March and April
- Higher mortality coincides with peak sea lion presence
- Average annual survival decreased from 2010-2014
- The number of sea lions hauled out near Astoria, OR increased over same time period
- Early attempts to identify reach survival were confounded by an acoustic tag effect so radio-telemetry is planned for 2016
- SNPs parent-based genetics testing is promising for hatchery and tributary level information on survival and movement

Acknowledgements:

Susan Hinton, George McCabe, and Bob Emmett of NOAA Fisheries Pt. Adams Research Station, Jim Simonson and crew of NOAA Fisheries Pasco Research Station, Laurie Weitkamp of NOAA Fisheries NWFSC, Newport Research Station, David Kuligowski & Don Van Doornik of NOAA Fisheries NWFSC, Manchester Research Station, John Hess, Doug Hatch & Ryan Brandstetter of CRITFC, Jason Romine and Mike Parsley of USGS, Chris Kern and Geoffrey Whisler of ODFW, Matt Campbell of IDF&G, Brian, Frank, & Stephanie Tarabochia, and Dan Marvin of Astoria, OR, Sean Hayes of NOAA Fisheries SWFSC, Kane Cunningham & Colleen Reichmuth of the Institute of Marine Sciences, Long Marine Laboratory, UCSC, NOAA Near Term Priority (2010 & 2011) and NOAA Fisheries Cooperative Research (2012, 2013, & 2014)

www.nwfsc.noaa.gov/research/divisions/fe/estuarine/adult-est-survival.cfm

Attachment C

SCHOOL OF AQUATIC & FISHERY SCIENCES
COLUMBIA BASIN RESEARCH

UNIVERSITY OF
WASHINGTON

TO: Tom Kahler

FROM: John R. Skalski and Richard L. Townsend

DATE: 1 JUNE 2015

RE: **Corrected comparison of juvenile survivals of spring Chinook, Coho, and steelhead released from Winthrop National Fish Hatchery**

This memo replaces our memo from 14 August 2014, presenting corrected results from the analysis conducted for that memo, and new analysis of data from 2014 releases. An error in the code used to generate the ratios in the "Rocky Reach to McNary" column of Table 4 of the attachment to the 2014 memo resulted in erroneous ratios in that column and in the P-values in the corresponding column in Table 5.

Attached are estimates for the annual reach survival for hatchery Coho Salmon, spring Chinook Salmon, and steelhead PIT-tagged and released from Winthrop National Fish Hatchery (Winthrop NFH). Release numbers are slightly smaller than the recorded release numbers due to removals of fish that have been censored for analysis prior to the first detection downriver of release. Table 1 displays the reach survival estimates from McNary to John Day Dam, 2008-2009. Detections at Rocky Reach Dam began in 2010, and survival estimates from Rocky Reach to McNary are included in the 2010-2014 reach survival estimates (Table 2). Annual reach travel-time estimates for each species are presented in Table 3.

Coho survival estimates were separately compared to spring Chinook and to steelhead for two reaches (Rocky Reach to McNary, McNary to John Day) (Table 4). Coho survival estimates from Rocky Reach to McNary were significantly different (P-value < 0.05; Table 5) from survival estimates for Chinook in three of the five years of study but were not significantly different from survival estimates for steelhead in four of the five years of study. Coho survival estimates from McNary to John Day were not significantly different from those of other species during any of the years analyzed (see Table 5). Coho survival from Rocky Reach to McNary was less than the survival of spring Chinook for four of the five years, but greater than for steelhead in three of the five years.

Table 6 is the list of tag files used in this analysis. There were two release sites for Coho (2009-2014) and spring Chinook (2011-2014) at the Winthrop NFH: Winthrop NFH and the Rearing Pond Back Channel. These were pooled on an annual basis to improve release sizes. Two steelhead tag files were not used in this evaluation because these groups of fish were not handled in a manner similar to the other releases. Fortunately, these release groups were very small lots of fish (in 2011: MRC11088.WAR (18 tags), and 2012: MRC12091.WAS (4 tags)).

Table 1: Cormack-Jolly-Seber (CJS) survival and detection estimates for pooled releases of Coho, Spring Chinook, and steelhead from Winthrop National Fish Hatchery in 2008-2009.

Release Year and Species	Adjusted Release Size	Probability of survival McNary to John Day	Probability of detection McNary	Probability of detection John Day	Bonneville combined probability of detection/survival (λ)
2008					
Coho	6,495	1.0863 (0.4231)	0.1408 (0.0190)	0.1601 (0.0598)	0.0197 (0.0080)
Spring Chinook	2,895	1.2397 (0.5117)	0.1403 (0.0230)	0.0783 (0.0307)	0.0390 (0.0156)
Steelhead	4,665	1.3598 (0.4692)	0.1118 (0.0165)	0.1592 (0.0515)	0.0240 (0.0084)
2009					
Coho	10,473	1.3007 (0.3888)	0.2002 (0.0197)	0.0658 (0.0191)	0.0444 (0.0131)
Spring Chinook	1,953	0.8952 (0.3821)	0.3113 (0.0450)	0.1015 (0.0430)	0.0833 (0.0357)
Steelhead	4,853	0.9547 (0.3363)	0.1602 (0.0262)	0.1365 (0.0447)	0.0556 (0.0191)

Table 2: Cormack-Jolly-Seber (CJS) survival and detection estimates for pooled releases of Coho Salmon, Spring Chinook, and steelhead from Winthrop National Fish Hatchery in 2010-2014.

Release Year and Species	Adjusted Release Size	Probability of survival	
		Rocky Reach to McNary	McNary to John Day
2010			
Coho	11,879	0.6153 (0.0996)	1.2678 (0.4173)
Spring Chinook	4,946	1.1668 (0.2698)	0.6740 (0.2811)
Steelhead	29,150	0.6556 (0.0592)	0.9223 (0.0542)
2011			
Coho	13,892	0.7189 (0.0632)	0.8581 (0.1936)
Spring Chinook	10,737	0.6601 (0.0509)	1.0351 (0.2132)
Steelhead	29,216	0.5669 (0.0298)	1.0736 (0.1295)
2012			
Coho	11,906	0.5646 (0.0437)	1.0191 (0.1882)
Spring Chinook	10,807	0.6844 (0.0516)	0.7656 (0.1036)
Steelhead	29,391	0.5478 (0.0364)	0.7844 (0.0891)
2013			
Coho	11,916	0.6185 (0.0871)	1.2725 (0.3911)
Spring Chinook	15,623	0.8681 (0.0726)	0.7592 (0.1316)
Steelhead	28,640	0.4879 (0.0541)	1.2029 (0.2221)
2014			
Coho	11,736	0.5828 (0.0735)	1.3191 (0.3763)
Spring Chinook	4,885	0.7992 (0.1412)	0.6412 (0.2001)
Steelhead	28,844	0.7042 (0.1082)	0.9403 (0.2714)

Release Year and Species	Probability of detection			Bonneville combined probability of detection/survival (λ)
	Rocky Reach	McNary	John Day	
2010				
Coho	0.5651 (0.0176)	0.0677 (0.0114)	0.0396 (0.0117)	0.0476 (0.0140)
Spring Chinook	0.5141 (0.0214)	0.0664 (0.0155)	0.0317 (0.0139)	0.0532 (0.0231)
Steelhead	0.5192 (0.0100)	0.0630 (0.0059)	0.0597 (0.0075)	0.0819 (0.0101)
2011				
Coho	0.6447 (0.0125)	0.1102 (0.0104)	0.1956 (0.0413)	0.0217 (0.0051)
Spring Chinook	0.3226 (0.0124)	0.1579 (0.0120)	0.1805 (0.0356)	0.0256 (0.0055)
Steelhead	0.4502 (0.0090)	0.1222 (0.0069)	0.2176 (0.0244)	0.0307 (0.0038)
2012				
Coho	0.3999 (0.0138)	0.2096 (0.0160)	0.1143 (0.0203)	0.0685 (0.0125)
Spring Chinook	0.1903 (0.0094)	0.1906 (0.0127)	0.1601 (0.0201)	0.0795 (0.0105)
Steelhead	0.3072 (0.0088)	0.1011 (0.0068)	0.2123 (0.0209)	0.0494 (0.0053)
2013				
Coho	0.5583 (0.0168)	0.0809 (0.0118)	0.0387 (0.0109)	0.0550 (0.0154)
Spring Chinook	0.3366 (0.0105)	0.1289 (0.0107)	0.0822 (0.0131)	0.0638 (0.0103)
Steelhead	0.4232 (0.0120)	0.0598 (0.0069)	0.0663 (0.0103)	0.0567 (0.0088)
2014				
Coho	0.2859 (0.0161)	0.1250 (0.0150)	0.0620 (0.0166)	0.0448 (0.0122)
Spring Chinook	0.1246 (0.0136)	0.1288 (0.0195)	0.1056 (0.0300)	0.0558 (0.0164)
Steelhead	0.2414 (0.0115)	0.0549 (0.0083)	0.0478 (0.0120)	0.0273 (0.0069)

Table 3: Harmonic travel-time estimates for pooled releases of Coho, spring Chinook, and steelhead from Winthrop National Fish Hatchery in 2008-2014. Standard errors are in parentheses. The bold number indicates the number fish used to estimate travel time.

		Species	**Travel Time To** (in days)		
	Migration year: 2008		McNary	John Day	Bonneville
From	Rocky Reach	Coho			
		Spring Chinook			
		Steelhead			
	McNary	Coho		2.27 (0.07) **42**	3.70 (0.19) **4**
		Spring Chinook		3.49 (0.22) **22**	5.83 (0.30) **8**
		Steelhead		2.52 (0.15) **34**	3.46 (0.21) **3**
	John Day	Coho			1.39 (0.11) **3**
		Spring Chinook			2.26 (0.10) **5**
		Steelhead			**0**
	Migration year: 2009		McNary	John Day	Bonneville
From	Rocky Reach	Coho			
		Spring Chinook			
		Steelhead			
	McNary	Coho		2.52 (0.10) **55**	4.13 (0.24) **18**
		Spring Chinook		3.86 (0.43) **15**	5.30 (0.42) **13**
		Steelhead		3.34 (0.32) **24**	6.03 (2.20) **2**
	John Day	Coho			1.65 (0.11) **8**
		Spring Chinook			1.98 (0.26) **5**
		Steelhead			1.72 (0.19) **4**
	Migration year: 2010		McNary	John Day	Bonneville
From	Rocky Reach	Coho	8.32 (0.20) **167**	10.29 (0.23) **118**	12.38 (0.38) **110**
		Spring Chinook	9.64 (0.21) **155**	12.78 (0.52) **45**	13.60 (0.38) **59**
		Steelhead	10.97 (0.15) **411**	14.80 (0.19) **361**	15.69 (0.17) **315**
	McNary	Coho		2.06 (0.13) **20**	3.78 (0.18) **9**
		Spring Chinook		3.09 (0.21) **8**	4.32 (0.39) **8**
		Steelhead		3.63 (0.18) **49**	5.32 (0.17) **38**
	John Day	Coho			1.65 (0.16) **7**
		Spring Chinook			1.90 (0.05) **4**
		Steelhead			2.05 (0.06) **38**

Table 3: Harmonic travel-time estimates for pooled releases (continued).

		Species	**Travel Time To** (in days)					
	Migration year: 2011		McNary		John Day		Bonneville	
From	Rocky Reach	Coho	5.77 (0.11)	**302**	7.53 (0.08)	**510**	8.16 (0.41)	**12**
		Spring Chinook	13.15 (0.11)	**188**	16.50 (0.46)	**247**	17.55 (1.21)	**28**
		Steelhead	7.67 (0.12)	**431**	10.13 (0.11)	**886**	10.11 (0.38)	**41**
	McNary	Coho			2.21 (0.05)	**93**	4.50 (0.44)	**2**
		Spring Chinook			3.36 (0.11)	**121**	5.62 (0.26)	**21**
		Steelhead			2.99 (0.08)	**246**	4.33 (0.25)	**15**
	John Day	Coho					1.13 (0.04)	**7**
		Spring Chinook					1.85 (0.14)	**14**
		Steelhead					1.39 (0.09)	**19**
	Migration year: 2012		McNary		John Day		Bonneville	
From	Rocky Reach	Coho	6.85 (0.13)	**287**	8.97 (0.19)	**142**	10.81 (0.33)	**64**
		Spring Chinook	12.24 (0.39)	**187**	16.94 (0.59)	**129**	18.68 (1.07)	**47**
		Steelhead	8.04 (0.19)	**308**	10.72 (0.19)	**478**	12.06 (0.68)	**42**
	McNary	Coho			2.86 (0.08)	**88**	4.75 (0.16)	**42**
		Spring Chinook			3.58 (0.11)	**120**	5.42 (0.20)	**55**
		Steelhead			3.14 (0.12)	**163**	4.03 (0.26)	**13**
	John Day	Coho					2.03 (0.14)	**21**
		Spring Chinook					1.99 (0.07)	**46**
		Steelhead					1.61 (0.09)	**29**
	Migration year: 2013		McNary		John Day		Bonneville	
From	Rocky Reach	Coho	6.79 (0.16)	**186**	8.42 (0.17)	**122**	9.81 (0.18)	**114**
		Spring Chinook	9.44 (0.19)	**396**	12.55 (0.29)	**165**	13.82 (0.42)	**88**
		Steelhead	6.96 (0.14)	**198**	9.26 (0.13)	**296**	9.91 (0.25)	**61**
	McNary	Coho			2.33 (0.12)	**18**	4.11 (0.12)	**17**
		Spring Chinook			3.19 (0.09)	**89**	4.56 (0.18)	**28**
		Steelhead			2.60 (0.13)	**46**	3.88 (0.42)	**7**
	John Day	Coho					2.09 (0.23)	**5**
		Spring Chinook					1.70 (0.06)	**25**
		Steelhead					1.65 (0.09)	**16**

Table 3: Harmonic travel-time estimates for pooled releases (continued).

		Species	**Travel Time To** (in days)					
	Migration year: 2014		McNary		John Day		Bonneville	
From	Winthrop NFH	Coho	33.70 (0.28)	**440**	36.99 (0.29)	**301**	37.25 (0.41)	**174**
		Spring Chinook	26.47 (0.36)	**387**	28.58 (0.49)	**203**	33.64 (0.84)	**69**
		Steelhead	30.25 (0.29)	**610**	35.97 (0.34)	**568**	34.90 (0.55)	**140**
	Rocky Reach	Coho	5.77 (0.18)	**108**	7.65 (0.22)	**63**	9.18 (0.29)	**37**
		Spring Chinook	11.75 (0.82)	**45**	13.59 (1.12)	**18**	16.96 (3.31)	**5**
		Steelhead	6.78 (0.21)	**127**	10.02 (0.32)	**121**	9.08 (0.38)	**34**
	McNary	Coho			2.30 (0.07)	**35**	3.59 (0.13)	**22**
		Spring Chinook			3.34 (0.19)	**25**	4.64 (0.31)	**13**
		Steelhead			3.16 (0.24)	**20**	3.68 (0.20)	**10**
	John Day	Coho					1.69 (0.14)	**11**
		Spring Chinook					1.86 (0.16)	**8**
		Steelhead					1.61 (0.17)	**7**

Table 4: Ratios of various juvenile reach survivals, Coho/spring Chinook and Coho/steelhead, 2008-2014. Numbers in bold indicate survival ratios that are significantly different from 1 ($P < 0.05$, two-tailed).

Species ratio	Year	Rocky Reach to McNary	McNary to John Day
Coho/Spring Chinook	2008		0.8763 (0.4973)
	2009		1.4530 (0.7571)
	2010	**0.5273 (0.1488)**	1.8810 (0.9994)
	2011	1.0891 (0.1274)	0.8290 (0.2533)
	2012	**0.8250 (0.0891)**	1.3311 (0.3047)
	2013	**0.7125 (0.1167)**	1.6761 (0.5914)
	2014	0.7292 (0.1583)	2.0572 (0.8698)
Coho/Steelhead	2008		0.7989 (0.4157)
	2009		1.3624 (0.6294)
	2010	0.9385 (0.1740)	1.3746 (0.4596)
	2011	**1.2681 (0.1299)**	0.7993 (0.2045)
	2012	1.0307 (0.1051)	1.2992 (0.2817)
	2013	1.2677 (0.2272)	1.0579 (0.3793)
	2014	0.8276 (0.1645)	1.4029 (0.5693)

Table 5: P-values testing the survival ratio (Ho: Coho/(spring Chinook or steelhead) = 1, Ha: Coho/(spring Chinook or steelhead) ≠ 1), 2008-2014. Numbers in bold indicate survival ratios that are significantly different from 1 ($P < 0.05$, two-tailed).

Species ratio	Year	Rocky Reach to McNary	McNary to John Day
Coho/Spring Chinook	2008		0.8035
	2009		0.5497
	2010	**0.0015**	0.3780
	2011	0.4843	0.4995
	2012	**0.0496**	0.2773
	2013	**0.0137**	0.2530
	2014	0.0872	0.2242
Coho/Steelhead	2008		0.6285
	2009		0.5648
	2010	0.7238	0.4150
	2011	**0.0390**	0.3263
	2012	0.7705	0.2881
	2013	0.2388	0.8788
	2014	0.2947	0.4792

Table 6: Tagging information for groups used in this analysis. All groups were released from Winthrop National Fish Hatchery (WINT) or the Rearing Pond in the Back Channel to Winthrop NFH (WINTBC).

Release Year		Tagging group(s)					
	Site	Date	Coho	Date	Spring Chinook	Date	Steelhead
2008	WINT	5 May	KGM07350.WI1 KGM07350.WI2 KGM07351.WI3 KGM07350.WI4 KGM07350.WI5 KGM07351.WI6	14 Apr	MRC07303.WI1 MRC07303.WI2 MRC07303.WI3	7 May	MRC07304.WI1 MRC07304.WI2 MRC07304.WI3 MRC07305.WI1
2009	WINT	22 Apr	KGM09006.WI3 KGM09006.WI4	16 Apr	MRC08290.WI2 MRC08290.WI3	21 Apr	MRC08289.WI1 MRC08289.WI2 MRC08289.WI3 MRC08290.WI1
	WINTBC	1 May	KGM09005.WI2 KGM09006.WI1				
2010	WINT	25 Apr	CMK10013.W15 CMK10013.W16	19 Apr	MRC09287.WT1 MRC09288.WT2	19 Apr	MRC09279.WT1 MRC09279.WT2 MRC09281.WT3 MRC09281.WT4 MRC09281.WT5 MRC09281.WT6 MRC09282.WT7 MRC09282.WT8
	WINTBC	1 May	CMK09348.WB1 CMK09348.WB2 CMK09348.WB3 CMK09348.WB4				
2011	WINT	18 Apr	CMK10344.W15 CMK10344.W16	18 Apr	MRC10281.WT1 MRC10281.WT2 MRC10281.WT3 MRC10281.WT4	19 Apr	MRC10277.WT2 MRC10278.WT1 MRC10278.WT3 MRC10278.WT4 MRC10279.WT1 MRC10279.WT2 MRC10280.WT3 MRC10280.WT4 MRC10280.WT5 MRC10280.WT6
	WINTBC	15 Apr	CMK10341.W04 CMK10341.W04	15 Apr	CMK10344.W10 CMK10344.W11		
2012	WINT	18 Apr	CMK11306.WI1 CMK11306.WI2	16 Apr	MRC11277.WT1 MRC11277.WT2 MRC11277.WT3 MRC11277.WT4	19 Apr	MRC11277.WT5 MRC11277.WT6 MRC11278.WT7 MRC11278.WT8 MRC11279.WT1 MRC11279.WT2 MRC11280.WT3 MRC11280.WT4
	WINTBC	26 Apr	CMK11312.WI1 CMK11312.WI2	26 Apr	CMK11306.WC1 CMK11306.WC2		

Table 6: Tagging information for groups used in this analysis. (Continued)

Release Year	Site	Tagging group(s)					
		Date	Coho	Date	Spring Chinook	Date	Steelhead
2013	WINT	15 Apr	CMK12313.W14 CMK12313.W15	15 Apr	CMK12312.W10 CMK12312.W11 MRC12279.WT1 MRC12279.WT2 MRC12279.WT3 MRC12279.WT4	12 Apr	MRC12276.WT1 MRC12276.WT2 MRC12276.WT3 MRC12276.WT4 MRC12277.WT5 MRC12277.WT6 MRC12278.WT7 MRC12278.WT8
	WINTBC	19 Apr	CMK12318.WB1	19 Apr	CMK12312.W08 CMK12312.W09		
2014	WINT	18 Apr	CMK13317.W14	15 Apr	MRC13277.WT1 MRC13277.WT2 MRC13277.WT3 MRC13277.WT4	14 Apr	MRC13275.WT1 MRC13275.WT2 MRC13276.WT3 MRC13276.WT4 MRC13295.WT1 MRC13295.WT2 MRC13295.WT3 MRC13295.WT4 MRC13296.WT5 MRC13296.WT6 MRC13296.WT7 MRC13296.WT8
	WINTBC	22 Apr	CMK13350.WB1 CMK13350.WB2				

Attachment D

From: Kristi Geris
To: Bob Rose (rosb@yakamafish-nsn.gov); Jim Craig (jim_l_craig@fws.gov); John Ferguson; Keller, Lance; kirk.truscott@colvilletribes.com; Korth, Jeff (DFW) (Jeff.Korth@dfw.wa.gov); Kristi Geris; Scott Carlon; "Tom Kahler (tkahler@dcpud.org)"
Cc: (Carmen.andonaegui@dfw.wa.gov); Aaron Beavers; Bill Tweit; Dale Bambrick; Gallaher, Becky; Justin Yeager; Keith Truscott; "Mary Mayo"; Ritchie Graves; Shane Bickford (sbickford@dcpud.org); Steve Hemstrom (steven.hemstrom@chelanpud.org); Steve Parker; Verhey, Patrick M (DFW); "william_gale@fws.gov"
Subject: FW: Sampling schedule
Date: Tuesday, June 23, 2015 12:43:13 PM

Hi HCP-CC: please see the emails below from Tom and Jeff Fryer regarding CRITFC's schedule for sockeye tagging at Wells Dam, as discussed during today's CC 6/23 meeting. Thanks! -kristi :)

Kristi Geris
ANCHOR QEA, LLC
kgeris@anchorqea.com
T 509.491.3151 x104
C 360.220.3988

-----Original Message-----
From: Tom Kahler [mailto:tomk@dcpud.org]
Sent: Tuesday, June 23, 2015 12:27 PM
To: Kristi Geris
Subject: FW: Sampling schedule

Hi Kristi,

Here's Fryer's schedule for sockeye tagging, as discussed today.

Thanks,

Tom

From: Jeff Fryer [fryj@critfc.org]
Sent: Sunday, June 21, 2015 9:11 PM
To: Tom Kahler
Subject: Fwd: Sampling schedule

Tom
Here's a target sockeye sampling schedule

Jeff

Sent via the Samsung Galaxy S™ III, an AT&T 4G LTE smartphone

-------- Original message --------
From: Jeff Fryer
Date:06/16/2015 5:16 PM (GMT-08:00)
To: Darin Hathaway , Kraig Mott
Subject: Sampling schedule

Week Starting Stat Week Acoustic + Temp/Depth Acoustic Only PIT tags

21-Jun	26	2	5	50
28-Jun	27	4	10	100
5-Jul	28	7	20	180
12-Jul	29	7	20	180
19-Jul	30	4	14	150
26-Jul	31	4	10	90
2-Aug	32	4	10	50
		32	89	800

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Coordinating Committees	**Date:**	October 27, 2015
From:	John Ferguson, Chairman		
Cc:	Kristi Geris		
Re:	Final Minutes of the August 25, 2015 HCPs Coordinating Committees Meeting		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Coordinating Committees met at the Radisson Gateway Hotel, in SeaTac, Washington, on Tuesday, August 25, 2015, from 9:30 a.m. to 11:00 a.m. Attendees are listed in Attachment A of these meeting minutes.

ACTION ITEM SUMMARY

- Scott Carlon will discuss the lamprey enumeration structures to be installed at Wells Dam with Aaron Beavers (National Marine Fisheries Service [NMFS] Fish Passage Engineer); approval of installation of the structures will be requested during the next Coordinating Committees meeting on September 22, 2015 (Item II-A). *(Note: Carlon said Beavers agreed salmon passage would not be impacted by the proposed lamprey modifications and approved the installation, as distributed to the Coordinating Committees on September 1, 2015.)*
- Lance Keller will provide Kristi Geris with the fish data discussed during the Rocky Reach Dam and Rock Island Dam end-of-summer spill discussion (Item III-A). *(Note: Keller provided the fish data to Geris following the meeting on August 25, 2015.)*
- The Coordinating Committees meeting on September 22, 2015, will be held by conference call or in person at the Radisson Hotel in SeaTac, Washington, as is yet to be determined (Item IV-A). ***(Note: The Coordinating Committees meeting on September 22, 2015, was canceled due to lack of agenda items, as distributed to the Coordinating Committees on September 11, 2015.)***
- **The Coordinating Committees meeting on October 27, 2015, will be held in person at the Radisson Hotel in SeaTac, Washington (Item IV-A).**

DECISION SUMMARY

- The Wells Coordinating Committee approved via email the proposed lamprey enumeration structures for installation in the fishways at Wells Dam during the 2015/2016 winter outage, as follows: Douglas PUD and U.S. Fish and Wildlife Service (USFWS) approved Tuesday, September 1, 2015, and NMFS, Washington Department of Fish and Wildlife (WDFW), the Colville Confederated Tribes (CCT), and the Yakama Nation (YN) approved Wednesday, September 2, 2015 (Item II-A).

AGREEMENTS

- No agreements were discussed during today's meeting.

REVIEW ITEMS

- Kristi Geris sent an email to the Coordinating Committees on August 10, 2015, notifying them that two Wells Project Land-use Permit Applications (Permit 716-01 Fry and Permit 828 See) were available for a 60-day review period, with edits and comments, or indication of no comments, due to Tom Kahler by Friday, October 9, 2015.
- Kristi Geris sent an email to the Coordinating Committees on October 16, 2015, notifying them that the draft Douglas PUD 2015 Bypass Passage-Dates Analysis was available for a 60-day review period, with edits and comments due to Tom Kahler by Tuesday, December 15, 2015.

DOCUMENTS FINALIZED

- No documents were recently finalized.

I. Welcome

A. Review Agenda (John Ferguson)

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

- Ferguson added an update on discussions regarding the Aquatic Settlement Workgroup (SWG) Twisp Weir Operations Plan.
- Tom Kahler added an update on Douglas PUD activities.

B. Aquatic SWG Twisp Weir Operations Plan (John Ferguson)

John Ferguson said he had an action item from the Aquatic SWG to discuss with the HCP Hatchery and Coordinating Committees a comment that arose about the operation of the Twisp Weir. In July 2015, the Aquatic SWG was discussing the Aquatic SWG Twisp Weir Operations Plan, and Kirk Truscott wanted to confirm the plan was consistent with the HCP Broodstock Collection Protocols with regard to percent hatchery-origin spawners (pHOS) management at the weir. Ferguson said he and Kristi Geris discussed this with Tracy Hillman (HCP Hatchery Committees Chairperson), and Andrew Gingerich (Douglas PUD Aquatic SWG Technical Representative) held a discussion internally with Douglas PUD. Ferguson said it was determined that Douglas PUD was operating within the current permits, and there were no issues or conflicts between the Aquatic SWG plan and HCP protocols. Tom Kahler added there is not a huge need for adult management at this location.

Jeff Korth asked if the weir sustained any damages from the recent wildfires in the area. Kahler said a staff member is planning to visit the weir today. He said the weir is currently not operating and guessed the only possible damages may be to the hydraulic power unit, power poles, the acclimation pond liner, and perhaps the fencing.

C. Meeting Minutes Approval (John Ferguson)

The Coordinating Committees reviewed the revised draft June 23, 2015, meeting minutes. Kristi Geris noted the following:

- The addition of two review items.
- Minor edits received from Jeff Korth clarifying state contingency planning for drought conditions as discussed during the HCP Hatchery Committees Hatchery and Genetic Management Plan update.
- Minor edits received from Tom Kahler clarifying versions of documents distributed regarding coho survival estimates.

Geris said all other comments and revisions received from members of the Committees were incorporated into the revised minutes. Coordinating Committees members present approved the June 23, 2015, meeting minutes, as revised.

D. Last Meeting Action Items (John Ferguson)

Action items from the Coordinating Committees meeting on June 23, 2015, and follow-up discussions, were as follows *(note: italicized item numbers below correspond to agenda items from the June 23, 2015, meeting):*

- *Chelan PUD will provide an updated Rocky Reach Juvenile Fish Bypass (RRJFB) pre-season marked fish release results table that includes additional notes about the results, as requested, to Kristi Geris for distribution to the Coordinating Committees (Item I-C).*

  Lance Keller provided the updated table to Geris on August 24, 2015, which Geris distributed to the Coordinating Committees that same day.
- *John Ferguson will coordinate with Brian Burke (National Marine Fisheries Service [NMFS]) about presenting to the Coordinating Committees in the fall 2015 Burke's presentation titled, "Ocean Conditions in 2014; Potential Consequences for Salmon," that Tracy Hillman (BioAnalysts) shared with the HCP Hatchery and Tributary Committees in the spring 2015 (Item I-C).*

  Ferguson said he spoke with Burke yesterday and confirmed that Burke will present during the Coordinating Committees meeting on October 27, 2015.
- *Tracy Hillman will provide the most recent progress report on nutrient work in the Yankee Fork Salmon River, as discussed during the HCP Tributary Committees Update, to Kristi Geris for distribution to the Coordinating Committees (Item II).*

  Hillman provided the report titled, "Salmon River Basin Nutrient Enhancement: Contract Year 2014-2015 Research, Monitoring, and Evaluation Annual Progress Report," (Kohler et al. 2015) to Geris following the meeting on June 23, 2015, which Geris distributed to the Coordinating Committees that same day.
- *Tom Kahler will provide the corrected memorandum outlining the comparison of juvenile survivals of spring Chinook and coho salmon and steelhead released from Winthrop National Fish Hatchery (NFH) to Kristi Geris for distribution to the Coordinating Committees (Item IV-A).*

Kahler provided the corrected memorandum to Geris following the meeting on June 23, 2015, which Geris distributed to the Coordinating Committees that same day.

- *Tom Kahler will contact Bob Rose regarding obtaining the YN's expedited approval of Wells Project Land-use Permit Application No. 1030-01 CCT; Item IV-B).*
  Kahler said he was unable to reach Rose, and the permit application moved forward following the end of the review period.
- *Tom Kahler will provide the Columbia River Inter-Tribal Fish Commission's (CRITFC's) letter outlining proposed scheduling for sockeye salmon sampling at Wells Dam in 2015 to Kristi Geris for distribution to the Coordination Committees (Item III-C).*
  Kahler provided CRITFC's schedule to Geris following the meeting on June 23, 2015, which Geris distributed to the Coordinating Committees that same day.
- *The Coordinating Committees meeting on July 28, 2015, will be held by conference call (Item VI-B).*
  This meeting was canceled due to lack of agenda items.

II. Douglas PUD

A. DECISION: Wells Fishways Lamprey Enumeration Structures (Tom Kahler)

Tom Kahler provided hard copies of the engineering design drawings of the lamprey enumeration structures to be installed at Wells Dam (Attachments B and C), which were also distributed electronically, along with the final Douglas PUD 2015 Lamprey Study Plan, to the Coordinating Committees by Kristi Geris on August 13, 2015. Kahler reviewed a side profile of the proposed modifications as depicted in the bottom half of Attachment B. He noted the existing downstream ramp connecting the fishway floor to the counting floor at the count window. He said this ramp is louvered so water may flow through it; however, he recalled that a few years ago, a smooth, stainless steel plate was installed on top of and on the window side of the louvered ramp in efforts to improve lamprey passage through the counting window area. He said the proposed modification is to install a tunnel (depicted by a dashed line in Attachment B), which will provide a lamprey passage route that is less exposed to the ambient light emitted from the counting window area. He explained that lamprey seem to be averse to the light encountered in this area, which affects choice of passage route whereby some lamprey avoid enumeration. He said the tunnel will be installed adjacent to the count window so lamprey may still be enumerated; however, lamprey will not be directly exposed to the light from the area.

Jim Craig asked what the tunnel is made of, and Kahler said it is made of stainless steel except for the portion that spans the counting floor in front of the window, which is smoked polycarbonate plating. Kahler added that this material will allow a small amount of light through, which should help with enumeration. John Ferguson asked if the count window is also monitored by video, and Kahler said it is, with exceptional resolution. Kahler added that Douglas PUD is also considering installing an alert system to notify counters when fish are present. Ferguson asked if any roughness would be added to the tunnel. Kahler said the ramp, tunnel, and floor are smooth; however, there may be slight velocity reduction in the tunnel due to boundary effects and turbulence by virtue of water flowing through the structure. He added that it was determined the velocity of water moving through the counting area should not change. Ferguson asked what guides lamprey to the entrance of the tunnel. Kahler said there is a broad lamprey entrance to the tunnel that extends out and across the entire floor of the fishway. Craig noted this is well-depicted in Figures 3 and 4 of the final Douglas PUD 2015 Lamprey Study Plan. Ferguson asked if the installation is planned to take place during the 2015/2016 winter maintenance outage at Wells Dam, and Kahler confirmed that is the plan. He added that the previously approved lamprey boxes will also be installed during this time, as well as nylon brushes to close potential gaps throughout the counting station of the fishways. Scott Carlon asked if the final Douglas PUD 2016 Lamprey Study Plan is the same as the previously 2015 plan approved in 2014, and Kahler confirmed it is. Jeff Korth asked if the tunnel exits into a lit area, and Kahler said most of the light will be behind the lamprey once they exit the tunnel. Kahler added that the light emits only from the count window area.

Carlon indicated that before approving the installation, he will need to discuss the lamprey enumeration structures to be installed at Wells Dam with Aaron Beavers in regard to potential impacts to salmon passage. The Coordinating Committees agreed to consider approval of installation of the structures during the next Coordinating Committees meeting on September 22, 2015. *(Note: Carlon said Beavers agreed salmon passage would not be* *impacted by the proposed lamprey modifications and approved the installation, as distributed to the Coordinating Committees on September 1, 2015.)*

Craig noted the final Douglas PUD 2015 Lamprey Study Plan includes a paragraph about water and air temperature monitoring during the transport of lamprey from Priest Rapids Dam to Wells Dam; however, there is no mention of tempering, or conducting a final water quality check to ensure there are no drastic temperature changes between locations. Kahler said he believes this will be addressed by the Aquatic SWG. Bob Rose noted that, typically, the goal is to be within one degree between locations. Carlon asked if lamprey have the same sensitivity to temperatures as salmonids. Rose said he is unsure and suggested asking experts on lamprey such as Ralph Lampman (YN).

(Note: the Wells Coordinating Committee approved via email the proposed lamprey enumeration structures for installation in the fishways at Wells Dam during the 2015/2016 winter outage, as follows: Douglas PUD and USFWS approved Tuesday, September 1, 2015, and NMFS, WDFW, the CCT, and the YN approved Wednesday, September 2, 2015.)

B. Wells Bypass Operations (Tom Kahler)

Tom Kahler said bypass operations at Wells Dam ended at midnight on August 19, 2015, consistent with the Wells Gas Abatement Plan and Bypass Operating Plan. He said Wells Dam staff are in the process of removing barriers this week. He said there were no barrier removals during the bypass period and bypass operations this year were very routine.

C. Wells Hatchery Modernization (Tom Kahler)

Tom Kahler recalled that the Wells Hatchery Modernization is ongoing concurrent with normal hatchery operations. He said the hatchery modernization also includes an overhaul of the well field, and that drilling began months ago and is still underway. He said a new public boat launch and larger parking area are also being constructed and almost complete. He added that the existing launch will be reserved for PUD use only, as was originally intended. He reviewed several photographs of the ongoing modernizations that were captured by an on-site webcam, including photographs of the new pollution abatement pond, settling basin, location of the new adult handling facility, and newly installed well. He also shared a photograph depicting newly installed netting around two holding ponds. He said every year, thousands of fish are lost to avian predation, and the netting was installed to help mitigate this loss. He shared a photograph depicting the new spawning channel and said the old channel has been demolished, except for a few sections that were long ago converted to raceways. He shared a photograph of the head tank structure under construction that includes separate surface water and groundwater head tanks. He said the old hatchery building and concrete ponds will stay, added that the old incubation and hatchery office building will be used for the sturgeon program, and explained a new incubation building for salmon and steelhead will be constructed.

John Ferguson asked if HDR Engineering, Inc. (HDR) developed all of the designs, and Kahler confirmed they did. Ferguson asked about an estimated completion date, and Kahler said completion is projected by early 2018. Kahler added that the new adult handling facility should be complete by spring 2016. The Coordinating Committees applauded this modernization effort, noting the large amount of coordination and planning required to accomplish this. Kahler said Greg Mackey (Douglas PUD HCP Hatchery Committees Representative) and Shane Bickford (Douglas PUD HCP Policy Committees Representative) have taken the lead on this effort, and he noted that full-time construction monitoring by HDR has also helped a lot.

D. Trapping at Wells Dam (Tom Kahler)

Tom Kahler said there have been no temperature issues to date. He said so far, water temperature has peaked at 19.5 degrees Celsius, and that 21 degrees Celsius is the fish handling threshold. He added that water temperature typically peaks in September; however, so far temperatures have remained below the threshold. He said he believes collection for the Carlton Program is now complete and that stock assessment is now the only activity ongoing at Wells Dam.

E. Fish and Water Management Tool Modernization (Tom Kahler)

Tom Kahler recalled the first beta version of the Fish and Water Management Tool (FWMT) went into use about 13 years ago, which he noted is old for computer software. He said, therefore, the FWMT is undergoing modernization and improvement. He explained that in

November 2014, a workshop was convened to discuss what users liked about the FWMT and what needs to be fixed. He said updates are also being made to the hydrological algorithms. He stated Phase 1 will be complete by the end of this month or early September 2015, and Phase 2 will start immediately. He said ESSA Technologies, the original designers of the FWMT, have been contracted for the redesign.

F. Wells Bypass PIT-Tag Detection (Tom Kahler)

Tom Kahler said Douglas PUD currently relies on passive integrated transponder (PIT)-tag detection at Rocky Reach Dam to determine whether bypass operations at Wells Dam were compliant with permits and licensing. Kahler said this approach will continue; however, Douglas PUD plans to install PIT-tag detection at Wells Dam, as well. He said this additional detection will be useful for several activities, including to true-up estimates of travel time between Wells Dam and Rocky Reach Dam. Kahler shared a photograph depicting the bypass barriers at Wells Dam. He explained there are three intakes per bypass spillway. He said in each bypass spillway, the two outer intakes are blocked by solid barriers, and a set of six baffled barriers is installed in the center intake, which look like panels of windows. He added that each of the four central bypass barriers has 16 windows, and the upper and lower barriers have 12 windows each. He said Biomark plans to install four PIT-tag antennas in the top two rows of windows of Bypass Bay 2 (four windows total, vertically to obtain vertical distribution). Kahler said existing data indicate that most fish pass Wells Dam via Bypass Bay 2 and Bypass Bay 4, and near the surface. He said in March 2016, Douglas PUD plans to test detection through Bypass Bay 2 using tagged fish from Wells Hatchery (similar to RRJFB tagged release testing). He said although the testing plan has not yet been developed, fish will likely be released directly in front of the bypass and at the debris boom to determine detection efficiency and the relative spatial distribution of fish, and travel times will be monitored to Rocky Reach Dam.

Scott Carlon asked about the velocity through the windows, and Kahler said he believes it is relatively low (about 2 to 4 feet per second). Kahler added that the windows are inside the trash rack slots in the intakes on the upstream side of the dam. He also noted that there is a gate on the other side of the dam about 30 feet away. He said when water approaches the gate, it increases in velocity; however, velocity is relatively low as it moves through the windows.

G. Douglas PUD Activities (Tom Kahler)

Methow River Groins Rehabilitation Work

Tom Kahler explained that groins, or large rock structures, were installed in the early 1980s to divert flow away from the bank and help flush sediment out of the Methow River. He said these structures are now eroding away and need rebuilding. He said work will begin September 3, 2015, and is scheduled to be complete by the end of the month. He said this is all in-water work, and a silt curtain will be placed around each structure (four total). He said the Wells Reservoir will be lowered to accommodate this work, as well as concurrent work being conducted at Chief Joseph Dam involving replacement of old, oak-slat screens from toe wells with new stainless steel screens. He said the work at Chief Joseph Dam will be conducted via a tunnel that floods when the tailrace elevation exceeds 782 feet, so the U.S. Army Corps of Engineers and Douglas PUD will coordinate operations to maintain the Chief Joseph Dam tailrace elevation below 782 feet. He said Douglas PUD plans to start lowering the Wells Reservoir next week.

Cassimer Bar Culvert Repair

Jeff Korth asked about the culvert repairs in the Cassimer Bar dikes. Kahler said this work will be completed in fall 2016. He said he believes the Aquatic SWG is addressing this issue with regard to resident fish. He said the work will involve replacing failing culverts connecting channels to the Okanogan River. He added that Jim McGee (Douglas PUD) is working with Patrick Verhey (Washington Department of Fish and Wildlife) on this project.

III. Chelan PUD

A. Rocky Reach Dam and Rock Island End-of-Summer Spill (Lance Keller)

Lance Keller said at Rocky Reach Dam, summer spill was shut off at midnight on August 7, 2015. He said at that point, the subyearling Chinook salmon count was 36,970 fish, which means the remaining 5% equaled 1,848 fish. He said fish counts through August 24, 2015, averaged 7.5 fish per day, ranging from 1 to 16 fish per day; which seems to agree with the decision to shut off spill on August 7, 2015. He said the Data Access in Real Time (DART) database estimated 96.9% passage on August 7, 2015. He recalled the criteria for spill shutdown include the following: 1) DART estimates 95% of the total migration is complete; and 2) when subyearling index counts from the juvenile bypass sampling facility are 0.3% or less of the cumulative run for 3 out of any 5 consecutive days.

Keller said at Rock Island Dam, summer spill was shut off at midnight on August 11, 2015. He said at that point, the subyearling Chinook salmon count was 15,246 fish, which means the remaining 5% equaled 762 fish. He said fish counts through August 21, 2015, averaged 6.4 fish per day, ranging from 1 to 12 fish per day; which seems to agree with the decision to shut off spill on August 11, 2015. He said the DART database estimated 98.5% passage on August 11, 2015.

Jeff Korth asked why the index counts for Rocky Reach Dam versus Rock Island Dam are so different. Keller explained that at Rocky Reach Dam, the RRJFB is only operated from 8:00 to 11:00 a.m., and at Rock Island Dam there is 24-hour collection in the bypass trap. He said DART provides an expansion for Rocky Reach Dam data, which keeps everything consistent.

Keller said he will provide Kristi Geris with the fish data discussed. *(Note: Keller provided the fish data to Geris following the meeting on August 25, 2015.)*

B. Rock Island Emergency Consultation (Lance Keller)

Lance Keller said last Thursday, August 20, 2015, Chelan PUD and the Federal Energy Regulatory Commission (FERC) convened via conference call to discuss the emergency consultation associated to the Rock Island Interim Fish Passage Plan for the Wanapum Dam incident. Keller said FERC plans to send NMFS and USFWS a letter indicating FERC is adopting the Biological Assessment (BA), and is requesting a response from NMFS and USFWS within 30 days regarding how the respective agencies plan to move forward. Keller noted that plans to remove the denil structures are included in the BA. He added that removal of the structures is scheduled to occur during the 2015/2016 winter maintenance outage at Rock Island Dam. He said the denil structures will be stored in the boneyard at Rock Island Dam.

IV. HCP Committees Administration

A. Next Meetings (John Ferguson)

The next scheduled Coordinating Committees meeting is on September 22, 2015, and it will be held by conference call or in person at the Radisson Hotel in SeaTac, Washington, as is yet to be determined. *(Note: The Coordinating Committees meeting on September 22, 2015, was canceled due to lack of agenda items, as distributed to the Coordinating Committees on September 11, 2015.)*

The October 27, 2015 meeting will be held in person at the Radisson Hotel in SeaTac, Washington.

The November 24, 2015 meeting will be held by conference call, in Eastern Washington, or in person at the Radisson Hotel in SeaTac, Washington, as is yet to be determined.

List of Attachments

Attachment A	List of Attendees
Attachment B	Lamprey Enumeration Structure Design Drawing 1
Attachment C	Lamprey Enumeration Structure Design Drawing 2

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Lance Keller*	Chelan PUD
Tom Kahler*	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Jim Craig*	U.S. Fish and Wildlife Service
Jeff Korth*	Washington Department of Fish and Wildlife
Bob Rose*†	Yakama Nation

Note:
* = Denotes Coordinating Committees member or alternate
† = Joined by phone

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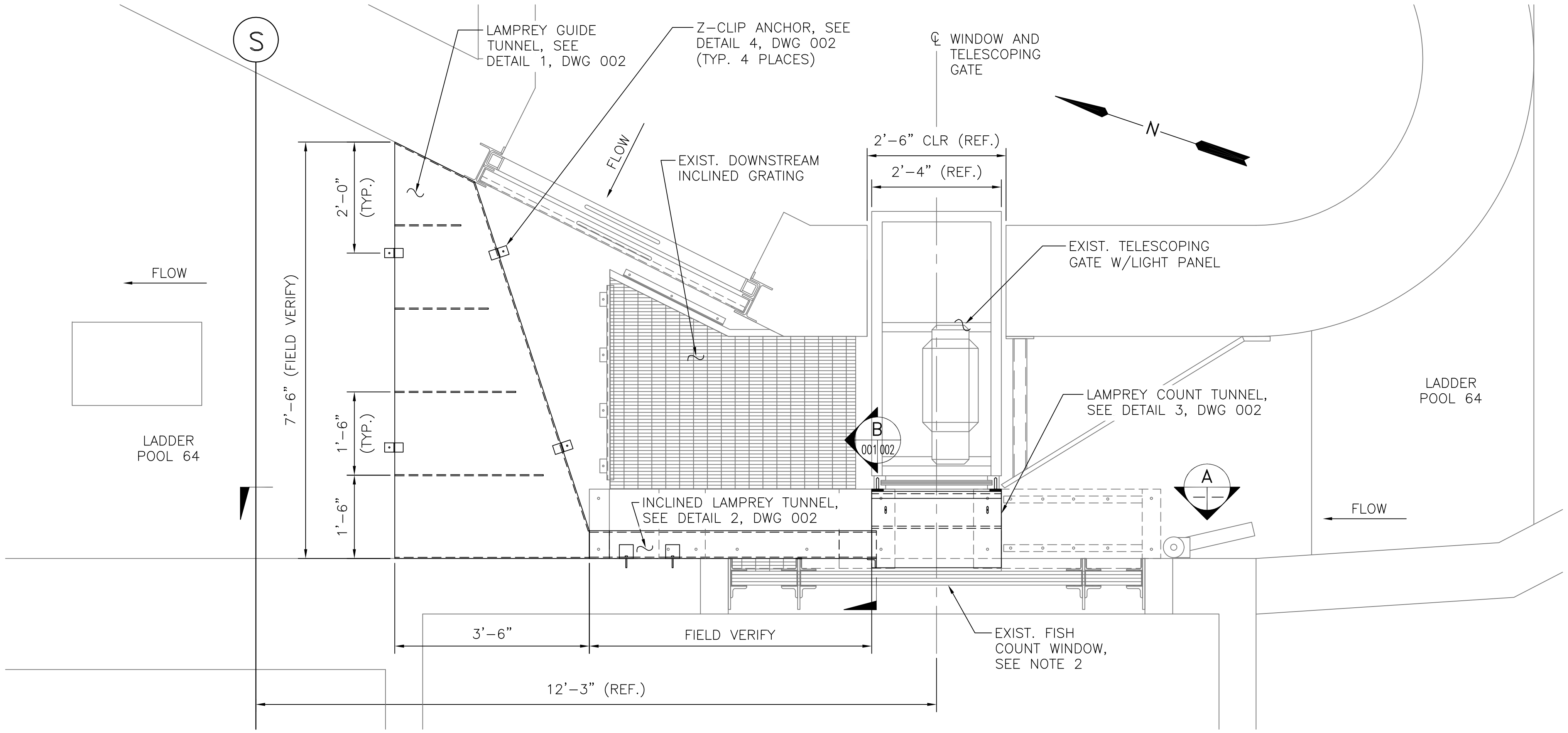
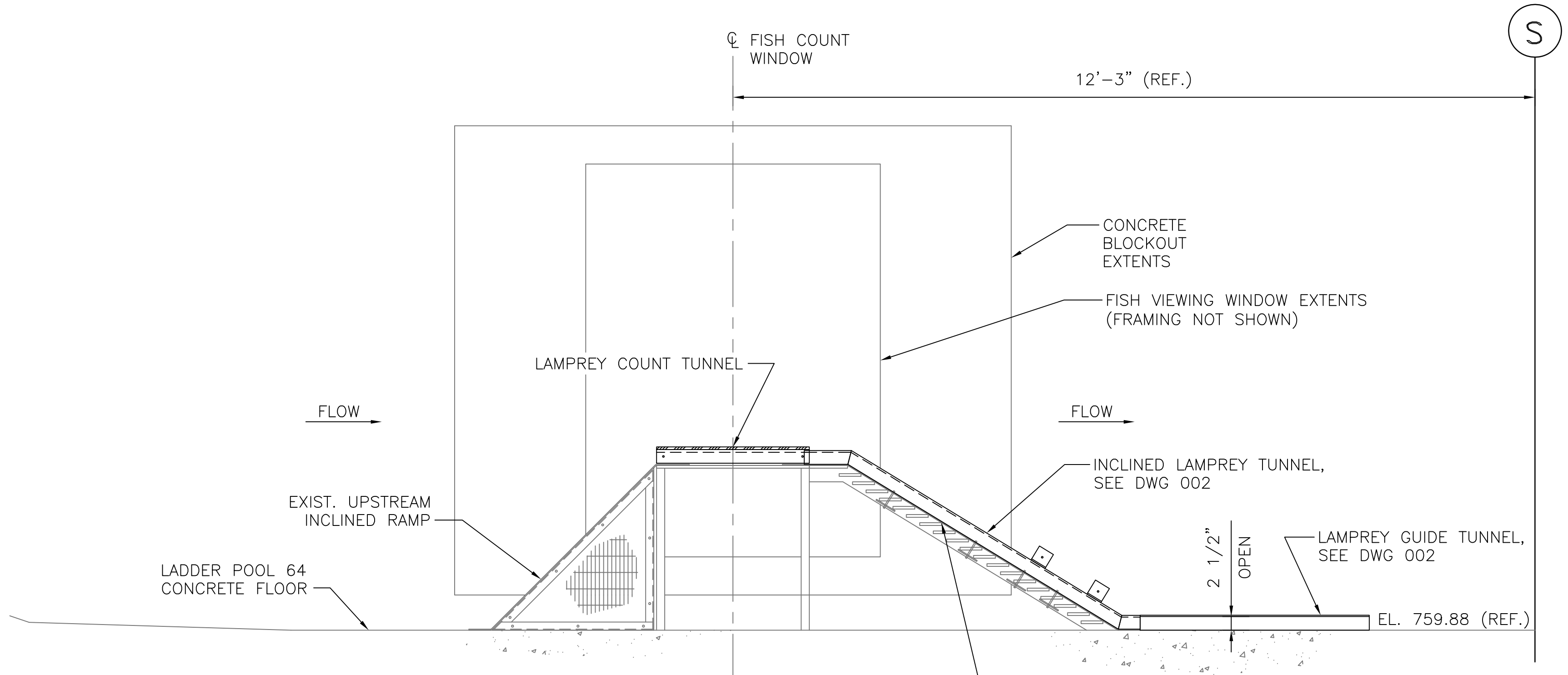


PLAN – EAST FISH FACILITIES
(WEST FISH OPP. HAND AND SIMILAR)

500 250 0 1 2
Scale in mm Scale in Feet



SECTION A
SCALE: 3/4"=1'-0"

NOTES:

1. THESE DRAWINGS WERE DEVELOPED FOR THE DISTRICT FOR FABRICATION AND INSTALLATION OF THE MODIFICATIONS TO BE MADE AT THE WELLS DAM EAST AND WEST FISH FACILITIES COUNTING WINDOWS TO IMPROVE LAMPREY PASSAGE AND COUNTING CAPABILITIES AND PREVENT LAMPREY FROM ACCESSING UNWANTED AREAS BY LIMITING GAPS TO 1/2" OR LESS IN THE LEAST DIMENSION.
2. AS-BUILT DRAWINGS DO NOT EXIST FOR THE LOUVERED RAMP, THE UPSTREAM METAL WALL, OR FISH COUNTING SHELF. THESE FABRICATIONS AS SHOWN MAY NOT BE DRAWN TO SCALE.
3. DIMENSIONS MARKED "(REF.)" ARE TAKEN FROM REFERENCE DRAWINGS OF THE DAM AND HAVE NOT BEEN VERIFIED.
4. ITEMS TO BE FABRICATED IN CONJUNCTION WITH THIS PROJECT WILL REQUIRE FIELD MEASURING, CUTTING, AND INSTALLATION IN ORDER TO FIT IN THE PROJECT AREA AND MEET THE GAP TOLERANCES OF 1/2" OR LESS GAP IN THE LEAST DIMENSION.
5. ALL STEEL SHALL BE 304 STAINLESS UNLESS OTHERWISE NOTED. ALL STEEL WELDING SHALL CONFORM TO THE REQUIREMENTS OF AWS D1.6.
6. TOUCH UP DAMAGED EXISTING HOT-DIP GALVANIZED COATINGS WITH ZIRP (COLD GALVANIZING COMPOUND) AS MANUFACTURED BY DUNCAN GALVANIZING OR EQUAL.

PRELIMINARY
NOT FOR CONSTRUCTION
03/30/2015

NO	DATE	REVISION	BY	CHK	JOB ENG	ENG PROJ	ENG

Public Utility District No.1 of Douglas County

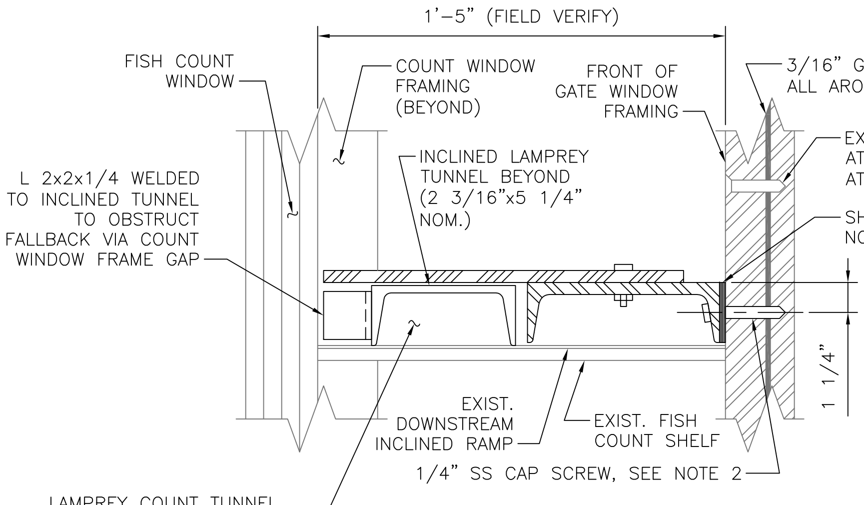
WELLS HYDROELECTRIC PROJECT
COLUMBIA RIVER

LAMPREY PASSAGE IMPROVEMENTS
EAST AND WEST FISH FACILITIES
PLAN AND SECTION

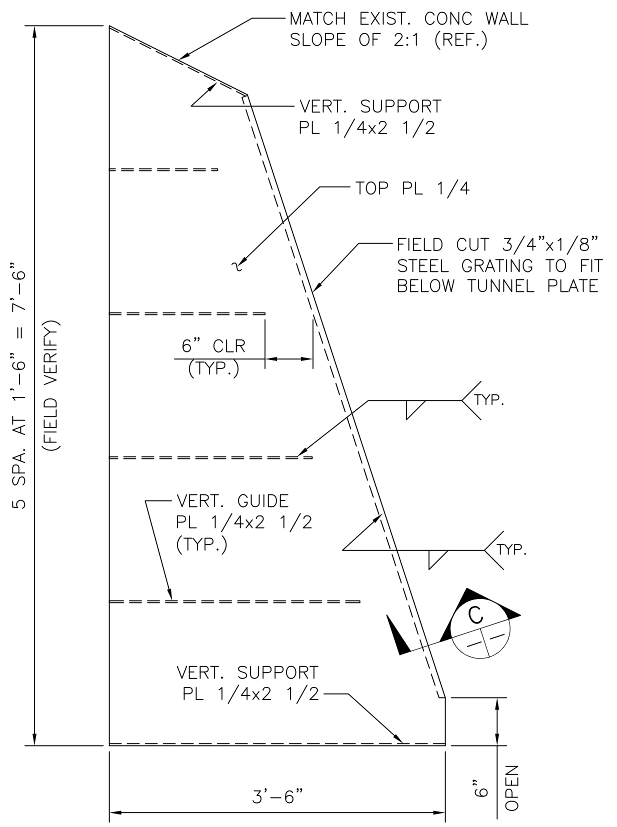
DESIGNED: DB DRAWN: ATH CHECKED: DATE: 03/2015 REVISION: A

JACOBS

DRAWING NUMBER: X643-06-6180-DS-001
SCALE: 3/4"=1'-0" SHT. 1 OF 2

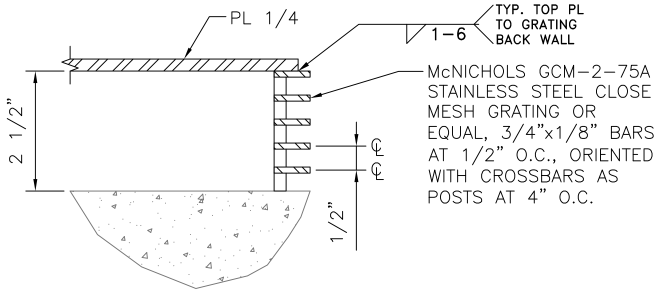


SECTION B
SCALE: 3" = 1'-0" B 001|002



LAMPREY GUIDE TUNNEL

DETAIL 1
SCALE: 1" = 1'-0" 001|002



SECTION C
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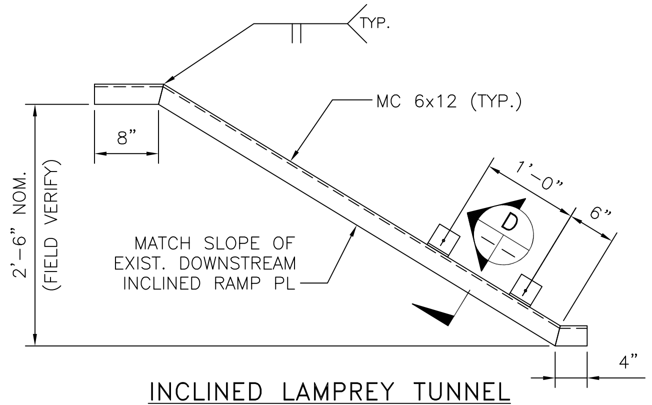
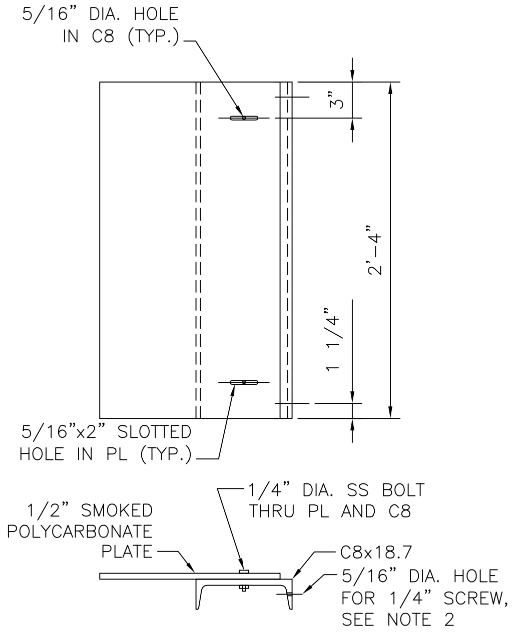


INCLINED LAMPREY TUNNEL

DETAIL 2
SCALE: 1" = 1'-0" 001|002

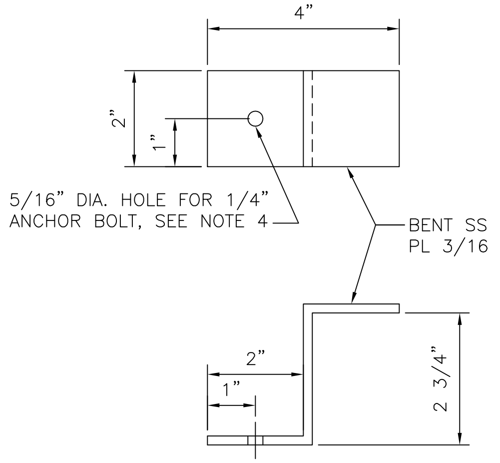
NOTES:

1. SEE DRAWING 001 FOR GENERAL NOTES.
2. TO INSTALL THE LAMPREY COUNT TUNNEL, DRILL AND TAP 2 1/2" INTO THE EXISTING GATE WINDOW FRAMING AT TWO PLACES FOR THE 1/4" STAINLESS STEEL CAP SCREWS SUCH THAT THEY DO NOT INTERFERE WITH EXISTING FRAMING ATTACHMENT SCREWS. HOLES SHALL BE LOCATED AT A HEIGHT ALLOWING THE C8 TO CLEAR THE EXISTING FISH COUNT SHELF AND THE UPSTREAM/DOWNSTREAM RAMP PLATES WITH NO MORE THAN A 1/2" GAP.
3. INSTALL LAMPREY COUNT TUNNEL USING 1/8" THICK, 2 1/2" SQUARE SHIMS AS NEEDED SO THAT THERE IS NO MORE THAN A 1/2" GAP BETWEEN THE C8 AND THE INCLINED LAMPREY TUNNEL MC6.
4. CONCRETE ANCHOR BOLTS SHALL BE 1/4"x2 1/4" HILTI KWIK-BOLT 3 STAINLESS STEEL EXPANSION ANCHORS.



LAMPREY COUNT TUNNEL

DETAIL 3
SCALE: 1 1/2"=1'-0" 001|002



Z-CLIP ANCHOR (4 REQ'D)

DETAIL 4
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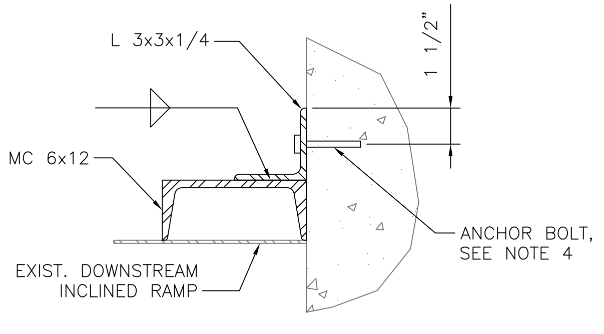

SECTION D
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PRELIMINARY
NOT FOR CONSTRUCTION
03/30/2015

NO	DATE	REVISION	BY	CHK	JOB ENG	ENG PROJ	ENG

Public Utility District No.1 of Douglas County

WELLS HYDROELECTRIC PROJECT
COLUMBIA RIVER

LAMPREY PASSAGE IMPROVEMENTS
EAST AND WEST FISH FACILITIES
SECTIONS AND DETAILS

DESIGNED: DB DRAWN: ATH CHECKED: DATE: 03/2015 REVISION: A
JACOBS
DRAWING NUMBER: X643-06-6180-DS-002
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ANCHOR QEA

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www.anchorqea.com

FINAL MEMORANDUM

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

Date: December 14, 2015

From: John Ferguson, HCP Coordinating Committees Chairman

Cc: Kristi Geris

Re: Final Minutes of the October 27, 2015, HCP Coordinating Committees Meeting

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Coordinating Committees met at the Radisson Gateway Hotel in SeaTac, Washington, on Tuesday, October 27, 2015, from 9:30 a.m. to 12:30 p.m. Attendees are listed in Attachment A to these meeting minutes.

ACTION ITEM SUMMARY

- Tom Kahler will provide the Wells Project Land-use Permits for renewal to Kristi Geris for distribution to the Coordinating Committees for review (Item IV-C).
- Chelan PUD will revise the draft 2015 Rocky Reach and Rock Island Spill Report, and will provide the final report to Kristi Geris for distribution to the Coordinating Committees (Item V-A). *(Note: Lance Keller provided a revised draft report for approval to Geris on December 4, 2015, which Geris distributed to the Coordinating Committees that same day.*)
- **The Coordinating Committees meeting on November 24, 2015, will be held by conference call (Item VI-B).**

DECISION SUMMARY

- Wells Coordinating Committee representatives present approved the Douglas PUD Coho Phase Designation Statement of Agreement (SOA; Item IV-A). *(Note: Jim Craig provided the U.S. Fish and Wildlife Service's [USFWS'] approval of the SOA via email on October 22, 2015.)*

AGREEMENTS

- Coordinating Committees representatives present agreed to add Alene Underwood (Chelan PUD HCP Hatchery Committees Representative) to the Coordinating Committees email distribution list (Item VI-A).

REVIEW ITEMS

- Kristi Geris sent an email to the Coordinating Committees on October 16, 2015, notifying them that the draft Douglas PUD 2015 Bypass Passage-dates Analysis was available for a 60-day review period, with edits and comments due to Tom Kahler by Tuesday, December 15, 2015 (Item IV-B).

FINALIZED DOCUMENTS

- The final Douglas PUD Coho Phase Designation SOA was distributed to the Coordinating Committees by Kristi Geris following the meeting on October 27, 2015 (Item IV-A).

I. NMFS

A. PRESENTATION: Physical and Biological Consequences of Recent Ocean Conditions (Brian Burke)

Brian Burke (National Marine Fisheries Service [NMFS]) shared a presentation titled, *Physical and Biological Consequences of Recent Ocean Conditions* (Attachment B), which was distributed to the Coordinating Committees by Kristi Geris on October 26, 2015.

This presentation provided an overview of ocean conditions, including changing sea surface temperatures and the recent “Blob” phenomenon, Pacific Decadal Oscillation, and the Oceanic Nino Index. NMFS scientists annually evaluate a number of ecosystem indicators, including zooplankton abundance and species richness, among other things. These indicators demonstrate the biological response to changing ocean conditions. The warming of sea surface temperatures in the offshore northern Pacific Ocean, or the “Blob,” became evident to scientists in the spring of 2013. Monitored data did not seem to indicate a significant biological response to this warming; although some data, such as Chlorophyll *a* levels and Columbia River salmon growth, suggested a positive response. The “Blob” gradually intensified and shifted onshore sometime around September 2014. Monitored data from post-September 2014 revealed several ecosystem indicators shifted from positive to negative. Shifts in normal conditions were widespread. The typical distribution of certain fish species shifted, having significant implications on commercial and tribal fisheries. Impacts to marine mammals and coastal birds, as well as other rare occurrences, were observed. While several data indicated a negative response, some data also suggested a mixed biological response. The large uncertainty is primarily due to the unique patterns observed in the ecosystem indicators in 2014 and 2015. Most of the patterns documented in 2014 and 2015 have not been observed in the past several decades. This is because of the simultaneous occurrence of warm water in the Gulf of Alaska and along the coast (the "Blob") and warm water coming up onto the shelf from the south as a result of the El Niño event.

II. Welcome

A. Review Agenda (John Ferguson)

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

B. Meeting Minutes Approval (John Ferguson)

The Coordinating Committees reviewed the revised draft August 25, 2015, meeting minutes. Kristi Geris said all comments and revisions received from members of the Committees were incorporated into the revised minutes. She said she also added the draft Douglas PUD 2015 Bypass Passage-dates Analysis for review in the upfront section of the revised minutes, and clarified throughout the minutes that the Coordinating Committees meeting on September 22, 2015, was canceled due to a lack of agenda items. Coordinating Committees members present approved the August 25, 2015, meeting minutes, as revised. *(Note: Jim Craig provided USFWS' approval of the revised minutes via email on September 22, 2015.)*

C. Last Meeting Action Items (John Ferguson)

Action items from the Coordinating Committees meeting on August 25, 2015, and follow-up discussions, were as follows. *(Note: italicized text corresponds to agenda items from the meeting on August 25, 2015):*

- *Scott Carlon will discuss the lamprey enumeration structures to be installed at Wells Dam with Aaron Beavers (NMFS Fish Passage Engineer); approval of installation of the structures will be requested during the next Coordinating Committees meeting on September 22, 2015 (Item II-A).*
  Carlon said Beavers agreed salmon passage would not be impacted by the proposed lamprey modifications and approved the installation, as distributed to the Coordinating Committees on September 1, 2015.
- *Lance Keller will provide Kristi Geris with the fish data discussed during the Rocky Reach Dam and Rock Island Dam end-of-summer spill discussion (Item III-A).*
  Keller provided the fish data to Geris following the meeting on August 25, 2015.

III. HCP Tributary and Hatchery Committees Update

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

Tracy Hillman updated the Coordinating Committees on the following actions and discussions that occurred at the HCP Tributary Committees meeting on September 10, 2015:

- *General Salmon Habitat Program Proposal:* The Cascade Columbia Fisheries Enhancement Group requested funding for its Silver Side Channel Revival – Phase I Project. The purpose of the project was to enhance aquatic habitat within the lower 2,000 feet of the Silver Side Channel located in the middle reach on the Methow River. The original intent was to enhance the entire 6,500 feet of the side channel, but due to landowner permission issues, only the lower third of the channel can be enhanced at this time. The HCP Tributary Committees believe the proposed project would provide some biological benefit; however, restoring only the lower third of the channel will not achieve the benefits the Committees believe are possible at a reasonable cost. Additionally, the total cost of the project is much higher when the actions are implemented piecemeal; therefore, the HCP Tributary Committees declined the opportunity to fund the project. The Committees indicated they would like to see a proposal to enhance the lower two-thirds of the channel, or the entire length of the channel, once the sponsor receives landowner permission.
- *Small Projects Program Proposal:* The Okanagan Nation Alliance submitted a Small Projects Program application for the Bank Stabilization at Shingle Dam Removal Site. The purpose of the project was to help stabilize stream banks following

the removal of Shingle Creek Dam. The Committees believe the channel will continue to evolve as it adjusts to the removal of the dam, and there is a large bedrock outcrop on stream left, which will eventually preclude further bank erosion. As such, the HCP Tributary Committees do not believe it is necessary to try to stabilize the bank, and the Committees declined the opportunity to fund the project.

- *Budget Modification:* The Rocky Reach Tributary Committee approved a budget amendment request from Trout Unlimited on the MVID Instream Flow Improvement Project.

Hillman said the HCP Tributaries Committees did not meet in October 2015; rather, some members attended project tours in Canada with the Priest Rapids Coordinating Committee Habitat Sub-Committee (PRCC-HSC). Hillman said they toured restoration projects on Shuttleworth, Ellis, and Penticton creeks. He said they also visited potential restoration sites on Naramata Creek and along the Penticton Channel. He said the tour also included a visit to Allendale Lake Dam located in the upper Shuttleworth Creek watershed. He said the PRCC-HSC is considering funding removal of the dam to improve stream flows in Shuttleworth Creek.

Hillman updated the Coordinating Committees on the following actions and discussions that occurred at the last HCP Hatchery Committees meeting on October 21, 2015:

- *Rock Island Dam Refurbishment Update:* Chelan PUD provided an update on the ongoing rehabilitation of Rock Island Dam Powerhouse 1 Turbine Units B4 through B8, as requested by Jeff Korth.
- *Five-Year Hatchery Monitoring and Evaluation (M&E) Review Planning:* The HCP Hatchery Committees are reviewing the Five-Year Hatchery M&E Report and identifying monitoring results for further evaluation. This includes spawning distribution of wild- and hatchery-origin fish in the Methow Basin, hatchery replacement rate (HRR) targets, straying and homing, size at release, and methods for estimating freshwater productivity. This evaluation has been ongoing for the past 5 to 6 months. The HCP Hatchery Committees are now trying to determine a HRR target for the Methow Basin. Douglas PUD pulled together a spreadsheet for the Hatchery Evaluation Technical Team (HETT) to review. The HETT will meet

October 29, 2015, to discuss the HRR target spreadsheet and provide the HCP Hatchery Committees a recommended path forward.

- *Goat Wall Acclimated Release:* The Yakama Nation (YN) is hoping to release 25,000 fish in 2016 from its Goat Wall Acclimation Site; however, permitting for the release is still pending. The YN is coordinating with Craig Busack (NMFS) to obtain a permit. If a permit cannot be obtained soon, the Washington Department of Fish and Wildlife (WDFW) offered to authorize the Goat Wall releases as an extension to WDFW activities.
- *Excess Hatchery-by-Hatchery-Origin Steelhead:* WDFW indicated they have surplus brood year 2015 steelhead on hand, including 24,000 fish from the Methow Safety-Net Program, and 35,000 fish from the Okanogan Program. NMFS indicated these fish cannot be released in anadromous waters (because the fish are in excess of permit limits), and WDFW said the fish cannot be culled, which means the surplus fish must be released in non-anadromous waters. WDFW proposed, from the Methow Safety-Net Program, releasing 12,000 fish into Alta Lake and 12,000 fish into Patterson Lake. From the Okanogan Program, WDFW proposed releasing 17,500 fish into Bonaparte Lake and 17,500 fish into Crawfish Lake. All releases have now been approved by the HCP Hatchery Committees.
- *Wells Hatchery Modernization:* Douglas PUD provided an update on the ongoing Wells Hatchery Modernization. Notably, the old spawning channels are now gone, and concrete is being poured for the new head tanks and adult-handling facility.
- *Consultation Update:* There were three consultation updates, as follows: 1) Craig Busack announced he has transitioned into a Chief Scientist role within his group, and will now provide technical support in Biological Opinion development, and National Environmental Protection Act document development. He will no longer write permits. Dale Bambrick (NMFS) is searching for a new NMFS HCP Hatchery Committees Representative to replace Busack; however, Busack will still be available for technical support; 2) NMFS is almost finished with the Wenatchee steelhead consultation process, which may go to General Council this week; and 3) Chelan PUD submitted a new Methow Spring Chinook Salmon Hatchery and Genetic Management Plan for review; however, the research, monitoring, and evaluation, and genetic standards components are still pending.

IV. Douglas PUD

A. DECISION: Coho Phase Designation SOA (Tom Kahler)

Tom Kahler said the draft Coho Phase Designation SOA was distributed to the Coordinating Committees by Kristi Geris on October 16, 2015. Kahler noted he made one minor revision to the version that was previously distributed, clarifying that the Wells Coordinating Committee agreed to designate Methow River coho salmon as in Phase III (Standard Achieved), immediately following the finalization of a "HCP Hatchery Committee-approved" hatchery-compensation agreement with the YN. He recalled that Douglas PUD and Tom Scribner (YN) have been working on the language to this SOA for more than a year, and now the SOA is ready for a Coordinating Committees vote.

Jeff Korth noted mention of 2018 in the SOA, and Douglas PUD's plans to conduct a Verification Study in 2020, and he asked if one of these dates would be the end date of the SOA. Kahler said no, that the proposed SOA is for the term of the HCP. He further explained that the 2018 date is related to the current agreement between Douglas PUD and the YN for hatchery compensation. He added that Douglas PUD's Survival Verification Study 10-year interval is 2020, which is irrespective to coho salmon hatchery compensation requirements. Korth asked if this SOA locks in the 3.7% project passage-loss value measured for yearling Chinook salmon and steelhead. Kahler said it does not, that the project passage-loss value changes with every new verification study. He added that the HCP stipulates a 3-year average, and after each verification study, there will be a new multiyear average that includes the results from each verification study in addition to the results from each year of the original three years of studies. John Ferguson asked if the SOA needs to be modified to clarify this. Korth said that will not be necessary, as Kahler's explanation adequately answered his questions. Ferguson asked, when the project passage-loss value changes, is hatchery production automatically rescaled, or is HCP Hatchery Committees' approval needed first. Kahler said rescaling is automatic. He added that the HCP Hatchery Committees conduct a hatchery recalculation every 10 years, which is a completely different cycle. He explained that hatchery recalculation is the HCP Hatchery Committees determining the number of fish passing through their respective projects, to which a survival value is applied. He said this survival value fluctuates based on a multi-year average.

Kirk Truscott asked, under the HCPs, when a Phase III (Standard Achieved) is reached, can a species fall out of that phase. Kahler said yes, and read the following excerpt from the Wells HCP (Section 4.2.5.1):

> *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.*

Wells Coordinating Committee representatives present approved the Douglas PUD Coho Phase Designation SOA. *(Note: Jim Craig provided USFWS' approval of the SOA via email on October 22, 2015.)*

Kahler completed the revisions discussed, and the final Douglas PUD Coho Phase Designation SOA (Attachment C) was distributed to the Coordinating Committees by Geris following the meeting on October 27, 2015.

B. Draft 2015 Wells Bypass Passage-dates Analysis (Tom Kahler)

Tom Kahler recalled that Douglas PUD evaluates bypass timing at Wells Dam every 10 years. He said this is done by monitoring salmonid outmigration at the juvenile sampling facility at Rocky Reach Dam, and comparing those data with Wells Dam bypass operation dates. He recalled that in 2011, based on analyses of bypass passage dates by Drs. John Skalski and Richard Townsend of Columbia Basin Research, the Wells Coordinating Committee changed the Wells Dam bypass operation dates to start April 9 and terminate August 19, beginning with 2012 bypass operations. Kahler said, since then, Skalski and Townsend have run an analysis of the proportion of outmigration affected by bypass operations at Wells Dam every year. Kahler said these analyses are then summarized in an annual report. He said Kristi Geris sent an email to the Coordinating Committees on October 16, 2015, notifying them that the draft Douglas PUD 2015 Bypass Passage-dates Analysis was available for a 60-day review period, with edits and comments due to Kahler by Tuesday, December 15, 2015.

John Ferguson asked if this report suggests no bypass operation date adjustments. Kahler said that is correct. He added that date adjustments are evaluated in 10-year intervals, and this report is just summarizing results from the 2015 passage season. He said if data were consistently non-compliant or alarming, that would be an impetus to review timing. He added that if no comments are received on the draft report by the end of the review period, he will finalize the report.

Kahler said this winter, Douglas PUD is planning to install four passive integrated transponder (PIT)-tag antennas in Wells Bypass Bay 2. He recalled that most fish typically pass Wells Dam via river right at Bypass 2, and then pass in decreasing numbers east across the dam. He said installation of PIT-tag detection will allow Douglas PUD to true up travel-time data from Wells Dam to Rocky Reach Dam.

C. Wells Project Land-use Permits (Tom Kahler)

Tom Kahler recalled that the Coordinating Committees have recently reviewed two types of Wells Project Land-use Permits: 1) old land-use permits for renewal, which predated the HCPs and needed to be renewed under the new license; and 2) new land-use permit applications. He said he recently received a list of 12 additional Wells Project Land-use Permits. He said 9 of the 12 permits have already been reviewed by the Coordinating Committees (post-signing of HCPs). He said for these nine permits, the Douglas PUD Lands Department sent out notice of pending land-use action to the individual signatories, so approval of the permits is not documented in historical HCP meeting minutes. He said 6 of 12 permits will likely not be processed for various reasons (e.g., the property was sold, or the permit holder deceased). He said two of 12 permits are still considered active, including one for a joint-use dock, and another for a community dock, both located within the city limits of Brewster, Washington.

Kahler asked the Coordinating Committees if they wanted to review these permits. He said the permits were already reviewed by the Coordinating Committees in 2007 and 2008.

Kirk Truscott suggested, because the Coordinating Committees representation is largely different now than in 2007 and 2008, and in order to remain consistent with review of other Wells Project Land-use Permits, permits should be provided for review. Kahler said he will provide the Wells Project Land-use Permits for renewal to Kristi Geris for distribution to the Coordinating Committees for review.

V. Chelan PUD

A. Draft 2015 Rocky Reach and Rock Island Spill Report (Lance Keller and Thad Mosey)

Lance Keller said the draft 2015 Rocky Reach and Rock Island Spill Report (Attachment D) was distributed to the Coordinating Committees by Kristi Geris on October 26, 2015. Keller recalled that Thad Mosey (Chelan PUD) replaced Steve Hemstrom as Spill Coordinator, and now Mosey develops the draft report.

Mosey reviewed the draft report (Attachment D), noting that Chelan PUD was largely able to provide adequate spill coverage at both dams throughout the 2015 spill season. Mosey said, however, at Rock Island Dam, the spring spill was started slightly late for sockeye salmon, which resulted in it being the only species where 95% or more spill coverage was not provided. He explained that the program RealTime (developed by Dr. John Skalski and the University of Washington) indicated that on April 15, 2015, the percent run of sockeye salmon past Rock Island Dam was 5.1%. He said, in anticipation of an early sockeye salmon run, he requested that the spill start on April 16, 2015. He said on April 15, 2015, RealTime indicated sockeye salmon passage was 5.1%, and by April 16, 2015, passage was at 7.0%. He said, however, at the time, daily counts were still unknown. He said as a result, the actual percent passed turned out to be 23.0%, which resulted in 77.0% spill coverage for sockeye salmon. He noted that the sockeye salmon value reported in the draft report (94.9%) is incorrect and needs to be revised to 77.0%.

John Ferguson asked how this can inform future years' spill operations. Keller suggested that Chelan PUD keep monitoring passage and see if a trend develops. He said, typically, spring spill at Rock Island Dam does not start until April 15, at the earliest. He said last year, this year, and 1985, are anomalies. Ferguson asked what this may mean for overall outmigration abundance. Keller said he is uncertain.

Chelan PUD will revise the draft 2015 Rocky Reach and Rock Island Spill Report, and will provide the final report to Geris for distribution to the Coordinating Committees. *(Note: Keller provided a revised draft report for approval to Geris on December 4, 2015, which Geris distributed to the Coordinating Committees that same day.*)

B. Continued Rehabilitation Schedule for Rock Island Units B5 to B8 (Lance Keller)

Lance Keller noted that Keith Truscott already contacted individual Coordinating Committees representatives regarding the rehabilitation of Rock Island Dam Powerhouse 1 units. Keller recalled that in 2003, the Federal Energy Regulatory Commission approved the rehabilitation of Rock Island Dam Powerhouse 1 Units B5 through B10. He said Powerhouse 1 is the original powerhouse, located at river left. He said Powerhouse 1 has 11 units, including Unit BH (house unit), then Units B1 to B10. He said Units B9 and B10 were rehabilitated in 2008 and 2012, respectively. He said the rehabilitation effort was then paused to observe how the rehabilitated units performed. He said now the rehabilitation effort is ready to move forward again, with Unit B6 to be completed first in 2017. He said testing indicated that rehabilitated Units B9 and B10 are performing better than expected (higher efficiency). He said although the new units increase Rock Island Dam's hydraulic capacity on paper, Chelan PUD has elected to continue operating Rock Island Dam at the same capacity as before the rehabilitation.

Keller said upgrades include installation of a new greaseless wicket gate design and greaseless turbine pit design. He said the existing five-blade turbine structure will now be a four-blade structure. He said a new liner will be installed within each unit, with the diameter being the same as the existing liner. He added that the concrete walls of the draft tube will also be filled in places to reduce draft tube turbulence.

Bob Rose asked how much time is needed to complete the overhaul process. Keller said about 1 year, from start to finish. Rose asked how many units are remaining to be rehabilitated. Keller said four of six units are remaining to rebuild, including Units B6 to be completed in 2017, B5 in 2018, B7 in 2019, and B8 in 2020. Rose asked if Chelan PUD plans to conduct retesting once all units are rehabilitated. Keller said yes, the timing of the completion of the Powerhouse 1 rehab should match up with the check-in survival study for Rock Island Dam.

VI. HCP Administration

A. HCP-CC Distribution List – Alene Underwood (Chelan PUD)

Kristi Geris said Alene Underwood, Chelan PUD HCP Hatchery Committees Representative, requested via email on October 19, 2015, to be added to the Coordinating Committees email distribution list. Lance Keller added that Underwood is now the new Fish and Wildlife Program Manager, and would like to keep tabs on both HCP Hatchery and Coordinating Committees affairs. Coordinating Committees representatives present agreed to add Underwood to the Coordinating Committees email distribution list.

B. Next Meetings

John Ferguson said Denny Rohr, Priest Rapids Coordinating Committee Facilitator, asked if the Coordinating Committees planned to adjust their November meeting date on account of the Thanksgiving holiday. Kirk Truscott and Bob Rose both indicated they will be unable to attend the November meeting. Other representatives indicated moving the meeting date up 1 week will not work with their schedules and suggested convening by conference call on the regularly scheduled date. The Coordinating Committees meeting on November 24, 2015, will be held by conference call.

The December 22, 2015, and January 26, 2016, meetings will be held by conference call in Eastern Washington, or in person at the Radisson Hotel in SeaTac, Washington, as is yet to be determined.

VII. List of Attachments

Attachment A	List of Attendees
Attachment B	Physical and Biological Consequences of Recent Ocean Conditions (NMFS presentation)
Attachment C	Final Douglas PUD Coho Phase Designation SOA
Attachment D	Draft 2015 Rocky Reach and Rock Island Spill Report

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman††	BioAnalysts
Lance Keller*	Chelan PUD
Thad Mosey†	Chelan PUD
Tom Kahler*	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Brian Burke	National Marine Fisheries Service
Jeff Korth*	Washington Department of Fish and Wildlife
Kirk Truscott*	Colville Confederated Tribes
Bob Rose*	Yakama Nation

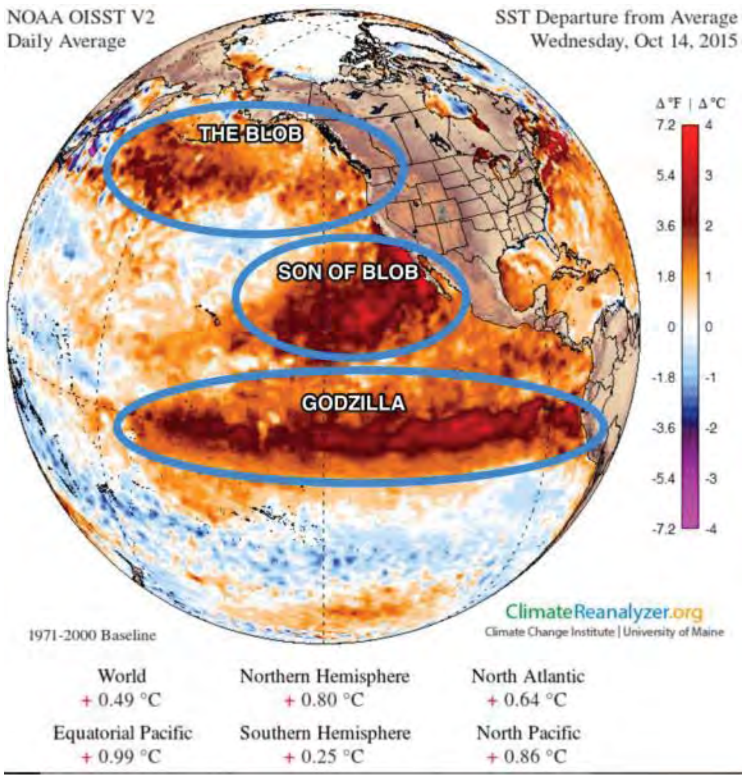
Notes:
* Denotes Coordinating Committees member or alternate
† Joined by phone
†† Joined for the NMFS presentation and HCP Tributary and Hatchery Committees Update

Attachment B

Physical and Biological Consequences of Recent Ocean Conditions

HCP-CC October 27, 2015

Brian Burke, NWFSC, NOAA Fisheries



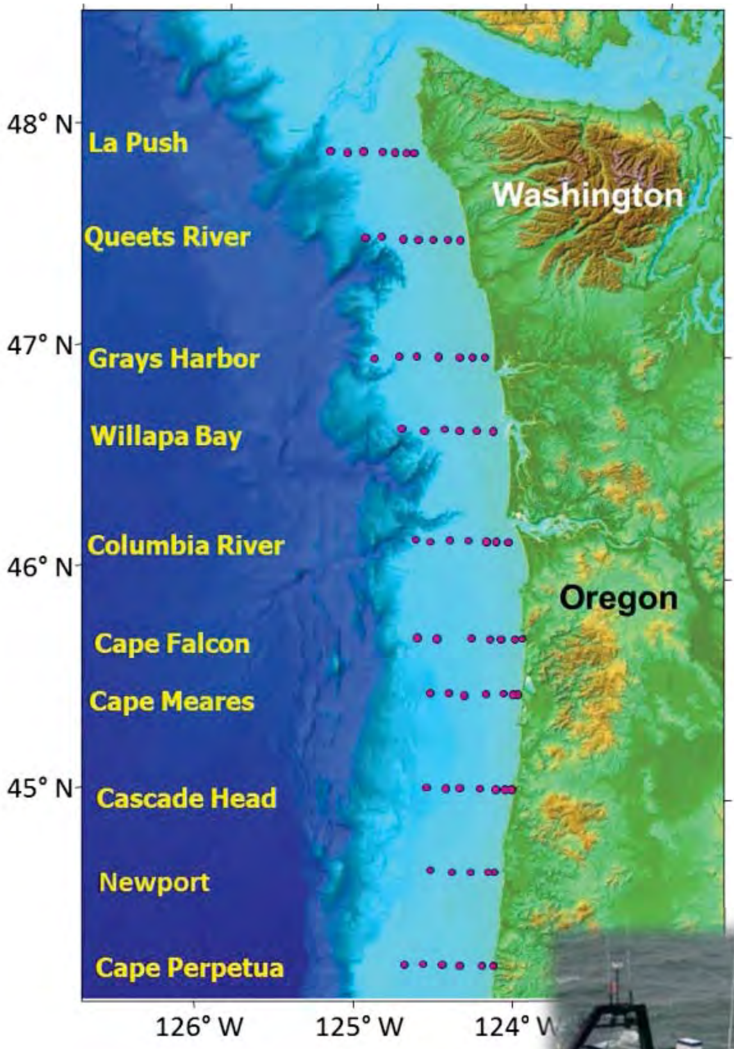
-Discover Magazine

- Short history of our project
- Short history of SST (2013-present) and the blob
- El Nino
- PDO
- Biological Response
  - Before and After September 2014
  - Harmful algal bloom
- Interior conditions

Observations

Juvenile salmon sampling:

- May (2006 – 2012, 2015-)
- June (1998 – present)
- September (1998 – 2012, 2015)

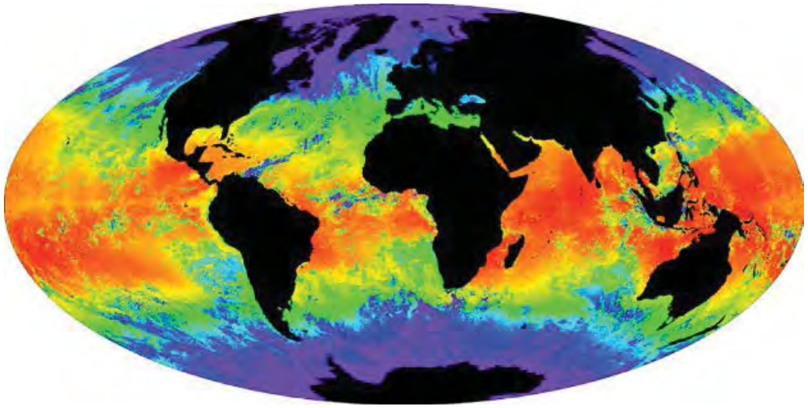


Indicators

(of ocean conditions relative to salmon)

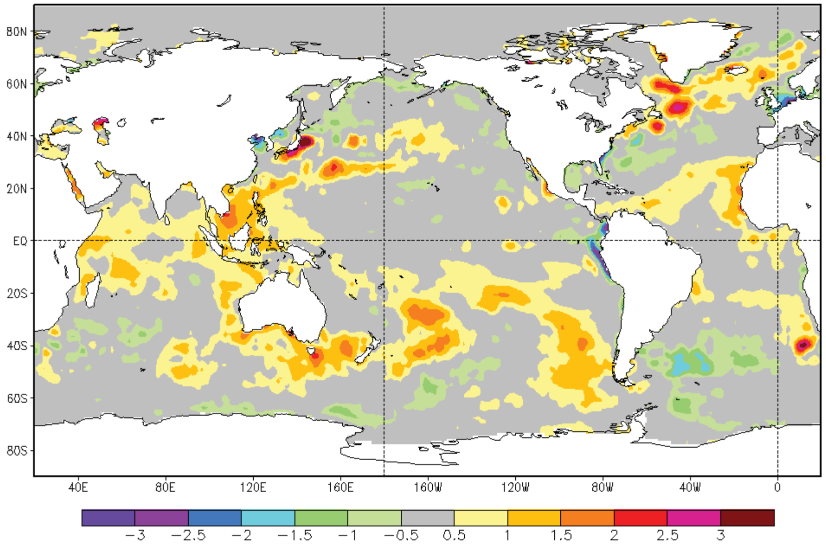
- **Basin Scale:**
  - PDO, NPGO, ONI
- **Local Scale SST:**
  - SST offshore and SST mid-shelf in summer; SST in winter
- **Coastal upwelling:**
  - spring transition; length of upwelling season, upwelling in spring; deep T and S in mid-shelf waters
- **Copepods:**
  - species richness, northern copepod biomass, copepod community structure index, date of biological spring transition
- **Ichthyoplankton:**
  - density in Jan-Mar of the larvae of species of fish that salmon eat
- **Salmon:**
  - catches of spring Chinook in June and coho in September

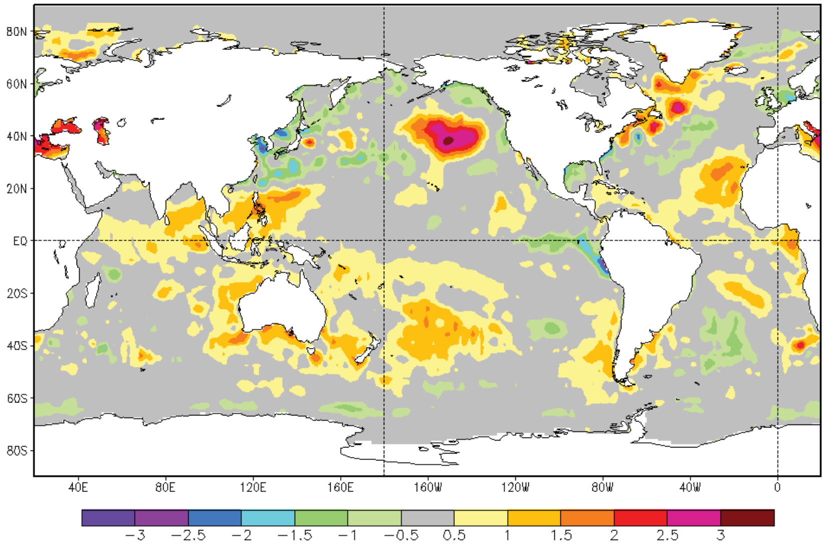
- Short history of our project
- Short history of SST (2013-present) and the blob
- El Nino
- PDO
- Biological Response
  - Before and After September 2014
  - Harmful algal bloom
- Interior conditions

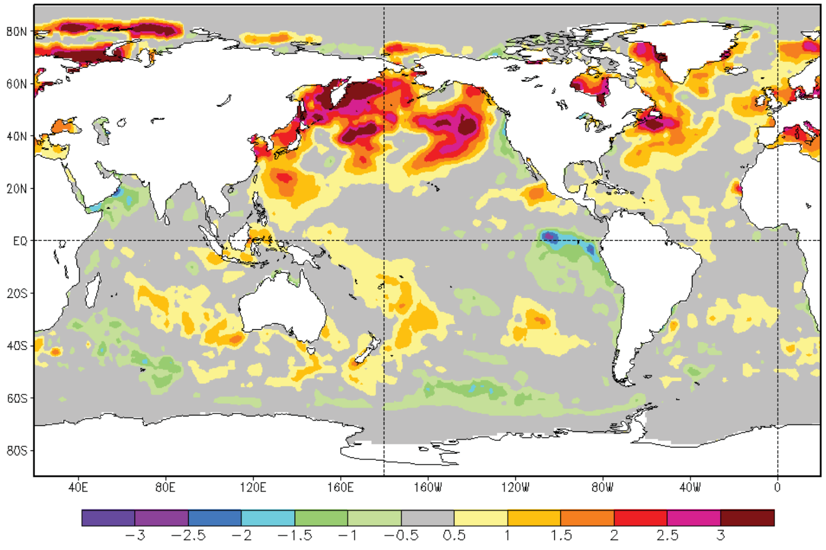


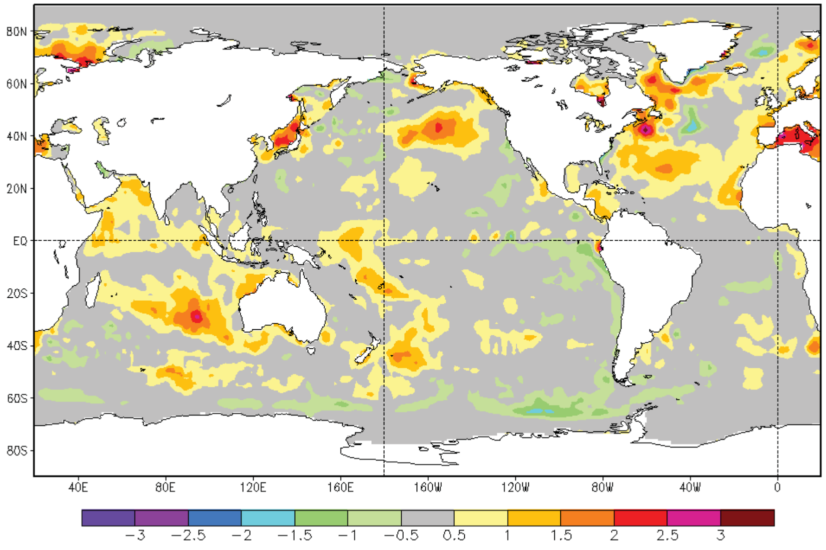
Attachment B

2013


Sea Surface Temperature Anomaly (°C), Base Period 1971–2000
Week of 3 APR 2013

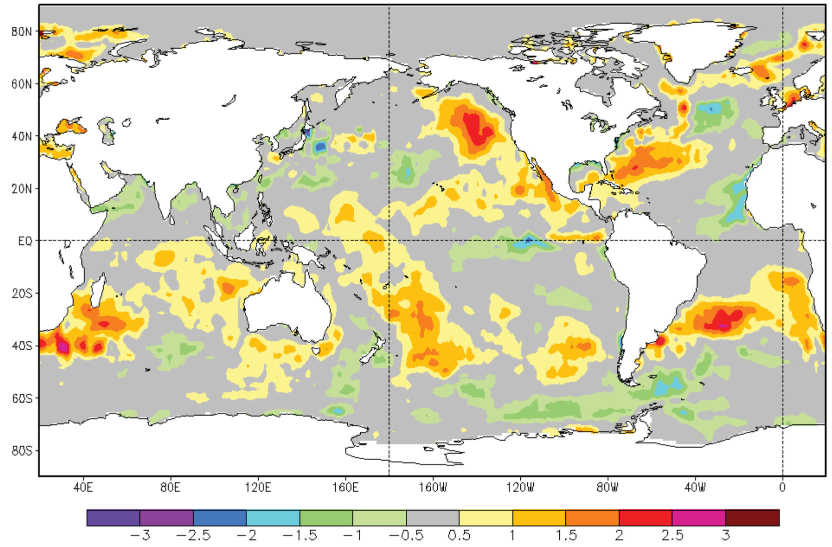

Sea Surface Temperature Anomaly (°C), Base Period 1971–2000
Week of 1 MAY 2013


Sea Surface Temperature Anomaly (°C), Base Period 1971–2000
Week of 7 AUG 2013

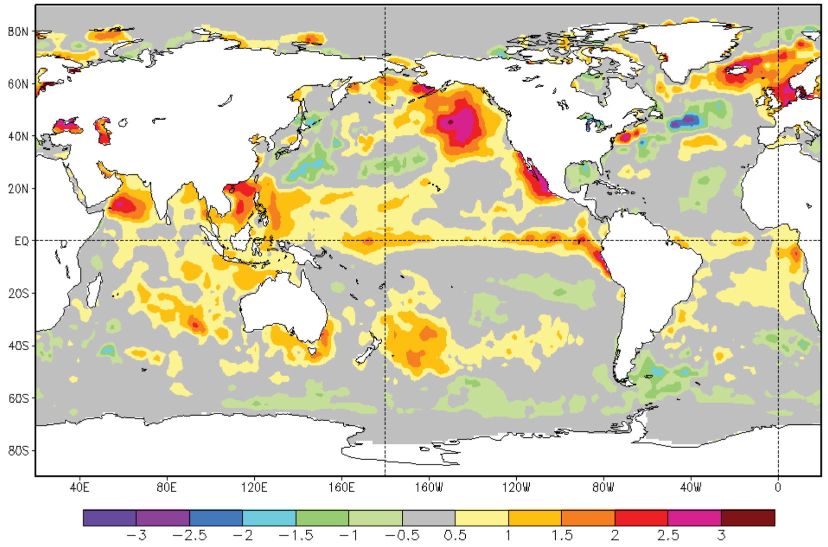

Sea Surface Temperature Anomaly (°C), Base Period 1971–2000
Week of 6 NOV 2013

2014

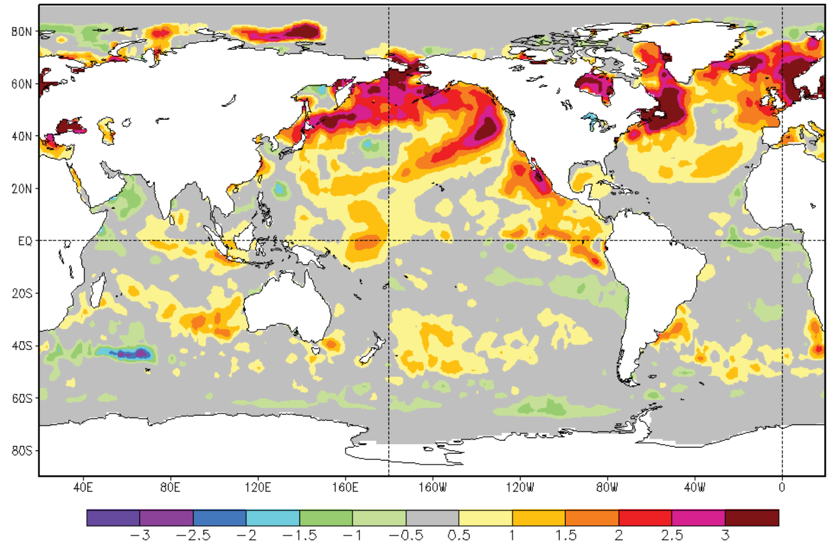
Sea Surface Temperature Anomaly (°C), Base Period 1971–2000
Week of 5 MAR 2014



Sea Surface Temperature Anomaly (°C), Base Period 1971–2000
Week of 4 JUN 2014

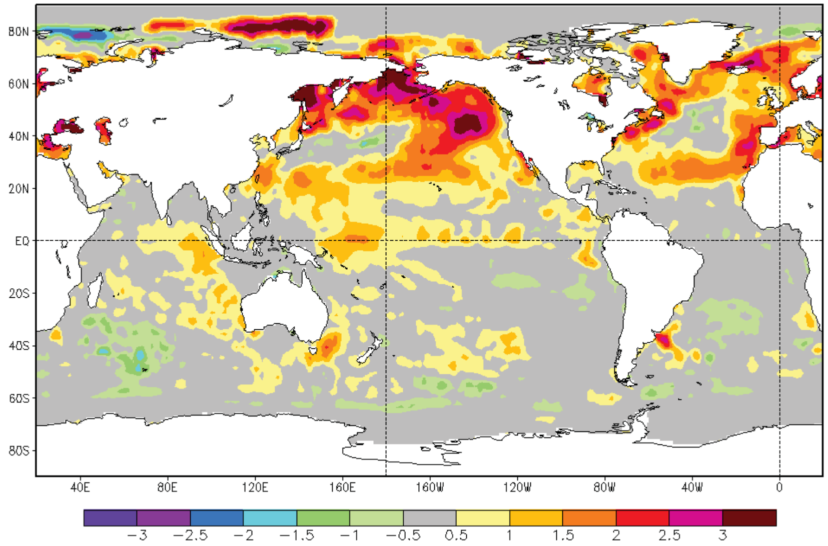


Sea Surface Temperature Anomaly (°C), Base Period 1971–2000
Week of 6 AUG 2014

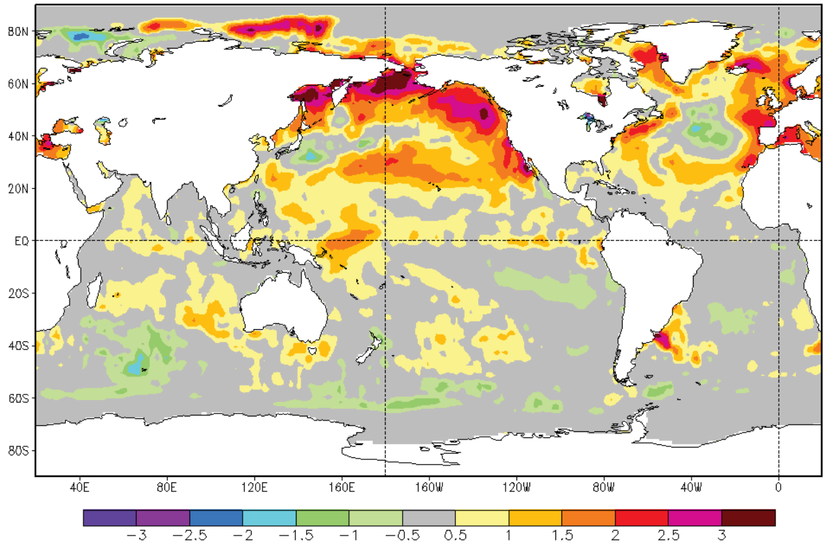


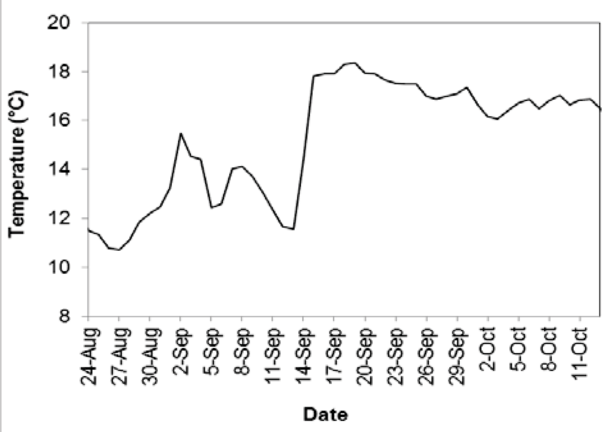
Shift onshore in September 2014

Sea Surface Temperature Anomaly (°C), Base Period 1971–2000
Week of 10 SEP 2014



Sea Surface Temperature Anomaly (°C), Base Period 1971–2000
Week of 24 SEP 2014



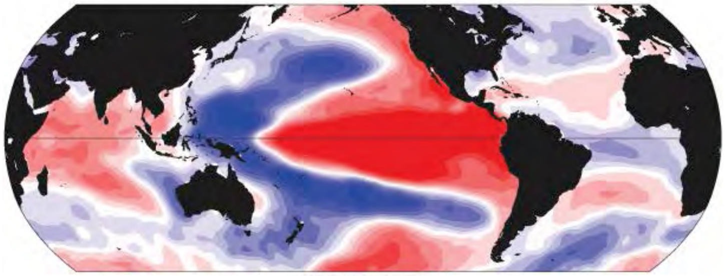


Sea surface temperatures
recorded at Stonewall Bank

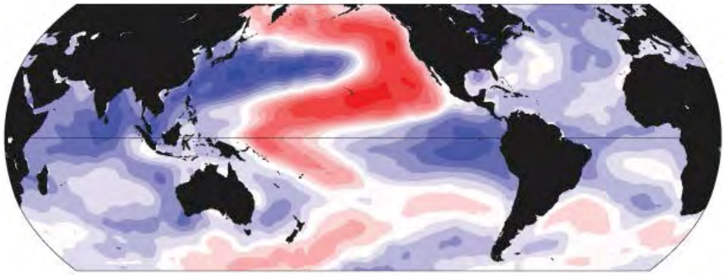
Attachment B

2015

Sea surface temperature anomaly patterns



Classic ENSO signal

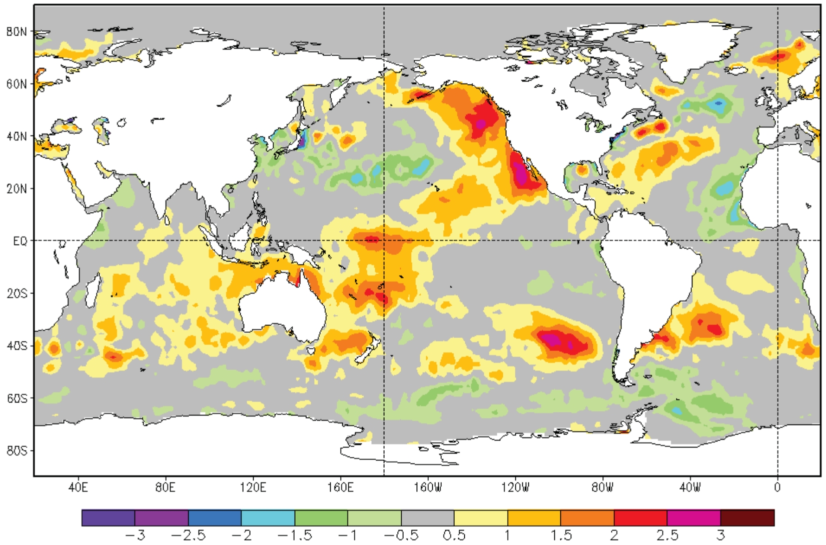


North Pacific Mode

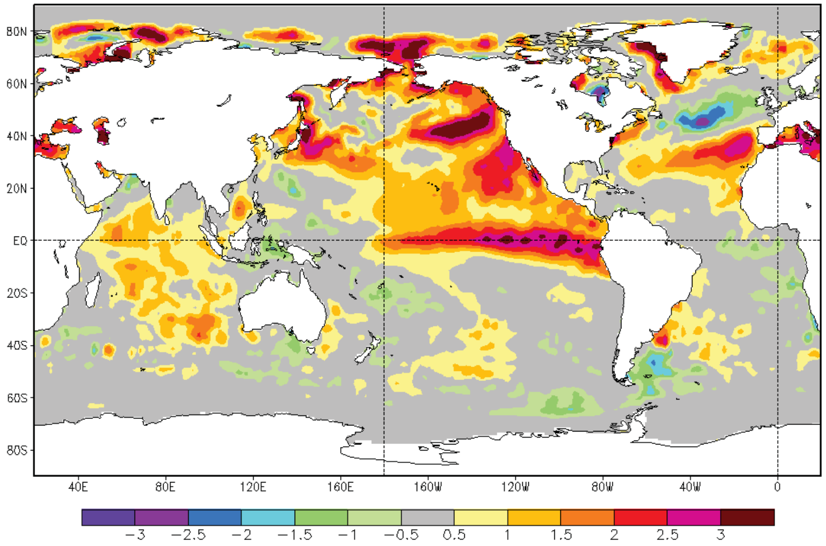
NOAA Climate.gov

https://www.climate.gov/author/dennis-hartmann

Sea Surface Temperature Anomaly (°C), Base Period 1971–2000
Week of 4 MAR 2015



Sea Surface Temperature Anomaly (°C), Base Period 1971–2000
Week of 5 AUG 2015



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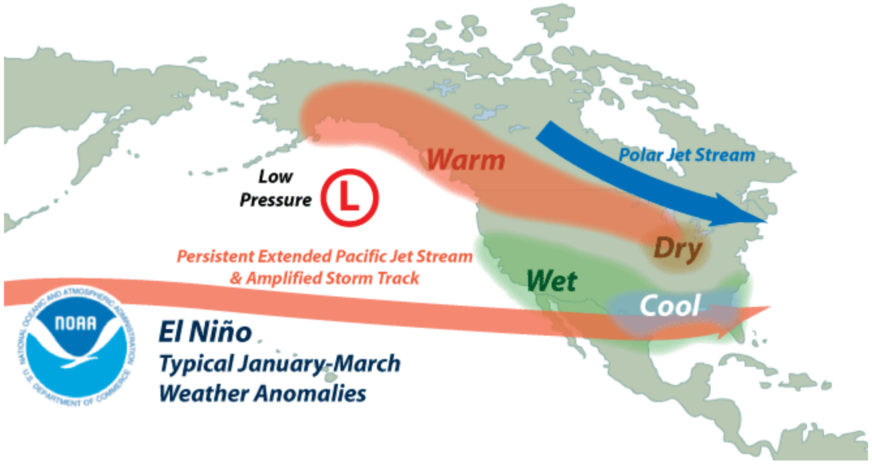
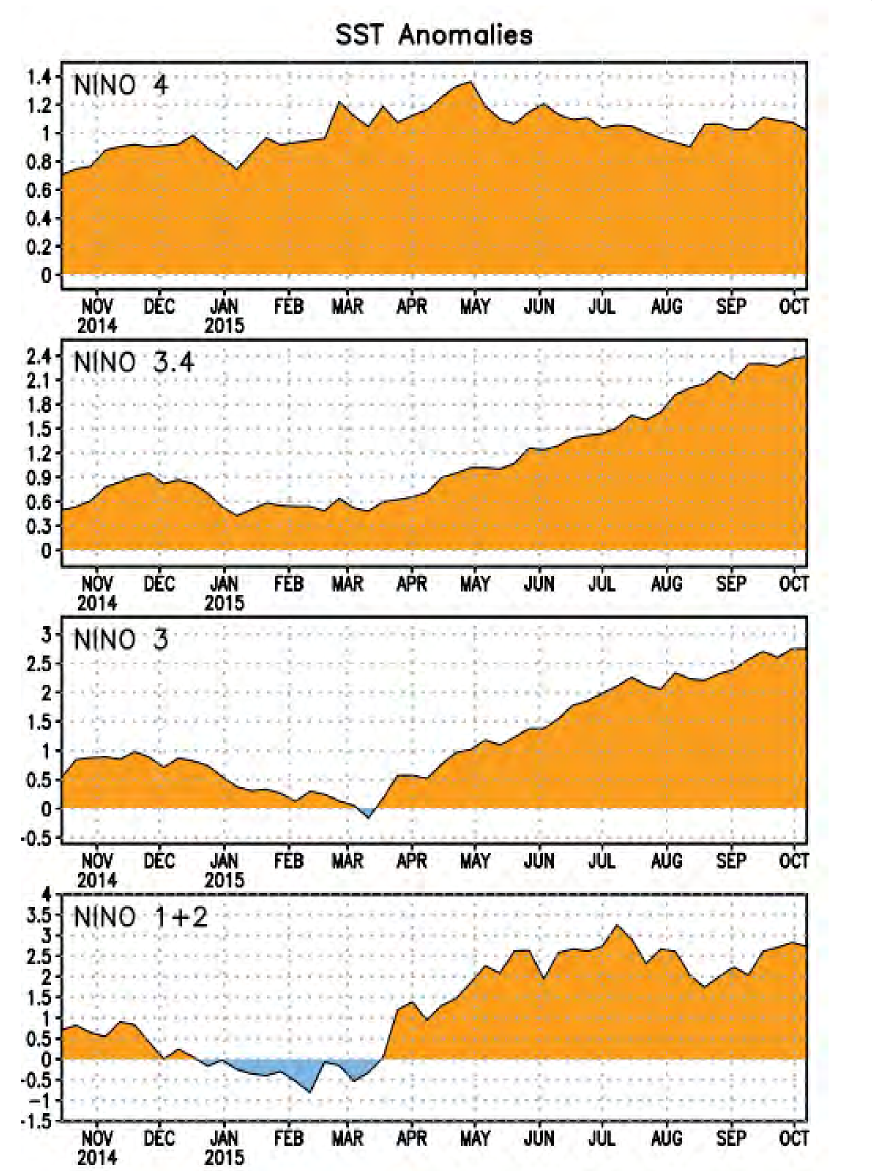
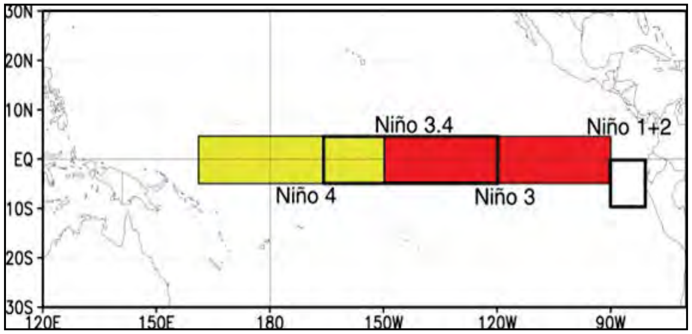


Niño Region SST Departures (°C) Recent Evolution

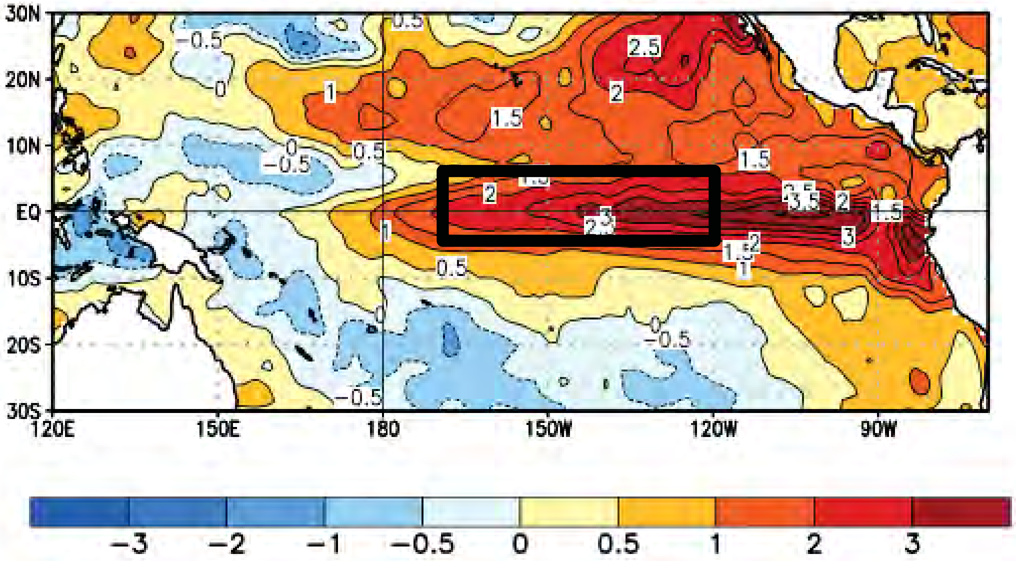


The latest weekly SST departures are:

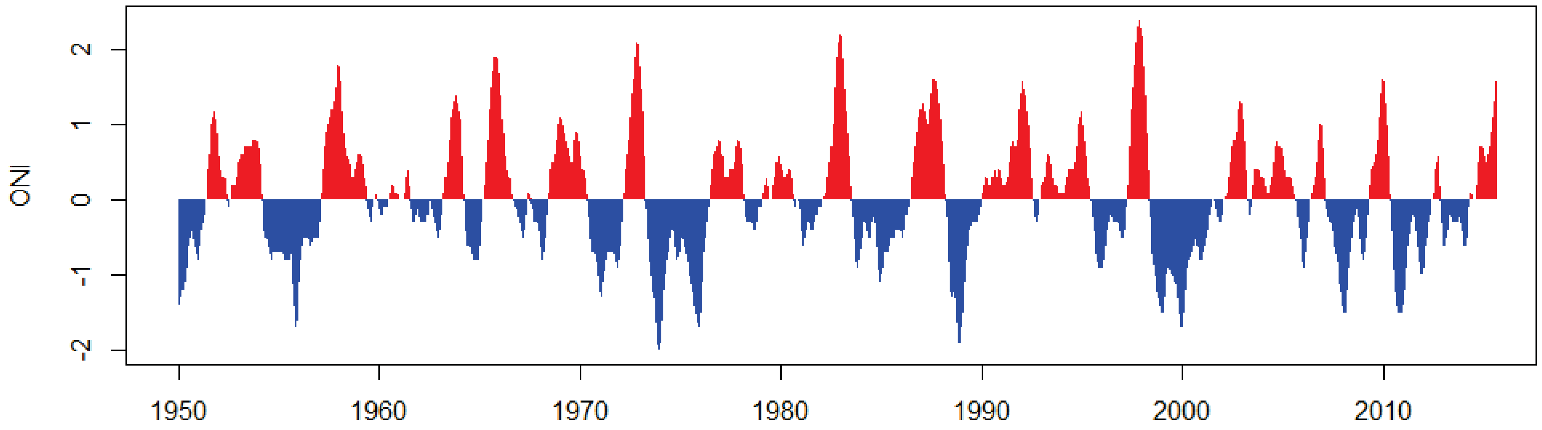
Niño 4	1.0ºC
Niño 3.4	2.4ºC
Niño 3	2.8ºC
Niño 1+2	2.7ºC



Attachment B



Average SST Anomalies
13 SEP 2015 – 10 OCT 2015

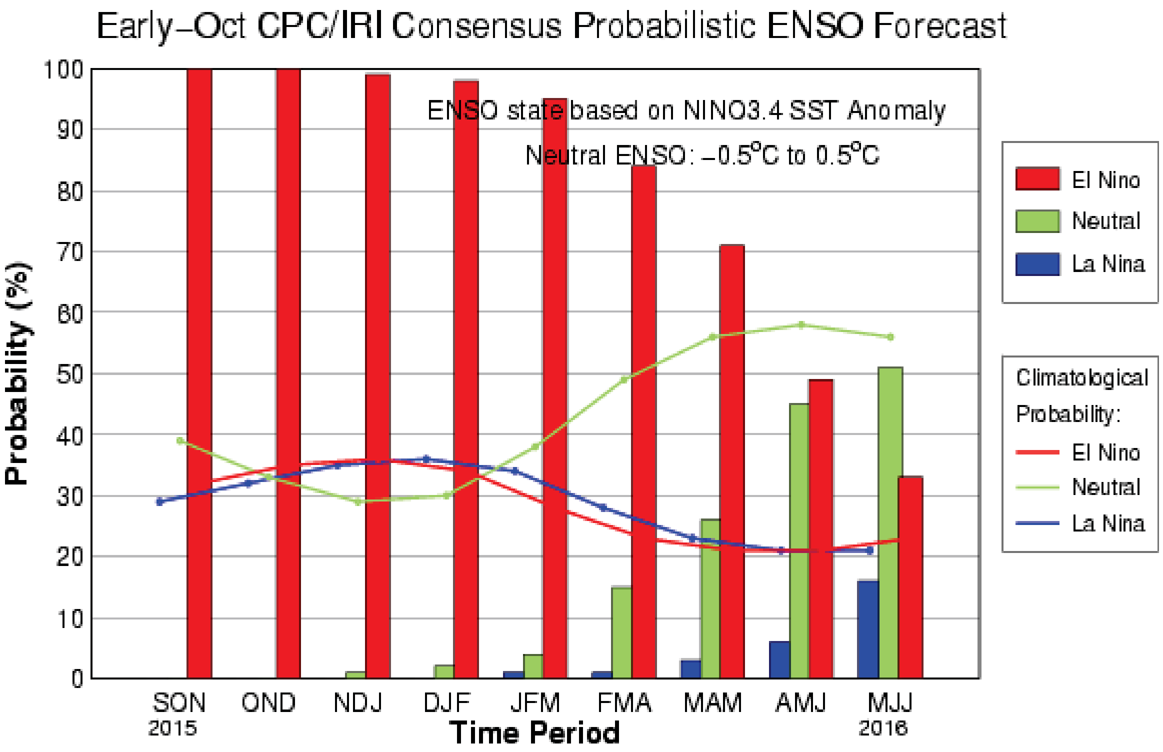


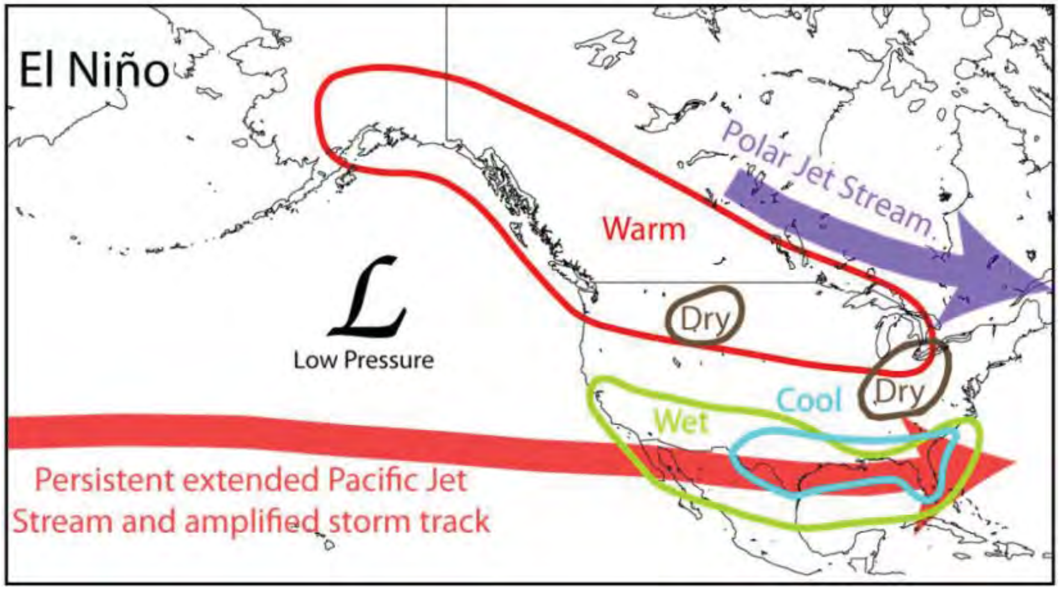
Attachment B

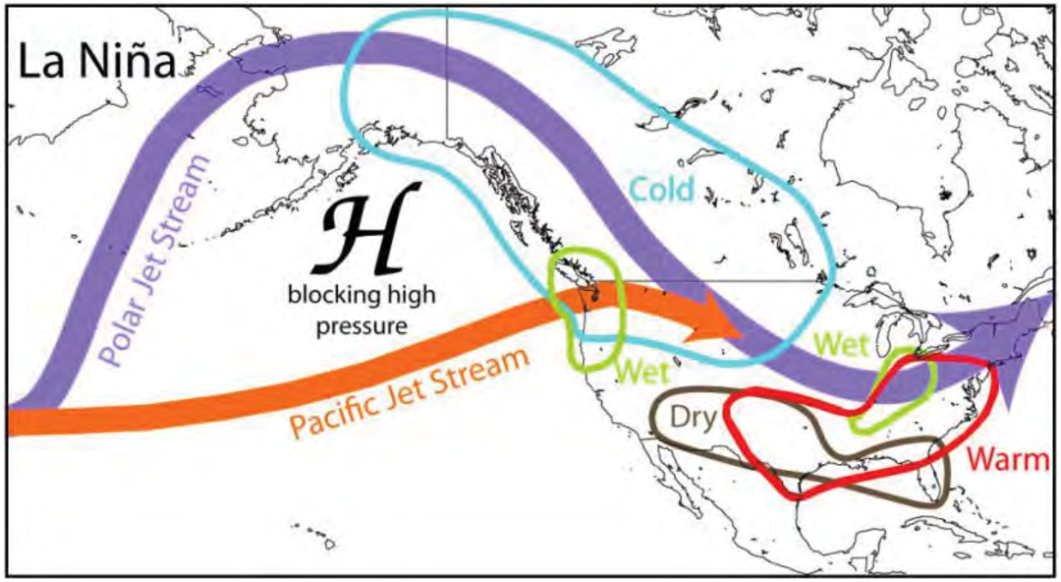
CPC/IRI Probabilistic ENSO Outlook

Updated: 8 October 2015

The chance of El Niño is approximately 95% through Northern Hemisphere winter and is just under 50% by late spring (AMJ) 2016.




El Niño
Polar Jet Stream
Warm
L
Low Pressure
Dry
Dry
Cool
Wet
Persistent extended Pacific Jet Stream and amplified storm track


La Niña
Polar Jet Stream
H
blocking high pressure
Cold
Wet
Wet
Wet
Pacific Jet Stream
Dry
Warm

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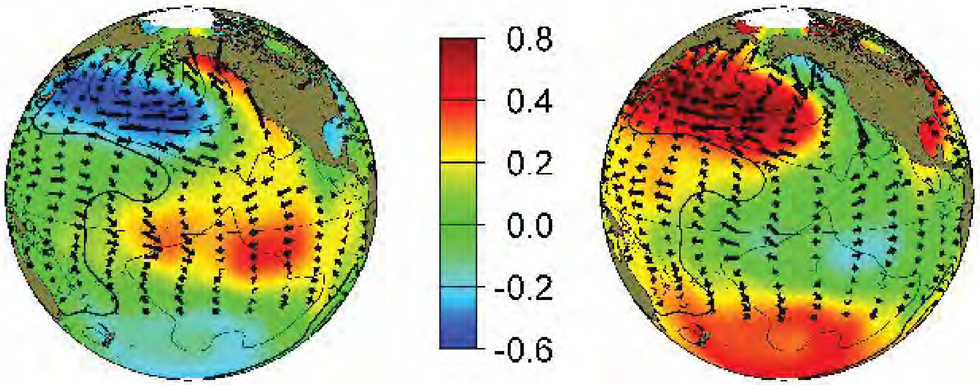
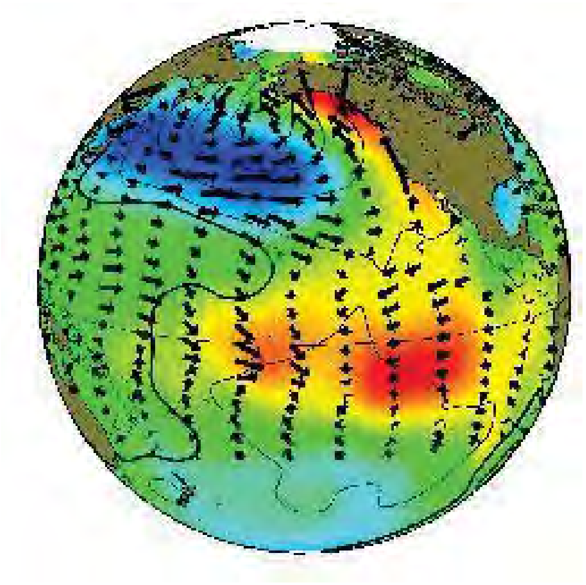
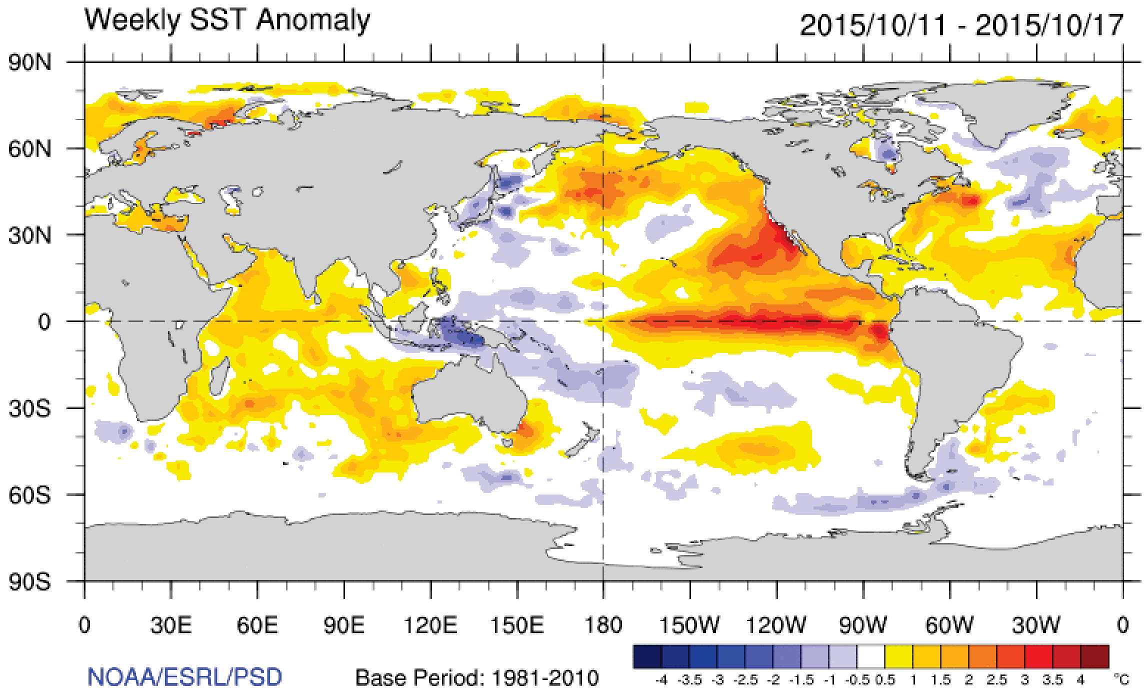
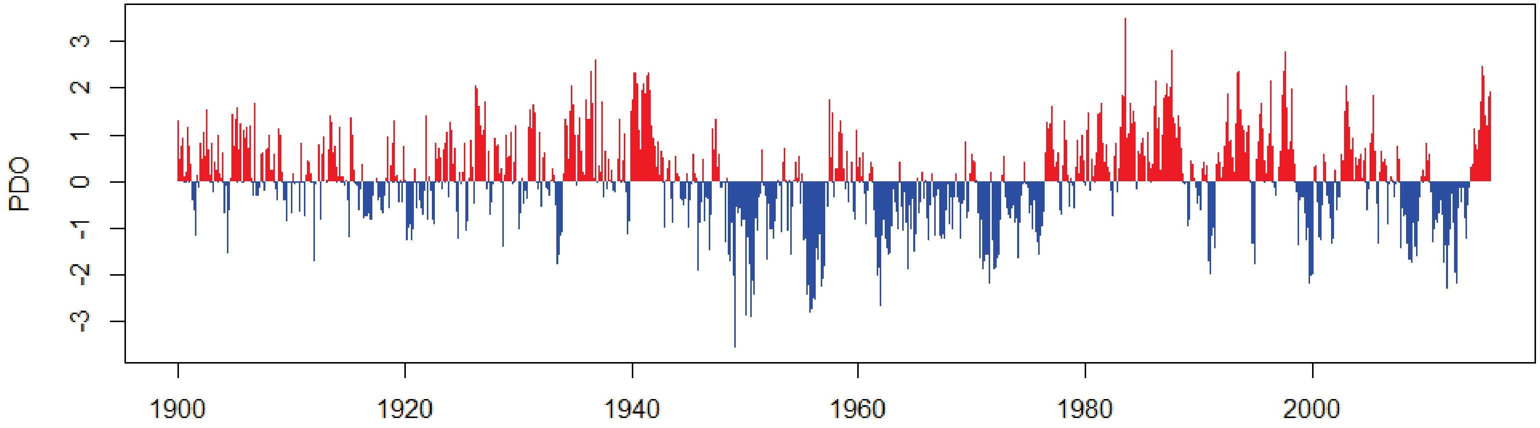


Attachment B







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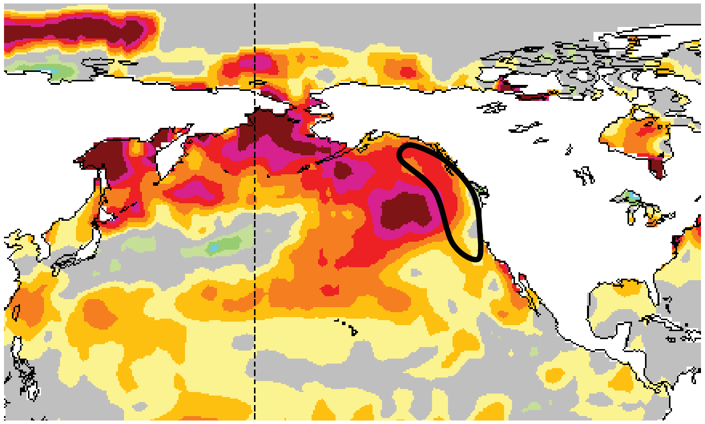
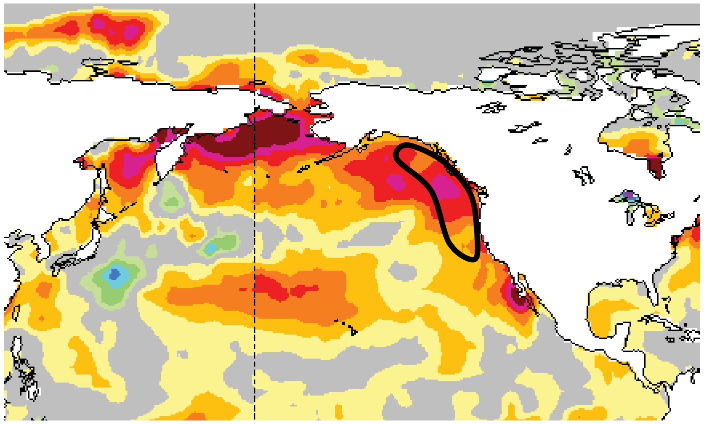
Attachment B

Prior to September 2014

before

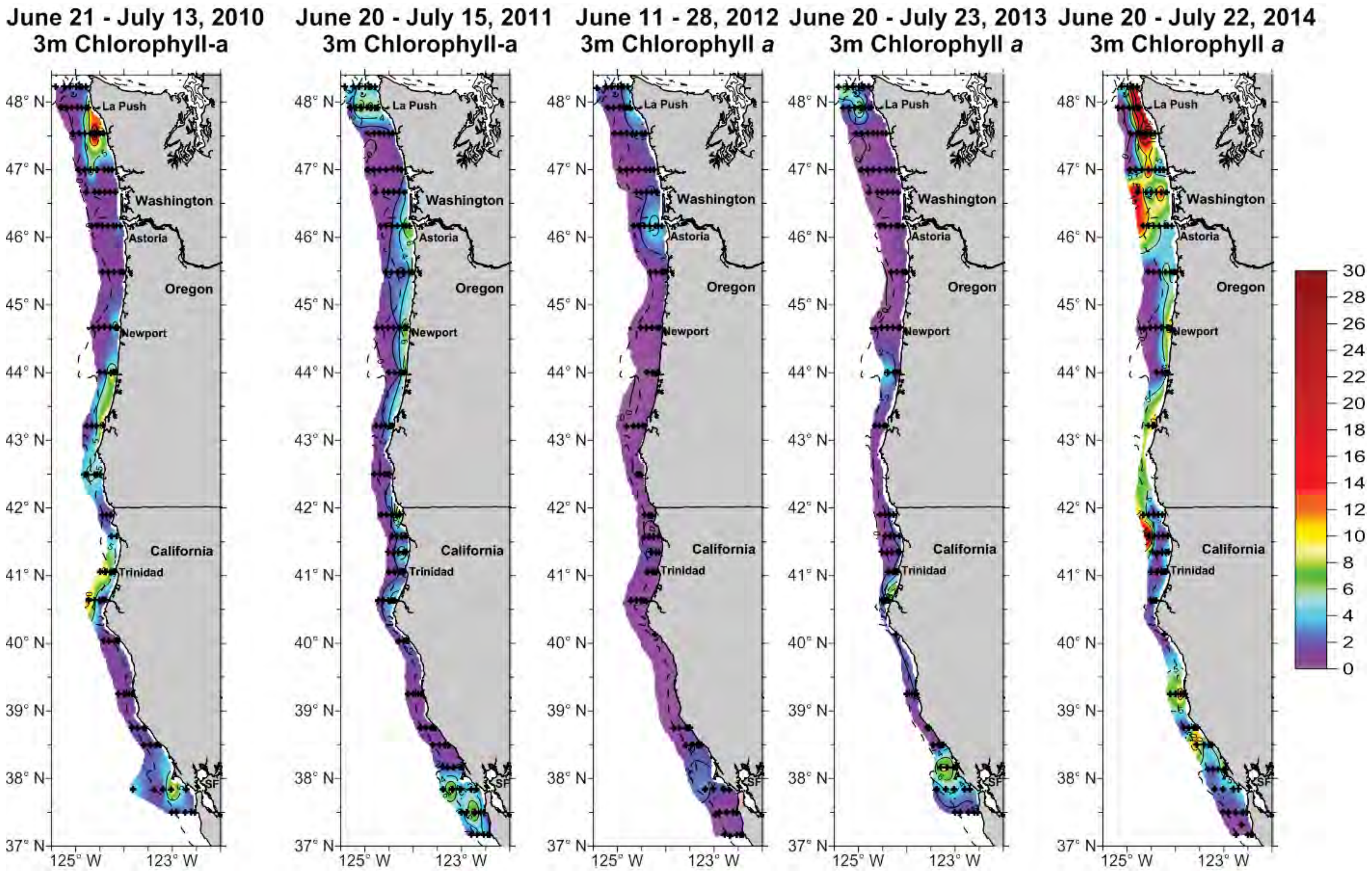


after



Attachment B

Chlorophyll was high in spring, 2014



June 21 - July 13, 2010
3m Chlorophyll-a

June 20 - July 15, 2011
3m Chlorophyll-a

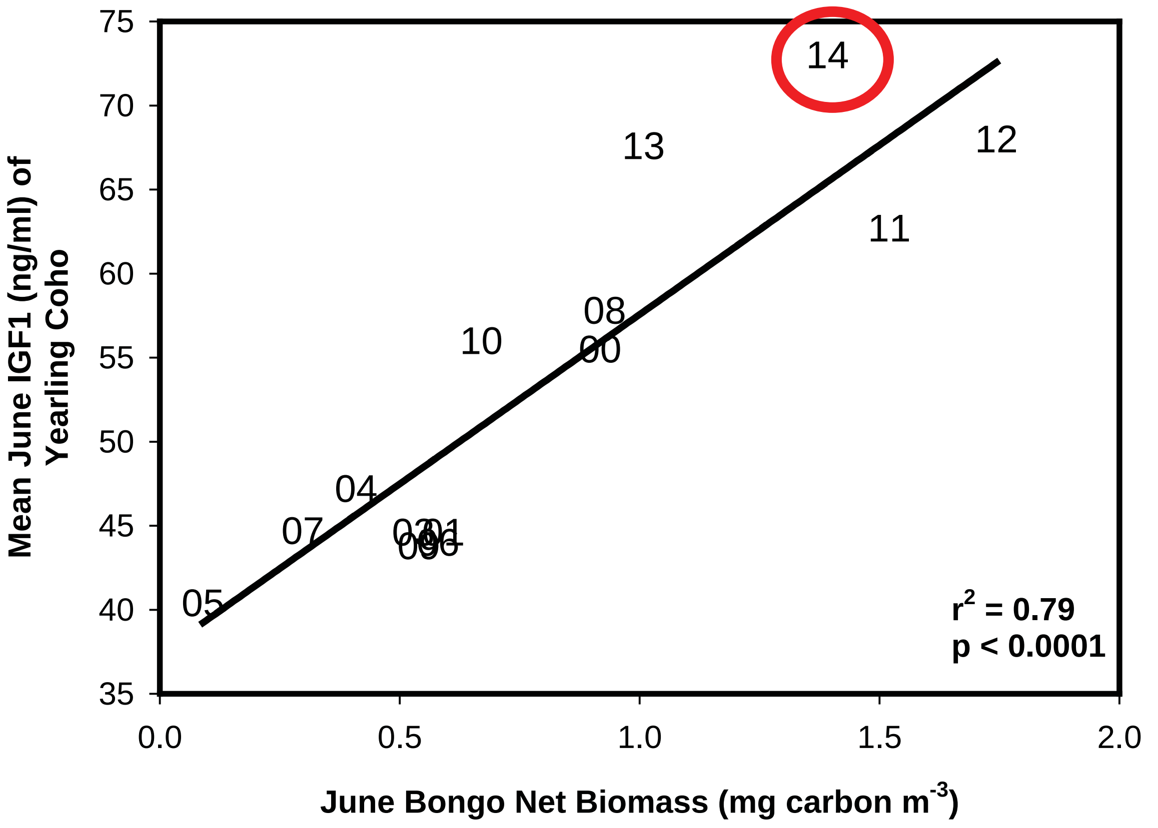
June 11 - 28, 2012
3m Chlorophyll *a*

June 20 - July 23, 2013
3m Chlorophyll *a*

June 20 - July 22, 2014
3m Chlorophyll *a*

Attachment B

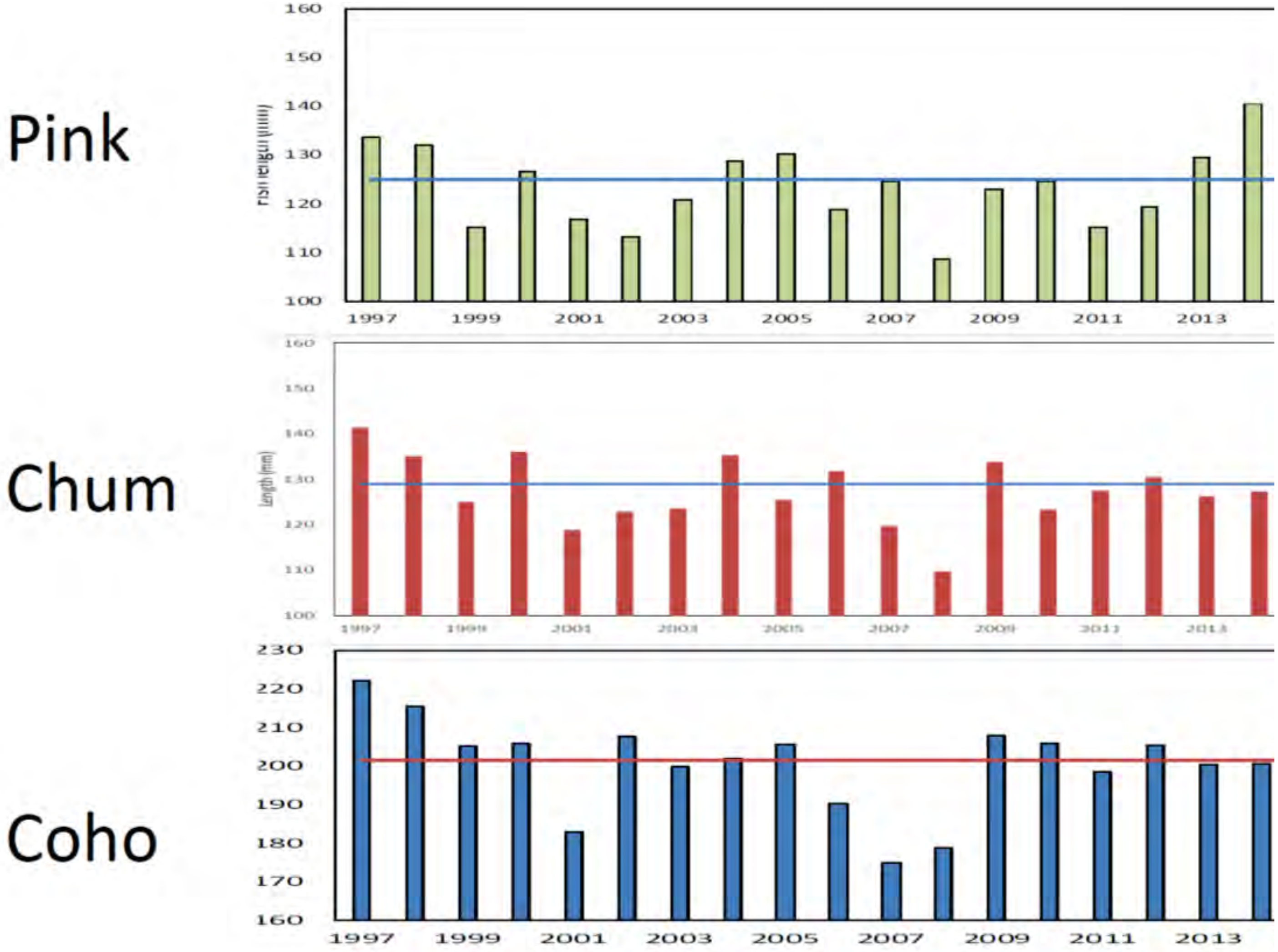
Columbia River salmon growth was high!



Attachment B

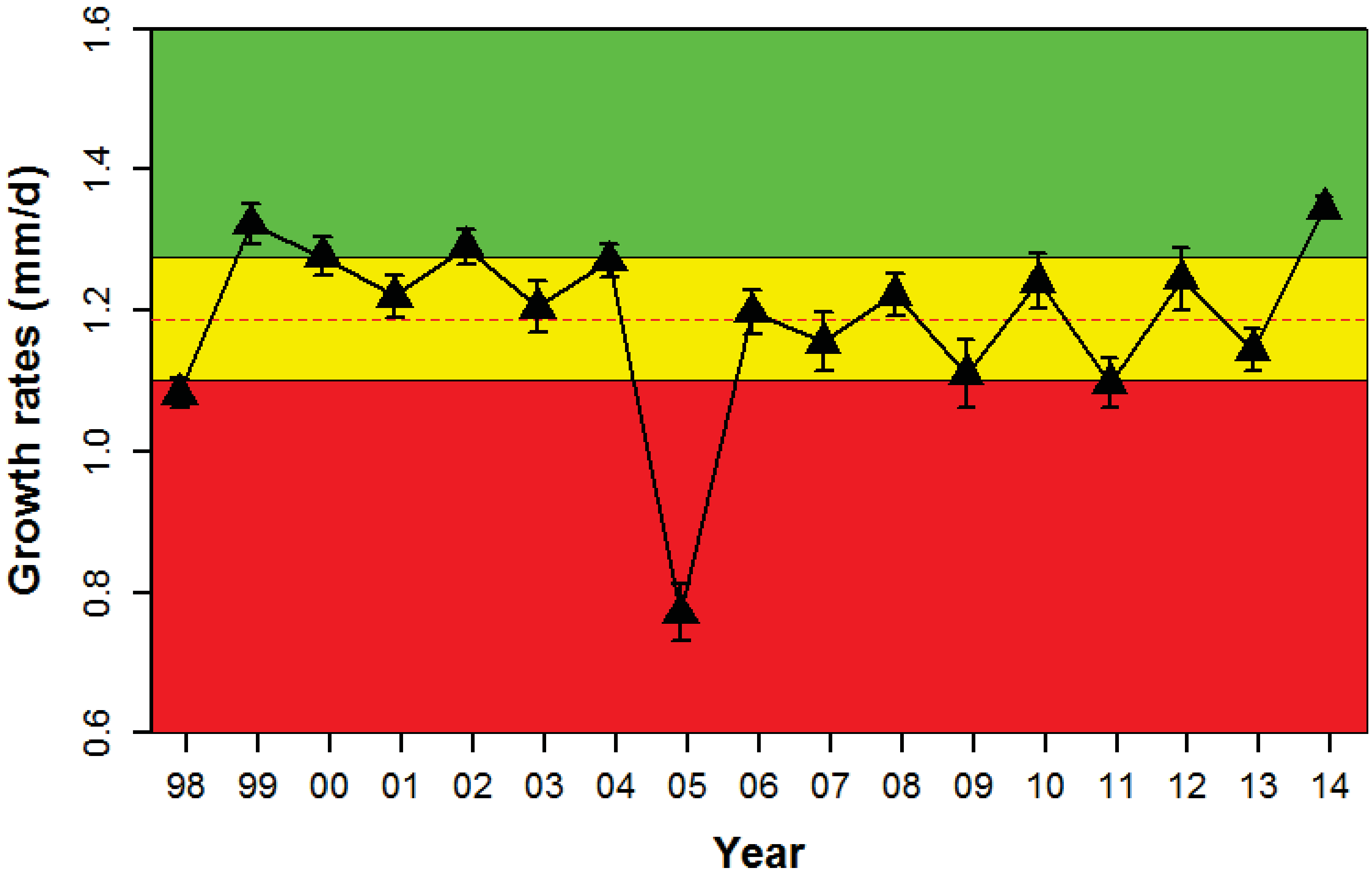
Southeast Alaska Coastal Monitoring Survey

Size of juvenile salmon on 24 July



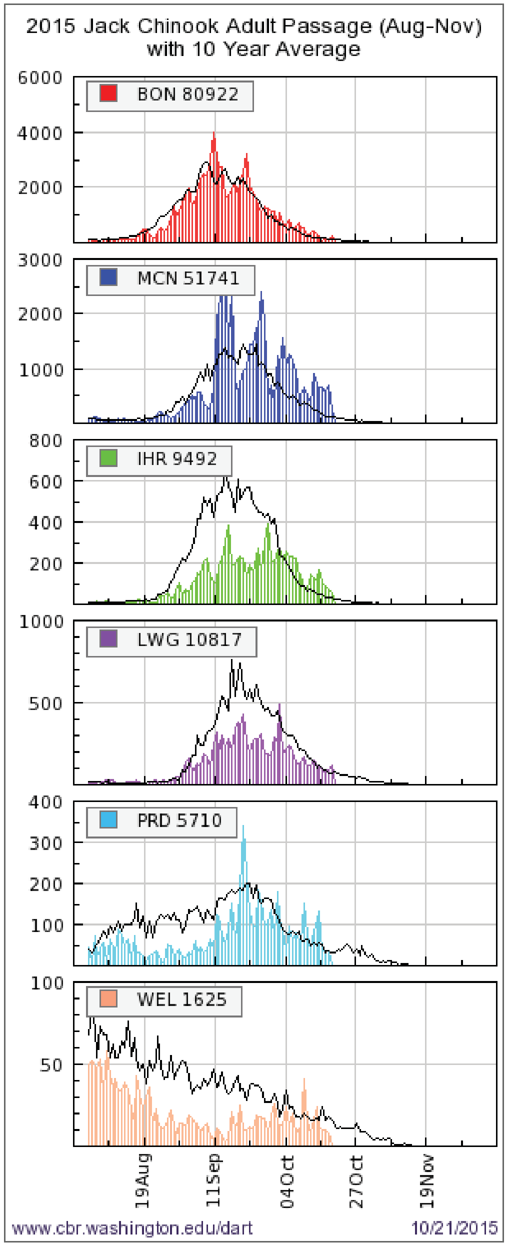
Attachment B

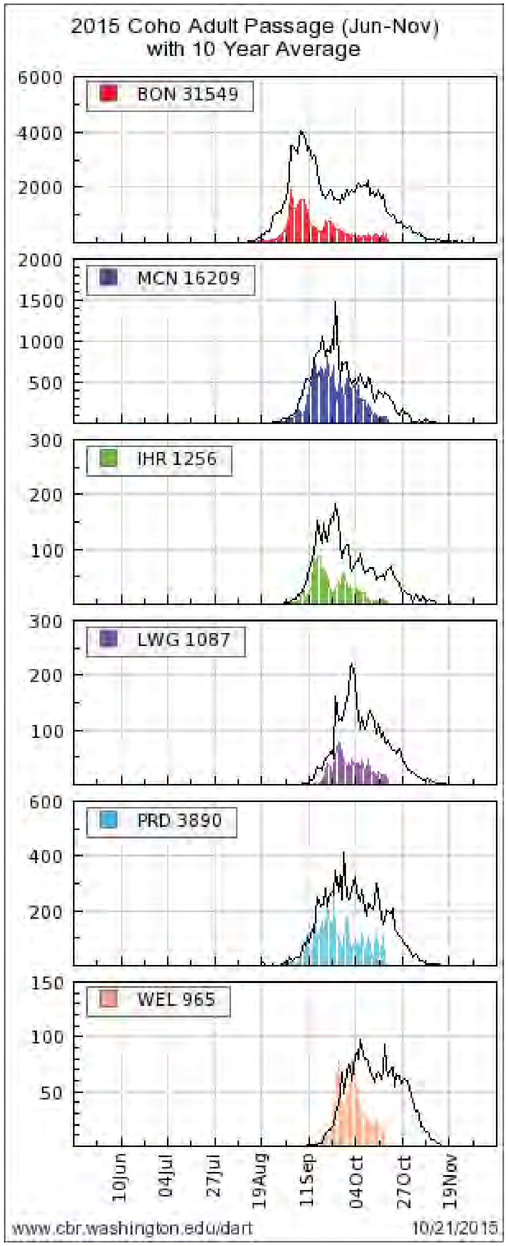
Best growth on record off the west coast of Vancouver Island in 2014 for juvenile Coho Salmon



Attachment B

What can we tell so far about 2014 outmigrants?

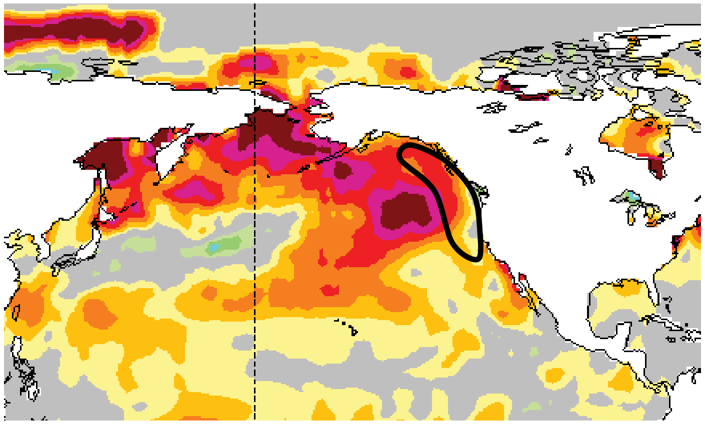




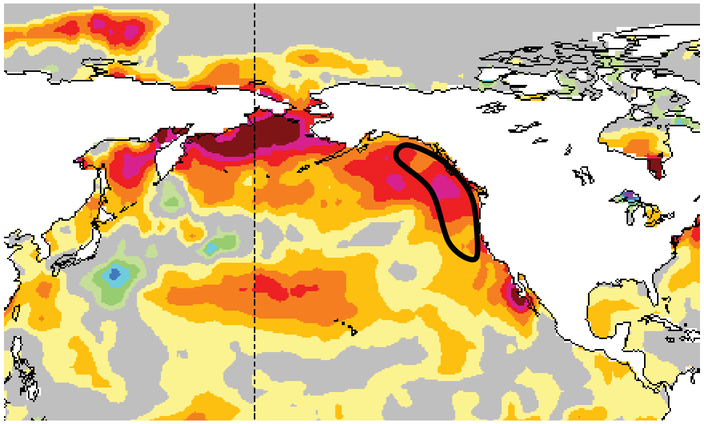
Attachment B

After September 2014

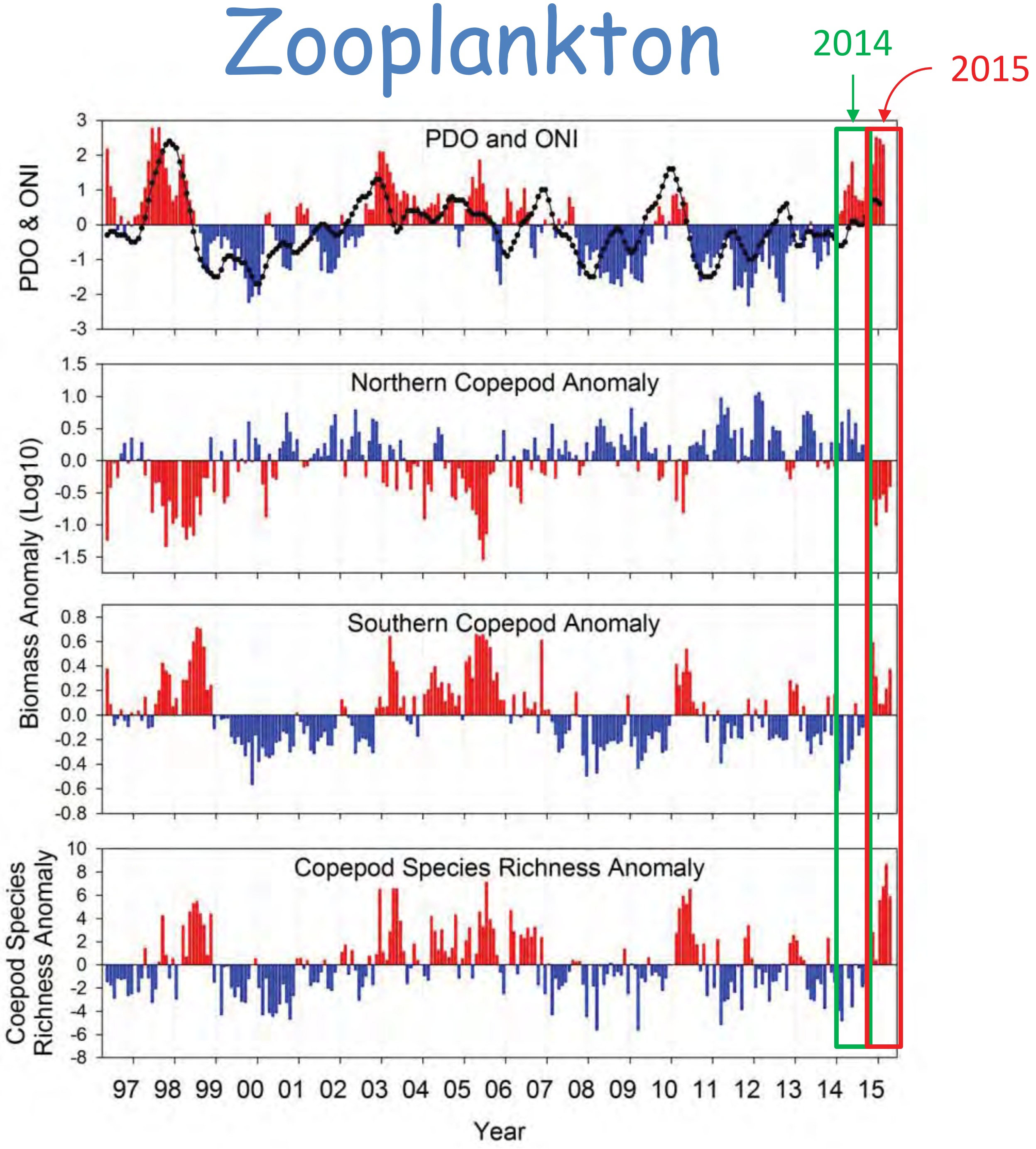
before



after



Zooplankton



Attachment B

In Alaska…

pomfret

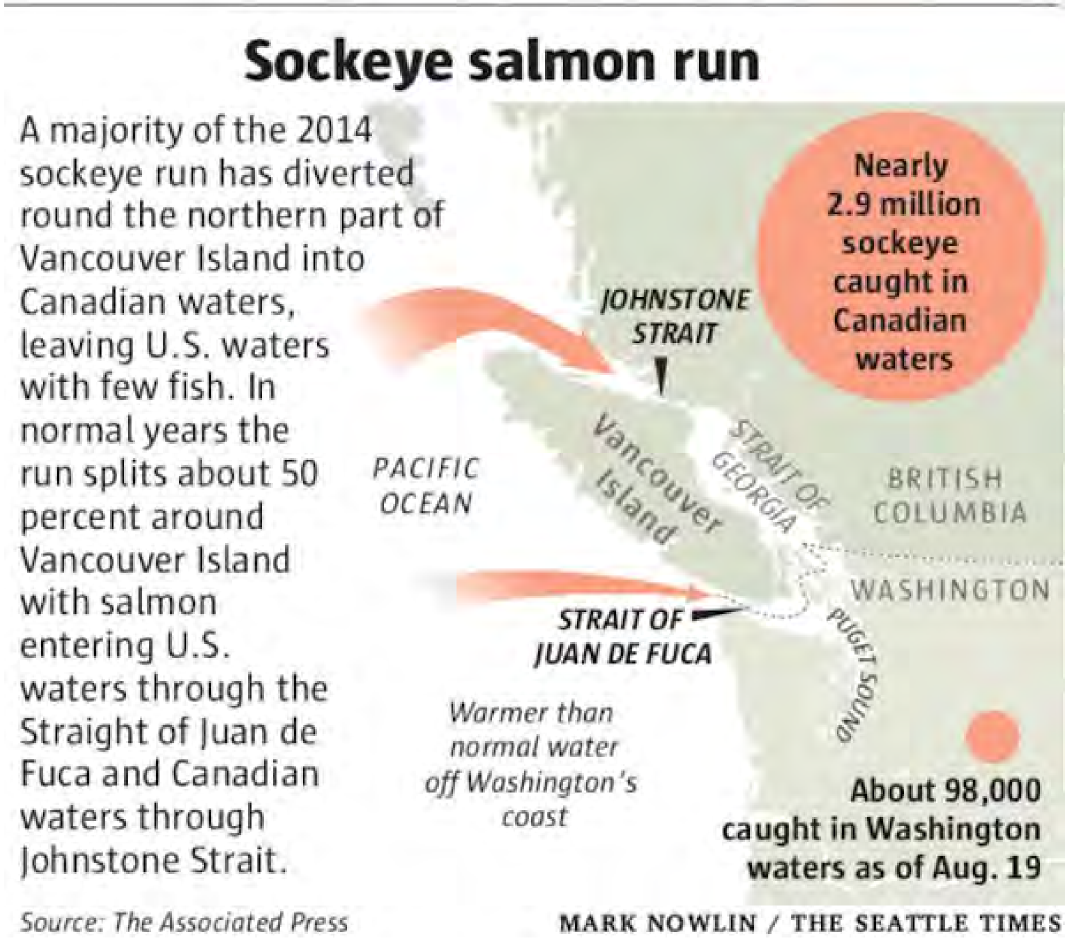
salmon shark

Mola mola

thresher shark

sablefish

In British Columbia…



Sockeye salmon run

A majority of the 2014 sockeye run has diverted round the northern part of Vancouver Island into Canadian waters, leaving U.S. waters with few fish. In normal years the run splits about 50 percent around Vancouver Island with salmon entering U.S. waters through the Straight of Juan de Fuca and Canadian waters through Johnstone Strait.

Nearly 2.9 million sockeye caught in Canadian waters

Warmer than normal water off Washington's coast

About 98,000 caught in Washington waters as of Aug. 19

Source: The Associated Press

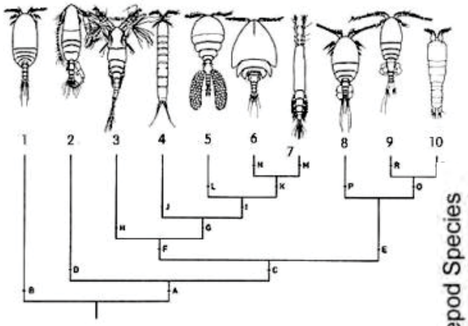
MARK NOWLIN / THE SEATTLE TIMES

Attachment B

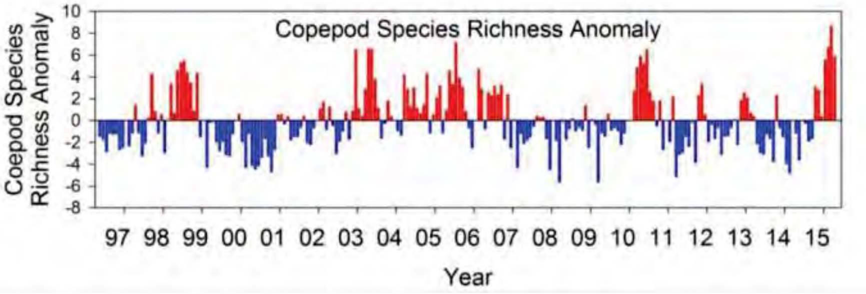
In Washington/Oregon…

Vellela vellela

larval sardine and anchovies



copepods



Attachment B

In California…

wahoo

tuna

moonfish

Monterey Bay National Marine Sanctuary

Pelagic red crabs (Pleuroncodes planipes) started washing ashore 7 October, 2015 on the Monterey Peninsula

1st time they've washed ashore since the 1982-83 El Niño

http://sanctuarymonitoring.org/photos/photo_search.php?search=kw&keywordSearchTerm=red+crab

Attachment B

2015 Elevated California Sea Lion Strandings in California

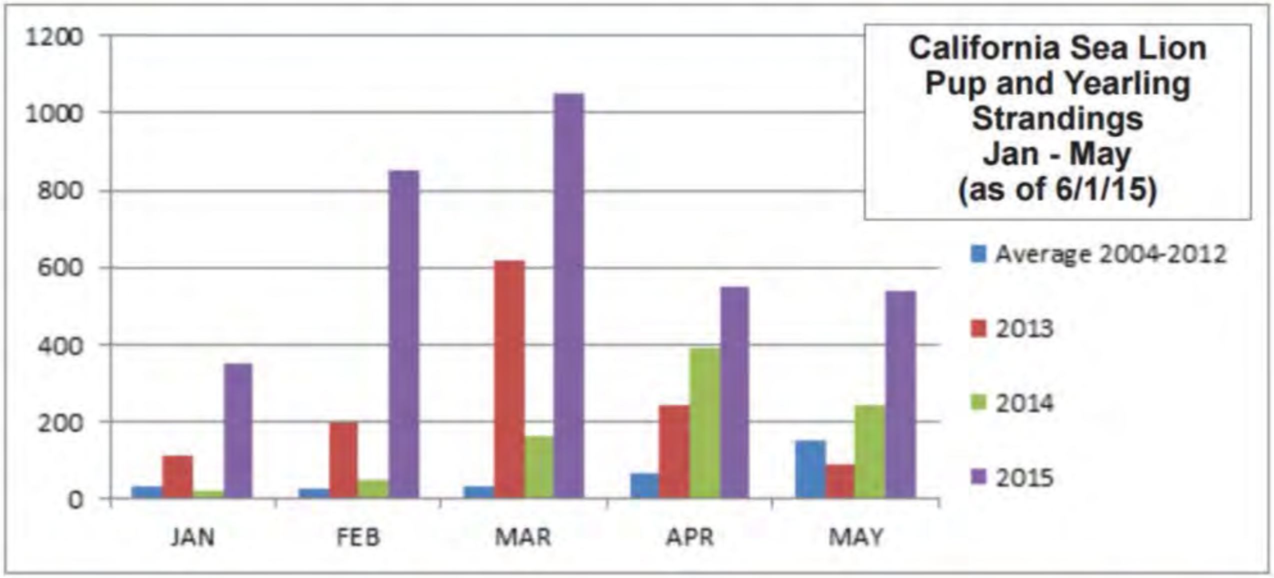


Figure 1: Comparison of monthly strandings for California sea lion pups and yearlings in 2013, 2014 and 2015 versus the average monthly stranding rate (2004-2012).

California sea lions

Astoria, OR

Coast-wide…

Cassin’s auklet

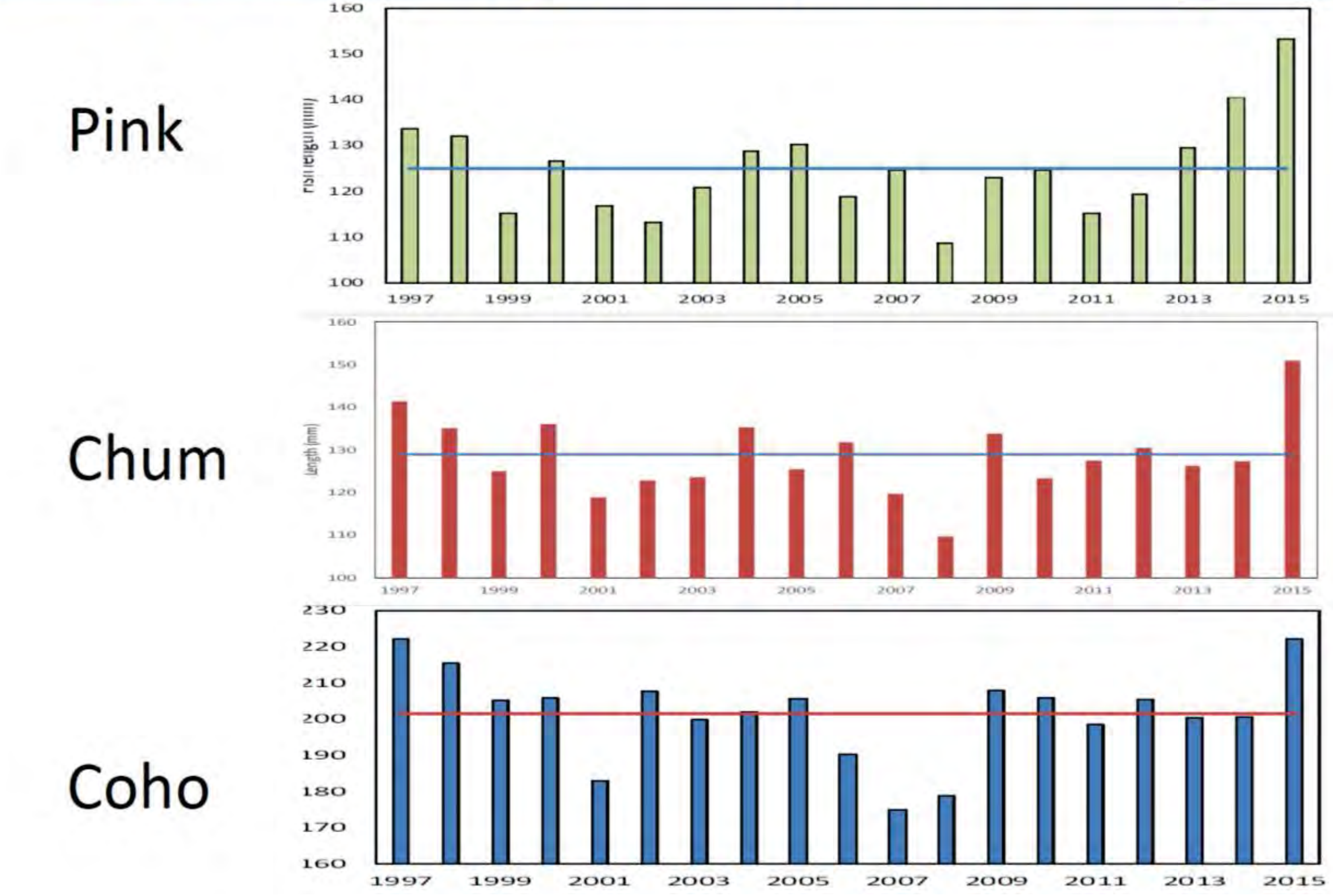
Attachment B

June 2015, off the mouth of the Columbia River

Attachment B

Southeast Alaska Coastal Monitoring Survey

2015: Size of juv. salmon on 24 July



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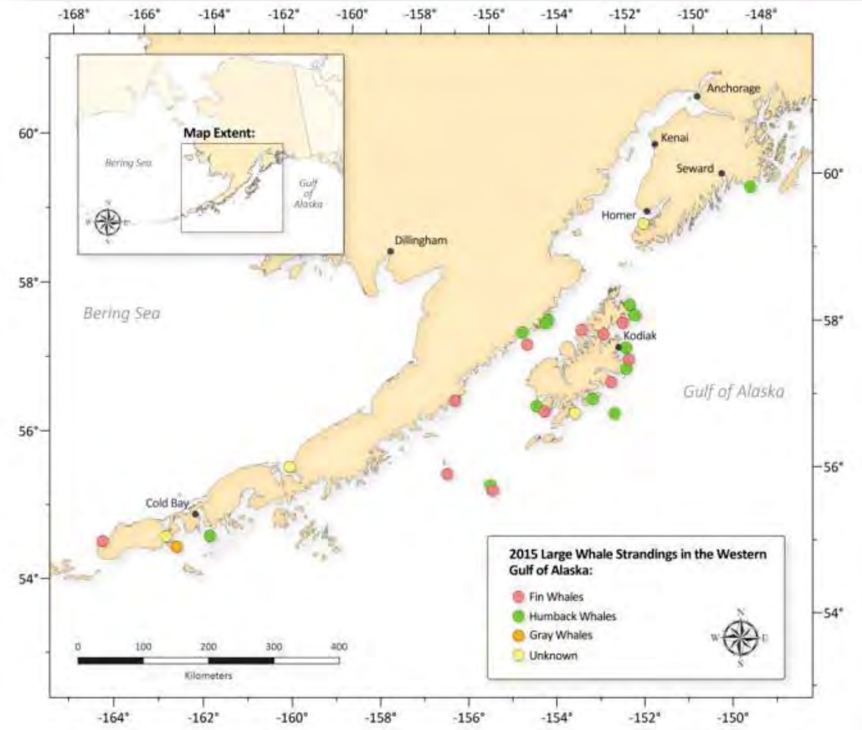
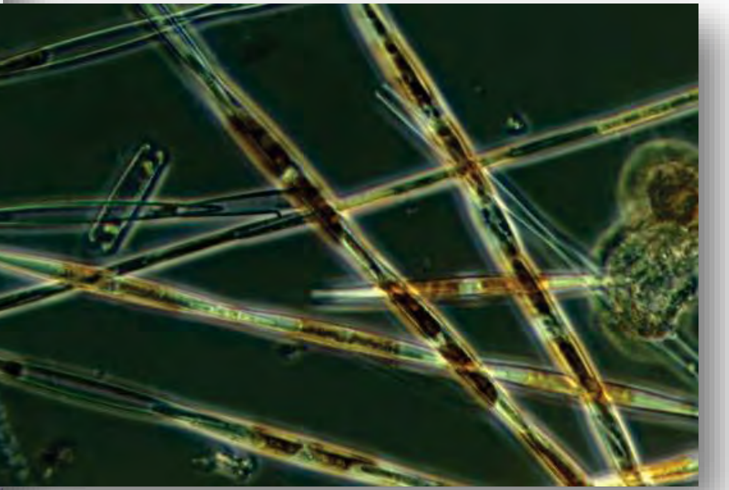
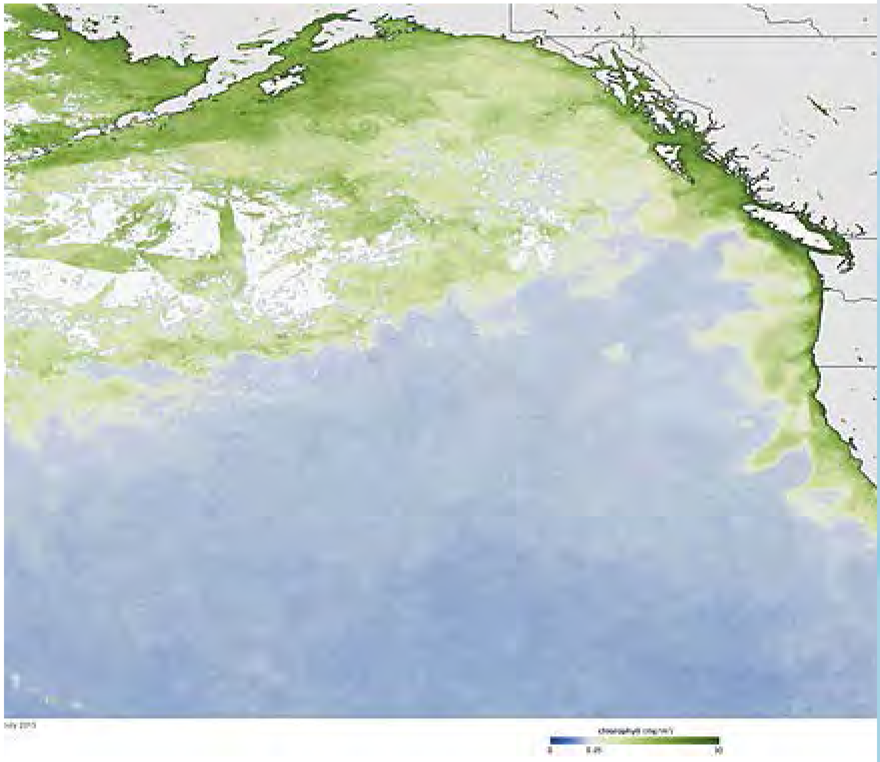
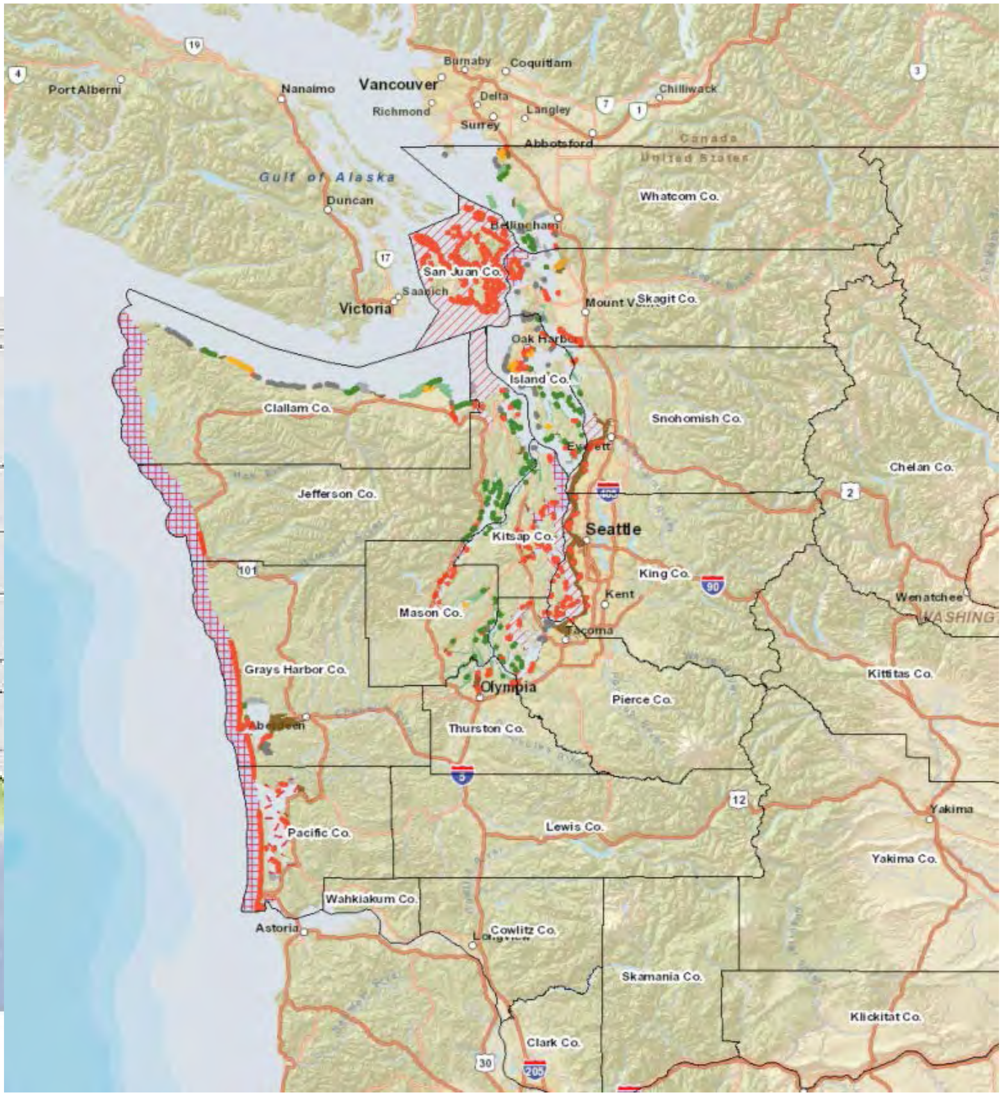

-168°
-166°
-164°
-162°
-160°
-158°
-156°
-154°
-152°
-150°
-148°
60°
58°
56°
54°
Map Extent:
Bering Sea
Gulf of Alaska
Anchorage
Kenai
Seward
Homer
Dillingham
Kodiak
Cold Bay
Bering Sea
Gulf of Alaska
2015 Large Whale Strandings in the Western Gulf of Alaska:
🟥 Fin Whales
🟩 Humback Whales
🟧 Gray Whales
🟨 Unknown
N
W
E
S
0
100
200
300
400
Kilometers
-164°
-162°
-160°
-158°
-156°
-154°
-152°
-150°



Attachment B

Harmful Algal Bloom





https://fortress.wa.gov/doh/eh/maps/biotoxin/biotoxin.html

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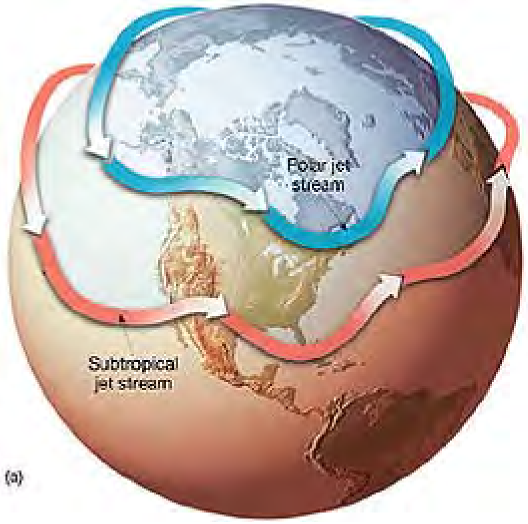
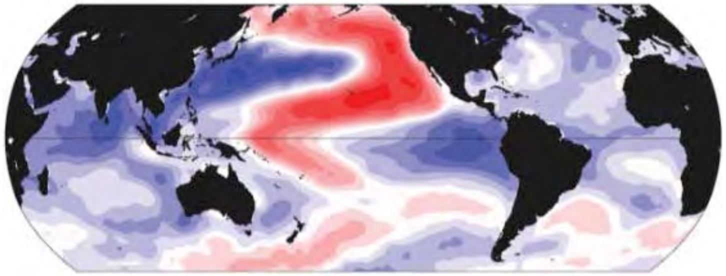
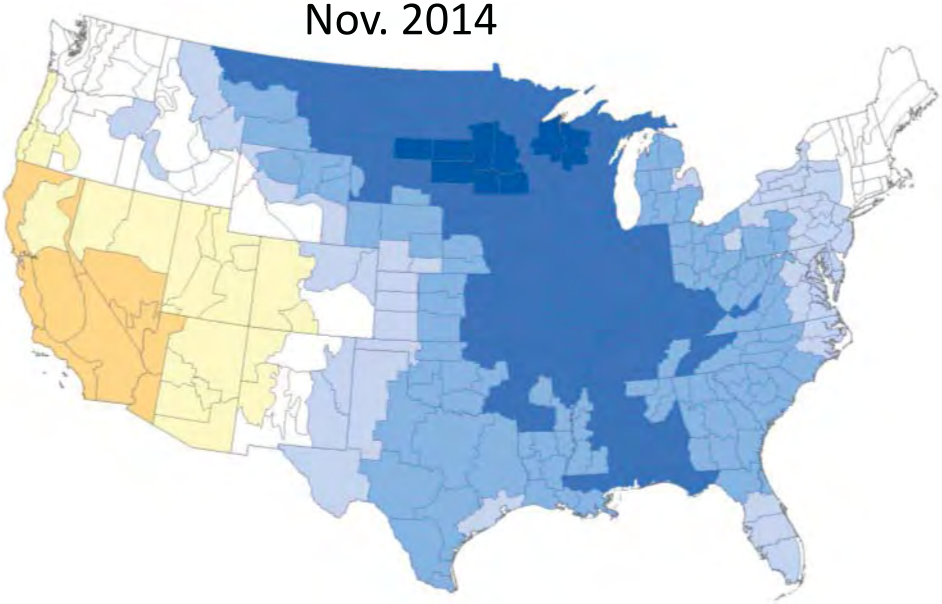


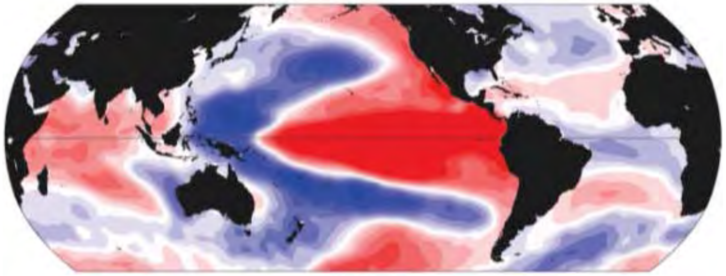
North Pacific Mode



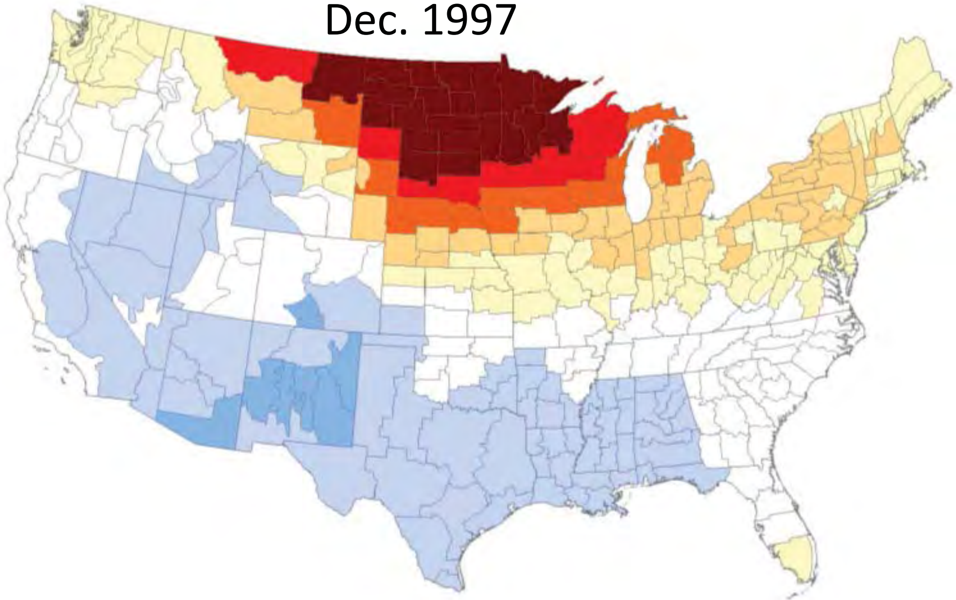
Nov. 2014



ENSO



Dec. 1997



https://www.climate.gov/author/dennis-hartmann

NOAA Climate.gov

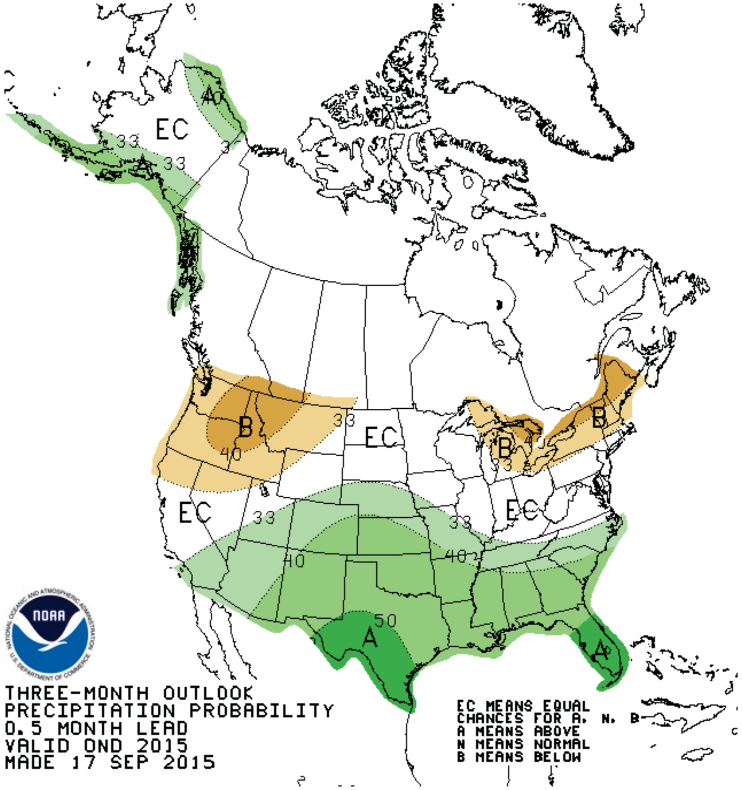
Attachment B

U. S. Seasonal Outlooks

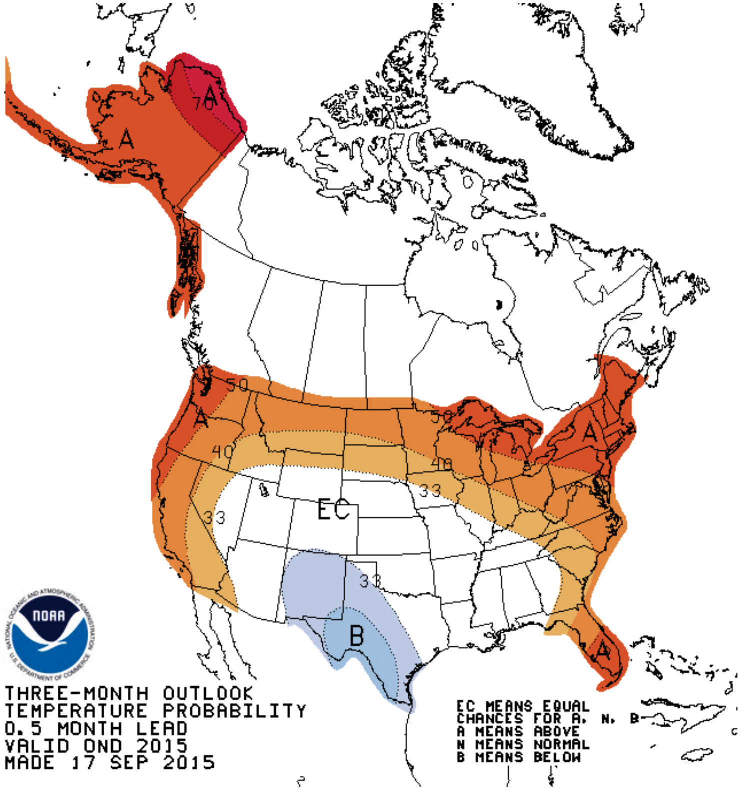
October - December 2015

The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.

Precipitation

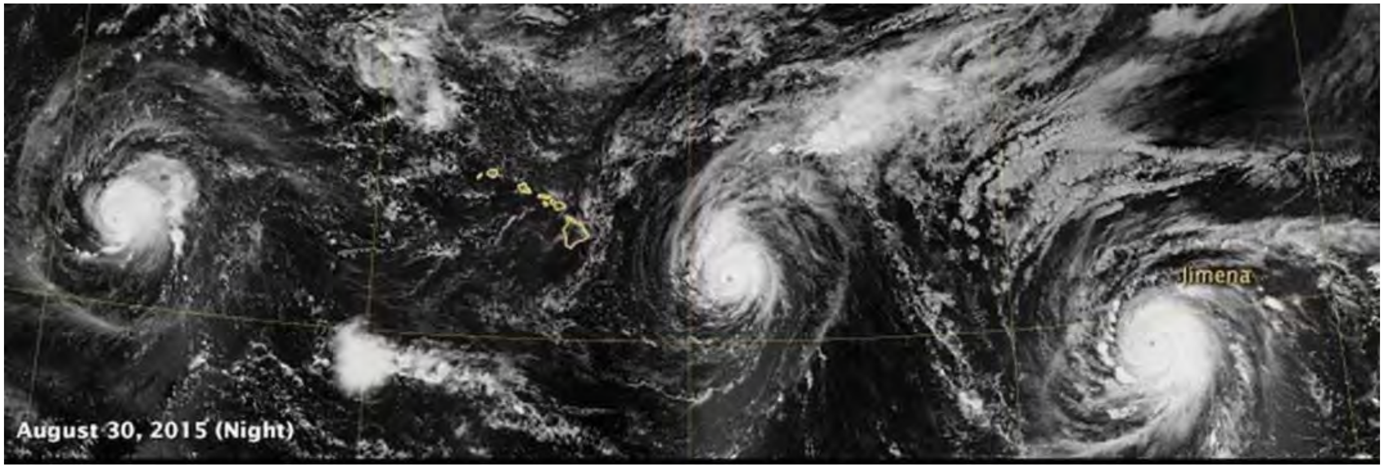


Temperature

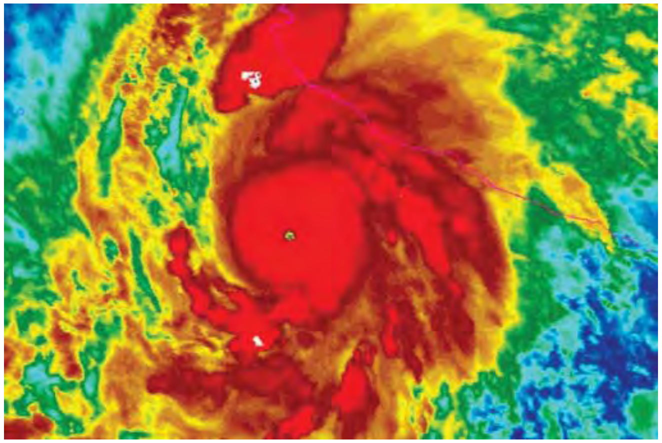


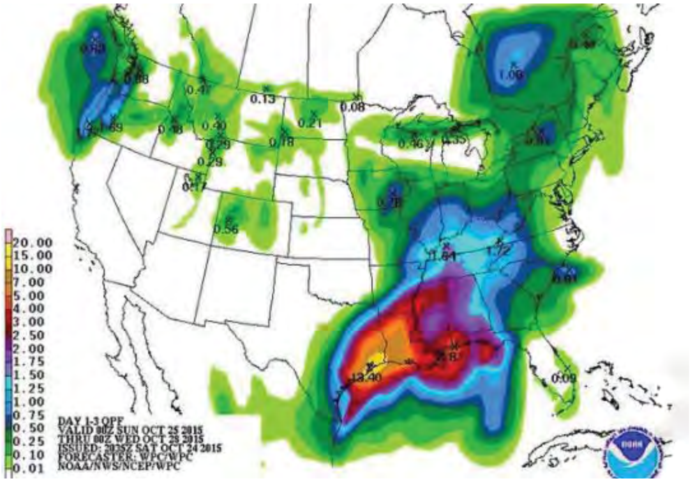
Attachment B

Strong El Niños decrease Atlantic hurricanes and increase Pacific hurricanes



- Most extreme tropical cyclone season on record
- Hurricane Patricia strongest hurricane recorded in Western Hemisphere





Wells HCP Coordinating Committee
Statement of Agreement Designating Coho Salmon as in Phase III (Standard Achieved)

Date of Approval: October 27, 2015

Statement:

The Wells HCP Coordinating Committee (CC) agrees that the Skalski and Townsend comparison of survival rates for yearling Chinook, coho, and steelhead, presented by Douglas PUD at the June 23, 2015 CC meeting, demonstrates that yearling coho survive hydrosystem passage at rates intermediate between yearling Chinook and steelhead. As such, the CC also agrees that the Skalski and Townsend analysis validates the assumption of Wells HCP Section 8.4.5.1 that juvenile coho survive at rates similar to the combined multi-year-average Wells Juvenile Project Survival estimate (currently 96.3%) resulting from studies conducted on yearling Chinook (2 years) and steelhead (2 years). Thus, the CC also agrees that Douglas PUD shall provide No-Net-Impact (NNI) hatchery compensation for Methow River coho equivalent to the multi-year-average project passage-loss value measured for yearling Chinook and steelhead (currently 3.7%). Because yearling Chinook and steelhead are in Phase III (Standard Achieved), the CC also agrees to designate Methow River coho as in Phase III (Standard Achieved), immediately following the finalization of a HCP Hatchery Committee (HC) approved hatchery-compensation agreement with the Yakama Nation (YN). Douglas PUD will begin hatchery production of Methow River coho for NNI hatchery-compensation in 2018 regardless of the status of a hatchery-compensation agreement with the YN. The term of this agreement shall extend through the term of the Wells HCP.

Background

The Wells HCP defines coho as a Plan Species without specifying NNI hatchery-compensation requirements because coho, as a locally extirpated species, were the subjects of a reintroduction-feasibility study when the HCP was signed. Section 8.4.5.1 of the Wells HCP describes the necessary circumstances under which the HC shall determine whether Methow River coho warrant NNI hatchery compensation, and gives the HC discretion over the program(s) by which Douglas PUD (DPUD) shall meet that obligation. Additionally, Section 8.4.5.1 established the then-current three-year-average Juvenile Project Survival value (96.2%) for yearling Chinook and steelhead as the interim rate at which DPUD would compensate for Methow River coho, assuming coho survival performance approximated that of yearling Chinook and steelhead. In 2007 when the HC determined that Methow River coho warranted NNI hatchery compensation, inadequate numbers of adult coho returned over Wells Dam to both allow the collection of brood for survival-study fish and fully stock the reintroduction program. Thus coho survival could not be studied, and the HC approved a 10-year hatchery-compensation agreement between DPUD and the YN whereby DPUD provided monetary support for the YN coho reintroduction program at the then 96.2% survival level. In 2010 a fourth year of survival studies was conducted and this study established the new four-year-average Juvenile Project Survival value for yearling Chinook and steelhead at 96.3%.

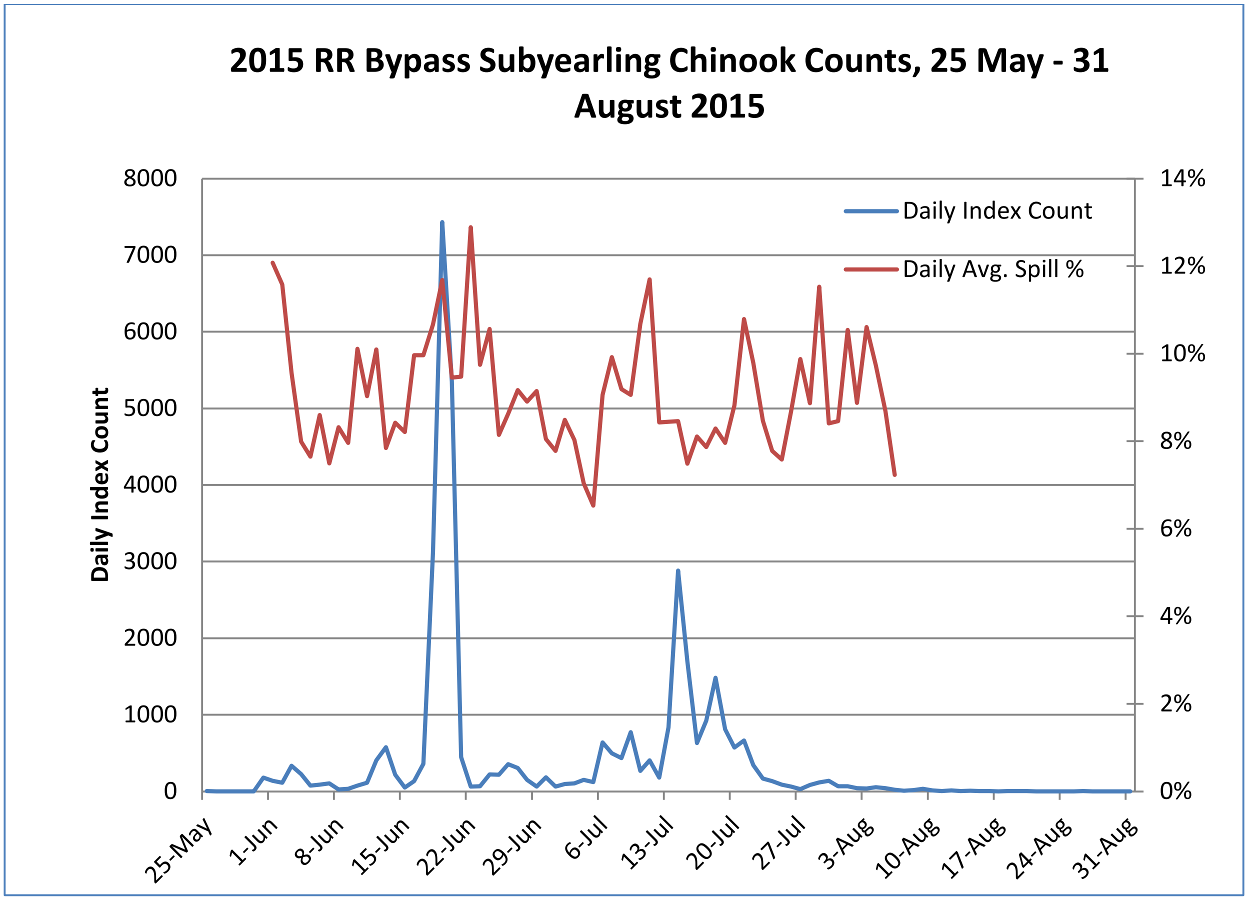
Consistent with the prior agreement, the demands for increased broodstock collection for current and future phases of the coho reintroduction program continue to preclude the implementation of coho survival studies in the Wells Project, and may continue to do so for the foreseeable future. DPUD and the YN intend to establish a new, multi-year, coho hatchery-compensation agreement to take effect in 2018, following approval by the Wells HCP Hatchery Committee, at the established rates of coho survival (96.3%) and corresponding hatchery compensation (3.7%). The term of that agreement shall extend through the term of the Wells HCP.

Chelan PUD
Rocky Reach and Rock Island HCPs
Final 2015 Fish Spill Report

2015 ROCKY REACH

Summer Spill

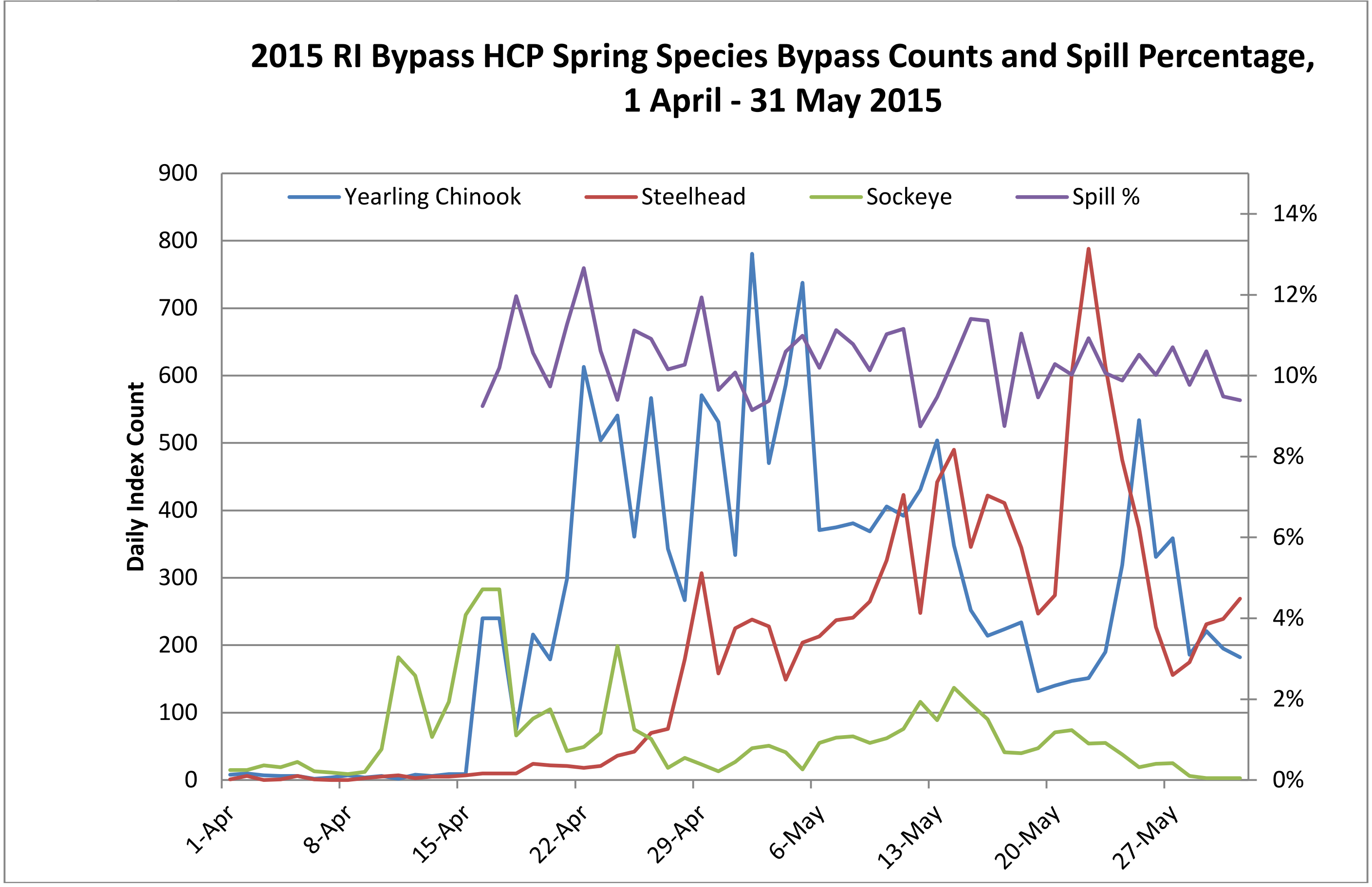
Target species: Subyearling Chinook
Spill target percentage: 9% of day average river flow
Spill start date: 1 June, 0001 hrs
Spill stop date: 7 August, 2400 hrs
95% Est. passage date: 4 August
Percent of run with spill: 96.9% on 7 August (estimated as of 31 August)
Cumulative index count: 37,104 subyearling Chinook (as of 31 August)
Summer spill percentage: 9.00% (8.88% fish spill, plus 0.12% forced spill)
Avg river flow at RR: 100,901 cfs (1 June - 7 August)
Avg spill rate at RR: 9,086 cfs (1 June - 7 August)
Total spill days: 68


2015 RR Bypass Subyearling Chinook Counts, 25 May - 31 August 2015

2015 ROCK ISLAND

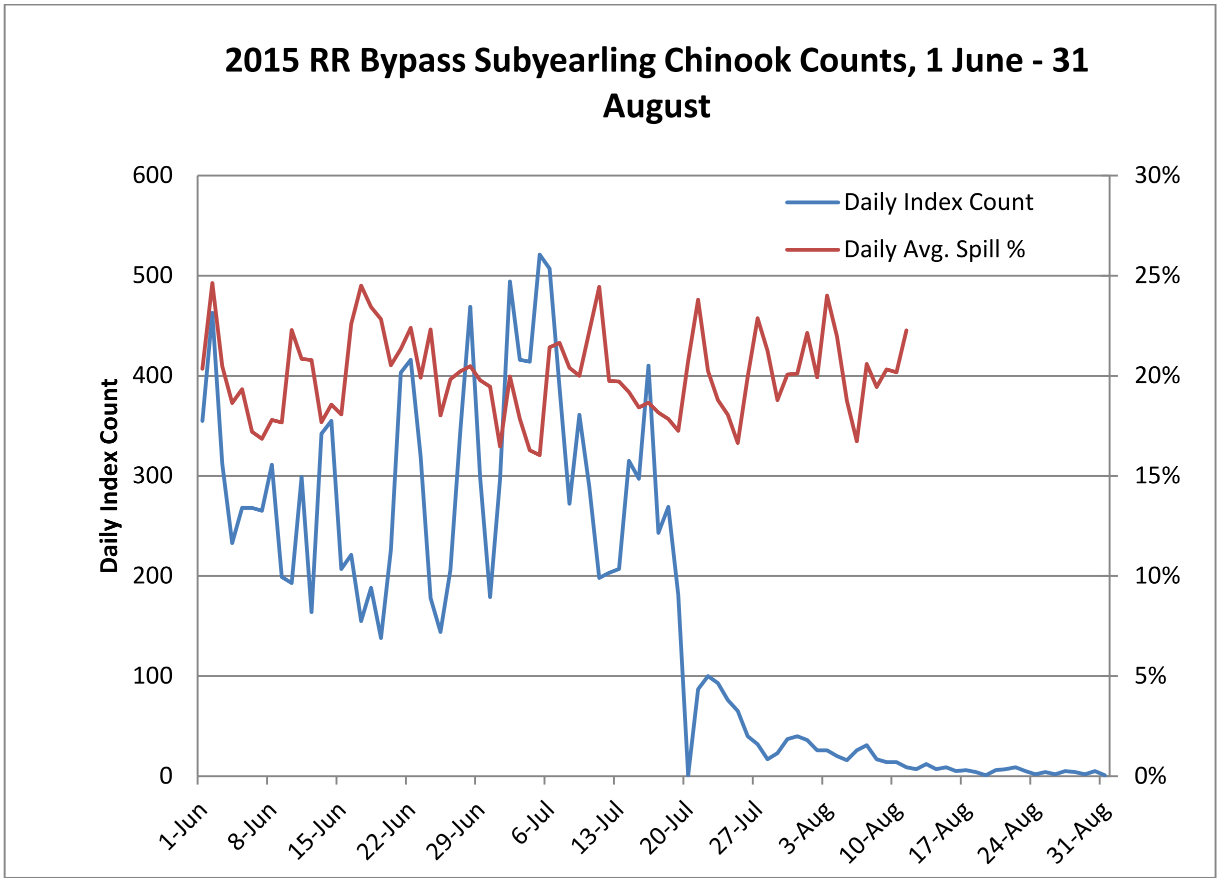
Spring Spill

Target species: Yearling Chinook, steelhead, sockeye
Spill target percentage: 10% of day average river flow
Spill start date: 16 April, 0001 hrs
Spill stop date: 31 May, 2400 hrs (immediate increase to 20% summer spill)
Percent of run with spill: Yearling Chinook - 99.7%; steelhead - 99.9%; sockeye - 94.9%
Cumulative index count: 16,762 yearling Chinook**;** 12,549 steelhead**;** 4,128 sockeye
Spring spill percentage: 10.29% fish spill
Avg river flow at RI: 108,333 cfs (16 April – 31 May)
Avg spill flow at RI: 11,144 cfs (16 April – 31 May)
Total spill days: 46


2015 RI Bypass HCP Spring Species Bypass Counts and Spill Percentage, 1 April - 31 May 2015

Summer Spill

Target species: Subyearling Chinook
Spill target percentage: 20% of day average river flow
Spill start date: 1 June, 0001 hrs
Spill stop date: 11 August, 2400 hrs
95% Est. passage date: 2 August
Percent of run with spill: Subyearling Chinook 98.5% (estimated as of 31 August)
Cumulative index count: 15,349 subyearling Chinook (as of 31 August)
Summer spill percentage**:** 19.86% fish spill
Avg river flow at RI: 102,557 cfs (1 June - 11 August)
Avg spill flow at RI: 20,370 cfs (1 June - 11 August)
Total spill days: 72



Juvenile Index Counts 2004-2015 from the Rocky Reach Juvenile Fish Bypass Sampling Facility and Rock Island Bypass Trap Smolt Monitoring Program (SMP) 1 April – 31 August.

Table 1. Rocky Reach Juvenile Bypass index sample counts, 2005-2015

Species	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014***	**2015**
Sockeye	17,575	239,185	169,937	136,206	40,758	724,394	67,879	384,224	199,497	553,645	**53,575**
Steelhead	5,821	4,329	4,532	8,721	6,309	4,931	5,683	4,902	2,528	5,270	**4,157**
Yearling Chinook	27,611	23,461	18,080	38,394	18,946	33,840	24,400	95,207	29,018	15,871	**32,220**
Subyearling Chinook	10,978	19,996	13,496	11,820	11,944	59,751	17,246	5,774	22,073	22,327	**37,104**

Table 2. Rock Island Smolt Monitoring Program index sample counts, 2005-2015

Species	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014***	**2015**
Sockeye	1,991	34,604	16,410	38,965	4,926	37,404	18,697	46,788	25,111	38,596	**4,128**
Steelhead	15,974	26,930	18,482	22,780	17,636	17,194	28,408	16,957	15,099	28,299	**12,549**
Yearling Chinook	14,797	37,267	23,714	22,562	9,225	11,802	26,407	25,759	28,324	26,429	**16,762**
Subyearling Chinook	18,710	27,106	15,686	15,940	8,189	23,205	27,397	27,298	17,170	34,527	**15,349**

***** 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.

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Coordinating Committees	**Date:**	January 26, 2016
From:	John Ferguson, HCP Coordinating Committees Chairman		
Cc:	Kristi Geris		
Re:	Final Minutes of the December 14, 2015, HCP Coordinating Committees Conference Call		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Coordinating Committees met by conference call on Monday, December 14, 2015, from 9:30 a.m. to 11:00 a.m. Attendees are listed in Attachment A to these meeting minutes.

ACTION ITEM SUMMARY

- Chelan PUD will provide the revised Draft 2015 Rocky Reach and Rock Island Spill Report to Kristi Geris for distribution to the Coordinating Committees, for approval during the Coordinating Committees meeting on January 26, 2016 (Item III-A). *(Note: Lance Keller provided the revised draft report to Geris on January 22, 2016, which Geris distributed to the Coordinating Committees that same day.)*
- Douglas PUD will provide the Draft 2015 Wells Dam Post-Season Bypass Report for review to Kristi Geris for distribution to the Coordinating Committees (Item IV-C). *(Note: Tom Kahler provided the draft report to Geris on December 15, 2015, which Geris distributed to the Coordinating Committees that same day.)*
- Douglas PUD will provide the Draft 2016 Wells HCP Action Plan for review to Kristi Geris for distribution to the Coordinating Committees (Item IV-D). *(Note: Tom Kahler provided the draft plan to Geris on December 21, 2015, which Geris distributed to the Coordinating Committees on December 22, 2015.)*
- **The Coordinating Committees meeting on January 26, 2016, will be held in-person at the Radisson Hotel in SeaTac, Washington (Item V-C).**

DECISION SUMMARY

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

AGREEMENTS

- Wells Coordinating Committee representatives present agreed to Douglas PUD's request for an expedited 30-day review period for two Wells Project Land-use Permit Applications (Erlandsen Tract 688 Joint Use Dock and Tract 694 Cascade Holdings Dock; Item IV-A).

REVIEW ITEMS

- Kristi Geris sent an email to the Coordinating Committees on October 16, 2015, notifying them that the draft Douglas PUD 2015 Bypass Passage-dates Analysis was available for a 60-day review period, with edits and comments due to Tom Kahler by Tuesday, December 15, 2015 (Item IV-C).
- Kristi Geris sent an email to the Coordinating Committees on December 14, 2015, notifying them that a Wells Project Land-use Permit Application (Erlandsen Tract 688 Joint Use Dock) was available for a 30-day review, with edits and comments, or indication of no comments, due to Tom Kahler by Wednesday, January 13, 2016 (Item IV-A).
- Kristi Geris sent an email to the Coordinating Committees on December 14, 2015, notifying them that a Wells Project Land-use Permit Application (Tract 694 Cascade Holdings Dock) was available for a 30-day review, with edits and comments, or indication of no comments, due to Tom Kahler by Wednesday, January 13, 2016 (Item IV-A).
- Kristi Geris sent an email to the Coordinating Committees on December 15, 2015, notifying them that the Draft 2015 Wells Dam Post-Season Bypass Report was available for a 30-day review, with edits and comments due to Tom Kahler by Thursday, January 14, 2016 (Item IV-C).
- Kristi Geris sent an email to the Coordinating Committees on December 22, 2015, notifying them that the Draft 2016 Wells HCP Action Plan was available for review, and that Douglas PUD will request approval of the document during the Coordinating Committees meeting on January 26, 2016 (Item IV-D).

- Kristi Geris sent an email to the Coordinating Committees on January 6, 2016, notifying them that the Draft 2016 Wells Dam Gas Abatement Plan and Bypass Operating Plan was available for review, with edits and comments due to Tom Kahler by Wednesday, February 10, 2016.

FINALIZED DOCUMENTS

- The Final 2015 Wells Dam Post-Season Bypass Report was finalized following a 30-day review period, which ended on January 14, 2016, and was distributed to the Coordinating Committees by Kristi Geris on January 22, 2016. As noted in the email, no comments were received from Coordinating Committees members on the draft report.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the Coordinating Committees and asked for any additions or changes to the agenda. No additions or changes were requested from Coordinating Committees representatives present; however, Ferguson added one administrative update regarding Washington State Department of Ecology (Ecology) Aquatic Settlement Work Group (SWG) representation.

B. Meeting Minutes Approval (John Ferguson)

The Coordinating Committees reviewed the revised draft October 27, 2015, meeting minutes. Kristi Geris said all comments and revisions received from members of the Committees were incorporated into the revised minutes. She said she also noted receipt of the revised Draft 2015 Rocky Reach and Rock Island Spill Report, per Chelan PUD's action item, throughout the revised minutes, as necessary. Coordinating Committees members present approved the October 27, 2015, meeting minutes, as revised. The U.S. Fish and Wildlife Service (USFWS) abstained, because a USFWS representative was not present at the October 27, 2015, meeting. *(Note: Scott Carlon provided the National Marine Fisheries Service's [NMFS'] approval of the revised minutes on November 18, 2015, and Jeff Korth provided the Washington Department of Fish and Wildlife's [WDFW's] approval of the revised minutes via email prior to the meeting on December 14, 2015.)*

C. Last Meeting Action Items (John Ferguson)

Action items from the Coordinating Committees meeting on October 27, 2015, and follow-up discussions, were as follows. *(Note: italicized text corresponds to agenda items from the meeting on October 27, 2015):*

- *Tom Kahler will provide the Wells Project Land-use Permits for renewal to Kristi Geris for distribution to the Coordinating Committees for review (Item IV-C).* Kahler said Beau Patterson (Douglas PUD) compiled the materials for review, and Kahler attempted to distribute them via email prior to the meeting today; however, the email did not seem to transmit due to the large file sizes (four files totaling about 20 megabytes in size). Kahler said he will upload the large files to the Coordinating Committees Extranet Site for Geris to distribute, and resend Patterson's email without the attachments, because Patterson's email contains an explanation of the permit applications. This will be further discussed during today's meeting.
- *Chelan PUD will revise the draft 2015 Rocky Reach and Rock Island Spill Report, and will provide the final report to Kristi Geris for distribution to the Coordinating Committees (Item V-A).*
  Lance Keller provided a revised draft report for approval to Geris on December 4, 2015, which Geris distributed to the Coordinating Committees that same day. This will be further discussed during today's meeting.

II. HCP Tributary and Hatchery Committees Update

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

Tracy Hillman said the HCP Tributary Committees did not meet in December 2015, and he updated the Coordinating Committees on the following actions and discussions that occurred at the HCP Tributary Committees meeting on November 12, 2015:

- *Small Projects Program Proposal:* The Rock Island HCP Tributary Committee received a Small Projects Program application from WDFW titled, "Peshastin Creek RM 10.5 Passive Integrated Transponder (PIT)-Tag Detection Site." The purpose of the project is to install a permanent instream PIT-tag detection site in Peshastin Creek just upstream from the Ruby Creek slide. The Ruby Creek slide was a small slide in Peshastin Creek that appears to have precluded fish passage. WDFW would like to

install PIT-tag detection upstream of Ruby Creek to help evaluate fish passage after restoration, obtain information on movement of bull trout, and evaluate potential effects of suction dredging. WDFW requested $36,256, and the Rock Island HCP Tributary Committee elected to contribute only $32,269, because the HCP Tributary Committees Policies and Procedures require that indirect costs cannot exceed 15% of the total cost. WDFW is coordinating internally to come up with the extra $4,209, and the Rock Island HCP Tributary Committee is waiting to hear back from WDFW. Jim Craig asked if PIT-tag detection will be installed prior to remedial action to document lack of passage before restoration. Hillman said that is the intent. He said WDFW would like to install PIT-tag detection this winter; however, WDFW is already busy fixing a number of its existing interrogation sites due to recent flooding, and there is concern there may not be time. Craig asked when the restoration is planned to occur. Hillman said he is not certain, and added that he believes the Salmon Recovery Funding Board will determine the start date.
Tom Kahler said he knows the restoration project received funding; however, he does not know about the start date. He added that Kate Terrell (USFWS) would know.

- *Scope of Work Change:* The HCP Tributary Committees received a change-of-scope request from Trout Unlimited on the, "Methow Valley Irrigation District Instream Flow Improvement Project." The original scope was to remove trees along the abandoned west-side ditch. However, the proposals came in much more expensive than budgeted, so the change of scope would provide the opportunity to negotiate buyouts of liability with some of the landowners, which would keep the project within budget. The HCP Tributary Committees approved the scope change. Craig asked if the purpose of the project was to remove dead trees before they fall over and potentially injure people. Hillman said that is correct. John Ferguson asked about impacts to the value of riparian zones, such as shading for fish, and Hillman said the ditch is now all in pipes, so the trees have died because they are no longer watered by ditch leakage.
- *Time Extension:* The Rocky Reach Tributary Committee received a time-extension request from the Okanogan Conservation District on the, "Similkameen RM 3.8 Restoration Project." The extension was needed because permits were delayed. The request was to extend the period of the project until October 2016. The Rocky Reach

Tributary Committee approved the request.

- *Next Steps:* The HCP Tributary Committees' next scheduled meeting will be on January 7, 2016.

Hillman updated the Coordinating Committees on the following actions and discussions that occurred at the last HCP Hatchery Committees meeting on November 18, 2015:

- *NMFS and USFWS Consultation Update:* Craig Busack (NMFS) indicated that the Wenatchee Steelhead Biological Opinion (BiOp) is almost complete, and NMFS is currently working on comments. Discussions are also underway on the Methow spring Chinook salmon consultation regarding research, monitoring, and evaluation; gene flow standards; and Busack's modified Ford model. Grant PUD, Chelan PUD, and Douglas PUD met with NMFS, and a target completion date was set for May 2016. Karl Halupka (USFWS) discussed Methow steelhead consultation. Halupka is currently reviewing all existing consultation activities as part of a gap analysis in order to identify gaps in coverage. He plans to provide a draft gap analysis for the Methow Basin before December 25, 2015. He also requested comments on the Wenatchee River steelhead BiOp before December 25, 2015.
- *Goat Wall Pond Acclimation:* The Yakama Nation (YN) is hoping to release spring Chinook salmon from its Goat Wall Acclimation Site in 2016; however, permitting for the release is still pending. The HCP Hatchery Committees explored options on how to move fish to the site; however, it cannot be done without the proper permits in place. Craig Busack indicated the YN is unlikely to have permits in place before March 2016, when the fish would need to be transferred. The YN would also need to PIT tag the fish by January or early February 2016. Therefore, due to permitting delays, a 2016 release is unlikely; however, the YN still intend to conduct 5 years of spring Chinook salmon releases, only now, this may start in 2017.
- *5-Year Hatchery Monitoring and Evaluation Review Planning – Objectives 4 and 5:* The HCP Hatchery Committees are discussing hatchery replacement rate (HRR) targets. The Hatchery Evaluation Technical Team (HETT), a sub-committee of the HCP Hatchery Committees, met last month to discuss HRRs and develop a recommended path forward. The HETT developed the following two-fold proposal: 1) HRRs will not be less than 1; and 2) if the natural replacement rate is more than 1,

then the HRR will be based on a sliding scale. The HCP Hatchery Committees evaluated this proposal and determined it may be simpler to set a fixed HRR. The HCP Hatchery Committees asked the HETT to compute an alternative proposal. The Hatchery Committees also suggested using a deviation metric to flag HRR values of potential concern. The HETT will meet again today, December 14, 2015, to discuss a revised proposal to present to the HCP Hatchery Committees. The HETT also discussed stray rates. Spring Chinook salmon released from the Chewuch Acclimation Facility are homing back to the Chewuch River at very low rates (20%). As a result, the YN suggested the HCP Hatchery Committees look into this. Spring Chinook salmon released from the Chewuch Acclimation Facility are straying primarily into the Methow River, and the YN wants to determine how to get more fish homing back to the Chewuch River. There has been a lot of discussion; however, the HCP Hatchery Committees decided to ask HETT to think about how to evaluate ways to reduce straying. This may involve conducting experiments. A point of contention is also how one defines strays. Methow spring Chinook salmon are Methow composites (i.e., MetComp); therefore, those fish released to the Chewuch that return to the Methow are not really "straying," because they belong to the same gene pool as those fish released to the Methow. The observed lack of homing to the Chewuch is more of an issue of spawner distribution. Kahler noted that despite the lack of homing of Methow spring Chinook salmon to the Chewuch River, there are high numbers of hatchery fish relative to natural fish in the Chewuch River. He said not everyone agrees the lack of homing is a problem. He also noted that if there are too many hatchery fish returning to the Chewuch River, this could have a negative impact on the proportion of hatchery-origin spawners (pHOS). Kirk Truscott also noted, however, that the lack of homing fidelity could become a problem with reduced adult returns from the recalculated programs.

- *Gene Flow Standards for Methow Spring Chinook Salmon:* The HCP Hatchery Committees are testing an adult management program in the Methow Basin, where hatchery fish are being removed. It seems the program has been quite successful. The goal is to reduce pHOS and increase the proportionate natural influence (PNI). The HCP Hatchery Committees agreed to use Craig Busack's three-population gene flow model for PNI, which will also be used in the consultation process.

- *DECISION: Supplemental Radio Tagging of Summer Steelhead:* The HCP Hatchery Committees received a proposal from WDFW and the University of Idaho to PIT tag and radio tag summer steelhead collected at Tumwater Dam and the Twisp Weir. WDFW and University of Idaho were trying to tag up to 500 summer steelhead at Priest Rapids Dam; however, due to lower-than-expected return rates, only 400 summer steelhead were tagged. There are now 100 tags left, and WDFW and the University of Idaho suggested that tagging at Tumwater Dam and the Twisp Weir could provide additional information on parameters, such as estimating stray rates and overwinter survival, among other things. The HCP Hatchery Committees approved the proposal, which will likely be conducted during spring 2016.
- *Next Meeting:* The HCP Hatchery Committees' next scheduled meeting will be this week on December 16, 2015.

III. Chelan PUD

A. DECISION: Revised Draft 2015 Rocky Reach and Rock Island Spill Report (Lance Keller)

Lance Keller said the revised Draft 2015 Rocky Reach and Rock Island Spill Report was distributed to the Coordinating Committees by Kristi Geris on December 4, 2015. He said, as discussed during the last Coordinating Committees meeting on October 27, 2015, the error in the percentage of sockeye that passed Rock Island Dam during spill at 10% in spring 2015 was corrected from 94.9% to 76.6%. Keller said, however, that the revised document will not be ready for a decision today. He said he received comments from Kirk Truscott, which need to be addressed in another revised report. Keller said one comment was regarding the graph for summer spill at Rock Island Dam. He said Truscott noted that the graph title has Rocky Reach Dam information in it. Keller said he confirmed the graph is for Rock Island Dam; however, the graph title was a copy-and-paste error, which he will correct. He said another comment from Truscott was regarding the same graph for Rock Island Dam. Keller said the graph shows subyearling counts starting on June 1, 2015, at about 350, and Truscott asked why a front-end tail is not depicted on the graph. Truscott further explained that without knowing the front-end spill, it is not clear how the percentage of fish protected by spill was derived. Keller said, although data for Rock Island Dam are driven by the spill program, at the same time, Rock Island Dam is a Fish Passage Center (FPC) site, so the data adhere to FPC species and run designations. Keller further explained that if subyearlings show up at Rock Island Dam at the tail-end of May, the Data Access in Real Time (DART) database would not include those data because FPC sites tally summer Chinook salmon passage starting June 1. Keller said he reviewed data at Rock Island Dam prior to June 1, 2015, and fish were trickling in beginning on May 28, 2015. He said there was a sharp increase on June 1, 2015, with 259 fish (including 226 adipose [ad]-fin clipped fish) passing Rock Island Dam. Keller said he will figure out the best way to demonstrate the front-end tail of the fish run and provide the revised Draft 2015 Rocky Reach and Rock Island Spill Report to Geris for distribution to the Coordinating Committees, for approval during the Coordinating Committees meeting on January 26, 2016.

Jim Craig asked if the scale can simply be moved back to show fish passage prior to June 1, 2015. Keller said spill is initiated at Rock Island Dam based on the presence of fish, not what DART reports on June 1. He said he can look into having DART slide the scale back, but he will need to discuss this with Dr. John Skalski (Columbia Basin Research). Keller said all historical data start on June 1, and if it is not feasible to calculate historical data, then the data will not match up. He said he will need to discuss this with the program RealTime staff.

Keller said he would like to have the Final 2015 Rocky Reach and Rock Island Spill Report included in the 2015 Rocky Reach and Rock Island HCP Annual Reports. John Ferguson asked if approving the revised draft spill report during the Coordinating Committees meeting on January 26, 2016, will provide adequate time to include the final report in the HCP Annual Reports. Geris said this should be adequate time.

B. Rock Island Adult Fish Ladder Winter Maintenance (Lance Keller)

Lance Keller recalled that Rock Island Dam has right, middle, and left fish ladders. He said annual winter maintenance occurs each year from December 1 to the end of February, with the stipulation that one fish ladder remains open at all times for fish passage. He said, when fishways are out of service, Chelan PUD Fish and Wildlife crews will conduct fish rescues.

Right Ladder

Keller said, on December 1, 2015, the right fish ladder at Rock Island Dam was taken offline for annual winter maintenance. He said, this year, the right ladder is the scheduled long outage. He said activities will include general maintenance, servicing the attraction water pump, and removal of the denil structure. He said the right ladder should be back in service by February 28, 2016.

Middle Ladder

Keller said, on December 15, 2015, the middle fish ladder at Rock Island Dam will be taken offline for annual winter maintenance. He said this year, the middle ladder is the scheduled short outage. He said activities will include general maintenance and inspections on the diffusion gratings and valves. He said the middle ladder should be back in service by December 31, 2015.

Left Ladder

Keller said, on January 4, 2016, the left fish ladder at Rock Island Dam will be taken offline for annual winter maintenance. He said activities will include general maintenance and removal of the denil structure. He recalled the in-water modifications where concrete was split to provide swim-through passage, and he said those structures will also be reconstructed back to normal. He said the left ladder should be back in service by February 28, 2016.

C. Rock Island Denil Removal (Lance Keller)

Lance Keller said denil removal at Rock Island Dam has been contracted and scheduled, and the process is underway.

Right Ladder

Keller said work will start on the right fish ladder on January 4, 2016, with removal of the tailrace entrance (i.e., TRE; the one installed against bedrock). He said removal should take 6 days, and then the crews will move across the tailrace to the left powerhouse entrance (i.e., LPE) on January 11, 2016. He said removal of the LPE should be complete on January 16, 2016, and then a few additional days have been scheduled to move to the other side of the project to the left ladder. He said some crews will stay on the right ladder to perform any needed patchwork.

Left Ladder

Keller said work will start on the left fish ladder from January 17 to January 30, 2016, with removal of the upper denil extension He said removal of the lower denil extension will take place from February 1 to February 7, 2016.

Keller said all removal activities are outlined in the Final Chelan PUD Rock Island Interim Fish Passage Plan Biological Assessment (IFPP BA) that was submitted to the Federal Energy Regulatory Commission (FERC) and distributed to the Coordinating Committees by Kristi Geris on June 12, 2015. Keller recalled that USFWS elected to draft a BiOp; however, the document will not be completed prior to the denil-removal process. Keller said Chelan PUD submitted a request to Steve Lewis (USFWS) and Jeff Krupka (USFWS) for concurrence to move forward with the denil removal schedule, as outlined in the Final Chelan PUD Rock Island IFPP BA. Keller said he believes Lewis will provide a letter of concurrence. Keller said he also spoke with Scott Carlon last week, and Carlon is also working on NMFS' letter of concurrence.

IV. Douglas PUD

A. Wells Project Land-use Permits (Tom Kahler)

Tom Kahler recalled discussing two Wells Project Land-use Permit Applications during the last Coordinating Committees meeting on October 27, 2015. He said, because the permit applications were reviewed by the Coordinating Committees so long ago, and representation on the Committees has since changed, the Wells Coordinating Committee elected to review the applications again. He added, as discussed during review of the last meeting's action items, he has uploaded the large files to the Coordinating Committees Extranet Site for Kristi Geris to distribute, and re-sent Beau Patterson's email without the attachments. Kahler said both permit applications are for docks located within Brewster city limits and that they comply with land-use policies. He said Douglas PUD is also requesting an expedited 30-day Coordinating Committees review period. He reiterated that these permit applications were already reviewed and approved by the Wells Coordinating Committee in 2007 and 2008.

Wells Coordinating Committee representatives present agreed to Douglas PUD's request for an expedited 30-day review period for two Wells Project Land-use Permit Applications (Erlandsen Tract 688 Joint Use Dock and Tract 694 Cascade Holdings Dock).

Geris sent an email to the Coordinating Committees on December 14, 2015, notifying them that two Wells Project Land-use Permit Applications (Erlandsen Tract 688 Joint Use Dock and Tract 694 Cascade Holdings Dock) were available for a 30-day review, with edits and comments, or indication of no comments, due to Kahler by Wednesday, January 13, 2016.

B. Wells Dam Projects/Maintenance Updates (Tom Kahler)

Tom Kahler said the west fish ladder at Wells Dam was taken offline for annual winter maintenance on December 1, 2015, and should be back in service by the first or second week of January 2016. He said a number of lamprey modifications are also planned for completion within the ladder this winter, which is the reason the fish ladder outage extends into January 2016. He said the low-level entrance lamprey box has already been installed. He said crews are currently installing cable for a new PIT-tag reader; however, he is uncertain when the new reader will be installed and estimated it may be early January 2016. He said a lamprey enumeration structure is also being installed in the count window. He recalled that this structure is a tunnel, which allows lamprey to pass the count window in relative darkness, opposed to the brightly lit window area, and still be enumerated. He said, in addition to these lamprey modifications, work is also being conducted on the fish pumps for the auxiliary water supply. He said also, in January 2016, a prototype antenna designed by Biomark will be installed in the upper baffle of Bypass Bay 2, with installation of an additional three antennas in time for operation during the bypass season in 2016.

Kahler said, once the west fish ladder is back online, annual maintenance and the same lamprey modifications will be performed in the east fish ladder.

Kirk Truscott asked why fish salvaged out of the west fish ladder were returned to the river downstream of the project. Kahler said, each year, fish salvaged out of the west fish ladder are returned to a downstream location; fish salvaged out of the east fish ladder are returned to an upstream location when conditions allow. He explained that the only release point on the upstream side of the dam is on the east side of the project, and that location is a complicated spot to get a trailer in and out of the water. He said the launch is narrow, steep, curved, and has a lot of loose gravel washed over it. He added that during winter months, it is also slick from snow and ice. He said that several years ago Douglas PUD discussed improving the boat launch with the U.S. Army Corp of Engineers; however, he does not know what came of those discussions. Truscott said his main concern is regarding adult steelhead. He said, if steelhead are in the ladder trying to pass and migrate upstream, and are then moved back downstream of the project, they have to wait until maintenance is complete to pass again. Kahler reminded Truscott that the fish can pass via the other fish ladder when one is down for maintenance. He added that most fish salvaged from the west ladder were white fish, and few were fish Douglas PUD expected were trying to pass the facility.

C. Draft 2015 Wells Dam Post-Season Bypass Report (Tom Kahler)

Tom Kahler said the 2015 Wells Dam Post-Season Bypass Report largely consists of Dr. John Skalski's Douglas PUD 2015 Bypass Passage-dates Analysis, which is currently out for review. Kahler said comments on the draft analysis are due tomorrow, December 15, 2015, and once finalized, he will add a cover page that describes how the bypass was operated and provide the Draft 2015 Wells Dam Post-Season Bypass Report for review to Kristi Geris for distribution to the Coordinating Committees. *(Note: Kahler provided the draft report to Geris on December 15, 2015, which Geris distributed to the Coordinating Committees that same day.)*

Kirk Truscott asked if the calculation for the percentage of subyearlings protected through spill at Wells Dam is based on Rocky Reach Juvenile Fish Bypass data. Kahler said that is correct. He added that Douglas PUD hopes to refine passage and travel time data between Rocky Reach Dam and Wells Dam for run-of-the-river salmonids, once the new Biomark antennas are installed in Bypass Bay 2.

D. Draft 2016 Wells HCP Action Plan (Tom Kahler)

Tom Kahler recalled that the Wells HCP Action Plan is a document Douglas PUD prepares each year summarizing planned activities with an HCP nexus for the upcoming year at and related to the Wells Project. He said the document is currently in internal review, and within a couple of weeks, he will provide the Draft 2016 Wells HCP Action Plan for review to Kristi Geris for distribution to the Coordinating Committees. John Ferguson asked about the review period for this document. Kahler said the review period is typically 30 days for action plans. He recalled that the individual sections in the action plan are first approved by the respective HCP Committees (i.e., HCP Tributary Committees and HCP Hatchery Committees), and then the Coordinating Committees approve the entire document. Kahler said Douglas PUD will likely request approval of the individual sections of the Draft 2016 Wells HCP Action Plan during HCP Committees meetings in January 2016, and then request Coordinating Committees approval of the entire document during the meeting on February 23, 2016. Ferguson asked if not approving the document until February 2016 will cause any issues. Kahler said he does not believe so. He added that the document is not a FERC requirement, but rather a courtesy document to the HCP Committees. *(Note: Kahler provided the draft plan to Geris on December 21, 2015, which Geris distributed to the Coordinating Committees on December 22, 2015.)*

V. HCP Administration

A. 2015 HCP Annual Reports

John Ferguson notified the Coordinating Committees that drafting of the 2015 HCP Annual Reports is underway. He said each report will be available for a 30-day Coordinating Committees review period. He said the Draft 2015 Wells HCP Annual Report will be available for review on Monday, February 8, 2016, and the Draft 2015 Rocky Reach and Rock Island HCP Annual Reports will be available for review on Thursday, February 18, 2016.

B. Ecology Aquatic SWG Technical Representative

John Ferguson notified the Coordinating Committees that Anna Harris is the new Ecology Aquatic SWG Technical Representative replacing Pat Irle, who was the former Ecology

Aquatic SWG Technical Representative. Ferguson said Harris is the new Ecology Clean Water Act Section 401/Hydroprojects Manager. Harris has been with Ecology for about 6 years, working in the Water Quality Technical Unit and performing national and state discharge permitting and compliance services for hatchery permits in the region.

C. Next Meetings

The next scheduled Coordinating Committees meeting is on January 26, 2016, to be held in-person at the Radisson Hotel in SeaTac, Washington. The February 23, 2016, and March 22, 2016, meetings will be held by conference call, in Eastern Washington, or in person at the Radisson Hotel in SeaTac, 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
Tom Kahler*	Douglas PUD
Jim Craig*	U.S. Fish and Wildlife Service
Jeff Korth*	Washington Department of Fish and Wildlife
Kirk Truscott*	Colville Confederated Tribes

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

APPENDIX B
HABITAT CONSERVATION PLAN HATCHERY COMMITTEES 2015 MEETING MINUTES AND CONFERENCE CALL MINUTES

ANCHOR QEA

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees	**Date:**	February 19, 2015
From:	Mike Schiewe, HCP Hatchery Committees Chair		
Cc:	Kristi Geris		
Re:	Final Minutes of the January 21, 2015 HCP Hatchery Committees Meeting		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees meeting was held at the Grant PUD office in Wenatchee, Washington, on Wednesday, January 21, 2015, from 9:30 am to 3:00 pm. Attendees are listed in Attachment A to these meeting minutes.

ACTION ITEM SUMMARY

- Chelan PUD, Douglas PUD, Grant PUD, and the Washington Department of Fish and Wildlife (WDFW) will coordinate on actions needed to finalize the Hatchery Monitoring and Evaluation (M&E) Plan Appendices (Item I-A).
- Mike Tonseth will incorporate Chelan PUD's edits into the revised draft 2014 Wenatchee Basin Steelhead Release Strategy, and will provide the revised document to Kristi Geris for redistribution to the Hatchery Committees (Item I-A). *(Note: Tonseth provided an updated strategy to Geris on January 23, 2015, which Geris distributed to the Hatchery Committees that same day.)*
- Hatchery Committees representatives will review and submit edits on the draft Wells 2015 HCP Action Plan to Douglas PUD prior to the next Hatchery Committees meeting on February 18, 2015 (Item II-A).
- Chelan PUD will provide a draft Rocky Reach and Rock Island 2015 HCP Action Plan to Kristi Geris for distribution to the Hatchery Committees and discussion during the February 18, 2015 meeting (Item II-A).
- The Yakama Nation (YN) will incorporate updates on kelt sampling at Wells Dam into the monthly kelt reconditioning updates that are routinely distributed to the Hatchery Committees (Item IV-A).
- The YN will coordinate with Charlie Snow (WDFW) on drafting a kelt sampling protocol for Wells Dam, and will provide the protocol to Kristi Geris for distribution

to the Hatchery Committees (Item IV-A).

- Chelan PUD will provide a draft report on the water recirculation pilot studies at Eastbank Fish Hatchery (FH) and Chiwawa Fish Facility to Kristi Geris for distribution to the Hatchery Committees for discussion during the Hatchery Committees meeting on February 18, 2015 (Item V-A).
- Mike Tonseth and Kirk Truscott will coordinate with Pat Phillips (Chief Joseph Hatchery Manager), and Keely Murdoch will coordinate internally with the YN, regarding the disposition of surplus juvenile Methow spring Chinook salmon at Eastbank Hatchery (Item V-B).
- Lynn Hatcher will provide a Hatchery and Genetic Management Plan (HGMP) update following the next joint National Marine Fisheries Service (NMFS)/U.S. Fish and Wildlife (USFWS) Biological Opinion (BiOp) Coordination Meeting to Kristi Geris for distribution to the Hatchery Committees (Item V-C).
- The YN will coordinate with Douglas PUD and Chelan PUD to develop a revised draft Upper Methow Spring Chinook Acclimation Proposal, and will provide the revised proposal to Kristi Geris for distribution to the Hatchery Committees (Item V-D).
- Chelan PUD will provide the draft Wenatchee spring Chinook salmon re-initiation of Endangered Species Act (ESA) consultation documents that will be discussed during the next joint NMFS/USFWS BiOp Coordination Meeting to Kristi Geris for distribution to the Hatchery Committees (Item V-E). *(Note: Alene Underwood provided these documents to Geris following the meeting on January 21, 2015, which Geris distributed to the Hatchery Committees that same day.)*

DECISION SUMMARY

- There were no decisions approved during today’s meeting.

AGREEMENTS

- There were no agreements discussed during today’s meeting.

REVIEW ITEMS

- Kristi Geris sent an email to the Hatchery Committees on January 16, 2015, notifying them that the draft Wells 2015 HCP Action Plan is available for review, with comments due to Douglas PUD prior to the next Hatchery Committees meeting on February 18, 2015, when Douglas PUD will request approval of the plan (Item II-A).

FINALIZED DOCUMENTS

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda, Review Last Meeting Action Items, Approve the November 19, 2014 Meeting Minutes (Mike Schiewe)

Mike Schiewe welcomed the Hatchery Committees and asked for any additions or changes to the agenda. Alene Underwood added a brief discussion on the Chelan PUD and Douglas PUD Methow Sharing Agreement.

The Hatchery Committees reviewed the revised draft November 19, 2014 meeting minutes. Kristi Geris said there was one outstanding comment remaining to be discussed regarding the YN's draft Upper Methow spring Chinook salmon acclimation proposal discussion. Geris said that the draft minutes report that Keely Murdoch had indicated that Table 4 in the draft proposal indicated that 25,000 spring Chinook salmon released upstream alone was not enough to drive percent hatchery-origin spawners (pHOS) values above the YN's goals. Greg Mackey indicated that he thought that Murdoch was referring to NMFS' goals. Murdoch confirmed that Mackey was correct and suggested revising "YN's goals" to "draft NMFS targets." Geris will incorporate the edits, as discussed, into the revised minutes and she said that all other comments and revisions received from members of the Committees have been incorporated into the revised minutes. The Hatchery Committees members present approved the draft November 19, 2014 meeting minutes, as revised, with NMFS abstaining as they did not attend the meeting.

Action items from the Hatchery Committees meeting on November 19, 2014, and follow-up discussions were as follows (italicized item numbers below correspond to agenda items from the meeting on November 19, 2014):

- *Chelan PUD will provide a draft report on the water recirculation pilot studies conducted at Eastbank FH and Chiwawa Fish Facility to the Hatchery Committees by December 17, 2014; the draft report will be discussed during the Hatchery Committees meeting on January 21, 2015 (Item I).*

  This will be discussed during today's meeting.
- *Mike Tonseth will provide a revised memo clarifying standardized methods for Hatchery M&E Plan Objective 8.3, Fecundity at Size, to the Hatchery Committees for review by December 17, 2014; the revised memo will be discussed during the Hatchery Committees meeting on January 21, 2015 (Item I).*

  Tonseth provided a revised memo to Kristi Geris on December 26, 2014, which Geris distributed to the Hatchery Committees that same day. Tonseth indicated that he was unable to determine where to append this memo, and Alene Underwood noted that the Hatchery M&E Plan Appendices have not yet been finalized. Underwood said that Chelan PUD will coordinate with Douglas PUD, Grant PUD, and WDFW, on actions needed to finalize the Hatchery M&E Plan Appendices.
- *WDFW will add a revised summary table to the 2014 Wenatchee Basin Steelhead Release Strategy, and will redistribute the final document to the Hatchery Committees by December 17, 2014; the final document will be discussed during the Hatchery Committees meeting on January 21, 2015 (Item I).*

  Tonseth provided the final document to Kristi Geris on December 26, 2014, which Geris distributed to the Hatchery Committees that same day. Catherine Willard noted that there was an error in the document that was recently distributed, which she emailed to Tonseth. Tonseth said that he will review Willard's email, correct the document, and will provide the updated final document to Geris for redistribution to the Hatchery Committees.
- *The YN will provide a revised draft Upper Methow Spring Chinook Acclimation Proposal to Kristi Geris for distribution to the Hatchery Committees by December 3, 2014; the Hatchery Committees will submit suggested edits and comments on the revised draft proposal by December 17, 2014; and the YN will redistribute a final revised draft proposal to the Hatchery Committees at least 10 days prior to the Hatchery Committees meeting on January 21, 2015 (Item II-A).*

  The YN provided a revised draft proposal to Geris on December 3, 2014, which she distributed to the Hatchery Committees that same day. This will be discussed during today's meeting.

- *The Hatchery Committees meeting scheduled for December 17, 2014, has been canceled (Item VI-A).*
  Observed.

II. Douglas PUD

A. Draft Wells 2015 HCP Action Plan (Tom Kahler and Greg Mackey)

Tom Kahler said that a draft Wells 2015 HCP Action Plan was distributed to the Hatchery Committees by Kristi Geris on January 16, 2015. Kahler said that the plan is similar to previous years. He noted that an estimated completion date will be added to the Wells Hatchery Modernization. He said that Douglas PUD plans to request approval of the hatchery portion of the plan at the next Hatchery Committees meeting on February 18, 2015. He added that the plan will be presented to the HCP Coordinating Committees next week, and to the HCP Tributary Committees at their next meeting. Greg Mackey requested that Hatchery Committees representatives closely review the M&E reporting and scheduling portion, with regard to development and review time, as well as how that schedule aligns with the development of the annual Hatchery M&E Implementation Plan. Hatchery Committees representatives will review and submit edits on the draft Wells 2015 HCP Action Plan to Douglas PUD prior to the next Hatchery Committees meeting on February 18, 2015. Alene Underwood also indicated that Chelan PUD will provide a draft Rocky Reach and Rock Island 2015 HCP Action Plan to Geris for distribution to the Hatchery Committees and discussion during the February 18, 2015 meeting.

III. Chelan PUD

A. Methow Sharing Agreement (Alene Underwood)

Alene Underwood said that over the past several months, Chelan PUD and Douglas PUD have been working to develop an Interlocal Agreement between Douglas and Chelan PUDs to rear Chelan PUD's Methow spring Chinook salmon production at Methow FH. She said that the plan is for the Chelan PUD 2015 spring Chinook salmon broodstock to be collected at Wells Dam and reared at Methow FH. She said that this arrangement was described in the HGMP for Chelan PUD's program and that it will be included in the new Methow BiOp. Mike Tonseth asked if NMFS has provided a letter of sufficiency for this plan; Underwood replied that they have not, but she said that Craig Busack is already aware of the potential agreement between Chelan PUD and Douglas PUD.

Keely Murdoch said that she appreciates that Chelan PUD and Douglas PUD are close to an agreement; however, she asked whether the Hatchery Committees would have an opportunity to review where fish would be reared and acclimated. She recalled the YN's interest in testing acclimation at Carlton Pond. She added that based on Chelan PUD's work using circulars ponds, she believes there could be a survival advantage. She also noted the previous low survival rates from Methow FH, and said that she is not necessarily supportive of returning to rearing at Methow FH without first evaluating overwinter acclimation at Chewuch Pond. Underwood noted that the agreement includes brood collection, incubation, and early-rearing—not final acclimation. She said that for this year, Chelan PUD's Methow production will still be acclimated at Carlton Pond. Murdoch noted that attraction of returning adults to Methow FH was a problem. Underwood recalled that the Hatchery Committees have long been supportive of rearing at Methow FH, which was agreed to in the original HGMP. She noted that Douglas PUD and Grant PUD have been meeting their Methow spring Chinook salmon production at Methow FH for many years. Murdoch said that the YN was interested in further discussing the opportunity to compare smolt-to-adult return rates (SARs) between Methow FH and Carlton/Chewuch Pond releases.

Greg Mackey acknowledged that Methow FH has had low SARs; however, he noted that they are approximately twice those at Winthrop National Fish Hatchery (NFH). He said that low SARs may be due to hatchery conditions or they may be due to other factors. He said that this year, spring Chinook salmon smolts will be the first reared and released at the lower recalculated values (Methow FH will release about 160,000 fish). He said that with Chelan PUD's fish, releases will increase to about 240,000 fish, which is still substantially less than the old program targets. He said that lower rearing densities should result in fitter fish, which in turn, may result in better SARs or other performance metrics. Murdoch asked if data comparing rearing densities are available, and Mackey replied that rearing densities will be halved. Tom Kahler added that Methow FH fish tend to return the earliest, which subjects them to higher sea lion predation, among other out-of-basin impacts. He said that they are also subjected to the fishery first and the longest, with the combination of these factors resulting in low SARs.

Kirk Truscott asked about the status of the Carlton Acclimation Pond, and whether it is a Chelan PUD facility. Underwood said that Chelan PUD owns the original acclimation pond constructed in 1989, as well as the land where Grant PUD built their new acclimation facility. Truscott suggested that the HGMP include either location for intermediate rearing. Underwood agreed that those are options; however, she noted that Chelan PUD owes Douglas PUD adequate notice of any changes, per draft conditions in the Interlocal Agreement.

IV. YN

A. *YN Kelt Reconditioning Project Request for Sampling at Wells Dam (Keely Murdoch and Matt Abrahamse)*

Keely Murdoch said that a request to sample at Wells Dam for the YN Kelt Reconditioning Project (Attachment B) was distributed to the Hatchery Committees by Kristi Geris on January 9, 2015. Murdoch explained that during a recent Northwest Power and Conservation Council (NPCC) check-in, an Independent Scientific Review Panel (ISRP) review of the YN Kelt Reconditioning Project was discussed, which was generally favorable; however, the ISRP requested that the YN compare phenotypic characteristics between reconditioned kelts and first-time steelhead spawners in Upper Columbia. Murdoch said that because the YN release reconditioned kelts in the fall, testing fecundity is not suitable as it involves lethal sampling. As an alternate approach, Matt Abrahamse (YN) developed a plan to compare: 1) maturation spawn timing; 2) condition factors; 3) available energy stores; 4) passive integrated transponder (PIT)-tag detection rates (spring); and 5) spring migration timing between reconditioned kelts at the time of release and first-time steelhead spawners. Murdoch said that the plan involves sampling during the same time when WDFW is conducting adult steelhead stock assessment monitoring at Wells Dam. Abrahamse said that the additional sampling would only include collecting blood samples, fish length and weight, and Fatmeter readings from up to 50 steelhead females (25 natural-origin recruits [NORs] and 25 hatchery-origin recruits [HORs]). He said that, specifically, concentrations of the egg yolk precursor protein vitellogenin and the hormone estradiol will be used as a measure of maturation, Fulton's Condition Factor (K-factor) and Fatmeter readings will be used to estimate energy levels, and PIT-tag detection rates will be compared between reconditioned kelts and first-time NOR spawners.

Abrahamse said that the additional sampling is fairly minimal, and will require very little extra handling or time. He further explained that the Fatmeter readers can be conducted when scales are sampled and length and weights are recorded, and the blood samples will be collected when fish are first anesthetized. Murdoch said that the request to the Hatchery Committees is not regarding the study design; rather, it is to sample at Wells Dam alongside WDFW's ongoing data collection. She said that the proposed sampling will be covered under the annual NMFS authorization, which Abrahamse has already requested. She added that Blane Bellerud (NMFS) typically provides the authorization letter by March or April.

Lynn Hatcher asked if any issues have been expressed about not addressing all of the ISRP's requests (e.g., testing fecundity). Murdoch said that most requests will be addressed, and she added that the fecundity comparison may still be addressed separately from this sampling proposal. Abrahamse said that the other ISRP request not addressed by this proposal is regarding egg size, which is not possible, considering the project design. Murdoch added that, based on discussions with the NPCC, the members understand that some requests are not possible.

Kirk Truscott asked about using ultrasound for assessing maturation timing, and Abrahamse said that the YN has considered ultrasound to evaluate ovary sizes. Mike Tonseth cautioned that it is necessary to ensure that the ultrasound unit is consistent from fish to fish, as well as the settings. He also recommended making comparisons between fish of the same age and similar size, as there can be morphological differences. Truscott asked if 25 NORs and 25 HORs separated into respective salt ages will be an adequate sample size for meaningful statistical power. Murdoch said that the first year of this study is meant to be exploratory, and if apparent differences are observed between salt ages, those will be considered in future studies. She said that the YN's main concern was regarding the blood samples. Tonseth noted that because WDFW will be conducting stock assessment monitoring anyway, there will be NOR and HOR controls for blood draw (i.e., others not subjected to blood draw); he suggested obtaining a few extra weight and Fatmeter readings to determine if blood draw has a negative effect on survival, by again relying on PIT-tag detection elsewhere in the system.

He suggested that regarding the fecundity requests, data mining could be conducted on Methow steelhead spawners, possibly looking at relative size differences for similar-aged fish.

Murdoch explained that Fatmeter measurements are used in other kelt programs to provide a way to estimate energy reserves of a fish. Tonseth said that Fatmeter readings have also been used in the Wenatchee Spring Chinook Reproductive Success Study (RSS), and are positively correlated with survival-to-spawn in Tumwater for spring Chinook salmon. He said that NORs tend to have higher lipids, which may contribute to higher survival in NOR spring Chinook salmon. Murdoch said that this difference is one of the reasons for including the HOR study group in the comparisons.

Greg Mackey asked how many years this study will take place, and Murdoch said that at this point, the YN has funding through 2017. She added, however, that depending on the first year, the proposal may be altered if some metrics do not appear useful. Mackey asked how and when sampling will take place (e.g., two fish at a time, over 2 weeks, etc.). Abrahamse said that ideally, sampling would take place within a couple of days of releasing kelts; however, he acknowledged that this may restrict trapping days. He added that the YN may sample fish relatively early because they are exploring the possibility of testing fish as early as possible, and then retaining fish that are not maturating another year. Mackey said that he has conducted blood sampling before with Atlantic salmon, and there were no noticeable mortalities. Abrahamse said that he has also conducted blood sampling on reconditioned fish via the caudal vein, with no noticeable mortalities.

Mackey said that Tom Kahler works closely with the operators sampling at Wells Dam. Kahler said that Douglas PUD will require all parties planning to sample at Wells Dam to provide plans ahead of time and complete security, trap operation, and safety training. He added that a 2015 Wells Dam trapping schedule will be presented to the HCP Coordinating Committees for approval in March or April, prior to trapping season for spring Chinook salmon.

Truscott asked if the YN will be trapping concurrent with WDFW. Murdoch said that it would, and added that YN staff will be present to help collect the extra data. Charlie Snow suggested sampling HORs collected for broodstock, which would also provide data on mortalities. Murdoch agreed that was a good idea. Snow also noted that fish abundance at Wells Dam can be pretty low late in the run, and suggested reviewing historical data to help plan when scheduling sampling.

Murdoch recalled the Hatchery Committees request for the YN to provide monthly progress reports on their Steelhead Kelt Reconditioning Program, and suggested including an update regarding this sampling effort in those progress reports to keep the Hatchery Committees informed. Mackey noted that the NORs versus HORs data will be of particular interest. Murdoch said that the YN will incorporate updates on kelt sampling at Wells Dam into the monthly kelt reconditioning updates that are routinely distributed to the Hatchery Committees. She added that the YN will also coordinate with Snow on drafting a kelt sampling protocol for Wells Dam, and will provide the protocol to Geris for distribution to the Hatchery Committees.

V. Joint HCP/Priest Rapids Coordinating Committee Hatchery Sub Committee Meeting

A. PRESENTATION: Circular Pond Rearing at Eastbank FH and Chiwawa Facility (Catherine Willard)

Catherine Willard provided a presentation titled, "Post-Release Performance of Chinook Salmon and Steelhead Reared in Partial Water Reuse Circular Vessels Compared to Traditional Flow-Through Raceways" (Attachment C), which was distributed to the Hatchery Committees by Kristi Geris following the meeting on January 22, 2015. The presentation highlighted the results from studies conducted by Chelan PUD and Grant PUD comparing the health and performance of summer Chinook salmon and steelhead that were reared in partial water reuse vessels (recirculating aquaculture systems; RASs) versus raceways (flow-through; FT) at Eastbank FH and Chiwawa Acclimation Facility in addition to comparing performance of summer Chinook reared in single pass circular vessels at Chelan Falls as compared with fish reared in FT raceways at the Entiat National Fish Hatchery. The impetus for the study was to investigate lower-water-use rearing methods (i.e., RASs/circular vessels) versus traditional methods (i.e., FT). Willard reviewed the results of fish performance metrics that were evaluated for fish reared in RASs versus FTs, including fish health, post-release survival, migration travel time, SARs, and age structure, as further described in Attachment C. Overall, for summer Chinook salmon, the study found equal or better survival and quality of fish and improved age structure for adult returns among fish reared in RASs versus FTs. Overall, for steelhead, the study results were mixed but promising with several confounding variables and no identifiable covariates.

Kirk Truscott asked about the methods for determining survival. He asked if survival was based on tag files, or if known fish releases were used for comparisons. Alene Underwood replied that survival was based on tag files of known releases with mortalities removed.

Mike Tonseth asked if travel times were adjusted based on release location, and Willard replied that they were.

Keely Murdoch asked how a mini-jack was defined. Willard explained, as shown in slide 35 of Attachment C, that 99.5% of all fish were interrogated at juvenile arrays prior to July 1; if the fish was detected after July 1, it was presumed to be a mini-jack.

Todd Pearsons (Grant PUD) noted, regarding slide 14 of Attachment C, that the primary difference between short-term (June to October) and long-term (June to February) RAS treatments is that it appears that winter growth may be more important; Willard agreed.

Truscott noted, regarding slide 21 of Attachment C, that it appears that mini-jack rates were low regardless of the rearing method. He asked, if mini-jacks were the more important biological risk, whether efforts should focus on the benefit of RASs on mini-jacks rather than jacks. Pearsons said that the two are closely correlated. Peter Graf (Grant PUD) added that the rate of PIT-tagged fish (y-axis) is more of an index and not a good indication of the true rate.

Tonseth asked if there was any analysis of hatchery health performance on FTs versus RASs; specifically, if any health issues were observed to differ between the two rearing methods. Willard said that specific evaluations were not conducted; however, anecdotally, nothing out of the ordinary was observed.

Truscott noted the several confounding variables for steelhead, including broodstock origin, and he asked how many different mating types were included. Willard replied that there were only two: wild-by-wild (WxW) and hatchery-by-hatchery (HxH). Truscott asked if there were PIT tags for each origin, and Willard replied that they are. Willard further explained that WxWs and HxHs were separated and distinguishable by rearing vessel. Truscott suggested evaluating survival by origin.

Tom Kahler asked if any differences in size and timing of migrants were observed. Willard said that fish reared in RASs tended to have faster travel times and also higher predation rates, which may be because they were released earlier.

Underwood said that Chelan PUD will provide a draft report on the water recirculation pilot studies to Geris for distribution to the Hatchery Committees for discussion during the Hatchery Committees meeting on February 18, 2015.

B. Methow and Wenatchee Spring Chinook Salmon Production Status Update (Mike Tonseth)

Methow Spring Chinook Salmon

Mike Tonseth said that about 37,000 surplus Methow spring Chinook salmon are on hand at Methow FH, projected to be in excess of 110% of the brood year (BY) 2014 production goal. He said that after discussions with hatchery staff, WDFW spoke with Chelan PUD about incorporating the surplus progeny into the Chelan PUD program. He recalled that for the Chelan PUD program at Eastbank Hatchery, spring Chinook salmon were collected via the Rocky Reach Trap and tangle netting in the Chewuch; and ultimately, only NORs collected at Rocky Reach and fish collected via tangle netting in the Chewuch were used. He said that because there were HORs included in the tangle netting, the 100% NORs target for Chelan PUD's conservation program was not met. He said that WDFW contacted Chelan PUD regarding removing HORs from their program and boosting the NOR component, prioritizing WxW progeny. He said that this left HxW fish; however, the wilds were already used in the WxW cross, so those genes are already represented in the mix. Alene Underwood asked why not remove the HxH fish. Tonseth replied that the decision was based on when the males matured. He explained that HxWs were prioritized over HxH where the hatchery expression is represented in the HxW crosses, and the HORs were removed where NOR males were already used in the WxW cross. Tonseth said that he also spoke with USFWS, but their program targets had already been met; he presumed that the Colville Confederated Tribes (CCT) would not need them if Winthrop NFH was at capacity. He added that the preference was for eyed egg transfers; however, the timing was such that the transfer would be of fry if done as soon as possible.

Tonseth said that if there is no program need for the fish at Eastbank Hatchery, the only alternative may be to transfer them to Banks Lake where they become land-locked Chinook salmon. Keely Murdoch asked if this alternative has been approved by *U.S. v Oregon*, and Tonseth replied that it has not. Tonseth added that this alternative has been implemented for other programs in the past; however, not for spring Chinook salmon. He noted that Chelan PUD's update to the Hatchery Committees regarding the sharing agreement between Chelan PUD and Douglas PUD suggests the possibility that the fish at Methow FH may be held at Methow FH to minimize or remove the need for transfer to Eastbank FH. Greg Mackey said that even if the sharing agreement does not pan out between Chelan PUD and Douglas PUD, Douglas PUD is supportive of holding the surplus fish longer at Methow FH; even to the point of transferring the fish to Carlton Pond in the fall after rearing to the parr stage.

Tonseth suggested that the CCT contact the USFWS to determine how many BY 2014 fish USFWS plans to transfer to the CCT. Kirk Truscott said that the CCT have already received eyed eggs. Murdoch noted that there will be mortalities at the eyed egg stage. Lynn Hatcher asked how many eyed eggs the CCT have for Section 10j fish, and Truscott said that he would need to check. Truscott added that green egg-to-smolt survival is approximately 85%, and Tonseth noted that there tends to be variability in terms of ponding loss. Tonseth suggested holding off on transferring the surplus fish until all components have been ponded, determine the losses, and then determine the numbers and where there is capacity to hold these fish. Mike Schiewe asked about the cause of the overage at Methow FH, and Tonseth replied that it was due to better-than-expected green egg-to-eyed egg survival and low bacterial kidney disease (BKD) culling.

Mackey asked about the egg fertilization protocol (i.e., split milt or separate males) at Eastbank FH. Tonseth said that the eggs were fertilized using a factorial mating design at Eastbank FH, with each egg lot receiving milt from individual primary males with milt from a backup male added after that. Mackey asked if each hatchery male is the primary male in one mating; Tonseth said that is correct, so the loss of those are not a loss to the program.

Truscott said that tagging occurs around the end of April, which Tom Kahler noted is a consideration. Murdoch noted that the YN may not be supportive of taking fish to Banks Lake; which, she added, is not covered by permit. Tonseth and Truscott said that they will coordinate with Pat Phillips (Chief Joseph Hatchery Manager), and Murdoch indicated that she will coordinate internally with the YN, regarding the disposition of surplus juvenile Methow spring Chinook salmon currently at Eastbank FH.

Wenatchee Spring Chinook Salmon

Tonseth reported that three female broodstock were culled from the Nason Creek Program due to high BKD, which left approximately 37,000 eyed eggs for 2014 brood. He said that depending on hatchery survival, this translates to about 34,000 smolts or 27% of the target goal for the Nason Creek Conservation Program. He said that about 141,000 eyed eggs were available for the Chiwawa Program, which is expected to yield about 136,000 smolts, or about 95% of the Chiwawa Conservation Program target. Further, by adding the 201,000 smolts expected from the Wenatchee Safety Net Program yields a total of about 371,000 smolts overall for the Wenatchee Spring Chinook Salmon Program, which is 101% of the combined Chiwawa and Nason Creek program targets. He said that this puts the combined program at about the fish release target; however, it is still well under the under target for the conservation component.

C. HGMP Update (Lynn Hatcher)

Lynn Hatcher said that he will provide a HGMP update following the next joint NMFS/ USFWS BiOp Coordination Meeting to Kristi Geris for distribution to the Hatchery Committees.

D. YN Upper Methow Spring Chinook Acclimation – Draft Proposal and SOA (Keely Murdoch)

Draft YN Upper Methow Spring Chinook Acclimation Proposal

Keely Murdoch said that comments were received from all three PUDs on the draft proposal. She said that Todd Pearsons proposed incorporating the expanded acclimation concept into a broader evaluation on how to improve spawning distribution. She said that the YN is supportive of the idea; however, she wanted it separate from this proposal so that it does not hold up permitting for this proposal. Kirk Truscott asked if this larger concept will be more like a research proposal. Pearsons clarified that the concept involves testing multiple approaches or methods to alter spawning distribution of hatchery fish. He added that it aligns with what the YN has proposed with acclimation. Truscott asked if this would be testing different strategies with the same objectives, and Pearsons indicated that was his idea.

Murdoch projected the draft YN Upper Methow Spring Chinook Acclimation Proposal that incorporated comments from all three PUDs (Attachment D), and discussed individual comments, as follows:

Section 1.2 Methow Spring Chinook – Figure 1

Murdoch said that several commenters indicated that Figure 1 was of limited value and misleading; Murdoch said that she disagreed. She said that the figure was taken directly from the 5-Year Hatchery M&E Report; it displays mean female carcass recovery by river mile from 2006 to 2010 to depict spawning distributions of Methow FH-origin, Winthrop NFH-origin, and NORs on the upper Methow River. She said that Chelan PUD suggested including additional data from the 5-Year Hatchery M&E Report (e.g., Figure 50); however, Murdoch said that she did not include Figure 50 or other related information because the other figures depict proportions. She said that because the goal of adult management is to remove as many HORs as possible before they spawn, proportions have limited use; she said that leaving Figure 1 in the proposal was preferred.

Greg Mackey said that the other graphs in the 5-Year Hatchery M&E Report are important to include because Figure 1 by itself is an incomplete depiction of these data. He recalled that when the 5-Year Hatchery M&E Report was first drafted the graph identified as Figure 1 in this proposal was included as the prescribed approach from the Analytical Framework; however, the authors of the report recognized that this analysis was insufficient to properly describe the data, so two additional graphs were added, which used proportions of hatchery to wild spawners within reaches to address the spatial distribution relative to the origin of the fish and number of spawners based on reach size to address relative seeding of the reaches. Murdoch said, however, that since then the program was substantially reduced in size, and combined with removing as many hatchery fish as possible, spawners by reach are expected to substantially change. Mackey said that he does not believe that large numbers of hatchery fish will necessarily be removed. He further explained that with the reduced program sizes, it will be much more likely that the programs will include mostly or all wild broodstock, resulting in a percent natural-origin broodstock (pNOB) value of 1 or close to 1. Given the high pNOB, the pHOS could be as high as 0.5 and still result in a proportion of natural influence (PNI) equal to 0.67, which is the minimum target for a conservation program. Since the analysis of spawner distribution in the 5-Year Hatchery M&E Report showed that all but two reaches had pHOS equal to or greater than 0.5 under the higher release regime, and the upper reaches tended to be near the 0.5 pHOS mark, it seems likely that not many hatchery fish (from Methow Hatchery) would need to be removed to achieve (what is believed to be) the PNI target.

Mike Tonseth noted that if there are additional changes in hatchery practices in-basin, such as remote acclimation, that fewer fish may return to the hatchery. He agreed with Murdoch that the landscape will be different because there are many untested approaches. Murdoch said that ultimately, this is the YN's proposal and other data were excluded because the YN did not feel they were applicable. Catherine Willard noted that Figure 1 is historical data, and she questioned why not include other historical data. Murdoch said that the point of Figure 1 is to show that spawning distributions are not the same. Willard noted that Figure 1 also implies other things because it represents incomplete data.

Truscott said he thought it would be helpful to include information by reach. Murdoch again cautioned that those data will change because of reduced program targets and adult management. Truscott suggested comparing reaches as a proportion of basin-wide spawning escapement; he offered that this would be a better assessment than trying to describe differences in spawner distribution. Murdoch agreed that this may be feasible.

Section 2.0 Goals and Objectives

Murdoch said that comments received on this section were largely from Douglas PUD. She thanked Douglas PUD for this input; however, she said that Douglas PUD's proposed "Goals and Objectives" (numbers 1 through 3) are beyond the scope of this proposal, and Douglas PUD's proposed "Learning Objectives" (number 4) are similar to what the YN has already proposed in the near-term objectives. She added that Douglas PUD's proposed numbers 1 through 3 are largely management objectives for the Methow River; she said that at this point, there is no Methow River Management Plan and this proposal is not intended to be such a plan. She said that the YN would like to keep the four near-term objectives, as originally proposed.

Mackey explained that what Douglas PUD proposed was more to capture what this proposal is intended to achieve. He said that this is an experiment about learning. He added that if this is a management action (he noted that he thinks it is, because listed fish are being used to enhance the performance of a hatchery program), he believes there needs to be measureable targets. He said that these do not need to be restrictive; however, certain parameters need to be defined (e.g., [something] by reach or zone of interest). Murdoch said that the YN has a responsibility to manage a resource, and if something is called a "management objective," this has explicit implications. Tom Kahler suggested, then, to reword the statement to make it a part of the study so it does not raise that concern. Mackey said that Douglas PUD and the YN are really proposing the same thing, only Douglas PUD is trying to define a measureable target. Murdoch said that the YN's proposal is consistent with the 5-Year Hatchery M&E Report, only they are testing whether fish released higher in the basin will yield different results. Mackey said that the YN can accomplish this comparison; however, he cautioned to think carefully about what is being achieved. He added that the comparison needs to be quantitative in some form (i.e., changed by [how much] in [what way]).

Truscott agreed that spawning escapement by reach cannot be determined with 25,000 fish (the current proposal). Truscott asked, regarding Douglas PUD's "Learning Objectives," why Douglas PUD proposed to obtain these data by reach when this cannot be obtained with only 5 years of data. Mackey said that the purpose behind these objectives was to quantify the effect. Truscott suggested reviewing historical data to determine what proportion of fish spawn in the upper reaches, and after implementing this program, evaluate those adult returns on a proportional basis to determine whether there was an effect. He added that based on those evaluations, the Hatchery Committees could determine what is biologically meaningful. Mackey agreed that this would be another option; and he added that Douglas PUD wants to implement the action in the most rigorous fashion. Truscott said that he was looking more to implementing the action and then determining next steps afterward.

Pearsons said that he believes that Douglas PUD is advocating quantitative targets as needed for an adaptively managed program. He added, for example, that if targets are being exceeded, this will help to inform future decisions. Murdoch suggested possibly developing some sort of testing targets, but not labeling them "management." She added that developing targets is still difficult because there are several unknown factors.

Murdoch said that the purpose of this project is to move spawning higher in the system so there is not so much spawning in the vicinity of the hatchery, as it is now. She added, however, that it is unrealistic to expect that many fish will not home back to Methow FH; she said that about 43% of fish reared at Methow FH and short-term acclimated in the Chewuch returned to the Methow River in recent years, leaving about 57% to spawn in the Chewuch. She said that the YN's objective is not to have a concrete-to-concrete program; rather, it is to make sure that conservation fish are spawning in optimal locations. Alene Underwood agreed with the intent of the program; she added that all that is missing is how success will be measured. Murdoch said that success is to have improved SARs in the upper basin, and Kahler asked what defines "improved." He said that proportion of returns between control and treatment groups can be compared, but it needs to be defined how much of an increase will constitute success.

Tonseth said he believes that the YN proposal is a pilot study. He agreed with Murdoch that a big part of this discussion is beyond the scope of this proposal, and would more appropriately belong in a management document similar to the Wenatchee Basin Management Plan. He reiterated that there are major changes occurring in this program, including reduced program size and implementation of adult management, both of which include several unknowns. He added that the progeny of NORs could perform differently than those of multi-generational HORs that have been in the basin. He said that this proposal provides another tool to help place these conservation fish where hatchery program managers want them.

Matt Cooper said that he discussed this with Bill Gale, and they had thoughts similar to those of Tonseth. Cooper questioned what could be achieved with statistical rigor with 25,000 fish. He added, however, that he agreed with including specificity regarding defining targets. He asked how fixed the objectives should be in terms of adaptive management.

Tonseth said that this is problematic because the consultation process has yet to start, and it is still unknown whether programs will be held to a pHOS or PNI objective. Lynn Hatcher said that he spoke with Craig Busack about this, who indicated that at this stage, effects on PNI should be considered. Hatcher added that NMFS supports supplementation, and that they are interested to know what types of impacts acclimation will have on the basin.

Cory Kamphaus said that this proposal is just a small piece of hatchery M&E. He added that it is a tool to get fish distributed differently. Pearsons asked what would be considered a success from a baseline of 25,000 hatchery releases and 25,000 upstream releases (e.g., 1 more upstream released fish in 1 year, 1 fish in 5 years, 10 fish in 5 years). Murdoch said that it depends on how many fish are there in the first place, and Tonseth added that each year, it depends on the number of NORs returning.

Murdoch said that this proposal started with addressing NMFS' and the PUD's concerns with PNI, pHOS, and appropriate release numbers. She said that now, however, each time the YN addresses one issue, another issue is raised. She said that the YN has addressed all issues raised to date, and suggested that for now, the YN: 1) keep the four near-term objectives originally proposed; and 2) better define and incorporate what the CCT proposed regarding making a comparison by reach proportional to the basin. She reiterated that currently, defining an absolute numerical goal is difficult due to the unknown factors. She said that if the Hatchery Committees would like to attempt to develop specific goals, the YN is open to suggestions.

(Proposed) Section 3.0 Sources of Uncertainty in States of Nature

Murdoch said that these are good questions; however, they are beyond the scope of this proposal. Mackey said that the sources of uncertainty he presented were examples that would affect the program, but as a way to focus the concept to the project, recommended, for example, stating sources of uncertainty with regard to adult management, and Truscott suggested that a lot of uncertainty will be addressed under the adult management plan. Murdoch agreed with Truscott, and suggested removing the proposed Section 3.0. Mackey suggested at least keeping a brief list of uncertainties that the YN is aware of.

Section 3.0 Project Proposal

First paragraph, last sentence (currently stricken out): Murdoch said that this sentence started out in earlier versions to be intentionally vague; however, based on feedback from NMFS, the YN revised this sentence to be more specific for permitting purposes. She said, therefore, that this sentence will remain in the proposal, per direction from NMFS.

Goat Wall Pond: Murdoch asked about the comment regarding Goat Wall Pond being worthy of a 5-year commitment, and Mackey clarified that Douglas PUD just did not want to shift locations in the middle of the study. Murdoch said that she agrees that moving sites would make a difference; however, if this was proposed, it would need to be approved by the Hatchery Committees.

Murdoch said that regarding the comment on Reaches M9 to M15 and the suggestion to limit the evaluation to a shorter stretch of the river, she was attempting to define the Upper Methow reaches where a lot of NORs spawn. She added that she was not trying to exclusively get fish to these reaches.

Table 1: Truscott asked if Table 1 is necessary; Murdoch said that the Hatchery Committees requested that the YN include this table.

Murdoch said that the YN will coordinate with Douglas PUD and Chelan PUD to develop a revised draft Upper Methow Spring Chinook Acclimation Proposal, and will provide the revised proposal to Kristi Geris for distribution to the Hatchery Committees.

Draft Goat Wall Acclimation SOA

Murdoch projected the draft Goat Wall Acclimation Statement of Agreement (SOA; Attachment E), and noted the edit received from Douglas PUD (in redline strikeout). Underwood also noted that Rocky Reach and Rock Island need to be added to the title of the SOA.

E. Re-initiation of Spring Chinook BiOp (Alene Underwood)

Alene Underwood said that NMFS and WDFW were discussing a new Wenatchee Spring Chinook BiOp; however, NMFS' Legal Counsel indicated that the applicants (Chelan PUD, Grant PUD, and WDFW) would need to request re-initiation of the BiOp for this action.

Underwood said that NMFS, in conjunction with the co-managers, made a preliminary decision on a preferred alternative approach to collect Wenatchee basin spring Chinook salmon broodstock at Tumwater Dam and the Chiwawa Weir beginning BY 2015. She said that Chelan PUD and Grant PUD drafted a letter to NMFS indicating that this new preferred broodstock collection strategy was not previously analyzed in the BiOp, and will ultimately lead to re-initiation of consultation; this was drafted with the intention of submitting a letter with signatures of the Priest Rapids Coordinating Committee Hatchery Sub Committee (PRCC HSC) and HCP Hatchery Committees.

Lynn Hatcher said he believes that this letter will be adequate. He added that NMFS' Legal Counsel just wanted a letter for record-keeping from either the three Mid-Columbia PUDs or the PRCC HSC and HCP Hatchery Committees. Underwood said that she hoped that the PRCC HSC and HCP Hatchery Committees could review the letter before it was discussed at the next joint NMFS/USFWS BiOp Coordination Meeting. She said that the letter was drafted using language from NMFS-produced documents, and that directly after today's meeting, she can provide the draft letter and associated Wenatchee spring Chinook salmon re-initiation of ESA consultation documents to Kristi Geris for distribution to the Hatchery Committees for review. Kirk Truscott said that the CCT will need time to review the documents internally. Keely Murdoch asked if the BiOp is on track for broodstock collection this year. Mike Tonseth said that based on direction from Amilee Wilson, NMFS is proceeding toward providing permit coverage by the time broodstock collection begins. He added that the 2015 Broodstock Collection Protocols will include this protocol. *(Note: Underwood provided the Wenatchee spring Chinook re-initiation of ESA consultation documents [Attachments F, G, H, and I] to Geris following the meeting on January 21, 2015, which Geris distributed to the Hatchery Committees that same day.)*

F. USFWS Bull Trout Consultation Update (Matt Cooper)

Matt Cooper said that a USFWS Bull Trout Consultation update will be provided during the next joint NMFS/USFWS BiOp Coordination Meeting.

VI. HCP Administration

A. Next Meetings

The next scheduled Hatchery Committees meetings are on February 18, 2015 (Chelan PUD); March 18, 2015 (Douglas PUD); and April 15, 2015 (Chelan PUD).

List of Attachments

Attachment A	List of Attendees
Attachment B	YN Kelt Reconditioning Project Request for Sampling at Wells Dam
Attachment C	Post-Release Performance of Chinook Salmon and Steelhead Reared in Partial Water Reuse Circular Vessels Compared to Traditional Flow-Through Raceways
Attachment D	Draft YN Upper Methow Spring Chinook Acclimation Proposal with Comments
Attachment E	Draft Goat Wall Acclimation SOA
Attachment F	HCP Hatchery Committees and PRCC HSC Letter to NMFS Re: New Preferred Broodstock Collection for Wenatchee Spring Chinook Hatchery Supplementation Programs
Attachment G	NMFS Letter to USFWS Re: New Preferred Broodstock Collection for Wenatchee Spring Chinook Hatchery Supplementation Programs
Attachment H	2015-2023 NMFS Preferred Approach to Wenatchee Spring Chinook Broodstock Collection – Attachment 1
Attachment I	Nason Creek and Chiwawa River Broodstock Collection Options – Attachment 2

Attachment A
List of Attendees

Name	Organization
Mike Schiewe	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Elizabeth McManus††	Ross Strategic
Andy Chinn††	Ross Strategic
Alene Underwood*	Chelan PUD
Catherine Willard*	Chelan PUD
Greg Mackey*	Douglas PUD
Tom Kahler*	Douglas PUD
Todd Pearsons	Grant PUD
Peter Graf††	Grant PUD
Deanne Pavlik-Kunkel	Grant PUD
Lynn Hatcher	National Marine Fisheries Service
Matt Cooper*	U.S. Fish and Wildlife Service
Cory Kamphaus††	Yakama Nation
Mike Tonseth*	Washington Department of Fish and Wildlife
Charlie Snow†	Washington Department of Fish and Wildlife
Kirk Truscott*	Colville Confederated Tribes
Keely Murdoch*	Yakama Nation
Matt Abrahamse	Yakama Nation

Notes:

*	Denotes Hatchery Committees member or alternate
†	Joined by phone
††	Joined for the joint HCP/PRCC portion

Phenotypic Characteristics of Reconditioned Steelhead Kelts and First-time Steelhead Spawners in the Upper Columbia

Yakama Nation Fisheries Resource Management
Upper Columbia Kelt Reconditioning Project
January 21, 2015

Purpose: To address ISRP Qualifications comparing reproduction related phenotypic characteristics between reconditioned kelts and first time steelhead spawners in Upper Columbia

Objective: To compare 1) maturation timing, 2) condition factors, 3) available energy stores, 4) PIT tag detection rates (spring), and 5) spring migration timing between reconditioned kelts at the time of release and first time spawners.

Methods

Reconditioning Facility: Collect blood samples, length and weight data, Fatmeter readings, and PIT-tag all reconditioned kelts prior to release.

Wells Dam: Collect blood samples, length and weight data, and Fatmeter readings from up to 50 steelhead females (25 NOR and 25 HOR) sampled during the WDFW's adult stock assessment monitoring at Wells Dam. Record PIT tag numbers from all NOR steelhead sampled at Wells Dam.

Data Analysis: Blood samples will be analyzed for concentrations of the maturation hormones vitellogenin and estradiol in the blood plasma. Hormone concentration will be applied as an index for maturation timing. Length and weight data will be used to calculate Fulton Condition Factor (K) and somatic lipid levels (%) measured through Fatmeter readings will be used as indices of available energy stores. Paired t-tests will be used to determine if there is a statistical difference in these three indices between reconditioned kelts at the time of release and first time spawners.

We will compare the PIT tag detection rates between reconditioned kelts and first time NOR spawners the spring following their sampling. PIT tag data will also be used to compare migration timing based on the date of first detection.

Time line: Sampling will be conducted between August 1 and October 31 annually beginning in 2015 and continuing through 2019.

Reporting: Results of this study will be included in the Upper Columbia Kelt Reconditioning Project’s annual report to Bonneville Power Administration.

Permit Coverage: Take of steelhead for this study will be covered by an annual National Marine Fisheries Service Determination of Take Letter (number TBD). We are requesting an allowable handling take of 25 NOR steelhead and 25 HOR steelhead at Wells Dam and allowable incidental mortality of 1 NOR and 1 HOR.

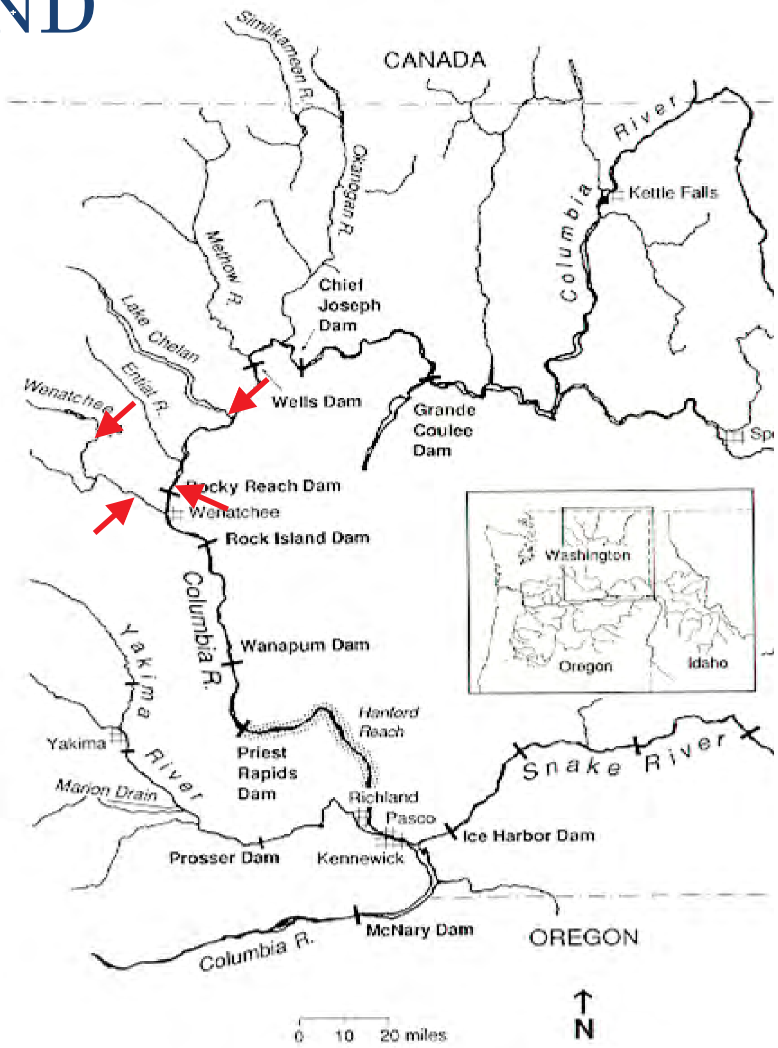
Attachment C

POST-RELEASE PERFORMANCE OF CHINOOK SALMON AND STEELHEAD REARED IN PARTIAL WATER REUSE CIRCULAR VESSELS COMPARED TO TRADITIONAL FLOW-THROUGH RACEWAYS

CHELAN COUNTY PUBLIC UTILITY DISTRICT
GRANT COUNTY PUBLIC UTILITY DISTRICT

ROCK ISLAND, ROCKY REACH, AND WELLS HCP HC
PRIEST RAPIDS CC HSC
JANUARY 21ST, 2015

PROGRAM BACKGROUND



- Summer Chinook
  - **Chelan River**
    - **RY2009 and RY2010**
      - Eastbank Hatchery (RAS/FT)
      - Acclimation (Chelan River netpens) and release to the Chelan River
    - **RY2012-RY2014**
      - Eastbank Hatchery
      - Acclimation Chelan Falls (RAS)
  - **Wenatchee River**
    - **RY2011 and RY2014**
      - Eastbank Hatchery (RAS/FT)
      - Acclimation (Dryden Pond) and release to the Wenatchee River
- Steelhead
  - **RY2010**
    - Chiwawa Hatchery (RAS)
    - Turtle Rock Island (FT)
  - **RY2011-Present**
    - Chiwawa Hatchery (RAS/FT)

PARTIAL WATER REUSE CIRCULAR VESSELS

- Known Operational Benefits
  - Use less water! 1/4 of a standard raceway.
  - Rotation of water ensures consistent velocities and oxygen.
  - Better waste capture and removal of TSS.

FISH PERFORMANCE?

- Fish health
- Post-release survival
- Travel time downstream
- Smolt-to-adult returns
- Age structure

STATEMENT OF AGREEMENT

Rocky Reach and Rock Island HCP Hatchery Committees

Statement of Agreement

February 20th, 2008

Regarding Pilot Study for Partial Water Reuse

"Determine if circular ponds with 75% reuse can be used to rear Chinook from ponding to yearling size at Eastbank, while producing fish with growth, health and vigor desired for the supplementation programs"

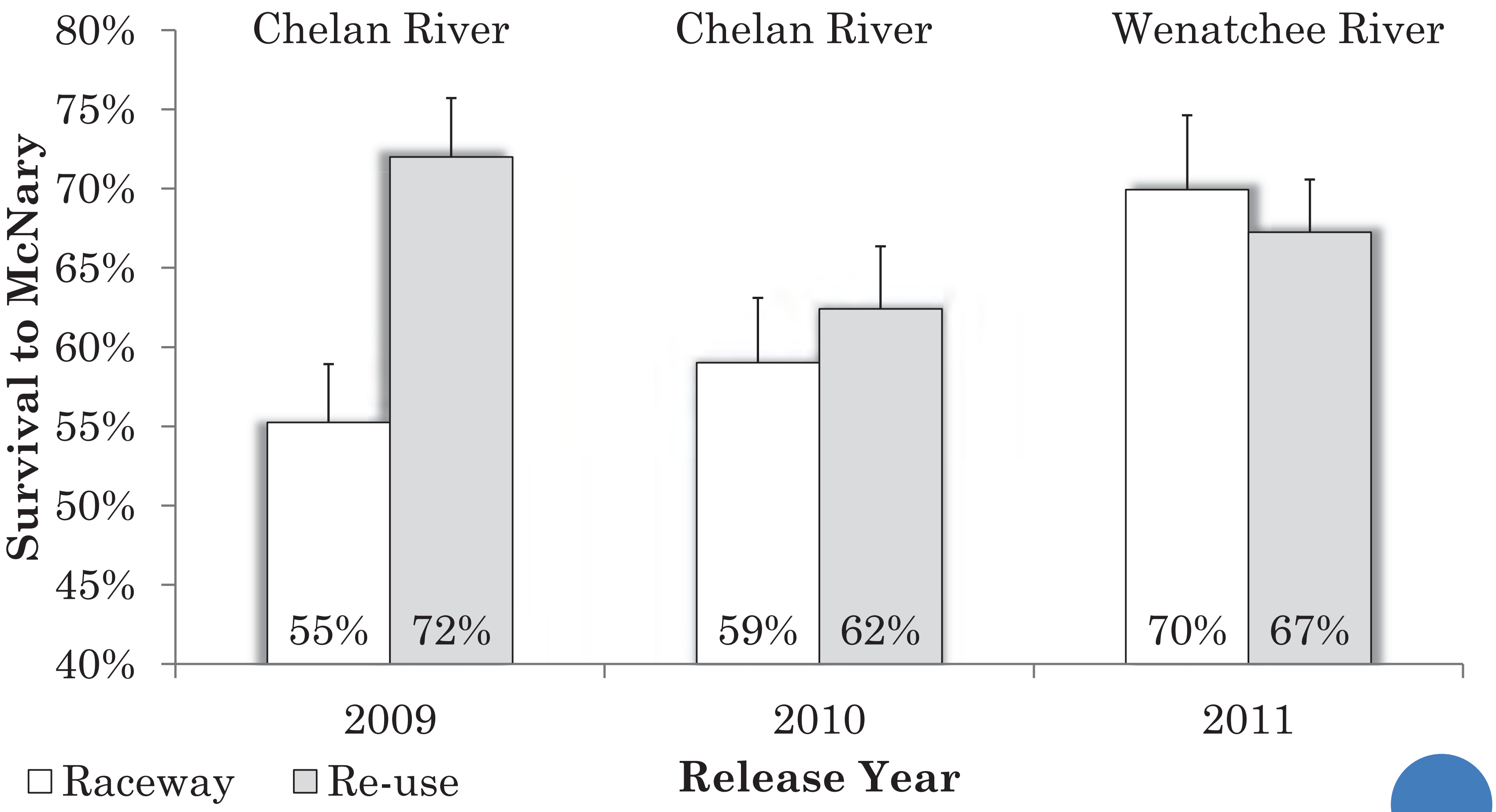
FISH HEALTH

- Survival
- Bacterial and viral fish pathogens
- Coefficient of variation
- Condition factor
- Fat

Attachment C

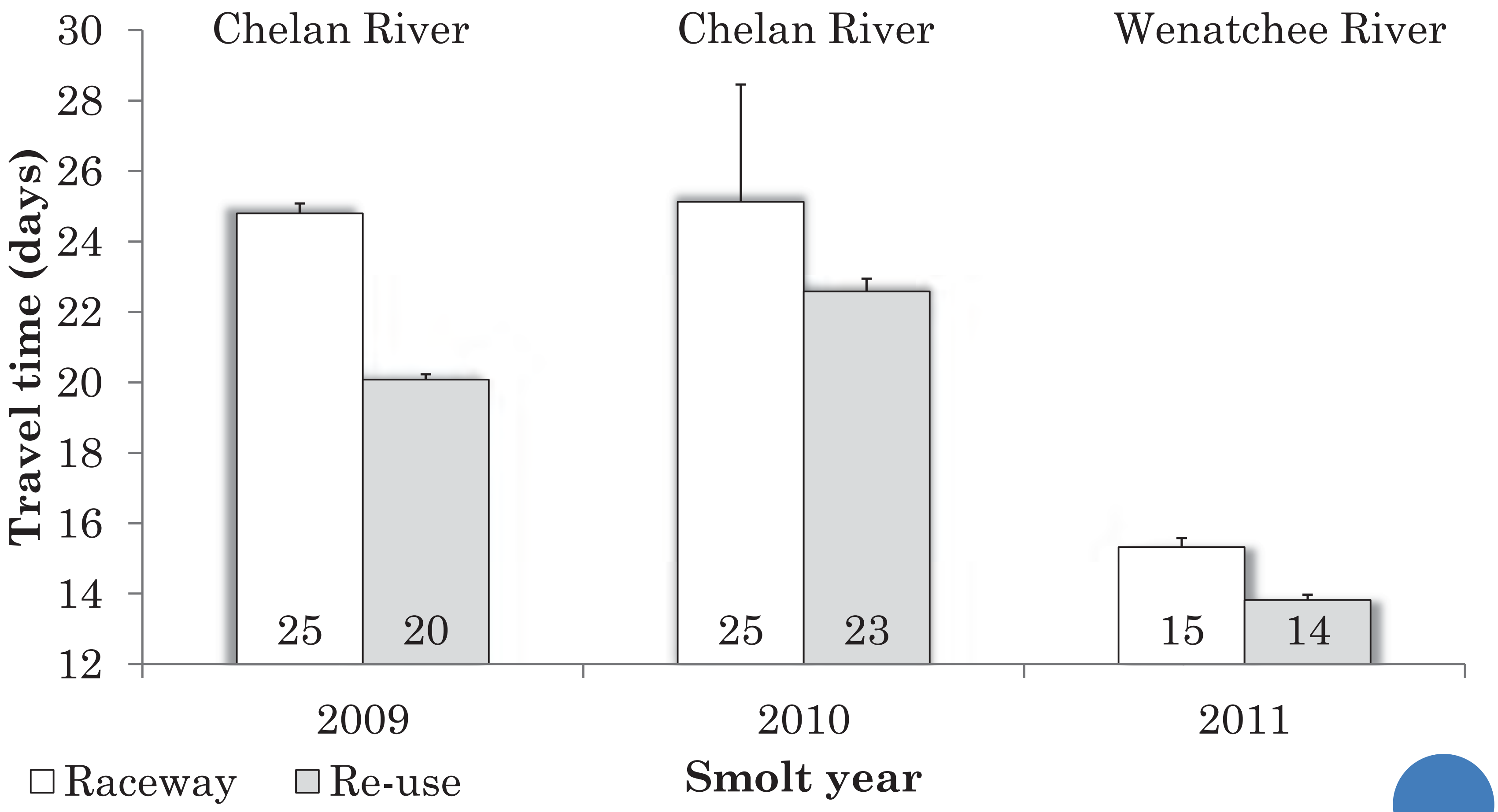
Summer Chinook

Survival to McNary



SUMMER CHINOOK

TRAVEL TIME TO MCNARY



STATEMENT OF AGREEMENT

Rocky Reach and Rock Island HCP Hatchery Committees

Statement of Agreement

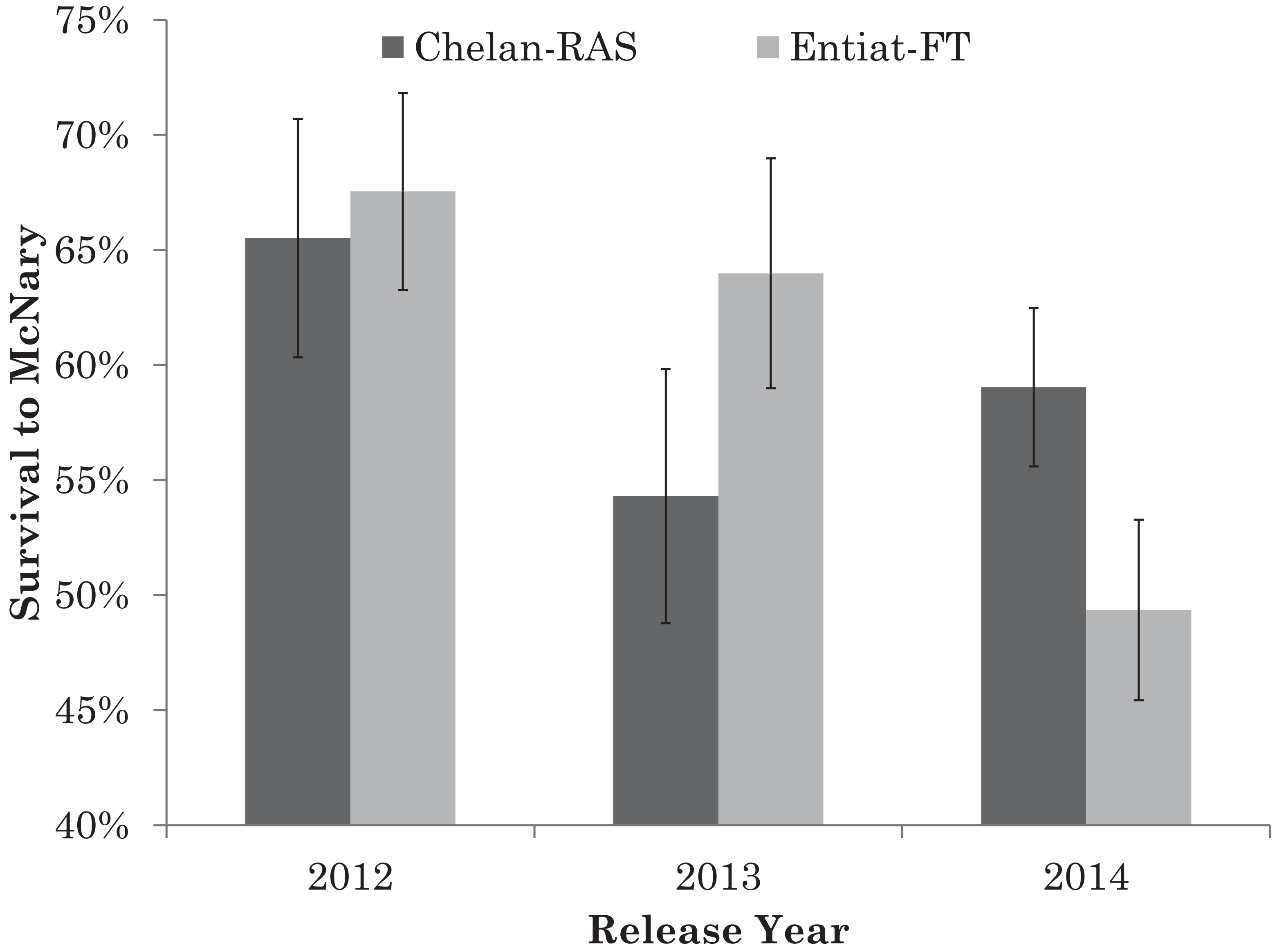
Regarding the use of Circular Culture Tanks at Chelan Falls

May 19, 2010

"The absolute survival of summer Chinook reared and acclimated in circulars at 0.2 DI would be compared against the performance of other smolts (from the same origin broodstock-Entiat summer Chinook) released above Rocky Reach Dam during the initial years of implementation. Key metrics would include survival from release to McNary and migration time to McNary. Success would require that Chelan Falls smolts perform as well or better than the existing programs (e.g., statistically no detectable difference or significantly better using the same parameters as the existing re-use comparisons). The overall purpose of the comparison is to measure performance against an existing, approved hatchery program."

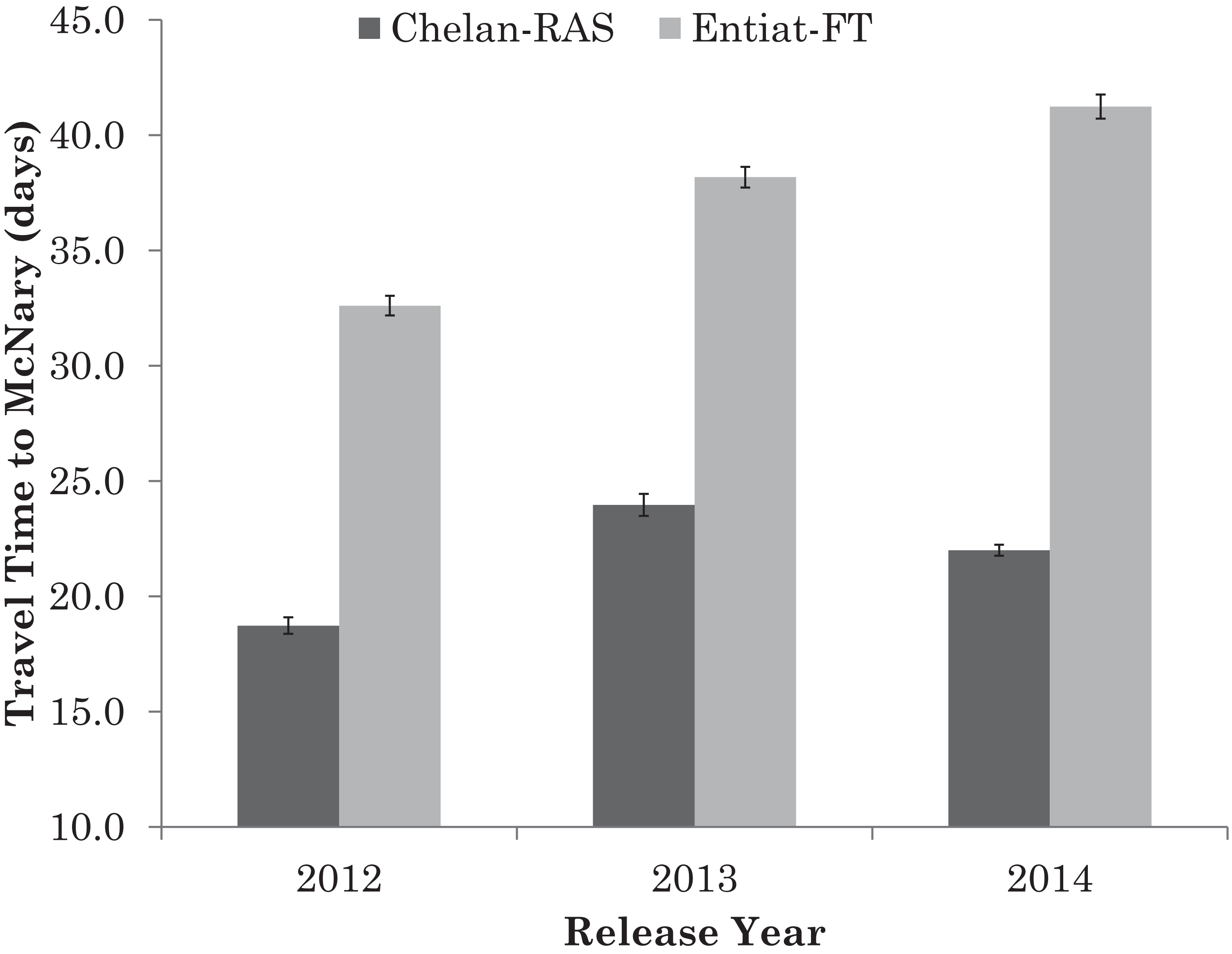
SUMMER CHINOOK

SURVIVAL TO MCNARY



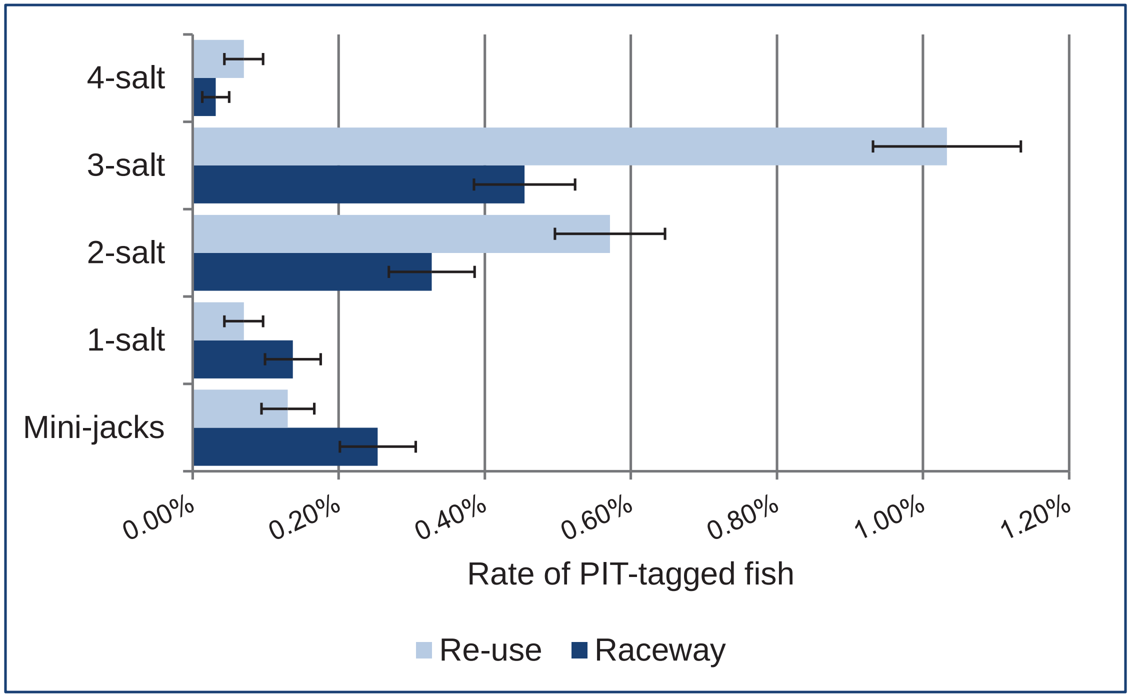
SUMMER CHINOOK

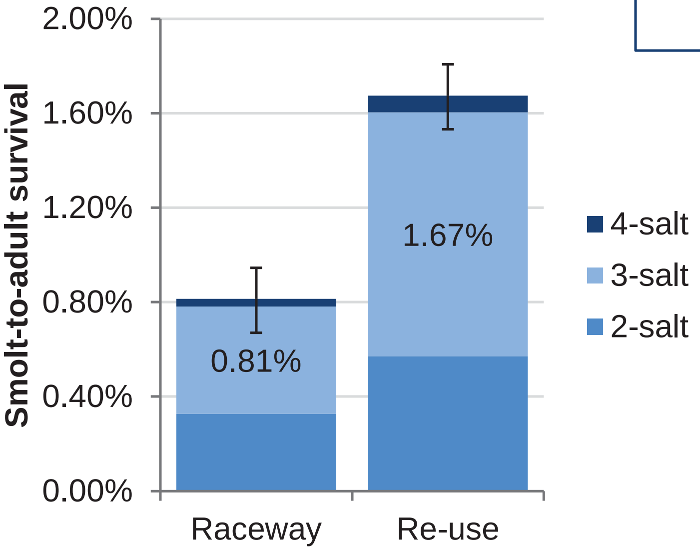
TRAVEL TIME TO MCNARY



SUMMER CHINOOK ADULT RETURNS

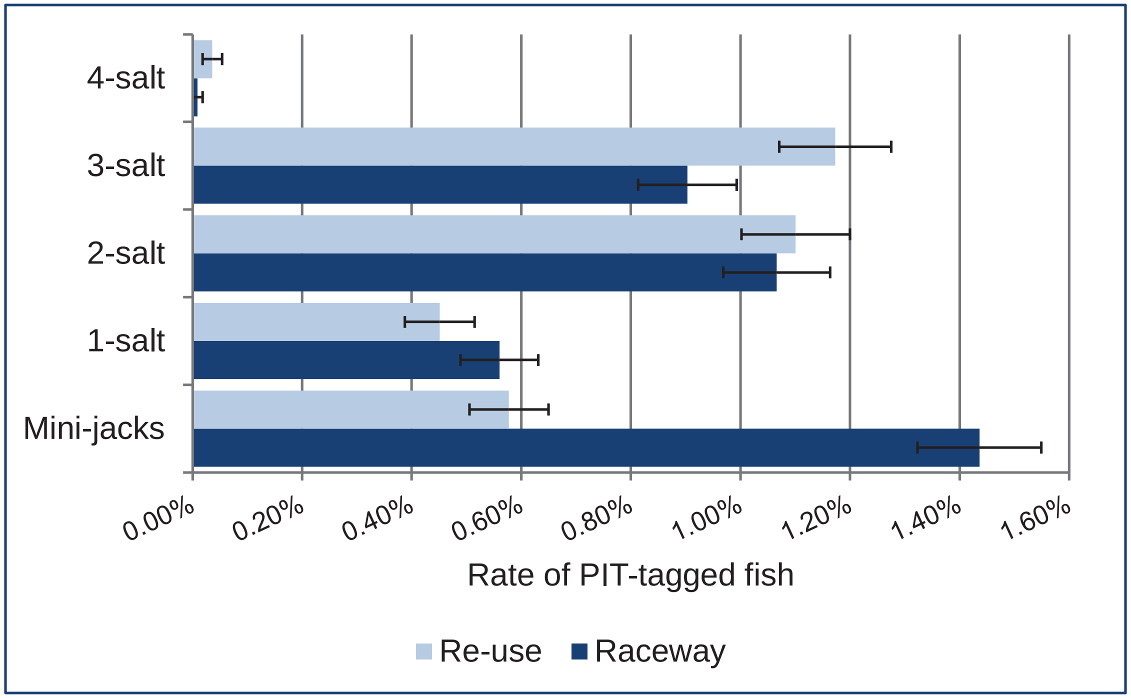
RELEASE YEAR 2009 CHELAN RIVER

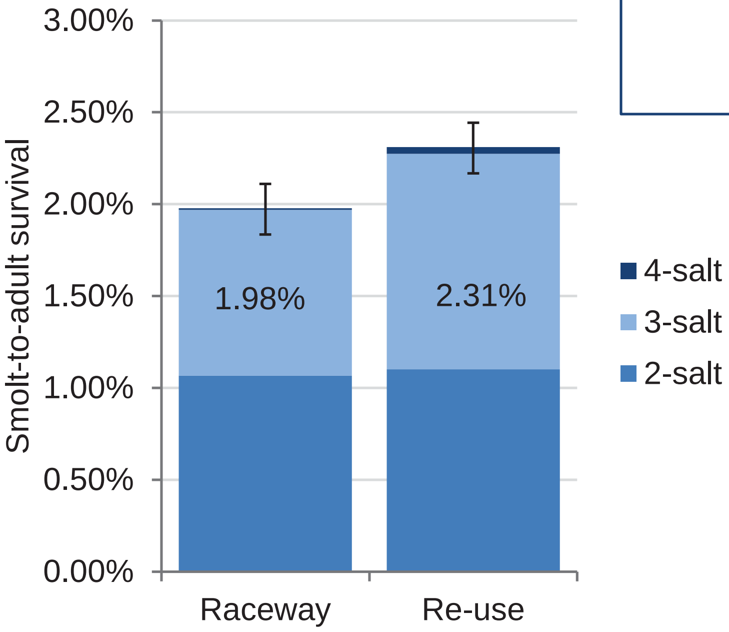




SUMMER CHINOOK ADULT RETURNS

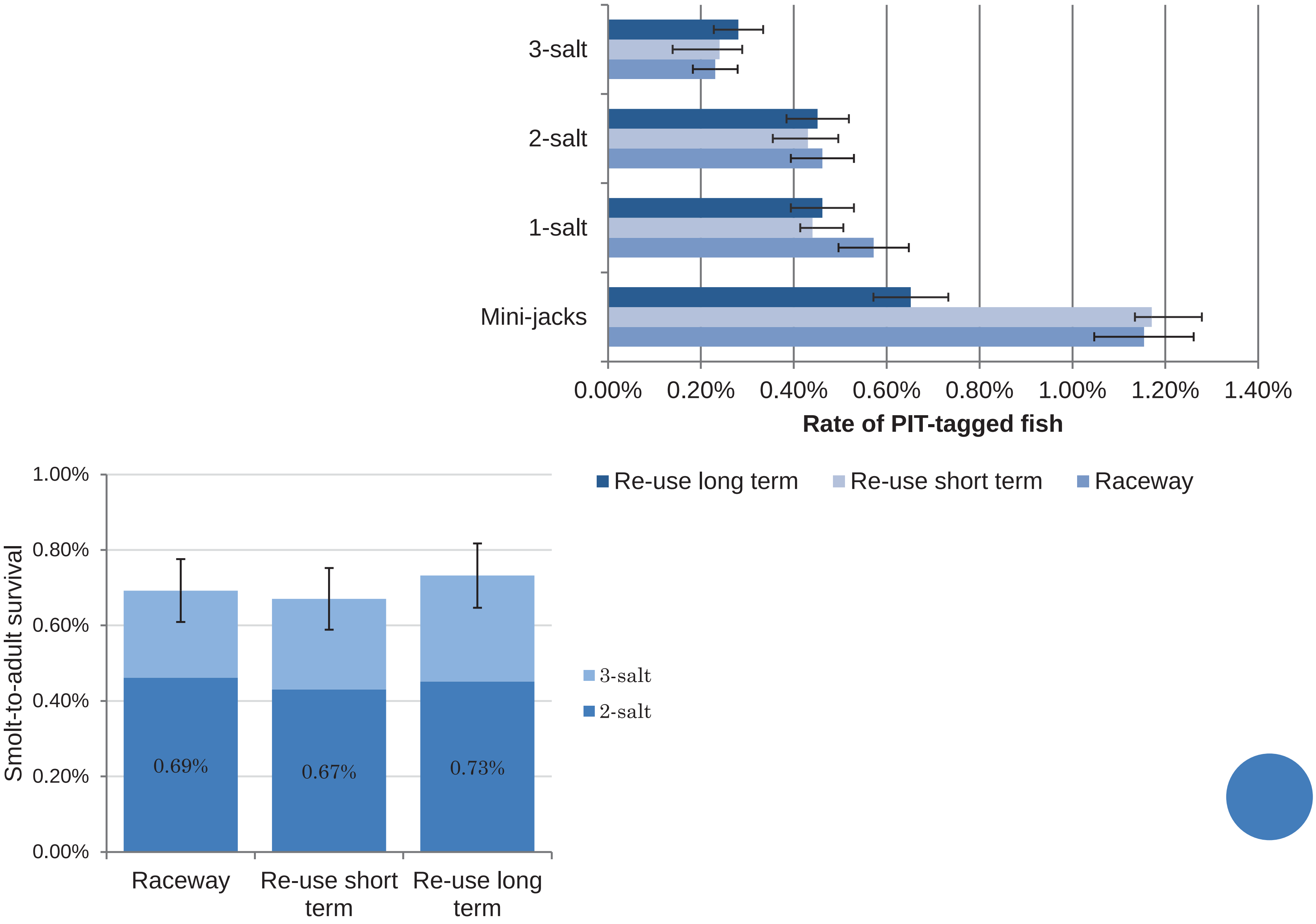
RELEASE YEAR 2010 CHELAN RIVER





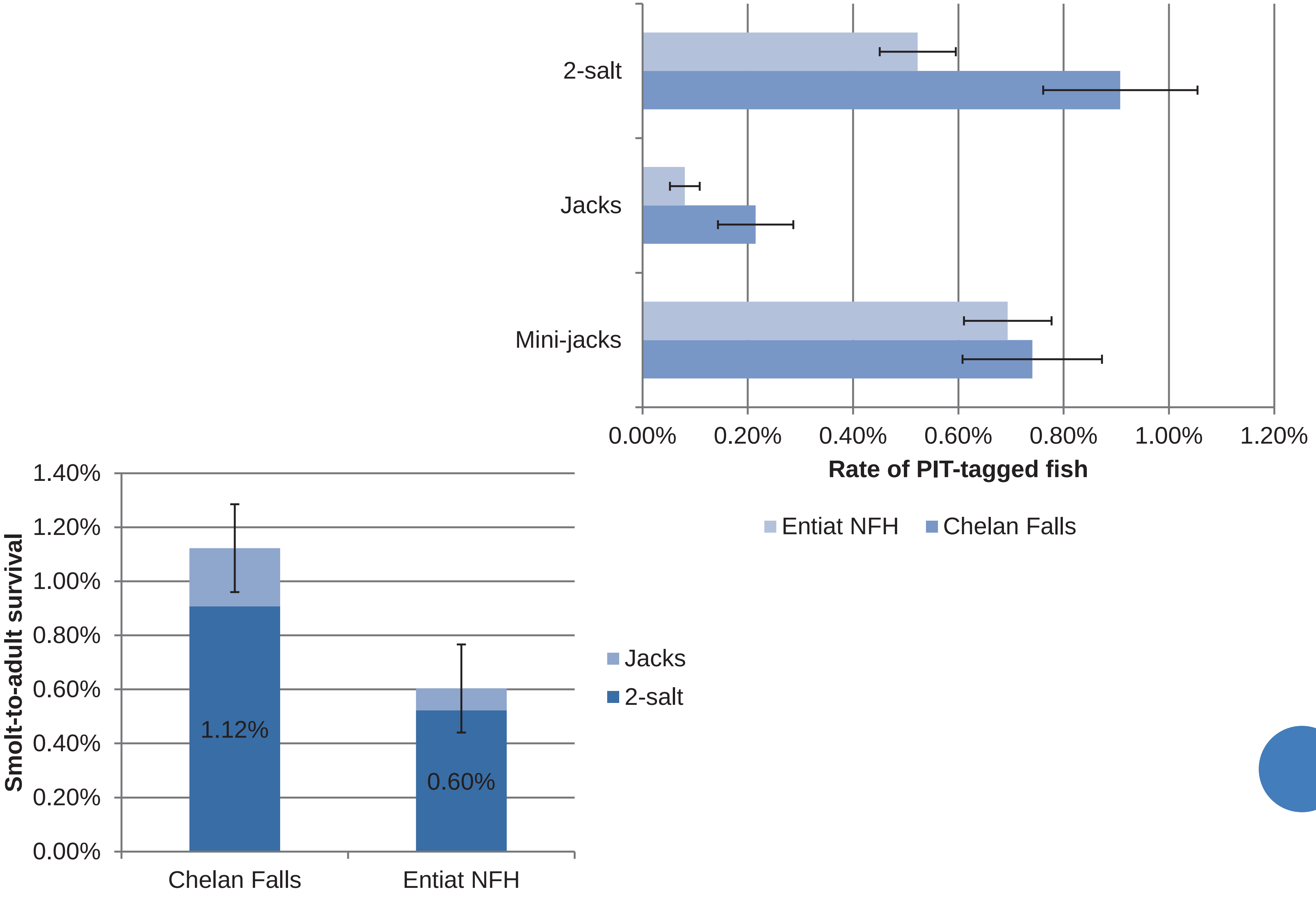
SUMMER CHINOOK ADULT RETURNS

RELEASE YEAR 2011 WENATCHEE RIVER



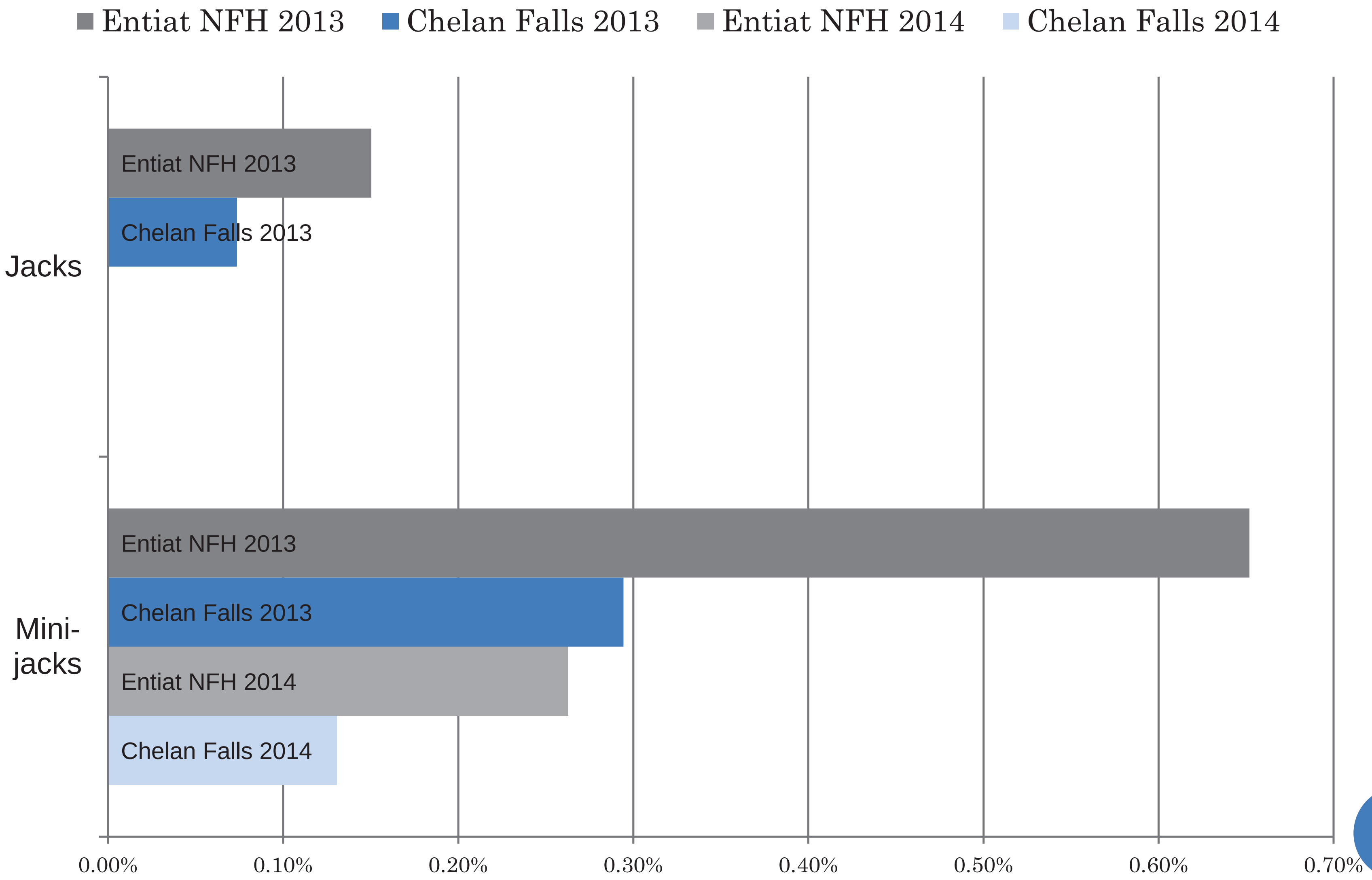
SUMMER CHINOOK ADULT RETURNS

RELEASE YEAR 2012 CHELAN FALLS AND ENTIAT NFH

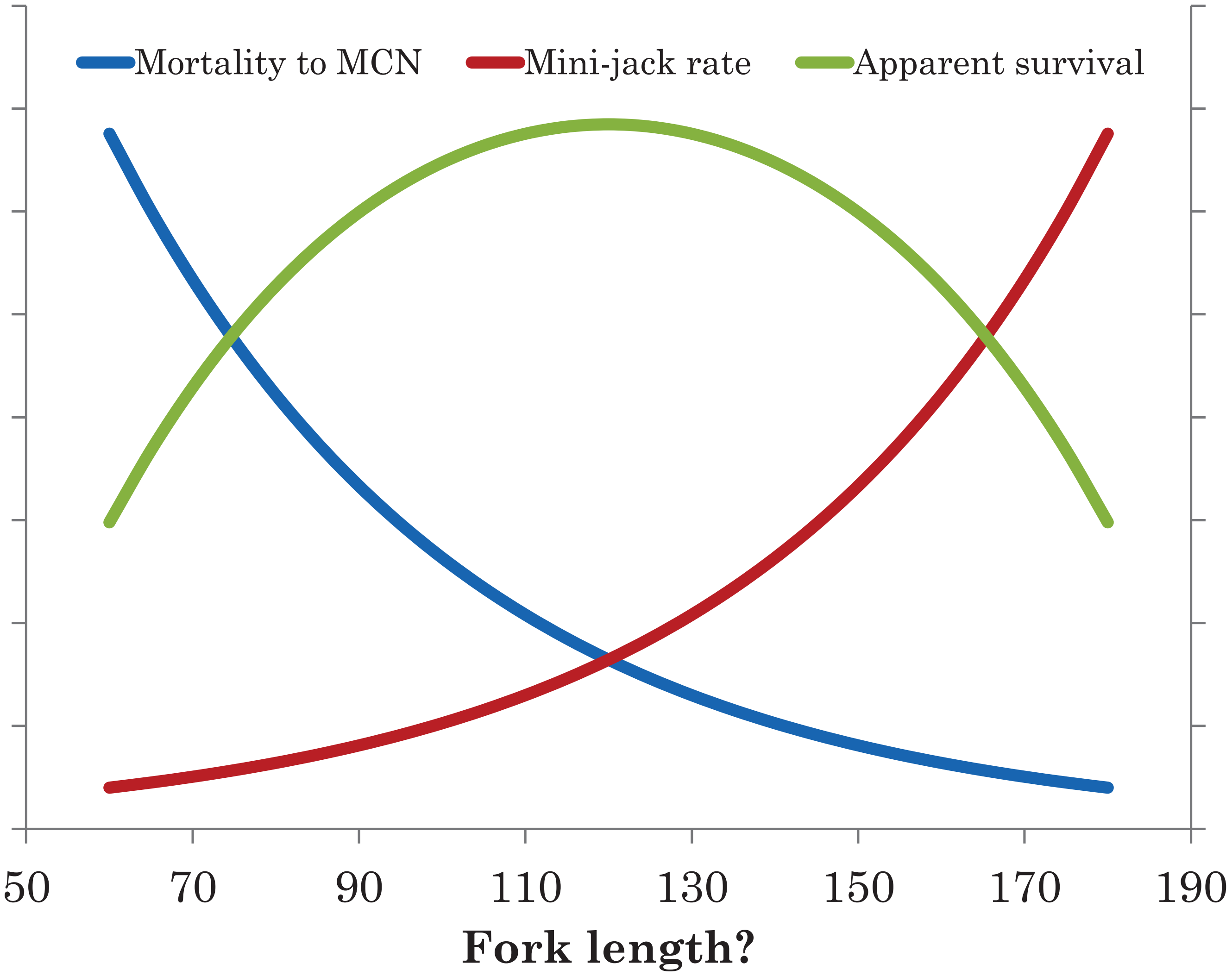


SUMMER CHINOOK ADULT RETURNS

RELEASE YEAR 2013 AND 2014 CHELAN FALLS AND ENTIAT NFH



TRADEOFF BETWEEN SURVIVAL AND PRECOCITY



Attachment C

TRADEOFF BETWEEN SURVIVAL AND PRECOCITY
SIZE TARGET STUDY

"Big"=15fpp

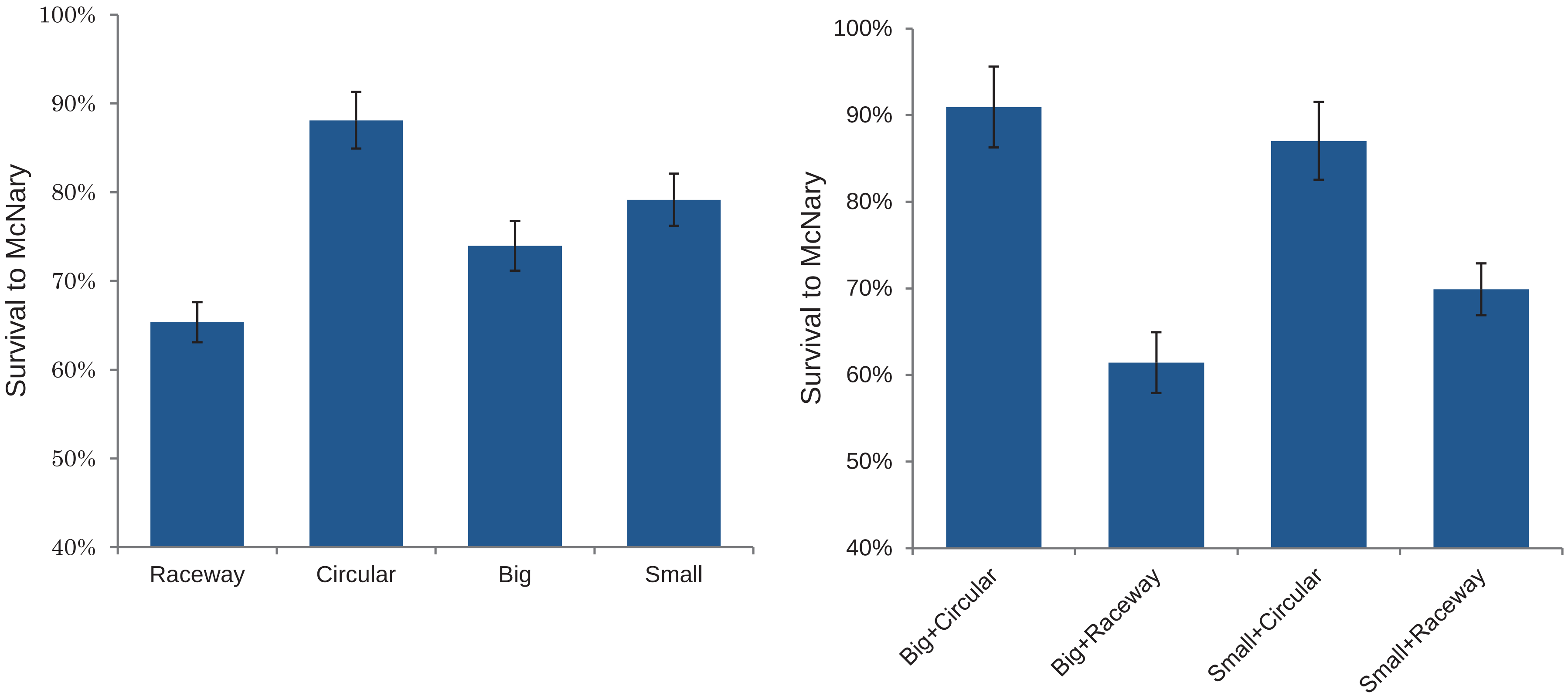
"Big"=15fpp

"Small"=20fpp

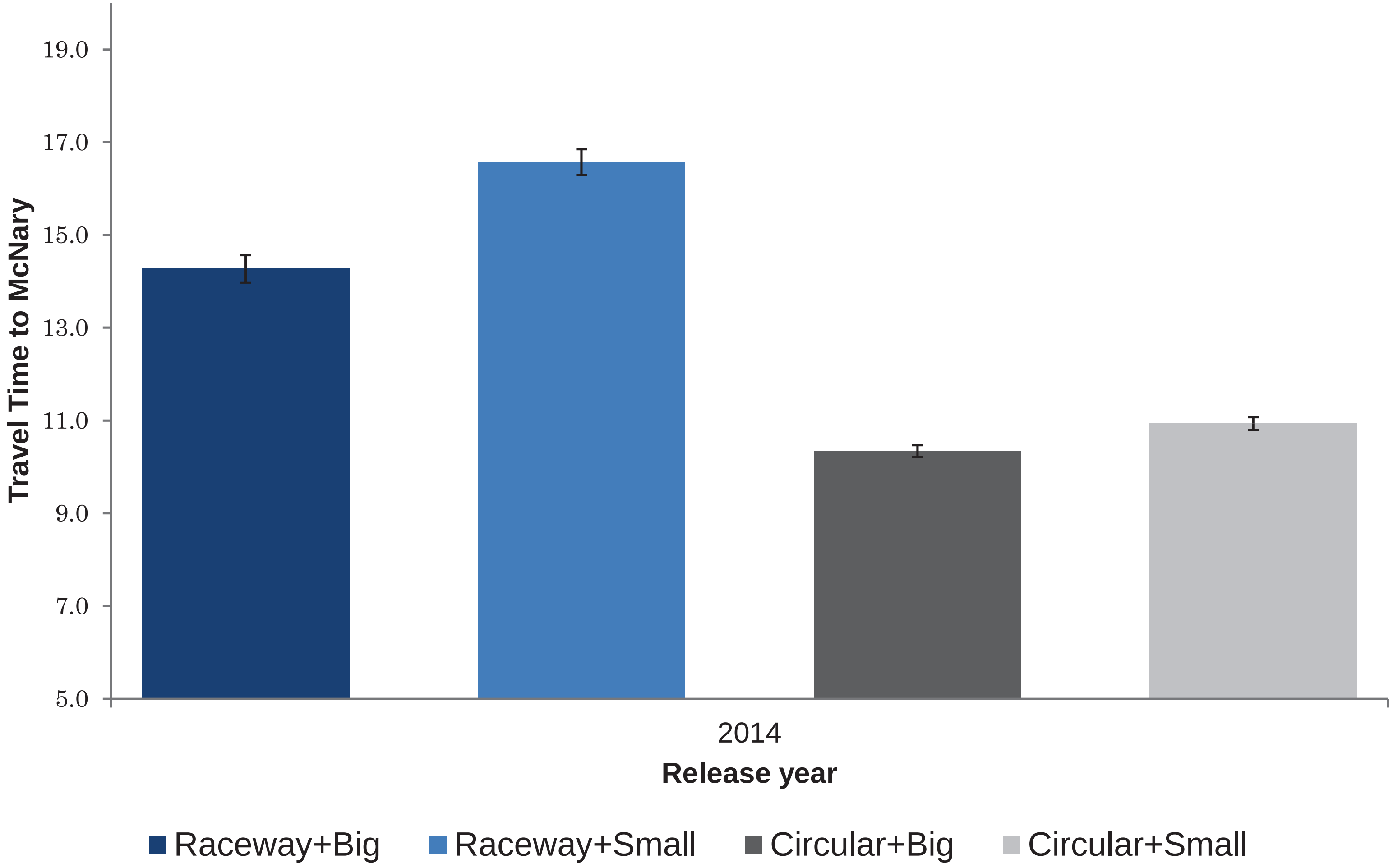
"Small"=20fpp

Summer Chinook

Release Year 2014 Wenatchee River

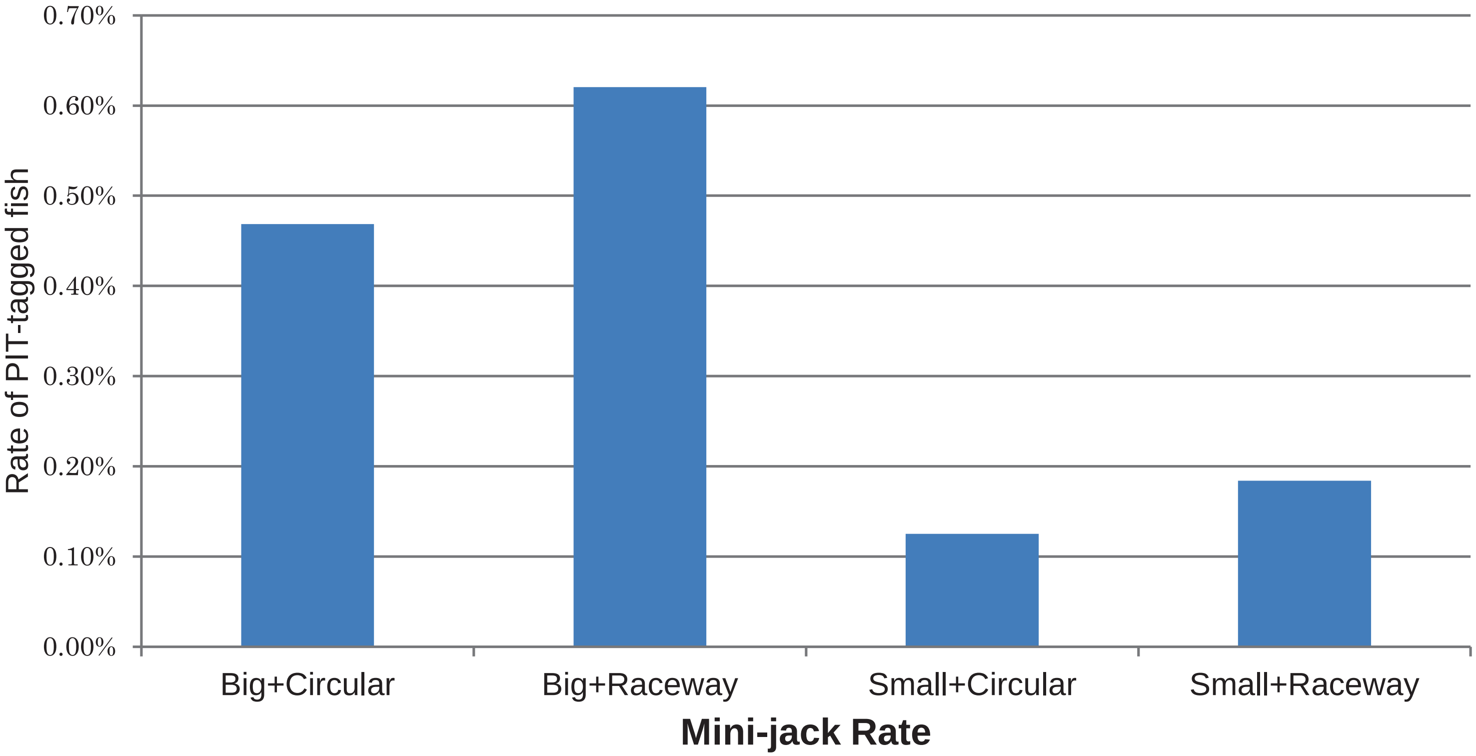


SUMMER CHINOOK
RELEASE YEAR 2014 WENATCHEE RIVER



SUMMER CHINOOK

RELEASE YEAR 2014 WENATCHEE RIVER



CONCLUSIONS
SUMMER CHINOOK

- Partial water reuse is promising for summer Chinook
- Regulatory compliance
  - Use less water
- Fish performance
  - Equal or better survival & quality fish
  - Improved age structure for adult returns
- Next steps
  - Determining the optimal size of out-migrants

STATEMENT OF AGREEMENT

Rocky Reach and Rock Island HCP Hatchery Committees

Statement of Agreement

Regarding the Evaluation of Water Reuse for Steelhead Rearing and Acclimation at Chiwawa

October 20th, 2010

"The success or failure of the second year juvenile pilot will be determined through outmigration analysis, fish health monitoring, and evaluation of within hatchery growth parameters (length, weightand coefficient of variation) as performed in the first year pilot. A statistically valid number of reuse steelhead will be PIT tagged prior to release for comparisons against other release groups in the Wenatchee River and its tributaries. Success would be defined as (1) survival to McNary by reuse steelhead is equal or better than the average of the District's other Wenatchee steelhead releases, (2) within hatchery survival is equal to or better than the average of the District's other Wenatchee steelhead releases."

WENATCHEE STEELHEAD PROGRAM

CHIWAWA HATCHERY

WENATCHEE STEELHEAD PROGRAM

CHIWAWA HATCHERY

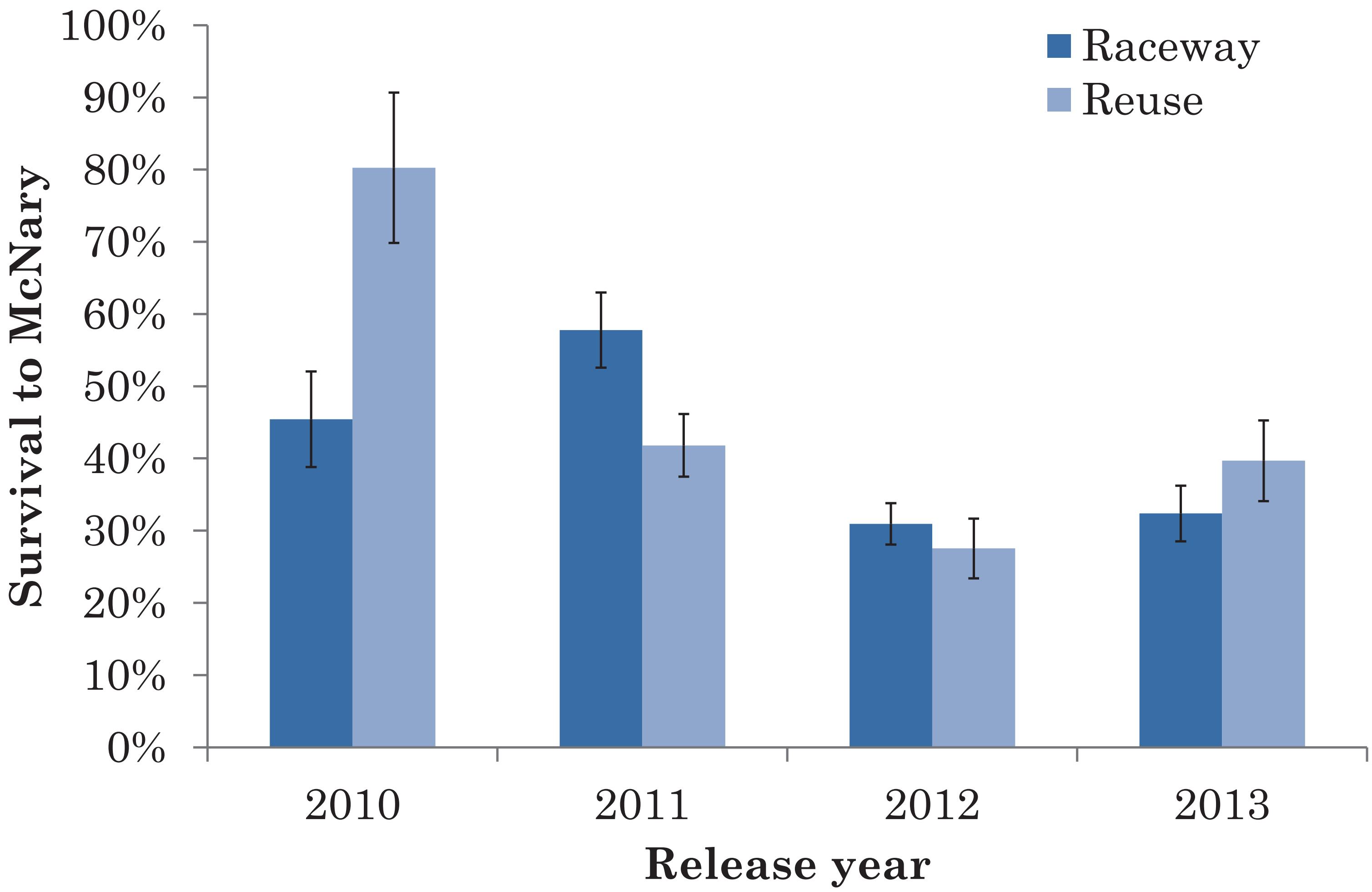
Attachment C

WENATCHEE STEELHEAD PROGRAM

CHIWAWA HATCHERY

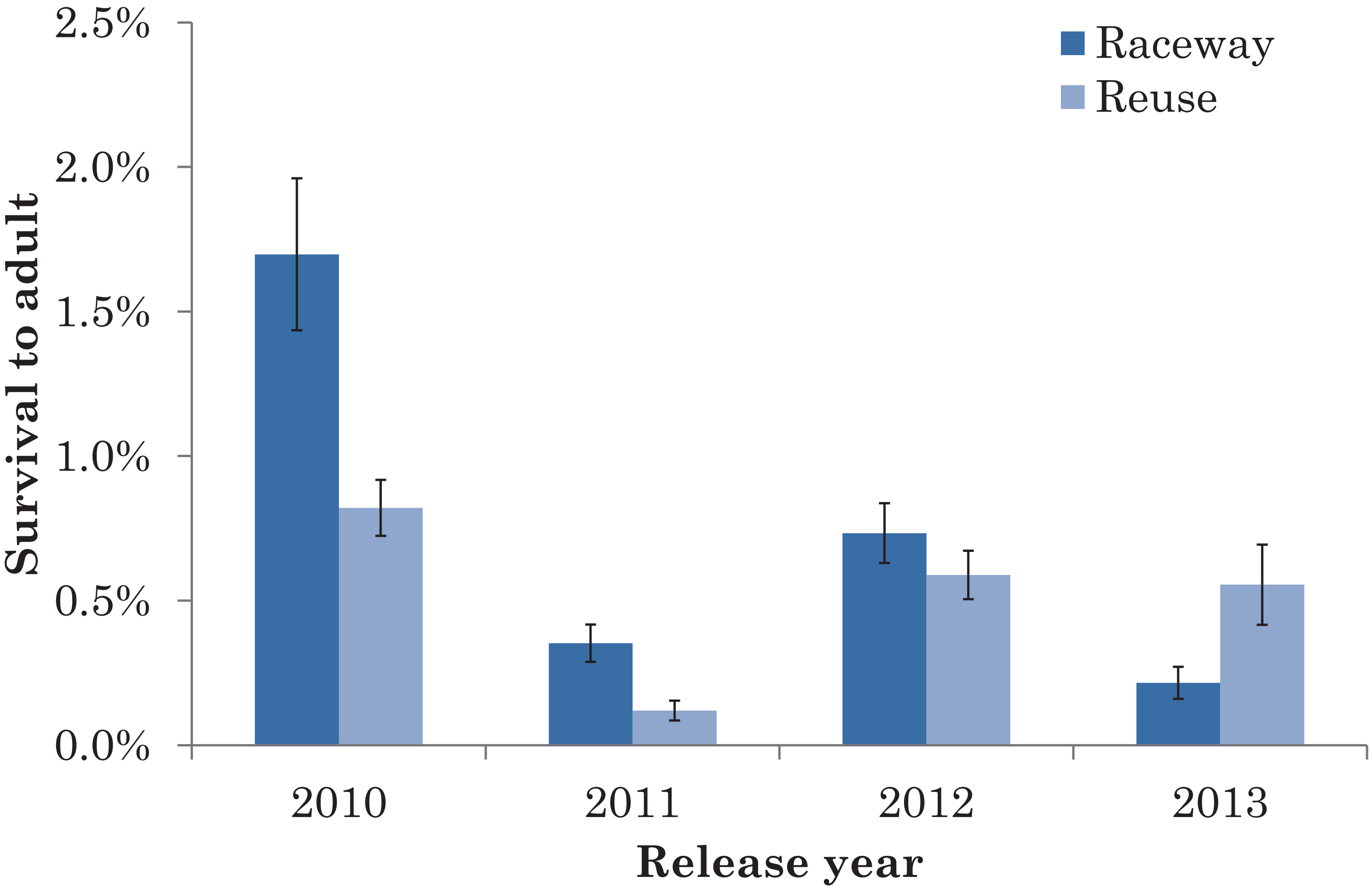
WENATCHEE STEELHEAD PROGRAM

JUVENILE SURVIVAL



WENATCHEE STEELHEAD PROGRAM

ADULT SURVIVAL



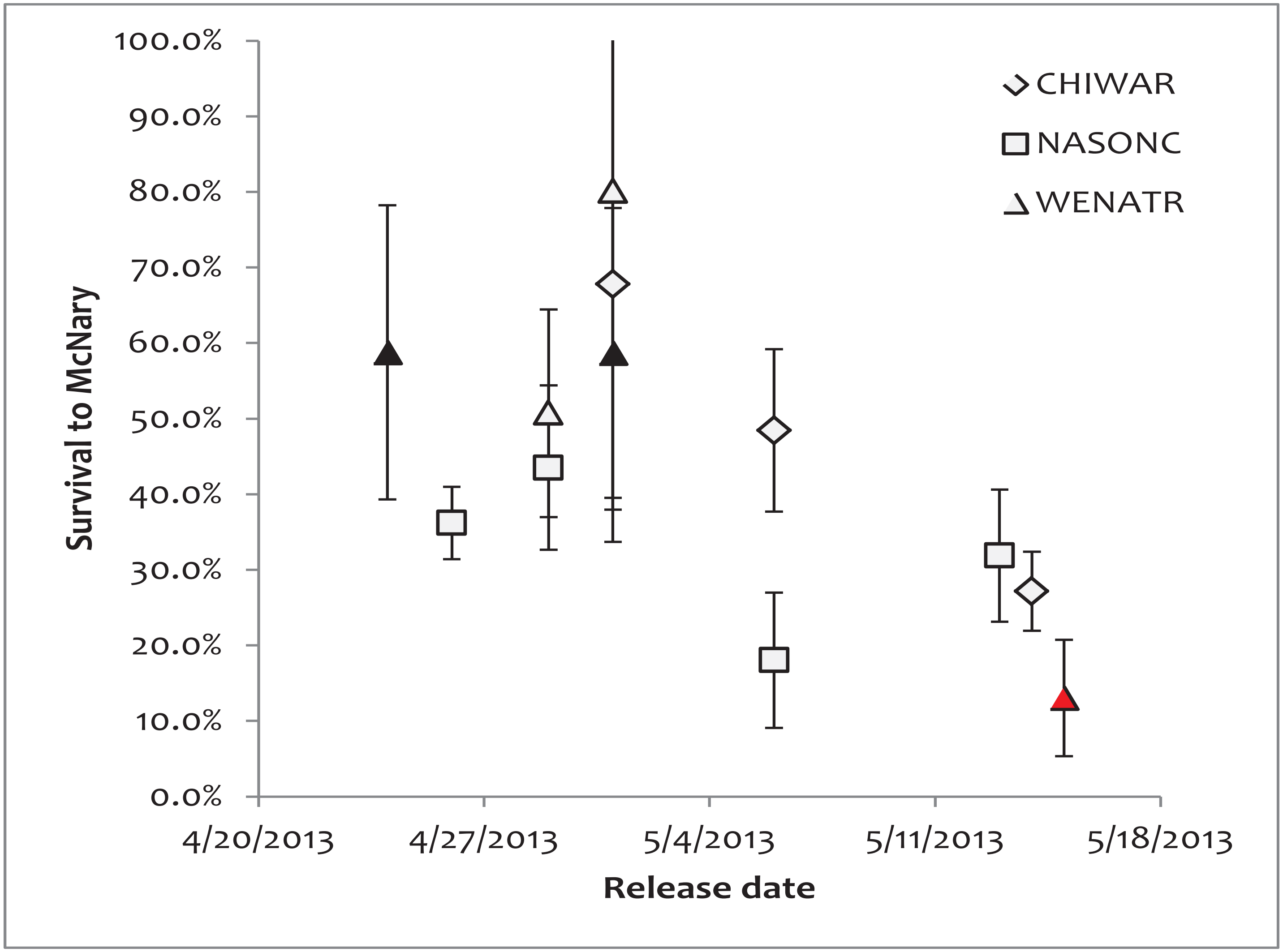
WENATCHEE STEELHEAD PROGRAM

CONFOUNDING VARIABLES

- Origin of brood
- Acclimation site and duration
- Release site
- Release timing
- Smolt size and CV
- Release strategy
- Number in release group

WENATCHEE STEELHEAD PROGRAM

SURVIVAL VERSUS RELEASE DATE



WENATCHEE STEELHEAD PROGRAM

CONCLUSIONS

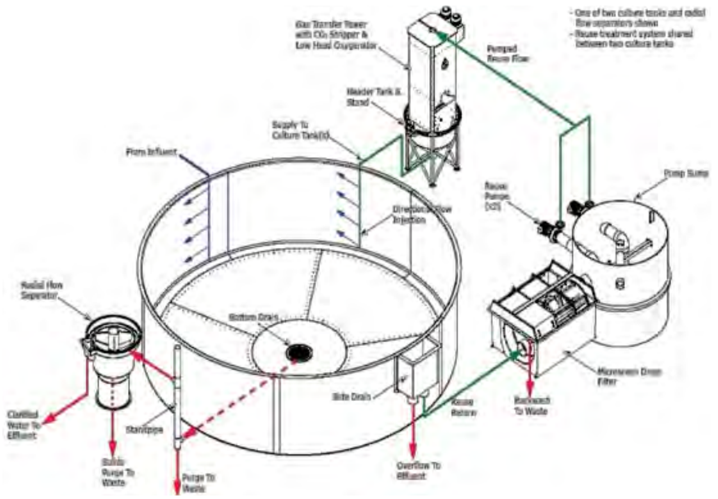
- Partial water reuse is promising for steelhead
- Steelhead reared in circular vessels display migratory behavior
- Mixed results but unable to identify drivers

PARTIAL WATER REUSE/CIRCULAR TECHNOLOGY

NEXT STEPS

- Continue to evaluate Wenatchee and Chelan summer Chinook
- Determining PIT sample sizes to evaluate RAS versus FT for steelhead program
- Size targets

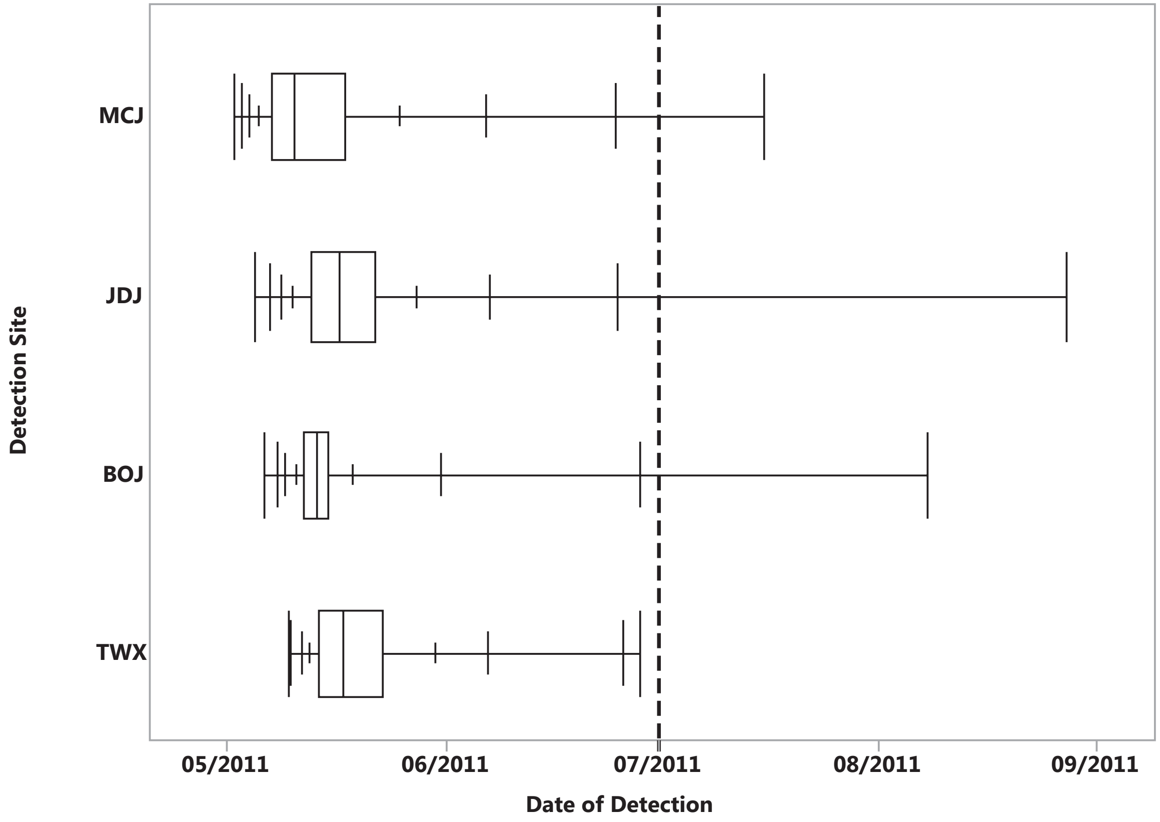
ACKNOWLEDGEMENTS



- Chelan County PUD
  - Ian Adams, Sam Dilly, Alene Underwood
- Grant County PUD
  - Peter Graf and Todd Pearsons
- Washington Department of Fish and Wildlife
  - Eastbank Hatchery staff, Chelan Hatchery Staff and Chiwawa Hatchery Staff
- The Conservation Fund's Freshwater Institute
  - Brian Vinci and Christopher Good
- Anchor QEA, LLC
  - Joshua Murauskas and Dalton Hance
- NOAA Fisheries
  - Donald Larsen, Brian Beckman, and Deborah Harstad

QUESTIONS?

Time of detections at juvenile arrays. At all locations, 99.5% were interrogated before July 1.



Attachment D

Upper Methow Spring Chinook Acclimation Proposal

Upper Columbia Spring Chinook and Steelhead Acclimation Project (BPA Project #200900100)

3 December 2014

Prepared by Keely Murdoch, Yakama Nation Fisheries Resource Management
Prepared for the Wells HCP Hatchery Committee and the PRCC Hatchery Sub-Committee

Commented [tp1]: Does this apply to CPUD programs as well?

Commented [c2]: As per language of our current HGMP that includes remote acclimation, CPUD should also be included.

1.0 Background

1.1 YN's Expanded Acclimation Project

YN's Upper Columbia Spring Chinook and Steelhead Acclimation Project (formerly known as the Expanded Acclimation Project) is based on the premise that acclimating salmon and steelhead in a manner that mimics natural systems can increase the effectiveness of integrated (conservation) hatchery programs by enhancing homing of adult fish to target reaches and can be used to improve the Viable Salmonid Population (VSP) status of ESA listed spring Chinook and steelhead.

The Columbia River Basin Fish Accords (MOA) recognize that hatchery actions can provide important benefits to ESA listed species. This Project seeks to improve the efficacy of current supplementation programs by providing additional short-term acclimation sites with ~~the purpose of improving the spawning distribution and/or homing fidelity of hatchery fish~~to enhance homing of adult salmon to identified reaches, which may contribute to improved productivity and survival.

The concept of acclimating salmon smolts in 'natural' ponds has been thoroughly tested over the last decade as part of YN's coho restoration project in the Wenatchee and Methow Rivers. The coho restoration project has demonstrated both high survival rates (juvenile and adults) as well as adult returns with SARs comparable or higher than established supplementation programs in the Upper Columbia (YN 2010). The success of YN's coho restoration project in the Wenatchee and Methow basins has also demonstrated that short-term acclimation will attract fish back to the areas where they were released rather than the hatchery facility where they were raised, effectively changing the spawner distribution (Kamphaus et al., 2013)

Commented [tp3]: Would you please send a copy of this report to the HSC? This is likely a very important document to support this approach.

Beginning in 2014, as a result of the HCP No-Net-Impact (NNI) recalculation, spring Chhinook smolt release numbers from most conservation hatchery programs in the Methow and Wenatchee basins will be significantly reduced. Because of this reduction, we believe it is crucially important that each program be operated in a manner which maximizes efficacy of the supplementation effort.~~, which includes~~One way to accomplish this may be by acclimating and releasing smolts in locations where they will return to high quality spawning and rearing habitat.

1.2 Methow Spring Chinook

Spring Chinook that are released from the Methow FH and WNFH have a spawning distribution significantly different than that of natural origin fish (Figure 1; Murdoch et al., 2011).

Commented [GM4]: This section should present the entirety of the data as found in the 5-year M&E report and newer data since then. As commented on before, the comparison of the average river km carcass recovery is not a valid biological assessment of the spawning distributions.

It is important to present the actual baseline of knowledge so that 1) proper management decisions can be made, and 2) assessment of management strategies can be made against the baseline.

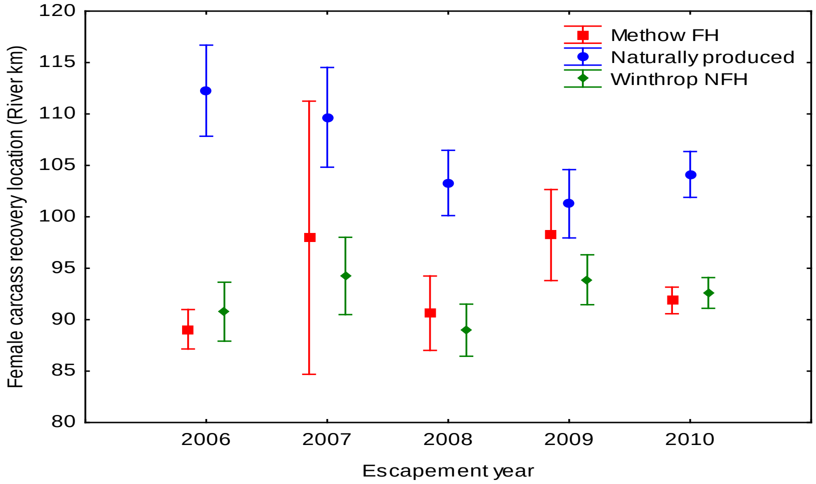


Figure 1. Mean spawner distribution based on female carcass recovery of hatchery and natural origin spring Chinook in the Methow River (Murdoch et al., 2011~~)~~).

Commented [WF5]: This figure is misleading. Figure 50 from the five year report (page 84) displays the mean carcass composition of spring Chinook in the Methow River (2006-2010) and if one were to only look at Figure 50, a different conclusion would be made re: spawning distribution of NORs and HORs. Additionally, the expanded carcass recovery data for return years 2010 to 2013 also tells a different story…carcass recovery as a % total is similar between HORs and NORs. I will send you the spreadsheet which I put the carc recovery data in.

Similarly, the most recent data (2006-2013) indicates the average spawn distribution for Hatchery Origin fish released from the Methow Fish Hatchery is rkm 92 compared to rkm 104 for natural origin fish (Snow et al., 2014).

Commented [GM6]: As commented on above

Commented [WF7]: Not certain what this statement is stating. Is it saying that most of the hatchery origin fish spawn near RKM 92 and natural origin fish spawn near RKM 104?

The skewed spawning distribution along with high densities of hatchery fish may be a contributing factor to the low productivity observed in the Methow River. We believe that the difference in spawner distribution can be directly attributed to hatchery spring Chinook imprinting and homing to Winthrop NFH (Rkm 81) and Methow FH (Rkm 85) from which the fish are reared and released.

Commented [GM8]: This needs a re-write based on the full picture of what we know about fish distribution.

The fundamental assumption behind ~~the theory of~~ supplementation is that hatchery fish returning to the spawning grounds are ‘reproductively similar’ to naturally produced fish; inherent in the supplementation strategy is that hatchery and naturally produced fish are intended to spawn together and in similar locations. If supplemented fish are not fully integrated into the naturally produced spawning population, the goals of supplementation may

Commented [GM9]: Not necessarily. You may actually desire to have hatchery fish populate areas where wild fish are at very low abundance or absent.

not be achieved (Hays et al., 2007). For this reason Objective 5 within the Monitoring and Evaluation plan for PUD Hatchery Programs (Hillman et al., 2013) is focused on ensuring that hatchery and natural origin fish have similar run timing, spawn timing, and spawning distribution.

Despite reductions in release numbers of spring Chinook and steelhead from CCPUD, DCPUD, and GCPUD supplementation programs (in 2014), we have no reason to expect improvements in the distribution of hatchery origin spawners, only the number on the spawning grounds. We believe that if Objective 5 is not currently met (as is the case in the upper Methow River), it is unlikely that the future spawning distribution of hatchery fish will change unless changes to the acclimation release strategy are made.

2.0 Goals and Objectives

~~Upper Methow Project Goal: Use short term acclimation in natural pond(s) to encourage hatchery origin spring Chinook recruitment to habitat areas such that the distribution of hatchery and natural origin spring Chinook is equal.~~

1. Management Context: Spring Chinook are produced under the Wells HCP and Priest Rapids Settlement Agreement at Methow Hatchery to be released in the Methow River. Annually, up to ~134,000 fish total are available for the Methow River releases.
2. Goal: Rebuild and Recover Methow Spring Chinook
3. Management~~Management~~~~Near-term~~ Objectives for the Methow River:::
    a. Achieve spawning escapement numbers for each reach of the Methow (aggregate numbers of spawners that are spatially informative can be applied).
    b. Meet pHOS target for each reach (an aggregate pHOS that is spatially informative can be applied).
    c. Maximize freshwater productivity of spring Chinook in the Methow River
4. Learning Objectives
    a. To evaluate if spawner distribution of spring Chinook in the Methow Basin can be ~~changed~~ expanded through short term spring acclimation.
    b. To evaluate what proportion of short term acclimated spring Chinook will ~~still~~ home back and return to the Methow Fish Hatchery (FH))).
    c. To determine appropriate numbers of hatchery spring Chinook to release in the upper Methow River to achieve PNI and/or pHOS goals.

~~Near-term Objectives:~~

~~1. To evaluate if spawner distribution of spring Chinook in the Methow Basin can be changed through short term spring acclimation~~

Commented [GM10]: In the upper Methow, pretty much every reach has at least 50% hatchery fish, or very close to that, if not substantially higher. So, hatchery fish are where the wild fish are in similar or greater numbers.

Commented [GM11]: We would expect a similar spawning distribution, but with proportionately reduced numbers. We'll see what actually happens.

Note that is a reach has a pHOS of 0.5 at the old release levels, and the fish are reduced by a bout 50%, the new expected pHOS would be about 0.33, which is pretty close to what NMFS has been looking for…

Commented [GM12]: As per above comments

Commented [tp13]: How does Greg's adaptive management goals and objectives compare to these? Are they consistent? It seems that the objectives need to be harmonized and integrated with one another so that there is a clear set of objectives and associated adaptive management. Otherwise there may be confusion about which objectives are the real ones and how management and evaluation will occur.

Commented [GM14]: We'd like to integrate this into an adaptive management structure, along with any other fish release strategy or other strategies designed to increase the chances of recovery. As such, we need to write the goals in a top down fashion so we can evaluate all methods in terms of a hierarchy of goals and objectives. I plan to create a more general adaptive management plan in which this would be integrated, along with any other methods, such a fish released on-station etc.

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Commented [GM15]: The goals and objectives need buy-in from the HC parties in order for this to work. I have made a small start, but this will require more thought and work.

Commented [WF16]: It would be beneficial to integrate the adaptive management framework that Greg provided with these objectives to include measurable metrics.

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~~2. To evaluate what proportion of short term acclimated spring Chinook will still home back and return to the Methow Fish Hatchery (FH)~~

~~3. To determine appropriate numbers of hatchery spring Chinook to release in the upper Methow River to achieve PNI and/or pHOS goals.~~

~~4.~~1. To monitor project performance indicators and where appropriate, compare performance indicators to an on-station reference group.

Commented [GM17]: This would be included in a set of performance measurable.

3.0 Sources of Uncertainty in States of Nature

a. Carrying capacity of spring chinook in the Methow River is uncertain, but there are existing estimates and methods to estimate carrying capacity.
    i. Spawning habitat limited? If the Methow River is spawning limited, increasing the number of spawners above the spawning capacity is unlikely to increase freshwater production.
    ii. Rearing habitat limited? If Methow River is rearing limited, how many spawners (I.e., females) are needed to fully see the habitat?
    iii. Reproductive effectiveness of hatchery fish relative to wild fish. If the reproductive effectiveness of hatchery fish is different from wild fish, then the number of hatchery spawners must be adjusted accordingly.
    iv. Genetic risk of hatchery fish crossing with wild fish. How many hatchery fish crossing wild fish pose a significant genetic risk?
    v. Risk of reducing the opportunity for wild x wild crosses in nature. Higher ratios of hatchery:wild spawners reduces the probability of wild x wild spawning events.
    vi. Homing and straying: Fish attempt to home to their natal location using cues acquired during egg-fry period imprinting, parr movements imprinting, smolt imprinting. The influence of each of these periods on where fish home specifically in the Methow River is uncertain.
    vii. Stochastic processes – notably, river runs dry from the Lost River area downstream 10-15 miles in some years during spawning and incubation periods. Fish homing to these reaches are likely to be more prone to reproductive failure on some years than fish homing to other reaches that remain watered in dry years.

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3.0 Project Proposal

To encourage hatchery origin spring Chinook adults to ~~distribute farther upstream~~return to spawn in specieifed reaches~~, and to meet project goals~~, YN proposes to acclimate 25,000 Chinook pre-smolts from Methow Fish Hatchery at YN's Goat Wall acclimation site beginning in spring 2016 and extended for five years. The project will be adaptively managed to protect ESA listed fish. ~~If the Early Winters Pond, also in the upper Methow Basin, becomes available it too may be considered for acclimation.~~.

1.1 Upper Methow Release Numbers

Appropriate release numbers in the Upper Methow should be driven by spawner carrying capacity, estimated wild fish ~~adbundance~~abundance, and available habitat. Reach based estimates of carrying capacity do not exist in the Methow basin~~.~~, but could be estimated from basin-wide carrying capacity estimates.~~.~~ However modeling can provide basin wide estimates. Mackey (2014), estimated the Methow Basin spawner Capacity (Ksp) to be either 2,962 spawners (Ricker S-R model 1992-2006) or 2,173 (Ricker S-R model 95th quantile; 1992-2006). Other estimates have ranged from a high of 4,077 (Fisher) to a low value of 782 (Mullen et al., 1992). Recovery Criteria for spring Chinook in the Methow require a minimum abundance of 2000 natural origin spawners (12-year geo-mean) for delisting. Using the delisting criteria as a minimum escapement target and the current distribution of NOR spawners in the Methow, we can estimate a minimum number of spawners which may be appropriate for the Upper Methow (as defined as reaches M9-M15, including the Lost River and early Winters Creek)

The mean NOR spawner abundance in the upper Methow (reaches M9-M15, including the Lost River and Early Winters Creek) for years 2005-2013 has been 185 (Table 1). A minimum target number of spawners for hatchery origin spawners in the upper Methow could then be 652 (minimum abundance goal – average NOR abundance; 837-185 =652). However releasing enough hatchery smolts to result in a spawner abundance in the Upper Methow of 652 fish would greatly exceed proposed pHOS targets (NMFS In Prep).

Table 1. Mean number of NOR spawners in Upper Methow and minimum additional spawners required to reach abundance target.

Reaches	Mean NOR Mean number NOR spawners (2005-2013)	Current Proportion of NOR spawners (2005-2013)	Target Minimum Spawner Abundance	Additional Spawners Required for Minimum Abundance

Commented [GM18]: The actual plan should include: 1) Explicit goals and objectives, hypotheses, 2) states of uncertainty, 3) identify the reaches targeted, 4) the number of fish to be released, 5) release location, date, etc., 6) calculated or defined targets that the management action should achieve (e.g., 100, x amount better than baseline, x amount better than another method etc. etc. These need to be explicit in how they were derived and the actual number or measureable, 7) the time-frame of the plan, 8) decision making criteria, 9) management decisions that will be based on the criteria and results. I may have omitted something, but this was all included in the adaptive management framework.

Commented [tp19]: It would be nice to have a map showing the location of the site relative to Methow and Winthrop hatcheries and perhaps also with the survey reaches. Charlie may have a map that you could work from.

Commented [GM20]: Need to determine if Goat Wall Pond is worthy of a 5-year commitment. If it is not, and another pond would be better and the acclimation would be changed to that pond, then need to re-write the proposal to discuss this. If this was the case, it may be preferable to structure the proposal to incorporate a comparison of both ponds. However, there are not enough fish to do everything…so the use of these fish needs to be carefully thought through.

Commented [WF21]: A map would be helpful.

Commented [tp22]: Is this the right reach to consider for capacity? It seems that this covers a very large area. If remote acclimation works, wouldn't you expect the fish to return to the vicinity of the Goat Wall site? If so, then would the target reach be something like M12-M15? Maybe you could present figures for both the longer and shorter reaches.

Commented [WF23]: This is a long stretch of river (RKM 86.8 to RKM 121.2). Where is the Goat Wall Acclimation pond relative to these reaches? It seems like M9-M11 would be below the acclimation site?

Commented [GM24]: Should identify the target reaches and discuss why these are the targets, and the characteristics of these reaches (e.g., length, known use by spawners etc.)

Commented [WF25]: This is probably just me not knowing, but where did this minimum abundance goal value come from?

Commented [GM26]: Should explain how this number was derived. If we start with 2000, 652 is some proportion of 2000 based on what? OK, I see the table below, but it still needs to be explained a little bit.

Commented [GM27]: Given the low numbers of wild spring Chinook, there will always be a conflict between maximizing spawners using hatchery fish verses attempting to constrain the deleterious genetic and ecological risks of hatchery programs.

Upper Methow (M9-15, Early Winters & Lost River)	185	41.9%	837	652
Middle Methow River (M5-M8, Suspension Creek, and Hatchery Outfalls)	18	4.1%	83	65
Chewuch River	164	36.6%	731	567
Twisp River	76	17.4%	349	273

While suitable spawning space exists, this project will be implemented in such a manner as to increase the spawning escapement in the upper Methow while working within the permit required sliding scale of pHOS. In a typical year, a release of 25,000 smolts from ~~Goal~~Goat~~l~~ Wall pond would yield an additional 78 adults (Table 2) on the spawning ground (with no adult removal); with adult removal this number could be markedly reduced.

Table 2. Anticipated number of returning spring Chinook adults from a release size of 25,000 at the Goat Wall Site. Acclimation Pond.

Target Number of Smolts	Anticipated Number of Adults Returned		
	Maximum SAR	Mean SAR	Minimum SAR
Upper Methow: Goat Wall Pond (25,000)	203 (0.81%)	78 (0.35%)	5 (0.02%)

Commented [GM28]: Is this the mean SAR of Methow Hatchery, or Chewuch Pond, or another pond?

3.1 Goat Wall Acclimation Site

The Goat Wall acclimation site is accessed through privately owned property and consists of a watered slough located downstream from the Lost River. Water to the pond is supplied through a diversion on Gate Creek and through natural groundwater seepage (Cold Creek). A temporary seine net system would be used to contain hatchery spring Chinook during the acclimation period. The Lost River Rd provides access to the site and is plowed during the winter. The site measures 0.08 acres (30' x 110') and is approximately 9500 cft, averaging 2.5 ft deep. We have observed the CFS ranging from 3.85 cfs (in May 2011) up to 11.6 cfs (July 2014). The site has a capacity to hold up to 30,000 fish at 16 fish per pound at densities less than 0.06 lbs/cft/in

3.1.3 Fish Transportation Procedures

Spring Chinook pre-smolts would be transported in March (preferably by WDFW tanker truck) from Methow FH to the Goat Wall location. Current fish-transport procedures include crowding and loading into distribution trucks via a fish pump. Water will be tempered as appropriate. Fish are tempered to within 3°C of the receiving water prior to release. Loading densities may range from 0.3 to 0.5 pounds of fish per gallon of water consistent with IHOT standards.

3.1.4 Fish Condition, Growth, and Health Monitoring

A pre-transfer fish health examination will be conducted by WDFW fish health specialists. Once in the acclimation site, fish will be monitored daily by staff for signs of disease symptoms (lethargic behavior, skin coloration, visible lesions, caudal fungus, etc.) through visual observations, feeding behavior and monitoring of daily mortality trends. Additionally, staff will collect data from a random sample of approximately 100 fish on a weekly basis for a total of 800?? during the entire acclimation period. Weekly sampling will include a general assessment of fish condition, stage of smoltification, fish length and fish weight so that growth rates and condition factors maybe be assessed. A fish health specialist will be contacted if any disease symptoms are noted. If required, YN staff under the direction of the fish health specialist will provide treatment for disease.

3.1.5 Release

Spring Chinook would be released as close as possible to the agreed upon size target (15 fpp). Targets are subject to change at the discretion of the HCP and PRCC Hatchery Committees. Spring Chinook will be volitionally released from the acclimation site into the Methow River in

Commented [tp29]: It would be helpful to describe how volitional release will occur. For example, when will fish first be allowed to leave? Do you expect to push the remainder of the fish out? How will the release compare to the timing and approach for the on-site release at Methow Hatchery?

mid-to-late April. Release typically occurs when > 90% of the acclimated group is displaying visual signs of smoltification (identified by transitional and/or smolt stage), target fpp is met and releasing into favorable river conditions (high water events).

Commented [tp30]: I thought the release was supposed to be volitional? Is this when the volitional release starts?

Commented [WF31]: Does this mean that volitional release will begin when greater than 90% ….?

4.0 Adult Return Rates and Adult Management

Historic adult return rates from the Methow Fish Hatchery can be found in Table 2 below.

Table 3. Brood year, number of smolts released, adult returns, and SAR (%) from the Methow Fish Hatchery 1992-2010 (data source: Snow et al. 2012).

Commented [WF32]: Typically the last 10 years are utilized as an average. They represent "more recent" SARs and current conditions.

Brood Year	Smolt Released	Adult Returns	SAR (%)
1993	210,849	192	0.091
1994	4,477	1	0.022
1995	28,878	122	0.422
1996	202,947	500	0.247
1997	332,484	821	0.247
1998	435,670	2,300	0.528
1999	180,775	145	0.080
2000	266,392	852	0.320
2001	130,787	508	0.388
2002	181,235	599	0.331
2003	48,831	57	0.117
2004	65,146	316	0.485
2005	156,633	328	0.209
2006	**211,717**	**1,714**	**0.810**
2007	**119,407**	**515**	**0.431**
Mean	**171,749**	**598**	**0.315**

Commented [GM33]: Do bold years indicate incomplete data?

Based on the mean SARs (%) from previous releases, we would expect an average of 78 adults to return to the Methow River from a release of ~~60,516~~25,000 smolts (Table 3).

The historic SARs for hatchery fish (Table 3) along with historic estimates of natural origin spawners in the Methow River can be used to provide a retrospective analysis of what we may be able to expect for PNI and pHOS metrics given the release of 25,000 in the Upper Methow and assuming no adult removal. This retrospective analysis provides insight into what PNI values could be in the future (Table 4). Based on this analysis, it is clear that even in the absence of adult management, numbers of fish proposed for acclimation in the upper Methow alone will not result in exceedance of the sliding scale of allowable pHOS presented in the DRAFT Methow Spring Chinook Section 10 Permit (NMFS, In Prep). However, it is unrealistic to expect that fish released as part of this project would be the only fish on the spawning grounds. Similarly, it is also unrealistic to expect that spring Chinook released from this project would not be attracted back to the Methow FH and would not be removed in adult management activities.

Commented [GM34]: Keep in mind that the sliding scale is for all hatchery fish, not just the acclimated fish. All analyses regarding pHOS and the like should include an overall assessment and the contribution of the acclimated fish to the overall assessment. That way it can be shown the contribution is either minor or significant and the HC can plan accordingly.

Commented [tp35]: The analysis seems incomplete without addressing this issue. Assumptions were made to deal with adult management activities in the analysis; could you also attempt to do an analysis with other fish on the spawning grounds? For example, could you assume the current distribution of hatchery fish by % and then use the scaled back production releases to estimate number of HOS from the different hatcheries?

Commented [WF36]: I think that fish released from all programs should be used for this exercise to ensure that pHOS is not being exceeded. The Winthrop NFH releases is approx. 400,000 fish which can play an important role in determining pHOS.

Commented [WF37]: One of the adaptive management objectives should include a measurable acceptable metric (determined by the HC) of adults that can be attracted back to the Methow FH from the acclimation program.

Table 1. Forecast of adult returns and PNI using a retrospective analysis of SARs and NOR spawning escapement. This analysis assumes ALL returning hatchery fish spawn in the Methow River and are NOT removed during adult management activities.

Return Year	**NORS**		**Hatchery SAR[a]**	**Hypothetical Hatchery Return**	**Hypothetical Proportion of Run**		**Target Basin-wide PHOS[b]**	**PNI (pNOB = 1)**	**PNI (pNOB = 0.75)**
	Basin Total	Methow			**Hatchery**	**Natural**			
2000	950	611	0.0025	62	0.09	0.91	0.2	0.92	0.89
2001	1832	594	0.0028	71	0.11	0.89	0.1	0.9	0.87
2002	345	86	0.0053	132	0.61	0.39	0.4	0.62	0.55
2003	58	8	0.0008	20	0.71	0.29	Anything	0.58	0.51
2004	488	199	0.0032	80	0.29	0.71	0.4	0.78	0.72
2005	527	221	0.0039	97	0.31	0.69	0.3	0.77	0.71
2006	328	128	0.0033	83	0.39	0.61	0.4	0.72	0.66
2007	266	152	0.0012	30	0.16	0.84	Anything	0.86	0.82
2008	298	172	0.0049	121	0.41	0.59	Anything	0.71	0.65
2009	564	261	0.0021	52	0.17	0.83	0.3	0.85	0.82
2010	601	290	0.0081	203	0.41	0.59	0.3	0.71	0.65
2011	961	432	0.0032	29	0.15	0.85	Anything	0.87	0.83
Mean	**602**	**262**	**0.0035**	**88**	**0.32**	**0.68**		**0.77**	**0.72**

a. For the purposes of this exercise hatchery SARs were matched with return year NORs based on a 4-year age class return

b. Green shading represents pHOS values with those allowed in the Draft Methow Spring Chinook BiOp. Red shading represents pHOS values exceeding those allowed in the Draft Methow Spring Chinook BiOp.

Commented [GM38]: These are returns not spawners? It would be better to use spawners. Returns are quite a bit higher than spawners for a number of reasons.

Commented [GM39]: Consider that in very general terms, the mean number of hatchery returns from the 224,000 combined hatchery production would be about 784. The average number of NORs is 602. This would be a pHOS of 0.57. If pNOB is 1, a pHOS of 0.5 provides a PNI of 0.67, so it may work out that given the smaller fish releases, the PUD mitigation with a pNOB of about 1 would have a decent PNI. The next trick is to avoid mining of the wild population. This whole idea needs more analysis to have more confidence in the results. However, this work to overview analysis would help this plan fit into the overall management context that NMFS and the HC may be pursuing.

Data from spring Chinook reared at the Methow FH and short term acclimated in the Chewuch Acclimation Pond (AP) indicates that on average 43% will 'stray' back to the Methow River (Murdoch et al., 2011), presumably due to attraction back to the Methow FH where they were reared. In some years this figure has been as high as 88~~%.~~% and as low as ???.???.~~%.~~ Table 5 presents the same data as Table 5 but assumes that 43% of the spring Chinook acclimated at the Goat Wall pond will be attracted back to the Methow FH and removed from the spawning population during adult management activities.

Commented [GM40]: Should give the reader the range, not just one side.

Commented [GM41]: I think it is fair to make this assumption for a thought exercise. See my previous comment related to this. Given broodstock removal and high pNOB, we may not need to remove that many hatchery fish to meet PNI.

Based on the analysis presented in Table 5, we expect an acclimated release of 25,000 spring Chinook smolts from Goat Wall to result in an increase of spring Chinook spawners using habitat areas in the upper Methow while making anticipated pHOS and/or PNI targets achievable.

Table 5. Forecast of adult returns and PNI using a retrospective analysis of SARs and NOR spawning escapement. This analysis assumes 57% of returning hatchery fish spawn in the Methow River and 43% are removed during adult management activities.

Return Year	**NORs**		**Hatchery SAR[a]**	**Hypothetical Hatchery Return**	**% HORs removed at MFH**	**Hypothetical HORS to spawn**	**Hypothetical Proportion of Run**		**Target Basin-wide PHOS[b]**	**PNI (pNOB = 1)**	**PNI (pNOB = 0.75)**
	Basin Total	Methow					**Hatchery**	**Natural**			
2000	950	611	0.0025	62	43%	27	0.04	0.91	0.2	0.96	0.95
2001	1832	594	0.0028	71	43%	31	0.05	0.89	0.1	0.95	0.94
2002	345	86	0.0053	132	43%	57	0.4	0.39	0.4	0.72	0.65
2003	58	8	0.0008	20	43%	9	0.52	0.29	Anything	0.66	0.59
2004	488	199	0.0032	80	43%	34	0.15	0.71	0.4	0.87	0.83
2005	527	221	0.0039	97	43%	42	0.16	0.69	0.3	0.86	0.82
2006	328	128	0.0033	83	43%	36	0.22	0.61	0.4	0.82	0.77
2007	266	152	0.0012	30	43%	13	0.08	0.84	Anything	0.93	0.90
2008	298	172	0.0049	121	43%	52	0.23	0.59	Anything	0.81	0.77
2009	564	261	0.0021	52	43%	22	0.08	0.83	0.3	0.93	0.90
2010	601	290	0.0081	203	43%	87	0.23	0.59	0.3	0.81	0.77
2011	961	432	0.0032	29	43%	12	0.03	0.85	Anything	0.97	0.96
Mean	**602**	**262**	**0.0035**	**88**		**35**	**0.18**	**0.68**		**0.86**	**0.82**

a. For the purposes of this exercise hatchery SARs were matched with return year NORs based on a 4-year age class return

b.Green shading represents pHOS values with those allowed in the Draft Methow Spring Chinook BiOp. Red shading represents pHOS values exceeding those allowed in the Draft Methow Spring Chinook BiOp.

5.0 Monitoring and Evaluation and Decision Criteria

Commented [tp42]: In the latest Snow et al. 2014 M&E report, I found 8 CWT recoveries in 2013 from Wolf Creek releases. It was in appendix C. There may enough data to make comparisons from these releases.

Commented [GM43]: This section will need to be integrated with the adaptive management framework.

The single most important elements here are identifying the management targets and the criteria by which any and all management strategies are assessed and management decisions made.

Commented [GM44]: The goals and objectives listed here should be the same ones in the objectives sections, and would follow the established hypotheses for each objective.

Being able to address near term objectives described in Section 2.0 is key to being able to adaptively manage the program, and to better understand what appropriate release numbers in the Upper Methow will be.

Objective 1: To evaluate if the spawning distribution of spring Chinook in the Methow Basin can be changed through short term spring acclimation

To accomplish Objective 1, all spring Chinook acclimated and released from Goat Wall will be marked with a unique CWT. Methods for collecting spawner location data based on carcass recovery and analytical details can be found in the Monitoring and Evaluation Plan for PUD Hatchery Programs: 2013 Update (Hillman et al., 2013). All spawning ground, carcass recovery data and CWT extraction and reading will be completed by WDFW during implementation of the PUDs regular M&E activities (Objective 5 in Hillman et al., 2013).

Commented [tp45]: How will you analyze the data to answer the Objective? What criteria will determine success? For example, do you want to have at least 40 spawners in the M12-M15 reach? Do you want the SARs to be equal to or better than they are from the Methow Hatchery releases?

Commented [WF46]: How will the analysis be conducted in order to evaluate the objective? For example, X% of fish acclimated returned and spawned in M12-M14. And then tie this number into Greg's adaptive management framework. Maybe there isn't a "number" to make a decision on now….instead state that these values will be determined by the HC.

Objective 2: To evaluate what proportion of short term acclimated spring Chinook will still home back to Methow Fish Hatchery

As described above all spring Chinook acclimated at Goat Wall will be marked with a unique CWT tag. CWT recovery necessary to meet objective 2 will occur at Methow FH by WDFW during spawning and adult management activities as normal to meet reporting and M&E objectives described in Hillman et al 2013.

Commented [WF47]: Again, to make adaptive management decisions, tie a number to the objective and determine if the program is achieving the objectives. Integrating Greg's adaptive management framework into these sections would be great.

Objective 3: To determine appropriate numbers of hatchery spring Chinook to release in the upper Methow based upon PNI/PHOS goals.

YN's Upper Columbia Spring Chinook and Steelhead Acclimation Project intends to release smolt numbers which will not exceed pHOS/PNI guidelines currently included in the Methow spring Chinook DRAFT section-10 permit (NMFS, In Prep). Any changes in permit requirements when the final section-10 permit becomes available will be incorporated into this proposal. The modeling presented in Table 5 (Section 4.0 above) illustrates that a release of 25,000 spring Chinook in the upper Methow is unlikely to pose a risk to permit requirements. Nonetheless, since this release will receive a unique CWT, contribution of this release towards pHOS in the Methow Basin will be evaluated.

Commented [tp48]: I don't think that this statement is supported unless analyses are done that includes all hatchery fish – not just the ones that are released from Goat Wall.

Commented [WF49]: The modeling should include releases from other programs to assure that permit requirements are being met.

Objective 4: To monitor project performance indicators and where appropriate, compare performance indicators to an on-station reference group.

Fish Condition and Growth

To monitor fish growth, condition and stage of smoltification a random sample of 100 smolts will be sampled weekly (e.g., approximately 800 from MH and 800 from Goat Wall for a total of 1600 fish). Weekly sampling will include a general assessment of fish condition, visual assessment of smoltification, fish length and fish weight so that growth rates and condition factors may be assessed.

Commented [tp50]: Somewhere in the proposal the expected length of time in the pond should be estimated (e.g., 8 weeks).

Release Monitoring and In-Pond Survival

Up to 7,000 spring Chinook within the site will be PIT tagged by YN. YN will design and install a PIT tag detection system at the sloughs' outlet to determine out-migration timing as well as produce an estimate of in-pond survival (following the volitional release and downstream migration). Additionally, daily predator observations will be recorded so that YN can respond in real-time to increased predation.

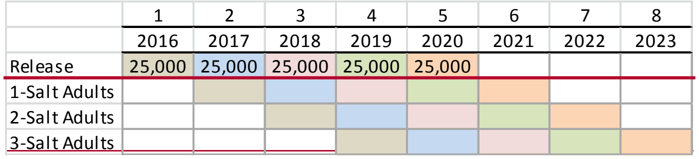
Tagging-to-Rocky Reach and McNary and Release-to-Rocky Reach and McNary survival rates. Tagging-to-Rocky Reach and McNary, and Release-to-Rocky Reach and McNary survival rates will also be measured using PIT tag detection. Survival estimates for both tagging and release will use Cormack-Jolly-Seber estimates with associated standard errors for both survival and detection probabilities (Columbia River DART). These survival rates will be compared to like metrics from the Methow FH on-station release.

Smolt-to-Adult survival

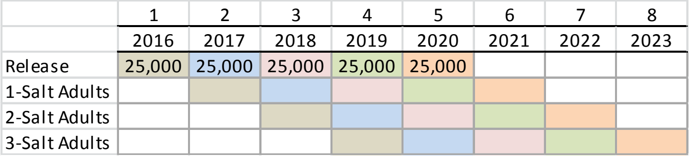
Smolt-to-Adult Return (SAR) rates will be calculated using the unique CWT for each acclimated release. SARs are typically reported in the PUD annual M&E report. SARs for the acclimated release can be compared to the on-station release by brood year.

Project Timeframe

Release would occur in ~~2015~~2016-~~2019~~2020.~~-2019.~~ In-pond and in-hatchery assessment would also occur in those years. Field assessment of adult return rates and spawning distributiondistribution~~distibuion~~ would occur in ~~2016~~2017-2023.



	1	2	3	4	5	6	7	8
	2016	2017	2018	2019	2020	2021	2022	2023
Release	25,000	25,000	25,000	25,000	25,000			
1-Salt Adults		🟫	🟦	🟥	🟩	🟧		
2-Salt Adults			🟫	🟦	🟥	🟩	🟧	
3-Salt Adults				🟫	🟦	🟥	🟩	🟧



	1	2	3	4	5	6	7	8
	2016	2017	2018	2019	2020	2021	2022	2023
Release	25,000	25,000	25,000	25,000	25,000			
1-Salt Adults		🟫	🟦	🟥	🟩	🟧		
2-Salt Adults			🟫	🟦	🟥	🟩	🟧	
3-Salt Adults				🟫	🟦	🟥	🟩	🟧

The five year timeframe is designed to achieve the near-term objective described above, which address critical uncertainties. A decision to continue releases will need to be made in 2019 based upon available information while the adult return data is collected through 2023.

Commented [GM51]: This should be a short section unto itself. I suggest we build in an interim decision step while we wait for the final data. However, this step would include an off-ramp and a proceed option depending on the various results to date, which could be assessed under the same type of adaptive management framework.

6.0 Adaptive Management and Study Design

Information collected through this project will be used to adaptively manage release of spring Chinook from the Methow Fish Hatchery. An adaptive management framework developed by Greg Mackey (DCPUD) will be used to make modifications to acclimation and release strategies as warranted.

Commented [GM52]: This material should be integrated above. This material needs more work by the HC, but provides a guide as to how the adaptive management framework can be structured. The key concept is that the adaptive management framework is not a separate thing for the management actions and assessment: it is the management plan and assessment and decision making vehicle.

Commented [WF53]: I suggest incorporating the adaptive management framework into Section 5.0.

Adaptive Management Framework (move to appendix or to an adaptive Mgt section).

~~1.~~5. Management Context: Spring Chinook are produced under the Wells HCP and Priest Rapids Settlement Agreement at Methow Hatchery to be released in the Methow River. Annually, up to ~134,000 fish total are available for the Methow River releases.

~~2.~~6. Goal: Rebuild and Recover Methow Spring Chinook (Wells HCP)

~~3.~~7. Management Objectives for the Methow River:
  - a. Achieve spawning escapement numbers for each reach of the Methow (aggregate numbers of spawners that are spatially informative can be applied).
  - b. Meet pHOS target for each reach (an aggregate pHOS that is spatially informative can be applied).
  - c. Maximize freshwater productivity of spring Chinook in the Methow River

~~4.~~8. Management Options:
  - a. Release fish from Methow Hatchery (on-station release)
  - b. Release fish from Goat Wall Pond (remote acclimation site)
  - c. Drop plant fish in the Goat Wall Pond reach(es)

~~5.~~9. Uncertain states of nature:
  - a. Carrying capacity of spring chinook in the Methow River is uncertain, but there are existing estimates and methods to estimate carrying capacity.
    - i. Spawning habitat limited? If the Methow River is spawning limited, increasing the number of spawners above the spawning capacity is unlikely to increase freshwater production.
    - ii. Rearing habitat limited? If Methow River is rearing limited, how many spawners (I.e., females) are needed to fully see the habitat?
    - iii. Reproductive effectiveness of hatchery fish relative to wild fish. If the reproductive effectiveness of hatchery fish is different from wild fish, then the number of hatchery spawners must be adjusted accordingly.
    - iv. Genetic risk of hatchery fish crossing with wild fish. How many hatchery fish crossing wild fish pose a significant genetic risk?
    - v. Risk of reducing the opportunity for wild x wild crosses in nature. Higher ratios of hatchery:wild spawners reduces the probability of wild x wild spawning events.
    - vi. Homing and straying: Fish attempt to home to their natal location using cues acquired during egg-fry period imprinting, parr movements

      imprinting, smolt imprinting. The influence of each of these periods on where fish home specifically in the Methow River is uncertain.
    vii. Stochastic processes – notably, river runs dry from the Lost River area downstream 10-15 miles in some years during spawning and incubation periods. Fish homing to these reaches are likely to be more prone to reproductive failure on some years than fish homing to other reaches that remain watered in dry years.

~~6.~~10. Management Options Hypotheses:
  a. Pre-Release Survival
    i. Goat Wall = On-Station
    ii. Goat Wall < On-Station
    iii. Goat Wall > On-Station
  b. Post-Release Survival to Rocky reach
    i. Goat Wall = On-Station
    ii. Goat Wall < On-Station
    iii. Goat Wall > On-Station
  c. Post-Release Survival to Returning Adult
    i. Goat Wall = On-Station
    ii. Goat Wall < On-Station
    iii. Goat Wall > On-Station
  d. Return Rate to Goat Wall target reaches (target reach/straying)
    i. Goat Wall = On-Station
    ii. Goat Wall < On-Station
    iii. Goat Wall > On-Station
  e. Achieve Hatchery Origin Female Spawner Escapement Target Numbers to Goat Wall reaches
    i. Goat Wall = Target
    ii. Goat Wall < Target
    iii. Goat Wall > Target
    iv. On-Station = Target
    v. On-Station < Target
    vi. On-Station > Target
  f. Achieve Hatchery Origin Male Spawner Escapement Target Numbers to Goat Wall reaches
    i. Goat Wall = Target
    ii. Goat Wall < Target
    iii. Goat Wall > Target
    iv. On-Station = Target
    v. On-Station < Target
    vi. On-Station > Target

- g. Overall Return Performance: P(Pre-Release Survival) * P(Post-Release Survival) * P(returning to target reach)
  - i. Goat Wall = On-Station
  - ii. Goat Wall < On-Station
  - iii. Goat Wall > On-Station
- h. Likelihood of contributing to recovery
  - i. Increase in fry production -Not assessed under this plan
  - ii. Increase in parr production -Not assessed under this plan
  - iii. Increase in smolt production -Not assessed under this plan
  - iv. Increase in wild adult returns -Not assessed under this plan

~~7.~~11. Implement Action

- a. Acclimate and release 25,000 Methow Hatchery smolts in Goat Wall pond (approximately March-April)
- b. Acclimate and release 109,000 Methow Hatchery smolts at Methow Hatchery Pond 13 (April release).
- c. All Goat Wall fish will carry a CWT code specific to the release site and release year.
- d. All Methow Hatchery fish will carry a CWT code(s) specific to the release site and release year.
- e. Goat Wall fish will be marked with up to 7,000 PIT tags
- f. Methow Hatchery fish will be marked with up to 7,000 PIT tags
- g. Acclimation will take place in spring 2016, 2017, 2018, 2019, 2020.
- h. Acclimation numbers and methods will be held constant except to correct obvious in-pond survival issues or by HC and HSC decision. Assessments will be performed on an annual basis, but full assessment of the project will take place after all adult returns have been assessed.
- i. The program may be terminated as determined by the Hatchery Committee.

~~8.~~12. Evaluation

Response criteria by individual hypothesis.

Hypothesis	Result	Response
Pre-Release Survival	= On-Station	Continue Acclimation
Pre-Release Survival	< On-Station	Assess and change practices if needed
Pre-Release Survival	<< On-Station	Discontinue acclimation or change practices
Pre-Release Survival	> On-Station	Continue Acclimation
Pre-Release Survival	>> On-Station	Continue Acclimation; consider expanding
Survival to Rocky Reach	= On-Station	Continue Acclimation
Survival to Rocky Reach	< On-Station	Assess and change practices if needed
Survival to Rocky Reach	<< On-Station	Discontinue acclimation or change practices
Survival to Rocky Reach	> On-Station	Continue Acclimation
Survival to Rocky Reach	>> On-Station	Continue Acclimation; consider expanding
Survival to Returning Adult	= On-Station	Continue Acclimation

Survival to Returning Adult	< On-Station	Assess and change practices if needed
Survival to Returning Adult	<< On-Station	Discontinue acclimation or change practices
Survival to Returning Adult	> On-Station	Continue Acclimation
Survival to Returning Adult	>> On-Station	Continue Acclimation; consider expanding
Return Rate to Target Reach	= On-Station	Continue Acclimation
Return Rate to Target Reach	< On-Station	Assess and change practices if needed
Return Rate to Target Reach	<< On-Station	Discontinue acclimation or change practices
Return Rate to Target Reach	> On-Station	Continue Acclimation
Return Rate to Target Reach	>> On-Station	Continue Acclimation; consider expanding
H Female Spawners	= Target	Continue Acclimation
H Female Spawners	< Target	Assess and change practices if needed
H Female Spawners	<< Target	Discontinue acclimation or change practices
H Female Spawners	> Target	Continue Acclimation; consider reducing release numbers
H Female Spawners	>> Target	Reduce release numbers
H Male Spawners	= Target	Continue Acclimation
H Male Spawners	< Target	Assess and change practices if needed
H Male Spawners	<< Target	Assess and change practices if needed
H Male Spawners	> Target	Continue Acclimation; consider reducing release numbers
H Male Spawners	>> Target	Reduce release numbers; change rearing practice
Overall Return Performance	= On-Station	Continue Acclimation
Overall Return Performance	< On-Station	Assess and change practices if needed
Overall Return Performance	<< On-Station	Discontinue acclimation
Overall Return Performance	> On-Station	Continue Acclimation
Overall Return Performance	>> On-Station	Continue Acclimation; consider expanding

Response criteria integrated across three critical hypotheses

Pre-Release Survival	Post-Release Survival	H Females to Target Reach	Response
=	=	=	Continue remote acclimation.
=	<	=	Continue remote acclimation; assess if SAR can be improved
=	>	=	Continue remote acclimation; assess if homing to target reaches can be improved
=	=	<	Assess if homing can be improved. Discontinue if homing cannot be improved.
=	=	>	Continue remote acclimation. Consider expanding remote acclimation if freshwater productivity warrants it.
=	>	>	Continue remote acclimation. Consider expanding remote acclimation if freshwater productivity warrants it.
=	>	<	Continue remote acclimation; assess if homing to target reaches can be improved
=	<	<	Discontinue remote acclimation unless SAR and homing can be improved
=	<	>	Continue remote acclimation; assess if SAR can be improved
<	=	=	Continue remote acclimation; assess if in-pond survival can be improved

<	<	=	Continue remote acclimation; assess if in-pond survival and SAR can be improved
<	>	=	Continue remote acclimation; assess if in-pond survival and homing can be improved
<	=	<	Discontinue remote acclimation unless in-pond survival and homing can be improved
<	=	>	Continue remote acclimation; assess if in-pond survival can be improved
<	>	>	Continue remote acclimation; assess if in-pond survival can be improved
<	>	<	Discontinue remote acclimation unless in-pond survival and homing can be improved
<	<	<	Discontinue remote acclimation
<	<	>	Discontinue remote acclimation unless in-pond survival and homing can be improved
>	=	=	Continue remote acclimation; assess if in-pond survival and SAR can be improved
>	<	=	Continue remote acclimation; assess if SAR can be improved
>	>	=	Continue remote acclimation; assess if homing can be improved
>	=	<	Discontinue remote acclimation unless homing can be improved
>	=	>	Continue remote acclimation. Consider expanding remote acclimation if freshwater productivity warrants it.
>	>	>	Continue remote acclimation. Consider expanding remote acclimation if freshwater productivity warrants it.
>	>	<	Discontinue remote acclimation unless homing can be improved
>	<	<	Discontinue remote acclimation unless SAR and homing can be improved
>	<	>	Continue remote acclimation, assess if SAR can be improved

Overall Performance Assessment

$P_{(\text{Pre-Release Survival})} = P_1$

$P_{(\text{Post-Release Survival})} = P_2$

$P_{(\text{returning to target reach})} = P_3$

Overall Performance = $P_1 * P_2 * P_3 = O_i$

If: $O_{\text{Goat Wall}} = O_{\text{On-Station}}$ then continue remote acclimation

$O_{\text{Goat Wall}} > O_{\text{On-Station}}$ then continue or expand remote acclimation

$O_{\text{Goat Wall}} < O_{\text{On-Station}}$ then discontinue remote acclimation

Additional factors to consider:

1. Use data to assess pHOS and PNI and to estimate release numbers needed for seeding and pHOS.
2. Assess ability of capturing hatchery fish for broodstock and adult management.
3. Assess the spatial distributions of Goat Wall and On-Station releases toward optimizing spatial distribution of hatchery spawners.

7.0 Summary

It is clear that for a supplementation program to be effective hatchery origin fish must spawn with natural origin fish and have access to available spawning habitat. Concrete-to-concrete hatchery management at best is unlikely to result in a supplementation program which will be effective in increasing the abundance of natural origin fish. At worst, a concrete-to-concrete hatchery program using natural origin broodstock may mine the natural origin component of the population. Acclimating fish in the natural environment, rather than releasing them from a hatchery, is one way to encourage fish to access available habitats alongside the natural origin returns. However, there are unknowns that need to be addressed to better understand the extent to which we can improve hatchery spawner distribution and how best to integrate hatchery spawners within the current management paradigm which requires extensive adult management. This acclimation proposal sets forth a frame work to test some of these uncertainties while actively managing adult returns on the spawning grounds.

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Appendix A: Upper Columbia Salmon and Steelhead Acclimation, Summary of Results To-Date

Attachment D

Yakama Nation Fisheries Resource Mgt
Expanded Acclimation Summary
Wenatchee and Methow Basins
2010-2014

Release Year	Basin	Species	Program	Acclimation Site	Number Acclimated	Marks	Size at Transfer (FPP)	Transfer Date	Size at Release (FPP)	Volitional Release Start	In pond survival (PIT)	Release-to-McNary survival (PIT)	Standard Error (SE)	Tagging-to-McNary survival (PIT)	Standard Error (SE)	SAR	Comments
2010	Wenatchee	Steelhead	Wenatchee Steelhead (CPUD)	Rohlfing's Pond (Nason Creek)	10,364	VIE/PIT	9.0	3/25/10	7.4	5/7/2010	92.70%	n/a	n/a	n/a	n/a	NYA	566 PITs in group. Seperated from coho with a barrier net.
	Methow	Spring Chinook	Winthrop NFH	Spring Creek	49,890	CWT	17.5	3/23/10	15.0	4/19/2010	99.94%	n/a	n/a	n/a	n/a	NYA	Co-mingled with coho; In-pond survival based on visual estimates of predation and recoverd mortalities since there were no PIT tags in this group.
			Methow FH/GCPUD	on-station		CWT/PIT	n/a	n/a		4/15/2010	n/a	n/a	n/a	62.98%	5.69%	NYA	No outlet detection systems were in-place for in-pond and release-to-McNary survival estimates
			Methow FH/GCPUD	Wolf Creek	25,591	CWT/PIT	18.0	3/26/10	14.4	4/18/2010	98.10%	n/a	n/a	58.55%	5.94%	NYA	9,999 PIT tags; no other species in pond; In-pond survival based on visual estimates of predation and recoverd mortalities rather than PIT tags. Lack of outlet detection did not allow for a release to McNary survival
2011	Wenatchee	Steelhead	Wenatchee Steelhead (CPUD)	Rohlfing's Pond (Nason Creek)	20,706	VIE/PIT	9.7	3/22/11	8.2	5/2/2011	88.90%	43.95%	3.89%	34.83%	3.03%	NYA	Seperated from coho with a barrier net; 9874 PIT tags; VIE only pink lft and rt elastomer. A high flow event between Mar 31-Apr 2 where approximately 1/3 of the pond escaped.
	Methow	Spring Chinook	Winthrop NFH	on-station	388,642	CWT/PIT	n/a	n/a	14.4	4/18/2011	98.81%	54.27%	5.42%	54.09%	5.26%	NYA	
			Winthrop NFH	Spring Creek	38,633	CWT/PIT	19.6	3/10/11	16.5	4/10/2011	93.48%	40.97%	3.62%	38.30%	3.17%	NYA	Saprolegnia Infection (flag tail) - release started early; Saprolegnia observed on-station pre-transfer worsened after transfer. Co-mingled with coho
			Methow FH/GCPUD	on-station	288,013	CWT/PIT	n/a	n/a	19.3	4/19/2011	99.90%	46.68%	3.79%	47.92%	3.81%	NYA	
			Methow FH/GCPUD	Wolf Creek	59,980	CWT/PIT	18.2	3/31/11	17.4	4/19/2011	99.08%	42.33%	3.99%	42.74%	3.97%	NYA	6,000 PIT tags; no other species in pond
2012	Wenatchee	Steelhead	Wenatchee Steelhead (CPUD)	Rohlfing's Pond (Nason Creek)	18,254	VIE/PIT	27.9	3/20/12	19.7	5/15/2012	93.80%	9.37%	3.00%	6.76%	1.37%	NYA	Poor outmigration survival due to extremely small size at transfer and subsequent release
	Methow	Spring Chinook	Winthrop NFH	Spring Creek	51,550	CWT/PIT	22.7	3/6/12	17.9	4/26/2012	98.70%	53.91%	5.19%	54.83%	4.14%	NYA	Co-mingled with coho
			Winthrop NFH	on-station	551,509	CWT/PIT	n/a	n/a	15.3	4/16/2012	105.6%*	50.58%	4.20%	53.43%	3.63%	NYA	*- Detection efficiency was 24.7% for the Spring Creek array
			Methow FH/GCPUD	on-station	284,389	CWT/PIT	n/a	n/a	16.9	4/23/2012	98.58%	64.70%	7.39%	63.43%	7.21%	NYA	
			Methow FH/GCPUD	Mid-Valley Pond	51,151	CWT/PIT	20.0	3/27/12	16.6	4/23/2012	91.50%	56.32%	3.74%	51.69%	3.41%	NYA	
2013	Methow	Spring Chinook	Winthrop NFH	Spring Creek	46,498	CWT/PIT	24.2	3/6/13	18.8	4/19/2013	94.99%	70.59%	9.30%	67.05%	8.72%	NYA	Co-mingled with coho
			Winthrop NFH	on-station	375,147	CWT/PIT	n/a	n/a	15.1	4/15/2013	100.6%*	53.98%	6.85%	56.65%	6.98%	NYA	*- Detection efficiency was 57.1% for the Spring Creek array
			Methow FH/GCPUD	on-station	341,399	CWT/PIT	n/a	n/a	13.5	4/19/2013	99.60%	55.29%	8.42%	54.21%	8.23%	NYA	
			Methow FH/GCPUD	Mid-Valley Pond	55,519	CWT/PIT	19.5	3/19/13	15.1	4/12/2013	85.60%	43.04%	7.54%	36.81%	6.45%	NYA	
2014	Methow	Spring Chinook	Methow FH/GCPUD	on-station	181,050	CWT/PIT	n/a	n/a	17.6	4/21/2014	99.84%	38.21%	6.47%	39.67%	6.61%	NYA	
			Methow FH/GCPUD	Mid-Valley Pond	22,039	CWT/PIT	20.0	3/19/14	15.1	4/21/2014	70.88%	44.49%	7.72%	30.92%	5.30%	NYA	

Wells HCP Hatchery Committee

DRAFT Statement of Agreement

Goat Wall Acclimation Plan

~~November 14, 2014~~January 21, 2015

Statement

The Wells Hatchery Committee agree to acclimate 25,000 Methow spring Chinook at the Goat Wall Acclimation Site as part of YN's Upper Columbia Spring Chinook and Steelhead Acclimation Project beginning with the 2016 release (BY2014) contingent upon a committee approved acclimation plan. The smolts would be short-term acclimated annually between March and May. This agreement will extend for 5 years unless otherwise modified by the HC. Annual reports and monthly updates will be provided to the HCP HC.

Background

YN's Upper Columbia Spring Chinook and Steelhead Acclimation Project is based on the premise that acclimating and releasing salmon and steelhead smolts in select locations can increase the effectiveness of integrated (conservation) programs Additional details can be found in Attachment 1 (Upper Methow Spring Chinook Acclimation Proposal). This SOA is also contingent upon approval of a similar SOA from the PRCC HSC.

Attachment F

Rob Jones
NMFS Recovery Division
National Marine Fisheries Service
1201 NE Lloyd Blvd., Suite 1100
Portland, OR 97232

Subject: New Preferred Broodstock Collection for Wenatchee spring Chinook Hatchery Supplementation Programs

Dear Mr. Jones

The Priest Rapids Coordinating Committee – Hatchery Subcommittee and the Rocky Reach and Rock Island Hatchery Committees are submitting to you the new preferred broodstock collection alternative to implement Chelan PUD's Chiwawa spring Chinook and Grant PUD's Nason Creek spring Chinook hatchery programs. These programs are currently implemented consisted with NMFS' Section 10(a)(1)(A) Permit 18121 and 18118. The new preferred broodstock collection alternative, not previously analyzed in the Biological Opinion for these programs, would collect Wenatchee basin spring Chinook salmon broodstock at Tumwater Dam and the Chiwawa weir beginning brood year 2015. This proposed method has been developed with considerable input from the upper Columbia River co-managers, the PRCC HSC, and HCP HC members and we support this proposed alternative as the best approach to (1) 1) maintain some level of genetic diversity within the basin for the Chiwawa, White and Little Wenatchee Rivers and the Nason Creek spring Chinook spawning aggregates while remaining consistent with NMFS' viability criteria and delineation of this population, (2) allow the programs to continue to contribute to recovery of the natural origin population, and (3) allow Chelan and Grant PUDs to meet their mitigation responsibilities (e.g., production levels) as currently authorized.,

In the last few years, technically and logistically challenging approaches to spring Chinook salmon broodstock collection have been attempted in the Wenatchee Basin for the purposes of conserving and fostering genetic diversity among major spawning aggregates. These have proven ineffective or unfeasible. Originally, separate culture of fish from the Chiwawa River, Nason Creek, and White River was planned. The plan for separate culture of White River fish was discontinued once it was demonstrated that adult broodstock collection was impossible. Subpopulation-specific culture of Chiwawa and Nason has also been shown to be unfeasible due to inability to genetically distinguish fish from the two streams with the needed precision. Although the PRCC – HSC and HCP HC is committed to conserving and fostering genetic diversity among major spawning aggregates where possible, we, in consultation with NMFS, must consider a less ambitious genetic approach for the foreseeable future to reduce handling effects of endangered spring Chinook salmon. Our preferred approach still allows for subpopulation-specific culture of spring Chinook from the Chiwawa River, but the Nason Creek program will now be based on collections from the run at large. The approach also includes some provision for exclusion of fish from the White River and Upper Wenatchee River.

We understand that you intend to reinitiate consultation based upon the description of the preferred broodstock collection method. Please accept this letter as our understanding and acceptance of the plan forward.
Sincerely,

PRCC-HSC
HCP HC

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OREGON 97232-1274

November 17, 2014

Tom McDowell
Western Washington U.S. Fish and Wildlife Office
Acting Manager
510 Desmond Drive SE, Suite 102
Lacey, WA 98503

Dear Mr. McDowell:

On August 7, 2014, NOAA's National Marine Fisheries Service made a preliminary decision on a preferred alternative approach to collect Wenatchee basin spring Chinook salmon broodstock at Tumwater Dam and the Chiwawa weir beginning brood year 2015. To assist with our evaluation, we requested any information or data you may have on the impact of our preliminary preferred alternative approach on bull trout. We also requested your input on all three alternatives presented to us by the Yakama Nation to consider while making our final decision on a preferred alternative.

On October 10, 2014, NOAA received a draft letter in response to our request for comments from the U.S. Fish and Wildlife Service regarding proposed changes to hatchery programs producing spring Chinook salmon (*Oncorhynchus tshawytscha*) from Nason Creek and the Chiwawa River in the Wenatchee sub-basin. This response described your perspective on current effects of all hatchery programs in the Wenatchee sub-basin on bull trout (*Salvelinus confluentus*) and provided your preliminary evaluation and recommendation regarding the three proposed alternatives. Your response also included four additional questions to help you better understand potential impacts associated with these alternatives.

On October 14, 2014, NOAA refined our approach with the Wenatchee hatchery program applicants (Chelan County Public Utility District, Grant County Public Utility District, and the Washington Department of Fish and Wildlife), taking in account the information you provided regarding impacts to bull trout through implementation of the Wenatchee spring Chinook salmon hatchery supplementation programs and answering the four questions provided by U.S. Fish and Wildlife Service. NOAA's refined preferred alternative approach represents a hybrid of alternatives 2 and 3 and is described in Attachment 1.

The Preferred Alternative described in Attachment 1 for spring Chinook salmon broodstock collection in the Wenatchee Basin would allow NMFS to (1) maintain some level of genetic diversity within the basin for the Chiwawa, White and Little Wenatchee Rivers and the Nason Creek spring Chinook spawning aggregates while remaining consistent with NMFS' viability criteria and delineation of this population, (2) allow the programs to continue to contribute to recovery of the natural origin population, (3) allow the applicants to meet their mitigation responsibilities (e.g., production levels) as currently authorized, (4) reduce impacts to bull trout from what is currently authorized under the section 10(a)(1)(A) permits for the Chiwawa River and Nason Creek hatchery programs through operations at the Chiwawa Weir and TWD, (5) reduce impacts to bull trout by eliminating tangle-netting in Nason Creek for spring Chinook salmon broodstock, and (6) work collaboratively with the USFWS and WDFW to develop and implement a standardized M&E program for bull trout in the Wenatchee sub-basin to determine relative impacts of the Chiwawa River and Nason Creek spring Chinook hatchery programs.

NOAA Fisheries appreciates your comments on these alternatives, and the ongoing efforts by the U.S. Fish and Wildlife Service and numerous partners in hatchery program implementation to reduce program effects on all listed species in the Wenatchee Basin. If you have any questions or comments regarding this letter, please contact Amilee Wilson at 360-753-5820.

Sincerely,

Robert P. Jones, Jr.
Anadromous Production and
Inland Fisheries Branch
Sustainable Fisheries Division

cc: Amilee Wilson, NOAA
Craig Busack, NOAA
Lynn Hatcher, NOAA
Karl Halupka, USFWS
William Gale, USFWS
Alene Underwood, CPUD
Deanne Pavlick-Kunkel, GPUD
Todd Pearsons, GPUD
Jeff Korth, WDFW
Mike Tonseth, WDFW
Steve Parker, YN
Keely Murdoch, YN

Enclosed: Attachment 1, 2015 – 2023 NMFS Preferred Approach to Wenatchee Spring Chinook Broodstock Collection
Attachment 2, Nason Creek and Chiwawa River Broodstock Collection Options (Proposed by the Yakama Nation – March 2014 HCP-HC Meeting)

2015 – 2023 NMFS Preferred Approach to Wenatchee Spring Chinook Broodstock Collection

In the last few years, technically and logistically challenging approaches to spring Chinook salmon broodstock collection have been attempted in the Wenatchee Basin for the purposes of conserving and fostering genetic diversity among major spawning aggregates. These have proven ineffective or unfeasible. Originally, separate culture of fish from the Chiwawa River, Nason Creek, and White River was planned. The plan for separate culture of White River fish was discontinued once it was demonstrated that adult broodstock collection was impossible. Subpopulation-specific culture of Chiwawa and Nason[1] has also now been shown to be unfeasible due to inability to genetically distinguish fish from the two streams with the needed precision. As a result, although NMFS still is committed to conserving and fostering genetic diversity among major spawning aggregates, we have fallen back to a less ambitious genetic approach for the foreseeable future to reduce handling effects of endangered spring Chinook salmon. Our preferred approach, outlined below, has been developed with considerable input from the state, federal, and tribal comanagers[2] in the Upper Columbia River (UCR) Basin. The approach still allows for subpopulation-specific culture of spring Chinook from the Chiwawa River, but the Nason Creek program will now be based on collections from the run at large. The approach also includes some provision for exclusion of fish from the White River and Upper Wenatchee River.

In contrast to earlier plans, this approach will have a greatly reduced impact on the spring Chinook salmon population from trapping, handling, and migration delay resulting from the earlier approaches. Also in contrast to earlier approaches, this plan addresses concerns about impacts to bull trout from trapping and migration delay that have risen during NMFS' ongoing section 7(a)(2) consultation with USFWS. NMFS believes the approach described below, which is a combination of strategies from Options 2 and 3 proposed by the Yakama Nation (Attachment 2), is the best means to achieve program objectives while minimizing potential negative effects to threatened bull trout and steelhead and endangered spring Chinook.

In evaluating this approach, it is important to consider time scale. NMFS is considering effects over the term of the current permit (about 10 years). An adaptive management framework cannot be developed at this time that would extend beyond this period because the section 10(a)(1)(A) permit authorizing take for this spring Chinook salmon enhancement program expires in approximately ten years, and production agreements and scheduled periodic readjustment of PUD production mitigation obligations under the UCR HCP's and Settlement Agreement may cause significant program changes after that.

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[1] The plan approved and permitted in 2013 (NMFS 2013a; NMFS 2013b; NMFS 2013c).

[2] Participants include U.S. Fish and Wildlife Service, National Marine Fisheries Service Regional staff, National Marine Fisheries Service Northwest Fisheries Science Center staff, Chelan Public Utility District (PUD), Grant PUD, Douglas PUD, Washington Department of Fish and Wildlife, Yakama Nation and the Confederated Tribes of the Colville Reservation.

Overview of NMFS Preferred Approach

Approximately (~) 64 and 74 natural origin (NO) adults are needed annually to meet the Nason and Chiwawa conservation programs, respectively. Approximately 66 hatchery-origin (HO) fish will also be needed for the Nason safety-net program.

All ~64 NO adults for the Nason program will be collected from the run at large at Tumwater Dam (TWD). An additional seven NO adults (~11 percent over the 64 NO fish needed) will also be collected at TWD to allow for the return of any possible Little Wenatchee and White River identified through genetic analysis to their streams of origin, as an added effort toward conservation of diversity. The ~66 HO fish needed for the Nason safety-net program will all be collected at TWD.

Collection of the ~74 NO adults for the Chiwawa conservation program will be accomplished through a combination of targeting PIT tagged NO adults at TWD[3], and use of the Chiwawa Weir, when needed. As many fish as possible will be collected at TWD, to limit bull trout impacts related to any use of the Chiwawa Weir.

We present the protocol summarized in greater detail and in comparison with previous broodstocking operations below.

Historical Operations (2012 and earlier):

- Operated Chiwawa Weir 4 days up/3 days down from May 1 through April 15 (total of 62 days possible) and retained every fish up to the requisite broodstock target or;
- Operated Chiwawa Weir 7 days per week/24 hours per day from May 1 through April 15 (up to 107 days total), retained every third NO fish up to the requisite broodstock target, and the requisite HO fish were collected at TWD (2011 and 2012 only).

2013 Operations:

- All broodstock collected for the Nason Creek and Chiwawa programs were targeted at Tumwater Dam, utilized a Parental Based Tagging (PBT) approach, and were assigned to respective spawning aggregates (with varying results).
    - This approach resulted in meeting the Chiwawa Conservation program, however, PBT was only successful in assigning a couple of NO fish to the Nason Creek Major Spawning Aggregate (MSA). Additional broodstock were targeted in Nason Creek using tangle netting.

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[3] This collection protocol has proven successful. In 2014, 25 PIT-tagged Chiwawa adults were collected at TWD.

2014 Operations:

- PIT tagged natural origin adults from the Chiwawa River and Nason Creek were targeted at Tumwater Dam.
    - This approach resulted in 25 previously PIT tagged NO fish for the Chiwawa program and no fish for the Nason Creek program.
- In addition to targeting tagged fish at TWD, the Chiwawa Weir was operated for a maximum of 15 days between July and mid-August, under a 24 hour up/24 hour down operation and a bull trout encounter limit of 67 fish.
    - The outcome of this approach was 37 NO adults were collected for the Chiwawa conservation program.
        - Although the combined number of brood stock collected for the Chiwawa program was only 62 of the 74 fish (84 percent), 100 percent (*N*=32) of the females needed to meet the production target were collected.
- For Nason Creek, tangle netting was implemented for the second year in a row and was a maximum of 15 days, conducted between July 15 and August 15.
    - The outcome was 28 NO fish collected for the Nason Creek conservation program. The goal was 64 NO fish; of the 28 fish, 12 were female and represented 38 percent of the females needed.
    - No bull trout were encountered during tangle netting activities. However, 17 adults and one juvenile were observed during pre-netting snorkeling sessions.

2015 NMFS preferred approach:

Nason Creek Conservation Program:

- Up to ~71 NO spring Chinook (to allow for up to 11 percent that may assign to the White and/or Little Wenatchee MSAs) would be collected at TWD between June 1 and July 15.
    - Brood stocking would run concurrent with adult management, RM&E, and the Spring Chinook Relative Reproductive Success Study.

Nason Creek Safety Net Program:

- Up to ~66 HO spring Chinook would be targeted at TWD 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.
    - The number of HO fish needed may be adjusted annually to make up for any potential shortfall of NO broodstock for the Nason and Chiwawa conservation programs. This will ensure mitigation goals are met even during low NO return years. Extra HO fish would also be collected to safeguard against a shortfall of

NO adults. Any surplus HO fish would be removed as part of the adult management program.

Chiwawa River Conservation Program:

- Approximately 30 previously PIT-tagged NO spring Chinook from the Chiwawa River would 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 ~74 total or ~32 females) would be collected at the Chiwawa Weir.
    - Weir operations would be on a 24 hour up/24 hour down schedule from about June 15 through August 1 (not to exceed 15 cumulative trapping days). 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.
    - Additionally, no more than 10 percent of the estimated mean number of adult bull trout in the Chiwawa Basin (using a rolling five year average derived from expanded redd counts) may be encountered during broodstock collection without concurrence from the USFWS.
- To ensure the production target is met for the Chiwawa program in the event insufficient NO adults are collected for the conservation program, HO adults would be collected at TWD to make up the shortfall, between June 1 and July 15.
- Implementation of the preferred alternative will result in significant changes in Chiwawa weir operation. Historically, weir operations have been as concentrated as seven days per week/24 hours per day (traditionally 4 days up/3 days down) between June 1 and August 15 (depending on flows). Under the preferred alternative, trapping would be limited to 15 days total (from July through mid-August) resulting in a 75 to 86 percent reduction in the total number weir operational days. In addition, through a minimum 24 hour down period for every 24 hours of operation, daily bull trout encounters would be reduced by 50 percent (from an average of 10 per day to 5 per day) based upon 2014 data. Overall, NMFS believes this modified spring Chinook salmon broodstock collection approach would result in a significant reduction in bull trout encounters (i.e., fish in the trap) and potential delays to bull trout (and spring Chinook) due to the increased frequency in down time of the weir.

Net Results of Preferred Alternative Implementation for Bull Trout:

Chiwawa Weir:

- Implementation of the preferred alternative would result in a 75 to 86 percent reduction in the total number operational days from historical operation;

- Implementation of the preferred alternative would also result in a 50 percent reduction in the average number of bull trout encountered in the trap from historical operation.

Conservation Fisheries:

- Implementation of the preferred alternative (or any broodstock collection method) is not expected to result in changes to conservation fisheries as an adult management tool.

Tumwater Dam:

- Implementation of the preferred alternative is expected to take advantage of known NO spring Chinook passing TWD concurrent with other activities ongoing at TWD (e.g., spring Chinook run composition sampling, Spring Chinook Relative Reproductive Success Study, removal of surplus HO spring Chinook (adult management), and sockeye run composition sampling). Unless bull trout are being collected for specific management or research objectives, any bull trout encountered would be passed without handling during these activities.
- Implementation of the preferred alternative would also eliminate the need to conduct tangle netting activities or other methods in Nason Creek to acquire NO fish which could result in greater effects to a smaller bull trout population than occurs at either TWD or the Chiwawa Weir.

Additional Considerations with Respect to Bull Trout

The current size of conservation programs for the Nason Creek and Chiwawa River is based upon the number of adults estimated to meet minimum escapement objectives (>80 percent of the time) and broodstock quotas. Several approaches can effectively reduce impacts of spring Chinook salmon hatchery programs on bull trout, but scaling back production is a last resort option. Changes in production levels for the Wenatchee spring Chinook salmon hatchery programs were already being implemented for 2013 due to the periodic recalculation of No Net Impact (NNI) as required by the HCP's and Settlement Agreement in 2012. Because the hatchery programs are tied to multi-decade agreements[4] for the UCR hydroelectric facilities, further reductions in production levels is only possible through concurrence of the signatories to the HCPs and Settlement Agreement or through recalculation of no net impact (NNI) based upon passage survival standards (recalculation occurs every ten years; the next recalculation period is

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[4] Anadromous Fish Agreement and Habitat Conservation Plan (HCP) Rocky Reach (RR) Hydroelectric Project Federal Energy Regulatory Commission (FERC) License No. 2145 (CPUD 2002b; Recitals A & B; NMFS 2007) and the Anadromous Fish Agreement and HCP Rock Island (RI) Hydroelectric Project FERC License No. 943 (CPUD 2002a; Recitals A & B; NMFS 2007), Priest Rapids Salmon and Steelhead Settlement Agreement (FERC Project No. 2114) (GPUD, USFWS, NOAA, WDFW, CCT, and YN 2005), Upper Columbia Spring Chinook and Steelhead Recovery Plan (UCSRB 2007), the 2008-2017 *United States v. Oregon* Management Agreement as modified in the January 23, 2009, submittal to the U.S. District Court (*U.S. v. Oregon* 2009), and Federal Columbia River Power System (FCRPS) Supplemental Comprehensive Analysis (SCA) (NMFS 2008; NMFS 2014).

2023), as well as approval through the next *U.S. v. Oregon Management Agreement* process (scheduled for 2018).

Presently, changes in the proportion of the conservation and safety net components represent the most realistic means to influencing where and how intensively trapping facilities are operated. If over the next few years, as natural origin fish abundance increases such that a significant proportion of the conservation program is being removed under adult management at TWD than are needed on the spawning grounds, then the parties may agree to convert more of the conservation program to safety net to avoid "mining" the NO population. A smaller conservation program results in fewer NO fish needed, and in the case of the Chiwawa Weir, if there were a 50 percent reduction in the size of the conservation program, half as many NO adults are needed which translates into reduced operations. This in turn reduces the number of bull trout encountered and potential passage delay.

In addition to modifying the relative sizes of the conservation and safety net programs, improvements in adult passage survival for NO spring Chinook from Bonneville Dam (BD) to Priest Rapids Dam (PRD), could significantly increase the number of previously PIT-tagged NO spring Chinook that could be intercepted at TWD (thereby reducing dependency on tributary efforts such as the Chiwawa Weir). In 2014, WDFW was successful in targeting those previously tagged NO fish at TWD. Of 29 adults that ascended TWD, 25 (86 percent) of the fish were collected for broodstock. Conversion of PIT-tagged fish from PRD to TWD was 94 percent. Conversion of PIT-tagged fish from BD to PRD was 76 percent. Improvement in adult survival from BD to PRD could increase the number of NO fish removed for broodstock at TWD for the Chiwawa program to greater than 50 percent (versus 34 percent in 2014), reducing the need to operate the Chiwawa Weir in future broodstock collection activities.

Ancillary to ongoing activities for salmon and steelhead, the USFWS and WDFW are in year two of a three-year effort to systematically conduct comprehensive redd surveys for all bull trout populations in the Upper Columbia Basin with a goal of identifying index reaches with known expansion factors for future surveys. For 2014, in the Chiwawa Basin alone, 769 bull trout redds have been counted. Assuming a two fish per redd expansion, that equates to about 1,538 spawners. By verifying true bull trout abundance in these watersheds where hatchery supplementation programs exist, we can have better idea of what the relative impacts (positive and negative) on the total abundance of bull trout populations in the Wenatchee sub-basin may be from implementing those programs.

Currently, the USFWS and WDFW are drafting a proposal to develop and implement a standardized monitoring and evaluation (M&E) program for bull trout abundance and productivity at the local level which directly supports Recovery Action 5.5.5 in the Bull Trout Recovery Plan (USFWS; 2002). A major portion of this program relies on estimates of age, sex ratio, size of migratory spawners (including repeat spawner rates), and migratory patterns (i.e., migration timing and spawning distribution) of adult bull trout. Implementing this M&E program would require a subset of both juvenile and adult bull trout to be handled and sampled. Because the spring Chinook salmon supplementation programs in the Wenatchee Basin would incur adult bull trout encounters through broodstock collection activities, regardless of what collection methods are used, sampling bull trout encountered during those activities will limit any additional trapping/collection efforts needed to meet the bull trout sample size criteria for the M&E program. In addition to making efficient use of bull trout encountered incidentally during hatchery program implementation to limit overall bull trout impacts, there is a monetary benefit as well. By combining these ongoing spring Chinook salmon hatchery activities with bull trout M&E, this would allow the limited budget for bull trout monitoring to go further, and the money that would otherwise be devoted to population sampling could be allocated to other areas of uncertainty influencing bull trout recovery.

Another Wenatchee spring Chinook salmon hatchery program that has the potential to impact bull trout that has been discussed infrequently between the Services is the White River spring Chinook salmon program. The White River spring Chinook salmon hatchery program was initiated in 1997 with captive-brood progeny from eggs and fry collected from White River spring Chinook salmon redds. In 2012 during the NNI recalculations for Wenatchee spring Chinook salmon programs, it was determined that a White River program was not feasible, primarily due to abundance issues related to low adult survival rates (NMFS 2013a). As a result, the White River spring Chinook salmon hatchery production was moved from the White River to Nason Creek, and a decision was made to sunset the White River spring Chinook salmon hatchery program in 2016. In February 2014, a decision was made to end the White River captive brood program even earlier than planned. This action results in elimination of juveniles in the White River basin after the 2015 final release. In addition, no adult collection strategies would be implemented in the White River for broodstock. The White River contains the second largest bull trout spawning population in the Wenatchee Basin, second only to the Chiwawa River population. This action would result in no effects (post 2015) to bull trout from elimination of the White River spring Chinook salmon hatchery program in the Wenatchee sub-basin.

Summary

The Preferred Alternative for spring Chinook salmon broodstock collection in the Wenatchee Basin described above allows NMFS to (1) maintain some level of genetic diversity within the basin for the Chiwawa, White and Little Wenatchee Rivers and the Nason Creek spring Chinook spawning aggregates while remaining consistent with NMFS' viability criteria and delineation of this population, (2) allow the programs to continue to contribute to recovery of the natural origin population, (3) allow the applicants to meet their mitigation responsibilities (e.g., production levels) as currently authorized, (4) reduce impacts to bull trout from what is currently authorized under the section 10(a)(1)(A) permits for the Chiwawa River and Nason Creek hatchery programs through modified operations at the Chiwawa Weir and TWD[5], (5) reduce impacts to bull trout by eliminating tangle-netting in Nason Creek for spring Chinook salmon broodstock, and (6) work collaboratively with the USFWS and WDFW to develop and implement a standardized M&E program for bull trout in the Wenatchee sub-basin to determine relative impacts of the Chiwawa River and Nason Creek spring Chinook hatchery programs.

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[5] NMFS Wenatchee River spring Chinook salmon biological opinion (NMFS 2013a) and section 10(a)(1)(A) permits 18118 and 18121 (NMFS 2013b; NMFSc).

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Nason Creek and Chiwawa River Broodstock Collection Options (Proposed by the Yakama Nation – March 2014 HCP-HC Meeting)

Options with consideration for development of within-basin genetic diversity

1. **Total Composite.** Nason Creek and Chiwawa River supplementation programs would both use a composite broodstock. The exact number of NORs needed to provide broodstock for both programs would be collected at Tumwater Dam (64 Nason Creek, 74 Chiwawa = 138 total). No genotyping of broodstock or extra handling of fish, and return of fish to the river would occur from Eastbank Hatchery. Overall this approach minimizes handling of naturally spawning spring Chinook and bull trout to the greatest extent. Genetic diversity could be allowed to naturally develop separately for tributaries above Lake Wenatchee (Little Wenatchee and White) and below Lake Wenatchee (Nason/ Chiwawa). Given the population size, a small number of fish from above the lake would be present in the Nason and Chiwawa broodstocks.

2. **Nason and Chiwawa Composite Only.** Nason Creek and Chiwawa River supplementation programs could both use a composite broodstock. The number of NORs needed to provide broodstock for both programs plus extra (up to 11%) would be collected at Tumwater Dam to allow for return of White River and Little Wenatchee genotyped fish to the river. Broodstock would be genotyped and any fish which are identified as being of Little Wenatchee and White River origin would be transported back to the upper Wenatchee and released to spawn naturally. A minimal number of fish of White River or Little Wenatchee origin will not type back to these spawning aggregates and would still be included in the composite broodstock. Overall this approach minimizes handling of naturally spawning spring Chinook and bull trout. Genetic diversity would be allowed to naturally develop separately for tributaries above Lake Wenatchee (Little Wenatchee and White River) and below Lake Wenatchee (Nason/Chiwawa River).

3. **Nason Composite Only.** Nason Creek supplementation program would use a composite broodstock of 64 NORs trapped at Tumwater Dam. Chiwawa River would use a broodstock of 74 NORs trapped at the Chiwawa Weir. If insufficient broodstock are collected at the Chiwawa Weir, returning hatchery fish (trapped at TWD) would be used as broodstock for the Chiwawa conservation program. Genetic diversity could develop separately for the Little Wenatchee, White Rivers, and Chiwawa River with a composite stock in Nason Creek. Genetic diversity would be allowed to naturally develop separately for tributaries above Lake Wenatchee (Little Wenatchee and White River) and below Lake Wenatchee (Nason/Chiwawa River). This method could result in double handling for some fish spawning in the Chiwawa River and additional bull trout handling.

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees	**Date:**	March 19, 2015
From:	Mike Schiewe, HCP Hatchery Committees Chair		
Cc:	Kristi Geris		
Re:	Final Minutes of the February 18, 2015 HCP Hatchery Committees Meeting		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees meeting was held at Chelan PUD headquarters in Wenatchee, Washington, on Wednesday, February 18, 2015, from 9:30 am to 3:00 pm. Attendees are listed in Attachment A to these meeting minutes.

ACTION ITEM SUMMARY

- Kirk Truscott will provide the Colville Confederated Tribes' (CCT's) edits and approval of the revised draft Hatchery Committees January 21, 2015 meeting minutes via email to Kristi Geris by Thursday, February 19, 2015 (Item I-A). *(Note: Truscott provided the CCT's approval of the revised draft minutes via email to Geris on February 19, 2015, which Geris distributed to the Hatchery Committees that same day.)*
- Chelan PUD will coordinate with Douglas PUD, Grant PUD, and the Washington Department of Fish and Wildlife (WDFW) on actions needed to finalize the Hatchery Monitoring and Evaluation (M&E) Plan Appendices, and will report back to the Hatchery Committees during the next Hatchery Committees meeting on March 18, 2015 (Item I-A).
- Keely Murdoch will coordinate internally with Yakama Nation (YN) staff and with Charlie Snow (WDFW) on drafting a kelt sampling protocol for Wells Dam by April 15, 2015; the YN will provide the draft protocol to Kristi Geris for distribution to the Hatchery Committees (Item I-A).
- Chelan PUD will provide a summary report on the water recirculation pilot studies at Eastbank Fish Hatchery (FH) and Chiwawa Fish Facility to Kristi Geris for distribution to the Hatchery Committees (Item I-A). *(Note: Underwood provided the final report to Geris following the meeting on February 18, 2015, which Geris*

distributed to the Hatchery Committees on February 19, 2015; a corrected final report was distributed on February 24, 2015.)

- Chelan PUD will provide their draft Methow Spring Chinook Hatchery Production Obligation Statement of Agreement (SOA) to Kristi Geris for distribution to the Hatchery Committees (Item III-B). *(Note: Alene Underwood provided the draft SOA to Geris following the meeting on February 18, 2015, which Geris distributed to the Hatchery Committees on February 19, 2015.)*
- Hatchery Committees representatives will submit edits and comments on the revised draft Wenatchee Spring Chinook Permit Re-initiation Letter to be sent to the National Marine Fisheries Service (NMFS) from the Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Sub-Committee (PRCC HSC) to Alene Underwood by Friday, February 27, 2015 (Item III-D). *(Note: no edits and comments on the revised draft letter were received, and the final letter was sent to NMFS on March 6, 2015.)*
- The YN will provide a revised draft YN Upper Methow Spring Chinook Acclimation Proposal and revised SOA to Kristi Geris for distribution to the Hatchery Committees by Friday, February 20, 2015; Hatchery Committees representatives will submit their approval, disapproval, or abstention via email to the YN (with a copy to Geris) by Wednesday, March 4, 2015 (Item IV-B). *(Note: the final draft proposal and SOA were distributed to the Hatchery Committees on February 20, 2015, as discussed; and the Hatchery Committees approved the proposal and SOA, with NMFS abstaining, as follows: the YN approved on March 3, 2015, NMFS abstained on March 3, 2015, Chelan PUD, Douglas PUD, WDFW, and the CCT approved on March 4, 2015, and the U.S. Fish and Wildlife [USFWS] approved on March 5, 2015.)*
- Hatchery Committees representatives will submit edits and comments on the draft 2015 Steelhead Release Plan to Mike Tonseth and Catherine Willard by Wednesday, March 4, 2015 (Item V-A).
- Hatchery Committees representatives will submit edits and comments on the draft 2015 Broodstock Collection Protocols to Mike Tonseth by Wednesday, March 6, 2015 (Item VI-A). *(Note: edits and comments on the draft protocols were received, and the revised draft protocols were distributed to the Hatchery Committees by Kristi Geris on March 12, 2015.)*
- Kristi Geris will distribute the draft 2015 Broodstock Collection Protocols to the

Wells HCP Coordinating Committees for review, with comments due to Mike Tonseth by Wednesday, March 6, 2015 (Item VI-A). *(Note: Geris distributed the draft protocols to the Wells HCP Coordinating Committees on February 19, 2015; and revised draft protocols were distributed on March 12, 2015.)*

- Mike Tonseth will coordinate with Craig Busack regarding an adult management section for the draft 2015 Broodstock Collection Protocols (Item VI-A).
- Kristi Geris will add Tracy Hillman to the Hatchery Committees email distribution lists (Item IX-B). *(Note: Geris added Hillman to the appropriate distribution lists on February 19, 2015, as discussed.)*
- Kristi Geris will contact Julene McGregor (Douglas PUD Information Systems Staff) to request access to the HCP Hatchery Committees Extranet site for Tracy Hillman (Item IX-B). *(Note: Geris sent an email to McGregor on February 19, 2015, requesting access for Hillman, as discussed.)*

DECISION SUMMARY

- The Hatchery Committees representatives present approved the hatchery portion of the 2015 Wells HCP Action Plan, as revised (Item II-A).
- The Hatchery Committees representatives present approved the hatchery portion of the 2015 Rocky Reach and Rock Island HCP Action Plan (Item III-A).
- The Hatchery Committees representatives present approved the Wenatchee Spring Chinook Permit Re-initiation Letter to NMFS from the Hatchery Committees and PRCC HSC, on condition that no substantive revisions are made following the 1-week review period (Item III-D).
- The Hatchery Committees approved via email vote the YN Upper Methow Acclimation Study Proposal and Goat Wall SOA, with NMFS abstaining, as follows: the YN approved on March 3, 2015, NMFS abstained on March 3, 2015, Chelan PUD, Douglas PUD, WDFW, and the CCT approved on March 4, 2015, and USFWS approved on March 5, 2015 (Item IV-B).

AGREEMENTS

- The Hatchery Committees and PRCC HSC representatives present agreed that Mike Schiewe will submit the Wenatchee Spring Chinook Permit Re-initiation Letter to NMFS on behalf of both Hatchery Committees (Item III-D).

REVIEW ITEMS

- Kristi Geris sent an email to the Hatchery Committees on March 12, 2015, notifying them that the revised draft 2015 Broodstock Collection Protocols is available for review (Item VI-A).

FINALIZED DOCUMENTS

- The final Comprehensive Summary of Partial Water Reuse and Circular Pond Rearing Systems at Chelan PUD Hatcheries was distributed to the Hatchery Committees by Kristi Geris on February 19, 2015 (Item I). *(Note: A corrected final report was distributed on February 24, 2015.)*
- The final 2015 Wells HCP Action Plan was distributed to the Hatchery Committees by Kristi Geris on February 27, 2015 (Item II-A).
- The final 2015 Rocky Reach and Rock Island HCP Action Plan was distributed to the Hatchery Committees by Kristi Geris on February 27, 2015 (Item III-A).
- The final YN Upper Methow Acclimation Study Proposal and Goat Wall SOA were distributed to the Hatchery Committees by Kristi Geris on March 9, 2015 (Item IV-B).

I. Welcome

A. Review Agenda, Review Last Meeting Action Items, Approve the January 21, 2015 Meeting Minutes (Mike Schiewe)

Mike Schiewe welcomed the Hatchery Committees and asked for any additions or changes to the agenda. Mike Tonseth added an update on surplus juvenile Methow spring Chinook salmon at Methow FH.

The Hatchery Committees reviewed the revised draft January 21, 2015 meeting minutes. Three items were discussed as follows:

- Regarding the YN's Upper Methow spring Chinook salmon acclimation proposal discussion, Greg Mackey requested that Tonseth clarify a statement that he made regarding how to measure success. Tonseth suggested striking his comment, as it did not add anything new to the discussion.

- Regarding Chelan PUD's Methow Sharing Agreement discussion, Keely Murdoch clarified that the discussion was not only about Carlton Pond, but also about overwintering in the Chewuch Pond, which was corrected throughout the discussion.
- Tom Kahler noted a few minor grammatical edits that were corrected.

Geris will incorporate the edits, as discussed, into the revised minutes. She said that all other comments and revisions received from members of the Committees have been incorporated into the revised minutes. Kirk Truscott requested additional time for review, and will provide his edits and approval via email to Geris by Thursday, February 19, 2015. The Hatchery Committees members present approved the draft January 21, 2015 meeting minutes, as revised. *(Note: Truscott provided the CCT's approval of the revised draft minutes via email to Geris on February 19, 2015, which Geris distributed to the Hatchery Committees than same day.)*

Action items from the Hatchery Committees meeting on January 21, 2015, and follow-up discussions were as follows (italicized item numbers below correspond to agenda items from the meeting on January 21, 2015):

- *Chelan PUD, Douglas PUD, Grant PUD, and WDFW will coordinate on actions needed to finalize the Hatchery M&E Plan Appendices (Item I-A).*
  Alene Underwood said that Chelan PUD reviewed the draft appendices. She suggested identifying actions needed to finalize the appendices, and said that Chelan PUD will coordinate with Douglas PUD, Grant PUD, and WDFW and will report back to the Hatchery Committees during the next Hatchery Committees meeting on March 18, 2015.
- *Mike Tonseth will incorporate Chelan PUD's edits into the revised draft 2014 Wenatchee Basin Steelhead Release Strategy, and will provide the revised document to Kristi Geris for redistribution to the Hatchery Committees (Item I-A).*
  Tonseth provided an updated strategy to Geris on January 23, 2015, which Geris distributed to the Hatchery Committees that same day.
- *Hatchery Committees representatives will review and submit edits on the draft Wells 2015 HCP Action Plan to Douglas PUD prior to the next Hatchery Committees meeting on February 18, 2015 (Item II-A).*
  This will be discussed during today's meeting.

- *Chelan PUD will provide a draft Rocky Reach and Rock Island 2015 HCP Action Plan to Kristi Geris for distribution to the Hatchery Committees and discussion during the February 18, 2015 meeting (Item II-A).*
  Alene Underwood provided the draft plan to Geris on January 27, 2015, which Geris distributed to the Hatchery Committees that same day. This will be discussed during today's meeting.
- *The YN will incorporate updates on kelt sampling at Wells Dam into the monthly kelt reconditioning updates that are routinely distributed to the Hatchery Committees (Item IV-A).*
  Keely Murdoch said that the YN will complete this item, as discussed, once fish arrive on station, which is when the YN starts generating the monthly reports.
- *The YN will coordinate with Charlie Snow (WDFW) on drafting a kelt sampling protocol for Wells Dam, and will provide the protocol to Kristi Geris for distribution to the Hatchery Committees (Item IV-A).*
  Keely Murdoch said that Matt Abrahamse (YN) is drafting the protocol, which will be in place prior to sampling that will start as early as August 2015. Tom Kahler noted that Douglas PUD presents a full list of trapping activities at Wells Dam to the HCP Coordinating Committees by mid-April. Murdoch said that she will coordinate internally with the YN staff and with Charlie Snow (WDFW) on drafting the kelt sampling protocol for Wells Dam by April 15, 2015. The YN will provide the draft protocol to Kristi Geris for distribution to the Hatchery Committees.
- *Chelan PUD will provide a summary report on the water recirculation pilot studies at Eastbank FH and Chiwawa Fish Facility to Kristi Geris for distribution to the Hatchery Committees for discussion during the Hatchery Committees meeting on February 18, 2015 (Item V-A).*
  Alene Underwood said that she will provide this report today. *(Note: Underwood provided the final report to Geris following the meeting on February 18, 2015, which Geris distributed to the Hatchery Committees on February 19, 2015; a corrected final report was distributed on February 24, 2015.)*
- *Mike Tonseth and Kirk Truscott will coordinate with Pat Phillips (Chief Joseph Hatchery Manager), and Keely Murdoch will coordinate internally with the YN, regarding the disposition of surplus juvenile Methow spring Chinook salmon at Eastbank FH (Item V-B).*

This will be discussed during today's meeting.

- *Lynn Hatcher will provide a Hatchery and Genetic Management Plan (HGMP) consultation update following the next joint NMFS/USFWS Biological Opinion (BiOp) Coordination Meeting to Kristi Geris for distribution to the Hatchery Committees (Item V-C).*

  Hatcher provided an update to Geris on January 30, 2015, which Geris distributed to the Hatchery Committees that same day.
- *The YN will coordinate with Douglas PUD and Chelan PUD to develop a revised draft Upper Methow Spring Chinook Acclimation Proposal, and will provide the revised proposal to Kristi Geris for distribution to the Hatchery Committees (Item V-D).*

  Keely Murdoch provided a revised proposal to Geris on February 6, 2015, which Geris distributed to the Hatchery Committees that same day. This will be discussed during today's meeting.
- *Chelan PUD will provide the draft Wenatchee spring Chinook salmon re-initiation of Endangered Species Act (ESA) consultation documents that will be discussed during the next joint NMFS/USFWS BiOp Coordination Meeting to Kristi Geris for distribution to the Hatchery Committees (Item V-E).*

  Alene Underwood provided these documents to Geris following the meeting on January 21, 2015, which Geris distributed to the Hatchery Committees that same day.

II. Douglas PUD

A. DECISION: Draft 2015 Wells HCP Action Plan (Greg Mackey)

Greg Mackey said that a revised draft 2015 Wells HCP Action Plan was distributed to the Hatchery Committees by Kristi Geris on February 6, 2015. Mackey said that no comments were received from Hatchery Committees representatives on the draft plan. Tom Kahler said that the HCP Tributary Committees approved the tributary portion with minor modifications, and Mike Schiewe said that the full plan will be considered for approval during the HCP Coordinating Committees meeting next week. The Hatchery Committees representatives present approved the hatchery portion of the 2015 Wells HCP Action Plan, as revised. *(Note: the final plan was distributed to the Hatchery Committees by Geris on February 27, 2015.)*

III. Chelan PUD

A. DECISION: Draft 2015 Rocky Reach and Rock Island HCP Action Plan (Alene Underwood)

Alene Underwood said that the draft 2015 Rocky Reach and Rock Island HCP Action Plan was distributed to the Hatchery Committees by Kristi Geris on January 27, 2015. Underwood said that no comments have been received from Hatchery Committees representatives on the draft plan. She reviewed the hatchery portion, as follows:

- **2014 Hatchery M&E Report**
- **2016 Hatchery M&E Work Plans:** These are the annual implementation plans.
- **Dryden Water Quality Monitoring (Year 4):** Chelan PUD committed to six actions to check-in on feasibility for meeting phosphorus total maximum daily load (TMDL) requirements.
- **Dryden Overwintering Feasibility and TMDL Check-In:** This plan developed in 2012 is scheduled to begin this summer.
- **Summer Chinook Size Target Study (Year 2):** This study, completed in conjunction with Grant PUD, will continue all year with a final report scheduled for December 2015.
- **Chelan Falls FH Rehabilitation Design:** This is for the office building only (no program changes). The office building is more than 60 years old. Construction is scheduled to start in 2016 and will be completed in 2 years.
- **Chiwawa Acclimation Facility Office Rehabilitation Construction:** This is for the building only (no program changes). Construction will include increasing office space and electrical capacity, and adding sleeping quarters. Construction is scheduled to start in April 2015.
- **Eastbank FH Office Rehabilitation Construction:** This is for the office building only (no program changes). The current building does not meet the needs of the staff.
- **Tumwater Fishway Concrete Repair:** Repairs began yesterday. The Rocky Reach Fish Forum is on site today while the fishway is dewatered. Repairs are scheduled to be complete by March 3, 2015. There will be no fish passage throughout the duration of the repairs; this was reviewed with the HCP Coordinating Committees last month.
- **Hatchery Program Broodstock Collection**
- **Hatchery Releases**

Kirk Truscott asked about potential risks to critical infrastructure supporting production during construction at Chelan Falls FH, Chiwawa Acclimation Facility, and Eastbank FH. Underwood said that construction is phased so that backup generators will not be offline until fish are released. The Hatchery Committees representatives present approved the hatchery portion of the 2015 Rocky Reach and Rock Island HCP Action Plan. *(Note: the final plan was distributed to the Hatchery Committees by Geris on February 27, 2015.)*

B. Chelan PUD Methow Spring Chinook Hatchery Production Obligation (Alene Underwood)

Alene Underwood presented a draft Chelan PUD Methow Spring Chinook Hatchery Production Obligation SOA (Attachment B), which she will provide to Kristi Geris for distribution to the Hatchery Committees. *(Note: Underwood provided the draft SOA to Geris following the meeting on February 18, 2015, which Geris distributed to the Hatchery Committees on February 19, 2015.)*

Underwood said that the draft SOA indicates that Chelan PUD will enter into an Interlocal Agreement (ILA) with Douglas PUD for the purpose of meeting Chelan PUD's hatchery production obligations for Methow spring Chinook salmon, which would include obtaining spring Chinook salmon broodstock from Wells Dam and Methow Hatchery, and holding and spawning of adults, incubation, and rearing at Methow FH. She added that final acclimation (i.e., spring acclimation) is not included in the ILA but may include the use of the Douglas PUD-owned Chewuch Pond or other remote acclimation sites.

Craig Busack asked if this SOA restores Chelan PUD production to the same status as during the previous Methow Hatchery Sharing Agreement (which was terminated in 2013). Underwood said that is correct, except for the acclimation portion. Keely Murdoch said that, as mentioned during the last Hatchery Committees meeting, the YN appreciates the effort made between Chelan PUD and Douglas PUD to reach agreement; however, the YN has concerns with the proposed ILA. She said that, as described in a comment letter from the YN regarding a possible Chelan PUD/Douglas PUD sharing agreement (Attachment C) that was distributed to the Hatchery Committees by Geris on February 6, 2015, the YN views this ILA as the path of least resistance. Murdoch noted that many years of data document unacceptably high 'stray rates,' or failure to home, for spring Chinook salmon reared at Methow FH and acclimated at Chewuch Pond. She recalled that when the Hatchery

Committees first discussed overwintering at Carlton Pond and release at Chewuch Pond, this was considered a potential benefit for improved homing to the Chewuch River. She suggested testing rearing at Eastbank FH, overwintering at Carlton Pond, and final acclimation at Chewuch Pond before Chelan PUD's program returns at Methow FH and acclimating at Chewuch Pond, where there are known "straying" problems for Chewuch-acclimated fish.

Busack said that he thought the YN's comment letter (Attachment C) was about survival rates. Murdoch said that survival rates are discussed in the letter; she recalled the presentation that Chelan PUD gave on circular rearing tanks during the last Hatchery Committees meeting on January 21, 2015, where there appeared to be several benefits of circulars for summer Chinook salmon. She said that at Carlton Pond, fish would be overwintered in circulars, and she suggested that there may be those same benefits for spring Chinook salmon. Busack asked whether Murdoch was implying that Methow FH was a poorly performing hatchery, or whether she was suggesting that survival might be higher in circular tanks at Carlton. Murdoch said it was the latter, but noted that it would take more than 1 year of data to establish. Busack said that he thought the YN was arguing that survival at Methow FH was chronically low, and Murdoch clarified that existing data indicates that smolt-to-adult return rates (SARs) for Methow-reared Chewuch-acclimated fish are low, as are SARs for other spring Chinook programs in the Methow Basin. Busack asked if Chewuch-acclimated survival is lower than for Methow-released fish. Murdoch said that is correct. Busack asked if Murdoch was talking about fish returning to the area of the river right next to the hatchery, and Murdoch said she is referring to fish not returning to the Chewuch. Tom Scribner said that the YN is trying to establish acclimation sites where they want fish to return, and added that it is a moot point if these fish are just returning to the hatchery where there were reared. Busack asked what the issue was with fish returning to their basin of origin. Murdoch said that the YN are not talking about a genetic stray; rather, they are referring to fish not returning to a target location (e.g., the Chewuch).

Underwood noted that Chelan PUD has an agreement with Grant PUD to share their new facility at Carlton, which includes eight circular tanks. She said, however, that there have been some fish health issues in one of the tanks, and Chelan PUD does not want to use the facility if lower densities will help Grant PUD's production. Todd Pearsons (Grant PUD) said that Grant PUD has not yet discussed the potential costs/benefits of effects of having Chelan PUD fish on-station related to rearing densities. Mike Tonseth noted that there are a lot of moving parts that would need to be addressed. He said that simply moving fish to Carlton in circulars in the near-term may improve SARs; however, it may come at a great cost in the Twisp River because Carlton-acclimated fish would have been exposed to Twisp water and may stray into the Twisp. Murdoch reiterated that data indicate that rearing at Methow FH and acclimating at Chewuch Pond is not working well, and she noted that attraction to the Twisp River remains unknown; therefore, she recommended that Carlton would be a good option for a short-term test. Tonseth cautioned, however, that all possible risks need to be considered. Greg Mackey said that strays from the Chewuch are about 43% on average, so clearly a lot of fish are returning to the Methow. He said that Methow FH releases have higher SARs than for fish transferred and acclimated at the Chewuch or Twisp ponds, so it seems to be something related to acclimation that is reducing survival of these fish; he said that it may be the physical stress associated with transferring them. He added that Twisp fish stray to the Methow Basin; however, at a lower rate than to the Chewuch, likely because the fish encounter the Twisp River prior to getting close to the Methow FH and Winthrop National Fish Hatchery (NFH) reach, which is immediately upstream of the Chewuch River. He also noted that fish reared at Eastbank FH and acclimated at Carlton and then Chewuch would first encounter the Eastbank FH outfall in the Columbia River, and presumably, some fish would be attracted there. He added that the next closest river is the Entiat River, and the proximity to Eastbank FH makes it likely that some fish would enter the Entiat River resulting in out-of-basin straying. He said that the fish would then encounter the Carlton Pond area of the Methow, where they were reared for a period of time, and would possibly be attracted there, as well as the Twisp River, prior to returning to the Chewuch River. He also added that, in addition, these fish would experience two transfers; which, given what has been observed for Methow FH fish transferred to acclimation ponds, would be likely to negatively affect their SARs.

Busack asked if Chelan PUD can draft the SOA with enough flexibility that Chelan PUD is not locked into a particular acclimation site. Underwood said that it is, noting that the draft SOA contemplates everything but final spring acclimation. Busack asked about rearing at Methow FH with extended acclimation at Carlton. Underwood said that is feasible;

however, it would require Chelan PUD to fund Douglas PUD for Methow FH and Grant PUD for Carlton. She said duplicate funding would be difficult to justify.

Busack asked Murdoch what the benefits are for rearing at Carlton. Murdoch explained that fish are moved off of Eastbank in the fall of the first year, which would theoretically minimize imprinting. She said that by fall, fish would be overwintering at Carlton, so they are in the Methow Basin all winter long, which should maximize imprinting. She said that when fish return, Carlton is not operating so fish would not home there. She added that based on results with coho salmon, there is a good chance to increase homing fidelity to the Chewuch.

Underwood said that if return data indicate 43% homing to the Methow, Chelan PUD would rather have fish return to the Methow than the Twisp or Entiat rivers. She said that because Chelan PUD is a permit applicant, they have to deal with these adults when they come back. She also noted that fish returning to the Methow are not technically strays; they are supplementing the Methow sub-basin population. Murdoch agreed with Chelan PUD regarding not wanting fish returning to the Twisp or Entiat rivers. Underwood clarified that Chelan PUD did not have a specific obligation to supplement the Chewuch River, only the Methow sub-basin spring Chinook population. Murdoch acknowledged this statement but added that the YN, as co-managers, have the desire to supplement individual tributaries to improve spawning distribution in the Methow sub-basin. Scribner added that there seems to be a difference in philosophy regarding achieving recovery. He said that it is not acceptable to the YN for fish to simply return to habitat directly in front of a fish hatchery. Busack said that he is supportive of trying new methods, and that he also does not like fish piling up in front of fish hatcheries; however, he said that his issue is this kaleidoscope of changing situations. He said that from a permitting perspective, the number of questions and level of experimentation being proposed is difficult to codify. Scribner asked if Busack was implying that the only option in permitting is to return to the status quo; Busack indicated that was not his intent. Scribner asked how much adaptive management can be included in the permits. Busack explained that as more flexibility is included in the permits, more analyses are required, which is the reason he wanted to hear more on this topic.

Kirk Truscott said that he understands that Chelan PUD is proposing what they thought the Hatchery Committees wanted. He said that regarding summer Chinook salmon circular rearing, he agrees with Murdoch that there may be smolt survival and age-at-return benefits with circulars. He said that he is concerned, however, with early rearing at Eastbank rather than in the Methow Basin because the fish may cue on Eastbank water. He said that he also shares Tonseth's concern regarding the potential impact to the Twisp River; however, Truscott suggested this might be managed with a coded wire tag. Mackey noted, however, that the Twisp Weir is not highly effective during the spring Chinook migration when the water is high and cannot be fished at all for extended periods of time at high flows. Truscott recalled discussing during the last Hatchery Committees meeting the possibility of a paired release study where half of the fish are overwintered at Carlton and the other half at Methow FH. He said that an assessment of smolt survival by brood year and population straying could be conducted using passive integrated transponder (PIT) tags. He acknowledged that this may not be feasible pending funding and permitting approval. Schiewe asked Truscott if the CCT would support early rearing at Eastbank, and Truscott replied that they would not.

Underwood noted that the program is only about 60,000 fish, and questioned whether that number in a paired test would produce statistically rigorous results to inform a decision. Murdoch noted that the YN had similar concerns with their Upper Methow Proposal, but are going forward with collecting whatever information they can. Truscott also noted that in a 5-year period only smolt survival data could be collected, and not SARs. Bill Gale added that the sample size also is not large enough to address questions about spawner distribution.

Tonseth agreed with Truscott regarding not supporting early rearing at Eastbank. However, he said that Carlton Pond could be considered a possibility. He summarized the YN is concerned with low numbers of fish returning to the Chewuch, and also regarding suboptimal SARs. He suggested reviewing the literature regarding what is being done and what the Hatchery Committees can implement to address those issues. He suggested reviewing Andy Dittman's (NMFS) work on eyed-egg imprinting, or reviewing literature on homing fidelity. Tonseth said that reshuffling fish within the basin is not going to solve anything. He also said that 15 to 20 days of late-term imprinting is not going to result in extremely high homing fidelity to the Chewuch. He suggested that the Hatchery

Committees investigate other options, while carefully avoiding elevating risk in other areas (e.g., in the Twisp and Entiat rivers).

Underwood said that the ILA has not yet been signed by Chelan PUD and Douglas PUD; however, the PUDs are coordinating on concepts and both PUDs are on board and planning accordingly. She said that the 2015 Broodstock Collection Protocols are written as if the ILA is in place (i.e., broodstock collection at Wells Dam). Schiewe asked when spring Chinook salmon broodstock collection starts at Wells Dam, and Matt Cooper said that it begins in May. Schiewe summarized that the Hatchery Committees have had a robust discussion and he asked Chelan PUD if they are proposing any changes to their SOA. Underwood said that they are not. Murdoch said that the YN will need to discuss the SOA further, and she noted that the YN are currently not prepared to approve the SOA with rearing at Methow FH. She asked if May is a deadline for approval, and Underwood said that approval will be needed soon in order to finalize the ILA between Chelan PUD and Douglas PUD. Truscott asked if there is an option to have two ILAs: one for a paired release test for comparing overwintering at Carlton versus the Methow FH, and one for overwinter rearing at Methow FH only. Underwood said that Chelan PUD would need to discuss this with Douglas PUD.

Truscott suggested that if there is much better smolt survival, the path forward could be to move the entire 223,000 conservation-based fish to a circular rearing strategy. Busack noted that with Carlton, there are three things being tested at once (i.e., circulars, acclimation, and the facility), so it will be difficult to discern which component is causing the change. Murdoch said that it may be a combination of the three, and she also noted that there are existing data to help make an informed decision.

Schiewe suggested that Chelan PUD distribute the Methow Spring Chinook Hatchery Production Obligation SOA for consideration next month.

C. Summer Chinook Salmon Size Target Study (Alene Underwood)

Alene Underwood said that this release year will be the final year of the Summer Chinook Size Target Study. She said that Chelan PUD plans to meet with NMFS Science Center staff next week to discuss a path forward, which will then be discussed with the Hatchery Committees during the next Hatchery Committees meeting on March 18, 2015.

D. Wenatchee Spring Chinook Salmon Permit Re-initiation Letter (Alene Underwood)

Alene Underwood said that a revised draft Wenatchee spring Chinook salmon permit re-initiation letter was distributed to the Hatchery Committees by Kristi Geris on February 17, 2015. Underwood said that the revised draft letter included edits and comments received from Mike Tonseth and Amilee Wilson (NMFS). Underwood recalled that NMFS requested this letter as a formality, and Chelan PUD thought it would be most appropriate for the letter to come from the Hatchery Committees and PRCC HSC. She asked, to this end, if signatures would be needed on the letter, and from whom. She also noted that Chelan PUD has received a revised draft Supplemental BiOp for this program.

Kirk Truscott noted that in the past, the Hatchery Committees sent a similar letter indicating unanimous consent from the Chair on behalf of the Committees. Craig Busack said that he thinks that should suffice, and suggested sending a printed copy via the U.S. Postal Service.

Bill Gale asked what level of content regarding USFWS consultation should be included in this letter. Tonseth said that this letter will be filed, and is also cited consistently throughout the revised BiOp; and through that, USFWS consultation is discussed extensively. Gale asked if Karl Halupka (USFWS) has reviewed this letter. Lynn Hatcher said that Halupka has attended meetings where this letter has been discussed and he has not raised any concerns. Busack said that he thinks the letter is fine as written.

The Hatchery Committees and PRCC HSC representatives present agreed that Mike Schiewe will submit the Wenatchee Spring Chinook Permit Re-initiation Letter to NMFS on behalf of the Hatchery Committees and PRCC HSC.

Gale asked if the letter needs to come from the Hatchery Committees or just the applicants. Underwood said that having the letter come from the Hatchery Committees was her idea because it was the Hatchery Committees who chose the program change. Busack asked Gale if there was an issue with having the letter come from the Hatchery Committees. Gale said he only wants to make sure Halupka has sufficient latitude to conduct his consultation. Underwood said that there is no tight deadline to send this letter, and Gale requested additional time for review. Hatchery Committees representatives will submit edits and comments on the revised draft Wenatchee Spring Chinook Permit Re-initiation Letter to be sent to NMFS from the Hatchery Committees to Underwood by Friday, February 27, 2015.

The Hatchery Committees representatives present also approved the Wenatchee Spring Chinook Permit Re-initiation Letter to NMFS from the Hatchery Committees, on condition that no substantive revisions are made following the 1-week review period.

IV. YN

A. Discussion of Hatchery Committees Roles and Responsibilities (Keely Murdoch)

Keely Murdoch said that she became concerned that the Hatchery Committees may be exceeding their responsibilities when discussing the draft YN Upper Methow Spring Chinook Acclimation Proposal at the last meeting. She said that the Hatchery Committees are occasionally asked to make management decisions that are the purview of the fishery co-managers; she noted that when the YN signed the HCPs they did not forfeit authority as a co-manager. She said, for example, that the number of fish the YN want returning to spawning grounds or where to release fish are resource management issues. She suggested that as the Hatchery Committees incorporate an adaptive management framework into HCP studies, they also clearly delineate which issues are the responsibility of the Hatchery Committees and which are not.

Mike Schiewe noted that the HCPs include explicit language that outlines the roles and responsibilities of the Hatchery Committees that each of the signatories agreed to guide their participation. He said that to encourage collaboration, each of the signatories agreed that each party to the HCPs has a single vote and Hatchery Committees' approval requires unanimous consent. Murdoch said, however, that there are some decisions that are not Hatchery Committees decisions. She said, for example, when NMFS signed the HCPs they did not forfeit regulatory authority. Schiewe agreed, and added similarly that issues such as harvest management and disposition of surplus HCP mitigation fish were examples of issues the Hatchery Committees deferred to the co-managers. He said, however, that implementing the HCP hatchery programs has always been the purview of the Hatchery Committees, and he recommended reviewing Hatchery Committees roles and responsibilities as outlined in the HCPs.

B. YN Upper Methow Spring Chinook Salmon Acclimation (Keely Murdoch)

Revised Draft Proposal

Keely Murdoch said that a revised draft YN Upper Methow Spring Chinook Acclimation Proposal was distributed to the Hatchery Committees by Kristi Geris on February 6, 2015. Murdoch said that the revised draft proposal was also vetted through the Joint Fisheries Parties. She said that comments on the revised draft proposal were received from the CCT (Attachment D) and Chelan PUD on February 17, 2015, and that the CCT also provided comments on the draft SOA (Attachment E). She said that Douglas PUD also provided minor grammatical comments on the draft proposal. *(Note: Murdoch provided comments received from Chelan PUD and the CCT to Geris following the meeting on February 18, 2015, which Geris distributed to the Hatchery Committees on February 19, 2015.)*

The Hatchery Committees reviewed comments on the revised draft proposal, as follows:

Table 1 – Target Minimum Spawner Abundance (CCT comment [see KT1 in Attachment D])
Kirk Truscott asked if it may be helpful to include data that detail the relative amount of habitat available. Murdoch suggested, instead, renaming the column header to "Estimated Minimum Spawner Abundance." Truscott agreed, noting that "Target Minimum Spawner Abundance" might be misinterpreted.

General Comment (NMFS comment)
Craig Busack noted that any acclimation sites that may be used in this study need to be clearly spelled out in the proposal. He added that the sites can only be those that have already been analyzed in a current BiOp. Murdoch said that Early Winters Pond was previously included in the proposal; however, it was removed as requested by the Hatchery Committees. Greg Mackey said that he wanted to limit switching sites after starting a trial unless an unanticipated problem arose; he said that under an adaptive management framework, it is important to test a site long enough to observe patterns. Murdoch said, however, that as noted under the proposal's uncertainties, Goat Wall Pond has never been used before and if something goes wrong, Early Winters Pond is nearby and may be a useful switch, if needed. Tom Scribner said that Early Winters Pond is not covered under an existing BiOp; Murdoch added that the YN is hoping that all coverage will be in place when the new permits are issued. Murdoch suggested keeping the proposal focused on Goat Wall

Pond, and then including a section on alternate sites in an appendix, with details on Early Winters Pond. Busack said that how the proposal is organized is up to the YN. Busack added that explicit language would need to be included that details what would cause a switch to another site.

General Comment (YN comment)
Scribner asked if the Hatchery Committees are proposing to acclimate at Goat Wall Pond for 5 years before expansion of the program. Truscott explained that the Hatchery Committees agreed that this is a research proposal to be implemented for 5 years, and based on the results, an assessment will be made on whether there is a reason to expanding the action. Scribner said that he was unaware that expansion of the program would need to wait 5 years. Mackey said that this proposal does not completely preclude the YN from expanding their acclimation program. He added that the proposal was initially for 1 year; however, he had recommended implementing the action for 5 years in order establish a stable program and to obtain more useful data. Murdoch added that the statistical power of a test using only 25,000 fish was also discussed, but considering the proposed sliding scale of percent hatchery-origin spawners (pHOS) (currently in consultation), it is hard to propose releasing more fish until it is better understood what proportion of fish will return to the hatchery. Lynn Hatcher suggested including language indicating that the program will be evaluated for 5 years; however, it may be modified pending Hatchery Committees review and approval.

Goat Wall Acclimation Site (CCT comment [see KT2 in Attachment D])
Truscott asked about including flow data to the proposal during the proposed acclimation period (i.e., March to mid-April). Murdoch said that she can obtain those data from Cory Kamphaus (YN).

General Comment (NMFS comment)
Busack suggested introducing the study proposal earlier in the document. Murdoch said that she will rearrange the document, as suggested.

Release Monitoring and In-Pond Survival (CCT comment [see KT3 in Attachment D])
Truscott suggested including language explaining what action will be taken in the event that in-pond survival is poor. Murdoch said that the YN expect that in-pond survival will be

lower than in-hatchery survival; however, she expects faster migration times and higher survival in the migratory corridor. She said that juvenile survival will be evaluated based on estimated survival to McNary Dam. Truscott said that the CCT are supportive of this, as long as in-pond survival data are still collected.

Smolt-to-Adult Survival (CCT comment [see KT4 in Attachment D])
Truscott recalled that the Chelan PUD Hatchery M&E Reports evaluate SARs with and without harvest; so, to be consistent with the M&E reports, he suggested measuring SARs back to the Methow Basin, as opposed to the mouth of the Columbia River. Murdoch said this will be accommodated.

Draft SOA
The Hatchery Committees reviewed the CCT's comments on the draft SOA (Attachment E). Truscott explained that his edits were intended to ensure an annual review of these data, with the Hatchery Committees agreeing that if the level of in-pond survival is not acceptable, the YN must provide an acceptable remedial action. Murdoch suggested revising "in-pond survival" to "juvenile survival." Mackey suggested, for clarity, including the year in which the last group will be released. The Hatchery Committees suggested edits to the CCT's comments, which were distributed to the Hatchery Committees by Geris on February 19, 2015 (Attachment F).

Bill Gale asked if the SOA should identify a date when a final report will be completed. Murdoch said that after 5 years of acclimation and releases, the YN can provide a 5-year summary. She added, however, that all data (e.g., SARs) for a final report will not be available until 2023, which means that after 5 years, the Hatchery Committees may need to make a decision on a path forward based on incomplete data. Alene Underwood suggested syncing a final report with the annual Hatchery M&E Reports.

Murdoch said that the YN will provide a revised draft YN Upper Methow Spring Chinook Acclimation Proposal and revised SOA to Geris for distribution to the Hatchery Committees by Friday, February 20, 2015. Hatchery Committees representatives will submit their approval, disapproval, or abstention via email to the YN (with a copy to Geris) by Wednesday, March 4, 2015. *(Note: the final draft proposal and SOA were distributed to the*

Hatchery Committees on February 20, 2015, as discussed; and the Hatchery Committees approved the proposal and SOA, with NMFS abstaining, as follows: the YN approved on March 3, 2015, NMFS abstained on March 3, 2015, Chelan PUD, Douglas PUD, WDFW, and the CCT approved on March 4, 2015, and USFWS approved on March 5, 2015.)

The final YN Upper Methow Acclimation Study Proposal and Goat Wall SOA were distributed to the Hatchery Committees by Kristi Geris on March 9, 2015.

V. Chelan PUD and WDFW

A. Draft 2015 Steelhead Release Plan (Catherine Willard and Mike Tonseth)

Catherine Willard said that the draft 2015 Steelhead Release Plan (Attachment G) was distributed to the Hatchery Committees by Kristi Geris on February 17, 2015. Willard noted that Chelan PUD and WDFW drafted this plan together. She said that the background section includes a description of the Chiwawa Acclimation Facility, as well as an explanation of the 'screening' method (historically referred to as the volitional method) used to differentiate between putative active migrants and non-active migrants. She said that release strategy objectives include evaluating best hatchery management practices for hatchery releases to optimize homing fidelity, minimize residualism, maximize out-migration survival, and minimize negative ecological interactions. She reviewed Table 1 in Attachment G, noting the paired release design by vessel type, brood origin, and release sites. She noted that Raceways 1 (RCY1) and 2 (RCY2) are located adjacent to each other, and a gate opens allowing fish to move between the raceways. She explained further that a net will be installed in RCY2, dividing it into two sections with the intent that the one side (outer) will be non-screened fish and the other side (center) will be potentially screened fish. She said that once a predetermined number of fish move from RCY2 to RCY1, those fish will be trucked and planted at the specified release locations. She said that the same thing will be done with the non-screened fish (non-active migrants). She also noted that each variable will be evaluated to determine whether the screening method is effective.

Bill Gale asked what survival metrics will be evaluated, and Willard replied that survival to McNary Dam will be evaluated. She said that fish detected in the system after July 1 will also be monitored. Gale asked if a power analysis has been conducted, and Willard said that Dr. John Skalski conducted an analysis, which indicated at least 80% confidence. Gale asked if Chelan PUD plans to evaluate early maturation, and Willard said that WDFW was planning to. Gale recommended that Chelan PUD and WDFW consult with Don Larsen (USFWS) about evaluating early maturation in steelhead, which Gale indicated can be difficult. Gale added that USFWS has been working on this at Winthrop NFH, and encouraged Chelan PUD and WDFW to review available Bonneville Power Administration reports. Mike Tonseth said that WDFW plans to coordinate with Larsen and others on what protocols have been implemented so that efforts are consistent with other locations.

Willard noted that in 2013, Chelan PUD observed that longer screening was associated with negative survival (i.e., later outmigration equaled lower survival). She said that based on the 2013 study and other literature, Chelan PUD and WDFW are proposing to terminate screening and have everything outplanted by May 8, 2015. Gale asked if Chelan PUD and WDFW have considered selecting index sites downstream of the release locations and conducting snorkel surveys or mark recapture. Tonseth said that mark recapture in the Wenatchee River has been attempted in the past; however, the system is too big to be effective. He added that regardless of where fish are released, it is believed that they all eventually end up in the mainstem Wenatchee River, so snorkel surveys and mark recapture are not feasible.

Tonseth said that this release plan presents the opportunity to implement measures, in compliance with existing permits, that attempt to minimize residualism. Keely Murdoch said that it is not clear what metrics are being evaluated to determine if there is a problem. She asked if there will be any post-release monitoring, such as comparative detection rates after July 1 between screened and non-screened fish. Tonseth said that those metrics will be monitored and evaluated.

Kirk Truscott asked, regarding the circulars and raceways, if all remaining fish will be forced out by May 8, 2015, regardless of screened or non-screened fish. Tonseth said that is correct with the exception of the 28,196 hatchery-by-hatchery fish destined for Blackbird, which will be full-term volitional through early June 2015.

Gale asked if there will be PIT-tag detection in the rearing vessels to monitor movement, and Tonseth said that there will be. Gale suggested monitoring diurnal movement, which he noted can be a key indicator of migrant status. Tonseth said that the primary migrant metric proposed in this plan is survival to McNary Dam, but he said that diurnal movement can also be considered.

Gale asked about transferring apparent non-migrants to resident fisheries as opposed to release in the anadromous zone. Murdoch said that the YN has concerns with this strategy. She added that in 2013, Chelan PUD presented data that evaluated in-basin detection rates where no difference was observed between volitional and forced fish (regarding tendencies to residualize). She suggested conducting further evaluations before assuming that fish in the forced group are more likely to residualize. Tonseth noted that evaluating the proposed screening method will help inform this question. Gale said that work conducted by WDFW, USFWS, and others strongly suggests that fish likely to residualize can be identified with relatively high probability; he added that it is unlikely that residuals effectively contribute to the steelhead population. He asked, then, why run the risk of releasing apparent non-migrants in an anadromous zone and potentially impacting wild fish. He also noted that very few non-migrants are subsequently detected as second-year smolts. Alene Underwood said that Chelan PUD and WDFW have spent considerable time discussing this topic with NMFS, who ultimately decided that as long as Chelan PUD implements a residual minimization plan by 2015, from NMFS' perspective, the risk of releasing potential residuals in the anadromous zone is acceptable.

Tonseth said that at this point, the plan is to generate data. Mike Schiewe encouraged members to submit comments on the test, not debate the merits of where to plant at this time. Hatchery Committees representatives agreed to submit edits and comments on the draft 2015 Steelhead Release Plan to Tonseth and Willard by Wednesday, March 4, 2015. Tonseth said that approval of the plan will be requested during the next Hatchery Committees meeting on March 18, 2015.

VI. WDFW

A. Draft 2015 Broodstock Collection Protocols (Mike Tonseth)

Mike Tonseth said that the draft 2015 Broodstock Collection Protocols was distributed to the Hatchery Committees by Kristi Geris on February 6, 2015. He recalled that he requested a comment deadline of March 6, 2015, so that he could distribute revised protocols in time for review prior to the next Hatchery Committees meeting on March 18, 2015. He said that the only comments received to date have been from Grant PUD. He said that the draft protocols are largely consistent with what has been done in the past, with the exception of the Wenatchee spring Chinook salmon programs. He said that there will be another comment period following the Hatchery Committees meeting on March 18, 2015, but there will not be another Hatchery Committees meeting prior to the submission deadline of April 15. He recalled that the Hatchery Committees have already reviewed a preliminary draft of the new layout. He said that one new section is not included in the current draft that is out for review, which includes programs with ongoing studies (e.g., size-at-release studies).

Todd Pearsons asked what would happen if permitting is not in place in time for the Wenatchee spring Chinook salmon programs. Tonseth said that if there is delay in issuing the BiOp, broodstock collection would default to the protocols implemented in 2014. He added that he could include 'default' language and reference the 2014 Broodstock Collection Protocols. Pearsons said that he thinks this would be useful, and also suggested adding a deadline for making a decision to default back to the 2014 Protocols. Tonseth said that brood collection at Tumwater Dam begins June 1, 2015, and suggested default to the 2014 Protocols if the new permit is not issued by then. Pearsons said that Grant PUD will need more time than that to plan for staffing. Lynn Hatcher said that during the NMFS/USFWS BiOp Coordination Meeting on January 28, 2015, Amilee Wilson indicated that the permit will be issued by March 2015. Tonseth suggested that, alternatively, if the new permit is not issued by April 15, 2015 (submission deadline), then the Wenatchee spring Chinook salmon programs will default to the 2014 Protocols.

Pearsons asked about adult management, and Tonseth said that he will coordinate with Craig Busack regarding an adult management section in the draft 2015 Broodstock Collection Protocols.

Geris said that she will also distribute the draft 2015 Broodstock Collection Protocols to the Wells HCP Coordinating Committees for review, with comments due to Tonseth by Wednesday, March 6, 2015. *(Note: Geris distributed the draft protocols to the Wells HCP Coordinating Committees on February 19, 2015; the revised draft protocols were distributed to the Hatchery Committees and Wells HCP Coordinating Committees on March 12, 2015.)*

B. Surplus Juvenile Methow Spring Chinook Salmon at Methow FH (Mike Tonseth)

Mike Tonseth recalled that last month, he notified the Hatchery Committees of an overage of wild-by-wild (WxW) Methow spring Chinook salmon progeny at Methow FH, and that WDFW was considering incorporating the surplus progeny into the Chelan PUD program in order to boost the natural-origin recruit (NOR) component in that program. He said that at that time, the Hatchery Committees agreed to investigate where there might be capacity to absorb the overage. He said he was notified last week, however, of a possible bacterial kidney disease (BKD) outbreak in two of four tanks holding excess WxW progeny at Methow FH, affecting roughly half of the total excess fish (i.e., approximately 20,000 fish). He said that mortality spiked in Tanks 12 and 24, which the fish health specialist described as "moderately high losses." He said that fish health samples have been sent to a lab to determine putative severity of BKD infection. He said that hatchery staff are considering treatments; however, Tonseth noted that based on past experiences, if fish break early (as with these fish), there is a high likelihood all the fish in the affected tanks will become infected, which poses the potential for infecting the remainder of the production when those fish are combined with the rest of the population. He said that based on these experiences, the fish health specialist's initial recommendation was to cull the affected fish; however, she also recommended waiting to make a decision until Friday, February 20, 2015, when the lab test results come back. Tonseth said that if the affected fish are culled, this would leave only about 20,000 fish to be absorbed, which he was confident could be accommodated.

Jayson Wahls (WDFW) added that biosecurity at Methow FH has been increased, noting that most affected fish have been moved outside and the rest will be moved within 2 weeks. Kirk Truscott noted that even if there is no additional mortality, most fish hatchery facilities may not want to accept the fish because of their disease history.

VII. NMFS

A. HGMP Update (Lynn Hatcher and Craig Busack)

Lynn Hatcher said that a NMFS/USFWS BiOp Coordination Meeting was held on January 28, 2015, and the next meeting will be held on March 26, 2015. He said that the ongoing litigation involving Puget Sound hatchery programs has been causing major delays in permitting. Craig Busack said that he was just informed yesterday that NMFS is receiving funding to hire two additional staff to help with drafting permitting documents. He noted that these staff will not initially be able to help with the technical details; however, they can help write the non-technical sections, which will free him up to address the technical sections. Hatcher and Busack reviewed HGMP updates, as described in the following sections.

Wenatchee Spring Chinook Salmon

NMFS distributed the draft Wenatchee Spring Chinook Re-initiation BiOp, with comments due Friday, February 20, 2015, and completion expected in March 2015. NMFS directed WDFW to implement the broodstock collection protocol based on having the BiOp completed.

Leavenworth Spring Chinook Salmon

The target completion date is pending the ongoing litigation.

Wenatchee Steelhead

The Wenatchee Steelhead BiOp is undergoing final review.

Winthrop Safety-Net and Methow Conservation Spring Chinook Salmon

All genetics sections have been drafted, and are pending Busack's review. Busack said that he first needs to draft genetic sections for two early winter steelhead BiOps (one in the Lower Columbia River and one in the Puget Sound), which he expects will take him through March 2015; then in April 2015, he hopes to resume work on the Winthrop Safety-Net and Methow Conservation spring Chinook salmon programs. He said that his intention is to address both programs in one single Methow Spring Chinook Salmon BiOp in order to avoid segmentation (i.e., dividing the BiOp into smaller, less risky pieces). He said that NMFS is relying on the applicability of the 2003 National Environmental Policy Act process; however, another Environmental Assessment (EA) may be needed. He said that, per the PUDs' requests, he has developed draft Research, Monitoring, and Evaluation language that is consistent for all program operators to show sharing of responsibilities; this language has been sent to Bill Gale for review. He said that regarding gene flow management, consultation began with a preliminary agreement on a pHOS standard that was developed in 2003; however, an alternate plan has been developed using a proportionate natural influence

(PNI) standard. He said, however, that the PNI standard only involved PUD production—not USFWS production. He asked that the PUDs coordinate with USFWS to develop a PNI approach for applying a PNI standard to reduce the contribution of the Winthrop Program to pHOS. Busack said that he is also working to include YN remote site acclimation in the BiOp. Gale asked if the new hires could draft a new EA if one is needed, and Busack said that the new staff will not likely be hired for another 6 months, so he will probably be the person drafting a new EA.

Methow Steelhead

The Supplemental EA is nearly complete. A Fishery and Adult Management Plan is still needed. Mike Tonseth noted that he plans to draft the Fishery and Adult Management Plan.

Okanogan Steelhead

The CCT reviewed the first part of the draft EA, but the completion date is unknown. Kirk Truscott noted that without a new permit, the broodstock collection strategy remains unchanged from the previous permit, which means the CCT would not be able to increase the NOR contribution to their broodstock.

B. NMFS HCP Hatchery Committees Representation (Craig Busack)

Craig Busack said that he will replace Lynn Hatcher as the NMFS HCP Hatchery Committees representative following Hatcher's retirement. He noted that this may further delay permitting, and that NMFS is discussing finding support for Busack on the Committees.

VIII. USFWS

A. USFWS Bull Trout Consultation Update (Bill Gale)

Bill Gale said that Karl Halupka distributed the draft USFWS Wenatchee BiOp and Incidental Take Statement (ITS) for review. Alene Underwood said that Halupka requested edits and comments by the end of February 2015, which, Underwood noted, may be a difficult deadline to meet. Mike Tonseth said that the goal is to complete the USFWS Wenatchee BiOp and ITS at the same time as the NMFS Wenatchee Spring Chinook Salmon BiOp; however, he noted that he is not certain that those timelines will line up. Todd Pearsons asked if all critical information is included in this version, and Tonseth replied that some portions are still being drafted.

IX. HCP Administration

A. Lynn Hatcher's Retirement (Mike Schiewe)

Mike Schiewe and the Hatchery Committees thanked Lynn Hatcher for his contributions on the Hatchery Committees, and wished him a happy retirement.

B. New Hatchery Committees Chairperson – Tracy Hillman (Alene Underwood)

Alene Underwood welcomed Tracy Hillman, who was selected to replace Mike Schiewe as Hatchery Committees Chair after Schiewe retires at the end of April 2015. Underwood said that Hillman will shadow Schiewe during these last few months before Schiewe retires. Kristi Geris said that she will add Hillman to the Hatchery Committees email distribution lists, and will also contact Julene McGregor (Douglas PUD Information Systems Staff) to request access to the HCP Hatchery Committees Extranet site for Hillman. *(Note: Geris added Hillman to the appropriate distribution lists and sent an email to McGregor requesting access for Hillman, as discussed, on February 19, 2015.)*

C. Next Meetings

The next scheduled Hatchery Committees meetings are on March 18, 2015 (Douglas PUD); April 15, 2015 (Chelan PUD); and May 20, 2015 (Douglas PUD).

List of Attachments

Attachment A	List of Attendees
Attachment B	Draft Chelan PUD Methow Spring Chinook Hatchery Production Obligation SOA
Attachment C	YN Comments on a Chelan PUD/Douglas PUD Sharing Agreement
Attachment D	Revised Draft YN Upper Methow Spring Chinook Acclimation Proposal – CCT Comments
Attachment E	Draft Goat Wall Acclimation SOA – CCT Comments
Attachment F	Draft Goat Wall Acclimation SOA – Hatchery Committees Edits
Attachment G	Draft 2015 Steelhead Release Plan

Attachment A
List of Attendees

Name	Organization
Mike Schiewe	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman††	BioAnalysts, Inc
Alene Underwood*	Chelan PUD
Catherine Willard*	Chelan PUD
Greg Mackey*	Douglas PUD
Tom Kahler*	Douglas PUD
Todd Pearsons	Grant PUD
Peter Graf	Grant PUD
Lynn Hatcher	National Marine Fisheries Service
Craig Busack*††	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
Jayson Wahls	Washington Department of Fish and Wildlife
Kirk Truscott*	Colville Confederated Tribes
Keely Murdoch*	Yakama Nation
Tom Scribner*††	Yakama Nation

Notes:

*	Denotes Hatchery Committees member or alternate
†	Joined by phone
††	Joined for select agenda items

Rocky Reach and Rocky Island HCP Hatchery Committees
Statement of Agreement
Regarding Chelan PUD's Methow Sub-basin Spring Chinook Hatchery Production Obligation
Draft for Discussion **– February 18, 2015**

Statement

The Rocky Reach and Rock Island Habitat Conservation Plan (HCP) Hatchery Committees (HC) agree that that Chelan PUD should enter into an Interlocal Agreement (ILA) with Douglas PUD for the purpose of satisfying Chelan PUD's hatchery production obligations for Methow spring Chinook. Specifically, the HC agree that Chelan should obtain spring Chinook broodstock from Wells Dam and that holding and spawning of adults, incubation, and early rearing should occur at the Methow Hatchery. Final acclimation (spring acclimation) is not included in the ILA but may include the use of the Douglas PUD-owned Chewuch Pond or other remote acclimation sites, as further described in the *Hatchery Genetic Management Plan for Methow Sub-basin spring Chinook*, submitted to NOAA on March 28, 2014 and approved by the HC on March 12, 2014.

Background

Recalculated hatchery production values required to meet Chelan PUD's No Net Impact (NNI) through release year 2023 were approved by the Rocky Reach and Rock Island Hatchery Committees on December 14, 2011. Chelan PUD is required to produce 60,516 Methow sub-basin hatchery spring Chinook.

Attachment C

Yakama Nation Fisheries

FISHERIES RESOURCE MANAGEMENT

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January 26, 2015

To: HCP Rocky Reach Hatchery Committee

During the January 21, 2015 regularly scheduled HCP Hatchery Committee Meeting, Chelan PUD informed the committee that they are once again negotiating a sharing agreement with Douglas PUD. I think we are all in agreement that this is great news for broodstock collection and signifies an end to any additional handling stress associated with additional trapping at Rocky Reach Dam and tangle netting in the Chewuch River. Chelan PUD also informed the HCP HC that they intend to return to rearing their Methow spring Chinook obligation at Methow FH.

We do not believe that the choice to change rearing locations is a choice that should be made by Chelan alone, rather any change in rearing location requires Committee discussion and approval. There are several reasons why the Committee may not want to return Chelan's spring Chinook to Methow FH.

1) Data to date indicates a long history of unacceptably high 'stray rates', or failure to home, for spring Chinook reared at Methow FH/Chewuch Acclimation Pond (AP). While there may not be a 'genetic risk' for in-basin MetComp strays, such a high proportion of fish straying from the intended location is a failure of the supplementation program to operate as intended. The DCPUD 5-year analytical report concludes that **"Increases in stray rates have prevented the program from increasing spawner abundance in the Chewuch River"** (Murdoch et al. 2012). It is entirely plausible that spring Chinook reared at Eastbank FH, overwintered in the Carlton Acclimation Facility followed by spring acclimation at the Chewuch AP will have a better homing fidelity to the Chewuch River than fish reared at Methow Fish Hatchery. There should be no attraction back to Methow FH; The Carlton facility is not operating at the time adult Chinook return to the Methow River; the primary homing attraction would then be to the Chewuch Pond.

Table 1. Stray rates by brood year of Chewuch spring Chinook and the number and proportion based on non-target recovery location (Murdoch et al. 2012)

Brood Year	Broodstock		Spawning Grounds		Stray Rate (%)
	Number	Proportion	Number	Proportion	
1992	1	1.00	0	0.00	3%
1993	19	0.86	3	0.14	21%
1994	0	0.00	0	0.00	0%
1996	15	0.79	4	0.21	46%
1997	44	0.62	27	0.38	22%
2001	46	0.13	321	0.87	88%
2002	92	0.24	299	0.76	74%
2003	3	0.12	22	0.88	46%
2004	35	0.33	70	0.67	86%
Mean		0.45			46%

Unfortunately, following Committee approval of the 5-year analytical report, subsequent annual reports do not consider Chewuch acclimated fish returning to Methow Fish Hatchery as 'strays' (C. Snow, WDFW, pers. comm. Jan 26 2015). Comparable stray-rate data, as presented in Table 1, are not available after 2010. However the stray rate to non-target spawning grounds within the Methow Basin is still excessively high (36-48% for brood years 2005-2007; excluding Chewuch returns to Methow Fish Hatchery).

2) SARs from all spring Chinook facilities in the Methow Basin are low, likely due to the lengthy migration through hydropower projects. Fish reared at Methow FH and acclimated at the Chewuch AP have lower SARS (mean = 0.197 for brood years 1992-2007) compared to fish released from Methow FH (mean=0.315; Brood Years 1993-2007). Survival rates may be improved through rearing in circulars at the Carlton Facility. Research conducted by Chelan PUD and presented to the Hatchery Committee on January 21 ,2015 indicated increased release-to-McNary Dam survival, faster downstream travel times, a significant reduction in jacks and mini-jacks with an increase in 2,3,and 4 salt returns, and greater SARs (though not significant) for circular reared summer Chinook.

3) It is the responsibility of the Committee to discuss and approve changes in implementation of HCP mitigation programs. Changing rearing locations from the current approved plan (HGMP dated 3/4/2014) requires committee approval; Choice of rearing location is not a decision that lies solely in the purview of Chelan PUD. The primary responsibility of the Committee is outlined in section 8.2.2 of the Rocky Reach HCP Agreement "Responsibilities: The Hatchery Committee shall oversee development of recommendations for implementation of the hatchery elements of the Agreement that the District is responsible for funding". Section 8.4.1 Hatchery Agreements, states "The district may enter into agreements with other entities for the rearing release, monitoring and evaluation and research of hatchery obligations. **The Hatchery Committee must approve any proposed agreements or trades of production**". At the January 21, 2015 HCP HC meeting, a sharing agreement for the rearing of Chelan's production at Methow FH was not characterized as 'proposed' for committee discussion and decision.

With only one year of the current rearing/release strategy we will not be able to determine how rearing and acclimation location affect homing and stray rates. Nor if survival rates are benefitted by overwinter rearing in circulars. The committee discussed and agreed to move Chelan's production to Eastbank with acclimation at Carlton and Chewuch. Similarly, another change in rearing location warrants similar discussion and SOA. A unilateral decision by Chelan PUD is not in the spirit of the HCP agreement nor is allowed under the HCP agreement.

It is our position to continue implementation of the current rearing strategy for a 5 year time period (minimum) in order to evaluate the effect on juvenile survival, adult survival, and spawning distribution for the program. At the conclusion of 5 years, a more informed decision to continue or move rearing locations can be made.

Thank you for your consideration,

Keely Murdoch
Yakama Nation

Literature Cited:

Murdoch, A., C. Snow, C. Frady, A. Repp, M. Small, S. Blankenship, T. Hillman, M. Miller, G. Mackey, and T. Kahler. 2012. Evaluation of the hatchery programs funded by Douglas County PUD, 5-year report, 2006-2010. Report to the Wells HCP Hatchery Committee, East Wenatchee, WA.

Upper Methow Spring Chinook Acclimation Proposal

Upper Columbia Spring Chinook and Steelhead Acclimation Project (BPA Project #200900100)

3 December 2014

Prepared by Keely Murdoch, Yakama Nation Fisheries Resource Management

1.0 Background

1.1 YN's Expanded Acclimation Project

YN's Upper Columbia Spring Chinook and Steelhead Acclimation Project (BPA Project #2009-00-001) is based on the premise that acclimating salmon and steelhead in a manner that mimics natural systems can increase the effectiveness of integrated (conservation) hatchery programs by enhancing homing of adult fish to target reaches and can be used to improve the Viable Salmonid Population (VSP) status of ESA listed spring Chinook and steelhead.

The Columbia River Basin Fish Accords (MOA) recognize that hatchery actions can provide important benefits to ESA listed species. This Project seeks to improve the efficacy of current supplementation programs by providing additional short-term acclimation sites with to enhance homing of adult salmon to identified reaches, which may contribute to improved productivity and survival.

The concept of acclimating salmon smolts in 'natural' ponds has been thoroughly tested over the last decade as part of YN's coho restoration project in the Wenatchee and Methow Rivers. The coho restoration project has demonstrated both high survival rates (juvenile and adults) as well as adult returns with SARs comparable or higher than established supplementation programs in the Upper Columbia (YN 2010). The success of YN's coho restoration project in the Wenatchee and Methow basins has also demonstrated that short-term acclimation will attract fish back to the areas where they were released rather than the hatchery facility where they were raised, effectively changing the spawner distribution (Kamphaus et al., 2013)

Beginning in 2014, as a result of the HCP No-Net-Impact (NNI) recalculation, spring Chinook smolt release numbers from most conservation hatchery programs in the Methow and Wenatchee basins will be significantly reduced. Because of this reduction, we believe it is crucially important that each program be operated in a manner which maximizes efficacy of the supplementation effort by acclimating and releasing smolts in locations where they will return to high quality spawning and rearing habitat.

1.2 Methow Spring Chinook

Spring Chinook that are released from the Methow FH and WNFH have a spawning distribution significantly different than that of natural origin fish (Figure 1; Murdoch et al., 2011).

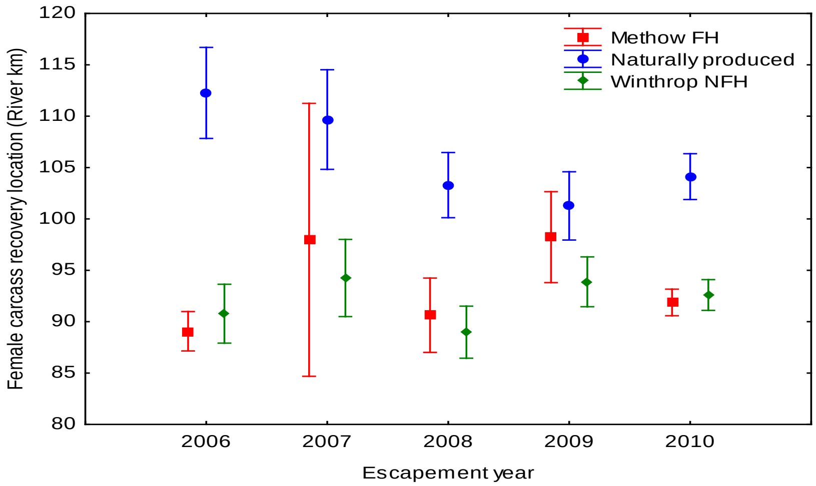

Figure 1. Mean spawner distribution based on female carcass recovery of hatchery and natural origin spring Chinook in the Methow River (Murdoch et al., 2011).

Similarly, the most recent data (2006-2013) indicates the average spawn distribution for Hatchery Origin fish released from the Methow Fish Hatchery is rkm 92 compared to rkm 104 for natural origin fish (Snow et al., 2014).

The difference in spawner distribution (2005-2013) by origin for spring Chinook in the Methow River is further illustrated in Figure 2. Figure 2. below is not depicting spawner composition by reach, rather the proportional distribution of hatchery and natural origin spawners respectively. Figure 2. Clearly illustrates that proportionately greater hatchery fish spawn in the lowermost reaches while proportionately greater natural origin fish spawn in the upper most reaches.

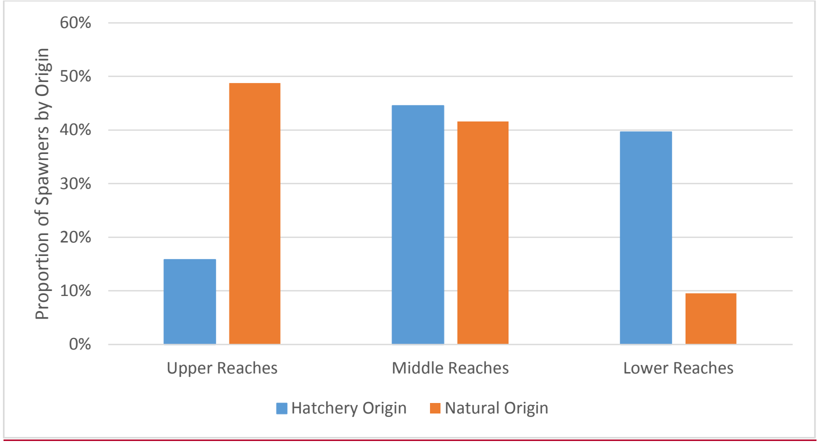

Figure 2. Spawning distribution of hatchery and natural origin spring Chinook in the Methow River as measured by female carcass recovery location (Upper Reaches = M11-M15 including the Lost River and Early Winters Creek, Middle Reaches = M8-M10 including Hancock Springs, Lower Reaches = M4-M7 including the hatchery outfalls and Wolf Creek; Data extracted 2005-2013 annual reports).

The skewed spawning distribution along with high densities of hatchery fish could ~~may~~ be a contributing factor to the low productivity observed in the Methow River. We believe that the difference in spawner distribution can be directly attributed to hatchery spring Chinook imprinting and homing to Winthrop NFH (Rkm 81) and Methow FH (Rkm 85) from which the fish are reared and released. Moving forward in 2015 and beyond, densities of hatchery origin fish on the spawning grounds will be reduced both by adult management and through a significant reduction in release numbers; however without some method to attract adult returns to the uppermost reaches we do not expect the spawner distribution to change.

The fundamental assumption behind supplementation is that hatchery fish returning to the spawning grounds are ‘reproductively similar’ to naturally produced fish; inherent in the supplementation strategy is that conservation hatchery released from acclimation ponds and naturally produced fish are intended to spawn together and in similar locations. If supplemented fish are not fully integrated into the naturally produced spawning population, the goals of supplementation may not be achieved (Hays et al., 2007). For this reason Objective 5 within the Monitoring and Evaluation plan for PUD Hatchery Programs (Hillman et al., 2013) is focused on ensuring that hatchery and natural origin fish have similar run timing, spawn timing, and spawning distribution.

Despite reductions in release numbers of spring Chinook and steelhead from CCPUD, DCPUD, and GCPUD supplementation programs (in 2014), we have no reason to expect improvements in the distribution of hatchery origin spawners, only the number on the spawning grounds. We believe that if Objective 5 is not currently met (as is the case in the upper Methow River), it is unlikely that the future spawning distribution of hatchery fish will change unless changes to the acclimation release strategy are made.

2.0 Goals and Objectives

The long-term measure of success would be realizing equal spawning distributions of conservation hatchery origin spring Chinook and natural origin returns, consistent with Objective 5 in the Monitoring and Evaluation Plan for PUD Hatchery Programs (Hillman et al., 2013).

However a small release of acclimated spring Chinook is likely insufficient to shift the overall spawner distribution of hatchery fish in the Methow basin since most smolts will released directly from the hatchery.

Rather we view this as a research proposal to answer critical uncertainties surrounding acclimation, and homing fidelity under the new management paradigm which requires pHOS/PNI targets and removal of hatchery fish from the spawning grounds.

With this proposal we will address the following short term objectives:

1) To determine if conservation hatchery spawner distribution can be altered through short –term spring acclimation in the Upper Methow basin.

Success for objective 1 will be a measureable change in spawning location for acclimated hatchery fish compared to hatchery fish released from Methow FH (See Data Analysis for details).

2) To determine what proportion of acclimated hatchery fish home back to Methow FH and are collected during adult management activities

There is no success or failure metric for Objective 2. Rather hatchery return rate data will be used to adaptively manage any future acclimation plans (beyond this proposal) and will be used to determine appropriate release numbers of spring Chinook in the upper Methow such that we do not exceed PNI/PHOS targets through an in ability to attract fish back to the hatchery (See Adaptive Management for details).

3) To compare project performance indicators (tagging-McNary survival, SARs) between acclimated and non-acclimated releases.

We consider success for objective 3 to be either no change or an increase in survival rates for acclimated releases compared to non-acclimated releases (See Data Analysis and Adaptive Management for details).

3.0 Sources of Uncertainty

Like most field research, uncertainties and unforeseen events may limit our ability to address the three objectives described above.

1) Because we are only proposing to acclimate and release 25,000 smolts, low return rates (below average) may result in an insufficient number of returning adults from which to fully address the three objectives and answer critical uncertainties. .

2) There is some variability in performance of fish acclimated in natural ponds. We generally believe that natural ponds result in benefits to acclimated fish, including more natural coloration, exposure to natural food sources, and predator avoidance skills. However in the history of our use of natural ponds for acclimation, we have come to realize that fish perform better in some ponds than other ponds, on rare occasions this has caused us to recommend discontinuing use of a pond. Goat Wall is a new acclimation pond, we have not acclimated fish at this location previously. However, smaller, protected acclimation sites (like Goat Wall) seem to work better than large open sites.

3) Adult Management (removal of hatchery adults from the spawning population) is a new strategy in the Methow River. It is unknown at what rates managers will be able to extract fish from the population. It is possible that over extraction of the acclimated fish could occur in which case we may not be able to address the three objectives outlined above. Similarly it is possible that an insufficient number of hatchery fish will be extracted leaving the hatchery program in violation of pHOS/PNI goals. Additionally, if hatchery fish are not collect/removed evenly from throughout the run there is a possibility that some segments of the spawning population may be differently affected than other.

4.0 Project Proposal

To encourage hatchery origin spring Chinook adults to distribute (and spawn) farther upstream than fish released from Methow Fish Hatchery. YN proposes to acclimate 25,000 Chinook pre-smolts from Methow Fish Hatchery at YN's Goat Wall acclimation site (Figure 3) beginning in spring 2016 and extended for five years.

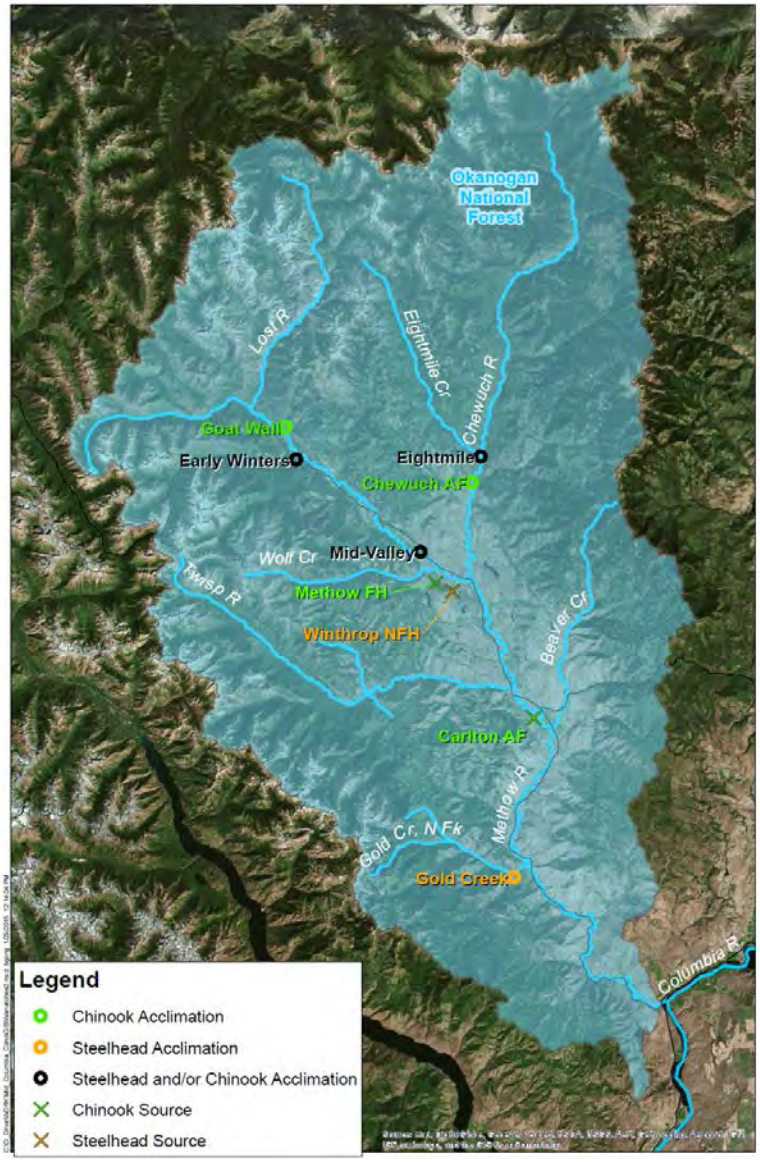

Figure 3. Locations of the Goat Wall Acclimation site relative to Methow Fish Hatchery, Winthrop NFH and other potential acclimations sites in the Methow Basin.

4.1 Upper Methow Release Numbers

Appropriate release numbers in the Upper Methow should be driven by spawner carrying capacity, estimated wild fish abundance, and available habitat. Reach based estimates of carrying capacity do not exist in the Methow basin~~.~~, but could be estimated from basin-wide carrying capacity estimates. Mackey (2014), estimated the Methow Basin spawner Capacity (Ksp) to be either 2,962 spawners (Ricker S-R model 1992-2006) or 2,173 (Ricker S-R model 95th quantile; 1992-2006). Other estimates have ranged from a high of 4,077 (Fisher) to a low value of 782 (Mullen et al., 1992~~). ~~).

Recovery Criteria for spring Chinook in the Methow require a minimum abundance of 2000 natural origin spawners (12-year geo-mean) for delisting. Using the delisting criteria as a minimum escapement target and the current distribution of NOR spawners in the Methow, we can estimate a minimum number of spawners which may be appropriate for the Upper Methow (Table 1; as defined as reaches M11-M15, including the Lost River and early Winters Creek). The mean NOR spawner abundance in the upper Methow (reaches M11-M15, including the Lost River and Early Winters Creek) for years 2005-2013 has been 89 (Table 1). A minimum target number of ~~spawners for~~ hatchery origin spawners in the upper Methow could then be 405 (minimum abundance goal based on delisting criterea– average NOR abundance; 837-185 =652). Which is far greater than the expected return from this acclimated release, leading us to believe that spawner capacity exists in the reaches near the proposed acclimation site.

Table 1. Mean number of NOR spawners in Upper Methow and minimum additional spawners required to reach abundance target.

Reaches	Mean NOR Mean number NOR spawners (2005-2013)	Current Proportion of NOR spawners (2005-2013)	Target Minimum Spawner Abundance	Additional Spawners Required for Minimum Abundance
Upper Methow Reaches (M11-15, Lost River, Early Winters)	89	20.2%	405	316
Middle Methow Reaches (M8-10, Hancock Springs)	96	21.8%	436	340
Lower Methow Reaches (M4-M7, Wolf Creek, Hatchery Outfalls)	17	3.9%	79	62
Combined Methow River Reaches	203	45.9%	919	716
Chewuch River	164	36.6%	731	567
Twisp River	76	17.4%	349	273
Combined Methow Basin	**441**	**100%**	**2000**	**1559**

Commented [KT1]: Ok, I understand your method to get to the target minimum and don't have any suggested alternatives, but because the upper, middle and lower reaches are different sizes (different amount of available habitat), might we rick over seeding habitat if we proceeded with acclimated numbers to achieve the "reach" targeted minimums? For example, if currently 20.2% of the NORs spawn in the upper Methow, but the upper Methow only made up 10% of the basin habitat, implementing an acclimation action to add up to 316 additional spawners may be counter productive. If available, would inclusion of a column that detailed the amount of habitat by "reach" be informative relative to presenting a target minimum spawner abundance? If I'm in left field let me know.

While suitable spawning space exists, this project will be implemented in such a manner as to increase the spawning escapement in the upper Methow while working within the permit required sliding scale of pHOS. In a typical year, a release of 25,000 smolts from Goat Wall pond would yield an additional 88 adults (Table 2) on the spawning ground (with no adult removal); with adult removal this number could be markedly reduced.

Table 2. Anticipated number of returning spring Chinook adults from a release size of 25,000 at the Goat Wall Site. Acclimation Pond based on minimum, mean, and maximum SARs observed at Methow FH for brood years 2000-2007 (Snow et al. 2014).

Target Number of Smolts	Anticipated Number of Adults Returned		
	Maximum SAR	Mean SAR	Minimum SAR
Upper Methow: Goat Wall Pond (25,000)	203 (0.81%)	88(0.35%)	28 (0.11%)

4.2 Goat Wall Acclimation Site

The Goat Wall acclimation site is accessed through privately owned property and consists of a watered slough located downstream from the Lost River. Water to the pond is supplied through a diversion on Gate Creek and through natural groundwater seepage (Cold Creek). A temporary seine net system would be used to contain hatchery spring Chinook during the acclimation period. The Lost River Rd provides access to the site and is plowed during the winter. The site measures 0.08 acres (30' x 110') and is approximately 9500 cft. We have observed the CFS ranging from 3.85 cfs (in May 2011) up to 11.6 cfs (July 2014). The site has a capacity to hold up to 30,000 fish at 16 fish per pound at densities less than 0.06 lbs/cft/in

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4.2.1 Fish Transportation Procedures

Spring Chinook pre-smolts would be transported in March (preferably by WDFW tanker truck) from Methow FH to the Goat Wall location. Current fish-transport procedures include crowding and loading into distribution trucks via a fish pump. Water will be tempered as appropriate. Fish are tempered to within 3°C of the receiving water prior to release. Loading densities may range from 0.3 to 0.5 pounds of fish per gallon of water consistent with IHOT standards.

4.2.2 Fish Condition, Growth, and Health Monitoring

A pre-transfer fish health examination will be conducted by WDFW fish health specialists. Once in the acclimation site, fish will be monitored daily by staff for signs of disease symptoms (lethargic behavior, skin coloration, visible lesions, caudal fungus, etc.) through visual observations, feeding behavior and monitoring of daily mortality trends. Additionally, staff will collect data from a random sample of approximately 100 fish on a weekly basis. Weekly sampling will include a general assessment of fish condition, stage of smoltification, fish length and fish weight so that growth rates and condition factors maybe be assessed. A fish health specialist will be contacted if any disease symptoms are noted. If required, YN staff under the direction of the fish health specialist will provide treatment for disease.

4.2.3Release

Spring Chinook would be released as close as possible to the agreed upon size target (15 fpp). Targets are subject to change at the discretion of the HCP and PRCC Hatchery Committees. Spring Chinook will be volitionally released from the acclimation site by removing the barrier net mid-to-late April. Release typically begins when > 90% of the acclimated group is displaying visual signs of smoltification (identified by transitional and/or smolt stage), target fpp is met and releasing into favorable river conditions (high water events). The release will truly be volitional, no fish will be pushed out of the pond. Our experience with spring Chinook in natural ponds indicates that they leave the pond within 7-10 days of removing the barrier net.

5.0 Adult Return Rates and Adult Management

Historic adult return rates from the Methow Fish Hatchery can be found in Table 2 below.

Table 3. Brood year, number of smolts released, adult returns, and SAR (%) from the Methow Fish Hatchery (data source: Snow et al. 2012).

Brood Year	Smolt Released	Adult Returns	SAR (%)
1996	202,947	500	0.246
1997	332.,484	821	0.247
1998	435,670	2300	0.528
1999	180,775	145	0.080
2000	266,392	852	0.320
2001	130,787	508	0.388
2002	181,235	599	0.331
2003	48,831	57	0.117
2004	65,146	316	0.485
2005	156,633	328	0.209
2006	211,717	1,714	0.810
2007	119,407	515	0.431
Mean	**194,335**	**721**	**0.349**

Based on the mean SARs (%) from previous releases, we would expect an average of 88 adults to return to the Methow River from a release of 25,000 smolts (Table 3).

The historic SARs for hatchery fish (Table 3) along with historic estimates of natural origin spawners in the Methow River can be used to provide a retrospective analysis of what we may be able to expect for PNI and pHOS metrics given the release of 25,000 in the Upper Methow and assuming no adult removal. This retrospective analysis provides insight into what PNI values could be in the future (Table 4). Based on this analysis, it is clear that even in the absence of adult management, numbers of fish proposed for acclimation in the upper Methow alone will not result in exceedance of the sliding scale of allowable pHOS presented in the DRAFT Methow Spring Chinook Section 10 Permit (NMFS, In Prep). However, it is unrealistic to expect that fish released as part of this project would be the only fish on the spawning grounds. Similarly, it is also unrealistic to expect that spring Chinook released from this project would not be attracted back to the Methow FH and would not be removed in adult management activities.

Table 4. Forecast of adult returns and PNI using a retrospective analysis of SARs and NOR spawning escapement. This analysis assumes ALL returning hatchery fish spawn in the Methow River and are NOT removed during adult management activities.

Return Year	NORS		Hatchery SAR[a]	Hypothetical Hatchery Return	Hypothetical Proportion of Run		Target Basin-wide PHOS[b]	PNI (pNOB = 1)	PNI (pNOB = 0.75)
	Basin Total	Methow			Hatchery	Natural			
2000	950	611	0.0032	80	0.12	0.91	🟩 0.2	0.89	0.87
2001	1832	594	0.0039	98	0.14	0.89	🟩 0.1	0.88	0.84
2002	345	86	0.0033	83	0.49	0.39	🟩 0.4	0.67	0.60
2003	58	8	0.0012	30	0.79	0.29	🟩 Anything	0.56	0.48
2004	488	199	0.0043	123	0.38	0.71	🟩 0.4	0.72	0.66
2005	527	221	0.0021	53	0.19	0.69	🟩 0.3	0.84	0.80
2006	328	128	0.0033	30	0.39	0.61	🟩 0.4	0.72	0.66
2007	266	152	0.0012	30	0.16	0.84	🟩 Anything	0.86	0.82
2008	298	172	0.0049	123	0.42	0.59	🟩 Anything	0.72	0.64
2009	564	261	0.0021	53	0.17	0.83	🟩 0.3	0.86	0.82
2010	601	290	0.0081	203	0.41	0.59	🟥 0.3	0.71	0.65
2011	961	432	0.0043	108	0.20	0.85	🟩 Anything	0.83	0.79
Mean	**602**	**262**	**0.0035**	**89**	**0.32**	**0.68**		**0.77**	**0.69**

a. For the purposes of this exercise hatchery SARs were matched with return year NORs based on a 4-year age class return

b. Green shading represents pHOS values with those allowed in the Draft Methow Spring Chinook BiOp. Red shading represents pHOS values exceeding those allowed in the Draft Methow Spring Chinook BiOp.

Data from spring Chinook reared at the Methow FH and short term acclimated in the Chewuch Acclimation Pond (AP) indicates that on average 43% will 'stray' back to the Methow River (Murdoch et al., 2011), presumably due to attraction back to the Methow FH where they were reared. In some years this figure has been as low as 0% for BY 1994 (which generated only 2 hatchery returns so straying could not really be evaluated) and as high as 88% for BY 2001. Table 5 presents the same data as Table 4 but assumes that 43% of the spring Chinook acclimated at the Goat Wall pond will be attracted back to the Methow FH and removed from the spawning population during adult management activities.

Based on the analysis presented in Table 5, we expect an acclimated release of 25,000 spring Chinook smolts from Goat Wall to result in an increase of spring Chinook spawners using habitat areas in the upper Methow while making anticipated pHOS and/or PNI targets achievable.

Table 5. Forecast of adult returns and PNI using a retrospective analysis of SARs and NOR spawning escapement. This analysis assumes 57% of returning hatchery fish spawn in the Methow River and 43% are removed during adult management activities.

Return Year	**NORs**		**Hatchery SAR**^{a}	**Hypothetical Hatchery Return**	**% HORs removed at MFH**	**Hypothetical HORS to spawn**	**Hypothetical Proportion of Run**		**Target Basin-wide PHOS**^{b}	**PNI (pNOB = 1)**	**PNI (pNOB = 0.75)**
	Basin Total	Methow					**Hatchery**	**Natural**			
2000	950	611	0.0025	80	43%	45.6	0.07	0.91	0.2	0.94	0.92
2001	1832	594	0.0028	97.5	43%	55.6	0.09	0.89	0.1	0.92	0.90
2002	345	86	0.0053	82.5	43%	47.0	0.35	0.39	0.4	0.74	0.68
2003	58	8	0.0008	30	43%	17.1	0.68	0.29	Anything	0.59	0.52
2004	488	199	0.0032	122.5	43%	69.8	0.26	0.71	0.4	0.79	0.74
2005	527	221	0.0039	52.5	43%	29.9	0.12	0.69	0.3	0.89	0.86
2006	328	128	0.0033	82.5	43%	47.0	0.27	0.61	0.4	0.79	0.74
2007	266	152	0.0012	30	43%	17.1	0.10	0.84	Anything	0.91	0.88
2008	298	172	0.0049	122.5	43%	69.8	0.29	0.59	Anything	0.78	0.72
2009	564	261	0.0021	52.5	43%	29.9	0.10	0.83	0.3	0.91	0.88
2010	601	290	0.0081	202.5	43%	115.4	0.28	0.59	0.3	0.78	0.72
2011	961	432	0.0032	107.5	43%	61.3	0.12	0.85	Anything	0.89	0.86
Mean	**602**	**262**	**0.0035**	**88**		**~~35~~50**	**0.23**	**0.68**		**0.83**	**0.79**

a. For the purposes of this exercise hatchery SARs were matched with return year NORs based on a 4-year age class return

b.Green shading represents pHOS values with those allowed in the Draft Methow Spring Chinook BiOp. Red shading represents pHOS values exceeding those allowed in the Draft Methow Spring Chinook BiOp.

5.0 Monitoring and Evaluation ~~and Decision Criteria~~

Being able to address near term objectives described in Section 2.0 is key to being able to adaptively manage this acclimation project; Making future recommendations for project changes and release sizes beyond this 5-year evaluation. Future decisions on whether to continue to acclimate fish at remote sites is within the purview of the resource managers and is not a decision made solely as part of YNs Salmon and Steelhead Acclimation Project (BPA Project #2009-00-001). For this reason specific decision criteria beyond this 5-year evaluation are not appropriate for this proposal but should be discussed and decided upon by the resource managers.

Objective 1: To determine if spawner distribution can be expanded through short-term spring acclimation in the Upper Methow Basin.

To accomplish Objective 1, all spring Chinook acclimated and released from Goat Wall will be marked with a unique CWT. Methods for collecting spawner location data based on carcass recovery and analytical details can be found in the Monitoring and Evaluation Plan for PUD Hatchery Programs: 2013 Update (Hillman et al., 2013). All spawning ground, carcass recovery data and CWT extraction and reading will be completed by WDFW during implementation of the PUDs regular M&E activities (Objective 5 in Hillman et al., 2013).

Hypothesis:

- H_0: The distribution of hatchery origin redds from acclimated releases (Goat Wall Acclimation Site) = The distribution of hatcher origin redds from non-acclimated *releases (Methow Fish Hatchery)*

Measured Variables:

- Location (GPS coordinates) of female salmon carcasses observed on spawning grounds (Hillman et al, 2013)

Derived Variables:

- Location of female salmon carcasses at the historic reach scale and at the 0.1 km scale

Data Analysis:

- Paired T-test based rkm of carcass recovery location
- Chi-square by reach

We will consider Objective 1 successful if the mean (rkm) female carcass recovery location for acclimated hatchery fish is greater than the mean (rkm) carcass recovery location for non-acclimated hatchery returns, and if a greater proportion of acclimated fish spawn in the upper reaches (M11-M15) than non-acclimated hatchery fish.

Objective 2: To determine what proportion of acclimated spring Chinook home back to Methow Fish Hatchery and are collected during adult management or broodstock collection activities.

As described above, all spring Chinook acclimated at Goat Wall will be marked with a unique CWT tag. CWT recovery necessary to meet objective 2 will occur at Methow FH by WDFW during spawning and adult management activities as normal to meet reporting and M&E objectives described in Hillman et al 2013. Alternatively detection of PIT tagged fish from both treatments (acclimated and non-acclimated) at the hatchery and at Wells Dam can be used to address Objective 2.

Hypothesis:

No hypothesis are being tested under Objective 2

Measured Variables:

- Count of CWT recovered by code at Methow FH
- Counts of CWT recovered by code at WNFH
- Counts of CWT recovered by code on the spawning grounds

Derived Variables:

- Estimates of fish return by code to Methow Fish Hatchery
- Estimates of fish return by code to Winthrop NFH
- Estimates of fish return by code to spawning grounds in the Methow Basin

Data Analysis:

CWT Analysis: The number of CWT fish from the acclimated release group recovered at the hatchery will be expanded based upon the in-hatchery sample rate and pre-release tag retention rate. The estimated proportion back to Methow Fish Hatchery will then be calculated based upon all in-basin tag recoveries for the acclimated release.

PIT Tag Analysis: The proportion of PIT tagged returns to Methow FH for the acclimated and non-acclimated release can be estimated by dividing the number of PIT tag detections/recovery at the hatchery by PIT tag detections over Wells.

There is no success or failure criteria for Objective 2. Hatchery return rate data for both acclimated and non-acclimated releases will be used to develop future acclimation proposals and make recommendations. Proportions of acclimated releases returning to the rearing facility will be used to recommend appropriate release numbers for spring Chinook in the upper Methow such that we do not exceed PNI/PHOS targets should the resources managers decide to continue acclimation beyond this 5-year plan.

Objective 3: To monitor project performance indicators and where appropriate, compare performance indicators to an on-station reference group.

Fish Condition and Growth

To monitor fish growth, condition and stage of smoltification a random sample of approximately 100 fish will be sampled weekly (for a total combined sample of 600-800 fish). Weekly sampling will include a general assessment of fish condition, visual assessment of smoltification, fish length and fish weight so that growth rates and condition factors may be assessed.

Success will be considered meeting size targets assuming fish are transferred to the pond at the appropriate size. There is no success criterial for the fish condition (k-factor) is a metric. Fish condition (k-factor) will be used to retrospectively understand any observed differences in survival rates.

Release Monitoring and In-Pond Survival

Up to 7,000 spring Chinook within the site will be PIT tagged by YN. YN will design and install a PIT tag detection system at the sloughs' outlet to determine out-migration timing as well as produce an estimate of in-pond survival (following the volitional release and downstream migration). Additionally, daily predator observations will be recorded so that YN can respond in real-time to increased predation.

There is no success criteria for this metric, data from release monitoring will be used to identify predation rates at the pond and make changes if necessary.

Commented [KT3]: Seems some criteria is needed to assess within pond survival compared to on-station survival in order to determine whether to continue the acclimation project, even within the 5-year period identified in the accompanying SOA. It get a bit tricky, as the true measurement of success relative to survival is the SAR. So…………. for instance a reduced in-pond survival for acclimated fish, but an increased smolt-to-smolt and SAR could off-set the reduced in-pond survival. Alternately, substantial reduced in-pond survival may not be able to be off-set by increased survival post release, so how and when do we decide that in-pond survival is poor enough to discontinue the project? Doesn't seem appropriate that if in-pond survival was poor, and we were unable to address the cause, we would just continue to acclimate fish in the pond throughout the 5-year study period. Thoughts?

Tagging-to-McNary Dam Survival

Equal groups of approximately 7,000 PIT tags will be applied to both the acclimated hatchery fish and the on-station release. Tagging will occur during the winter prior to acclimation and release. Because tagging occurs prior to transfer, the Tagging-to-McNary survival metric is inclusive of in-pond survival, and downstream migratory survival. Theoretically, Release-to-McNary Survival could be greater for acclimated releases than non-acclimated releases, therefore a potentially higher in-pond mortality rate could be ameliorated and later life stages. Therefore comparing Tagging-to-McNary survival rates for both on station and acclimated releases is a better comparison of overall juvenile survival than a Release-to-McNary metric.

Tagging-to- McNary Dam survival will be measured with PIT tags. Survival estimates for both tagging and release will use Cormack-Jolly-Seber estimates with associated standard errors for both survival and detection probabilities (Columbia River DART). These survival rates will be compared to like metrics from the Methow FH on-station release.

Hypothesis

- H_0: Tagging-to-McNary survival for acclimated fish = Tagging-to-McNary survival for Methow FH on station releases.

Measured Variables:

- Unique PIT tags at tagging
- Unique PIT tag detections at McNary Dam
- Unique PIT tag detections at John Day or Bonneville Dam

Derived Variables:

- Cormak-Jolly Seber estimates and standard error for both survival and detection probabilities using Columbia River DART

Data Analysis:

- Paired T-test by year for acclimated and on station releases

We will consider this metric successful if the tagging-to-McNary survival rates are equal to or greater than the on station releases.

Smolt-to-Adult survival

Smolt-to-Adult Return (SAR) rates will be calculated using the unique CWT for each acclimated release. SARs are typically reported in the PUD annual M&E report. SARs for the acclimated release can be compared to the on-station release by brood year.

Hypothesis

- H_0: Smolt-to-Adult survival rates for acclimated fish < Smolt-to-adult survival rates for Methow FH on station releases.

Measured Variables:

- Numbers of CWTs recovered at the hatchery, spawning grounds, and in fisheries

Derived Variables:

- Estimated return to the mouth of the Columbia

Commented [KT4]: Why the mouth of the Columbia? Why not SAR to the Methow Basin? Seems more important to assess the SAR to the Methow, as this location is the basin of origin and returning adults to spawning grounds is a primary objective of the conservation program.

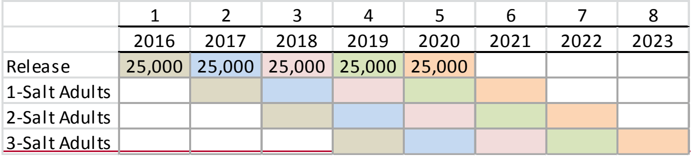
Data Analysis:

- SARs for acclimated and non-acclimated release can be compared with a paired T-test by year.

We will consider this metric successful if the SARs for acclimated hatchery returns are equal to or greater than the on station releases.

Project Timeframe

Release would occur in 2016-2020. In-pond and in-hatchery assessment would also occur in those years. Field assessment of adult return rates and spawning distribution would occur in 2017-2023. Data collected from the spawning grounds and from the hatchery will occur during regular M&E activities described in Hillman et al. 2013.



	1	2	3	4	5	6	7	8
	2016	2017	2018	2019	2020	2021	2022	2023
Release	25,000	25,000	25,000	25,000	25,000			
1-Salt Adults		🟫	🟦	🟥	🟩	🟧		
2-Salt Adults			🟫	🟦	🟥	🟩	🟧	
3-Salt Adults				🟫	🟦	🟥	🟩	🟧

The five year timeframe is designed to achieve the near-term objective described above, which address critical uncertainties. Pending results the Yakama Nation may submit future proposals to continue or expand the Upper Columbia Salmon and Steelhead Acclimation Project (BPA Project #2009-00-001) in 2019 based upon available information while the adult return data is collected through 2023.

6.0 Adaptive Management

Information collected through this project may be used by YN in the development of future proposals and can also be used by the resources managers to make decisions about spawner distribution, desired escapement levels, and hatchery release locations. Management decisions that may result from this data are within the purview of the resource managers and therefore will not be included in this research proposal. Similarly, decisions pertaining to hatchery operations are within the purview of the HCP Hatchery Committees and the PRCC Hatchery Sub Committees and therefore are not included within this proposal.

7.0 Literature Cited.

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Appendix A: Upper Columbia Salmon and Steelhead Acclimation, Summary of Results To-Date

Yakama Nation Fisheries Resource Mgt
Expanded Acclimation Summary
Wenatchee and Methow Basins
2010-2014

Release Year	Basin	Species	Program	Acclimation Site	Number Acclimated	Marks	Size at Transfer (FPP)	Transfer Date	Size at Release (FPP)	Volitional Release Start	In pond survival (PIT)	Release-to-McNary survival (PIT)	Standard Error (SE)	Tagging-to-McNary survival (PIT)	Standard Error (SE)	SAR	Comments
2010	Wenatchee	Steelhead	Wenatchee Steelhead (CPUD)	Rohlfing's Pond (Nason Creek)	10,364	VIE/PIT	9.0	3/25/10	7.4	5/7/2010	92.70%	n/a	n/a	n/a	n/a	NYA	566 PITs in group. Seperated from coho with a barrier net.
	Methow	Spring Chinook	Winthrop NFH	Spring Creek	49,890	CWT	17.5	3/23/10	15.0	4/19/2010	99.94%	n/a	n/a	n/a	n/a	NYA	Co-mingled with coho; In-pond survival based on visual estimates of predation and recoverd mortalities since there were no PIT tags in this group.
			Methow FH/GCPUD	on-station		CWT/PIT	n/a	n/a		4/15/2010	n/a	n/a	n/a	62.98%	5.69%	NYA	No outlet detection systems were in-place for in-pond and release-to-McNary survival estimates
			Methow FH/GCPUD	Wolf Creek	25,591	CWT/PIT	18.0	3/26/10	14.4	4/18/2010	98.10%	n/a	n/a	58.55%	5.94%	NYA	9,999 PIT tags; no other species in pond; In-pond survival based on visual estimates of predation and recoverd mortalities rather than PIT tags. Lack of outlet detection did not allow for a release to McNary survival
2011	Wenatchee	Steelhead	Wenatchee Steelhead (CPUD)	Rohlfing's Pond (Nason Creek)	20,706	VIE/PIT	9.7	3/22/11	8.2	5/2/2011	88.90%	43.95%	3.89%	34.83%	3.03%	NYA	Seperated from coho with a barrier net; 9874 PIT tags; VIE only pink lft and rt elastomer. A high flow event between Mar 31-Apr 2 where approximately 1/3 of the pond escaped.
	Methow	Spring Chinook	Winthrop NFH	on-station	388,642	CWT/PIT	n/a	n/a	14.4	4/18/2011	98.81%	54.27%	5.42%	54.09%	5.26%	NYA	
			Winthrop NFH	Spring Creek	38,633	CWT/PIT	19.6	3/10/11	16.5	4/10/2011	93.48%	40.97%	3.62%	38.30%	3.17%	NYA	Saprolegnia Infection (flag tail) - release started early; Saprolegnia observed on-station pre-transfer worsened after transfer. Co-mingled with coho
			Methow FH/GCPUD	on-station	288,013	CWT/PIT	n/a	n/a	19.3	4/19/2011	99.90%	46.68%	3.79%	47.92%	3.81%	NYA	
			Methow FH/GCPUD	Wolf Creek	59,980	CWT/PIT	18.2	3/31/11	17.4	4/19/2011	99.08%	42.33%	3.99%	42.74%	3.97%	NYA	6,000 PIT tags; no other species in pond
2012	Wenatchee	Steelhead	Wenatchee Steelhead (CPUD)	Rohlfing's Pond (Nason Creek)	18,254	VIE/PIT	27.9	3/20/12	19.7	5/15/2012	93.80%	9.37%	3.00%	6.76%	1.37%	NYA	Poor outmigration survival due to extremely small size at transfer and subsequent release
	Methow	Spring Chinook	Winthrop NFH	Spring Creek	51,550	CWT/PIT	22.7	3/6/12	17.9	4/26/2012	98.70%	53.91%	5.19%	54.83%	4.14%	NYA	Co-mingled with coho
			Winthrop NFH	on-station	551,509	CWT/PIT	n/a	n/a	15.3	4/16/2012	105.6%*	50.58%	4.20%	53.43%	3.63%	NYA	*- Detection efficiency was 24.7% for the Spring Creek array
			Methow FH/GCPUD	on-station	284,389	CWT/PIT	n/a	n/a	16.9	4/23/2012	98.58%	64.70%	7.39%	63.43%	7.21%	NYA	
			Methow FH/GCPUD	Mid-Valley Pond	51,151	CWT/PIT	20.0	3/27/12	16.6	4/23/2012	91.50%	56.32%	3.74%	51.69%	3.41%	NYA	
2013	Methow	Spring Chinook	Winthrop NFH	Spring Creek	46,498	CWT/PIT	24.2	3/6/13	18.8	4/19/2013	94.99%	70.59%	9.30%	67.05%	8.72%	NYA	Co-mingled with coho
			Winthrop NFH	on-station	375,147	CWT/PIT	n/a	n/a	15.1	4/15/2013	100.6%*	53.98%	6.85%	56.65%	6.98%	NYA	*- Detection efficiency was 57.1% for the Spring Creek array
			Methow FH/GCPUD	on-station	341,399	CWT/PIT	n/a	n/a	13.5	4/19/2013	99.60%	55.29%	8.42%	54.21%	8.23%	NYA	
			Methow FH/GCPUD	Mid-Valley Pond	55,519	CWT/PIT	19.5	3/19/13	15.1	4/12/2013	85.60%	43.04%	7.54%	36.81%	6.45%	NYA	
2014	Methow	Spring Chinook	Methow FH/GCPUD	on-station	181,050	CWT/PIT	n/a	n/a	17.6	4/21/2014	99.84%	38.21%	6.47%	39.67%	6.61%	NYA	
			Methow FH/GCPUD	Mid-Valley Pond	22,039	CWT/PIT	20.0	3/19/14	15.1	4/21/2014	70.88%	44.49%	7.72%	30.92%	5.30%	NYA	

Wells and Rocky Reach HCP Hatchery Committees

DRAFT Statement of Agreement

Goat Wall Acclimation Plan

February 18, 2015

Statement

The Wells and Rocky Reach Hatchery Committees agree to acclimate 25,000 Methow spring Chinook at the Goat Wall Acclimation Site as part of YN's Upper Columbia Spring Chinook and Steelhead Acclimation Project's (BPA Project# 2009-00-001) beginning with the 2016 release (BY2014) Goat Wall. The smolts would be short-term acclimated annually between March and May. This agreement will extend for 5 years, contingent upon HC annual review and concurrence of acceptable in-pond survival and/or concurrence of acceptable remediation actions to address unacceptable in-pond survival. ~~unless otherwise modified by the HC.~~ Annual reports and monthly updates will be provided to the HCP HC.

Commented [KT1]: This may be totally unacceptable to you. What I'm trying to get to is a a way to annually identify a process to assess the in-pond survival and provide an off-ramp if survival is sufficienly low and can't be adequately addressed. Because this is an untested pond, seems appropriate to have a off-ramp process. Thoughts?

Background

YN's Upper Columbia Spring Chinook and Steelhead Acclimation Project is based on the premise that acclimating and releasing salmon and steelhead smolts in select locations can increase the effectiveness of integrated (conservation) programs Additional details can be found in Attachment 1 (Upper Methow Spring Chinook Acclimation Proposal). This SOA is also contingent upon approval of a similar SOA from the PRCC HSC.

Wells and Rocky Reach HCP Hatchery Committees

DRAFT Statement of Agreement

Goat Wall Acclimation Plan

February 18, 2015

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The Wells and Rocky Reach Hatchery Committees agree to acclimate 25,000 Methow spring Chinook at the Goat Wall Acclimation Site as part of YN's Upper Columbia Spring Chinook and Steelhead Acclimation Project's (BPA Project# 2009-00-001) beginning with the 2016 release (BY2014) Goat Wall. The smolts would be short-term acclimated annually between March and May. Releases will continue through 2020 ,~~This agreement will extend for 5 years,~~ contingent upon HC annual review and concurrence of acceptable juvenile~~in-pond~~ survival and/or concurrence of acceptable remediation actions to address unacceptable juvenile survival~~ in-pond survival~~. ~~unless otherwise modified by the HC.~~ Annual reports and monthly updates will be provided to the HCP HC.

Background

YN's Upper Columbia Spring Chinook and Steelhead Acclimation Project is based on the premise that acclimating and releasing salmon and steelhead smolts in select locations can increase the effectiveness of integrated (conservation) programs Additional details can be found in Attachment 1 (Upper Methow Spring Chinook Acclimation Proposal). This SOA is also contingent upon approval of a similar SOA from the PRCC HSC.

Memorandum

Date: February 18th, 2015

To: HCP Hatchery Committees

From: Chris Moran (WDFW), McLain Johnson (WDFW) and Catherine Willard (CPUD)

Re: 2015 Wenatchee Steelhead Release Plan (Brood Year 2014)

Background

Chelan PUD is required to produce 247,300 steelhead smolts for release into the Wenatchee River Basin in 2015 as part of the Rock Island and Rocky Reach HCP requirements. As of February, approximately 266,000 Wenatchee summer steelhead (131,146 HxH and 134,429 WxW) are on station at the Facility.

Beginning in winter 2011 the Chelan PUD Wenatchee River steelhead program was relocated to the Chiwawa Acclimation Facility ("Facility") (Figure 1) following significant upgrades to accommodate tributary based overwinter acclimation for the Wenatchee steelhead program. Steelhead are transferred from Eastbank Hatchery to the Facility in November and released in April through May. The Facility consists of three, in line circular, dual-drain tanks within an enclosed building and are operated on a partial water reuse system (RAS). The two outer tanks hold steelhead during rearing and the center tank is used solely for receiving fish that are allowed to move from the outer tanks to the center tank during release. Fish are not provided the opportunity to move to the center tank until gates are removed (typically April 20th). When the center tank contains a pre-determined number of fish for a release, fish are loaded into a hatchery truck and truck-planted at one of five release locations. This "screening" method has been used to differentiate between apparent active migrants (fish that move from the outer tanks to the center tank) from apparent non-active migrants (fish that do not move from the outer tank to the center tank).

In addition to the circular vessels, there are three traditional flow-through raceways (RCY) located outside. The smaller of the three, Raceway Three (RCY3) is used to rear steelhead when it is not needed for rearing "high ELISA" spring Chinook juveniles. Raceways One (RCY1) and Two (RCY2) are located adjacent to each other. The wall between the two raceways contains a gated opening that when removed, allows fish to move between the raceways. In addition to removing the gate, the water is lowered in the receiving pond (typically April 20th) to establish a directional flow that apparent active migrant fish may cue to. Similar to the RAS vessels, this set-up allows for a screening method that attempts to differentiate between apparent active- and apparent non-active migrants. When RCY1 contains the pre-determined number of fish suitable for release, fish are loaded into a transport truck and truck-planted at one of five release locations. Historically, this screening method has been termed a volitional release but is currently termed a screening method as this more accurately describes the end result of the action.

2015 Release Strategy Objectives

- Evaluate best hatchery management practices for hatchery releases to optimize homing fidelity, minimize residualism, maximize out-migration survival, and minimize negative ecological interactions (Draft NMFS Wenatchee River Steelhead Section 10 Permit).
- Assess hatchery release practices to inform development of a residualism baseline for the Wenatchee steelhead program consistent with the Draft NMFS Wenatchee River Steelhead Section 10 Permit DRAFT Steelhead Residual Management Plan.
- Utilize data collected from the 2015 Wenatchee River Steelhead release to assess applicable monitoring and evaluation objectives (i.e., Objectives 4 and 6) for the Wenatchee River summer steelhead hatchery program (Hillman et al. 2013).

Methods

The 2015 release strategy will evaluate the effectiveness of the screening method, and the role of rearing vessel (RAS versus FT), and brood origin on fish performance (e.g., juvenile survival and SARS). A similar evaluation of this screening method (termed volitional release) was conducted in 2013, where approximately 20,000 passive integrated transponder (PIT) tagged juvenile steelhead were utilized for detailed monitoring and evaluation of post release performance. For 2015, the release numbers and locations identified in Table 1 will build on the 2013 release data and enable a more thorough investigation of the screening methodology at the program level.

Release Timing

Wagner et al. (1963) suggested that the optimal release date of hatchery steelhead is equal to the peak of the wild steelhead emigration in the same watershed. Additionally the Draft NMFS Wenatchee River Steelhead Section 10 Permit states the following “The Permit Holders will release hatchery origin smolts at 6 fish per pound when fish are ready to emigrate directly to the ocean and during the period in which natural origin smolts out-migrate from the Wenatchee Basin”. Based on the last five years of Lower Wenatchee smolt trap outmigration data, natural origin Wenatchee steelhead emigration peaks the first week of May. In 2013 survival to McNary Dam for Wenatchee hatchery steelhead juveniles was found to be negatively related to release date (r=-0.506, p=0.04) and positively related to juveniles detected in the Wenatchee Basin after July 1 (Figure 1). In an effort to more closely align hatchery steelhead releases with the peak outmigration period for wild steelhead and potentially increase smolt to smolt survival, all fish located at the Facility will be released by May 8th; fish acclimated at Blackbird Island Pond will be allowed to volitionally move out of the pond through the end of June (after which time the pond outlet will be closed as in years past).

Release Location

In an effort to reduce potential steelhead residualism, consistent with objectives of this steelhead release plan and found in the Draft NMFS Wenatchee River Steelhead Section 10 permit, two historic hatchery steelhead release locations, RKM 15.6 of the Chiwawa River and RKM 19.3 of Nason Creek, will be eliminated for the 2015 release. Hausch and Melnychuk (2012) completed a meta-analysis of hatchery practices and residualization of hatchery steelhead and found that releases of fish located closer to a confluence with a major river produced fewer residuals than those located further upstream. The remaining release locations, one each in Nason Creek, Chiwawa River, upper Wenatchee River, and the lower Wenatchee River are included in Table 1 below.

Pre-release Monitoring and Evaluation

Throughout acclimation and release, established sampling, transfer and release protocols will be followed (Hillman et al. 2013). Additionally, assessment of precocial maturation will be conducted via lethal sampling from Raceways 1 and 2 (n=150 “first movers”; n=150 “late movers”, n= “150 non-movers”. Prior to transfer and release, WDFW and CCPUD will develop a detailed plan that ensures all procedures for assessing precocial maturation (e.g. lengths, weights, gonadal mass measurements, etc.) are followed.

Table 1. Steelhead release numbers and locations, 2015.

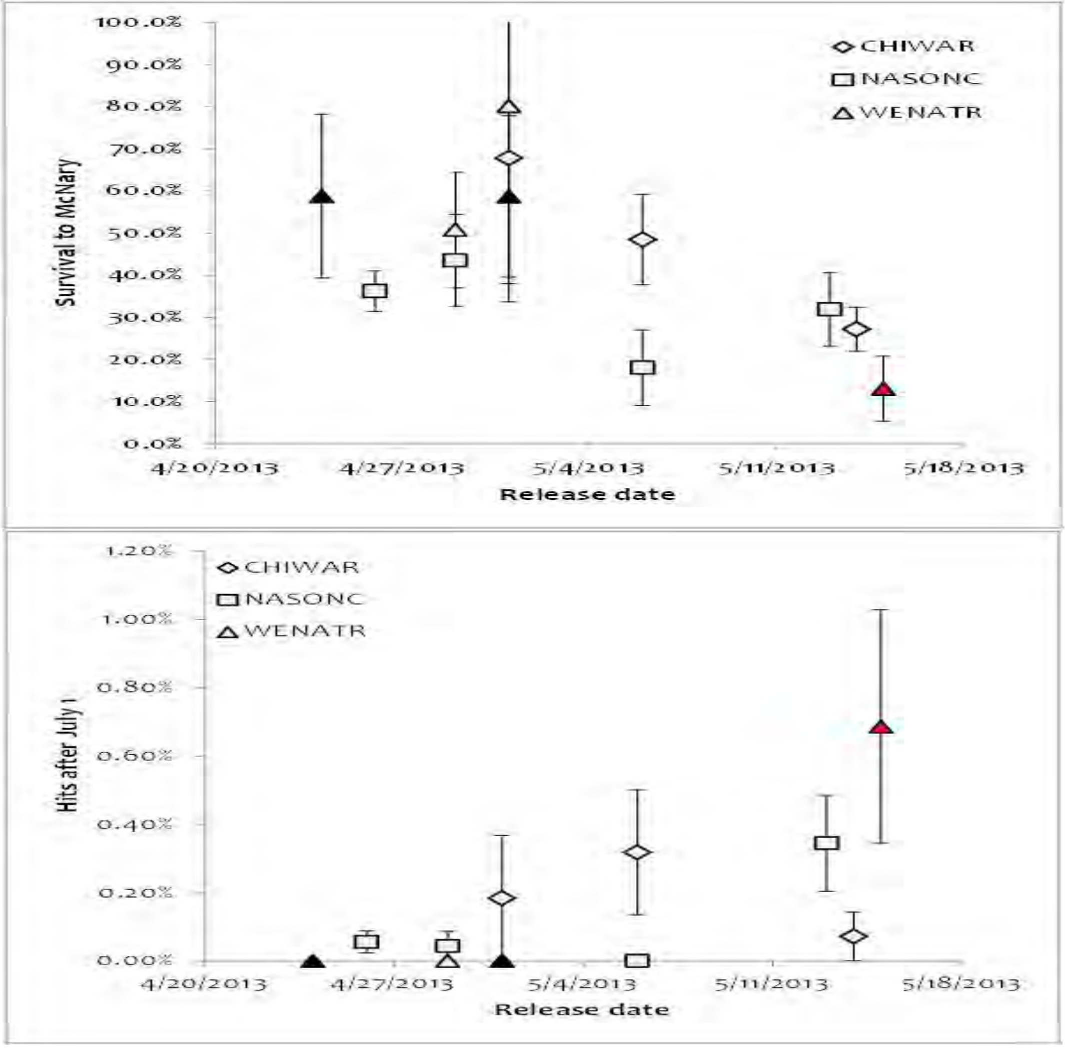
Vessel	Origin[1]	Number	Estimated # PIT-tagged	Destination	rkm	Screened or non-screened method
RAS1	WxW	6,250	1,225	Nason	7.0	Non-screened
RCY1	Mixed	29,640	1,667	Nason	7.0	Screened
RAS2	WxW	6,250	1,225	Nason	7.0	Screened
RCY2	Mixed	29,640	1,667	Nason	7.0	Non-screened
		71,780		**Total**		
RAS1	WxW	6,250	1,225	U. Wenatchee	79.2	Non-screened
RCY1	Mixed	49,000	2,756	U. Wenatchee	79.2	Screened
RAS2	WxW	6,250	1,225	U. Wenatchee	79.2	Screened
RCY2	Mixed	49,000	2,756	U. Wenatchee	79.2	Non-screened
		110,500		**Total**		
RCY2	Mixed	28,046	1,577	Chiwawa	11.4	Non-screened
RCY1	Mixed	28,046	1,577	Chiwawa	11.4	Screened
		56,092		**Total**		
RCY1	Mixed	TBD		L. Wenatchee	40.2	Non-movers
ELISA	HxH	28,196	2,100	Blackbird	40.5	N/A

[1] Mixed = HxH and WxW.

[2] Both forced and volitional releases will occur April 20 - May 8; any remaining non-migrants will be released by May 8.

Figure 1. Chiwawa Acclimation Facility site description.

Figure 2. Wenatchee yearling steelhead survival (top panel) and proportion of fish detected in-basin after July 1 (lower panel) by release sites and dates.



* Red fill represents the release of non-exiting fish, black fill represents fish forced-released, and open fill represents fish volitionally released.

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees	**Date:**	April 15, 2015
From:	Mike Schiewe, HCP Hatchery Committees Chair		
Cc:	Kristi Geris		
Re:	Final Minutes of the March 18, 2015 HCP Hatchery Committees Meeting		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees meeting was held at Douglas PUD headquarters in East Wenatchee, Washington, on Wednesday, March 18, 2015, from 9:30 am to 12:30 pm. Attendees are listed in Attachment A to these meeting minutes.

ACTION ITEM SUMMARY

- Keely Murdoch will provide a draft Yakama Nation (YN) Kelt Sampling Protocol for sampling at Wells Dam in 2015, to Kristi Geris for distribution to the Hatchery Committees and discussion during the Hatchery Committees meeting on April 15, 2015 (Item I-A). *(Note: Murdoch provided the protocol to Geris on April 2, 2015, which Geris distributed to the Hatchery Committees that same day.)*
- Mike Tonseth and Craig Busack will consult Ken Warheit (Washington Department of Fish and Wildlife [WDFW]) regarding decision rules for White River and Little Wenatchee River broodstock assignments for the Nason Creek Conservation Program (Item II-A).
- Mike Tonseth will provide the revised draft 2015 Broodstock Collection Protocols to Kristi Geris by Monday, March 23, 2015, for distribution to the Hatchery Committees and Wells HCP Coordinating Committee for review, with Hatchery Committees' comments due to Tonseth by close of business Thursday, March 26, 2015; Tonseth will provide a final revised draft for approval by Friday, March 27, 2015, with email vote due by Monday, April 6, 2015 (Item II-A). *(Note: Tonseth distributed the revised draft protocols for approval to Kristi Geris on March 27, 2015, as discussed; and the Colville Confederated Tribes [CCT], Chelan PUD, and Douglas PUD provided edits on the revised draft protocols for approval to Geris on March 31, April 1, and April 6, 2015, respectively, which Geris distributed to the Hatchery Committees those same*

days. Tonseth then provided the final draft protocols for approval to Geris on April 8, 2015, which Geris distributed to the Hatchery Committees that same day.)

- Keely Murdoch will verify the YN's approval, disapproval, or abstention on the draft Chelan PUD Methow Spring Chinook Hatchery Production Statement of Agreement (SOA) by Wednesday, April 1, 2015 (Item III-A). *(Note: Murdoch provided a separate SOA for approval to Kristi Geris on March 20, 2015, which the Hatchery Committees approved as revised on March 31, 2015.)*
- The Hatchery Evaluation Technical Team (HETT) will convene to discuss a timeline for finalizing the Hatchery Monitoring and Evaluation (M&E) Plan appendices and will report back to the Hatchery Committees during the next meeting on April 15, 2015 (Item III-C). *(Note: a meeting is scheduled for Wednesday, April 29, 2015.)*

DECISION SUMMARY

- The Hatchery Committees representatives present approved the 2015 Steelhead Release Plan (Item III-B).
- The Hatchery Committees approved via email the Final SOA "Regarding Timeline for Review of 'Evaluation of Hatchery Programs Funded by Douglas County PUD 5-Year Report 2006-2010'", as revised, as follows: Chelan PUD, National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS), WDFW, the CCT, and the YN approved March 27, 2015, and Douglas PUD approved March 31, 2015.
- The Hatchery Committees approved via email the Final 2015 Broodstock Collection Protocols, as follows: Chelan PUD, NMFS, WDFW, and the CCT approved April 8, 2015, Douglas PUD and the YN approved April 9, 2015, and USFWS approved April 10, 2015 (Item II-A).

AGREEMENTS

- The Hatchery Committees unanimously agreed to revisit the results of M&E in the Methow Basin to date, and develop an adaptive management plan to improve the performance of the Methow Hatchery Programs (Item III-A).
- The Hatchery Committees representatives present agreed to reconvene the HETT to finalize the Hatchery M&E Plan appendices (Item III-C).
- The Hatchery Committees representatives present agreed for Chelan PUD to continue

their Summer Chinook Size Target Study for an additional year (Item III-D).

REVIEW ITEMS

- Kristi Geris sent an email to the Hatchery Committees on March 27, 2015, notifying them that the revised draft Broodstock Collection Protocols for approval is available for review, with approval, disapproval, or abstention due to Mike Tonseth by April 6, 2015 (Item II-A). *(Note: the CCT, Chelan PUD, and Douglas PUD provided edits on the revised draft protocols for approval to Kristi Geris on March 31, April 1, and April 6, 2015, respectively, which Geris distributed to the Hatchery Committees those same days. Tonseth then provided the final draft protocols for approval to Geris on April 8, 2015, which Geris distributed to the Hatchery Committees that same day.)*
- Kristi Geris sent an email to the Hatchery Committees on April 1, 2015, notifying them that the draft 2014 Chelan PUD and Grant PUD Hatchery M&E Annual Report is available for a 60-day review, with edits and comments due to Tracy Hillman by Monday, June 1, 2015.

FINALIZED DOCUMENTS

- The final 2015 Steelhead Release Plan for the Wenatchee Basin was distributed to the Hatchery Committees by Kristi Geris on March 19, 2015 (Item III-B).
- The final 2014 Wells HCP Annual Report was distributed to the Hatchery Committees by Kristi Geris on March 27, 2015.
- The final 2014 Rocky Reach and Rock Island HCP Annual Reports were distributed to the Hatchery Committees by Kristi Geris on April 10, 2015.
- The final 2015 Broodstock Collection Protocols was distributed to the Hatchery Committees by Kristi Geris on April 13, 2015 (Item II-A). *(Note: a revised final protocols was distributed on April 14, 2015.)*

I. Welcome

A. Review Agenda, Review Last Meeting Action Items, Approve the February 18, 2015 Meeting Minutes (Mike Schiewe)

Mike Schiewe welcomed the Hatchery Committees and asked for any additions or changes to the agenda. Greg Mackey added an update on the Wells Hatchery Modernization.

The Hatchery Committees reviewed the revised draft February 18, 2015 meeting minutes. Mackey requested clarification of the exchange between Craig Busack and Keely Murdock about Chelan PUD's Methow spring Chinook salmon hatchery production and low smolt-to-adult return rates (SARs) for Methow Fish Hatchery (FH). Murdoch clarified that the discussion was regarding a number of spring Chinook salmon programs in the Methow Basin, not just Methow FH. Kristi Geris will incorporate the edits, as discussed, into the revised minutes. She said that all other comments and revisions received from members of the Committees have been incorporated into the revised minutes. The Hatchery Committees members present approved the draft February 18, 2015 meeting minutes, as revised.

Action items from the Hatchery Committees meeting on February 18, 2015, and follow-up discussions were as follows (italicized item numbers below correspond to agenda items from the meeting on February 18, 2015):

- *Kirk Truscott will provide the CCT's edits and approval of the revised draft Hatchery Committees January 21, 2015 meeting minutes via email to Kristi Geris by Thursday, February 19, 2015 (Item I-A).*
  Truscott provided CCT approval of the revised draft minutes via email to Geris on February 19, 2015, which Geris distributed to the Hatchery Committees that same day.
- *Chelan PUD will coordinate with Douglas PUD, Grant PUD, and WDFW on actions needed to finalize the Hatchery M&E Plan Appendices, and will report back to the Hatchery Committees during the next Hatchery Committees meeting on March 18, 2015 (Item I-A).*
  This will be discussed during today's meeting.
- *Keely Murdoch will coordinate internally with YN staff and with Charlie Snow (WDFW) on drafting a kelt sampling protocol for Wells Dam by April 15, 2015; the YN will provide the draft protocol to Kristi Geris for distribution to the Hatchery Committees (Item I-A).*
  Murdoch said that she will provide a draft YN Kelt Sampling Protocol for sampling at Wells Dam in 2015, to Geris for distribution to the Hatchery Committees and discussion during the Hatchery Committees meeting on April 15, 2015.

- *Chelan PUD will provide a summary report on the water recirculation pilot studies at Eastbank FH and Chiwawa Fish Facility to Kristi Geris for distribution to the Hatchery Committees (Item I-A).*
  Underwood provided the final report to Geris following the meeting on February 18, 2015, which Geris distributed to the Hatchery Committees on February 19, 2015; a corrected final report was distributed on February 24, 2015.
- *Chelan PUD will provide their draft Methow Spring Chinook Hatchery Production Obligation SOA to Kristi Geris for distribution to the Hatchery Committees (Item III-B).*
  Alene Underwood provided the draft SOA to Geris following the meeting on February 18, 2015, which Geris distributed to the Hatchery Committees on February 19, 2015. This will be discussed further during today's meeting.
- *Hatchery Committees representatives will submit edits and comments on the revised draft Wenatchee Spring Chinook Permit Re-initiation Letter to be sent to the NMFS from the Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Sub-Committee (PRCC HSC) to Alene Underwood by Friday, February 27, 2015 (Item III-D).*
  No edits and comments on the revised draft letter were received, and the final letter was sent to NMFS on March 6, 2015.
- *The YN will provide a revised draft YN Upper Methow Spring Chinook Acclimation Proposal and revised SOA to Kristi Geris for distribution to the Hatchery Committees by Friday, February 20, 2015; Hatchery Committees representatives will submit their approval, disapproval, or abstention via email to the YN (with a copy to Geris) by Wednesday, March 4, 2015 (Item IV-B).*
  The final draft proposal and SOA were distributed to the Hatchery Committees on February 20, 2015, as discussed; the Hatchery Committees approved the proposal and SOA, with NMFS abstaining, as follows: the YN approved on March 3, 2015, NMFS abstained on March 3, 2015, Chelan PUD, Douglas PUD, WDFW, and the CCT approved on March 4, 2015, and USFWS approved on March 5, 2015.
- *Hatchery Committees representatives will submit edits and comments on the draft 2015 Steelhead Release Plan to Mike Tonseth and Catherine Willard by Wednesday, March 4, 2015 (Item V-A).*
  This will be discussed during today's meeting.

- *Hatchery Committees representatives will submit edits and comments on the draft 2015 Broodstock Collection Protocols to Mike Tonseth by Wednesday, March 6, 2015 (Item VI-A).*

  Edits and comments on the draft protocols were received, and the revised draft protocols were distributed to the Hatchery Committees by Kristi Geris on March 12, 2015. This will be discussed further during today's meeting.
- *Kristi Geris will distribute the draft 2015 Broodstock Collection Protocols to the Wells HCP Coordinating Committees for review, with comments due to Mike Tonseth by Wednesday, March 6, 2015 (Item VI-A).*

  Geris distributed the draft protocols to the Wells HCP Coordinating Committees on February 19, 2015. Revised draft protocols were distributed on March 12, 2015.
- *Mike Tonseth will coordinate with Craig Busack regarding an adult management section for the draft 2015 Broodstock Collection Protocols (Item VI-A).*

  This will be discussed during today's meeting.
- *Kristi Geris will add Tracy Hillman to the Hatchery Committees email distribution lists (Item IX-B).*

  Geris added Hillman to the appropriate distribution lists on February 19, 2015, as discussed.
- *Kristi Geris will contact Julene McGregor (Douglas PUD Information Systems Staff) to request access to the HCP Hatchery Committees Extranet site for Tracy Hillman (Item IX-B).*

  Geris sent an email to McGregor on February 19, 2015, requesting access for Hillman, as discussed.

II. WDFW

A. DECISION/Discussion: Revised Draft 2015 Broodstock Collection Protocols (Mike Tonseth)

Mike Tonseth said several members provided comments on the draft 2015 Broodstock Collection Protocols, and the revised draft protocols (Attachment B) were distributed to the Hatchery Committees by Kristi Geris on March 12, 2015. Tonseth said that he provided responses to almost all comments, and that there are only a few outstanding items regarding marking for the Okanogan, Chiwawa, and Nason programs. The Hatchery Committees discussed additional comments, as follows:

Douglas PUD Comments

Methow River Basin Spring Chinook (page 7, first paragraph)

Greg Mackey noted he will provide edits to this statement, which clarifies what needs to occur.

YN Comments

Methow River Basin Spring Chinook (page 3, first paragraph of this section)

Keely Murdoch said that the YN does not agree with Chelan PUD's deletion of, "including the Methow and Chewuch programs." Murdoch said she understands that because this is a composite broodstock it is technically not a program; however, she said this is similar to the Nason "program." Alene Underwood suggested changing "program" to "releases." Mackey said that neither are accurate because the statement is referring to the actual collection of fish from a population, irrespective of where the fish are going (i.e., the statement is about removal of fish). Kirk Truscott suggested adding, "brood collection of NORs at Wells will be based upon assignment of Twisp to the Twisp program and non-Twisp with the non-Twisp NORs being used to support Methow and Chewuch River releases."

Chiwawa River Conservation Program Broodstocking (page 20, second bullet, fourth sub-bullet)

Murdoch cautioned that indicating, "up to 50% of the total broodstock requirement would be collected," could result in not collecting enough broodstock. She suggested including a statement that allows the opportunity mid-season to increase that number collected, if needed. Tonseth said that opportunity will be available, and he noted that hatchery staff will be continually tracking the run. Murdoch suggested removing 50% and indicating sufficient broodstock will be collected to meet program. Tonseth explained the protocols provide guidance to hatchery staff, and including numbers is intended to avoid potential confusion. He added that he still provides real time updates. Murdoch said leaving 50% is okay, so long as there is an understanding that the number may change. Tonseth suggested adding a disclaimer that actual collection of hatchery fish may be higher or lower depending on run composition. Truscott suggested revising the language such that in the event that insufficient natural-origin recruits (NORs) are collected to meet program, hatchery-origin recruits (HORs) will be collected to make up any shortfall. Craig Busack said that for permitting NMFS needs explicit language.

Nason Creek Conservation Program Broodstocking (page 21, first bullet)

Murdoch said, as the YN noted in the draft Section 10 Permit and Biological Opinion (BiOp), they were unaware that Little Wenatchee fish were as genetically distinct as White River fish. She asked if Little Wenatchee fish can be identified with a high degree of certainty. Busack asked about the intent of this protocol. Truscott said the protocol allows collection of up to 11% of fish that do not assign to Nason or Chiwawa. Murdoch said that when fish return to Nason Creek, they typically do not type back to Nason Creek. She vaguely recalled a study where only one fish typed to Nason. Busack said that his recollection of this study was that of fish collected and classified as Nason Creek, there was about a 30% chance the fish typed to Chiwawa. However, he said he would need to confirm this. He asked Murdoch if she was requesting further clarification on the decision rule, and Murdoch said that is correct. Murdoch added that the YN initially considered excluding White River, Nason, and Chiwawa broodstock; however, the draft BiOp included the Little Wenatchee for exclusion, and now both are listed in broodstock protocols. Busack reviewed a 2013 study by Ken Warheit, and based on this study, Busack said inclusion of the Little Wenatchee may have been an error. Todd Pearsons (Grant PUD) asked if the concern is that fish will be released that should be kept. Murdoch agreed that this is a concern, as well as the inability to distinguish Little Wenatchee fish. Busack suggested removing the Little Wenatchee for now and consulting Ken Warheit. Busack asked if the protocol would be acceptable if the Little Wenatchee was removed, and Murdoch said it would be. Truscott suggested the over-collection percentage be based on the proportion of NORs that do not assign to Nason and Chiwawa. Murdoch said she thought that all fish collected would be kept, excluding those assigning to White River. Pearsons suggested establishing decision rules for guidance, including minimum assignment rates. Tonseth said that other rules may address if/then scenarios. He suggested also reviewing the sideboard language established in 2013. Busack noted there is a lot of uncertainty in any given assignment. He added Warheit has likely already established decision rules. Truscott asked if the 11% was based on certainty. Murdoch said that she calculated the 11%, which is the proportion of fish that spawn in White River; however, it does not account for spawning probabilities. Busack asked if this meant that on average, 11% of NORs spawn in the White River. Murdoch said that is correct, during about a 10-year period. She also added it should be a safe over-collection number. Busack asked if decision rules are needed, and Pearsons recommended doing so to clearly define for hatchery staff when to keep or release fish. Tonseth and Busack said they will consult Warheit regarding decision rules for White River and Little Wenatchee River broodstock assignments for the Nason Creek Conservation Program.

CCT Comments

Appendix B (page 29, BY 2015, Okanogan spring Chinook)

Truscott noted that spring Chinook salmon released from the Okanogan Reintroduction Program will be adipose-present. Tonseth said that this will be okay in the near-term, but may be problematic if Wells Dam is used for adult management or returns of HORs are so low they are collected at the dam.

Tonseth said that he will provide the revised draft 2015 Broodstock Collection Protocols to Geris by Monday, March 23, 2015, for distribution to the Hatchery Committees and Wells HCP Coordinating Committee for review, with Hatchery Committees' comments due to Tonseth by close of business Thursday, March 26, 2015. Tonseth will then provide a final revised draft for approval by Friday, March 27, 2015, with email vote due by Monday, April 6, 2015. *(Note: Tonseth distributed the revised draft protocols for approval to Geris on March 27, 2015, as discussed; and the CCT, Chelan PUD, and Douglas PUD provided edits on the revised draft protocols for approval to Geris on March 31, April 1, and April 6, 2015, respectively, which Geris distributed to the Hatchery Committees those same days. Tonseth then provided the final draft protocols for approval to Geris on April 8, 2015, which Geris distributed to the Hatchery Committees that same day.)*

The Hatchery Committees approved via email the final 2015 Broodstock Collection Protocols, as follows: Chelan PUD, NMFS, WDFW, and the CCT approved April 8, 2015, Douglas PUD and the YN approved April 9, 2015, and USFWS approved April 10, 2015. The final protocols was distributed to the Hatchery Committees by Geris on April 13, 2015.

III. Chelan PUD

A. DECISION: Methow Spring Chinook Hatchery Production SOA (Alene Underwood)

Alene Underwood said the draft Methow Spring Chinook Hatchery Production Obligation SOA was distributed to the Hatchery Committees by Kristi Geris on February 19, 2015. Underwood said the only comments received on the draft SOA were from the YN

(Attachment C), which were distributed to the Hatchery Committees by Geris on March 17, 2015. Underwood said that Chelan PUD does not support incorporation of the YN edits. She explained that a 1-year sharing agreement is: 1) not an option; 2) does not provide necessary stability or assurance that any party to the agreement meets its HCP obligations; 3) goes against the spirit of hatchery sharing agreements; and 4) makes uncertain the ability to meet long-term obligations. She added, regarding Chelan PUD developing and implementing a study to address conditions in the Methow Basin, Chelan PUD does not recognize this as their sole responsibility. She noted that Chelan PUD is fulfilling their Methow Basin obligation by releasing fish in the Chewuch, and if the Hatchery Committees wish to develop a proposal addressing issues above and beyond that, Chelan PUD is willing to participate, separately from this SOA.

Matt Cooper asked if Chelan PUD wants any dates in this SOA, and Underwood said that they do not. Underwood added this SOA is intended to be consistent with all HCP long-term agreements, which Greg Mackey noted is at least 10 years. Tom Kahler noted that logistically, an agreement cannot be made for only 1 year because fish need to be on station longer than that. Murdoch said that, as discussed last month and the month before, the YN are not prepared to agree to a long-term commitment to a program they think does not work. She added that data show poor results for Methow-reared fish, and the YN will not enter into an agreement unless there are efforts to remedy the concerns. She added that the YN considers their edits to be a condition of reaching agreement.

Greg Mackey noted the Hatchery Committees agreement is separate from the Interlocal Agreement (ILA) between Douglas PUD and Chelan PUD. He explained all PUDs are obliged by law to have ILAs when sharing resources with each other. He said this relates to distribution of rate payers’ money, and the limitation of giving away something of value without being compensated. He also added that ILAs are a very rigid process. He said what Douglas PUD looks for in this agreement is long-term stability, mutually beneficial terms, and ease of implementation. He added that Douglas PUD’s concern is that Douglas PUD and Chelan PUD have already negotiated an ILA, so Douglas PUD may not be able to support anything different than the currently proposed SOA. Tom Kahler added that Grant PUD is affected by this agreement as well, so it is not a simple matter to start changing things. He also added that there is a lot of legal staff time and approval that is required; so, it is also impractical for Douglas PUD to develop a short-term agreement.

Kirk Truscott said he understands the YN revisions being problematic to the PUDs. He added he also understands the YN concerns regarding lack of homing fidelity to the Chewuch. He said, however, if the options are agreeing to Chelan PUD's proposed SOA or reverting back to last year's broodstock collection methods, then he would agree with the SOA as originally presented. He said there are understandable concerns with homing fidelity to the Chewuch, which he believes the Hatchery Committees should commit to addressing. He noted that approving Chelan PUD's SOA does not preclude addressing issues in the Chewuch.

Mike Tonseth agreed with Truscott and Murdoch in terms of SAR performance and homing fidelity; however, he said these issues are not limited to just one program. He recalled that during the last recalculation of the HCP programs, the Joint Fisheries Parties agreed not to compartmentalize the Methow program. He added, based on the last Five-Year Hatchery M&E Report, the Chewuch is not the only place with homing fidelity issues. He said these issues are bigger than just Chelan PUD's mitigation obligation, and the YN's revisions unfairly tie Chelan PUD to a commitment that is really the responsibly of all signatories to the HCPs, as well as Grant PUD. He suggested Douglas PUD and Chelan PUD move forward with their proposed ILA, and a separate "sister" SOA could be drafted that commits the Hatchery Committees to address the issues in the Methow jointly. Murdoch said the YN could probably agree to a separate SOA; however, they will not agree to a long-term SOA until such an SOA is approved.

Craig Busack said NMFS welcomes this new agreement between Chelan PUD and Douglas PUD; and added NMFS may not even be able to permit Chelan PUD's fallback plans. He said NMFS prefers that Chelan PUD's program returns to how it operated before. He said, in moving forward, NMFS agrees with WDFW and the CCT (i.e., fix what is broken and change things moving forward, as needed).

Kahler noted, even if this SOA was not being considered, this discussion would still be occurring. Busack asked what existing data indicate about homing fidelity in the Methow.

Murdoch said about 80% of the Chewuch-released fish return to Methow FH. Mackey noted 80% is the high, and 40% is more typical, which is still higher than desirable. Busack said that it appears there is a high degree of attraction to Methow FH, and he suggested working on fixing that. Mackey said, because this is a conservation program, the goal is to recover the population. He said this involves evaluating metrics and how they affect progress toward meeting this goal, and then making informed decisions. Busack said returning the program to the way it was presents the smallest number of problems for permitting. He added there is a good chance the Chelan PUD Program may fall behind in permitting again if this is not settled soon.

Murdoch noted that addressing the issues in the Methow was discussed in the Five-Year Hatchery M&E Report, and the Hatchery Committees have not responded to them. Busack noted, however, for the past 4 to 5 years, fish have been released from YN acclimation sites to investigate this. Murdoch agreed, but noted all releases were in the vicinity of Methow FH. Busack asked about the purpose of those releases. Murdoch replied it was to test the concept of remote acclimation and not to address issues in the Chewuch.

Underwood said Chelan PUD needs to start collecting broodstock by May 1, 2015, and an agreement is needed before then. She added Chelan PUD is not drafting the sister SOA because their SOA is already drafted. Truscott asked why another paragraph cannot be added to Chelan PUD's SOA just to put the YN at ease about the Hatchery Committees' commitment to investigate improving the Methow program. Mike Schiewe said that Chelan PUD's SOA is just asking permission to enter into an ILA with Douglas PUD; anything further is the responsibility of the Hatchery Committees. Mackey noted Chelan PUD's SOA is a Rocky Reach and Rock Island HCP document, so committing the entire Hatchery Committees in their SOA is not appropriate.

Tonseth said the Hatchery Committees need to review the Five-Year Hatchery M&E Report and develop a plan, which will not happen before Chelan PUD needs approval of this agreement. He asked if it may be possible for the Hatchery Committees to enter in a "gentleman's agreement" that the Committees are committed to actions to improve the Methow programs, with the meeting minutes serving as the record of this agreement, as has been done in the past. He said actions could then start next month and suggested assigning a small subcommittee to evaluate all options and discuss how to develop a plan. Schiewe asked Hatchery Committees representatives if they would consider approval of Chelan PUD's SOA, with an agreement included in the meeting minutes to develop a plan to address the issues in the Methow starting with the results of the M&E program. Chelan PUD, USFWS, the CCT, WDFW, and NMFS approved, and the YN disapproved at this time. Murdoch added she will need to review this with Tom Scribner, and a gentleman's agreement was not likely acceptable. Chelan PUD and Douglas PUD agreed that a drop dead date for needing approval of this SOA would be April 1, 2015. Murdoch said she will verify the YN's approval, disapproval, or abstention on the draft Chelan PUD Methow Spring Chinook Hatchery Production SOA by Wednesday, April 1, 2015. The Hatchery Committees unanimously agreed on the need to revisit the results of M&E in the Methow Basin to date, and develop an adaptive management plan to improve the performance of the Methow Hatchery Programs. *(Note: Murdoch provided a separate SOA for approval to Geris on March 20, 2015, which the Hatchery Committees approved as revised on March 31, 2015.)*

B. DECISION: 2015 Steelhead Release Plan (Catherine Willard and Mike Tonseth)

Catherine Willard said the draft 2015 Steelhead Release Plan for the Wenatchee Basin was distributed to the Hatchery Committees by Kristi Geris on February 17, 2015, with edits and comments due to her and Mike Tonseth by Wednesday, March 4, 2015. Willard said no comments were received on the draft plan.

Keely Murdoch said the YN likes the plan and what it is testing; however, she added that as discussed last month, the plan does not identify the metrics monitored or how those data will be analyzed. Willard said that she remembers this comment, and recalled that because the plan indicates that M&E objectives for the Wenatchee River summer steelhead hatchery program will be assessed, it was decided no revisions were needed. Murdoch said she thought additional information on metrics other than those in the M&E (e.g., rates of residualism) was going to be added. Willard clarified that this plan evaluates metrics that may cause fish to residualize—it does not evaluate residualism itself. Mike Tonseth said, for example, the plan includes gonadal examination. Willard emphasized the document describes a release strategy and is not a research proposal. Murdoch said that next year, the YN would like to see a study proposal. The Hatchery Committees representatives present approved the 2015 Steelhead Release Plan. *(Note: the final plan was distributed to the Hatchery Committees by Geris on March 19, 2015.)*

C. Hatchery M&E Appendices Review (Catherine Willard)

Catherine Willard said, per Chelan PUD's action item to coordinate on actions needed to finalize the Hatchery M&E Plan Appendices, Chelan PUD reviewed the last draft appendices, which were distributed in fall 2013, and suggested reconvening the HETT to finalize the document. Alene Underwood said that this approach can complete the task without bogging down the entire Hatchery Committees. The Hatchery Committees representatives present agreed to reconvene the HETT to finalize the Hatchery M&E Plan appendices. The HETT will convene to discuss a timeline for finalizing the appendices and will report back to the Hatchery Committees during the next meeting on April 15, 2015.

D. Summer Chinook Size Target Study (Catherine Willard)

Catherine Willard said Chelan PUD is proposing to continue the Summer Chinook Size Targets Study for 1 additional year, evaluating the same size targets as were used in the past 2 years, as described in a Brood Year (BY) 2014 Summer Chinook Size Targets Summary (Attachment D) that Willard distributed during the meeting and distributed via email by Kristi Geris following the meeting on March 18, 2015.

Willard said during the first year of this study, there were challenges to reaching the specific size targets. She explained that at Chelan Falls, the four incremental size targets were not achieved (two "small" groups and two "big" groups; instead, two size targets were achieved (i.e., one "big" and one "small" group). At Dryden, fish sizes were not at target until fall, and then growth increased when it needed to flatten out, so the small fish sizes caught up to the large fish sizes. She recalled that for BY 2012, as discussed during the Hatchery Committees meeting on January 21, 2015, size targets were generally met, and preliminary results showed a difference in juvenile performance by rearing vessel x size target group for Wenatchee summer Chinook salmon.

Alene Underwood said Chelan PUD is proposing to continue testing for an additional year to replicate last year's success, which will better inform a long-term decision. She added testing was initially planned for 2 years, with a decision in the third year; however, adding an additional year of testing will push back making a long-term decision another year. Willard added hatchery staff indicated that BY 2013 fish are currently on track to meet size targets.

Kirk Truscott asked if the same compensatory growth is expected this year as was observed in previous years, and if there is a concern there are not distinct size groups. Willard said, for Dryden, the study is intended to contribute information about the performance of smaller sized hatchery-origin fish, which may help Chelan PUD meet the phosphorus total maximum daily load targets at the facility. Underwood added Chelan PUD is uncertain about what to expect this year. She said she hopes that compensatory growth is not as significant as the first year of the study. Todd Pearsons said some compensatory growth may be good in the spring, noting the positive correlation between growth in spring and migration speed and survival. Tracy Hillman asked if the density of fish is changed when fish are transferred to the acclimation ponds (i.e., compensatory growth affect). Willard said that the density decreases when the fish move to the acclimation ponds, and Pearsons clarified the discussion is about physiological growth.

The Hatchery Committees representatives present agreed for Chelan PUD to continue their Summer Chinook Size Target Study for an additional year.

IV. NMFS

A. HGMP Update (Craig Busack)

Craig Busack said he will provide a more comprehensive review on permitting progress during the next NMFS/USFWS BiOp coordination meeting on March 26, 2015. He reviewed brief HGMP updates, as described in the following sections.

Wenatchee Spring Chinook Salmon

The revised draft Wenatchee Spring Chinook Re-initiation BiOp is nearly complete. Amilee Wilson is passing the BiOp to Busack for finalizing so she can tend to the legal action that was recently filed against Leavenworth National Fish Hatchery.

Winthrop Safety-Net and Methow Conservation Spring Chinook Salmon

As discussed last month, Busack plans to re-engage on this BiOp in April 2015. Busack recalled recommending the PUDs and USFWS discuss the following items: 1) sharing research, monitoring, and evaluation (RME) responsibilities; and 2) adult management with regard to developing a proportionate natural influence (PNI) approach for applying a PNI standard to reduce the contribution of the Winthrop Program to percent hatchery-origin spawners. Busack asked if the PUDs and USFWS have discussed these items. Alene Underwood said that regarding shared RME responsibilities, the PUDs and NMFS drafted language which is now with USFWS for review. Busack asked if there has been further discussion, and Underwood replied there has not. Busack said that he will follow up on this. Greg Mackey said, regarding developing a PNI approach, Douglas PUD developed a draft PNI sliding scale, which is also with USFWS for review.

Wenatchee Steelhead

This BiOp is undergoing final formatting. Some elements in the latest template need to be added.

V. USFWS

A. USFWS Bull Trout Consultation Update (Matt Cooper)

Matt Cooper said Karl Halupka (USFWS) is still waiting to receive comments on the draft USFWS Wenatchee BiOp and Incidental Take Statement. Mike Tonseth added Halupka will provide more details on bull trout consultation during the next NMFS/USFWS BiOp Coordination Meeting on March 26, 2015.

VI. Douglas PUD

A. Wells Hatchery Modernization Update (Greg Mackey)

Greg Mackey recalled that the last update was when Douglas PUD was nearing completion of the Conceptual Detailed Design Phase. He said the final design is now complete and that the project is now out to bid, with the bid opening at the end of this week. He said that assuming an acceptable bid is received, Douglas PUD plans to hire a contractor within a couple of weeks. He said construction is scheduled to begin in late-spring 2015. He also recalled that Wells Hatchery will remain fully operational during construction.

Kirk Truscott asked how long construction is expected to last, and Mackey replied through the end of August 2017.

VII. HCP Administration

A. Next Meetings

The next scheduled Hatchery Committees meetings are on April 15, 2015 (Chelan PUD); May 20, 2015 (Douglas PUD); and June 17, 2015 (Chelan PUD).

List of Attachments

Attachment A	List of Attendees
Attachment B	Revised Draft 2015 Broodstock Collection Protocols
Attachment C	Draft Methow Spring Chinook Hatchery Production Obligation SOA – YN Comments
Attachment D	BY 2014 Summer Chinook Size Targets Summary

Attachment A
List of Attendees

Name	Organization
Mike Schiewe	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Alene Underwood*	Chelan PUD
Catherine Willard*	Chelan PUD
Greg Mackey*	Douglas PUD
Tom Kahler*	Douglas PUD
Todd Pearsons	Grant PUD
Craig Busack*†	National Marine Fisheries Service
Matt Cooper*	U.S. Fish and Wildlife Service
Mike Tonseth*	Washington Department of Fish and Wildlife
Kirk Truscott*	Colville Confederated Tribes
Keely Murdoch*	Yakama Nation

Notes:

* Denotes Hatchery Committees member or alternate

† Joined by phone for Decisions Items and HGMP Update

STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE
Wenatchee Research Office
3515 Chelan Hwy 97-A Wenatchee, WA 98801 (509) 664-1227 FAX (509) 662-6606

February ~~6~~12, 2015

To: HCP HC and PRCC HSC

From: Mike Tonseth, WDFW

Subject: **DRAFT UPPER COLUMBIA RIVER SALMON AND STEELHEAD BROODSTOCK OBJECTIVES AND SITE-BASED BROODSTOCK COLLECTION PROTOCOLS**

The attached protocol was developed for hatchery programs rearing spring Chinook salmon, summer Chinook salmon and summer steelhead associated with the mid-Columbia HCPs;~~,~~ spring Chinook salmon, summer Chinook salmon and steelhead programs associated with the 2008 Biological Opinion for the Priest Rapids Hydroelectric Project (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 operated by the Washington Department of Fish and Wildlife (WDFW), with the exception of 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).

This protocol is intended to be a guide for 2015 collection of salmon and steelhead 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, Priest Rapids Salmon and Steelhead Settlement Agreement), changes to programs as approved by the HCP-HC and PRCC-HSC, and to comply with ESA permit provisions, the USFWS 2008 Rocky Reach Biological Opinion (Service reference number 13260-2008-F-0116) ~~?~~and consultation requirements~~?~~.~~.~~

Notable in this year's protocols are:

- Continuing for 2015, no age-2 or 3 males will be incorporated into spring or summer Chinook programs unless necessary to maintain effective population size (minimum female to male ratio of 1:0.75; conservation programs only).

- Use of ultrasono~~a~~graphy~~ultrasonagraphy~~ to determine the sex of each fish retained for brood to better ~~assure~~ ensure achieving the appropriate number of females for program production~~.~~ (Does not include Priest Rapids Hatchery).

Commented [SL1]: I think it's appropriate here to cite the USFWS Rocky Reach BiOp which has terms and conditions to minimize impacts of handling to bull trout at Tumwater Dam.

Added to second paragraph.

Commented [SL2]: "…and to minimize impacts to non-target species." My impression is now this document is being used as a tool for not only salmon and steelhead.

Clarification: this document is an annual program implementation plan thereby a tool for meeting salmon and steelhead mitigation requirements und eth HCPs and Settlement Agreement – it is not a document for how to manage bull trout. Actions taken are intended to meet those program objectives while minimizing impacts to non-target species such as bull trout.

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Commented [KCH3]: May seem redundant, but consider making this explicit to highlight consultation with FWS.

I am fine with leaving it in however once the consultation is complete the ITS becomes part of the ESA permit provisions – semantics I guess.

Commented [AU4]: I would encourage you to only include truly notable differences in 2015 from previous years. As I read through these, most, if not all, of these are ongoing activities, no?

You are correct that many of these are ongoing activities but rather than identifying differences between this year and the previous year, this section is intended to get folks to focus on important elements of the programs for this year even if it is repetitive.

History has shown that if we don't do this to some degree, things have a way of falling through the crack (hopefully the appendices will help alleviate much of those issues as well).

Commented [tp5]: Do you explain later in the document what the threshold is?

No, however I adjusted the note.

Commented [MT6]: Including PRH should be considered. If we are concerned about spawning too many fish, use of ultra sound assures the appropriate female equivalents are on hand so that overages and underage's are minimized.

- Utilization of genetic sampling/assessment to differentiate Twisp River and Methow River Basin natural-origin spring Chinook adults collected at Wells Dam, and CWT interrogation during spawning of hatchery spring Chinook collected at the Twisp Weir and~~,~~ Methow FH ~~and Winthrop NFH~~ to differentiate Twisp and Methow Composite hatchery fish for discrete management of Twisp and Methow Composite production components for the GPUD, CPUD and DPUD programs.

- Collection of only hatchery adult steelhead at Wells Dam/H~~h~~atchery for the Lower Methow safety-net (WFH/MFH), and Wells Hatchery Okanogan and mainstem Columbia safety-net programs.

- Collection of spring Chinook for the Nason Creek and Chiwawa programs using combination of Tumwater Dam and the Chiwawa Weir.

- Targeted collection of 100% of the Wenatchee summer Chinook and Wenatchee hatchery origin steelhead broodstock at Dryden Dam to reduce the number of activities that may contribute to delays in fish passage at Tumwater Dam (some adult collections at Tumwater may be necessary if sufficient adults cannot be acquired at Dryden Dam).

- Targeted collection of 100% of the natural origin steelhead broodstock at Tumwater Dam.

- Collection of summer Chinook broodstock from the Eastbank outfall, sufficient to meet a 576K yearling juvenile Chelan Falls program.

- Collection of surplus hatchery origin steelhead from the Twisp Weir (up to 25% of the required broodstock) to produce the 100K Methow safety-net on-station-released smolts (up to 14 adults). The remainder of the broodstock (37) will be WNFH returns collected at WNFH (or by angling/trapping/tangle netting 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 2016.

- Summer Chinook collections at Wells Dam to support the CJH program may occur if CCT broodstock collection efforts fail to achieve broodstock collection objectives.

- Collection from the Wells Hatchery volunteer channel of Wells summer Chinook to support the YN, Yakima River summer Chinook program.

- Targeted collection of 1,000 adipose present, non-coded wire tagged fall Chinook from the PRD OLAFT.

- Targeted collection of about 400 adipose present, non-coded wire tagged fall Chinook using hook and line efforts in the Hanford Reach.

Commented [JW7]: Do we know if Chelan PUD's program will be collected here also?

We are proceeding as though it will.

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Commented [BG8]: We discontinued this practice. Analysis of data in conjunction with the increased sampling activities associated with surplusing lead us to the conclusion that it was not a practice that was feasible nor did it net many fish….All ad present non-CWT fish (both during spawning and surplusing) are immediately released unharmed or transferred to the state as NOR broodstock….

Edits accepted.

Commented [KCH9]: Surprised by no mention of tangle netting in Nason and Chewuch. Seems like tangle netting had been a secondary broodstock collection approach that is becoming the primary. Seems like a notable change to me.

No tangle netting activities are proposed for 2015 (either Nason or Chewuch). As a point of clarification, notable elements in the protocols are intended to draw the primary audience (e.g hatchery and M&E staff to key things they will be doing. Please keep in mind this is an implementation plan, not an exclusion plan – if it isn't in here we have no plans on doing it.

Commented [SL10]: Please clarify potential target broodstock collection numbers in the event Dryden Dam targets are not able to be achieved. It didn't appear this issue was addressed in the below sections?

There is no way to predict what the likelihood let alone quantify the target numbers would be for going to alternate collection locations. If an alternate location is needed the maximum number to be collected is already identified in their respective program tables.

Commented [KCH11]: Will this require changes in the operation of the Twisp Weir to meet this need, or is the expectation that this broodstock collection will be concurrent with other broodstock collection. Just want to understand if the potential exists for the weir to be operated for additional days solely to collect these 14 steelhead

Not sure what you are referring to in terms of changes to the operation of the Twisp Weir. Broodstock collection for SHD would not run concurrent with spring Chinook (the only other program that would be using this site for BS collection) due to difference in run timing and flow paramters that the trap can operate in. This may be a side discussion that needs to take place between yourself, DPUD and WDFW.

Commented [KT12]: Since 2015 is projected to be a larger return of fall Chinook than 2014, I'm Ok with this for 2015. However, CCT's agreement to target natural origin fall Chinook at the OLAFT was contingent upon progress toward investigations of alternate strategies to collect natural origin fall Chinook in the Hanford Reach. Aside from the ABC, I have not seen any progress on other alternate strategies for Hanford Reach collections. Lack of progress in this effort is not consistent with the spirit of what CCT agreed to when agreeing to NOR collections at the OLAFT. ...

Commented [KCH13]: When we consult on the mainstem programs, we'll want to see available info about non-target species hooked during these efforts, especially bull trout.

Easy enough.

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 2015 Broodstock Collection Protocols are:

Appendix A: 2015 Biological Assumptions for UCR ~~s~~Spring, ~~s~~Summer~~spring, summer~~, and Fall Chinook and 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

Methow River Basin

Spring Chinook

Inclusion of natural-origin fish in the broodstock will be ~~a~~ prioritized for the aggregate conservation program~~.~~ ~~At~~in the Methow ~~Hatchery~~Basin.~~.~~ Collections of natural-origin fish will not exceed 33% of the Methow Composite (i.e., non-Twisp~~, including the Methow and Chewuch programs~~) and Twisp natural-origin run escapement consistent with take provisions in Section 10 (a)(1)(A) Permit 1196.

Commented [c14]: Since there is not a Chewuch program, I recommend deleting to avoid confusion.

This was intended to speak to Methow and Chewuch releases (identified as programs here) which is still part of the overall program. I am fine with the change.

Hatchery-origin spring Chinook will be collected in numbers excess to program production requirements ~~T~~to~~To~~ facilitate BKD management, comply with ESA Section 10 permit take provisions, and to meet programmed ~~production, hatchery-origin spring Chinook, if needed to meet~~ production shortfalls with natural origin fish.~~,~~ ~~will be collected in numbers excess to program production requirements~~. Based on historical Methow FH spring Chinook ELISA levels above 0.12, the hatchery origin spring Chinook broodstock collection will include hatchery origin spring Chinook in excess to broodstock requirements by approximately ~~29.7~~20.5% (based upon the most recent 5-year mean ELISA results for the Methow/Chewuch program; ~~20.5~~29.7% for the Twisp program). For purposes of BKD management and to comply with maximum production levels and other take provisions specified in ESA Section 10 permit 1196, 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 production at 223,765 yearling smolts. Culling of eggs from natural-origin females will not occur unless their ELISA levels are determined by WDFW Fish Health 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 ~~in~~ returning hatchery- and natural-origin spring Chinook will continue and will be reported in the annual monitoring and evaluation report

Commented [KCH15]: Seems a high proportion of extra fish to take!

Proportion wise yes but numerically it amounts to a maximum of about 40 fish (20 females, assuming the broodstock were comprised of 100% HO adults). Also keep in mind this is for hatchery fish – not wild.

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 ~~that~~ 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. Spring Chinook collected at Methow Hatchery will be held at MFH until genetic analysis results are received and then handled accordingly.

Commented [JW16]: Not sure if matters, but we will be holding all Spring Chinook at Wells Hatchery until we receive genetic results back from lab.

Edits should clarify.

Commented [TK17]: Check with Jayson: does his comment mean fish collected in the Methow will be transferred to Wells for holding pending genetic analysis? Otherwise, I'm not following the point of his comment.

No, only Wells collected fish will stay at Wells until the genetic results are in. Fish collected at MFH will stay at MFH (or transferred to WNFH).

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 (combined, these make up the entire Methow Basin spring Chinook population) will be released back into the Columbia River. Based on the broodstock-collection schedule at Wells Dam (3-day/week, 16 hours/day, up to 48 hours per week cumulatively), extraction of natural-origin spring Chinook is expected to be approximately 33% or less.

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 ~~less~~ no more than 33%. Trapping at the Winthrop NFH will be included, if needed, because of broodstock shortfalls.

Pre-season run-escapement of Methow-origin spring Chinook to Wells Dam during 2015 is estimated at 3,185 spring Chinook, including 2,678 hatchery and 507 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.

The following broodstock collection protocol was developed based on BKD management strategies, projected return for BY 2015 Methow Basin spring Chinook at Wells Dam (Table 1 and Table 2), and assumptions listed in Appendix A.

The 2015 aggregate Methow spring Chinook broodstock collection will target up to 130 adult spring Chinook (20 Twisp, 110 Methow; Table 3). Based on the pre-season run forecast, Twisp fish are expected to represent 3% of the adipose present, CWT tagged hatchery adults and 13%

of the natural origin spring Chinook passing above Wells Dam (Tables 1 and 2). Based on this proportional contribution and a collection objective to limit extraction to no greater than 33% of the age-4 and age-5 natural-origin spawning escapement to the Twisp, the 2015 Twisp origin broodstock collection will total 20 wild fish, representing 100% of the broodstock necessary to meet Twisp program production of 30,000 smolts. Methow Composite fish are expected to represent 57% of the adipose present CWT tagged hatchery adults and 87% of the natural origin spring Chinook passing above Wells Dam (Tables 1 and 2). Based on this proportional contribution and a collection objective to limit extraction to no greater than 33% of the age-4 and age-5 natural-origin recruits, the 2015 aggregate Methow broodstock collection will total 110 natural origin spring Chinook.. Broodstock collected for the aggregate Methow program represents 100% of the broodstock necessary to meet the Methow ~~FH~~ program production of ~~193~~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 1196. The Grant/Douglas/Chelan PUD 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~~-~~.

Table 1. Brood year 2010-2012 age class-at-return projection for wild spring Chinook above Wells Dam, 2015.

Brood year	Smolt Estimate		Age-at-return: Twisp Basin				Age-at-return: Methow Basin				
	Twisp[1]	Methow Basin[2]	Age-3	Age-4	Age-5	Total	Age-3	Age-4	Age-5	Total	SAR[3]
2010	8,927	50,165	5	45	**9**	59	62	403	**102**	567	0.00662
2011	10,047	36,344	6	**52**	9	67	45	**292**	74	411	0.00662
2012	12,277	35,976	**7**	62	12	81	**45**	289	73	407	0.00662
Estimated 2015 Return			**7**	**52**	**9**	**68**	**45**	**292**	**102**	**439**	

[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] *Mean Twisp NOR spring Chinook SAR to Wells Dam estimated using natural origin PIT tag returns (BY 2003-2007; Charlie Snow, personal communication).*

Table 2. Brood year 2010-2012 age class and origin run escapement projection for UCR spring Chinook at Wells Dam, 2015.

	Projected 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	102	1,299	133	**1,534**	45	292	102	**439**	147	1,591	235	**1,973**
%Total				57%				87%				62%
Twisp	19	30	18	**67**	7	52	9	**68**	26	82	27	**135**
%Total				3%				13%				4%

Commented [GM18]: There may need to be an alternative plan for Chelan spring Chinook broodstock due to the uncertainty of the status of their program

We will wait to develop an alternate plan until we know the outcome of the CPUD/DPUD sharing agreement next week.

Commented [JW19]: Do we know for sure that Chelan PUD is trapping at Wells?

We are proceeding as if brood collection for Chelan's obligation will occur at WD.

Commented [KM20]: Don't we usually have a contingency statement about shortfalls in Twisp being made up with Met-Comp and visa versa??

I thought the last sentence addressed that but I made a small language adjustment for clarification. In terms of the vice versa, I don't know if we would ever be at a point where Twisp could support shortfalls in the MetComp program. Stranger things have happened I suppose.

Commented [KCH21]: This makes sense in terms of hatchery production, but may artificially skew the contribution of jacks to wild production (given removal of non-jacks for hatchery programs). Over time, seems like this could have effects on wild-spawning populations similar to the artificial selection for younger age of maturation and return that this provision seeks to avoid in the hatchery program. Because wild spawner populations are small, they may be susceptible to small shifts in the ratio of jacks to full adults on the spawning grounds. If it's not already happening, seems like it could be a good idea to monitor trends in jack proportion among natural-origin spawners over time.

This would be true (and a concern) if wild jacks were in abundance (typically they make less than 5% of the return). Unlike hatchery fish that can be 30%+ age 3 males in the return. The take home on all of this whether a wild or hatchery jack is jacks beget jacks. It is more important to exclude age-3 males in the broodstock due to the survival advantage hatcheries provide that to manage for a fractional change in age-3 composition in the natural population.

Winthrop (MetComp)	275	696	106	**1,077**					275	696	106	**1,077**
%Total				40%								34%
Total	396	2,025	257	**2,678**	52	344	111	**507**	448	2,369	368	**3,185**

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		**Total**
		Hatchery	Wild	
Chelan PUD	60,516		17F/17M	**34**
Douglas PUD	29,123		8F/8M	**16**
Grant PUD	134,126		39F/39/M	**78**
Total	**223,765**		**64F/64/M**	**128**

By program		Number of Adults		**Total**	Collection location	Mating protocol
		Hatchery	Wild			
Twisp	**30,000**		**9F/9M**	**20**	Wells Dam/Twisp Weir	2x2 factorial
MetComp	**193,765**		**55F/55M**	**110**	Wells Dam/Methow Hatchery	2x2 factorial
Total	**223,765**		**64F/64M**	**130**		

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 20, 2015. Broodstock collection and stock assessment sampling activities authorized through the 2015 Douglas PUD Hatchery M&E Implementation Plan will occur simultaneously up to 3-days/week, up to 16 hours/day (not to exceed 48 cumulative hours per week). 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 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 Well FH pending genetic results and then transferred to~~the~~ Methow FH. Fish collected at MFH will remain at MFH or transferred to WNFH.

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 ~~continuing~~ may continue through August 22. The trap may be operated up to five days per week/24 hours per day (provided it is manned during active trapping).

Commented [JW22]: See comment 2.

Commented [KCH23]: I was surprised not to see any mention of tangle netting in the Chewuch as a means of spring Chinook broodstock collection. If this approach may be used, I think it deserves separate mention because it is sufficiently different from other facility-based methods that it carries different risks both for wild spring Chinook and non-target species like bull trout. If tangle netting is retained as a broodstock collection option, I think this protocol should include the conservation measures developed during discussions about this technique in recent years. These conservation measures are included in technical assistance letters we sent regarding this activity and in the draft ITS for the Wenatchee programs.

For 2015, tangle netting is not being proposed as a broodstock collection option. These annual protocols are intended to identify what action will be taken in the current year. Had tangle netting been proposed we would have included the conservation measures that were coordinated in previous years.

Commented [TK24]: See comment 3.

Language edited for clarification.

Commented [GM25]: Mike- I'm curious- is this a date specified in a permit, or is it driven by fish biology and hatchery operation? I agree we will be done well before that date in any case.

I believe this is based on the latest time the trap was operated for broodstock in the past. I agree that to the extent we can reduce operation time the better. I edited it based upon Toms comments that provide the flexibility to go out that far but in developing operational protocols perhaps we can tighten it up a bit.

Commented [TK26]: Additionally, why is it necessary to run it so long? If contingent on other factors, then say "may continue through August 22." We need to avoid running it to the extent practicable. Get our brood and shut it down so we can avoid bull trout.

See my comment to Greg above.

Commented [KCH27]: We hope that in the future we can think about using real-time information to reduce bull trout impacts and increase broodstock collection efficiency at the Twisp Weir, similar to Chiwawa Weir.
With so few spring Chinook needing to be collected, why is the trapping schedule so aggressive, and not the 3 d/wk, up to 16 hr/d approach used elsewhere?

One of the reasons is that the weir is largely inefficient, particularly in higher flows. With a less aggressive juvenile target, it should make reaching broodstock targets more attainable which in turn should reduce operation time and hence BT impacts.

Trapping at the Methow Outfall trap and Winthrop NFH ladder operations will run concurrent with Twisp Weir. Adults captured at Methow Outfall will be transferred to WNFH and prioritized for incorporation into WNFH brood thereby maximizing removal of WNFH origin safety-net HOR's as supported by the HGMP's of both facilities.

Commented [CM28]: Pending Douglas approval for 2015, if not incorporate in 2016. Mike T please wordsmith as appropriate….

Steelhead

Douglas PUD and Grant PUD steelhead mitigation programs above Wells Dam utilize adult broodstock collections from multiple sources and locations such as at Wells Dam, Twisp Weir, Methow Hatchery volunteer trap, WNFH volunteer trap, angling in Methow River, and/or the Omak Creek weir (Table 5). Generally incubation/rearing occur for the Methow safety net, Okanogan, and Columbia River release at Wells Fish Hatchery (FH) with incubation/early rearing at Methow Hatchery for the Twisp conservation program. The USFWS collects broodstock via hook-and-line in the Methow Basin, returns to WNFH and surplus fish removed at Methow Hatchery and the Twisp Weir.

Commented [GM29]: Mike, I'll leave it to you and USFWS to characterize their brood collection.

Put this text in as a placeholder.

You captured it pretty close. Thanks.

Generalized, specific program brood sources are structured as follows:

Well Hatchery – Twisp River Release

The Wells Hatchery Twisp River release has shifted to a locally collected Twisp wild broodstock conservation program. Adults are collected in the spring of the current spawn year.

Wells Hatchery – Methow River Release

The Wells Hatchery Methow River release (Methow safety net program)has shifted to 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 activities at the Twisp Weir, Methow Hatchery, WNFH, and through hatchery fish intercepted during natural origin brood hook and line collection for the USWFS Winthrop conservation program.

Wells Hatchery-Columbia River Release

The Wells Hatchery Columbia River releases will use returns to the Methow Hatchery volunteer trap to the extent possible, and will be augmented with Wells stock as required to fulfill the program. To ensure the safety-net programs have broodstock, some broodstock will be collected at Wells Dam in the fall of 2015, and held at Wells Hatchery (Table 5). These fall-collected Wells stock fish will be considered surplus to the spring-collected Methow and Okanogan broodstock, and eggs and/or fry from these surplus broodstock may be utilized for other programs in the upper Columbia.

Winthrop NFH – Methow River Release

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The USFWS Methow River release will primarily use natural origin fish collected through hook and line collection efforts in the Methow River each spring. In the event NO collection falls short of the target, hatchery origin returns to WNFH will prioritized, followed by excess hatchery fish at the Twisp Weir then from excess hatchery returns to Methow Hatchery. Transfer of adult and/or gametes/eggs between program will be carefully choreographed to ensure fish are being utilized in the most efficient and effective manner.

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Okanogan River releases

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The Okanogan River uses a combination of natural origin adults collected in Omak Creek and hatchery origin adults collected in Omak Creek or elsewhere in the Okanogan Basin through CCT collection efforts. As a backup to potential collection shortfalls in the Okanogan, the Okanogan program will be augmented with collection of hatchery origin adults occurs in the fall at Wells Dam. These fall-collected Wells stock fish will be considered surplus to the spring-collected Methow and Okanogan broodstock, and eggs and/or fry from these surplus broodstock may be utilized for other programs in the upper Columbia.

Steelhead programs located upstream of Wells Dam and at Wells Hatchery are presented in Table 4.

Table 4. 2016 brood year Steelhead Programs at Wells Hatchery and Upstream of Wells Dam

Program	Hatchery	Owner	Release Location	Release Target	Broodstock Collection Locations~~Location~~
Twisp Conservation	Methow Hatchery (incubation); Wells Hatchery (rearing)	Douglas PUD	Twisp Acclimation Pond	48,000	Twisp WxW
Methow Safety-Net	Wells Hatchery	Douglas PUD	Methow Hatchery	100,000	HxH: Twisp ~~Hatchery~~ Weir (25%) + WNFH Hatchery (75%) or WNFH to make up balance
Mainstem Columbia Safety-Net	Wells Hatchery	Douglas PUD	Wells Hatchery	160,000	HxH: Methow Hatchery returns (1st option); Wells Hatchery/Dam (Wells Stock) (2nd option)
WNFH Conservation Program	WNFH	USFWS	WNFH	Up to ~~1~~200,000	~~Up to 25 collected at Wells Dam/Hatchery HO only~~);~~); remaining 25 collected by USFWS~~Maximize use of ~~WxW~~NOR, up to 55 pair captured by hook and line in the Methow River above Twisp, volunteers to WNFH, and tangle netting in Spring Creek.
Omak Creek	Wells Hatchery	Grant PUD	Omak Creek	Up to ~~2~~40~~20~~,000[1]	Okanogan Basin/Omak Creek (up to 16 wild or hatchery)
Okanogan	Wells Hatchery	Grant PUD	Okanogan Basin	Up to 100,000[1]	Wells Stock collected at Wells Dam/Hatchery or at tributary locations in the Okanogan Basin operated by the CCT

[1] The Grant PUD programs will total 100,000 smolts, +-10% (58 broodstock).~~,~~ Broodstock collection number, origin, ~~and~~ location, and smolt numbers will be consistent with those detailed in National Marine Fisheries Service (NMFS) letter to Randall Friedlander (CCT) and Jeff Grizzel (GPUD) dated February 27, 2014 and detailed in Table 4 and Table 5 herein.

~~Douglas PUD and Grant PUD SsteelheadSteelhead mitigation programs above Wells Dam (including the USFWS steelhead program at Winthrop NFH) utilize adult broodstock collections at Wells Dam, Twisp Weir, Methow Hatchery volunteer trap, WNFH volunteer trap, angling in Methow River, and the Omak Creek weir (Table 5),) and incubation/rearing at Wells Fish Hatchery (FH) and incubation/early rearing at Methow Hatchery (Twisp program). USFWS collects broodstock via hook-and-line in the Methow Basin. The Methow steelhead program is shifting to locally collected Twisp wild broodstock (Twisp conservation program), and hatchery origin broodstock representative of the Twisp and WNFH conservation programs (Methow safety-net program). The Wells Hatchery Columbia River releases will use returns to the Methow Hatchery volunteer trap to the extent possible, and will be augmented with Wells stock~~

Commented [KCH30]: Consider moving info in this column to new table proposed on next page.

Tables 5 and 6 were rejiggered so hopefully it makes it easier to follow. Not certain another table will help – the programs are very complex.

Commented [KCH31]: Is this the same as Twisp Acclimation Pond?

Changed to reflect reality. The weir is adjacent to the Twisp Acclimation Pond.

Commented [JW32]: Are we still collecting these fish for WNFH? They told us this year that we were no longer collecting fish for them. Could be a possible back-up for them and if they don't want them they could go to Ringold.

No collection for WNFH.

Commented [GM33]: USFWS can confirm their number, but they are now collecting all of their broodstock. No arrangement for trapping at Wells is in place.

See edits.

Commented [KT34]: ESA Section 10 Permit 1412 allows up to 40K smolts released into the Okanogan Basin which would include Omak Creek. With anadromous passage above Mission Falls in Omak Creek, smolt releases in Omak Creek may exceed the typical 20K. Total smolts released into the Okanogan Basin will not exceed 100K +-10%.

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Commented [GM35]: Mike, I'll leave it to you and USFWS to characterize their brood collection.

Put this text in as a placeholder.

You captured it pretty close. Thanks.

~~as required to fulfill the program. To ensure the safety-net programs have broodstock, some broodstock will be collected at Wells Dam in the fall of 2015, and held at Wells Hatchery (Table 5). These fall-collected Wells stock fish will be considered surplus to the spring-collected Methow and Okanogan broodstock, and eggs from these surplus broodstock may be transferred to Ringold Hatchery. In addition, Wells Hatchery may be used for adult management and steelhead removed for adult management may be retained for the Ringold program.~~

The following broodstock collection protocol was developed based on mitigation program production objectives (Table 6), biological assumptions (Appendix A), and the probability that sufficient adult steelhead will return in 2015/2016 to meet production objectives absent a preseason forecast at the present time.

For the 2016 brood steelhead programs operating above Wells Dam, a total of 350 adults (152 natural origin and 198 hatchery origin adults) are estimated to be needed to fulfill the respective mitigation obligations (Table 6). To support these obligations and to ensure sufficient backup adults are on hand in the event tributary based collection efforts fall short of targets, trapping at Wells Dam and/or Wells FH will selectively retain up to 316 hatchery origin steelhead (west [and east, as necessary] ladder and volunteer trap collection; Table 5).

Twisp Conservation Program

In the spring of 2016, 26 wild steelhead will be targeted at the Twisp Weir and transferred to the Methow Hatchery for spawning, incubation, and early rearing (up to 60-d post ponding to facilitate viral testing of progeny resulting from live spawning females for the YN kelt reconditioning program), after which they will be moved to Wells Hatchery for the balance of rearing (Table 5).

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) will be targeted at the Twisp Weir and moved to Wells Hatchery for spawning. No less than 46 hatchery adults will be targeted at Methow Hatchery and if needed/available, WNFH volunteer traps to meet the balance of the program needs (Table 6). Up to 60 hatchery origin Wells stock held at the Wells Hatchery will be used as a final option if broodstock collection at the Twisp Weir, and WNFH and MH traps are unsuccessful (Table 5).

Methow Conservation Program (USFWS)

Approximately 110 natural origin adults (55 pair) will 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 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.

Commented [KCH36]: For what purpose? Because the Ringold program is not introduced or listed in tables 4, 5, and 6, please consider describing how it fits in somewhere in this section. Maybe add Ringold to the tables, or provide a cross reference if Ringold program is described somewhere in later sections.

The Ringold SHD program has operated as a sink for surplus eggs/fish in previous years for overproduction and/or resulting from backup collections for above Wells Dam SHD programs.

The WDFW has very clearly defined culling policies and when eyed eggs and more importantly fry/fish in excess of production obligations, latitude for destroying them is extremely limited which is why we look to other programs that can benefit from them.

The Ringold SHD program is a federally funded program covered through the Mitchell Act.

I revised the statement.

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Commented [JW37]: Should this be 14?

Yep.

Commented [GM38]: See Table –it has 14

Changed to 14.

Okanogan Hatchery/Endemic Program

Fifty-eight (58) adult steelhead will be targeted in the Okanogan Basin, including up to 16 natural-origin adults collected from Omak Creek for a 40K endemic program operated by the CCT and funded by GCPUD as part of their 100K UCR steelhead mitigation obligation (Table 5). Additionally, up to 58 hatchery adult steelhead will be targeted at Wells Dam/Hatchery as a back-up collection contingency due to unknown broodstock collection efficiencies in the Okanogan River Basin (Table 5).

~~COMMENT ON MFH>WNFH STEELHEAD TRANSFERS?~~

Table 5. Broodstock collection locations, number, and origin by program.

Program	Number of Adults[1]		Primary collection location	Number of backup adults[2]	Backup collection location(s)	Total adult collection[1]	
	Hatchery	Wild				Hatchery	Wild
DPUD Columbia R.	96		Wells Dam	NA	NA	96	
DPUD Methow R.	60		Twisp weir (14) Methow FH (46)	Up to 60	WNFH[3] Wells Dam	120	
DPUD Twisp R.		26	Twisp weir	NA	NA		26
GPUD Okanogan R.	42	16	Omak Cr. Okanogan R.	58	Wells Dam	100	16
USFWS Methow R.		110	Methow R. WNFH[4]	NA	Methow FH		110
Total (PUD programs)	**198**	**42**				**316**	**42**
Total (All programs)	**198**	**152**		**118**		**316**	**152**

[1] Assumes a 1:1 sex ration (see table 6).
[2] All backup broodstock are hatchery origin adults.
[3] May include hatchery origin adults collected via the USFWS hook and line efforts for natural origin fish in the Methow River and adult returns to WNFH.
[4] May also include excess hatchery origin adults collected at Methow FH and the Twisp Weir.

~~Table 5. Broodstock collection locations, number, and origin by program.~~

~~**Program**~~	~~**Wells Dam or Hatchery**~~		~~**Twisp Weir**~~		~~**WNFH**~~		~~**Methow Hatchery**~~		~~**Omak Creek/Okanogan Basin**~~	
	~~H~~	~~W~~	~~H~~	~~W~~	~~H~~	~~W~~	~~H~~	~~W~~	~~H~~	~~W~~
~~Twisp Conservation~~				~~26~~						
~~Methow Safety Net~~	~~Up to 60[1] (backup)~~		~~14~~		~~Up to 60~~		~~Up to 60~~			
~~Mainstem Columbia~~	~~96~~									

Commented [TK39]: The uncorrected Omak/Okanogan total from Table 5 is 58, but apparently should be 64 as stated here. Table 6 also indicates 48 + 16

Commented [JW40]: Should this be 64?

58 is correct.

Commented [MAH41]: Currently, we've worked out collection of excess HOR steelhead captured in the MFH trap (primarily for the NOAA study). 1st we should collectively be maximizing use of WNFH return gametes even if some of these go to mainstem/Wells releases, 2nd for WDFW should be MFH returns, last should be Wells collected fish. Co

Works in principle – hopefully the logistics can work out that way.

Commented [tp42]: Where are these fish held, spawned, and reared? Who pays for them?

Not sure to which fish you are referring to but if you are talking about backup fish collected to as a contingency for PUD programs then the respective PUDs are responsible until it has been identified that they are no longer needed.

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Commented [MT43]: I scrapped the previous Table 5 in favor of this version in the hopes to simplify things a bit. I think at the end of the day there are too many moving parts with these SHD programs to effectively/efficiently capture all of the details and if we did it would probably be too cumbersome and still create confusion.

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Commented [KT44]: When I totaled the original broodstock totals in Table 5, I came up with 512 broodstock, and with revised/edited totals for the Okanogan basin program (i.e. 58 at Wells and 58 in the Okanogan Basin) I come up with 528 broodstock. Neither of which sum to the total presented in Table 6

Commented [KT45]: 14 hatchery origin adults collected at the Twisp Weir do not appear to be accounted for in Table 6

The 14 are part of the 60 required for the program.

Commented [BG46]: Our experience at WNFH would lead me to think that collecting this many HOR volunteers may not be likely. May also want to include hook and line collection of HOR brood. This could be done in conjunction with WNFH collections and eventually include volunteers angling as part of the existing sport fishery.

~~Safety Net~~										
~~Omak Creek/Okanogan Basin~~									~~Up to 58 not to exceed 16 natural origin~~[2] ~~16~~[2]	
~~Okanogan Basin~~	~~Up to 4258~~[3] ~~482~~[3] ~~42~~[3]								~~4824 2~~	
~~Total~~	~~21419819 8~~		~~14~~	~~26~~	~~60~~	~~96~~	~~60~~		~~42482 42~~	~~16~~[2]

[1] ~~Broodstock derived from adult management at Wells Hatchery and surplus brood collected as backup for Methow and Okanogan programs.~~

[2] [2] ~~Natural origin targeted, but hatchery origin will also be collected if required to meet 58 total broodstock form the Okanogan/Omak Creek collection. Wild origin preferred, but hatchery origin broodstock will also be collected to meet target.~~

[3] ~~Back-up collection to assure 100,000ensureassure80,000 smolt production for the Okanogan Basin due to unknown collection efficacy in the Okanogan River Basin.~~

~~The following broodstock collection protocol was developed based on mitigation program production objectives (Table 6), program assumptions (Appendix A), and the probability that sufficient adult steelhead will return in 2015/2016 to meet production objectives absent a preseason forecast at the present time.~~

~~Trapping at Wells Dam and/or Wells FH will selectively retain up to 204 hatchery origin steelhead (west [and east, as necessary] ladder collection). No adults for the Ringold program will be specifically targeted at Wells in 2015. In the spring of 2015, 26 wild steelhead will be targeted at the Twisp Weir and transferred to the Methow Hatchery for spawning, incubation, and early rearing (up to 60-d post ponding to facilitate viral testing of progeny resulting from live spawning females for the YN kelt reconditioning program), after which they will be moved to Wells Hatchery for the balance of rearing. In addition, up to 16 surplus hatchery-origin Twisp-stock steelhead (to meet to meet up to 25% of the 100K Methow Safety-Net release) will be targeted at the Twisp Weir Wells stock held at the Wells Hatchery will be used as a final option if broodstock collection at the Twisp Weir, and WNFH and MH traps are unsuccessful.and/or Methow Hatchery and either spawned/incubated at Methow FH or and moved to Wells Hatchery for spawning. Additionally, in the event of a shortage Twisp Weir will be utilized to as necessary to augment WNFH brood stock. Conversely, SsurplusSurplus WNFH hatchery returns will be used to augment the Twisp/Methow hatchery-origin collection if needed. for the Methow Safety-net release.. Should there be inadequate surplus steelhead from these two sources, hatchery steelhead (presumed Methow Safety-Net origin) captured at the Methow Hatchery volunteer trap will be used to fulfill the Should there be inadequate surplus steelhead from these two sources, hatchery steelhead (presumed Methow Safety-Net origin) captured at the Methow Hatchery volunteer trap will be used to fulfill theprogram. Wells stock held at the Wells Hatchery will be used as a final option if broodstock collection at the Twisp Weir, and WNFH and MH traps are unsuccessful. Fifty-eight (58)Sixty-four (64) adult steelhead will be targeted in the Okanogan Basin, including up to 16 natural-origin adults.(see Table 5, Footnote 2) adults collected from Omak Creek for a 20K endemic program operated by the CCT and funded by GCPUD as part of their 100K UCR steelhead mitigation obligationadults. Additionally, up to 5848 hatchery adult steelhead will be targeted at Wells Dam/Hatchery as a back-up collection contingency due to unknown broodstock collection efficiencies in the Okanogan River Basin.~~

Commented [TK49]: Table 6 has 48.

Commented [KT47]: If Okanogan/Omak Creek collection is a bust, 58 broodstock required to meet 100K smolt production for the Okanogan River Basin.

Commented [TK48]: Text says 48, and Table 6 has 2 x 48 for total Okanogan Wells plus in-basin.

Commented [KT50]: New total with 58 collected at Wells rather than 42

Commented [KT51]: 60 hatchery collected at WNFH do not appear to be accounted for in Table 6

Commented [KT52]: 96 total wild at WNFH does not appear in any of the program of collection locations within this table, nor does it appear to be accounted for in Table 6.

Commented [TK53]: Text says 64, which would be 48 + 16.

Commented [KT54]: 204 does not comport with the original total for Wells Dam/Wells FH collection location in Table 5 (198) nor the new total in Table 5 (214) to account for 58 hatchery origin brood collected rather than the original number of 42 .

Commented [KT55]: Table 5 has 14 not 16

Changed to 14.

Commented [JW56]: Should this be 14?

Yep.

Commented [GM57]: See Table –it has 14

Changed to 14.

Commented [JW58]: These fish will all be transferred, spawned, and reared at Wells Hatchery. Douglas PUD does not want them at Methow.

Commented [TK59]: The uncorrected Omak/Okanogan total from Table 5 is 58, but apparently should be 64 as stated here. Table 6 also indicates 48 + 16

Commented [JW60]: Should this be 64?

58 is correct.

~~Omak Creek for a 20K endemic program operated by the CCT and funded by GCPUD as part of their 100K UCR steelhead mitigation obligation.~~

~~Overall collection for the programs will be 328 fish (a combination of program specific and back-up adults; Table 6) and limited to no more than 33% of the entire run or 33% of the natural origin return. Hatchery and natural origin collections will be consistent with run-timing of hatchery and natural origin steelhead at Wells Dam. Trapping at the Wells Dam ladders will occur between 01 August and 31 October, three days per week, up to 16 hours per day, as required to meet broodstock objectives. Trapping will be concurrent with summer Chinook broodstocking efforts through 15 September on the west ladder. 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.~~

~~Program~~	~~Broodstock Collection Locations and (numbers)~~			~~Start date~~	~~End date~~		
	~~Primary~~	~~Secondary~~	~~Tertiary~~				

Table 6. Number of broodstock needed to produce approximately 608,000 smolts for the above Wells Dam 2016 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	48F/48M		**96**	MFH/Twisp Weir/Wells Dam	1:1
DPUD[2] Methow R.	100,000	30F/30M		**60[4]**	Twisp Weir, MFH, WNFH, Wells Dam	1:1
DPUD Twisp R.	48,000		13F/13M	**26**	Twisp Weir	2x2 Factorial
GPUD Okanogan R.[3]	100,000	21F/21M	8F/8M	**58[5]**	Okanogan R./Omak Creek	1:1
USFWS	200,000		55F/55M	**110[6]**		
Total[4]	**608,000**	**99F/99M**	**76F/76M**	**350**		

[1] Mainstem Columbia releases at Wells Dam. Target HxH parental adults as the hatchery component.

[2] Methow hatchery 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.

[3] Okanogan Basin releases, including Omak Creek is100,000 smolts as part of GCPUD's 100K summer steelhead obligation and targets 58 adults in the Okanogan Basin, including up to 16 natural origin adults to fulfill the Okanogan Basin Production of 100,000 smolts comprised of natural origin and locally-adapted steelhead returning to the Okanogan River. Up to an additional 58 adults will be targeted at Wells dam to secure the production goal. Retention of progeny from these fish will be dependent upon success of CCT trapping efforts in Okanogan Basin tributaries.

[4] Up to an additional 60 hatchery adults will be collected at Well FH as a fall back to shortfalls in collections at the Twisp Weir, MFH, or WNFH.

[5] Up to an additional 58 hatchery origin adults will be collected at Wells Dam as backup to potential shortfalls in Okanogan Basin collection efforts.

Commented [A61]: I think this sentence is missing something?

Deleted.

Commented [KT62]: 328 cited here is inconsistent with the original Table 6 totals by program presented in Table 6 (i.e. original by-program values total 354, not 328 as shown in Table 6). Additionally, 328 does not comport with the broodstock totals in Table 5 (original or revised values in Table 5)

See changes in new tables 5 and 6.

Commented [KCH63]: I struggled through this paragraph multiple times. Consider converting to a table. I know there are lots of tables already, but I think this info might be easier to digest in a table. Potential format below.

Hopefully the restructure of the tables and text above will help make thing easier to follow.

Commented [MT64]: I scrapped the previous Table 6 – there were just too many edits to try and add corrections and still have it make sense in red line version. This new Table speaks to how many adults are need to meet the program objectives only based upon the biological assumptions. It makes no inference (other than in footnotes) what additional fish may be collected as backup – that is left up to Table 5.

[6] Collection priority: 1) hook and line, 2) adult returns to WNFH, 3) excess adult returns to Methow Hatchery.

Overall collection for the PUD programs will be 358 fish (a combination of program specific and back-up adults; Table 5) and 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 run-timing of hatchery and natural origin steelhead at Wells Dam and the Twisp Weir. Trapping at the Wells Dam ladders will occur between 01 August and 31 October, up to three days per week, and up to 16 hours per day, as required to meet broodstock objectives. Trapping will be concurrent with summer Chinook broodstocking efforts through 15 September on the west ladder (Appendix D). Operational criteria and dates for the Twisp Weir are still under construction.

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.

~~Table 6. Number of broodstock needed for the above Wells Dam 2016 brood summer steelhead programs (approximately 458,000 smolts), collection location, and mating strategy. Also includes broodstock necessary for outside programs that rely on adult collection at Well Hatchery.~~

~~Program~~	~~Production target/request~~	~~Number of Adults~~[2]		~~Total~~	~~Collection location~~	~~Mating protocol~~
		~~Hatchery~~	~~Wild~~			
~~DPUD~~[1]	~~160,000~~	~~48F/48M~~		~~96~~	~~MFH/Twisp Weir/Wells Dam~~	~~1:1~~
~~DPUD~~[2]	~~100,000~~	~~30F/30M~~		~~120~~[45]~~120~~[5]	~~Twisp Weir, MFH, WNFH, Wells Dam~~	~~1:1~~
~~DPUD Twisp~~	~~48,000~~		~~13F/13M~~	~~26~~	~~Twisp Weir~~	~~2x2 Factorial~~
~~GPUD Okan.~~[3]	~~100,00080,000~~	~~2458-42F/58-4224F/24M~~	~~0-8F/0-8M~~	~~11696~~[6]~~96~~[6]	~~Okanogan R./Omak Creek/Wells Dam~~	~~1:1NA~~
~~GPUD Omak~~[4]	~~20,000~~		~~8F/8M~~	~~16~~	~~Omak Cr. Weir~~	~~NA~~
~~Total~~[4]	~~408,000~~	~~102F/102M~~	~~21F/21M~~	~~328358~~		

[1] ~~Mainstem Columbia releases at Wells Dam. Target HxH parental adults as the hatchery component.~~

[2] ~~Methow hatchery 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.~~

[3] ~~Okanogan Basin releases, including Omak Creek is100,000 smolts as part of GCPUD's 100K summer steelhead obligation. Up to 45848 adults will be targeted at Wells dam to secure the production goal. Retention of progeny from these fish will be dependent upon success of CCT trapping efforts in Okanogan Basin tributaries. Additionally, 58 adults will be targeted in the Okanogan Basin, including up to 16 natural origin adults to fulfill the Okanogan Basin Production of 100,000 smolts comprised natural origin and locally-adapted steelhead returning to the Okanogan River.~~

[4] ~~Broodstock targeted is 16 total (8 male/8 female) of mixed origin composition based upon what is trapped.~~

[45] ~~Includes an additional 60 hatchery60hatchery adults collected at Well FH as a fall back to shortfalls in collections at the Twisp Weir, MFH, or WNFH.~~

Commented [KCH65]: I struggled through this paragraph multiple times. Consider converting to a table. I know there are lots of tables already, but I think this info might be easier to digest in a table. Potential format below.

Hopefully the restructure of the tables and text above will help make thing easier to follow.

Commented [KT66]: 58 adults collected at Wells and 58 collected in the Okanogan Basin totals 116

Commented [JW67]: Currently, we collect these at Wells also for a back-up in case the CCT can't reach their WxW brood efforts. That way GCPUD can still reach their 100,000 plant goal if they don't collect any wilds from Omak CK.

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Commented [KT68]: 408,000 is inconsistent with the 458,000 provided in the Table 6 heading.

Commented [KCH69]: Unclear why highlighted numbers are different.

Commented [KT70]: New total. Note the revised 358, still does not comport with broodstock totals in Table 5 (original or revised values in Table 5)

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~~[56] Includes an additional 5848 hatchery adults collected at Wells FH as a contingency to shortfalls in collections from Okanogan Basin specific brood stocking efforts and 58 adult steelhead , not exceeding 16 natural origin steelhead collected in the Okanogan Basin .~~

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 Carlton Pond.

The TAC 2015 Columbia River UCR summer Chinook return projection to the Columbia River (Appendix D) and BY 2010, 2011, and 2012 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 2015, up to 98 natural-origin summer Chinook at Wells Dam west (and east, if necessary) ladder(s), including 49 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.

Commented [KT71]: Will stock assessment sampling occur concurrent with broodstock collection? Spring Chinook and steelhead stock assessment activities at Wells Dam were referenced in the broodstock collection sections for these programs, respectively.

Added.

Should use of Wells Dam be needed to meet any shortfalls in broodstock for summer/fall Chinook programs occurring in the Okanogan Basin, 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 broodstock collection efforts for the Methow summer Chinook program and or steelhead collection efforts for steelhead programs above 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.

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		49F/49M	**98**	Wells Dam	1:1
Total	**200,000**		**98**	**98**		

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 following broodstock collection protocol was developed based on mitigation objectives and program assumptions (Appendix A).

WDFW will target 494 run-at-large summer Chinook from the volunteer ladder trap at Wells Fish Hatchery outfall for the Wells sub-yearling and yearling programs, 70 adults for the Lake Chelan triploid program, and up to 174 for the YN 275K-350K green egg request for the Yakima summer Chinook program (Table 8). Due to fish health concerns associated with the volunteer collection site (warming Columbia River water during late August), the volunteer collection will begin July 11 and terminate by August 31.

Commented [GM72]: No, there is no agreement or request from USFWS to get Wells fish for the Entiat NFH.

Correct – Confirmed with USFWS.

Commented [JW73]: Is the Wells volunteer ladder still a back-up for the Entiat program?

No – Confirmed with USFWS.

Summer/fall Chinook mitigation programs that release juveniles directly into the Columbia River between Wells and Rocky Reach dams have traditionally been supported through adult broodstock collections at the Wells Hatchery volunteer channel. For 2015, broodstock collection for the Chelan Falls summer Chinook program will be prioritized at the Eastbank Outfall (EBO) using in-channel seining/netting beginning July 1 (or earlier if summer Chinook are detected in the outfall) through September 15. Collection efforts in the EBO in 2013 and 2014 were sufficient to meet the adult requirements for the Chelan Falls program. 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 from the Wells Volunteer channel to make up the difference. The 2015 broodstock target for the Chelan Falls program is 350 adults (Table 8). The total production level supported by this collection is up to 576,000 yearlings for the Chelan Falls program. ~~Continuing in 2015, the broodstock requirement for the Chelan Falls summer Chinook program will be prioritized through broodstock collection of summer Chinook in the Eastbank Outfall (EBO). The total production level supported by this collection is up to 576,000 yearlings for the Chelan Falls program.~~

~~Again for 2015, broodstock collection for the Chelan Falls summer Chinook program will be prioritized at the Eastbank Outfall (EBO) using in-channel seining/netting beginning July 1 (or earlier if summer Chinook are detected in the outfall) through September 15. Collection efforts in the EBO in 2013 and 2014 were sufficient to meet the adult requirements for the Chelan Falls program. 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 from the Wells Volunteer channel to make up the difference. The 2015 broodstock target for the Chelan Falls program is 350 adults (Table 8).~~

~~The total production level supported by this collection is up to 576,000 yearlings for the Chelan Falls program.~~

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Table 8. Number of broodstock needed 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. Also includes broodstock necessary for outside programs that rely on adult collection at Well Hatchery in 2015.

Program	Production target	Number of Adults[2]		Total	Collection location	Mating protocol
		Hatchery	Wild			
Wells 1+	320,000	96F/96M		**192**	Wells VC[3]	1:1
Wells 0+	484,000	151F/151M		**302**	Wells VC[3]	1:1
Lk. Chelan Triploid	NA	35F/35M		**70**	Wells VC[3]	1:1
Chelan Falls 1+	576,000	175F/175M		**350**	EB outfall	1:1
Yakama Nation	350,000[1]	87F/87M		**174**	Wells VC~~[2]~~[3]	NA
Total[4]	**1,730,000**	**~~66~~544F/544M**		**1,~~018~~088**		

[1] The YN request is for between 275K and 350 green eggs to support the Yakima River summer Chinook program.

[2] 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.

[3] Wells Hatchery volunteer channel trap.

~~[4] Includes 70 adults collected for the Lake Chelan triploid Chinook program.~~

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Commented [TK74]: Not sure what about this number….

Good question. Edits should make more sense now.

Commented [TK75]: With the 70 per Footnote 4, this would be 1088.

Since the 70 adults are a line item in Table 8, I simply removed the footnote and corrected the total. It may have been an artifact of cut and paste of last year's foot notes.

Wenatchee River Basin

In 2015 the Eastbank Fish Hatchery (FH) is expecting to 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 2015 is 144,026 smolts, and based upon the biological assumptions (Appendix A) will require a total broodstock collection of ~~74~~ about 80 natural origin spring Chinook (Table 10). The spring Chinook production obligation 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 142 adults (70 natural origin and 62 hatchery origin; Table 10).

Commented [TK76]: Seems like something's missing her

Additional language should straighten it out.

Pre-season run-escapement of Wenatchee spring Chinook to Tumwater Dam during 2015 is estimated at ~~xxx~~ 3,851 spring Chinook, including ~~xxx~~ 2,915 hatchery and ~~xxx~~ 935 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 ~~less~~ no more than 33%.

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Table 9. Age-4 and age-5 class return projection for wild and hatchery spring Chinook to Tumwater Dam during 2015. ~~Estimates were generated by a recently developed model (WDFW unpublished data).~~

	Chiwawa Basin			Nason Cr. Basin			Wenatchee Basin to Tumwater Dam		
	Age-4	Age-5	Total	Age-4	Age-5	Total	Age-4	Age-5	Total
Estimated wild return	497	158	**655**	123	39	**162**	710	225	**935**
Estimated hatchery return	2,749	166	**2,915**				2,749	166	**2,915**
Total	3,246	324	**3,570**	123	39	**162**	**3,459**	**391**	**3,851**

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	18F/18M	~~35F~~40F/~~35M~~40M	~~**106^{1}**~~**116^{1}**	Chiwawa Weir and Tumwater Dam^{4} ~~(PIT tagged)???~~	2x2 factorial
Nason Conservation	125,000		~~36F~~35F/~~36M~~35M	~~72^{2}~~70^{2}	Tumwater Dam^{4}~~Nason Creek~~ and ~~Tumwater Dam (PIT tagged)~~	2x2 factorial
Nason Safety net	98,670	33F/~~33M~~33M^{3}		**66**	Tumwater Dam	1:1
Total	**367,969**	**102**	~~**142**~~**150**	~~**244**~~**252**		

[1] Includes 36 hatchery origin adults (represents ~50% of the adult target) to ensure the Chiwawa production goal is met if insufficient NO adults are collected).

[2] Includes ~11% additional ~~NONOR~~NO fish to account for fish that may assign back to the White or Little Wenatchee rivers spawning aggregates. No more than 64 ~~NONOR~~NO will be retained for spawning.

[3] Due to the lack of returning hatchery fish from the Nason program (first age-4 returns are expected in 2017), Chiwawa hatchery fish will collected to satisfy the Nason Cr. safety net program and released from Chiwawa Ponds.

[4] 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).

[5] Collection of NO fish at Tumwater for the Nason program will include (to the extent possible) previously PIT tagged adults (NO juveniles PIT tagged at the Nason smolt trap).

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Commented [KCH77]: Consider adding this given bulleted items below.

Kept some of the proposed language – added additional bullet.

Commented [AU78]: I thought we were planning for the "new" collection method and not including Nason Creek?

Correct – edited.

Commented [KCH79]: Recent letter suggests all Nason conservation fish will be collected at Tumwater and not in Nason. Will this be revised, or still want to retain the tangle-netting option?

You are correct, Nason will be composited with BS collected at TWD. Change made.

Commented [tp80]: I am assuming that these are Chiwawa hatchery fish?? Perhaps a footnote would be beneficial to clarify

Footnote added.

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Commented [KCH81]: Will genetic assignment tests continue if collection shifts to Tumwater Dam run at large?

Yes. We are only compositing the Nason program. We want, to the degree possible, limit incorporation of the White R and Little Wenatchee MSAs.

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Chiwawa River Conservation Program Broodstocking:

- Based upon estimates of returning previously PIT tagged ~~NONOR~~NO fish to Tumwater Dam (Table 11), approximately 30 previously PIT-tagged ~~NONOR~~NO spring Chinook from the Chiwawa River would 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 ~70 total or ~35 females) would be collected at the Chiwawa Weir.
  - Weir operations would be on a 24 hour up/24 hour down schedule from about June 15 through August 1 (not to exceed 15 cumulative trapping days). Timing of trap operation would be based on ~~NONOR~~NO fish passage at TWD and would use estimated travel times (derived from PIT tags) to the lower Chiwawa PIT tag antenna array.
  - Additionally, no more than 10 percent of the estimated mean number of adult bull trout in the Chiwawa Basin (using a rolling five year average derived from expanded redd counts) may be encountered during broodstock collection without concurrence from the USFWS.
  - In the absence of adequate redd count data to calculate the 10% threshold, ~~I~~if~~If~~ after 15-days of weir operation, 67 bull trout encounters, or 15 August, the NO~~R~~ broodstock target is not reached, the balance of the mitigation obligation will be met through hatchery fish already retained for the Chiwawa program at TWD.
  - To ensure the production target is met for the Chiwawa program, in the event that ~~it is~~ insufficient NOR~~NO~~ adults are collected for the conservation program, HOR~~HO~~ adults (up to 50% of the total broodstock requirement~~ ?~~)~~brood)~~ would be collected at TWD to make up the shortfall (see Table 10)~~,~~ between June 1 and July 15.
  - Historic and in-season data for NOR 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 ~~them~~ 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.

Commented [KCH82]: Our draft ITS suggests an upper bound of 73, and a 5-yr avg of 60. Given this ITS is still draft, sticking with 67 here for 2015 broodstock collection is OK – it'll make achieving the 5-yr avg easier!

Commented [AU83]: Is this still a hard number given the bullet above re: rolling 10 percent?

In the interim yes. There is insufficient redd count data to estimate what 10% of the (spawning not overall) population may be. If the comprehensive redd surveys conducted in 2014 are any indication as to what the population in the Chiwawa may be, the 67 value may be considerably below 10%. We need a longer time series of comprehensive survey data.

Commented [KT84]: Incomplete sentence.

Should read better now.

Commented [KM85]: Why up to 50%. Hopefully we do not need to incorporate more than 50% of the brood as HORs but if we need to make program we will. Also you have an incomplete sentence here.

I arbitrarily picked 50%. While we were largely successful in 2014 collecting broodstock for the program, there is still enough uncertainty in using previously PIT tagged fish and with operational constraints at the Chiwawa Wier, that it seems prudent to hedge the collection a bit to ensure the production obligation is met. If 2015 goes smoothly then in future brood plans we will pare this back a lot.

Table 11. PIT tagged natural origin adults to Tumwater Dam for the most recent 5-years (2010-2014) with conversion rates from Bonneville Dam.

Return year	Detections at Bonneville Dam		Detections at Tumwater Dam			
	Nason	Chiwawa	Nason	Conversion rate	Chiwawa	Conversion rate
2010	15	78	2	0.133	62	0.795
2011	16	115	12	0.750	81	0.704
2012	7	60	5	0.714	52	0.867
2013	2	29	2	1.000	22	0.759
2014	6	66	1	0.167	29	0.439
Mean	9.2	69.6	4.4	0.553	49.2	0.713
Geomean	7.3	63.5	3.0	0.412	44.1	0.695

Nason Creek Conservation Program Broodstocking:

- Up to ~72 ~~NONOR~~NO spring Chinook (to allow for up to 11 percent that may assign to the White and/or Little Wenatchee MSAs; Table 10) would be collected at TWD between June 1 and July 15.
  - Only 60 ~~NOR~~NO adults will be retained to produce the necessary Nason Conservation program.
  - Collection of HO fish may occur in the event NO collection/retention falls short of expectation.
  - Brood ~~stocking~~ stock collection would run concurrent with adult management, RM&E, and the Spring Chinook Relative Reproductive Success Study.

Nason Creek Safety Net Program Broodstocking:

- Up to ~66 ~~HOHOR~~HO spring Chinook adults would be targeted at TWD (Table 10) between June 1 and July 15, concurrent with ~~NONOR~~NO brood stock collection, adult management, RM&E, and the Spring Chinook Relative Reproductive Success (RRS) Study.
  - The number of ~~HOHOR~~HO ~~fish~~ adults needed may be adjusted annually to make up for any potential shortfall of ~~NONOR~~NO broodstock for the Nason ~~and Chiwawa~~ conservation program~~s~~. This will ensure mitigation goals are met even during low ~~NONOR~~NO return years. Extra ~~HOHOR~~HO ~~fish~~ adults would also be collected to safeguard against a shortfall of NO~~RNO~~ adults. Any surplus HO~~RHO~~ ~~fish~~ adults would be removed as part of the adult management program.

Steelhead

Commented [tp86]: This is not good. I would like to chat about this sometime. Why are the rates so much lower for Nason? Why are they so low?

Could simply be a matter of sample size but this is a discussion better had elsewhere.

Commented [KM87]: The conservation component can include HORs to meet the full program size. Inclusion of HORs should be listed as a contingency. With a composite broodstock I agree that it is unlikely that we would have to rely on HORs but I don't want to set a precedent in the protocols that we will not. It is possible that we wind up with too many WR fish in our broodstock and then are short NOR broodstock …in which case we back fill with HORs.

Because we will be running samples weekly 9os that we don't detain non-target fish any longer than necessary, we would likely see a potential shortfall coming and be able to correct according. In short I don't expect there to be an issue.

Added language.

Commented [KCH88]: The draft ITS includes terms and conditions derived from conservation measures we developed during our coordination regarding past tangle netting. If tangle netting will be retained as an option for Nason conservation broodstock collection, I'd suggest adding the draft terms and conditions here.

No tangle netting for the Nason Cr program is proposed for 2015 which is why it is not included in this protocol. Had tangle netting been proposed, we would have included the conservation measures previously coordinated.

Commented [A89]: Will the collection be throughout the run between June 1 and July 15? I believe that last year once trapping at TWD began, all HORs were kept for broodstock up to the needed number and any HORs after broodstock needs were met went to adult management. This biases the broodstock collection to the early returnees.

This is the general time frame that adults will be targeted for retention. While collection is somewhat front loaded, we generally try to get fish from the middle 80% of the return (doesn't always align like this). HO broodstock collection and HO fish passed to meet escapement objectives are met before adult management occurs (except for age 3 HO males – they are not passed or retained for broodstock).

Commented [KM90]: The conservation component can include HORs as necessary (see mgt plan). The safety net does not get bigger if insufficient NORs are collected. Primary goal for the conservation program is NORs, followed by HORs from the conservation program, followed by HORs from the safety net program.

The steelhead mitigation program in the Wenatchee Basin uses~~use~~ broodstock collected at Dryden and Tumwater dams located on the Wenatchee River. Per ESA section 10 Permit 1395 provisions, broodstock collection will target adults necessary to meet a ~~50%~~ natural origin – conservation (WxW) oriented program, not to exceed 33% of the natural origin steelhead return to the Wenatchee Basin and a ~~50%~~ hatchery origin (HxH) – safety net program~~, not to exceed 33% of the natural origin steelhead return to the Wenatchee Basin~~. 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:

Commented [KCH91]: Every time I see this description of the conservation and safety-net programs I have to smile because on the face of it, the description makes it look like they're indistinguishable; i.e., 50:50 hatchery origin:natural origin for both.

See edits. Better clarification?

WDFW will retain a total of 130 mixed origin steelhead for broodstock for a smolt release objective of 247,300 smolts (Table 12). The 64 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. Hatchery x wild and hatchery x hatchery parental cross and unknown hatchery parental cross adults will be excluded from the broodstock collection. Hatchery steelhead parental origins will be determined through evaluation of VIE tags, adipose/CWT presence/absence, and PIT tag interrogation during collection. 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 ~~assure~~ ensure achieving the appropriate females 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~~d~~ 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.

Commented [KCH92]: More opining - I continue to be shocked by the amount of trapping and other effort needed to collect broodstock for this program,

Keep in mind that this doesn't mean all of these activities will be used. We are simply identifying options should shortfalls occur. With runs that we have seen recently, we have been able to meet broodstock targets in the summer/fall time period. There has been only one year since 1998 that broodstock were needed in the spring.

Table 12. Number of broodstock needed for the combined 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		33F/33M	**66**	TWD[3]/Dryden LBT-RBT[4]	2x2 factorial
Wenatchee Safety net[2]	123,650	32F/32M		**64**	Dryden LBT-RBT[4] /TWD[4]	1:1
Total	**247,300**	**64**	**66**	**130**		

[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 minimizes 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 2015 is 500,001 smolts (181,816 GCPUD mitigation and 318,185 CCPUD mitigation).

The TAC 2015 Columbia River UCR summer Chinook return projection to the Columbia River (Appendix D) and BY 2010, 2011 and 2012 spawn escapement to the Wenatchee River indicate sufficient summer Chinook will 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 dam 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 252 natural-origin, summer Chinook at Dryden and/or Tumwater dams, including 126 females (Table 13). To better ensure ~~assure~~ 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 01 July 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.

Commented [tp93]: It would be worthwhile to describe how often the trap will be run for all activities that occur at Tumwater

See Appendix D.

Table 13. Number of broodstock needed for the combined Chelan and Grant PUD Wenatchee summer Chinook production obligations of 500,001 smolts, collection location, and mating strategy.

Program	Production target	Number of Adults		Total	Collection location	Mating protocol
		Hatchery	Wild			
Chelan PUD	318,185		80F/80M	**160**	Dryden LBT-RBT[1] /TWD[2]	1:1
Grant PUD	181,816		46F/46M	**92**		
Total	**500,001**		**126F/126M**	**252**		

[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-November. 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 ~~Meseberg~~ Springs Hatchery ~~(hereafter Ringold Springs)~~ – 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- ~~Smolt release objectives for Ringold Springs occur as green eggs collected at Priest Rapids FH~~PRH ~~and incubated at~~ Bonneville Hatchery until they are transferred for spring acclimation and release at ~~prior to eyed-egg transfers to~~ Ringold Springs.

For 2015, up to 1,000 adipose present, non-coded wire tagged (~~presumed~~ high proportion of natural origin~~wild~~) fall Chinook adults will be targeted at the OLAFT (as approved by the PRCC-HSC). Additional NO~~R~~ adults targeted as a continued pilot evaluation through hook-and-line angling efforts in the Hanford Reach to increase the proportion of natural origin adults in the broodstock to meet integration of the hatchery program will also be incorporated into the program. It is estimated that approximately 400 adults may be collected through the hook-and-line efforts. -Close coordination between broodstock collections at the volunteer channel, the OLAFT and through hook-and-line efforts in the Hanford Reach will need to occur so over collection is minimized. Fish surplus to production needs will be culled at the earliest possible life-stage (e.g, brood collected, brood spawned, eggs). Presumed NOR's collected and spawned from either hook-and-line caught broodstock or OLAFT collections will be prioritized for PRH programs (i.e. OLAFT and Hanford Reach anger caught fish will be externally marked, held in a separate ~~raceways~~ 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 OLAFT and angling collected adults at spawning and through incubation/early rearing.

Based upon the biological assumptions in Appendix A, an estimated 3,823 females will need 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, hook-and-line efforts on the Hanford Reach, and/or the Priest Rapids Dam off ladder trap (OLAFT; Table 14).

To increase the probability of incorporating a higher percentage of NOR's from the volunteer channel, adipose present, non-CWT males and females will be prioritized for retention and males older than 3 will be prioritized.

Implementation Assumptions

Commented [KCH94]: Is this the same facility as is used for steelhead (upstream of Wells programs)? I know these protocols are primarily written for HC insiders, but for outsiders it can be confusing if the same facility has multiple names. Please consider compiling a standardized table of major hatchery facilities, their acronyms, and their locations.

Ringold Springs Hatchery has two hatchery programs, one fall Chinook funded by the ACOE and one steelhead program that uses excess UCR hatchery steelhead or adult returns to RSH and is funded by Mitchell Act.

As for a list of acronyms I will see about putting one together – may not get it done in time for this document though.

Commented [KCH95]: The number of NORs that volunteer in the channel at PRH (Table 14) is surprisingly high to me. Curious why this happens?

Keep in mind that this is an estimate based upon some very crude calculations. Currently 61% of the PRH production cannot be differentiated from wild fish due to the lack of an external mark or electronically detectable tag (such as CWT). The current estimate of NO fish in the volunteer trap is about 3.4% with very wide confidence intervals simply because the sampling is not geared toward determining the number of NO fish. In addition about 88% of the attraction flow is provided from a surface water intake, the remaining 12% is ground water.

1) Broodstock may be collected at any or all of the following locations/means: the PRD off ladder trap (OLAFT – operated 4-days per week/8 hrs/day to collect up to 1,000 presumed NOR's), 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 ≥ 75 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.

4) Only adipose present, non-CWT males and females will be retained for broodstock from volunteer channel collected broodstock unless a shortage is expected.

5) Only progeny of adipose present, non-wired fish encountered through hook-and-line angling and at the OLAFT will be prioritized for retention into the program.

6) Broodstock collected from the OLAFT and by hook-and-line will exclude age-2 and to the degree possible age-3 fish (<75 cm) 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 NOR's in the collection (e.g. collection of 1 in 5 age-3 fish for broodstock from the OLAFT).

7) All gametes of fish spawned from hook-and-line broodstocking efforts and/or OLAFT collections will be incorporated into the PRH based program~~.~~.

8) Real time otolith reading and an alternative mating strategy will be implemented in 2015 similar to 2014. Otoliths from males from the OLAFT and PRH collections will be collected during the peak spawning week and read prior to spawning. If the male is natural origin, then it will be spawned with 4 females, otherwise it will be spawned with two. ~~This strategy, coupled with a gene-flow estimate of pNOB substantially increase PNI in 2014.~~

9) All eggs or juveniles leaving PRH (including surplus) will have a unique otolith mark so that returning adults can be identified.

~~7)~~10)

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 ~~Meseberg~~ Springs hatcheries, collection location, and mating strategy.

Program	Production target	Number of Adults	**Total**	Collection location	Mating protocol
Grant PUD	5,599,504	1,935F/967M	**2,902**		
ACOE-PRH	1,700,000	617F/309M	**926**		

Commented [KCH96]: See comment above regarding applying this thinking to natural runs as well.

Again, this would be true (and a concern) if wild jacks were in abundance (typically they make less than 5% of the return). Unlike hatchery fish that can be 30%+ age 3 males in the return. The take home on all of this whether a wild or hatchery jack is jacks beget jacks. It is more important to exclude age-3 males in the broodstock due to the survival advantage hatcheries provide that to manage for a fractional change in age-3 composition in the natural population.

Commented [KCH97]: Our Priest Rapids BO from 2007 has only one term and condition regarding fishway ops and it basically says provide year-round passage. Are there requirements anywhere else regarding migratory delay at Priest Rapids. I'm asking because it looks like a lot of broodstock collection is happening here, suggesting that the volume of fish processing to be done could contribute to delays. Does this facility have monitoring gear (PIT antennas) that could be used to detect delay and if so, are there requirements to respond to delay > 48 hrs?

When this facility is operated for broodstock collection, it is limited to operating no more than 8 hours per day/ up to 5 days per week. There is always nighttime passage so while yes there are PIT tag arrays that could be used to detect delays, with the facility open to passage ¾ of every day, delays, particularly those which could lead to >48 delays are highly unlikely.

Commented [MT98]: Deleting this statement. While modifying the PNI calculation such that it appears that there is a much higher pNOB, the reality is there isn't. There is currently no agreement to use a hybrid calculation o represent PNI by the parties – agreement to test a 1:4 strategy does not infer such an agreement.

Additionally, while mathematically it may appear there is more gene flow, using a hybrid 1:4 strategy does not increase the genetic contribution.

Commented [KCH99]: Is this the same as Ringold Springs?

Yes. Adjusted for consistency.

Commented [tp100]: Have the latest prespawn mortality, size-based fecundities, mating protocols, and survivals been incorporated in this table to avoid over collection of brood? Please confirm with Mike Lewis to make sure that he is comfortable with the proposed number of fish to be collected.

Yes.

ACOE – Ringold[1]	3,500,000	1,271F/636M	**1,907**
Total	**10,799,504**	**3,823F/1,912M**	**5,735**

Collection location	Estimated number of adults		Total		
	Hatchery	Wild			
Priest Rapids Hatchery	**2,917F/1,270M**	**103F/45M**	**4,335**	PRH volunteer trap	1:2
OLAFT[2]	**307F/153M**	**360F/180M**	**1,000**	PRD off-ladder trap	1:2, 1:4
ABC[3]	**23F/45M**	**113F/219M**	**400**	Hanford Reach	1:2, 1:4
Total	**3,247F/1,468M** (4,715; 82.2%)	**576F/444M** (1,020; 17.8%)	**5,735**		

[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] Estimated number of fall Chinook females and males to be acquired from the OLAFT in 2015. F/M ratios were derived through run at large data. Estimates of H/W were derived through otolith results.

[3] ABC fish are adults collected from hook and line collection efforts on the Hanford Reach. Estimates of F/M were derived through 2012-2014 spawn numbers. Estimates of and H/W were derived through otolith results from 2012 and 2013.

Appendix A

2015 Biological Assumptions for UCR spring, summer, and Fall Chinook and Summer Steelhead Hatchery Programs ~~– Footnotes yet to be included~~

Program	Mean Values for 2009-2013								Mean Values 2007-2011 Brood
	ELISAs		Fecundity		Prespawn Survival				
	H	W			H		W		
	> 0.12	> 0.2	H	W	M	F	M	F	G-E-R Survival[3]
Methow SPC	0.205	0.000	3,671	4,058	0.980	0.993	0.979	0.997	0.878
Twisp SPC	0.297	0.040	3,557	4,153	0.980	1.000	0.980	0.898	0.884
Twisp SHD	[redacted]	[redacted]	[redacted]	5,610	[redacted]	[redacted]	1.000	0.975	0.713
Wells SHD	[redacted]	[redacted]	6,022	5,864	0.957	0.936	0.975	0.942	0.609
Okanogan SHD Safety Net	[redacted]	[redacted]	6,022	[redacted]	[redacted]	0.936	[redacted]	[redacted]	0.609
Wells SUC 1+	0.012	0.000	4,183	4,552	0.964	0.972	0.959	0.938	0.836
Wells SUC 0+	0.012	0.000	4,183	4,552	0.964	0.972	0.959	0.938	0.798
YN Green Eggs	0.012		4,183		0.964	0.972			
Methow SUC	0.000	0.004	[redacted]	4,861	[redacted]	[redacted]	0.968	0.963	0.887
Chelan Falls 1+~~[a]~~[1]	0.051	[redacted]	4,372	[redacted]	0.985	0.944	[redacted]	[redacted]	0.844
Wenatchee SUC	0.000	0.005	[redacted]	5,031	[redacted]	[redacted]	0.974	0.958	0.825
Wenatchee SHD	[redacted]	[redacted]	6,014	5,839	0.974	0.921	0.965	0.941	0.690
Nason ~~SPC[b]~~SPC[2]	0.000	0.044	[redacted]	4,662	[redacted]	[redacted]	0.986	0.948	0.842
~~Chiwaw~~Chiwawa~~Chiwaw~~Chiwawa SPC	0.087	0.039	4,159	4,699	0.978	0.995	0.989	0.948	0.842
Priest Rapids FAC 0+~~[c,d]~~	[redacted]	[redacted]	3,829	[redacted]	0.870	0.820	[redacted]	[redacted]	0.860
ACOE @PRH	[redacted]	[redacted]	3,829	[redacted]	0.870	0.820	[redacted]	[redacted]	0.860
ACOE @Ringold	[redacted]	[redacted]	3,829	[redacted]	0.870	0.820	[redacted]	[redacted]	0.860

[1] Fecundities, ELISA's and prespawn survival values are based upon only two years data due to the shift in broodstock collection location from the Wells volunteer channel to the Eastbank Outfall.

[2] Green egg to release survival is based upon survival performance of fish acclimated and released from the Chiwawa program. Spring 2015 will be the first juvenile release from the Nason Creek program.

[3] Green egg to release survival.

Commented [tp101]: I like these comprehensive tables. They really save a lot of space.

Commented [KCH102]: Does GER mean green-egg to release?

Yes. Added footnote for clarification.

Commented [tp103]: Has Mike Lewis reviewed this? We over collected in 2014 and had to surplus a lot of eggs

Data provided by Steve Richards.

Commented [tp104]: These fecundities seem low.

Data provided by Steve Richards.

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Appendix B
Current Brood Year Juvenile Production Targets, Marking Methods, Release Locations

Brood Year	Production Group	Program Size	Marks/Tags[3]	Additional Tags	Release Location	Release Year
Summer Chinook						
2015	Methow SUC 1+ (GPUD)	200,000	Ad +CWT	~~??????~~5000 PIT minimum~~?~~	Methow River at CAF	2017
2015	Wells SUC 0+ (DPUD)	480,000	Ad + CWT	~~?~~	Columbia R. at Wells Dam	2016
2015	Wells SUC 1+ (DPUD)	320,000	Ad + CWT	~~?~~	Columbia R. at Wells Dam	2017
2015	Chelan Falls SUC 1+ (CPUD)	576,000	Ad + CWT	10,000~~?~~ PIT	Columbia R. at CFAF	2017
2015	Wenatchee SUC 1+ (CPUD/GPUD)	500,001	Ad + CWT	~~??~~20,400~~????5000 PIT minimum?~~	Wenatchee R. at DAF	2017
Spring Chinook						
2015	Methow SPC (C,D,GPUD)	108,249	CWT only	~~?~~7,000 PIT	Methow R. at MFH	2017
2015	Methow SPC (C,D,GPUD)	25,000[1]	CWT only	~~?~~7,000 PIT	Methow R. at GWP (YN)	2017
2015	Methow SPC (C,D,GPUD)	60,516	CWT only	15,000~~?~~	Chewuch R. at CAF	2017
2015	Twisp SPC (C,D,GPUD)	30,000	CWT only	~~?~~5,000 PIT	Twisp R. at TAF	2017
2015	Methow SPC (USFWS)	400,000	Ad + CWT	10,000 PIT	Methow River at WNFH	
2015	Okanogan SPC[4] (CCT)	200,000	Ad + CWT		Okanogan R. at	2017
2015	Chief Joe SPC[5] (CCT)	700,000	Ad + 200K CWT?		Columbia R. at CJH	2017
2015	Chiwawa R. SPC (CPUD) (conservation)	144,026	CWT only		Chiwawa River at CPD	2017
2015	Nason Cr. SPC (GPUD) (conservation)	125,000	CWT + blank body tag		Nason Cr. at NAF	2017
2015	Nason Cr. SPC (GPUD) (safety net)	98,670	Ad + CWT		Chiwawa R. at CPD	2017
Fall Chinook						
2015	Priest Rapids FAC 0+	1.7M	Ad + Oto	~~10,718 PIT~~	Columbia River at	2016

Commented [KM105]: Where is Wenatchee Spring Chinook?

Included now.

Commented [tp106]: I don't see the upper Wenatchee spring Chinook in here. Also, it might be beneficial to have the tagging of all UC hatchery programs (including CJH and USFWS) so that we can see if we will be able to distinguish all hatchery fish from one another. Perhaps you could do a PUD table and then a separate table that includes all other programs.

It would be worth putting in a footnote that the CWT are all in the snout

Done.

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Commented [GM107]: Mike- I think Fish Passage Center is still PIT tagging some Wells summers for the comparative survival study, but don't know exactly what they do.

I will leave blank until we can get firm numbers.

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Commented [GM108]: Mike- I think Fish Passage Center is still PIT tagging some Wells summers for the comparative survival study, but don't know exactly what they do.

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Commented [A109]: Chiwawa and Nason spring Chinook?

Added.

Commented [KCH110]: Why no Wenatchee programs here?

Oversight (was in a previous draft but was somehow omitted). See changes.

Commented [GM111]: YN PIT tags these as control for acclimation pond

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Commented [GM112]: YN PIT tags these

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	(ACOE)			~~3,772 PIT3,772 PIT3,772 PIT3,772 PIT3,772 PIT3,772 PIT~~Approximately 43,000 spread across the fish released from PRH ~~3,772 PIT 3,772 PIT 6,302 PIT 21,436 PIT~~	PRH	
2015	Priest Rapids FAC 0+ (GPUD)	600,000	Ad+CWT+Oto		Columbia River at PRH	2016
2005	Priest Rapids FAC 0+ (GPUD)	600,000	CWT + Oto		Columbia River at PRH	2016
2015	Priest Rapids FAC 0+ (GPUD)	1M[2]	Ad + Oto		Columbia River at PRH	2016
2015	Priest Rapids FAC 0+ (GPUD)	3.4M	Oto only		Columbia River at PRH	2016
2015	Ringold Springs FAC 0+ (ACOE)	3.5M	Ad + Oto		Columbia River at RSH	2016
Steelhead						
~~2016~~	~~Wenatchee WxW~~	~~37,095~~12,500	~~CWT only~~	~~2,450?~~	~~Nason Cr. direct release~~	~~2017~~
2016	Wenatchee ~~HxH~~Mixed (HxH/WxW) (CPUD)	~~29,676~~66,771	Ad + CWT (HxH) CWT only (WxW)	~~3,330~~5,400?	Nason Cr. direct release	2017
~~2016~~	~~Wenatchee WxW~~	~~29,676~~	~~CWT only~~	~~?~~	~~Chiwawa R. direct release~~	~~2017~~
2016	Wenatchee ~~HxH~~Mixed (HxH/WxW) (CPUD)	~~23,494~~53,170	Ad + CWT (HxH) CWT only (WxW)	~~3,154~~4,300?	Chiwawa R. direct release	2017
~~2016~~	~~Wenatchee WxW~~	~~56,879~~12,500	~~CWT only~~	?2,450	~~Wenatchee R. direct release~~	~~2017~~
2016	Wenatchee ~~HxH~~Mixed (HxH/WxW) (CPUD)	~~45,480~~102,359	Ad + CWT (HxH) CWT only (WxW)	?~~5,510~~8,278	Wenatchee R. direct release	2017
2016	Wenatchee HxH (CPUD)	25,000	Ad + CWT	?~~2,100~~2,022	Wenatchee R. at BBP	2017
2016	Twisp WxW (DPUD)	48,000	CWT only	~~?~~5,000 PIT	Twisp River at TAC	2017
2016	Wells HxH (DPUD)	100,000	Ad only	~~?~~ 5,000 PIT	Methow River at MFH	2017
2016	Wells HxH (DPUD)	160,000	Ad only	~~?~~ 5,000 PIT	Columbia R. at Wells Dam	2017
2016	Methow WxW	200,000	Ad + CWT	10,000 PIT	Methow R. at	2017

Commented [tp113]: Is this a WDFW funded group? GPUD hasn't agreed to do more than the 2 rows above this.

Yes WDFW funded. Added footnote.

Commented [A114]: It's difficult to break up the releases by brood origin since the outside raceway 2 is mixed WxW and HxH

I think there may be some confusion here. The proposed changed values add up to 266K+. The total Wenatchee program is 247,300 fish – these edited values look to be 2015 release year numbers – what are needed are the 2016 brood numbers. I have changed them back to the original numbers.

The PIT tag number may still need to be revised for the Wenatchee SHD program.

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	(USFWS)				WNFH	
2016	Okanogan HxH (CCT/GPUD)	Up to 100K	Ad only?		Okanogan R.	2017
2016	Okanogan WxW (CCT/GPUD)	Up to 40K	Body CWT		Omak Creek	2017

[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.

[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.

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Appendix C

Return Year Adult Management Plans

~~Additional work to be completed on this section. Adult management plans will only include spring Chinook and steelhead.~~

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 for cast may be available to lay out what the expected surplus is, how many can 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 3,851 (935 natural origin [24.3%] and 2,915 hatchery origin [75.7%]) spring Chinook back to Tumwater Dam in the Wenatchee Basin. Approximately 3,517 Chiwawa spring Chinook are to reach Tumwater Dam in 2015, of which about 655 (18.6%) and 2,915 fish (81.4%) are expected to be natural and hatchery origin spring Chinook, respectively. Additionally, about 162 natural origin spring Chinook are expected back to Nason Creek with the balance 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 2015. Estimates were generated by recently developed run prediction and pre-spawn mortality models (WDFW unpublished data).

	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	497	158	**655**	123	39	**162**	710	225	**935**
Estimated hatchery return	2,749	166	**2,915**				2,749	166	**2,915**
Total	3,246	324	**3,570**	123	39	**162**	**3,459**	**391**	**3,851**

[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.

Commented [KCH115]: Not reviewed – too incomplete. But this is a key piece that we would very much like to have an opportunity to review, because of high potential for effects on bull trout.

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Absent conservation fisheries or adult removal at Tumwater Dam (TWD), the expected number of age- and age-5 Hatchery Origin Returns (HOR) for the upper Wenatchee River Basin as a whole is estimated to be approximately ~~2.5~~3.1 times the expected number of Natural Origin Returns (NORs; ~~3.8~~4.5 times the number of NOR's in the Chiwawa River). The combined HOR~~HO~~ and NOR~~NO~~ returns will represent about ~~3.3~~4 times the number of adults needed to meet the interim Chiwawa run escapement to TWD of 900 fish indicating a disproportion number of hatchery origin spring Chinook will be on the spawning grounds in the fall of ~~2014~~2015. The conservation fishery is estimated to remove about ~~157~~ 259 HOR~~HO~~ Chiwawa adults (Table 3) which will require additional adult management to occur at TWD.

Additional Adult Management

~~2014~~ 2015 adult management actions are intended to provide for near 100% removal of age-3 hatchery males (jacks) and up to about 50% of the age-4 and age-5 hatchery origin adults (about ~~302~~ 399 males and ~~515~~ 680 females according to current models, Table 2). In addition to the conservation fishery, approximately ~~232~~ 252 adults will be removed between TWD and the Chiwawa Weir and retained for brood~~-~~stock to support meeting the combined Grant and Chelan PUD Wenatchee spring Chinook obligation, the balance will be surplused at TWD and used for tribal and/or food bank disbursements or nutrient enhancement projects (Table 3).

Table 2. Run escapement and spawning escapement of Chiwawa River hatchery and natural origin fish to Tumwater Dam and the Chiwawa River in 2015.

	To Tumwater Dam		To Chiwawa River		Adults surplused at TWD[3]	Total Chiwawa spawners
	Wild	Hatchery	Wild[1]	Hatchery[2]		
Females[4]	496	1,836	258	195	680	**453**
Males[4]	439	1,079	225	114	399	**339**
Sub-total	935	2,915	483	309	1,079	**792**
Pre-spawn survival[6]			0.831	0.287		
Expected PNI						**0.39**
Expected pHOS						**0.72**

[1] Wild broodstock needs of ~~74~~ 80 wild NO fish (32 females/32 males) for the Chiwawa conservation program have already been accounted for in this total as well as pre-spawn mortality.

[2] Adjusted for pre-spawn mortality.

[3] Does not include ~~all~~ age-3 hatchery males "jacks"~~-~~ removed during adult management activities at TWD and through the conservation fishery.

[4] Age-4 and age-5 fish only. Gender proportions were made based upon a 5-year average sex ration for hatchery and wild fish of the same age class.

[5] This should result in approximately ~~477~~ 452 redds in the Chiwawa Basin under the assumption that each female produces only one redd.

[6] Due to the expected poor environmental conditions expected in the Wenatchee Basin in 2015, prespawn survival values applied to the 2015 estimate is based upon the lowest observed survival to date (2001). 2001 was a water year very similar to how 2015 is shaping up.

Table 3. Estimated returns of Icicle H~~h~~atchery, Chiwawa H~~h~~atchery, and Chiwawa wild adults and estimated number of adults removed through adult management activities in the Wenatchee Basin in 2015.

	Estimated Returns			
	Icicle	Chiwawa HO	Chiwawa NO	Total
Estimated return	7,332	2,916	655	10,903

Commented [KM116]: 2015?

Yep. Corrected.

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% of return	0.672	0.267	0.061	
Harvest at2% take limit[1]	270	259	13[2]	542
Estimated Chiwawa Hatchery Fish Removed				
	Fishery	Broodstock	TWD removal	Total
Number of HO adults removed by method[3]	259	98	722	1,079

[1] For Wenatchee River fishery area only. Does not include Icicle River fishery harvest.
[2] While included as harvest, it is NO incidental hooking mortality associated with HO fish removal.
[3] Only includes age-4 and age-5 adults

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Wenatchee Summer Steelhead

Depending on the outcome of preseason and in-season estimates of hatchery and natural origin steelhead to the Wenatchee Basin during the annual run cycle monitoring at the Priest Rapids Dam Off Ladder Trap (OLAFT), removal of surplus adult steelhead may occur at Tumwater Dam or in combination with a conservation fishery.

A more detailed run forecast will be available in September 2015. Adult management plans will be finalized then and appended to this document.

Methow Spring Chinook

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Pre-season estimates project a total of 3,185 (507 natural origin [15.9%] and 2,678 hatchery origin [84.1%]) spring Chinook back to Methow Basin. Of the 2,678 hatchery returns, about 1,537 are estimated to from the conservation program with the balance of 1,077 from the WNFH safety net program (Table 4).

Table 4. Brood year 2010-2012 age class and origin run escapement projection for UCR spring Chinook at Wells Dam, 2015.

	Projected 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	102	1,299	133	**1,534**	45	292	102	**439**	147	1,591	235	**1,973**
%Total				57%				87%				62%
Twisp	19	30	18	**67**	7	52	9	**68**	26	82	27	**135**
%Total				3%				13%				4%
Winthrop (MetComp)	275	696	106	**1,077**					275	696	106	**1,077**
%Total				40%								34%
Total	396	2,025	257	**2,678**	52	344	111	**507**	448	2,369	368	**3,185**

It is likely that some level of adult management will be required to limit the number of hatchery spring Chinook on the spawning grounds. Because a conservation fishery is not yet possible under current permit limitations, adult management will need to occur through operation of the volunteer channel traps located at both the Methow Hatchery (MH) and Winthrop NFH (WNFH).

Presently hatchery fish from MH fish 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 in natural origin brood for the MH conservation program, and c) to support the 400K safety net program at WNFH. As such WNFH will operate their return channel to support removal of excess safety net fish. MH will operate its volunteer trap and will provide surplus adults (in excess to the MH needs) to WNFH to support the safety net program or retain adults to facilitate testing translocation of conservation fish to under seeded spawning areas as approved by the HCP HC and PRCC HSC.

In-season assessment of the magnitude and origin composition of the spring Chinook return above Wells Dam will be used to provide in-season adjustments to hatchery/wild composition and total broodstock collection, consistent with ESA Section 10 Permit 1196.

Methow Summer Steelhead

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Depending on the outcome of preseason and in-season estimates of hatchery and natural origin steelhead to the Methow Basin during the annual run cycle monitoring at the Priest Rapids Dam Off Ladder Trap (OLAFT), removal of surplus adult steelhead may occur at the Twisp Weir (primarily as an action related to the steelhead RSS), the Wells Hatchery Volunteer Channel, volunteer returns to the Methow Hatchery and Winthrop NFH, or in combination with a conservation fishery.

A more detailed run forecast will be available in September 2015. Adult management plans will be finalized then and appended to this document.

Okanogan Summer Steelhead

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Depending on the outcome of preseason and in-season estimates of hatchery and natural origin steelhead to the Okanogan Basin during the annual run cycle monitoring at the Priest Rapids Dam Off Ladder Trap (OLAFT), removal of surplus adult steelhead may utilize a conservation fishery or in combination with removal through spring Okanogan tributary weir operations.

A more detailed run forecast will be available in September 2015. Adult management plans will be finalized then and appended to this document.

Appendix D

Site Specific Trapping Operation Plans

Commented [GM117]: Mike- We have been slowly developing a Twisp Weir Operating Plan – firstly to address bull trout concerns raised by USFWS, but ultimately some version of this plan should be used in the BS Protocols. We're still a ways off. We are working with Charlie and the Methow Hatchery guys to make it realistic to real world operations.

Ok. I added some wiggle language in that section below indicating we were still working through issues and would update it when appropriate.

Tumwater Dam

For 2015, WDFW and ~~the Districts~~Chelan PUD~~District~~ 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:** Throughout all trapping activities described in this plan, the two PIT tag antennae arrays within the Tumwater Dam ladder (weir 15 and 18, see Appendix 2), will be monitored by WDFW and detections of previously PIT tagged fish will be evaluated to determine the median passage time of fish between first detection at weir 15 and last detection at weir 15 or weir 18. Median passage estimates will be updated with every 10 PIT-tagged fish encountering weir 15. 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.

Commented [SL118]: Can we also use historic bull trout passage as tool in this equation as well?

There will need to be a much more detailed conversation about how it would be used, what data would be incorporated (e.g. time series), and what the effect doing so would be on the programs ability to meet their respective goals and objectives (both production mitigation and M&E) which could have broader implications to the HCPs and Settlement Agreement.

This discussion would likely have heavy committee involvement which can take time.

Commented [KCH119]: Good idea!

2) **Improved Fish Handling Efficiency**: Several infrastructure improvements at Tumwater allow WDFW and other operators to cycle through sampled fish more quickly. These improvements consist of an additional holding tank and an improved conveyance system between the trap and holding tank. The facility improvements and additional staffing by WDFW (3 operators instead of 2) during peak spring Chinook and sockeye passage (i.e. June 1 and July 15), will ensure that the trapping denil is operated constantly allowing unimpeded passage through the trap. Historically, the trapping denil has been periodically shut down while fish we~~a~~re being processed.

Commented [SL120]: Can simply state here that night-time passage will be provided?

That's not what is being talked about here. I added language to bullet three that speaks to nighttime passage. This is the operational pinch point where continual movement of fish (for spring Chinook and bull trout) is most important.

3) **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).

4) **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.

5) **Planned Tumwater trapping operations from ~~-~~September 1 until mid-December:** The trap will return to a 24 hours/7day/week manned or unmanned active trapping for steelhead and Coho broodstock collection and adult steelhead management. During this time period bull trout are rare and spring Chinook are not present at Tumwater. For this trapping period, real-time monitoring will continue to be implemented.

6) **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.

7) **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~~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

Commented [KCH121]: Again, I'm surprised by the omission of any discussion of tangle netting.

Please keep in mind that the preferred alternative for spring Chinook broodstock collection in the Wenatchee Basin specifically does not include tangle netting activities. The annual broodstock collection protocols are intended to provide an outline wo what activities will occur for the current year.

Had tangle netting been proposed, an outline of that activity would have been presented in the body of the text.

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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 2015. Blue denotes steelhead, brown spring Chinook, orange sockeye, pink summer Chinook, and green Coho.

Activity	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
SHD pHOS ~~mgt[2]~~mgt[1]		15 Feb	🟦	🟦	🟦	15 June			1 Sep	🟦	🟦	15 Dec
Su. SHD BS ~~collection[3]~~collection[2]									1 Sep	🟦	15 Nov	
Su. SHD Spawner Esc. ~~tagging[4]~~tagging[3]		15 Feb	🟦	🟦	🟦	15 June			1 Sep	🟦	🟦	15 Dec
Spring Chinook ~~RSS[5]~~RSS[4]					1 May	🟫	15 Jul					
Sp Chinook run ~~comp[6]~~comp[5]					1 May	🟫	15 Jul					
Sp Chinook pHOS ~~mgt[7]~~mgt[6]					1 May	🟫	15 Jul					
~~LNFH Non-tagged HOR~~ Sp Chin stray ~~mgt[8]~~mgt[7]					1 May	🟫	15 Jul					
Sockeye run ~~comp[9]~~comp[8]							15 Jul	15 Aug				
Sockeye spawner esc ~~tagging[10]~~tagging[9]							15 Jul	15 Aug				
Su. Chin BS ~~collection[11]~~collection[10]							1 Jul	🟥	15 Sep			
Coho BS ~~collection[12]~~collection[11]									1 Sep	🟩	30~~15~~ Nov	

~~[2]~~ [1] Adult management of the 2015 brood will end in June 2015. However it is anticipated that adult management will occur for the 2016 brood beginning 1 September or earlier if conducted in conjunction with broodstock collection activities at Tumwater Dam for other species.

~~[3]~~ [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.

~~[4]~~ [3] SHD spawner composition tagging at Tumwater Dam will run concurrent with SHD adult management and other (broodstock) activities at Tumwater Dam.

~~[5]~~ [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.

~~[6]~~ [5] Spring Chinook run composition sampling will run concurrent with the RSS.

~~[7]~~ [6] Spring Chinook pHOS management will end in July consistent with the arrival of the sockeye return and run concurrent with RSS activities.

~~[8]~~ [7] Removal of ~~Leavenworth NFH~~ unknown hatchery origin spring Chinook strays at Tumwater Dam will run concurrent with the RSS.

~~[9]~~ [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.

~~[10]~~ [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.

~~[11]~~ [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.

~~[12]~~ [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.

Commented [KM122]: Coho at Tumwater are permitted through Dec 7 but typically continue through late Nov.

Ok. Provided clarifying language to footnote 11.

Commented [SL123]: Overlaying bull trout passage here would be useful here in relation to proposed activities for 2015.

I understand what you are trying to accomplish here but struggle to find the best way to do it. To simply identify the earliest and latest dates bull trout may be observed/passed doesn't paint an accurate picture and could easily be misinterpreted or provide an incorrect characterization.

This is a case of trying put something very specific into a table that speak in generalities. I will give it some thought and see what would be reasonable. Don't know if we could pull it off this year. Need to make sure it would be appropriate and contribute to implementation of these programs.

Commented [MT124]: Deleted. Footnote clarifies target group.

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Dryden Dam

For 2015, WDFW and ~~the District~~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 five days per week, 24 hours per day beginning July 1 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

Commented [SL125]: Are the same activities currently ongoing at TWD to minimize passage effects to bull trout occurring at Dryden?

Firstly, Dryden Dam does not represent a passage barrier for bull trout unless they volunteer into one of the two ladders (it is a low head irrigation diversion dam). When the Dryden Traps are operating, fish are removed daily, outside of the trapping windows, passage is fully open.

Additionally there are no PIT tag arrays in either the left or right bank ladders at Dryden so there is no way to determine what if any delays (outside the maximum 24 hrs for fish in the trap itself) occur for any fish.

sooner if it appears that run contribution to the facilities exceeds reasonable limits for adult holding.

If daily river temperatures meet or exceed 21º C (69.8º 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 2015. 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
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]~~tagging~~							🟦 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~~15~~ Nov	
Right Bank												
Su. SHD BS collection[1]							🟦 1 Jul	🟦	🟦	🟦	🟦 15 Nov	
Su. SHD Run Comp.							🟦 1 Jul	🟦	🟦	🟦	🟦	
Su. SHD spawner esc. Tagging2~~tagging~~							🟦 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	🟩	🟩 30~~15~~ Nov	

[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.

[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 5d/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 5d/week 24hr/day 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.~~Additional footnotes to be inserted here.~~

Wells Dam Ladder and Hatchery Volunteer Traps

For 2015, WDFW and ~~the District~~Douglas PUD~~istrict~~ are proposing the following plan (A summary of activities by month for the Wells Dam East/West ladder and Wells FH volunteer traps is summarized in Table 3):

Commented [KM126]: Coho at Dryden are often collected through the end of November (permitted through Dec 7)

Ok. Provided clarifying language to footnote 4.

Commented [SL127]: Highlighting bull trout passage here would be useful as well.

I understand what you are trying to accomplish here but struggle to find the best way to do it. To simply identify the earliest and latest dates bull trout may be observed/passed doesn't paint an accurate picture and could easily be misinterpreted or provide an incorrect characterization.

This is a case of trying put something very specific into a table that speak in generalities. I will give it some thought and see what would be reasonable. Don't know if we could pull it off this year. Need to make sure it would be appropriate and contribute to implementation of these programs.

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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 construction activities on the hatchery modernization preclude use of either the West ladder or volunteer traps.

If the East ladder trap is used, it may begin as early as May 1 and 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. Anticipated trap operation is not expected to go beyond November 15.

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 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 East ladder trap. Anticipated trap operation is not expected to go beyond November 15.

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 July 1 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.

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.

Table 3. 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 2015. 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
East/West Ladders												
Su. SHD BS collection[1]									1 Sep		15 Nov	
Su. SHD run comp.									1 Sep		15 Nov	

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	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Su. SHD Spawner Esc. Tagging[2]									1 Sep		15 Nov	
Sp Chinook BS collection					1 May		15 Jul					
Sp Chinook run comp					1 May		15 Jul					
Su. Chin BS collection[3]							1 Jul		15 Sep			
Coho BS collection[5]									1 Sep		15 Nov	
Wells Volunteer Trap												
Su. SHD BS collection[1]									1 Sep		15 Nov	
SHD pHOS mgt.[6]		15 Feb				15 June			1 Sep			15 Dec
Su. Chin BS collection[4]							1 Jul		15 Sep			
Su. Chin Surplussing							1 Jul			30 Oct		

[1] Summer steelhead broodstock collection will be prioritized at West ladder and volunteer traps. However if broodstock objectives cannot be met at either of those two locations then trapping may occur at the East ladder concurrent with other activities.

[2] SHD spawner composition tagging at Wells Dam will run concurrent with other (broodstock or M&E) activities at Wells Dam.

[3] 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.

[4] 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.

[5] Coho trapping may be conducted at both East and/or West ladders. Trapping at Wells Dam ladder traps for Coho broodstock will follow an up to 3d/week 16hr/day trapping schedule and may run concurrent with other broodstock collection, run sampling, or adult management activities. Trapping at the Wells Dam ladder will cease no later than November 15.

[6] Adult management of the 2015 brood will end in June 2015. However it is anticipated that adult management will occur for the 2016 brood beginning 1 September or earlier if conducted in conjunction with broodstock collection activities at the Wells Hatchery volunteer channel for other species.~~Additional footnotes to be inserted here~~

Methow Hatchery Volunteer and Twisp Weir Traps

For 2015, WDFW and ~~the District~~Douglas PUD are proposing the following plan (A summary of activities by month for Methow Hatchery volunteer trap and the Twisp Weir is summarized in Table 4):

Specific operation details for the Methow Hatchery volunteer trap and Twisp Weir are still being worked through. Once those details have been fleshed out more thoroughly, this section will be updated.

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.

Table 4. 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 2015. 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
Methow Hatchery[1]												
SHD pHOS mgt.			1 Mar			15 Jun			1 Sep		15	

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	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
											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				1-30 Apr								
SHD pHOS mgt.			1 Mar		30 May							
Sp. Chinook BS collection						1 June		15 Aug				
Sp. Chinook pHOS mgt.						1 June		~~15~~ 22 Aug				
~~Coho BS collection~~???												

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[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 2015 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.

~~Additional footnotes to be inserted here.~~

Table 5. Summary of broodstock collection, VSP monitoring, and/or run composition sampling activities anticipated to be conducted at the Priest Rapids Dam Off Ladder Trap (OLAFT) in 2015. Blue denotes steelhead, purple fall Chinook, and orange sockeye.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
SHD VSP Monitoring[1]							1 Jul				15 Nov	
Fall Chin. BS collection[2]									1 Sep		15 Nov	
Fall Chinook Run Comp.[3]									1 Sep		15 Nov	
Sockeye BS Collection						22 Jun	10 Jul					

[1] Steelhead VSP monitoring targets 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] To acquire the target 1,000 adipose present, non-CWT adult fall Chinook for broodstock, the OLAFT is operated up to 5 days per week, 8 hours per day. Three of the five days are concurrent with the SHD VSP monitoring. The trap is opened to passage each night.

[3] Fall Chinook run composition runs concurrent with SHD VSP monitoring and/or fall Chinook broodstock collection activities.

[4] Sockeye broodstock collection to support YN reintroduction efforts in the Yakima is based upon an 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.

~~I really like these tables. Lots of useful info in a really accessible format! Any chance of making one for Priest Rapids OLAFT?~~

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Commented [TK128]:

Commented [GM129]: No specific coho broodstock collection has been proposed or agreed to at this point. There would also be an issue of permitting.

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Commented [KM130]: No coho collection at Twisp Weir.

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Appendix E

Columbia River TAC Forecast

Table 1. 2015 Columbia River at mouth salmon and steelhead returns – actual and forecast.

			2014 Forecast	2014 Return	2015 Forecast
Spring Chinook	**Total Spring Chinook**		**308,000**	**315,600**	**312,600**
	Willamette		58,700	51,800	55,400
	Sandy		5,500	6,000	5,500
	Cowlitz*		7,800	10,500	11,200
	Kalama*		500	1,000	1,900
	Lewis*		1,100	1,500	1,100
	Select Areas		7,400	2,200	5,000
	Lower River Total		**81,000**	**73,000**	**80,100**
	Wind*		8,500	4,000	4,800
	Drano Lake*		13,100	8,700	7,800
	Klickitat*		2,500	2,900	2,700
	Yakima*		9,100	8,800	9,300
	Upper Columbia	Total	24,100	33,100	27,500
	Upper Columbia	*Wild*	3,700	5,700	4,500
	Snake River Spr/Sum	Total	125,000	137,900	140,800
	Snake River	*Wild*	42,200	46,000	45,300
	Upriver Total		**227,000**	**242,600**	**232,500**
Summer Chinook	**Upper Columbia**		**67,500**	**78,300**	**73,000**
Sockeye	**Total Sockeye**		**347,100**	**645,100**	**394,000**
	Wenatchee		63,400	118,500	106,700
	Okanogan		282,500	523,700	285,500
	Snake River		1,200	2,900	1,800

Commented [tp131]: This looks wrong

Forgot to add the last zero.

Appendix F

Annual Chelan, Douglas, and Grant County PUD RM&E Implementation Plans –hyperlinks may not work yet but will in final draft. If you need these documents please send me a request.

Chelan PUD
~~..\..\..\Chelan HCP Stuff\Annual M&E Implementation Plans\2015 Chelan Hatchery Monitoring and Evaluation Implementation Plan.pdf~~..\..\..\Chelan HCP Stuff\Annual M&E Implementation Plans\2015 Chelan Hatchery Monitoring and Evaluation Implementation Plan.pdf..\..\..\Chelan HCP Stuff\Annual M&E Implementation Plans\2015 Chelan Hatchery Monitoring and Evaluation Implementation Plan.pdf~~..\..\..\Chelan HCP Stuff\Annual M&E Implementation Plans\2015 Chelan Hatchery Monitoring and Evaluation Implementation Plan.pdf~~..\..\..\Chelan HCP Stuff\Annual M&E Implementation Plans\2015 Chelan Hatchery Monitoring and Evaluation Implementation Plan.pdf..\..\..\Chelan HCP Stuff\Annual M&E Implementation Plans\2015 Chelan Hatchery Monitoring and Evaluation Implementation Plan.pdf~~..\..\..\Chelan HCP Stuff\Annual M&E Implementation Plans\2015 Chelan Hatchery Monitoring and Evaluation Implementation Plan.pdf~~

Douglas PUD
~~..\..\..\Douglas HCP Stuff\Annual M&E Implementation Plans\FINAL-2015 DCPUD ME Implementation Plan.pdf~~..\..\..\Douglas HCP Stuff\Annual M&E Implementation Plans\FINAL-2015 DCPUD ME Implementation Plan.pdf..\..\..\Douglas HCP Stuff\Annual M&E

Implementation Plans\FINAL-2015 DCPUD ME Implementation Plan.pdf~~..\..\..\Douglas HCP Stuff\Annual M&E Implementation Plans\FINAL-2015 DCPUD ME Implementation Plan.pdf~~..\..\..\Douglas HCP Stuff\Annual M&E Implementation Plans\FINAL-2015 DCPUD ME Implementation Plan.pdf..\..\..\Douglas HCP Stuff\Annual M&E Implementation Plans\FINAL-2015 DCPUD ME Implementation Plan.pdf~~..\..\..\Douglas HCP Stuff\Annual M&E Implementation Plans\FINAL-2015 DCPUD ME Implementation Plan.pdf~~

Grant PUD

~~..\..\..\Grant HSC Stuff\Annual Implementation Plans\2015 GPUD Hatchery ME Implementation Plan for the Wenatchee Basin_final.pdf~~..\..\..\Grant HSC Stuff\Annual Implementation Plans\2015 GPUD Hatchery ME Implementation Plan for the Wenatchee Basin_final.pdf..\..\..\Grant HSC Stuff\Annual Implementation Plans\2015 GPUD Hatchery ME Implementation Plan for the Wenatchee Basin_final.pdf~~..\..\..\Grant HSC Stuff\Annual Implementation Plans\2015 GPUD Hatchery ME Implementation Plan for the Wenatchee Basin_final.pdf~~..\..\..\Grant HSC Stuff\Annual Implementation Plans\2015 GPUD Hatchery ME Implementation Plan for the Wenatchee Basin_final.pdf..\..\..\Grant HSC Stuff\Annual Implementation Plans\2015 GPUD Hatchery ME Implementation Plan for the Wenatchee Basin_final.pdf~~..\..\..\Grant HSC Stuff\Annual Implementation Plans\2015 GPUD Hatchery ME Implementation Plan for the Wenatchee Basin_final.pdf~~

Commented [tp132]: I have distributed a draft PRH plan that hopefully can be approved and included here

Will add it when approved.

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.

Improved Fecundity Estimates

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.

Adult Collection Adjustments

C) Make in-season adjustments to adult collections based upon a fecundity-at-length regression model for each population/program and origin composition needs (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.

Within-Hatchery Program Adjustments

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:

- 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:

- 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
- 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.

Attachment A
List of Attendees

Name	Organization
Mike Schiewe	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Alene Underwood*	Chelan PUD
Catherine Willard*	Chelan PUD
Greg Mackey*	Douglas PUD
Tom Kahler*	Douglas PUD
Todd Pearsons	Grant PUD
Craig Busack*†	National Marine Fisheries Service
Matt Cooper*	U.S. Fish and Wildlife Service
Mike Tonseth*	Washington Department of Fish and Wildlife
Kirk Truscott*	Colville Confederated Tribes
Keely Murdoch*	Yakama Nation

Notes:

- * Denotes Hatchery Committees member or alternate
- † Joined by phone for Decisions Items and HGMP Update

Rocky Reach and Rocky Island HCP Hatchery Committees
Statement of Agreement
Regarding Chelan PUD's Methow Sub-basin Spring Chinook Hatchery Production Obligation
Draft for Discussion – February 18, 2015

Statement

The Rocky Reach and Rock Island Habitat Conservation Plan (HCP) Hatchery Committees (HC) agree that that Chelan PUD should enter into an Interlocal Agreement (ILA) with Douglas PUD for the purpose of satisfying Chelan PUD's hatchery production obligations for Methow spring Chinook. Specifically, the HC agree that in 2015 Chelan should obtain spring Chinook broodstock from Wells Dam and that holding and spawning of adults, incubation, and early rearing should occur at the Methow Hatchery. Final acclimation (spring acclimation) is not included in the ILA but may include the use of the Douglas PUD-owned Chewuch Pond or other remote acclimation sites, as further described in the *Hatchery Genetic Management Plan for Methow Sub-basin spring Chinook*, submitted to NOAA on March 28, 2014 and approved by the HC on March 12, 2014. This agreement applies only to 2015 and is contingent upon the CPUD developing and implementing a committee approved study to identify ways to improve homing friendly to the Chewuch River (for fish reared at Methow FH).

Background

Recalculated hatchery production values required to meet Chelan PUD's No Net Impact (NNI) through release year 2023 were approved by the Rocky Reach and Rock Island Hatchery Committees on December 14, 2011. Chelan PUD is required to produce 60,516 Methow sub-basin hatchery spring Chinook.

Hatchery Committee-March 18th

Summer Chinook Size Targets BY 2014
Size target and vessel experiment for brood year 2012, 2013, 2014 Dryden Pond Summer Chinook salmon

Treatment *	Target fish size at release in fpp (grams) in May	Pond Type at Eastbank Hatchery	Number of fish per treatment**	
Big-Circular	10 (45 gm)	Circular-Reuse	50,000	Transferred to Dryden in March
Small-Circular	15 (30 gm)	Circular-Reuse	50,000	
Big-Raceway	10 (45 gm)	Rectangular	150,000	
Small-Raceway	15 (30 gm)	Rectangular	150,000	

***Treatments will be differetially coded wire tagged and some fish from each treatment will be PIT-tagged.**
**** 100,000 are not part of the experiment**

Chelan Falls size at release BY 2012, 2013, 2014

Treatment	Size at release (fpp)	Pond Type at Chelan Falls	Number of fish per treatment	
A	10 (45 gm)	Circular	150,000	Transferred to Chelan Falls in November
B	13 (35 gm)	Circular	150,000	
C	18 (25 gm)	Circular	150,000	
D	22 (20 gm)	Circular	150,000	

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees	**Date:**	May 21, 2015
From:	Mike Schiewe, HCP Hatchery Committees Chair		
Cc:	Kristi Geris		
Re:	Final Minutes of the March 27, 2015 HCP Hatchery Committees Conference Call		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees meeting was held by conference call on Friday, March 27, 2015, from 9:30 am to 11:30 am. Attendees are listed in Attachment A to these meeting minutes.

ACTION ITEM SUMMARY

- Tom Kahler will submit Douglas PUD's approval, disapproval, or abstention on the revised draft Statement of Agreement (SOA) titled, "Regarding Timeline for Review of 'Evaluation of Hatchery Programs Funded by Douglas County PUD 5-Year Report 2006-2010'," by end of day Monday, March 30, 2015 (Item II-A). *(Note: Kahler indicated Douglas PUD's approval of the revised draft SOA via email on March 31, 2015.)*

DECISION SUMMARY

- The Hatchery Committees approved Chelan PUD's Methow Spring Chinook Hatchery Production Obligation SOA, as follows: Chelan PUD, National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), Washington Department of Fish and Wildlife (WDFW), and the Colville Confederated Tribes (CCT) approved on March 18, 2015, and the Yakama Nation (YN) approved on March 27, 2015 (Item II-A).
- The Hatchery Committees approved the SOA titled, "Regarding Timeline for Review of 'Evaluation of Hatchery Programs Funded by Douglas County PUD 5-Year Report 2006-2010'," as revised, as follows: Chelan PUD, NMFS, USFWS, WDFW, CCT, and

YN approved on March 27, 2015; Douglas PUD approved via email on March 31, 2015 (Item II-A).

AGREEMENTS

- Aside from the SOAs, there were no other agreements discussed during today's conference call.

REVIEW ITEMS

- Kristi Geris sent an email to the Hatchery Committees on March 27, 2015, notifying them the revised draft Broodstock Collection Protocols for approval are available for review, with approval, disapproval, or abstention due to Mike Tonseth by April 6, 2015. *(Note: the CCT, Chelan PUD, and Douglas PUD provided edits on the revised draft protocols for approval to Kristi Geris on March 31, April 1, and April 6, 2015, respectively, which Geris distributed to the Hatchery Committees those same days. Tonseth then provided the final draft protocols for approval to Geris on April 8, 2015, which Geris distributed to the Hatchery Committees the same day.)*
- Kristi Geris sent an email to the Hatchery Committees on April 1, 2015, notifying them the draft 2014 Chelan PUD and Grant PUD Hatchery M&E Annual Report is available for a 60-day review, with edits and comments due to Tracy Hillman by Monday, June 1, 2015.

FINALIZED DOCUMENTS

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda (Mike Schiewe)

Mike Schiewe welcomed the Hatchery Committees and said the purpose of today's meeting is to consider three proposed versions of an SOA establishing a schedule for the review and evaluation of the existing 5-year-analysis report of monitoring and evaluation (M&E) data from the Methow Basin, and newer data, and developing study plans and actions for improving Methow hatchery performance.

II. All

A. Methow Hatchery Performance Statements of Agreement (All)

The YN provided a draft SOA titled, "Review of 5-year Analytical Report and Metrics not Achieving Agreed Targets for Methow Spring Chinook," (Attachment B) to Kristi Geris on March 20, 2015, which Geris distributed to the Hatchery Committees the same day. Edits and comments on the YN draft SOA were received from WDFW (Attachment C), and also jointly from Douglas PUD and Chelan PUD (Attachment D), both received on March 26, 2015, which Geris distributed to the Hatchery Committees the same day.

Several Hatchery Committees members questioned the need for an SOA, because the HCPs required the Hatchery Committees to continually work to improve hatchery program performance. Craig Busack asked if there are any Hatchery Committees members who would not approve the YN draft SOA as written, and if so, why not. Tom Kahler and Alene Underwood said they would not agree to the YN's draft SOA as written; both indicating that an SOA should target a holistic approach rather than calling out specific M&E metrics. Kahler and Underwood indicated the "Statement" section of the SOA is what is important and binding, and the "Background" section, which focuses too narrowly on issues that are not generally agreed upon by Hatchery Committees members, is unnecessary.

Catherine Willard projected WDFW edits to the YN draft SOA (Attachment C) via WebEx, along with additional suggested edits, as previously discussed.

Tom Scriber said the primary purpose of the YN draft SOA is to establish a 2015 start date for developing a plan to address under-performing metrics identified in the 5-year analytical report for the Methow Basin. Kahler agreed developing a plan for reviewing the findings of the report should start immediately; however, he cautioned that establishing a completion date for potential study plans is dependent on the nature of the studies proposed and how they coincide with the salmonid rearing cycle.

Bill Gale suggested that the Hatchery Committees should be setting the much broader goal of reviewing all of the HCP hatchery programs. He also asked if Grant PUD was involved in any of these discussions. Kahler said he and Greg Mackey were in contact with Todd Pearsons (Grant PUD), and that Grant PUD agreed with the need to develop a study plan. Kahler added, although Douglas PUD is supportive of starting the review and study development process in 2015, he cautioned that completing a study plan in 2015 may not be feasible, given the time remaining in 2015. Keely Murdoch agreed, and language was added to WDFW's edited draft SOA (projected via WebEx) indicating that the goal was to begin identifying studies and actions to improve program performance within 1 year after the SOA was approved.

After additional edits were made to WDFW's edited draft SOA, the revised draft SOA (Attachment E) was approved by Chelan PUD, NMFS, USFWS, WDFW, CCT, and YN. Kahler indicated Douglas PUD needs to obtain approval from their General Manager before approving the revised draft SOA, which Kahler anticipated could be completed by March 30, 2015. Kahler said he will submit Douglas PUD's approval, disapproval, or abstention on the revised draft SOA titled, "Regarding Timeline for Review of 'Evaluation of Hatchery Programs Funded by Douglas County PUD 5-Year Report 2006-2010'," by end of day Monday, March 30, 2015. *(Note: Kahler indicated Douglas PUD's approval of the revised draft SOA via email on March 31, 2015.)*

Because the revised draft SOA is now approved, Mike Schiewe asked the YN if they were prepared to approve Chelan PUD's Methow Spring Chinook Hatchery Production Obligation SOA (distributed February 19, 2015), which authorizes the establishment of an Interlocal Agreement with Douglas PUD and was approved by all other Hatchery Committees members, except the YN, at the last Hatchery Committees meeting on March 18, 2015. Schiewe recalled the YN had requested additional time to consider their approval pending the outcome of an agreement on today's approved revised draft SOA calling for a 2015 review of Methow M&E results and development of studies and actions needed for program improvements. The YN approved Chelan PUD's Methow Spring Chinook Hatchery Production Obligation SOA, which completed Hatchery Committees action on this SOA.

III. HCP Administration

A. Next Meetings

The next scheduled Hatchery Committees meetings are on April 15, 2015 (Chelan PUD), May 20, 2015 (Douglas PUD), and June 17, 2015 (Chelan PUD).

List of Attachments

Attachment A	List of Attendees
Attachment B	Draft YN SOA, “Review of 5-year Analytical Report and Metrics not Achieving Agreed Targets for Methow Spring Chinook”
Attachment C	Draft YN SOA, “Review of 5-year Analytical Report and Metrics not Achieving Agreed Targets for Methow Spring Chinook” – WDFW edits
Attachment D	Draft YN SOA, “Review of 5-year Analytical Report and Metrics not Achieving Agreed Targets for Methow Spring Chinook” – Douglas PUD and Chelan PUD edits
Attachment E	Revised Draft SOA, “Regarding Timeline for Review of ‘Evaluation of Hatchery Programs Funded by Douglas County PUD 5-Year Report 2006-2010”

Attachment A
List of Attendees

Name	Organization
Mike Schiewe	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Alene Underwood*	Chelan PUD
Catherine Willard*	Chelan PUD
Greg Mackey*	Douglas PUD
Tom Kahler*	Douglas PUD
Craig Busack*	National Marine Fisheries Service
Bill Gale*	U.S. Fish and Wildlife Service
Mike Tonseth*	Washington Department of Fish and Wildlife
Kirk Truscott*	Colville Confederated Tribes
Tom Scribner*	Yakama Nation
Keely Murdoch*	Yakama Nation

Note:

*Denotes Hatchery Committees member or alternate

Rocky Reach, Rocky Island, and Wells Dam HCP Hatchery Committees
Statement of Agreement
Review of 5-year Analytical Report and Metrics not Achieving Agreed Targets for Methow Spring Chinook
20 March 2015

Statement

The Rocky Reach, Rock Island, and Wells Dam Habitat Conservation Plan (HCP) Hatchery Committees (HC) agree that to identify, develop and implement investigations to address elements of the Methow FH spring Chinook programs which are failing to achieve identified targets as described in Murdoch et al., 2012). During 2015, the HCP HC will identify metrics, and develop study designs. Agreed upon studies will be implemented beginning in 2016.

Background

The HCP Hatchery Committee (HCP HC) is responsible for developing the monitoring and evaluation program (M&E Plan) to assess overall performance of Chelan and Douglas PUDs hatchery programs. The first M&E plans were approved in 2005 (Murdoch and Peven 2005; DCPUD HCP HC 2005) with revisions to one regional objective in 2007 (Murdoch and Peven 2007; DCPUD HCP HC 207). The first 5-year analytical reports finalized in 2012 (Murdoch et al. 2012, Hillman et al., 2012). The M&E plan has clearly defined metrics and targets and is intended to be used to adaptively manage hatchery programs so that they may achieve stated goals (Murdoch and Peven, 2005; DCPUD HCP HC 2007).

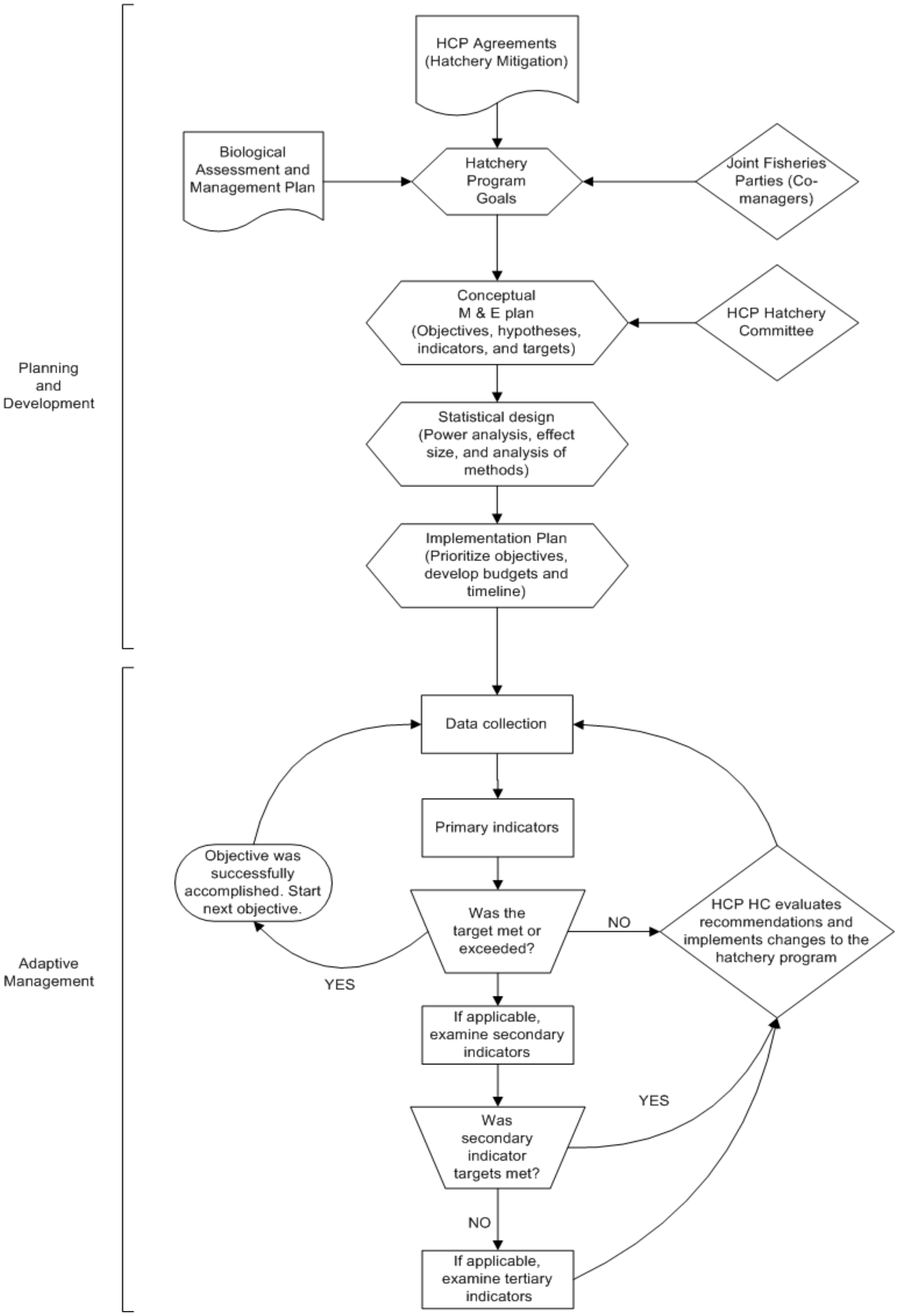
1. Support the recovery of **ESA** listed species[1] by increasing the abundance of the natural adult population, while ensuring appropriate spatial distribution, **genetic stock integrity**, and adult spawner **productivity**.
2. Increase the abundance of the natural adult population of unlisted plan 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.
3. Provide salmon for harvest and increase harvest opportunities, while segregating returning adults from natural tributary spawning populations.

Following the approval of the first 5-year analytical report (Murdoch et al, 2012), the Committees followed through on revisions to the M&E plan but never took the action (for various reasons including recalculation of hatchery program release numbers) to address hatchery metrics that were not meeting committee agreed to targets.

---

[1] While the HCP is not a recovery plan into itself, the hatchery component of it must be consistent with hatchery goals and objectives through the ESA, and as such should aid in the recovery of listed fish.

Now that programs have been reduced in size, it is important that the HCP Hatchery Committees review which metrics are not achieving desired targets and prepare plans to address these metrics as illustrated in Figure 1 (Murdoch and Peven, 2005).



Murdoch, A., and C. Peven. 2005. Conceptual Approach to Monitoring and Evaluating the Chelan County Public Utility District Hatchery Programs. *Prepared for:* Chelan PUD Habitat Conservation Plan's Hatchery Committee.

Douglas County PUD Habitat Conservation Plan Hatchery Committee. 2005. Conceptual approach to monitoring and evaluation for hatchery programs funded by Douglas County Public Utility District. *Prepared for:* Douglas PUD Habitat Conservation Plan Hatchery Committee.

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Murdoch, A., C. Snow, C. Frady, A. Repp, M. Small, S. Blankenship. 2012. Evaluation of hatchery programs funded by Douglas County PUD 5-year report 2006-2010. *Prepared for:* Wells HCP Hatchery Committee.

Attachment C

Rocky Reach, Rocky Island, and Wells Dam HCP Hatchery Committees
Statement of Agreement
Review of 5-year Analytical Report and Metrics not Achieving Agreed Targets for Methow Spring Chinook
20 March 2015

Statement

The Rocky Reach, Rock Island, and Wells Dam Habitat Conservation Plan (HCP) Hatchery Committees (HC) agree ~~that~~ to identify, develop and implement investigations to address elements of the Methow FH spring Chinook programs which are ~~failing~~ falling short ~~to achieve~~of identified targets as described in Murdoch et al., 2012). During 2015, the HCP HC will identify metrics, and develop study designs. Agreed upon studies will be implemented according to time schedules established for each study~~beginning in 2016~~.

Background

The HCP Hatchery Committee (HCP HC) is responsible for developing the monitoring and evaluation program (M&E Plan) to assess overall performance of Chelan and Douglas PUDs hatchery programs. The first M&E plans were approved in 2005 (Murdoch and Peven 2005; DCPUD HCP HC 2005) with revisions to one regional objective in 2007 (Murdoch and Peven 2007; DCPUD HCP HC 207). The first 5-year analytical reports finalized in 2012 (Murdoch et al. 2012, Hillman et al., 2012). The M&E plan has clearly defined metrics and targets and is intended to be used to adaptively manage hatchery programs so that they may achieve stated goals (Murdoch and Peven, 2005; DCPUD HCP HC 2007).

1. Support the recovery of **ESA** listed species[1] by increasing the abundance of the natural adult population, while ensuring appropriate spatial distribution, **genetic stock integrity**, and adult spawner **productivity**.
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.
3. Provide salmon for harvest and increase harvest opportunities, while segregating returning adults from natural tributary spawning populations.

Following the approval of the first 5-year analytical report (Murdoch et al, 2012), the Committees followed through on revisions to the M&E plan but never took the action (for various reasons including recalculation of hatchery program release numbers) to address hatchery metrics that were not meeting committee agreed to targets.

Commented [MT1]: As originally stated, this assumes that the programs have failed when the case may be that the targets are not realistic (as a result the programs fail every time). An example of this is where the committees made significant adjustments to the in-hatchery survival metrics for numerous programs because a) the original metrics (which were somewhat arbitrarily assigned) were too low and program performance far exceeded the expectation or b) the original metrics (again somewhat arbitrarily assigned) were realized to be unachievable due to one factor or another (i.e. facility limitations, stock specific response, etc).

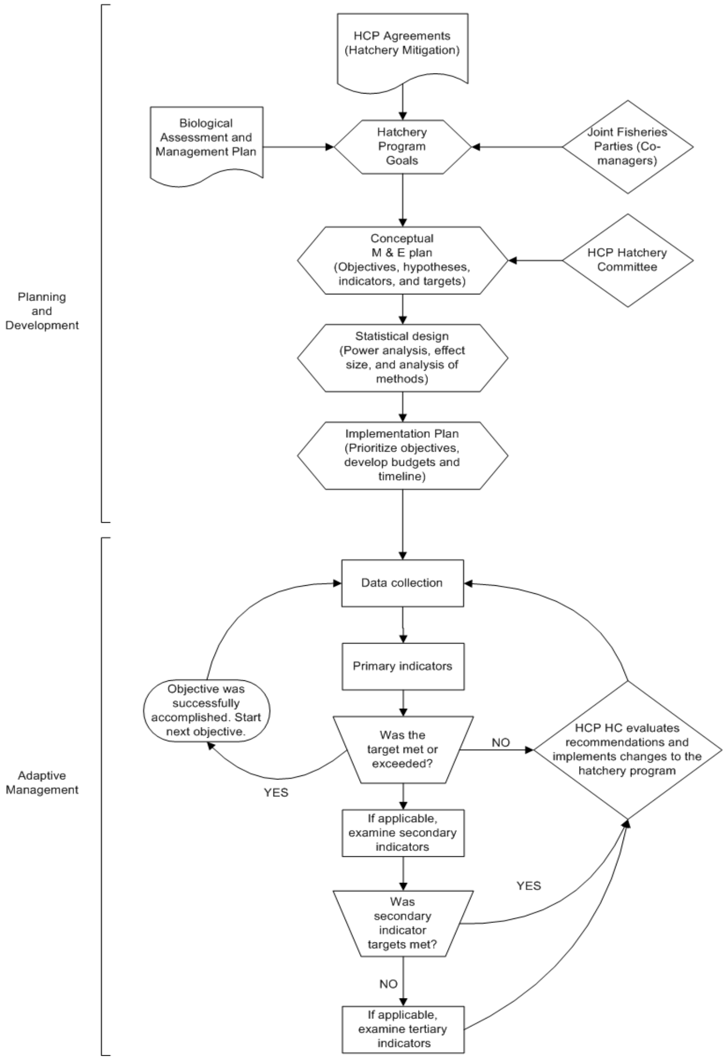
Because we (the Hatchery Committee reps) have failed to do our due diligence in reviewing/discussing the recommendations made in the five year report, again this statement makes rather broad assumptions/conclusions. A review of the report may suggest that multiple factors are at play. In short I don't want to look at the targets (achieved or not) as the be all, end all decision element (but they should at least guide the committee down the right road).

Commented [MT2]: While this may be ideal, this may not be realistic depending on how long it takes to get a study plan approved, contracting in place, and/or necessary infrastructure changes before a specific study could be implemented. What I am suggesting here is that when a proposal is developed, a (realistic) timeline is established and then held to.

---

[1] While the HCP is not a recovery plan into itself, the hatchery component of it must be consistent with hatchery goals and objectives through the ESA, and as such should aid in the recovery of listed fish.

Now that programs have been reduced in size, it is important that the HCP Hatchery Committees review which metrics are not achieving desired targets and prepare plans to address these metrics as illustrated in Figure 1 (Murdoch and Peven, 2005).



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Rocky Reach, Rocky Island, and Wells ~~Dam~~ HCPs Hatchery Committees
Statement of Agreement
Review of the "Evaluation of ~~h~~Hatchery P~~p~~rograms ~~f~~Funded by Douglas County PUD 5-year ~~r~~Report 2006-2010" ~~M&E 5-year Analytical Report and Metrics not Achieving Agreed Targets~~ for Methow Spring Chinook Under an Adaptive Management Process

27~~0~~ March 2015

Statement

The Rocky Reach, Rock Island, and Wells ~~Dam~~ Habitat Conservation Plans (HCPs) Hatchery Committees (HC) agree to evaluate the results of "Evaluation of H~~h~~atchery P~~p~~rograms F~~f~~unded by Douglas County PUD 5-year R~~r~~eport 2006-2010"and more current ~~information~~ data ~~Analytical~~ regarding Methow Basin spring Chinook, and use this evaluation in an adaptive management process to identify potential improvements in operating the spring Chinook program(s) and/or a study or studies to be conducted to gain better understanding of the M&E results and to inform possible actions. The HC will begin the evaluation in 2015, and will proceed with implementation of selected actions or studies as soon as practicable following agreement on those actions/studies. ~~that to identify, develop and implement investigations to address elements of the Methow FH spring Chinook programs which are failing to achieve identified targets as described in Murdoch et al., 2012). During 2015, the HCP HC will identify metrics, and develop study designs. Agreed upon studies will be implemented beginning in 2016.~~

~~Background~~

~~The HCP Hatchery Committee (HCP HC) is responsible for developing the monitoring and evaluation program (M&E Plan) to assess overall performance of Chelan and Douglas PUDs hatchery programs. The first M&E plans were approved in 2005 (Murdoch and Peven 2005; DCPUD HCP HC 2005) with revisions to one regional objective in 2007 (Murdoch and Peven 2007; DCPUD HCP HC 207). The first 5-year analytical reports finalized in 2012 (Murdoch et al. 2012, Hillman et al., 2012). The M&E plan has clearly defined metrics and targets and is intended to be used to adaptively manage hatchery programs so that they may achieve stated goals (Murdoch and Peven, 2005; DCPUD HCP HC 2007).~~

1. ~~Support the recovery of **ESA** listed species[1] by increasing the abundance of the natural adult population, while ensuring appropriate spatial distribution, **genetic stock integrity**, and adult spawner **productivity**.~~

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.~~

3. ~~Provide salmon for harvest and increase harvest opportunities, while segregating returning adults from natural tributary spawning populations.~~

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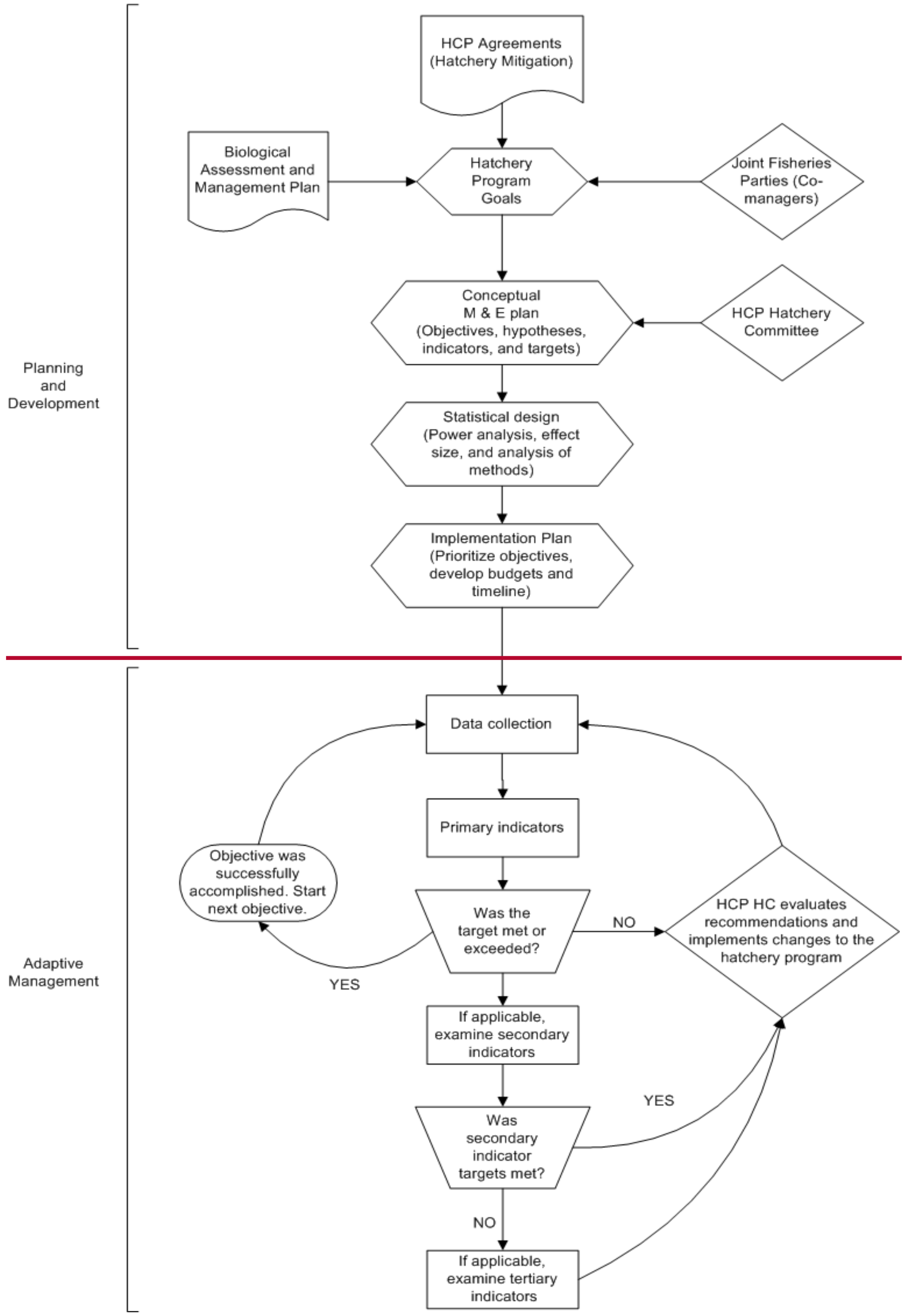
[1] ~~While the HCP is not a recovery plan into itself, the hatchery component of it must be consistent with hatchery goals and objectives through the ESA, and as such should aid in the recovery of listed fish.~~

~~Following the approval of the first 5-year analytical report (Murdoch et al, 2012), the Committees followed through on revisions to the M&E plan but never took the action (for various reasons including recalculation of hatchery program release numbers) to address hatchery metrics that were not meeting committee agreed to targets.~~

~~Now that programs have been reduced in size, it is important that the HCP Hatchery Committees review which metrics are not achieving desired targets and prepare plans to address these metrics as illustrated in Figure 1 (Murdoch and Peven, 2005).~~



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Rocky Reach, Rocky Island, and Wells HCPs Hatchery Committees
Statement of Agreement
Regarding Timeline for Review of "Evaluation of Hatchery Programs Funded by Douglas County PUD 5-Year Report 2006-2010"
27 March 2015

Statement

The Rocky Reach, Rock Island, and Wells Dam Habitat Conservation Plan (HCP) Hatchery Committees (HC) agree to review results of "Evaluation of Hatchery Programs Funded by Douglas County PUD 5-year Report 2006-2010" and more current data regarding Methow Basin spring Chinook and identify, develop and implement investigations to address elements of the Methow FH spring Chinook programs to improve program performance. The HC will begin the evaluation in 2015. Within a year of the SOA approval, the Parties will have identified and prioritized potential studies or other actions to address program deficiencies. Implementation of selected actions or studies will occur as soon as practicable following development and agreement on those actions/studies.

Background

The HCP Hatchery Committee (HCP HC) is responsible for developing the monitoring and evaluation program (M&E Plan) to assess overall performance of Chelan and Douglas PUDs hatchery programs. The first M&E plans were approved in 2005 (Murdoch and Peven 2005; DCPUD HCP HC 2005) with revisions to one regional objective in 2007 (Murdoch and Peven 2007; DCPUD HCP HC 2007). The first 5-year analytical reports finalized in 2012 (Murdoch et al. 2012, Hillman et al., 2012). The M&E plan has clearly defined metrics and targets and is intended to be used to adaptively manage hatchery programs so that they may achieve stated goals (Murdoch and Peven, 2005; DCPUD HCP HC 2007).

1. Support the recovery of ESA listed species[1] by increasing the abundance of the natural adult population, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity.

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.

3. Provide salmon for harvest and increase harvest opportunities, while segregating returning adults from natural tributary spawning populations.

Following the approval of the first 5-year analytical report (Murdoch et al, 2012), the Committees followed through on revisions to the M&E plan but never took the action (for various reasons including

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recalculation of hatchery program release numbers) to address hatchery metrics that were not meeting committee agreed to targets.

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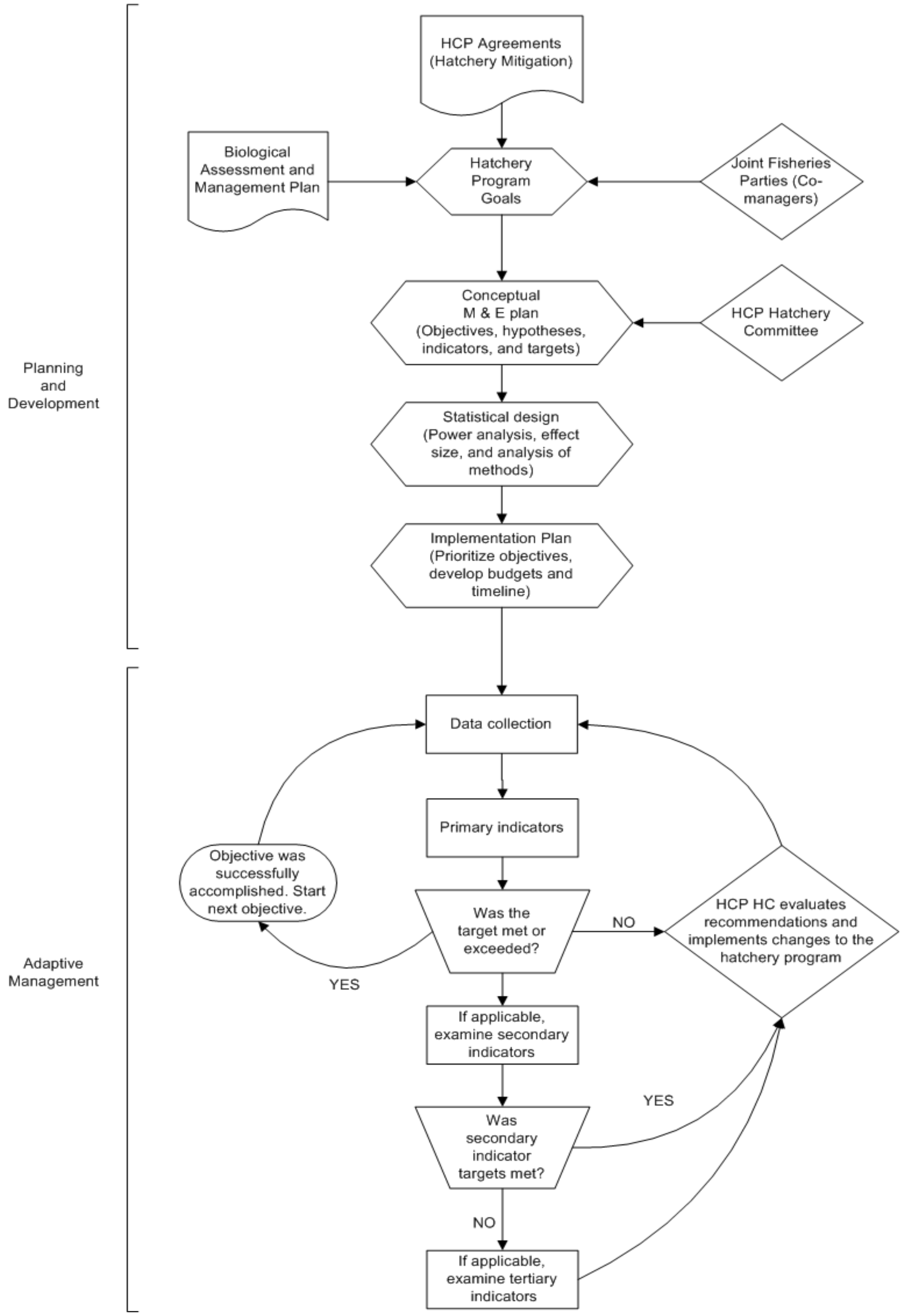

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FINAL MEMORANDUM

To: Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees
Date: May 21, 2015
From: Mike Schiewe, HCP Hatchery Committees Chairman
Cc: Kristi Geris
Re: Final Minutes of the April 15, 2015 HCP Hatchery Committees Meeting

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees meeting was held at Chelan PUD headquarters in Wenatchee, Washington, on Wednesday, April 15, 2015, from 9:30 a.m. to 12:00 p.m. Attendees are listed in Attachment A to these meeting minutes.

ACTION ITEM SUMMARY

- Greg Mackey and Mike Tonseth will provide proposed targets for Methow spring Chinook salmon adult management for potential implementation in 2015 to Kristi Geris for distribution to the Hatchery Committees by Wednesday, April 29, 2015 (Item II-A).
- Greg Mackey, Catherine Willard, and Keely Murdoch will develop a draft plan and schedule for reviewing the Methow Basin Five-Year Hatchery Monitoring and Evaluation (M&E) results and new information for consideration by the Hatchery Committees at least 10 days prior to the next Hatchery Committees meeting on May 20, 2015 (Item II-B).

DECISION SUMMARY

- There were no decisions approved during today's meeting.

AGREEMENTS

- There were no agreements discussed during today's meeting.

REVIEW ITEMS

- Kristi Geris sent an email to the Hatchery Committees on April 1, 2015 notifying them the draft 2014 Chelan PUD and Grant PUD Hatchery M&E Annual Report is available for a 60-day review, with edits and comments due to Tracy Hillman by Monday, June 1, 2015.

FINALIZED DOCUMENTS

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda, Review Last Meeting Action Items, Approve the March 18, 2015 Meeting Minutes (Mike Schiewe)

Mike Schiewe welcomed the Hatchery Committees and asked for any additions or changes to the agenda. No additions or changes were requested.

The Hatchery Committees reviewed the revised draft March 18, 2015, meeting minutes. Kristi Geris said a second revised draft was distributed to the Hatchery Committees on April 9, 2015, which included additional edits from Chelan PUD and administrative updates (with changes tracked in redlines). Geris said all other comments and revisions received from members of the Committees were incorporated in the revised minutes, and that there were no outstanding edits or questions to discuss. Keely Murdoch clarified that while discussing broodstock collection for the Nason Creek Conservation Program, she indicated she thought all fish collected would be kept, excluding—not including—those assigning to White River. Geris said she will make this revision, as requested, and the Hatchery Committees members present approved the draft March 18, 2015, meeting minutes, as revised.

Action items from the Hatchery Committees meeting on March 18, 2015, and follow-up discussions, were as follows (italicized item numbers below correspond to agenda items from the meeting on March 18, 2015):

- *Keely Murdoch will provide a draft Yakama Nation (YN) Kelt Sampling Protocol for sampling at Wells Dam in 2015, to Kristi Geris for distribution to the*

Hatchery Committees and discussion during the Hatchery Committees meeting on April 15, 2015 (Item I-A).
Murdoch provided the protocol to Geris on April 2, 2015, which Geris distributed to the Hatchery Committees the same day.

- *Mike Tonseth and Craig Busack will consult Ken Warheit (Washington Department of Fish and Wildlife [WDFW]) regarding decision rules for White River and Little Wenatchee River broodstock assignments for the Nason Creek Conservation Program (Item II-A).*
  This item was completed.
- *Mike Tonseth will provide the revised draft 2015 Broodstock Collection Protocols to Kristi Geris by Monday, March 23, 2015, for distribution to the Hatchery Committees and Wells HCP Coordinating Committee for review, with Hatchery Committees' comments due to Tonseth by close of business Thursday, March 26, 2015; Tonseth will provide a final revised draft for approval by Friday, March 27, 2015, with email vote due by Monday, April 6, 2015 (Item II-A).*
  Tonseth distributed the revised draft protocols for approval to Kristi Geris on March 27, 2015, as discussed. The Colville Confederated Tribes (CCT), Chelan PUD, and Douglas PUD provided edits on the revised draft protocols for approval to Geris on March 31, April 1, and April 6, 2015, respectively, which Geris distributed to the Hatchery Committees those same days. Tonseth provided the final draft protocols for approval to Geris on April 8, 2015, which Geris distributed to the Hatchery Committees the same day. The Hatchery Committees approved (via email) the final 2015 Broodstock Collection Protocols, as follows: Chelan PUD, National Marine Fisheries Service (NMFS), WDFW, and CCT approved the protocols on April 8, 2015; Douglas PUD and the YN approved the protocols on April 9, 2015; and the U.S. Fish and Wildlife Service (USFWS) approved the protocols on April 10, 2015. The final protocols were distributed to the Hatchery Committees by Geris on April 13, 2015.
- *Keely Murdoch will verify the YN's approval, disapproval, or abstention on the draft Chelan PUD Methow Spring Chinook Hatchery Production Statement of Agreement (SOA) by Wednesday, April 1, 2015 (Item III-A).*
  Murdoch provided a separate SOA for approval to Kristi Geris on March 20, 2015, which the Hatchery Committees approved, as revised, on March 31, 2015.

- *The Hatchery Evaluation Technical Team (HETT) will convene to discuss a timeline for finalizing the Hatchery M&E Plan appendices and will report back to the Hatchery Committees during the next meeting on April 15, 2015 (Item III-C).* A meeting is scheduled for Wednesday, April 29, 2015.

II. Douglas PUD

A. Methow Spring Chinook Adult Management for Implementation in 2015 (Greg Mackey)

Greg Mackey said a Methow Spring Chinook Adult Management presentation was distributed to the Hatchery Committees by Kristi Geris prior to the meeting on April 15, 2015. *(Note: a revised presentation [Attachment B] was distributed after the meeting on April 15, 2015.)*

Mackey said Douglas PUD and WDFW have been discussing the potential implementation of adult management of spring Chinook salmon in the Methow Basin. He said, as noted on slide 1 of Attachment B, the NMFS Permit Extension Letter for Permits 1196, [1347,] and 1395 (dated September 20, 2013), states broodstock collection and adult management of spring Chinook salmon in the Methow Basin may occur during the extension, as approved by consensus of the Mid-Columbia HCP Hatchery Committees, with NMFS concurrence. He noted that this language does not mandate the permit holders to implement adult management of spring Chinook salmon in the Methow Basin; however, he suggested it may be beneficial to take advantage of the opportunity to learn how adult management could be used for managing percentage hatchery-origin spawners (pHOS) in the basin. To that end, Douglas PUD and WDFW developed some draft information for the Hatchery Committees to consider.

Mackey reviewed Table 1 on slide 2 of Attachment B, noting that NMFS had developed this proposed sliding scale based on a similar scale for Wenatchee spring Chinook and is believed to be an approach similar to that which may be included in the Methow Biological Opinion (BiOp). Mackey said that following additional review of Table 1, the PUDs believed some of the proposed pHOS numbers were unrealistically low; therefore, Table 2 on slide 2 of Attachment B was developed, which defaults to 0.25 once more than 900 natural-origin spawners return. Bill Gale asked if the last three tiers of Table 2 reflect maximized adult management (i.e., a lesser pHOS may be targeted; however, it may not be attainable).

Mackey said that is correct and the reason for the change was that the PUDs wanted to avoid establishing targets that could not be achieved.

Mackey said Table 3 on slide 3 of Attachment B establishes expected percent natural-origin broodstock (pNOB) and proportionate natural influence (PNI) goals. He said Table 3 includes a Methow-based pNOB, which Douglas PUD feels is achievable. He said that once the pNOB target was established the pHOS sliding scale was converted to a PNI scale, as depicted in Figure 1 on slide 4 of Attachment B. He noted near the breakpoint of the bins (bins are depicted by blue diamonds in Figure 1), there are large changes in PNI targets (e.g., from 0.56 to 0.67) that can result from as little as a one fish differential in natural-origin spawner escapement. To avoid this phenomenon, he applied a function to fit the sliding scale to minimize this effect, which resulted in a continuous calculation of the scale based on natural-origin spawner escapement instead of bins. Craig Busack asked if this function converts the bracket system to a continuous sliding scale, and Mackey said that is correct (i.e., the function is called the monomolecular function). He said Table 4 on slide 5 of Attachment B reports the sliding scale comparison to the function-derived values.

Mackey said the graph on slide 6 of Attachment B depicts an analysis that applies this proposed sliding scale using assumed numbers based on the 2015 Broodstock Collection Protocols. Mackey noted the analysis assumes a run of 500 wild fish and includes only the Methow and Chewuch complexes (it does not include the Twisp population). Busack asked if this analysis only models the Douglas PUD and Grant PUD components. Mackey said that is correct for pNOB. Busack asked about the Chelan PUD component, and Mackey replied it does not matter for this analysis so long as the brood composition is the same. Busack asked if this analysis considers Winthrop fish, and Mike Tonseth said that it does not. Tonseth added that this only addresses conservation programs. Gale noted there is still a lot to be resolved. Mackey agreed, noting this analysis is fairly simple and does not take into consideration all the components that need to be addressed in the Methow Basin. Busack asked what 372 represents; Mackey explained that is the number of wild spawners after broodstock removal. Busack asked how to consider different pNOB levels in different programs. Mackey said the pNOB was modeled as if for one homogenous program to simplify the analysis.

Mackey reviewed Table 5 and Table 6 on slide 7 of Attachment B. He noted the surprisingly small number of wild-by-wild (WxW) crosses spawning in nature when pHOS increases. Busack questioned the calculations in Table 6, noting, based on the values provided, there should be more WxW spawning in nature. Mackey said he believed the calculations were correct; however, that he would review them when he has access to the original spreadsheet he used to develop the examples. Busack said, regardless, the general message is quite clear—taking wild fish into the hatchery reduces the wild populations spawning in nature. *(Note: Mackey provided revised calculations following the meeting on April 15, 2015, as reported in Attachment B.)*

Mackey asked the Hatchery Committees about their initial thoughts on whether or not adult management of spring Chinook salmon in the Methow Basin should be pursued this year. He noted fish will be arriving at the Methow Fish Hatchery (FH) outfall by late-May 2015. Gale suggested, that this year, it may be most beneficial to develop research questions and collect more data on what actions are feasible and how those actions may contribute to managing adults on the spawning grounds. He suggested not targeting PNI goals this year and instead focusing on collecting additional data. Tonseth recommended developing at least a soft target, but cautioned against removal of too many fish from the basin. He also suggested establishing loose sidebars to evaluate the effectiveness of real-time monitoring. He asked, in terms of a safety net, to what degree should Methow FH fish be removed for broodstock for safety net at Winthrop National Fish Hatchery (NFH). Busack asked what percentage of returning adults to Winthrop NFH are Methow spring Chinook salmon, and Matt Cooper said it is about 15% on average. Gale said, in general, the majority of surplus hatchery fish removed at Winthrop NFH are Winthrop origin, and about 20 to 30% are Methow FH fish. He added that Methow FH is used to remove additional fish for broodstock purposes. He questioned if closing the Methow FH fish ladder would result in fish spawning in the upper reaches or cause fish to remain in that reach. Busack inquired about flexibility in the operation of the Methow FH, and Mackey said it can be operated however they would like. Keely Murdoch asked if there is passive integrated transponder (PIT)-tag detection at the Methow FH trap and outfall, and Mackey said that there is a PIT-tag detector at the trap, and that in the past the YN had operated more than one detector in the volunteer channel (for the Coho project), but he did not know if this was still in operation. Murdoch suggested monitoring those data to determine when fish are arriving and leaving the trap and outfall areas. Tonseth said this may be a timing issue, noting that if fish cannot immediately access the trap, they may leave the channel all together. Kirk Truscott suggested evaluating what proportion of spring Chinook salmon redds in the Methow Basin occur in the Methow FH channel, with and without adult management, as a way to determine if adult management has an effect on where fish spawn. Gale speculated, if the Methow FH fish channel was closed, some fish may go to the Winthrop channel to spawn. Tonseth said this could be studied by monitoring PIT-tagged fish.

Mackey suggested, for this year, he and Tonseth will provide a plan with proposed targets for Methow spring Chinook salmon adult management for implementation in 2015 to Geris for distribution to the Hatchery Committees by Wednesday, April 29, 2015. *(Note: the plan was sent on May 8, 2015 after including review and development including USFWS and WDFW biological and hatchery staff and Grant PUD review.)*

B. Review of Five-Year Hatchery M&E Report (Greg Mackey)

Greg Mackey suggested that the entire Hatchery Committees fully engage in this effort. He added that some smaller groups may need to convene; however, he recommended all review and decisions should be handled by the entire Hatchery Committees. Keely Murdoch suggested approaching review of the Five-Year Hatchery M&E Report with a more global scope (i.e., more basins and species). Mackey reminded the Hatchery Committees of the narrow focus of the SOA titled, "Regarding Timeline for Review of 'Evaluation of Hatchery Programs Funded by Douglas County PUD 5-Year Report 2006-2010'," (approved March 27, 2015). Murdoch then suggested approaching review of the report by species and basin, starting with spring Chinook salmon in the Methow Basin, and moving forward program-by-program (e.g., Methow, Twisp, Chewuch). Mike Tonseth agreed with Murdoch's suggestion, and recommended reviewing the recommendations included in the last five-year report to prioritize the remaining programs. Mackey concurred with this approach, and further recommended considering more recent data along with those data included in the last five-year report, and evaluating the higher level objectives and then secondary objectives as indicated in the M&E plan hierarchy and as they pertain to the last five-year report recommendations. Mackey, Catherine Willard, and Murdoch agreed to develop a draft plan for reviewing the Methow Basin Five-Year Hatchery M&E results, and new information for consideration by the Hatchery Committees, at least 10 days prior to the next Hatchery

Committees meeting on May 20, 2015. Tom Scribner suggested involving Charlie Snow in this effort, and Mackey indicated Snow will be involved, as needed.

III. NMFS

A. Hatchery and Genetic Management Plan Update (Craig Busack)

Craig Busack said the reinitiation Wenatchee Spring Chinook BiOp was sent to the National Oceanic and Atmospheric Administration General Counsel (NOAA-GC) for review last week. He added he has not heard anything back, but speculated that ongoing litigation regarding Puget Sound hatchery programs may slow the review process. He said the Wenatchee Steelhead BiOp is also ready for review; however, he has not forwarded it to NOAA-GC, which will allow them to focus on one BiOp at a time.

IV. U.S. Fish and Wildlife Service

A. U.S. Fish and Wildlife Service Bull Trout Consultation Update (Bill Gale)

Bill Gale said Karl Halupka (USFWS) is still waiting to receive comments on the draft USFWS Wenatchee BiOp and Incidental Take Statement.

V. BioAnalysts

A. Presentation: "The Thermal Blob" (Tracy Hillman)

Tracy Hillman shared a presentation titled, *Ocean Conditions in 2014; Potential Consequences for Salmon,* which was prepared by NMFS and presented at a recent Life-Cycle Modeling Workshop in Seattle, Washington. *(Note: permission was not obtained to distribute this presentation; therefore, only a brief overview of the presentation is provided below.)*

This presentation described the different ecosystem indicators NMFS scientists annually evaluate and how the indicators relate to salmon runs. These include the Pacific Decadal Oscillation, Oceanic Nino Index, sea surface temperatures, zooplankton abundance and species richness, and other selected conditions. He said results from 2014 suggest bad news for future salmon runs. Conversely, measures of Chlorophyll *a* in the nearshore ocean suggest good news for salmon. The Upwelling Index and juvenile salmon survey data suggest a mixed outcome. In general, the forecasting models indicate decreased salmon returns in the next few years; however, the confidence intervals associated with the estimates are large, indicating high uncertainty. The large uncertainty is primarily due to the unique patterns observed in the ecosystem indicators in 2014. Most of the patterns documented in 2014 have not been observed in the past several decades.

B. Presentation: "Pinnipedageddon" (Tracy Hillman)

Tracy Hillman shared a presentation titled, *Estimation of Survival and Run Timing of Adult Spring/Summer Chinook from the Columbia River Estuary to Bonneville Dam,* which was prepared by NMFS and presented at a recent Life-Cycle Modeling Workshop in Seattle, Washington. *(Note: permission was not obtained to distribute this presentation; therefore, only a brief overview of the presentation is provided below.)*

This presentation included estimates of the numbers of pinnipeds counted in the estuary from 2010 through 2014 and provided an early estimate for 2015; the latter of which is about four times greater than the number estimated in 2014. Based on mark-recapture studies in the estuary since 2010, average annual Chinook salmon survival has ranged from 55 to 90%. Mortality was highest and travel times to Bonneville Dam were slowest for fish tagged in March and April. The higher mortality and longer travel times coincided with peak numbers of sea lions. In addition, the average annual survival of Chinook salmon decreased from 2010 to 2014, which correlates with the number of sea lions hauled out near Astoria, Oregon. The study also indicated parental-based genetics testing shows promise for evaluating hatchery- and tributary-level information on Chinook salmon survival and movement. The increasing numbers of pinnipeds in the estuary could create survival bottlenecks for selected salmon runs.

VI. HCP Administration

A. Mike Schiewe's Retirement

Mike Schiewe reminded the Hatchery Committees members that this was his last meeting before Dr. Tracy Hillman of BioAnalysts becomes the new Chairman on May 1, 2015. He recalled, during the past 10 years, the Hatchery Committees have addressed many complex questions, and successfully resolved them. He wished the representatives continued success. The Hatchery Committees representatives present thanked Schiewe for his years of leadership and contributions to the Hatchery Committees and the HCPs.

B. Next Meetings

The next scheduled Hatchery Committees meetings are on May 20, 2015 (Douglas PUD), June 17, 2015 (Chelan PUD), and July 15, 2015 (Douglas PUD).

List of Attachments

Attachment A	List of Attendees
Attachment B	Revised Methow Spring Chinook Adult Management Presentation

Attachment A
List of Attendees

Name	Organization
Mike Schiewe	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Alene Underwood*	Chelan PUD
Catherine Willard*	Chelan PUD
Greg Mackey*	Douglas PUD
Tom Kahler*	Douglas PUD
Todd Pearsons	Grant PUD
Craig Busack*†	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
Jeff Korth*†	Washington Department of Fish and Wildlife
Jayson Wahls	Washington Department of Fish and Wildlife
Kirk Truscott*	Colville Confederated Tribes
Tom Scribner*†	Yakama Nation
Keely Murdoch*	Yakama Nation

Notes:

* Denotes Hatchery Committees member or alternate
† Joined by phone

NMFS Extension Letter Regarding Permits 1196 and 1395, September 20, 2013

…

We expect that broodstock collection and adult management of steelhead in the Wenatchee and Methow basins will occur during the extension. Broodstock collection and adult management spring Chinook salmon in the Methow basin **may** also occur during the extension. Until new steelhead harvest plans are developed and approved, steelhead fisheries in the basins will be managed as per permit 1395. Any additional management details affecting other program elements that are not fully described in application documents or draft permits will be determined by consensus of the Mid-Columbia HCP Hatchery Committee or the Priest Rapids Coordinating Committee Hatchery Subcommittee, with NMFS concurrence.

…

Table 1. Sliding scale for management of returning adult Methow spring Chinook salmon (Busack 2013). pHOS is calculated on the basis of all spawners in the Methow Basin.

Natural-Origin Escapement	Management Response
<300	500 total spawners
301-500	pHOS ≤ 0.4
501-900	pHOS ≤ 0.3
901-1500	pHOS ≤ 0.2
1501-2000	pHOS ≤ 0.1
>2000	pHOS = 0

Table 2. Modified pHOS Sliding Scale

Natural-Origin Escapement	Management Response
<300	500 total spawners
301-500	pHOS ≤ 0.4
501-900	pHOS ≤ 0.3
901-1500	pHOS ≤ 0.25
1501-2000	pHOS ≤ 0.25
>2000	pHOS ≤ 0.25

Attachment B

Table 3. Convert pHOS to PNI sliding Scale

Sliding Scale			
Wild	**pHOS**	pNOB	PNI
300	0.6	0.75	0.56
500	0.4	0.80	0.67
900	0.3	1.00	0.77
1500	0.25	1.00	0.80
2000	0.25	1.00	0.80
2500	0.25	1.00	0.80

$PNI = a(1-e^{-bx})$

Where: a = a constant that = the asymptote
b = a constant that defines the function shape
x = wild spawners
e = natural log base

to fit a function to the sliding scale, where:

a = 0.80
b = 0.00378

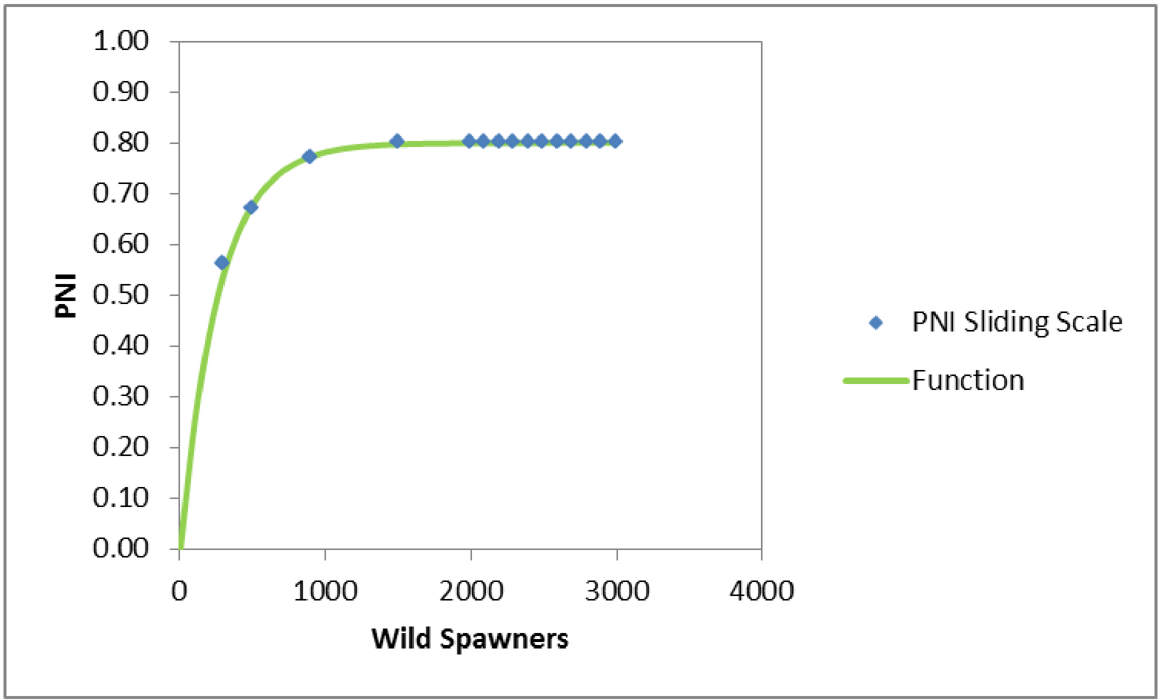

Figure 1. PNI sliding scale values and the PNI function [$PNI = a(1-e^{-bx})$] fit to these points with a=0.80 and b=0.00378.

Table 4. Sliding scale comparison to the function-derived values

Sliding Scale				PNI Function
Wild	**pHOS**	pNOB	PNI	
<300	*500 Total Spawners*			
300	0.6	0.75	0.56	0.54
500	0.4	0.80	0.67	0.68
900	0.3	1.00	0.77	0.77
1500	0.25	1.00	0.80	0.80
2000	0.25	1.00	0.80	0.80
2500	0.25	1.00	0.80	0.80

Assume run of 500 wild fish:

PNI target from sliding scale = 0.6039
Wild spawners = 372
pNOB = 0.50 or 0.75 or 1.00

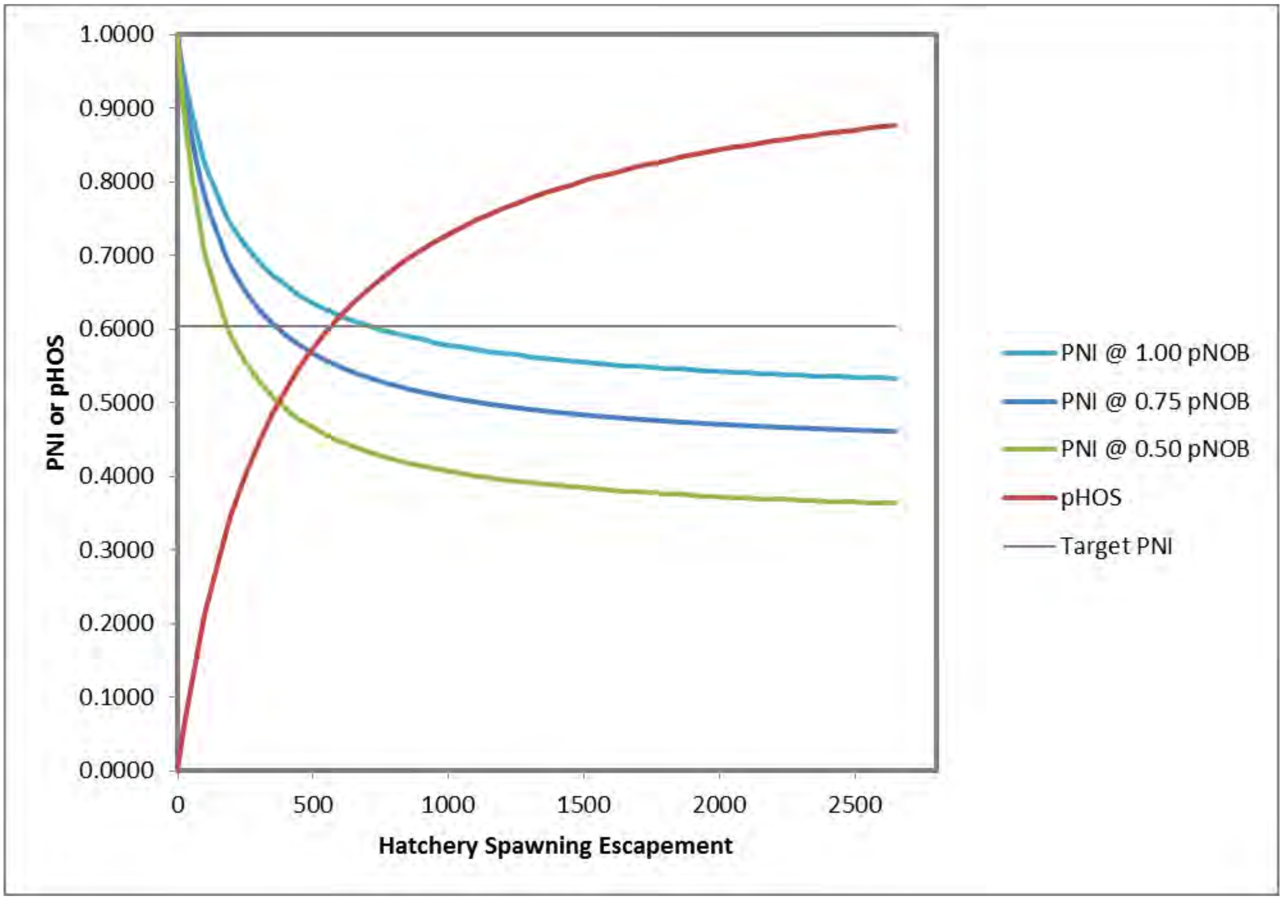

Table 5. Result of Implementing Adult Management

pNOB	% Extraction	Hatchery Escapement	pHOS	PNI
1.00	73%	700	0.65	0.6039
0.75	87%	350	0.48	0.6039
0.50	94%	180	0.29	0.6039

Table 6. Effects on WxW spawning and HRR

pNOB	Wild Brood	HOS	HRR Projection – Wild Brood	% WxW Spawning In Nature
1.0000	128	700	5.4688	12.0%
0.7500	96	350	3.6458	26.5%
0.5000	64	180	2.8125	45.4%

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees	**Date:**	June 18, 2015
From:	Tracy Hillman, HCP Hatchery Committees Chairman		
Cc:	Kristi Geris		
Re:	Final Minutes of the May 20, 2015 HCP Hatchery Committees Meeting		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees meeting was held at Douglas PUD headquarters in East Wenatchee, Washington, on Wednesday, May 20, 2015, from 9:30 a.m. to 12:00 p.m. Attendees are listed in Attachment A to these meeting minutes.

ACTION ITEM SUMMARY

- Greg Mackey will provide Douglas PUD's responses to Kirk Truscott's comments on the draft 2015 Methow Basin Spring Chinook Adult Management Plan to Kristi Geris for distribution to the Hatchery Committees following the meeting on May 20, 2015 (Item II-A). *(Note: Mackey provided Douglas PUD's responses to Geris on May 20, 2015, which Geris distributed to the Hatchery Committees that same day.)*
- Charlie Snow (Washington Department of Fish and Wildlife [WDFW]) will provide data that compare Methow spring Chinook salmon spawning escapements with Wells Dam fish counts for years available, to Kristi Geris for distribution to the Hatchery Committees (Item II-A).
- Keely Murdoch and Mike Tonseth will discuss internally the feasibility of installing passive integrated transponder (PIT)-tag detection in the Methow Fish Hatchery (FH) volunteer channel (Item II-A).
- Greg Mackey and Mike Tonseth will update escapement numbers in the draft 2015 Methow Basin Spring Chinook Adult Management Plan, and will provide a revised draft plan to Kristi Geris for distribution to the Hatchery Committees (Item II-A).
- Greg Mackey, Catherine Willard, Keely Murdoch, Todd Pearsons (Grant PUD), Charlie Snow, Andrew Murdoch (WDFW), and Tracy Hillman will coordinate to

prepare information on Hatchery Monitoring and Evaluation (M&E) Plan Objectives 1, 4, and 7, for discussion during the next Hatchery Committees meeting on June 17, 2015 (Item V-A).

- Keely Murdoch will coordinate with Matt Abrahamse (Yakama Nation [YN]) on possibly presenting recent data on the YN Kelt Reconditioning Program during a future Hatchery Committees meeting (Item VIII-A).
- Kristi Geris will distribute an electronic copy of the draft HCP Hatchery Committees Meeting Protocols Summary to the Hatchery Committees for review, along with Geris' additional edits, as discussed during the Hatchery Committees meeting on May 20, 2015 (Item IX-A). *(Note: Geris distributed the summary and additional edits to the Hatchery Committees on May 21, 2015.)*
- Hatchery Committees representatives will provide edits and comments on the draft HCP Hatchery Committees Meeting Protocols Summary to Tracy Hillman (with a copy to Kristi Geris) by Thursday, June 4, 2015 (Item IX-A).

DECISION SUMMARY

- The Hatchery Committees representatives present approved the 2015 Methow Basin Spring Chinook Adult Management Plan, as revised (Item II-A).

AGREEMENTS

- The Hatchery Committees representatives present agreed to consider developing a monitoring plan for the Methow FH volunteer channel (Item II-A).
- The Hatchery Committees representatives present supported the proposed Methow Spring Chinook Review of Five-Year Annual Report Plan Outline (Item V-A).

REVIEW ITEMS

- Kristi Geris sent an email to the Hatchery Committees on April 1, 2015, notifying them that the draft 2014 Chelan PUD and Grant PUD Hatchery M&E Annual Report is available for a 60-day review, with edits and comments due to Tracy Hillman by Monday, June 1, 2015 (Item IV-A).

- Kristi Geris sent an email to the Hatchery Committees on May 21, 2015, notifying them that the draft HCP Hatchery Committees Meeting Protocols Summary is available for review, with edits and comments due to Tracy Hillman (with a copy to Geris) by Thursday, June 4, 2015 (Item IX-A).

FINALIZED DOCUMENTS

- Kristi Geris sent an email to the Hatchery Committees on June 2, 2015, notifying them that the Final 2014 Chelan PUD and Grant PUD Hatchery M&E Annual Report is now available for download from the Hatchery Committees Extranet Site.

I. Welcome

A. Review Agenda, Review Last Meeting Action Items, Approve the March 27, 2015 Conference Call Minutes and April 15, 2015 Meeting Minutes (Tracy Hillman)

Tracy Hillman welcomed the Hatchery Committees and asked for any additions or changes to the agenda. The following revisions were requested:

- Greg Mackey added a Wells Dam spring Chinook salmon broodstock collection update.
- Catherine Willard added a Chiwawa River instream flow update.
- Bill Gale removed the U.S. Fish and Wildlife Service (USFWS) Bull Trout Consultation update.
- Keely Murdoch added a YN Kelt Reconditioning Program update.

The Hatchery Committees reviewed the revised draft March 27, 2015, conference call minutes. Hillman recalled that this meeting was convened to discuss approval of the Statement of Agreement (SOA) titled, "Regarding Timeline for Review of 'Evaluation of Hatchery Programs Funded by Douglas County PUD 5-Year Report 2006-2010'." He also recalled that Hatchery Committees approval of this SOA resulted in approval of Chelan PUD's Methow Spring Chinook Hatchery Production Obligation SOA authorizing the establishment of an Interlocal Agreement with Douglas PUD. Kristi Geris added that all comments and revisions received from members of the Committees were incorporated in the revised minutes, except for a minor edit Mike Tonseth submitted prior to today's meeting, which clarified that Willard operated the WebEx during this meeting, and not him.

Hatchery Committees members present approved the draft March 27, 2015, conference call minutes, as revised.

The Hatchery Committees reviewed the revised draft April 15, 2015, meeting minutes. Hillman said there were two outstanding comments to be discussed regarding Douglas PUD's discussion of Methow spring Chinook salmon adult management for implementation in 2015. He said Mackey had requested confirmation on the details of a discussion among Tonseth, Craig Busack, and Matt Cooper. Tonseth clarified that he had asked, in terms of a safety net, to what degree should Methow FH fish be removed *for broodstock for safety net at Winthrop National Fish Hatchery (NFH)*. He also clarified that Busack had asked what percentage of returning adults *to Winthrop NFH* are Methow spring Chinook salmon, and Cooper said it is about 15% on average. Willard also clarified that under the same discussion on Table 2 on slide 2 of Attachment B, percent hatchery-origin spawners (pHOS) defaults to 0.25 once more than 900 *natural-origin* spawners return. Lastly, also under the same discussion, Hillman clarified that PNI means "proportionate natural influence," not "proportion of natural influence." Geris said she will incorporate revisions, as discussed. Hatchery Committees members present approved the draft April 15, 2015, meeting minutes, as revised. *(Note: Gale provided USFWS approval of the revised draft April 15, 2015, meeting minutes via email on May 19, 2015, which Geris distributed to the Hatchery Committees that same day.)*

Action items from the Hatchery Committees meeting on April 15, 2015, and follow-up discussions, were as follows (italicized item numbers below correspond to agenda items from the meeting on April 15, 2015):

- *Mackey and Tonseth will provide proposed targets for Methow spring Chinook salmon adult management for potential implementation in 2015 to Geris for distribution to the Hatchery Committees by Wednesday, April 29, 2015 (Item II-A).* Mackey provided a draft 2015 Methow Basin Spring Chinook Adult Management Plan for review to Geris on May 7, 2015, which Geris distributed to the Hatchery Committees on May 8, 2015. This will be further discussed during today's meeting.
- *Mackey, Willard, and Murdoch will develop a draft plan and schedule for reviewing the Methow Basin Five-Year Hatchery M&E results and new information for*

consideration by the Hatchery Committees at least 10 days prior to the next Hatchery Committees meeting on May 20, 2015 (Item II-B).

Mackey provided a Methow Spring Chinook Review of Five-Year Annual Report Plan Outline to Geris on May 14, 2015, which Geris distributed to the Hatchery Committees that same day. This will be further discussed during today's meeting.

II. Douglas PUD/WDFW

A. DECISION: Draft 2015 Methow Basin Spring Chinook Adult Management Plan (Greg Mackey)

Greg Mackey said a draft 2015 Methow Basin Spring Chinook Adult Management Plan was distributed to the Hatchery Committees by Kristi Geris on May 8, 2015. Comments on the draft plan were received from the Colville Confederated Tribes (CCT) and the National Marine Fisheries Service (NMFS) on May 15 and May 18, 2015, respectively, which Geris distributed to the Hatchery Committees those same days. These and additional comments were discussed, as follows:

CCT Comments

Mackey said CCT comments on the draft plan were largely minor clarifications; however, there were three more substantive comments that he told Kirk Truscott he would discuss with the Hatchery Committees on Truscott's behalf. Mackey said he will provide Douglas PUD responses to Truscott's full set of comments to Geris for distribution to the Hatchery Committees following the meeting on May 20, 2015. Mackey added that Truscott was satisfied with Douglas PUD's responses to CCT comments on the draft plan. *(Note: Mackey provided Douglas PUD's responses to CCT comments on the draft 2015 Methow Basin Spring Chinook Adult Management Plan [Attachment B] to Geris on May 20, 2015, which Geris distributed to the Hatchery Committees that same day.)*

Detailed Plan (page 1, 1.a.)

As noted in a comment bubble, Truscott asked if adipose (ad)-clipped fish encountered at the Twisp Weir will be transported to Winthrop NFH for broodstock (Winthrop NFH and Okanogan Reintroduction Program) and/or surplusing. Mackey clarified that these fish will be transported to Winthrop NFH for surplusing, which includes broodstock supporting the

Section 10J Program (i.e., Chief Joseph Hatchery Okanogan Reintroduction Program). He said Winthrop NFH staff will determine how many fish to use for each.

Detailed Plan (page 2, 2.d.ii.)

Mackey recalled the sliding scale presented during the last Hatchery Committees meeting on April 15, 2015, which indicated a breakpoint at 300 or fewer natural-origin recruit (NOR) spawning escapement when the target total spawning escapement would be 500. As noted in a comment bubble, Truscott indicated that a 500 total spawning escapement for the Methow mainstem and Chewuch seems low. Mackey agreed that this draft scale needs further review. He also noted that this plan applies only to 2015, and he believes there will be more than 300 wild spawners, so this should not be a factor this year.

Detailed Plan (page 4, 4.d.)

Mackey said a statement was included to possibly transport MetComp hatchery returns to a specific reach of the Methow River in order to experimentally augment spawner numbers. He said this statement was included to keep the possibility open, and Truscott wanted to stress that such an action would need to be permissible under existing permits and approved by the HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Sub-Committee (PRCC HSC).

NMFS Comments

Detailed Plan (page 2, 2.d.)

Craig Busack noted that if expressed as a ratio, pHOS is hatchery:total, not hatchery:wild. Mackey said this typo will be corrected.

YN Comments

Detailed Plan (page 1, 1.c.)

Keely Murdoch said it is not clear how a pHOS of 0.50 was derived for the Twisp River or how it fits with the sliding scale for the basin. Mackey said a maximum pHOS of 0.50 (i.e., $\leq$0.50) is specified for the Twisp Program in the Hatchery and Genetic Management Plan (HGMP). Murdoch asked if the Twisp Program is viewed independently from the rest of the basin. Tom Kahler recalled that when the HGMP was developed, there were rules unique to the Twisp Program, and this plan is consistent with the HGMP. Murdoch suggested in moving forward, the Hatchery Committees need to discuss how PNI is calculated and how the Twisp Program fits into the basin-wide calculation.

Busack asked if maintaining a pHOS of $\leq$0.50 in 1.c. is consistent with 1.e. He added, if the Twisp Weir is only operating for broodstock collection, can a pHOS of $\leq$0.50 be met? Mackey said this depends on the year; and added that depending on the efficiency of collecting Twisp broodstock, adult management might be limited that year. He said it typically takes a while to target wild fish at the Twisp Weir, offering opportunity to perform adult management, and in the meantime, the desired ratio of wild to hatchery fish in the Twisp River can be implemented. He said in the past, this has been successfully accomplished for steelhead, but this will be the first attempt with spring Chinook salmon. Kahler added that the challenge is, during the spring Chinook salmon run, during the peak of the freshet, the weir often cannot be operated. He said that fortunately, the numbers of smolts released to the Twisp Basin should allow for hatchery spawner escapement appropriate for the pHOS target in general, without having to remove very many fish. Tracy Hillman asked over what percentage of the run distribution is the weir operated. Kahler said it varies by year, noting that in 2011, the weir was operational most of the year; however, on average across multiple years, the weir was non-operational about 27% of the time (based on a small multi-year analysis).

Mike Tonseth said a big part of this plan for 2015 was to pick a direction and move forward. He noted that this facility has never been operated for adult management, so a starting point needed to be chosen, and what was outlined in the HGMP seemed to be achievable. He said, in terms of long-term planning, he agrees with Murdoch that the Twisp Program needs to be evaluated regarding what role it plays in pHOS relative to other programs. Mackey noted that for PNI, he would prefer to track and manage the Twisp Program separately, because that is how it is laid out in the HGMP. He added, however, that this can be easily merged, as well.

Synopsis of the adult management plan for 2015 (page 1, 1.a.); Detailed Plan (page 1, 1.c.)
Murdoch noted a statement included twice in the draft plan that indicates, "percent natural-origin broodstock (pNOB) will be >0.50 and may be allowed to fluctuate between

0.50 and 1.0 in order to achieve pHOS ≤0.50." Murdoch said, considering how small the Twisp Program is, she questioned broodstocking being a key influence on pHOS when managing for a certain pHOS level. She asked if this was intended to be PNI. Kahler explained, considering there is not a large run to the Twisp River, if targeting a pNOB of 1.0, it would be difficult meeting pHOS because of the reduced total number of wild fish in the spawning population. He added that the number of brood collected is limited by wild fish available. Murdoch asked if this means there may not be a need for much adult management, and Kahler said that is correct.

<u>Detailed Plan (general comment)</u>
Murdoch asked about the predicted run size in the Methow Basin and how it fits into the sliding scale. Mackey said the predicted run size in the Methow Basin is 329 wild spawners, which is noted on page 3, 2.d.iv.1., located below Figure 1. He caveated that this number was developed based on the best-available data at that time (from the 2015 Broodstock Protocol), and added that fish are now passing Wells Dam in higher numbers than what were used in this calculation. He said, as of late last week, wild run escapement was 325; at that time, projections indicated that the run was about halfway through, so this number could possibly double. Charlie Snow said pre-spawn mortality can be fairly high, noting that the redd-based escapement alone could be about 60% of the Wells run estimate. He said this would not be due entirely to mortalities; some fish drop back or go to other basins. Busack asked if Snow could provide data that compare Methow spring Chinook salmon spawning escapements with Wells Dam fish counts for years available, and Snow said he will provide those data to Geris for distribution to the Hatchery Committees.

<u>Detailed Plan (general comment)</u>
Murdoch recalled discussing during the Hatchery Committees meeting on April 15, 2015, monitoring fish arriving and leaving the Methow FH trap and outfall areas, which she noted is not addressed in this plan. She suggested evaluating fish movement near Methow FH on a finer scale in order to trap more effectively and ensure the area around the trap does not become overcrowded. Mackey replied, historically, the Methow FH trap has been successful in collecting broodstock when hatchery releases in the basin were much larger without problems at the Methow volunteer trap. He said Methow FH staff are monitoring the trap

multiple times a day, and he does not think overcrowding will be an issue. Murdoch suggested, however, during a large-run year, it could become crowded, which may result in fish backing out of the trap area. She said if the trap is not monitored at certain hours of the day (e.g., late at night), the trap could become crowded during that time. She also asked about a Trap Operation Plan. Tonseth said the Methow FH trap is operated 24 hours a day. He said during the early- and tail-end of the run, it is not critical to monitor the trap all day; however, as the run starts to build, a cap has been established of how many fish should be at the trap at a given time. He explained, as this limit is approached, the trap will be checked more frequently. In summary, he said the fish will drive how frequently the trap is monitored. Mackey added, hatchery and M&E crews have discussed and are aware of these issues. He said in the future, Douglas PUD may draft a Trap Operation Protocol for the Methow FH trap, as they did for the Twisp Weir. He noted a protocol or plan gives trap operators a handbook to operate by.

Murdoch asked if there are plans to install PIT-tag detection in the outfall to the Methow FH. Mackey said there is one PIT-tag array located at the entrance of the trap. Murdoch asked about farther down the channel, noting she thinks it would help to inform the effectiveness of the trap. Mackey said that the YN has had PIT-tag antennas in the channel in the past for their Coho project and may have a PIT-tag antenna installed in the Methow FH channel now. Mackey said that the important metric is comparing how many fish were removed at the Methow FH trap to how many reached the spawning grounds. He asked Snow if WDFW conducts spawner surveys in the Methow FH channels, and Snow replied that they do. Snow added that for spring Chinook salmon, spawner surveys are conducted weekly during spawning season. Mackey said visual counts of fish are also collected during spawner surveys. Snow said for many years, Methow FH staff applied a hole-punch to hatchery jacks to avoid resampling, and some hole-punched fish returned to the trap several times. Bill Gale said at Spring Creek, fish pass an array before entering the pond, and if a fish is detected at the array but not in the pond, this alerts staff to investigate why this may be. Catherine Willard added with a double array, directionality can also be monitored.

Murdoch said it would be beneficial to have a monitoring component associated to this plan; however, she is unsure of the timeline to get the plan approved. Tonseth noted that the question might be more if the equipment can be obtained and installed in time for monitoring this year. Murdoch said she was unsure if the YN's PIT-tag antenna is still in place. She also said she would like the Hatchery Committees to reach agreement on moving forward with a monitoring plan. Murdoch and Tonseth said they will both discuss internally the feasibility of installing PIT-tag detection in the Methow FH volunteer channel. Kahler also noted that Douglas PUD does not own the property where the YN's PIT-tag antenna was installed for monitoring coho salmon, and he indicated it would be helpful if the YN contacted the property owners, if needed, because they have an existing relationship with them.

The Hatchery Committees representatives present agreed to consider developing a monitoring plan for the Methow FH volunteer channel.

USFWS Comments

<u>Synopsis of the adult management plan for 2015 (page 1, 3.a.); Detailed Plan (page 2, 2.c.)</u>
Bill Gale requested changing both statements indicating that, "All adipose clipped adults encountered will be removed," to "All hatchery-origin adults encountered will be removed."

<u>Detailed Plan (page 4, 4.a.ii.)</u>
Matt Cooper suggested, via email, increasing the Winthrop NFH brood transfer goal by 10% (to approximately 450) to account for any pre-spawn mortality related to handling and trucking. Mackey said this change will be made, as suggested.

<u>Detailed Plan (page 4, 4.)</u>
Cooper suggested, via email, adding language specifying that when there is not enough conservation brood to meet both (Methow and Okanogan) objectives, Methow FH transfers for Methow releases at Winthrop NFH will be prioritized. Mackey said this language will be added, as suggested.

Mackey said he and Tonseth will update escapement numbers in the draft 2015 Methow Basin Spring Chinook Adult Management Plan, and will provide a revised draft plan to Geris for distribution to the Hatchery Committees. Mackey asked Snow if he had any updates on run escapement. Snow said WDFW crews are conducting their third week of trapping at Wells Dam. He said, excluding this week, a total of 469 NORs have passed Wells Dam, and 110 NORs have been trapped. He said crews are awaiting DNA analyses on about 70 NORs, and so far, a total of 24 NORs have been typed to the Methow and Twisp rivers.

Tonseth said Douglas PUD and WDFW are seeking approval of the methods outlined in this plan; however, he noted that this is a living document that may be modified as more data become available. The Hatchery Committees representatives present approved the 2015 Methow Basin Spring Chinook Adult Management Plan, as revised.

III. Douglas PUD

A. Wells Dam Spring Chinook Broodstock Collection Update (Greg Mackey and Charlie Snow)

Greg Mackey said he spoke with the Wells Hatchery Manager yesterday, who indicated a total of 24 Metcomp and about four Twisp fish have been identified through genetic testing. Mackey said additional fish are currently undergoing genetic testing; however, results are not yet available. He said it seems there are large amounts of ad-present, coded-wire-tag (CWT)-absent fish with scale samples indicating those fish are actually hatchery fish. He said, however, the CWT loss rate is typically very low. Charlie Snow explained that this year, there is a huge hatchery return and relatively small wild return, so even with a low CWT loss rate, there will still be a large amount of unmarked hatchery fish proportionate to wild returns. He said, for example, to date, staff have sampled more than 800 fish, and among the ad-present fish, about 17 fish have returned as unmarked hatchery fish (based on scale samples). He said this equates to only about 1.9% tag loss, which is expected. He said, during the first week of sampling, about 36 fish were retained that were thought to be wild and only 1 came back as a hatchery fish. He said, during week two, about 75 fish were retained that were thought to be wild, but scale samples indicated about 16 of those fish were hatchery fish. Mackey said he was under the impression the CWT loss rate was higher, in which case he was going to propose retaining more fish in case they were needed. He said, however, given Snow's explanation, no adjustments will be needed. Snow added that a quality check on tagging is conducted close to marking; however, tag loss can occur any time during a fish's life cycle.

IV. Chelan PUD

A. Draft 2014 Chelan PUD and Grant PUD Hatchery M&E Report (Catherine Willard)

Catherine Willard reminded the Hatchery Committees that Kristi Geris sent an email to the Hatchery Committees on April 1, 2015, notifying them the draft 2014 Chelan PUD and Grant PUD Hatchery M&E Annual Report was available for a 60-day review, with edits and comments due to Tracy Hillman by Monday, June 1, 2015. Hillman noted the comments are due the same day the report is due. Keely Murdoch suggested in future years, moving the comment deadline to an earlier date. Mike Tonseth agreed, and also suggested the Hatchery Committees should consider permitting deadlines as a starting point and work backward to identify when the M&E report is due. Hillman said he will try to produce the final report as quickly as possible once all comments are received, and he asked Hatchery Committees members to submit comments early, if possible, to help expedite this process.

B. Chiwawa River Instream Flow Update (Catherine Willard)

Catherine Willard said, in anticipation of a low flow year and potential drought, Chelan PUD is planning to fill the Chiwawa ponds earlier than usual, beginning on May 21, 2015. She said filling the ponds during higher river flow will avoid the need for filling the ponds during periods of river flow outside instream flow requirements and non-consumptive water use restrictions. She also noted that by this date, all fish will have been released. Mike Tonseth further explained that the State Legislature is currently considering bills for drought contingency funding, and the Chiwawa Facility made that list. He said the question came back to Alene Underwood about what kind of contingency plan is in place at Chiwawa should low flows occur. Keely Murdoch asked if some sort of flow will be maintained in the ponds, and Willard replied that there will be.

V. Chelan PUD/Douglas PUD/YN

A. Five-Year Hatchery M&E Review Planning (Catherine Willard/Greg Mackey/Keely Murdoch)

Catherine Willard said she, Keely Murdoch, and Greg Mackey developed a Methow Spring Chinook Review of Five-Year Annual Report Plan Outline (Attachment C), which was distributed to the Hatchery Committees by Kristi Geris on May 14, 2015. Willard reviewed Attachment C, noting that today, the plan is to review a summary of findings for the Twisp, Methow, and Chewuch spring Chinook salmon programs. She said an excerpt from the Five-Year Hatchery M&E Plan Report (Attachment D) was distributed to the Hatchery Committees by Geris on May 18, 2015, which Mackey will review. Willard said, as outlined in Attachment C, Hatchery M&E Plan objectives have been divided into groups and will be reviewed during subsequent Hatchery Committees meetings. She said Hatchery Committees members will document which objectives are not meeting targets, flag items to revisit, and where applicable, develop recommendations or document reasons for not revisiting objectives. She said the goal is to complete a review of all objectives by August 2015, and start a process of addressing flagged objectives by February 2016. Murdoch noted that similar objectives were grouped together for discussion purposes. The Hatchery Committees representatives present supported the proposed Methow Spring Chinook Review of Five-Year Annual Report Plan Outline.

Mackey reviewed Attachment D, which compiles summary information contained at the end of each section of the Five-Year Hatchery M&E Plan Report for Twisp River, Chewuch River, and Methow River spring Chinook salmon. He said for each program, the following information is being provided: 1) goal and program descriptions; 2) summary; and 3) a table containing a summary assessment of M&E objectives. He noted that each program indicated a fish release number of about 183,000, which he said were not the actual release numbers. He recalled the reason for this was because the HCPs did not specify how many fish go in each river. The total release of 550,000 was divided equally among the Twisp, Methow, and Chewuch for HCP “goal” purposes, and recommended ignoring those numbers as they have changed dramatically. Mackey then reviewed the major findings of each Objective or each of the three programs: Methow, Twisp, and Chewuch. The review was a verbal narrative of the report findings summary tables that were supplied to the Committees and were taken for the 5-Year report.

Tracy Hillman asked what needs to be done to keep on schedule, as outlined in Attachment C. Mackey, Willard, Murdoch, Todd Pearsons, Charlie Snow, Andrew Murdoch, and Hillman will coordinate to prepare information on Hatchery M&E Plan Objectives 1, 4, and 7, for discussion during the next Hatchery Committees meeting on June 17, 2015. Murdoch said, considering the change in landscape, she is hopeful people will keep an open mind while reviewing these objectives. Hillman also noted there are additional data available since the Five-Year Hatchery M&E Plan Report was completed. Pearsons asked what types of discussions and review will take place throughout the next few months. Mackey said there will first be a technical review of results, and then, starting in September 2015, a review from a management standpoint will begin as an adaptive management feedback loop. Hillman reiterated that these programs have changed significantly, and recommended the Hatchery Committees keep that in mind as they make projections about possible changes. Mackey agreed, noting that recalculation was well underway when the original report was being written and the authors were aware of this; however, the recalculated numbers were not yet finalized at that time.

VI. Hatchery Evaluation Technical Team (HETT)

A. HETT Update (Catherine Willard/Greg Mackey)

Hatchery M&E Plan Appendices

The HETT convened on April 29, 2015, at the WDFW Research Office in Wenatchee, Washington, to discuss finalizing the Hatchery M&E Plan Appendices. Catherine Willard noted that Greg Mackey provided background on developing the Hatchery M&E Plan Appendices, as well as an update on the last iteration of the appendices. Willard said the HETT discussed a plan for completing the appendices, noting the appendices are living documents, subject to change as more data become available. She said while the HETT discussed how much work is left, it became apparent that much of the work is already complete. She said Appendix 1, which addresses carrying capacity, is the most onerous in terms of work remaining to be done. She said appendices were split up among HETT members to complete by May 29, 2015 (Appendix 1, assigned to Tracy Hillman and Andrew Murdoch, is due June 30, 2015). Willard said Kristi Geris will then distribute a Doodle Poll to reconvene the HETT sometime in July 2015. Hillman also noted that Appendix 3, which addresses spatial distribution of wild and hatchery spawners, may need to be further discussed within the Hatchery Committees regarding which programs require complete spatial overlap and which require partial or complete segregation.

Predation, Competition, and Disease (PCD) Risk Modeling

Craig Busack asked if PCD risk modeling is complete. Mackey replied that it is, and added that a final report was completed in June 2014. Busack noted an error in the model, and said he has been considering reprogramming the model for use in future Biological Opinions (BiOps). Hillman suggested Busack notify the Hatchery Committees if he does reprogram the model. Busack said he may be able to obtain internal funding to work on this; however, he has not yet had time to do so. He added, despite the error in the model, he found a lot of value in the datasets the Hatchery Committees developed through the Non-Target Taxa of Concern modeling.

VII. NMFS

A. HGMP Update (Craig Busack)

Craig Busack said from now on, NMFS is no longer allowed to issue permits without first obtaining completed consultations by USFWS. He said he does not feel this will cause any problems, and added he believes this is actually good news because USFWS processes are now moving forward. Keely Murdoch asked how this will affect permitting for Wenatchee spring Chinook salmon. Busack said there should be no concern about this permit because it has already been issued. He added he is still working on the Incidental Take Statement for the Wenatchee Spring Chinook Re-initiation BiOp. He said this is progressing slower than usual because Amilee Wilson (NMFS) worked on this first before passing it onto Busack; so, he needs to read more than usual to get caught up. He said he hopes to complete this by next week. Todd Pearsons said he is concerned with the high number of fish passing Tumwater Dam already; however, he said this will be discussed further during tomorrow's PRCC HSC meeting.

Busack said the following items are currently consuming his time: 1) the necessity to complete the Leavenworth BiOp by the end of May 2015, by order from the Department of Justice (Wilson working on this); and 2) the ongoing Puget Sound litigation. Busack added NMFS is growing more concerned with litigation risk.

VIII. YN

A. YN Kelt Reconditioning Program Update (Keely Murdoch)

Keely Murdoch recalled the Hatchery Committees' approval of the YN's SOA to live-spawn Twisp River steelhead contingent on the YN providing monthly YN Kelt Reconditioning Program Reports when available, which Murdoch noted are being distributed now through October 2015 (Kristi Geris distributed the first report on the year yesterday, May 19, 2015). Murdoch also recalled a request or comment for Matt Abrahamse to present end-of-the-year results to the Hatchery Committees when available, and Murdoch asked the Hatchery Committees if there is interest in such a presentation. She said a report summarizing data collected through the end of the contract (January 31, 2015) is also available and can be distributed. She noted that spring 2015 data will be included in next year's report. The Hatchery Committees agreed a presentation would be interesting, and Murdoch said she will coordinate with Abrahamse on possibly presenting recent data on the YN Kelt Reconditioning Program during a future Hatchery Committees meeting.

IX. HCP Administration

A. Review of Meeting Protocols

Tracy Hillman said he reviewed the HCPs to identify HCP meeting protocols, and compiled what he found in a document. He distributed hard copies of a draft HCP Hatchery Committees Meeting Protocols Summary to Hatchery Committees representatives present. He noted that protocols with a footnote were copied directly out of the HCPs, and others are protocols that have been established and agreed on throughout the years. He asked the Hatchery Committees to review the document and note anything he missed. He also reviewed a few late additions received from Kristi Geris, which are not included in the handout. Hillman said this document is mostly for his benefit; it will help his transition into the HCP Hatchery Committees Chairman position and keep future proceedings like business as usual.

Hatchery Committees representatives will provide edits and comments on the draft HCP Hatchery Committees Meeting Protocols Summary to Hillman (with a copy to Geris) by Thursday, June 4, 2015. Geris said she will distribute an electronic copy of the draft HCP Hatchery Committees Meeting Protocols Summary to the Hatchery Committees for review, along with Geris' additional edits, as discussed during the Hatchery Committees meeting on May 20, 2015. *(Note: Geris distributed the summary and additional edits*

[Attachment E] to the Hatchery Committees on May 21, 2015.)

B. Next Meetings

The next scheduled Hatchery Committees meetings are on June 17, 2015 (Chelan PUD), July 15, 2015 (Douglas PUD), and August 19, 2015 (Chelan PUD).

List of Attachments

Attachment A	List of Attendees
Attachment B	Douglas PUD Responses to CCT Comments on the Draft 2015 Methow Basin Spring Chinook Adult Management Plan
Attachment C	Methow Spring Chinook Review of Five-Year Annual Report Plan Outline
Attachment D	Excerpt from the Five-Year Hatchery M&E Plan Report
Attachment E	Draft HCP Hatchery Committees Meeting Protocols Summary

Attachment A
List of Attendees

Name	Organization
Tracy Hillman	BioAnalysts, Inc.
Kristi Geris	Anchor QEA, LLC
Keith Truscott	Chelan PUD
Catherine Willard*	Chelan PUD
Greg Mackey*	Douglas PUD
Tom Kahler*	Douglas PUD
Todd Pearsons	Grant PUD
Craig Busack*†	National Marine Fisheries Service
Bill Gale*†	U.S. Fish and Wildlife Service
Mike Tonseth*	Washington Department of Fish and Wildlife
Charlie Snow†	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation

Notes:

* Denotes Hatchery Committees member or alternate
† Joined by phone

Methow Basin Spring Chinook Adult Management Plan: 2015

May 7, 2015

Methow Spring Chinook adult management activities at PUD facilities authorized by the NMFS letter, dated September 20, 2013, extending permits 1196, 1395, and 1347. This plan uses information from the Methow Hatchery Spring Chinook HGMP draft and preliminary planning information resulting from the Methow spring Chinook consultation process with National Marine Fisheries Service and the Federal nexus consultation with U.S. Fish and Wildlife Service.

Synopsis of the adult management plan for 2015:

1. Twisp Weir
    a. All adipose-clipped adults encountered will be removed. 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 pHOS ≤0.50.
2. Methow Hatchery
    a. Approximatley25% of MetComp hatchery return run removed to achieve a PNI target using a sliding scale (~1,149 spawning escapement after aggregate removal with WNFH removal).
        i. All hatchery-origin age-3 males removed
    b. All adipose-clipped adults encountered will be removed.
3. Winthrop National Fish Hatchery
    a. All adipose clipped adults encountered will be removed.
    b. Approximately 25% of MetComp hatchery return run removed (~1,149 spawning escapement after aggregate removal with Methow Hatchery removal).
        i. All hatchery-origin age-3 males removed

Detailed Plan:

1. 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 stray from outside of the basin).
    b. Age-3 hatchery returns will be removed and euthanized or transported to WNFH.
    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 pHOS ≤0.50.
    d. Wild fish will be collected as broodstock – up to ~20, but not to exceed 33% of the wild run. Hatchery fish may be collected as broodstock dependent on collection of wild fish collection.
    e. The Twisp Weir will be fished for broodstock collection purposes, only, in 2015. Adult management activities will be incidental to broodstock collection. Once broodstock collection is completed, the weir will be opened to fish passage. During broodstock

Commented [KT1]: Will they be transported to WNFH for broodstock (WNFH and Okanogan reintroduction) and/or surplusing?

Commented [GM2]: Covered in Part 4, below. Transported to WNFH for surplusing.

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. This is not a complete description of the Twisp Weir operations plan. A separate plan is currently under development.

2. Methow River and Chewuch River Spring Chinook (MetComp)
    a. Stock assessment will be performed at Wells Dam during spring Chinook broodstock collection. This information on stock, hatchery:wild, and male:female composition coupled with fish counts, will be used in conjunction with fish counts at Wells Dam 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
        ii. The Methow Hatchery Volunteer trap will be fished continuously (24 hours per day/7 days per week) throughout the run and fish removed at least once daily, but as often as needed when fish are present. Adjustments to the operation of this trap will be made based upon capture rates as well as bull trout encounters (combined non-lethal take of bull trout for all hatchery program operations excluding Twisp Weir is 76 adults and 31 sub-adults. Lethal take is 2 adults and 5 sub-adults).
        iii. Trapping will cease at Methow Hatchery when removal of hatchery-origin adults meets the target number (as established in this document and adjusted in-season, as necessary) to achieve the desired hatchery-origin spawning escapement. The trap will continue to fish if broodstock are still needed for the Methow Hatchery program.
        iv. Trapping will cease at Methow Hatchery if overall hatchery operation bull trout take is likely to be exceeded. However, in-season assessment will keep careful track of bull trout encounters and 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.
    c. WNFH Returns: all adipose-clipped returns encountered at WNFH volunteer trap and Methow Hatchery Volunteer trap will be removed.
        i. Returns to WNFH will be retained there for broodstock or surplusing.
        ii. Returns to Methow Hatchery will be transferred to WNFH for broodstock or surplusing.
        iii.
    d. MetComp returns will be removed to achieve a targeted hatchery:wild (pHOS) ratio of 0.78 based upon estimates in the 2015 Broodstock Protocol and the following:
        i. pNOB for MetComp assumed to be 1.00
        ii. If natural-origin spawning escapement is less than ~~300~~190, the overall spawner escapement goal of natural + hatchery origin will be 500. If natural origin

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Commented [KT3]: This appears to be disproportionately restrictive total spawn escapement for NOR spawn escapement below 300 vs above 300. If I'm interpreting this correct, at 300 NOR spawn escapement (not run escapement) the target total spawn escapement is 500 (300 NOR and 200 HOR); however at 329 NOR spawn escapement the total spawn escapement is 1,479 (329 NOR and 1,149 HOR)(see section 2.d.iv below).

At 300 NOR spawn escapement and a total spawn escapement of 500, the resultant pHOS is 0.40; however and 329 NOR (just 29 more NOR than the 300 NOR spawn escapement, the total spawn escapement target is 1,479, resulting in a pHOS of 0.78. Why restrict the total spawn escapement to just 500 at a 300 NOR spawn escapement, when the resultant pHOS is substantively less than when at a slightly greater NOR spawn escapement that results in a greater escapement and resultant pHOS.

I realize that we have a minimum target PNI, but 500 total spawn escapement for the Methow mainstem and Chewuch seems pretty low.

Commented [GM4]: Several points on this:

1. This plan is for 2015 only and we very likely will have many more than 300 wild spawners so this is moot. We could even remove it at this point.
2. This was from the scale that NMFS proposed but needs further review and has not been agreed to.
3.The scale could employ the PNI function that I made down to a lower spawner escapement threshold. I will take a look at how that could work. It may make more sense.

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spawning escapement is ~~300~~ 190 or greater, the PNI method, below, will be applied:

iii. PNI derived from sliding scale function (Figure 1) = 0.5693

$PNI = a(1-e^{-bx})$

Where: a = a constant that = the asymptote = 0.80

b = a constant that defines the function shape = 0.00378

x = wild spawners = 329 (projected after broodstock removal)

e = natural log base

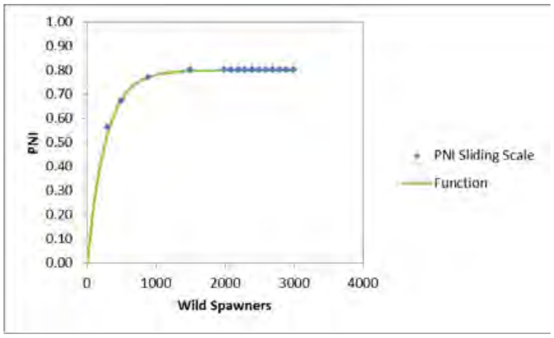

Figure 1. PNI sliding scale values and the PNI function [$PNI = a(1-e^{-bx})$] fit to these points with a=0.80 and b=0.00378.

iv. This results in a projected MetComp spawning escapement of:
    1. 329 wild MetComp
    2. 1,149 Hatchery MetComp
    3. Overall spawning escapement 1,479.

v. Where ≈25% of MetComp hatchery returns need to be removed (75% spawning escapement).

3. Adjustment of adult management targets:
    a. The number of MetComp hatchery fish to be targeted for removal will be adjusted based on estimated returns to Wells Dam. Adjustments will be performed as necessary in near-real time (as in-season data collection allows). At approximately the half-way point in the spring Chinook run at Wells Dam, the final adult management targets will be calculated and distributed to the HCP Hatchery Committees and Grant PUD hatchery Sub-Committee and the field biologists and hatchery staff performing the adult management actions.

Commented [KT5]: With the apparent early run-timing of spring Chinook, how will you determine the 50% passage date at Wells? Average historical run timing probably won't work.

Commented [GM6]: We will approximate it based on the experienced biologists' opinion and available data. I have asked WDFW for an updated estimate of wild escapement based on current Wells data. It should be way higher than the Brood Protocol estimates and will likely substantially change the actual numbers form what is presented in this draft.

   b. The adult management target for WNFH returns is not expected to be adjusted.
   c. Adjustment of adult management in the Twisp River will be based on in-season data and observations at the Twisp Weir.
   d. A spreadsheet tool will be provided to facilitate calculation of the necessary targets.

4. Disposition of Fish
   a. MetComp hatchery returns will be used as broodstock as follows:
      i. Methow Hatchery MetComp program – augment natural-origin broodstock with hatchery-origin as needed (note – pNOB target is 1.00).
      ii. WNFH Safety-Net Program – up to 400 hatchery-origin MetComp fish will be transferred to WNFH for broodstock.
      iii. Fish surplus to broodstock needs will be handled by WDFW and USFWS for disposition according to agency guidelines.
         1. MetComp and WNFH hatchery returns collected at Methow Hatchery and surplus to broodstock needs will be transferred to WNFH for surplusing.
         2. MetComp and WNFH hatchery returns collected at WNFH and surplus to broodstock needs (inclusive of WNFH and Okanogan reintroduction program) will be retained there for surplusing.
   b. Twisp hatchery returns will be passed upstream of the Twisp Weir except for those that will be removed to meet the pHOS target. These fish may be retained for Twisp broodstock or transported to WNFH for surplusing.
   c. Natural-Origin Returns: Natural origin spring Chinook may be retained at Methow Hatchery for the Methow Hatchery MetComp program or the Twisp Program (as determined through genetic testing – see the 2015 Broodstock Protocols). Captured natural-origin MetComp fish not needed for broodstock will be trucked to the Methow River for release above Foghorn Dam and Twisp fish will be released in the Twisp River upstream of the weir.
   d. MetComp hatchery returns may also be transported to a specific reach of the Methow River in order to experimentally augment spawner numbers. Such an action will require approval of the HCP hatchery Committees and the Grant PUD Hatchery Sub-Committee.

Commented [KT7]: If needed, WNFH returns collected at MF should be included in the broodstock supporting the CJH Okanogan reintroduction program.

Commented [GM8]: We didn't differentiate how WNFH would use their brood. I will check with Matt Cooper to make sure the 400 number includes the Okanogan production. We can easily add that WNFH brood are for WNFH and Okanogan production to the document so it is clear.

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Commented [KT9]: Is this authorized in any permit? If this were to occur, would these fish be excess the spawn escapement target and if so, what is the impact to achieving the PNI target?

Commented [GM10]: This is not specifically authorized so HC approval would be needed before this action could occur, if we believe it would be useful. NMFS would have the weigh in at the HC and give us their opinion if this is permissible within the intent of the existing Permits.

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Projected Results

Table 1. Projected results of adult management on Methow Basin Spring Chinook in 2015 based on run and broodstock projections from the 2015 Broodstock Protocols. The basin and MetComp total pNOB and PNI use an average pNOB weighted by projected hatchery-origin spawning escapement for each program.

	Returns		Broodstock		Removal Rate	Spawning Escapement					
Program	**Hatchery**	**Wild**	**Hatchery**	**Wild**	**Hatchery**	**Hatchery**	**Wild**	**Total**	**pHOS**	**pNOB**	**PNI**
Twisp	67	68	0	20	0.2836	47	48	95	0.5000	1.0000	0.6690
MetComp	1,543	439	0	110	0.2547	1,149	329	1,478	0.7774	1.0000	0.5626
WNFH	1,077	0	400	0	0.8000	215	0	215		0.0000	
					Basin Total	1,411	377	1,788	0.7891	0.8498	0.5179
					MetComp Total	1,364	329	1,693	0.8057	0.8424	0.5111

Table 2. Projected Numbers of hatchery-origin Spring Chinook to remove at adult management facilities

Program	**Number to Remove**	**Number to MH Brood**	**Number to WNFH Brood**	**Number to Surplus**
Twisp – Methow Hatchery	20	0	0	20
MetComp – Methow Hatchery	394	0	394	0
WNFH	862	0	6	856

Commented [KT11]: Does this include the brood necessary to support the Okanogan reintroduction program?

Commented [KT12]: Table 2 doesn't appear to account for broodstock to support the Okanogan reintroduction program.

Commented [GM13]: USFWS indicated that their brood number is 400 and we did not intend to convey the detailed us of this brood here, but we can. The idea is that hatchery MetComp returns to from Methow would be prioritized for WNFH brood, and if needed they would use WNFH returns.

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Commented [KT14]: Are these Methow FH MetComp or Winthrop MetComp? If the 400 brood for the Winthrop Program includes the Okanogan Reintroduction Program then the 400 brood would be a combination of Methow Met Comp and Winthrop MetComp, consistent with the 400K and 200K Winthrop NFH and Okanogan Reintroduction programs, respectively. Correct?

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Table 3. Assumptions and Data Sources:

Variable	Datum	Source
Twisp Natural Origin Returns	68	2015 Broodstock Protocols
Twisp Hatchery Origin Returns	67	2015 Broodstock Protocols
MetComp Natural Origin Returns	439	2015 Broodstock Protocols
MetComp Hatchery Origin Returns	1,543	2015 Broodstock Protocols
WNFH Hatchery Origin Returns	1,077	2015 Broodstock Protocols
Twisp Hatchery Removal Rate	0.2836	calculated
MetComp Hatchery Removal Rate	0.2547	calculated
WNFH Hatchery Removal Rate	0.8000	USFWS personal communication
PNI Target Twisp	0.6319	Calculated – sliding scale function
PNI Target MetComp	0.5626	Calculated – sliding scale function

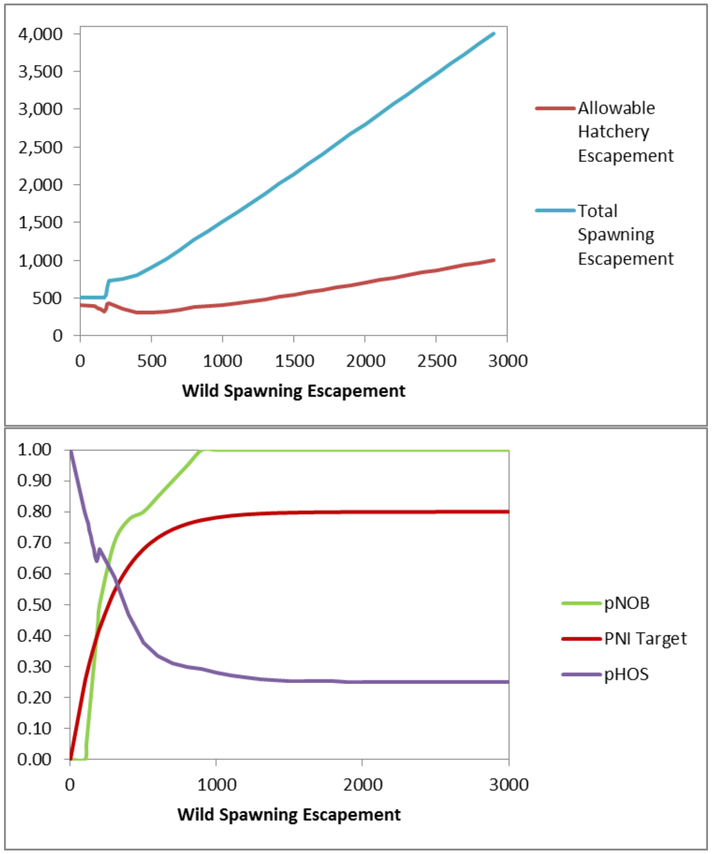

Figure 2. Behavior of pHOS and escapement based on wild spawning escapement, PNI scale and assumed pNOB levels

Suggested Approach to Review of 5-Year Analytical Report: 2005-2010

Methow Spring Chinook (Methow, Twisp, and Chewuch)

Developed by Greg Mackey, Keely Murdoch, and Catherine Willard

May 2015

Meeting Date	Task	Outcome
May 20, 2015	Overview of objectives. Review of summary findings of the Twisp, Methow, and Chewuch Programs	Review findings. Distribute excerpts from the Report. Discussion of the review approach.
June 17, 2015	Detailed review of results and recommendations for Productivity Indicators: **Objective 1**: spawner abundance, natural-origin abundance, and adult productivity **Objective 7**: freshwater productivity and Monitoring Indicator: **Objective 4**: hatchery replacement rate	Document objectives which are not meeting targets. Flag issues the Committee wants to revisit and address. Where applicable develop new recommendations or document reasons for not revisiting objectives which are not achieving targets.
July 15, 2015	Detailed review of results and recommendations for Monitoring Indicators: **Objective 2:** migration timing, spawn timing and redd distribution **Objective 5:** stray rates	Document objectives which are not meeting targets. Flag issues the Committee wants to revisit and address. Where applicable develop new recommendations or document reasons for not revisiting objectives which are not achieving targets.
August 19, 2015	Detailed review of results and recommendations for Monitoring Indicators: **Objective 3:** genetic diversity, effective population size, age at maturity and size at maturity **Objective 6:** size and number of juveniles released **Objective 8:** harvest	Document objectives which are not meeting targets. Flag issues the Committee wants to revisit and address. Where applicable develop new recommendations or document reasons for not revisiting objectives which are not achieving targets.
September 16, 2015 – February 17, 2016	Review and summarize the findings of the review process. Commence adaptive management feedback loop.	This meeting marks the start of a process to address flagged objectives by either developing committee approved studies or implementing agreed upon changes. Expect continued development at future meetings.

Twisp River Spring Chinook

Goal – Support the recovery of Twisp River spring Chinook salmon[1] by increasing the abundance of the natural adult population, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity.

Program **–** Collect sufficient Twisp-origin broodstock (hatchery and naturally produced) from the Twisp weir, Wells Dam and Methow Hatchery in order to release 183,000 yearling smolts from the Twisp Acclimation Pond.

Summary

Juvenile Twisp spring Chinook survival was at or above the expected standard within the hatchery. Poor post-release survival, resulting in hatchery replacement rates below the 4.5 target, is responsible for the low observed HRR values. However, the specific life stage(s) responsible for low SARs is unknown. Juvenile hatchery fish have been released at the target length and weight, but the number of fish released has only been on average 29% of the release target due to lack of Twisp-specific broodstock. Adult hatchery Twisp spring Chinook have similar spawn timing and redd distribution as naturally produced adult Twisp spring Chinook in the Twisp River. Hatchery and natural-origin fish did not differ in age at return within brood years, and neither age-four males nor females differed in length by origin. Both spawn timing and spawning distribution of hatchery and naturally produced fish was similar within a given year. The Twisp population has remained genetically differentiated from the Methow and Chewuch populations.

Twisp adults strayed into the Methow and Chewuch rivers at higher than expected rates. Nevertheless, the fact that half of the strays were recovered in Methow Hatchery reveals strong homing back to this natal facility. Salmon are believed to imprint sequentially at various life stages, enabling them to home back to natal waters that they may not inhabit at the parr-smolt transition stage (e.g., Naturally produced Twisp River subyearling Chinook emigrants that rear in Methow River). Thus the lack of earlier life-stage imprinting on Twisp water may cause some fish to home back to the Methow Hatchery and vicinity, rather than to the Twisp. Additionally, the acclimation period in the spring may not be long enough to allow key imprinting during the parr-smolt transformation. Combined or individually, these or other factors may result in the observed level of straying.

Spring Chinook total spawner abundance has decreased and the abundance of NORs has not increased in the Twisp River when compared to reference populations, indicating that the release of hatchery-origin fish has not provided the anticipated demographic boost to the natural-origin population. At the same time, productivity in the

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[1] While the HCP is not a recovery plan, the hatchery component of it must be consistent with hatchery goals and objectives through the ESA, and as such should aid in the recovery of listed fish.

Twisp has not significantly diverged from that of reference populations during the time of supplementation, indicating that the presence of hatchery-origin spawners has not significantly decreased productivity compared to reference populations. The decline in abundance of total spawners and lack of increase in NORs are of concern. Low smolt-to-adult survival of hatchery fish, low natural recruitment rate, and straying of hatchery fish outside the Twisp to other parts of the Methow Basin contribute to these troubling population dynamics results. The proportion of hatchery-origin spawners in the Twisp has averaged 0.55, with some years exceeding 0.75. While a delicate balance between demographic benefit and genetic risk of hatchery programs exists, the greatest threat(s) facing the Twisp population is not likely a paucity of hatchery-origin spawners given the lack of response of the population to hatchery supplementation. A brief assessment of all objectives is provided in Table 14.

Table 14. Summary assessment of M & E objectives for the Twisp spring Chinook hatchery program.

Obj.	Primary indicator	Assessment
1	Spawner abundance	Spawner abundance in the Twisp River has declined.
	Natural-origin abundance	Abundance of natural-origin fish in the Twisp population has not increased.
	Adult productivity	Adult productivity has not changed between pre- and during supplementation periods.
2	Migration timing	Insufficient data to assess this objective.
	Spawn timing	Exhibit similar spawn timing as naturally produced fish.
	Redd distribution	Exhibit similar spawning distribution as naturally produced fish.
3	Genetic diversity	Twisp spring Chinook are still distinct from the other stocks in the Methow Basin.
	Effective population size	Ratio of Ne/N is constant as expected.
	Age at maturity	Age at return within brood years did not significantly differ among male and female fish of hatchery and natural-origin.
	Size at maturity	Male and female age 4 hatchery fish were similar in size to naturally produced age 4 fish.
4	Hatchery replacement rate	Post-release survival of hatchery fish was significantly lower than the target of 4.5. Hatchery survival was greater than the natural replacement rate.
5	Stray rates	Brood year stray rates were significantly higher than the target of 5%. However, stray rates into the Methow and Chewuch rivers were within acceptable levels. Twisp spring Chinook did not stray outside of the Methow Basin.
6	Size and number of juveniles released	Target size and number of fish released were met. However, program release goals have not been met due to a low abundance of fish and lack of broodstock.
7	Freshwater productivity	Egg to smolt survival is low, but is not related to the proportion of hatchery fish on the spawning grounds.
8	Harvest	Harvest rates of Twisp spring Chinook have been negligible for both hatchery and naturally produced fish.

Chewuch River Spring Chinook

Goal – Support the recovery of Chewuch spring Chinook salmon[2] by increasing the abundance of the natural adult population, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity.

Program **–** Collect sufficient broodstock from Wells Dam and Methow Hatchery (hatchery and naturally produced) in order to release 183,000 yearling smolts from the Chewuch Acclimation Pond.

Summary

Hatchery-origin Chewuch spring Chinook have experienced hatchery replacement rates (HRR) that were not significantly different from the target value, but met or exceeded this value in only about one-third of the years. The mean HRR was also not significantly different from the natural replacement rate (NRR). However, examination of the harmonic means (used because of a few extremely large values in the data) suggests that the HRR was four times higher than the NRR. The smolt-to-adult survival rate of hatchery fish was significantly lower than the survival target. Juvenile hatchery fish have been released at the target length and weight, and the mean number of fish released has met the program release goal since 2000, but broodstock has been predominately composed of hatchery fish (mean = 84%). Adult hatchery Chewuch spring Chinook have similar spawn timing and redd distribution as naturally produced adult spring Chinook in the Chewuch River. Hatchery-origin females have a similar age structure to natural-origin fish, but hatchery males matured at an earlier age in two of four years examined. The difference was driven by an increase in age-3 and decrease in age-5 males compared to natural-origin males. The Chewuch population has shown a slight increase in genetic differentiation over time from the Methow and Twisp populations, perhaps caused by low effective population size exacerbating genetic drift.

Chewuch hatchery fish strayed at a very high rate, on average only 57% of the Chewuch-program hatchery fish returning to the Methow Basin spawn in the Chewuch River, and this rate apparently increased beginning in 2001. A number of factors may have influenced this increase, including changes in broodstock composition and hatchery rearing techniques, changes in carcass recovery methodologies, and adult abundance.

Releases of hatchery spring Chinook to the Chewuch have not increased the abundance of spawners or NORs in the Chewuch River. Chewuch spring Chinook are increasingly more genetically similar to Methow and Winthrop hatchery fish, presumably as a result of high levels of straying and the Methow-Composite broodstock.

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[2] While the HCP is not a recovery plan into itself, the hatchery component of it must be consistent with hatchery goals and objectives through the ESA, and as such should aid in the recovery of listed fish.

Spawning escapement in the Chewuch River has not increased during supplementation compared to reference populations. Similarly, poor natural-origin fish survival has contributed to a decrease in NORs. However, the spawner-abundance trend for the Chewuch is strongly positive, and since 2001, spawner abundance has been similar to reference streams. The statistical difference detected in spawner abundance was caused by the Chewuch spawning population being much lower than the reference population shortly after supplementation began. While a number of problematic issues exist with Chewuch spring Chinook, the increase in spawner abundance suggests that the hatchery program has succeeded in returning spawners to a level of abundance similar to reference populations. However, the proportionate natural influence (PNI) for the Chewuch from 2001-2010 is 0.14 due to the low NORs and increasing hatchery spawners. Productivity in the Chewuch has remained unchanged during the time of supplementation indicating that the presence of hatchery spawners has not decreased productivity compared to reference populations. Low smolt-to-adult survival of hatchery fish, low natural recruitment rate, and straying of hatchery fish outside of the Chewuch contribute to these population dynamics results. A brief assessment of all objectives is provided in Table 27.

Table 27. Summary assessment of M&E objectives for the Chewuch spring Chinook hatchery program.

Obj.	Primary indicator	Assessment
1	Spawner abundance	Hatchery program has not increased spawner abundance in the Chewuch River.
	Natural-origin abundance	Abundance of natural-origin fish has declined.
	Adult productivity	Adult productivity has not decreased.
2	Migration timing	Insufficient data to assess this objective.
	Spawn timing	Exhibit similar spawn timing as naturally produced fish.
	Redd distribution	Exhibit similar spawning distribution as naturally produced fish.
3	Genetic diversity	Chewuch spring Chinook are more closely related to Methow stock than Twisp stock. Differences among stocks are decreasing over time.
	Effective population size	Ratio of Ne/N is constant as expected.
	Age at maturity	For those years analyzed, female hatchery and naturally produced mean age at maturity was similar. Male hatchery fish have returned at an earlier age for some brood years.
	Size at maturity	Male and female age-4 hatchery fish were similar in size as naturally produced fish.
4	Hatchery replacement rate	Post-release survival of hatchery fish was low but not significantly lower than expected. Hatchery survival was not greater than the natural replacement rate.
5	Stray rates	Stray rates into the Methow River far exceeded the target, but fish did not stray outside of the Methow Basin.
6	Size and number of juveniles released	Target size and number of fish released were met.
7	Freshwater productivity	Insufficient data to assess this objective.
8	Harvest	Harvest rates of Chewuch fish have been negligible for both hatchery and naturally produced fish.

Methow River Spring Chinook

Goal – Support the recovery of Methow spring Chinook salmon[3] by increasing the abundance of the natural adult population, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity.

Program **–** Collect sufficient broodstock from the Foghorn Dam, Wells and Methow hatcheries (hatchery and naturally produced) in order to release 183,333 yearling smolts from the Methow Acclimation Pond.

Summary

Survival of juvenile Methow spring Chinook have consistently met or exceeded the expected standard within the hatchery and met the standard to the adult stage (SAR). Juvenile hatchery fish have been released at the target weight, but lower than the target length. The target number of fish released has been met in most years, but broodstock has been predominately hatchery fish (mean = 84%). Adult hatchery Methow spring Chinook have similar migration and spawn timing as naturally produced fish, but mean spawning location was different in most years examined. However, given the complete spatial overlap of hatchery and naturally produced fish on the spawning grounds and the drastic over escapement of hatchery fish on the spawning grounds (K_{sp} = 490 spawners) any differences in mean spawning distribution are irrelevant. Female Methow hatchery fish mature at similar ages as naturally produced fish, but male Methow hatchery fish mature at an earlier age than naturally produced males. Stray rates of Methow hatchery fish are all below target goals. Methow and Winthrop hatchery fish were genetically similar prior to the use of the Methow-Composite stock. The effective population size was not related to spawner abundance, and relative to the spawner abundance has decreased over time. This suggests that either variance in reproductive success has increased, or inbreeding (fewer successful breeders) has increased.

Methow FH has not increased the abundance of spawners or NORs in the Methow River relative to reference populations. Productivity in the Methow has not changed during supplementation compared to the pre-supplementation period. However, the results presented here are confounded by the presence of hatchery fish from Winthrop NFH previous to commencement of the Methow Hatchery program. Interestingly, the number of hatchery yearling spring Chinook released into the Methow River was significantly lower (t-test: $P < 0.0001$) during supplementation (mean = 563,805; SD = 253,470) than before the supplementation program was initiated (mean = 971,160, SD = 157,918). Therefore, the influence Methow Hatchery program could be difficult to detect analytically, but also the potential effectiveness of the program may have already been compromised by decades of past hatchery practices. PNI has averaged 0.18

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[3] While the HCP is not a recovery plan into itself, the hatchery component of it must be consistent with hatchery goals and objectives through the ESA, and as such should aid in the recovery of listed fish.

during the supplementation period, well below the desired minimum of 0.67. The combination of WNFH and Methow Hatchery returns, combined with inadequate availability of natural-origin broodstock has resulted in this low PNI. Freshwater productivity in the Methow Basin is currently not significantly influenced by spawner abundance or the proportion of hatchery fish on the spawning grounds, but results may also be confounded by a long legacy of artificial propagation in the Basin or simply that smolt monitoring was initiated too late in the program to detect a change. While bias in the estimation of emigrants and redds may introduce error to this analysis these issues are currently being addressed for future data collection efforts, the extent to which past data collection may be affected is not known. A brief assessment of all objectives is provided in Table 38.

Table 38. Summary assessment of M&E objectives for the Methow spring Chinook hatchery program.

Obj.	Primary indicator	Assessment
1	Spawner abundance	Hatchery program has not increased spawner abundance in the Methow River relative to reference populations.
	Natural-origin abundance	Abundance of natural-origin fish has not increased and may have declined.
	Adult productivity	Adult productivity has not decreased.
2	Migration timing	Exhibit similar run timing at Wells Dam as naturally produced fish.
	Spawn timing	Exhibit similar spawn timing as naturally produced fish.
	Redd distribution	In some years, mean spawning location of hatchery fish was farther downstream than naturally produced fish. Mean spawning location of naturally produced fish has also shifted downstream.
3	Genetic diversity	Methow spring Chinook are more closely related to Chewuch stock than Twisp stock. Methow and Winthrop stocks are very closely related.
	Effective population size	Ratio of Ne/N is has declined over time and is not correlated to abundance (N).
	Age at maturity	For those years analyzed, female hatchery and naturally produced mean age at maturity was similar. Male hatchery fish have returned at an earlier age then male natural-origin fish for some brood years.
	Size at maturity	Male and female age-4 hatchery fish were similar in size to naturally produced fish.
4	Hatchery replacement rate	Post-release survival of hatchery fish met the HRR target. Hatchery survival was significantly greater than the natural replacement rate, but the natural replacement was very low.
5	Stray rates	Stray rates into the Chewuch and Twisp rivers were within acceptable levels as were stray rates outside of the Methow Basin.
6	Size and number of juveniles released	Target weight and number of fish released were met.
7	Freshwater productivity	Spawner abundance and the proportion of hatchery fish on the spawning grounds have little influence on productivity, but the analysis may be confounded due to historical hatchery impacts and biases in the data.
8	Harvest	Harvest rates of Methow fish have been negligible for both hatchery and naturally produced fish.

Methow Basin Spring Chinook Discussion and Recommendations

Currently, the Mid-Columbia PUD HCP Hatchery Committees and Grant PUD Hatchery Sub-Committee are conducting adjustment of the hatchery compensation programs. The anticipated result of this adjustment of the combined PUDs' hatchery compensation for the Methow Basin will be the production of approximately 225,000 yearling spring Chinook at the Methow Hatchery. This is a substantial decrease in production and will require adjustment of the management strategies for the Twisp, Chewuch and Methow populations. In addition to the production decrease, future management strategies for Methow Basin spring Chinook must holistically incorporate the genetic consequences of past management practices, current knowledge of homing and straying in the basin, pursuit of PNI goals, and the status of hatchery and natural replacement rates, as presented in this report.

The stray rates of Twisp and Chewuch fish greatly exceeded target thresholds. In the case of the Twisp, the stray rate resulted in approximately 25% of Twisp-origin fish migrating to other parts of the Methow Basin or to the Methow Hatchery. Approximately half of these strays did indeed home to Methow Hatchery suggesting imprinting to this facility at life-stages prior to spring smolting. However, the Twisp already experiences hatchery returns in excess of pHOS targets necessary to meet PNI goals. Therefore, measures to return a greater proportion of Twisp-origin fish to the Twisp River will not result in meaningful conservation gains, except to the extent that the Twisp program could be reduced in size commensurate with an increase in successful homing, and more wild spawners could be allowed to spawn naturally rather than being used for broodstock. Twisp strays to the Methow or Chewuch comprised small proportions of those recipient populations and do not represent a risk to those populations.

The Chewuch fish displayed similar stray patterns to the Twisp fish, but at a higher rate. However, since 1997 both the Methow and Chewuch programs used MetComp stock (Chewuch not entirely MetComp until 2007), and thus Chewuch strays were not necessarily a risk to the Methow population. In contrast, the Winthrop NFH released a large number of Carson-stock fish during the supplementation period, greatly reducing the relative risks to the Methow imposed by Chewuch strays. The HSRG reported, based on modeling results, that their preferred hatchery solution for the Methow Basin would return approximately the same number of natural-origin adults as a no-supplementation option. Indeed, the analyses in this report support the HSRG prediction: natural-origin returns did not increase during the supplementation period relative to reference populations.

In the case of the Chewuch, the hatchery program has apparently not provided a benefit in the form of increased natural-origin spawners or the development of local adaptation, and had a high stray rate. Therefore, our recommendation is to either modify or discontinue the Chewuch program. Possible modifications for consideration include the development of methods to collect local broodstock, sizing the program to release only progeny of Chewuch stock, and managing the proportion of hatchery spawners on the spawning grounds. Alternatively, a discontinuation of the Chewuch program (with production possibly shifted to the Methow) could allow the management of the Chewuch under a no-supplementation strategy that could provide important insight into the response of a population to the discontinuation of a hatchery program (e.g., Entiat spring Chinook). The Chewuch could serve as a reference population for the Twisp and Methow programs, and possibly other programs outside the basin. Recall that natural-origin returns have not increased under the supplementation program; thus a no-hatchery strategy in the Chewuch does not appear to entail increased risk to recovery goals, and may actually reduce risk and increase chances for recovery.

The Methow program experienced low stray rates, but adult returns from Winthrop NFH were still more abundant on the spawning grounds. The Methow program could benefit from the development of a local broodstock, although, such an effort is premature while the river is so heavily influenced by Winthrop NFH spawners. Should the WNFH program successfully address adult management, either through robust adult management practices, or changes to the program such as a reduction in size or releasing fish out of basin, the Methow spring Chinook program could adopt a local broodstock program.

Anticipated hatchery production levels as a result of adjustment of hatchery compensation in 2013/2014 will force changes in the management of spring Chinook. We recommend the implementation of the Twisp program with release size adjusted as necessary to meet PNI goals. Management in the remainder of the basin must balance the number of natural-origin fish available with the potential options for the Chewuch and Methow programs. Perhaps the most realistic option would implement only one of these two programs. Both the Chewuch and Methow programs face significant issues that likely compromise the effectiveness of each program. The Chewuch offers an opportunity to establish a reference stream, or possibly a locally adapted program, while the value of substantially modifying the Methow program remains questionable without first addressing the management of adult returns from the Winthrop NFH program. Nevertheless, the Methow program also offers the opportunity to establish a locally-adapted type of program with minimal risk and low rates of straying. The added benefit of choosing the Methow rather than the Chewuch to establish a locally adapted program is that it also includes the opportunity to manage the Chewuch with a no hatchery strategy and establish it as a reference population (e.g., Entiat spring Chinook).

Recommendations

1. Assess the potential to use a PIT-tag based assessment for 1) estimating survival to key life stages, 2) population estimates of key life stages, 3) developing estimates of carrying capacity, and 4) understanding life-history traits such as juvenile movement and rearing, homing and straying. This approach should allow assessment of both the hatchery and natural populations to detect limiting life stages. It is unclear to what extent such an approach could supersede current methodologies, such as rotary screw trapping. To the extent a PIT-tag approach would improve the ability to address the four questions above, develop field and analytical methods to employ this PIT-tag approach.

2. Improve broodstock collection for the Twisp program to optimize available fish for broodstock. Maximize operation of the Twisp Weir when fish are present and trapping conditions permit operation of the trap. During high water periods, when working the mid-channel trap compromises crew safety, explore the use of the near-shore trap or the concrete left-bank trap. Modify fish-retention rules to optimize trapping opportunities while still allowing the desired spawning escapement.

3. Investigate the potential for incubation in natal streams or using natal stream water to improve homing.

4. The stray rates of Twisp and Chewuch fish exceed the target thresholds. Several possible approaches may ameliorate this issue, including extending the period of acclimation (improbable due to logistical constraints) or exposing the fish to target water (e.g., Twisp or Chewuch) at earlier life-stages. Both approaches attempt to allow fish to imprint on Twisp or Chewuch water at key life-history stages. It is currently unclear at which life-stage(s) imprinting would most effectively increase homing to the Twisp or Chewuch. We recommend an experimental approach to improve homing that may also yield widespread practical improvement for other programs.

5. Implement new hatchery NNI production levels, the anticipated basin release from Methow Hatchery will be approximately 225,000 smolts.

6. Chewuch and Methow broodstock must incorporate an increasingly greater proportion of natural-origin fish to achieve PNI goals. A “stepping stone” broodstock focused on maximizing the mating of natural-origin parents for use in both broodstock and on the spawning grounds could be implemented. These progeny should be tagged, but not marked. The remainder of the production would consist of hatchery x hatchery matings and should be tagged and adipose-fin clipped. This marking scheme would allow the retention of these fish in selective fisheries, removal at dams, weirs, and hatcheries, while maximizing the number of hatchery fish with natural-origin parents on the spawning grounds. The actual production goal would be dependent on the future of both the Chewuch and Winthrop NFH programs.

7. Historically, the Chewuch broodstock suffered from a lack of natural-origin fish; without infrastructure improvements the proportion of natural origin broodstock will not increase and management of the proportion of hatchery fish on the spawning grounds will not be possible. Continuation of the current program (i.e., Met-Comp) would likely result in a further reduction in genetic diversity and, subsequently, productivity of the Chewuch stock without a demographic benefit from the hatchery program. If PNI goals cannot be achieved in the Chewuch, the current hatchery production should be discontinued or moved to a location that

would eliminate any potential negative impacts to the Chewuch spring Chinook population.

8. The goal of the Methow FH is supplementation, while Winthrop NFH will produce a safety-net program, and was originally built for mitigation and harvest augmentation. The current abundance level of naturally produced fish is too low to adequately support the combined smolt release goal of these two programs, and this fact has resulted in an average PNI of 0.13 through the most recent brood year covered by this report. We recommend the implementation of changes to both programs with the specific purpose of increasing the productivity of wild fish and the hatchery fish that are allowed to spawn naturally. We recommend evaluating the efficacy of methods for removing surplus hatchery fish. These may include use of the volunteer channels at Winthrop and Methow hatcheries, and/or other means of removal. Because returning adults from Winthrop NFH are currently not needed for conservation purposes, a minimum of 90% should be removed. In addition, a change in the marking scheme at Winthrop NFH (i.e., 100% adipose fin-clipped) would also contribute to reducing the overall number of fish returning to the Methow Basin.

9. Implement the adult management plan in the draft Methow Spring Chinook HGMP for both Winthrop NFH and Methow Hatchery fish.

10. Following HGMP approval by NOAA, update M & E Plan to ensure objectives and targets are consistent.

Attachment E

HCP Hatchery Committees Meeting Protocols

HCP Hatchery Committees' Responsibilities:

The Hatchery Committees oversee development of recommendations for implementation of the hatchery elements of the three Agreements for which the Districts have responsibility for funding. This includes overseeing the implementation of improvements and monitoring and evaluation relevant to the Districts' hatchery programs, as identified in the Hatchery Compensation Plans, the Permits, and Agreements. The Hatchery Committees also coordinate in-season information sharing and discuss unresolved issues. The Hatchery Committees' decisions shall be based upon the likelihood of biological success, time required to implement, and cost-effectiveness of solutions.

Meeting Protocols:

1. The HCP HCs are decision-making bodies and make decisions or recommendations by consensus. Consensus is the unanimous consent of all HCP HC members. Abstention does not prevent a unanimous vote. [1]
2. 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, who shall delay a vote on the agenda item for up to five (5) business days. A Party may invoke this right only once per delayed agenda item.[1]
    a. The HCP HCs have historically been amicable to a Party requesting additional time for internal vetting prior to a vote (within reason). This request and agreement typically have occurred during the meeting following contentious discussions and the inability to reconcile differences at that time.
3. The HCP HCs shall meet at least twice per year or as frequently as needed (when requested by any two members) to conduct business and resolve disputes.[1]
4. The Chair will distribute draft agendas with Decision Items at least ten (10) business days before each meeting.[1]
    a. Draft agendas with no Decision Items can be distributed seven (7) days before the meeting.
5. Draft meeting notes will be distributed to members of the HCP HCs within fourteen (14) days of the next meeting.
    a. Revised draft minutes for approval will be distributed within seven (7) days of the next meeting.
6. All Studies and Reports prepared under the Anadromous Fish Agreements will be available for at least a 60-day review period unless decided otherwise.[1]
7. Dispute Resolution will follow the protocols and timelines defined in the HCPs.
8. Conflict of Interest: the latest Conflict of Interest Policy expired in January 2015.
9. Meeting logistics

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[1] The identified protocol comes from the Anadromous Fish Agreement and Habitat Conservation Plans for the Wells, Rocky Reach, and Rock Island Hydroelectric Projects.

  a. The monthly meeting location alternates between Chelan PUD Headquarters in Wenatchee, WA and Douglas PUD Headquarters in East Wenatchee, WA every other month, unless agreed otherwise.
  b. Decision Items are addressed first following the opening of the meeting (this is to accommodate Committees members who cannot attend the entire meeting).
  c. The order of Chelan PUD and Douglas PUD agenda items alternate every month (i.e., if one month Chelan PUD presents first and Douglas PUD second, next month Douglas PUD will present first and Chelan PUD second); other agenda items are listed in order they are received, and revolving agenda items are covered last.

Commented [KG1]: Not sure if this is an "agreed upon protocol," or just how Mike liked to 'keep things even.'

10. HCP Hatchery Committees Extranet Site and Distribution List Access
  a. The HCPs agreed on a system requiring HCP Coordinating Committees review and approval to provide non-HCP Reps/Alts access to HCP Extranet Sites and distribution lists. For example, if a WDFW non-HCP Rep/Alt requests access to the HCP Hatchery Committees Extranet Site, the WDFW HC Rep needs to pass the request to the WDFW CC Rep, who then needs to request CC approval).
  b. Historically, administrative access (i.e., Chair or support) has been granted without CC approval; however, is discussed with the CC at the next possible CC meeting.

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees	**Date:**	July 16, 2015
From:	Tracy Hillman, HCP Hatchery Committees Chairman		
Cc:	Kristi Geris		
Re:	Final Minutes of the June 17, 2015 HCP Hatchery Committees Meeting		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees meeting was held at Chelan PUD headquarters in Wenatchee, Washington, on Wednesday, June 17, 2015, from 9:30 a.m. to 3:00 p.m. Attendees are listed in Attachment A to these meeting minutes.

ACTION ITEM SUMMARY

- Tracy Hillman will provide the paper titled, "Anadromy and residency in steelhead and rainbow trout (*Oncorhynchus mykiss*): a review of the processes and patterns," (Kendall et al. 2014) to Kristi Geris for distribution to the Hatchery Committees (Item II-A). *(Note: Hillman provided this paper, as well as a paper titled, "Analyzing large-scale conservation interventions with Bayesian hierarchical models: a case study of supplementing threatened Pacific salmon," (Scheuerell et al. 2015), to Geris on June 18, 2015, which Geris distributed to the Hatchery Committees that same day.)*
- Anchor QEA will set up a WebEx (screen share) for all future Hatchery Committees meetings to more effectively share information with those attending the meeting via conference call (Item II-A). *(Note: Sarah Montgomery set up a WebEx, as discussed, and will include the screen share access link on all future meeting agendas.)*
- Greg Mackey and Mike Tonseth will provide a revised Methow Basin Spring Chinook Adult Management Worksheet and the revised 2015 Methow Basin Spring Chinook Adult Management Plan to Kristi Geris for distribution to the Hatchery Committees (Item III-A). *(Note: Mackey provided these revised documents to Geris on June 18, 2015, which Geris distributed to the Hatchery Committees that same day.)*

- Craig Busack will resend the Doodle Poll to schedule the next joint National Marine Fisheries Service (NMFS)/U.S. Fish and Wildlife (USFWS) Biological Opinion (BiOp) Coordination Meeting (Item VI-A). *(Note: Busack resent the poll on June 18, 2015.)*
- Greg Mackey will provide his presentation titled, "Carrying Capacity of Spring Chinook and Summer Steelhead in the Methow River Basin, Washington," that he presented at a past American Fisheries Society (AFS) Conference to Kristi Geris for distribution to the Hatchery Committees (Item VIII-A). *(Note: Mackey provided this presentation to Geris on June 18, 2015, which Geris distributed to the Hatchery Committees that same day.)*
- Tracy Hillman and Kristi Geris will incorporate edits discussed into the draft Hatchery Committees Meeting Protocols, and will distribute the updated draft to the Hatchery Committees (Item IX-A). *(Note: Hillman and Geris updated the draft, as discussed, which Geris distributed to the Hatchery Committees on June 18, 2015.)*
- Tracy Hillman and Anchor QEA will coordinate future joint Hatchery Committees/ Priest Rapids Coordinating Committee Hatchery Sub-Committee (PRCC HSC) sessions with the PRCC HSC Facilitator, as needed (Item IX-B).
- Kristi Geris will distribute a Doodle Poll to reschedule the Hatchery Committees meeting in August 2015 (Item IX-C). *(Note: Geris distributed a poll on June 18, 2015.)*

DECISION SUMMARY

- There were no decisions approved during today's meeting.

AGREEMENTS

- The Hatchery Committees representatives present agreed to change the deadline for Chelan PUD to provide their draft Hatchery Monitoring and Evaluation (M&E) Annual Implementation Plan to the Hatchery Committees for review from July 1 (as previously agreed to on December 12, 2012) to August 1 of the year preceding the proposed M&E activities, so long as there are no significant changes requiring Hatchery Committees discussion (Item IV-C).
- The Hatchery Committees representatives present agreed to Chelan PUD's proposed Hatchery M&E Annual Report schedule to provide the Hatchery Committees with a

draft Hatchery M&E Annual Report for a 30-day review by June 15, with the final report due to NMFS by September 1 (Item IV-D).

- The Hatchery Committees representatives present agreed to convene joint sessions with the PRCC HSC when there are agenda items applicable to and which require participation from both the Hatchery Committees and PRCC HSC, with the conditions that: 1) any items requiring Committees decision (i.e., Decision Items) will be discussed to the extent necessary and voted on separately in the respective Committees; 2) prior to joint sessions, it will be made clear at the onset of the discussion that the item is a joint discussion and all Parties are welcome to speak freely; and 3) following joint sessions, the PRCC HSC will be provided with the joint section(s) of the draft meeting minutes for review, as well as the opportunity to comment on the joint discussions, and with the final minutes for their respective administrative records (Item IX-B).

REVIEW ITEMS

- Kristi Geris sent an email to the Hatchery Committees on July 1, 2015, notifying them that the draft 2016 Douglas PUD Hatchery M&E Implementation Plan is available for a 60-day review period, with edits and comments due to Greg Mackey by Sunday, August 30, 2015.

FINALIZED DOCUMENTS

- Kristi Geris sent an email to the Hatchery Committees on June 20, 2015, notifying them that the Final 2014 Chelan PUD and Grant PUD Hatchery M&E Annual Report and final appendices are now available for download from the Hatchery Committees Extranet site.

I. Welcome

A. Review Agenda, Review Last Meeting Action Items, Approve the May 20, 2015, Meeting Minutes (Tracy Hillman)

Tracy Hillman welcomed the Hatchery Committees, and introduced Sarah Montgomery (Anchor QEA). Hillman said Montgomery will shadow Kristi Geris for a few months and will eventually replace Geris as the Hatchery Committees Support Staff. Montgomery said she is a biologist who recently graduated from the University of Washington, and she is excited about her new role on the Hatchery Committees.

Hillman asked for any additions or changes to the agenda. No additions or changes were requested.

The Hatchery Committees reviewed the revised draft May 20, 2015, meeting minutes. Kristi Geris said there is one outstanding comment to be discussed regarding the Hatchery Evaluation Technical Team (HETT) Update. She said while discussing the Predation, Competition, and Disease Risk Modeling, Craig Busack noted an error in the model, and Greg Mackey requested clarification on the source of the error. Busack briefly explained how he noticed the error and offered to provide a summary to include in the minutes. He added that the point of his statement was to indicate there was an error, which is captured in the minutes. Mackey agreed and suggested striking his comment and Busack's response about the source of the error in the revised minutes.

Keely Murdoch requested a revision to a question she posed while discussing the Draft 2015 Methow Basin Spring Chinook Adult Management Plan. She clarified that she asked if there are plans to install passive integrated transponder (PIT)-tag detection specifically in the outfall to the Methow Fish Hatchery (FH)—not generally around Methow FH. Hillman also noted a run-on sentence reported under the Five-Year Hatchery M&E Review Planning discussion, and suggested breaking the sentence into two sentences. Geris said she will incorporate revisions, as discussed. Hatchery Committees members present approved the draft May 20, 2015, meeting minutes, as revised.

Action items from the Hatchery Committees meeting on May 20, 2015, and follow-up discussions, were as follows (italicized item numbers below correspond to agenda items from the meeting on May 20, 2015):

- *Greg Mackey will provide Douglas PUD's responses to Kirk Truscott's comments on the draft 2015 Methow Basin Spring Chinook Adult Management Plan to Kristi Geris for distribution to the Hatchery Committees following the meeting on May 20, 2015 (Item II-A).*

Mackey provided Douglas PUD's responses to Geris on May 20, 2015, which Geris distributed to the Hatchery Committees that same day.

- *Charlie Snow (Washington Department of Fish and Wildlife [WDFW]) will provide data that compare Methow spring Chinook salmon spawning escapements with Wells Dam fish counts for years available, to Kristi Geris for distribution to the Hatchery Committees (Item II-A).*

  Snow provided these data to Geris on May 29, 2015, which Geris distributed to the Hatchery Committees that same day.
- *Keely Murdoch and Mike Tonseth will discuss internally the feasibility of installing PIT-tag detection in the Methow FH volunteer channel (Item II-A).*

  Murdoch said the Yakama Nation (YN) installed two arrays, which will also capture directionality. Greg Mackey added that the YN and WDFW are coordinating on this effort.
- *Greg Mackey and Mike Tonseth will update escapement numbers in the draft 2015 Methow Basin Spring Chinook Adult Management Plan, and will provide a revised draft plan to Kristi Geris for distribution to the Hatchery Committees (Item II-A).*

  This will be discussed during today's meeting.
- *Greg Mackey, Catherine Willard, Keely Murdoch, Todd Pearsons (Grant PUD), Charlie Snow, Andrew Murdoch (WDFW), and Tracy Hillman will coordinate to prepare information on Hatchery M&E Plan Objectives 1, 4, and 7, for discussion during the next Hatchery Committees meeting on June 17, 2015 (Item V-A).*

  This will be discussed during today's meeting.
- *Keely Murdoch will coordinate with Matt Abrahamse (YN) on possibly presenting recent data on the YN Kelt Reconditioning Program during a future Hatchery Committees meeting (Item VIII-A).*

  This will be discussed during today's meeting.
- *Kristi Geris will distribute an electronic copy of the draft HCP Hatchery Committees Meeting Protocols Summary to the Hatchery Committees for review, along with Geris' additional edits, as discussed during the Hatchery Committees meeting on May 20, 2015 (Item IX-A).*

  Geris distributed the summary and additional edits to the Hatchery Committees on May 21, 2015.

- *Hatchery Committees representatives will provide edits and comments on the draft HCP Hatchery Committees Meeting Protocols Summary to Tracy Hillman (with a copy to Kristi Geris) by Thursday, June 4, 2015 (Item IX-A).*
  This will be discussed during today's meeting.

II. YN

A. YN Kelt Reconditioning Program Update (Matt Abrahamse)

Matt Abrahamse shared a presentation titled, "YN Upper Columbia Kelt Reconditioning Project – 2014 Status Update," (Attachment B), which Kristi Geris distributed to the Hatchery Committees on June 18, 2015. This presentation included an introduction to the YN Upper Columbia Kelt Reconditioning Project and an overview of project objectives, methods, and 2014 results. Based on 2014 survival, weight metrics, and maturation rates, as well as detections in 2015, Twisp-origin kelts appear to be successful. Questions and comments were discussed as follows:

Mainstem Trapping (slide 8 of Attachment B)

Greg Mackey asked how fish populations are differentiated. Abrahamse said some are differentiated by PIT-tag; and Keely Murdoch said that last year, those trapped at Rock Island Dam were released at Kirby Billingsley Hydro Park, and then tracked to see where they went. Therefore, knowing the origin of the kelts that were reconditioned was not necessary since they were released in the Columbia River and were free to seek their natal rivers.

Survival (slide 13 of Attachment B)

Kirk Truscott asked if individuals were selected based on condition, or if all kelts caught were retained. Abrahamse said natural-origin recruit (NOR) females were targeted, with a grading system applied for condition. He explained if fish are retained that have a lot of wounds, active fungus, and/or descaling, they tend to die quickly and also bring those infections into the tanks. He said typically, fish are retained if they have only a few nicks, minimal fin wear, and no active fungal infections. He added that coloration does not matter. Bill Gale asked if new fish are separated when they arrive from those already being held, and Abrahamse said they are not; they are held in the same tank.

Todd Pearsons asked if only females were retained. Abrahamse said primarily; however, some males were retained at the Rock Island Dam. He explained that males were not retained in the tributaries because it is difficult to determine whether they are done spawning. He said additionally, in general, males are in poor condition because they migrate more and subsequently have more wounds and wear, and typically are not as successful in a reconditioning setting. He said there has been up to 10% post-spawn mortality, and the cause is uncertain; however, the YN is working to determine how to improve that. He noted in 2014, there was an issue with fish jumping out of the tank because there were more fish in the tank than in previous years. Murdoch said this was resolved by covering the tanks.

Weight Gained (slide 14 of Attachment B)

Abrahamse noted that weight gain is not the best indicator of reconditioning success; however, it is good for overwinter survival and post-spawning migrations. Murdoch also noted that live-spawned kelts from the hatcheries grew the most. Abrahamse explained the reason for this is because live-spawned fish start feeding faster and have not undergone the same stress that many wild fish go through to spawn in the wild.

Tracking (slide 18 of Attachment B)

Gale noted that some fish were identified as mature or not mature at the time of release, and asked if there was any clear pattern between whether fish spawned or emigrated without spawning subsequent to release. Abrahamse said there is not, and added that there is also not enough information to determine whether the fish spawned or not. Gale asked if only measuring estradiol at release may not be effectively determining maturation. Abrahamse said he is not sure, and noted that vitellogenin levels are also measured at release. Gale asked how effective measuring vitellogenin levels is in determining maturation. Murdoch explained that the YN is working with Fish Biologist, Andy Pierce, at the Columbia River Inter-Tribal Fish Commission, who has completed a lot of research on blood indicators. She said Pierce developed criteria for maturation, so the YN sends him the estradiol and vitellogenin levels, and he determines whether the fish are maturing or not. She said the uncertainty is what happens to non-maturing fish after they are released. Abrahamse said in other projects, after non-mature fish are released, they are never detected again; so, this is new territory to investigate.

Truscott asked about confirming maturation using ultrasound. Abrahamse said at this life stage, ultrasound would be difficult. Truscott said ultrasound may still be interesting to do, and suggested comparing maturation of reconditioned fish to newly arriving volitionally migrating females. Murdoch said this comparison will be evaluated during sampling at Wells Dam in the fall (as discussed during the Hatchery Committees meeting on January 21, 2015). Abrahamse said, with regard to using ultrasound, it is difficult to measure differences in ovary sizes at this life stage; however, the YN will consider looking into this.

Mike Tonseth asked if the YN has considered using a surrogate. He suggested taking a complimentary group of hatchery-origin females, managing them the same as wild fish, drawing estradiol levels, and then killing the fish and conducting a gross physical examination to determine the status of the gonads. Abrahamse said the YN has considered this; however, not on a large scale. He said the challenge is collecting more fish, and higher survival creates a space limitation. Also, the work done by Pierce has addressed this relationship.

Tonseth asked about stock specificity (i.e., if there is different blood chemistry among stocks). Murdoch said there could be a difference. Gale asked if blood is drawn when fish are first retained and again prior to release to evaluate increase in estradiol and vitellogenin levels. Abrahamse said this is done only before release.

Tonseth asked how kelts encountered by anglers are being documented. Abrahamse said this is being done by floy tags.

General Questions/Comments

Pearsons asked what proportion of the overall population do these fish represent (i.e., how many fish convert to mature and spawn in terms of the total population). Abrahamse said so far, this is not the focus of the program. Rather the focus has been on trying to answer reproductive success viability (i.e., confirm fish are producing viable offspring before evaluating how much to contribute to the total spawning population). Murdoch noted that this is not a huge program. She said in some areas, there are very few NORs, so only a few can make a big difference. She said in terms of small areas, this may mean a big abundance boost; however, in terms of the overall population, these are not huge numbers. Gale also noted the value in taking fish for use in hatchery programs and giving them the opportunity to spawn in the wild. He said he is not sure this will ever have a big impact on abundance.

Tracy Hillman suggested the Hatchery Committees review a paper titled, "Anadromy and residency in steelhead and rainbow trout (*Oncorhynchus mykiss*): a review of the processes and patterns," (Kendall et al. 2014). Hillman said he will provide the paper to Geris for distribution to the Hatchery Committees. *(Note: Hillman provided this paper, as well as a paper titled, "Analyzing large-scale conservation interventions with Bayesian hierarchical models: a case study of supplementing threatened Pacific salmon," (Scheuerell et al. 2015), to Geris on June 18, 2015, which Geris distributed to the Hatchery Committees that same day.)*

The Hatchery Committees requested that a screen share be set up for future meetings to more effectively share information with those attending the meeting via conference call. Anchor QEA will set up a WebEx (screen share) for all future Hatchery Committees meetings, as requested. *(Note: Sarah Montgomery set up a WebEx, as discussed, and will include the screen share access link on all future meeting agendas.)*

III. Douglas PUD

A. Methow Spring Chinook Adult Management Update (Greg Mackey and Mike Tonseth)

Greg Mackey said Methow FH and Winthrop NFH staff have been performing adult management at the Winthrop NFH and Methow FH outfalls since the beginning of the spring Chinook salmon run. He recalled that the Methow Spring Chinook Adult Management Plan included the preliminary numbers reported in the 2015 Broodstock Collection Protocols, which he noted are not too different from the actual numbers; however, he wanted to use actual run data to inform how many fish to remove at hatcheries in the Methow Basin. He said the spring Chinook salmon run at Wells Dam is nearly complete, and the most recent run estimates have been received. He said challenges include: 1) projecting the number of spawners on the spawning grounds, which then drives the Proportionate Natural Influence (PNI) and percent hatchery-origin spawners (pHOS); 2) knowing how many hatchery-origin recruits (HORs) to remove at the hatchery; and 3) understanding the rates at which fish transition from Wells Dam counts to the hatchery outfall and to the spawning grounds.

Mackey reviewed a draft Spring Chinook Adult Management 2015 Calculator (Attachment C). He said on the Proportion of Natural-Origin Fish in Hatchery Broodstock (pNOB) Data tab in Attachment C, Table 3.1 was taken directly out of the 2013 Hatchery M&E Annual Report. He noted in the column to the right of Table 3.l, pNOB is calculated for each respective year. He said on the Raw Run Numbers tab in Attachment C, the calculations indicate about 708 NORs and more than 8,000 HORs are expected to go to the Methow Basin. He also noted about half of the total fish suffer from pre-spawn losses. He asked Charlie Snow if a redd expansion was applied to these calculations, and Snow said it was. Keely Murdoch asked if the 8,000 HORs included Winthrop NFH, and Mackey said it does. Mackey added that pre-spawn loss includes fish leaving the system, as well as mortalities. Craig Busack asked if these calculations mean that among the fish destined for the Methow Basin, half of them do not show up. Mackey said this is correct. Snow explained that the starting point for the Wells Dam count includes fish that fell back or were double-counted at the dam. Mackey said hatchery fish returning to the volunteer channels of the two hatcheries might have a conversion rate closer to 80 to 90% based on recent results from USFWS surplusing efforts. He added that the pre-spawn loss is actually based on redd counts and carcass recoveries. Thus, by the time fish spawn, more fish have been lost because they have another month or so before spawning in the wild. He said, therefore, the pre-spawn hatchery conversion from Wells Dam to the hatchery outfalls should be closer to 80%.

Mackey said staff conducting adult management need to know how many fish to remove at the hatcheries, so ultimately, it needs to be determined how many of those hatchery fish end up converting to spawners in the wild. Murdoch asked if fish removal at Methow FH is coordinated with removal at Winthrop NFH. Jayson Wahls (WDFW) said all fish removed at Methow FH are hauled to Winthrop NFH, where they are surplused by Winthrop NFH staff. Murdoch said, ultimately, the goal should be to remove as many Winthrop NFH fish as possible, and then just remove fish at Methow FH, as needed. Bill Gale said a possible issue with this plan is if Methow FH reaches its quota and shuts down, then fish wanting to ascend to Methow FH may not return to Winthrop NFH once they cannot get into Methow FH. Mike Tonseth noted this may not be the case, which is why the Hatchery Committees have recommended installing PIT-tag detection in the Methow outfall to determine where fish may go. Gale said in the past few years, there have been several Methow fish collected at Winthrop NFH, and Tonseth said this may be independent of whether the Methow outfall was open or closed.

Tonseth asked about surplus to date. Mackey said to date, he estimated about 3,412 hatchery spawners to the Methow River, but about 3,300 have been surplused with another 100 ready to go; therefore, he said something is wrong because these numbers indicate more than 99% effectiveness in removing fish, and he does not believe they are close to removing the amount of fish they need to. He said these numbers will be updated.

Mackey reviewed the Calculator tab in Attachment C. He said about 98% of hatchery fish need to be removed to hit the PNI target of 0.59. He explained that pNOB should be derived from the parental broods off the returning fish to represent their hatchery-wild genetic legacy accurately. The three brood cohorts had low average pNOB due to the large program size in the past and lack of wild fish, resulting in a stringent pHOS requirement to meet the PNI target according to the sliding scale. Presently and in the future, increasing pNOB will result in a more relaxed pHOS necessary to achieve the PNI target. Busack asked if the pNOB of 0.35 represents all programs. Mackey said it does not; it only includes Metcomp (does not include Winthrop). Busack asked if Metcomp also excludes Twisp, and Mackey said this is correct. Mackey added that Twisp would slightly increase pNOB; however, including Winthrop would significantly decrease pNOB.

Gale suggested, at some point, the Hatchery Committees need to discuss a pNOB value for a stepping stone program (i.e., Winthrop NFH). He added it is not appropriate to always apply a pNOB of 0.0. Tonseth said pNOB for a stepping stone program might be close to 0.0 if this can be achieved with 99% removal at a weir. He added, in terms of pNOB, Winthrop NFH is essentially a non-factor. Gale questioned whether pNOB is being set too high, noting it seems incorrect to assign the same pNOB level to segregated programs such as Leavenworth and Winthrop. Murdoch suggested if the goal is operating Winthrop NFH as the safety net program and emphasizing the Methow Hatchery program, it seems pHOS should be the metric, not PNI, because pNOB cannot be (sensibly) applied to Winthrop NFH. Gale said the goal is per basin—not per facility. Busack noted it would be simple to split goals into separate facilities; with a pHOS of 5% for the segregated Winthrop NFH program. Gale noted, however, it is not a segregated program. Tonseth suggested one way to have some measurable pNOB level is to live-spawn all NOR males from the Methow and ship them to Winthrop NFH. This would produce some portion of hatchery-by-wild crosses, but would also not exceed the 33% extraction rate of wild fish. Busack said another possible solution would be to integrate the Winthrop Program. Tonseth agreed, but noted that NORs could not be used to do it. He added if the Winthrop Program is assumed to be safety net, the goal is still to remove most of those fish.

Mackey said on the Calculator tab of Attachment C, there is an issue regarding the wild spawning escapement and allowable hatchery escapement, which will be updated. He asked when fish tend to stop arriving to Winthrop NFH. Matt Cooper said usually about the first week in July. Cooper added that this year it may be earlier.

Mackey and Tonseth said they will provide a revised Methow Basin Spring Chinook Adult Management Worksheet and the revised 2015 Methow Basin Spring Chinook Adult Management Plan to Kristi Geris for distribution to the Hatchery Committees.
(Note: Mackey provided these revised documents to Geris on June 18, 2015, which Geris distributed to the Hatchery Committees that same day. Busack also mentioned a 3-way PNI model that could be adapted to the situation in the Methow.)

IV. Chelan PUD

A. Methow Basin Spring Chinook Program (Alene Underwood)

Interlocal Agreement (ILA)

Alene Underwood said yesterday, Chelan PUD provided Douglas PUD with a signed ILA, which Douglas PUD plans to present to its Board for final approval. Underwood said the ILA is a 10-year agreement to collect Chelan PUD Methow spring Chinook salmon at Wells Dam and hold and early-rear at Methow FH. Craig Busack asked if Douglas PUD has any causes for concern about approving the ILA, and Greg Mackey said not to his knowledge.

BY 2015 Chelan PUD Methow Spring Chinook Broodstock

Underwood apologized for the last-minute email distributed last week regarding broodstock collection for Chelan PUD's BY 2015 Methow spring Chinook salmon obligation. She said the Hatchery Committees agreed via email on June 12, 2015, to forego tangle netting in the Chewuch River, and instead collect HOR MetComp spring Chinook salmon at Methow FH to backfill the program. She said Chelan PUD now has a full complement of fish for their BY 2015 Methow Spring Chinook Program, noting the fish are HORs and not NORs.

B. Penticton Hatchery 2015 Fry Releases (Alene Underwood)

Alene Underwood announced that there was the first official fish release from the newly minted sockeye salmon hatchery in Penticton. She said roughly 1.7 million fry were released, with the majority (about 80%) released in Shingle Creek. She said fish were volitionally released from raceways to Shingle Creek via a transfer line, and the entire release was completed in less than 8 hours. She said, as for the hatchery, there are some minor water quality issues that are being addressed this summer. She added, however, these types of issues are expected with any new hatchery. Mike Tonseth asked about the nature of the water quality issues. Underwood said there was low dissolved oxygen (DO) and also biofouling in the degassing towers. She said pump tests are scheduled to start next week.

Kirk Truscott asked about the size of the facility. Underwood said the facility footprint is for an 8-million egg take; however, it is currently only plumbed for a 5-million egg take. She said this year, the facility accommodated a 2.2-million egg take, which was more than expected, that ended up yielding roughly 1.7 million fry. Truscott asked if for this first year numbers were intentionally low. Underwood said that is correct in the interest of working out issues that are inherent with a new facility and also the logistics of getting that many fish.

Craig Busack asked if Shingle Creek drains to Skaha Lake. Underwood said yes, Shingle Creek drains into the Penticton channel, which drains into Skaha. Tracy Hillman asked, in light of the climate issues expected this summer, will there be a significant temperature and DO squeeze in Lake Osoyoos, and, if so, how will the release of 1.7 million sockeye affect overall juvenile sockeye survival. Underwood said there is a robust M&E program in place to monitor for any potential issues. Truscott recalled in the past, fish and water managers planned water releases in the Okanagan to help mitigate issues with DO. Tom Kahler noted that last year, roughly 491,000 fish passed Wells Dam and there were only about 177,000 estimated spawners, not including Skaha escapement, which means more than 200,000 fish were lost to temperature and other issues between Wells Dam and the spawning grounds. He added a key reason that many fish survived was because there were three big rain events and the United States and Canada parties coordinated large water releases (i.e., pulses) during those rain events. He said the future of this population depends on Skaha and Okanagan lakes, and rain events. He also noted that, historically, in the 1800s, there was an April run (return timing to the lower Columbia), which now happens in late-May to early-June. He said the current run timing is not sustainable because of the thermal barriers to migration in the Okanogan River and Osoyoos Lake and adult holding/juvenile rearing success in Osoyoos Lake, and noted the need for an early run component to get through the Okanogan River and Osoyoos Lake before the onset of the thermal barrier, into Skaha and Okanagan lakes where conditions favor adult holding.

C. 2015 Chelan PUD Hatchery M&E Implementation Plan Schedule (Catherine Willard)

Catherine Willard said, historically, the draft Hatchery M&E Implementation Plan was due to the Hatchery Committees for review by July 1 of the year preceding the proposed M&E activities (Hatchery Committees Agreement, December 12, 2012). She said last year, the Hatchery Committees agreed to extend the deadline for Chelan PUD to provide their draft Hatchery M&E Annual Implementation Plan to the Hatchery Committees for review from July 2014 to August 2014 (Hatchery Committees Agreement, June 18, 2014). She said this year, Chelan PUD is requesting to provide their draft plan to the Hatchery Committees for review in August 2015, for the same reasons described last year. She said additionally, last year was the first year using new methodology, and Chelan PUD is planning to meet with Andrew Murdoch to finalize a few things, so an August submittal will also help with that. Alene Underwood further suggested changing the submittal date to August from this point forward. Keely Murdoch recalled the issue in past years was when there were significant changes that needed review prior to contracting. She said to this end, the YN is supportive of the August deadline, so long as there are no significant changes that may require more thorough Hatchery Committees discussions.

The Hatchery Committees representatives present agreed to change the deadline for Chelan PUD to provide their draft Hatchery M&E Annual Implementation Plan to the Hatchery Committees for review from July 1 (as previously agreed to on December 12, 2012) to August 1 of the year preceding the proposed M&E activities, so long as there are no significant changes requiring Hatchery Committees discussion.

D. Revised Chelan PUD Hatchery M&E Annual Report Review/Submission Timeline (Catherine Willard)

Catherine Willard said previously, the Hatchery Committees comment deadline and the NMFS submission deadline for the Chelan PUD Hatchery M&E Annual Report was on the same day. She said NMFS agreed to move the NMFS submission deadline to September 1, which will be included in the new spring Chinook salmon permits. She said Chelan PUD is now proposing submitting the annual report for a Hatchery Committees 30-day review on June 15, which will give Tracy Hillman from July 15 to August 31 to address revisions prior to submitting the report to NMFS. Bill Gale questioned if 30 days is an adequate review period. Alene Underwood said this is consistent with Grant PUD's annual report in their committee. Mike Tonseth added that NMFS is trying to standardize submission dates in all permits, which means finding a consistent review deadline that allows adequate time to address edits. Underwood also noted that internal deliverable dates (e.g., from WDFW to BioAnalysts) will not change. Hillman also added that with this new schedule, the Hatchery Committees will now be able to review the compliance sections, which previously were not included in time for Hatchery Committees review.

The Hatchery Committees representatives present agreed to Chelan PUD's proposed Hatchery M&E Annual Report schedule to provide the Hatchery Committees with a draft Hatchery M&E Annual Report for a 30-day review by June 15, with the final report due to NMFS by September 1.

V. HETT

A. HETT Update (Catherine Willard)

Catherine Willard said draft Hatchery M&E Plan Appendices 2 through 6 were due May 29, 2015, and all were received except Appendix 3, which was assigned to Keely Murdoch. Murdoch said she plans to complete this, and believes it will be easy. Willard said Appendix 1, assigned to Tracy Hillman and Andrew Murdoch, is due June 30, 2015. Willard said following receipt of all draft appendices, a Doodle Poll will be distributed to reconvene the HETT to review the draft appendices.

VI. NMFS

A. Hatchery and Genetic Management Plan (HGMP) Update (Craig Busack)

Craig Busack reviewed HGMP updates, as described in the following sections.

Wenatchee Steelhead

Amilee Wilson (NMFS) completed the Leavenworth BiOp, and now has been focusing on this BiOp, which is close to being ready for National Oceanic and Atmospheric Administration General Counsel (NOAA-GC) review. Mike Tonseth asked if this BiOp falls under the new guidance that first requires Section 7 Consultation prior to NOAA-GC review. Busack said the new guidance is not policy (i.e., required). He explained that Wilson conducts thorough research in reference to bull trout coverage, which has been adequate to argue that everything is well-covered.

Methow Conservation Spring Chinook Salmon

Busack expects to finish drafting permits for the Wenatchee Chinook Hatchery Programs in the next few weeks and then plans to continue working on Methow spring Chinook salmon. Busack asked if Chelan PUD is providing NMFS with a revised HGMP, and Alene Underwood said a letter addendum will be provided soon.

Leavenworth Spring Chinook Salmon

Bill Gale reiterated that the Leavenworth BiOp is now complete.

Underwood asked about the next scheduled joint NMFS/USFWS BiOp Coordination Meeting. Busack said no date has been set yet, and he said he will resend the Doodle Poll to schedule the next meeting. *(Note: Busack resent the poll on June 18, 2015.)*

VII. USFWS

A. USFWS Bull Trout Consultation Update (Bill Gale)

Bill Gale said Karl Halupka (USFWS) indicated that next week, he plans to be able to continue working on the draft USFWS Wenatchee BiOp and Incidental Take Statement (ITS), which he had temporarily stopped working on to address other consultations. Gale said there has not been a lot of progress on the BiOp, but work is planned to resume soon. He urged everyone to submit edits and comments to Halupka as soon as possible, so Halupka can address all comments at the same time. Alene Underwood said Chelan PUD submitted comments on the ITS; however, she is not sure if comments were submitted on the BiOp. She added that she will look into this. Mike Tonseth said WDFW is still working on compiling comments. Gale suggested touching base with Halupka to let him know the status of incoming comments.

VIII. Chelan PUD/Douglas PUD/Grant PUD/YN

A. Review of the "Evaluation of Hatchery Programs Funded by Douglas County PUD 5-year Report 2006-2010" – Methow Spring Chinook Objectives 1, 4, 7 (Greg Mackey)

Greg Mackey shared a presentation titled, "Review of Five-Year Hatchery M&E Report – Methow Spring Chinook Salmon," (Attachment D), which Kristi Geris distributed to the Hatchery Committees on June 18, 2015. Mackey recalled the Hatchery Committees' agreement to review the Methow Basin spring chinook results in the Five-Year Hatchery M&E Report. Keely Murdoch also recalled when discussing schedule of the review of the Five-Year Hatchery M&E Report, the intent was to review and compare the results to objective targets and then flag items the Hatchery Committees believe need further addressing. Mackey reviewed Attachment D, which was organized by Hatchery M&E Objective and by stock. Hatchery M&E Objectives addressed included: 1) Objective 1: total spawner abundance, NOR abundance, and adult productivity; 2) Objective 4: hatchery replacement rate; and 3) Objective 7: freshwater productivity. These objectives were reviewed for each Methow spring Chinook salmon program (i.e., Twisp, Chewuch, and

Methow). All graphs, tables, and summaries were copied directly from the Five-Year Hatchery M&E Report. Questions and comments were discussed as follows:

Objective 1: Spawner Abundance, NOR Abundance, and Adult Productivity Graphs (slides 4 to 12)

Mackey explained that reference streams were chosen for each stock as depicted on separate graphs (i.e., Twisp: N=4; Chewuch: N=3; and Methow: N=5). He said the vertical gray line on each graph defines the periods of time before and after the Methow Hatchery Program began (i.e., before and after supplementation). He said the analysis was a Before-After-Control-Impact design (BACI) with the ratios of before and after metrics of reference stream to target stream compared to determine whether the hatchery program was having an effect on the population.

Objective 1: Chewuch Spawner Abundance (slide 5)

Craig Busack asked what percentage of HORs were in the Chewuch prior to supplementation. Charlie Snow said some historical indices indicate there were hatchery fish; however, age and origin data are lacking. Busack recalled when NMFS first genetically sampled in the Chewuch, they found relatively few fish that were HORs. Tracy Hillman said HORs were first measured in the Methow in 1993 at 2%. He said by 1996, based on elemental scale analyses, the estimated proportion of HORs increased to 68%. Busack asked if this was lower for the Chewuch and Twisp, and Hillman said it was.

Objective 1: Twisp Recruits/Spawner (slide 10)

Murdoch said it appears during the post-supplementation period, productivity is decreasing. Mackey agreed, but noted the key point is that the patterns of reference and target streams are roughly the same. He added that although the data in the graphs jump around, the relationships are almost identical for the two in each comparison. He also noted that even though recruits per spawner have changed throughout the years, those changes track with changes observed in the reference streams. Busack asked if the graphs were plotted using the same scale, and Mackey said they were.

Objective 1: Twisp, Chewuch, and Methow Tables (slides 13, 15, 17)

Busack asked if the analyses addressed auto-correlation in the data, and Hillman said they did not. Busack asked if this analysis was conducted combining all three stocks (i.e., Twisp, Chewuch, and Methow). Mackey said all analyses were separate and an analysis on a combined stock was not performed. Busack noted that some argue these are not sub-populations, and he asked if reference streams could be paired to the whole basin. Hillman said considering how well each spawning aggregate matched up with the reference streams, he guessed reference streams would match up with the entire population.

Objective 1: Summary (slide 19)

Busack asked about the effect size. Hillman said this was shown in earlier tables.

Objective 4: Natural Replacement Rate (NRR) versus Hatchery Replacement Rate (HRR) (slides 20, 22, and 24)

Mackey said for each stock, NRR and HRR were calculated for all available years, then the arithmetic and geometric means were calculated and compared to determine if HRR was substantially higher than NRR. He said the Biological Assessment and Management Plan (BAMP 1998) indicated an expected HRR value of 4.5, and the goal is to have an HRR notably higher than NRR. Busack asked how HRR is measured, and Hillman said HRR was calculated using the total HORs returning to the basin. He said HRRs were calculated using HORs with and without harvest adjustments. Matt Cooper asked how NRR is measured. Charlie Snow said NRR is largely calculated based on spawning ground surveys, but also accounts for harvest and harvest-related mortalities. He said for Chinook salmon stocks that are adipose-present, surrogate coded-wire-tagged stocks are used to determine contribution, and fisheries-related mortality rates are applied to those fishery numbers.

Mackey said geometric means were used to dampen the effect of divergent numbers. He said the HRR and NRR means are not very different; however, the geometric means differ a bit more when the effects of large values are removed. Busack questioned the use of geometric means for this analysis. Hillman noted that geometric means are typically used in multiplicative processes and are probably not appropriate in this case. Mackey explained that these data include occasional years that are really high compared to others, and they have a big influence on the mean. Busack said he still does not agree that the geometric mean is applicable here. Murdoch asked how the BAMP value (i.e., 4.5) was derived.

Hillman said he thinks Andrew Murdoch (WDFW) and Chuck Peven (former Chelan PUD; Peven Consulting, Inc.) calculated the value, which is a back-calculation to determine the return rate for smolt-to-adult return ratios (SARs). Busack asked if the value was related to mitigation requirements, and Snow said he thinks it was.

Busack said he is uncertain what a reasonable HRR would be in the Methow Basin; and he asked if the calculated HRRs for this basin are considered poor performance. Willard said for the Twisp, as noted on slide 21 of Attachment D, the Five-Year Hatchery M&E Report indicated that, "poor post-release survival, resulting in HRRs below the 4.5 target, is responsible for the low observed HRR values." Pearsons also suggested a good basis for comparison might be nearby basins. Murdoch suggested evaluating HRRs by life stage and determining where it can be improved. Busack asked what HRRs are for Winthrop NFH, and Cooper said he suspected they were not too different. Mackey guessed they might be slightly lower because Winthrop NFH SARs are typically somewhat lower. Hillman reviewed HRRs for Chiwawa versus the Methow, noting that in general, Chiwawa HRRs are a bit higher; however, he said Chiwawa HRRs do not appear to correlate with the Methow. Mackey said the value of striving to have a high HRR in this age of pHOS and adult management should be considered. He questioned how many hatchery fish should be returning if 60 to 80% are removed each year. The key metric is to at least have an HRR that is high enough to avoid mining the wild population for broodstock.

Truscott suggested that to improve the program, it may be wise to conduct precocity work (i.e., evaluating growth rate and size at release). He noted if fish have a high precocity rate, they will not contribute as anadromous adults. Tonseth said high precocity rates might bias HRRs because SARs are being calculated based on juvenile releases, which may not accurately reflect the smolt population. This is because some of the released fish residualize and do not smolt. He said if calculations are corrected for this, it may result in higher HRRs (i.e., HRRs may be artificially suppressed by released fish that residualize). Gale noted that this is supposed to be a question of program performance. Tonseth said he is not suggesting removing this program element. Rather, he is suggesting evaluating how precocial males and/or residual fish may be affecting HRRs.

Objective 7: Methow Freshwater Productivity (slide 32)

Gale asked if this graph includes only the upper Methow or the entire river. Murdoch guessed it was just the upper because each was analyzed separately in the report. Hillman asked if the number of emigrants included subyearlings and yearlings, or only yearlings. He asked because the relationship can be used to determine if spawning habitat or rearing habitat is limiting juvenile abundance. For example, if a density-dependent relationship is found with subs and yearlings combined, spawning habitat may be limiting. In contrast, if there is no density dependence with subs and yearlings combined, but there is with only yearlings, then rearing habitat may be limiting. Mackey guessed this graph included subs and yearlings. Kahler asked when WDFW started operating smolt traps into the fall (until ice-up). Snow thought in the Twisp, it was in the past 2 to 3 years. He added that the juvenile production would be included in the spring smolt estimate and added to the fall parr estimate.

Methow Basin Spring Chinook Salmon Discussion (slide 35)

Gale noted the Five-Year Hatchery M&E Report indicating that "in the case of the Chewuch, the hatchery program has apparently not provided a benefit," and Gale asked if there has been a negative effect. Murdoch said the results do not indicate that either. Tonseth said the hatchery programs were intended to contribute to recovery. He added that a benefit (increase) needs to be demonstrated from the program, and not 'no change.' Murdoch reiterated that the Hatchery Committees can get at this by flagging items requiring more in-depth discussions to determine why there is no improvement. For example:

Hatchery M&E Objective 1

Murdoch said several changes are underway (e.g., reduced program sizes, lower rearing densities, and adult management), and once everything goes into effect, maybe changes will become apparent. Mackey suggested, in the case of the Methow Basin, to consider setting up a management program where the Twisp is operated as a small "state of the art" conservation program with careful control of PNI, and the Methow operated as a heavily hatchery influenced river with both Winthrop NFH and Methow programs operating, and the Chewuch not supplemented. Given it can easily take 15 years of data just to begin to understand the effects of such approaches on population dynamics, such an approach would allow a 3-way comparison in about 15 years that would take 45 years if each treatment were applied sequentially. Setting up simultaneous contrasting management approaches would identify whichever approach works best in comparison to others in a much shorter period of time.

Hatchery M&E Objective 4

Murdoch suggested re-evaluating HRR targets. Busack suggested thinking about whether HRRs are better or worse than expected. He asked if hatcheries are performing as they should, or if this is as good as it gets. He suggested comparing Methow Basin HRRs to other programs.

Hatchery M&E Objective 7

Murdoch said it seems that the goals to not decrease productivity are being met; however, there are not much data to review. Mackey agreed that data are lacking.

Snake River Basin (Scheuerell et al. 2015, abstract) (slide 43)

Busack noted that in this paper, modeling showed fewer spawners with supplementation. He said he is not sure if supplementation is not working or if it is not being run correctly. Pearsons said the point of noting this paper was to put Twisp and Methow data into perspective. He questioned how different the Scheuerell et al. (2015) findings are from other basins. He added, he believes that findings in the Methow are not that different than what is happening in other basins (i.e., not anomalous).

Columbia River Basin (Independent Scientific Advisory Board 2015 Density Dependence Report; slide 46)

Busack criticized this report for including sweeping statements, demonstrating a limited understanding of the diversity of supplementation programs, and including significant data but from an unpublished source (i.e., smolts per spawner). He said it would be interesting to take Methow data and conduct the same analysis.

Pearsons asked Mackey if he can provide his presentation titled, "Carrying Capacity of Spring Chinook and Summer Steelhead in the Methow River Basin, Washington," that Mackey presented at a past AFS Conference to Geris for distribution to the Hatchery Committees.

Mackey agreed. *(Note: Mackey provided this presentation to Geris on June 18, 2015, which Geris distributed to the Hatchery Committees that same day.)*

Hillman suggested, as Murdoch said, to review Hatchery M&E Objectives 1, 4, and 7, and flag items that warrant further discussion. He said the Hatchery Committees will then circle back and re-evaluate these pieces. He said next month, Hatchery M&E Objectives 2 and 5 will be reviewed.

IX. HCP Administration

A. Hatchery Committees Meeting Protocols

Tracy Hillman said Kristi Geris sent an email to the Hatchery Committees on May 21, 2015, notifying them that the draft HCP Hatchery Committees Meeting Protocols Summary is available for review, with edits and comments due to Hillman (with a copy to Geris) by Thursday, June 4, 2015. Hillman said edits were received from Chelan PUD (Attachment E) on May 22, 2015, as distributed to the Hatchery Committees that same day. Hillman reviewed Chelan PUD's edits, and Keely Murdoch clarified that Decision Item documents (e.g., Statement of Agreement) shall be distributed to the Hatchery Committees at least 10 business days before a meeting at which the Decision Item is *voted upon*—not just *discussed*. Hillman and Geris said they will incorporate edits discussed into the draft Hatchery Committees Meeting Protocols, and will distribute the updated draft to the Hatchery Committees. *(Note: Hillman and Geris updated the draft, as discussed, which Geris distributed to the Hatchery Committees on June 18, 2015.)*

B. Coordination/Joint Sessions with PRCC HSC

Tracy Hillman said he received an email from Elizabeth McManus (Ross Strategic, PRCC HSC Facilitator) requesting that the Hatchery Committees and PRCC HSC convene joint sessions when discussing agenda items applicable to and requiring participation from both the Hatchery Committees and PRCC HSC. Keely Murdoch said this has been discussed a fair amount in the past, and she believes coordination on joint topics will benefit both Committees. Bill Gale agreed. Hillman said the HCP Tributary Committees and the PRCC Habitat Subcommittee convene joint sessions as needed, as well, explaining that the joint session is sandwiched between the HCP Tributary Committees meeting in the morning and the PRCC Habitat Subcommittee meeting in the afternoon.

The Hatchery Committees representatives present agreed to convene joint sessions with the PRCC HSC when there are agenda items applicable to and which require participation from both the Hatchery Committees and PRCC HSC, with the conditions that: 1) any items requiring Committees decision (i.e., Decision Items) will be discussed to the extent necessary and voted on separately in the respective Committees; 2) prior to joint sessions, it will be made clear at the onset of the discussion that the item is a joint discussion and all Parties are welcome to speak freely; and 3) following joint sessions, the PRCC HSC will be provided with the joint section(s) of the draft meeting minutes for review, as well as the opportunity to comment on the joint discussions, and with the final minutes for their respective administrative records. Gale suggested including this agreement in the Hatchery Committees Meeting Protocols, and the Hatchery Committees agreed. Hillman and Anchor QEA indicated they would coordinate future joint sessions with the PRCC HSC Facilitator, as needed.

C. Next Meetings

Tracy Hillman said it was recently brought to his attention that the 2015 AFS Conference is being held during the same week as the Hatchery Committees meeting on August 19, 2015. The Hatchery Committees suggested scheduling the Hatchery Committees August meeting on a different date. Kristi Geris said she will distribute a Doodle Poll to reschedule the August meeting. *(Note: Geris distributed a poll on June 18, 2015.)*

The next scheduled Hatchery Committees meetings are on July 15, 2015 (Douglas PUD), August 2015 (TBD), and September 16, 2015 (Douglas PUD).

List of Attachments

Attachment A	List of Attendees
Attachment B	YN Upper Columbia Kelt Reconditioning Project – 2014 Status Update
Attachment C	Draft Spring Chinook Adult Management 2015 Calculator
Attachment D	Review of Five-Year Hatchery M&E Report – Methow Spring Chinook Salmon

Attachment E Draft Hatchery Committees Meeting Protocols – Chelan PUD edits

Attachment A
List of Attendees

Name	Organization
Tracy Hillman	BioAnalysts, Inc.
Kristi Geris	Anchor QEA, LLC
Sarah Montgomery	Anchor QEA, LLC
Alene Underwood*	Chelan PUD
Catherine Willard*	Chelan PUD
Greg Mackey*	Douglas PUD
Tom Kahler*	Douglas PUD
Todd Pearsons	Grant PUD
Craig Busack*†	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
Jayson Wahls	Washington Department of Fish and Wildlife
Kirk Truscott*	Colville Confederated Tribes
Keely Murdoch*	Yakama Nation
Matt Abrahamse	Yakama Nation

Notes:

* Denotes Hatchery Committees member or alternate
† Joined by phone

Attachment B

YN Upper Columbia Kelt Reconditioning Project

2014 Status Update

Matt Abrahamse
Fisheries Biologist
Yakama Nation Fisheries Resource Management

Introduction

- Iteroparity
  - Unique to steelhead in anadromous Salmonids
  - Retain genetic diversity
  - Increase lifetime reproductive success
  - Negatively correlated with distance from ocean
- Artificial Reconditioning
  - Culturing kelts for 6-10 months
  - Reinitiate feeding, growth, and redevelop mature gonads
  - May help counter selective forces imposed by hydroelectric system
  - Still need documentation of reproductive success

Project Objectives

- The general objective of the project is to test whether the abundance of naturally produced Upper Columbia steelhead on natural spawning grounds can be increased through the use of long-term kelt reconditioning methods.
  - **Objective 1**: Recondition UCR steelhead kelts using long-term methods at existing facilities
  - **Objective 2**: Evaluate kelt survival and effectiveness of reconditioning methods
  - **Objective 3**: Collaborate with ongoing M&E studies to document the reproductive success of kelts released from the reconditioning project

Methods

Kelt Collection

Reconditioning

Release

Tracking

Kelt Collection

- Live-spawning
- Tributary trapping
- Main stem dam trapping

Live-Spawning

- Anesthetized with MS222
- Needle inserted under pelvic fin
- 5-10 psi of air injected
- Eggs collected
- Air purged

Tributary Trapping

- Temporary weirs
  - Little Bridge Creek
  - Hancock Springs
  - SF Gold Creek
- Effective
- NOR females rare

Mainstem Trapping

- Ability to collect kelts from Wenatchee, Entiat, Methow and Okanogan basins
- Trapping done by CPUD
- Transport to MSKF done by YN

Reconditioning

- Feeding
  - Krill for 1 month
  - Transition to brood diet
  - 2% of body weight
- Treatment
  - Formalin
  - Emmamectin

Release

- Mid-October
- All kelts released regardless of maturation
- Live spawned and weir kelts released in Methow
- RI kelts released in Columbia
- Released at night
- Tracked via PIT tags

Results

Collection

Survival

Weight Gain

Body Fat

Maturation

Tracking

Collection Results

2014

Location	# Collected
Winthrop NFH	33
Rock Island Dam	26
Methow Salmon Hatchery	14
Tributary Weirs	3
Total	76

Survival

2014

	# Collected	# Released	% Survival
Winthrop NFH	33	25	**75.8**
Rock Island Dam Bypass	26	19	**73.1**
Methow Salmon Hatchery	14	11	**78.8**
Tributary Weirs	3	3	**100.0**
Total	76	58	**76.3**

Yakama Nation Fisheries

Weight Gained

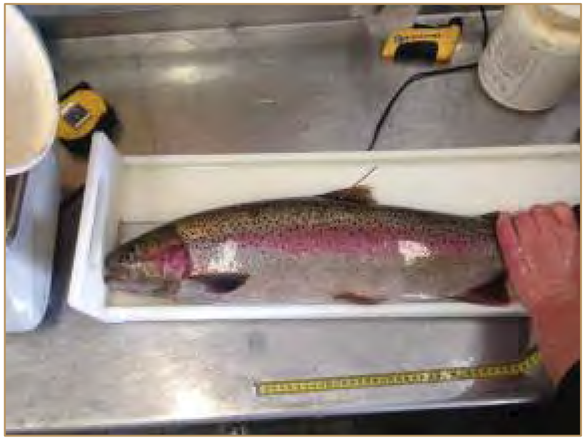
2014

	Mean (kg)	Range (kg)
Winthrop NFH	1.53	(0.24, 3.02)
RI Dam Bypass	1.18	(0.66, 1.80)
Methow SH	1.54	(1.54, 2.79)
Tributary Weirs	1.40	(1.19, 1.61)
Total	1.43	(0.24, 3.02

Before

2014/03/19

After



Body Fat %

	Mean (%)	Range (%)
Winthrop NFH	5.6	(1.3, 9.9)
RI Dam Bypass	4.6	(1.9, 7.6)
Methow SH	5.8	(2.9, 10.5)
Tributary Weirs	4.1	(2.5, 5.4)
Total	5.2	(1.3, 10.5)

Before

After

Maturation Rates

2014

		Re-maturing		Non Re-maturing	
	Total	**#**	**%**	**#**	**%**
Winthrop NFH	25	16	64.0	9	36.0
RI Dam Bypass	19	5	26.3	14	73.7
Methow SH	11	8	72.7	3	27.3
Tributary Weirs	3	2	66.7	1	33.3
Total	58	31	53.4	27	46.6

Tracking

Detections in 2015

	# Released	# Detected	% Detected
Winthrop NFH	25	16	64.0
Rock Island Dam Bypass	19	9	47.4
Methow Salmon Hatchery	11	7	68.0
Tributary Weirs	3	2	66.6
Total	58	34	58.6

Tracking

Other Notable Observations

- 6 kelts sampled at Twisp Weir
- 9 of detected fish in not mature
- 15 with upstream and downstream detections
- 6 encountered by anglers

3DD.003BC49A4D

- 3/28/15– Lower Twisp River
- 4/21/15 – Twisp River Weir
- 6/2/15 – Bonneville
- 6/4/15 – Estuary Towed Array

Yakama Nation Fisheries

3D9.1C2D733EA6

- 3/15/15 – Foster Creek
- 3/19/15 – Foster Creek
- 3/24/15 – Foster Creek
- 3/25/15 – Foster Creek
- 3/29/15 – Tunk Creek
- 4/01/15 – Tunk Creek
- 5/16/15 – Rock Reach Dam Juv.
- 6/01/15 – Bonneville

Conclusions

- Twisp origin kelts appear to be successful
- Strides towards evaluating reproductive viability
- Future Direction
  - Continue to pursue Twisp River kelts
  - Explore possibility of holding non-mature kelts overwinter and determine fate of non-mature kelts post-release
  - Comparisons between in-river reference groups and reconditioned kelts
  - Continue to evaluate kelt success

HONOR. PROTECT. RESTORE.

Questions?

Attachment C

Enter		**Brood**
Hatchery Run Size - estimated	4711	
pNOB	0.345286	2011,2011,2012
Wild Run Size - estimated	354	

Sliding Scale Function	
a	0.800000
b	0.003780
e	2.718282

Methow/Chewuch

Wild Spawning Escapement	**pNOB**	**pHOS**	**PNI Target**	**Allowable Hatchery Escapemen**	**Hatchery Fish To Remove**	**Proportion Hatchery Fish to Remov**	**Total Spawning Escapement**	**PNI check**	**pHOS Check**
354	0.35	0.2398	0.5901	112	4,599	0.98	466	0.5901	0.2403

Attachment D

Review of 5 Year Hatchery M&E Report
Methow Spring Chinook Salmon

Hatchery Committee, June 2015

Outline

- Review results of the following objectives from the 5 year M&E report:
    - Objective 1: total spawner abundance, natural-origin recruitment abundance, and adult productivity
    - Objective 4: hatchery replacement rate
    - Objective 7: freshwater productivity
- Findings from recent publications
- Review recommendations from 5 year M&E report

Hatchery Compensation Plan

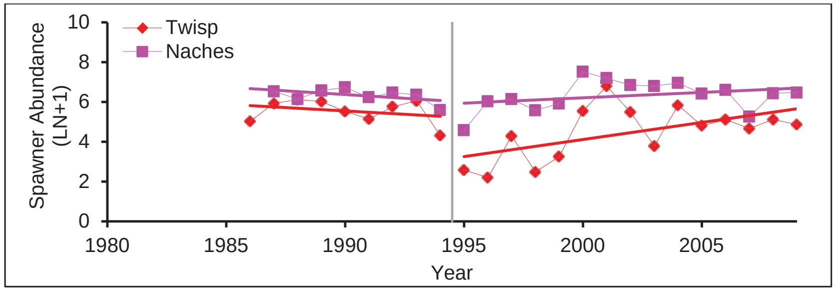
Hatchery Objective

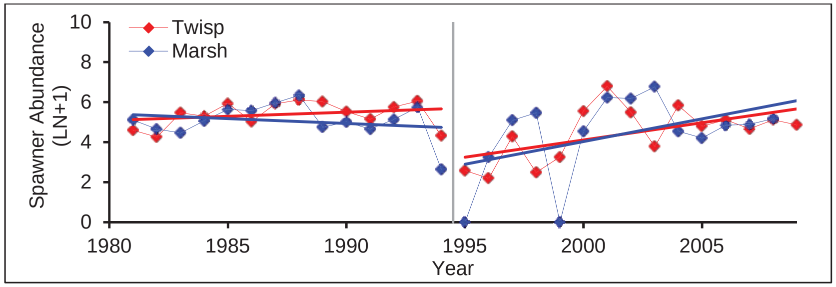
8.1.2.

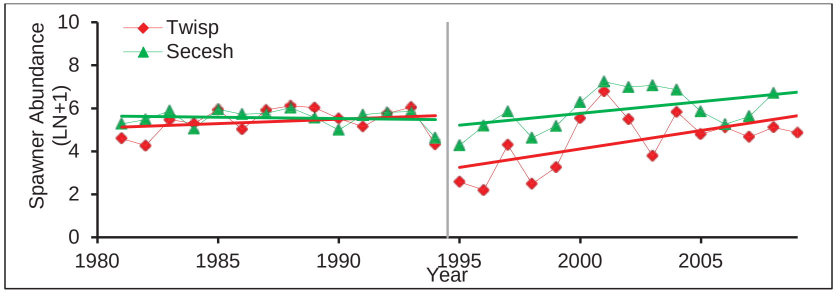
The District shall implement the specific elements of the hatchery program consistent with overall objectives of rebuilding natural populations and achieving NNI. Species specific hatchery programs objectives developed by the JFP may include contributing to the rebuilding and recovery of naturally reproducing populations in their native habitats, while maintaining genetic and ecologic integrity and supporting harvest.

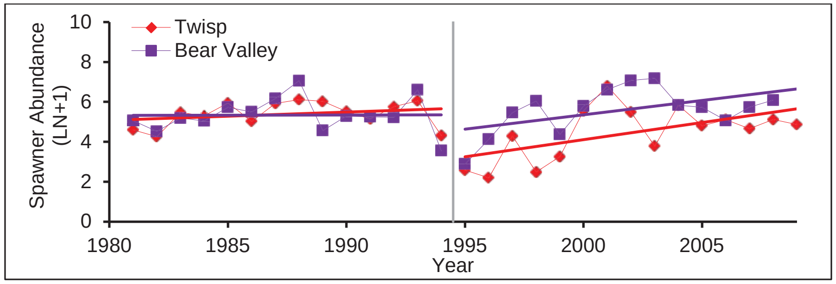
Objective 1

Twisp: Spawner Abundance



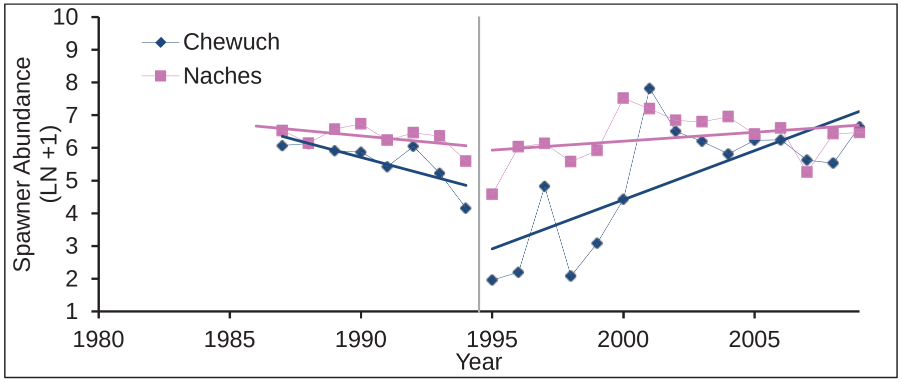


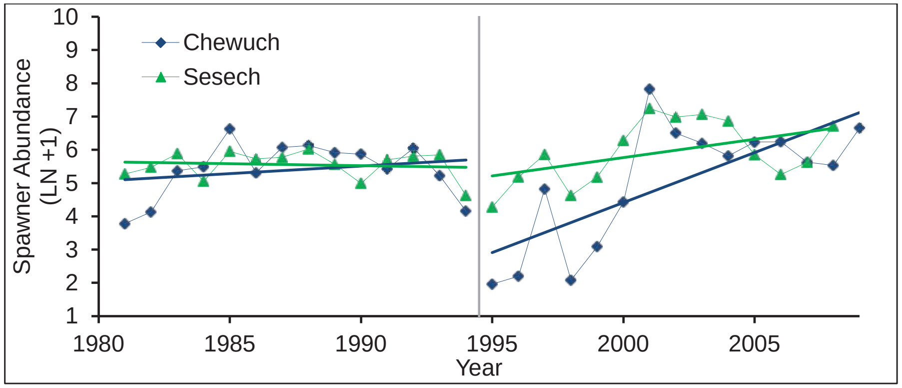


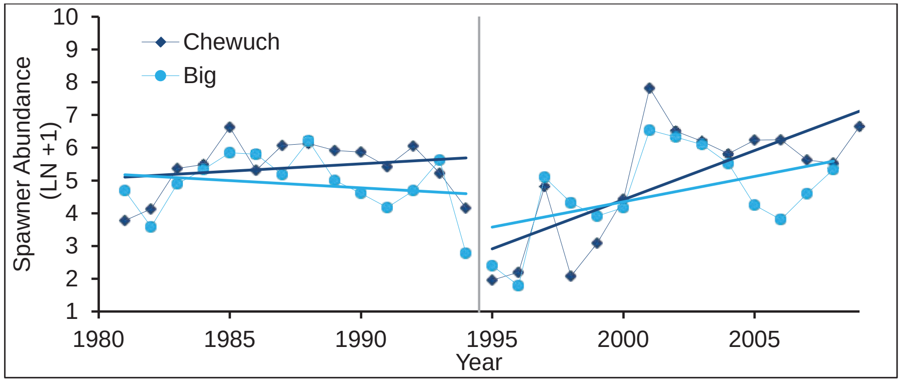


Objective 1

Chewuch: Spawner Abundance

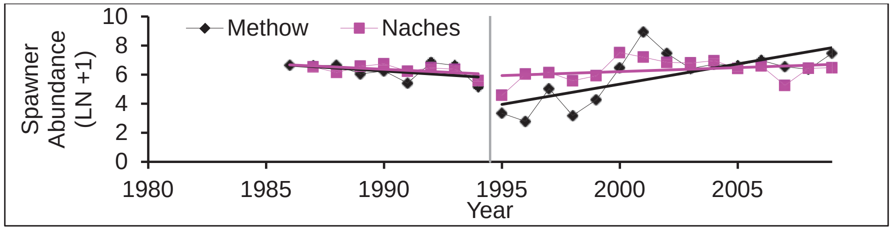


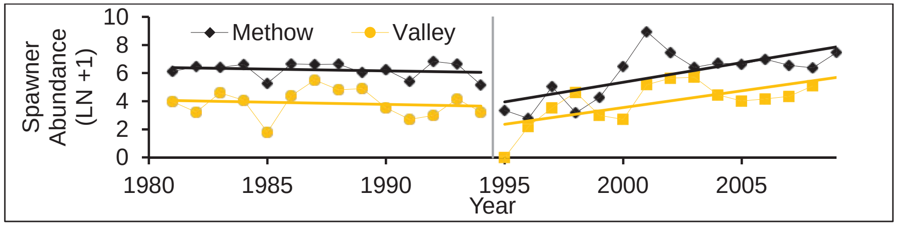


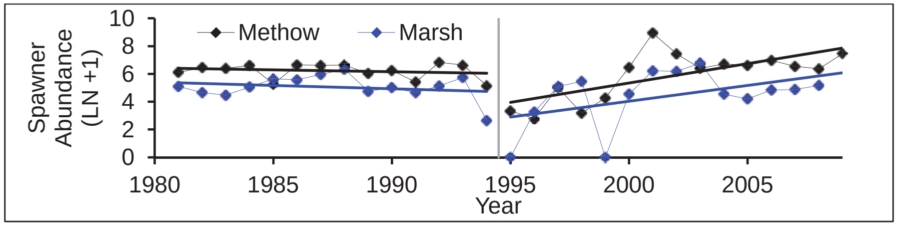


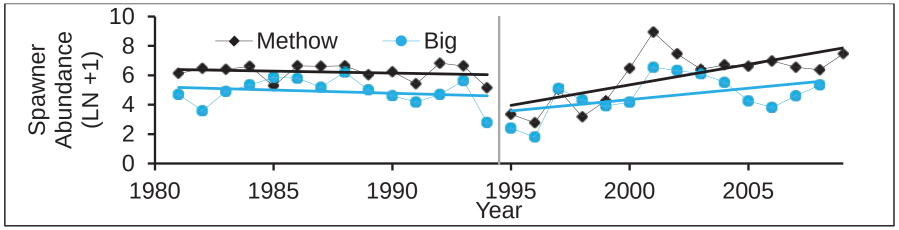
Objective 1

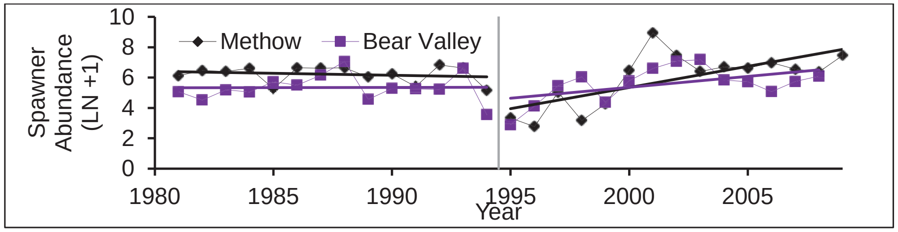
Methow: Spawner Abundance





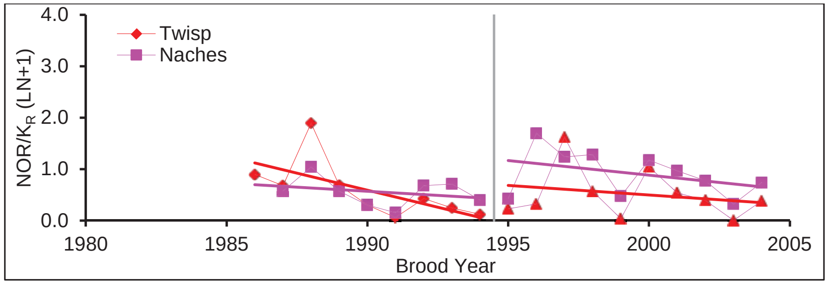


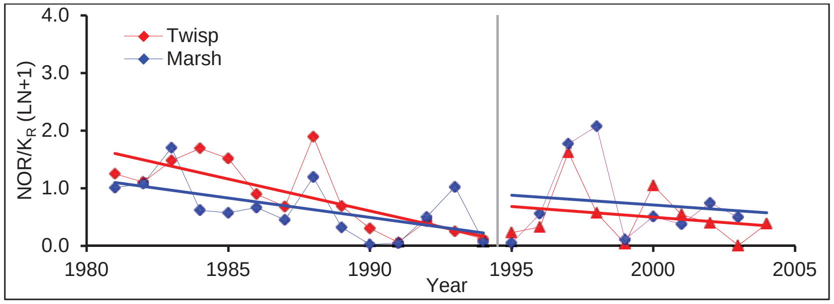


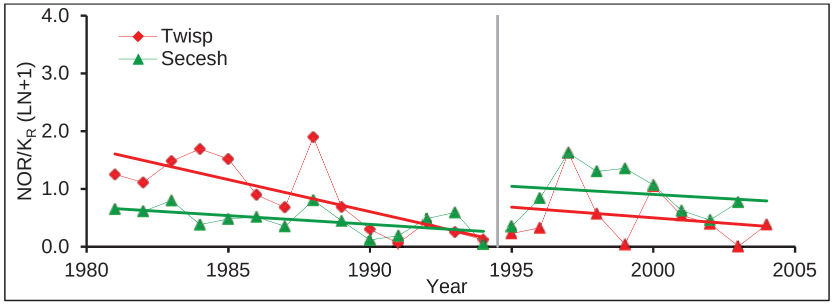


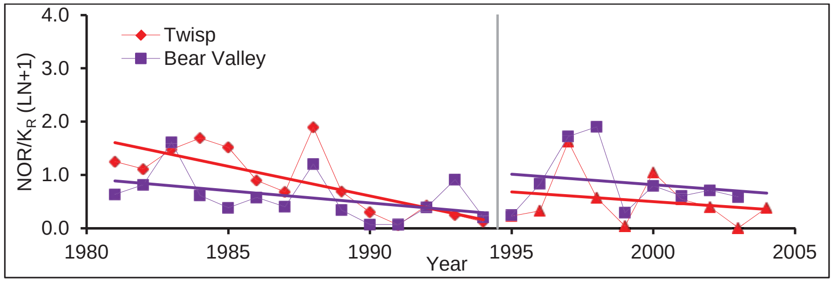
Objective 1

Twisp: NOR Abundance



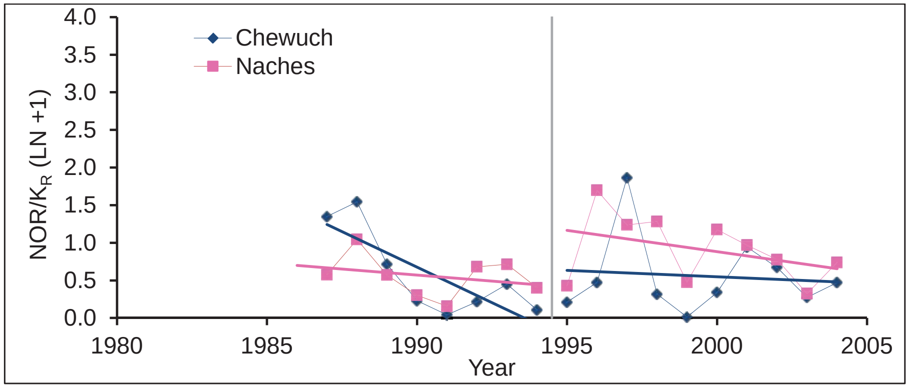


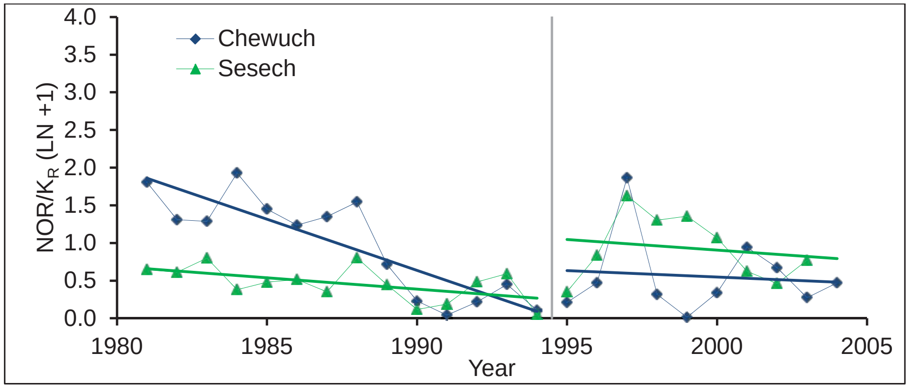


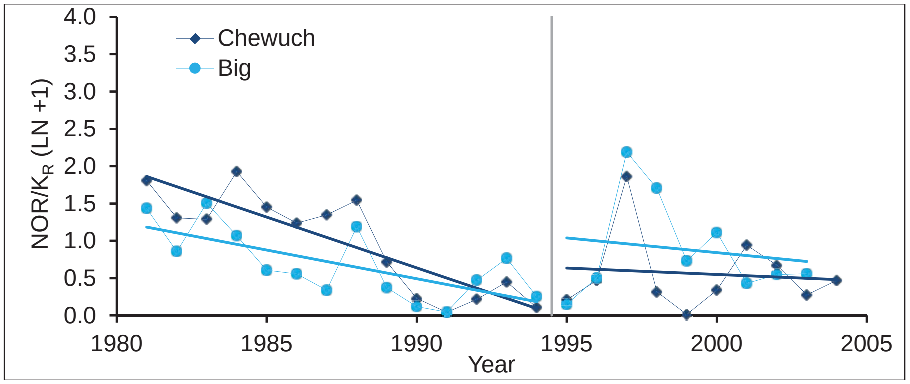


Objective 1

Chewuch:NOR Abundance

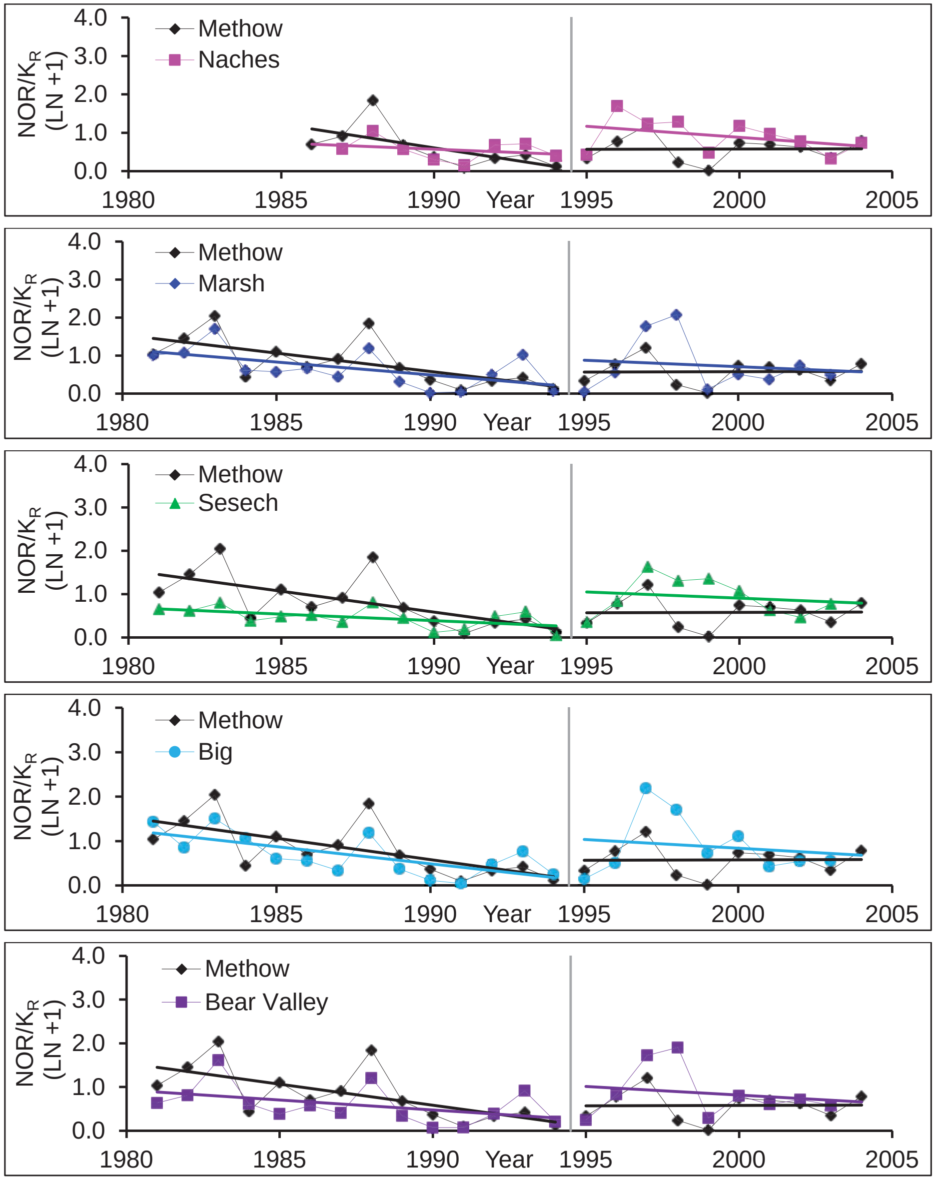






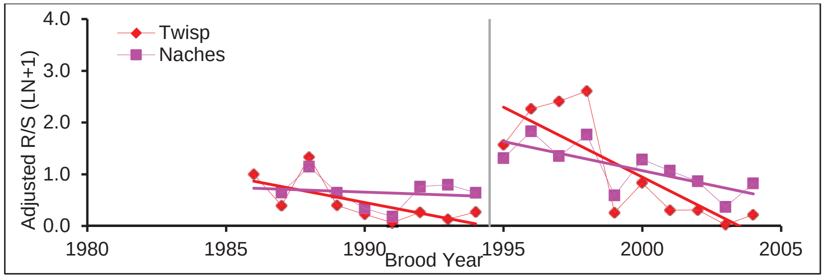
Objective 1

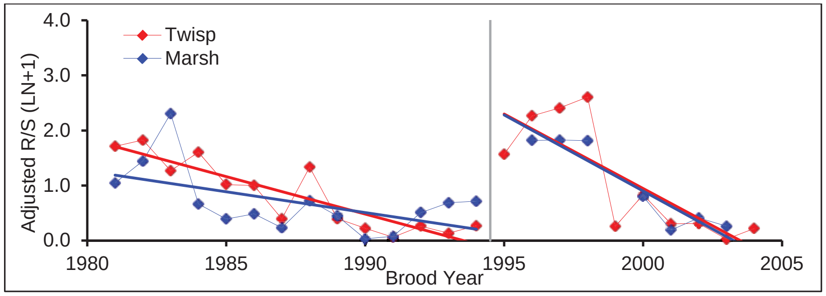
Methow:NOR Abundance

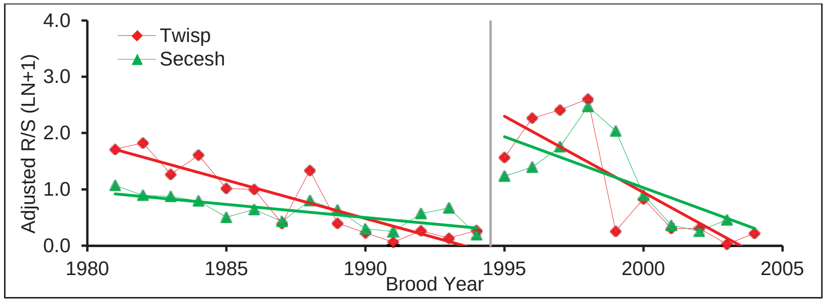


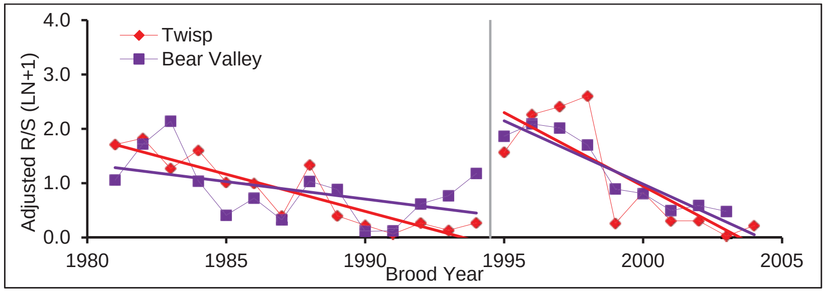
Objective 1

Twisp:Recruits/spawner





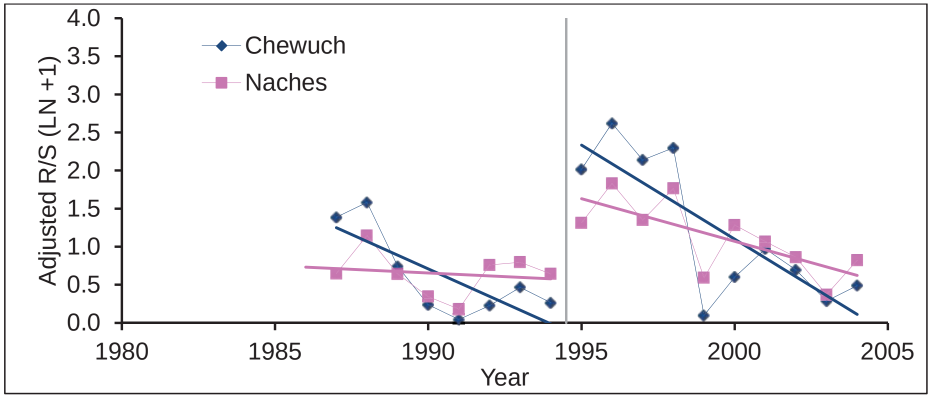


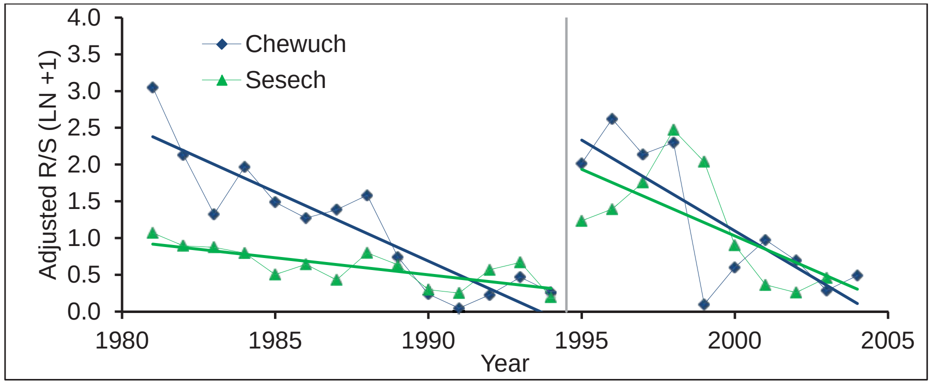


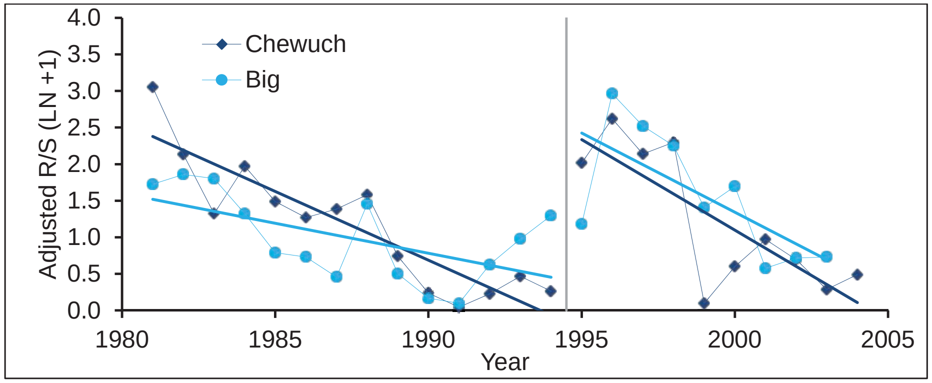
Attachment D

Objective 1

Chewuch: Recruits/spawner

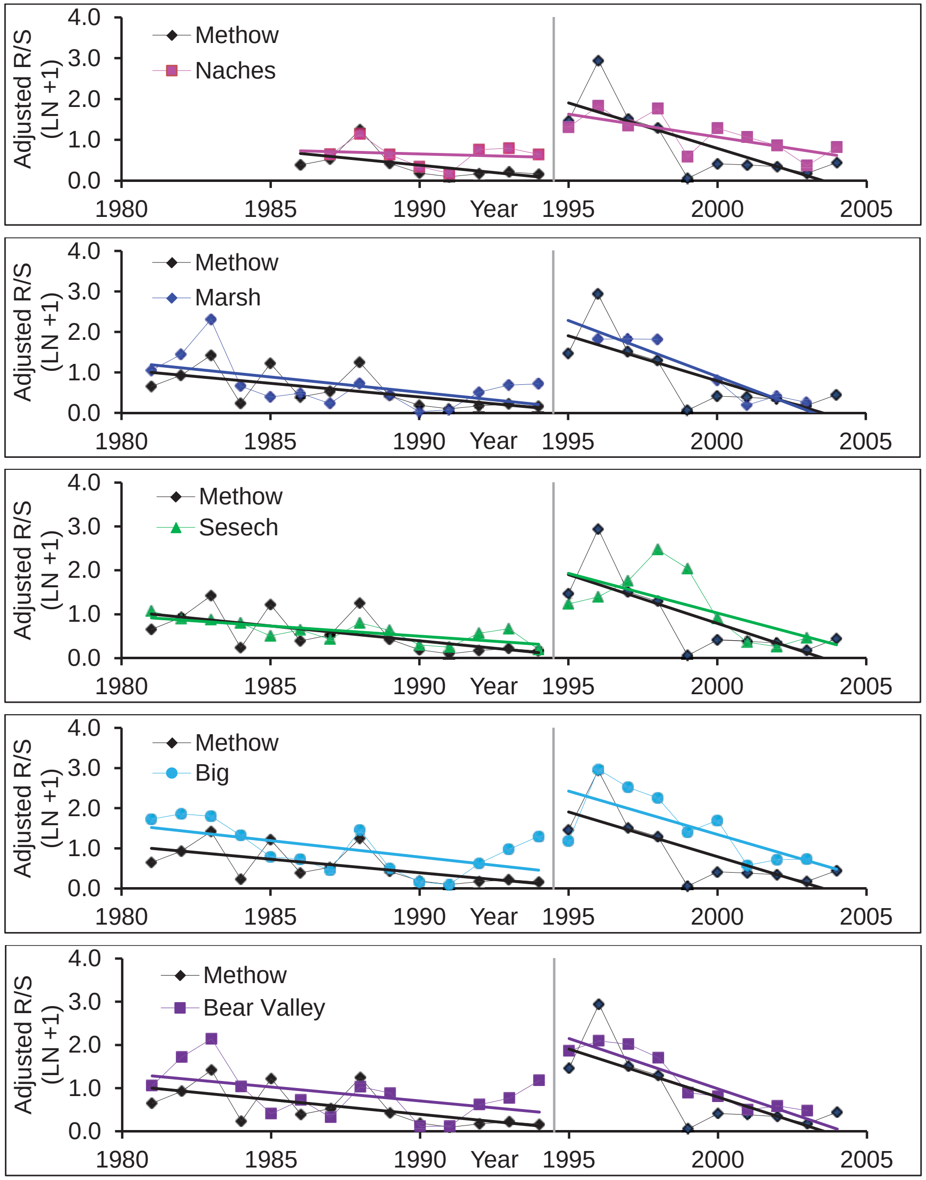






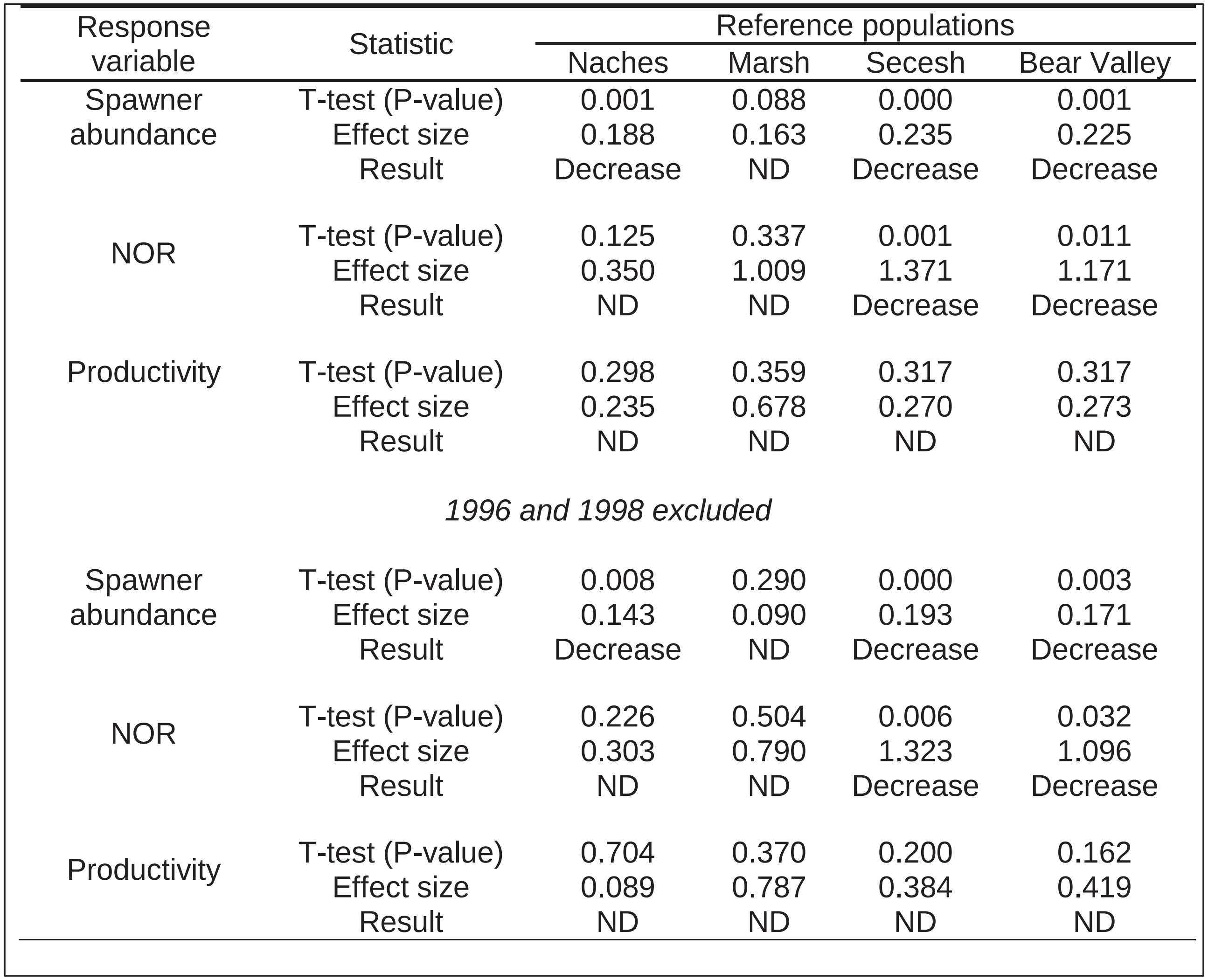
Objective 1

Methow: Recruits/spawner



Attachment D

Objective 1
Twisp (Tables 6 and 14)



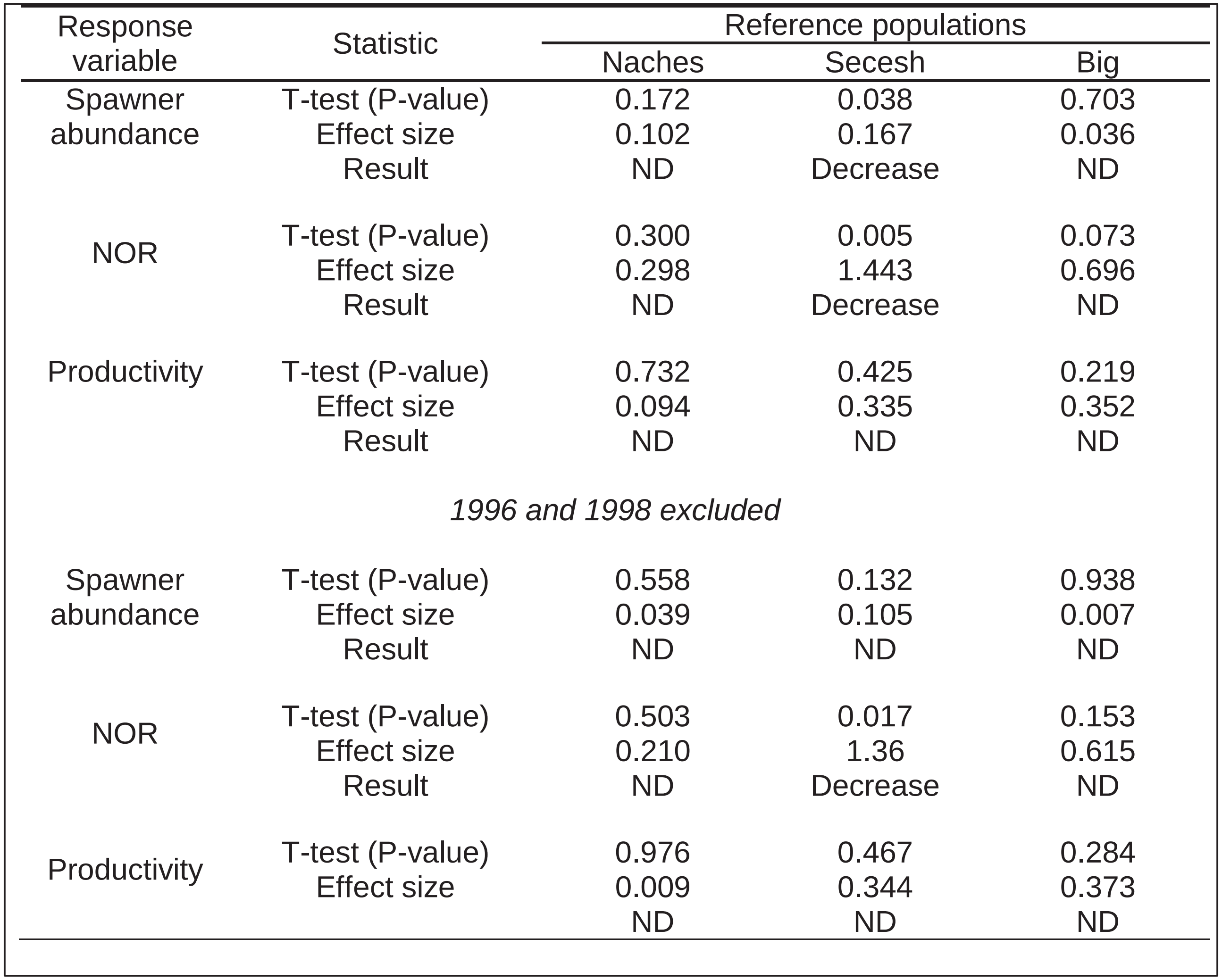
Response variable	Statistic	Reference populations			
		Naches	Marsh	Secesh	Bear Valley
Spawner abundance	T-test (P-value)	0.001	0.088	0.000	0.001
	Effect size	0.188	0.163	0.235	0.225
	Result	Decrease	ND	Decrease	Decrease
NOR	T-test (P-value)	0.125	0.337	0.001	0.011
	Effect size	0.350	1.009	1.371	1.171
	Result	ND	ND	Decrease	Decrease
Productivity	T-test (P-value)	0.298	0.359	0.317	0.317
	Effect size	0.235	0.678	0.270	0.273
	Result	ND	ND	ND	ND
1996 and 1998 excluded					
Spawner abundance	T-test (P-value)	0.008	0.290	0.000	0.003
	Effect size	0.143	0.090	0.193	0.171
	Result	Decrease	ND	Decrease	Decrease
NOR	T-test (P-value)	0.226	0.504	0.006	0.032
	Effect size	0.303	0.790	1.323	1.096
	Result	ND	ND	Decrease	Decrease
Productivity	T-test (P-value)	0.704	0.370	0.200	0.162
	Effect size	0.089	0.787	0.384	0.419
	Result	ND	ND	ND	ND

Location	Spawner Abundance	NOR Abundance	Productivity
Twisp	Declined	Not increased	Not changed

Objective 1
Twisp: Summary

“Spring Chinook total spawner abundance has decreased and the abundance of NORs has not increased in the Twisp River when compared to reference populations, indicating that the release of hatchery-origin fish has not provided the anticipated demographic boost to the natural-origin population. At the same time, productivity in the Twisp has not significantly diverged from that of reference populations during the time of supplementation, indicating that the presence of hatchery-origin spawners has not significantly decreased productivity compared to reference populations. “

Objective 1
Chewuch (Tables 19 and 27)



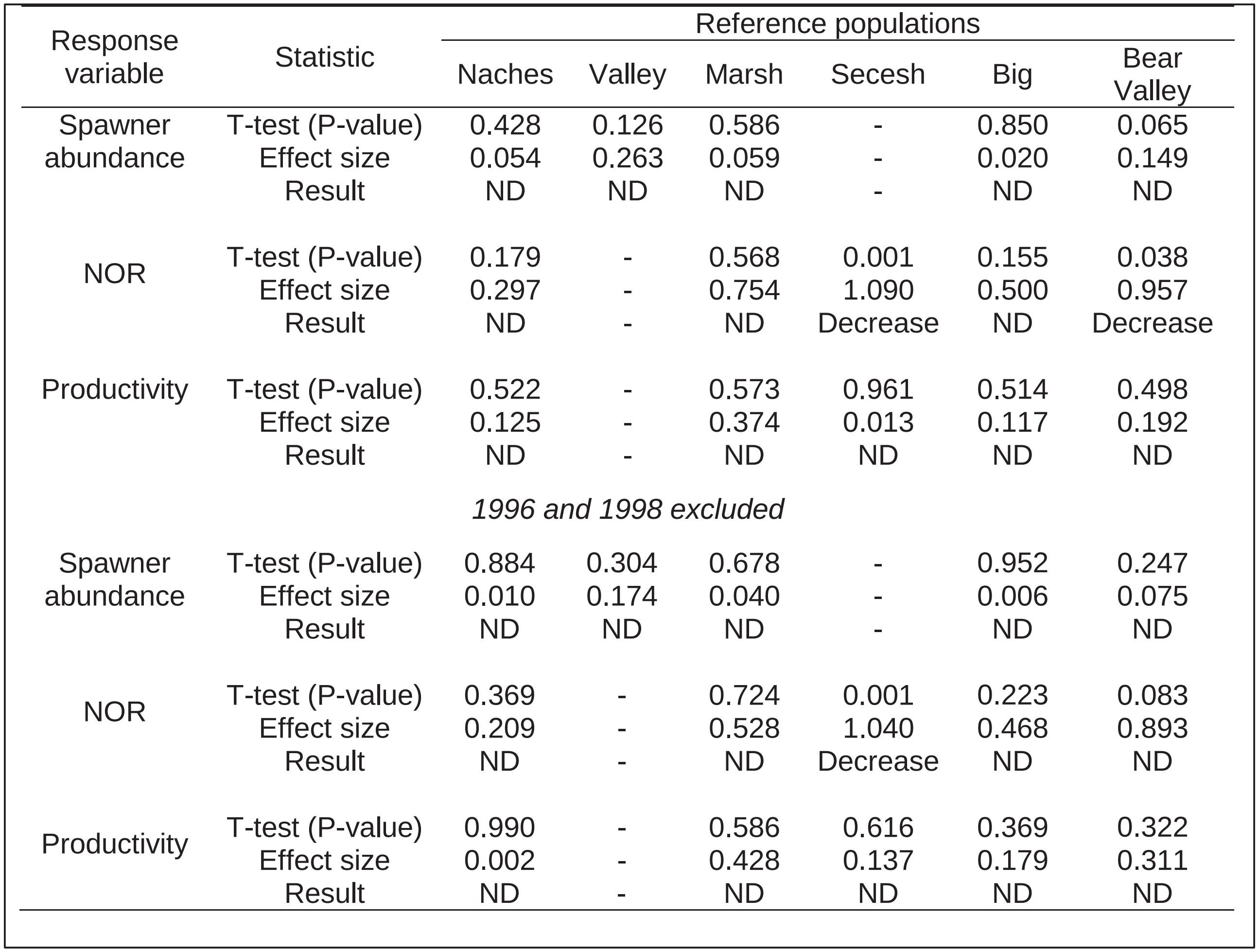
Response variable	Statistic	Reference populations		
		Naches	Secesh	Big
Spawner abundance	T-test (P-value)	0.172	0.038	0.703
	Effect size	0.102	0.167	0.036
	Result	ND	Decrease	ND
NOR	T-test (P-value)	0.300	0.005	0.073
	Effect size	0.298	1.443	0.696
	Result	ND	Decrease	ND
Productivity	T-test (P-value)	0.732	0.425	0.219
	Effect size	0.094	0.335	0.352
	Result	ND	ND	ND
1996 and 1998 excluded				
Spawner abundance	T-test (P-value)	0.558	0.132	0.938
	Effect size	0.039	0.105	0.007
	Result	ND	ND	ND
NOR	T-test (P-value)	0.503	0.017	0.153
	Effect size	0.210	1.36	0.615
	Result	ND	Decrease	ND
Productivity	T-test (P-value)	0.976	0.467	0.284
	Effect size	0.009	0.344	0.373
		ND	ND	ND

Location	Spawner Abundance	NOR Abundance	Productivity
Chewuch	Not increased	Declined	Not decreased

Objective 1
Chewuch: Summary

“Spawning escapement in the Chewuch River has not increased during supplementation compared to reference populations. Similarly, poor natural-origin fish survival has contributed to a decrease in NORs. However, the spawner-abundance trend for the Chewuch is strongly positive, and since 2001, spawner abundance has been similar to reference streams. The statistical difference detected in spawner abundance was caused by the Chewuch spawning population being much lower than the reference population shortly after supplementation began. While a number of problematic issues exist with Chewuch spring Chinook, the increase in spawner abundance suggests that the hatchery program has succeeded in returning spawners to a level of abundance similar to reference populations. However, the proportionate natural influence (PNI) for the Chewuch from 2001-2010 is 0.14 due to the low NORs and increasing hatchery spawners. Productivity in the Chewuch has remained unchanged during the time of supplementation indicating that the presence of hatchery spawners has not decreased productivity compared to reference populations. “

Objective 1:
Methow (Tables 30 and 38)



Response variable	Statistic	Reference populations					
		Naches	Valley	Marsh	Secesh	Big	Bear Valley
Spawner abundance	T-test (P-value)	0.428	0.126	0.586	-	0.850	0.065
	Effect size	0.054	0.263	0.059	-	0.020	0.149
	Result	ND	ND	ND	-	ND	ND
NOR	T-test (P-value)	0.179	-	0.568	0.001	0.155	0.038
	Effect size	0.297	-	0.754	1.090	0.500	0.957
	Result	ND	-	ND	Decrease	ND	Decrease
Productivity	T-test (P-value)	0.522	-	0.573	0.961	0.514	0.498
	Effect size	0.125	-	0.374	0.013	0.117	0.192
	Result	ND	-	ND	ND	ND	ND
		1996 and 1998 excluded					
Spawner abundance	T-test (P-value)	0.884	0.304	0.678	-	0.952	0.247
	Effect size	0.010	0.174	0.040	-	0.006	0.075
	Result	ND	ND	ND	-	ND	ND
NOR	T-test (P-value)	0.369	-	0.724	0.001	0.223	0.083
	Effect size	0.209	-	0.528	1.040	0.468	0.893
	Result	ND	-	ND	Decrease	ND	ND
Productivity	T-test (P-value)	0.990	-	0.586	0.616	0.369	0.322
	Effect size	0.002	-	0.428	0.137	0.179	0.311
	Result	ND	-	ND	ND	ND	ND

Location	Spawner Abundance	NOR Abundance	Productivity
Methow	Not increased	Not increased and may have declined	Not decreased

Objective 1
Methow: Summary

"Methow FH has not increased the abundance of spawners or NORs in the Methow River relative to reference populations. Productivity in the Methow has not changed during supplementation compared to the pre-supplementation period. However, the results presented here are confounded by the presence of hatchery fish from Winthrop NFH previous to commencement of the Methow Hatchery program. Interestingly, the number of hatchery yearling spring Chinook released into the Methow River was significantly lower (t-test: $P < 0.0001$) during supplementation (mean = 563,805; SD = 253,470) than before the supplementation program was initiated (mean = 971,160, SD = 157,918). Therefore, the influence Methow Hatchery program could be difficult to detect analytically, but also the potential effectiveness of the program may have already been compromised by decades of past hatchery practices. PNI has averaged 0.18 during the supplementation period, well below the desired minimum of 0.67. The combination of WNFH and Methow Hatchery returns, combined with inadequate availability of natural-origin broodstock has resulted in this low PNI. "

Objective 1

Summary (Tables 14, 27, 38)

Location	Spawner Abundance	NOR Abundance	Productivity
Twisp	Declined	Not increased	Not changed
Chewuch	Not increased	Declined	Not decreased
Methow	Not increased	Not increased and may have declined	Not decreased

Objective 4

Twisp: NRR vs. HRR

Brood year	HRR	NRR
1992	1.2	0.3
1993	0.6	0.1
1994	1.0	0.3
1996	6.4	8.6
1997	3.6	10.2
1998	2.2	12.6
1999	1.9	0.3
2000	2.7	1.3
2001	1.5	0.1
2002	13.3	0.4
2003	1.5	0.0
2004	3.3	0.2
Mean (SD)	3.3 (3.5)	2.9 (4.7)
Geometric mean	2.3	1.2

The HRR of the Twisp spring Chinook program was significantly less than the expected value (4.5) in the BAMP (Man Whitney U-test: P = 0.02, Table 8). The HRR only met or exceeded the BAMP value for 17% of the broodyears. However, the HRR was significantly greater than the NRR (Mann Whitney U-test: P = 0.04). Comparison of the geometric means reveals that HRR is 1.9 time higher than NRR.

Objective 4

Twisp: Summary

“Juvenile Twisp spring Chinook survival was at or above the expected standard within the hatchery. Poor post-release survival, resulting in hatchery replacement rates below the 4.5 target, is responsible for the low observed HRR values. However, the specific life stage(s) responsible for low SARs is unknown.”

Objective 4

Chewuch: NRR vs. HRR

Brood year	HRR	NRR
1992	1.9	0.1
1993	1.1	0.5
1994	0.2	0.3
1996	0.6	12.8
1997	4.6	7.5
2001	8.7	0.1
2002	5.7	0.2
2003	1.0	0.1
2004	1.5	0.3
Mean (SD)	2.8 (2.9)	2.4 (4.6)
Geometric Mean	1.6	0.5

“The mean HRR value of the Chewuch spring Chinook program was not significantly different from the expected value (4.5) in the BAMP (Mann Whitney U-test: P = 0.22, Table 21). However, the HRR met or exceeded the BAMP value for 33% of the brood years. Similarly, the mean HRR value was not significantly different from the mean NRR (Mann-Whitney U-test: P = 0.08). However, examination of the geometric means suggests that HRR is likely approximately 3.2 times higher than NRR (Table 21).”

Objective 4

Chewuch: Summary

“Hatchery-origin Chewuch spring Chinook have experienced hatchery replacement rates (HRR) that were not significantly different from the target value, but met or exceeded this value in only about one-third of the years. The mean HRR was also not significantly different from the natural replacement rate (NRR). However, examination of the harmonic means (used because of a few extremely large values in the data) suggests that the HRR was four times higher than the NRR. “

Objective 4

Methow: NRR vs. HRR

Brood year	HRR	NRR
1993	2.1	0.2
1994	0.5	0.2
1995	10.2	2.8
1996	4.9	17.9
1997	4.4	3.5
1998	14.3	2.6
1999	1.6	0.1
2000	5.8	0.4
2001	7.4	0.0
2002	7.4	0.1
2003	1.9	0.1
2004	6.0	0.3
Mean (SD)	5.4(4.0)	2.4(5.1)
Geometric Mean	4.0	1.0

“The mean HRR value of the Methow spring Chinook program was not significantly different from the expected value (4.5) in the BAMP (Mann Whitney U-test: P = 0.15, Table 32), and met or exceeded the BAMP value for 75% of the brood years. The mean HRR value was significantly greater than the mean NRR (Mann Whitney U-test: $P < 0.007$). The HRR geometric mean is 4 times greater than the NRR geometric mean. Survival rates of fish in the hatchery have consistently met or exceeded survival standards (Snow et al. 2011). “

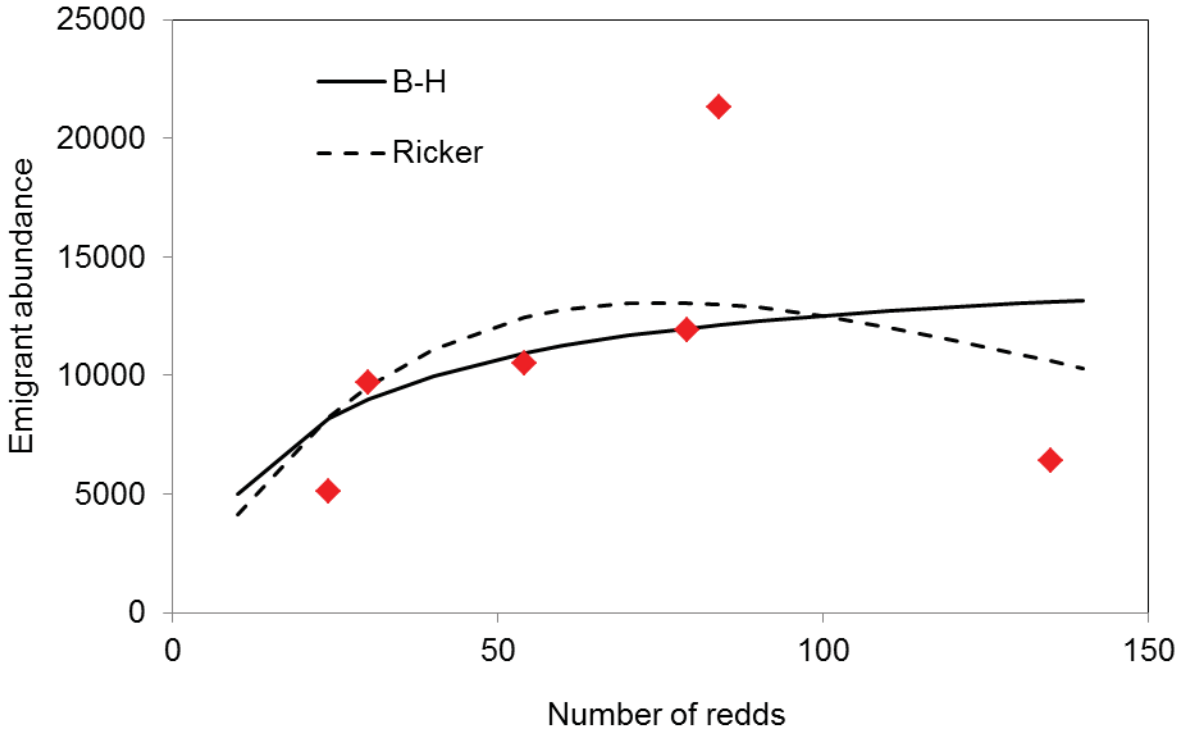
Objective 4

Methow: Summary

“The mean HRR value of the Methow spring Chinook program was not significantly different from the expected value (4.5) in the BAMP and met or exceeded the BAMP value for 75% of the brood years. The mean HRR value was significantly greater than the mean NRR. The HRR geometric mean was four times greater than the NRR geometric mean. Survival of juvenile Methow spring Chinook have consistently met or exceeded the expected standard within the hatchery and met the standard to the adult stage (SAR).”

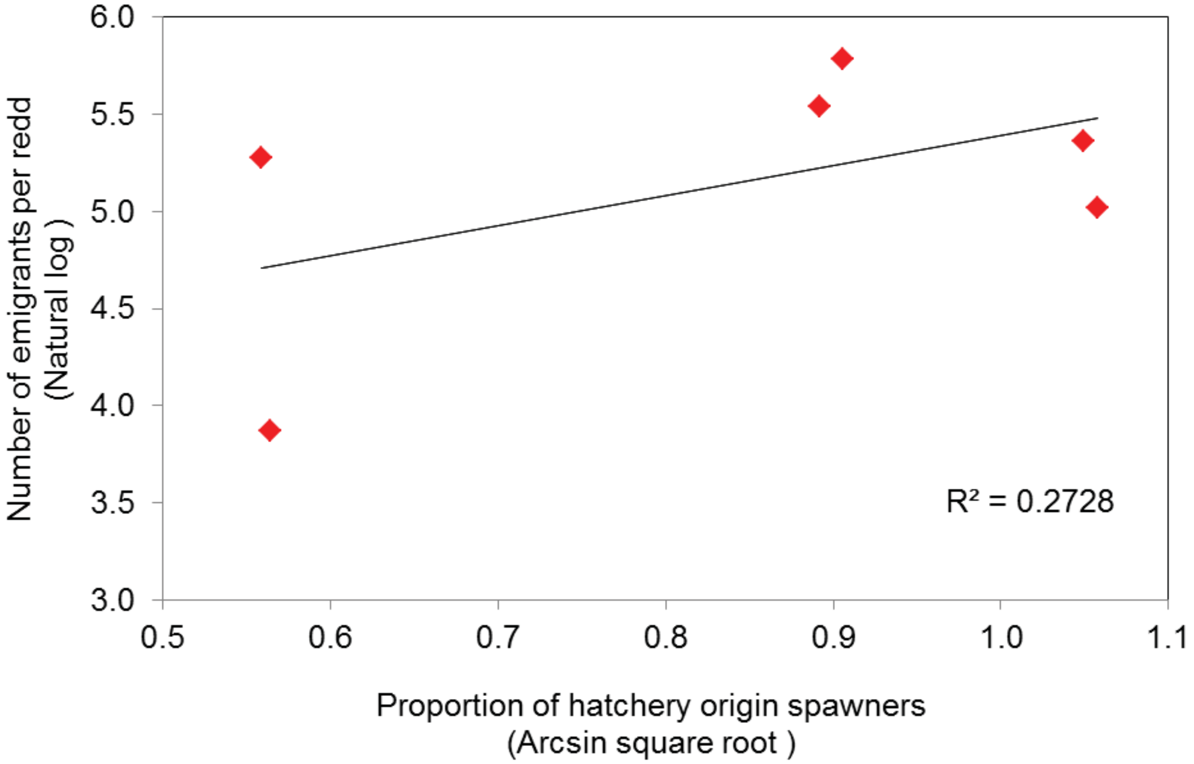
Objective 7

Twisp: Freshwater Productivity



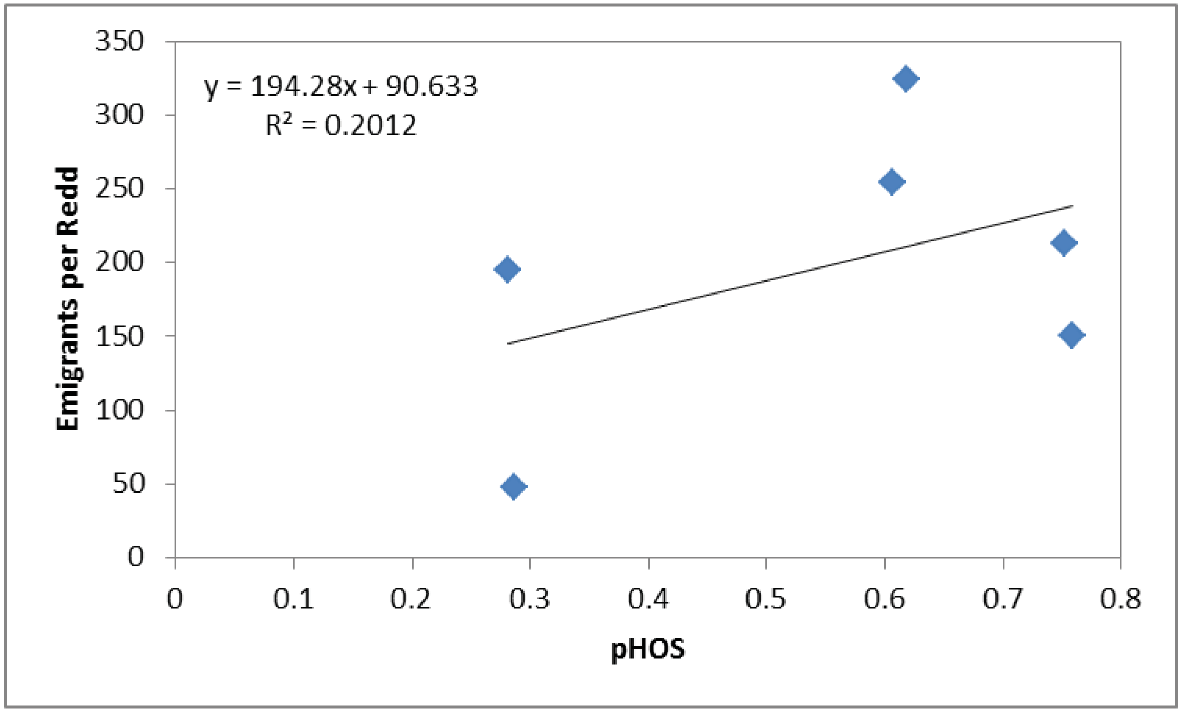
Objective 7

Twisp: Freshwater Productivity



Objective 7

Twisp: Freshwater Productivity



Objective 7

Twisp: Summary

“Smolt monitoring on the Twisp River did not begin until 2005, and more data is necessary to better understand the relationships between spawner abundance and the influence of hatchery spawners in their habitat. Low mean egg-to-emigrant survival in the Twisp River (2004 – 2009 mean = 5%) may be related to biases in abundance estimates, poor reproductive success, or both. Studies are currently underway to assess biases in abundance estimates.”

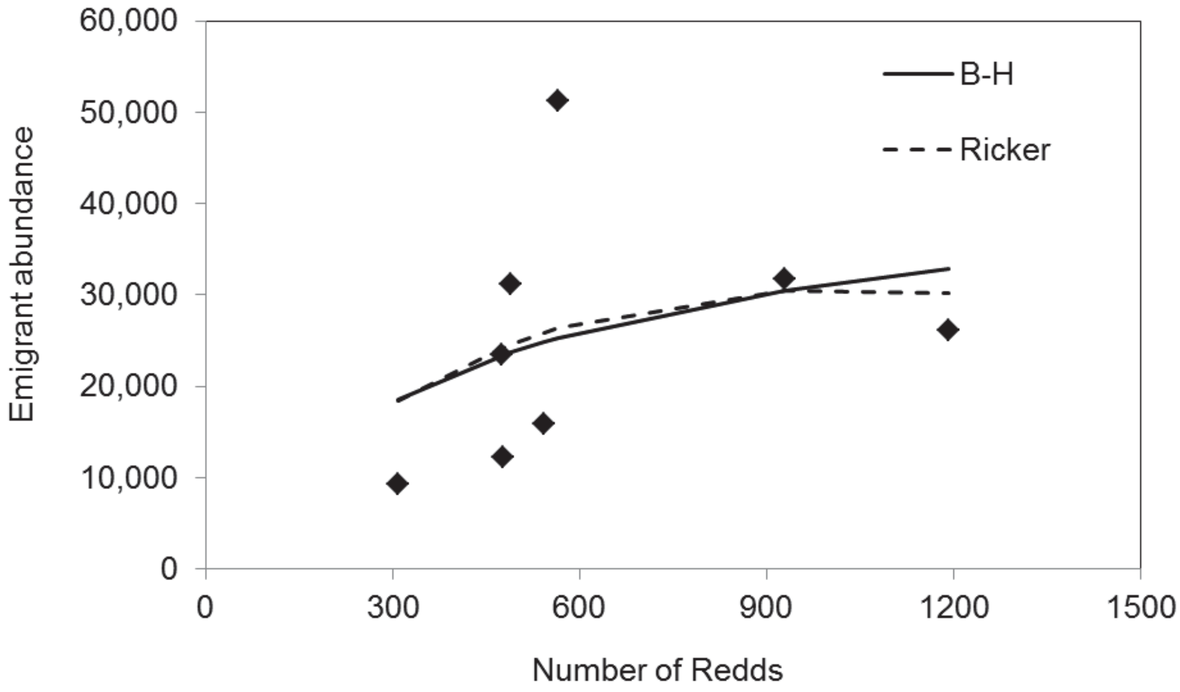
Objective 7

Chewuch: Summary

“Recent estimates of freshwater productivity are not available for the Chewuch River. Smolt monitoring was conducted in the Chewuch River between 1993 and 1996, but those data are incomplete for the entire brood year due to difficulty in trap operation.”

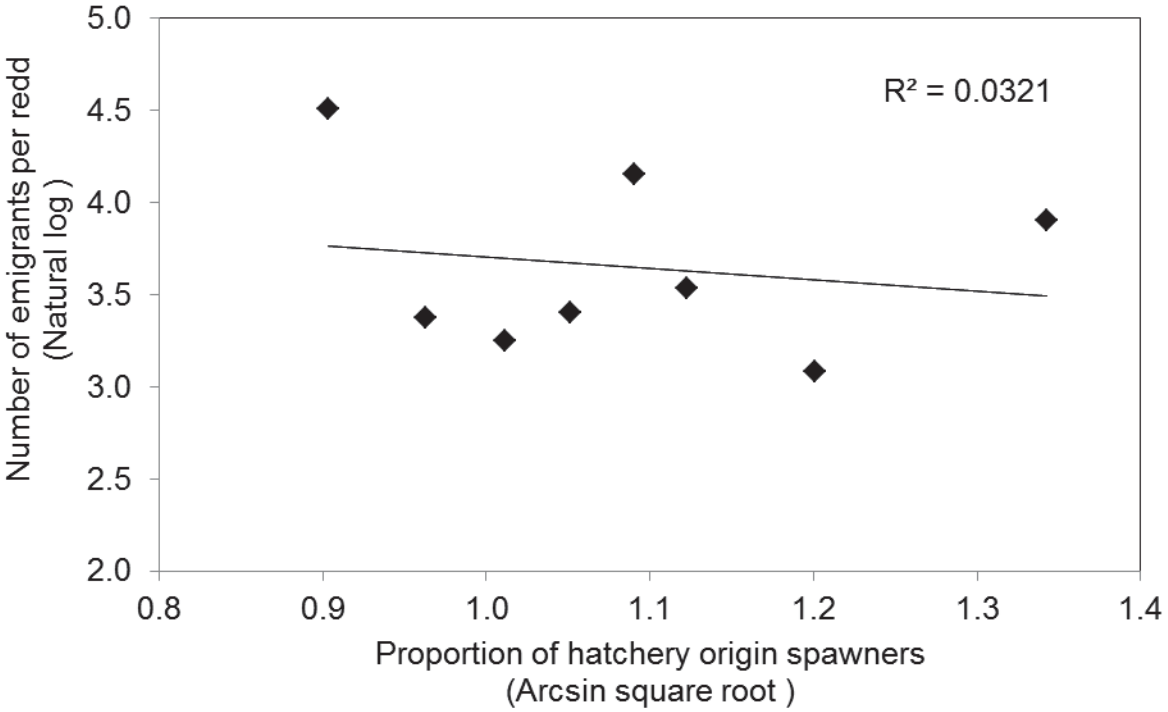
Objective 7

Methow: Freshwater Productivity



Objective 7

Methow: Freshwater Productivity



Objective 7

Methow: Summary

“Smolt monitoring on the Methow River began in 2004 and understanding the relationships between spawner abundance and the influence of hatchery spawners in their habitat will require additional years of data. Extremely low mean egg-to-emigrant survival in the Methow River (2004 – 2009 mean = 1%) may be related to biases in abundance estimates, poor reproductive success, habitat limitations, or some combination. However, spawner abundance (i.e., number of redds) was only responsible for a low proportion of the variance in number of emigrants, unlike what was observed in the Chiwawa River where spawner abundance accounted for as much as 60% of the variation in smolts (T. Hillman, unpublished data, 2011). In summary, analyses of freshwater productivity in the Methow River suggest that both the proportion of hatchery spawners and the total abundance of spawners has little influence on productivity and the number of emigrants, respectively. “

Attachment D

Discussion and Recommendations from 5 year M&E Report

Methow Basin Spring Chinook Discussion

(Applicable to Objectives 1, 4 and 7)

- "In the case of the Chewuch, the hatchery program has apparently not provided a benefit in the form of increased natural-origin spawners or the development of local adaptation, and had a high stray rate. Therefore, our recommendation is to either modify or discontinue the Chewuch program. Possible modifications for consideration include the development of methods to collect local broodstock, sizing the program to release only progeny of Chewuch stock, and managing the proportion of hatchery spawners on the spawning grounds. Alternatively, a discontinuation of the Chewuch program (with production possibly shifted to the Methow) could allow the management of the Chewuch under a no-supplementation strategy that could provide important insight into the response of a population to the discontinuation of a hatchery program (e.g., Entiat spring Chinook). The Chewuch could serve as a reference population for the Twisp and Methow programs, and possibly other programs outside the basin. Recall that natural-origin returns have not increased under the supplementation program; thus a no-hatchery strategy in the Chewuch does not appear to entail increased risk to recovery goals, and may actually reduce risk and increase chances for recovery."

Recommendations from 5 year report

(Applicable to Objectives 1, 4 and 7)

1. Assess the potential to use a PIT-tag based assessment for 1) estimating survival to key life stages, 2) population estimates of key life stages, 3) developing estimates of carrying capacity, and 4) understanding life-history traits such as juvenile movement and rearing, homing and straying. This approach should allow assessment of both the hatchery and natural populations to detect limiting life stages. It is unclear to what extent such an approach could supersede current methodologies, such as rotary screw trapping. To the extent a PIT-tag approach would improve the ability to address the four questions above, develop field and analytical methods to employ this PIT-tag approach.

Attachment D

Recommendations from 5 year report

(Applicable to Objectives 1, 4 and 7)

5. Implement new hatchery NNI production levels, the anticipated basin release from Methow Hatchery will be approximately 225,000 smolts.

Attachment D

Recommendations from 5 year report

(Applicable to Objectives 1, 4 and 7)

7. Historically, the Chewuch broodstock suffered from a lack of natural-origin fish; without infrastructure improvements the proportion of natural origin broodstock will not increase and management of the proportion of hatchery fish on the spawning grounds will not be possible. Continuation of the current program (i.e., Met-Comp) would likely result in a further reduction in genetic diversity and, subsequently, productivity of the Chewuch stock without a demographic benefit from the hatchery program. If PNI goals cannot be achieved in the Chewuch, the current hatchery production should be discontinued or moved to a location that would eliminate any potential negative impacts to the Chewuch spring Chinook population.

5 Year Report

- "The HSRG reported, based on modeling results, that their preferred hatchery solution for the Methow Basin would return approximately the same number of natural-origin adults as a no-supplementation option. Indeed, the analyses in this report support the HSRG prediction: natural-origin returns did not increase during the supplementation period relative to reference populations."

Attachment D

Context

Findings in the Methow basin are consistent with results from nearby areas (Wenatchee, Methow, farther away areas (Snake River Basin), and throughout the Columbia Basin

Attachment D

Chiwawa Spring Chinook (Monitoring and Evaluation of the Chelan County PUD Hatchery Programs, Five-Year (2006-2010) Report, Hillman et al. 2012)

- Analyses of the available data were unable to show that the Chiwawa spring Chinook supplementation program has significantly increased total spawning abundance and NORs in the Chiwawa River basin.
- Based on comparisons with suitable reference populations, the supplementation program may have reduced the productivity of the population. However, there was no significant association between pHOS and the residuals from the stock-recruitment models.
- There was a clear density-dependent relationship between numbers of spring Chinook spawners in the Chiwawa Basin and numbers of juveniles produced. The capacity of the Chiwawa Basin appears to average about 98,000 parr or about 55,000 yearling smolts. As spawner abundance exceeds 1,300 adult Chinook, density dependent mortality increases.
- The effects of hatchery-origin spawners on juvenile productivity are equivocal. There was weak evidence that increasing the number of hatchery-origin spawners reduces juvenile productivity, but this cannot be proven at this time.

Findings from other nearby areas

- Generally similar results in the Wenatchee (Hillman et al.) and the Yakima (Fast et al. 2015) (Natural origin recruits didn’t increase)

Snake River Basin (Scheuerell et al. 2015, abstract)

“We evaluated the effects of a large-scale supplementation program on the density of adult Chinook salmon Oncorhynchus tshawytscha from the Snake River basin in the northwestern United States currently listed under the U.S. Endangered Species Act. We analyzed 43 years of data from 22 populations, accounting for random effects across time and space using a form of Bayesian hierarchical time-series model common in analyses of financial markets. We found that varying degrees of supplementation over a period of 25 years increased the density of natural-origin adults, on average, by 0–8% relative to nonsupplementation years. Thirty-nine of the 43 year effects were at least two times larger in magnitude than the mean supplementation effect, suggesting common environmental variables play a more important role in driving interannual variability in adult density. Additional residual variation in density varied considerably across the region, but there was no systematic difference between supplemented and reference populations.”

- Mark D. Scheuerell, Eric R. Buhle, Brice X. Semmens, Michael J. Ford, Tom Cooney & Richard W. Carmichael. 2015. Analyzing large-scale conservation interventions with Bayesian hierarchical models: a case study of supplementing threatened Pacific salmon. Ecology and Evolution

Scheuerell et al. 2015 (page 6)

- “We found very limited support for a supplementation effect at both the individual population and ESU levels (Table 1).”
- “Thus, on average supplemented populations increased by 0–8.4% relative to nonsupplemented years. The probability that b_i was positive (i.e., the intended direction) ranged from 0.50 to 0.84 for individual populations (Table 1). Equivalently, then, there was a 16–50% chance that supplementation may have actually caused some decrease in densities of wild adults across the ESU.”

Scheuerell et al. 2015 (page 7)

“We found that over varying timespans since the 1980s, hatchery supplementation of threatened O. tshawytscha has had rather minimal effects on increasing the density of naturally spawning adults. For example, in the East Fork Salmon River, we estimated with 95% probability that 11 consecutive years of supplementation (i.e., the fewest among all populations) ultimately produced somewhere between a 13% decrease and 28% increase in the density of natural-origin adults. Similarly, 23 successive years of supplementation in the Upper Mainstem Salmon River (i.e., the most among all populations) resulted in densities of natural-origin adults that were between 17% less and 16% greater than years prior to supplementation. Notably, the 95% credible interval of the estimated effect of supplementation spanned zero in all cases, indicating some nonzero probability that hatchery supplementation actually had negative impacts on natural-origin adults.”

Columbia River Basin (ISAB 2015 Density Dependence Report)

- "Density Dependence and its Implications for Fish Management and Restoration in the Columbia River Basin"
- The ISAB report can be found at http://www.nwcouncil.org/media/7148891/isab2015-1.pdf
- Executive Summary and link posted to the HSC Boxnet site

Attachment D

ISAB 2015

- “Density effects on productivity are particularly evident in spring/summer Chinook salmon populations throughout the Snake River Basin where increasing spawners from 20,000 to 50,000 adult females has not resulted in additional smolt production. Additional evidence that increased abundance of juvenile Chinook is associated with reduced smolt size strongly suggests that food availability in freshwater habitat is limiting growth at current densities. In short, the capacity of some watersheds to support salmon or steelhead appears to have been exceeded at spawning abundances that are low relative to historical levels.”

Attachment D

Key Finding 4

- Hatchery releases account for a large proportion of current salmon abundance. Total smolt densities may be higher now than historically. By creating unintended density effects on natural populations, supplementation may fail to boost natural origin returns despite its effectiveness at increasing total spawning abundance.

Attachment D

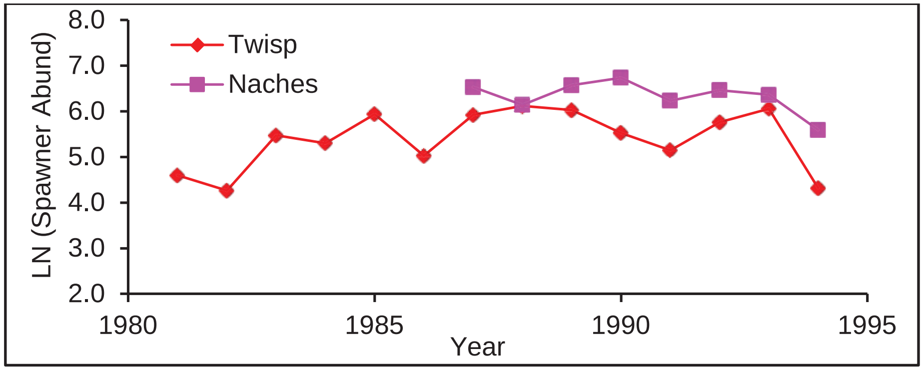
ISABs Key Recommendations for Anadromous Salmonids

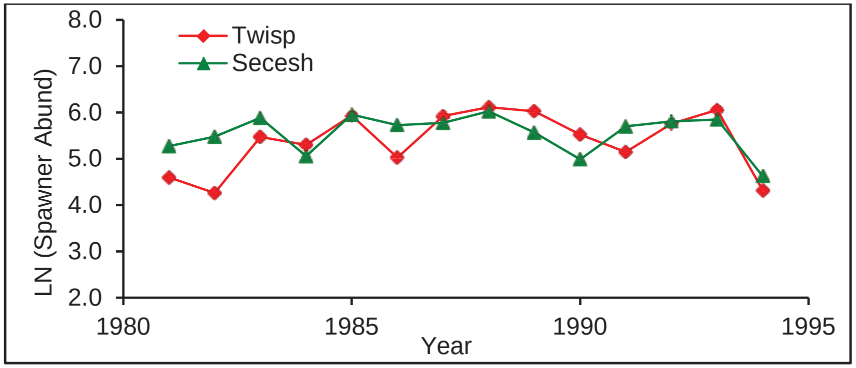
1. Account for density effects when planning and evaluating habitat restoration actions.
2. Establish biological spawning escapement objectives that account for density dependence.
3. Balance hatchery supplementation with the Basin’s capacity to support existing natural populations by considering density effects on the abundance and productivity of natural origin salmon.
4. Improve capabilities to evaluate density dependent growth, dispersal, and survival by addressing primary data gaps.

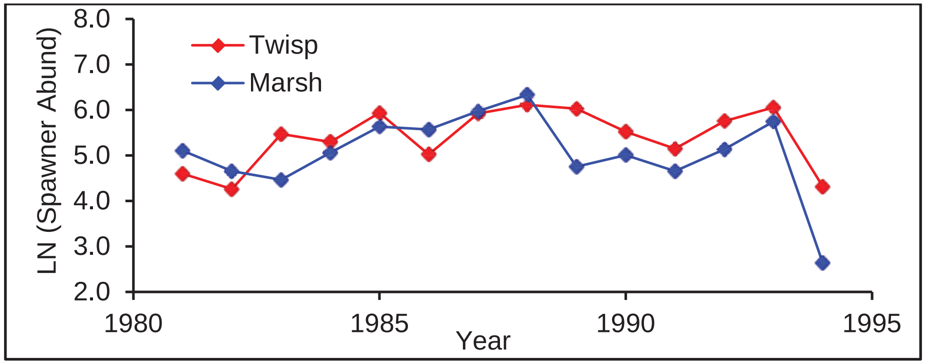
Discussion and Questions

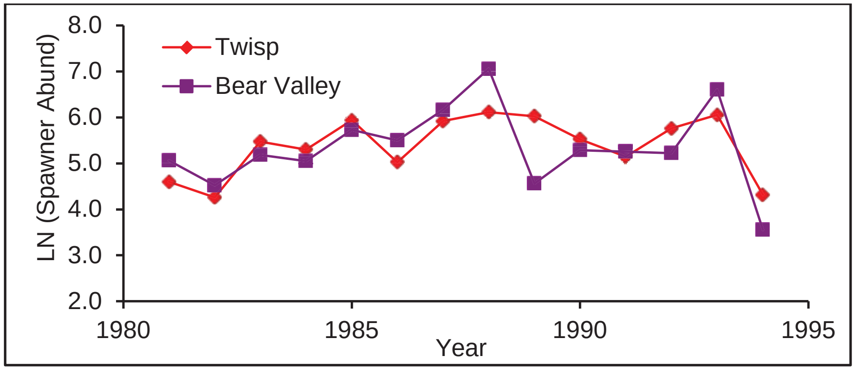
Attachment D

Twisp: Spawner Abundance Reference

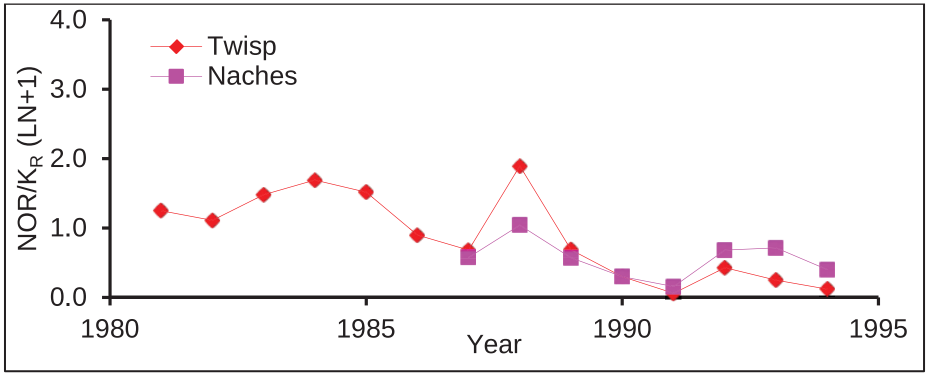


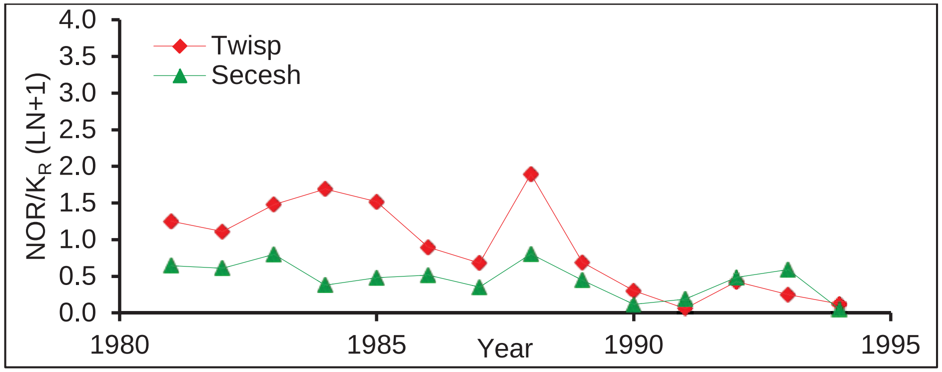


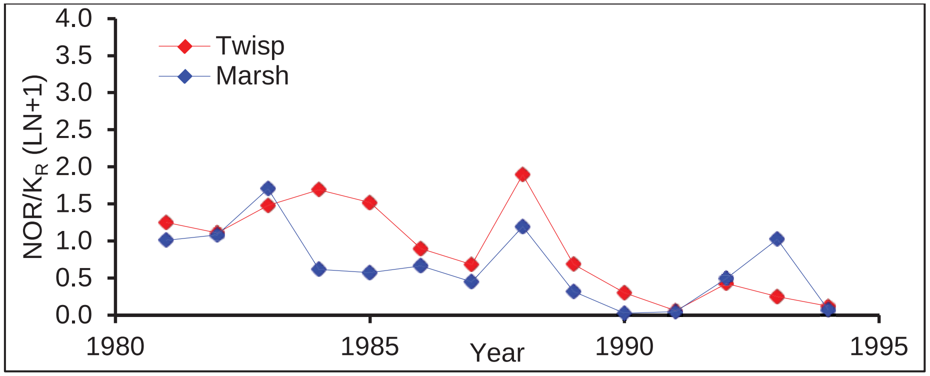


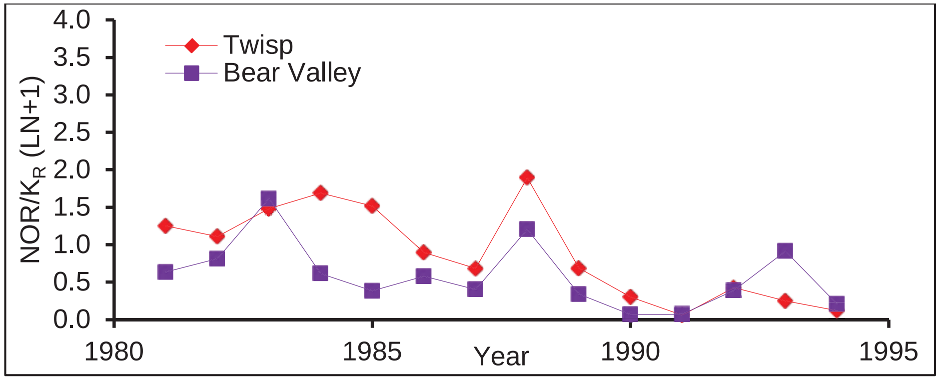


Twisp: NOR Recruits Reference



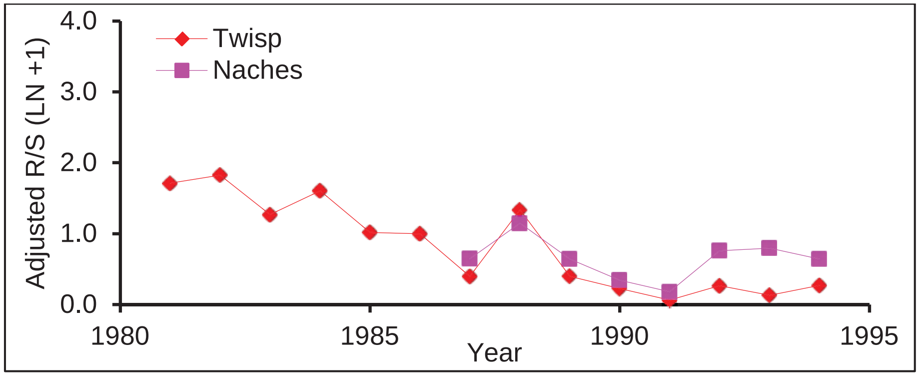


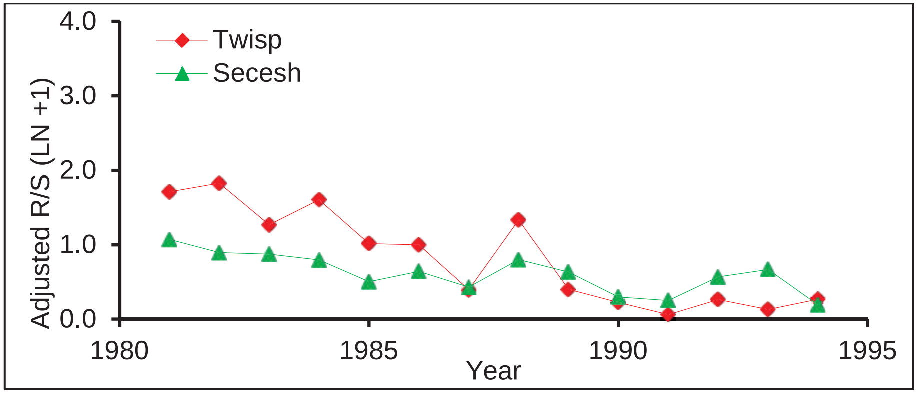


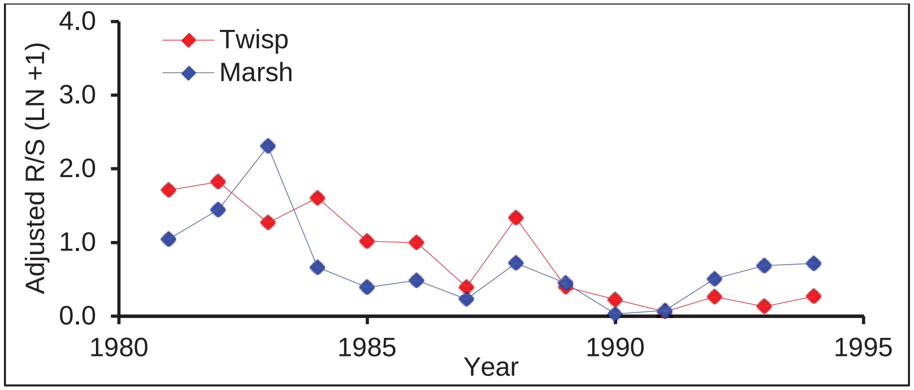


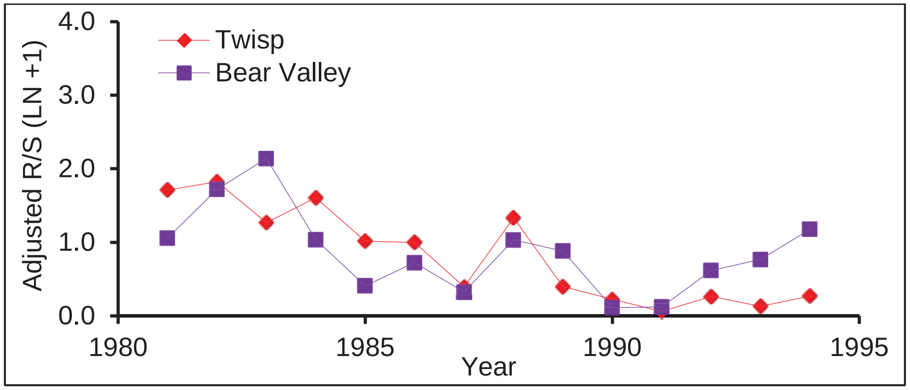
Attachment D

Twisp: Adult Productivity Reference









Twisp: Minimal Detectable Difference

Treatment years	Minimal detectable differences by reference population			
	Naches	Marsh	Secesh	Bear Valley
Spawner Abundance				
15	0.43	1.92	0.73	1.14
20	0.38	1.75	0.66	1.05
25	0.35	1.61	0.62	0.97
50	0.26	1.22	0.47	0.74
LN Spawner Abundance				
15	0.32	0.40	0.35	0.37
20	0.30	0.39	0.33	0.36
25	0.29	0.37	0.32	0.34
50	0.24	0.32	0.27	0.29
Natural-Origin Recruits (adjusted for capacity)				
15	1.08	3.53	2.77	2.38
20	0.97	3.21	2.54	2.18
25	0.89	2.97	2.35	2.02
50	0.69	2.35	1.88	1.62
LN Natural-Origin Recruits (adjusted for capacity)				
15	0.86	2.80	1.67	1.62
20	0.77	2.56	1.53	1.48
25	0.71	2.37	1.42	1.37
50	0.55	1.90	1.14	1.10
Productivity (adjusted for spawner capacity)				
15	1.31	2.60	1.67	1.38
20	1.18	2.37	1.53	1.27
25	1.08	2.19	1.42	1.17
50	0.84	1.73	1.13	0.94
LN Productivity (adjusted for spawner capacity)				
15	0.88	2.11	1.19	1.07
20	0.79	1.92	1.09	0.98
25	0.72	1.77	1.01	0.91
50	0.56	1.40	0.81	0.73

Twisp: Ranking Reference Populations

Reference populations	Weighted score			Ranking		
	Spawner abundance	Natural origin recruits	Productivity	Spawner abundance	Natural origin recruits	Productivity
Naches	92	85	85	1	1	1
Marsh	90	83	81	2	3	3
Secesh	86	83	85	4	3	1
Bear Valley	88	84	83	3	2	2

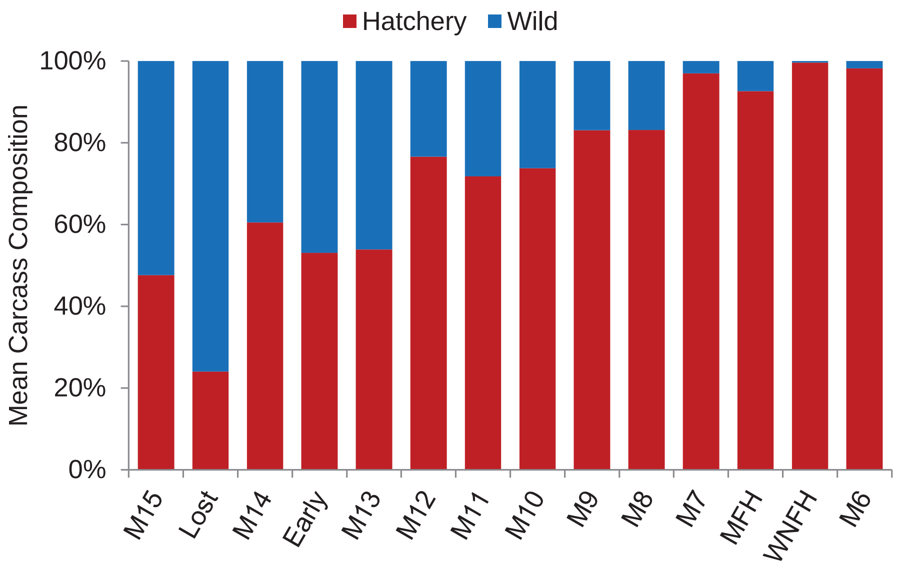


Figure 50. Mean carcass composition of spring Chinook in the Methow River, 2006 – 2010.

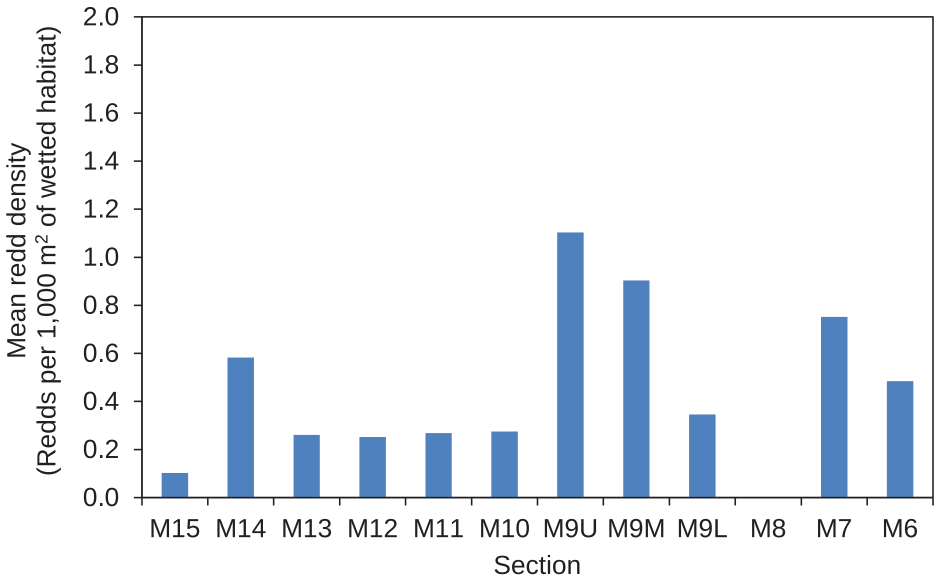


Figure 51. Redd density of spring Chinook in the Methow River in 2011. Reach area was normalized based wetted width and redd locations between 2006 and 2010.

Attachment E

HCP Hatchery Committees Meeting Protocols

HCP Hatchery Committees' Responsibilities:

The Habitat Conservation Plans Hatchery Committees (HCP HC) oversee development of recommendations for implementation of the hatchery elements of the three ~~Agreements~~ Habitat Conservation Plans for which the Districts have responsibility for funding. This includes overseeing the implementation of improvements and monitoring and evaluation relevant to the Districts' hatchery programs, as identified in the Hatchery Compensation Plans, the Permits, and Agreements. The Hatchery Committees also coordinate in-season information sharing and discuss unresolved issues. The Hatchery Committees' decisions shall be based upon the likelihood of biological success, time required to implement, and cost-effectiveness of solutions.

Meeting Protocols:

1. The HCP HCs are decision-making bodies and make decisions or recommendations by consensus. Consensus is the unanimous consent of all HCP HC members. Abstention does not prevent a unanimous vote. [1]
2. 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, who shall delay a vote on the agenda item for up to five (5) business days. A Party may invoke this right only once per delayed agenda item.[1]
   a. The HCP HCs have historically been amicable to a Party requesting additional time for internal vetting prior to a vote (within reason). This request and agreement typically have occurred during the meeting following contentious discussions and the inability to reconcile differences at that time.

3. The HCP HCs shall meet at least twice per year or as frequently as needed (when requested by any two members) to conduct business and resolve disputes.[1]

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~~3.~~4. Decision Item documents (e.g., Statement of Agreement) shall be distributed to the HCP HCs at least ten (10) business days before a meeting at which the Decision Item is discussed. This provision can be waived by agreement of all HCP HC parties.

~~4.~~5. The Chair will distribute draft agendas with Decision Items at least ten (10) business days before each meeting.[1]
   a. Draft agendas with no Decision Items can be distributed seven (7) days before the meeting.

~~5.~~6. Draft meeting notes will be distributed to members of the HCP HCs within fourteen (14) days of the next meeting.
   a. Revised draft minutes for approval will be distributed within seven (7) days of the next meeting.

~~6.~~7. All Studies and Reports prepared under the Anadromous Fish Agreements will be available for at least a 60-day review period unless decided otherwise.[1]

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[1] The identified protocol comes from the Anadromous Fish Agreement and Habitat Conservation Plans for the Wells, Rocky Reach, and Rock Island Hydroelectric Projects.

~~7.~~8. Dispute Resolution will follow the protocols and timelines defined in the HCPs.

~~8.~~9. Conflict of Interest: the latest Conflict of Interest Policy expired in January 2015.

10. Meeting logistics

    a. The monthly meeting location alternates between Chelan PUD Headquarters in Wenatchee, WA and Douglas PUD Headquarters in East Wenatchee, WA every other month, unless agreed otherwise.

    b. Decision Items are addressed first following the opening of the meeting (this is to accommodate Committees members who cannot attend the entire meeting).

    c. The order of Chelan PUD and Douglas PUD agenda items alternate every month (i.e., if one month Chelan PUD presents first and Douglas PUD second, next month Douglas PUD will present first and Chelan PUD second); other agenda items are listed in order they are received, and revolving agenda items are covered last.

Commented [KG1]: Not sure if this is an "agreed upon protocol," or just how Mike liked to 'keep things even.'

11. HCP Hatchery Committees Extranet Site and Distribution List Access

    a. The HC~~P~~s agreed on a system requiring HCP Coordinating Committees review and approval to provide non-HCP Reps/Alts access to HCP Extranet Sites and distribution lists. For example, if a WDFW non-HCP Rep/Alt requests access to the HCP Hatchery Committees Extranet Site, the WDFW HC Rep needs to pass the request to the WDFW CC Rep, who then needs to request CC approval).

    b. Historically, administrative access (i.e., Chair or support) has been granted without CC approval; however, is discussed with the CC at the next possible CC meeting.

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees	**Date:**	August 31, 2015
From:	Tracy Hillman, HCP Hatchery Committees Chairman		
Cc:	Kristi Geris		
Re:	Final Minutes of the July 15, 2015 HCP Hatchery Committees Meeting		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees meeting was held at Douglas PUD headquarters in East Wenatchee, Washington, on Wednesday, July 15, 2015, from 9:30 a.m. to 1:30 p.m. Attendees are listed in Attachment A to these meeting minutes.

ACTION ITEM SUMMARY

- Kristi Geris will follow up with Craig Busack to confirm edits to statements made by Busack, as reflected in the revised draft Hatchery Committees June 17, 2015 meeting minutes (Item I-A). *(Note: Busack confirmed the edits via email on July 16, 2015, which Geris distributed to the Hatchery Committees that same day.)*
- Mike Tonseth will coordinate with Craig Busack on the Hatchery Committees' decision regarding the fate of excess brood year (BY) 2014 Methow spring Chinook salmon currently being held at Eastbank Fish Hatchery (FH) and Methow FH (Item II-A).
- Sarah Montgomery will contact Craig Busack and request National Marine Fisheries Service (NMFS) concurrence of the Wells Hatchery Committee agreement regarding Douglas PUD's proposed Hatchery Monitoring and Evaluation (M&E) Annual Report schedule (Item III-B). *(Note: Busack provided NMFS concurrence of the agreement via email on July 20, 2015, which Montgomery distributed to the Hatchery Committees that same day.)*
- Douglas PUD will provide the draft 2014 Douglas PUD Hatchery M&E Report to Sarah Montgomery by August 1, 2015, which Montgomery will distribute to the Hatchery Committees for review (Item III-B). *(Note: Greg Mackey provided the draft*

report to Montgomery on July 31, 2015, and Montgomery distributed the draft report to the Hatchery Committees for review on August 1, 2015.)

- Sarah Montgomery will distribute a Doodle Poll to reconvene the Hatchery Evaluation Technical Team (HETT) in August 2015, as no suitable meeting date was found in July (Item IV-A). *(Note: Montgomery distributed a poll for August 2015 on July 16, 2015, and another for September 2015 on August 20, 2015, as no suitable meeting date was found in August.)*

DECISION SUMMARY

- The Hatchery Committees representatives present approved the following for excess BY 2014 Methow spring Chinook salmon currently being held at Eastbank FH and Methow FH:
    1. Transfer 29,755 fish (hatchery-by-hatchery [HxH] or hatchery-by-wild [HxW]) to Winthrop National Fish Hatchery (NFH) to be incorporated into the Winthrop NFH Safety Net Program.
    2. Transfer remaining excess brood (approximately 26,000 wild-by-wild [WxW]) to Methow FH for release from Methow FH or satellite locations (Item II-A).

AGREEMENTS

- The Wells Hatchery Committee representatives present agreed to Douglas PUD's proposed Hatchery M&E Annual Report schedule to provide the Hatchery Committees with a draft Hatchery M&E Annual Report for a 30-day review by August 1, 2015, with the final report due to NMFS by October 1, 2015 (Item III-B). *(Note: Craig Busack provided NMFS concurrence of this agreement via email on July 20, 2015, which Sarah Montgomery distributed to the Hatchery Committees that same day.)*

REVIEW ITEMS

- Kristi Geris sent an email to the Hatchery Committees on July 1, 2015, notifying them that the draft 2016 Douglas PUD Hatchery M&E Implementation Plan is available for a 60-day review period, with edits and comments due to Greg Mackey by Sunday, August 30, 2015 (Item III-A).

- Sarah Montgomery sent an email to the Hatchery Committees on July 23, 2015, notifying them that the draft 2016 Chelan PUD Hatchery M&E Implementation Plan is available for a 60-day review period, with edits and comments due to Catherine Willard by Monday, September 21, 2015.
- Sarah Montgomery sent an email to the Hatchery Committees on August 1, 2015, notifying them that the draft 2014 Douglas PUD Hatchery M&E Report is available for a 30-day review period, with edits and comments due to Greg Mackey by Monday, August 31, 2015 (Item III-B).

FINALIZED DOCUMENTS

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda, Review Last Meeting Action Items, Approve the June 17, 2015, Meeting Minutes (Tracy Hillman)

Tracy Hillman welcomed the Hatchery Committees and asked for any additions or changes to the agenda. Bill Gale removed the U.S. Fish and Wildlife Service (USFWS) bull trout consultation update, and added an update on activities at Leavenworth NFH. The NMFS Hatchery Genetic Management Plan (HGMP) update was also removed, as no NMFS representatives were able to attend today's meeting.

The Hatchery Committees reviewed the revised draft June 17, 2015, meeting minutes. Kristi Geris said there are several outstanding comments to be discussed, as follows (Note: *italicized text* indicates clarifying edits):

- Regarding the Methow spring Chinook salmon adult management update, Gale clarified that it seems incorrect to assign the same proportion of natural-origin fish in hatchery broodstock (pNOB) *level to segregated programs such as Leavenworth and Winthrop*.
- Regarding the same discussion, Greg Mackey clarified that Craig Busack noted it would be simple to split goals into separate facilities; *with a percent hatchery-origin*

spawner (pHOS) of 5% for the segregated Winthrop NFH program. Geris will follow-up with Busack to confirm Mackey's edits. *(Note: Busack confirmed Mackey's edits via email on July 16, 2015, which Geris distributed to the Hatchery Committees that same day.)*

- Regarding the same discussion, the Hatchery Committees suggested adding a note indicating that Busack also mentioned a three-way proportionate natural influence (PNI) model that could be adapted to the situation in the Methow Basin.
- Regarding the HGMP update, Mackey clarified that Busack expects to finish drafting permits for the *Wenatchee* Chinook Hatchery Programs in the next few weeks. Geris will follow-up with Busack to confirm Mackey's edits. *(Note: Busack confirmed Mackey's edit via email on July 16, 2015, which Geris distributed to the Hatchery Committees that same day.)*
- Regarding review of the "Evaluation of Hatchery Programs Funded by Douglas County PUD 5-Year Report 2006-2010," Kirk Truscott clarified that he noted if fish have a high precocity rate, they will not contribute as *anadromous* adults.
- Regarding the same discussion, Hillman clarified that he said hatchery-origin recruits (HORs) were first *measured* in the Methow in 1993 at 2%.

Geris noted that edits and comments have not yet been received from Grant PUD on the draft joint Hatchery Committees/Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) section of the draft June 17, 2015, meeting minutes, as both Todd Pearsons (Grant PUD), and Peter Graf (Grant PUD) had been on vacation until yesterday, July 14, 2015. Pearsons said Grant PUD reviewed the joint section and has no edits or comments to submit. Hatchery Committees members present approved the draft June 17, 2015, meeting minutes, as revised.

Action items from the Hatchery Committees meeting on June 17, 2015, and follow-up discussions, were as follows (*italicized* item numbers below correspond to agenda items from the meeting on June 17, 2015):

- *Tracy Hillman will provide the paper titled, "Anadromy and residency in steelhead and rainbow trout (*Oncorhynchus mykiss*): a review of the processes and patterns,"*

(Kendall et al. 2014) to Kristi Geris for distribution to the Hatchery Committees (Item II-A).
Hillman provided this paper, as well as a paper titled "Analyzing large-scale conservation interventions with Bayesian hierarchical models: a case study of supplementing threatened Pacific salmon" (Scheuerell et al. 2015) to Geris on June 18, 2015, which Geris distributed to the Hatchery Committees that same day.

- *Anchor QEA will set up a WebEx (screen share) for all future Hatchery Committees meetings to more effectively share information with those attending the meeting via conference call (Item II-A).*
  Sarah Montgomery set up a WebEx, as discussed, and will include the screen share access link on all future meeting agendas.
- *Greg Mackey and Mike Tonseth will provide a revised Methow Basin Spring Chinook Adult Management Worksheet and the revised 2015 Methow Basin Spring Chinook Adult Management Plan to Kristi Geris for distribution to the Hatchery Committees (Item III-A).*
  Mackey provided these revised documents to Geris on June 18, 2015, which Geris distributed to the Hatchery Committees that same day.
- *Craig Busack will resend the Doodle Poll to schedule the next joint NMFS/USFWS Biological Opinion (BiOp) Coordination Meeting (Item VI-A).*
  Busack resent the poll on June 18, 2015.
- *Greg Mackey will provide his presentation titled, "Carrying Capacity of Spring Chinook and Summer Steelhead in the Methow River Basin, Washington," that he presented at a past American Fisheries Society (AFS) Conference to Kristi Geris for distribution to the Hatchery Committees (Item VIII-A).*
  Mackey provided this presentation to Geris on June 18, 2015, which Geris distributed to the Hatchery Committees that same day.
- *Tracy Hillman and Kristi Geris will incorporate edits discussed into the draft Hatchery Committees Meeting Protocols, and will distribute the updated draft to the Hatchery Committees (Item IX-A).*
  Hillman and Geris updated the draft, as discussed, which Geris distributed to the Hatchery Committees on June 18, 2015.

- *Tracy Hillman and Anchor QEA will coordinate future joint Hatchery Committees/ PRCC HSC sessions with the PRCC HSC Facilitator, as needed (Item IX-B).*
  Hillman said he, Anchor QEA, and the PRCC HSC facilitator team are coordinating as discussed.
- *Kristi Geris will distribute a Doodle Poll to reschedule the Hatchery Committees meeting in August 2015 (Item IX-C).*
  Geris distributed a poll on June 18, 2015.

II. WDFW

A. Chelan PUD Spring Chinook Program at Methow FH (Greg Mackey and Mike Tonseth)

Greg Mackey recalled that as of the last Hatchery Committees meeting on June 17, 2015, Chelan PUD had provided Douglas PUD with a signed Interlocal Agreement (ILA), which Douglas PUD planned to present to its Board for final approval. Mackey said the ILA has been approved and Chelan PUD is back at Methow FH, which means the Methow FH M&E program now includes all three PUDs (i.e., Douglas, Chelan, and Grant).

B. DECISION: Excess BY 2014 Methow Spring Chinook (Mike Tonseth)

Mike Tonseth recalled discussing during the Hatchery Committees meeting on January 21, 2015, a potential overage originating out of Eastbank FH for BY 2014 Methow spring Chinook salmon. He said at that time, there were excess WxW fish at Methow FH, and excess HxW and WxW fish at Eastbank FH (where the hatchery component was the secondary component). He recalled contemplating a number of options for the excess fish, but ultimately deciding to wait until fish were tagged to determine populations.

Tonseth said, unfortunately, inventories were more robust than previously thought, which resulted in more fish on station than originally projected. He said high survival from green egg to ponding at both Eastbank and Methow FHs (upper-80% to 90%) has resulted in roughly 302,000 Methow spring Chinook juveniles on hand, which is about 135% of the aggregate production obligation of approximately 224,000 fish; however, it is only 55% of the release level allowed by extended Permit 1196. Tonseth said he is still awaiting feedback from Craig Busack regarding NMFS' opinion on exceeding the current program release goals. Mackey said he is not sure if the Permit 1196 extension letter discusses fish numbers.

Tonseth clarified that it does not; however, it alludes to a program implementation element of the new HGMP that could still be covered by the existing permit with the caveat of added ability to perform adult management. He said this is the gray area, and questioned whether the current numbers are grossly over the allowable release target, or well within. He said there are roughly 47,000 WxW fish at Eastbank FH, roughly 30,000 HxH also at Eastbank FH, and roughly 225,000 at Methow FH. He said from a technical perspective, there are about 37,000 excess fish, and he added that it would be preferable to keep all of the WxW fish.

Tonseth said WDFW asked the Colville Confederated Tribes (CCT) if they could take some of the excess fish. The CCT indicated they are already at capacity. He said USFWS indicated they have capacity to incorporate 30,000 fish into their Winthrop Safety Net Program. He added that those plans, including viral sampling, are underway. Bill Gale clarified that USFWS thinks they have space, and a final inventory should be ready by the end of this week. He asked if the 30,000 fish slated for Winthrop NFH are marked, and Tonseth said they are snout-wired and adipose (ad)-clipped.

Tonseth said if USFWS can take 30,000 fish from Eastbank FH, this leaves about 270,000 WxW progeny for the combined conservation program, including about 47,000 fish at Eastbank FH (with transfer of those fish pending Hatchery Committees decision). He said WDFW believes this is within the existing permit, even though numbers are considerably above the recalculated mitigation level. He said the excess fish cannot be culled. He said WDFW's preference is to send the fish to the Methow Basin. He added that because the 47,000 fish at Eastbank FH are predominantly from the Chewuch River, WDFW wants those fish returning to the Chewuch River. He recalled the email outlining options for the excess BY 2014 Methow spring Chinook that was distributed to the Hatchery Committees by Kristi Geris on July 9, 2015. The four options were as follows:

1. Retain excess fish at Methow FH and release from facility or satellite locations
2. Release excess fish as sub-yearlings as soon as possible or as reasonable
3. Overwinter acclimate excess fish at Carlton Pond, then transfer to Chewuch Pond in the spring
4. Other?

Tonseth said WDFW does not support Options 2 or 3, but wanted to include them for consideration. He said he spoke with Douglas PUD, who agreed the best approach is to release the fish at Methow FH and perform adult management, as needed (Option 1). Kirk Truscott asked if Option 1 poses any regulatory issues. Tonseth said he does not believe so; however, he plans to confirm this with Busack. Mackey said he spoke with the Wells Hatchery Complex Manager and confirmed there is space for the excess fish. He also suggested allowing the Hatchery Operators to decide when to transfer the fish, likely in early fall 2015. Todd Pearsons asked if the fish will be of similar size so they can be pooled together, and Mackey said he would have to check. Tonseth said coordination will be through Brian Lyon (WDFW), the new Eastbank FH Complex Manager (formerly Similkameen Hatchery staff). Gale asked who will coordinate with Chris Pasley (USFWS, Winthrop NFH Complex Manager) on the 30,000 fish being transferred to Winthrop NFH. Tonseth said he or Lyon will coordinate with Pasley on the Winthrop NFH transfer. Tonseth added that once the time comes to transfer fish, he recommended direct communication between Lyon and Pasley for the Winthrop NFH transfer, and Lyon and Brandon Kilmer (WDFW) for the Methow FH transfer.

Keely Murdoch said the Yakama Nation's (YN's) preferred option is to overwinter at Carlton Pond and transfer to Chewuch Pond in the spring (Option 3). She said this option provides a second data point on how this rearing scheme affects homing rates to the Chewuch River. She said, however, she understands Option 3 is not the preferred option for others, so the YN is supportive of Option 1 in the interest of reaching agreement. Tracy Hillman asked if NMFS has provided a vote. Tonseth said he has not yet received a vote from NMFS, and that he will coordinate with Busack on the Hatchery Committees' decision regarding the fate of excess BY 2014 Methow spring Chinook salmon currently being held at Eastbank FH and Methow FH.

Tom Kahler projected the official NMFS Permit 1196 Extension Letter (2013), and Mackey read the following:

"NMFS has taken into account new information submitted by the applicants that describe reductions in hatchery production as a result of 2012 recalculations of PUD obligations. Also, we do not anticipate that the number of broodstock collected for these programs will be higher than the current hatchery propagation programs described in the 2013 Upper Columbia River Salmon and Steelhead Broodstock Objectives and Site Based Broodstock Collection Protocols (WDFW 2013). Finally, we note that the proposed direct-take programs all include measures to reduce risk from large proportions of hatchery fish spawning in the wild. Provided that the planned program reductions and feasible risk reduction measures that are described in the application documents and draft permits are implemented, the existing permits, including all Terms and Conditions will remain in force until new permits are issued."

Gale noted that he would also like Hatchery Committees approval of the proposed Winthrop NFH transfer. Hillman asked if there is a backup plan. Tonseth said a backup plan will be drafted if the scenario arises and added that if something needs to be discussed with the Hatchery Committees before the next meeting, he will contact the Committees via email. He also noted the upside of this situation that for BY 2014 at Methow FH, the pNOB will be 1.0 for the first time ever.

The Hatchery Committees representatives present approved the following for excess BY 2014 Methow spring Chinook salmon currently being held at Eastbank FH and Methow FH:

1. Transfer 29,755 fish (HxH or HxW) to Winthrop NFH to be incorporated into the Winthrop NFH Safety Net Program; and
2. Transfer remaining excess brood (approximately 26,000 WxW) to Methow FH for release from Methow FH or satellite locations.

C. Methow Spring Chinook Adult Management (Mike Tonseth and Greg Mackey)

Mike Tonseth said, as discussed last month, about 98% of hatchery fish need to be removed to hit the projected PNI target of 0.59 based on a spring Chinook salmon run estimate above Wells Dam of 8,123 hatchery-origin adults and 818 natural-origin adults. He said factoring in assumptions about pre-spawn mortality on fish from Wells Dam to hatchery outfalls, and then from outfall locations to the spawning grounds, the estimated number of hatchery-origin adults to remove is about 6,592 fish. He said currently the number of hatchery-origin adults removed is 5,518 fish. He added that among those removed, 1,888 fish were removed from Methow FH, 3,498 fish from Winthrop NFH, and 132 jacks were removed at Wells Dam during broodstock collection. He said the plan is to operate as long as possible, maximizing the operation window. He applauded the effort to date, noting that crews have already removed approximately 84% of the target removal number. He said that Michael Humling (USFWS) snorkeled the lower regions and found hundreds of fish still holding. Bill Gale noted that Kristi Geris just forwarded an email from Humling to the Hatchery Committees today before the meeting summarizing Humling's findings. Tonseth also noted that for the Methow River, there is generally another surge of fish once spawning starts.

Gale said one problem USFWS is now encountering is running out of outlets. He added that no one wants these fish for consumption. He said Chris Pasley is coordinating with a maggot farmer; however, that option involves storing frozen carcasses. He said Northwest Harvest may also be an option. Tonseth said he is also coordinating with a Nutrient Enhancement Program, which is about ready to accept carcasses to produce analogs. He said he plans to contact Mike Lewis (WDFW) at Priest Rapids Dam to coordinate a transfer.

Tracy Hillman asked about the estimated number of fish in-basin that have escaped to spawn (have not been surplused). Tonseth said there are about 3,000 hatchery-origin adults unaccounted for, which may include a certain number of pre-spawn mortalities; and about 818 natural-origin adults, which may be about 318 accounting for pre-spawn mortalities.

Kirk Truscott asked if the Twisp Weir was operated this year. Tonseth said it was operated for only a short period of time because Douglas PUD was able to collect their full HCP spring Chinook salmon broodstock obligation at Wells Dam. He said no adult management was conducted at the weir, and added that WDFW anticipates that, in general, any adult management at the Twisp Weir will be limited.

III. Douglas PUD

A. Draft 2016 Douglas PUD Hatchery M&E Implementation Plan (Greg Mackey)

Greg Mackey said Kristi Geris sent an email to the Hatchery Committees on July 1, 2015, notifying them that the draft 2016 Douglas PUD Hatchery M&E Implementation Plan is available for a 60-day review period, with edits and comments due to Mackey by Sunday, August 30, 2015. Mackey said the plan is almost identical to last year. He also noted plans to repeat the Twisp Weir juvenile steelhead sampling effort.

B. Draft 2014 Douglas PUD Hatchery M&E Report (Greg Mackey)

Greg Mackey said Douglas PUD received the draft 2014 Douglas PUD Hatchery M&E Report from Charlie Snow (WDFW), and the draft report is now with Grant PUD and Chelan PUD for review before being distributed to the Hatchery Committees for review. Mackey said he discussed with Todd Pearsons review timelines for the Priest Rapids (Grant PUD), Wenatchee (Chelan PUD), and Methow (Douglas PUD) Hatchery M&E Reports, and Pearsons suggested staggering the review periods. Mackey said this could be helpful to both the writers and reviewers of the individual reports. He recalled in the past, review timelines used to be based on NMFS permitting; however, he noted that permits are not necessarily the driving force behind these deadlines. Pearsons said Grant PUD's new permit stipulates a September 1, 2015 deadline for the Wenatchee Hatchery M&E Report, and an August 2015 deadline for the Priest Rapids Hatchery M&E Report. He asked if the Hatchery Committees prefer that the review timelines are in sync or staggered. Keely Murdoch said it seems logical to stagger the timelines; however, it may also be difficult to keep track of the different deadlines. Bill Gale suggested that drafting the reports may be the driver and asked if the same writers author all three reports. Pearsons said the Wenatchee and Priest Rapids Hatchery M&E Reports have different authors, but the Methow Hatchery M&E Report involves all three PUDs.

Pearsons suggested adopting the same review period duration for the Methow Hatchery M&E Report as for the Wenatchee Hatchery M&E Report, but staggering the due date for the Methow Hatchery M&E Report by one month (i.e., October 1, 2015 deadline). He added that this timeline is similar to the existing schedule. Tracy Hillman asked if there is any information contained within the Methow Hatchery M&E Report that is needed by the Hatchery Committees before October 1, 2015 to make future management decisions (e.g., Broodstock Collection Protocols). Mike Tonseth said he does not believe so. Mackey said the Methow Hatchery M&E Report can be used to inform the upcoming Methow Hatchery M&E Plan for the next year; however, if a change is needed to the plan, this is typically understood before the final annual report is complete (i.e., the Committees do not need to wait for the report to be complete). He asked Snow if this timeline works for him, and Snow indicated that it does.

The Wells Hatchery Committee representatives present agreed to Douglas PUD's proposed Hatchery M&E Annual Report schedule to provide the Hatchery Committees with a draft Hatchery M&E Annual Report for a 30-day review by August 1, 2015, with the final report due to NMFS by October 1, 2015. Sarah Montgomery said she will contact Craig Busack and request NMFS concurrence of this agreement. *(Note: Busack provided NMFS concurrence of the agreement via email on July 20, 2015, which Montgomery distributed to the Hatchery Committees that same day.)*

Douglas PUD will provide the draft 2014 Douglas PUD Hatchery M&E Report to Montgomery by August 1, 2015, which Montgomery will distribute to the Hatchery Committees for review. *(Note: Mackey provided the draft report to Montgomery on July 31, 2015, and Montgomery distributed the draft report to the Hatchery Committees for review on August 1, 2015.)*

C. Methow Basin – Possible Water Right Restrictions (Tom Kahler)

Tom Kahler said earlier in the year, Douglas PUD received a letter from the Washington State Department of Ecology (Ecology) regarding the 2015 water forecast for the Methow Basin, which indicated that this year may be a dry year, and if so, Ecology will contact Douglas PUD again regarding water usage at Methow FH and associated facilities. Kahler said in June 2015, Ecology sent another letter to Douglas PUD containing an Order stipulating that beginning June 29, 2015, Douglas PUD must notify Ecology of plans to divert water. He said this affects the following three things:

- Surface water for Foghorn Ditch from December to May
- Surface water for the Twisp Pond for spring use
- Douglas PUD's groundwater right

Kahler said Douglas PUD contacted Ecology, and Ecology clarified that no action is required if Douglas PUD discharges groundwater to the river above or at the point where water would return to the river, which they do. He said the surface water right may become a problem later in the year; however, this depends on the climate between now and then. He added that Douglas PUD plans to coordinate and communicate actions, as needed. Mike Tonseth asked if the Order applies to consumptive use only (rather than non-consumptive use). Kahler said that is correct, and clarified that the potential issue is the withdrawal at Foghorn Dam and the discharge, less than 1 mile downstream, which can potentially result in a dewatered reach.

Kahler said historically this has never been an issue. He recalled receiving a similar letter from Ecology in 2001; however, no actions were ever required because of when the water was used. He said Douglas PUD needs to develop a contingency plan in case there is still a low-water situation. Tonseth said the forecast does not look good, noting below normal precipitation until January 2016.

D. PRESENTATION: Carrying Capacity (Greg Mackey)

Greg Mackey shared a presentation titled “Carrying Capacity of Spring Chinook and Summer Steelhead in the Methow River Basin, Washington” (Attachment B), which Kristi Geris distributed to the Hatchery Committees on June 18, 2015. This presentation included a review of methods for estimating carrying capacity, including estimates based on habitat capacity, smolt estimates, and stock-recruit relationships. Stock-recruit models and quantile regression were discussed using hypothetical and real data to demonstrate different types of carrying capacity estimates for Methow spring Chinook salmon and summer steelhead (i.e., stock-recruit models provided a model of the average stock-recruit response, while quantile regression fit through the 95th quantile provided an estimate of the maximum stock-recruit response that is likely given the data). An overview of estimates was also reviewed, which included additional methods for estimating carrying capacity cited from existing literature. Similarities among estimates can provide a level of confidence, while contradicting data may prove difficult in identifying the “correct” estimate. Questions and comments were discussed as follows:

Ksp and Kr (Slide 22 of Attachment B)

Mackey noted that between the Ricker and 95th Quantile models, the number of estimated spawners needed to produce the maximum number of recruits (Ksp) is very similar, while the estimated number of maximum recruits (Kr) is radically different (almost double). Kirk Truscott asked with regard to the vastly different Kr values which of the two curves (i.e., Ricker or 95th Quantile) resulted in the greatest confidence. Tracy Hillman said it seems the 95th Quantile would have the smaller confidence interval; the statistical analysis should provide confidence intervals. Hillman asked if one is interested in estimating the carrying capacity, why not just use the highest data point (instead of modeling)? Mackey said this can be done; however, modeling the data allows one to evaluate the stock recruit relationship across any number of spawners. Todd Pearsons added that from a management perspective, Ksp cannot be determined based only on one point; the curve is needed. Mackey said this is also a useful tool for ecological purposes.

Steelhead – 95th Quantile (Slide 31 of Attachment B)

Mackey said the 95th Quantile fit suggests the population could replace itself at about 1,000 spawners. Hillman asked whether this is for the entire Methow Basin or one tributary. Mackey said it is for the entire basin and is based on the Quantitative Analysis Report steelhead run reconstruction work by Cooney et al. (2002), as referenced on Slide 2 of Attachment B.

General Comments

Keely Murdoch noted that when considering carrying capacity and the upper limit for a basin, often it gets overlooked that the model assumes spawners are using habitat appropriately. She said, for example, in the Chiwawa River or Upper Methow Basin, the bulk of the fish populating the dataset are HORs spawning in high densities, which are strongly influenced by factors that are not the same for natural-origin recruits (NORs). She said, therefore, the numbers tend to be highly influenced by where HORs tend to spawn. She said this can result in underestimating carrying capacity for a basin. Hillman said this may have a greater influence on productivity than on carrying capacity. That is, density-dependent factors should operate in such a way that areas within the river or watershed with high densities will have lower survival and growth, while areas within the same river or watershed with lower densities should have high survival and growth. He said, for example, in the Chiwawa River, high densities of fish (mostly HORs) spawn in the lower Chiwawa River where the habitat is of lower quality, while lower densities of fish (mostly NORs) spawn in the upper river where there is higher quality habitat. He said if density-dependent factors are regulating the population, the carrying capacity should not change as a result of different densities within different areas. He added, on the other hand, the intrinsic productivity of the stock (slope of the stock-recruitment curves at the origin) could change under the scenario described by Murdoch. Hillman said this is because large numbers of fish are spawning in low-quality habitat, which reduces egg-to-fry or egg-to-parr survival, and therefore productivity. With regard to Slide 19 of Attachment B, Hillman said the steeper the slope at the origin, the higher the productivity. He said during modeling of supplemented and reference populations during the 5-year analysis, he found that populations with low carrying capacities tended to have higher intrinsic productivities, while populations with higher capacities tended to have lower intrinsic productivities. He said the reason for this is unknown.

Bill Gale questioned, regarding steelhead, how to contemplate the idea that both anadromous and resident fish contribute to recruits. He asked if any hypothetical modeling has been conducted to determine how the data are affected. Andrew Murdoch (WDFW) said efforts are underway for exploring how resident populations affect overall data. He suggested it will not be a big factor. He said studies are ongoing in the Yakima Basin, which should be extremely informative. He added that the efforts will include a pedigree analysis.

IV. HETT

A. HETT Update (Catherine Willard)

Catherine Willard said draft Appendices 2 through 6 were due May 29, 2015, and all have been received. She said draft Appendix 1 was due June 30, 2015, and has not been received. She said Tracy Hillman and Andrew Murdoch are still working to complete draft Appendix 1, and planning is underway to schedule the next HETT meeting. Hillman said Appendix 1 addresses estimation of carrying capacity for all stocks and populations. He said all data are compiled, but as Greg Mackey noted in his presentation, there are many ways to calculate carrying capacity, and the HETT first needs to discuss which method is preferred. Hillman said as a side note, he is working with Tim Beechie (NMFS Northwest Fisheries

Science Center) on using geomorphic and stream habitat variables to estimate carrying capacity for juvenile spring Chinook salmon. Hillman said this approach assumes a given class of habitat will produce so many juvenile Chinook salmon. He said if one knows the total amount of each class of habitat within the basin, one can then calculate the total number of fish that could be produced within the basin. He said this is similar to an approach used by the HETT in the past; however, the HETT used Intrinsic Potential rather than geomorphic classification to extrapolate abundance. He further explained that most of the data for the geomorphic exercise comes from the summer Chiwawa surveys and noted that in addition to snorkeling randomly selected sites from the pool of habitat types within each geomorphic reach, they also measure the physical dimensions (width, depth, and length) of every habitat unit within the sampling frame (complete census). He said the work with Beechie provides a "bottom-up approach" to estimating carrying capacity, while the modeling work conducted by Mackey offers a "top-down approach."

Willard said Kristi Geris distributed a Doodle Poll on July 2, 2015, to reconvene the HETT in July 2015; however, there is not a date that works for everyone's schedules. Willard suggested reconvening in August 2015, and Sarah Montgomery said she will distribute a Doodle Poll to reconvene the HETT in August 2015. *(Note: Montgomery distributed a poll on July 16, 2015.)*

Hillman asked how quickly the Hatchery Committees need the appendices finalized. Mackey said they did not need to be finalized right away, and added that Appendix 1 was mainly intended as background information for report writing.

V. USFWS

A. Leavenworth NFH Update (Bill Gale)

Bill Gale said there have already been several days of high-water temperatures (70 degrees Fahrenheit) at Leavenworth NFH. He noted that this high-water temperature condition has occurred in the past, but this year the high temperatures have occurred earlier in the year. He said there is concern regarding juveniles on station, and as flows reduce from Icicle Creek, the hatchery may lose its groundwater source. He said USFWS is closely tracking the situation. He said the hatchery is drawing water from Snow and Nada lakes 1 month early to help increase flow and decrease temperature in Icicle Creek. He said use of reservoir water has already decreased water temperature at the hatchery; however, those reservoirs may not refill depending on precipitation. He said USFWS also received authorization from Ecology and the Environmental Protection Agency to discharge a portion of, or all, effluent to the hatchery channel (opposed to the normal point of discharge) to recharge the aquifer. He said he believes the adult brood on station can be carried to spawning; he just hopes there are no issues with *columnaris*. He said USFWS opted not to perform an emergency fish release.

VI. Joint HCP Hatchery Committees/PRCC HSC

A. *Review of the "Evaluation of Hatchery Programs Funded by Douglas County PUD 5-Year Report 2006-2010" – Methow Spring Chinook Objectives 2, 5 (Catherine Willard)*

Catherine Willard shared a presentation titled "Review of 5-Year Hatchery M&E Report – Methow Spring Chinook Salmon" (Attachment C), which Sarah Montgomery distributed to the Hatchery Committees following the meeting on July 15, 2015. The presentation was organized by Hatchery M&E Objective and by stock. Hatchery M&E Objectives addressed Objective 2 (migration timing, spawn timing and redd distribution), and Objective 5 (stray rates). These objectives were reviewed for each Methow spring Chinook salmon program (i.e., Twisp, Chewuch, and Methow). Questions and comments were discussed as follows:

Objective 2: Twisp Migration Timing (Slide 4 of Attachment C)

Mike Tonseth asked if migration timing is still an issue, and Andrew Murdoch said it is not. Tonseth asked if the next 5-year report will have some values where data were not yet available in the previous report, and Murdoch said he believes so. Murdoch added that he does not believe there has been a big difference in migration timing.

Objective 2: Twisp Redd Distribution (Slide 6 of Attachment C)

Tracy Hillman asked if low run size was the reason why there appeared to be a relatively large difference in NOR and HOR redd distribution in 2006. Murdoch said he is not sure, but noted that during that time, sample size in the spawner surveys was a problem.

Objective 2 (General Comments)

Hillman asked if there are any concerns or items that should be flagged for future discussion under Objective 2. The following were discussed:

Keely Murdoch said spawner distribution in the Methow Basin is a problem that needs to be addressed. She noted that last year, the Hatchery Committees approved the Goat Wall Evaluation Study, which is addressing this; at this time, no action is needed until that study is underway. She said she does not believe additional studies are needed unless the Hatchery Committees want to discuss adult management plans.

Bill Gale noted that the years reviewed in this presentation were years when there was no adult management. He said now, with HORs being removed, the numbers should be better. He added he believes there should be a significant net improvement in productivity in the basin.

Tonseth noted the downstream shift in mean spawning location for NORs, as depicted in Figure 49 on Slide 14 of Attachment C. Gale asked if there might be some other explanation why in later years NORs were further downstream. Tom Kahler suggested tracking this. Kirk Truscott questioned whether the evaluation of spawning location is proportional. He suggested this may not be an environmental issue; rather, it may be the product of NORs spawning lower in the basin. He asked if there are corresponding data for NORs in the upper basin. Hillman noted that the y-axis only shows river kilometers (rkm) ranging from 80 to 120 rkm. He said if the axis showed rkm ranging from 0 to 120 rkm, these data points would look like a horizontal line suggesting little trend in spawning distribution. He said it seems significant because of the way the figure was developed.

Andrew Murdoch said regarding the Wenatchee Basin, and the Relative Reproductive Success (RRS) Study, at the tributary level, there are different patterns between HORs and NORs. He said in areas of similar spawning distribution of HORs and NORs, there is no difference in RRS; however, overall reproductive success of hatchery fish is lower. Keely Murdoch said the report speculated that the similar RRS could be the result of lower overall densities in the White and Little Wenatchee rivers. She added that the overall reduced survival was the result of known low survival rates through Lake Wenatchee, rather than similar spawning distribution. Andrew Murdoch said everything is measured at the Lower Wenatchee River, so there is a lake effect. He added that in the Upper Wenatchee River there is a habitat issue, and in the White River there is a lake issue. He said habitat and genetic effects need to be separated. He said in the Chiwawa Basin, HORs are spawning in suboptimal habitat in the lower river, but their adult progeny move upstream to spawn, resulting in a different distribution than their parents, which is slowly biasing productivity estimates. He questioned whether this is happening in other locations.

Objective 5: Twisp Summary (Slide 21 of Attachment C)

Gale asked about the stray rate target of 5%. Hillman explained that the current criteria were established by the Interior Columbia Basin Technical Recovery Team and included in the Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan. These criteria indicate that fish that do stray to non-target independent populations should not comprise greater than 5% of the non-target spawning population, and fish that stray into non-target spawning areas within a population should not comprise greater than 10% of the non-target spawning aggregate.

Objective 5: Chewuch Summary (Slide 26 of Attachment C)

Gale said with regard to Andrew Murdoch's question about whether what is happening in the Wenatchee Basin is happening elsewhere, this does not seem to be the case in the Methow River. Keely Murdoch noted that there is a strong attraction back to the Methow River. She added that the Wenatchee River is different because fish are not reared in the Wenatchee River; rather, they are reared at Eastbank FH and overwintered at the Chiwawa Facility. Tonseth said early rearing at Eastbank FH may be the reason for high stray rates into the Entiat River. Gale questioned whether progeny of HORs will return to the Chewuch River. Andrew Murdoch said this has not been observed in the Wenatchee pedigree data. He said progeny of HORs in the Chiwawa River may stray from their natal locations due to parents spawning in suboptimal habitat. He hopes adult progeny of fish spawning in the lower Chewuch River will spawn in the upper Chewuch River. He said the Upper Wenatchee River is a similar example, where the habitat is so poor, the few surviving adult progeny go elsewhere to spawn.

Objective 5 (General Comments)

Willard asked if there are any concerns to flag regarding Objective 5. The following were discussed:

Tonseth said the opportunity exists to test alternative techniques to evaluate site fidelity, such as eyed-egg-imprinting and side-by-side evaluations.

Truscott said it is a problem if NORs are removed for programs and they are not returning to the tributaries of origin. Keely Murdoch agreed and suggested flagging this objective for further discussion. Truscott added that he is also concerned with the return rates to Methow FH, notably juveniles of NOR parents.

Gale said Methow spring Chinook salmon are different than Wenatchee spring Chinook salmon in that the hatchery population is not tributary-specific; rather, they are Methow composites (MetComp). He said he is not sure whether there are two populations at this point. He said it would be optimal to get more fish in the Chewuch River and better quality habitat, but it seems this is being viewed as if fish are being removed. He added that fish are not being removed from the Chewuch River; rather, they are not going into the Chewuch River. Keely Murdoch disagreed with Gale, noting that although MetComp is one population. She said the purpose of Chewuch River releases is to supplement the Chewuch River. Gale said he largely agrees; however, the discussions for Objective 5 imply that fish are straying when they are really returning. He clarified that the Hatchery Committees want more fish in certain locations. Tonseth noted that if the goal is to supplement the Chewuch River, there is no benefit if all the fish go to the Methow River. Tom Kahler said the Hatchery Committees also need to determine how many fish should be returning to the Chewuch River; and Gale added also what is feasible. Mackey said that number needs to be within the management goals (e.g., pHOS and spatial distribution). Gale suggested adult outplanting, where HOR adults are outplanted in the Chewuch River at an acceptable pHOS level, and hoping their progeny return to the Chewuch River; Tonseth said this can be tested. Hillman noted the importance of obtaining input from Craig Busack to align with other regulatory functions. Hillman also suggested the importance of sequential imprinting on where fish tend to home.

How Spawner Distribution Affects Productivity and Reproductive Success (Slide 42 of Attachment C)

Keely Murdoch reviewed quotes from the Chiwawa RRS Study. She said the study includes empirical data explaining why spawning distribution is so important to productivity and RRS. She said the study showed that spawning location for females accounted for a fair amount of difference in RRS when using spawning habitat as a covariate.

Ford et al. 2013 (Slides 43 to 44 of Attachment C)

Keely Murdoch said Andrew Murdoch was referring to this study while discussing RRS in the Wenatchee Basin.

Ford et al. 2009 (Slide 45 of Attachment C)

Keely Murdoch said the far right column of Table 9 represents RRS, which she believes illustrates the importance of having equal spawning distributions. She said she believes low RSSs in the Wenatchee system are due to predation on fish moving through Lake Wenatchee, which is consistent with other studies.

Hillman said next month, the Hatchery Committees will review Hatchery M&E Objectives 3, 6, and 8.

VII. HCP Administration

A. Next Meetings

Tracy Hillman asked if anyone anticipated additional joint HCP Hatchery Committees/PRCC HSC items to discuss at next month's meeting. None were identified.

The next scheduled Hatchery Committees meetings are on August 28, 2015 (Chelan PUD), September 16, 2015 (Douglas PUD), and October 21, 2015 (Chelan PUD).

List of Attachments

Attachment A	List of Attendees
Attachment B	Carrying Capacity of Spring Chinook and Summer Steelhead in the Methow River Basin, Washington

Attachment C Review of 5-Year Hatchery M&E Report – Methow Spring Chinook Salmon

Attachment A
List of Attendees

Name	Organization
Tracy Hillman	BioAnalysts, Inc.
Kristi Geris	Anchor QEA, LLC
Sarah Montgomery	Anchor QEA, LLC
Catherine Willard*	Chelan PUD
Greg Mackey*	Douglas PUD
Tom Kahler*	Douglas PUD
Todd Pearsons	Grant PUD
Bill Gale*	U.S. Fish and Wildlife Service
Mike Tonseth*	Washington Department of Fish and Wildlife
Andrew Murdoch††	Washington Department of Fish and Wildlife
Charlie Snow†	Washington Department of Fish and Wildlife
Kirk Truscott*	Colville Confederated Tribes
Keely Murdoch*	Yakama Nation

Notes:
* Denotes Hatchery Committees member or alternate
† Joined by phone
†† Joined for joint HCP Hatchery Committees/PRCC HSC item

Attachment B

Carrying Capacity of Spring Chinook and Summer Steelhead in the Methow River Basin, Washington

Gregory Mackey

Douglas County PUD

Attachment B

Acknowledgments

WDFW: Charlie Snow, Charles Frady, Alex Repp

Cooney, et al. 2002. Upper Columbia River Steelhead and Spring Chinook Salmon Quantitative Analysis Report

Ford, et al. 2001. Upper Columbia River Steelhead and Spring Chinook Salmon Population Structure and Biological Requirements

Brian Cade (USGS) - Quantile Regression

Attachment B

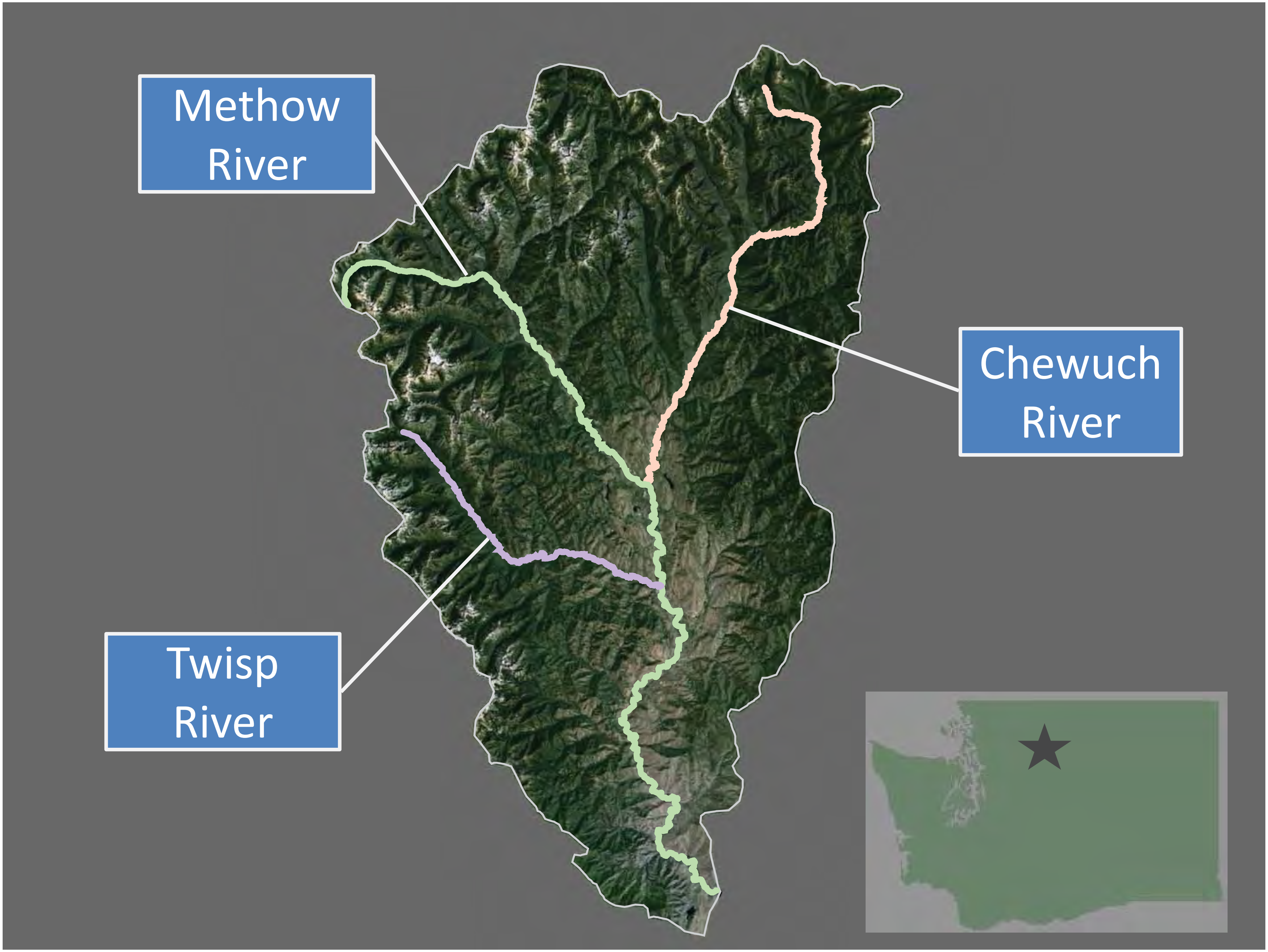
Methow Populations

Spring Chinook

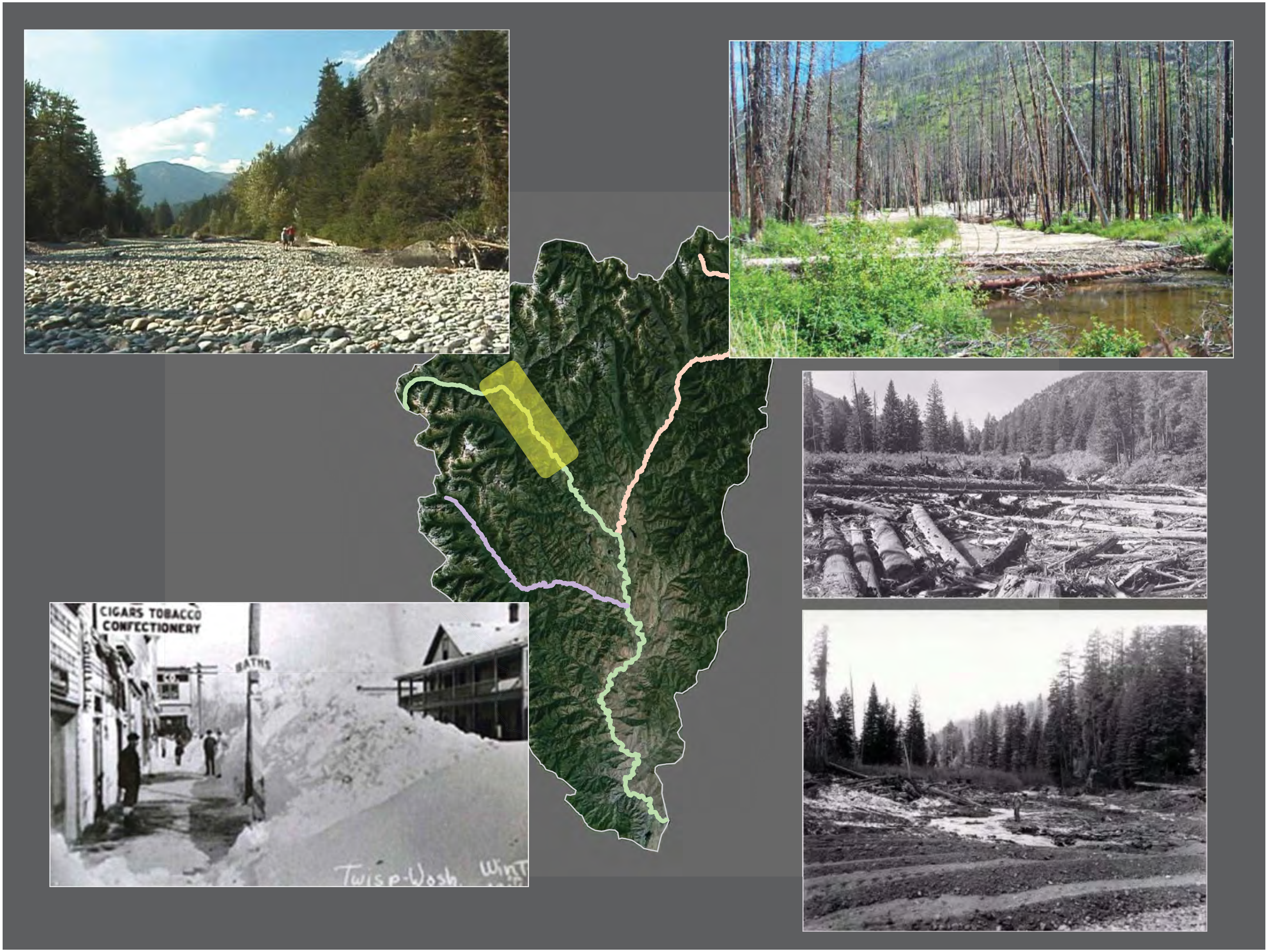
- Upper Colombia ESU
- Listed under ESA as endangered

Summer Steelhead

- Upper Colombia DPS
- Listed under ESA as threatened


Methow River
Chewuch River
Twisp River

Attachment B



Summer Steelhead pHOS ~ 0.78 (1999-2012)

Spring Chinook pHOS ~ 0.78 (2001-2010)

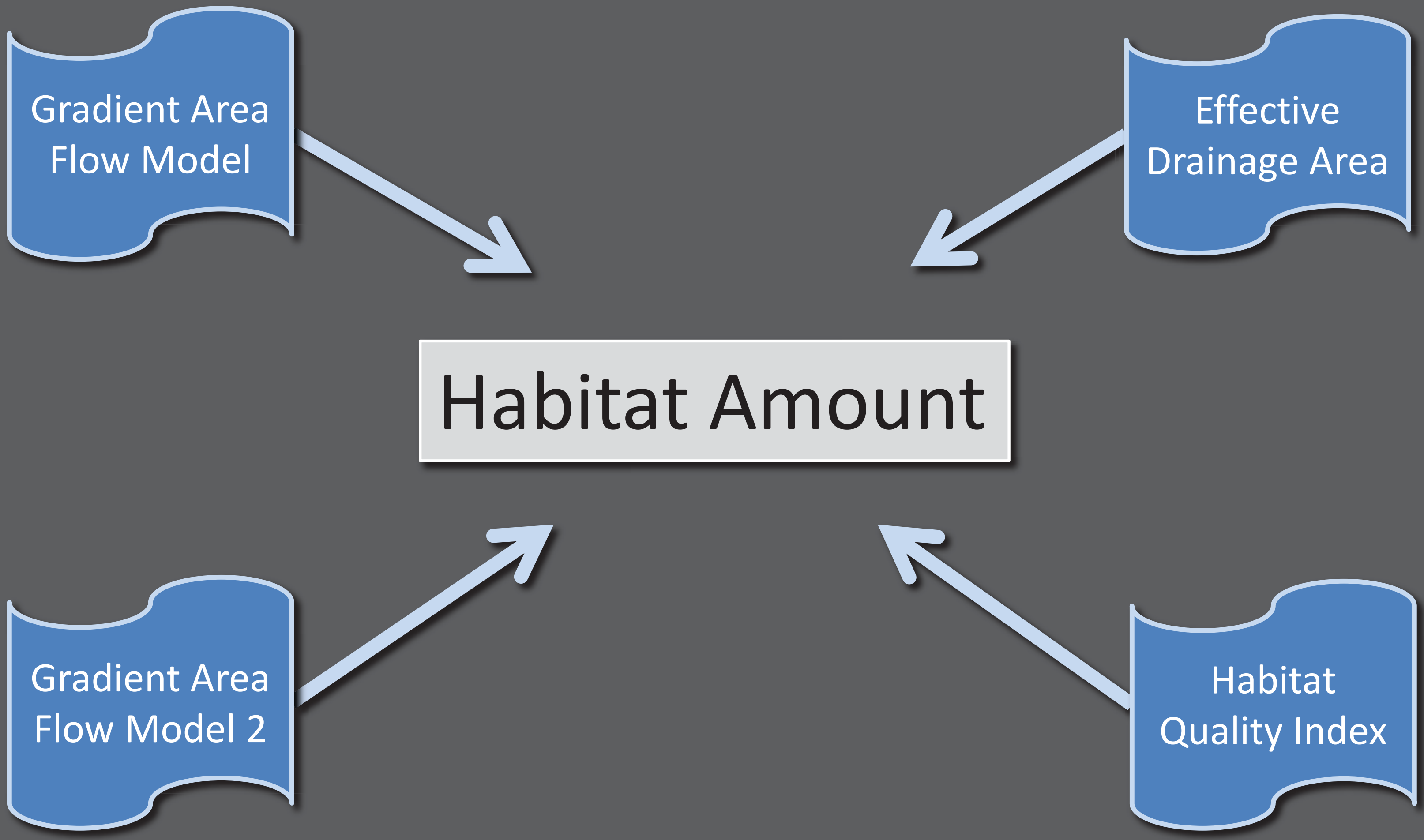
Attachment B

Oh Yeah, there are other species!

Pacific lamprey	(*Lampetra tridentata*)
Longnose dace	(*Rhinichthys cataractae*)
Coho	(*O. kisutch*)
Bull trout	(*Salvelinus confluentus*)
Sculpin	(*Cottus spp.)*
Whitefish	(*Prosopium williamsoni*)
Bridge lip sucker	(*Catostomus columbianus*)
Sockeye	(*O. nerka*)
Sucker	(*Catostomus spp.*)
Redside shiner	(*Richardsonius balteatus*)
Cutthroat trout	(*O. clarki*)
Brown bullhead	(*Ictalurus nebulosus*)

Attachment B

Methods of Estimating Carrying Capacity: Habitat


Gradient Area Flow Model

Effective Drainage Area

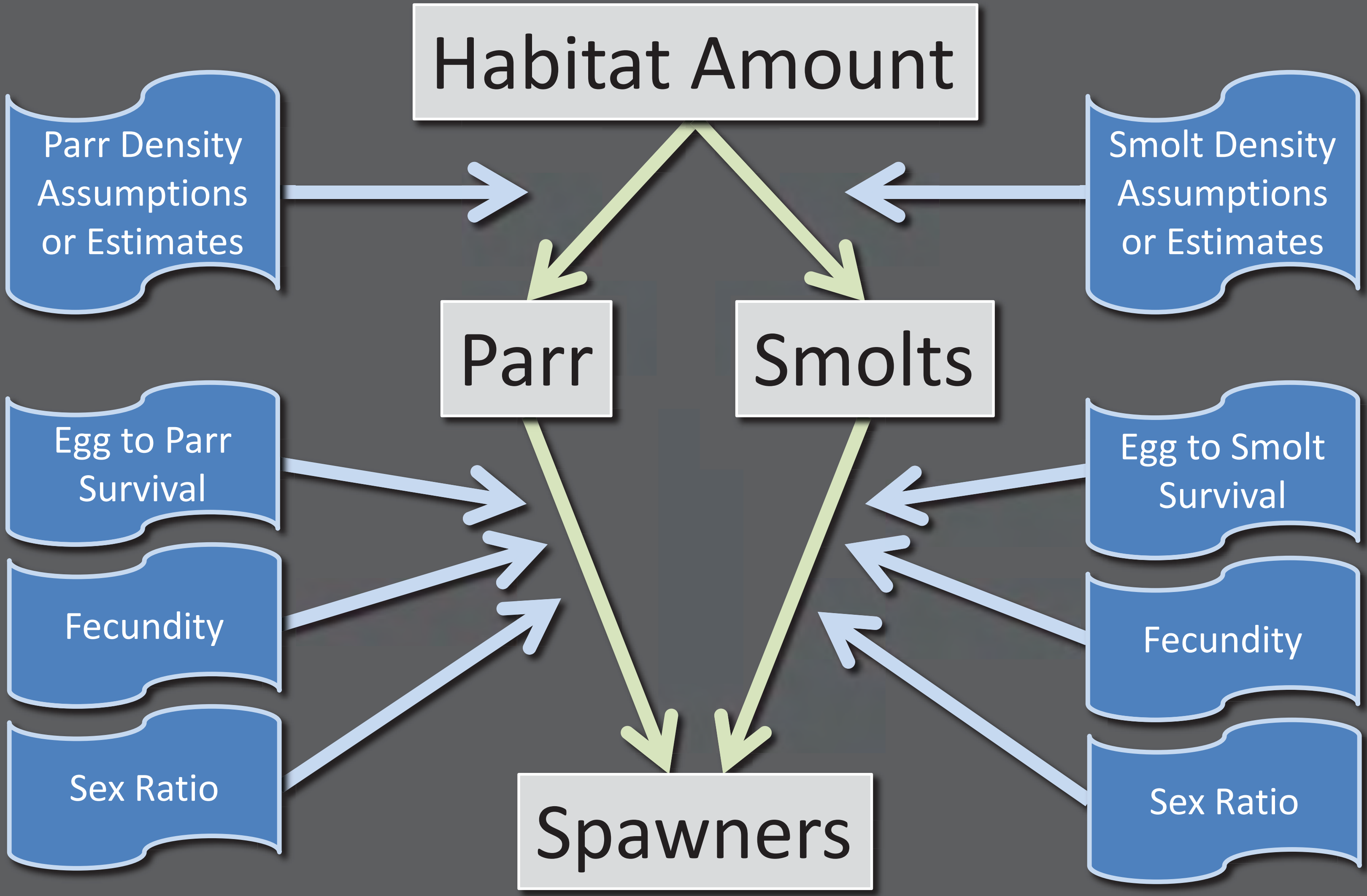
Habitat Amount

Gradient Area Flow Model 2

Habitat Quality Index

Attachment B

Methods of Estimating Carrying Capacity: Ksp



Habitat Amount

Parr Density Assumptions or Estimates

Smolt Density Assumptions or Estimates

Parr

Smolts

Egg to Parr Survival

Fecundity

Sex Ratio

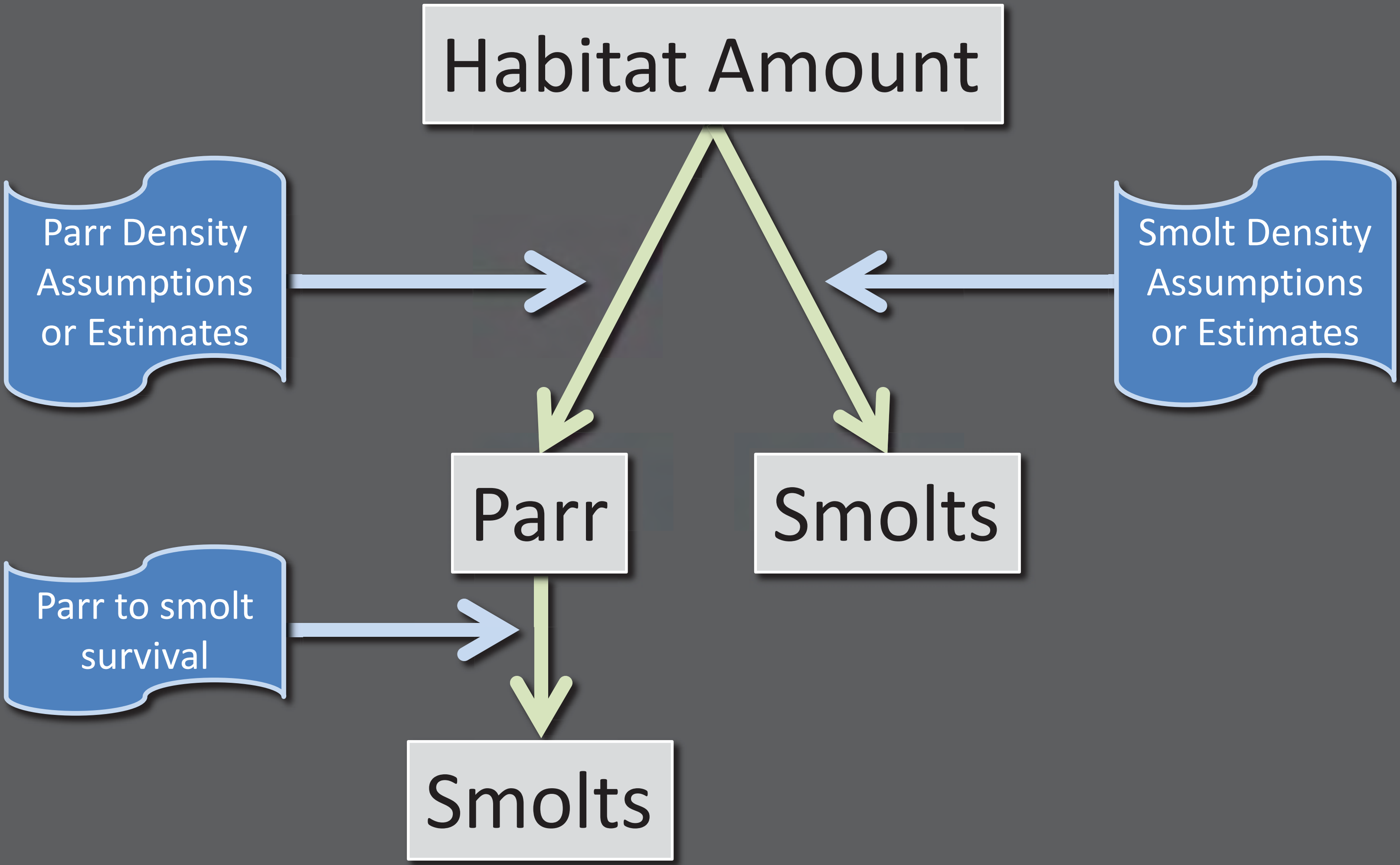
Egg to Smolt Survival

Fecundity

Sex Ratio

Spawners

Methods of Estimating Carrying Capacity: Kr



Habitat Amount

Parr Density Assumptions or Estimates

Smolt Density Assumptions or Estimates

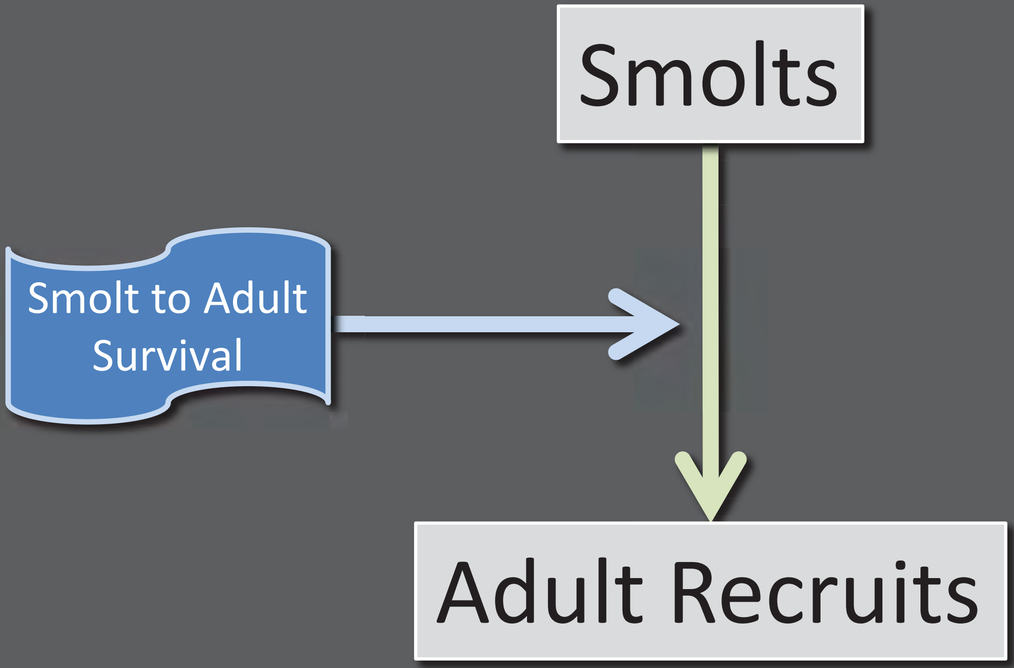
Parr

Smolts

Parr to smolt survival

Smolts

Methods of Estimating Carrying Capacity: Kr

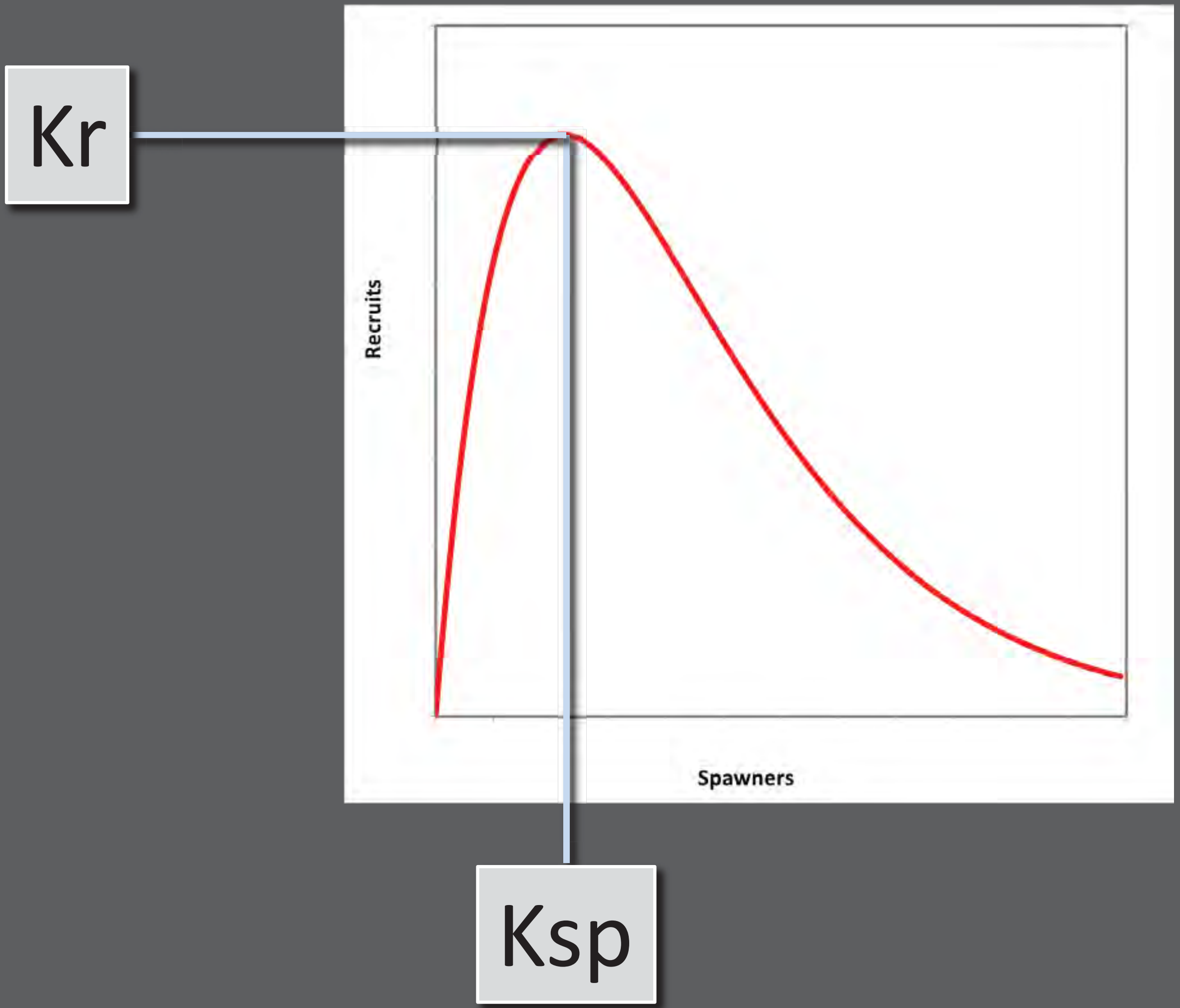


Smolts

Smolt to Adult Survival

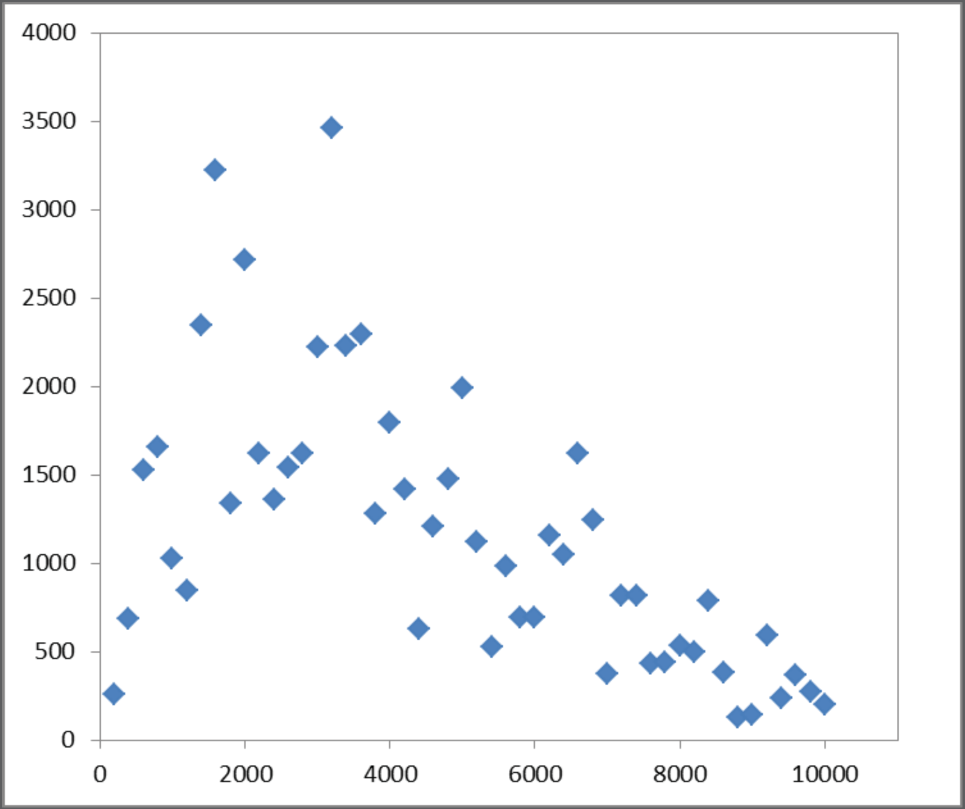
Adult Recruits

Methods of Estimating Carrying Capacity: SR Models

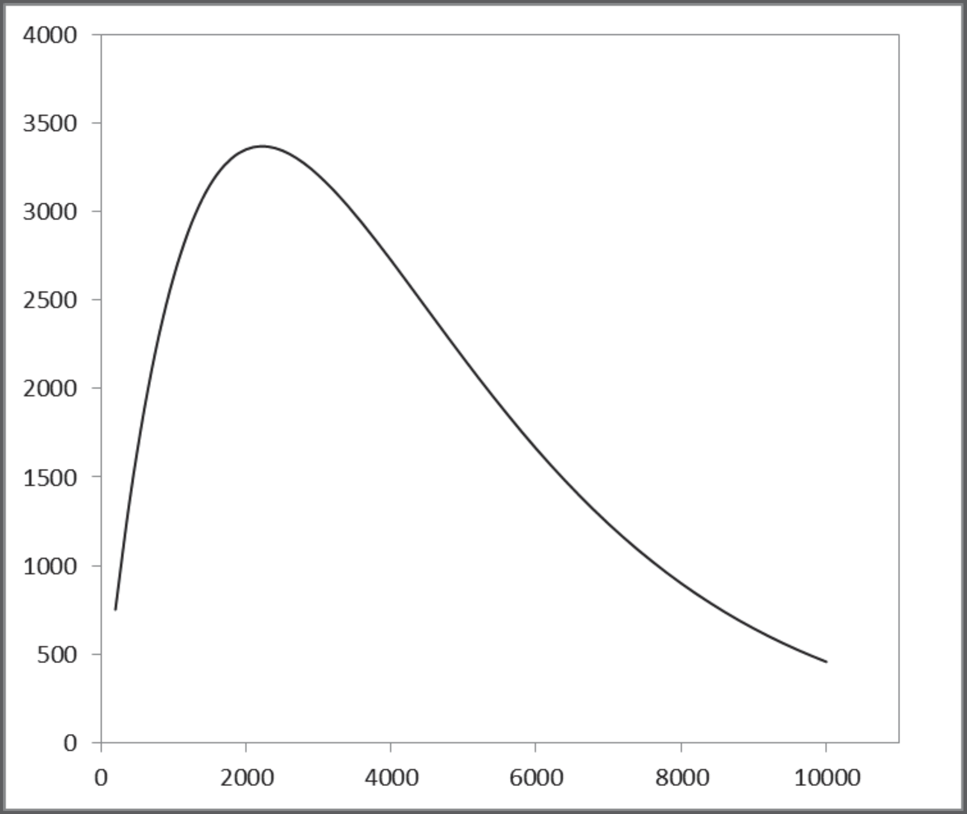


Attachment B

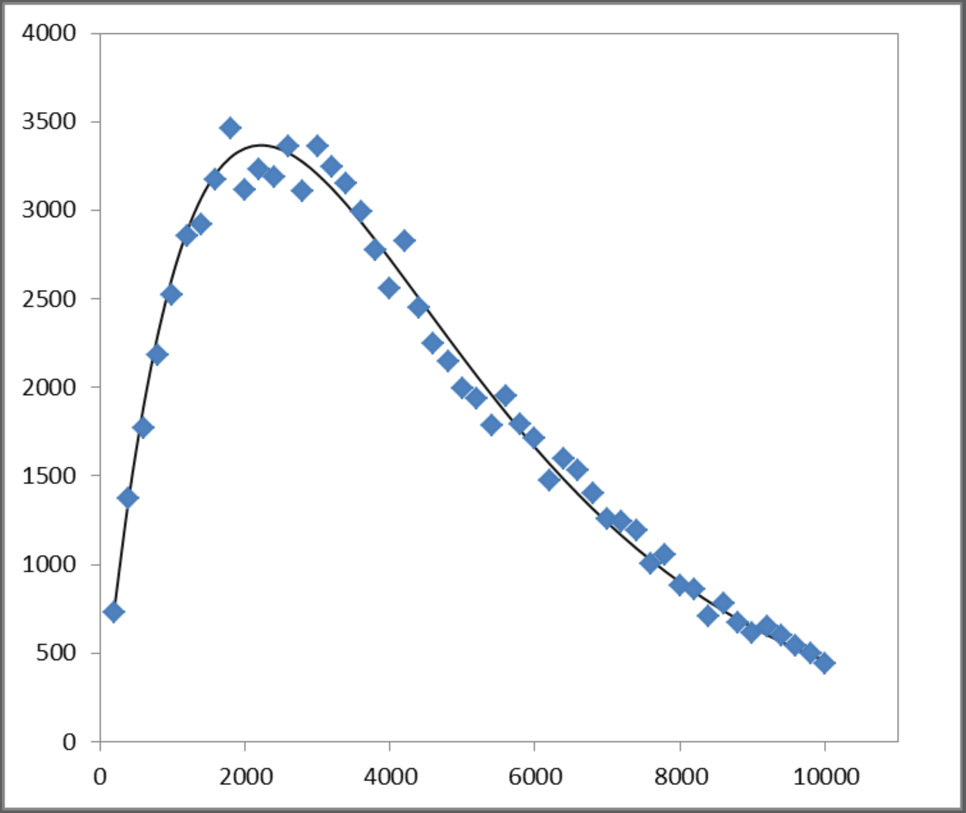
Stock Recruit and Limiting Factors



Stock Recruit Model

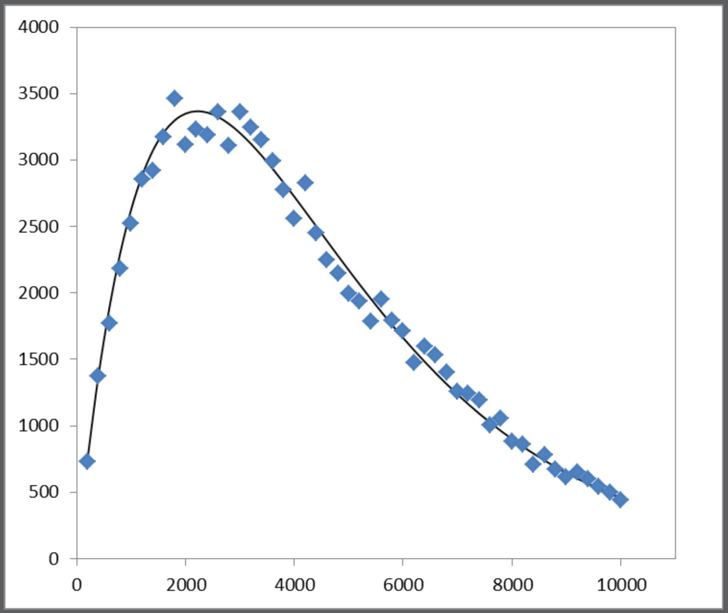


Generate Data

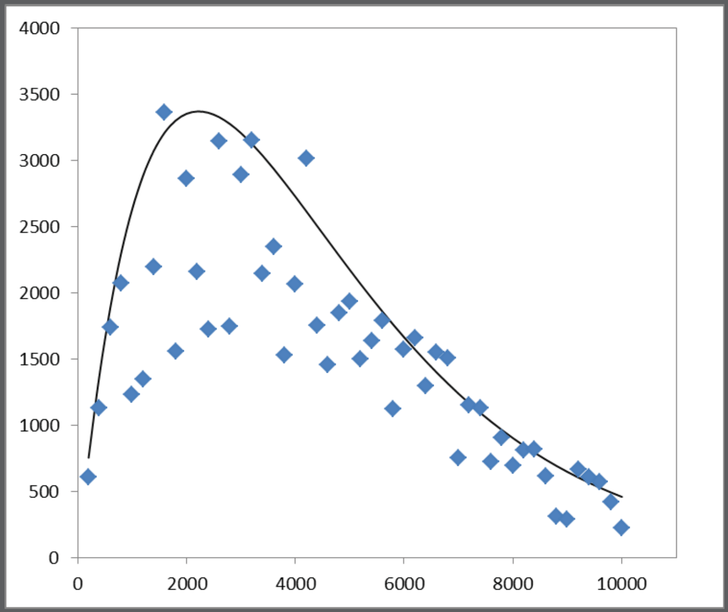


Attachment B

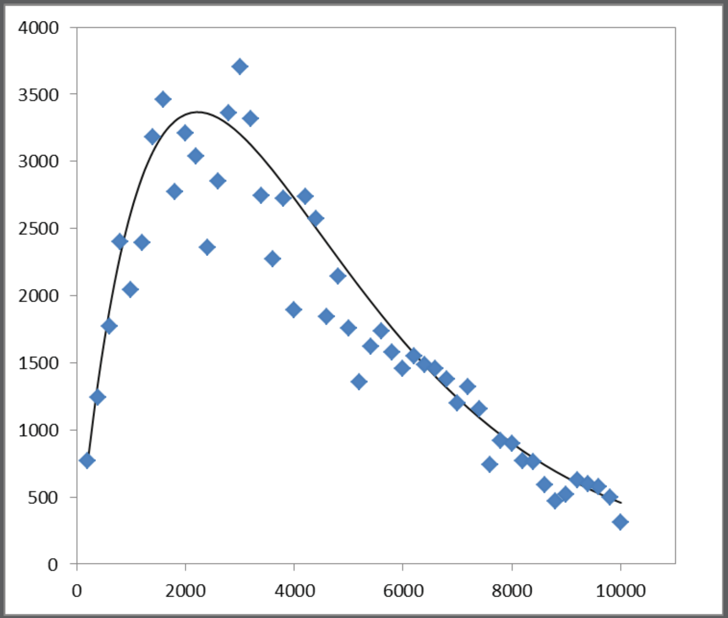
1 factor



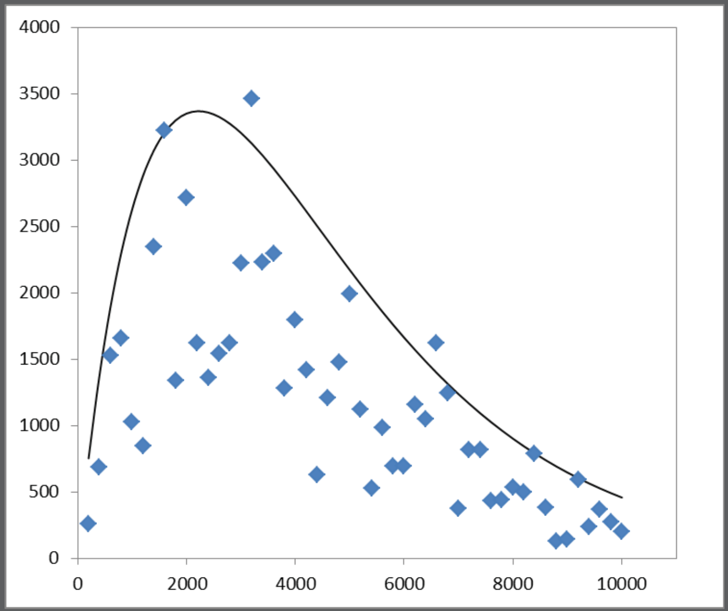
3 factors



2 factors

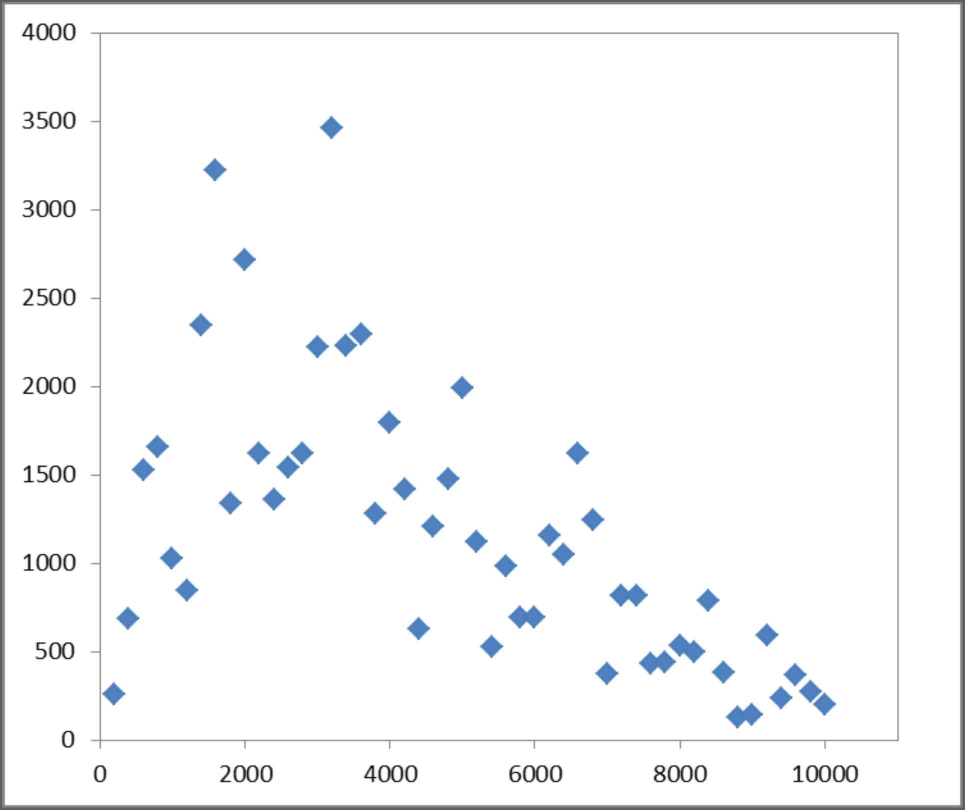


4 factors

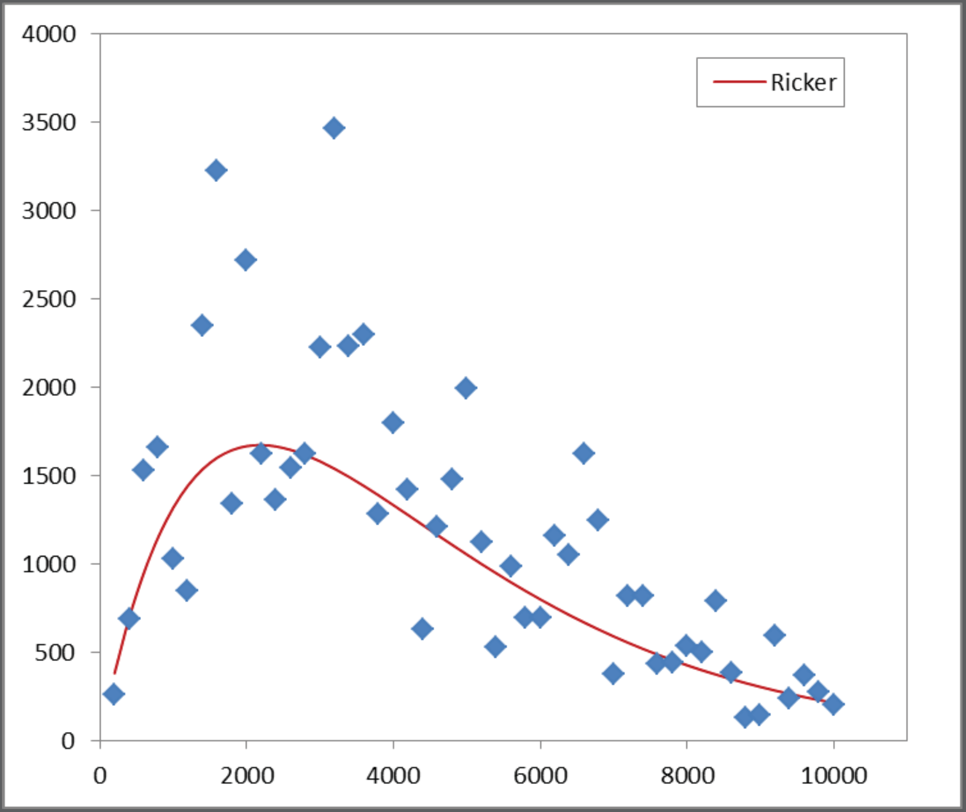


adapted from Cade and Noon, 2003

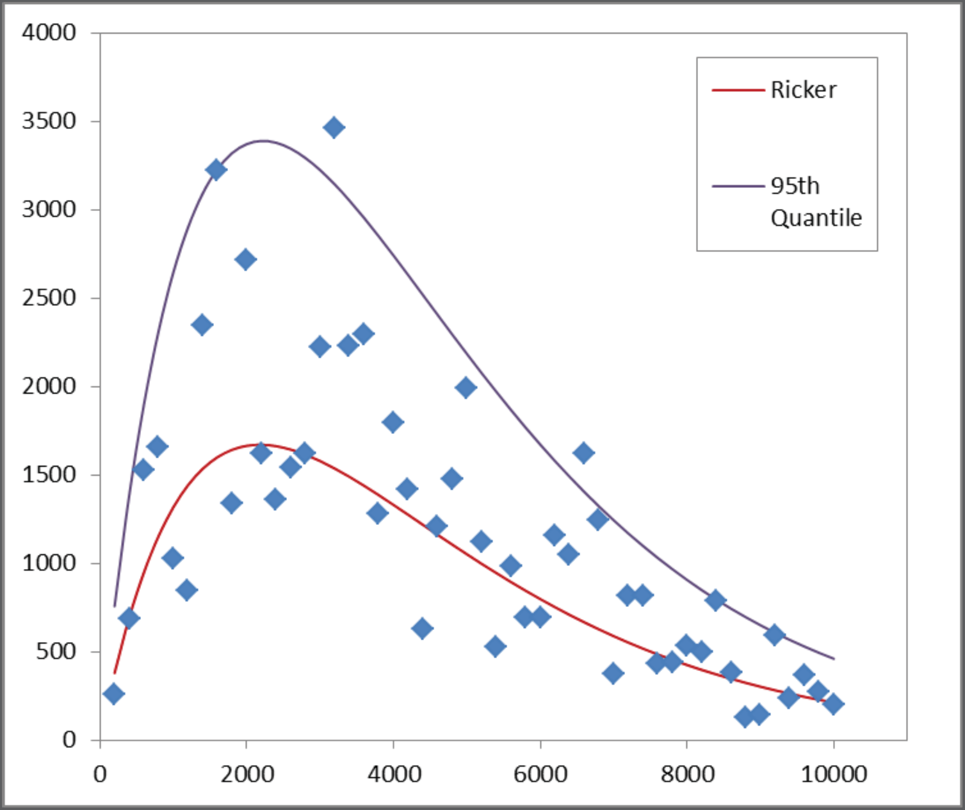
Functional Relationships in a Stock Recruit Distribution: Quantile Regression



Ricker: mean response

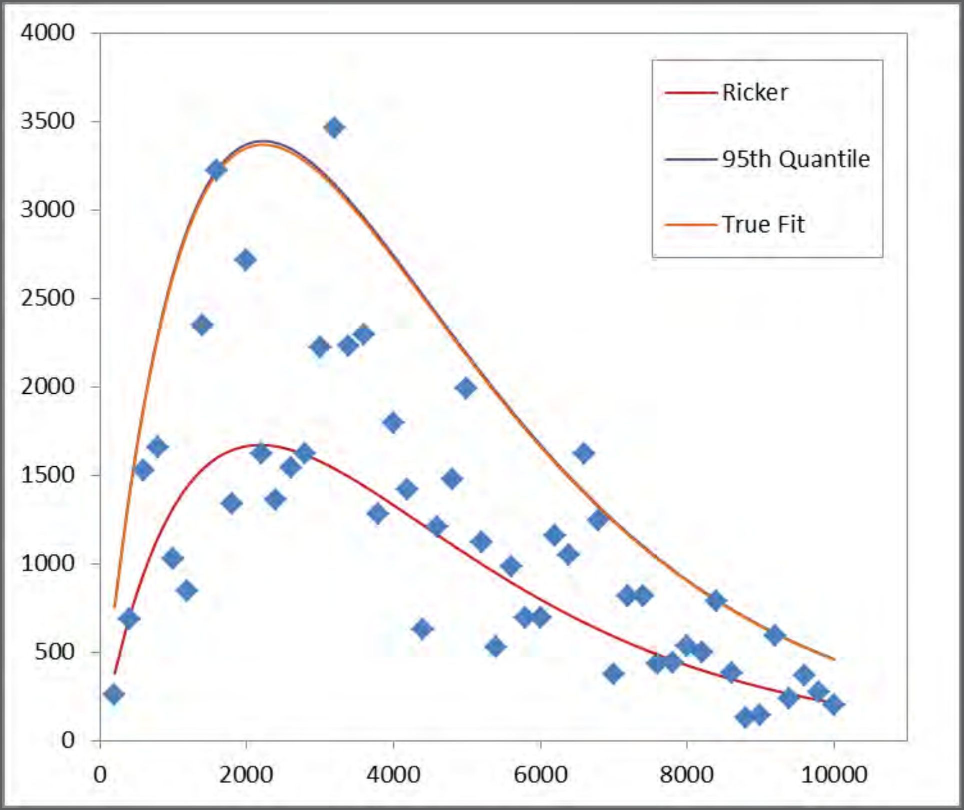


Response at Chosen Quantile



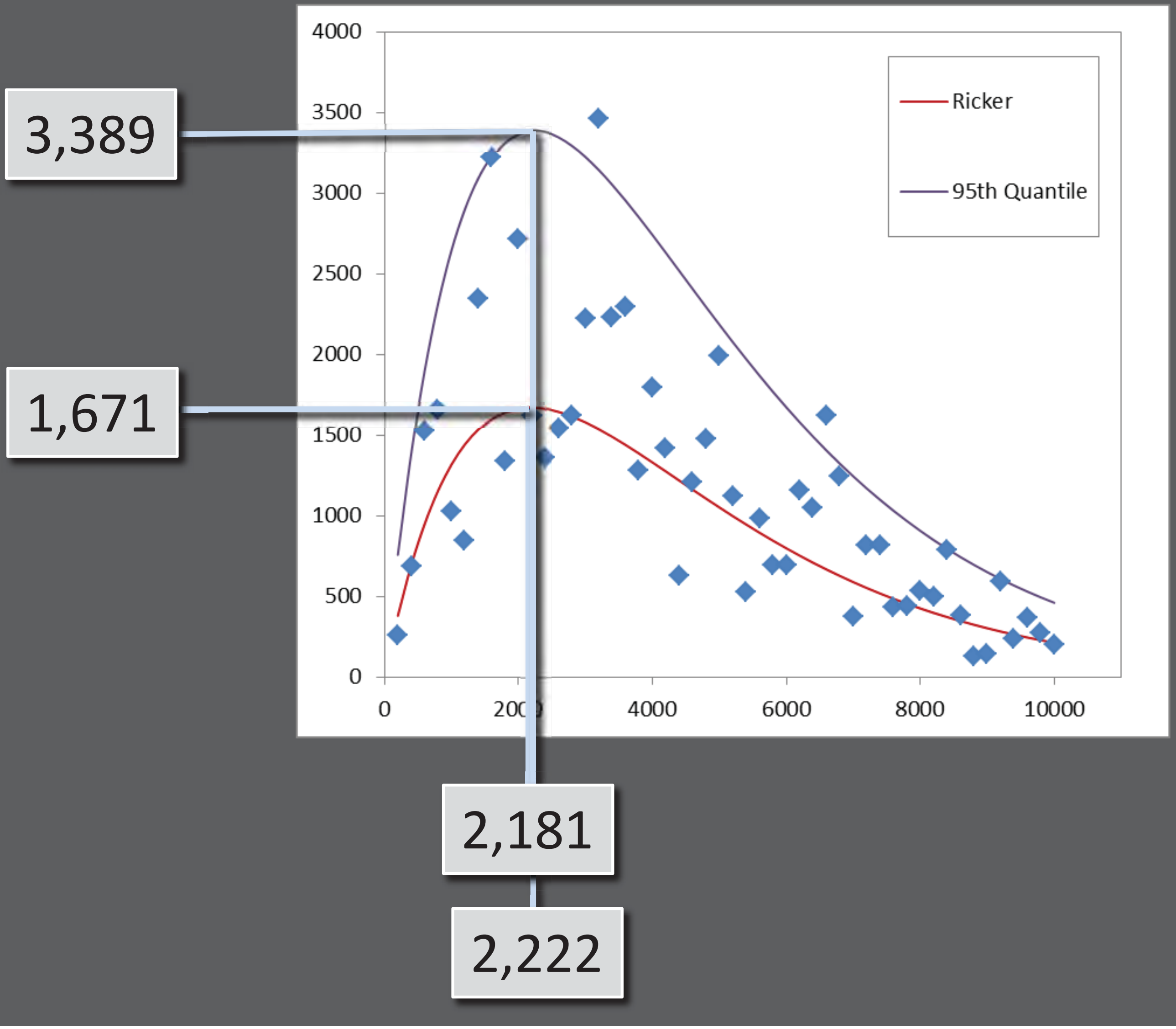
Koenker, 2013. Quantreg version 5.05; Package for R

Add the True Underlying Relationship



Attachment B

Ksp and Kr



3,389

1,671

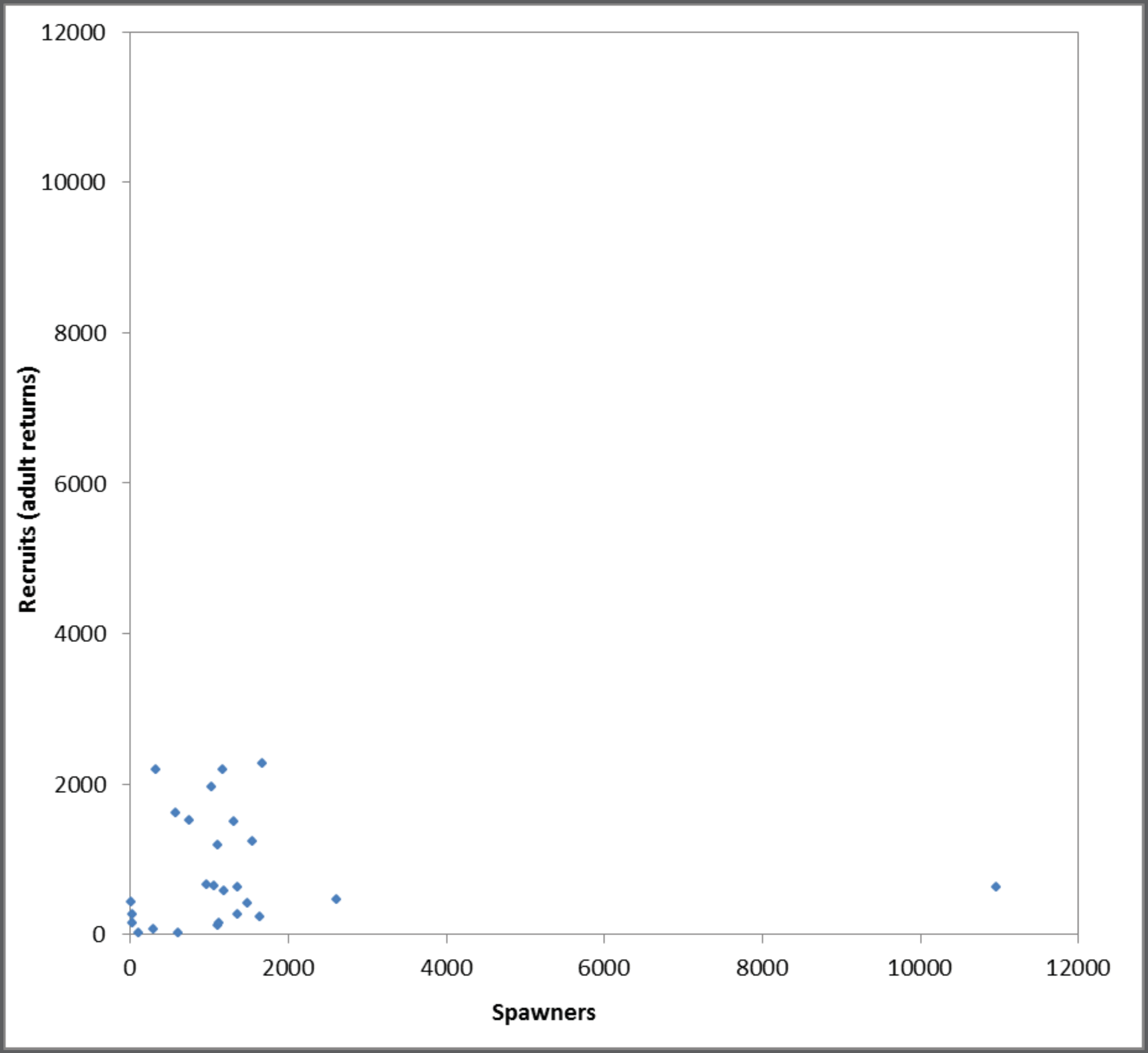
2,181

2,222

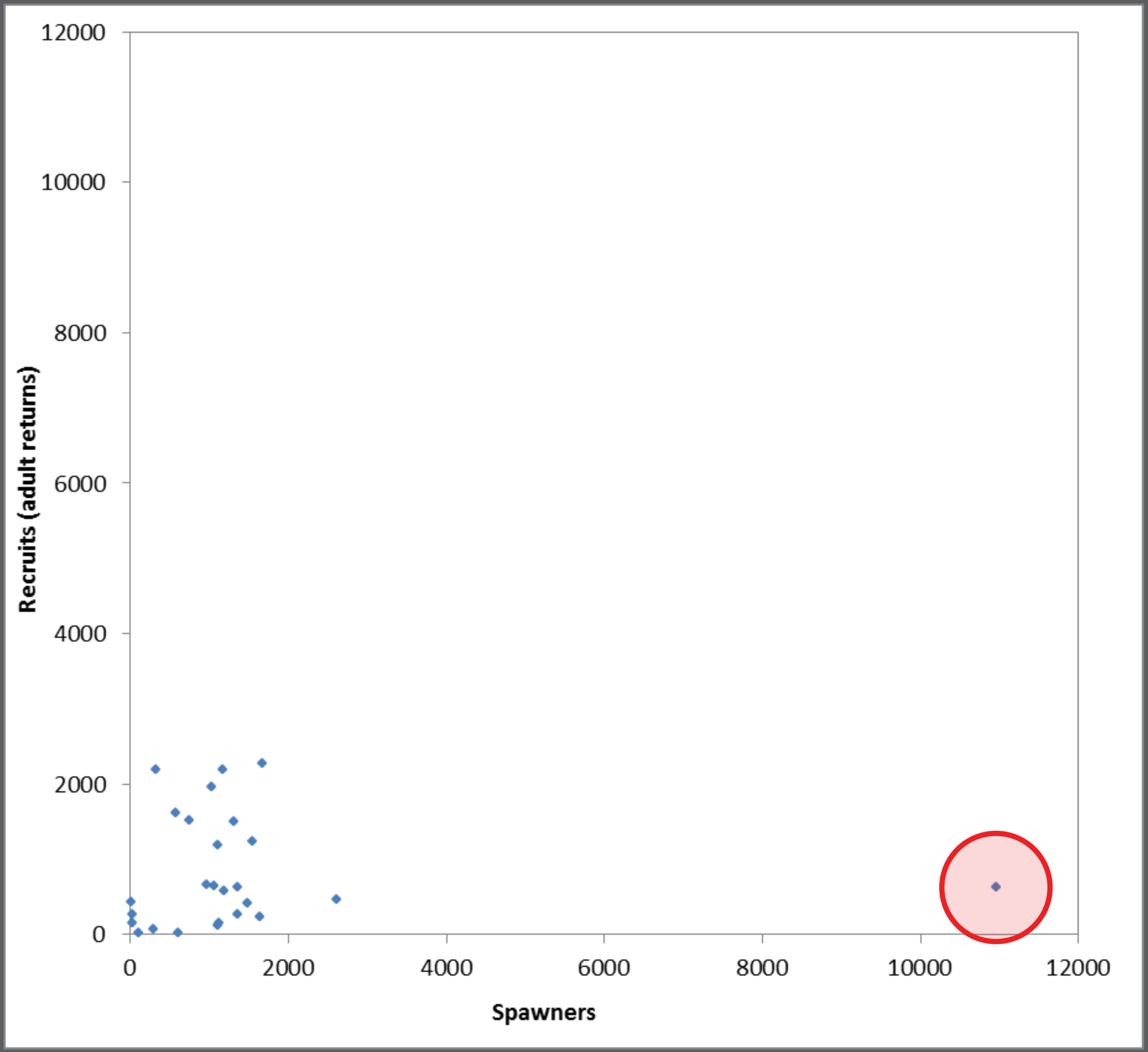
Attachment B

Real Data

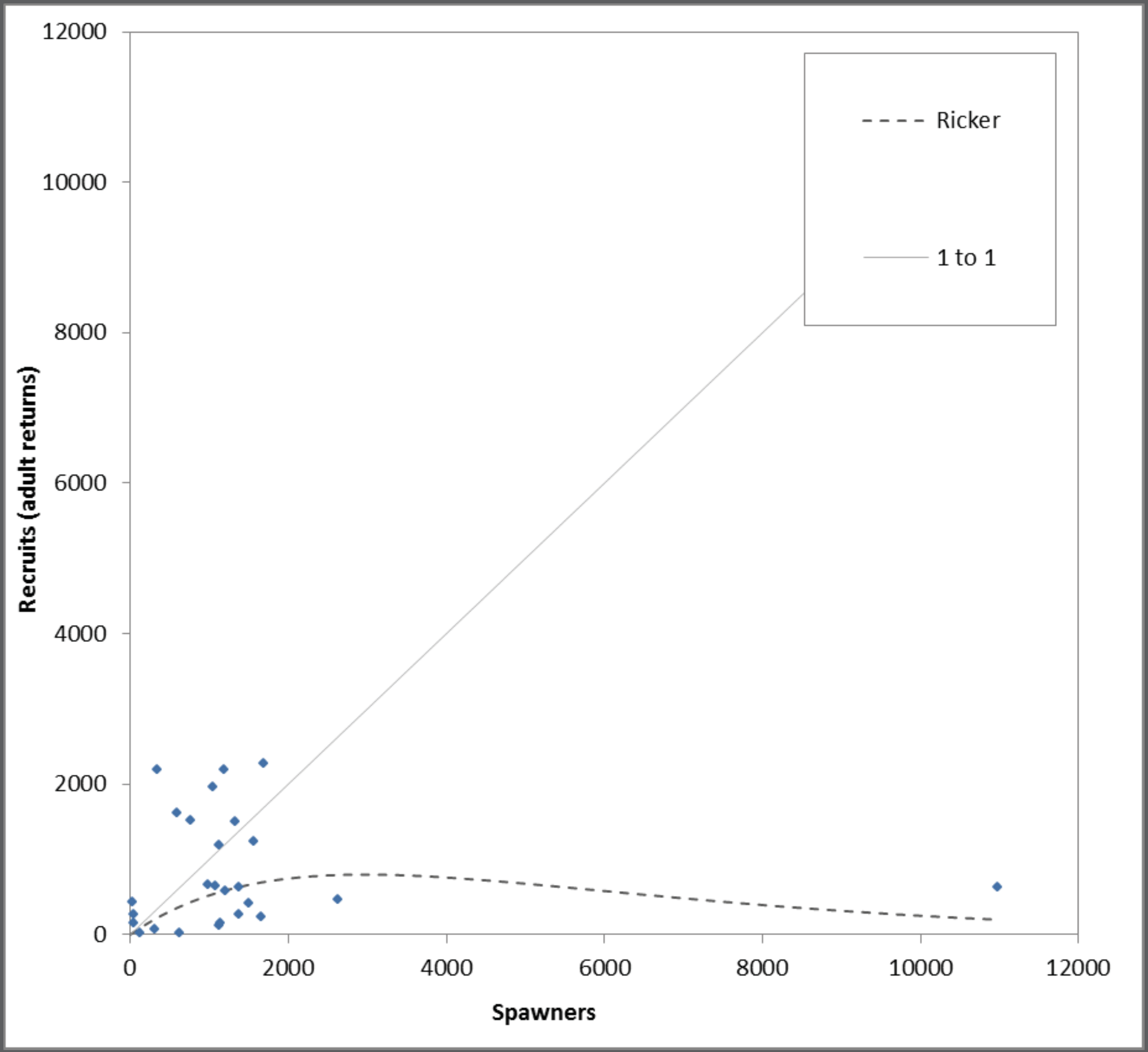
Spring Chinook (1981-2007)



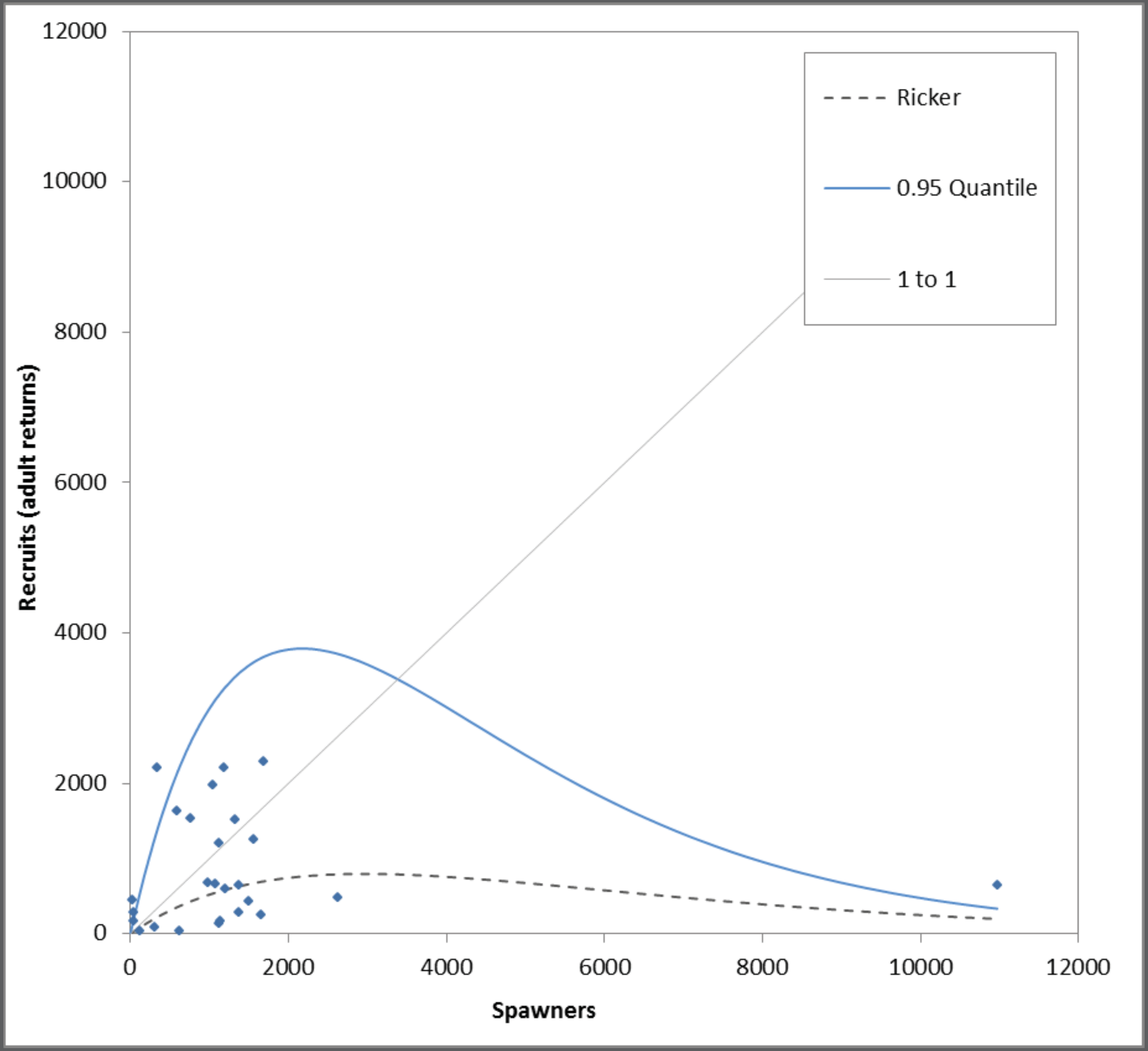
Spring Chinook (1981-2007)



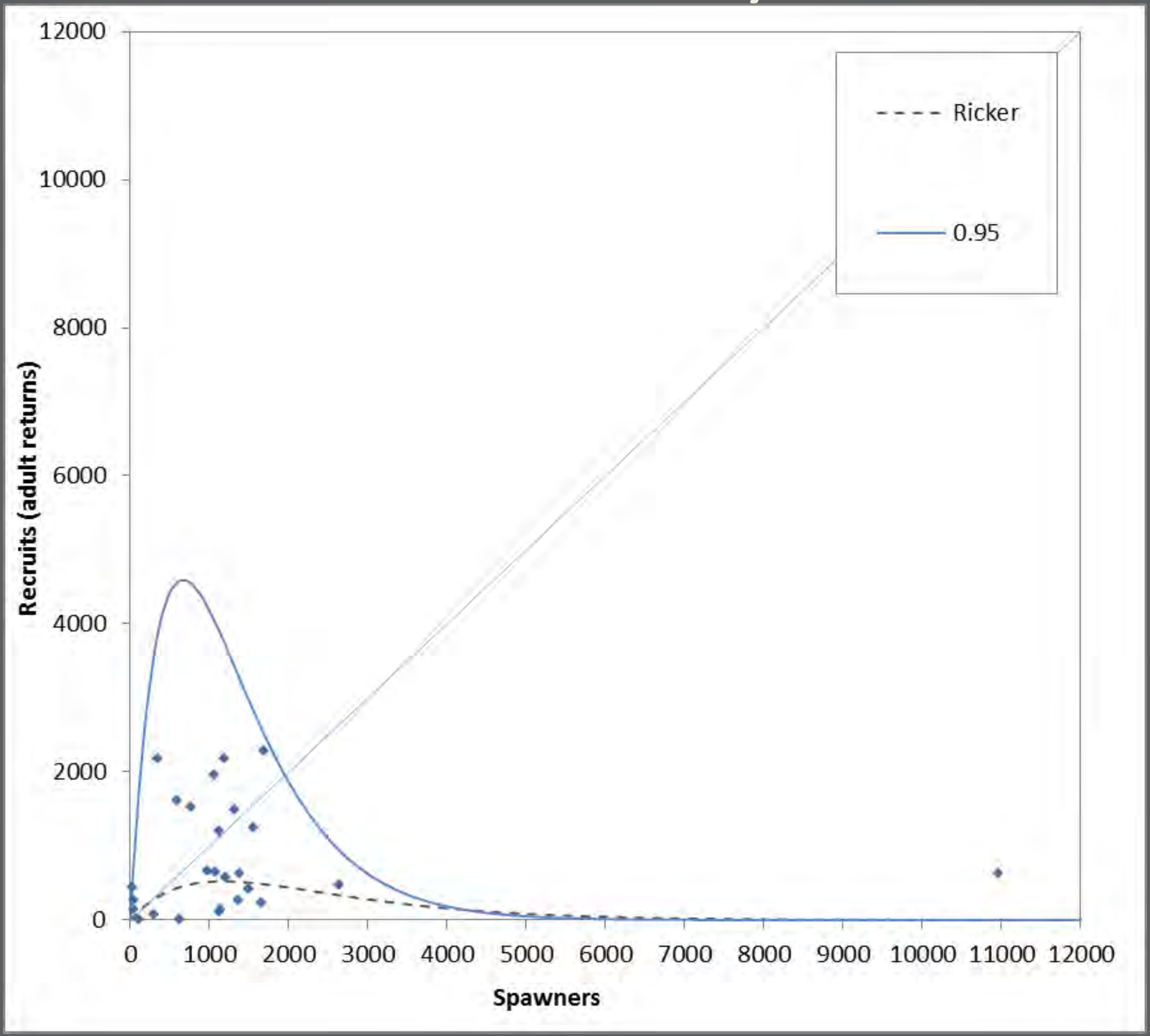
Spring Chinook - Ricker



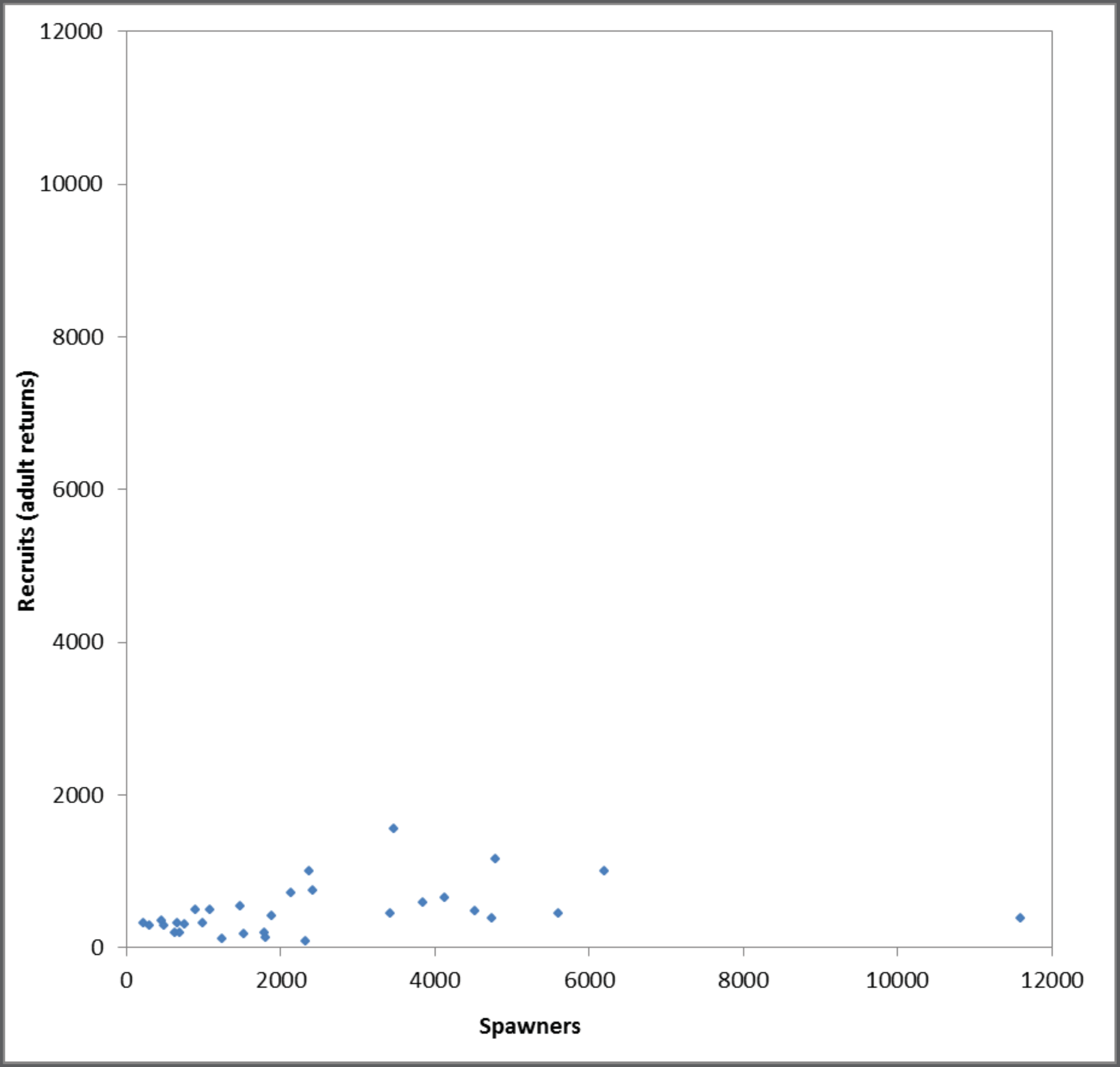
Spring Chinook – 95th Quantile



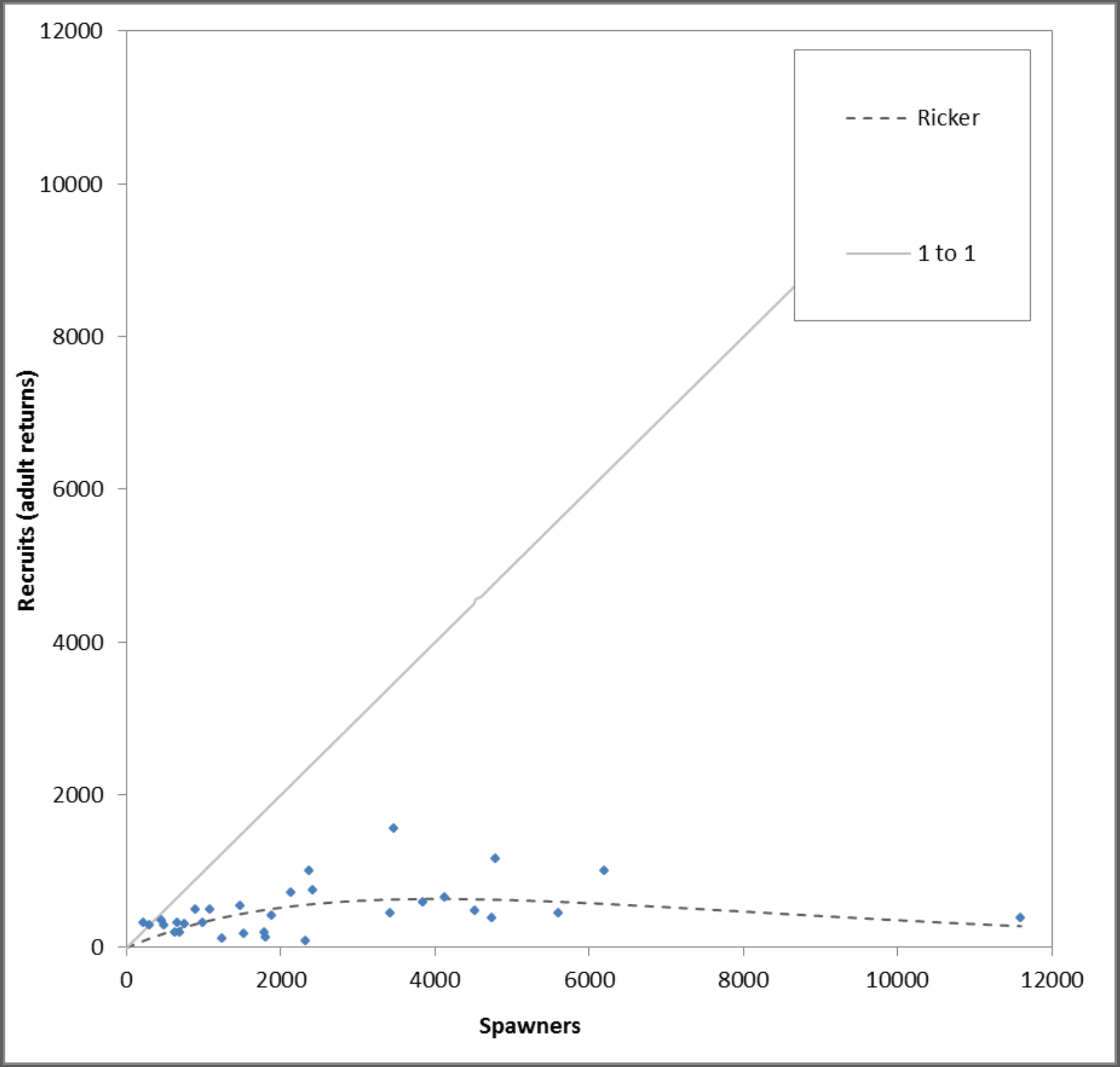
Spring Chinook (extreme value not modeled)



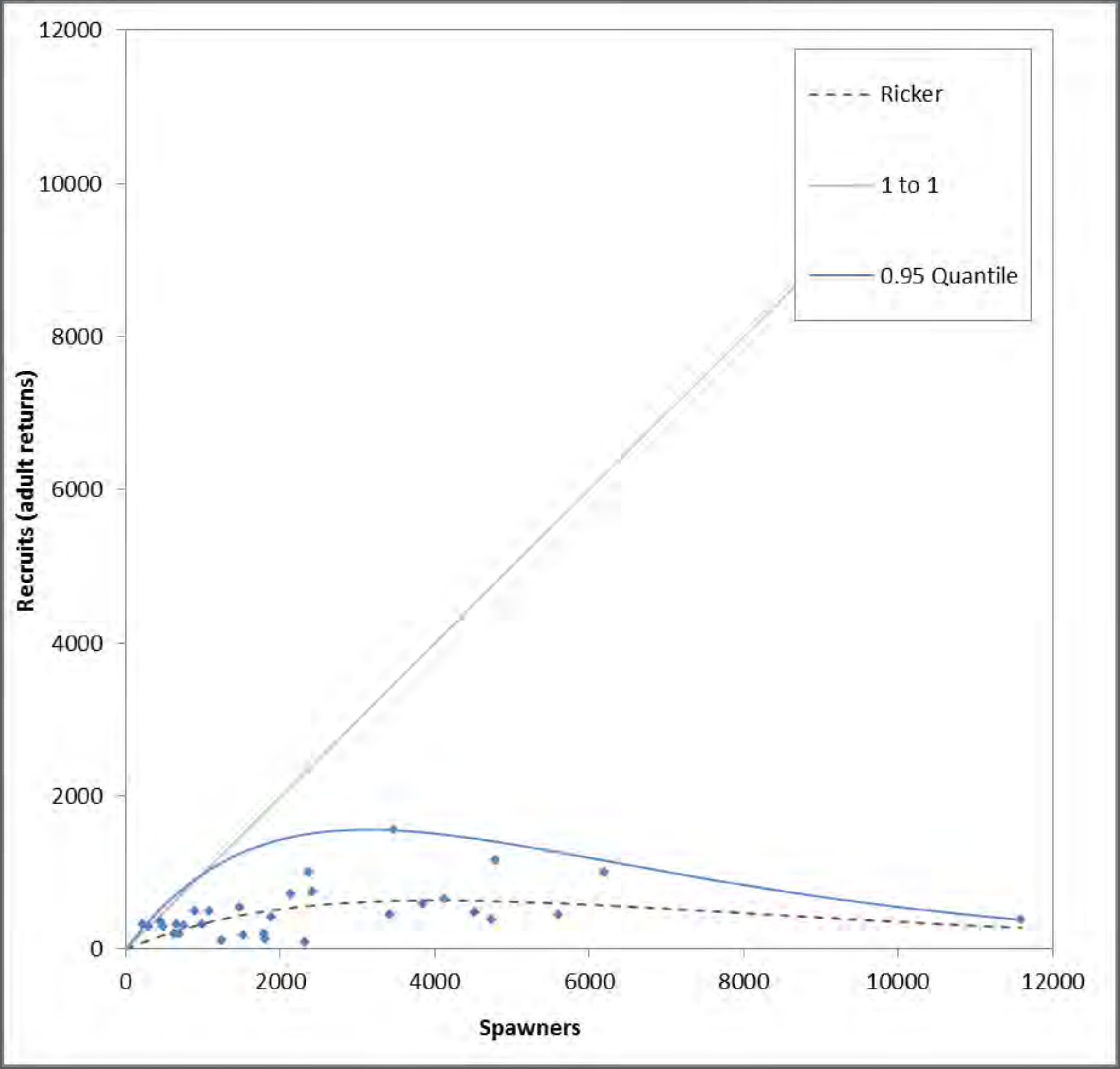
Steelhead (1976-2006)



Steelhead - Ricker



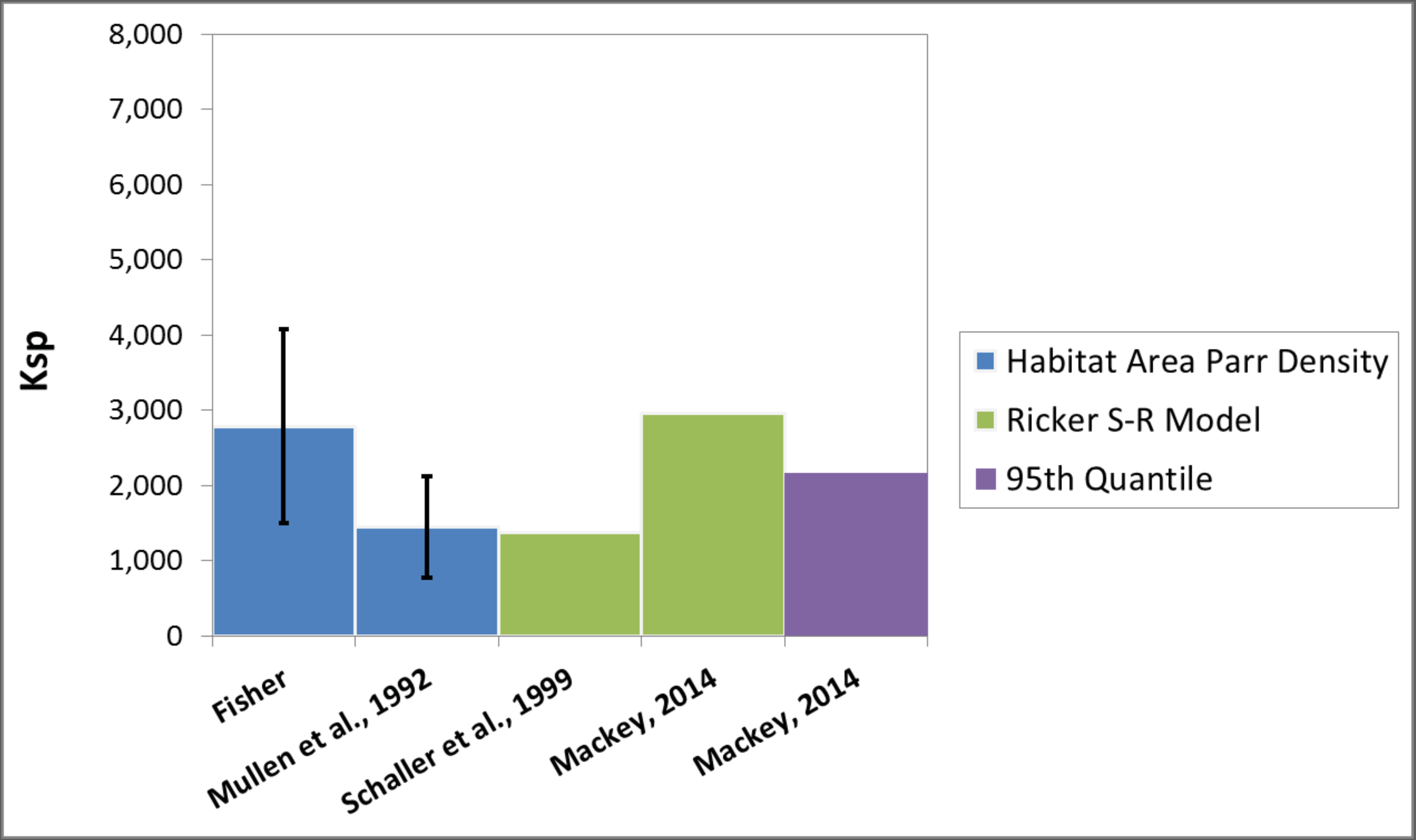
Steelhead – 95th Quantile



Attachment B

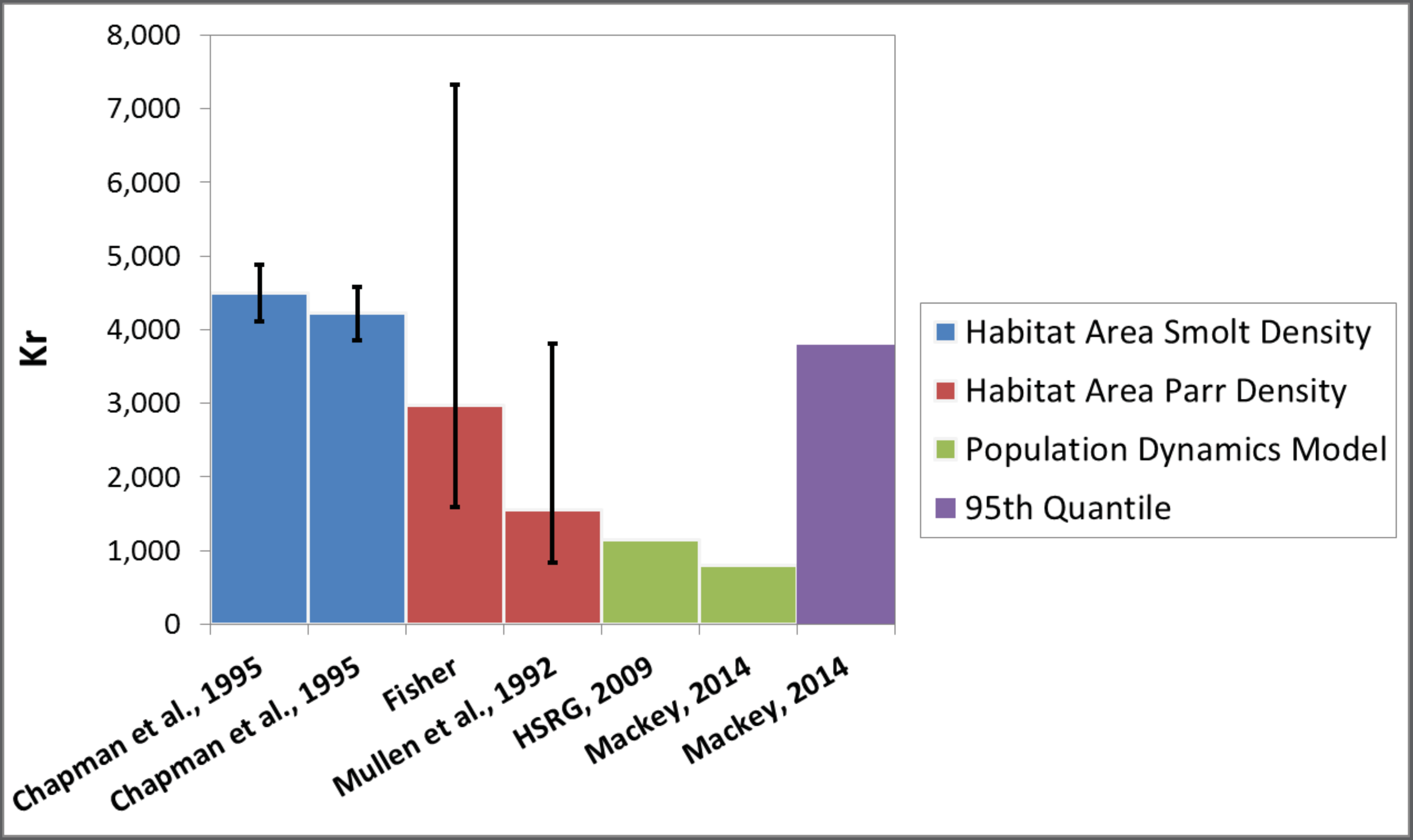
Overview of Estimates

Spring Chinook Ksp



adapted from Ford et al., 2001

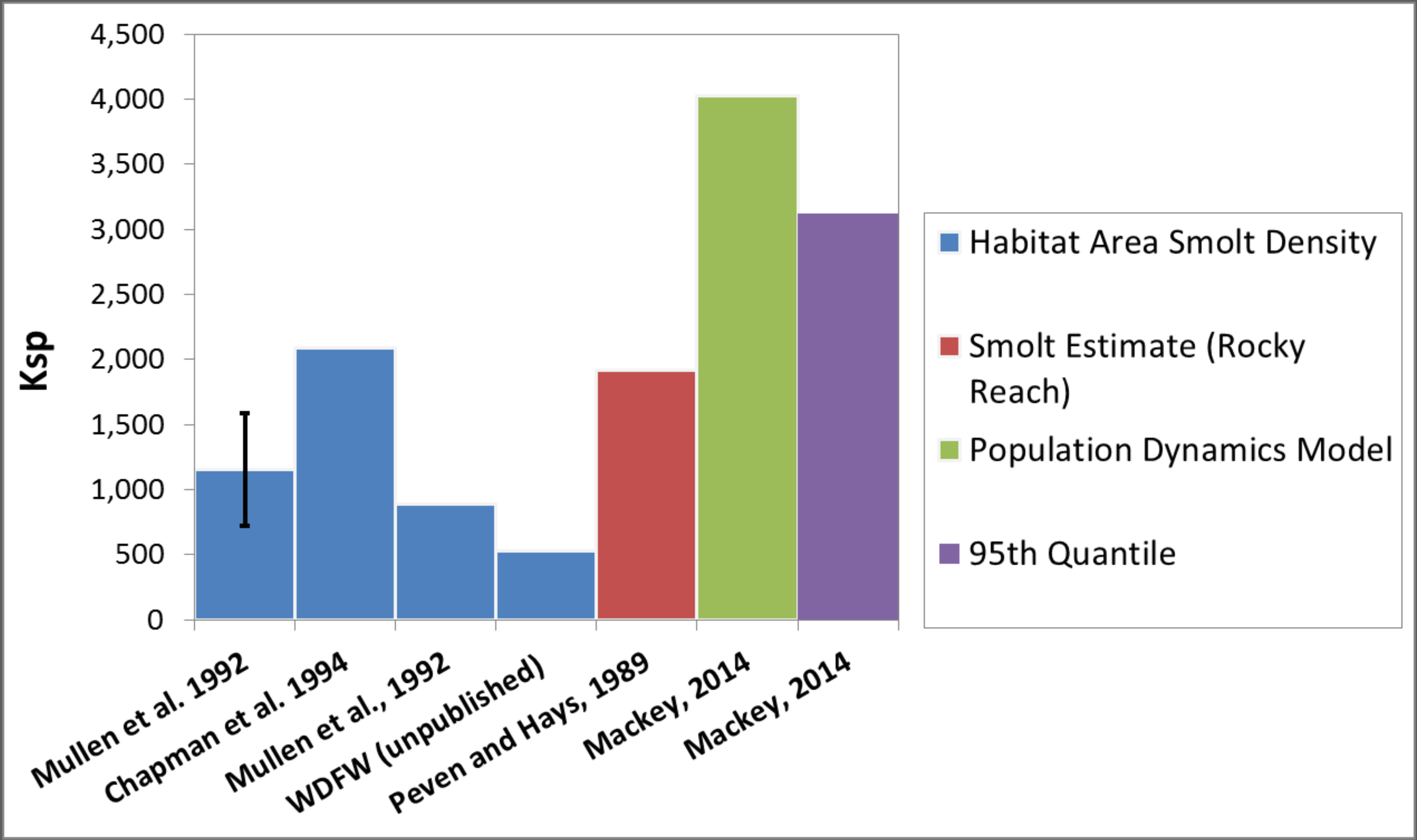
Spring Chinook Kr



adapted from Ford et al., 2001

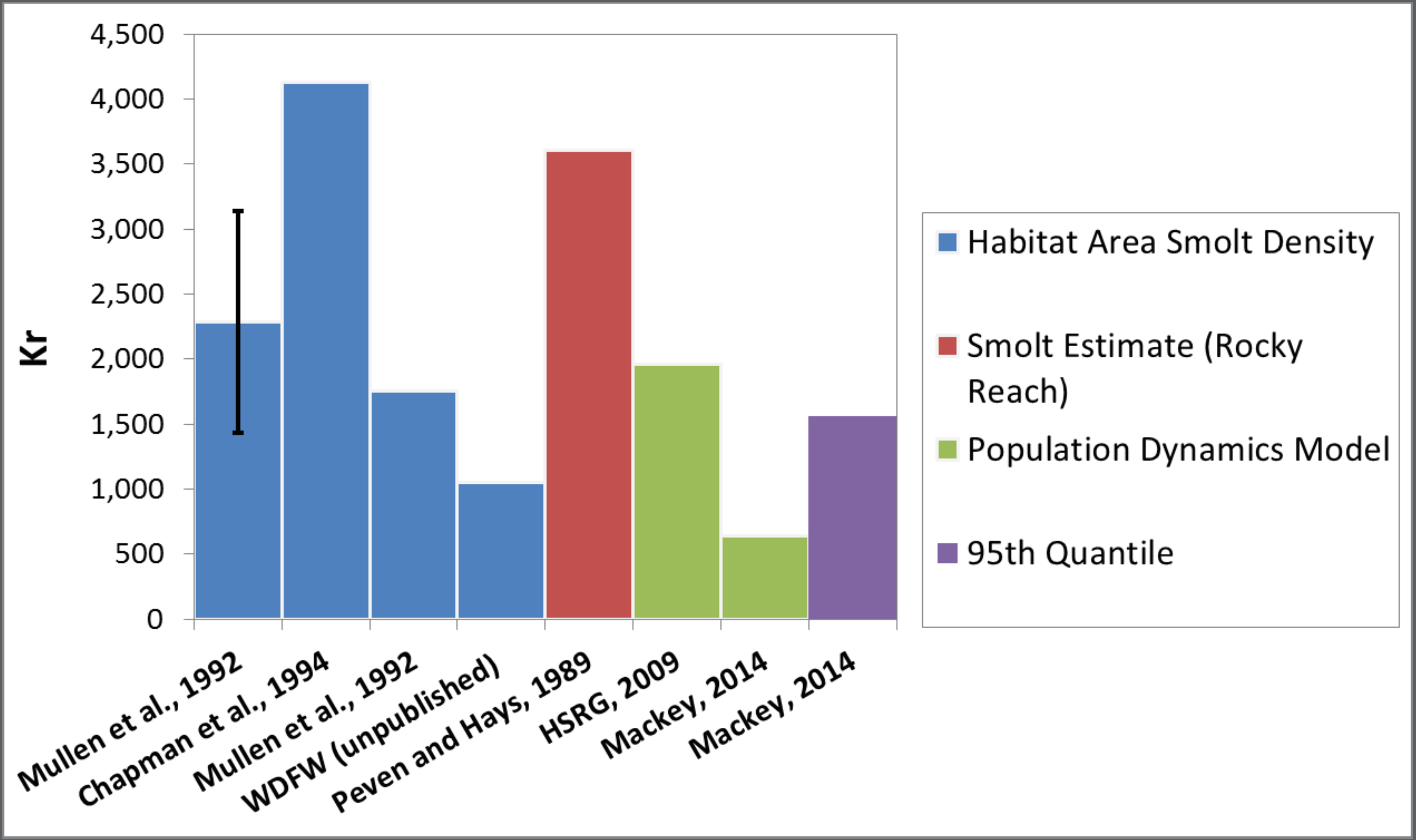
Attachment B

Summer Steelhead Ksp



adapted from Ford et al., 2001

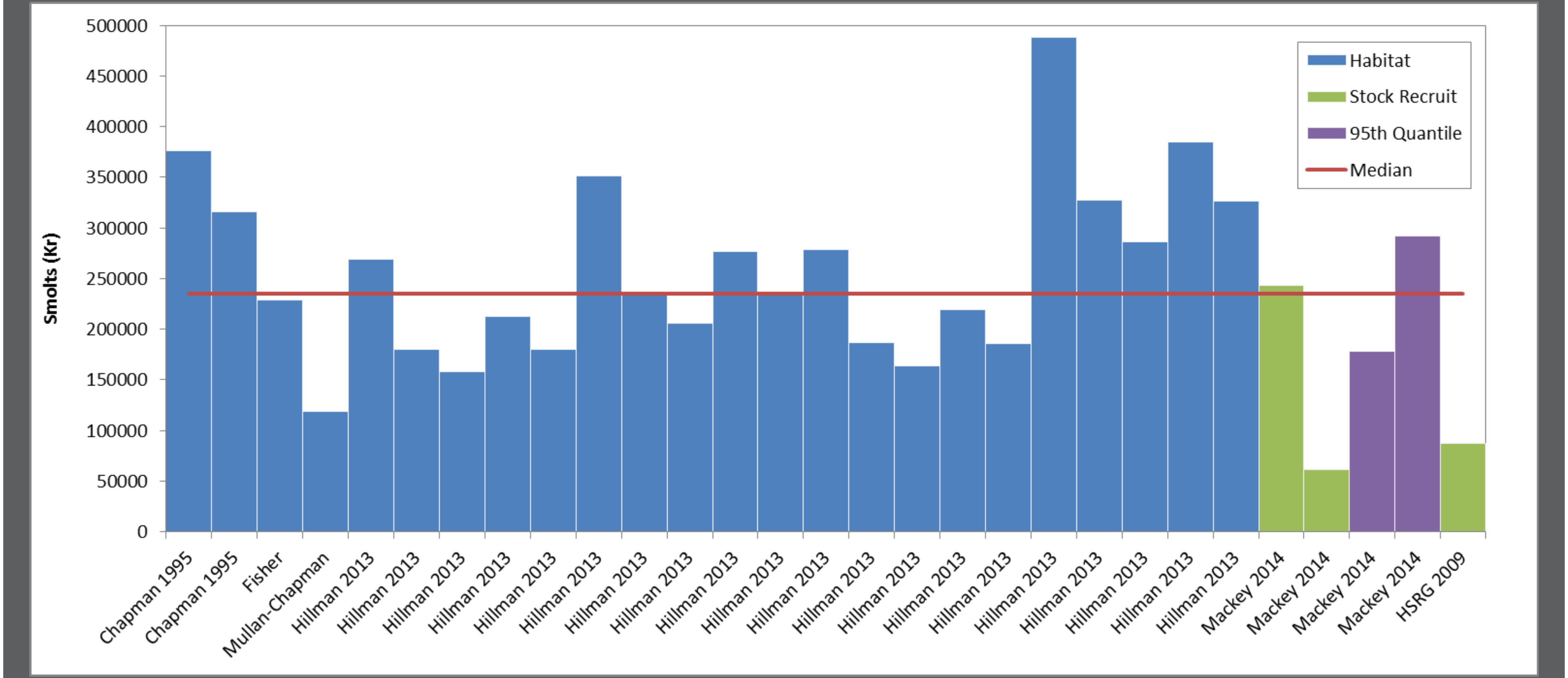
Summer Steelhead Kr



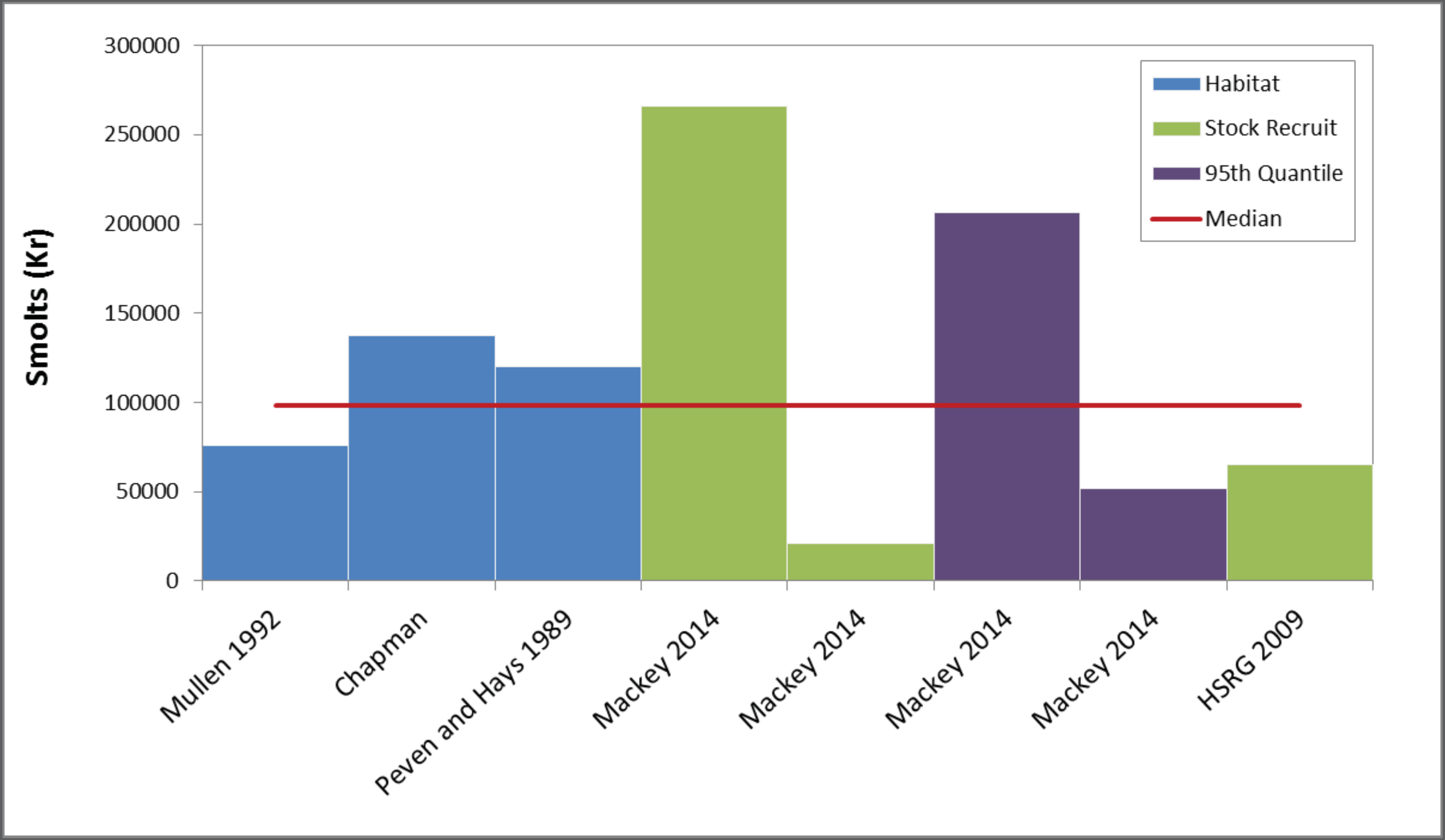
adapted from Ford et al., 2001

Attachment B

Spring Chinook Smolt Kr



Steelhead Smolt Kr



Conclusions

- Quantile Regression techniques can be used in stock recruit model parameter estimation to explore the upper limits of response in the S-R distribution.
- This may reveal the upper potential of the SR relationship when emancipated from other limiting factors.
- Concordance among estimates can provide a sense of confidence, while…
- Dissonance may make it hard to identify the “right” estimate.

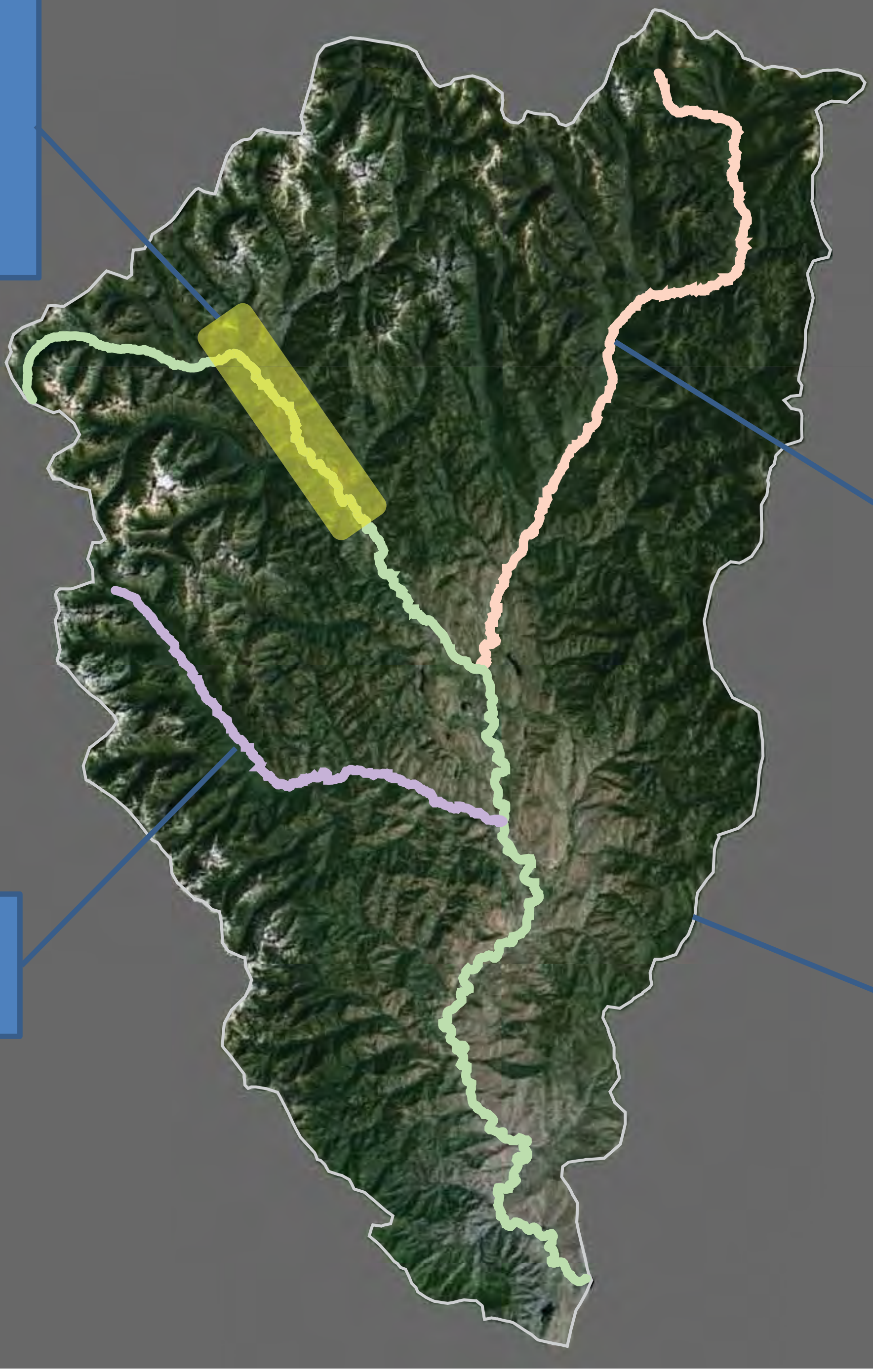
Attachment B

Attachment B

Attachment B

Attachment B

Attachment B



Goes dry (9 of 15 spring Chinook broodyear cohorts, 1992-2006)

Massive fires and silt (70% burned)

Very cold

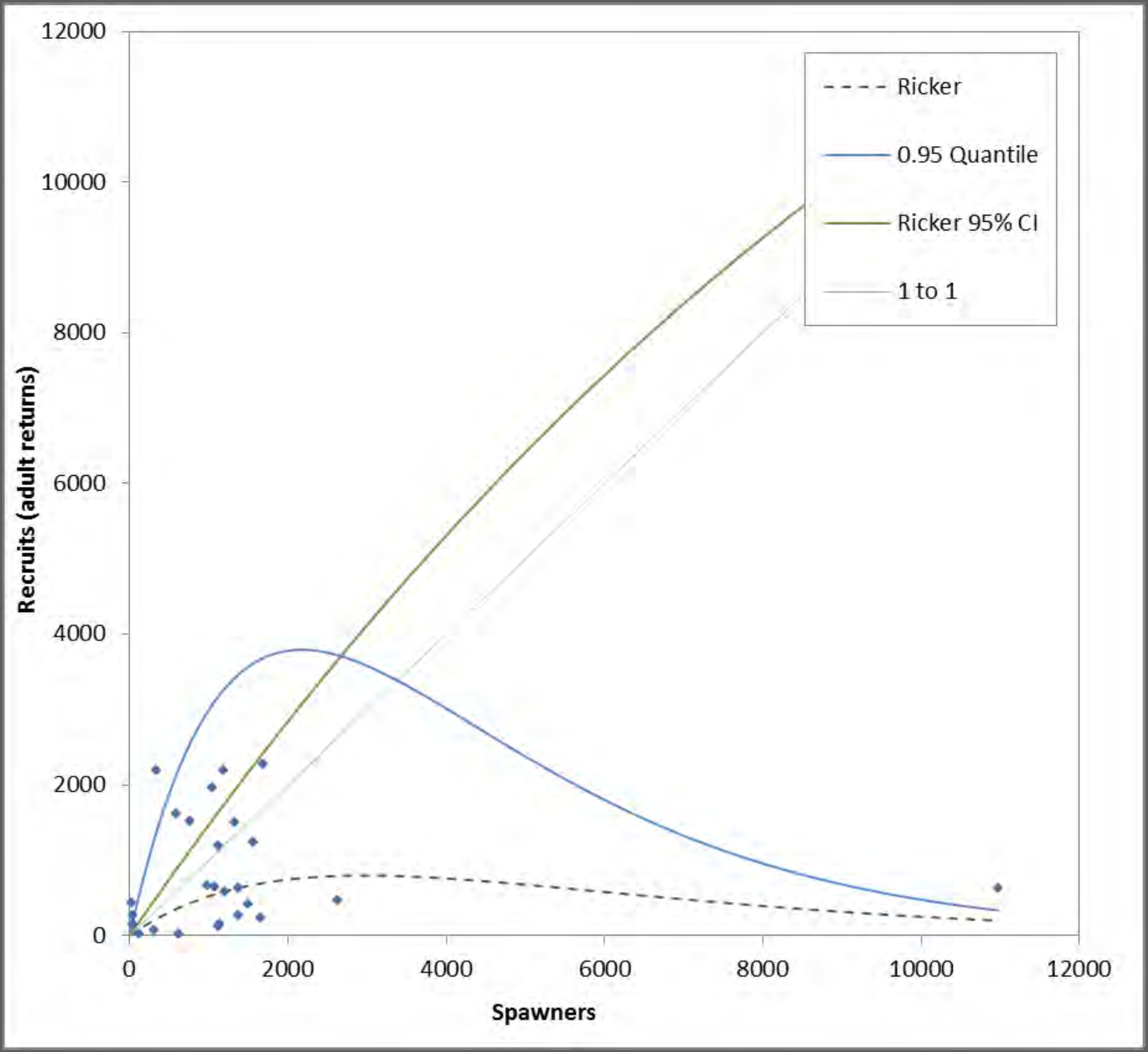
Dry: 13” precipitation annually

Attachment B

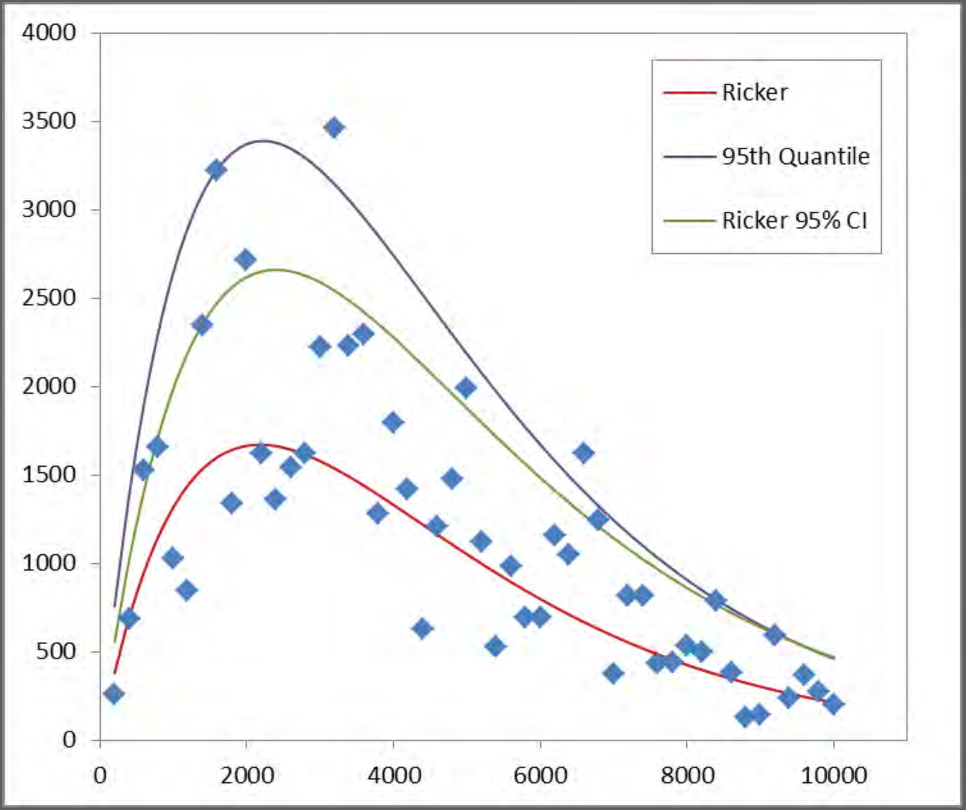
Ksp and Kr of Examples

Model	**Ksp**	**Kr**	**R/S**
Ricker	2,181	1,671	0.77
Ricker 95% CI	2,401	2,660	1.11
Ricker @ 95th Quantile	2,222	3,389	1.53

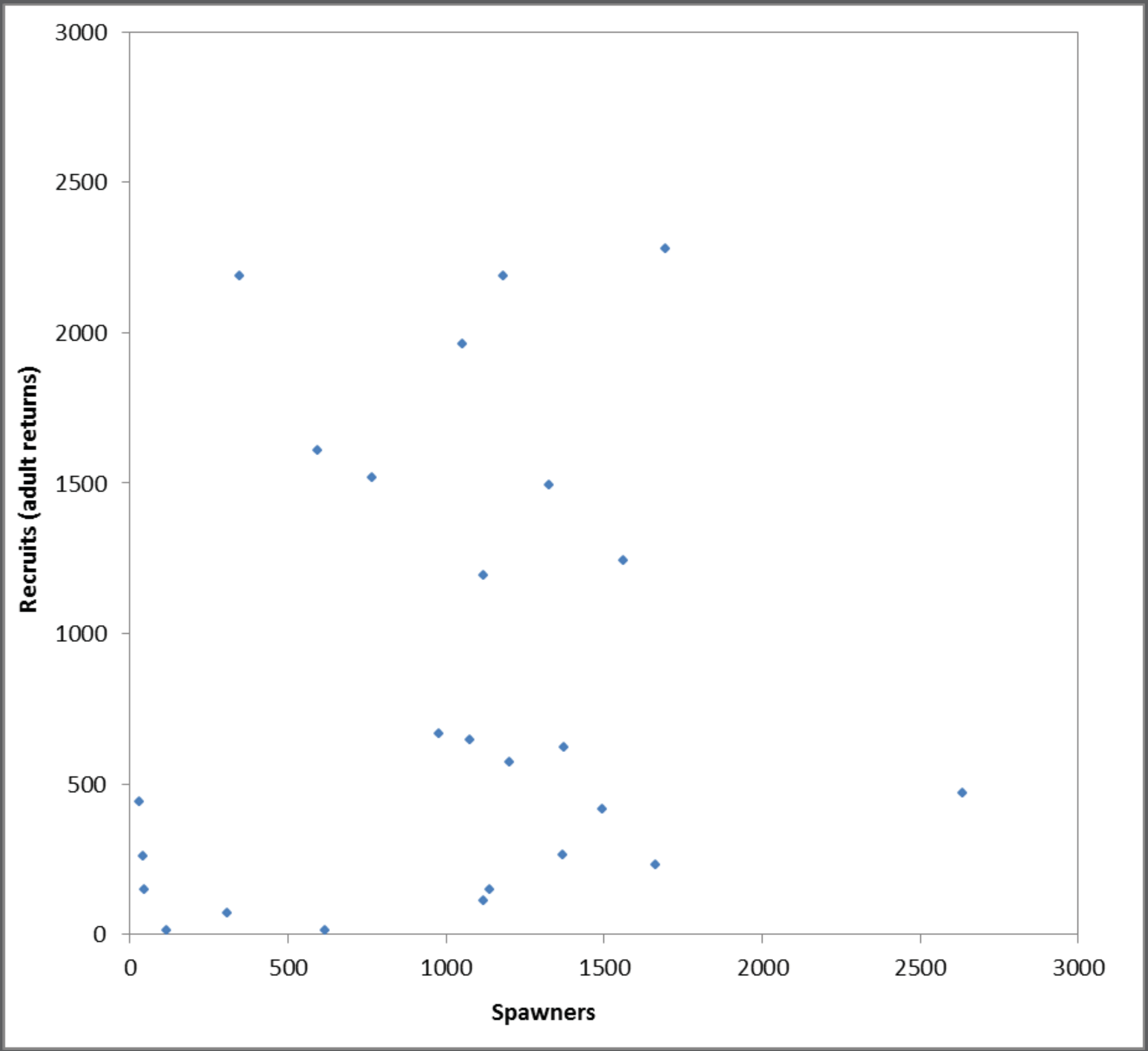
Spring Chinook – 95th CI Ricker



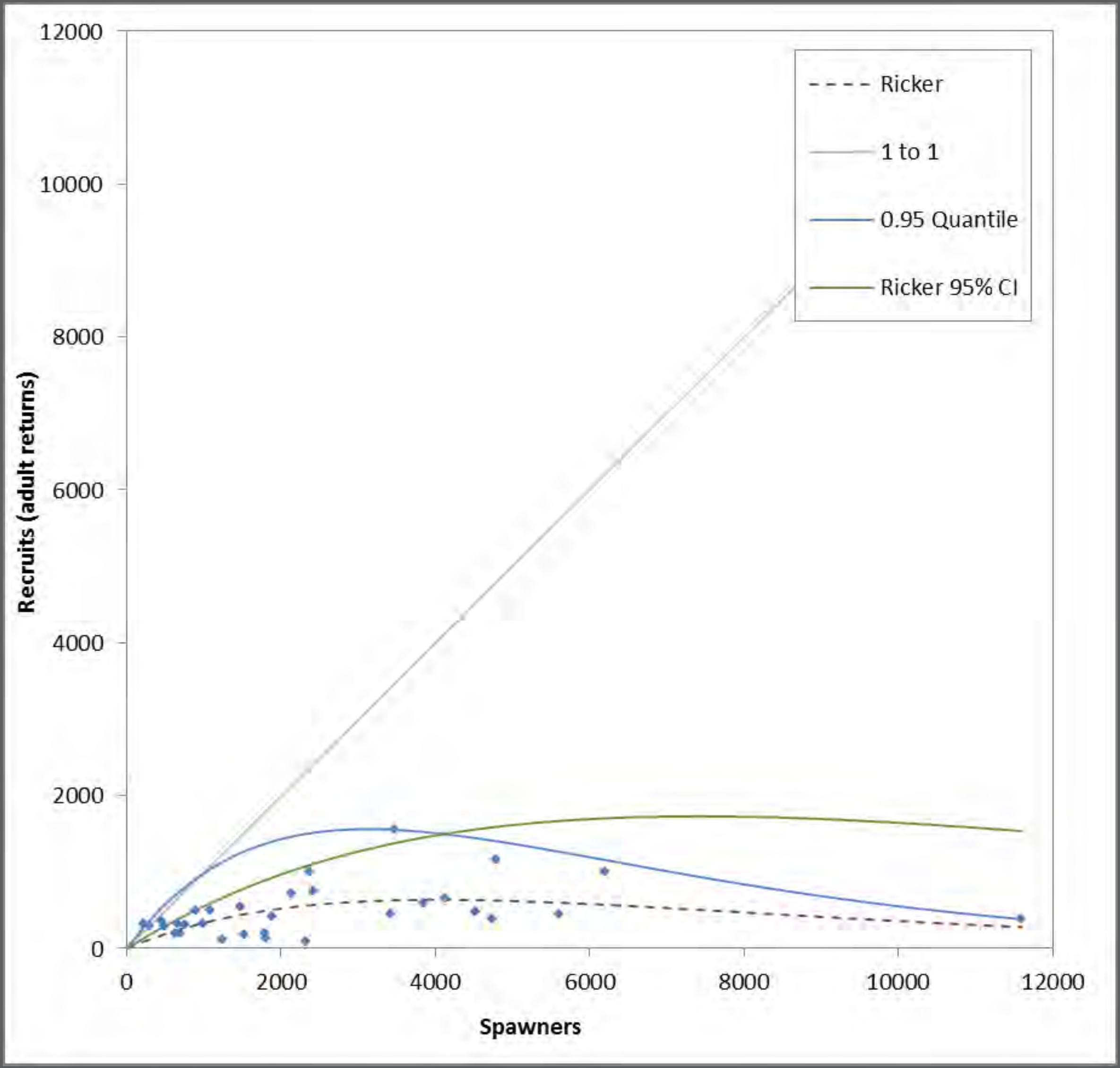
Confidence Interval Compared to Quantile



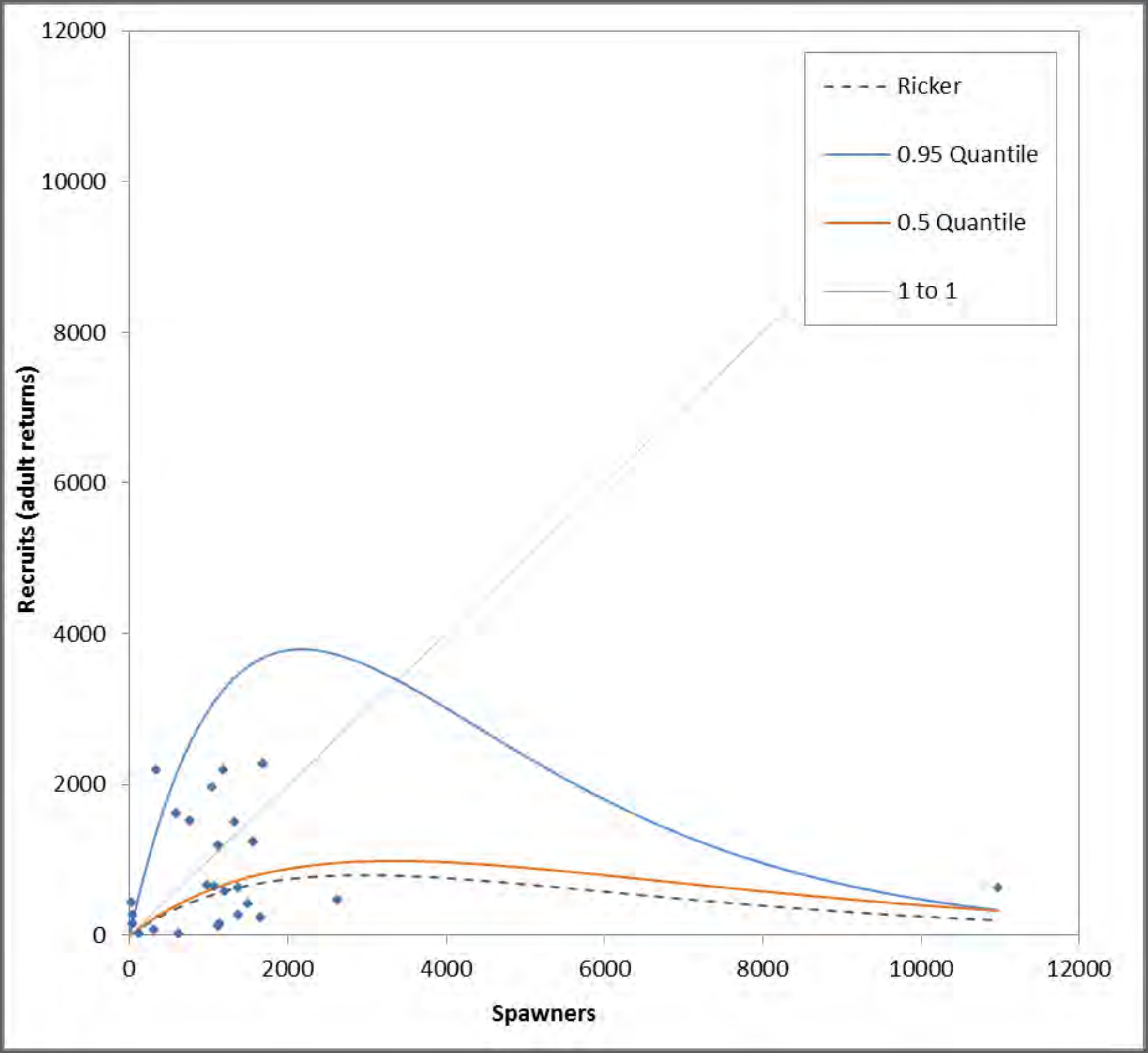
Spring Chinook (1981-2007)



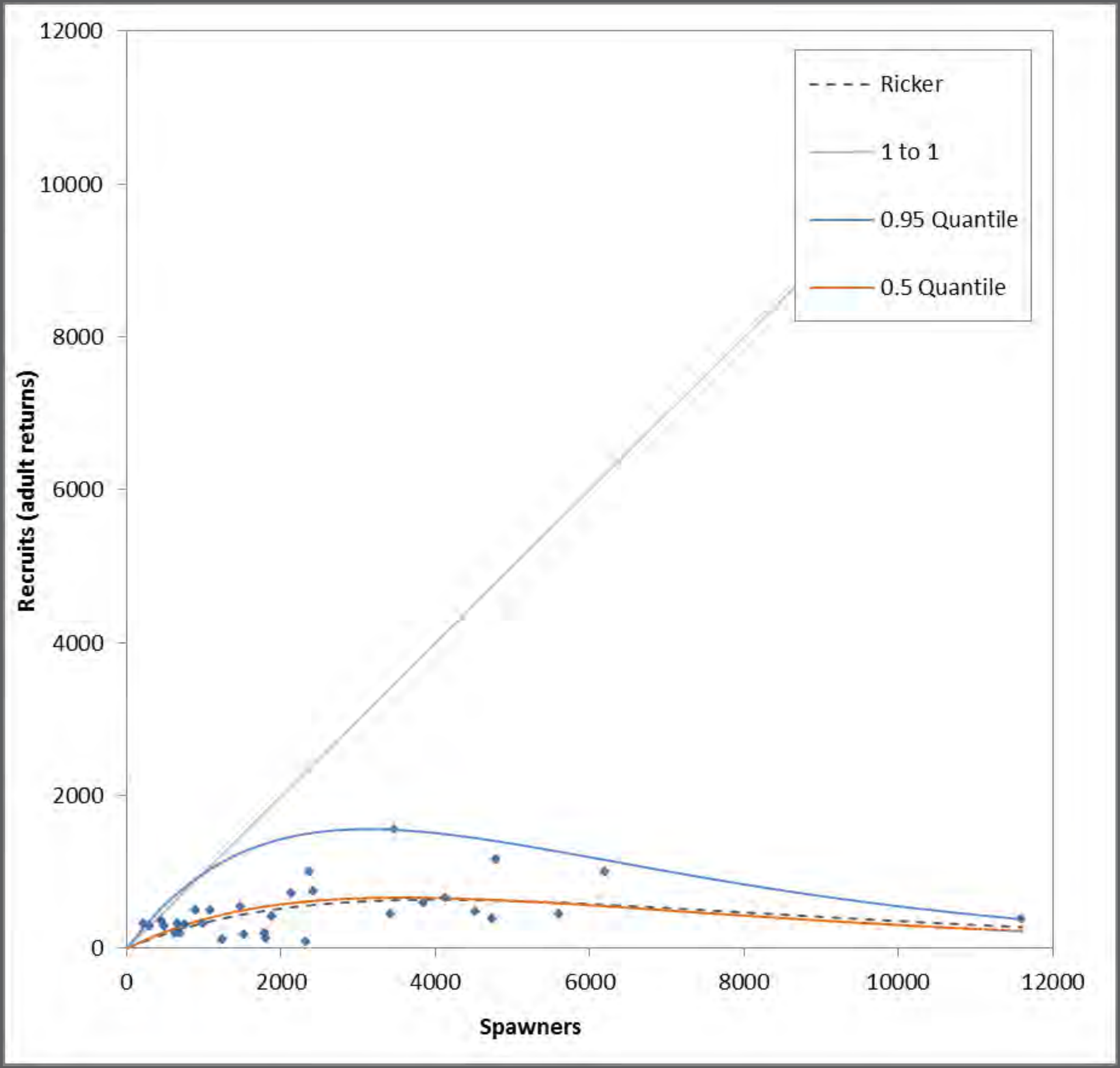
Steelhead – 95th CI Ricker



Spring Chinook – 50th Quantile



Steelhead – 50th Quantile



Attachment B

Methods of Estimating Carrying Capacity

1. Estimate Amount of Habitat
    - Drainage Area
    - Stream Length
    - Habitat Quality

2. Estimate spawners based on recruits (back-cast)
    - Assume survival, fecundity, sex ratio
    - Assume number of smolts per spawner

3. Estimate recruits based on prior recruit life stage (forward-cast)
    - Assume survival to target life stage

4. Population Dynamics Models
    - Central tendency (linear regression to estimate parameters)
    - Quantile fit (quantile regression to estimate parameters)

Attachment B

Spring Chinook Ksp

Type	Method	Source	Low	Mean	High
Area -> Parr Density -> Survival -> Fecundity -> Sex Ratio	Adult equivalents based on 19.17 parr/100m2, 4% egg to smolt survival, 4,100 eggs/female, 1:1 sex ratio	Fisher	1,498	2,788	4,077
Area -> Parr Density -> Survival -> Fecundity -> Sex Ratio	Adult equivalents based on 10.00 parr/100m2, 4% egg to smolt survival, 4,100 eggs/female, 1:1 sex ratio	Mullen et al., 1992	782	1,455	2,127
Population Dynamics Model	Ricker S-R model (1960-1995)	Schaller et al., 1999		1,379	
Population Dynamics Model	Ricker S-R model (1992-2006)	Mackey, 2014		2,962	
Population Dynamics Model	Ricker S-R model 95th quantile (1992-2006)	Mackey, 2014		2,173	

adapted from Ford et al., 2001

Attachment B

Spring Chinook Kr

			Smolts			Adult Recruits		
Type	**Method**	**Source**	**Low**	**Mean**	**High**	**Low**	**Mean**	**High**
Area -> Smolt Density	Chiwawa S-R model results applied to total stream area weighted by intrinsic potential and temp limited	T. Hillman, 2013	--	179,875	--	--	--	--
Area -> Smolt Density	221 smolts/sq mile effective drainage area	Chapman et al., 1995	--	375,921	--	4,105	4,496	4,887
Area -> Smolt Density	Chapman corrected for HQI accuracy (0.84)	Chapman et al., 1995	--	315,774	--	3,851	4,218	4,584
Area -> Parr Density -> Survival	Smolt Equivalents based on parr densities and 14.7-40% overwinter survival	Fisher	122,864	228,595	334,325	1,597	2,972	4,346
Area -> Parr Density -> Survival	Smolt Equivalents based on parr densities and 14.7-40% overwinter survival	Mullen et al., 1992	64,092	119,246	174,400	833	1,550	2,267
Population Dynamics Model	Parameters estimated by linear regression (B-H)	HSRG, 2009	--	--	--	--	1,140	--
Population Dynamics Model	Parameters estimated by linear regression	Mackey, 2014	--	--	--	--	797	--
Population Dynamics Model	Parameters estimated by quantile regression	Mackey, 2014	--	--	--	--	3,794	--

adapted from Ford et al., 2001

Attachment B

Summer Steelhead Ksp

Type	Method	Source	Low	Mean	High
Area -> Smolt Density -> Survival	Based on smolt capacity with 66 smolts/spawner	Mullen et al. 1992	723	1,154	1,585
Area -> Smolt Density -> Survival	Based on smolt capacity with 66 smolts/spawner	Chapman et al. 1994	--	2,088	--
Area -> Smolt Density -> Survival	GAFM adult equivalents with 66 smolts per spawner	Mullen et al., 1992	--	887	--
Area -> Smolt Density -> Survival	WDFW (unpublished) GAFM2 adult equivalents with 66 smolts per spawner	WDFW (unpublished)	--	532	--
Smolts -> Survival	Rocky Reach smolt estimates (1985-1998) with 66 smolts per spawner		--	1,921	--
Population Dynamics Model	Ricker S-R model (1976-2006)	Mackey, 2014	--	4,029	--
Population Dynamics Model	Ricker S-R model 95th quantile (1976-2006)	Mackey, 2014	--	3,125	--

adapted from Ford et al., 2001

Attachment B

Summer Steelhead Kr

			Adults Recruits		
Type	**Method**	**Source**	**Low**	**Mean**	**High**
Area -> Density -> Survival	Based on smolt capacity with 3.0% smolt to adult survival	Mullen et al., 1992	1,433	2,285	3,137
Area -> Density -> Survival	Based on 81 smolts/sq. mile and 3.0% smolt to adult survival	Chapman et al., 1994	--	4,133	--
Area -> Density -> Survival	GAFM adult equivalents with 3.0% smolt to adult survival	Mullen et al., 1992		1,757	--
Area -> Density -> Survival	GAFM2 adult equivalents with 3.0% smolt to adult survival	WDFW (unpublished)	--	1,053	--
Smolts -> Survival	Rocky Reach smolt estimates (1985-1998) with 3.0% smolt to adult survival		--	3,605	--
Population Dynamics Model	Parameters estimated by linear regression (B-H)	HSRG, 2009	--	1,962	--
Population Dynamics Model	Ricker S-R model (1976-2006)	Mackey, 2014	--	638	--
Population Dynamics Model	Ricker S-R model 95th quantile (1976-2006)	Mackey, 2014	--	1,562	--

adapted from Ford et al., 2001

Attachment C

Review of 5 Year Hatchery M&E Report
Methow Spring Chinook Salmon

Hatchery Committee, July 2015

Outline

- Review results of the following objectives from the 5 year M&E report:
  - Objective 2: migration timing, spawn timing and redd distribution
  - Objective 5: stray rates
- Review recommendations from 5 year M&E report

Hatchery Compensation Plan

Hatchery Objective

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 programs 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.

Objective 2
Twisp-Migration Timing

"Low sample size for a specific run-years and age-classes prohibited the analysis of migration timing between hatchery and natural-origin adults at Wells Dam, Twisp River weir or Twisp River PIT tag antenna array."

Objective 2
Twisp-Spawn Timing

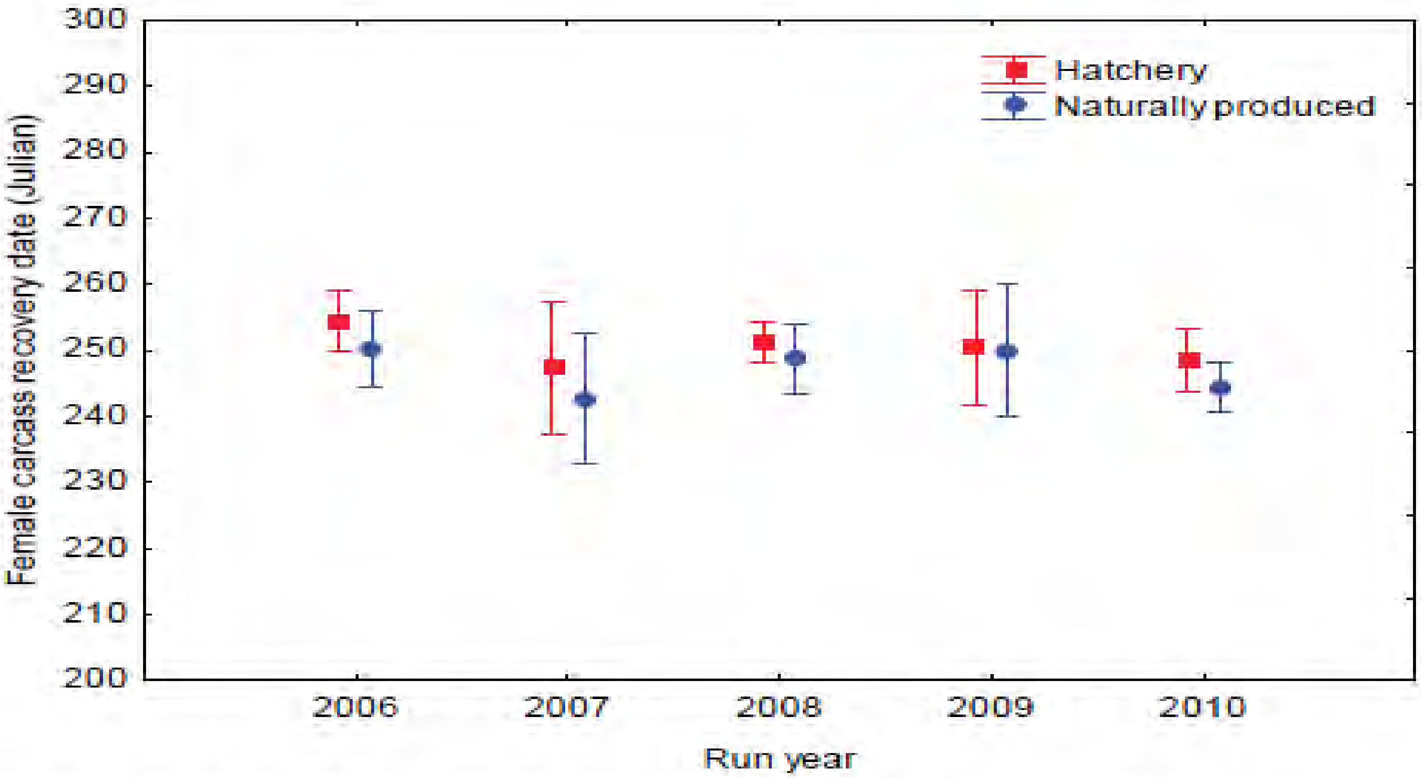


Figure 7. Mean female carcass recovery date of Twisp River spring Chinook.

"No difference in spawn timing, based on female carcass recovery date, was found across years (ANOVA: P = 0.10), origin (ANOVA P = 0.15) or among origins within years (ANOVA year x origin interaction term: P = 0.98; Figure 7)."

Objective 2
Twisp-Redd Distribution

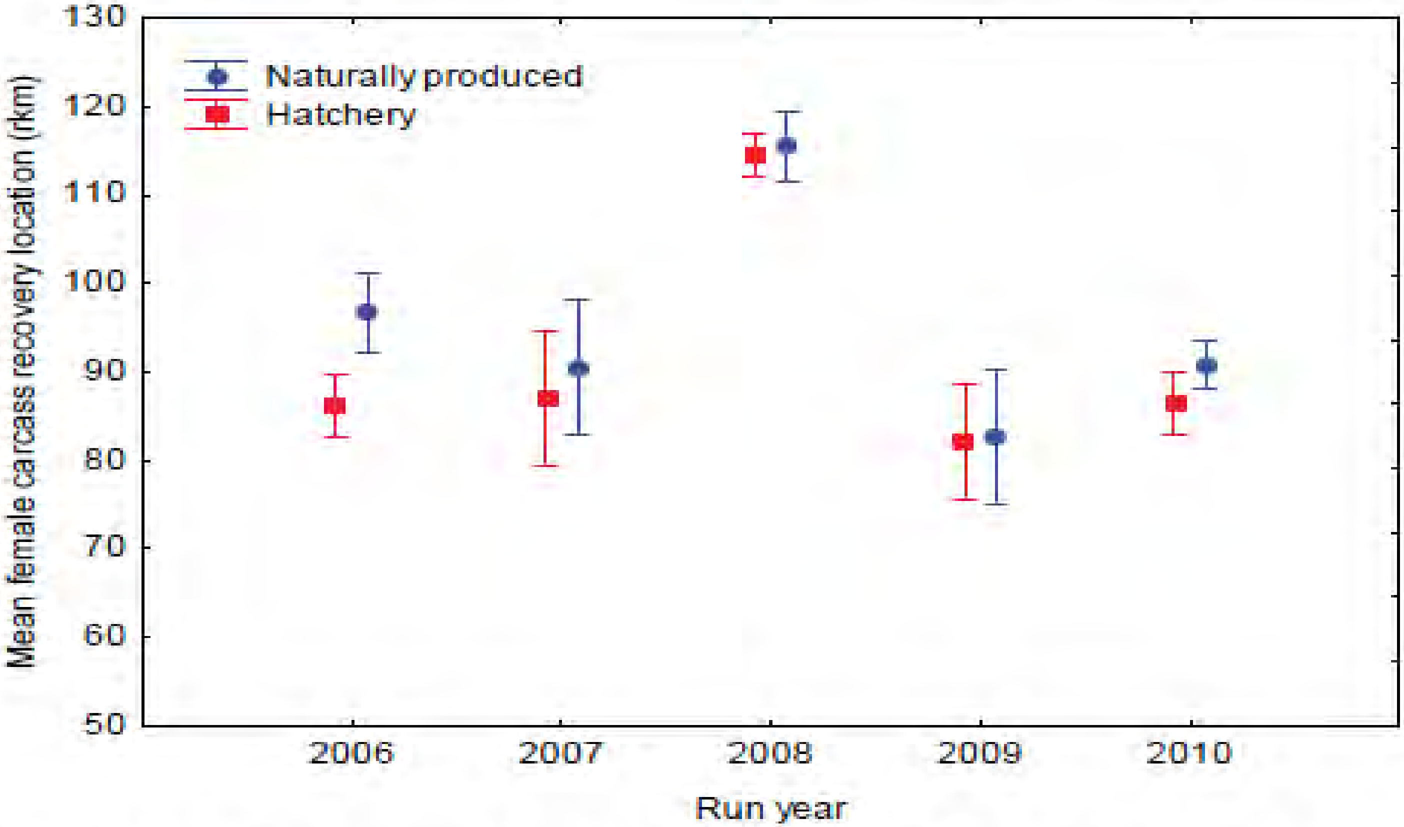


Figure 8. Mean female carcass recovery location of Twisp River spring Chinook.

“The mean location (river kilometer) of recovered carcasses of hatchery and naturally produced females was not significantly different within years (ANOVA year x origin interaction term: P = 0.13; Figure 8). Mean female carcass-recovery location, irrespective of origin, were significantly farther upstream in 2008 than in the remaining years analyzed (ANOVA: P < 0.001; see Fig. 8).”

Objective 2
Twisp: Summary

"Adult hatchery Twisp spring Chinook have similar spawn timing and redd distribution as naturally produced adult Twisp spring Chinook in the Twisp River. Both spawn timing and spawning distribution of hatchery and naturally produced fish was similar within a given year."

Location	Migration Timing	Spawn Timing	Redd Distribution
Twisp	Insufficient data	Similar spawn timing	Similar spawning distribution

Objective 2
Chewuch-Migration Timing

"Migration timing of Chewuch spring Chinook was not analyzed due to lack of stock-specific data. The Chewuch population is not monitored for migration timing."

Objective 2
Chewuch-Spawn Timing

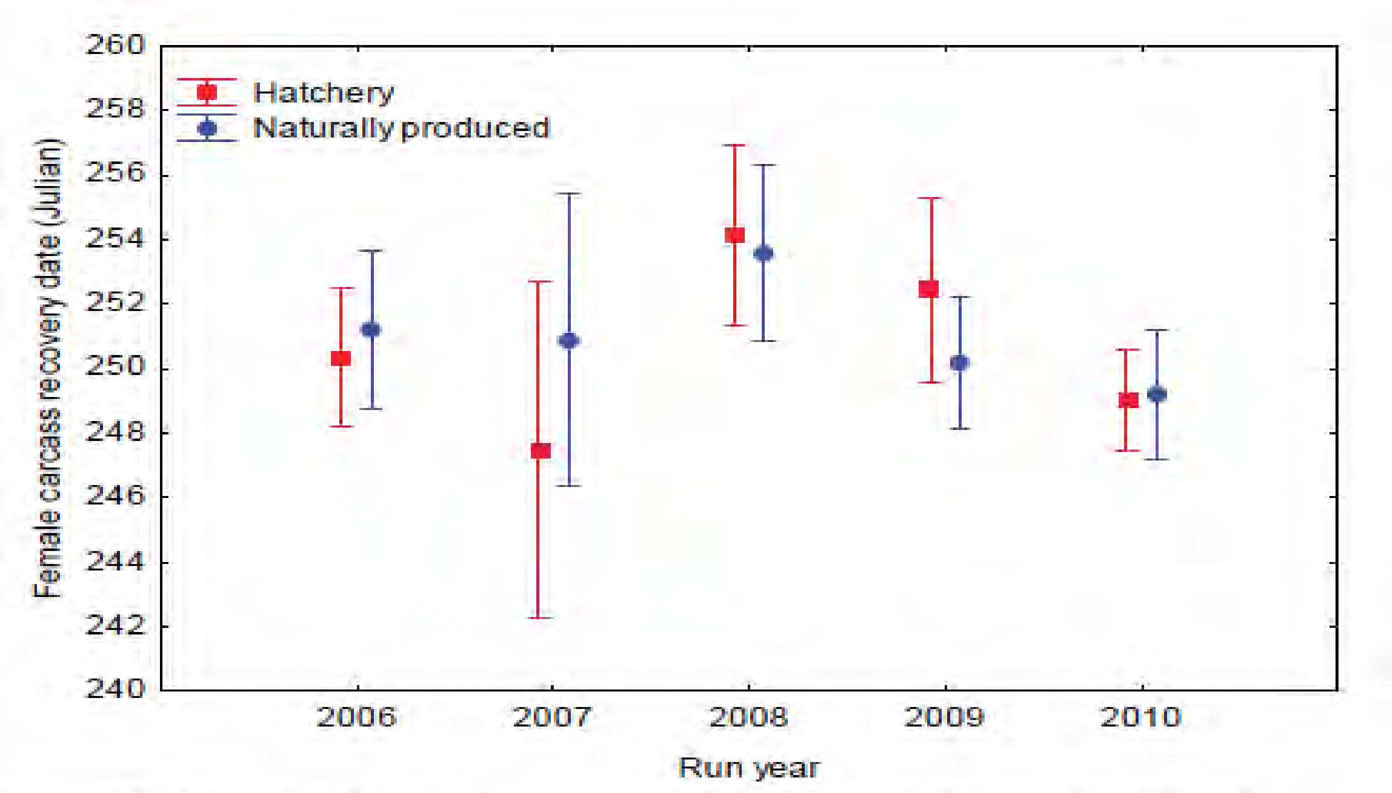


Figure 26. Mean female carcass-recovery date of Chewuch River spring Chinook

Differences in spawn timing, based on female carcass-recovery date, were found across years (ANOVA: P = 0.002). However, no difference was detected between origins (ANOVA P = 0.74) or among origins within years (ANOVA year x origin interaction term: P = 0.57; Figure 26).

Objective 2
Chewuch-Redd Distribution

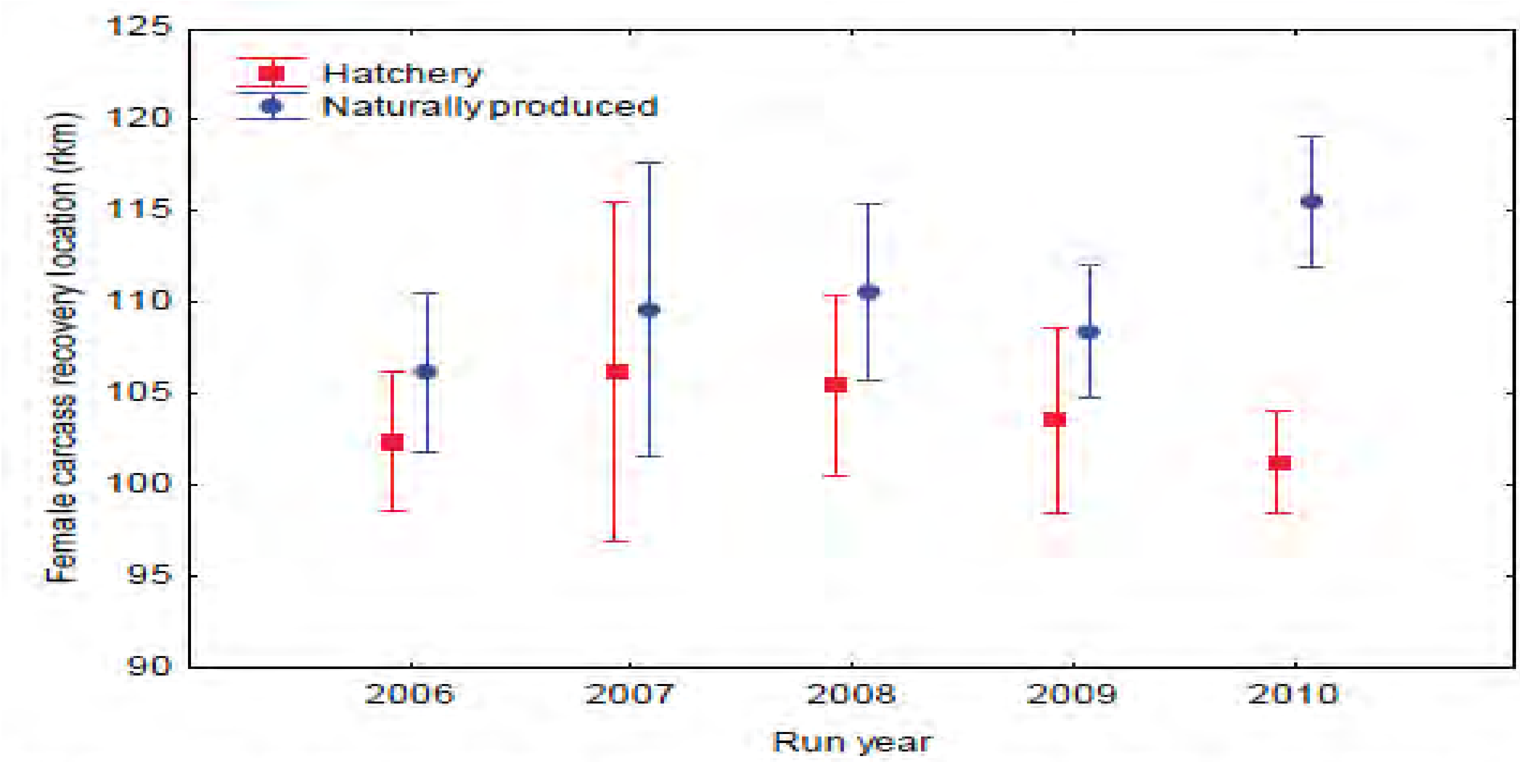


Figure 27. Mean female carcass-recovery location of Chewuch River spring Chinook.

“No difference in female carcass-recovery location (natural-log transformed) was detected between years (ANOVA: *P* =0.22). However, differences were detected among (ANOVA: *P* < 0.001) and within origins among years (ANOVA year x origin interaction term: *P* = 0.031; Figure 27). Post hoc analysis using a Tukey Unequal N HSD test detected a difference in female carcass-recovery location between hatchery and naturally produced fish in 2010 (*P* < 0.001).”

Objective 2
Chewuch: Summary

"Adult hatchery Chewuch spring Chinook have similar spawn timing and redd distribution as naturally produced adult spring Chinook in the Chewuch River."

Location	Migration Timing	Spawn Timing	Redd Distribution
Chewuch	Insufficient data	Similar spawn timing	Similar spawning distribution

Objective 2
Methow-Migration Timing

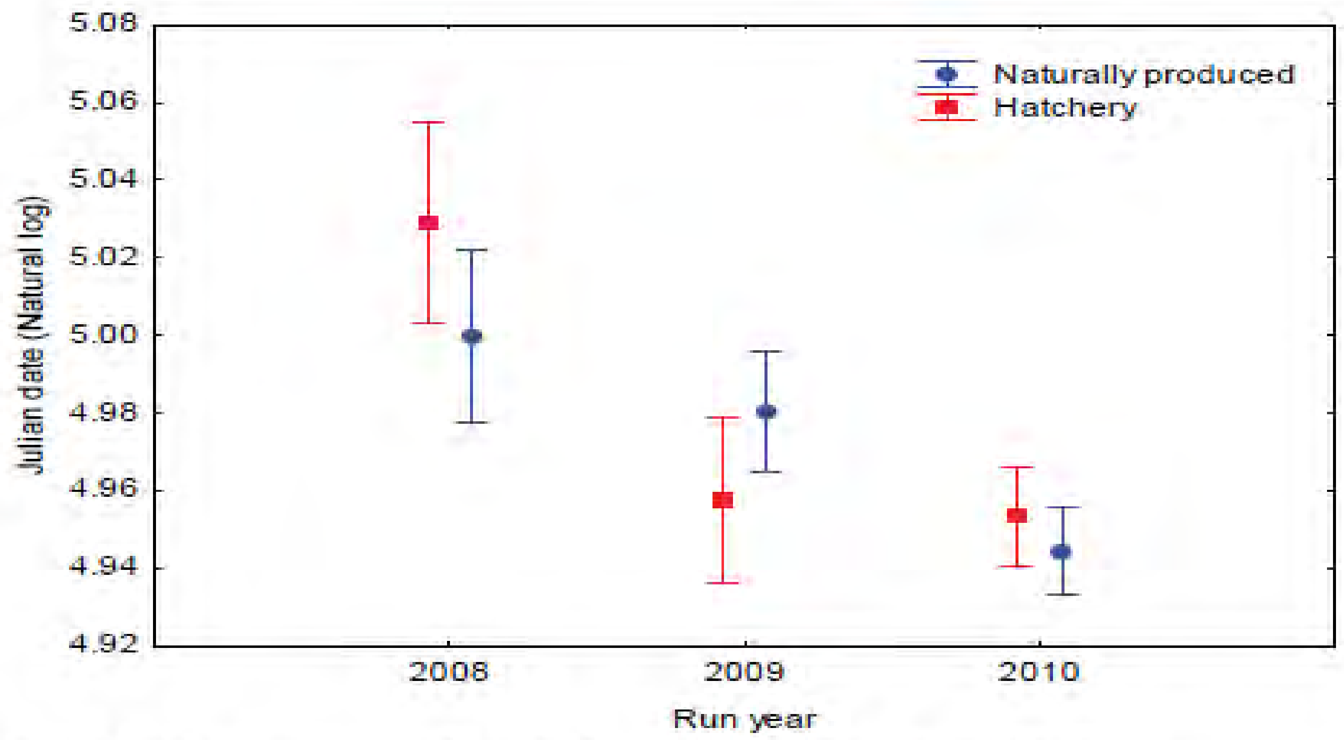


Figure 47. Mean run timing of age-4 Methow spring Chinook at Wells Dam.

“Low sample size for a specific run year and age class prohibited the analysis of migration timing for most years and age classes. The only stock and age class with consistent sample sizes (*N* = 25 or larger) was age-four fish from the Methow- Composite stock for run years 2008-2010. Julian date was transformed using the natural-log to more closely approximate a normal distribution. Results detected significant differences between years (ANOVA: *P* < 0.001), but not between hatchery and natural-origin (ANOVA: *P* = 0.52). Although significant differences were detected in the interaction term of years and origins (ANOVA year x origin interaction term: *P* <0.05), a Tukey HSD test for unequal sample sizes found no difference among origins within any year examined (*P* > 0.63; Figure 47).”

Objective 2
Methow-Spawn Timing

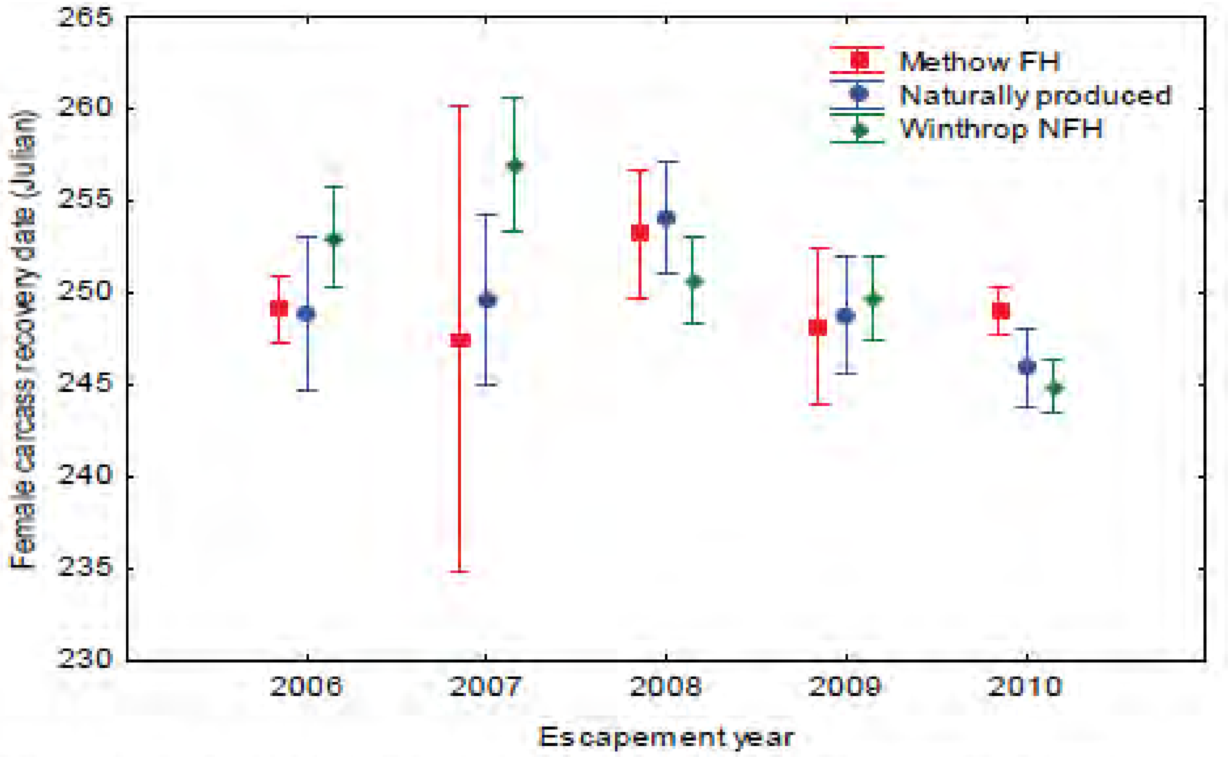


Figure 48. Mean female carcass-recovery date of Methow River spring Chinook.

"Significant differences in spawn timing, based on female carcass recovery date, were found across years (ANOVA: $P < 0.001$), but not among hatchery and natural-origin (ANOVA $P = 0.98$) or among origins within years (ANOVA year x origin interaction term: $P = 0.43$). Differences were detected in female carcass recovery date between Methow hatchery fish and hatchery fish released from Winthrop NFH, but only in 2010 ($P < 0.01$; Figure 48)."

Objective 2
Methow-Redd Distribution

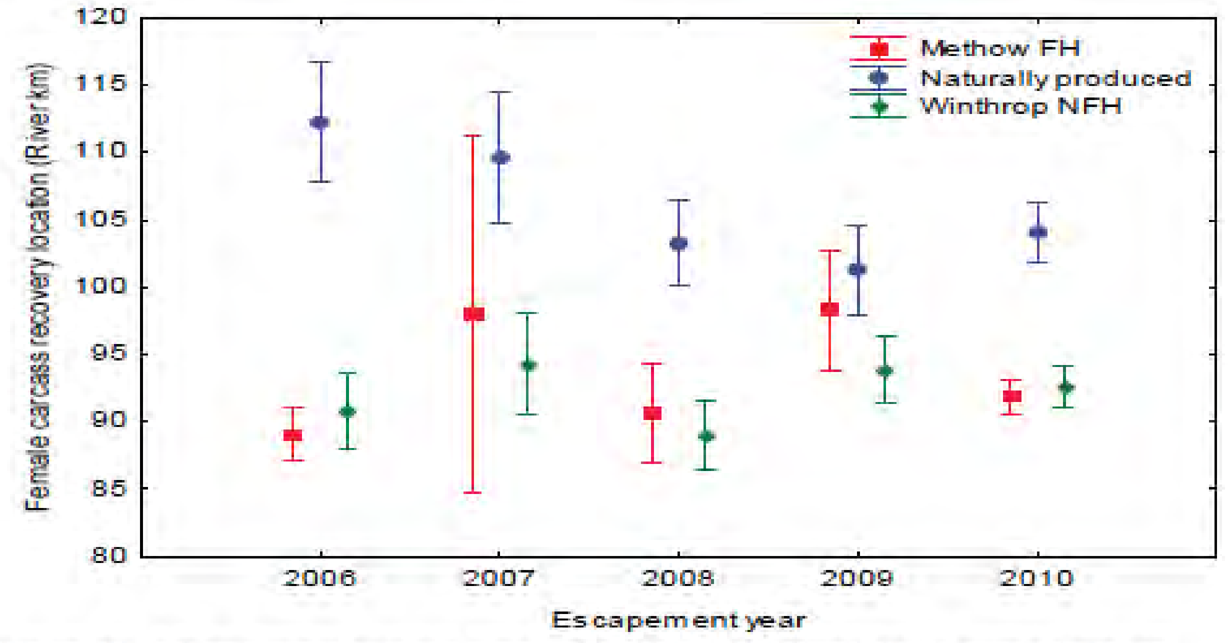


Figure 49. Mean female carcass recovery location of Methow River spring Chinook.

"Significant differences in female hatchery and natural-origin carcass-recovery location were not detected between years (ANOVA: *P* = 0.100). Differences in spawning location (female carcass recovery location used as a proxy for spawning location) were detected among females of hatchery and natural origins (ANOVA: *P* < 0.001) and between naturally produced and hatchery female carcass recovery location within years (ANOVA year x origin interaction term: *P* < 0.001). No difference was found in carcass recovery location between female hatchery fish from Methow FH and Winthrop NFH (ANOVA year x origin interaction term: *P* = 0.22; Figure 49). "

Attachment C

Objective 2
Methow-Redd Distribution

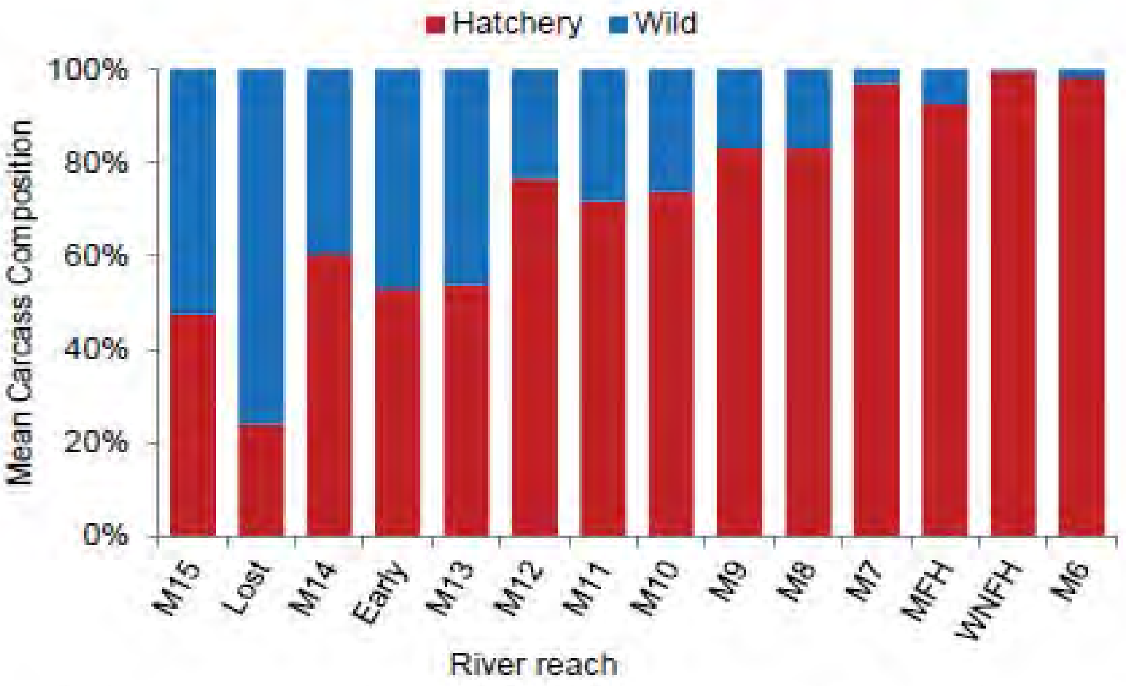


Figure 50. Mean carcass composition of spring Chinook in the Methow River, 2006 – 2010.

“Although the mean hatchery female carcass recovery location is significantly different then natural origin (i.e., mean hatchery female spawning location is downstream of mean natural origin females), hatchery and natural produced fish are fully integrated in the Methow River. Over the last five years hatchery fish, regardless of release location, have comprised nearly 50% or greater of the spawning population in all reaches except the Lost River (Figure 50).”

Attachment C

Objective 2
Methow-Redd Distribution

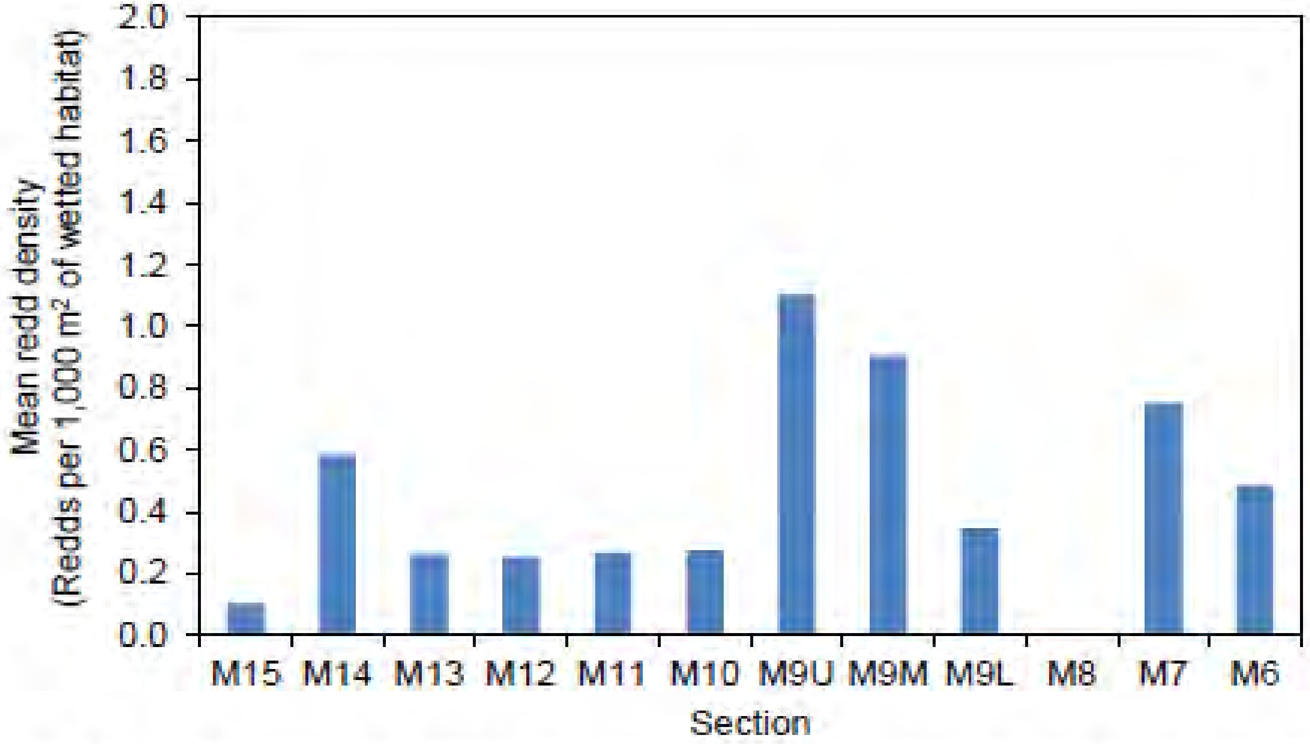


Figure 51. Redd density of spring Chinook in the Methow River in 2011. Reach area was normalized based wetted width and redd locations between 2006 and 2010.

“Furthermore, spawning habitat in the Methow River is also fully seeded, but does vary depending on habitat quality (Figure 51).”

Objective 2
Methow: Summary

"Adult hatchery Methow spring Chinook have similar migration and spawn timing as naturally produced fish, but mean spawning location was different in most years examined. However, given the complete spatial overlap of hatchery and naturally produced fish on the spawning grounds and the drastic over escapement of hatchery fish on the spawning grounds (Ksp = 490 spawners) any differences in mean spawning distribution are irrelevant."

Location	**Migration Timing**	**Spawn Timing**	**Redd Distribution**
Methow	Similar migration timing at Wells	Similar spawn timing	In most years, mean spawning location of hatchery fish was farther downstream than naturally produced fish. Mean spawning location of naturally produced fish has also shifted downstream.

Attachment C

Objective 5
Twisp-Stray Rates

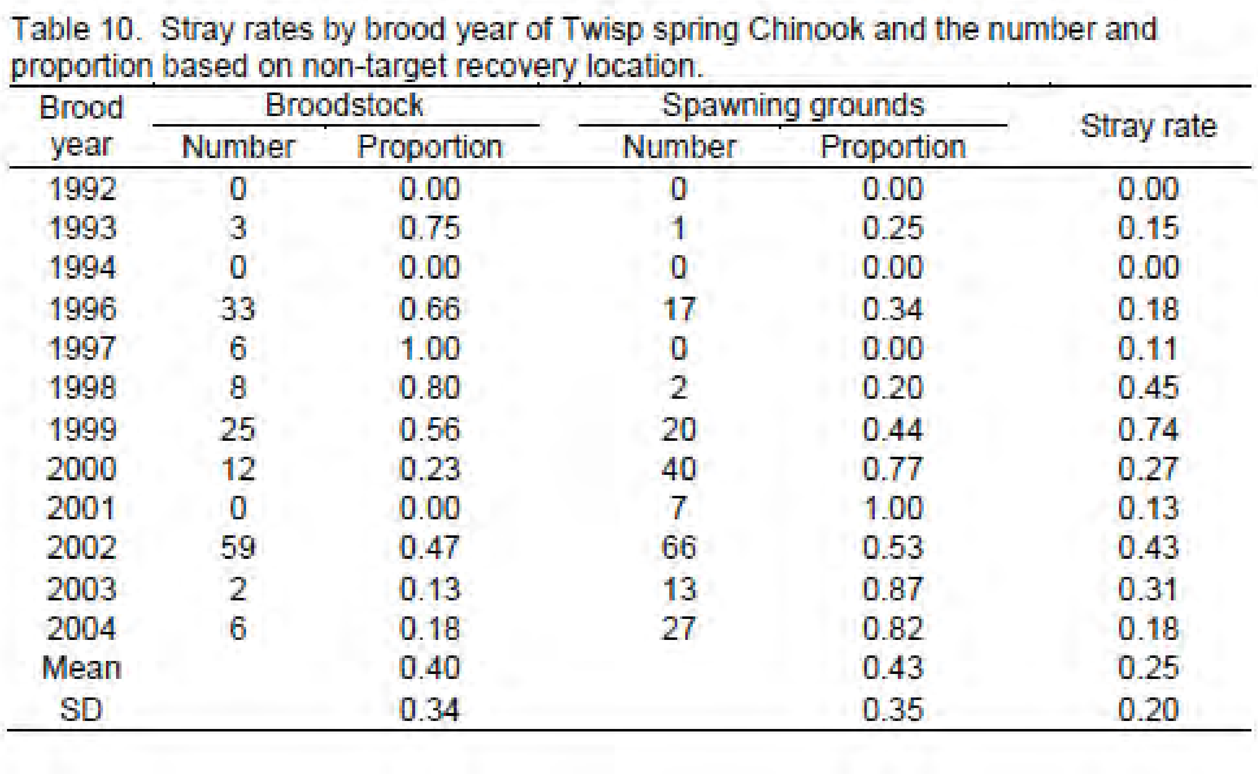


Table 10. Stray rates by brood year of Twisp spring Chinook and the number and proportion based on non-target recovery location.

Brood year	Broodstock Number	Broodstock Proportion	Spawning grounds Number	Spawning grounds Proportion	Stray rate
1992	0	0.00	0	0.00	0.00
1993	3	0.75	1	0.25	0.15
1994	0	0.00	0	0.00	0.00
1996	33	0.66	17	0.34	0.18
1997	6	1.00	0	0.00	0.11
1998	8	0.80	2	0.20	0.45
1999	25	0.56	20	0.44	0.74
2000	12	0.23	40	0.77	0.27
2001	0	0.00	7	1.00	0.13
2002	59	0.47	66	0.53	0.43
2003	2	0.13	13	0.87	0.31
2004	6	0.18	27	0.82	0.18
Mean		0.40		0.43	0.25
SD		0.34		0.35	0.20

Brood stray rates

"The mean stray rate of Twisp spring Chinook based on the estimated total number of coded wire tag recoveries by brood year was significantly greater (25%) than the target of 5% (t-test: $P < 0.02$). Stray fish were recovered in similar proportions both in broodstock and on the spawning grounds (Table 10)."

Attachment C

Objective 5
Twisp-Stray Rates

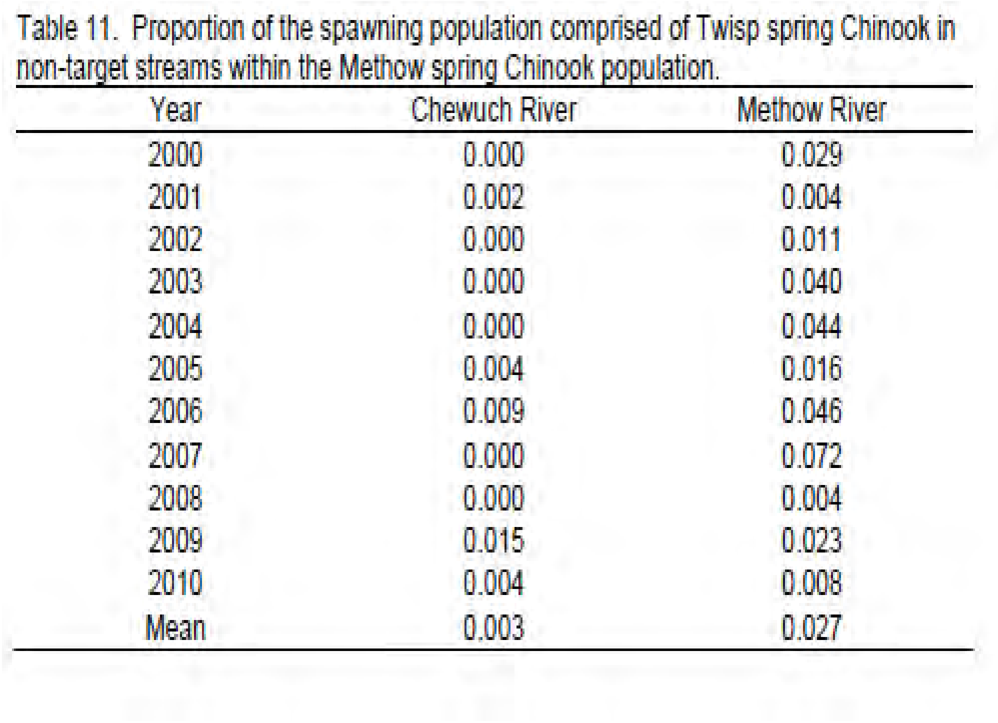


Table 11. Proportion of the spawning population comprised of Twisp spring Chinook in non-target streams within the Methow spring Chinook population.

Year	Chewuch River	Methow River
2000	0.000	0.029
2001	0.002	0.004
2002	0.000	0.011
2003	0.000	0.040
2004	0.000	0.044
2005	0.004	0.016
2006	0.009	0.046
2007	0.000	0.072
2008	0.000	0.004
2009	0.015	0.023
2010	0.004	0.008
Mean	0.003	0.027

Stray rates within population

“Analysis of stray rates within and between independent populations did not begin until 2000 due to lack of spawning ground data in prior years. Twisp spring Chinook have been recovered as carcasses on both the Chewuch and Methow rivers, comprising an average of 0.3% and 2.7% of those respective spawning populations. The proportion of the spawning population within non-target streams of the Methow spring Chinook population was significantly lower than the maximum threshold of 10% (t-test: $P < 0.0001$; Table 11).”

Objective 5
Twisp-Stray Rates

Stray rates outside of the population
"The Entiat River was the only other independent population where Twisp spring Chinook have been recovered on the spawning grounds. Twisp fish comprised 2.5% of the Entiat spawning population in 2007."

Objective 5
Twisp: Summary

“Twisp adults strayed into the Methow and Chewuch rivers at higher than expected rates. Nevertheless, the fact that half of the strays were recovered in Methow Hatchery reveals strong homing back to this natal facility. Salmon are believed to imprint sequentially at various life stages, enabling them to home back to natal waters that they may not inhabit at the parr-smolt transition stage (e.g., Naturally produced Twisp River subyearling Chinook emigrants that rear in Methow River). Thus the lack of earlier life-stage imprinting on Twisp water may cause some fish to home back to the Methow Hatchery and vicinity, rather than to the Twisp. Additionally, the acclimation period in the spring may not be long enough to allow key imprinting during the parr-smolt transformation. Combined or individually, these or other factors may result in the observed level of straying.”

Location	Stray Rates
Twisp	Brood year stray rates were significantly higher than the target of 5%. However, stray rates into the Mehtow and Chewuch rivers were within acceptable levels. Twisp spring Chinook did not stray outside of the Methow Basin.

Objective 5
Chewuch-Stray Rates

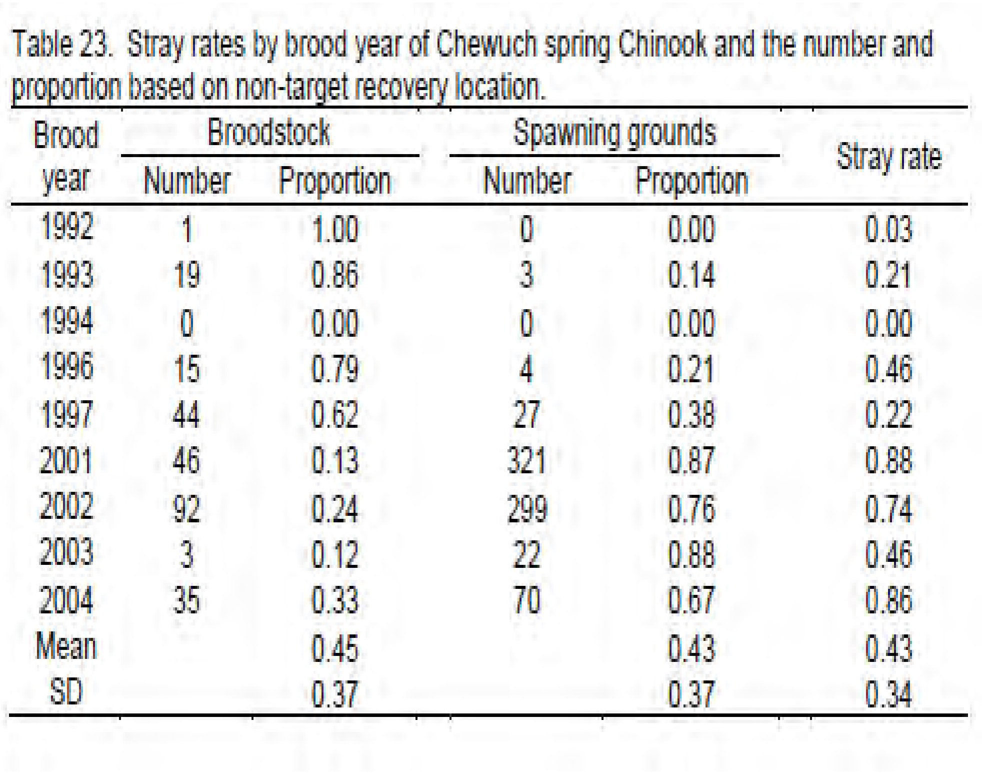


Table 23. Stray rates by brood year of Chewuch spring Chinook and the number and proportion based on non-target recovery location.

Brood year	Broodstock		Spawning grounds		Stray rate
	Number	Proportion	Number	Proportion	
1992	1	1.00	0	0.00	0.03
1993	19	0.86	3	0.14	0.21
1994	0	0.00	0	0.00	0.00
1996	15	0.79	4	0.21	0.46
1997	44	0.62	27	0.38	0.22
2001	46	0.13	321	0.87	0.88
2002	92	0.24	299	0.76	0.74
2003	3	0.12	22	0.88	0.46
2004	35	0.33	70	0.67	0.86
Mean		0.45		0.43	0.43
SD		0.37		0.37	0.34

Brood stray rates

“The mean stray rate of Chewuch spring Chinook based on the estimated total number of coded wire tag recoveries by brood year was significantly greater (43%) than the target of 5% (t-test: P < 0.02). Stray fish were recovered in similar proportions both in broodstock and on the spawning grounds (Table 23).”

Objective 5
Chewuch-Stray Rates

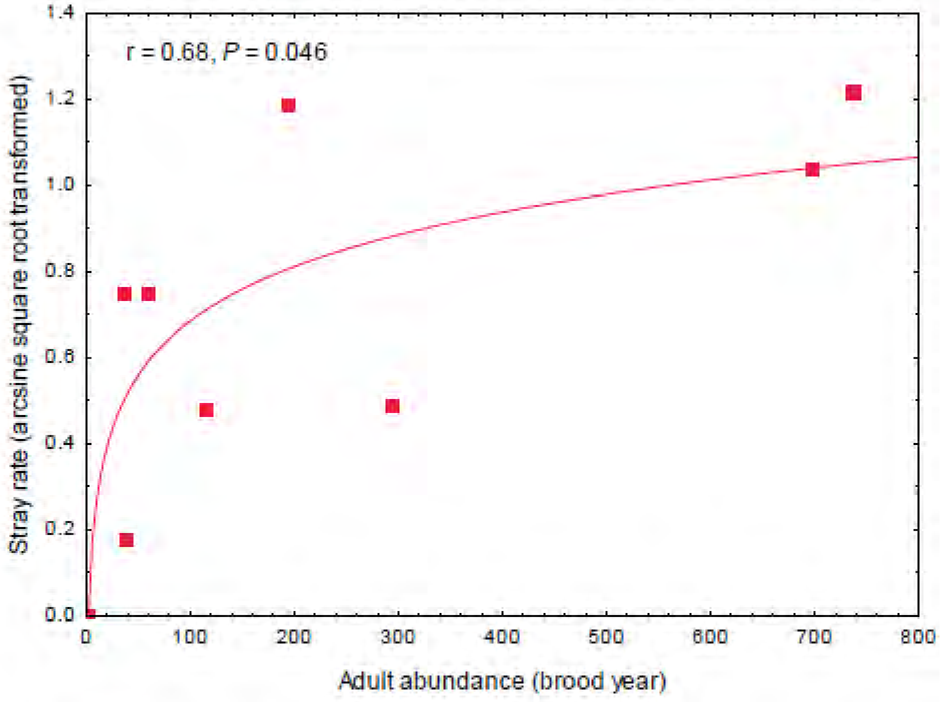


Figure 36. Relationship between the stray rate and brood year abundance of Chewuch spring Chinook.

Brood stray rates

“Stray rates of Chewuch spring Chinook have increased over time (Figure 36) possibly due to the changes in broodstock (i.e., initiation of the “Methow-composite” stock in 1997). The mean stray rate for the most recent four complete brood years was three times greater than the first five brood years of the program. The positive relationship between stray rate and abundance suggest that recovery of stray fish on the spawning grounds may be related to spawner density or simply a bias in sampling in years of low abundance (Figure 36). Regardless, increases in stray rates have prevented the program from increasing spawner abundance in the Chewuch River.”

Attachment C

Objective 5
Chewuch-Stray Rates

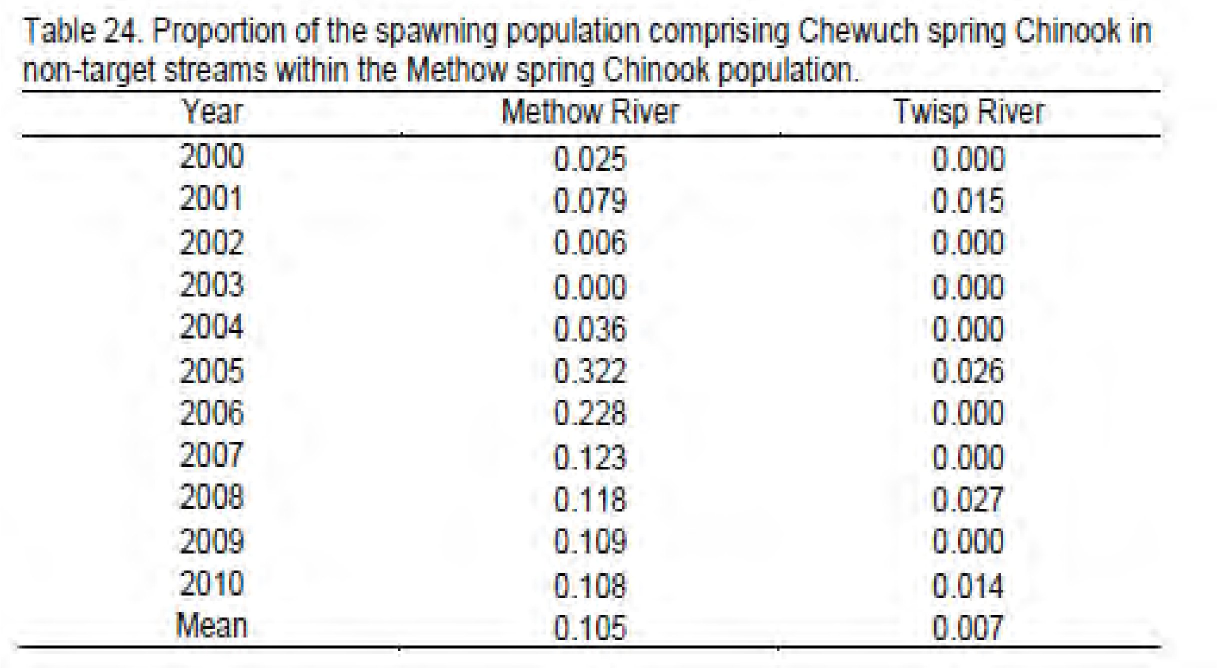


Table 24. Proportion of the spawning population comprising Chewuch spring Chinook in non-target streams within the Methow spring Chinook population.

Year	Methow River	Twisp River
2000	0.025	0.000
2001	0.079	0.015
2002	0.006	0.000
2003	0.000	0.000
2004	0.036	0.000
2005	0.322	0.026
2006	0.228	0.000
2007	0.123	0.000
2008	0.118	0.027
2009	0.109	0.000
2010	0.108	0.014
Mean	0.105	0.007

Stray rates within population
“Analysis of stray rates within and between independent populations did not begin until 2000 due to lack of spawning ground data in prior years. Surveyors recovered Chewuch spring Chinook carcasses on both the Methow and Twisp rivers, where Chewuch spring Chinook comprised an average of 10.5% and 0.7% of the spawning population, respectively (Table 24). The proportion of the spawning populations Chewuch spring Chinook comprised in the Twisp River was significantly lower (t-test: $P < 0.0001$) than the maximum target of 10% and no different from that target in the Methow River (t-test: $P = 0.57$).”

Objective 5
Chewuch-Stray Rates

Stray rates outside population
“The only other independent population from which Chewuch spring Chinook have been recovered on the spawning grounds was the Similkameen River in 2001. An estimated five fish spawned in the Similkameen River. This likely posed little genetic risk to the Similkameen summer Chinook population due to the fact that spring Chinook are unlikely to cross breed with summer Chinook due to difference in spawn timing, and the Similkameen has a very high abundance of summer Chinook spawning.”

Objective 5
Chewuch: Summary

“Chewuch hatchery fish strayed at a very high rate, on average only 57% of the Chewuch-program hatchery fish returning to the Methow Basin spawn in the Chewuch River, and this rate apparently increased beginning in 2001. A number of factors may have influenced this increase, including changes in broodstock composition and hatchery rearing techniques, changes in carcass recovery methodologies, and adult abundance.”

Location	Stray Rates
Chewuch	Stray rates into the Methow River far exceeded the target, but fish did not stray outside of the Methow Basin.???

Objective 5
Methow-Stray Rates

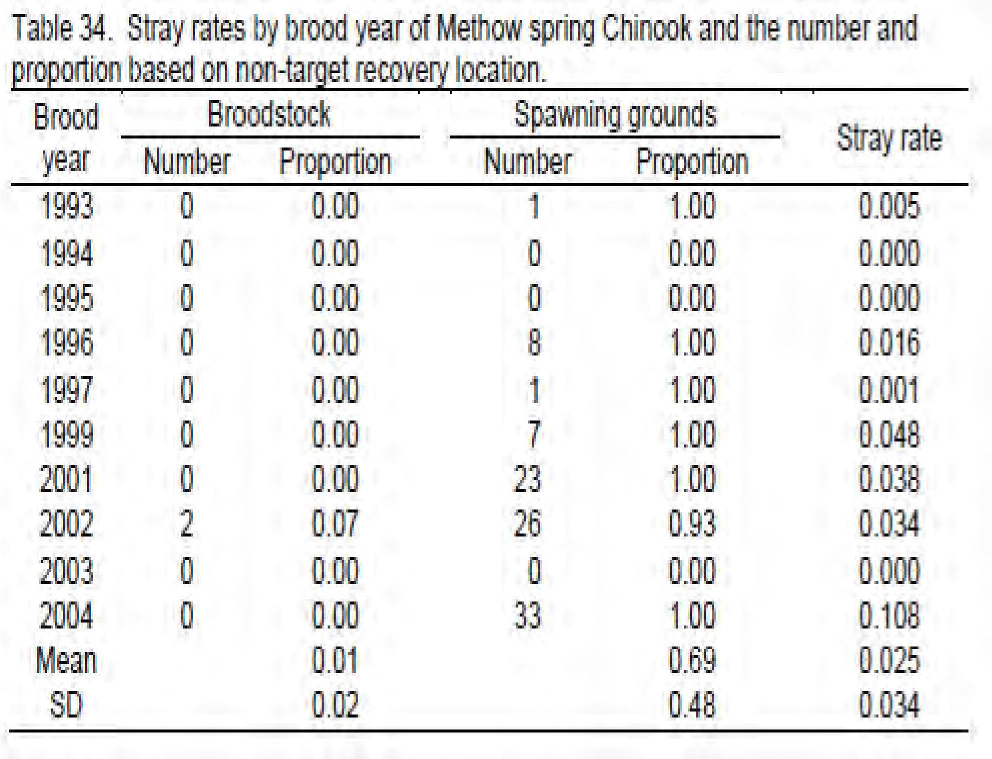


Table 34. Stray rates by brood year of Methow spring Chinook and the number and proportion based on non-target recovery location.

Brood year	Broodstock Number	Broodstock Proportion	Spawning grounds Number	Spawning grounds Proportion	Stray rate
1993	0	0.00	1	1.00	0.005
1994	0	0.00	0	0.00	0.000
1995	0	0.00	0	0.00	0.000
1996	0	0.00	8	1.00	0.016
1997	0	0.00	1	1.00	0.001
1999	0	0.00	7	1.00	0.048
2001	0	0.00	23	1.00	0.038
2002	2	0.07	26	0.93	0.034
2003	0	0.00	0	0.00	0.000
2004	0	0.00	33	1.00	0.108
Mean		0.01		0.69	0.025
SD		0.02		0.48	0.034

Brood stray rates

“The mean stray rate of Methow spring Chinook based on the estimated total number of coded wire tag recoveries by brood year was significantly lower (2.5%) than the target of 5% (t-test: $P < 0.02$). Stray fish were recovered predominately on the spawning grounds (Table 34). Stray rates of Methow spring Chinook have been at consistently low levels until the 2004 brood year. It is unknown why a sudden increase in stray fish was observed for that brood year despite a moderate level of returning fish.”

Objective 5
Methow-Stray Rates

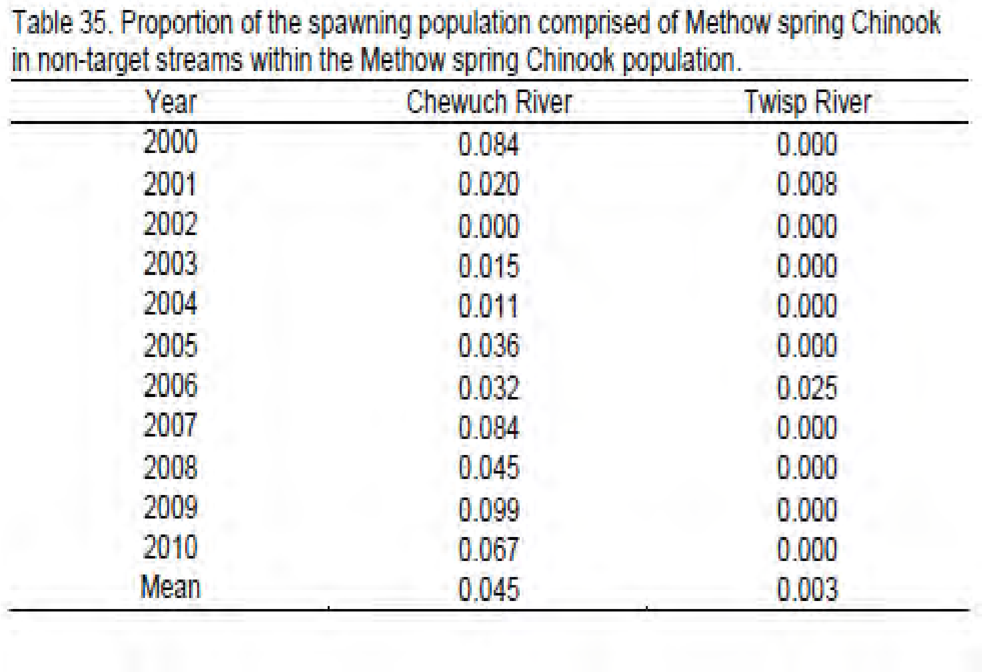


Table 35. Proportion of the spawning population comprised of Methow spring Chinook in non-target streams within the Methow spring Chinook population.

Year	Chewuch River	Twisp River
2000	0.084	0.000
2001	0.020	0.008
2002	0.000	0.000
2003	0.015	0.000
2004	0.011	0.000
2005	0.036	0.000
2006	0.032	0.025
2007	0.084	0.000
2008	0.045	0.000
2009	0.099	0.000
2010	0.067	0.000
Mean	0.045	0.003

Stray rates within population

“Analysis of stray rates within and between independent populations did not begin until 2000 due to lack of spawning ground data in prior years. Methow spring Chinook have been recovered as carcasses in both the Chewuch and Twisp rivers, comprising an average of 4.5% and 0.3%, respectively, of the spawning populations (Table 35). The proportion of the spawning populations that Methow spring Chinook comprised in the Chewuch and Twisp rivers was significantly lower (t-tests: $P < 0.001$, and $P < 0.0001$, respectively) than maximum target of 10%.”

Objective 5
Methow-Stray Rates

Stray rates outside population

“The only independent populations where Methow spring Chinook have been recovered on the spawning grounds were the Similkameen River, Entiat River and Chiwawa River. An estimated 14 fish spawned in the Similkameen River which is a very abundant summer Chinook spawning tributary and thus posed little to no genetic risk. An additional two fish were estimated to have spawned in the Chiwawa River in 2006. Methow spring Chinook routinely are recovered on the Entiat River in 5 of the last 11 years, but at very low levels. When recovered in the Entiat River, Methow spring Chinook have comprised less than 2% of the spawning population, a significantly lower value than the maximum acceptable level of 5% (t-test: $P > 0.007$).”

Objective 5
Methow: Summary

"Stray rates of Methow hatchery fish are all below target goals."

Location	Stray Rates
Chewuch	Stray rates into the Chewuch and Twisp rivers were within acceptable levels as were stray rates outside of the Methow Basin.

Discussion and Recommendations from 5 year M&E Report

Methow Basin Spring Chinook Discussion

(Applicable to Objectives 2 and 5)

"The stray rates of Twisp and Chewuch fish greatly exceeded target thresholds. In the case of the Twisp, the stray rate resulted in approximately 25% of Twisp-origin fish migrating to other parts of the Methow Basin or to the Methow Hatchery. Approximately half of these strays did indeed home to Methow Hatchery suggesting imprinting to this facility at life-stages prior to spring smolting. However, the Twisp already experiences hatchery returns in excess of pHOS targets necessary to meet PNI goals. Therefore, measures to return a greater proportion of Twisp-origin fish to the Twisp River will not result in meaningful conservation gains, except to the extent that the Twisp program could be reduced in size commensurate with an increase in successful homing, and more wild spawners could be allowed to spawn naturally rather than being used for broodstock. Twisp strays to the Methow or Chewuch comprised small proportions of those recipient populations and do not represent a risk to those populations."

Methow Basin Spring Chinook Discussion

(Applicable to Objectives 2 and 5)

"The Chewuch fish displayed similar stray patterns to the Twisp fish, but at a higher rate. However, since 1997 both the Methow and Chewuch programs used MetComp stock (Chewuch not entirely MetComp until 2007), and thus Chewuch strays were not necessarily a risk to the Methow population. In contrast, the Winthrop NFH released a large number of Carson-stock fish during the supplementation period, greatly reducing the relative risks to the Methow imposed by Chewuch strays. The HSRG reported, based on modeling results, that their preferred hatchery solution for the Methow Basin would return approximately the same number of natural-origin adults as a no-supplementation option. Indeed, the analyses in this report support the HSRG prediction: natural-origin returns did not increase during the supplementation period relative to reference populations."

Methow Basin Spring Chinook Discussion

(Applicable to Objectives 2 and 5)

"In the case of the Chewuch, the hatchery program has apparently not provided a benefit in the form of increased natural-origin spawners or the development of local adaptation, and had a high stray rate. Therefore, our recommendation is to either modify or discontinue the Chewuch program. Possible modifications for consideration include the development of methods to collect local broodstock, sizing the program to release only progeny of Chewuch stock, and managing the proportion of hatchery spawners on the spawning grounds. Alternatively, a discontinuation of the Chewuch program (with production possibly shifted to the Methow) could allow the management of the Chewuch under a no-supplementation strategy that could provide important insight into the response of a population to the discontinuation of a hatchery program (e.g., Entiat spring Chinook). The Chewuch could serve as a reference population for the Twisp and Methow programs, and possibly other programs outside the basin. Recall that natural-origin returns have not increased under the supplementation program; thus a no-hatchery strategy in the Chewuch does not appear to entail increased risk to recovery goals, and may actually reduce risk and increase chances for recovery."

Methow Basin Spring Chinook Discussion

(Applicable to Objectives 2 and 5)

"The Methow program experienced low stray rates, but adult returns from Winthrop NFH were still more abundant on the spawning grounds. The Methow program could benefit from the development of a local broodstock, although, such an effort is premature while the river is so heavily influenced by Winthrop NFH spawners. Should the WNFH program successfully address adult management, either through robust adult management practices, or changes to the program such as a reduction in size or releasing fish out of basin, the Methow spring Chinook program could adopt a local broodstock program."

Methow Basin Spring Chinook Discussion

(Applicable to Objectives 2 and 5)

"Anticipated hatchery production levels as a result of adjustment of hatchery compensation in 2013/2014 will force changes in the management of spring Chinook. We recommend the implementation of the Twisp program with release size adjusted as necessary to meet PNI goals. Management in the remainder of the basin must balance the number of natural-origin fish available with the potential options for the Chewuch and Methow programs. Perhaps the most realistic option would implement only one of these two programs. Both the Chewuch and Methow programs face significant issues that likely compromise the effectiveness of each program. The Chewuch offers an opportunity to establish a reference stream, or possibly a locally adapted program, while the value of substantially modifying the Methow program remains questionable without first addressing the management of adult returns from the Winthrop NFH program. Nevertheless, the Methow program also offers the opportunity to establish a locally-adapted type of program with minimal risk and <u>low rates of straying</u>. The added benefit of choosing the Methow rather than the Chewuch to establish a locally adapted program is that it also includes the opportunity to manage the Chewuch with a no hatchery strategy and establish it as a reference population (e.g., Entiat spring Chinook)."

Recommendations from 5 year report

(Applicable to Objectives 2 and 5)

1. Assess the potential to use a PIT-tag based assessment for 1) estimating survival to key life stages, 2) population estimates of key life stages, 3) developing estimates of carrying capacity, and 4) understanding life-history traits such as juvenile movement and rearing, homing and straying. This approach should allow assessment of both the hatchery and natural populations to detect limiting life stages. It is unclear to what extent such an approach could supersede current methodologies, such as rotary screw trapping. To the extent a PIT-tag approach would improve the ability to address the four questions above, develop field and analytical methods to employ this PIT-tag approach.

Recommendations from 5 year report

(Applicable to Objectives 2 and 5)

3. Investigate the potential for incubation in natal streams or using natal stream water to improve homing.

Recommendations from 5 year report

(Applicable to Objectives 1, 4 and 7)

4. The stray rates of Twisp and Chewuch fish exceed the target thresholds. Several possible approaches may ameliorate this issue, including extending the period of acclimation (improbable due to logistical constraints) or exposing the fish to target water (e.g., Twisp or Chewuch) at earlier life-stages. Both approaches attempt to allow fish to imprint on Twisp or Chewuch water at key life-history stages. It is currently unclear at which life-stage(s) imprinting would most effectively increase homing to the Twisp or Chewuch. We recommend an experimental approach to improve homing that may also yield widespread practical improvement for other programs.

Recommendations from 5 year report

(Applicable to Objectives 2 and 5)

7. Historically, the Chewuch broodstock suffered from a lack of natural-origin fish; without infrastructure improvements the proportion of natural origin broodstock will not increase and management of the proportion of hatchery fish on the spawning grounds will not be possible. Continuation of the current program (i.e., Met-Comp) would likely result in a further reduction in genetic diversity and, subsequently, productivity of the Chewuch stock without a demographic benefit from the hatchery program. If PNI goals cannot be achieved in the Chewuch, the current hatchery production should be discontinued or moved to a location that would eliminate any potential negative impacts to the Chewuch spring Chinook population.

Discussion and Questions

How spawner distribution affect productivity and reproductive success

- Williamson et al. 2010
  - "…carcass recovery location was the only measured trait that differed notably between hatchery and wild origin fish. Carcass recovery location also had a significant effect on fitness, such that fish that were recovered higher in the watershed had higher average fitness than those that were recovered lower in the watersheds."
  - "Overall, these results indicated that spawning location explains a portion but not all the reduced fitness of hatchery fish in this study"
  - " For females, the hatchery coefficient in the linear model becomes non-significant and very close to zero when spawning location is included as a covariate"
  - "density of spawners is higher in the lower reaches, owing to the large number of hatchery fish produced by the supplementation program. Second spawning and rearing habitat in the lower reaches are more impacted by roads and development.
  - "releasing fish higher in the watershed might therefore result in improved fitness of returning hatchery adults"

Ford et al. 2013

- We have previously shown that spawning location within the Nason Creek and Chiwawa River was an important determent of reproductive success and also largely explained the reduced female hatchery fish reproductive success (Williamson et al. 2010). We were also interested in determining whether hatchery fish relative reproductive success varied among major tributaries. We found that outside of Nason Creek and the Chiwawa River, hatchery fish and wild fish tended to have similar reproductive success when measured by counting returning adult progeny (Table 9).

Ford et al. 2013

- This result may be driven by lower spawning densities in the Little Wenatchee and White River spawning areas. Previous studies have also found that reduced hatchery fish fitness can be density dependent (Fleming et al. 1993; Fleming et al. 1994).
- At this point its unclear if high densities of hatchery fish in Nason Creek and the Chiwawa River are the cause of lower hatchery fish reproductive success in those areas or if selection against hatchery fish is simply relaxed in the lower density spawning areas outside these two tributaries.

Ford et al. 2009

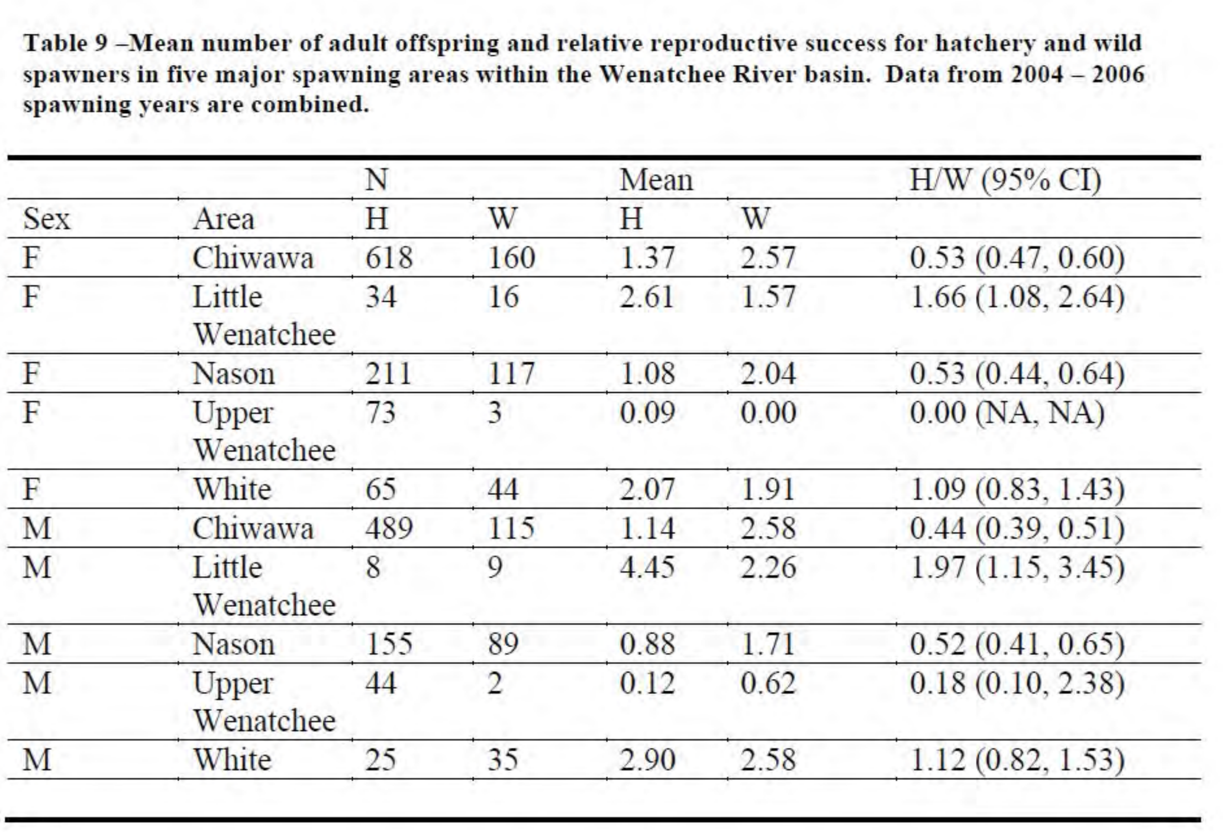
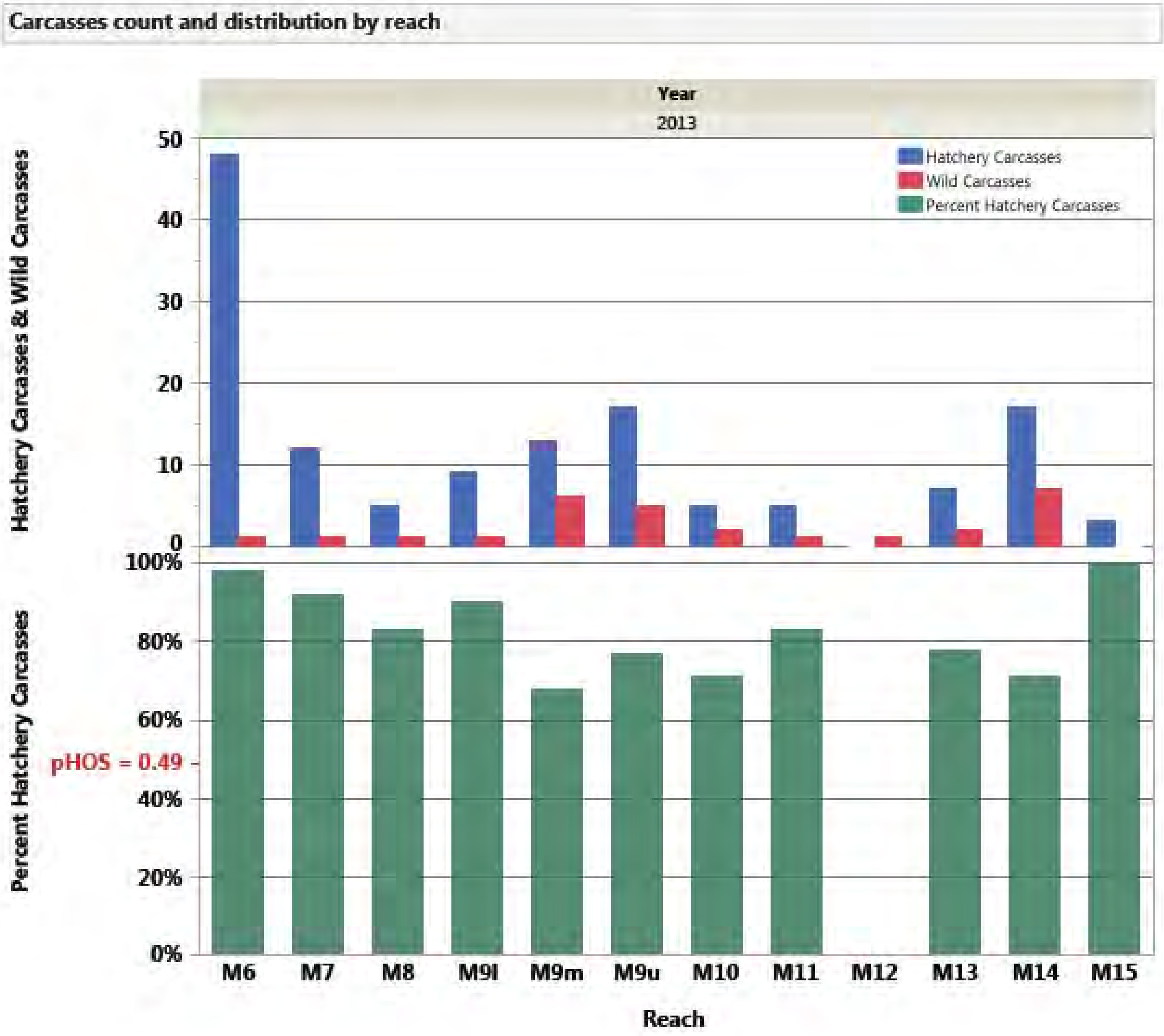


Table 9 –Mean number of adult offspring and relative reproductive success for hatchery and wild spawners in five major spawning areas within the Wenatchee River basin. Data from 2004 – 2006 spawning years are combined.

		N		Mean		H/W (95% CI)
Sex	Area	H	W	H	W	
F	Chiwawa	618	160	1.37	2.57	0.53 (0.47, 0.60)
F	Little Wenatchee	34	16	2.61	1.57	1.66 (1.08, 2.64)
F	Nason	211	117	1.08	2.04	0.53 (0.44, 0.64)
F	Upper Wenatchee	73	3	0.09	0.00	0.00 (NA, NA)
F	White	65	44	2.07	1.91	1.09 (0.83, 1.43)
M	Chiwawa	489	115	1.14	2.58	0.44 (0.39, 0.51)
M	Little Wenatchee	8	9	4.45	2.26	1.97 (1.15, 3.45)
M	Nason	155	89	0.88	1.71	0.52 (0.41, 0.65)
M	Upper Wenatchee	44	2	0.12	0.62	0.18 (0.10, 2.38)
M	White	25	35	2.90	2.58	1.12 (0.82, 1.53)

Objective 2
Methow-Redd Distribution



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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees	**Date:**	September 16, 2015
From:	Tracy Hillman, HCP Hatchery Committees Chairman		
Cc:	Sarah Montgomery		
Re:	Final Minutes of the August 28, 2015 HCP Hatchery Committees Meeting		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees meeting was held at Chelan PUD headquarters in Wenatchee, Washington, on Friday, August 28, 2015, from 9:30 a.m. to 3:00 p.m. Attendees are listed in Attachment A to these meeting minutes.

ACTION ITEM SUMMARY

- Mike Tonseth and Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) will develop a timeline for conducting genetic sampling for HCP program species (Item II-A).
- Sarah Montgomery will compile the 5-Year Hatchery Monitoring and Evaluation (M&E) Report objectives flagged for Methow spring Chinook salmon and distribute the compiled list to the Hatchery Committees for review (Item II-A). *(Note: Montgomery compiled the flagged objectives, and distributed the list to the Hatchery Committees on September 4, 2015.)*
- The Hatchery Committees will review and prioritize the 5-Year Hatchery M&E Report objectives flagged for Methow spring Chinook salmon during the next Hatchery Committees meeting on September 16, 2015 (Item II-A).
- Andrew Murdoch will keep the Hatchery Committees updated on the WDFW moratorium on hexacopter use (Item III-A).
- Keely Murdoch will discuss internally the Yakama Nation's (YN's) support to release approximately 18,000 mostly hatchery-by-hatchery (HxH) Methow spring Chinook salmon into Banks Lake (Item V-B). *(Note: Keely Murdoch followed up with*

Tom Scribner (YN), and distributed via email additional input on this discussion to the Hatchery Committees following the meeting on Friday, August 28, 2015.)

- The Hatchery Evaluation Technical Team (HETT) will reconvene on Thursday, October 29, 2015, at 9:00 a.m., at the WDFW Research Office in Wenatchee, Washington, to continue finalizing the Hatchery M&E Plan appendices (Item VI-A).
- Craig Busack will provide the 3-Population Gene Flow Planning Tool discussed during today's meeting to Sarah Montgomery for distribution to the Hatchery Committees (Item VII-A). *(Note: Busack provided the tool to Montgomery following the meeting on August 28, 2015, which Montgomery distributed to the Hatchery Committees that same day.)*
- Chelan PUD will provide an update on water for acclimation facilities during the next Hatchery Committees meeting on September 16, 2015 (Item VIII-A).
- Sarah Montgomery will update the Hatchery Committees Meeting Protocols document to reflect the Hatchery Committees agreement regarding the HCP Plan review period, and will distribute the updated document to the Hatchery Committees (Item IX-A). *(Note: Montgomery updated the protocols and distributed the updated document (Attachment J) to the Hatchery Committees on September 4, 2015.)*

DECISION SUMMARY

- There were no decisions approved during today's meeting.

AGREEMENTS

- The Hatchery Committees representatives present approved the 2016 Chelan PUD Hatchery M&E Implementation Plan (Item III-A).
- The Hatchery Committees representatives present agreed that the 60-day review period for HCP Plans may be shortened to 30 days when approved by the Hatchery Committees (Item IX-A).

REVIEW ITEMS

FINALIZED DOCUMENTS

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda; Review Last Meeting Action Items; Approve the July 15, 2015, Meeting Minutes (Tracy Hillman)

Tracy Hillman welcomed the Hatchery Committees and asked for any additions or changes to the agenda. The following revisions were requested:

- Bill Gale removed the U.S. Fish and Wildlife Service (USFWS) bull trout consultation update and added an update on activities at Leavenworth National Fish Hatchery (NFH).
- Craig Busack removed the National Marine Fisheries Service (NMFS) Hatchery Genetic Management Plan (HGMP) update.
- Tom Kahler added an update on the draft 2014 Douglas PUD Hatchery M&E Report.
- Greg Mackey sent an email to Hillman and Sarah Montgomery on August 27, 2015 with an image of fire retardant in Twisp River to show the Hatchery Committees.
- Keely Murdoch requested a decision item be added for WDFW regarding the fate of excess brood year (BY) 2014 Methow spring Chinook salmon.

The Hatchery Committees reviewed the revised draft July 15, 2015, meeting minutes. Outstanding comments were discussed, as follows *(note: italicized text indicates clarifying edits)*:

- Regarding the WDFW decision item on excess BY 2014 Methow spring Chinook salmon, Mike Tonseth noted a typo that there were roughly 37,000—not 3,700—excess fish on hand.
- Regarding the Relative Reproductive Success (RRS) Study, Andrew Murdoch clarified he indicated there is no difference in RRS; however, overall *reproductive* success of *hatchery fish* is lower.

Hatchery Committees members present approved the draft July 15, 2015, meeting minutes, as revised.

Action items from the Hatchery Committees meeting on July 15, 2015, and follow-up discussions, were as follows *(note: italicized text below corresponds to agenda items from the meeting on July 15, 2015)*:

- *Kristi Geris will follow up with Craig Busack to confirm edits to statements made by Busack, as reflected in the revised draft Hatchery Committees June 17, 2015 meeting minutes (Item I-A).*
  Craig Busack confirmed the edits via email on July 16, 2015, which Kristi Geris distributed to the Hatchery Committees that same day.
- *Mike Tonseth will coordinate with Craig Busack on the Hatchery Committees' decision regarding the fate of excess brood year (BY) 2014 Methow spring Chinook salmon currently being held at Eastbank Fish Hatchery (FH) and Methow FH (Item II-A).*
  Mike Tonseth and Craig Busack confirmed NMFS approval of the Hatchery Committees decision regarding excess BY 2014 Methow spring Chinook salmon. Alene Underwood requested an update on the plan for transfers. Tonseth said transfers to Methow are set. With the group of approximately 29,000 fish, Winthrop NFH is receiving approximately 11,000 fish. WDFW still has approximately 18,000 excess fish on hand at Eastbank FH and are trying to figure out where to take them. Tonseth explained WDFW believes the only viable option for these excess fish is to transfer them to Banks Lake. Keely Murdoch requested this be added as an agenda item for further discussion.
- *Sarah Montgomery will contact Craig Busack and request National Marine Fisheries Service (NMFS) concurrence of the Wells Hatchery Committee agreement regarding Douglas PUD's proposed Hatchery Monitoring and Evaluation (M&E) Annual Report schedule (Item III-B).*
  Craig Busack provided NMFS concurrence of the agreement via email on July 20, 2015, which Sarah Montgomery distributed to the Hatchery Committees that same day.
- *Douglas PUD will provide the draft 2014 Douglas PUD Hatchery M&E Report to Sarah Montgomery by August 1, 2015, which Montgomery will distribute to the Hatchery Committees for review (Item III-B).*

Greg Mackey provided the draft report to Montgomery on July 31, 2015, and Sarah Montgomery distributed the draft report to the Hatchery Committees for review on August 1, 2015.

- *Sarah Montgomery will distribute a Doodle Poll to reconvene the Hatchery Evaluation Technical Team (HETT) in August 2015, as no suitable meeting date was found in July (Item IV-A).*

  Sarah Montgomery distributed a poll for August 2015 on July 16, 2015, another for September 2015 on August 20, 2015, and another for October 2015 on August 20, 2015, as no suitable meeting date was found in August or September.

II. Joint HCP Hatchery Committees/PRCC HSC

A. Five-Year Hatchery M&E Review Planning – Methow Spring Chinook Salmon Objectives 3, 6, and 8 (Keely Murdoch)

Keely Murdoch shared a presentation titled "5-Year Analytical Report Review: Objectives 3, 6, and 8" (Attachment B), which Sarah Montgomery distributed to the Hatchery Committees on September 1, 2015. The presentation was organized by Hatchery M&E Objective and by stock. The presentation addressed Objective 3 (genetic diversity, population structure, and effective population size), Objective 6 (size and number of hatchery fish released), and Objective 8 (harvest opportunities using hatchery adults). These objectives were reviewed for each Methow spring Chinook salmon program (i.e., Twisp, Chewuch, and Methow rivers). Questions and comments were discussed as described in the following subsections.

Objective 3: Twisp mean heterozygosity and allelic richness (Slide 3 of Attachment B)

Craig Busack asked how many broodstock were used. Mike Tonseth said at the time, there were widely varying program sizes. Tonseth said he does not believe there were ever more than 30 spawners. He added that release numbers were between 50,000 and 70,000 every year. Busack said he is not surprised by these results considering the small numbers of spawners. Andrew Murdoch noted that the report has all of the sample size information.

Objective 3: Differentiation over time between natural origin broodstock and hatchery-origin broodstock collections (Slide 4 of Attachment B)

Busack said it seems the hatchery-origin recruits (HORs) are diverging from the natural-origin recruits (NORs); however, this is difficult to interpret with the separation. Andrew

Murdoch noted that for many years there was no integration; it was 100% HOR broodstock. Keely Murdoch asked if different results are expected for the next 5-year report. Andrew Murdoch said yes, because these data show the last 5 years plus the previous 15 years.

Objective 3: Relationship between the effective population size and the spawning population (Slides 6 and 7 of Attachment B)

Busack said it appears the effective number of breeders is about one-tenth of the spawning population size. Keely Murdoch asked what this means, and Busack explained that the population may have several hundred spawners, and the rate of genetic change through drift may be faster than predicted. He added that it could also mean that few fish are producing a lot of progeny and some are not producing many. Busack said this is a unique dataset because the populations are not closed, yet they are differentiated to this degree, affecting the true rate of genetic drift.

Objective 3: Pairwise Fixation Index (Fst) values and ratio of effective population size/spawning population (Ne/N) over time (Slides 13 and 14 of Attachment B)

Bill Gale asked if lines portrayed on these graphs mean that the line is significantly different than zero. Keely Murdoch noted that the Twisp River is an example where there is an increase in pairwise Fst over years of separation, but the relationship is not significant. Busack noted that in this slide, Fst is calculated for all samples, and then time between years is calculated. He said, for example, a comparison between a 2012 and a 2000 sample would be made. He said this graph is entirely predictable because all populations drift and change over time. Gale asked if the slope is not different than zero, how can there be an increase or change over time. Busack explained that the data are increasing; therefore, it cannot be rejected that there is no change. He added that a slight uptick in Fst is entirely consistent with what would be expected. He said understanding what large Fsts represent would help interpretation of the statistic. He noted that populations drift, so a large increase in Fst may or may not indicate a hatchery effect; he suggested that the programs are over-monitored for molecular genetic information. Keely Murdoch said a p-value is not cited in the report, and significance is not discussed. Gale said he is trying to determine how important this is and if it warrants further evaluation and discussion. Busack said calculating pairwise Fsts for multi-year samples will always result in an increase. Keely Murdoch said the slope would be close to zero if the outlier is removed. Busack suggested that everything drifts and these comparisons are not very important.

Objective 6: Mean size at release of Twisp River spring Chinook salmon (Slide 29 of Attachment B)

Busack asked if there is a standard for coefficient of variation. Tonseth said 9 was originally identified as the standard, but it was an arbitrary value identified as a target when the program was first set up. Tracy Hillman asked if the standard is still 9 and Tonseth confirmed. Busack said that for any serious attempt at assessing ecological interactions, one needs to know the coefficient of variation. Andrew Murdoch noted the standard is listed in the M&E plan. Tom Kahler added it is also in the annual reports.

Objective 6: Target length for Methow spring Chinook salmon releases (Slides 29, 31, and 33 of Attachment B)

Keely Murdoch asked why the target length is different between Twisp, Chewuch, and Methow rivers. Andrew Murdoch explained the target length is based off of the target weight, which is the original program goal, and they tailored the length targets based on length-weight analysis for each program. Kahler noted Douglas PUD could not meet the length targets identified in Piper[1] for these spring Chinook salmon programs, without greatly exceeding the weight targets. Andrew Murdoch said it is easy to complete such an analysis for the Chelan PUD program. Hillman conferred that length-weight relationships have been completed for Chelan PUD programs.

Objective 6: Recommendations (Slide 35 of Attachment B)

McLain Johnson asked if the recommendation is to run the Twisp Weir better.
Keely Murdoch explained that all releases except Twisp spring Chinook salmon were meeting program goals, and broodstock collection was identified as lacking. Tonseth said that prior to recalculation the release targets for each program were simply the total Methow Hatchery production divided by three, which resulted in an unrealistic target for the Twisp program. The new goals are more achievable. Tonseth stated USFWS does not believe WDFW should maximize the use of the Twisp Weir, over concerns for impacts on bull trout.

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[1] Piper, R., I. McElwain, L. Orme, J. McCraren, L. Fowler, and J. Leonard, 1982. Fish hatchery management. U.S. Department of the Interior Fish and Wildlife Service, Washington D.C.

Andrew Murdoch agreed, and noted that modifications to the weir and reduced broodstock collection facilitate achievement of collection targets for the Twisp program. Tonseth said no broodstock was collected at the Twisp Weir this year, as the necessary number of Twisp broodstock (identified via genetic analysis) was collected at Wells Dam.

General Comments

Gale asked if the frequency of genetic sampling was changed to every 10 years. Kahler said it had been every 5 years. Gale noted now sampling occurs in 10-year intervals and asked when the next round of sampling is scheduled to occur. Kahler said the next round of sampling will take place in 2016 or 2017. Tonseth added he thinks it is due before the next 5-year report. Hillman noted genetic monitoring started in 2007. Andrew Murdoch said WDFW scheduled monitoring year-by-year and did one program species each year. He said each program has a different year to smooth out budgeting. Tonseth suggested they go back and look at these schedules because it might make sense to realign everything for every other 5-year report in order to update all programs within one report. Andrew Murdoch said the year-by-year monitoring was scheduled in a staggered manner so that each round of monitoring and the associated data analysis is completed in time for the 5-year report. He said the timeline was specifically developed to fit the report schedule. Tonseth suggested he and Andrew Murdoch develop a timeline for conducting genetic sampling for HCP program species.

Kirk Truscott asked if the target for size at release should be revisited at a later meeting, considering the less-than-desired SAR values in the Methow Basin. Truscott said rate of growth matters as well as size at release. Truscott questioned if the target size at release is currently at an appropriate level to maximize survival. Catherine Willard said NMFS is presenting data on CPUD's and GPUD's summer Chinook salmon size target study during the November 2015 HC meeting. Alene Underwood agreed a target for size at release should be revisited. Hillman said the HETT put together an appendix for this, presenting length and weight relationships for each stock. Underwood said it was a data synthesis, not a recommendation. Hillman said it is up to Hatchery Committees to decide to re-evaluate the size at release. Truscott stated the important topic is looking at the growth pattern to get to that length of fish. Truscott asked if the fish need a fast growth period in the fall prior to release. Underwood said it is also important to measure this against what is actually possible in the hatchery in terms of growth. Truscott said the same consideration should be given to transferring fish. Hillman said during the production of the Chelan PUD 5-year Hatchery M&E Report, size at release and growth were discussed. He said they did not include any recommendations; rather, it was highlighted for the Hatchery Committees to address. Andrew Murdoch said that jacks are driving survival, so the Hatchery Committees should be sure to discuss adults. He said if growth is manipulated to reduce jacks, lower smolt-passage survival but more adults may result. Tonseth agreed and said it depends on the preferred tradeoff. Andrew Murdoch said hatchery constraints at the facility level should also be considered; it is hard to balance because there could be smaller size at release, as well as lower jacks and adults if hatchery constraints are not considered. He said the HETT has discussed the importance of monitoring growth each month and is asking hatchery staff to collect data on growth rates and size distributions. Hillman stated when Chelan PUD was writing its Chelan PUD 5-year Hatchery M&E Report, slowing down growth rates in the winter was discussed.

Hillman asked about possible flags regarding the relative differences in size and age at maturity of natural and hatchery-produced fish. Busack said there were concerns about this in other programs. In another project, hatchery fish were returning 2 centimeters shorter at age, but this difference disappeared over time. The fish may be returning younger and smaller at age, but that may be related to the hatchery rearing regime. Hillman agreed with Busack, noting that differences in size and age at maturity will exist; however, the current working hypothesis is that natural and hatchery fish will be the same. Hillman suggested developing a threshold size difference (effect size), and Tonseth suggested incorporating such information in the next 5-year report. He said programs have been weighted predominantly toward HORs in the last 5 years, whereas the difference may be more broodstock-oriented. Tonseth thinks it should remain the same unless an increasing or consistent difference is reported. Andrew Murdoch said if there is a constant hatchery effect through time, it can be explained as the cause; however, if the hatchery effect changes over time, it becomes a red flag. Truscott asked if the females are shorter and have differences in fecundity. Tonseth said the females are shorter but does not believe that differences in fecundity were significant. Truscott asked if the egg sizes were different. Andrew Murdoch said fecundity and egg size are not included in this report, but they did see differences. Busack added in another project fish were younger and smaller at age and less fecund at size, which may or may not remain true in other systems. Andrew Murdoch noted they are tracking those relationships, and does not think there are differences in egg size, just differences in fecundity.

Truscott asked if they see a difference in pre-spawn mortality between hatchery and wild fish. Andrew Murdoch said they are seeing differences in fat content and are still working on figuring out pre-spawn mortality. He said spawning location and where the fish hold up likely affects pre-spawn mortality.

Hillman said, according to the 5-Year Hatchery M&E Report review schedule, from September 2015 through February 2016, the Hatchery Committees will review and summarize findings from this review process. He noted that Montgomery has been tracking flagged objectives, and that following this meeting, she will compile the 5-Year Hatchery M&E Report objectives flagged for Methow spring Chinook salmon and distribute the compiled list to the Hatchery Committees for review. *(Note: Montgomery compiled the flagged M&E Report objectives and distributed the list to the Hatchery Committees on September 4, 2015.)*

Hillman asked the group what strategy it prefers for identifying recommendations. Keely Murdoch recalled once objectives were flagged for review, the plan was to circle back on those and discuss in committee whether they can do studies or address them in committee. Keely Murdoch suggested starting at the top of the flagged objectives list and proceeding in the order they were flagged. Tonseth asked if this suggested process was recorded. Keely Murdoch responded that yes, the September meeting marks the start of the process to address studies or recommendations. Gale suggested all flagged objectives be looked at in totality for prioritization. Hillman said the Hatchery Committees will review the flagged objectives table in September and identify which ones to address at the October meeting. The Hatchery Committees will review and prioritize the 5-Year Hatchery M&E Report objectives flagged for Methow spring Chinook salmon during the next Hatchery Committees meeting on September 16, 2015.

III. Chelan PUD

A. Draft 2016 Chelan PUD Hatchery M&E Implementation Plan (Catherine Willard)

Catherine Willard said the draft 2016 Chelan PUD Hatchery M&E Implementation Plan was distributed to the Hatchery Committees by Sarah Montgomery on July 23, 2015. Willard said there are two notable changes: 1) M&E for Methow spring Chinook salmon is now addressed in the Douglas PUD Hatchery M&E Implementation Plan and annual Douglas PUD Hatchery M&E Report; and 2) summer Chinook salmon redd surveys will be conducted using the same methods as last year instead of via the proposed hexacopter method. She explained that hexacopters cannot be used due to legislative restrictions.

Craig Busack asked about the hexacopter legislation restrictions. Andrew Murdoch explained that there is a WDFW moratorium on the purchase of hexacopter gear. He said hexacopter use for natural resource data collection is widely supported; however, enforcement and data collection need to be separated in policy before use is allowed. He said another meeting is planned this month; however, a policy will likely not be in place next year. He added that he will keep the Hatchery Committees updated on the WDFW moratorium as more information becomes available. The Hatchery Committees representatives present approved the 2016 Chelan PUD Hatchery M&E Implementation Plan.

B. Chelan Falls Summer Chinook Salmon Broodstock Collection (Catherine Willard)

Mike Tonseth said Chelan Falls alternate brood source needed to be pursued because outfall collections were not meeting expectations. He said collection at Wells Dam was dismissed because of modernization. He said the Colville Confederated Tribes (CCT) were surplusing fish at Chief Joseph Dam, so he reached out to Kirk Truscott and asked if they could support brood collection to backfill shortfalls. He said Truscott provided the requested assistance. Tonseth said as of early this week, they have sufficient broodstock to meet production obligations for Chelan Falls. Tonseth said they are still collecting at Chelan Falls, and will prioritize those fish over the ones collected at Chief Joseph Dam. Tonseth said all of the broodstock is collected and 245 adults from Chief Joseph Dam were transported to East Bank FH, with approximately 50 to 60 adults in each truck.

C. Spring Chinook Salmon Spawning Ground Surveys (Catherine Willard)

Willard said spawning ground surveys started the last week of July to obtain a zero count, and redds were visible the week of August 20, 2015. She said this resembles data from Chiwawa River and Little Wenatchee River last year. She added there are only 2 redds so far this year in Nason Creek, compared to 20 last year at this time. She said this year is also different because of the Wolverine Fire, which is currently coming up over the Chiwawa ridge, and the U.S. Forest Service (USFS) has closed everything north of Highway 2. Willard said she and Andrew Murdoch are coordinating with Jeff Rivera (USFS) to come up with a plan for continuing the surveys. She said the Upper Chiwawa River survey was supposed to occur on Saturday August 30, 2015, and surveyors will get back into the area as soon as possible.

Tracy Hillman provided an update on parr estimation work. Hillman said all but the last 2 days of surveys were finished because the USFS rescinded access due to fires. Hillman said a lot of juvenile Chinook salmon were found high in the system. He said water temperatures were warmer than usual, reaching 12 to 13 degrees Celsius in the Chiwawa River near Phelps Creek. He said the highest numbers of parr were observed from Finner Creek up to Trinity. Hillman said there were very few Chinook salmon downstream, where temperatures reached 18 to 19 degrees Celsius. He added where large abundances of age 1 or older steelhead were usually observed in the Lower Chiwawa River, few were counted this year. He said in past years, many older juvenile steelhead (approximately 5,000 to 10,000) were observed, but this year few older steelhead, some age 0 juvenile steelhead, and a lot of adult bull trout were found. Hillman added that sockeye salmon were found all the way up to approximately Alpine Campground. More adult sockeye salmon were observed in the Chiwawa River this year than in past years. He said very high numbers of adult bull trout are also being observed. In one pool, 45 adult bull trout were counted. Bull trout ranged in size from 17 to 30 inches. He said that interestingly, juvenile Chinook salmon were observed in the same pools as adult bull trout. Based on observations, bull trout were targeting 6- to 8-inch whitefish, not juvenile Chinook salmon. Hillman said in the Little Wenatchee River, where several hundred Chinook salmon are usually counted in multiple channels with logjams, very few juvenile Chinook salmon were counted this year. He said sample sites also lacked steelhead, brook trout, bull trout, and sockeye salmon. In contrast, thousands of longnose dace were found. Hillman suggested the longnose dace may be in larger numbers because there were few predators (brook trout, rainbow trout, and bull trout) in the river this year. Hillman said this year is very different, and that density-independent effects may be more important than in past years. Andrew Murdoch noted WDFW has seen a few pre-spawn and post-spawn carcasses, but nothing like those seen on the Tucannon River in June, where ten per day per reach were found. Andrew Murdoch emphasized that fish have responded to temperature. Hillman said northern pikeminnow were found in the lower Chiwawa River, which is unusual.

D. Eastbank and Chiwawa Acclimation Facility Construction Updates (Catherine Willard)

Alene Underwood said both office buildings at Eastbank and Chiwawa are being updated. She said the concrete pad and office building have been removed at Eastbank, and substantial completion is expected in December 2015. She said the new facility will include more storage room and offices. Underwood said the backup generator is being replaced at Chiwawa, and a bunkhouse is being added. She said the new building has been framed, and substantial completion is expected by October 2015.

IV. Douglas PUD

A. Draft 2014 Douglas PUD Hatchery M&E Report (Tom Kahler)

Tom Kahler said Sarah Montgomery sent an email to the Hatchery Committees on August 1, 2015, notifying them that the draft 2014 Douglas PUD Hatchery M&E Report is available for a 30-day review period, with edits and comments due to Greg Mackey by Monday, August 31, 2015.

B. Fire Retardant in Twisp River Photo (Tom Kahler)

Tom Kahler presented a photo called "Fire Retardant in Twisp River" to the Hatchery Committees (Attachment C), distributed initially by Jeremy Cram and Charles Snow (WDFW). Andrew Murdoch commented that there is residual red retardant in the Methow River, as well, which lasted for about 25 minutes. Catherine Willard stated that the USFS monitored water quality in Chelan River after a retardant drop landed in the area, and the water went from a pH of 6 to a pH of 9. Keely Murdoch stated that retardant can kill fish and asked what happens in these situations. She recalled they are not supposed to use retardant within 300 feet of a waterway unless there are structures needing protection. She also recalled the USFS is not supposed to drop retardant if there are Endangered Species Act (ESA)-listed species present. Willard said the Forest Service has a fire retardant avoidance plan to minimize dropping retardant in waterways. Keely Murdoch asked if the USFS monitors fish kills. Willard said the plan includes checking for dead fish once, which has been done on the Chelan River. Andrew Murdoch added the USFS saw clearly where the retardant hit, and there were no fish lying on the banks in that area.

V. WDFW

A. PRESENTATION: Adult Survival of Hatchery Spring Chinook Salmon Volitionally or Forced Released as Juveniles in the Chiwawa River (McLain Johnson)

McLain Johnson shared a presentation titled "*Adult Survival of Hatchery Spring Chinook Salmon Volitionally or Forced Released as Juveniles in the Chiwawa River*" (Attachment D). Johnson said this research has been ongoing for more than a decade, and he also presented this talk at the American Fisheries Society conference last week. He said the objective of the study was to determine if release methodology—forced release or volitional release—significantly influenced the smolt-to-adult survival of hatchery-reared Chiwawa River spring Chinook salmon. Johnson said this study looked at more than 1 million hatchery fish, and forced-release juveniles displayed higher smolt-adult survival in and across years, though still below 1%. He said the mechanism remains unclear, but these results are consistent with some previous data. Questions and comments were discussed as described in the following subsections.

What is the mechanism for differences in survival?

Johnson said conditions during emigration are variable, and survival through the hydro system is not constant over time. He said life-stage-specific survival studies are warranted in order to address the hypothesis that differences in survival are due to inconstant survival through the hydro system over time. Johnson said differences in survival could also be attributed to release timing and not release method.

Passive Integrated Transponder-tagging addendum

Johnson said in 2005, 5,000 fish were Passive Integrated Transponder (PIT)-tagged in each group and survival was evaluated to McNary Dam in order to examine bottlenecks of survival in the hydro system. Tracy Hillman said those fish were tracked back to Bonneville Dam, and force-released fish had twice the survival of volitional-released fish. He said the forced-release fish arrived at McNary Dam very quickly, and the smolt-to-adult return to Bonneville Dam was twice as high for forced-release compared to volitional release. Hillman said he does not think the size of the fish is the main factor in their survival now that he has revisited the data. Johnson said he has not examined which volitional release fish had the same release date as the forced-release fish. Bill Gale said it would be good to look at which of the 10,000 PIT-tagged fish in 2005 were non-migrants. He said the juvenile survival of volitional migrants may be higher than the forced-released fish, and the key to this analysis would be removing the non-migrants from the analysis. He questioned what the purpose of volitional release is, other than to select out non-migrants. Alene Underwood explained that this may be different with steelhead, but with spring Chinook salmon, there is no requirement to hold non-migrant fish back. She asked if it matters whether there are a few more non-migrants out of the pond for spring Chinook salmon, suggesting that despite the attention on the hydro system, there may be a general reluctance to discuss volitional release not working in every application. Craig Busack said volitional release is easy to "sell" and that it sounds like a better idea. He added that for him to accept forced release as a better strategy, he would like to see a biological theory for why that is true. Gale said he thinks there is evidence that there is no difference and neither strategy is better. Gale said he would strongly argue that volitional release should be used for selecting out non-migrants in order to do something different with them. Johnson said predator saturation might be one explanation for why forced-release fish have higher survival. Gale said that juvenile survival is driven by how many of the fish are able to migrate, and because they have a broad migration window, it may not matter if they are all forced out.

Timing of release

Keely Murdoch questioned whether differences in survival are a result of when the fish were released rather than how the fish were released. She said the study would have to be switched, with release timing for groups switched. Tom Kahler said survival and detection probability fluctuate hugely over time. Catherine Willard said every year is different; for example, in 2015, steelhead located at the Chiwawa acclimation facility may not have been "moving" because they were not getting environmental cues provided by increased t flows.

Gale said hatchery managers actually decide when to let the fish go, and some hatchery release dates are driven by when they need to do maintenance. Andrew Murdoch said for this study, a good date for forced release could not be predicted, so a date was picked in the middle of the volitional release period. He questioned the purpose of this release strategy and suggested if the fish were tracked the entire way, they could start to explore the mechanisms for differences in survival.

Precocity

Gale said physiology should be brought into the conversation, and asked about the rates of precocity. He asked if selecting out non-migrants was an option. He suggested using forced-release strategy if there is no alarm about the rates of precocity and letting the hatchery managers decide when to release the fish. Andrew Murdoch said regarding migration survival, every hatchery is different and the differences in survival can be masked by other effects since the migration is so long. He replied high levels of precocity are not seen if measured based on the level of Chinook salmon on spawning grounds. He added sometimes partial migration is seen, and the fish do not return to spawning grounds. Hillman asked if the proportion of movers versus stayers is different in the two release groups. Gale said he thinks the proportion of non-movers in both of the two ponds is the same. Gale said he has compared all forced-release versus all volitional-release migrants, and saw higher survival in volitional-release migrants. He said if the stayers are pooled together with the volitional release, the difference disappears. Johnson said this is probably close to what actually happens. Hillman said if the assumption that the proportion of stayers is the same for both groups, some of the fish that are forced out would have stayed, but that is not what the results are showing. Hillman said once the fish reach flowing water, they appear to move downstream. He recalled a study he conducted in the Wenatchee River following culling of juvenile spring Chinook salmon from the Leavenworth Hatchery in the late 1980s. He said as large numbers of hatchery fish drifted downstream, they “pulled” wild juvenile Chinook salmon from rearing areas. He referred to this as the “Pied Piper Effect.” The wild fish clustered with the downstream drifting hatchery fish and were generally the target of predators. Hillman agreed with Gale’s suggestion that stayers in the volitional group may need to be removed from the analyses. Kirk Truscott asked if smolt-to-adult survival was assessed for return by age. Johnson replied that the numbers are too small to run advanced statistics, but they appear similar. Truscott noted the PIT-tag return data would be the key to this analysis. Gale said with only 5,000 PIT tags per group, they likely would not be able to assess that data with statistics. Andrew Murdoch said this study is strictly looking at release methodology, and said all the fish had been ad-clipped.

Release methodology then and now

Johnson explained the program has changed, and there is now a week-long volitional release. Mike Tonseth said with steelhead on station, the best approach is being considered, and there is not enough capacity for additional studies for spring Chinook salmon at Chiwawa FH. Tonseth said since 2006, fish have been released with a 1-week volitional release. Hillman noted the current release strategy resulted in survivals to Bonneville Dam that are equal to or greater than the survival estimates for BY 2005. Underwood said the release methodology for Chiwawa spring Chinook was not changed until the entire steelhead program was acclimated at the Chiwawa acclimation facility beginning with brood year 2011, and the release strategy from 2005 to 2009 was a 4-week volitional release, with all fish being forced out at the end of 4 weeks. Andrew Murdoch said there is a lot of variation between years, and survival needs to be looked at through the hydro system in order to find the best time for release, no matter the release strategy. He said something else would have to be changed if the priority is to eliminate precocity or reduce ecological interactions. He emphasized the migration corridor takes most of the fish. Andrew said WDFW even stopped snorkeling, because there were more wild precocial fish on the redds than hatchery fish.

Hillman said there were volitional and forced releases through BY 2009, but the release strategy changed to only volitional beginning with BY 2010. He said that is interesting because for BYs 2005 to 2008, the survival from release to McNary Dam was about 60% (with the exception of BY 2007; survival =44%), but since BY 2009, survival is consistently between 45% and 55%. He noted that for BYs 2009 and 2010, the survival to McNary decreased. Gale said it would be interesting to see if survival went down basin-wide. Truscott commented that those would have been migrants in 2011 to 2012, which were extreme water years, and he would have expected the opposite results. Kahler said in 2011, total dissolved gas levels were high in the entire system, and Truscott added those 2 years had extreme volumes of water. Hillman said some of the years with the highest survival rates had the slowest travel times. Kahler said the proportion of the run that is barged at

McNary Dam fluctuates with flow volume, and barging influences SAR rates; so, relative differences in barging rates between forced and volitional migrants could possibly explain SAR differences.

B. DECISION: Excess BY 2014 Methow Spring Chinook Salmon (Mike Tonseth)

Mike Tonseth recalled discussing during the Hatchery Committees meeting on July 15, 2015, the overage originating out of Eastbank FH for BY 2014 Methow spring Chinook salmon. He said at that time, there were two unknowns: the status of approximately 200,000 Colville-component Methow spring Chinook salmon and the status on-hand population at Winthrop NFH. Both parties were still waiting to finish tagging in order to determine the population size and capacity to absorb the overage of approximately 29,000 HxH spring Chinook salmon at Eastbank FH. Tonseth recalled the Hatchery Committees decisions on July 15, 2015 to do the following:

1. Transfer 29,755 fish (HxH or hatchery-by-wild [HxW]) to Winthrop NFH to be incorporated into the Winthrop NFH Safety Net Program; and
2. Transfer remaining excess brood (approximately 26,000 wild-by-wild [WxW]) to Methow FH for release from Methow FH or satellite locations.

Tonseth said Methow FH is able to accept transfer of approximately 47,000 WxW Methow spring Chinook salmon, bringing the population up to 120% of post-recalculated plan program release numbers. He said this would amount to approximately 270,000 of the planned 224,000 fish. He said once inventories were complete, CCT were already at 110% of post-recalculated plan program release numbers, therefore they have no additional capacity because these fish would need to go to a remote acclimation site, and CCT does not want ponds to be at greater than 100% capacity. Tonseth said once inventories were complete at Winthrop NFH, there was not as much capacity as initially thought. He said approximately 11,000 of the 29,000 (HxH or HxW) will be accepted for incorporation into the Winthrop NFH Safety Net Program. Tonseth noted all programs are nearly maxed out.

He said approximately 18,000 HxH and HxW Methow spring Chinook salmon remain in overage at Eastbank FH. He stated WDFW's policy that disposing of these fish is not an option because of ESA issues, and the only avenue appears to be to releasing them into non-anadromous waters. He said Banks Lake has been used in the past. He added applying the average smolt-to-adult returns for the 18,000 Methow spring Chinook salmon would equate to approximately 42 adults, so these are hatchery fish that would be otherwise culled. Keely Murdoch asked if all programs are maxed out for release targets or for facility. Tonseth replied Methow FH is close to being maxed out for capacity, and steelhead are also being reared on station, so that starts to compromise the ability to keep densities down on spring Chinook salmon. He said Methow FH is a conservation program, and they are all WxW, so they do not want to add a lot of HxH fish into the program. Bill Gale added the decision to take approximately 11,000 HxH or HxW fish at Winthrop NFH was based on capacity. Tonseth said in summary, these fish are all HxH and an insignificant number. He said they would have been culled earlier if WDFW had been aware of the overages. Keely Murdoch asked if any of the approximately 18,000 fish are HxW. Tonseth replied there are some HxW, but the wild component were wild males already used as primary cross for the WxW component at Eastbank FH; therefore, there is no loss of genetic contribution by culling fish. Keely Murdoch recalled YN previously being unsupportive of taking endangered spring Chinook salmon and putting them into Banks Lake. Keely Murdoch referenced the July 15, 2015 meeting minutes, and said the Hatchery Committees were talking about three different options, none of which included Banks Lake. She said she does not agree with it at this point in time. She asked if it is possible to carry some fish over at Methow FH and then transfer them into a remote acclimation site. She recalled the Hatchery Committees discussion of overwintering the fish and moving them to Carlton Ponds. She said she understands this is over the recalculated number, but it is still within the permit of potential release (since the existing, extended permits were for a Methow Hatchery capacity of 550,000). Craig Busack asked if Keely Murdoch is saying it is okay to release these extra fish. Keely Murdoch said that was a point made during the July 15, 2015 Hatchery Committees meeting. Busack said NMFS reissued these permit extensions under the assumption that people would follow the new program, not assuming they would take advantage of the earlier numbers. Busack said if the fish are over 120% of program, they should not be released. Tonseth said he first brought this discussion to the Hatchery Committees in January or February. He said he advocated taking the fish to Banks Lake, but due to resistance at that time and the potential avenue for other programs to absorb the overage fish, Banks Lake was not included. Tonseth recalled during the July 15, 2015 Hatchery Committees meeting, WDFW did not support overwintering at Carlton Pond. He said transferring to an acclimation facility later in the year also is not supported by WDFW, because fish would have to be held at Methow FH until spring, where there is not enough capacity without compromising WxW fish. Tonseth said the timeline for this decision is the next few weeks if possible. Gale asked if the two options are transferring fish to Banks Lake and a subyearling release. Tonseth responded yes. Busack said he could agree with the release into the Columbia River. Tonseth said they did release fish into the Columbia River one year, but he does not believe it was spring Chinook salmon. He said these fish are all coded-wire-tagged (CWT). Busack suggested to Keely Murdoch that when she takes this decision up the chain of command to perhaps reference these fish as surplus to recovery needs, rather than endangered, because they do not have the same kind of protection as "endangered" fish. He said every time more fish are produced than what is agreed to, the Hatchery Committees resist the decision to cull the fish. Busack said they are already above the buffer. Keely Murdoch thanked him for the suggestions. Kirk Truscott said CCT have accepted transferring the extra fish to Banks Lake. Tracy Hillman asked if this is only option and inquired about subyearling releases into the Columbia River. Tonseth said he does not like that idea because then multiple fish in that area would have the same CWT code, which would create tracking and analysis difficulties for Matt Cooper. Tonseth said he thinks it is cleaner to transfer them to Banks Lake. Busack said compromising on monitoring should be considered. Gale said if the fish are put into Banks Lake, they have potential to contribute to sport harvest, and if the fish are released as subyearlings into the Columbia River, they do nothing except contribute to predator growth. Gale said either option is suitable to USFWS, but his preference is Banks Lake. Alene Underwood said Chelan PUD supports what the co-managers want to do, but that Chelan PUD does not want to continue to care for fish that do not contribute to mitigation. Busack said NMFS supports transferring fish to Banks Lake to avoid compromising monitoring efforts. Keely Murdoch said she will discuss internally the YN's support to release approximately 18,000 mostly HxH Methow spring Chinook salmon into Banks Lake.

VI. HETT

A. HETT Update (Greg Mackey/Catherine Willard)

Catherine Willard said the HETT will reconvene on Thursday, October 29, 2015, at 9:00 a.m., at the WDFW Research Office in Wenatchee, Washington, to continue finalizing the Hatchery M&E Plan appendices.

VII. NMFS

A. PRESENTATION: 3-Population Gene Flow Planning Tool (Craig Busack)

Craig Busack said this presentation is a combination of PowerPoints, papers, and a spreadsheet. He said the background of the materials is Mike Ford's 2002 model extended to multiple populations. Busack said he made a spreadsheet tool in order to assess gene flow and is presenting on the basic concept of Proportionate Natural Influence (PNI) and the development of the 3-population model.

Busack shared a presentation titled "Derivation and Properties of the PNI Statistic: a Tool for Managing Integrated Hatchery Programs" (Attachment E), which Sarah Montgomery distributed to the Hatchery Committees on September 1, 2015. The presentation addressed how a population undergoes hatchery-selective forces and natural-selective forces to eventually reach a genetic equilibrium point somewhere between the hatchery-origin optimum and the natural-origin optimum. This equilibrium point, called z*, is determined mainly by gene flow rates, or how domesticated a population becomes depending on gene flow in both directions. The equilibrium point z* is approximated by the proportionate natural influence ratio: p_{NOB} / p_{NOB} + p_{HOS}, where p_{NOB} is the proportion of broodstock consisting of natural-origin fish, and p_{HOS} is the proportion of fish spawning naturally consisting of hatchery-origin fish.

Integrated programs represent gene flow between natural and hatchery environments. In the Ford 2002 model, a population lives in two environments with distinct optima. Selection in each environment tugs the population characteristics toward its optima. In a system where a population is affected by hatchery and natural selection forces, the distance between the optima is determined by the selectivity between the hatchery and natural environment. Hatchery- and natural-selective forces are different. This narrow theoretical basis gives the gene flow planning tool power.

Busack shared a paper titled, “Selection in Captivity during Supportive Breeding May Reduce Fitness in the Wild” (Attachment F), which Montgomery distributed to the Hatchery Committees on September 1, 2015. Busack said that as a population moves away from its optimum, fitness declines; therefore, a population tries to be as close to optima as possible. He added, the way that populations move is determined by recursion equations, which can be put in a spreadsheet in order to predict future generations.

Tracy Hillman asked if Ford was calculating the absolute or relative factor. Busack responded that it does not make a big difference. He said the modeling is assuming a normally distributed population with traits determined by genes with small effects, and selection is fairly weak. He added model robustness has been assessed by Baskett and Waples[2], who showed that model robustness depends on optima distance and if selection happens before or after reproduction. Busack shared a paper titled, “Evaluating Alternative Strategies for Minimizing Unintended Fitness Consequences of Cultured Individuals on Wild Populations,” (Attachment G), which Montgomery distributed to the Hatchery Committees on September 1, 2015.

Busack shared a paper titled, “Extending the Ford model to Three or More Populations,” which Montgomery distributed to the Hatchery Committees on August 26, 2015. Busack shared a revised version of the paper, “Extending the Ford model to Three or More Populations 2” (Attachment H), which Montgomery distributed to the Hatchery Committees on September 1, 2015.

Busack said the equations in his paper are simplified versions of the original recursion equations in Ford’s model. He said these equations can be applied to fall Chinook salmon or Methow spring Chinook salmon, for example. Andrew Murdoch asked if this is adaptable for all types of populations. Busack replied yes.

Busack shared a spreadsheet titled “Methow Gene Flow Tool.” Andrew Murdoch said he thought Todd Pearson’s concern was for Hanford Reach fall Chinook salmon. Busack

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[2] Baskett, M.L., and R.S. Waples, 2012. Evaluating Alternative Strategies for Minimizing Unintended Fitness Consequences on Cultured Individuals on Wild Populations. Conservation Biology: 27 no. 1, pages 83-94.

explained how to input spawning and broodstock proportions for three different populations into the model. Busack displayed the sheet of raw numbers and explained how he set optima and starting points. Andrew Murdoch asked if the optima and selection factors are not very sensitive, and Busack confirmed. Andrew Murdoch asked about inputting into the model a scenario where the two hatchery programs have different optima. Busack said the optimum is determined by the hatchery rearing environment, and has nothing to do with the genes that enter the environment. He added hatchery programs can be input with different optima, which will affect PNI. Busack said he will provide the tool discussed during today's meeting. Montgomery distributed "Methow Gene Flow Tool 2" (Attachment I) to the Hatchery Committees after the meeting on August 28, 2015.

Kirk Truscott asked if the model accounts for programs that deal with multigenerational hatchery fish in terms of fitness. Busack replied this is a single generation, non-age-structured model. Andrew Murdoch asked if a program like Winthrop FH could be weighted because it has been in operation longer. Busack replied it would even out in equilibrium, and the tool should not be used to model generations. Bill Gale asked if this tool could calculate the genetic risk of programs in the Methow Basin. Busack replied that for Winthrop FH, a suitable range for proportion hatchery origin spawners and for variation in broodstock composition will have to be set. Mike Tonseth said if the goal was to increase the wild gene component, wild males collected for the Methow FH program could be used at Winthrop FH as well. He said, in low adult return years, those risks would be offset by doubling up on males. Gale added there are other basins where multiple hatchery programs are contributing to natural populations, and asked how this is approached elsewhere. Busack said other programs might be doing a source breakdown of hatchery fish, but it is unlikely that they are separating by hatchery in detail. Gale asked if it makes sense to consider managing the Methow Basin programs as an experimental period for the next 10 years, and if that would help the consultation with NMFS. Busack replied this is a unique situation without control structures, and with fairly modest changes, PNI could be considerably increased. Andrew Murdoch asked if anyone is trying to connect the gene flow model outputs to observed productivity. Busack said he does not think they are set up to test whether or not the Hatchery Scientific Review Group (HSRG) guidelines work. He added more genomic information will be available in the future, which will help measure the fitness effects, but right now it is very conceptual. Andrew Murdoch said in the Tucannon River, he would need a 4-population gene flow model due to straying. Busack replied the model is extendable, but warned not to let the biological complexity get further than the biological uncertainty. Gale suggested in cases where multiple groups are spawning and hatcheries are combined into one group, risk would only be exaggerated, and PNI reduced.

VIII. USFWS

A. Leavenworth NFH Update (Bill Gale)

Bill Gale said Leavenworth NFH is experiencing low water and high temperatures due to being on surface source water. He said an ich outbreak in ponds occurred in June 2015 during a period of 70-degree-Fahrenheit weather. He said in response to the outbreak, they turned the water from Snow Lakes on early, and transferred approximately 250,000 of the healthiest fish to Chief Joseph Hatchery. He added approximately 160,000 of the unhealthiest fish were euthanized, freeing up almost an entire bank and allowing more flow to the ponds. He said water pump-back was also being tested, which increases the temperature in one well and the height of the aquifer and diverts no flow from the channel. Gale said broodstock has not been affected since the priority was to give the best water to broodstock. He added that fish have started spawning and so far they are just under the release goal.

Keely Murdoch asked Mike Tonseth if there have been problems with broodstock. Tonseth replied there have not, and the biggest question is if there is water available for acclimation facilities. Tonseth requested an update on acclimation facilities at the September Hatchery Committees meeting from Chelan PUD. Chelan PUD will provide an update on water for acclimation facilities during the next Hatchery Committees meeting on September 16, 2015. Kirk Truscott added he was hoping to see a flow release from the Okanagan River for sockeye salmon. Tom Kahler said that water from Okanagan Lake is not available for that action, but the new rule curve for when the Osoyoos Lake is lowered and filled may allow some water for release. Alene Underwood said the Okanagan Nation Alliance will present an annual update at the Priest Rapids Coordinating Committee Hatchery Sub-Committee September 2015 meeting to answer any questions prior to broodstock collection beginning in October.

IX. HCP Administration

A. Review Period for HCP Plans

The Hatchery Committees representatives present agreed that the 60-day review period for HCP Plans may be shortened to 30 days when approved by the Hatchery Committees. Tracy said Sarah Montgomery will update the Hatchery Committees Meeting Protocols document, and distribute the updated document to the Hatchery Committees (Attachment J).

B. Next Meetings

The next scheduled Hatchery Committees meetings are on September 16, 2015 (Douglas PUD), October 21, 2015 (Chelan PUD), and November 18, 2015 (Douglas PUD).

List of Attachments

Attachment A	List of Attendees
Attachment B	5-Year Analytical Report Review: Objectives 3, 6, and 8
Attachment C	Fire Retardant in Twisp River
Attachment D	Adult Survival of Hatchery Spring Chinook Salmon Volitionally or Forced Released as Juveniles in the Chiwawa River
Attachment E	Derivation and Properties of the PNI Statistic: a Tool for Managing Integrated Hatchery Programs
Attachment F	Selection in Captivity during Supportive Breeding May Reduce Fitness in the Wild
Attachment G	Evaluating Alternative Strategies for Minimizing Unintended Fitness Consequences of Cultured Individuals on Wild Populations
Attachment H	Extending the Ford Model to Three or More Populations 2
Attachment I	Methow Gene Flow Tool 2
Attachment J	HCP-HC Meeting Protocols

Attachment A
List of Attendees

Name	Organization
Tracy Hillman	BioAnalysts, Inc.
Kristi Geris	Anchor QEA, LLC
Sarah Montgomery	Anchor QEA, LLC
Catherine Willard*	Chelan PUD
Alene Underwood*	Chelan PUD
Tom Kahler*	Douglas PUD
Bill Gale*	U.S. Fish and Wildlife Service
Matt Cooper*	U.S. Fish and Wildlife Service
Michael Humling†	U.S. Fish and Wildlife Service
Craig Busack*†	National Marine Fisheries Service
Mike Tonseth*	Washington Department of Fish and Wildlife
Andrew Murdoch	Washington Department of Fish and Wildlife
McLain Johnson	Washington Department of Fish and Wildlife
Kirk Truscott*	Colville Confederated Tribes
Keely Murdoch*	Yakama Nation

Notes:
* Denotes Hatchery Committees member or alternate
† Joined by phone

Attachment B

5-year Analytical Report Review

Objectives 3, 6, and 8

Spring Chinook (Methow, Twisp, Chewuch)

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
  - Q1: is the allele frequency of hatchery fish similar to the allele frequency of naturally produced and donor fish?
- 3.2 Genetic distances between ‘populations’
  - Q1: Does the genetic distance among subpopulations within a supplemented population remain the same over time?
- 3.3 Effective spawning population
  - Q1: is the ratio of effective population size (Ne) to spawning population size (N) constant over time?
- 3.4 Age at Maturity
  - Q1: Is the age at maturity of hatchery and naturally produced fish similar?
- 3.5 Size at Maturity
  - Q1: Is the size at maturity of hatchery and naturally produced fish similar?

Objective 3: Twisp River

- Twisp spring Chinook had significantly lower mean heterozygosity and allelic richness than Chewuch or Methow stocks.
- The Twisp hatchery-origin collections were mostly differentiated using Fst from Twisp natural-origin collections, although they were more closely related to Twisp natural-origin collections than to collections in other tributaries

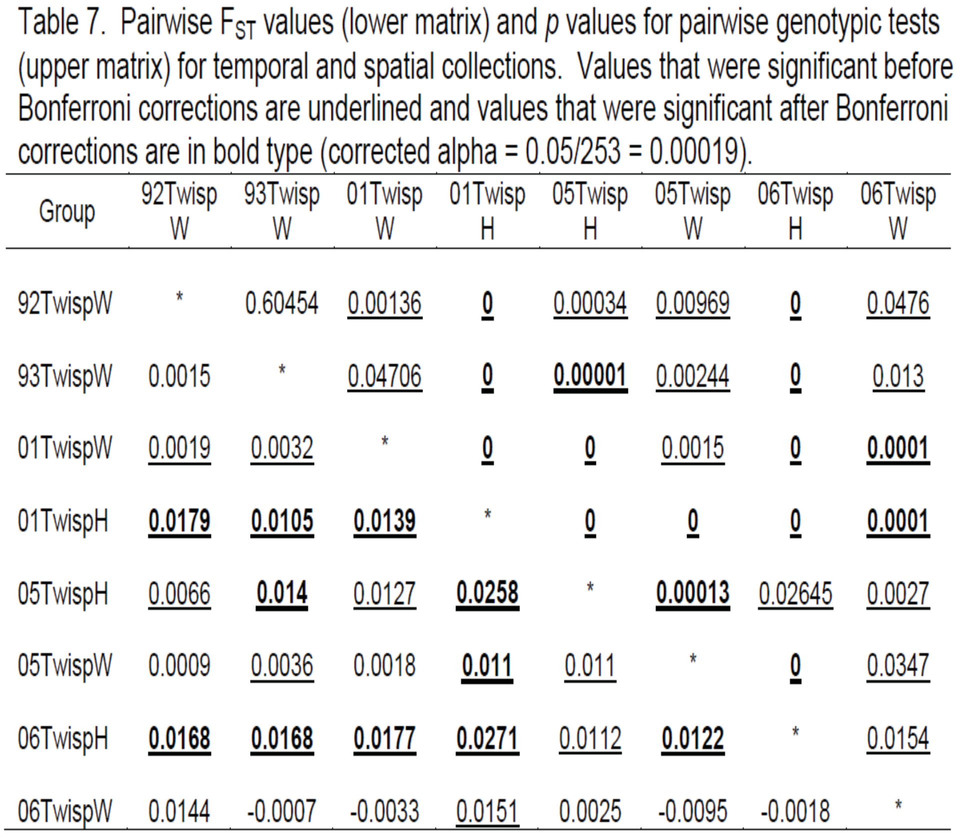

Table 7. Pairwise F_{ST} values (lower matrix) and *p* values for pairwise genotypic tests (upper matrix) for temporal and spatial collections. Values that were significant before Bonferroni corrections are underlined and values that were significant after Bonferroni corrections are in bold type (corrected alpha = 0.05/253 = 0.00019).

Group	92Twisp W	93Twisp W	01Twisp W	01Twisp H	05Twisp H	05Twisp W	06Twisp H	06Twisp W
92TwispW	*	0.60454	0.00136	**0**	0.00034	0.00969	**0**	0.0476
93TwispW	0.0015	*	0.04706	**0**	**0.00001**	0.00244	**0**	0.013
01TwispW	0.0019	0.0032	*	**0**	**0**	0.0015	**0**	**0.0001**
01TwispH	**0.0179**	**0.0105**	**0.0139**	*	**0**	**0**	**0**	**0.0001**
05TwispH	0.0066	**0.014**	0.0127	**0.0258**	*	**0.00013**	0.02645	0.0027
05TwispW	0.0009	0.0036	0.0018	**0.011**	0.011	*	**0**	0.0347
06TwispH	**0.0168**	**0.0168**	**0.0177**	**0.0271**	0.0112	**0.0122**	*	0.0154
06TwispW	0.0144	-0.0007	-0.0033	0.0151	0.0025	-0.0095	-0.0018	*

Objective 3: Twisp River

Funded by Douglas County PUD

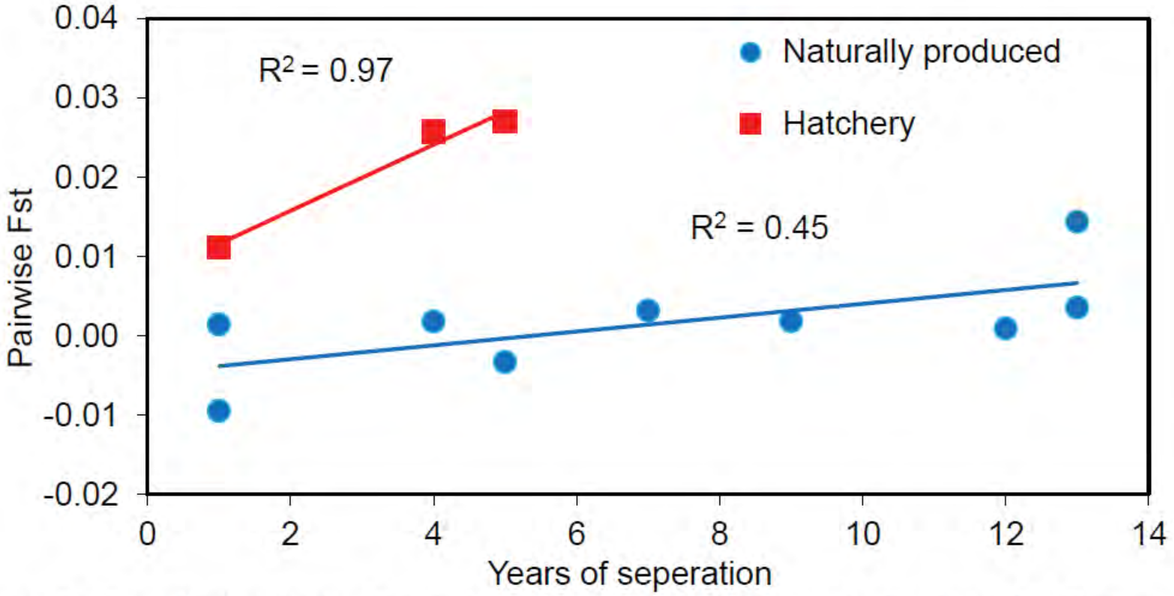

Figure 9. Graph of pairwise F_{ST} values versus time between collections for Twisp spring Chinook.

Increase in differentiation over time within Twisp natural origin broodstock collections and within Twisp hatchery-origin broodstock collections.

Objective 3: Twisp

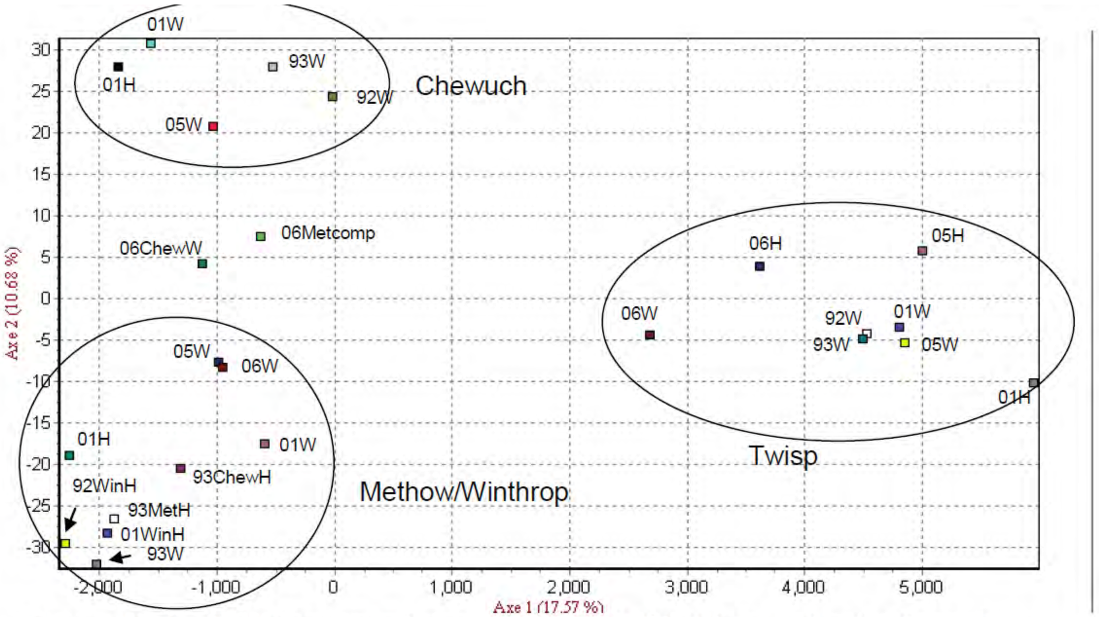

Figure 10. Factorial correspondence analysis plot of hatchery and natural spring Chinook collections from the Methow, Chewuch and Twisp rivers. Hatchery- and natural-origin collections are indicated by “H” and “W”, respectively, after the two-digit code for collection year (Small et al. 2007).

Twisp spring Chinook, both natural and hatchery origin, remain genetically differentiated from Methow and Chewuch stocks. Early samples from the Twisp River were more tightly clustered than later collections suggesting some differentiation within the stock over time.

Objective 3: Twisp

Funded by Douglas Cou

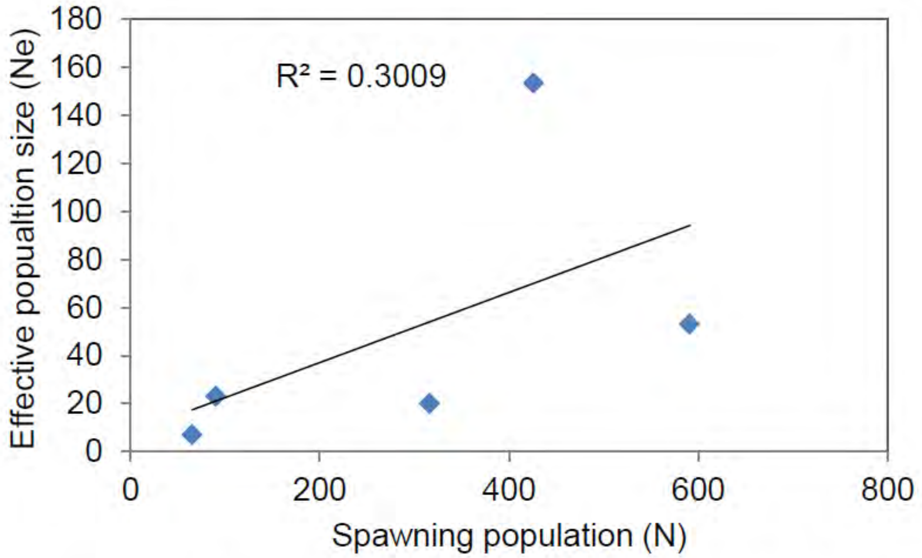

Figure 11. Relationship between the effective population size and the spawning population for naturally produced spring Chinook in the Twisp River.

The abundance of natural spawners was positively correlated with N_e but the relationship was not significant

Objective 3: Twisp

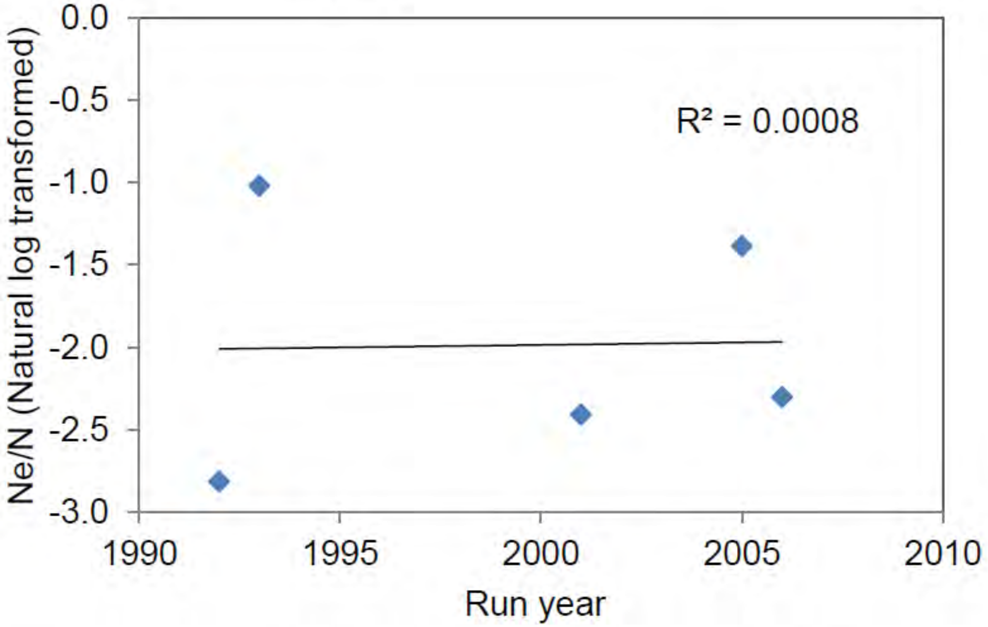

Figure 12. The ratio of N_e/N for naturally produced Twisp spring Chinook.

The relationship between N_e and N did not change over time

Objective 3: Twisp River

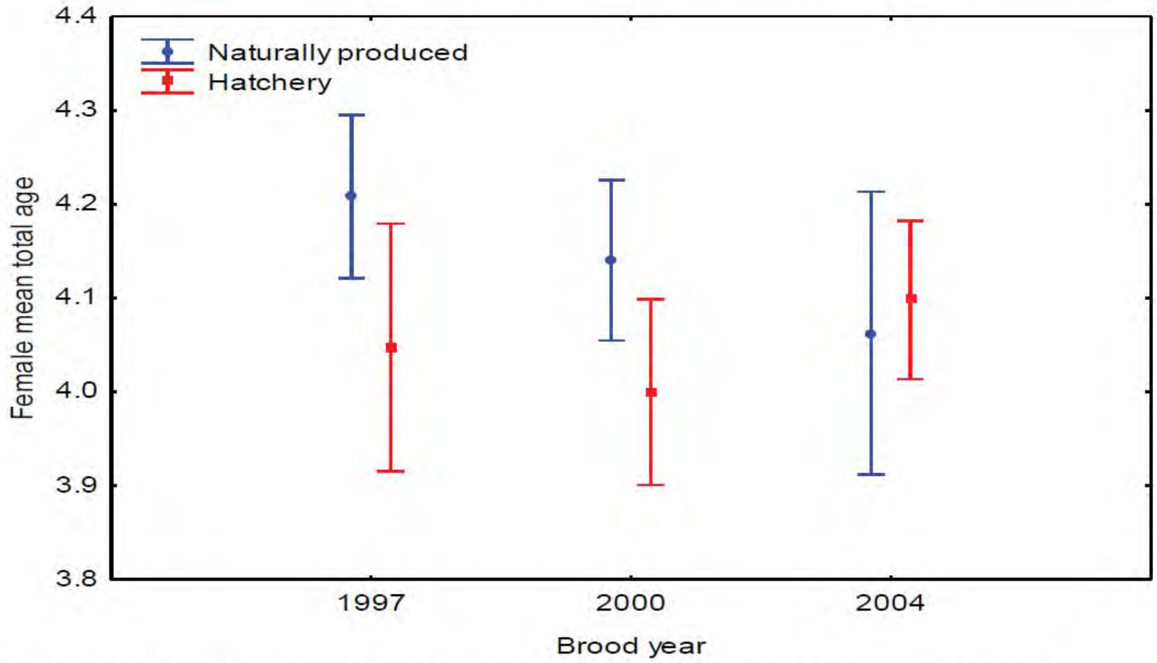

Figure 13. Mean age at maturity of female Twisp River spring Chinook salmon.

Low numbers of adult returns at the beginning of the program limited the analysis of age and size at maturity for brood years 1997, 2000, and 2004. Mean female and male hatchery and natural origin age was significantly different when compared by origin across years, but post-hoc multiple comparisons found no difference among origins within brood years.

Objective 3: Twisp River

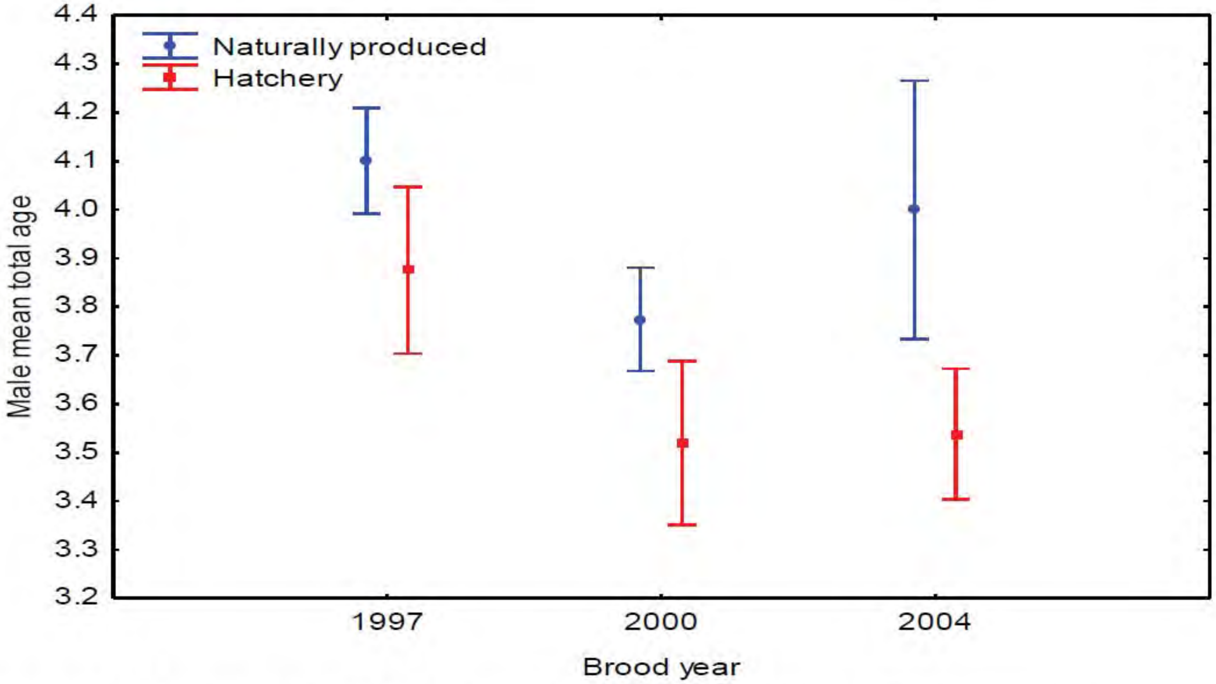

Figure 14. Mean age at maturity of male Twisp River spring Chinook salmon.

Low numbers of adult returns at the beginning of the program limited the analysis of age and size at maturity for brood years 1997, 2000, and 2004. Mean female and male hatchery and natural origin age was significantly different when compared by origin across years, but post-hoc multiple comparisons found no difference among origins within brood years.

Objective 3: Twisp River

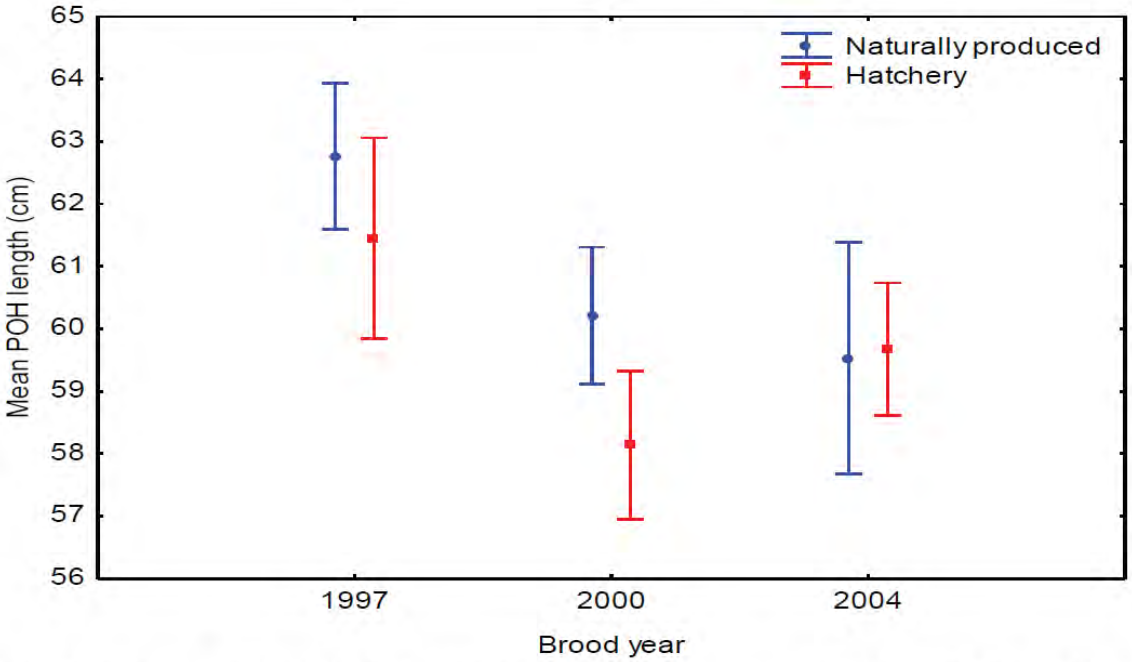

Figure 15. Mean post-orbital to hypural plate (POH) length of age 4 female Twisp River spring Chinook.

Low adult returns also limited the evaluation of size at maturity to age four fish. Although differences were detected across brood years for both females and males, no difference among origins was detected for females or males within a brood year.

Objective 3: Twisp River

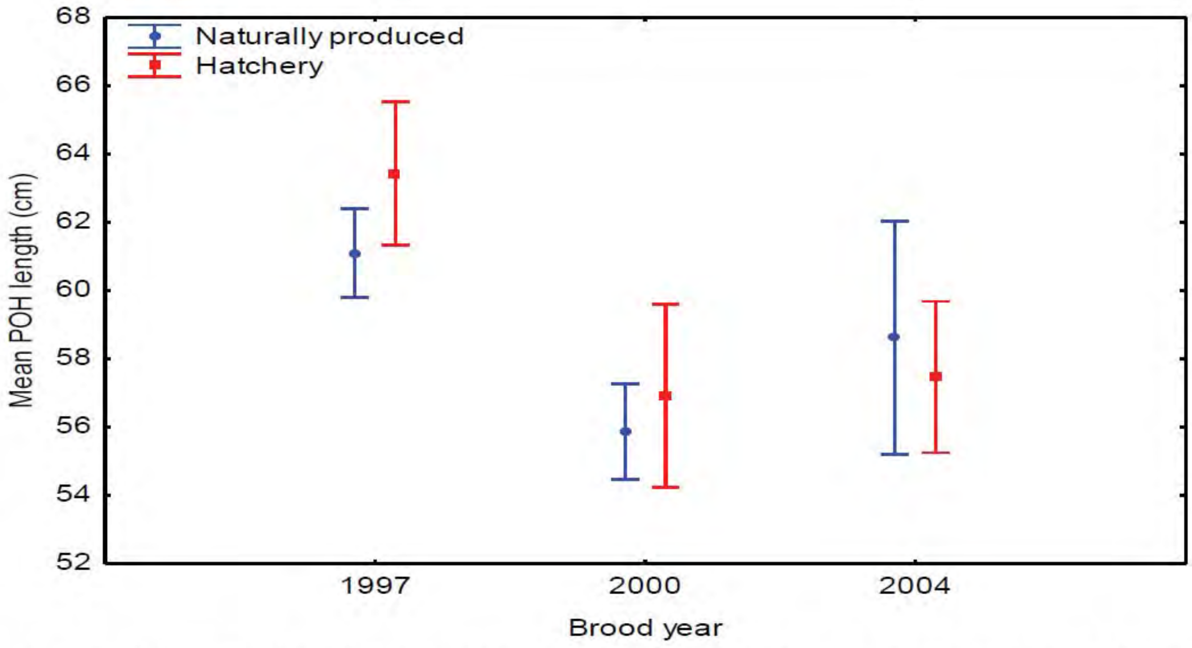

Figure 16. Mean post-orbital to hypural plate (POH) length of age 4 male Twisp River spring Chinook.

Objective 3: Chewuch River

- Chewuch spring Chinook had similar mean values for heterozygosity and allelic richness as Methow spring Chinook, but significantly higher values than Twisp spring Chinook.
- Low differentiation between Methow and Chewuch collections some of which was not significantly different than zero after corrections.

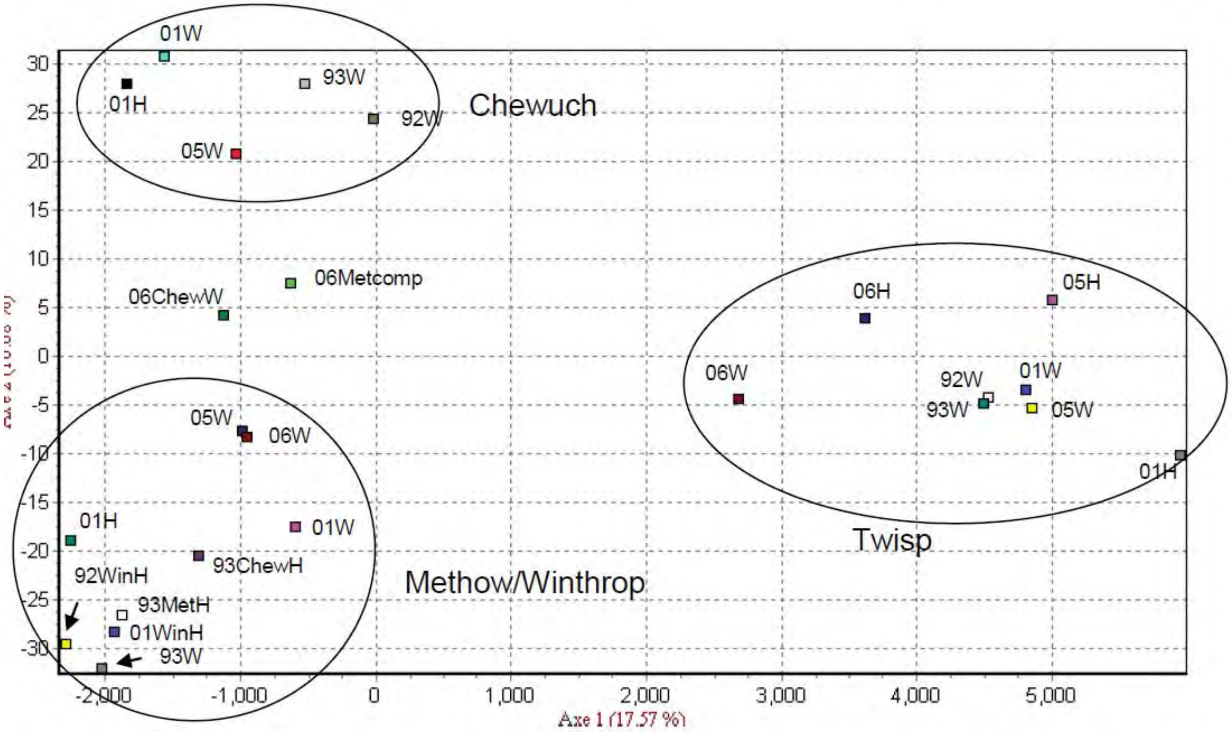

Figure 28. Factorial correspondence analysis plot of hatchery and natural spring Chinook collections from the Methow, Chewuch and Twisp rivers. Hatchery- and natural-origin collections are indicated by "H" and "W", respectively, after the two-digit code for collection year (Small et al. 2007).

Objective 3: Chewuch River

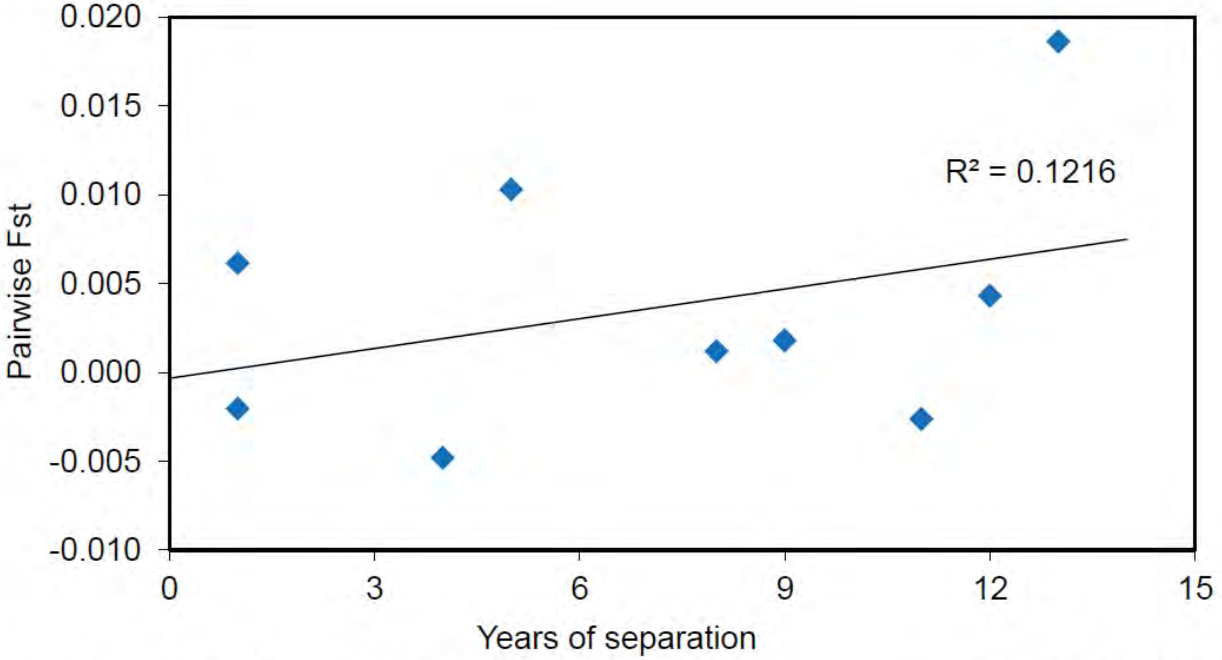

Figure 29. Graph of pairwise F_{ST} values versus time between collections for Chewuch spring Chinook.

Slight increase in differentiation over time possibly due to drift and introgression from the Methow through the Methow Composite stock.

Objective 3: Chewuch River

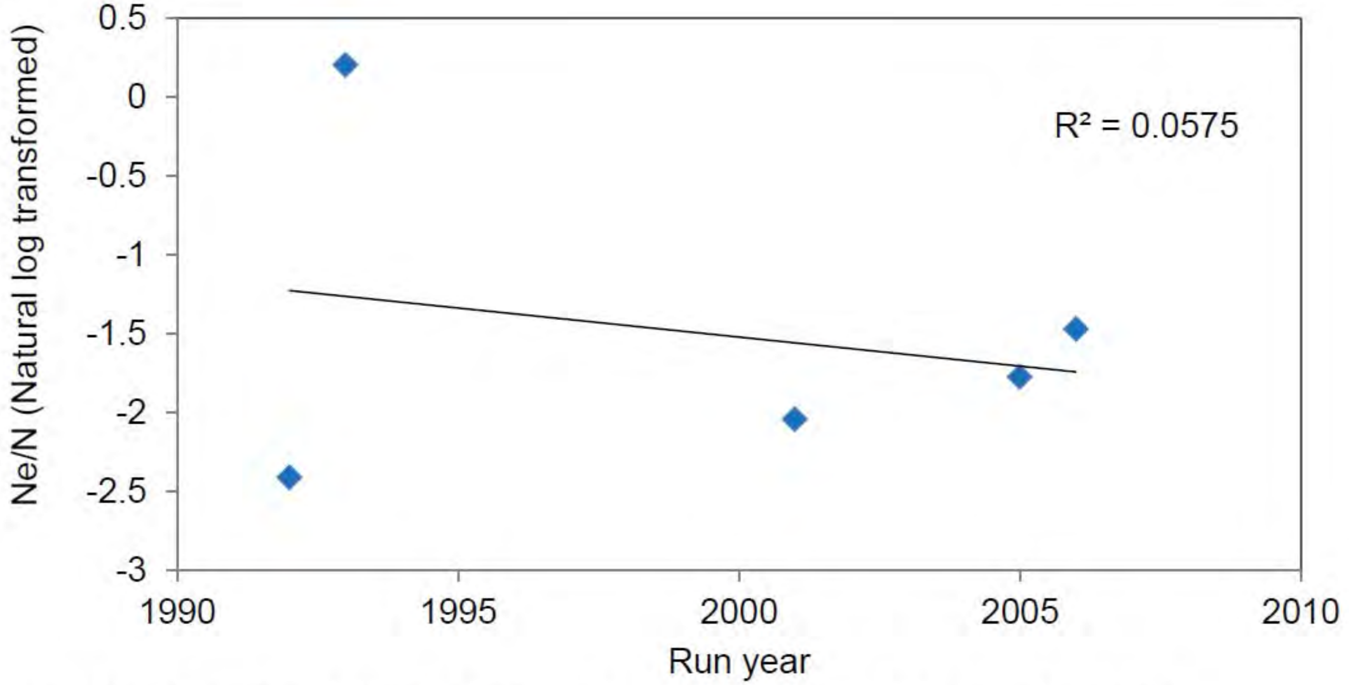

Figure 30. The ratio of N_e/N for naturally produced Chewuch spring Chinook.

The ratio of Ne/N of naturally produced fish did not change for the years examined.

Objective 3: Chewuch River

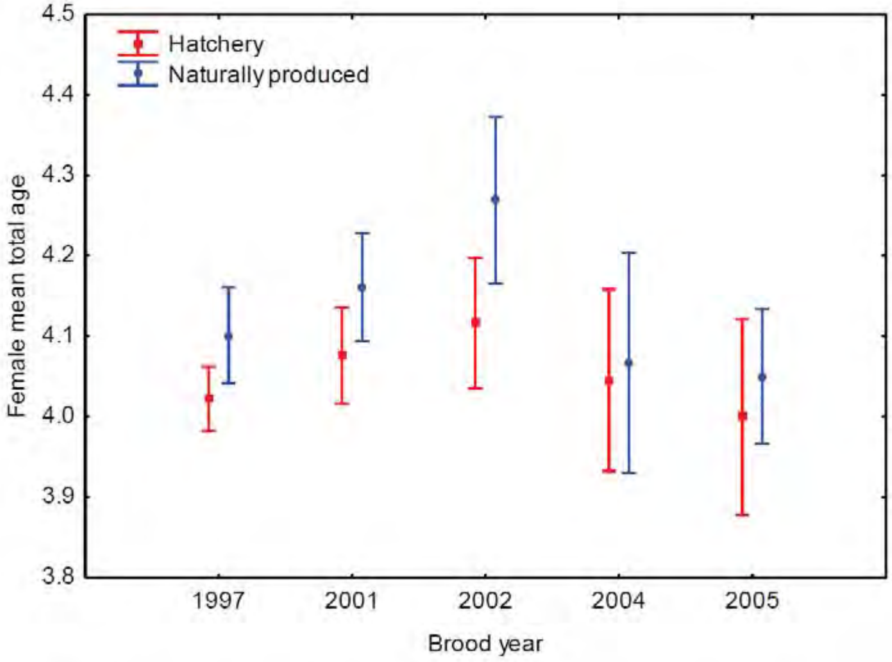

Figure 31. Mean female age at maturity of Chewuch River spring Chinook salmon.

Female mean age was significantly different based on origin and brood year but post-hoc multiple comparison tests found no difference among origins within a brood year.

Objective 3: Chewuch River

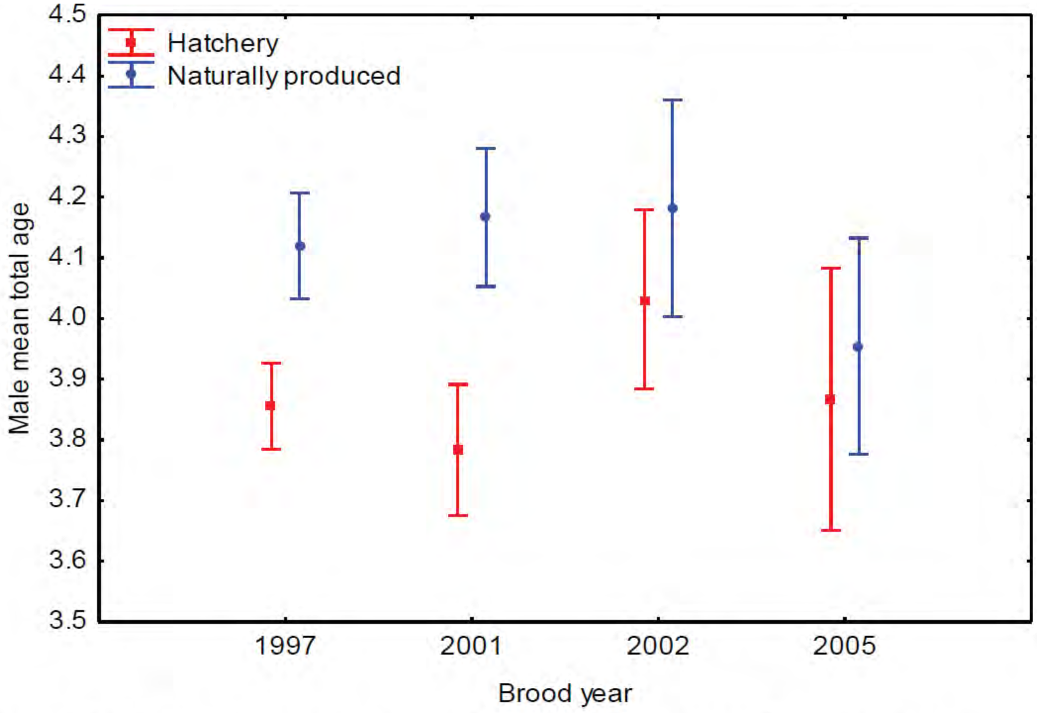

Figure 32. Mean male age at maturity of Chewuch River spring Chinook salmon.

Significant differences were found among the mean age of male Chewuch spring Chinook in two of the four brood years examined.

Objective 3: Chewuch River

Figure 32. Mean male age at maturity of Chewuch River spring Chinook salmon.

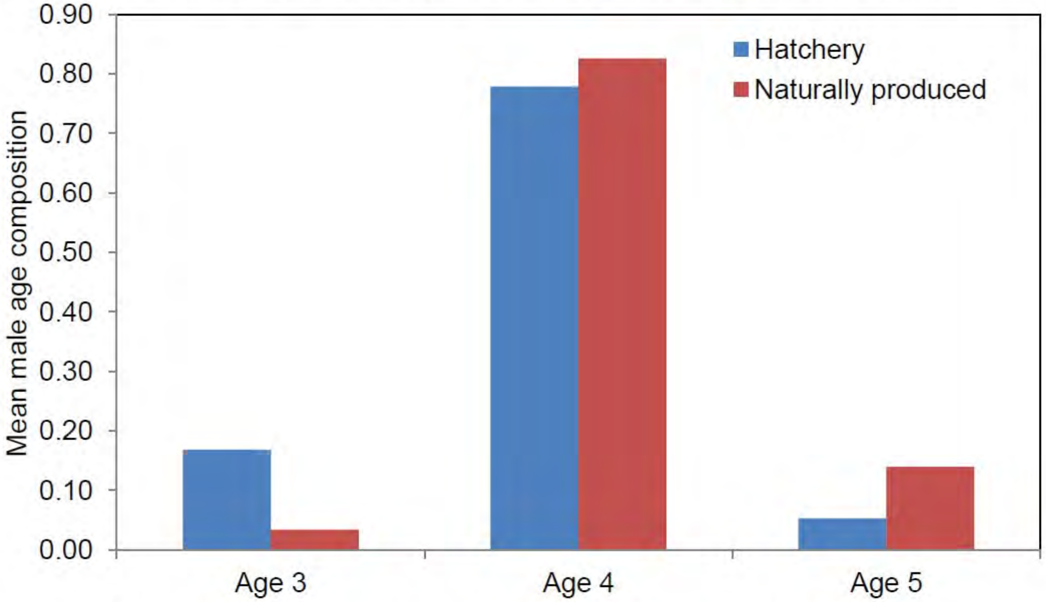

Figure 33. Mean male age composition of hatchery and naturally produced Chewuch River spring Chinook, brood years 1997, 2001, 2002, and 2005.

In years with a significant difference, male hatchery fish were composed of a greater proportion of age-3 and a lower proportion of age-5 fish compared to naturally produced fish.

Objective 3: Chewuch River

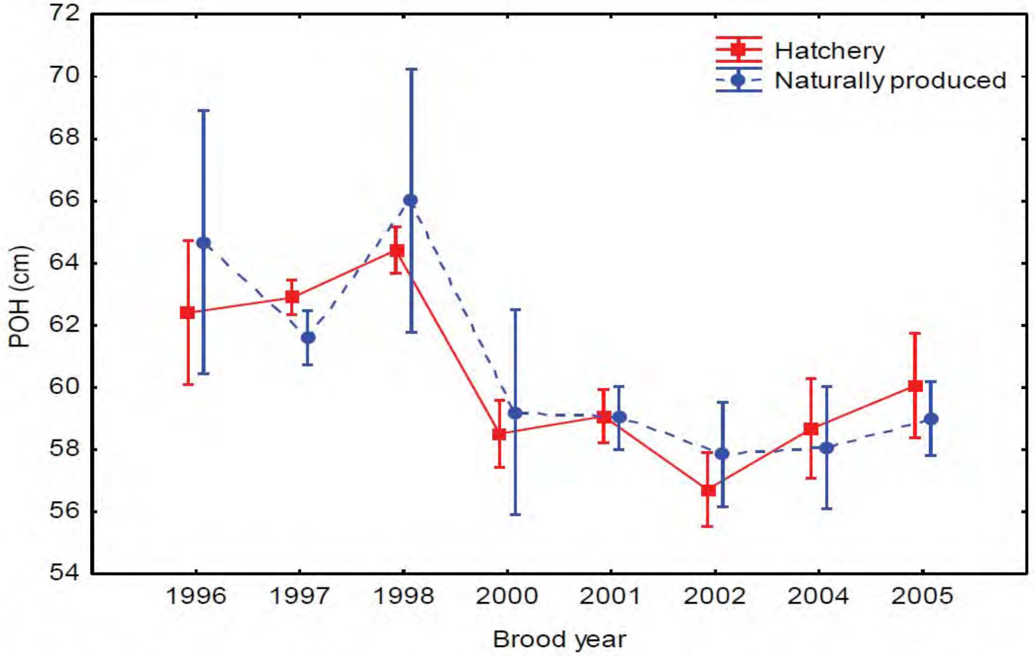

Figure 34. Mean post-orbital to hypural plate (POH) length of age-4 female Chewuch River spring Chinook.

Low adult returns limited the evaluation of size at maturity of age-four fish. No difference in size within the age-four fish was detected for females.

Objective 3: Chewuch River

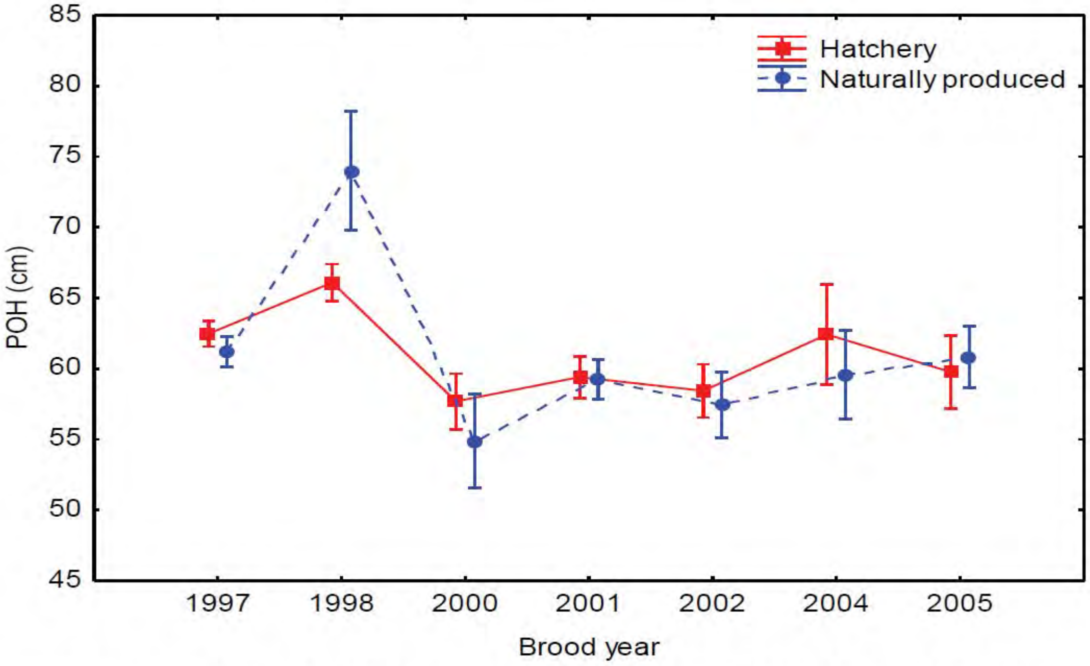

Figure 35. Mean post-orbital to hypural plate (POH) length of age-4 male Chewuch River spring Chinook.

Differences were not detected for male fish across years, but differences were found among origins within years. Differences within years were attributed to a small sample size (n=5) of naturally produced males in 1998.

Objective 3: Methow River

- Methow spring Chinook had similar mean heterozygosity and allelic richness as Chewuch spring Chinook, but were significantly higher than Twisp spring Chinook.
- Low differentiation between Methow and Chewuch natural origin collections, some of which were not significantly different after corrections.
- WNFH collections were not differentiated from most Methow natural-origin collections suggesting WNFH introgression into the Methow population.

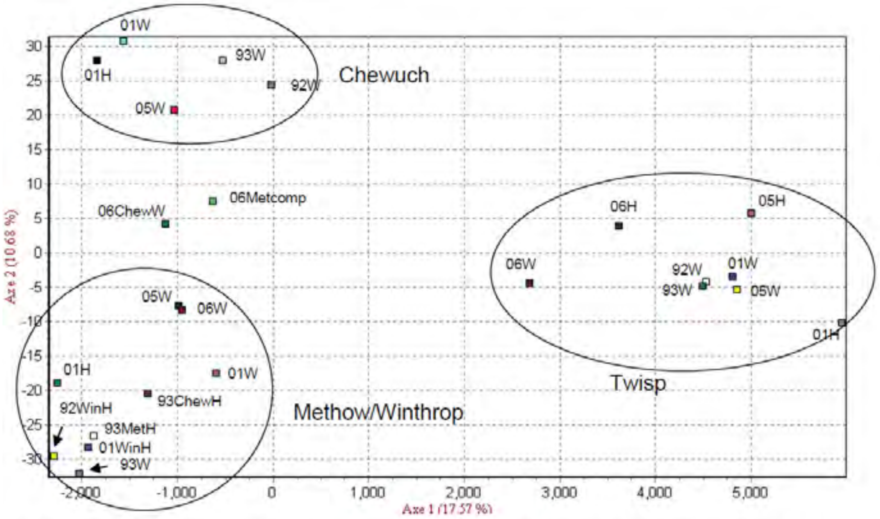

Figure 52. Factorial correspondence analysis plot of hatchery and natural spring Chinook collections from the Methow, Chewuch and Twisp rivers. Hatchery- and natural-origin collections are indicated by "H" and "W", respectively, after the two-digit code for collection year (Small et al. 2007)

Objective 3: Methow River

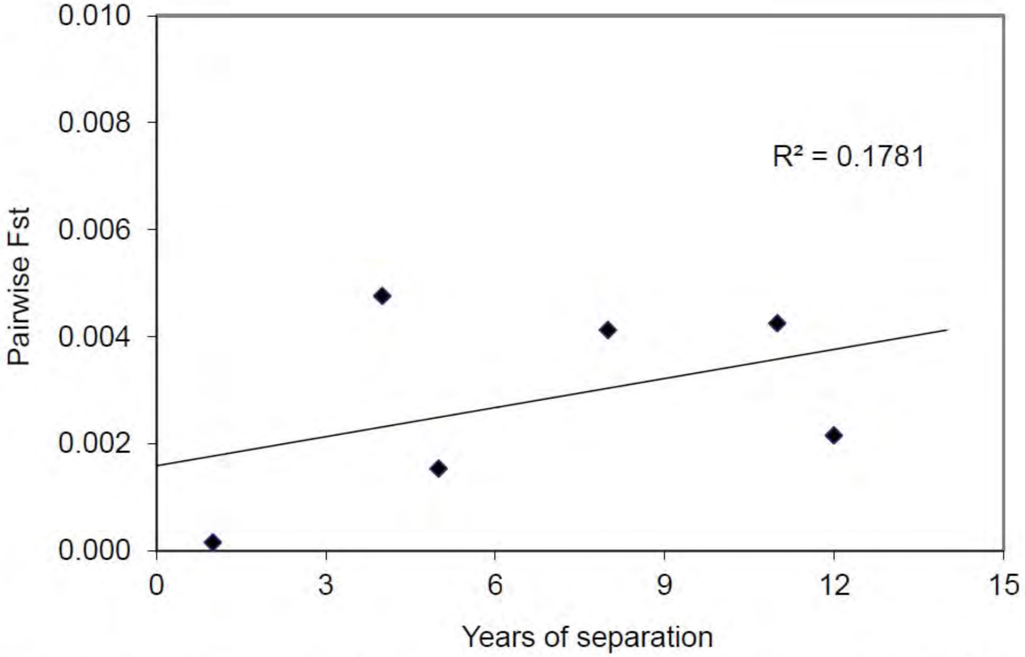

Figure 53. Graph of pairwise F_{ST} values versus time between collections for Methow spring Chinook.

Slight increase in differentiation (Fst values) over time, possibly due to drift and introgression from Methow-Composite stock. Increased differentiation is a likely signal that genetic drift is increasing as Ne decreases.

Objective 3: Methow River

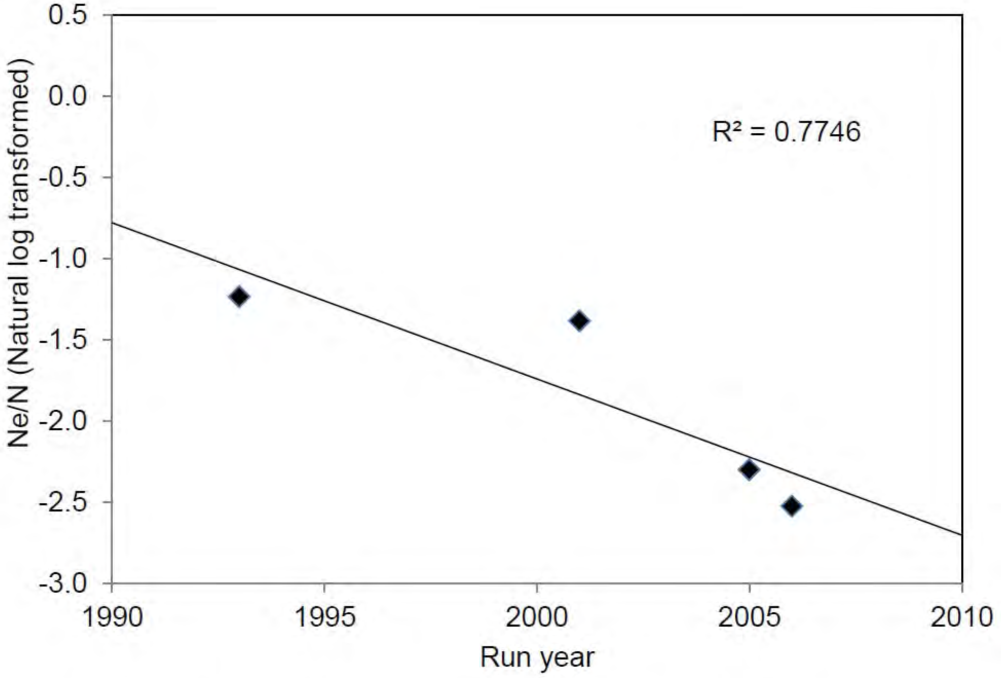

Figure 54. The ratio of N_e/N for naturally produced Methow spring Chinook.

The abundance of natural spawners was not correlated with Ne. However the ratio of Ne/N of naturally produced fish has been decreasing over time indicating a decrease in Ne during the supplementation period. Decreases in Ne over time may be the result of inbreeding or large variation in reproductive success, both of which are likely in populations predominately comprising hatchery-origin fish.

Objective 3: Methow River

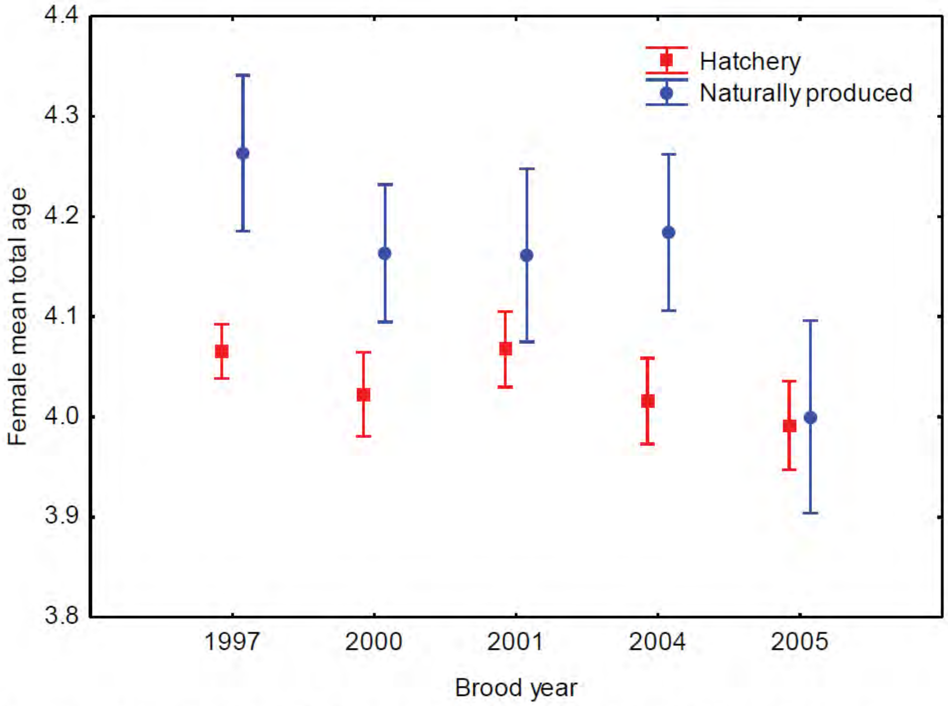

Figure 55. Mean female age at maturity of Methow River spring Chinook salmon.

Low numbers of adult returns at the beginning of the program limited the analysis of age and size at maturity to more recent brood years. Female age was significantly different based on origin and brood year, but post-hoc multiple comparison tests found no difference among origins within any brood year.

Objective 3: Methow River

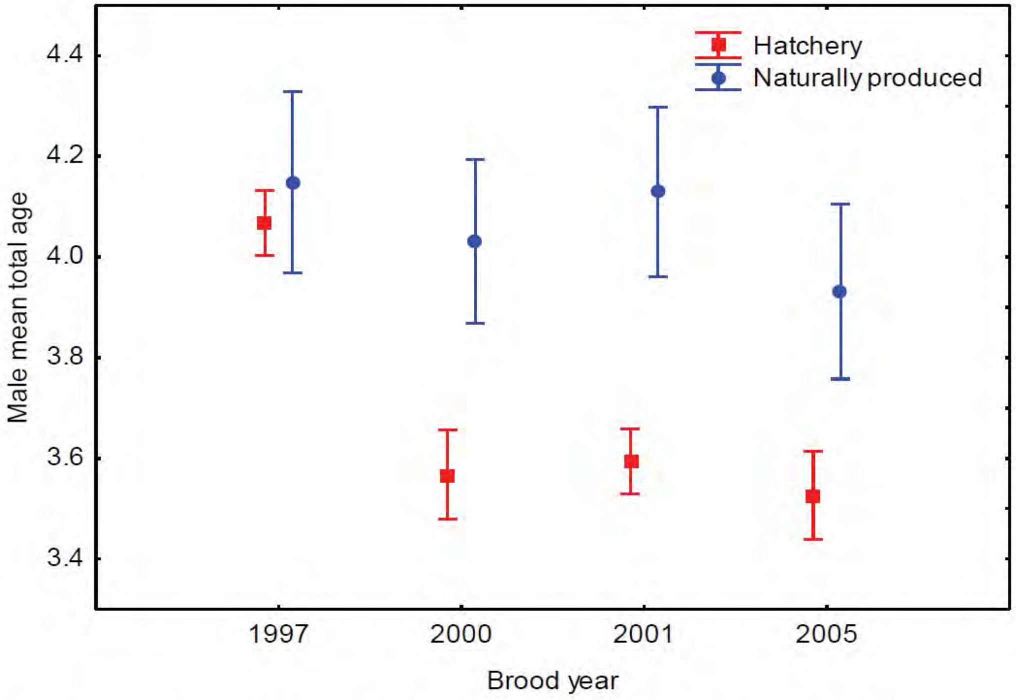

Figure 56. Mean male age at maturity of Methow River spring Chinook salmon.

Significant differences were found among the mean age of male Methow spring Chinook across brood years and origins. Significant differences were detected among origins within brood years in two of the brood years examined.

Objective 3: Methow River

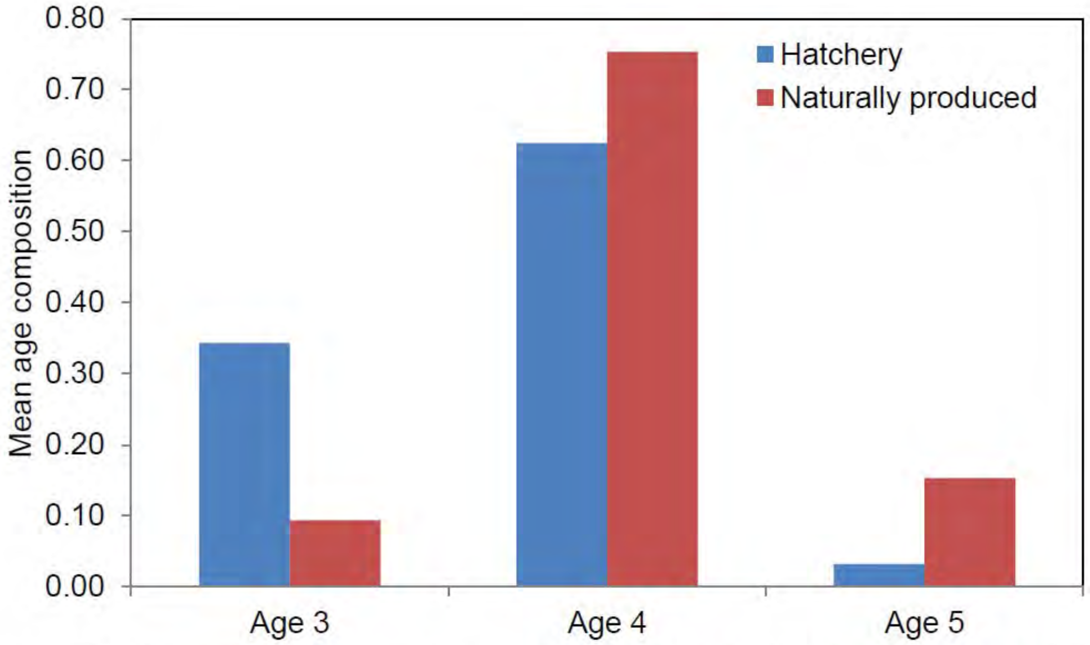

Figure 57. Mean male age composition of hatchery and naturally produced Methow River spring Chinook, brood years 1997, 2000, 2001, and 2005.

Male hatchery fish were composed of a greater proportion of age-3 and a lower proportion of age-5 fish compared to natural origin fish.

Objective 3: Methow River

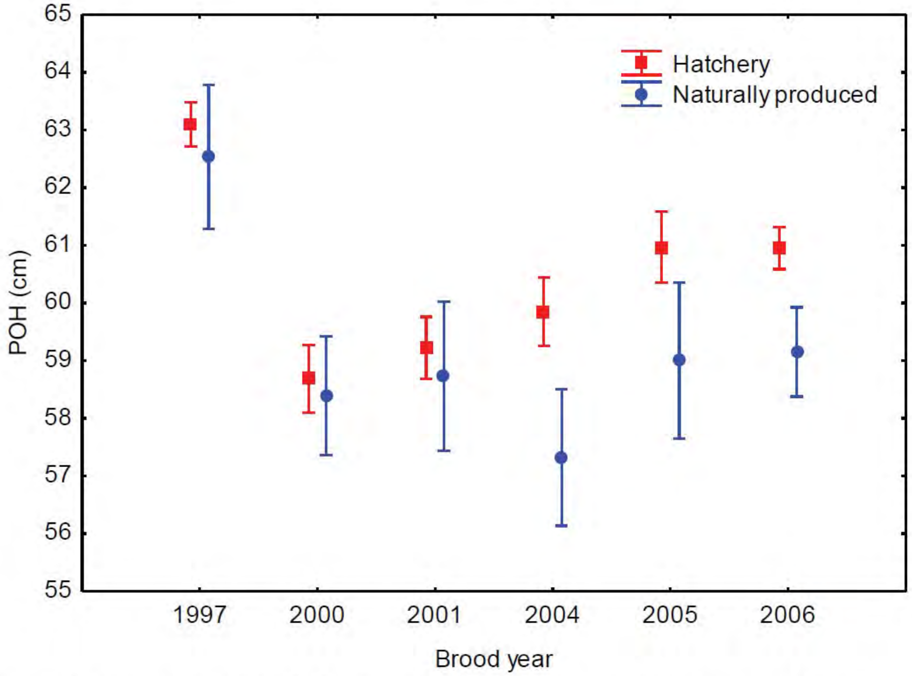

Figure 58. Mean post-orbital to hypural plate (POH) length of age-4 female Methow River spring Chinook.

Low adult returns limited the evaluation of size-at-maturity to age-four fish. Differences in size within the female age-four fish were detected among brood years and origins but no differences were found among origins within years.

Objective 3: Methow River

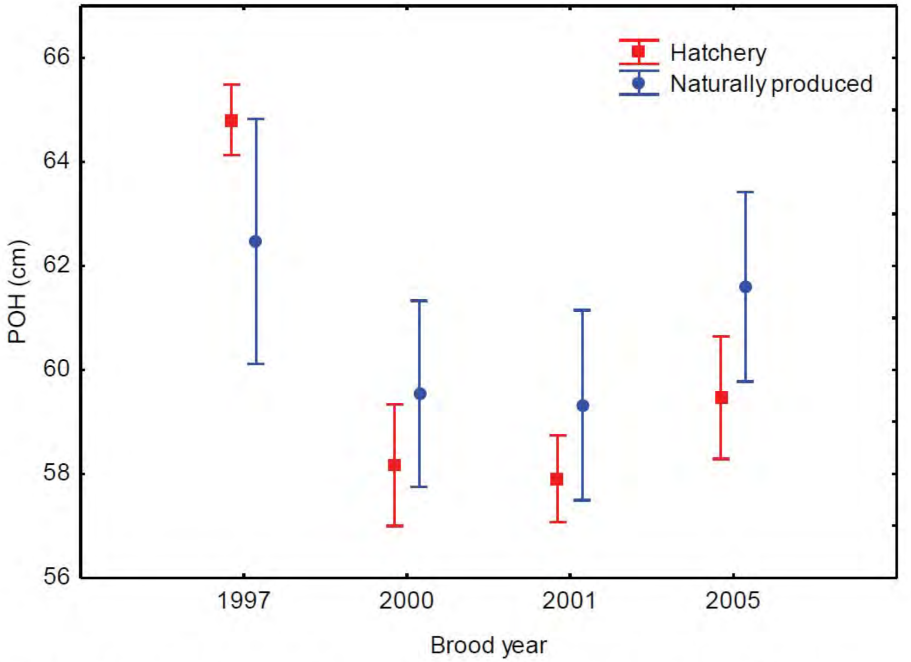

Figure 59. Mean post-orbital to hypural plate (POH) length of age-4 male Methow River spring Chinook.

Similar differences in size for male Methow age-four fish were detected across brood years and origins, but differences were not found among origins within brood years.

Objective 6: Determine if hatchery fish were released at the programmed size and number.

- **6.1 Size of Hatchery Fish (*Monitoring Indicator*)**
  - **Q1:** Is the size of hatchery fish released equal to the program goal?
- **6.2 Number of Hatchery Fish (*Monitoring Indicator*)**
  - **Q1:** Is the number of hatchery fish released equal to the program goal?

Objective 6: Twisp River

Table 12. Mean size at release of Twisp River spring Chinook salmon.

Brood year	Fork length	Weight		Brood year	Fork length	Weight
1992	135	30.0		2002	136	30.3
1993	133	29.8		2003	133	28.2
1994	139	31.4		2004	130	27.9
1996	137	30.7		2005	139	33.9
1997	133	28.2		2006	134	29.6
1998	138	30.3		2007	128	24.9
1999	156	47.7		2008	129	26.8
2000	133	27.2		Mean	135	29.9
2001	123	21.6		Target	135	30.2

The mean length of release was 135 mm and not significantly different from the release target size.
The mean weight at release was 29.9g and not significantly different from the release target size.

Objective 6: Twisp River

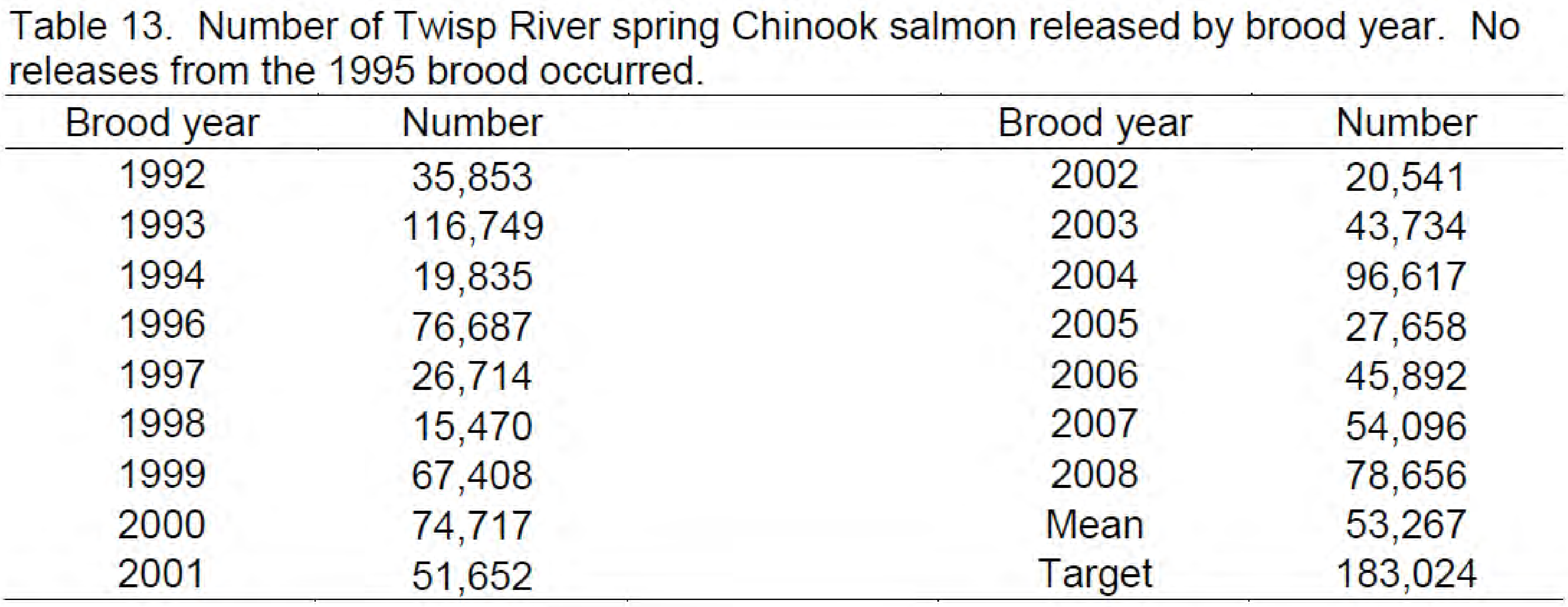

Table 13. Number of Twisp River spring Chinook salmon released by brood year. No releases from the 1995 brood occurred.

Brood year	Number	Brood year	Number
1992	35,853	2002	20,541
1993	116,749	2003	43,734
1994	19,835	2004	96,617
1996	76,687	2005	27,658
1997	26,714	2006	45,892
1998	15,470	2007	54,096
1999	67,408	2008	78,656
2000	74,717	Mean	53,267
2001	51,652	Target	183,024

The Twisp River program released a significantly lower number of fish between 1992 and 2008 than the program goal. Because hatchery life-stage survival rates were at or above survival standards, failure to meet program release goals were attributed to insufficient broodstock.

Objective 6: Chewuch River

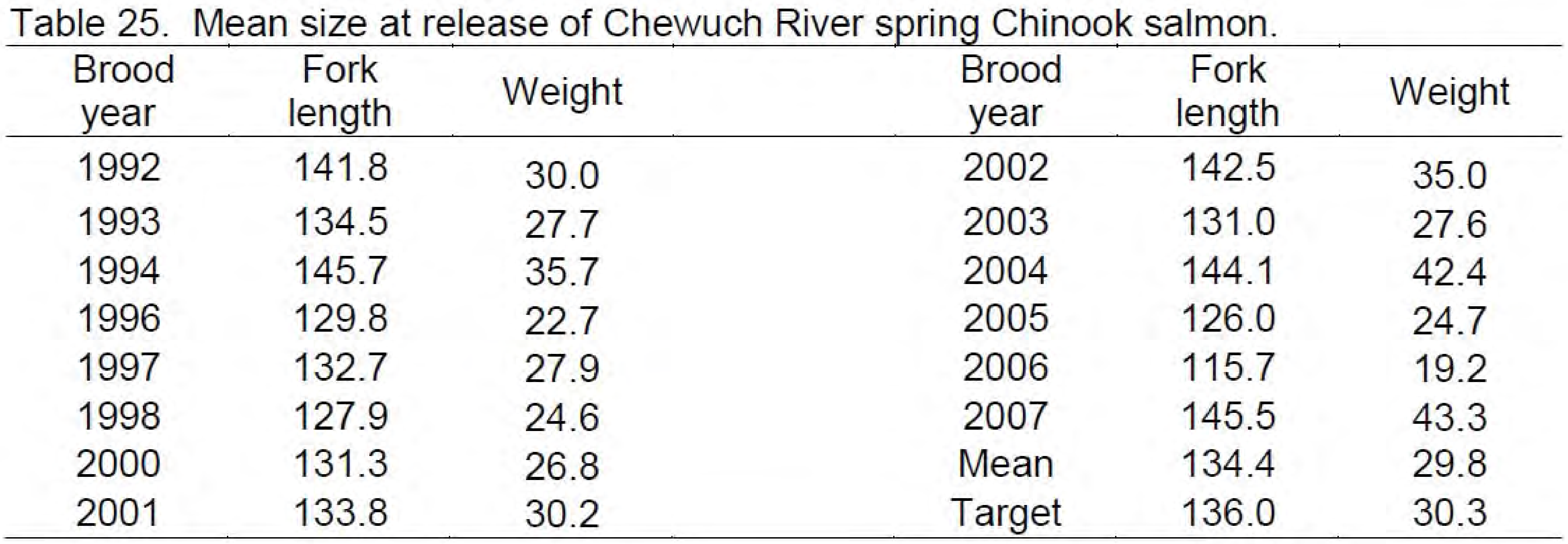

Table 25. Mean size at release of Chewuch River spring Chinook salmon.

Brood year	Fork length	Weight	Brood year	Fork length	Weight
1992	141.8	30.0	2002	142.5	35.0
1993	134.5	27.7	2003	131.0	27.6
1994	145.7	35.7	2004	144.1	42.4
1996	129.8	22.7	2005	126.0	24.7
1997	132.7	27.9	2006	115.7	19.2
1998	127.9	24.6	2007	145.5	43.3
2000	131.3	26.8	Mean	134.4	29.8
2001	133.8	30.2	Target	136.0	30.3

The target length and weight for Chewuch spring Chinook was 136mm and 30.3 g, respectively. The mean length at release was 134mm and the mean weight at release was 29.8g, both of which were not significantly different from the target value.

Objective 6: Chewuch River

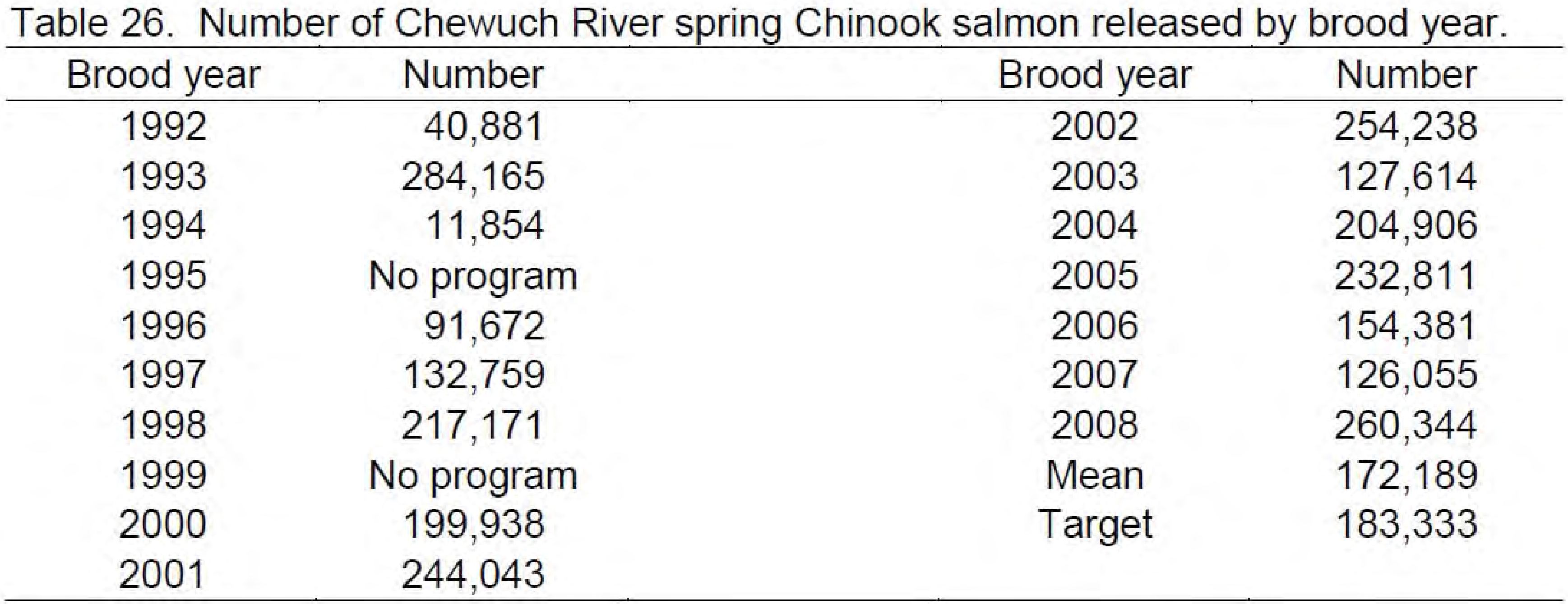

Table 26. Number of Chewuch River spring Chinook salmon released by brood year.

Brood year	Number	Brood year	Number
1992	40,881	2002	254,238
1993	284,165	2003	127,614
1994	11,854	2004	204,906
1995	No program	2005	232,811
1996	91,672	2006	154,381
1997	132,759	2007	126,055
1998	217,171	2008	260,344
1999	No program	Mean	172,189
2000	199,938	Target	183,333
2001	244,043		

The Chewuch spring Chinook program released an average of 172,189 fish and was not significantly different from the program goal. Years when broodstock was not collected (1995 and 1999) due to low run size were not included in the analysis.

Objective 6: Methow River

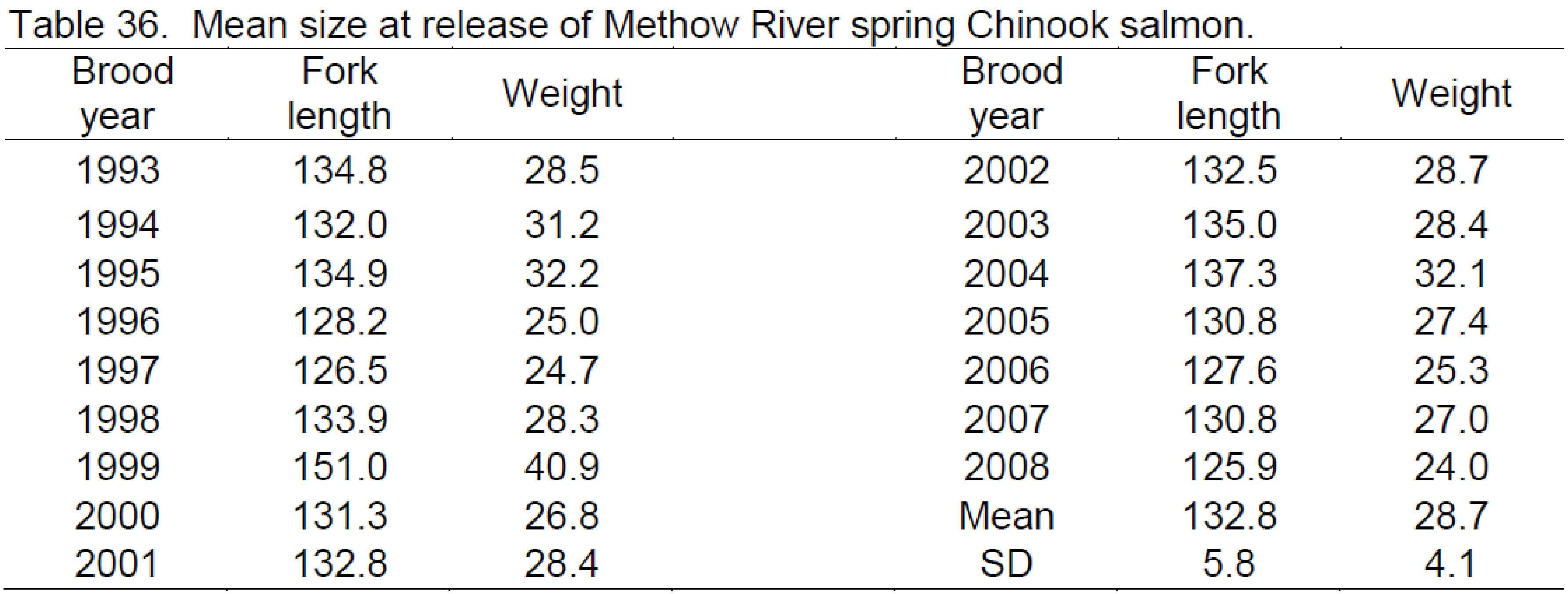

Table 36. Mean size at release of Methow River spring Chinook salmon.

Brood year	Fork length	Weight	Brood year	Fork length	Weight
1993	134.8	28.5	2002	132.5	28.7
1994	132.0	31.2	2003	135.0	28.4
1995	134.9	32.2	2004	137.3	32.1
1996	128.2	25.0	2005	130.8	27.4
1997	126.5	24.7	2006	127.6	25.3
1998	133.9	28.3	2007	130.8	27.0
1999	151.0	40.9	2008	125.9	24.0
2000	131.3	26.8	Mean	132.8	28.7
2001	132.8	28.4	SD	5.8	4.1

The target length and weight for Methow spring Chinook was 137mm and 30.3 g, respectively. The mean length at release was 132.8 mm, significantly smaller than the target length at release. The mean weight at release was 28.7 g which was not significantly different from the target weight.

Objective 6: Methow River

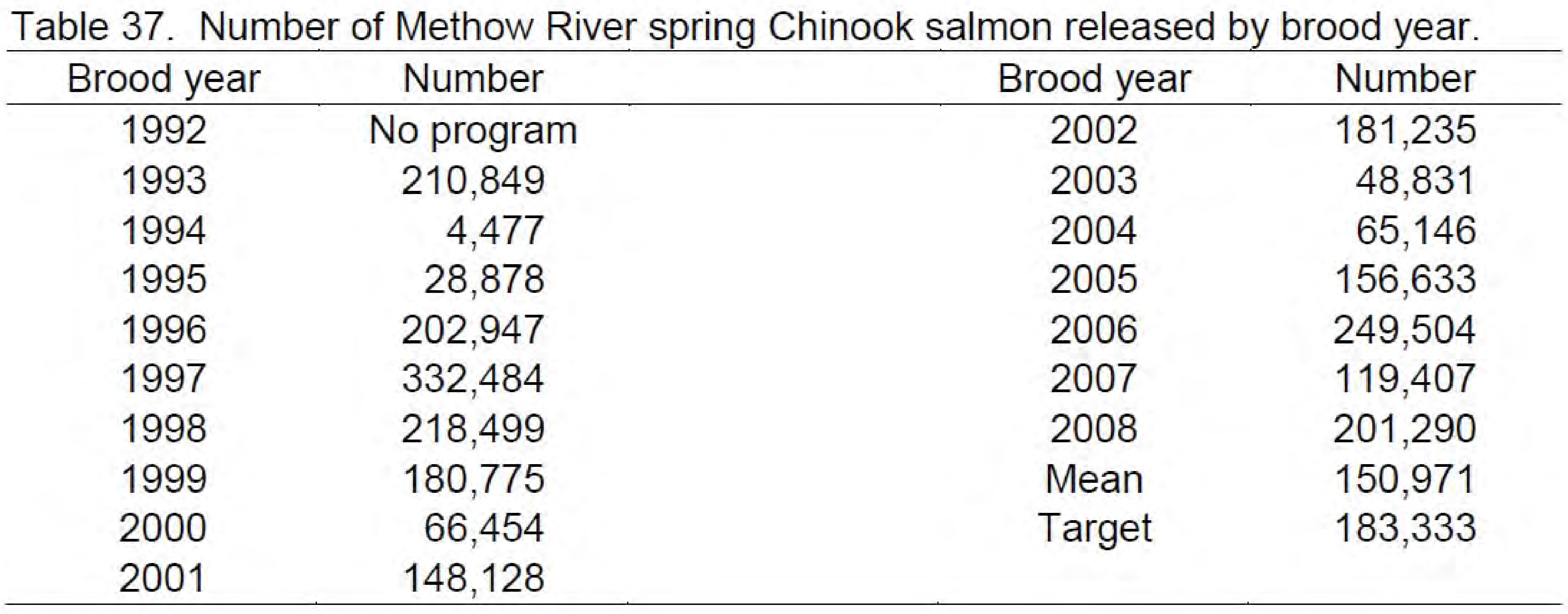

Table 37. Number of Methow River spring Chinook salmon released by brood year.

Brood year	Number	Brood year	Number
1992	No program	2002	181,235
1993	210,849	2003	48,831
1994	4,477	2004	65,146
1995	28,878	2005	156,633
1996	202,947	2006	249,504
1997	332,484	2007	119,407
1998	218,499	2008	201,290
1999	180,775	Mean	150,971
2000	66,454	Target	183,333
2001	148,128		

The Methow spring Chinook program released an average of 150,971 fish and was not significantly different from the program goal. We did not included brood year 1992 in the analysis because broodstock was not collected that year due to low run size.

Objective 6 Recommendations

- Improve broodstock collection for the Twisp program to optimize available fish for broodstock. Maximize operation of the Twisp Weir when fish are present and trapping conditions permit operation of the trap. During high water periods, when working the mid-channel trap compromises crew safety, explore the use of the near-shore trap or the concrete left-bank trap. Modify fish-retention rules to optimize trapping opportunity while still allowing the desired spawning escapement.

Objective 8: Determine if harvest opportunities have been provided using hatchery returning adults where appropriate.

- Direct harvest of Methow, Twisp, and Chewuch program spring Chinook salmon has not occurred since fish were listed as endangered in 1999, except for Columbia Rive tribal fisheries. Furthermore, juvenile fish have not been adipose fin clipped since the 1999 brood. Hence, harvest rates in the last 10 years have been minimal and limited to indirect post-release mortality associated with Columbia River commercial and sport fisheries or tribal non-selective fisheries.

Adult Survival of Hatchery Spring Chinook Salmon Released Volitionally or Forcibly as Juveniles

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Attachment D

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CHELAN COUNTY
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Fish and Wildlife Program

Eastbank Hatchery Complex

Hatchery/Wild Interactions Unit (Supplementation Research Team)

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE

Attachment D

Background

- Spring Chinook Salmon
- Broad declines
- Expansive propagation
- ESA Listing

14308 **Federal Register** / Vol. 64, No. 56 / Wednesday, March 24, 1999 / Rules and Regulations

Upper Columbia River

- Several hatchery programs
- Returns remain low
- Hatchery reform principles
- Address uncertainties

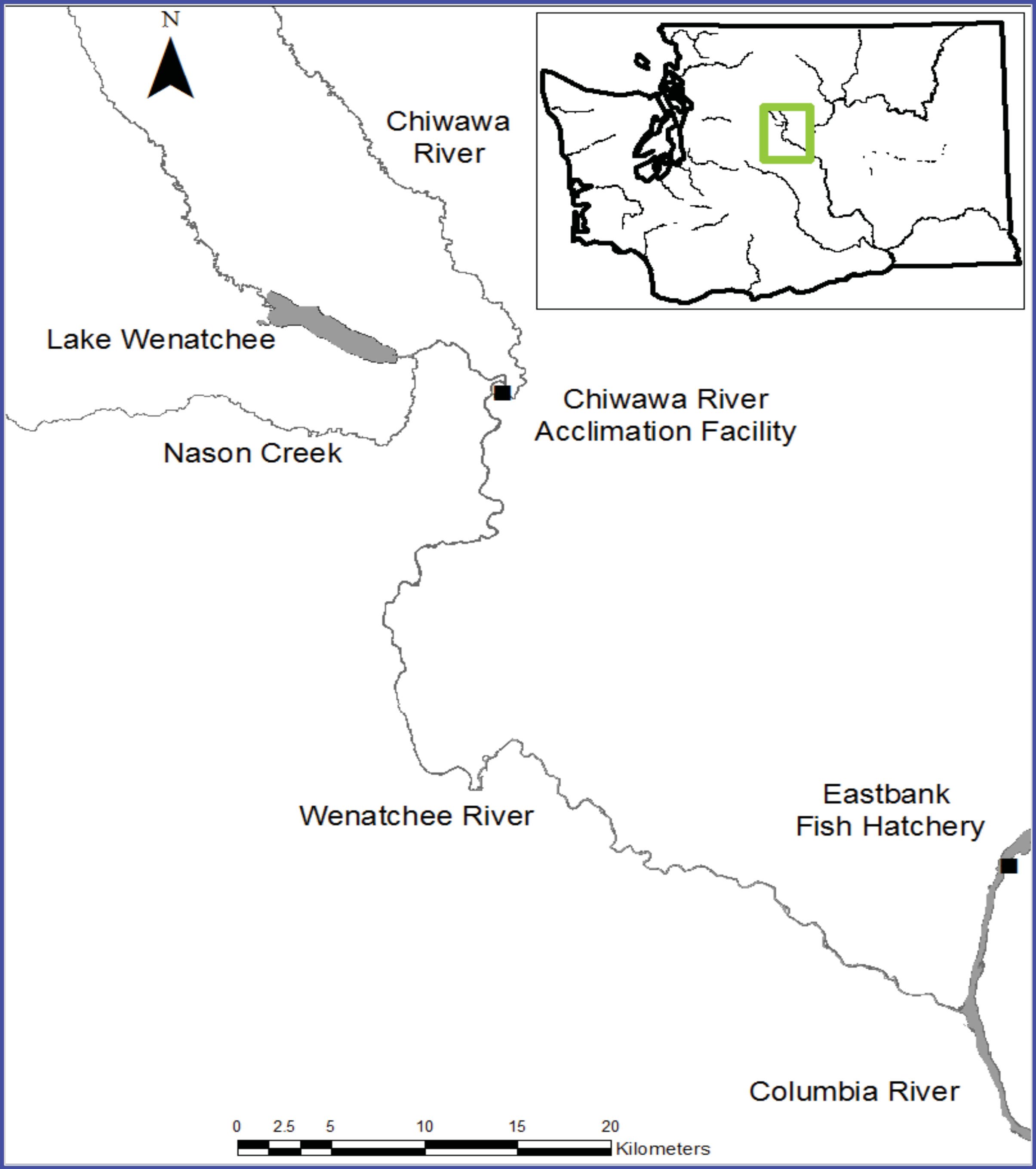
Release Strategy

Spring Chinook?

- Forced Release (FR)
  - Prescribed date
  - Pros and Cons
- Volitional Release (VR)
  - Release window
  - Pros and Cons
- Previous research
  - Evenson and Ewing 1992
  - Appleby et al. 2004
  - Gale et al. 2009
  - Clarke et al. 2011

Objective

- Determine if release methodology (FR or VR) significantly influenced the smolt-to-adult survival of hatchery-reared Chiwawa River spring Chinook Salmon.

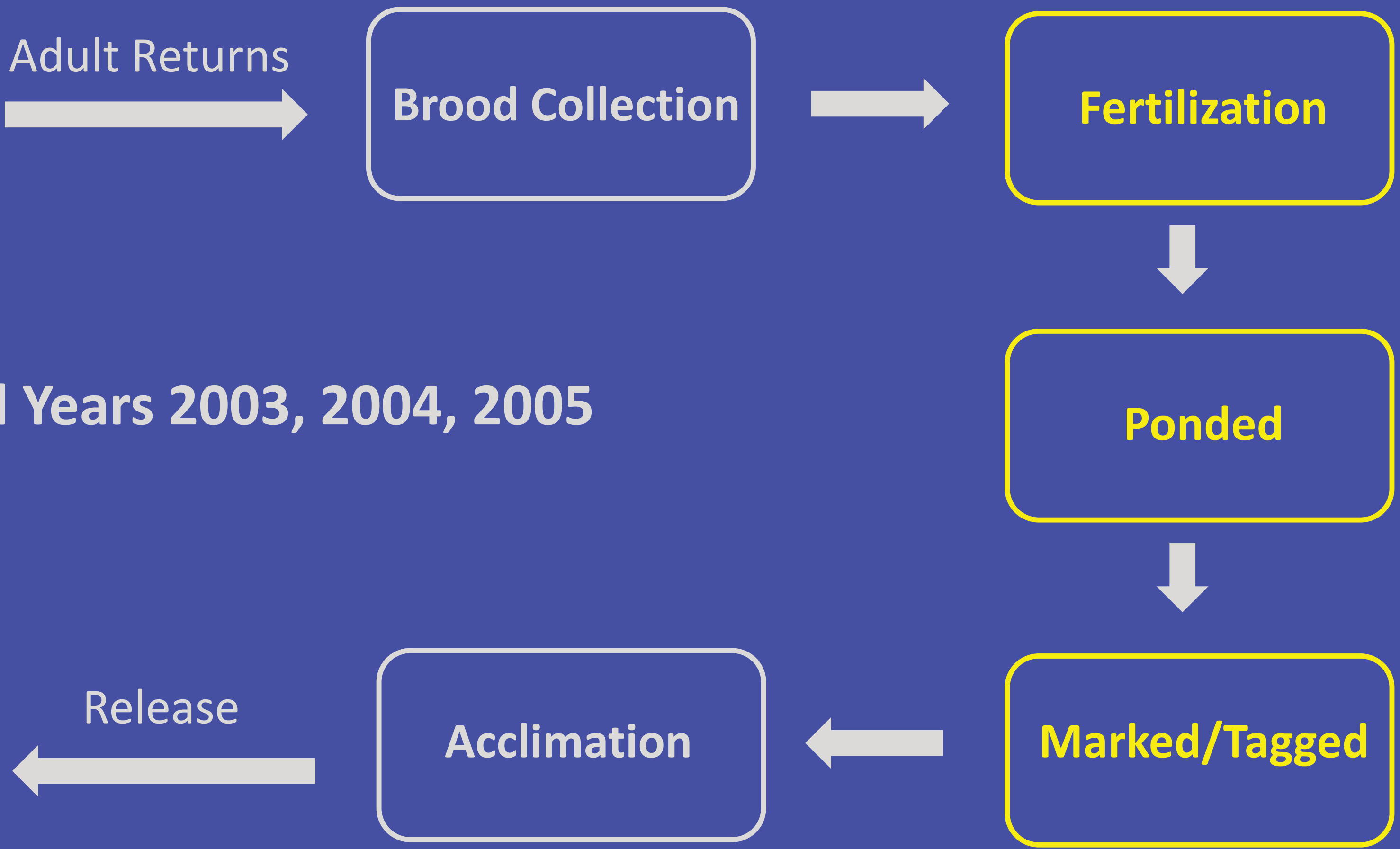

N
Chiwawa River
Lake Wenatchee
Chiwawa River Acclimation Facility
Nason Creek
Wenatchee River
Eastbank Fish Hatchery
Columbia River
0
2.5
5
10
15
20
Kilometers

Attachment D

Chiwawa River Acclimation Facility

Attachment D

Rearing Profile


Adult Returns

Brood Collection

Fertilization

Ponded

Marked/Tagged

Acclimation

Release

Brood Years 2003, 2004, 2005

Release

- Pre-release sampling
  - Length sample (n=200)
  - Monthly and day of release
- Forced release
  - One day
- Volitional release
  - Four weeks

Methods

- Pre-release sampling
  - Two-way ANOVA with post-hoc HSD
- Adult returns
  - RMIS (CWT tag recoveries)
- Smolt-to-adult survival (SAS)
  - Adult return / CWT released

- Survival differences (*G* - test)
  - Between release methods
- Significance level of 0.05

Attachment D

Brood year	Release method	Sample date	Release date(s)	Mean ± SE FL (mm)
2003	Volitional	April 18	April 18-May 18	151.1 (0.79)
	Forced	May 2	May 2	167.1 (0.70)
2004	Volitional	April 17	April 17-May 17	139.1 (0.56)
	Forced	Apr 28	Apr 28	145.9 (0.66)
2005	Volitional	April 16	April 16-May 15	129.0 (0.66)
	Forced	May 1	May 1	136.0 (0.55)

- Mean length at release decreased annually
    - Year effect: $P < 0.01$
- FR displayed greater mean length than VR during all years
    - Release group effect: $P < 0.01$
- FR displayed greater mean length than VR within years
    - Release group *x* year interaction: $P < 0.01$
- Limitation?

Attachment D

Brood year	Release method	Juveniles released	Adults (SAS)	*G*	*P*
2003	Volitional	148,312	503 (0.34%)	1.8	0.17
	Forced	68,390	260 (0.38%)		
2004	Volitional	228,154	1,160 (0.51%)	91.8	< 0.01
	Forced	220,259	1,616 (0.73%)		
2005	Volitional	247,399	696 (0.28%)	8.3	< 0.01
	Forced	244,701	800 (0.33%)		

- Variation in release numbers BY 2003, otherwise consistent
- BY 2004 had highest returns in both release methods
- SAS higher for FR in all years (significant in 2004 and 2005)

Summary

- Over a million fish released
  - 533,350 FR and 623,865 VR
- FR displayed higher survival in, and across years
  - 3 yr. mean SAS - FR (0.48%) and VR (0.38%)
- Results consistent with Evenson and Ewing 2002

Attachment D

Discussion

- Survival of FR was modestly higher (26%)
  - Returns remain low (SAS < 1%)
- Mechanism producing higher survival is not clear
  - Conditions during emigration are variable (e.g. discharge, spill)
  - Survival through hydro system is not constant over time
- Life stage specific survival studies warranted
  - Juvenile survival from release through hydro projects
- The differences in survival during this study may be attributable to release timing

Discussion

- Benefits of VR
  - Management of precocity (e.g. ecological risk)
  - Non-migrant management
- Cost savings
  - (e.g. reduced feed costs)

Addendum

- Survival to McNary

Brood year	Release method	# PIT Tags	Survival (SE)
2005	Volitional	4,988	0.638 (0.027)
	Forced	4,993	0.662 (0.027)

Attachment D

?

Johnson, M. S., A. R. Murdoch, and C. P. H. Moran. 2015. Adult Survival of Hatchery Spring Chinook Salmon Released Volitionally or Forcibly as Juveniles. North American Journal of Aquaculture. In press.

Attachment E

Derivation and Properties of the PNI Statistic, a Tool for Managing Integrated Hatchery Programs

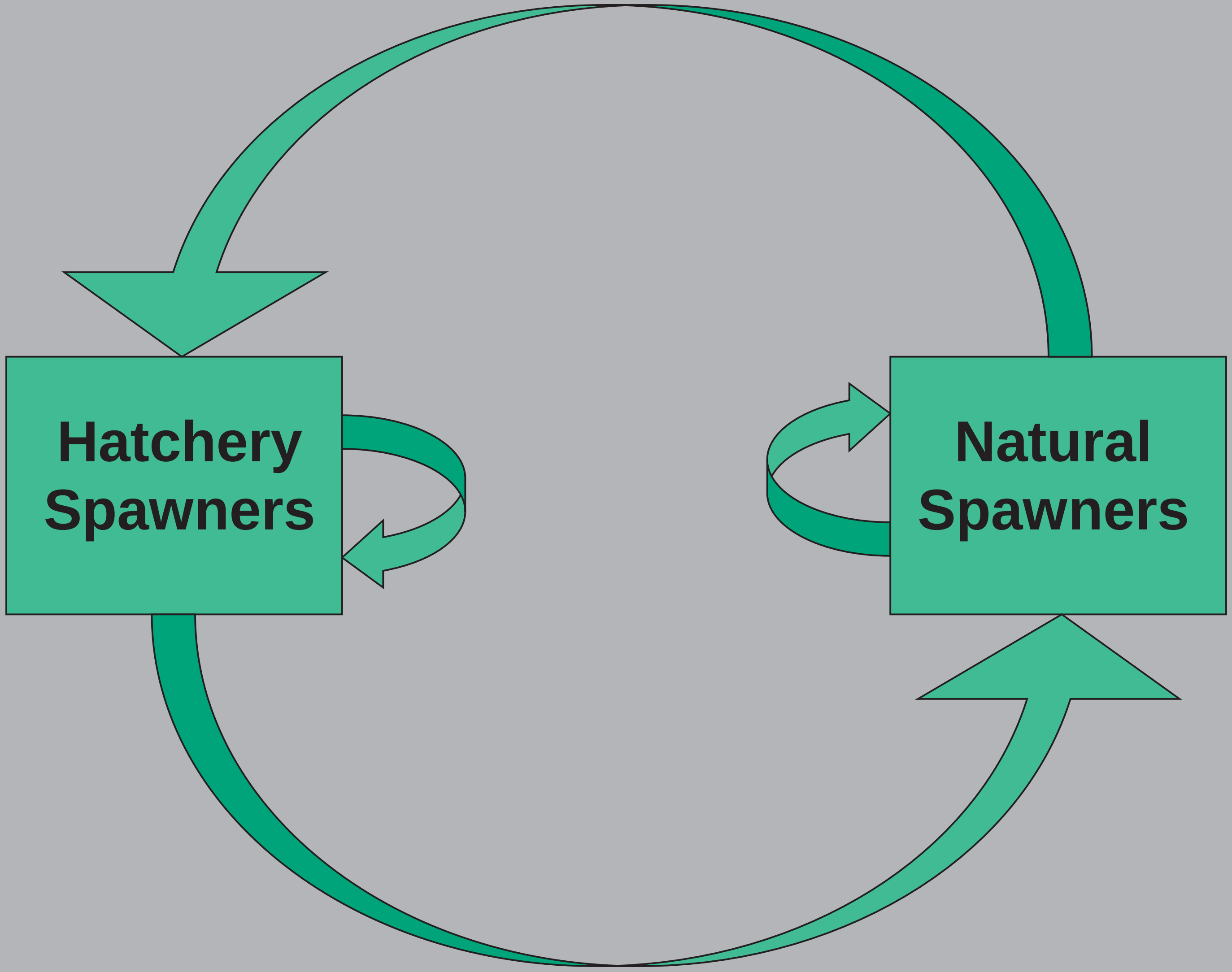
Washington
Department of
FISH AND
WILDLIFE

Craig Busack
Science Division
Fish Program
Washington Department of Fish & Wildlife

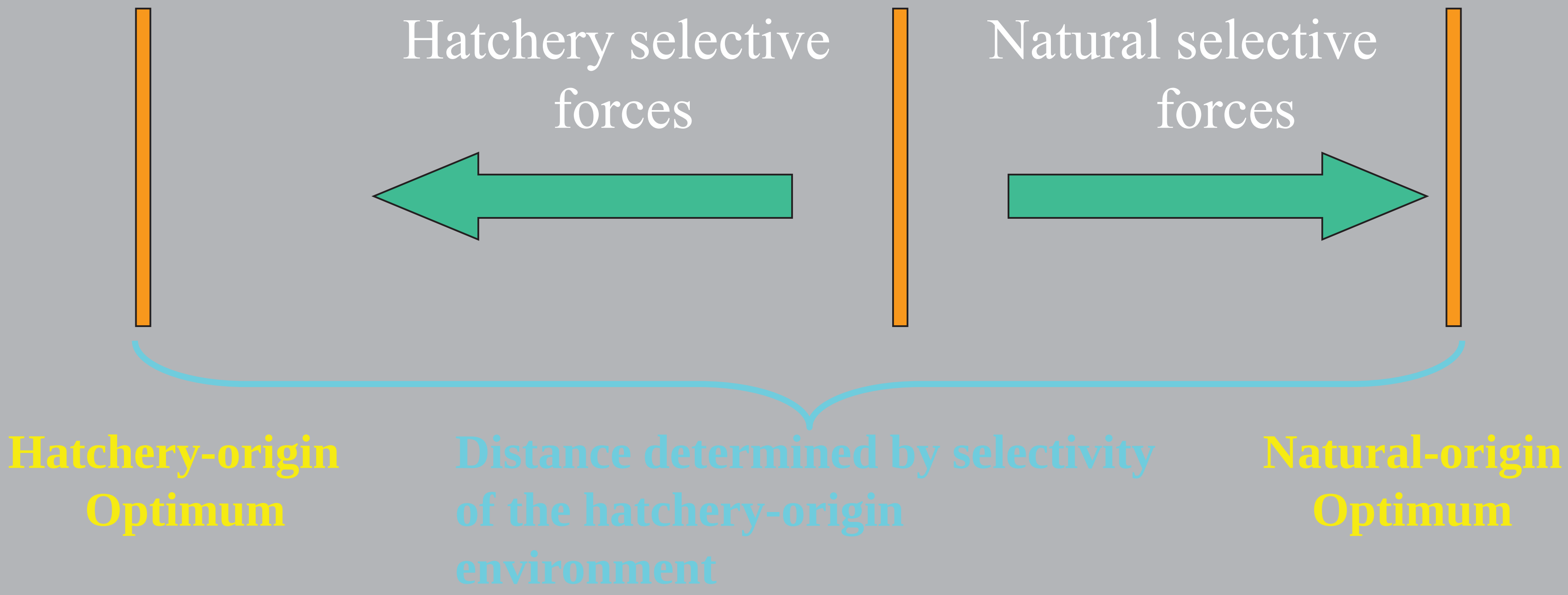
Attachment E

Gene Flow in a Population in an Integrated Hatchery Program

(modified from Lynch and O'Hely, 2001)



In the Ford (2002) model such a population lives in two environments with distinct optima. Selection in each environment tugs the population characteristics toward its optimum.



Hatchery selective forces

Natural selective forces

Hatchery-origin Optimum

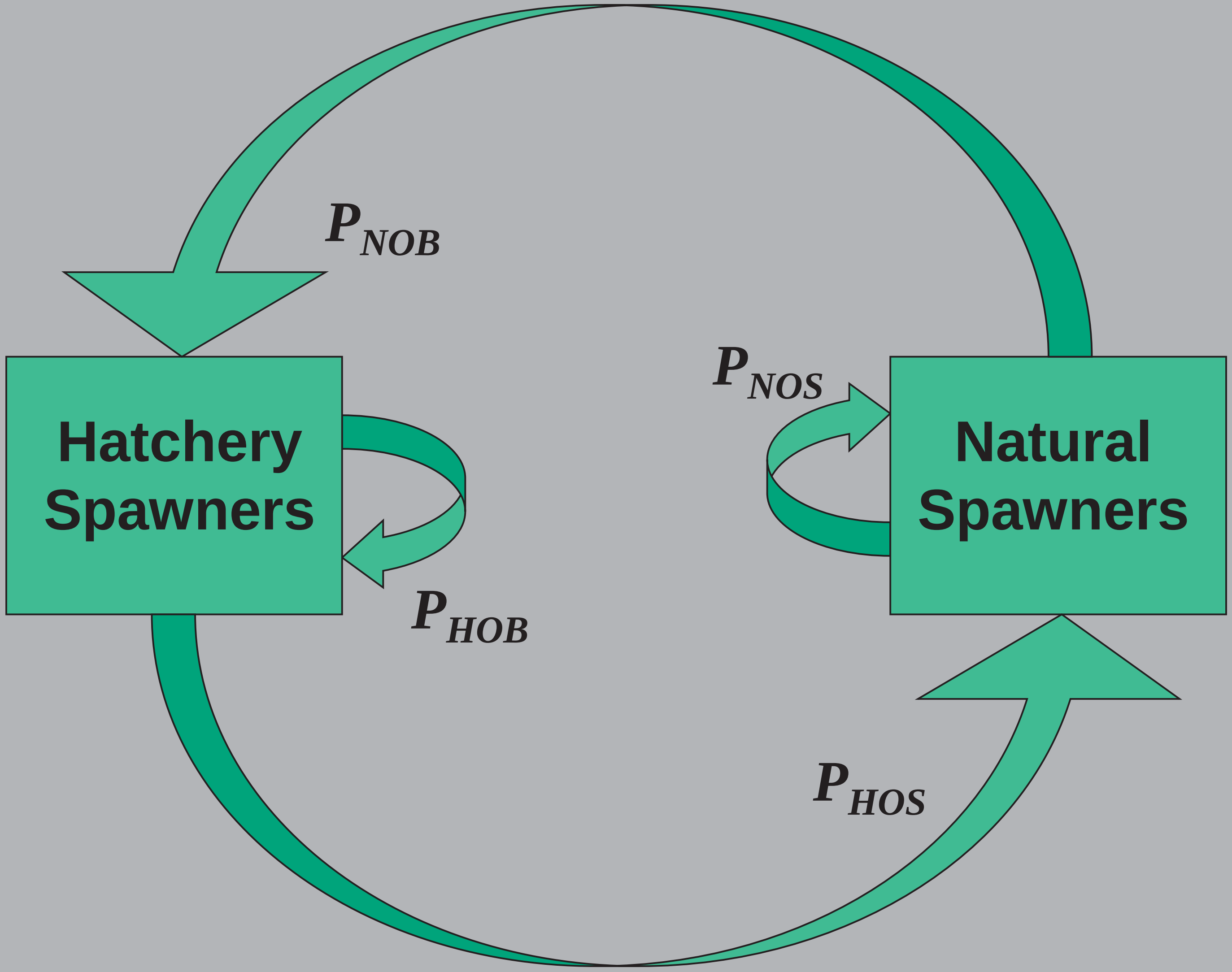
Distance determined by selectivity of the hatchery-origin environment

Natural-origin Optimum

The population will eventually reach an equilibrium point somewhere between the optima.

Potential Gene Flow Paths in a Population with Both Hatchery and Natural Production

(modified from Lynch and O'Hely, 2001)


Hatchery Spawners

Natural Spawners

P_{NOB}

P_{HOB}

P_{NOS}

P_{HOS}

Attachment E

Ford (2002) Stabilizing Selection Model of Integrated Hatchery Program

The equilibrium point *in absolute terms* is determined by: 1) optima, 2) selection strength, 3) variance, 4) heritability, and 5) gene flow rates (N to H, H to N).

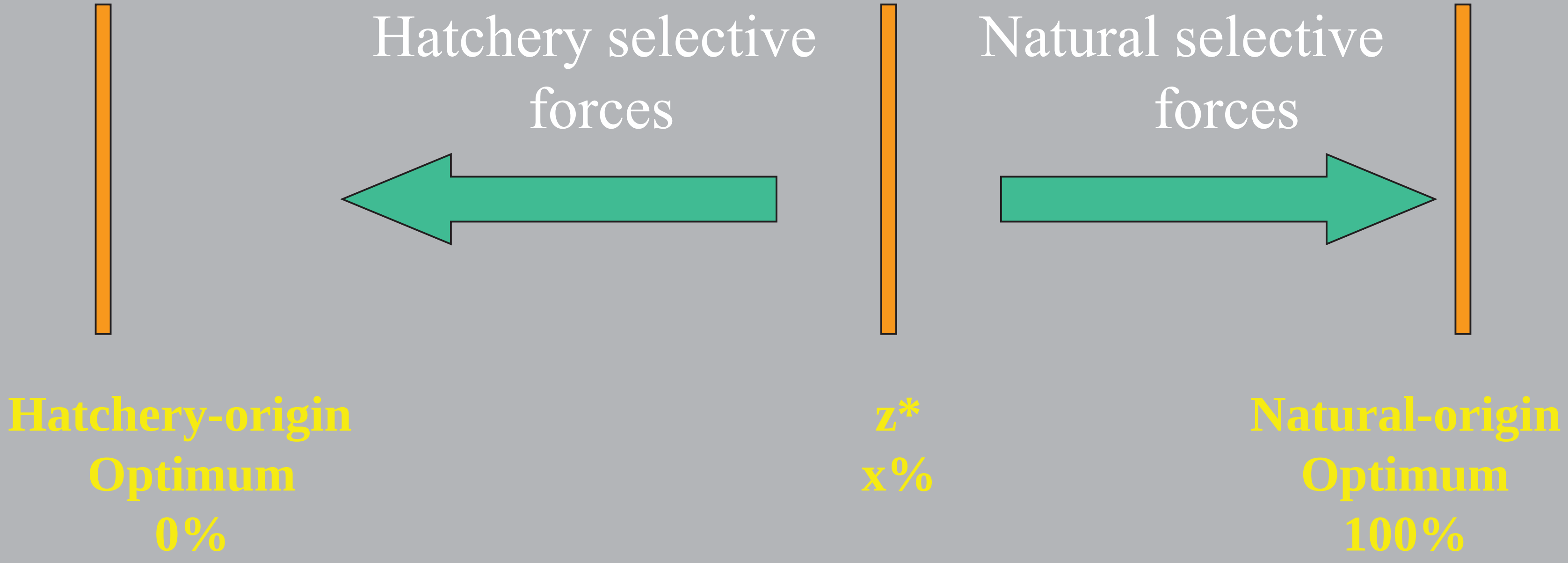
But

The equilibrium point *in relative terms* is determined *mainly* by: gene flow rates (N to H, H to N).

Attachment E

The population will eventually reach a relative equilibrium point (z*) between the optima that depends mainly on the gene flow levels.

In other words, how domesticated it becomes depends on gene flow in the two directions.



Hatchery selective forces

Natural selective forces

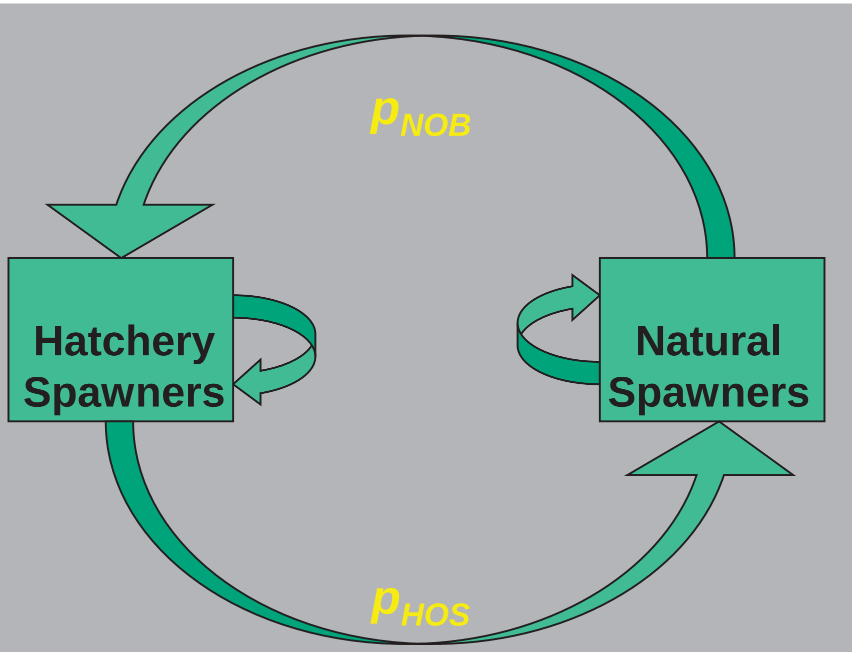
Hatchery-origin
Optimum
0%

z*
x%

Natural-origin
Optimum
100%

z^* is approximated well by the ratio

$$\frac{p_{NOB}}{p_{NOB} + p_{HOS}}$$



p_{NOB} = proportion of broodstock consisting of natural-origin fish

p_{HOS} = proportion of fish spawning naturally consisting of hatchery-origin fish

This ratio is called *proportionate natural influence* or PNI.

Caveat: proportions need to reflect per capita productivity of natural-origin and hatchery-origin fish

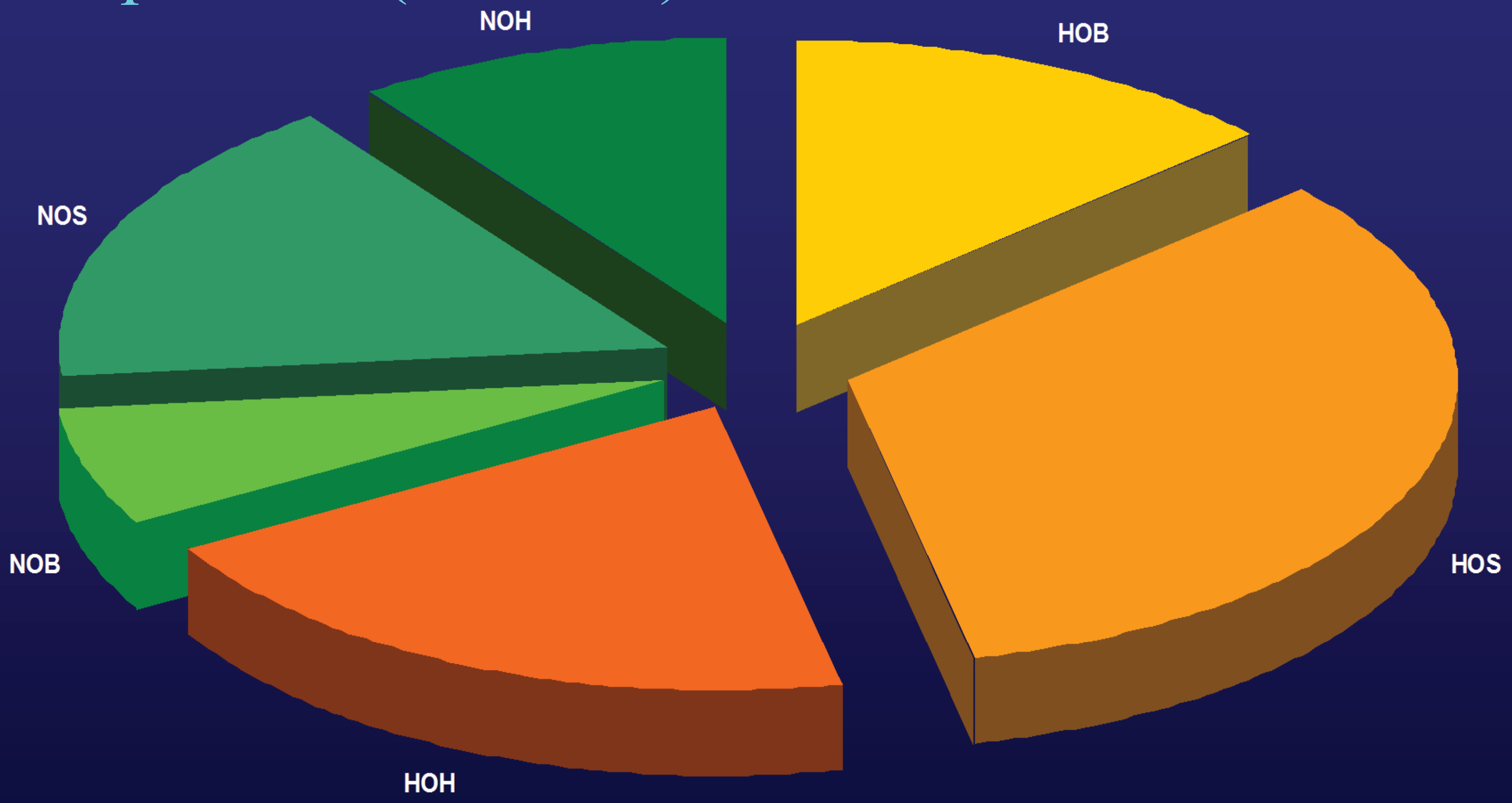
Attachment E

But, the equilibrium point *in relative terms* (z^*_w) is determined *mainly* by the relative gene flow rates (N to H, H to N).

Gene flow ratios required to achieve specified Z_w^* values

Z_w^*	P_{NOB}/P_{HOS}	$P_{NOB}/(P_{HOS}+P_{NOB})$
0.1	0.11	0.1
0.3	0.43	0.3
0.5	1.00	0.5
0.7	2.33	0.7
0.9	9.00	0.9

Composition of Returning Adults in an Integrated Population (Detailed)



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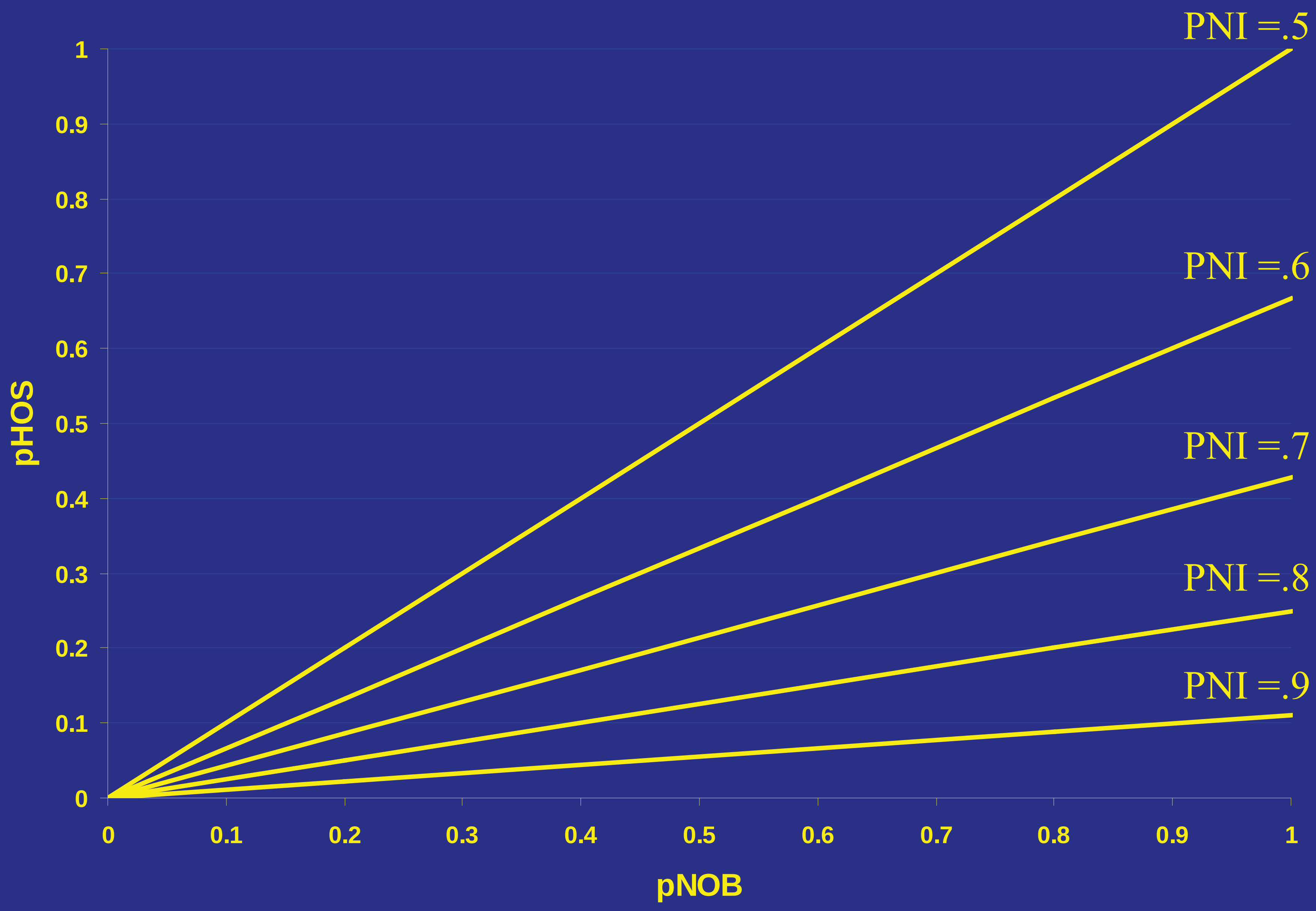
Effect of pNOB and pHOS on Proportionate Natural Influence



Attachment E

Key Research Areas for Ford Model and Refinement of PNI Concept

Sensitivity of PNI to factors other than gene flow

Assumptions about selection and heritability in the two environments

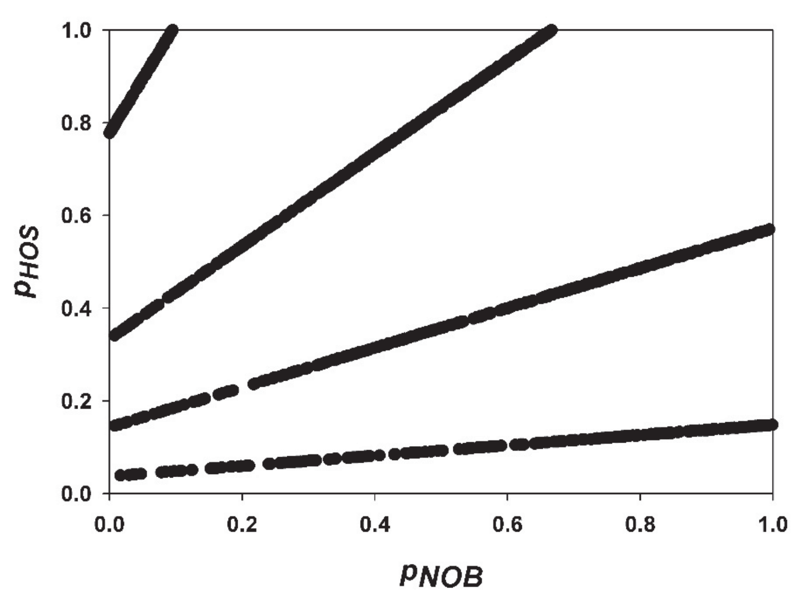
Equilibrium vs. short-term behavior

Single-trait vs. multiple traits

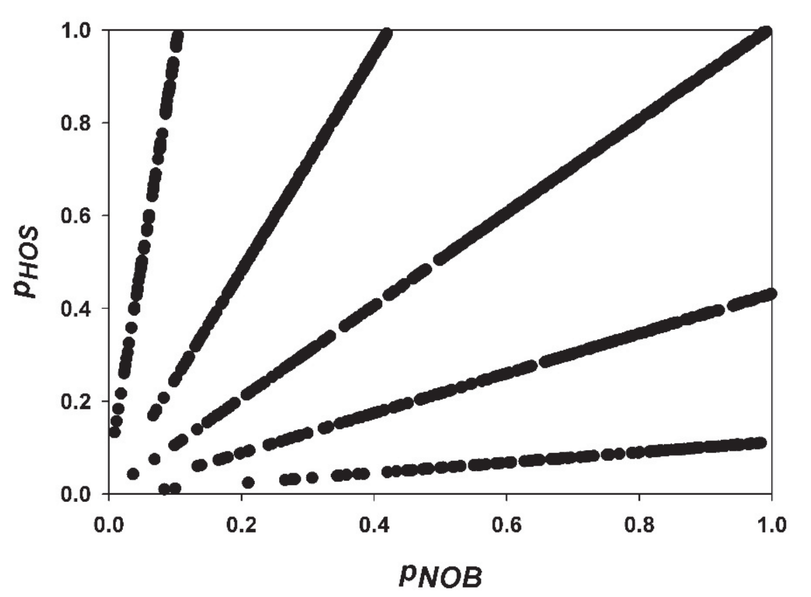
Fundamental model assumptions

Sensitivity of PNI to factors other than gene flow: P_{NOB}-P_{HOS} combinations required to achieve specified $Z_w{}^*$ values under different heritability-selection strength combinations

Strong selection ,
high heritability



Weak selection,
low heritability



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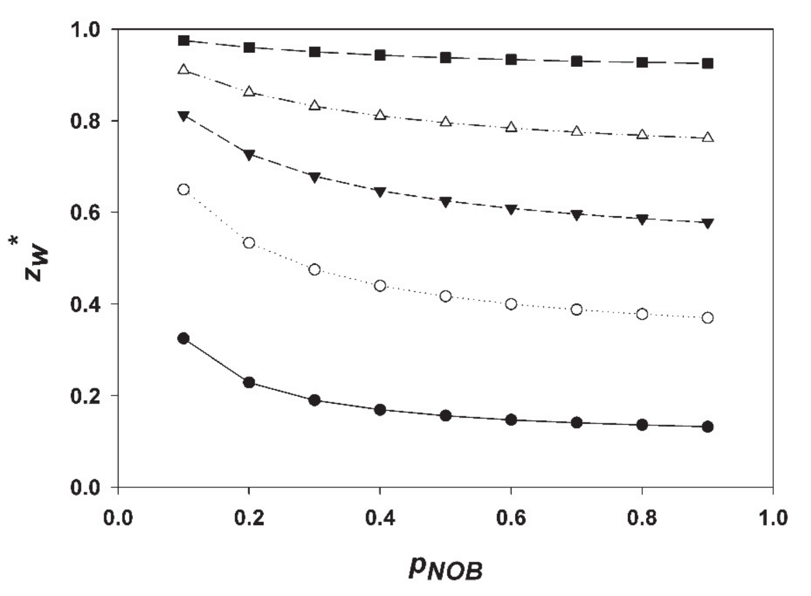
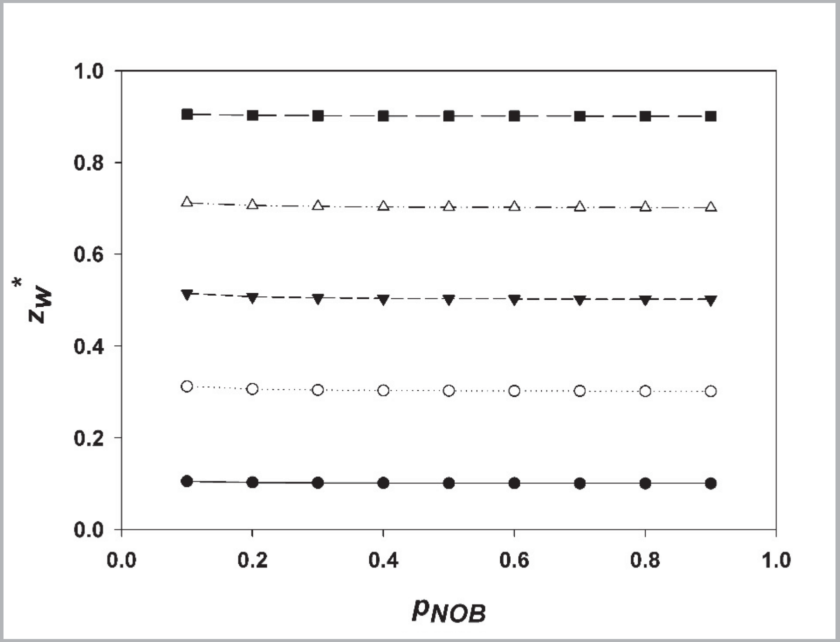
Sensitivity of PNI to factors other than gene flow: Biases in PNI under different heritability-selection strength combinations

Strong selection, high heritability



Weak selection, low heritability



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Assumptions about selection and heritability in the two environments: Effect of differing heritabilities

$$z_w^{*\prime} \approx z_w^{*}\left(\frac{h_w^2}{h_c^2}\right)^{x}$$

X ranges from 1.01(ω =4) to 1.14 (ω =4)

Assumptions about selection and heritability in the two environments: Effect of differing selection strengths

$$Z_w^{*\,\prime} \approx Z_w^{*}\left(\frac{\omega_c^2}{\omega_w^2}\right)^{X}$$

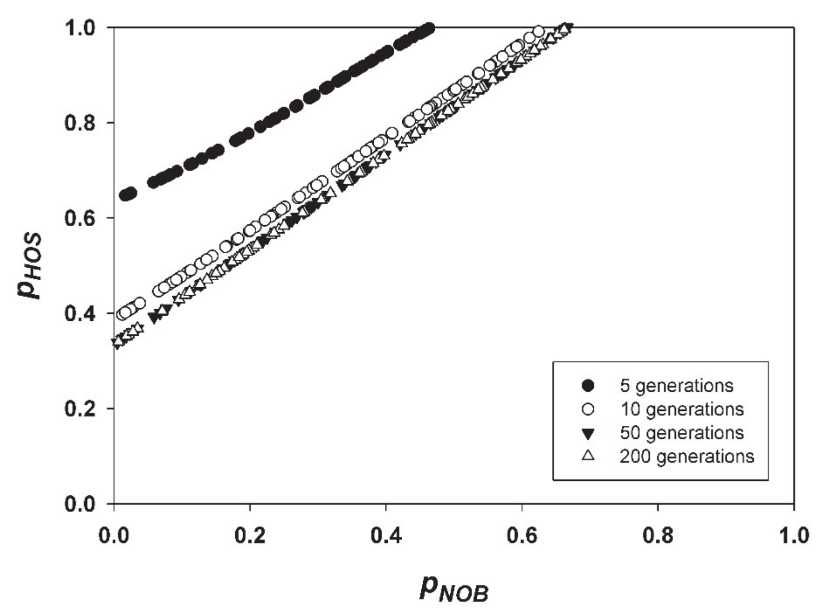
X ranges from 0.78 (h^2 =0.1) to 0.86 (h^2 =0.5)

Attachment E

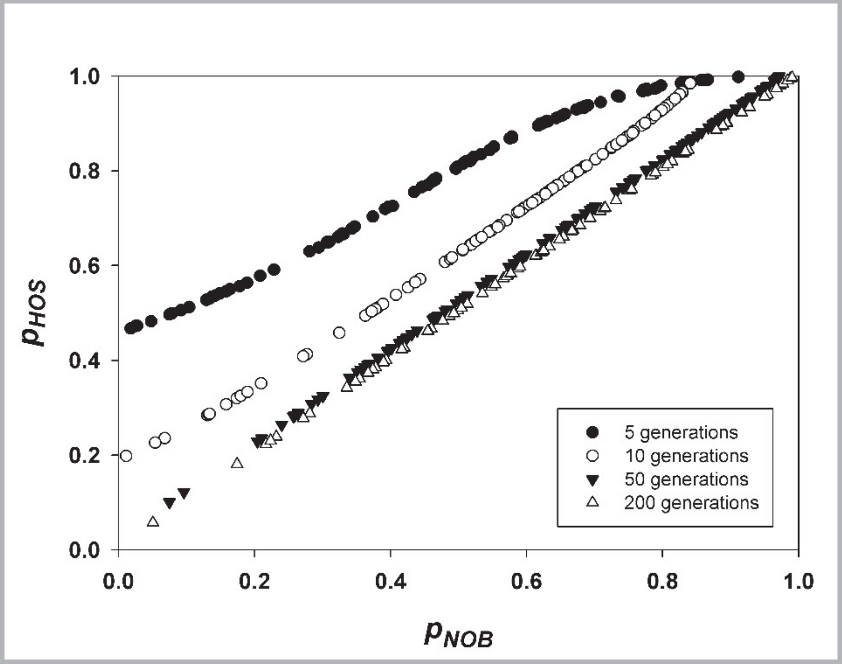
Equilibrium vs. short-term behavior:

0.5 Isopleths of Z_w* analogs at 5, 10, 50, and 200 generations

Strong selection ,
high heritability



Weak selection,
low heritability

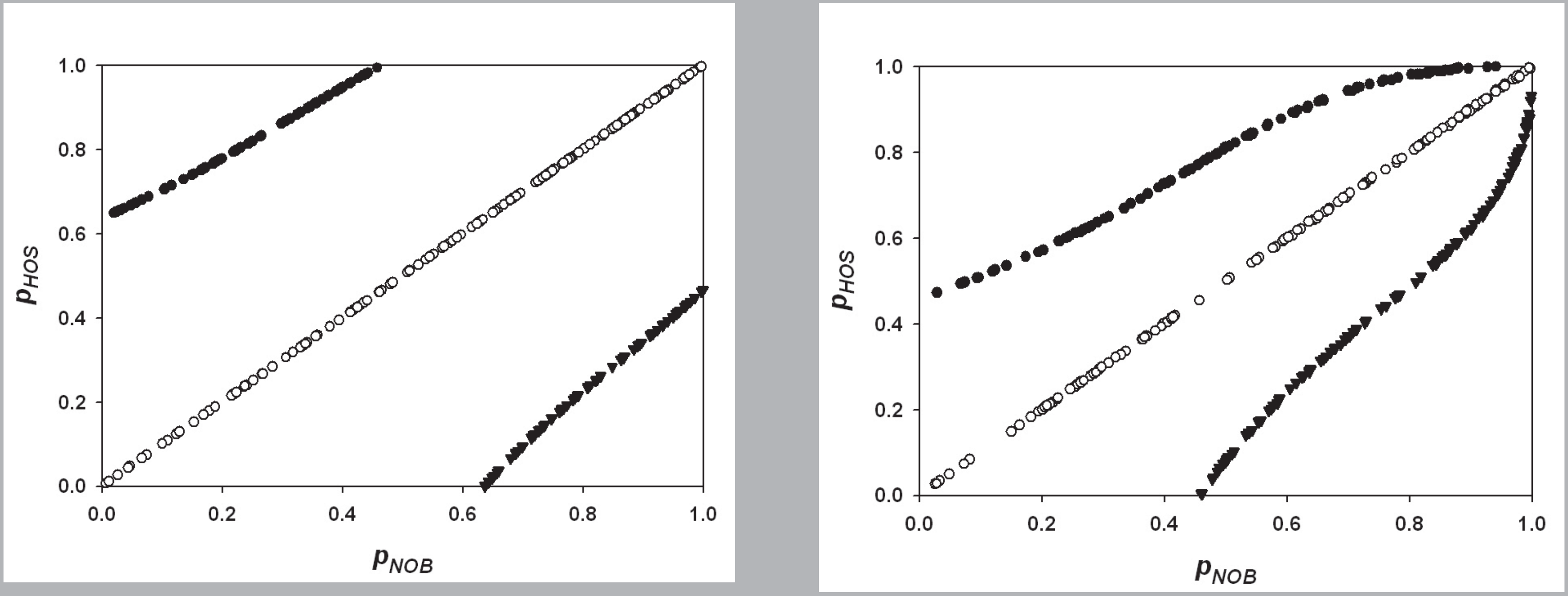


Equilibrium vs. short-term behavior:

0.5 Isopleths of Z_w*, Z_c*, and (Z_w*+ Z_c*)/2 analogs at 5 generations

**Strong selection ,
high heritability**

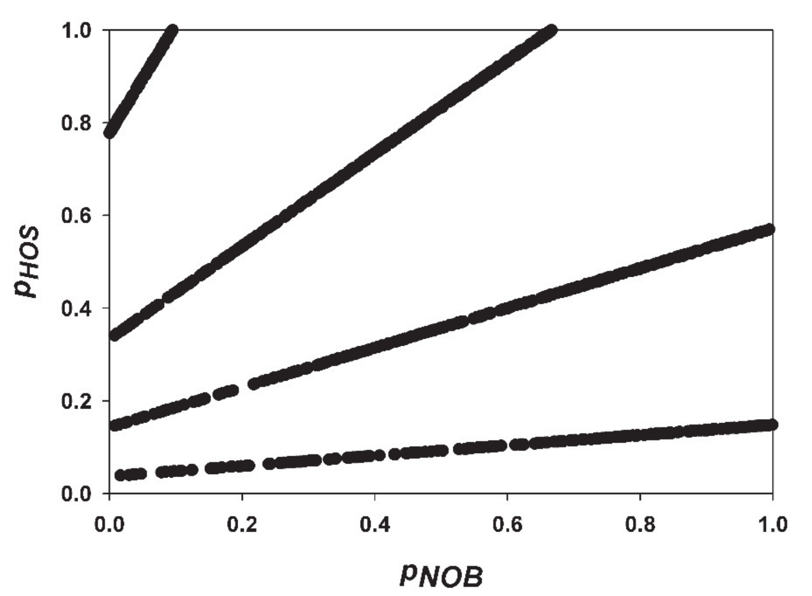
**Weak selection,
low heritability**

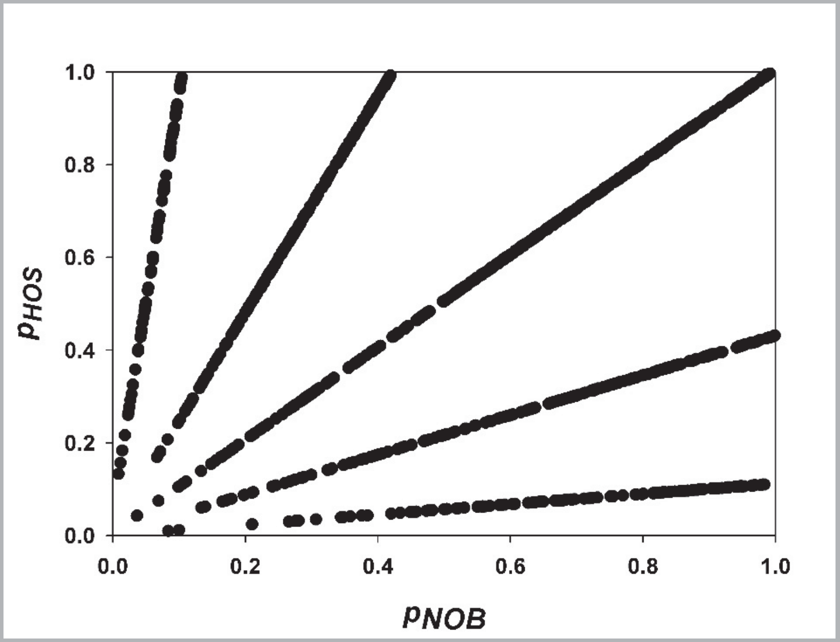


Sensitivity of PNI to factors other than gene flow: P_{NOB}-P_{HOS} combinations required to achieve specified Z_w^* values under different heritability-selection strength combinations

Strong selection ,
high heritability

Weak selection,
low heritability





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Mike Ford, Paul McElhany and Jeff Hard (NOAA)

Selection in Captivity during Supportive Breeding May Reduce Fitness in the Wild

MICHAEL J. FORD

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Abstract: *I used a quantitative genetic model to explore the effects of selection on the fitness of a wild population subject to supportive breeding. Supportive breeding is the boosting of a wild population's size by breeding part of the population in captivity and releasing the captive progeny back into the wild. The model assumes that a single trait is under selection with different optimum trait values in the captive and wild environments. The model shows that when the captive population is closed to gene flow from the wild population, even low levels of gene flow from the captive population to the wild population will shift the wild population's mean phenotype so that it approaches the optimal phenotype in captivity. If the captive population receives gene flow from the wild, the shift in the wild population's mean phenotype becomes less pronounced but can still be substantial. The approach to the new mean phenotype can occur in less than 50 generations. The fitness consequences of the phenotypic shift depend on the details of the model, but a >30% decline in fitness can occur over a broad range of parameter values. The rate of gene flow between the two environments, and hence the outcome of the model, is sensitive to the wild environment's carrying capacity and the population growth rate it can support. The results have two important implications for conservation efforts. First, they show that selection in captivity may significantly reduce a wild population's fitness during supportive breeding and that even continually introducing wild individuals into the captive population will not eliminate this effect entirely. Second, the sensitivity of the model's outcome to the wild environment's quality suggests that conserving or restoring a population's habitat is important for preventing fitness loss during supportive breeding.*

La Selección en Cautiverio Durante la Reproducción de Apoyo Puede Reducir la Adaptabilidad en Condiciones Silvestres

Resumen: *Se empleó un modelo genético cuantitativo para explorar los efectos de la selección en la adaptabilidad de una población silvestre sujeta a reproducción de apoyo. La reproducción de apoyo involucra el fomento del tamaño poblacional silvestre mediante la reproducción de parte de la población en cautiverio y la liberación de progenie cautiva al medio silvestre. El modelo asume que una sola característica se encuentra bajo selección con diferentes valores óptimos de esta característica en los ambientes de cautiverio y silvestres. El modelo muestra que cuando la población cautiva está cerrada al flujo de genes de la población silvestre, aún niveles bajos de flujo de genes de la población cautiva a la población silvestre sesgaría la media del fenotipo de la población silvestre de tal manera que se aproxime al óptimo del fenotipo en cautiverio. Si la población cautiva recibe un flujo de genes de la población silvestre, el sesgo del fenotipo promedio de la población silvestre sería menos pronunciado pero aún sustancial. El acercamiento a la nueva media del fenotipo puede ocurrir en menos de 50 generaciones. Las consecuencias de adaptación del sesgo del fenotipo depende de los detalles del modelo, pero puede ocurrir una disminución de hasta <30% en la adaptabilidad en un rango amplio de valores de parámetros. La tasa de flujo de genes entre los dos ambientes y por lo tanto el producto del modelo es sensible a la capacidad de carga del ambiente silvestre y de la tasa de crecimiento poblacional que puede soportar. Los resultados tienen dos implicaciones importantes para los esfuerzos de conservación. Primero, muestran que la selección en cautiverio puede reducir significativamente la adapt-*

Paper submitted June 19, 2000; revised manuscript accepted July 25, 2001.

ación de una población durante reproducción de apoyo y que aunque se introduzcan continuamente individuos silvestres a la población cautiva, no se eliminaría completamente este efecto. Segundo, la sensibilidad del resultado del modelo a la calidad del ambiente silvestre sugiere que la conservación o restauración de la calidad del hábitat silvestre es importante para prevenir la pérdida de adaptabilidad durante la reproducción de apoyo.

Introduction

Supportive breeding is a method of boosting population size that involves breeding part of a population in captivity and then releasing the captive progeny back into the wild (Ryman & Laikre 1991). If captive individuals have high rates of survival compared with those of wild individuals, and if their progeny can be successfully returned to the wild, supportive breeding can be used to increase the size of the population and lower its risk of extinction (Cuenco et al. 1993). Supportive breeding has been used for a variety of species (Olney et al. 1994), and it has recently become an especially common tool for increasing the size of fish populations. For example, many of the proposed management alternatives for the conservation and recovery of Pacific salmonid populations (*Oncorhynchus* sp.) currently listed under the U.S. Endangered Species Act involve some form of supportive breeding (or "supplementation," Hedrick et al. 1994; National Marine Fisheries Service 1995).

In addition to the potential benefit of increasing abundance, supportive breeding poses risks to wild populations. For example, Ryman and Laikre (1991), Waples and Do (1994), and Ryman et al. (1995) found that supportive breeding can result in a reduction in effective population size. Waples (1991), Busack and Currens (1995), and Campton (1995) review other deleterious genetic effects of supportive breeding. One potential deleterious effect discussed in all of these reviews is selection that occurs in the captive environment. Selection that occurs in captivity can be deleterious because traits that are advantageous in the captive environment may not be advantageous in the wild. If the trait distribution in a wild population is at an optimum that has been shaped by selection in the wild environment, releasing individuals into the population that have a different distribution as a result of selection in captivity will result in a reduction in the mean fitness of the population. If supportive breeding proceeds for many generations, the trait distribution of the wild population might evolve far away from its wild optimum. Further, selective change could occur in captivity even if there is no deliberate plan for artificial selection. In Pacific salmonids, for example, there is evidence that conditions in captivity inadvertently select for behavioral and morphological traits that are not optimal in the wild (e.g., Reisenbichler & McIntyre 1977; Nickelson et al. 1986; Fleming & Gross 1989; Swain & Riddell 1990; Fleming & Gross 1992, 1993, 1994; Flagg et al. 1995).

Most well-understood adaptations involve traits such as morphology and behavior whose distributions in a population are influenced by multiple genetic and environmental factors (reviews by Hard 1995, Lynch 1996). Because these traits are influenced by many genes whose individual effects on the phenotype are unknown, a detailed understanding of the genetic architecture of these traits is usually impossible to attain. Instead, they must be studied with the tools of quantitative genetics (Falconer & Mackay 1996; Roff 1997). This means that the genetic and environmental influences on the distribution of a set of traits is described statistically, with no attempt to describe the genetic basis of the traits in detail.

I used a quantitative genetic model to explore how the combined effects of selection in two environments, captive and wild, can influence the distribution of a phenotypic trait and the fitness of a population. This model makes numerous simplifying assumptions, but it is expected to provide a more realistic understanding of how selection might operate during supportive breeding than has been possible with previous models, which have generally assumed that selection in captivity occurs at a single genetic locus (e.g., Byrne et al. 1992). Doyle (1983) used a quantitative genetic model to explain how domestication could occur in aquacultural settings, but assumed a completely closed captive population. Tufto (2000) recently employed several quantitative genetic models to explore a situation in which a population continually receives migrants from a genetically divergent population, but did not examine the case of two-way migration. As part of a broader study of supportive breeding, Adkison (1994) employed a quantitative genetic model similar to the one I describe here. I employed a much simpler demographic model, however, and focused more narrowly on exploring the conditions under which the model predicts changes in the distribution of a phenotypic trait.

My primary goals were to (1) develop a simple model of selection on a quantitative trait during supportive breeding and (2) evaluate the sensitivity of the model to its parameters, which include the strength of selection in the captive and wild environments, the rate of exchange between the two environments, the maximum reproductive rate of the population in each environment, and the duration of supportive breeding. The model does not take into account all the genetic factors that could affect the outcome of supportive breeding. Instead, I used a simple model to gain some insight into the possible effects of artificial or natural selection on supportive breeding and to determine the sensitivity of these potential effects to the different parameters in the model.

Phenotypic Model

I used a simple deterministic model of phenotypic evolution drawn from Lande (1976), Via and Lande (1985), and Bulmer (1985). Assuming a population of infinite size and discrete generations, the response of a single phenotypic trait to selection in one generation can be described by

$$\Delta\bar{z} = [\bar{z}_s - \bar{z}]h^2, \tag{1}$$

where $\bar{z}$ is the mean trait value before selection, $\bar{z}_s$ is the mean trait value after selection, and h^2 is the realized heritability of the trait. Lande (1976) showed that if the trait is normally distributed with mean $\bar{z}$ and constant variance σ^2, and is subject to bell-shaped (Gaussian) selection with an optimal trait value of θ and range of high-fitness trait values of ω (Fig. 1), the relative fitness, W, of an individual with trait value z is

$$W(z) = \exp\left(\frac{-(z-\theta)^2}{2\omega^2}\right) \tag{2}$$

the mean relative fitness of the population, $\overline{W}$, is

$$\overline{W}(\bar{z},\theta,\omega) \propto \exp\left(\frac{-(\bar{z}-\theta)^2}{2(\omega^2+\sigma^2)}\right) \tag{3}$$

and the change in mean trait value from one generation to the next is described by

$$\bar{z}' = \bar{z} + \left[\frac{\bar{z}\omega^2 + \theta\sigma^2}{\omega^2+\sigma^2} - \bar{z}\right]h^2. \tag{4}$$

Under this model, selection causes $\bar{z}$ to change over time so that the mean trait value approaches the opti-

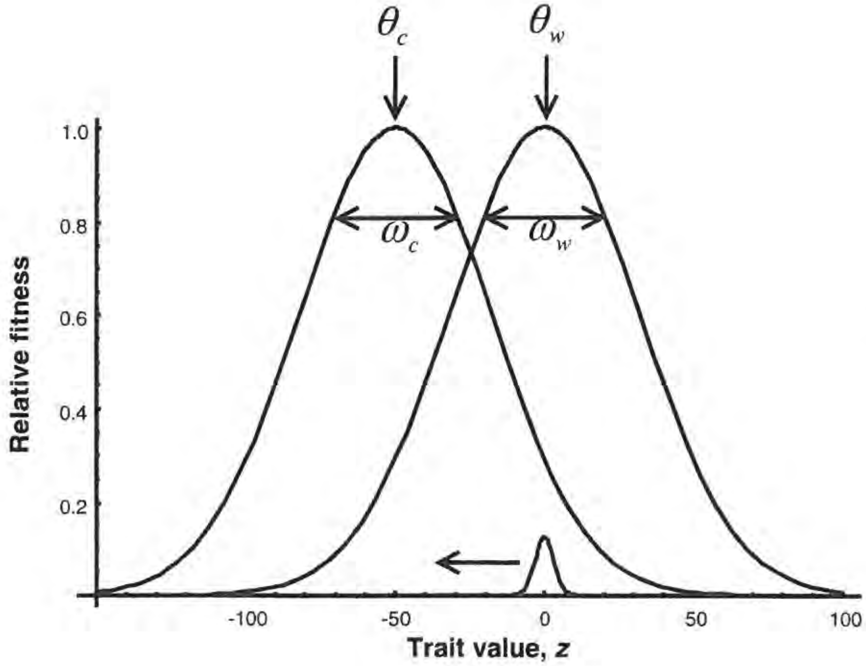

Figure 1. The basic concept of the phenotypic model. The curve on the right is the function describing the fitness in the wild environment of an individual with trait value z *(equation 2). Fitness in the wild is maximized for individuals with trait value* z = θ_w. *The curve on the left is the function describing fitness in the captive environment. The optimal trait value in the captive environment is* z = θ_c. *The width of the fitness curves, and hence the strength of selection, is described by the parameters* ω_w *and* ω_c *for the wild and captive environments, respectively* ($\omega_w^2 = \omega_c^2 = 1000$). *The smaller curve under the wild fitness function describes a population that has evolved so that its mean phenotype is equal to the optimal phenotype in the wild. The phenotypic variance in this population,* σ^2, *is 10, and is assumed to remain constant. If part of the population is taken into captivity and used for supportive breeding, the captive-fitness function slowly moves the trait distribution in the population to the left, toward the captive optimum.*

mum trait value (Fig. 1). The model assumes that selection is weak enough for mutation and recombination to continually replenish genetic variation so that the total variance and heritability of the trait do not change over time (Lande 1976). This assumption is supported by numerous empirical examples of continual phenotypic change from long-term artificial selection (Roff 1997). The model also assumes that all changes in the mean trait value are due to selection and that other potential causes of phenotypic change, such as random genetic drift or phenotypic plasticity, can be ignored. For the time scales and strengths of selection I examined, phenotypic changes produced by drift will be small as long as populations are reasonably large ($N_e >> 10$) (Lande 1976). For small populations in which drift cannot be ignored, the model results can be interpreted as the average outcome that would be expected were the populations to be replicated many times. This model does not take into account short-term phenotypic changes caused by developmental plasticity.

Bulmer (1985) extended this selection model to the case of two populations, and I followed a similar approach (Fig. 1). I let $\bar{z}_w$ and $\bar{z}_c$ be the means of a normally distributed trait in the wild and captive populations, respectively. For simplicity, I assumed that in each population the trait has the same (constant) phenotypic variance, σ_2. I let θ_w, ω_w, θ_c, and ω_c be the parameters for the Gaussian fitness function (equation 3) in the wild and captive environments, respectively. Assuming Gaussian selection and random mating in each environment, the recursion equations for the change in the mean value of the trait in each population are

$$\begin{aligned}\bar{z}'_w = p_w\left\{\bar{z}_w + \left[\frac{\bar{z}_w\omega_w^2 + \theta_w\sigma^2}{\omega_w^2 + \sigma^2} - \bar{z}_w\right]h^2\right\} + \\ (1 - p_w)\left\{\bar{z}_c + \left[\frac{\bar{z}_c\omega_w^2 + \theta_w\sigma^2}{\omega_w^2 + \sigma^2} - \bar{z}_c\right]h^2\right\}\end{aligned} \tag{5}$$

and

$$\begin{aligned}\bar{z}'_c = p_c\left\{\bar{z}_c + \left[\frac{\bar{z}_c\omega_c^2 + \theta_c\sigma^2}{\omega_c^2 + \sigma^2} - \bar{z}_c\right]h^2\right\} + \\ (1 - p_c)\left\{\bar{z}_w + \left[\frac{\bar{z}_w\omega_c^2 + \theta_c\sigma^2}{\omega_c^2 + \sigma^2} - \bar{z}_w\right]h^2\right\},\end{aligned} \tag{6}$$

where p_w is the proportion of the individuals in the wild population that originated from the wild population the previous generation and p_c is the proportion of individuals in the captive population that originated from the captive population the previous generation.

Setting $\bar{z}_w'$ equal to $\bar{z}_w$ and $\bar{z}_c'$ equal to $\bar{z}_c$ and solving for $\bar{z}_w$ and $\bar{z}_c$, the equilibrium mean trait values in each population are

$$\hat{z}_w = \frac{\sigma^2((1 + p_c(h^2 - 1))\theta_w + (h^2 - 1)(p_w - 1)\theta_c) + \theta_c(\omega_w^2 - \omega_w^2 p_w) - \theta_w\omega_c^2(p_c - 1)}{\sigma^2(2 - p_w - p_c + h^2(p_w + p_c - 1)) + \omega_w^2(1 - p_w) + \omega_c^2(1 - p_c)} \tag{7}$$

and

$$\hat{z}_c = \frac{\sigma^2((h^2 - 1)\theta_w(p_c - 1) + (1 + (h^2 - 1)p_w)\theta_c) + \theta_c(\omega_w^2 - p_w\omega_w^2) - \theta_w\omega_c^2(p_c - 1)}{\sigma^2(2 - p_w - p_c + h^2(p_w + p_c - 1)) + \omega_w^2(1 - p_w) + \omega_c^2(1 - p_c)}. \tag{8}$$

The equilibrium mean fitnesses of each population can be found by substituting the equilibrium mean trait values into equation 3.

In a plot of equation 7, it is apparent that the level of gene flow from the captive population to the wild population is a key parameter in determining the equilibrium mean trait value in the wild population (Fig. 2). Figure 2a illustrates a worst-case scenario in which the captive population is completely closed to gene flow from the wild population ($p_c = 1$), but the wild population is subject to continual gene flow from the captive population ($p_w < 1$). This situation may occur, for example, in the case of many salmon hatchery or aquaculture programs. In this scenario, the wild population's mean phenotype is shifted so that it approaches the optimal phenotype in captivity unless the level of gene flow from the captive population is very small. In other words, when the captive population is closed to gene flow from the wild, even a small amount of gene flow from the captive into the wild population will shift the wild population's mean equilibrium phenotype toward the optimal phenotype in captivity.

At the other extreme, when the captive population is completely replenished with wild-origin individuals every generation ($p_c = 0$), the relationship between the wild population's mean phenotype and the level of gene flow from the captive population is more linear (Fig. 2d). For any particular level of selection in captivity, the absolute shift in the wild population's mean phenotype is less than half what it was in the case of a closed captive population. Intermediate levels of gene flow from the wild into the captive population produce intermediate shifts in mean phenotype (Fig. 2b & 2c). The relationship between gene flow into the wild population and the wild population's mean trait value also becomes increasingly nonlinear the more the captive population is closed to wild gene flow. These relationships are essentially insensitive to the strength of selection in each population (ω_w and ω_c), so long as the strength of selection is equal in each population. When the strength of selection is unequal in the two populations, the equilib-

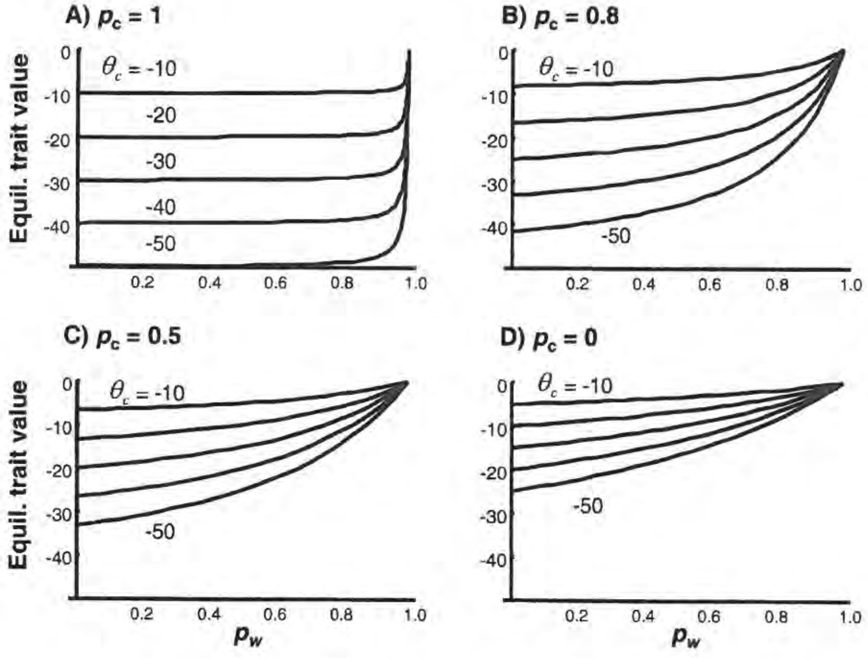

Figure 2. Equilibrium trait values in the wild population as a function of the proportion of wild-origin individuals in the wild population (p_W), captive-origin individuals in the captive population (p_c), and optimal phenotypic value in captivity (θ_c). In plot A, the captive population consists entirely of captive-origin individuals every generation. In plot D, the captive population consists entirely of wild-origin individuals every generation. Plots B and C show intermediate cases. In each case, heritability (h^2) is 0.5, the phenotypic variance (σ^2) is 10, the optimal wild-trait value (θ_w) is 0, and the widths of the selection functions (ω_w^2 and ω_c^2) are both 1000.

rium phenotype tends toward the optimum of the environment with stronger selection.

The fitness consequences of shifts in mean phenotype depend on the difference between the optimal trait values and the strength of selection in each environment, but they can be large for a broad range of parameter values (Fig. 3). When selection is relatively strong ($\omega^2 = 10\sigma^2$), for example, the fitness of the wild population can be reduced by 80% or more if the captive population is closed to immigration from the wild (Fig. 3a). The wild population is protected from this decline in fitness only when gene flow from the captive into the wild population approaches zero. Weaker selection results in a less dramatic loss of fitness, but even very weak selection ($\omega^2 = 100\sigma^2$) can produce large reductions in fitness if the captive population is closed to immigration

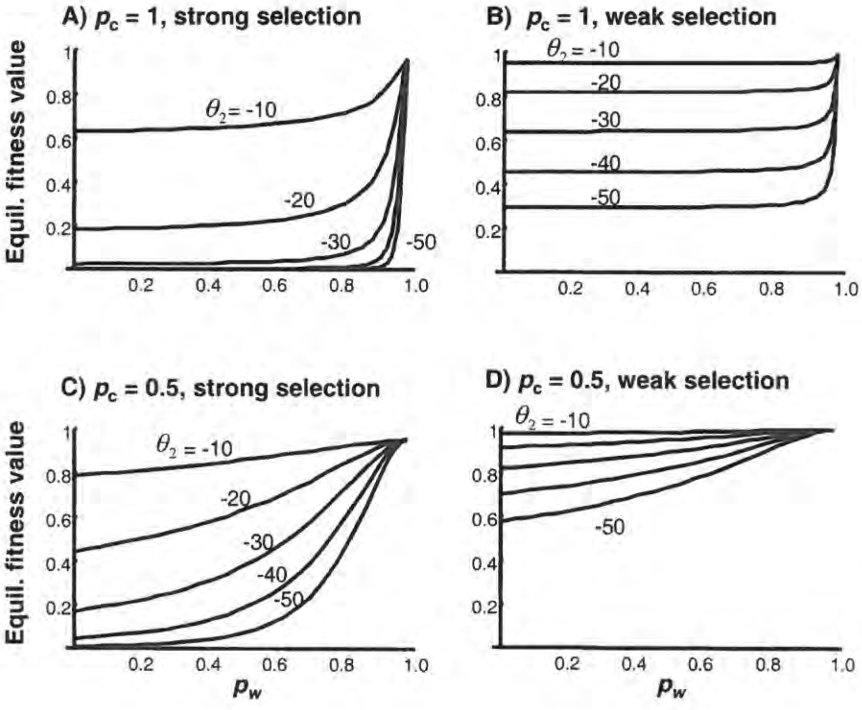

Figure 3. Equilibrium mean fitness values in the wild population as a function of the proportion of wild-origin individuals in the wild population (p_W), captive-origin individuals in the captive population (p_c), and optimal phenotypic value in captivity (θ_c). In all plots, the optimal wild-trait value (θ_w) is 0, and heritability (h^2) is 0.5. In plots A and C, selection is relatively strong ($\sigma^2 = 10$ and $\omega_w^2 = \omega_c^2 = 100$). In plots B and D, selection is relatively weak ($\sigma^2 = 10$ and $\omega_w^2 = \omega_c^2 = 1000$).

from the wild (Fig. 3b). As in the case of strong selection, the fitness response in the wild population is extremely nonlinear. Opening the captive population to immigration from the wild results in a much smaller—but still potentially significant—loss of fitness if selection is weak (Fig. 3d), but it can still produce large reductions when selection is strong (Fig. 3c & 3d). Remarkably similar results to those presented in Fig. 3 have also been found in a model of the accumulation of deleterious mutations during supportive breeding (Lynch & O'Hely 2001).

The rate of approach to the equilibrium fitness values can be rapid if selection is strong. For a population initially at its optimal wild trait value, selection can shift the mean phenotype 90% of the way to its new equilibrium value in <50 generations, and substantial reductions in wild fitness can occur in <20 generations (Table 1). For many short-lived organisms, such as Pacific salmon, this time frame is relevant to conservation efforts. The time to approach the new equilibrium value is sensitive to the strength of selection but relatively insensitive to the rate of gene flow between the captive and wild environments (Table 1).

Demographic Model

The phenotypic model is useful for illustrating relationships between key parameters, but it does not explicitly incorporate the demographics of supportive breeding. In particular, this model implicitly assumes that there are an effectively infinite number of individuals in each population so that the immigration proportions, $1 - p_w$ and $1 - p_c$ can be set at arbitrary values. In reality, the immigration proportions vary depending on the growth rates of each population, which are themselves functions of the mean population fitness in each population. Under many conditions, the immigration proportions are therefore expected to be influenced by selection.

Table 1. Time, in generations, for a wild population's mean phenotype to reach 50% and 90% of the way toward its new equilibrium value after the start of supportive breeding.

	Strong selection[a]				*Weak selection*[b]			
	$p_c = 1$		$p_c = 0.5$		$p_c = 1$		$p_c = 0.5$	
p_w	t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}
0.1	16	50	16	48	138	456	135	446
0.25	17	48	15	47	139	458	135	440
0.50	17	49	16	44	140	464	127	404
0.75	19	52	16	44	144	444	123	422
1.0	23	53	15	42	147	459	113	313

[a] *The width of the fitness functions,* ω_w^2 *and* ω_c^2*, is 100; the phenotypic variance,* σ^2*, is 10;* t_i *is the number of generations needed to reach* i% *of the way to the equilibrium mean fitness value; and* p_c *and* p_w *are the proportion of captive breeders that originated from captivity and wild breeders that originated from the wild, respectively.*

[b] $\omega_w^2 = \omega_c^2 = 1000, \sigma^2 = 10.$

To address this issue, I combined the phenotypic model with a simple, discrete generation-demographic model of supportive breeding similar to that described by Ryman and Laikre (1991) and Cuenco (1994). The life cycle starts when adults are either taken into captivity or allowed to breed in the wild environment. Reproduction occurs separately in each environment, and the number of offspring produced is determined by multiplying the maximum potential reproductive rate of the population in the environment by the mean relative fitness of the population. All captive offspring are then released back into the wild environment, where they grow to adulthood and the life cycle starts over again. The model assumes that captive adults are marked in some way, so that it is possible to determine the rate of exchange between the captive and wild environments. The recursion equations describing the number of breeding adults in one generation as a function of the number of breeders in the previous generation are

$$\begin{aligned} N'_w = {} & (1 - m_w) f_w(N_w) \overline{W}(\bar{z}_w, \theta, \omega_w) + \\ & m_c f_c(N_c) \overline{W}(\bar{z}, \theta, \omega_w) \end{aligned} \tag{9}$$

and

$$\begin{aligned} N'_c = {} & (1 - m_c) f_c(N_c) \overline{W}(\bar{z}_c, \theta, \omega_c) + \\ & m_w f_w(N_w) \overline{W}(\bar{z}_w, \theta_c, \omega_c), \end{aligned} \tag{10}$$

where $N_w{}'$ and $N_c{}'$ are the number of breeders in the wild and captive populations, respectively, in generation $t + 1$; N_w and N_c are the number of breeders in generation t; m_w is the fraction of the adult progeny from the wild population that returns to breed in the captive population; m_c is the fraction of the adult progeny from the captive population that returns to spawn in the wild population; $f_w(N_w)$ and $f_c(N_c)$ are functions that describe the maximum per-capita reproductive rate in the wild and captive environments, respectively. The m_w and m_c are emigration rates prior to selection, and $1 - p_w$ and $1 - p_c$ are net immigration rates after selection.

Any number of functions could be used in equations 9 and 10 to describe reproduction. For simplicity, all the scenarios assume reproduction is independent of density in each environment up to an environment-specific limit, such that

$$f_w(N_w) = \begin{Bmatrix} N_w R_w, \text{ for } N_w < K_w \\ K_w R_w, \text{ for } N_w \geq K_w \end{Bmatrix} \tag{11}$$

and

$$f_c(N_c) = \begin{Bmatrix} N_c R_c, \text{ for } N_c < K_c \\ K_c R_c, \text{ for } N_c \geq K_c \end{Bmatrix}, \tag{12}$$

where R_w and R_c are the maximum per-capita reproductive rates the wild and captive environments can support, respectively, and K_w and K_c are the carrying capacities of the wild and captive environments, respectively. The maximum per-capita reproductive rate for an environment is defined as that which a population at low density with $\overline{W} = 1$ would have in that environment. Carrying capacity is defined here as the breeding population size above which no further increases in recruitment are possible. The maximum possible number of adult recruits produced by the wild and captive environments are therefore K_wR_w and K_cR_c, respectively. Like the phenotypic model, the demographic model is entirely deterministic.

It is worth briefly examining the outcome of the demographic model with no selection in either the wild or captive environments. To do this, I initially made four additional simplifying assumptions. First, I assumed that at the start of supportive breeding the wild population is declining at a constant rate and that breeders brought into captivity will produce more than one adult offspring per breeder ($R_w < 1$ and $R_c > 1$). Second, I assumed that the first priority of the supportive breeding project is to exactly fill the captive environment to its capacity, K_c. Third, I assumed that wild-origin and captive-origin adults are taken into captivity in proportion to their abundance. Fourth, I assumed that the population will remain below the carrying capacity of the wild environment. The third assumption means that m_w equals the proportion of the entire population (of both captive and wild origin) that returns to breed in captivity. These assumptions mean that

$$m_w = \left\{ \begin{array}{c} \dfrac{K_c}{N_wR_w + N_cR_c}, \text{ for } N_wR_w + N_cR_c > K_c \\ 1, \text{ for } N_wR_w + N_cR_c < K_c \end{array} \right\} \quad (13)$$

and

$$m_c = 1 - m_w .$$

Assuming that R_w, R_c, and K_c remain constant, equations 9 and 10 can be solved to find the equilibrium number of breeders in the captive and wild populations,

$$\hat{N}_w = \frac{K_cR_c - K_c}{1 - R_w} \quad (14)$$

and

$$\hat{N}_c = K_c .$$

At equilibrium, the proportion of each population that consists of adults born in the wild environment will be

$$\hat{p}_w = \frac{R_w(R_c - 1)}{R_c - R_w} . \quad (15)$$

Under these assumptions, the equilibrium size of the wild population is determined solely by the capacity of the captive environment and the maximum per-capita reproductive rates in the wild and captive environments. The equilibrium proportion of each population born in the wild is determined solely by the per-capita reproductive rates in each environment so that as $R_w \to 1$, $p_w \to 1$, and as $R_c \to \infty$, $p_w \to R_w$.

The demographic and phenotypic models can be combined by substituting

$$p_i = \frac{(1 - m_i)\overline{W}(\bar{z}_i, \theta, \omega_i) f_i(N_i)}{N_i^*} \quad (16)$$

into equations 5 and 6, where N_i^* is the total population size of the ith population after migration and selection. The resulting system of phenotypic and demographic equations does not appear to be readily mathematically tractable, but it can be easily iterated to explore the model's behavior. Below, I explore how several key parameters, including the relative reproductive rates and carrying capacities of the wild and captive environments, affect the outcome of the model.

The dynamics of the combined demographic and phenotypic models can be complicated. As an example, consider a situation where at the time supportive breeding is initiated the wild population is declining at a rapid rate ($R_w = 0.05$) and the maximum potential reproductive rate in captivity is considerably higher than in the wild ($R_c = 3$). The captive population is founded by wild-origin individuals, with a mean phenotype initially equal to the optimum in the wild. The optimal phenotype in captivity is substantially different (approximately 16 phenotypic standard deviations) from the wild optimum. The first 100 generations of this scenario are plotted in Fig. 4. Initially, the wild population rapidly decreases and the captive population increases as wild individuals are brought into captivity. The fitness of the captive population is initially low (because the wild individuals' mean phenotype is far from the captive optimum), so once the wild population goes extinct the captive population begins to decline as well (Fig. 4b). The rate of decline slows, however, as the population adapts to the captive environment (Fig. 4c), and eventually the captive population starts to increase in size (Fig. 4b). After about 25 generations, the captive population has become productive enough that it has "surplus" individuals that can be reintroduced into the wild (Fig. 4a). In generations 25 to 100, the population continues to evolve toward the captive optimum, so its fitness in captivity continues to improve while its fitness in the wild slowly declines (Fig. 4c & 4d).

A key result from the combined demographic and phenotypic model is that, when the wild population is well below its carrying capacity, the effect of supportive breeding on the wild population's mean fitness is highly dependent on the maximum potential reproductive rates in both the wild and captive environments (Fig. 5a). When R_w is relatively large and R_c is large enough

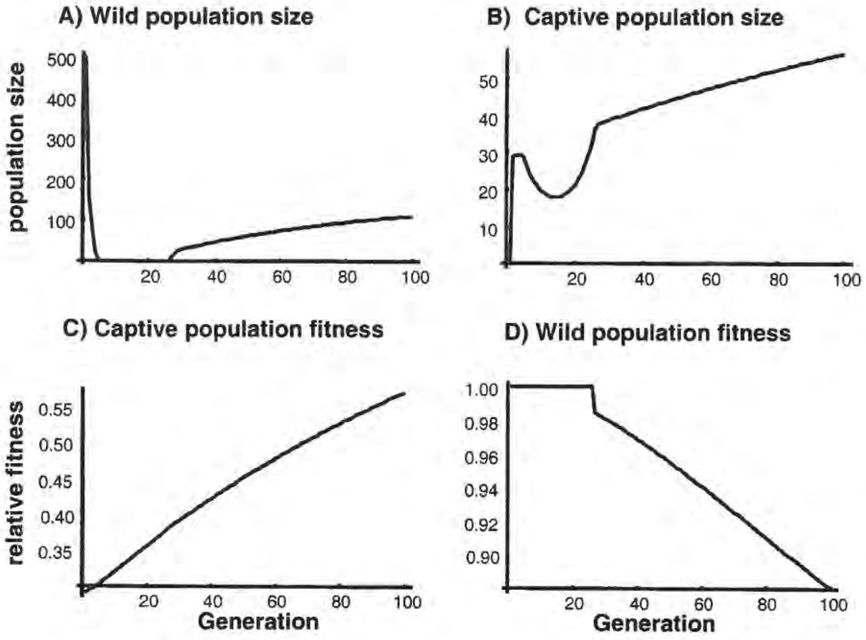

Figure 4. Population size and mean fitness of the wild and captive populations over the course of 100 generations of supportive breeding. Plot A shows the wild population's size, plot B shows the captive population's size, plot C shows the captive population's fitness, and plot D shows the wild population's fitness. The optimal phenotype in the wild (θ_w) is 0; the optimal phenotype in captivity (θ_c) is −50; the phenotypic variance (σ^2) is 10, and selection is weak in both environments ($\omega_w^2 = \omega_c^2 = 1000$). Heritability ($h^2$) is 0.5.

that the captive population has surplus production to contribute individuals to the wild population, the proportion of wild-produced individuals remains relatively high, and, as expected from the results of the purely phenotypic model, the mean fitness of the wild population remains relatively unchanged by the supportive breeding program. On the other hand, when either R_w or R_c is relatively small, the proportion of wild-produced individuals also becomes small, and the mean fitness of the wild population declines as its mean phenotype evolves away from its optimum value.

If the wild population has a finite carrying capacity, the simple relationship between the reproductive rates in the two environments and the proportion of wild-origin individuals no longer applies, and it becomes possible to "overload" the wild environment with captive individuals. In this case, if the carrying capacity is low relative to the surplus productivity of the captive population, the fitness of the wild population can decline substantially (Fig. 5b). This result is again consistent with the results from the purely phenotypic model. When the wild environment is overloaded with captive-origin individuals, the proportion of wild-origin individuals, p_w, becomes small, and relatively few fish that have been selected for the wild phenotype are produced compared with the large number of captively reared migrants.

Model Assumptions and Limitations

The phenotypic model makes several simplifying assumptions, the most important of which are that the phenotypic trait of interest is normally distributed with constant variance, that selection on the trait is constant and stabilizing, that all changes in the mean trait value are due to selection, and that there is no concurrent selection on correlated traits. The demographic model makes additional assumptions, such as discrete generations and a specific form of density-dependent reproduction. These assumptions are unlikely to be met exactly but are close enough to reality to provide insight into the likely outcomes of supportive breeding. For example, the assumption that a trait will remain normally distributed with constant variance will be approximately met if selection is sufficiently weak ($\omega^2 >> \sigma^2$), migration rates are sufficiently high, and mutation and recombination act to continually normalize variation.

Likewise, the assumption of stabilizing selection in wild populations is probably qualitatively correct for many traits. For example, wild populations of Pacific salmonids often appear to have local adaptations that increase fitness in their spawning and rearing habitats (Taylor 1991), and many behavioral and morphological traits in Pacific salmonids (such as run timing) are probably under some form of stabilizing selection. The assumption that selection on wild populations is constant is unlikely to be exactly true, but it will be qualitatively correct as long as the wild optimum does not change appreciably over the course of the supportive breeding project or if the difference between the wild and captive optima is much larger than the range of variation within either optima. The assumption that only one trait is subject to selection is obviously not true, but modeling additional traits adds considerably to the number of parameters in the model without providing much additional insight. The demographic assumptions are certainly not

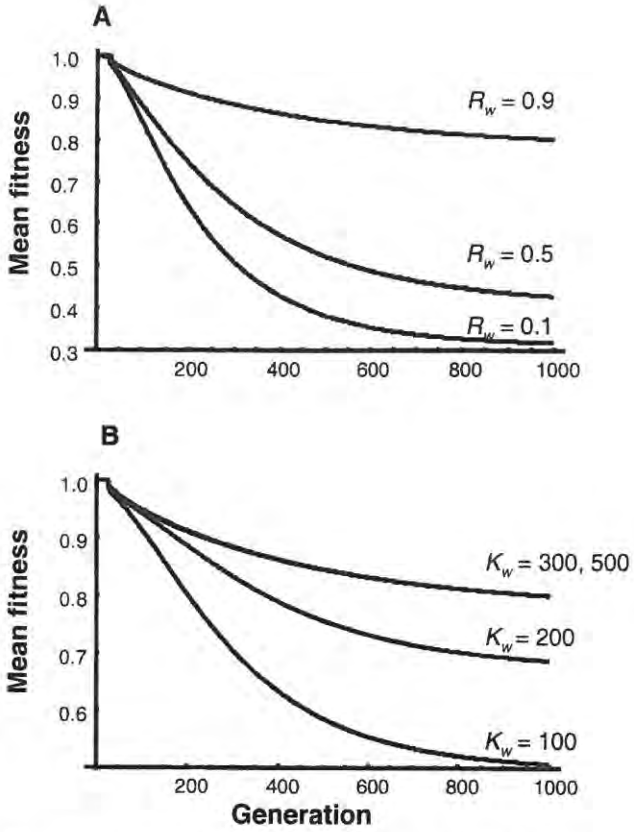

Figure 5. Effect of varying maximum reproductive rate in the wild (R_w) (plot A) and carrying capacity in the wild (K_w) (plot B) on mean fitness of the wild population during 1000 generations of supportive breeding. The optimal phenotype in the wild (θ_w) is 0; the optimal phenotype in captivity (θ_c) is −50; the phenotypic variance (σ^2) is 10, and selection is weak in both environments ($\omega_w^2 = \omega_c^2 = 1000$). The maximum reproductive rate in captivity (R_c) is 3. The maximum wild reproductive rate (R_w) in part B is 0.9. Heritability (h^2) is 0.5.

exactly correct for many species, but they are nonetheless commonly used in fisheries management as a first approximation to more complex demographics.

Conservation Implications

For salmonids there are several examples of reductions in fitness caused by captive propagation (e.g., Reisenbichler & McIntyre 1977; Leider et al. 1990; Fleming et al. 1996). The results of the model show that these fitness reductions are not unexpected, although they are expected to vary depending on factors such as the strength of selection and the rate of exchange between captive and wild populations. The model provides some insight not immediately obvious from existing empirical studies. First, most experimental studies of the fitness effects of captive breeding focus on the survival or reproductive success of captively propagated fish when they are released into the wild. The long-term effects of such releases on the mean fitness of a supplemented wild population have not been measured, but the model shows that these effects can be significant (Figs. 3 & 5).

Second, most empirical studies to date have focused on genetic changes in captive populations that received few if any wild immigrants subsequent to the initial founding of the captive population. In contrast, nearly all of the more recent supportive-breeding projects for Pacific salmonids involve deliberately managed migration between captive and wild populations (e.g., Carmichael & Messmer 1995). The primary purpose of regularly bringing wild-origin broodstock into these programs is to avoid domestication of the captive stock. I explicitly explored this two-population scenario and found that substantial phenotypic changes and fitness reductions can occur even if a large fraction of the captive broodstock is brought in from the wild every generation (Figs. 2 & 3). This suggests that regularly bringing wild-origin broodstock into captive populations cannot be relied upon to eliminate the effects of inadvertent domestication selection, although the rate and level of domestication will be reduced compared with those of a completely closed captive population.

The sensitivity of the degree of phenotypic change to the relative proportions of captive and wild individuals—and hence indirectly to the maximum potential reproductive rates in the wild and captive environments—has two interesting implications. First, it means that wild-origin breeders are important to a population's viability in the wild even in cases where the wild population is not able to sustain itself without the aid of supportive breeding. All the scenarios I explored had wild per-capita reproductive rates of <1, so the wild population in each case would have gone extinct deterministically without the aid of supportive breeding. Those wild populations with relatively high reproductive rates ($R_1 > 0.9$), however, were much less prone to phenotypic change during supportive breeding than less-healthy populations (Fig. 5).

The dependence on the potential reproductive rate in the wild environment means that conserving or restoring a population's habitat (or addressing other factors that limit the population's reproductive rate) may be the most effective method of preventing phenotypic change during supportive breeding, even if these improvements are not sufficient to allow the population to sustain itself entirely naturally. The results also suggest that controlling the exchange rate between captive and wild populations would be an effective way of limiting domestication of wild populations. In a supportive-breeding situation, however, where the goal is to use captive individuals to increase the size of a declining wild population, it may be impossible to achieve the desired demographic boost while keeping the proportion of captive-origin individuals in the wild population low (Cuenco 1994). On the other hand, for some fish species there exist aquaculture programs that result in the inadvertent release of captively bred individuals into wild populations. My results suggest that such inadvertent releases can, given enough time, result in substantial phenotypic changes and fitness loss in wild populations even at low rates of introgression (Fig. 2a).

The sensitivity of the model to the wild reproductive rate also implies that those populations most in need of supportive breeding are also those most vulnerable to phenotypic change due to selection in captivity. This suggests that in situations where improving the wild reproductive rate is not feasible, it is especially critical to avoid strong selection in captivity. Representative sampling of the population for broodstock (Hard et al. 1992) and the use of "natural" methods of breeding and rearing (e.g., Maynard et al. 1995) may be particularly important in situations where wild reproductive rates are low, although the ability of these measures to adequately mimic the selection that occurs in the wild environment is unknown.

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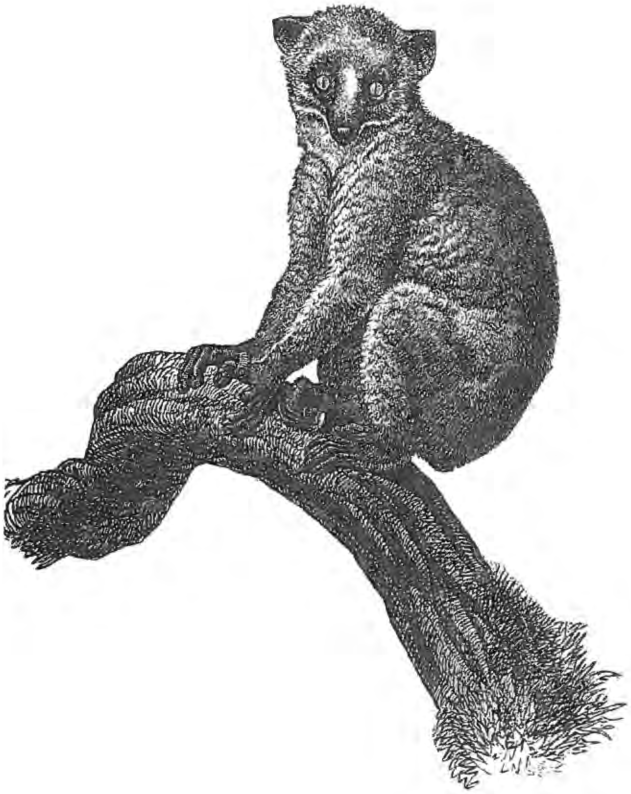

Conservation Biology

Attachment G

Contributed Paper

Evaluating Alternative Strategies for Minimizing Unintended Fitness Consequences of Cultured Individuals on Wild Populations

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Abstract: *Artificial propagation strategies often incur selection in captivity that leads to traits that are maladaptive in the wild. For propagation programs focused on production rather than demographic contribution to wild populations, effects on wild populations can occur through unintentional escapement or the need to release individuals into natural environments for part of their life cycle. In this case, 2 alternative management strategies might reduce unintended fitness consequences on natural populations: (1) reduce selection in captivity as much as possible to reduce fitness load (keep them similar), or (2) breed a separate population to reduce captive-wild interactions as much as possible (make them different). We quantitatively evaluate these 2 strategies with a coupled demographic–genetic model based on Pacific salmon hatcheries that incorporates a variety of relevant processes and dynamics: selection in the hatchery relative to the wild, assortative mating based on the trait under selection, and different life cycle arrangements in terms of hatchery release, density dependence, natural selection, and reproduction. Model results indicate that, if natural selection only occurs between reproduction and captive release, the similar strategy performs better. However, if natural selection occurs between captive release and reproduction, the different and similar strategies present viable alternatives to reducing unintended fitness consequences because of the greater opportunity to purge maladaptive individuals. In this case, the appropriate approach depends on the feasibility of each strategy and the demographic goal (e.g., increasing natural abundance, or ensuring that a high proportion of natural spawners are naturally produced). In addition, the fitness effects of hatchery release are much greater if hatchery release occurs before (vs. after) density-dependent interactions. Given the logistical challenges to achieving both the similar and different strategies, evaluation of not just the preferred strategy but also the consequences of failing to achieve the desired target is critical.*

Keywords: artificial propagation, domestication selection, hatcheries, migration load, *Oncorhynchus* spp, quantitative genetic model, rapid evolution

Evaluación de Estrategias Alternativas para Minimizar las Consecuencias No Inesperadas en la Adecuación de Individuos Criados en Cautiverio sobre Poblaciones Silvestres

Resumen: *Las estrategias de propagación artificial a menudo incluyen selección en cautiverio que conduce a atributos que no son adaptativos en el medio silvestre. En programas de propagación enfocados a la producción en lugar de contribuciones demográficas a las poblaciones silvestres, los efectos sobre las poblaciones silvestres pueden ocurrir por medio de escapes no intencionales o la necesidad de liberar individuos en ambientes naturales durante parte de su ciclo de vida. Para reducir consecuencias no esperadas de la propagación artificial sobre poblaciones naturales, los manejadores pueden reducir la selección en cautiverio lo más posible para reducir la carga de adaptabilidad o criar una población separada para reducir, lo más posible, las interacciones cautiverio-medio silvestre. Evaluamos cuantitativamente estas estrategias de manejo con un modelo demográfico-genético que basamos en pesquerías de salmón del Pacífico. El modelo*

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incorporó una variedad de procesos y dinámicas relevantes: selección en el criadero relativo al medio silvestre, apareamiento selectivo con base en el atributo seleccionado, y ordenamiento diferente de los eventos en el ciclo de vida (liberación del criadero, densodependencia, selección natural y reproducción). Cuando la selección natural ocurrió entre la reproducción y la liberación, la reducción de la selección en cautiverio fue más efectiva en la reducción de consecuencias no esperadas en la adecuación que la cría de una población separada. Sin embargo, cuando la selección natural ocurrió entre la liberación y la reproducción, ambas estrategias redujeron las consecuencias no esperadas en la adecuación por la oportunidad de la selección natural de purgar individuos no adaptativos antes de que ocurra el entrecruzamiento. En este caso, el método apropiado dependería de la factibilidad de cada estrategia y de la meta demográfica (e.g., incremento de la abundancia natural o asegurar que una alta proporción de reproductores naturales sea producida naturalmente). Los efectos sobre la adaptabilidad de la liberación de individuos criados en cautiverio fueron mucho mayores cuando la liberación ocurrió antes (versus después) de las interaccione densodependientes. Debido a los retos logísticos de reducir la selección en cautiverio y la cría de una población separada, la evaluación de la estrategia preferida y de las consecuencias de no alcanzar la meta deseada son de importancia crítica.

Palabras Clave: Carga de migración, criaderos, evolución rápida, modelo genético cuantitativo, *Oncorhynchus* spp., propagación artificial, selección de domesticación

Introduction

Artificial propagation can be both a conservation tool, in the case of captive breeding (Ebenhard 1995; Frankham et al. 2002), and a potential threat to biological diversity, in cases such as spillover or release from agriculture, forestry, ranching, and aquaculture leading to invasive species or types (Laikre et al. 2010). Selection in captivity, whether accidental or purposeful, often leads to traits that are maladaptive in the wild (Frankham et al. 2002). In captive breeding focused on conservation-based supplementation, such selection is widespread and can undermine the success of the program by leading to poor survivorship or reproductive success of artificially-propagated individuals and degrading fitness in wild populations (Ebenhard 1995; Frankham 2008). In artificial propagation programs focused on production, such selection can lead to unintended negative fitness effects on wild populations when any artificially-propagated individuals escape (Laikre et al. 2010).

Escapement (i.e., release of artificially propagated individuals into the natural environment) might occur through unintentional spillover (e.g., from agriculture and commercial forestry) or when program goals depend on releasing individuals into the natural environment for part of their life cycle (e.g., hatcheries for marine stock enhancement, game bird supplementation, insect pollinators). Production programs are responsible for the majority of released individuals (Laikre et al. 2010), but their fitness effects on natural populations have received less attention in wildlife and forestry management. Although containment would avoid fitness consequences by ensuring that no cultured individuals have an opportunity to interbreed with wild individuals, complete containment is nearly impossible to achieve, and many production programs necessarily involve the intentional release of cultured individuals to the natural environment.

For reducing unintended fitness consequences in the context of captive breeding, the goal is clear: avoid as much selection in captivity as is feasible (Frankham et al. 2002). Reducing selection in captivity is also a potential strategy for reducing unintended fitness consequences in production programs, but the fact that such programs do not have demographic contribution to wild populations as part of their goals suggests a second alternative: purposefully selecting for different phenotypes to separate them from the wild population. Under the latter strategy, not only might the lower fitness of captive-reared individuals lead to a low likelihood of survival in the wild, but if any traits under selection (e.g., timing of reproduction, body size) affect assortative mating, then captive-reared and wild individuals might be less likely to interbreed.

In the first, "similar" strategy, interbreeding events will have small fitness effects but will be common, whereas in the second, "different" strategy, interbreeding events will be rare but any that do happen will have large fitness effects. Therefore, these alternatives trade-off between their effect on (1) the probability that captively bred individuals will survive in the wild and successfully reproduce, and (2) the severity of the genetic consequences from each interbreeding event that does occur. This trade-off is inevitable given that heritable attributes that reduce survival or reproductive success of cultured individuals will also lead to the most serious reductions in fitness for interbreeding events that occur. Although these inherent trade-offs have been recognized by some (Naish et al. 2007), no detailed evaluations have been conducted.

Salmon hatcheries present a study system that encapsulates both types of artificial propagation programs (conservation hatcheries for wild population support, production hatcheries for fishery support; Utter & Epifanio 2002; Naish et al. 2007) and for which negative fitness effects of selection in captivity on a variety of traits are well-established (Reisenbichler & Rubin 1999; Araki et al. 2008; Hutchings & Fraser 2008). Hatcheries involve partial-life-cycle captive rearing, taking in adults during their return migration, or the migration of adults from oceans to the river spawning grounds, and releasing the offspring before outmigration, or the migration of juveniles from rivers to the ocean feeding grounds. Therefore, hatchery-reared and wild fish inevitably interact at some stages.

Here we rigorously test the intuitive logic of the similar and different strategies through a quantitative model, with the goal of determining whether one strategy performs better (i.e., has lower unintended fitness consequences on the wild population) in general and, if not, identifying the conditions under which each is more effective at reducing unintended fitness consequences on wild populations. A number of models applied to selection in hatchery or aquaculture environments (e.g., Hutchings 1991; Lynch & O'Hely 2001; Tufto 2001; Ford 2002) provide insight into elements of this question, especially the influence of the amount of exchange between the captive and natural population. We provide the first integration of all of the dynamics relevant to the similar and different alternatives, where both survivorship and mating likelihood depend on trait differences driven by selection, into a single model.

Methods

We base the model on a generic Pacific salmon (*Oncorhynchus* spp.) life cycle with coupled demographic and genetic dynamics, where the evolutionary dynamics represent a generic trait. One example of a relevant trait is spawn time, a heritable trait under selection in hatcheries (Hoffnagle et al. 2008) that affects both fitness and assortative mating (i.e., fish spawning around the same time are more likely to mate with each other; Hendry & Day 2005). From the coupled dynamics, we analyze how fitness and demographic effects of the hatchery depend on model assumptions with respect to life cycle timing and density dependence.

Conceptual Model Overview

The model follows the coupled demographic-genetic dynamics through 4 major stages: reproduction, outmigration, ocean residence, and return migration (Fig. 1), with census at the spawner stage just before reproduction. We use a quantitative genetic model such that phenotypes can assume a continuum of values depending on both the underlying genotypes and random environmental effects. During reproduction, genotypes are inherited and phenotypes depend on genotypes. We model assortative mating with a correlation between phenotypes of individuals in a mating pair (i.e., 2 individuals with more similar phenotypes are more likely to mate) to account for the effect of phenotypic selection in the hatchery on mating likelihood with wild individuals. We assume that per-capita production of juveniles is higher in the hatchery than in the wild, which is essential for any successful hatchery program (Waples et al. 2007).

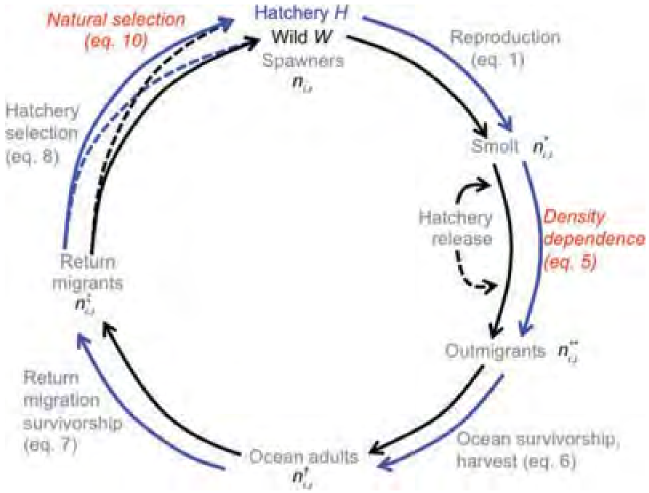

Figure 1. Illustration of model dynamics (Eqs. 1–10). Each time step represents a full life cycle. Within each time step, the model steps through reproduction, hatchery release, density-dependent mortality, ocean survivorship and harvest, return migration survivorship, and both hatchery and natural selection. Both density-dependence and natural selection, highlighted in red and with italics, can occur at either outmigration or return migration, where the 5 orderings explored are, (1) as illustrated, which serves as the default life cycle; (2) both density dependence and natural selection on return migration, with density dependence preceding selection; and, given natural selection on outmigration, (3) density dependence on outmigration before natural selection; (4) density dependence on outmigration after natural selection; or (5) density dependence on return migration. Under the default life cycle, we explore hatchery release after (dashed arrow) as well as before (solid arrow, the default) density dependence. The black dashed line between return migration and spawning indicates any wild fish selected for the hatchery, and the blue dashed line between return migration and spawning indicates hatchery fish escapement to spawn in the wild.

During outmigration, both hatchery release and density-dependent mortality occur, with the relative timing of these events determining whether hatchery and wild fish affect each other's survivorship. During ocean residence, we implement density-independent mortality to model both natural and harvest survivorship. During return migration, 3 events occur: return migration survivorship, hatchery removal, and natural selection. For return migration survivorship, we assume lower survivorship for hatchery-reared fish due to the non-genetic effects of rearing in the hatchery environment (as hatchery fish generally have lower smolt-adult survival than wild fish; Waples et al. 2007).

We assume that the hatchery selects on the phenotype during collection of hatchery broodstock; for example, hatcheries often select early returning fish to ensure they meet their egg-take quotas (Hoffnagle et al. 2008). How much the optimal trait in the hatchery differs from that in the wild determines where the hatchery strategy falls on the different-similar continuum. Here we model a hatchery that selects only on phenotype and does not distinguish wild-reared and hatchery-reared fish, and anything not selected for the hatchery can spawn in the wild. For natural selection, we implement stabilizing selection for an optimal trait, which determines the survivorship of natural spawners of both wild and hatchery origin. In reality, both natural selection and density dependence occur at a variety of life history stages. Therefore, we test alternative timings for these dynamics.

Mathematical Model Details

Our model follows the population density distribution $n_{i,t}(f, g)$, where $n_{i,t}(f, g)\,\mathrm{d}f\,\mathrm{d}g$ describes the number of individuals in population i (W for wild or H for hatchery) at time t with phenotypes between f and $f + \mathrm{d}f$ and genotypes between g and $g + \mathrm{d}g$. Integrating this distribution over all phenotypes and genotypes yields total population size $N_{i,t} = \iint n_{i,t}(f, g)\,\mathrm{d}f\,\mathrm{d}g$, and normalizing this distribution yields joint genotype-phenotype probability distribution $\phi_{i,t}(f, g) = n_{i,t}(f, g)/N_{i,t}$. Because the dynamics considered here (in particular, disruptive selection by hatchery removal on the remaining population and the combination between populations experiencing different selection) can lead to substantial departures from normality of both breeding values and environmental effects, we follow this full breeding value distribution (analogous to Coulson et al. 2010).

For reproduction, given 2 individuals with phenotype-genotype combinations (f_1, g_1) and (f_2, g_2), let their mating probability density be $\Psi(f_1, g_1, f_2, g_2)$, the probability density of their offspring genotypes depend on parental genotypes given the transmission function $T(g \mid g_1, g_2)$, and the probability density of their offspring phenotypes depend on offspring genotypes given the function $P(f \mid g)$. Then, given per-capita reproductive output (smolts per spawner) R_i in location i (where $R_W < R_H$), the offspring population density distribution in each location i at time t is

$$n^*_{i,t}(f, g) = R_i N_{i,t} P(f \mid g) \iiiint T(g \mid g_1, g_2) \times \Psi_i(f_1, g_1, f_2, g_2)\,\mathrm{d}f_1\,\mathrm{d}g_1\,\mathrm{d}f_2\,\mathrm{d}g_2 \quad (1)$$

(analogous to Slatkin 1970). To define the mating function, we let assortative mating depend on parental phenotypes (f_1, f_2) and the correlation between successful mating phenotypes a_i ($0 \le a_i < 1$, where $a_i = 0$ for no assortative mating; note that any assortment by population of origin can only occur due to phenotypic differences). In this case, following Feldman & Cavalli-Sforza (1977, Eq. 16), the mating function is the encounter probability (product of proportion of each parental type in the population) weighted by the correlation factor according to

$$\Psi_i(f_1, g_1, f_2, g_2) = \frac{\phi_{i,t}(f_1, g_1)}{\int \phi_{i,t}(f_1, g)\,\mathrm{d}g} \frac{\phi_{i,t}(f_2, g_2)}{\int \phi_{i,t}(f_2, g)\,\mathrm{d}g} \frac{\exp\left[-\dfrac{(f_1 - \mu_{f,i,t})^2 - 2a_i(f_1 - \mu_{f,i,t})(f_2 - \mu_{f,i,t}) + (f_2 - \mu_{f,i,t})^2}{2F_{i,t}(1 - a_i^2)}\right]}{2\pi F_{i,t}\sqrt{1 - a_i^2}}, \quad (2)$$

given mean phenotype $\mu_{f,i,t} = \iint f\phi_{i,t}(f, g)\,\mathrm{d}f\,\mathrm{d}g$ and phenotypic variance $F_{i,t} = \iint (f - \mu_{f,i,t})^2 \phi_{i,t}\mathrm{d}f\,\mathrm{d}g$. Given each offspring genotype drawn from a distribution determined by the average of its parental genotypes and the amount that mutation increases genetic variance each generation M, the transmission function is

$$T(g \mid g_1, g_2) = \frac{1}{\sqrt{2\pi(G_{i,t}/2 + M)}} e^{\frac{-(g - \frac{g_1+g_2}{2})^2}{G_{i,t}/2+M}}. \quad (3)$$

This approach assumes a large number of loci each contribute additively, with a small effect of each locus, to the overall genotype. Note that the genetic variance used for the offspring distribution (population-level variance $G_{i,t} = \iint (g - \mu_{g,i,t})^2 \phi_{i,t}\mathrm{d}f\,\mathrm{d}g$ given mean genotype $\mu_{g,i,t} = \iint g\phi_{i,t}\mathrm{d}f\,\mathrm{d}g$) ignores linkage disequilibrium to account for the effect of evolving genetic variance on inheritance and follow the full reproductive model from our source for the assortative mating dynamics (Feldman & Cavalli-Sforza 1977); changing this assumption does not affect the qualitative trends presented here (Appendix S1). Finally, given random environmental variation E and no phenotype plasticity, the offspring phenotype is randomly distributed around its genotype according to

$$P(f \mid g) = \frac{1}{\sqrt{2\pi E}} e^{\frac{-(f-g)^2}{2E}}. \quad (4)$$

During outmigration, we employ density-dependence according to the Beverton–Holt function with parameter α (a widely used model of density dependence in salmon dynamics, especially stage-specific density dependence, e.g., Scheuerell et al. 2006; see Satake & Araki 2012 for how choice of density dependence can affect results in hatchery models). Given hatchery release before density-dependence, this yields

$$\begin{aligned} n^{**}_{i,t}(f,g) &= \frac{n^{*}_{i,t}(f,g)}{1+\alpha\sum_{j\in\{W,H\}}\iint n^{*}_{j,t}(f',g')\,\mathrm{d}f'\,\mathrm{d}g'} \\ &= \frac{n^{*}_{i,t}(f,g)}{1+\alpha\sum_{j\in\{W,H\}} N^{*}_{j,t}}. \end{aligned} \tag{5}$$

During ocean residency, density-independent survivorship occurs with proportion ν_o surviving, which combines both natural and harvest mortality. The surviving population is

$$n^{\dagger}_{i,t}(f,g) = \nu_o n^{**}_{i,t}(f,g). \tag{6}$$

During return migration, each population experiences population-dependent return survival $\nu_{s,i}$, where $\nu_{s,W} = 1$ and $\nu_{s,H} < 1$ to express the post-smolt survivorship and spawning success of hatchery-reared fish relative to that of wild-origin fish, where hatchery-reared fish generally have lower survival and spawning success due to non-genetic effects of hatchery rearing. Therefore, each return-migrating population is

$$n^{\ddagger}_{i,t}(f,g) = \nu_{s,i} n^{\dagger}_{i,t}(f,g). \tag{7}$$

Note that applying lower density-independent survivorship for hatchery-reared fish to earlier life history stages (ocean stage, at outmigration after density dependence) will result in the same outcome for the population distribution dynamics.

Next the hatchery removes individuals for hatchery spawning, in the process selecting on the phenotype. The hatchery selects for optimal trait θ_{H} given selection variability S_{H}, which is inversely related to selection strength. We modify this selection by the proportion $\rho_{\mathrm{H},t}$ controlled by the target hatchery population size, such that the hatchery population density in the next generation is

$$\begin{aligned} n_{H,t+1}(f,g) &= \rho_{\mathrm{H},t}\exp\left[-\frac{(f-\theta_{\mathrm{H}})^2}{2S_{\mathrm{H}}}\right] \\ &\quad\times(n^{\ddagger}_{W,t}(f,g) + n^{\ddagger}_{\mathrm{H},t}(f,g)). \end{aligned} \tag{8}$$

To determine the modifier $\rho_{\mathrm{H},t}$, we set a target of $\hat{N}_{\mathrm{H}}$ fish for hatchery rearing and a maximum proportion of the total spawning population that can be removed for the hatchery ρ_{M} such that

$$\rho_{\mathrm{H},t} = \min\left(\frac{\hat{N}_{\mathrm{H}}}{\sum_{i\in\{\mathrm{W,H}\}}\iint\exp\left[-\frac{(f-\theta_{\mathrm{H}})^2}{2S_{\mathrm{H}}}\right]n^{\ddagger}_{i,t}(f,g)\mathrm{d}f\,\mathrm{d}g}, \rho_{\mathrm{M}}\right). \tag{9}$$

The remainder not selected for the hatchery return to spawn in the wild, undergoing natural selection. This selection occurs as stabilizing selection for the optimal trait θ_{W} given selection variability S_{W} inversely related to selection strength (as in Lande 1976; Ford 2002). Applying this selection to the wild-spawning population yields

$$\begin{aligned} n_{\mathrm{W},t+1}(f,g) &= \exp\left[-\frac{(f-\theta_{\mathrm{W}})^2}{2S_{\mathrm{W}}}\right] \\ &\quad\times\left(1-\rho_{\mathrm{H},t}\exp\left[-\frac{(f-\theta_{\mathrm{H}})^2}{2S_{\mathrm{H}}}\right]\right) \\ &\quad\times(n^{\ddagger}_{\mathrm{W},t}(f,g) + n^{\ddagger}_{\mathrm{H},t}(f,g)). \end{aligned} \tag{10}$$

Note that because the same trait determines both assortative mating (Eq. 2) and fitness (Eq. 10), this model falls under the magic trait class of models concerning assortative mating (Gavrilets 2004).

In addition to the sequence of events described above, we explore the model with hatchery release after density dependence (Eq. 5 without the summation), density dependence (Eq. 5) at spawning rather than outmigration (after hatchery selection, to model competition for spawning sites), and natural selection (Eq. 10) occurring after reproduction (before hatchery release, with density dependence on outmigration before or after natural selection or on return migration).

Model Implementation and Analysis

Because the model is not analytically tractable, we numerically simulate the relevant scenarios. We choose values (e.g., strong natural selection as reflected in values of S_{W} and S_{H}; all values provided in Table 1) where fitness effects of hatchery-reared fish influence the population dynamics of wild fish, as it is under those circumstances that the question of similar versus different hatchery strategies is of most interest. Because hatchery environments can incur both artificial selection, which is often stronger than natural selection, and weaker, relaxed selection for traits under selection in the wild, we use a default of equivalent selection strength in the hatchery to the wild. For the hatchery production (R_{H}) and relative hatchery survivorship in the wild ($\nu_{s,\mathrm{H}}$, reflective of non-genetic effects of rearing in the hatchery environment), we choose values in line with empirical observation of the overall returning number of adults per spawner (Waples et al. 2007). In addition, we choose a default environmental variance (E) to result in a heritability similar to values observed for life history and phenological traits (Carlson & Seamons 2008); note that heritability evolves as genetic variation evolves with the evolution of the full breeding value distribution. We choose the value for the amount that mutation increases genetic variation (M) relative to the environmental variance from the

Table 1. Model parameters, meaning, and default values used in the numerical analysis of Eqs. (1)–(10).

Parameter	*Description*	*Default value*
R_i	Per-capita reproductive output (smolts per spawner) in each of the hatchery and wild populations	$R_{\mathrm{W}} = 3; R_{\mathrm{H}} = 8R_{\mathrm{W}}$
a_i	Phenotypic correlation between mating pairs (strength of assortative mating)	$a_W = a_H = 0.5$
M	Amount mutation increases genetic variance each generation	10^{-3}
E	Environmental variance	1
θ_i	Optimal trait in environment i (wild or hatchery)	$\theta_W = 50, \theta_H = 35 - 50$
S_i	Width of selection function in environment i (inversely related to selection strength)	$S_H = S_W = 5$
α	Density-dependent parameter for Beverton–Holt function	3×10^{-5}
ν_o	Ocean survivorship (density-independent)	0.7
$\nu_{s,\mathrm{H}}$	Relative smolt-to-adult survivorship and spawning success for hatchery-reared fish (given $\nu_{s,\mathrm{W}} = 1$)	0.3
$\hat{N}_{\mathrm{H}}$	Target population size for the hatchery	1000
ρ_{M}	Maximum proportion of the total population (or wild population in the case of a mixed-target hatchery) that the hatchery can remove	0.8

empirically-observed range reported in Lynch (1988). We also explore model sensitivity to all parameter values.

We initialize the model at the expected equilibrium for each population considered independently (natural population size at its carrying capacity based on the density-dependence parameter α, hatchery population size at hatchery capacity $\hat{N}_{\mathrm{H}}$, genotype-phenotype distribution centered the optimal traits for each environment). Then we run the model for 50 time steps (generations), which is beyond the point where simulations reach equilibrium, and report equilibrium censused in the spawning stage. For more details on the numerical analysis, see Appendix S1.

We use 3 metrics to determine the fitness and demographic effects of the hatchery on the wild population. The first metric is the equilibrium fitness of wild individuals in the natural (wild) environment $\bar{\mathcal{F}}_{\mathrm{WW}}$. To determine fitness of population i in environment j, we use the population's genotype-phenotype probability distribution $\phi_{i,t}(f, g) = n_{i,t}(f, g)/N_i$ multiplied by the environment-dependent fitness for each phenotype $\exp[-(f - \theta_j)^2/(2S_j)]$ and integrated over all phenotypes and genotypes

$$\mathcal{F}_{ij,t} = \iint \exp\left[-\frac{(f - \theta_j)^2}{2S_j}\right] \phi_{i,t}(f, g)\,\mathrm{d}f\,\mathrm{d}g \qquad (11)$$

(Lande 1976). The second metric is the equilibrium wild population size ($\bar{N}_{\mathrm{W}} = \iint \bar{n}_{\mathrm{W}}(f, g)\mathrm{d}f\,\mathrm{d}g$, where the bar indicates equilibrium value), scaled by the equilibrium population size in equivalent simulations without a hatchery ("no-hatchery baseline"). Both of these metrics are derived from the full phenotype-genotypic population density $\bar{n}_W(f, g)$; see Appendix S2 for sample results that describe this distribution at equilibrium. Third, to explore the effect of the hatchery on the wild population in the same way that it is often measured empirically, we calculate the fraction of natural spawners that are of natural origin (i.e., the proportion of natural spawners $n_{\mathrm{W},t+1}$ in Eq. 10 that originated in the wild as $n^*_{\mathrm{W},t}$ fry, thus measured on the within-generation, individual level rather than the genetic level). These metrics reflect a goal of minimizing unintended consequences given a production program, rather than a captive breeding program focused on demographic supplementation, as the similar versus different question applies only to the former.

Our central determinant for the degree of similarity of selection in the hatchery and natural environments is the difference in optimal traits θ_{H} and θ_{W}. Assuming constant θ_{W} while changing $\theta_{\mathrm{H}} \leq \theta_{\mathrm{W}}$, $\theta_{\mathrm{H}} - \theta_{\mathrm{W}} = 0$ indicates identical hatchery and natural environments (as a theoretical benchmark unlikely to be achieved in reality), and decreasing $\theta_{\mathrm{H}} - \theta_{\mathrm{W}}$ indicates increasing difference in selection between the 2 environments. Given the underlying dynamics, larger values for the optimal trait in the hatchery relative than in the wild ($\theta_{\mathrm{H}} - \theta_{\mathrm{W}} > 0$) would lead to a mirror image to these plots. We express hatchery selection in terms of the value of $\theta_{\mathrm{H}} - \theta_{\mathrm{W}}$ rather than in terms of phenotypic standard deviations because, with genetic and phenotypic variance evolving with the full breeding value distribution, these values change with θ_{H} (Appendix S2).

Results

When investigating a variety of options for the timing of density dependence and natural selection (Fig. 2) in the life cycle, we find that whether the different strategy presents a viable alternative to the similar strategy depends critically on the timing of natural selection. If natural selection only occurs after reproduction, before

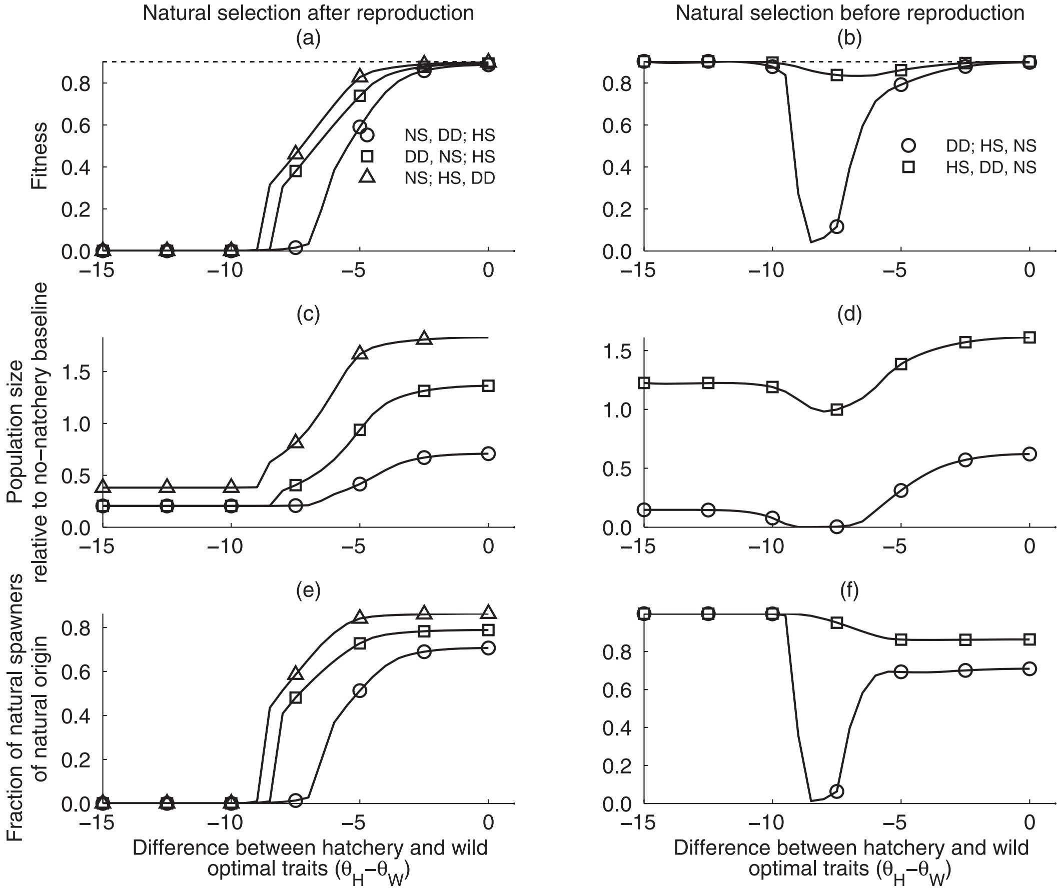

Figure 2. The effect of different timings for natural selection (NS), density-dependence (DD), and hatchery removal/selection (HS). The semicolon in the legends separates events that occur at outmigration from those that occur at return migration; all 3 events in the lines with squares in the right-hand column occur after return migration. Columns separate simulations with natural selection occurring at outmigration (panels a, c, e) or return migration (panels b, d, f), and rows provide the model outcome for 3 different metrics of hatchery effects on wild population (fitness of wild individuals in the natural environment in panels a and b, wild population size scaled to the population size at equilibrium for the equivalent model without a hatchery in panels c and d and fraction of natural spawners of natural origin in panels e and f). The dotted line in the fitness plots indicates the equilibrium value in equivalent simulations without a hatchery (below one because of mutation-selection balance plus environmental variance leads to phenotypic variation around the optimal phenotype). Delimiting markers (circles, squares, and triangles) indicate every fifth data point.

hatchery release, then hatchery-reared fish not taken into the hatchery will spawn in the wild before natural selection can remove their genes, and their offspring present a continual, recurring fitness drag, which increases with increasing difference between the hatchery and wild selection (lower value for $\theta_H - \theta_W$ in Fig. 2a). This leads to a decline in the wild population size (Fig. 2c) and replacement of the wild population by fish of hatchery origin (Fig. 2e). On the other hand, if natural selection occurs just before or at spawning, and if hatchery-reared fish are different enough that most will not survive that natural selection event, most wild spawners will be of wild origin (Fig. 2f) and have the same fitness as if there were no hatchery (Fig. 2b). In other words, the different (low $\theta_H - \theta_W$) strategy is a viable alternative to the similar ($\theta_H - \theta_W \sim 0$) strategy only when natural selection occurs between release and reproduction. When there is an intermediate fitness minimum between these 2 strategies, both extremes tend to perform equivalently in terms of fitness effects on the wild population (Fig. 2b), and the demographic effect depends on the metric: keeping them similar tends to lead to greater natural population sizes (Fig. 2d) but a lower fraction of natural spawners of natural origin (Fig. 2f) compared to making them different.

When exploring the relative timing of hatchery release and density-dependent mortality in the wild (with natural selection during return migration; Fig. 3), we find a strong interaction between density-dependent

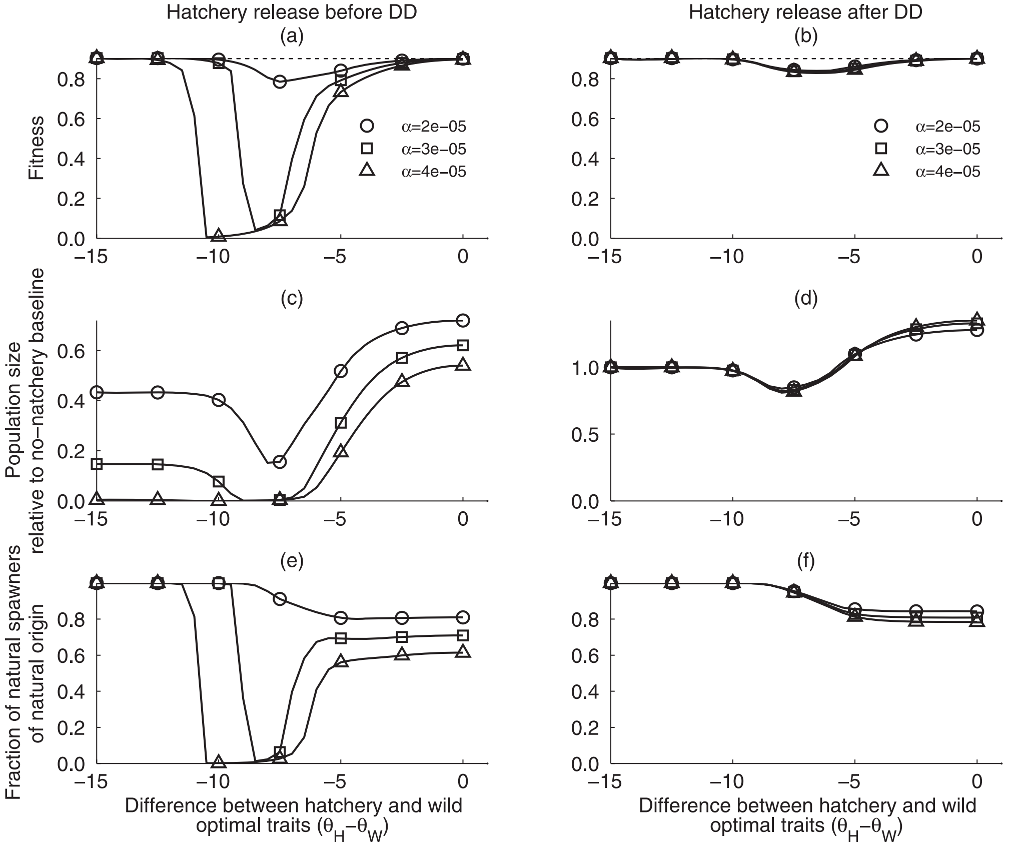

Figure 3. The effect of different assumptions for the density-dependent dynamics: hatchery-reared fish release before (left column; panels a, c, e) or after (right column; panels b, d, f) density-dependent mortality occurs in the wild, for differing strengths of density-dependence (increasing strength, or decreasing carrying capacity, with increasing Beverton–Holt parameter α). The dotted lines in the fitness plots indicate the no-hatchery baseline.

and fitness effects of hatchery-reared fish on the wild population. Specifically, intermediate hatchery selection (such that hatchery-reared fish are similar enough for some to survive to reproduce in the natural environment but different enough to cause a significant fitness drag when they do so) has a much more negative effect, both in terms of population size and fitness, when hatchery-reared fish are released before density dependence (Figs. 3a, c, e as compared to Figs. 3b, d, f). In this case, hatchery-reared fish first increase the density-dependent mortality of natural spawners at outmigration and then reduce the fitness of the remaining wild population at spawning, as opposed to only affecting fitness.

The qualitative trend of both similar and different strategies minimizing unintended fitness consequences in comparison to an intermediate strategy if natural selection occurs between outmigration and return migration applies to a wide array of parameter values (Fig. 4). The potential for significant fitness consequences of an intermediate strategy depends most strongly on the values for the strength of density dependence, the reproductive output both for natural spawners and in the hatchery, ocean survivorship, and the hatchery size.

Discussion

Keep them Similar versus Make them Different

Our model indicates that, for artificial propagation programs where escapement is unintentional, the effect of domestication selection on wild populations and the appropriate strategies for mitigating unintended fitness consequences depends critically on the relative timing of natural selection, density dependence, and release of artificially propagated individuals in the life cycle. Specifically, the different strategy of breeding a separate population is a viable alternative to the similar strategy of reducing selection in the captive environment only if strong natural selection occurs between captive release and reproduction, so that it can purge maladapted individuals before they leave any offspring (Fig. 2b). Otherwise, if natural selection only occurs between reproduction and captive release, the different strategy leads to a migrational meltdown (sensu Ronce & Kirkpatrick 2001), where input of maladaptive individuals reduces survivorship the following generation and hence increase the relative contribution of the maladaptive individuals

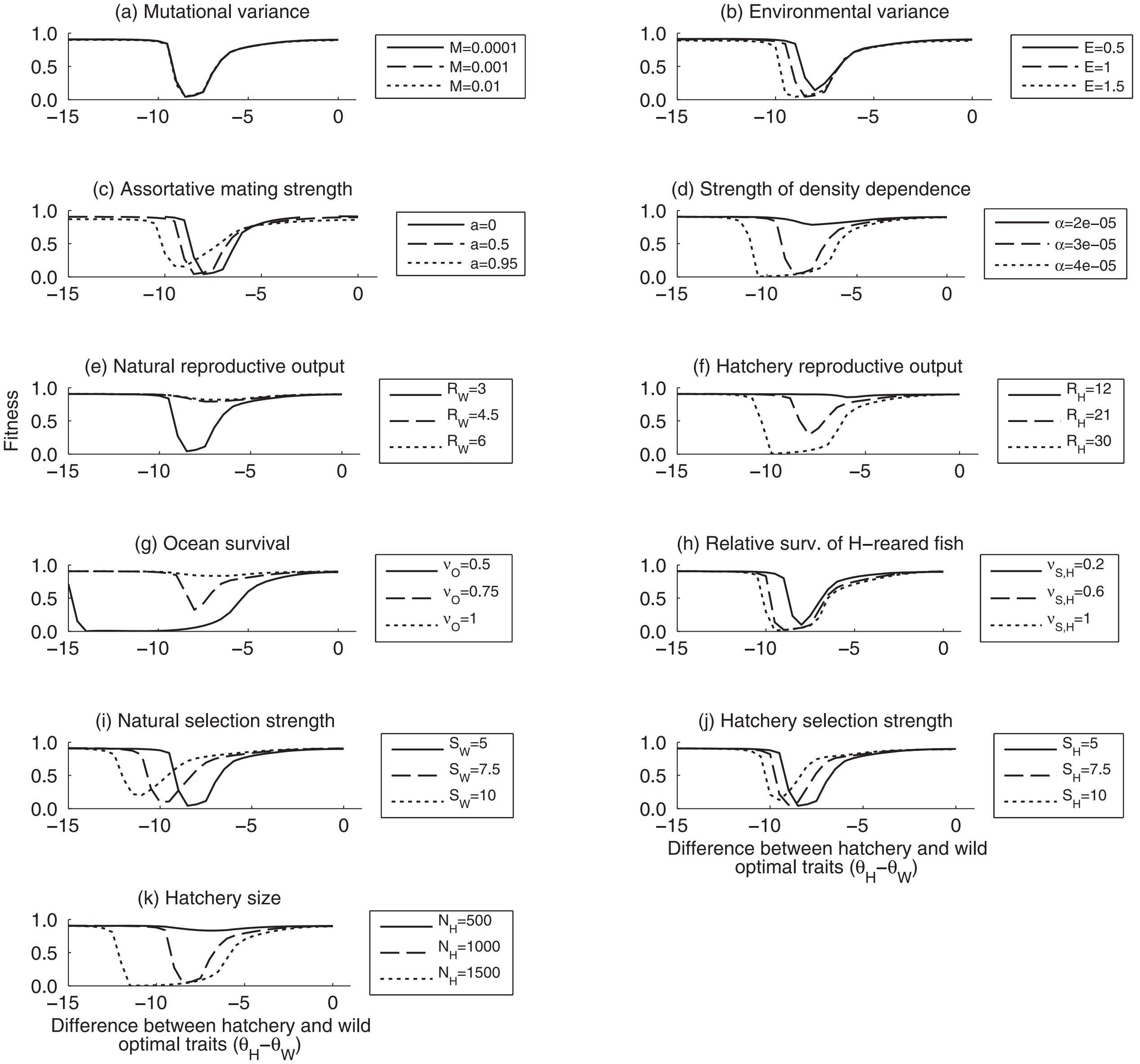

Figure 4. The effect of different parameter values on the model outcome under model default assumptions (density dependence at outmigration, hatchery release before density dependence, and natural selection at spawning) on fitness of wild fish in the wild. In panel (e), $R_H = 8R_W$ for all simulations. Note that the carrying capacity decreases with increasing α (strength of density dependence) in panel (d) and S_i is inversely related to selection strength in panels (i)–(j).

from the captive population each generation, with the eventual replacement of the wild population with genotypes adapted to the captive environment. In this case, the similar strategy always performs better (Fig. 2a).

Our results resonate with a variety of existing models. Replacement with maladapted individuals occurs in models with simpler genetic structure applied to aquaculture and crop production as well as hatcheries (Hutchings 1991; Byrne et al. 1992; Haygood et al. 2003; Satake & Araki 2012) in addition to generic models of gene flow and spatially variable selection (reviewed by Lenormand 2002). Purging of maladapted individuals also occurs in a model with one-way migration (J. Huisman and J. Tufto unpbl.), where selection occurs between migration and reproduction, given strong selection. In addition, informed by a model without explicit genetic dynamics, Lorenzen (2005) argues that the greatest negative effects of stock enhancement on the wild population will occur at intermediate fitness differences. Finally, Ronce & Kirkpatrick (2001) highlight the importance of the relative timing of migration, selection, and reproduction in their generic model, where selection between migration and reproduction decreases the potential for migrational meltdown.

Parallels between our results and this wide-ranging set of models strengthen the generality of our conclusions, which expand on previous results to provide a more comprehensive comparison of the similar and different strategies. Furthermore, though our model construction is motivated by salmon, the use of multiple life cycle constructs and a generic stabilizing selection function allows for broad applicability for artificial propagation programs that involve partial-life-cycle captive rearing (e.g., other fish hatcheries, game birds, insect pollinators). In particular, our central conclusion that strong natural selection between captive release and reproduction is necessary for the different strategy to be a viable alternative to the similar strategy (robust to a wide variety of parameter values; Fig. 4) can apply to the wide range of artificial production programs that exist across agriculture, forestry, hunting, and harvest (Laikre et al. 2010).

Under conditions where the similar and different strategies are viable alternatives for reducing unintended fitness consequences, the preferable strategy depends on both the demographic goal and relative feasibility of achieving each strategy. We discuss feasibility in the next section below. With respect to the demographic goal, the different strategy better achieves the goal of maximizing the fraction of natural breeders of natural origin due to the purging effect (Fig. 2f). Conversely, the similar strategy better achieves the goal of maximizing wild population size due to the potential for the similar, captive-reared individuals to contribute to the population with relatively minor fitness drag (Fig. 2d).

A Question of Feasibility

Our simulations and the relevant theory thus support the possibility of the different and similar strategies as viable alternatives, provided they are extreme enough, with intermediate strategies leading to the greatest fitness and demographic consequences. However, extremes of either strategy can be difficult or impossible to achieve in reality. Effectiveness of the similar strategy will be constrained by the difficulty in minimizing domestication selection in the benign captive environment (Frankham et al. 2002). Given that multiple traits under varying degrees of management control are under selection in captive environments (Reisenbichler & Rubin 1999; Hutchings & Fraser 2008) and drive fitness consequences for wild populations (Araki et al. 2007), the use of a single trait is a limiting assumption of our model; however, Tufto (2010) found that the inclusion of multiple co-evolving traits with correlated selection has a relative minor effect in an analogous model.

Genetic or life history constraints can also limit how different of a trait a captive environment can select for, in particular whether it can be extreme enough to avoid interbreeding and fitness consequences (Seamons et al. in press). Furthermore, achieving the different strategy with a naive population would typically incur substantial transient fitness consequences. Specifically, because a strategy different enough to reduce unintended fitness consequences requires selecting for traits that lead to a very low likelihood of survival in the wild, the frequency of such traits in a naive natural population will be extremely low. Therefore, a naive wild population will not have enough individuals to initially fill the target numbers for a new captive population with an extreme different strategy, and that captive population will only be able to arrive at the different strategy through gradual directional selection (rather than the instantaneous stabilizing selection modeled here given the equilibrium analysis). In this case, the population would move through a phase of large unintended fitness consequences (the fitness trough in Fig. 2b) before it becomes different enough for purifying selection to be effective. Avoiding this transient phase of large fitness consequences would require either controlling the escapement of captive-reared individuals during the period of directional selection or starting with a pre-adapted captive population (e.g., from a different location).

Therefore, though our model suggests the best possible scenario for either strategy, it also indicates the potential for substantial fitness and demographic consequences for artificial propagation programs that do not achieve these ideals, in line with the fitness effects suggested in previous models of selection in hatchery and aquaculture environments (e.g., Lynch & O'Hely 2001; Tufto 2001; Ford 2002). These models indicate that additional policies can improve both the similar and different strategies. Specifically, targeting a combination of captive-reared and wild-reared fish in a hatchery can slow down domestication selection and therefore assist the similar strategy (Lynch & O'Hely 2001; Ford 2002), and controlling captive-to-wild gene flow can help isolate the artificially propagated population and therefore assist the different strategy (Hutchings 1991; Lynch & O'Hely 2001; Tufto 2001; Ford 2002).

Because of both logistical challenges to achieving these various controls as well as the potential for unexpected outcomes, evaluating the outcome under optimal control as well as the consequences of deviation from the management target is critical. Models such as ours provide quantitative frameworks for such evaluations. For example, the rate of change in fitness for deviations from the extreme strategies (absolute slope at either side of the fitness trough) can indicate which strategy will incur greater fitness consequences for failure to achieve the desired target, which is typically the different strategy under the parameter values explored here (Fig. 4).

The Role of Density Dependence

In addition to the timing of natural selection, we find that the timing of density dependence relative to captive release has a significant influence on potential for unintended fitness consequences of artificial propagation (Fig. 3). In particular, much stronger fitness and demographic consequences occur with captive release before as compared to after density-dependent interactions because in the former case captive-reared fish increase the density-dependent mortality of wild individuals, thus reducing their relative contribution to the next generation. The timing of population regulation relative to exchange (soft vs. hard selection) has long been established as a major determining factor in the effect of exchange between populations experiencing differential selection (Christiansen 1975).

In reality for salmon, density dependence occurs at a variety of stages, and the strength of density dependence can vary with environmental conditions. Therefore, one expects any negative hatchery effects on wild populations to be particularly strong during years with greater resource limitation, such as years with poor ocean conditions for outmigrating salmon (Levin et al. 2001). One possible management implication of our results is that later hatchery release, which would reduce the amount of density-dependent interactions between hatchery-reared and naturally spawned fish, would also reduce unintended fitness consequences. A more generic model of genetic exchange between 2 populations, where density dependence occurs both before and after exchange, suggests that the efficacy of such an approach will depend critically on the relative size of each (here, hatchery vs. wild) population (Debarre & Gandon 2011). However, increased time in captivity will increase the opportunity for domestication. Furthermore, later hatchery release can also increase straying of hatchery-reared fish due to the loss of imprinting on the habitat at early stages, which might degrade metapopulation structure and diversity, with the potential to reduce resilience to environmental change (Lindley et al. 2009). Therefore, metapopulation structure and environmental heterogeneity, 2 processes not included here, require consideration for a more conclusive recommendation with respect to release timing.

Model Assumptions

As with any model, ours necessarily includes a number of simplifying assumptions. The theory of gene flow provides insight into how these assumptions might affect our results. Along with the assumptions discussed above, we implement a quantitative genetic model that ignores linkage disequilibrium, drift, and overlapping generations. Though overlapping generations would not affect the outcome of our model given the lack of environmental variation in many cases, they would affect cases where domestication selection affects generation time, such as by selecting for earlier maturity. Existing theory indicates that exchange between populations and any subsequent fitness load can cause similar demographic consequences in models with and without overlapping generations (Tufto 2000).

Genetic drift can lead to the accumulation of deleterious alleles, which can interact with selection in captivity to drive unintended fitness consequences (Lynch & O'Hely 2001). On the other hand, drift can also allow for a positive role of exchange between populations through the replenishment of lost genetic variation (Alleaume-Benharira et al. 2006). Therefore, it is not clear that ignoring genetic drift biases our model in any given direction. Typically, incorporating a finite number of loci contributing to a trait with linkage and variation in the effect size of individual loci does not substantially influence the outcome of models with exchange between populations experiencing differential selection (Tufto 2000; Huisman & Tufto in *press*). However, the effect of these assumptions does become stronger with strong selection and large differences between populations, which occurs under the different scenario here. One assumption typical to quantitative genetic models that we carefully avoid is that of normal genetic and phenotypic distributions: we follow full breeding value distributions, which we found necessary to properly evaluate the different strategy (Appendix S1). Overall, whereas relaxation of these assumptions might be necessary for a tactical model applied to a particular scenario, the general conclusions from our strategic model (sensu May 2001) highlight the crucial importance of the relative timing of natural selection, reproduction, density dependence, and captive escapement to understanding and quantifying the effect of captive rearing on wild populations.

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Supporting Information

A more detailed description of the numerical analysis implementation (Appendix S1) and sample output of the full genotype-phenotype distributions (Appendix S2) are available online. The authors are solely responsible for the content and functionality of these materials. Queries (other than absence of the material) should be directed to the corresponding author.

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Extending the Ford model to Three or More Populations

Craig Busack
NMFS Sustainable Fisheries Division
August 31, 2015

The commonly cited HSRG guidelines for integrated hatchery programs are based on a model developed by Mike Ford (NMFS-NWFSC) and published in Conservation Biology in 2002 (Ford 2002). The purpose of this paper is to explain how the model can be extended to additional populations, and demonstrate the value of this approach.

The Ford model assumes a normally distributed trait with heritability h^2, variance σ^2 and phenotypic means $\bar{z}_w$ and $\bar{z}_c$ in the natural (wild) and hatchery (captive) environments, respectively. The trait is under Gaussian stabilizing selection with fitness functions having optima θ_w and θ_c, and selection strengths ω_w and ω_c in the natural and hatchery environments, respectively. The recursion equations for changes (Ford's equations 5 and 6) in the mean trait values in the two environments are:

$$\bar{z}_w' = p_w\left[\bar{z}_w + \left(\frac{\bar{z}_w\omega_w^2 + \theta_w\sigma^2}{\omega_w^2 + \sigma^2} - \bar{z}_w\right)h^2\right] + (1 - p_w)\left[\bar{z}_c + \left(\frac{\bar{z}_c\omega_w^2 + \theta_w\sigma^2}{\omega_w^2 + \sigma^2} - \bar{z}_c\right)h^2\right] \qquad (1)$$

$$\bar{z}_c' = p_c\left[\bar{z}_c + \left(\frac{\bar{z}_c\omega_c^2 + \theta_c\sigma^2}{\omega_c^2 + \sigma^2} - \bar{z}_c\right)h^2\right] + (1 - p_c)\left[\bar{z}_w + \left(\frac{\bar{z}_w\omega_c^2 + \theta_c\sigma^2}{\omega_c^2 + \sigma^2} - \bar{z}_w\right)h^2\right] \qquad (2)$$

where p_w is the proportion of individuals spawning naturally that are natural-origin fish, and p_c is the proportion of individuals in the hatchery broodstock that are hatchery-origin fish. Although equilibrium values for natural-origin and hatchery-origin fish could be generated by iterating these equations until the solutions did not change, Ford also developed equations for the equilibrium trait values. For natural-origin fish, for example, the equilibrium point is given by:

$$\hat{z}_w = \frac{\sigma^2((1 + p_c(h^2 - 1))\theta_w + (h^2 - 1)(p_w - 1)\theta_c + \theta_c(\omega_w^2 - \omega_w^2 p_w) - \theta_w\omega_c^2(p_c - 1)}{\sigma^2(2 - p_w - p_c + h^2(p_w + p_c - 1)) + \omega_w^2(1 - p_w) + \omega_c^2(1 - p_c)} \qquad (3)$$

These equations could in theory be used for an actual trait, provided the heritability, selection strength, an optima were known, but it is debatable that these are known for any trait in salmon or steelhead. The equations' purpose in the paper was to demonstrate the relative importance of the various parameters in the equation in determining genetic change, and for the range of parameter values that Ford explored, the most important by far were the gene flow rates from natural to hatchery and vice versa. The HSRG concluded that a useful statistic would be *proportionate natural influence* or *PNI*, the position of the natural population equilibrium point relative to the two optima. Substituting the expressions pNOB and pHOS for Ford's $(1 - p_c)$ and $(1 - p_w)$, respectively, the HSRG also presented a simple equation that approximates PNI: $PNI \approx pNOB/(pNOB + pHOS)$. Although the PNI approximation equation is commonly used as a performance metric, it is important to keep in mind that it is not an instantaneous measure of population condition, but an approximation of the equilibrium point at which the population would arrive after many generations.

In extending the Ford equations to additional populations it is useful to use an alternative form of his equations, one based on Lande's (1976) equation:

$\bar{x}' = \left(1 - \frac{h^2\sigma^2}{\omega^2 + \sigma^2}\right)\bar{x}$ (4) , where $\bar{x}$ is the deviation of the population trait mean from the optimum. Ford's equation 1 can then be rewritten as:

$$(\bar{z}_w{}' - \theta_w) = \left(1 - \frac{h_w^2\sigma^2}{\omega_w^2 + \sigma^2}\right)\left(p_w(\bar{z}_w - \theta_w) + (1 - p_w)(\bar{z}_c - \theta_w)\right) \qquad (5)$$

Although the particular situation Ford was considering was gene flow between a hatchery population and a natural population, there is nothing in the equations that strictly applies to either a hatchery or a natural population. The equations simply describe the effect of gene flow between two populations[1]. Equations 1 and 2 can be rewritten as:

$$(\bar{z}_1{}' - \theta_1) = \left(1 - \frac{h^2\sigma^2}{\omega_1^2 + \sigma^2}\right)\left(p_{11}(\bar{z}_1 - \theta_1) + p_{21}(\bar{z}_2 - \theta_1)\right) \qquad (6)$$

$$(\bar{z}_2{}' - \theta_2) = \left(1 - \frac{h^2\sigma^2}{\omega_2^2 + \sigma^2}\right)\left(p_{12}(\bar{z}_1 - \theta_2) + p_{22}(\bar{z}_2 - \theta_2)\right) \qquad (7),$$

where p_{ij} is the proportion of spawners in population *j* that originated from population *i*. Extension to three populations is now straightforward:

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[1] Throughout this document the term population is used simply to denote a group of fish spawning together, not a population defined for recovery purposes.

$$(\bar{z}_1{}' - \theta_1) = \left(1 - \frac{h^2\sigma^2}{\omega_1^2 + \sigma^2}\right)\left(p_{11}(\bar{z}_1 - \theta_1) + p_{21}(\bar{z}_2 - \theta_1) + p_{31}(\bar{z}_3 - \theta_1\right) \qquad (8)$$

$$(\bar{z}_2{}' - \theta_2) = \left(1 - \frac{h^2\sigma^2}{\omega_2^2 + \sigma^2}\right)\left(p_{12}(\bar{z}_1 - \theta_2) + p_{22}(\bar{z}_2 - \theta_2) + p_{32}(\bar{z}_3 - \theta_2\right) \qquad (9)$$

$$(\bar{z}_3{}' - \theta_3) = \left(1 - \frac{h^2\sigma^2}{\omega_3^2 + \sigma^2}\right)\left(p_{13}(\bar{z}_1 - \theta_3) + p_{23}(\bar{z}_2 - \theta_3) + p_{33}(\bar{z}_3 - \theta_3\right) \qquad (10)$$

Derivation of equilibrium equations from equations 8-10 is also straightforward, but is messy and not necessary at this point, so is left to the adventurous reader.

This three-population extension of the Ford model can be applied to any scenario where three populations are linked, and obviously be extended to include even more populations. It was first developed in planning for a possible Snake River fall Chinook salmon recovery scenario featuring a hatchery, an area with a large number of hatchery-origin spawners, and an area with lower hatchery influence, but appears ideally suited to development of gene flow guidelines for “stepping-stone” situations, where an integrated program operates alongside a genetically linked isolated program, and both have some effect on a natural population through gene flow. A pertinent case in point is that of spring Chinook in the Methow basin, where an integrated supplementation program at the Methow Fish Hatchery (MFH) operates alongside an isolated safety-net program at the Winthrop National Fish Hatchery (WNFH)[2]. Returnees from both programs spawn in the wild, and the WNFH can be genetically linked to the MFH program in that all or nearly all the WNFH broodstock could consist of MFH returnees, with the remainder being WNFH returnees. I will develop this example in detail below.

Let:

Population 1= natural spawners in Methow basin

Population 2=MFH broodstock

Population 3=WNFH broodstock

Assume that optima for both hatcheries are the same, and are different from the optimum for the natural spawning population. Further assume that selection strength is the same everywhere, and

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[2] Although these are real hatchery programs, the gene flow values used in the example are meant to be illustrative, not necessarily accurate depictions of current or proposed true values for these programs.

assume a reasonable heritability (e.g., 0.5). All these are routine assumptions that were used in application of the Ford model to develop HSRG guidelines.

Let P be the matrix of spawning proportions (=gene flow surrogates).

P_{11} Proportion of natural spawners that are natural-origin fish	P_{12} Proportion of MFH broodstock that are natural-origin fish	P_{13} Proportion of WNFH broodstock that are natural-origin fish
P_{21} Proportion of natural spawners that are MFH returnees	P_{22} Proportion of MFH broodstock that are MFH returnees	P_{23} Proportion of WNFH broodstock that are MFH returnees
P_{31} Proportion of natural spawners that are WNFH returnees	P_{32} Proportion of MFH broodstock that are WNFH returnees	P_{33} Proportion of WNFH broodstock that are WNFH returnees

Set starting points for z values. These can be arbitrary. But I recommend values between the optima. Then run the equations recursively until the z values equilibrate, and calculate PNI for the natural population as percentage of the distance between the optima[3]. Different combinations of P values can be used to simulate different situations. The lack of equilibrium equations is annoying, but simulating to equilibrium points, which may require hundreds of generations, can be done very easily in a spreadsheet or with a simple R script.

The following tables demonstrate use of the concept[4]. First assume that 50% of the fish on the spawning grounds are of natural-origin, 30% are MFH returnees, and 20% are WNFH returnees; that the MFH program broodstock is 80% natural-origin fish and 20% MFH returnees; and finally that the WNFH program broodstock is completely isolated. Without the multi-population stepping stone approach, there is no adequate way to compute PNI. If you chose to ignore the source of the hatchery fish on the spawning grounds and just

Spawners/Broodstock

Sources	**Natural Population**	**MFH Program**	**WNFH Program**
Natural	**0.5**	**0.8**	**0**
MFH Program Returnees	**0.3**	**0.2**	**0**
WNFH Program Returnees	**0.2**	**0**	**1**

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[3] This PNI value is the true PNI, in contrast to the simple approximation equation for two populations. It may be possible to develop an approximation equation for this situation, but it is unclear how useful this would be.

[4] In the example I used a selection strength of 3 sd and a heritability of 0.5.

assume a pHOS of 0.5, calculating PNI using the familiar equation, you would get 0.63, which seems (and is) way too high because so many of the hatchery-origin spawners are not part of the integrated program. Using the stepping stone model, however, you get a PNI value of 0.19, demonstrating the huge load on PNI originating from the fish on the spawning grounds from the isolated program (if all the hatchery-origin spawners were WNFH returnees, the PNI value would be 0.10).

Now consider linking the WNFH program to the MFH program by using surplus MFH returnees as broodstock. Suppose 80% of WNFH broodstock needs can be met this way. The gene-flow matrix is shown to the left. This scenario yields a PNI of 0.55, a big improvement over 0.19.

Spawners/Broodstock

Sources	**Natural Population**	**PUD Program**	**WNFH Program**
Natural	**0.5**	**0.8**	**0**
PUD Program Returnees	**0.3**	**0.2**	**0.8**
WNFH Program Returnees	**0.2**	**0**	**0.2**

By investigating the consequences of a series of realistic gene flow matrices, gene flow objectives for both programs can be developed that will result in a specified PNI.

Literature Cited

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Spawners/Broodstock

Sources	Natural Population	PUD Program	WNFH Program
Natural	0.5	0.8	0
PUD Program Returnees	0.3	0.2	1
WNFH Program Returnees	0.2	0	0
Total (each column must add to 1.0)	1	1	1

PNI	0.57

HCP Hatchery Committees Meeting Protocols

Last modified: September 4, 2015

HCP Hatchery Committees' Responsibilities:

The Habitat Conservation Plans Hatchery Committees (HCP-HC) oversee development of recommendations for implementation of the hatchery elements of the three HCPs for which the Districts have responsibility for funding. This includes overseeing the implementation of improvements and monitoring and evaluation relevant to the Districts' hatchery programs, as identified in the Hatchery Compensation Plans, the Permits, and Agreements. The HCP-HCs also coordinate in-season information sharing and discuss unresolved issues. HCP-HCs' decisions shall be based upon the likelihood of biological success, time required to implement, and cost-effectiveness of solutions.

Meeting Protocols:

1. The HCP-HCs are decision-making bodies and make decisions or recommendations by consensus. Consensus is the unanimous consent of all HCP-HC members. Abstention does not prevent a unanimous vote.[1]
2. 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, who shall delay a vote on the agenda item for up to five (5) business days. A Party may invoke this right only once per delayed agenda item.[1]
    a. The HCP-HCs have historically been amicable to a Party requesting additional time for internal vetting prior to a vote (within reason). This request and agreement typically have occurred during the meeting following contentious discussions and the inability to reconcile differences at that time.
3. The HCP-HCs shall meet at least twice per year or as frequently as needed (when requested by any two members) to conduct business and resolve disputes.[1]
4. Decision Item documents (e.g., Statement of Agreement) shall be distributed to the HCP-HCs at least ten (10) business days before a meeting at which the Decision Item is voted upon. This provision can be waived by agreement of all HCP-HC Parties.
5. The Chair will distribute draft agendas with Decision Items at least ten (10) business days before each meeting.[1]
    a. Draft agendas with no Decision Items can be distributed seven (7) days before the meeting.
6. Draft meeting notes will be distributed to members of the HCP-HCs within fourteen (14) days of the next meeting.
    a. Revised draft minutes for approval will be distributed within seven (7) days of the next meeting.
7. All Study Plans and Reports prepared under the Anadromous Fish Agreements will be available for a 60-day review period unless otherwise approved by the Hatchery Committees.[1]

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[1] The identified protocol comes from the Anadromous Fish Agreement and Habitat Conservation Plans for the Wells, Rocky Reach, and Rock Island Hydroelectric Projects.

8. Dispute Resolution will follow the protocols and timelines defined in the HCPs.
9. Conflict of Interest: the latest Conflict of Interest Policy expired in January 2015.
10. Meeting logistics
    a. The monthly meeting location alternates between Chelan PUD Headquarters in Wenatchee, WA and Douglas PUD Headquarters in East Wenatchee, WA every other month, unless agreed otherwise.
    b. If a meeting is canceled, or the normal alternating meeting location is disrupted for any reason, the regular schedule will remain unchanged.

       For example:
       HC Jul Mtg: Douglas PUD
       HC Aug Mtg: Canceled
       HC Sep: Douglas PUD
    c. Decision Items are addressed first following the opening of the meeting (this is to accommodate Committees members who cannot attend the entire meeting).
    d. The order of Chelan PUD and Douglas PUD agenda items alternate every month (i.e., if one month Chelan PUD presents first and Douglas PUD second, next month Douglas PUD will present first and Chelan PUD second); other agenda items are listed in order they are received, and revolving agenda items are covered last.

2. Joint Sessions with the Priest Rapids Coordinating Committee Hatchery Sub-Committee (PRCC HSC)
    a. The HCP-HCs agreed to convene joint sessions with the PRCC HSC, as needed (i.e., when there are agenda items applicable and requiring participation from both the HCP-HCs and PRCC HSC).
    b. While discussion of shared agenda items may occur jointly, any items requiring Committees decision (i.e., Decision Items) will be voted upon separately in the respective Committees.
    c. Prior to joint HCP-HC/PRCC HSC sessions, it will be made clear at the onset of the discussion that the item is a joint discussion and all Parties are welcome to speak freely.
    d. Following joint HCP-HC/PRCC HSC sessions, both HCP-HC and PRCC HSC Parties will be provided with the draft meeting minutes for review, and will be provided the opportunity to comment. The final minutes will also be provided to both HCP-HC and PRCC HSC Parties for their respective administrative records.

3. HCP-HC Extranet Site and Distribution List Access
    a. The HCP-HC agreed on a system requiring HCP Coordinating Committees review and approval to provide non-HCP Reps/Alts access to HCP Extranet Sites and distribution lists. For example, if a WDFW non-HCP Rep/Alt requests access to the HCP Hatchery Committees Extranet Site, the WDFW HC Rep needs to pass the request to the WDFW CC Rep, who then needs to request CC approval).
    b. Historically, administrative access (i.e., Chair or support) has been granted without CC approval; however, is discussed with the CC at the next possible CC meeting.

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees	**Date:**	October 22, 2015
From:	Tracy Hillman, HCP Hatchery Committees Chairman		
Cc:	Sarah Montgomery		
Re:	Final Minutes of the September 16, 2015, HCP Hatchery Committees Meeting		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees meeting was held at Douglas PUD headquarters in East Wenatchee, Washington, on Wednesday, September 16, 2015, from 9:30 a.m. to 1:00 p.m. Attendees are listed in Attachment A to these meeting minutes.

ACTION ITEM SUMMARY

- Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) will provide the presentation titled "Wenatchee River Relative Reproductive Success Studies" (Attachment B) presented during today's meeting to Sarah Montgomery for distribution to the Hatchery Committees (Item II-B). *(Note: Andrew Murdoch sent the presentation to Sarah Montgomery on September 22, 2015, and she distributed it to the Hatchery Committees the same day.)*
- Matt Cooper will calculate hatchery replacement rates (HRR) for Winthrop National Fish Hatchery (NFH) for discussion during the next Hatchery Committees meeting on October 21, 2015 (Item III-A). *(Note: Bill Gale sent the HRR spreadsheet to Sarah Montgomery on October 19, 2015, and she distributed it to the Hatchery Committees the same day.)*
- Greg Mackey will develop an HRR calculation spreadsheet for discussion during the next Hatchery Committees meeting on October 21, 2015 (Item III-A). *(Note: Mackey sent the spreadsheet to Montgomery on October 13, 2015, and she distributed it to the Hatchery Committees the same day.)*
- The Hatchery Committees will discuss Objective 4 (HRR) of the prioritized 5-Year Hatchery Monitoring and Evaluation (M&E) Report objectives flagged for

Methow spring Chinook salmon during the next Hatchery Committees meeting on October 21, 2015 (Item III-A).

- Sarah Montgomery will update the 5-Year Hatchery M&E Report objectives flagged for Methow spring Chinook salmon and distribute the updated list to the Hatchery Committees for review (Item III-A). (Note: *Montgomery updated the flagged objectives document on October 14, 2015 and distributed it to the Hatchery Committees the same day.)*
- Keely Murdoch will discuss with Cory Kamphaus (Yakama Nation [YN]) the timing of passive integrated transponder (PIT)-tagging fish for the Goat Wall acclimated release (Item IV-A).
- The Hatchery Committees will discuss Goat Wall Acclimated Release during the next Hatchery Committees meeting on October 21, 2015 (Item IV-A).
- Tracy Hillman will request Craig Busack's attendance at the next Hatchery Committees meeting on October 21, 2015, for discussion of Goat Wall Acclimated Release (Item IV-A). (Note: *Hillman requested Busack's attendance on October 9, 2015 and received confirmation that Busack would attend on the same day.)*

DECISION SUMMARY

- There were no decisions approved during today's meeting.

AGREEMENTS

- There were no agreements during today's meeting.

REVIEW ITEMS

- There are no items that are currently out for review.

FINALIZED DOCUMENTS

- Sarah Montgomery sent an email to the Hatchery Committees on September 30, 2015, notifying them that the Final 2014 Douglas PUD and Grant PUD Hatchery M&E

Annual Report is now available for download from the Hatchery Committees Extranet site.

- Sarah Montgomery sent an email to the Hatchery Committees on September 30, 2015, notifying them that the Final 2016 Douglas PUD, Chelan PUD and Grant PUD Hatchery M&E Implementation Plan is now available for download from the Hatchery Committees Extranet site.
- Sarah Montgomery sent an email to the Hatchery Committees on October 5, 2015, notifying them that the Final 2016 Chelan PUD Hatchery M&E Implementation is now available for download from the Hatchery Committees Extranet site.

I. Welcome

A. Review Agenda, Review Last Meeting Action Items, Approve the August 28, 2015, Meeting Minutes (Tracy Hillman)

Tracy Hillman welcomed the Hatchery Committees and asked for any additions or changes to the agenda. The following revisions were requested:

- Alene Underwood requested switching the order of Items II-A and II-B, in order that the Water Rights and Drought Planning Update be discussed first.
- Bill Gale removed the U.S. Fish and Wildlife Service bull trout consultation update.

The Hatchery Committees reviewed the revised draft August 28, 2015, meeting minutes. Sarah Montgomery said there are several outstanding comments to be discussed, and the Hatchery Committees addressed these comments.

Hatchery Committees members present approved the draft August 28, 2015, meeting minutes, as revised.

Action items from the Hatchery Committees meeting on August 28, 2015, and follow-up discussions, were as follows *(note: italicized text below correspond to agenda items from the meeting on August 28, 2015):*

- *Mike Tonseth and Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) will develop a timeline for conducting genetic sampling for HCP program species (Item II-A).*

Murdoch said McLain Johnson (WDFW) will develop the timeline.

- *Sarah Montgomery will compile the 5-Year Hatchery Monitoring and Evaluation (M&E) Report objectives flagged for Methow spring Chinook salmon and distribute the compiled list to the Hatchery Committees for review (Item II-A*).
  Montgomery compiled the flagged objectives and distributed the list to the Hatchery Committees on September 4, 2015.
- *The Hatchery Committees will review and prioritize the 5-Year Hatchery M&E Report objectives flagged for Methow spring Chinook salmon during the next Hatchery Committees meeting on September 16, 2015 (Item III-A).*
- *Andrew Murdoch will keep the Hatchery Committees updated on the WDFW moratorium on drone hexacopter use (Item III-A).*
  Andrew Murdoch said meetings are ongoing and draft policies are being developed.
- *Keely Murdoch will discuss internally the Yakama Nation's (YN's) support to release approximately 18,000 mostly hatchery-by-hatchery (HxH) Methow spring Chinook salmon into Banks Lake (Item V-B).*
  Keely Murdoch followed up with Tom Scribner (YN) and distributed, via email, additional input on this discussion to the Hatchery Committees following the meeting on Friday, August 28, 2015. Keely Murdoch said Scribner provided YN support for releasing these fish into Banks Lake on a phone call with Tonseth.
- *The Hatchery Evaluation Technical Team (HETT) will reconvene on Thursday, October 29, 2015, at 9:00 a.m., at the WDFW Research Office in Wenatchee, Washington, to continue finalizing the Hatchery M&E Plan appendices (Item VI-A).*
- *Craig Busack will provide the 3-Population Gene Flow Planning Tool discussed during today's meeting to Sarah Montgomery for distribution to the Hatchery Committees (Item VII-A).*
  Busack provided the tool to Montgomery following the meeting on August 28, 2015, which Montgomery distributed to the Hatchery Committees that same day.
- *Chelan PUD will provide an update on water for acclimation facilities during the next Hatchery Committees meeting on September 16, 2015 (Item II-A).*
- *Sarah Montgomery will update the Hatchery Committees Meeting Protocols document to reflect the Hatchery Committees agreement regarding the HCP Plan*

review period, and will distribute the updated document to the Hatchery Committees (Item IX-A).

Montgomery updated the protocols and distributed the updated document to the Hatchery Committees on September 4, 2015.

II. Chelan PUD

A. Water Rights and Drought Planning Update (Ian Adams)

Alene Underwood introduced Ian Adams, Chelan PUD's hatchery operations maintenance coordinator. Underwood said Adams is responsible for Chelan PUD's hatcheries and it is his job to ensure hatcheries and acclimation sites have enough water. Adams discussed three acclimation sites: Similkameen Pond; Chiwawa Ponds; and Chelan Falls Ponds. Adams said, at Similkameen Pond, 75% of the instream flow requirements are being met, and thus the ponds will be filled from the south well supply. Adams said the other source of water is surface water intake, which will be used after the initial consumptive fill. Adams said the current schedule has fish arriving in mid-October.

At Chiwawa Ponds, the two sources of water are the Wenatchee and Chiwawa rivers. Adams said Chelan PUD planned to move spring Chinook salmon to Chiwawa Ponds for acclimation the second week of October, which is one to two weeks later than normal because a construction project pushed the schedule back. Adams said 46% of the minimum instream flow requirements are currently being met, but having expected this, the ponds were filled in May, and a maintenance flow has been running. Adams said once the fish are transferred into the facility, operation of the facility will not be affected by minimum instream flows.

Adams said Chelan Falls ponds are not subject to minimum instream flow requirements, and the facility expects to receive fish around November 1, 2015.

B. Steelhead Relative Reproductive Success Study (Mike Ford/Andrew Murdoch)

Alene Underwood said Chelan PUD has an objective in its HCPs to study the relative reproductive success of steelhead. Underwood said, in 2009, a Statement of Agreement was put together for 4 years of ongoing work that would satisfy obligations as agreed on by the

Hatchery Committees. Underwood said Andrew Murdoch's and Mike Ford's (National Marine Fisheries Service) presentation is an update on this research.

Andrew Murdoch and Ford shared a presentation titled, "Wenatchee River Relative Reproductive Success Studies" (Attachment B). Andrew Murdoch said, after this meeting, he and Ford will produce a final report with updated analysis. The study objective is to measure the relative reproductive success 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 measureable biological characteristics. The presentation included an overview of the study design, comparisons to other relative reproductive success (RRS) studies, and discussions covering differences in traits (migration timing, age at maturity, size at age, fecundity, spawn timing, and spawning location) and RRS, including the influence of biological traits and parental origin. Questions and comments were discussed as described in the following subsections.

Background (Slide 3 of Attachment B)

Bill Gale asked what the proportion of natural-origin broodstock (pNOB) was in the Little Sheep Creek program. Andrew Murdoch replied it was greater than 50%, but the Little Sheep Creek study was more of a run-of-the-river experiment, and they did not control the proportion of hatchery-origin spawners (pHOS) or escapement at the weir.

Study Design (Slide 5 of Attachment B)

Andrew Murdoch said Ford also genotyped brood years 2006 and 2007, and many of the hatchery fish were genotyped to parents. Andrew Murdoch said steelhead were collected as smolts in smolt traps or rearing areas using hook-and-line sampling.

Sex Ratios (Slide 9 of Attachment B)

Andrew Murdoch said ultrasound was used to determine sex ratios of sampled fish, and overall, male hatchery steelhead return to Tumwater Dam in greater numbers than male natural steelhead. Underwood asked if all the steelhead sampled were scanned with ultrasound. Ford replied steelhead from brood year 2008 were not scanned with ultrasound, but all others were. Ford clarified that parentage analysis was completed without initially assigning a sex to each fish. Ford said a small number of fish were assigned to two putative parents of the same sex; to resolve these assignments, adjustments were made for sexing errors.

Ocean Age (Slides 10-11 of Attachment B)
Catherine Willard asked Andrew Murdoch to include information on freshwater age of male and female steelhead. Andrew Murdoch replied the average freshwater hatchery age is just more than 1 year, and natural-origin steelhead average 2.2 years. Andrew Murdoch added that there were a few fish that held over, but 98% of the hatchery steelhead were yearling emigrants.

Priest Rapids Dam Run Timing from 2007 to 2010 (Slide 16 of Attachment B)
Andrew Murdoch said there is no difference in run timing to Priest Rapids Dam; the trend observed at Tumwater Dam is not evident downstream. Andrew Murdoch suggested that differences in imprinting may be causing this variance.

Potential Egg Deposition (Slide 18 of Attachment B)
Andrew Murdoch commented that he and Ford have not yet determined how to correct for the differences due to 1 year where there were more natural eggs in spawning beds, versus 3 years where hatchery-origin eggs were more prominent.

Spawner Distribution (Slides 24-25 of Attachment B)
Underwood asked if all of the steelhead in this analysis were PIT-tagged. Andrew Murdoch replied yes, nearly all of the fish were PIT-tagged.

Gale asked if Chiwaukum Creek consistently had more natural spawners, and suggested that natural-origin steelhead might sense Chiwaukum Creek is good habitat for spawning. Andrew Murdoch responded that hatchery-origin steelhead are not planted in Chiwaukum Creek; it is a cold-water tributary, and wild steelhead generally spawn in the lower reaches.

Todd Pearsons asked if the spawner distributions reflect the number and type of steelhead stocked in those locations. Andrew Murdoch replied that he would have to break the data into cross-type groups in order to answer that question. Release location is based on cross-type. Andrew Murdoch said, for example, most of the hatchery-origin wild by wild (WxW) steelhead were released into Nason Creek, and most of the hatchery by wild (HxW) steelhead were released into the Upper Wenatchee River or the Chiwawa River. Ford added that this analysis has also been done for Chinook salmon data, so it should be possible for steelhead, except in locations where cross-types are released in two areas. Underwood said the analysis does not account for fish that did not return to the Wenatchee River, merely spawner distribution of those fish that did return. Mike Tonseth added the fish are not strays, because they returned to the Wenatchee Basin. Andrew Murdoch said adult management caused differences between 2011 and previous years; hatchery fish occur primarily in Nason Creek because that has been the primary cross-type allowed to spawn there naturally.

Pedigree Assignment Rates (Slide 26 of Attachment B)

Ford noted that steelhead spawning and rearing occurs below Tumwater Dam. Pearsons asked if any resident males were collected by line sampling or if all parent fish were collected at Tumwater Dam, and noted there is usually a high proportion of un-typed males. Ford replied the study only included anadromous steelhead sampled at Tumwater Dam, and Andrew Murdoch noted there are very few wild rainbow trout in the area.

Progeny Distribution by Cross (Slides 27-28 of Attachment B)

Ford noted the progeny distribution is all based on juveniles (ages 1 and 2 combined), and there are no adult-to-adult measurements; however, there is usually a good correlation between the two.

Relative Reproductive Success by Year and Cross (Slide 29 of Attachment B)

Gale noted, for male steelhead, in 2008 and 2009, there is little observable difference in RRS between HxW and WxW hatchery-origin fish. Gale asked if this is a result of male fish dominating spawning. Ford replied the general opinion is hatchery males have lower RRS than hatchery females. Willard asked why the program no longer creates HxW crosses. Andrew Murdoch replied the program has evolved into a conservation and safety net program, so there is no use for HxW crosses.

Factors Influencing the Number of Progeny (Slides 30-33 of Attachment B)

Ford commented it may be worthwhile to assess spawning location as a factor influencing the number of progeny. Tracy Hillman asked if there is a correlation between age and fork length. Ford replied yes; 2-salt steelhead are on average larger by 10 centimeters. Ford noted if the variables are correlated, using one variable instead of both age and fork length may be useful in the negative-binomial Generalized Linear Model that was used to analyze the data.

Gale asked if the very low numbers of HxH and HxW fish allowed to spawn in 2011 confounded analysis of these results. Ford replied a year term is used in the model in order to remove average differences among years, which is an artifact of sample size. Ford said the study has hatchery fish for only 2 years (2008 and 2009), so if there is another variable it would not be possible to account for it. Gale suggested the analysis may be overemphasizing the negative effect on hatchery fish. Andrew Murdoch used 2011 as an example where there might be an unknown effect of spawning location because the majority of WxW fish went to Nason Creek.

Wenatchee vs. Other Steelhead RRS Studies (Slide 36 of Attachment B)

Kirk Truscott asked if the Hood River study was an adult-to-adult study. Ford said yes, and this is an important caveat because the studies are assessing different life stages, and some places do have large differences between juvenile and adult steelhead RRS.

General Comments

Greg Mackey noted the study findings indicate that programs are working, because WxW hatchery-origin fish have a similar RRS to wild fish. Mackey asked what risks remain for operating hatchery programs for WxW fish, and if there is a net demographic boost. Ford replied it seems one could calculate the demographic risk versus genetic benefit of the hatchery and determine if it is worth taking fish out of the wild in order to keep hatchery programs going. Ford said one key to determining the risks in this situation is understanding why HxW crosses have such a decline in RRS compared to WxW crosses. Ford said uncertainties in the genetics and RRS of these fish mean it is not realistic yet to say there is zero risk. Keely Murdoch said Ford's comments provide support for the argument that spawning distribution should be examined more closely. Keely Murdoch said sometimes fish are released in different locations based on the crosses, so that can affect RRS. Underwood

said fish are stocked based on crosses, but the location is usually the same, with WxW fish being stocked in Nason Creek. Andrew Murdoch added fish stocking based on crosses was consistent throughout this study, but now WxW fish go into Chiwawa River.
Keely Murdoch suggested that if the fish are all stocked in different locations, they may have homing fidelity, which affects the results; the release locations for these fish may not be preferred habitat for steelhead. Andrew Murdoch said data from 2011 would be helpful in addressing this question because there are only WxW hatchery-origin steelhead, and homing fidelity could be assessed based on release location.

Gale said unmonitored steelhead production below Tumwater Dam accounts for some of the unknown pieces of this study, but resident populations may also contribute anadromous adults to the population. Andrew Murdoch said resident areas were not heavily surveyed, and the only spawning overlap found was in Upper Peshastin Creek. Andrew Murdoch said above Tumwater Dam, there are some resident fish above anadromous areas, which may contribute a small anadromous component; however, the fish have not been studied or tagged because this scope of work is not included in the survey.

Truscott noted some of the juvenile samples came from angling below Tumwater Dam. Andrew Murdoch said there are few juveniles in the spawning areas because most of the fish spawn above Tumwater Dam and juveniles rear below it. Andrew Murdoch said all of the fish that spawned in Icicle Creek and other tributaries could migrate to the rearing area where sampling occurred in Tumwater Canyon. Andrew Murdoch said there were six riffles containing approximately 90% of the juvenile steelhead sampled, and he suggested there may be a density-dependent issue in Tumwater Canyon.

Pearsons asked why the comparisons were limited to two other RRS studies.
Andrew Murdoch said he included the most similar studies for comparison. Ford said those two studies used for comparison were also looking at supplementation programs. Ford added that for RRS numbers, there is no big observable difference between species, but there is a large observable difference between broodstock types. Ford said, especially for steelhead, hatchery broodstock may have an even greater difference from natural broodstock because hatchery fish are forced into a 1-year life cycle, which is not natural.

Gale commented at Winthrop NFH that spawning differences between adults from a 1- and 2-year-old smolt program are being compared in order to find out which is more successful. Gale said facility constraints resulted in going to a 2-year program.

Truscott asked how the number of juveniles produced per number of female or male fish in Wenatchee Basin compares to other systems. Truscott asked if there is a genetic risk associated with effective population size if the target escapement is set at 1,100, but only 20% of the fish are producing offspring. Ford said most fish in RRS studies produce zero recordable offspring, sometimes because they did not spawn, and sometimes because they produced zero offspring, and sometimes because they were not sampled. Ford said huge variance in reproductive output in individuals is a general characteristic of fish populations, so it is not unnatural, though it may be a concern for effective population size. Ford added that for wild fish and WxW hatchery-origin fish, approximately 50% of adult fish produced zero offspring. Andrew Murdoch emphasized that this study was not able to sample to the degree needed to capture offspring from all possible families because not all places where juveniles rear were sampled. Andrew Murdoch said performing a RRS study in a truly natural environment (a control or reference stream with a history of no hatchery fish) would be interesting for comparison, because wild fish and hatchery fish may be performing similarly, but both may be performing poorly compared to an unsupplemented reference population.

Ford asked if there is an absolute estimate of the number of smolts leaving the Wenatchee River. Andrew Murdoch said there is, but there are issues with the data because of problems with trap efficiency. Andrew Murdoch said they are multi-year class fish with documented trap avoidance issues, so during migration, the trap efficiency is 1% or less; during periods of lower water, but when smolts tend to be not migrating (and trap efficiency is higher), steelhead juveniles actively move around (avoid) the trap.

C. Spring Chinook Spawning Ground Surveys (Catherine Willard)

Catherine Willard said fires in the Chiwawa drainage are burning, but access is now available to the upper Chiwawa River (access was not available due to wildfires in the area), and spawning ground surveys can be performed. Willard said although the data have not been analyzed, spawning is observed to be later than last year. Tonseth said peak spawning for spring Chinook salmon in the hatchery occurred last week. Willard responded that peak spawning may have been missed in the upper Chiwawa during the time period the survey crew did not have access due to the wildfire.

III. Joint HCP Hatchery Committees/PRCC HSC

A. Five-Year Hatchery M&E Review Planning – Review and Prioritize Flagged Objectives (Greg Mackey)

Greg Mackey explained that the Methow spring Chinook Review of 5-Year Annual Report Outline Flags are organized by the date of the meeting, the content of the objective, and any flagged items or comments for further discussion. The Hatchery Committees reviewed the flagged objectives and comments. Questions and comments were discussed as described in the following section.

Mackey said one comment from Objective 1 was that the Twisp River program could be operated as a conservation program, the Chewuch River left un-supplemented, and the Methow River managed as a typical hatchery program. Mackey said the Hatchery Committees had flagged Objective 4 for discussion of HRR targets and should put available data into context in order to understand the HRR targets. Mackey said Objective 7 was flagged for further discussion because there is not much information about freshwater productivity, and it remains unknown if hatchery fish influence productivity. Mackey added smolt-trap population-estimate data are the current source of data for this objective, but the population estimates are not reliable and not many years were available for analysis for this 5-year report. Mackey said there was a lot of variance in the regression graph because data are lacking. Tracy Hillman said there are few years of data on juvenile productivity.
Bill Gale asked if the question about productivity is not confounded by other factors contributing to juvenile productivity in the basin, such as climate change and habitat restoration. Mackey said pHOS does not vary much throughout the years of data, so there is very little contrast in the data, making it hard to distinguish the effects of pHOS on productivity. Gale said pHOS will change with adult management, so it will become easier to distinguish. Hillman suggested that as pHOS changes with adult management, greater

contrast in pHOS will allow a better evaluation of the effects of pHOS on juvenile productivity

Mackey said Objectives 1 and 7 are linchpins because they address whether the hatchery program has a positive effect on the population. Mackey said Objectives 1 and 7 cannot necessarily be used directly for management decisions, but they are big signals, and other objectives could help inform what is going on with Objectives 1 and 7. Hillman said several changes have already been made to the hatchery program that will affect Objectives 1 and 7.

Mackey said, for Objective 2, Keely Murdoch pointed out the Goat Wall evaluation study currently underway provides data for looking at spawner distribution. Mackey said the data suggested that there may also be a downstream shift in mean spawning location of natural-origin recruits, but this seems to be an artifact of the graph in the 5-year report. Mackey said, for Objective 5 (straying, or non-target-returning), the Hatchery Committees discussed techniques to evaluate site fidelity. Mike Tonseth said the first set of data on return rates to Methow Fish Hatchery will inform fidelity, and after spawning began this year, several hundred additional fish have been collected through the Methow Hatchery Trap. Mackey said some fish that stray into the Methow River come from the Chewuch River, and one way to solve this would be to not put fish in the Chewuch River. Keely Murdoch said YN does not support terminating supplementation in the Chewuch River, rather, they desire higher homing fidelity and propose we address the fidelity problem. Gale said Objective 5 addresses site fidelity, so a fish returning to the Methow River should not be called a stray because Methow Basin is a composite program. Keely Murdoch said the fish would not be called a genetic stray, but there is poor site fidelity for hatchery fish released in the Chewuch River. Gale asked whether site fidelity belongs in Objective 5. Gale said fish not returning to target areas should be addressed, but it might not fall under Objective 5. Hillman said successful homing is discussed under Objective 5 in the annual reports, so the terminology may be confusing; however, breaking out site fidelity as a separate objective might be more confusing. Tonseth confirmed in the context of a specific supplementation strategy, like for the Chewuch River, that if fish released in the Chewuch River do not return, it is a site fidelity and a straying issue. Tonseth said it is not a genetic stray, but it is still contradictory to management practice. Hillman said, in the recovery plan, Chewuch is split out as a separate stock, so Craig Busack's feedback will be needed to determine whether this is a genetic issue. Mackey said there might not be management issues if an adequate number of fish are returning to the Chewuch River despite some Chewuch releases also returning to the Methow River, so a target should be developed for how many fish should return to fulfill the intent of the release strategy.

Hillman said that the topics flagged so far as high priorities for continued discussion are HRR, spawning distribution, and homing. Alene Underwood said the purpose of today's discussion is to prioritize which objectives should be highlighted for further discussion in the coming months. Mackey said, for Objective 6, target size at release of juveniles should be addressed in terms of early maturation and survival. Gale said, from the Winthrop NFH perspective, Winthrop stocks should be included or studied concurrently for genetics. Mackey said that samples are gathered from all populations in a region, an outgroup is also collected, and then genetic diversity (Fst) and population structure analyses are performed. Tonseth said the genetic analysis addresses species, not programs, so all programs for one species should be studied at once. Tom Kahler said, for spring Chinook salmon, the analyses were all in separate reports for separate rivers. Tonseth said it might be simpler to have all analyses in one report, but it may have been contracted out separately in the past. Todd Pearsons asked if Busack had a concern about the frequency of monitoring or the variables being monitored. Tonseth clarified in order to detect genetic differences, 5 years may be too frequent, but the variables being monitored were okay. Catherine Willard said Busack's opinion was that Fst should still be monitored, but it is not a concern at the moment. Tonseth said, for Objective 6, an evaluation of the coefficient of variation should be included in the next round of analyses. Kirk Truscott said a size-at-release was identified, but it might not be the most appropriate value. Hillman said accurate length-weight relationships with associated condition factors have been obtained. Tonseth said corrections should have been made in appendices to the 5-year monitoring plan. Mackey said length-weight relationships were calculated for the 5-Year Hatchery M&E Report, but it may or may not be in the appendix to the plan.

Gale asked if there are enough PIT-tag data to assess the relationship between length-weight and survival to Rocky Reach Dam. Tonseth replied no because length and weight are measured at PIT tagging, well before the fish are released.

Hillman summarized the objectives flagged for further discussion and topics for discussion within those objectives:

- Objective 2 – Spawning distribution of wild and hatchery fish
- Objective 4 – Hatchery replacement rates
- Objective 5 – Straying and homing
- Objective 6 – Size-at-release of juveniles
- Objective 7 – Freshwater productivity (review methods)

Gale suggested Objective 4 would be a good objective to discuss first. Pearsons asked whether each objective will be discussed separately or whether there should be a strategy for addressing more than one at a time. Tonseth said once an objective is discussed, insights can be applied to later objectives, but not all need to be discussed at once. Kahler asked whether every hatchery program measures HRR. Gale replied all of the hatchery programs collect the data necessary to calculate HRR. Kahler said, for the Upper Columbia River spring-run Chinook salmon evolutionarily significant unit, HRR for Winthrop NFH, Chiwawa Fish Hatchery, and Leavenworth NFH should be used for analytical context. Kahler asked whether Yakima/Klickitat and Cle Elum hatcheries should be included. Mackey said it can be problematic to compare to other facilities because coded wire tag expansion was done differently at different locations, and differential harvest results in noise in the data. Gale asked why HRR is an important statistic and what it informs that SAR does not. Mackey said HRR represents adult-to-adult data and it is convenient, and also allows comparing to wild "NRR". Gale said Matt Cooper will calculate HRR for Winthrop NFH for discussion during the next Hatchery Committees meeting on October 21, 2015.

Mackey said there is an escapement target for Methow spring Chinook salmon, and HRR can be calculated for the production of a set number of fish. Mackey said one approach for calculating an HRR target is to establish the number of hatchery returns needed based on escapement goals, and then calculate HRR using the program size. This would provide an

HRR target that is based on management goals and the program size. Mackey said he will develop an HRR calculation spreadsheet for discussion during the next Hatchery Committees meeting on October 21, 2015. Hillman said the HRR appendix to the 5-Year M&E Implementation Plan may be useful to the discussion of Objective 4. Gale asked what the schedule is for reviewing the flagged objectives. Underwood said objectives through the end of 2015 will be reviewed in order to keep with the timeline. Underwood clarified that in the new 5-year plan, straying is discussed in Objective 6.

The Hatchery Committees will discuss Objective 4 (HRR) of the prioritized 5-Year Hatchery M&E Report objectives flagged for Methow spring Chinook salmon during the next Hatchery Committees meeting on October 21, 2015.

Sarah Montgomery will update the 5-Year Hatchery M&E Report objectives flagged for Methow spring Chinook salmon and distribute the updated list to the Hatchery Committees for review.

IV. Yakama Nation

A. Goat Wall Acclimated Release

Keely Murdoch said, according to the Goat Wall Acclimation Plan, 2016 is supposed to be the first year of acclimated releases at Goat Wall. Keely Murdoch said that Chelan and Douglas PUDs requested YN have its own ESA permit coverage for the releases. Craig Busack had previously written a letter extending Permit 1196 for the PUDs, and YN has added a proposed appendix to the Hatchery and Genetic Management Plan. Keely Murdoch said with Busack not in attendance, it will be hard to have this discussion, but YN is not sure how to get permit coverage for Goat Wall acclimated release. Keely Murdoch emphasized that this is a potential issue and requested this agenda item be discussed again at the October 21, 2015, Hatchery Committees meeting with Busack in attendance. Tracy Hillman said he would request Busack's attendance at the next meeting. Sarah Montgomery said she will add this item to the agenda for the next meeting. Todd Pearsons asked when the fish for the acclimated release were PIT-tagged, and stated that it would be good to know the size of fish at the time of their release. Keely Murdoch said she is not sure whether they were PIT-tagged or when, but YN could still sample some of the fish to collect size information. Pearsons said it would be good to be able to tie an individual length to survival and asked if there are any hatchery constraints preventing PIT-tagging and measuring the fish in February. Keely Murdoch replied that she will discuss Pearsons' suggestion with Cory Kamphaus. Bill Gale said personnel who PIT-tag and measure the fish may be busy PIT-tagging fish at other facilities during that time period.

Gale asked whether the National Marine Fisheries Service (NMFS) is still planning on moving forward with a change in representation for the Hatchery Committees.
Mike Tonseth replied that NMFS is filling some positions. Alene Underwood said the eventual plan is for NMFS to have a change in representation for the Hatchery Committees, but the timeline is unknown.

V. Hatchery Evaluation Technical Team

A. Hatchery Evaluation Technical Team (HETT) Update (Greg Mackey/Catherine Willard)

Tracy Hillman said the HETT will reconvene on Thursday, October 29, 2015, at 9:00 a.m., at the WDFW Research Office in Wenatchee, Washington, to continue finalizing the Hatchery M&E Plan appendices. Bill Gale said Matt Cooper might not be available.

VI. HCP Administration

A. Next Meetings

The next scheduled Hatchery Committees meetings are on October 21, 2015 (Chelan PUD), November 18, 2015 (Douglas PUD), and December 16, 2015 (Chelan PUD).

List of Attachments

Attachment A	List of Attendees
Attachment B	Wenatchee River Relative Reproductive Success Studies

Attachment A
List of Attendees

Name	Organization
Tracy Hillman	BioAnalysts, Inc.
Sarah Montgomery	Anchor QEA, LLC
Alene Underwood*	Chelan PUD
Catherine Willard*	Chelan PUD
Ian Adams†	Chelan PUD
Greg Mackey*	Douglas PUD
Tom Kahler*	Douglas PUD
Todd Pearsons	Grant PUD
Mike Ford	National Marine Fisheries Service
Bill Gale*	U.S. Fish and Wildlife Service
Mike Tonseth*	Washington Department of Fish and Wildlife
Andrew Murdoch	Washington Department of Fish and Wildlife
Kirk Truscott*	Colville Confederated Tribes
Keely Murdoch*	Yakama Nation

Notes:
* Denotes Hatchery Committees member or alternate
† Joined by phone

Wenatchee River Relative Reproductive Success Studies

Michael Ford (NOAA)
Andrew Murdoch (WDFW)

Acknowledgements

Initial funding for this study was provided by NOAA, but CCPUD funded the majority of the work as part of their requirements under the Rock Island and Rocky Reach HCPs. WDFW MGL provided broodstock genotypes that greatly added to the study and were also funded by CCPUD under their Hatchery M & E program.

Background

- Hood River RRS Studies (Araki 2008)
  - Adult life stage only
  - Domesticated programs
    - Summer run = 31-45%
    - Winter run = 6-11%
  - Local broodstock (winter run)
    - 1st Gen(e.g., W x W) = 85%
    - 2nd Gen (e.g., H x W) = 38%
- Little Sheep Creek (Bernston et al. 2011)
  - Adult and juvenile life stages
  - Hatchery program started in 1982 uses both hatchery and wild broodstock
  - RRS = 30 to 60% no difference between life stages

Study Objective

- Measure the relative reproductive success of hatchery-origin steelhead in the natural environment
- Determine the degree to which any differences in reproductive success between hatchery and natural steelhead can be explained by measurable biological characteristics

Study Design

- 4 brood years (2008 – 2011)
  - – Adult (parents) sampled at Tumwater Dam
    - – W; WW; WH; HH; UH
  - – Juveniles (progeny) sampled at smolt traps and rearing areas
  - – Multiple juvenile life stages (parr and smolt)
    - Age 1 (parr and smolt)
    - Age 2 (parr and smolt)

Agenda

- Differences in traits (Andrew)
  - Migration timing
  - Age at maturity
  - Size at age
  - Fecundity
  - Spawn timing
  - Spawning location
- Relative Reproductive Success (Mike)
  - Overview
  - Influence of biological traits
  - Influence of parental origin

Attachment B

Steelhead at Tumwater Dam

Brood Year	Hatchery	Wild	Total	% of Run Escapement	Run escapement
2008	842	454	1296	0.999	1297
2009	1196	349	1545	0.998	1548
2010	1456	776	2232	0.997	2238
2011	312	811	1123	0.990	1134
All years	3806	2390	6196	0.997	6217

Attachment B

Hatchery/Wild Ratios

Brood Year	Sex	Hatchery	Wild	H/W Ratio
2008	**All**	**842**	**454**	**1.85**
	Male	580	252	2.30
	Female	262	202	1.30
2009	**All**	**1196**	**349**	**3.43**
	Male	549	167	3.29
	Female	647	182	3.55
2010	**All**	**1456**	**776**	**1.88**
	Male	885	391	2.26
	Female	571	385	1.48
2011	**All**	**312**	**811**	**0.38**
	Male	171	325	0.53
	Female	141	486	0.29

Attachment B

Sex Ratios

Year	Sex	Hatchery			Natural	
		Number	M:F		Number	M:F
2008	F	252	2.15:1.0		207	1.33:1.0
	M	542			276	
2009	F	634	0.86:1.0		181	0.93:1.0
	M	544			168	
2010	F	565	1.56:1.0		385	1.02:1.0
	M	884			392	
2011	F	140	1.23:1.0		481	0.67:1.0
	M	172			322	
All	F	1,591	1.35:1.0		1,254	0.92:1.0
	M	2,142			1,158	

Male hatchery steelhead return in relatively greater abundance than male natural steelhead

Attachment B

Ocean Age (Males)

Salt age	HH	HW	WW	Wild
1	66	729	576	657
2	35	254	299	453
1	0.65	0.74	0.66	0.59
2	0.35	0.26	0.34	0.41

Male hatchery steelhead have a younger ocean age

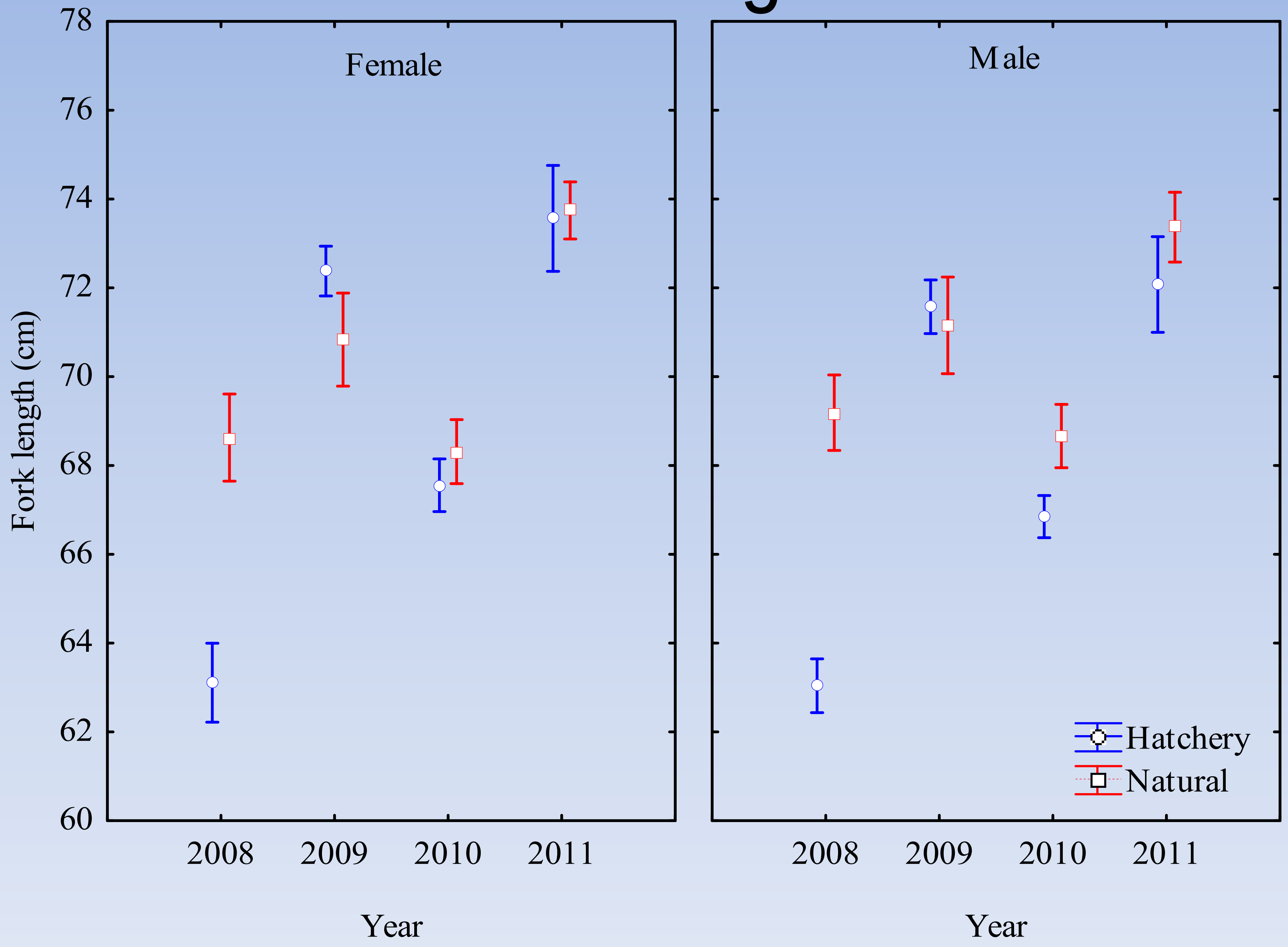
Ocean Age (Females)

Salt age	HH	HW	WW	Wild
1	21	338	226	421
2	58	397	433	833
1	0.27	0.46	0.34	0.34
2	0.73	0.54	0.66	0.66

Female hatchery steelhead have a more similar ocean age

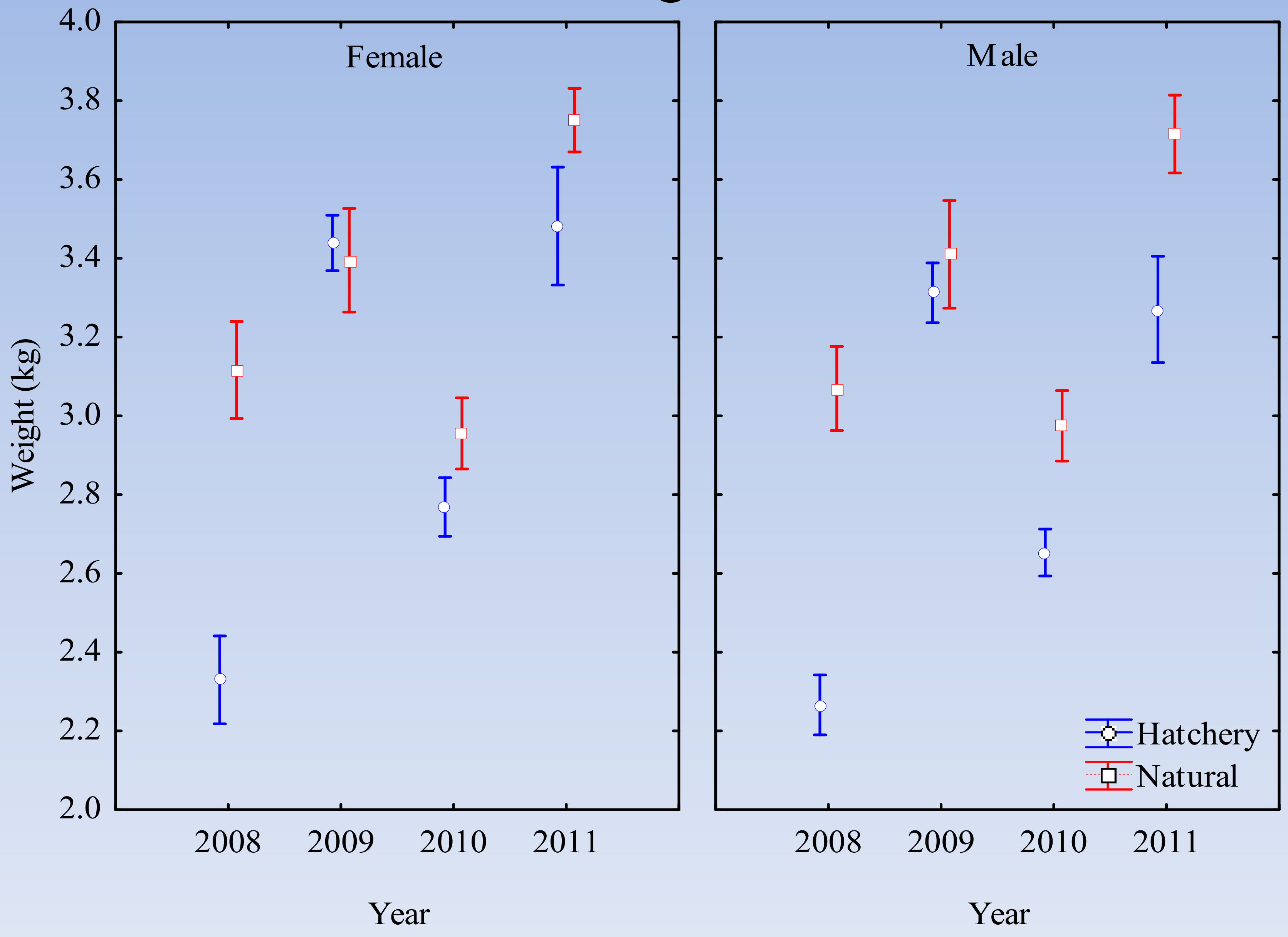
Attachment B

Fork Length

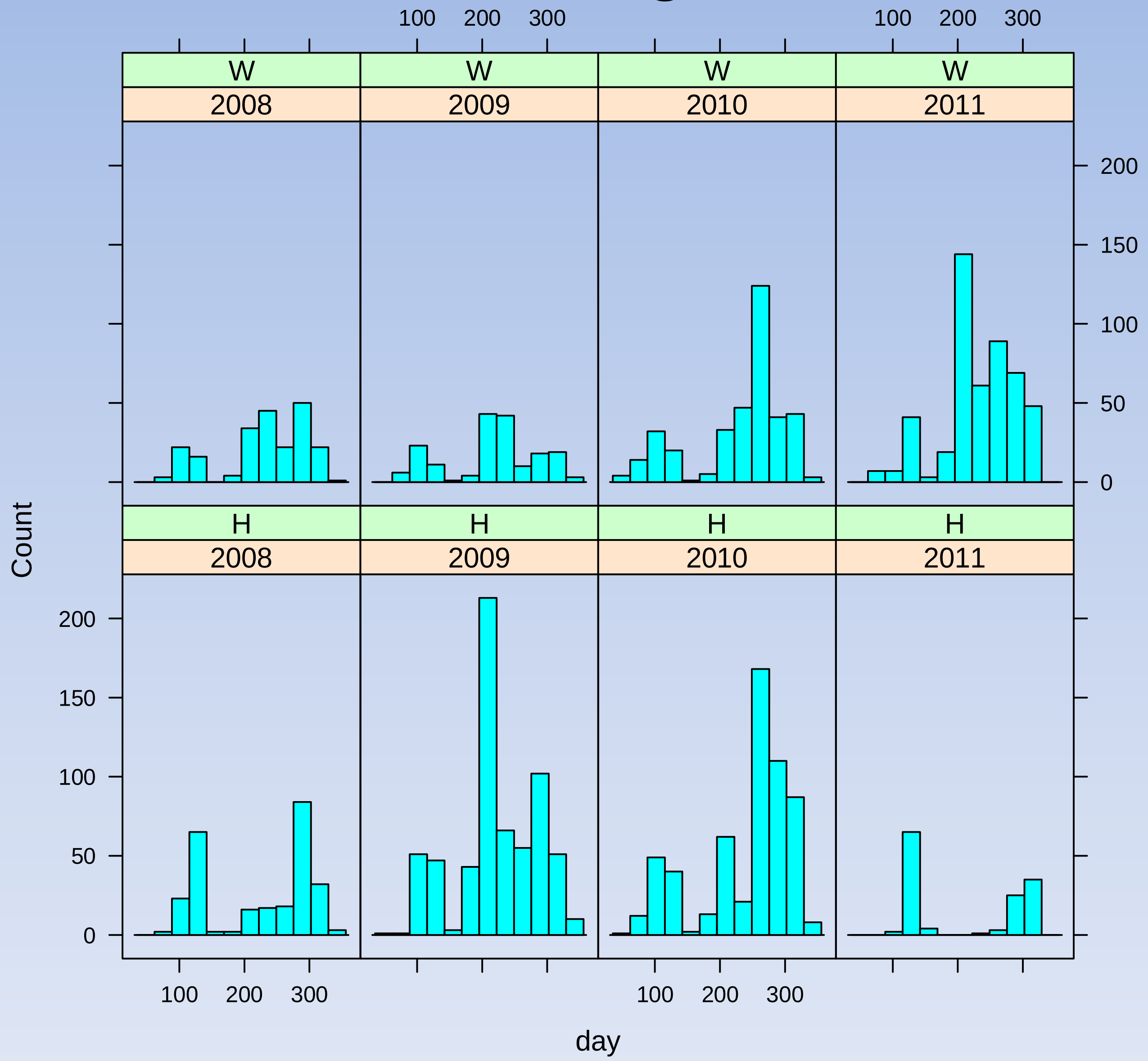


Attachment B

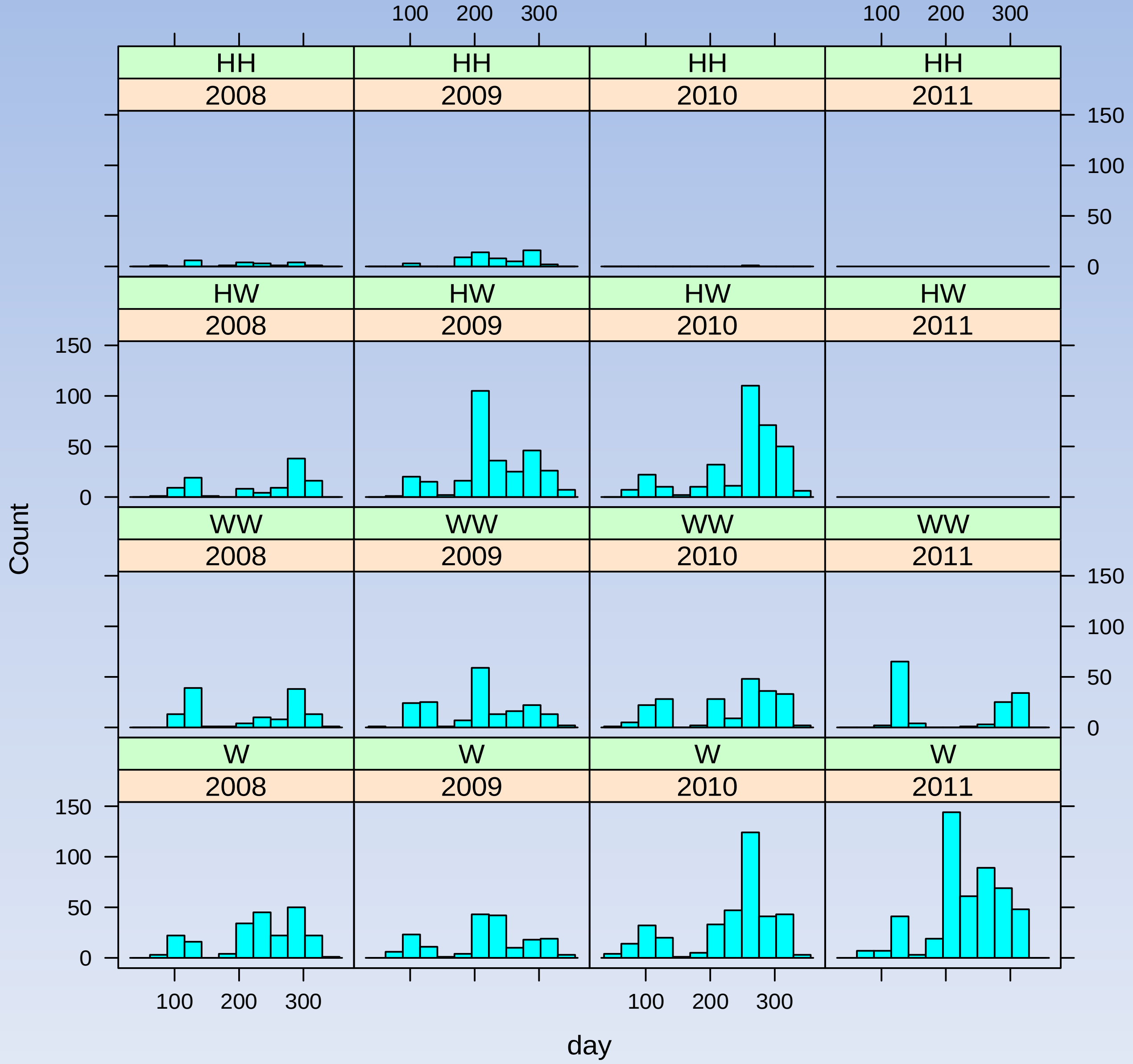
Weight



Arrival Timing - females



Arrival Timing - females



13% spring

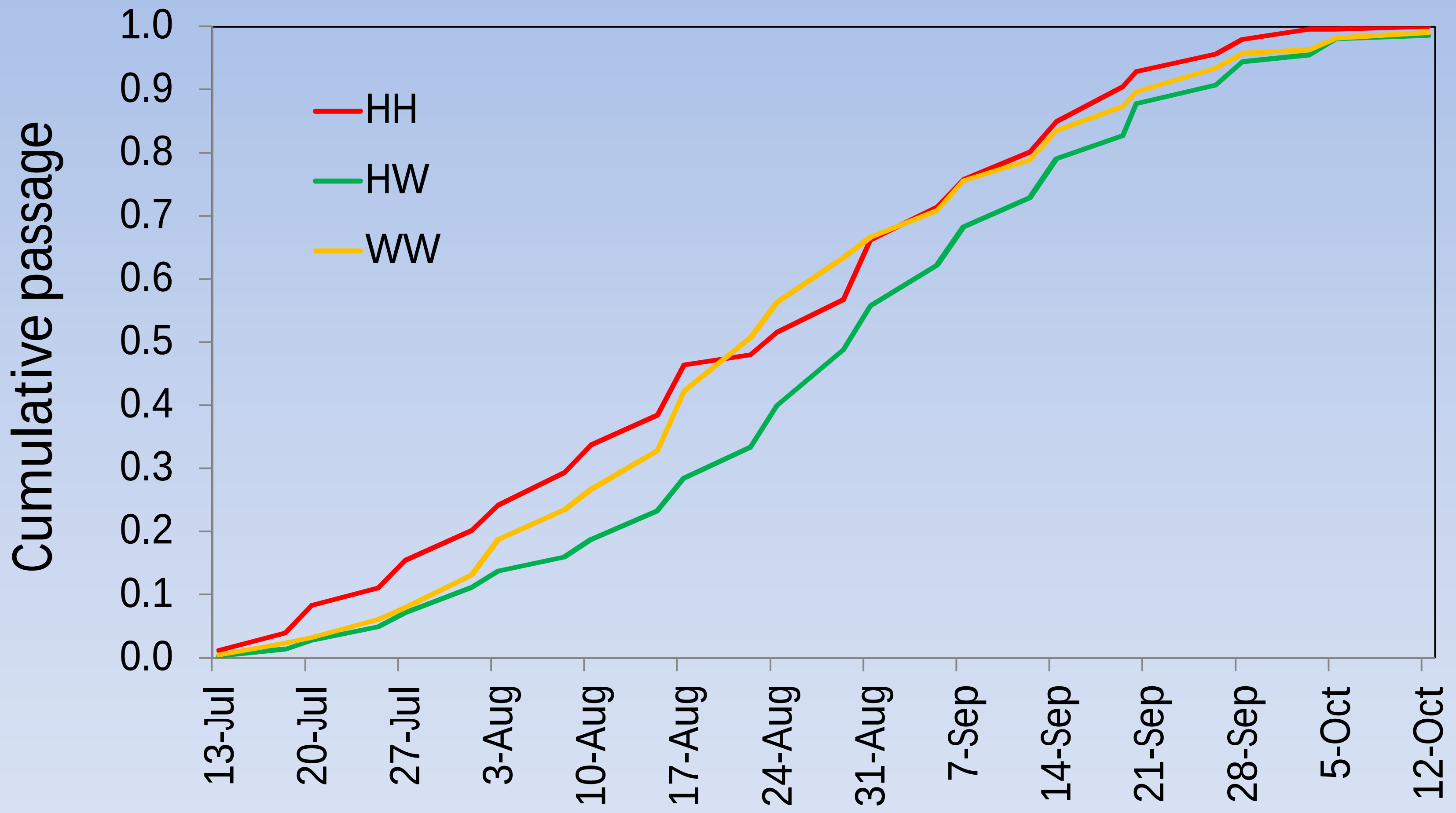
15% spring

35% spring

17% spring

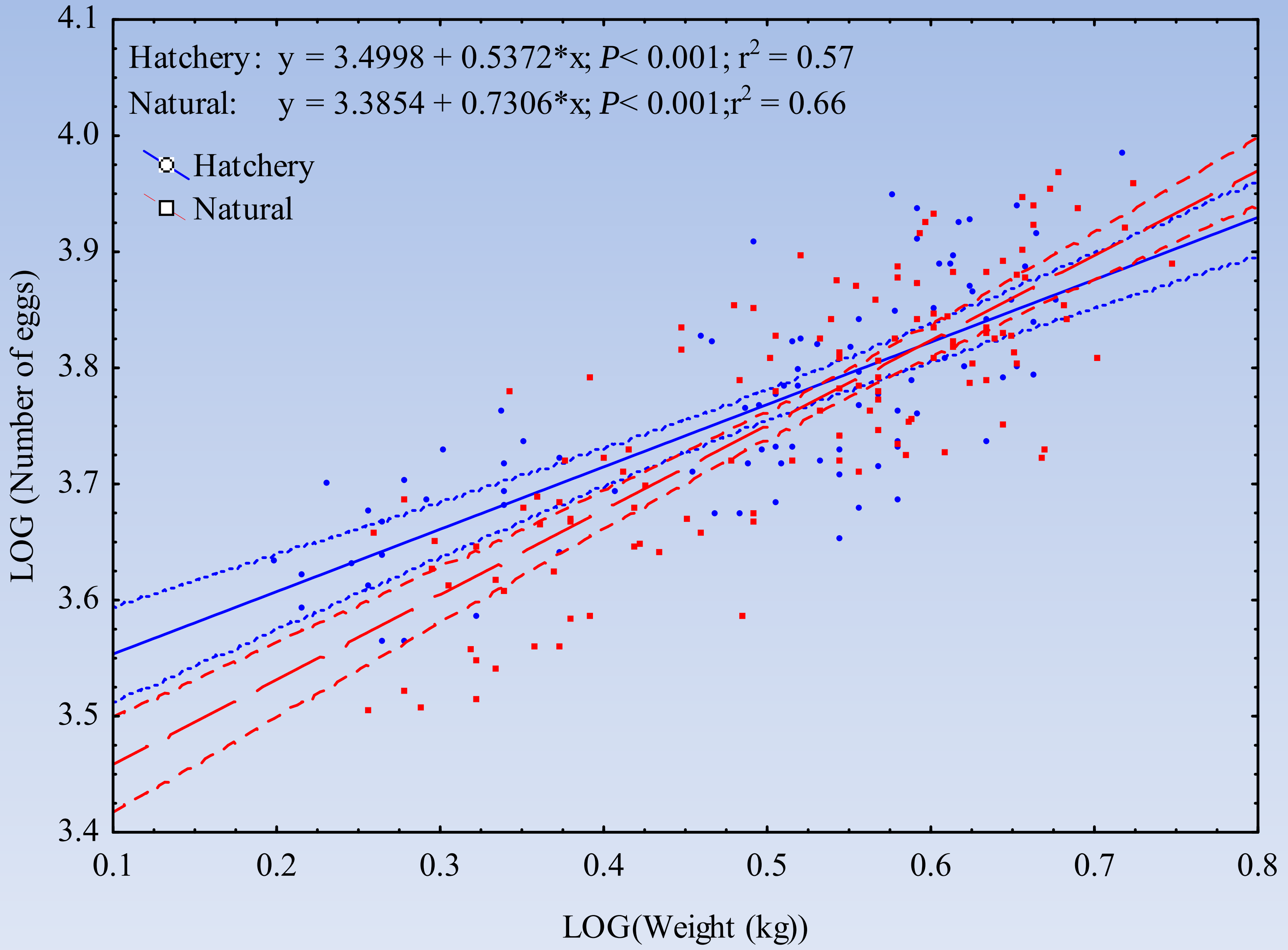
Attachment B

PRD Run Timing (2007-2010)



Attachment B

Fecundity

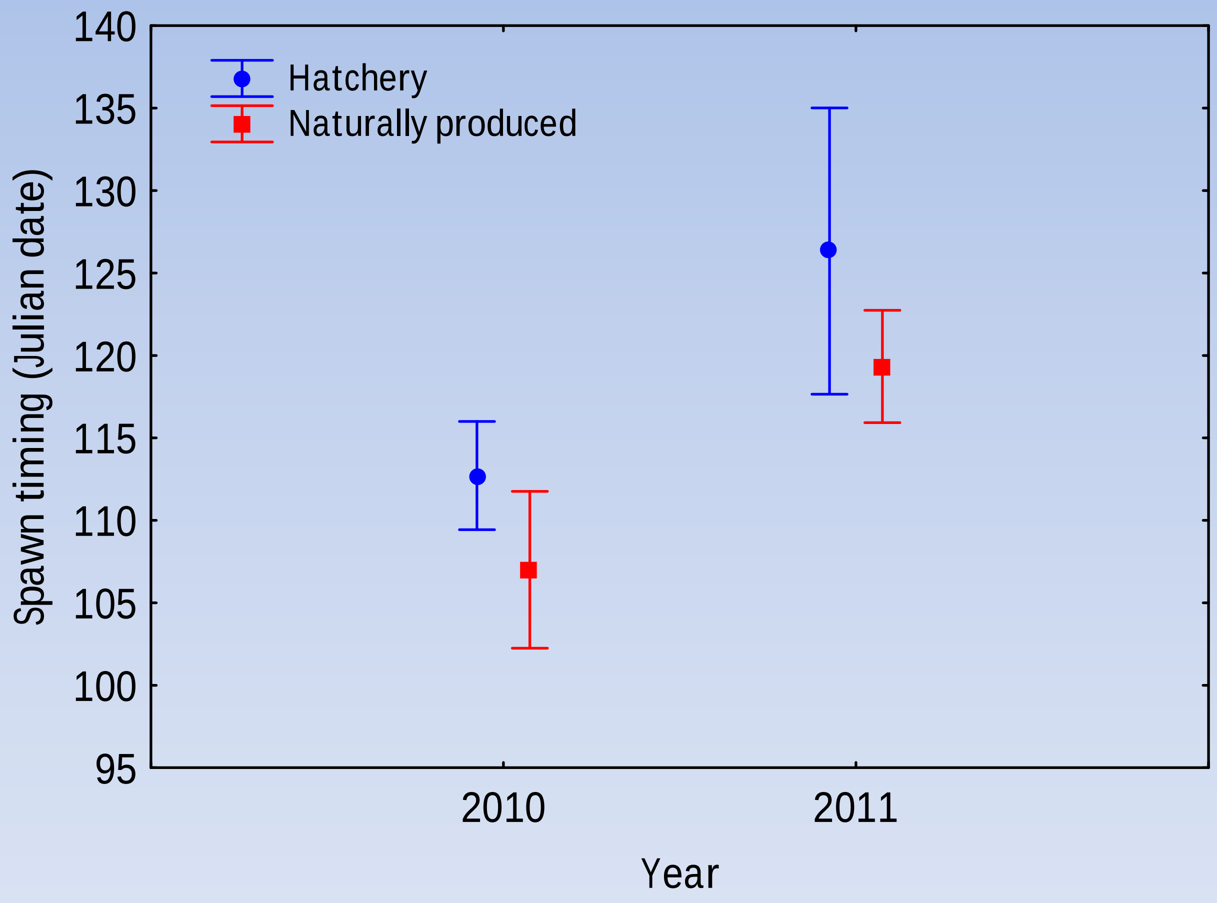


Attachment B

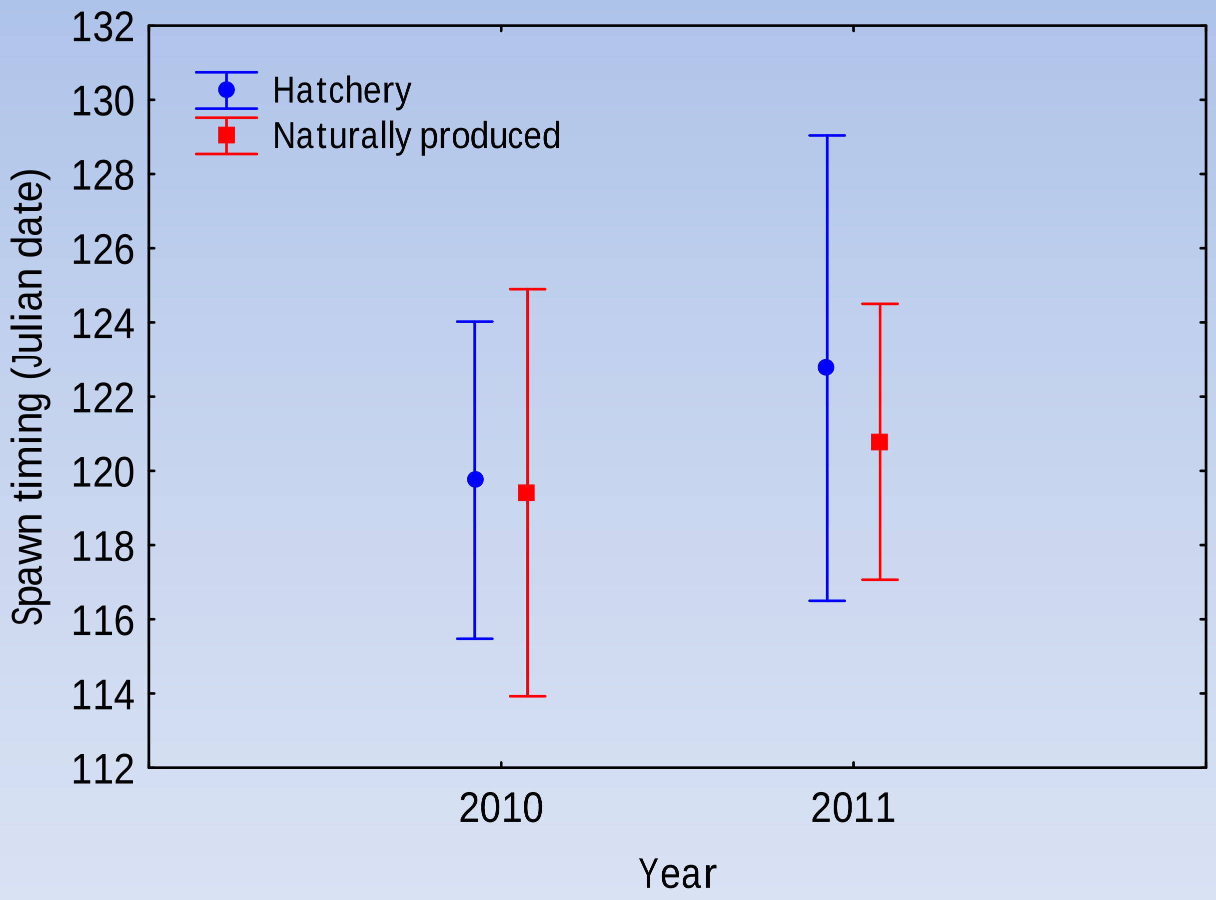
Potential Egg Deposition

Year	Origin	N	Mean	SE	Total	Difference
2008	Hatchery	252	4,932	59	1,242,912	8.8%
	Natural	207	5,516	65	1,141,864	
2009	Hatchery	634	6,105	37	3,870,739	263.7%
	Natural	181	5,880	70	1,064,211	
2010	Hatchery	565	5,409	39	3,056,076	49.6%
	Natural	384	5,319	48	2,042,466	
2011	Hatchery	140	6,134	79	858,817	-71.9%
	Natural	481	6,349	43	3,053,653	

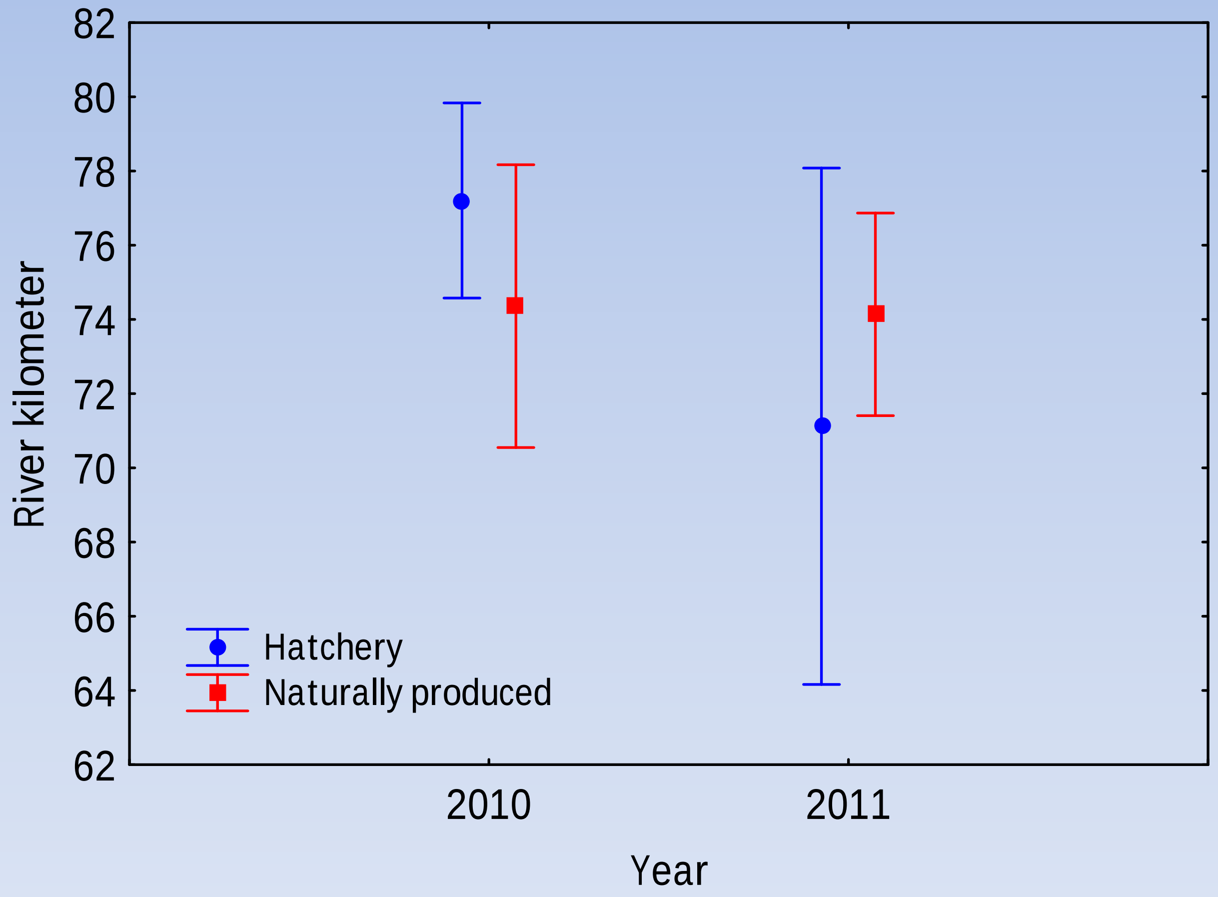
Wenatchee River



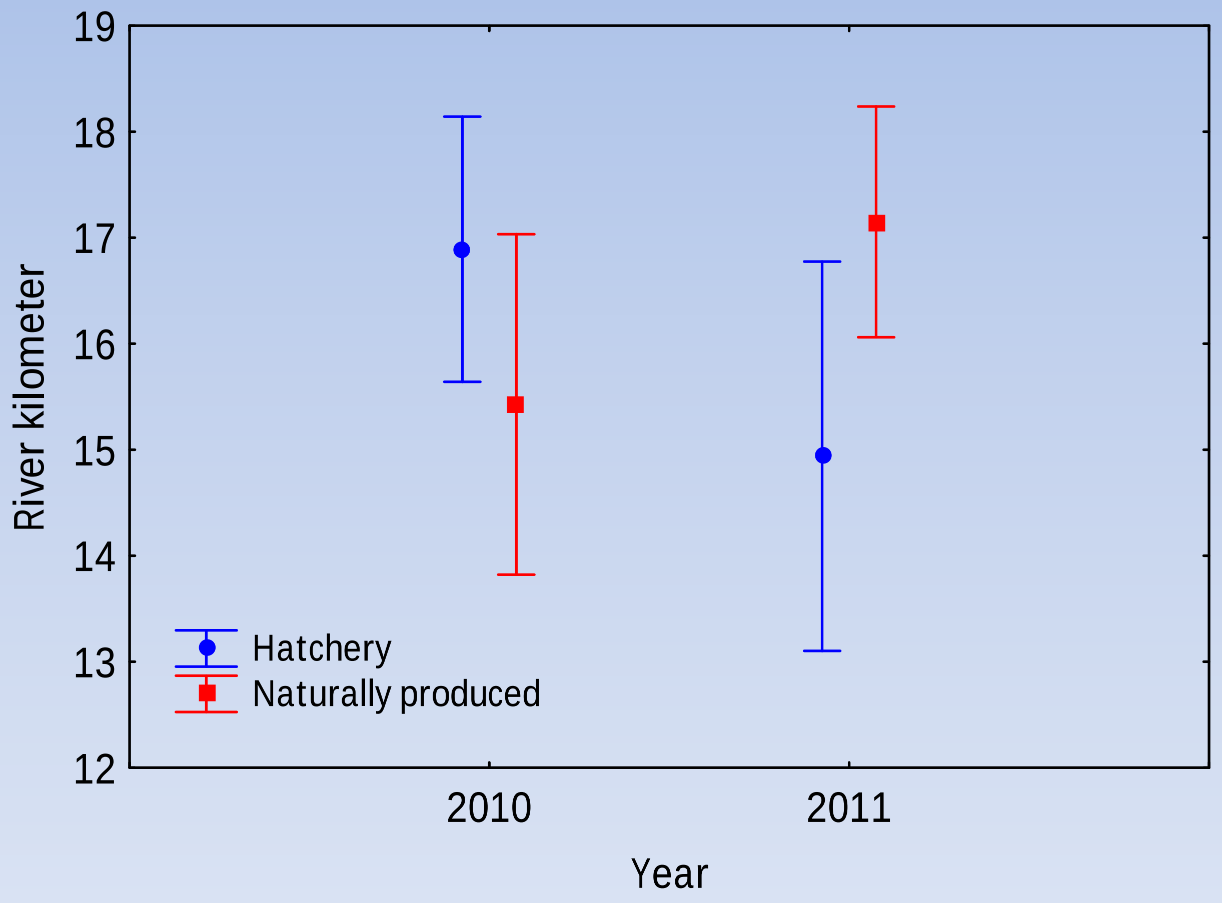
Nason Creek


Hatchery
Naturally produced
Spawn timing (Julian date)
132
130
128
126
124
122
120
118
116
114
112
2010
2011
Year

Wenatchee River



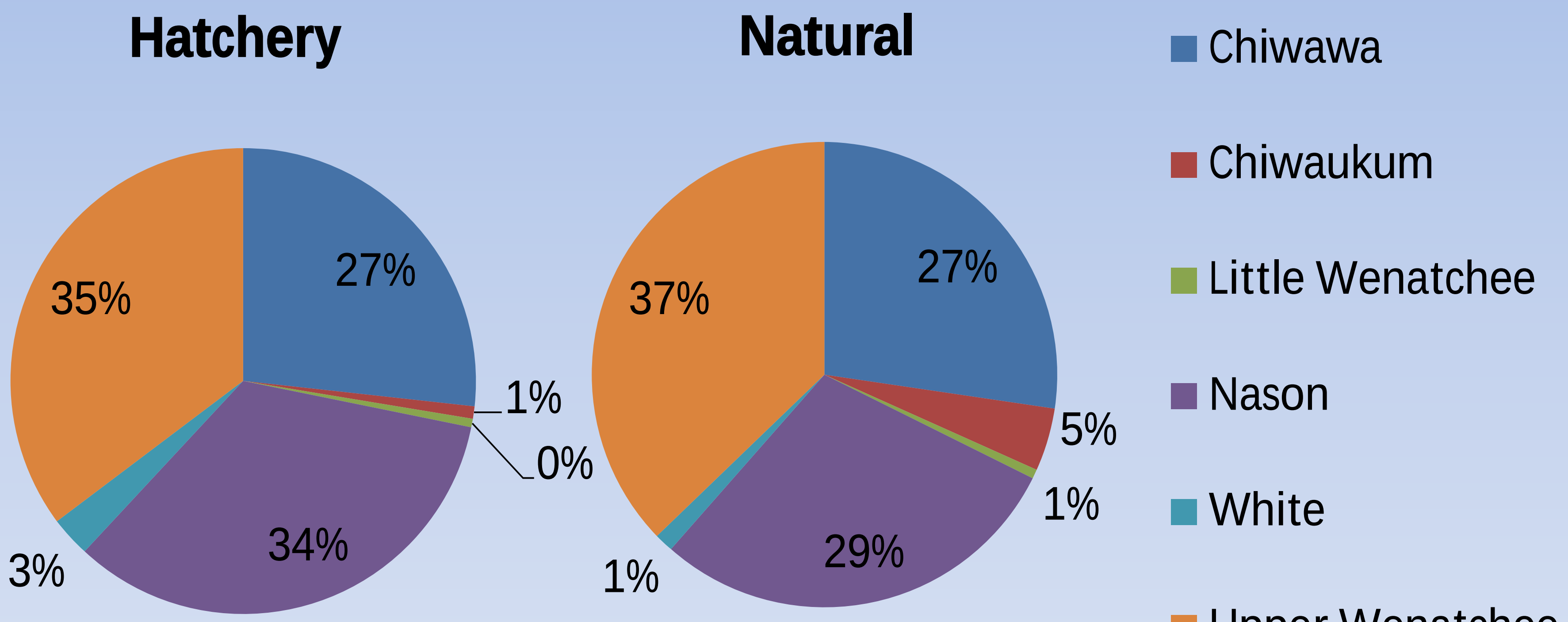
Nason Creek


19
18
17
16
15
14
13
12
River kilometer
2010
2011
Year
Hatchery
Naturally produced

Spawning location

- Elevation was not a significant factor
  - Wenatchee River
    - No difference was detected between or within years (Kruskal – Wallis ANOVA: P = 0.07)
  - Nason Creek
    - Differences were detected between years (Kruskal – Wallis ANOVA: P = 0.05), but not between origins in 2010 (P = 1.0) or 2011 (P = 0.09).

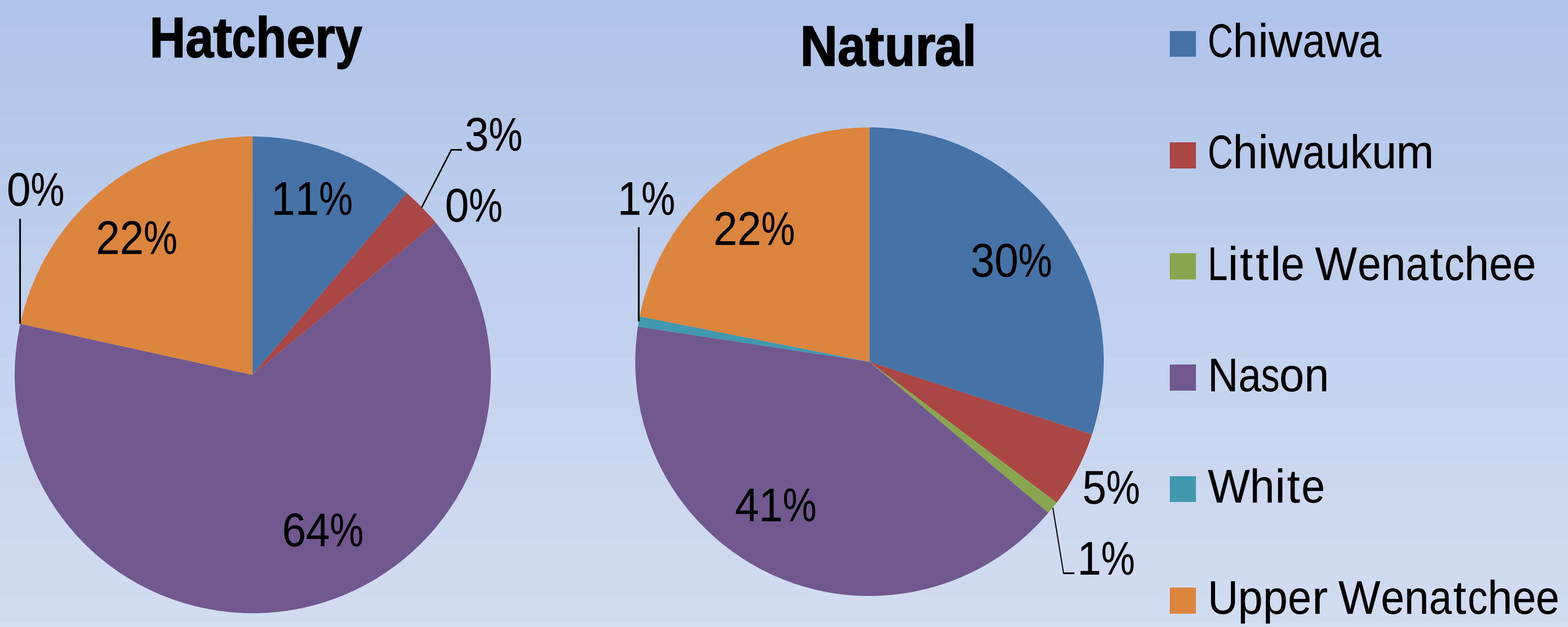
Spawner Distribution 2008-2010



Similar distributions among spawning areas with natural fish using Chiwaukum more and Nason Creek less compared to hatchery fish

Attachment B

Spawner Distribution 2011



Hatchery fish were predominating spawning in Nason Creek

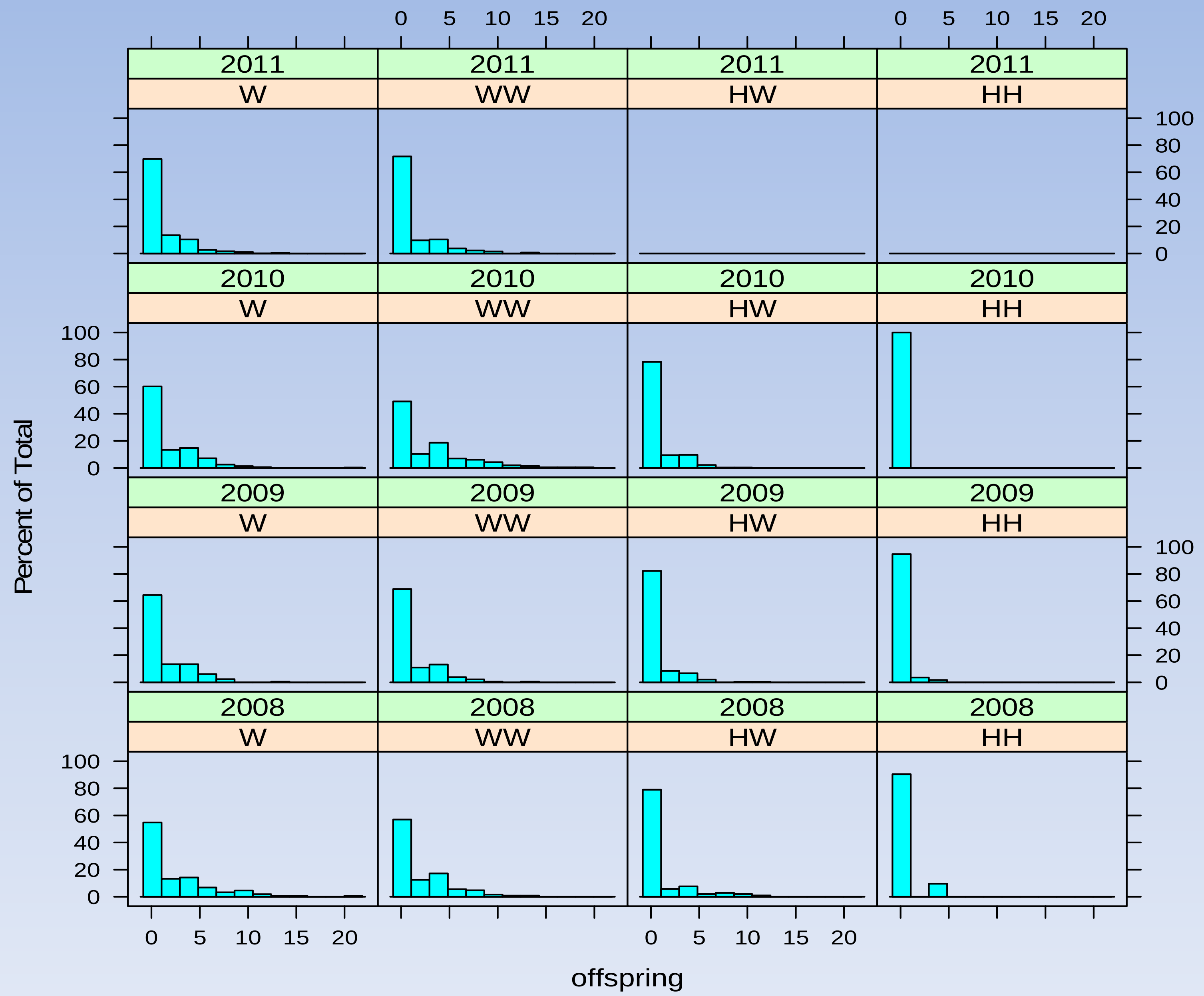
Attachment B

Pedigree Assignment Rates

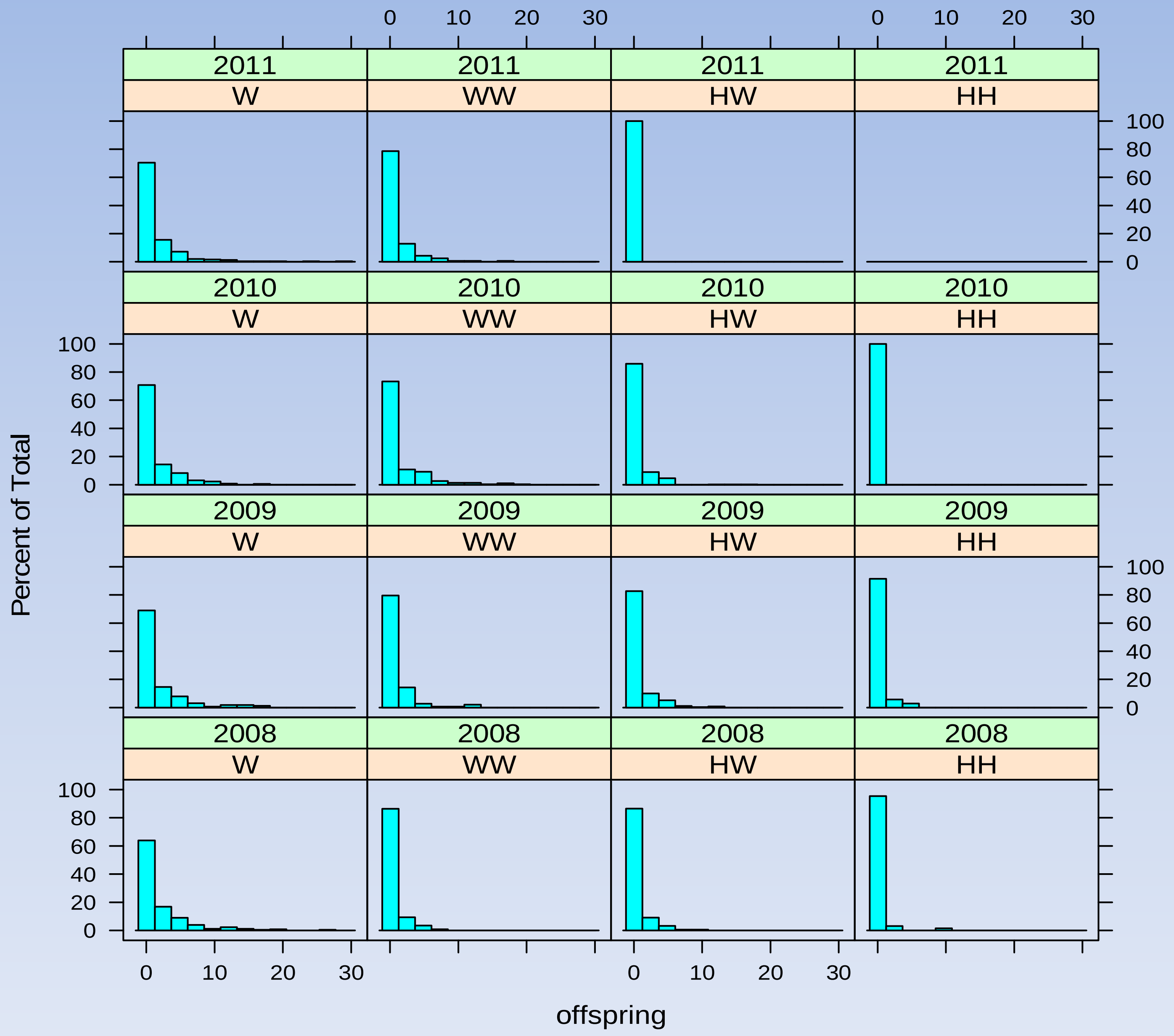
96 Single Nucleotide Polymorphism loci

Parents	N	Proportion
Two parents	4,296	0.540
Mom only	1,648	0.212
Dad only	1,169	0.150
Neither parent	788	0.100

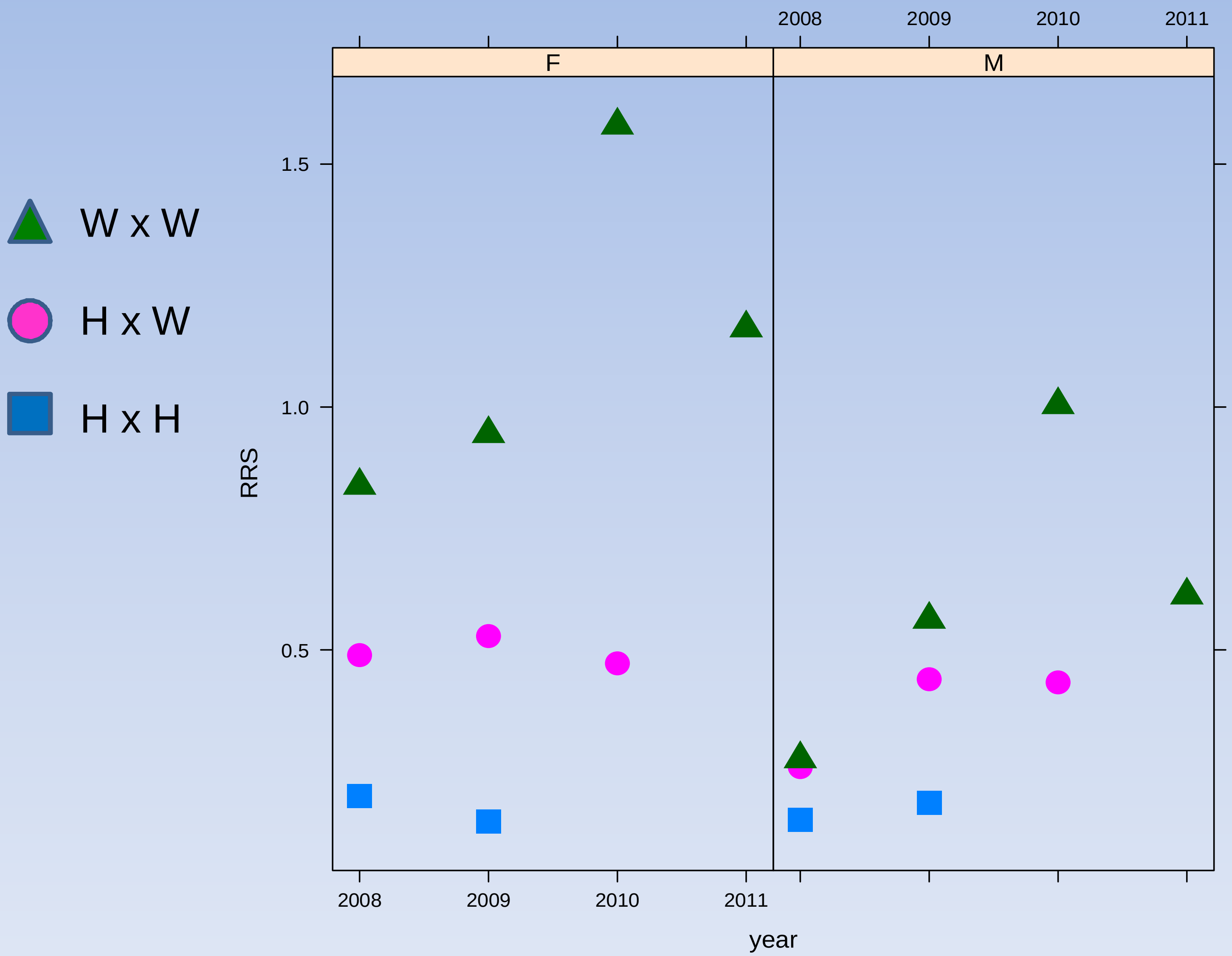
Progeny Distribution by Cross - females



Progeny Distribution by Cross - males



RRS by Year and Cross



Factors Influencing the Number of Progeny (H vs. W) - males

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-6.17	1.25	-4.918	8.75E-07
as.factor(salt.age)2	-0.55	0.34	-1.585	0.113
originW	0.42	0.18	2.384	0.0171
fkl	0.09	0.02	4.331	1.49E-05
seasonsummer	0.29	0.46	0.634	0.5258
day	0.00	0.00	0.036	0.9712

Factors Influencing the Number of Progeny (HW vs. WW vs. W) -- males

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-7.62	0.60	-12.798	< 2e-16
as.factor(salt.age)2	-0.71	0.15	-4.756	1.97E-06
conscrossHW	0.70	0.26	2.743	0.00609
conscrossW	1.34	0.25	5.301	1.15E-07
conscrossWW	1.02	0.26	3.988	6.67E-05
fkl	0.09	0.01	10.639	< 2e-16
seasonsummer	0.44	0.21	2.116	0.03437
day	0.00	0.00	-0.274	0.78422

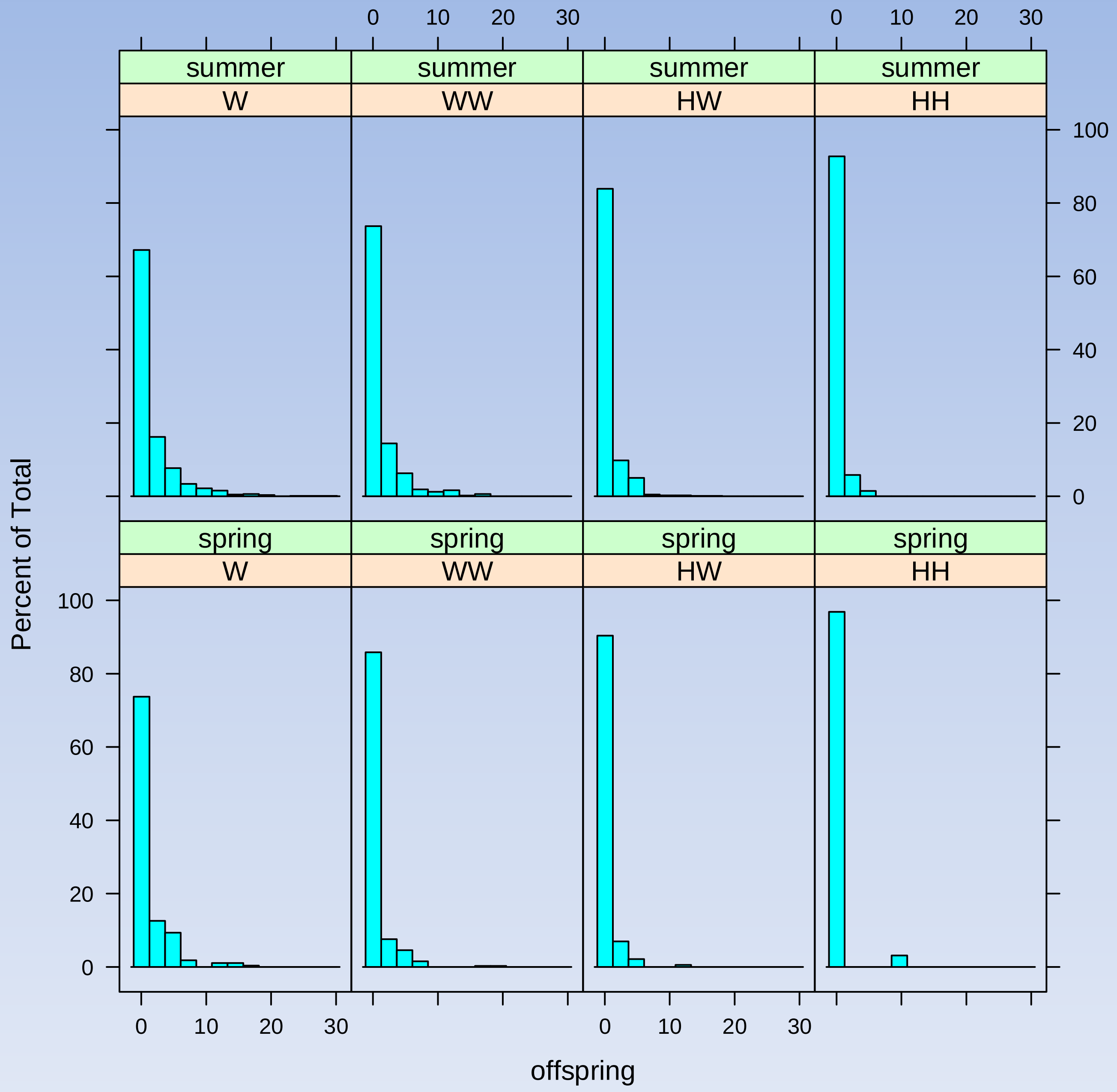
Factors Influencing the Number of Progeny (H vs. W) - females

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-3.17	0.51	-6.276	3.48E-10
originW	0.10	0.06	1.596	0.111
as.factor(salt.age)2	-0.17	0.12	-1.414	0.157
seasonsummer	0.12	0.14	0.821	0.412
fkl	0.05	0.01	5.567	2.60E-08
day	0.00	0.00	-0.281	0.779

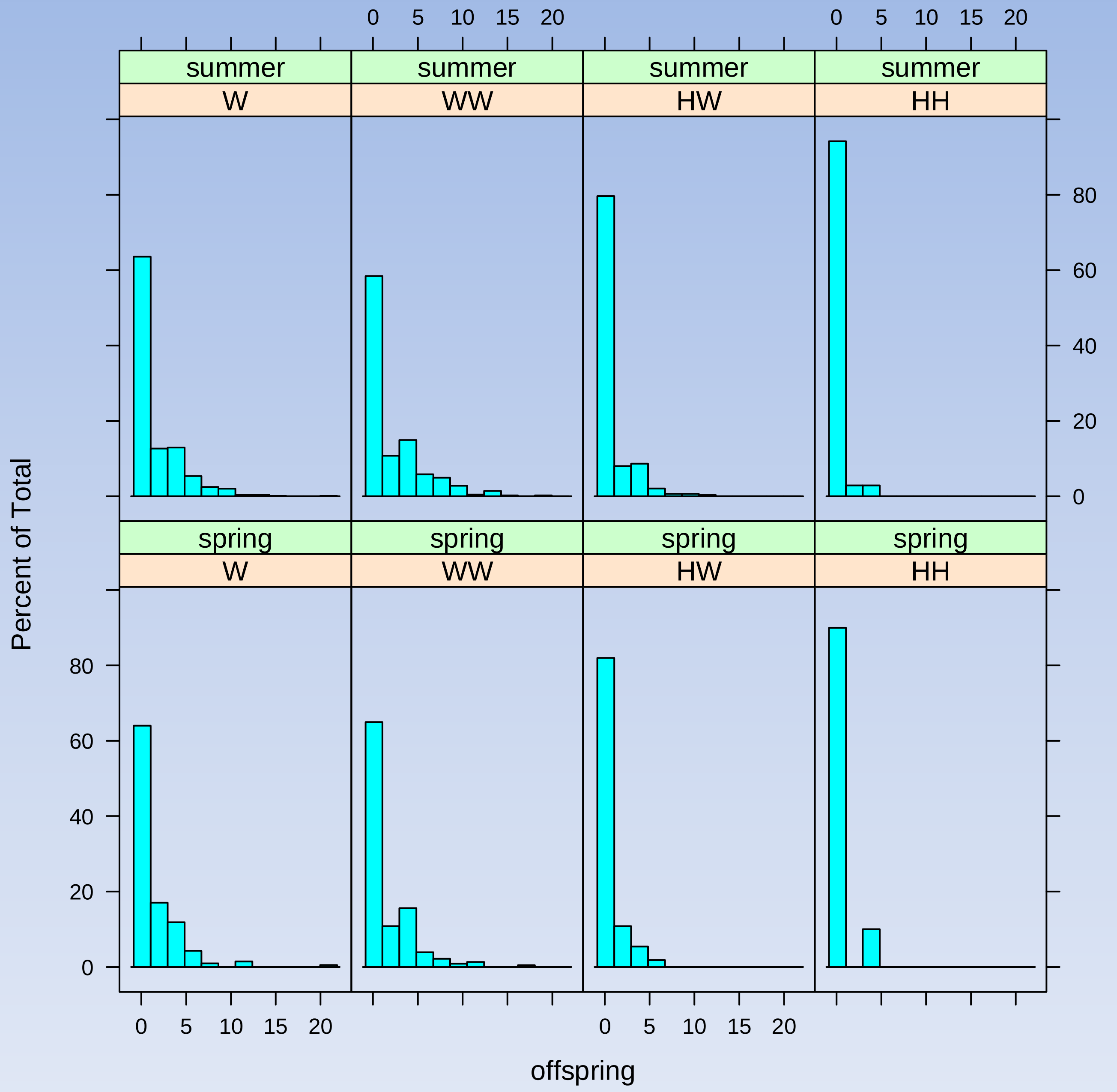
Factors Influencing the Number of Progeny (HW vs. WW vs. W) -- females

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-4.04	0.56	-7.183	6.84E-13
as.factor(salt.age)2	-0.14	0.12	-1.184	0.236359
conscrossHW	0.98	0.26	3.758	0.000171
conscrossW	1.50	0.26	5.808	6.33E-09
conscrossWW	1.76	0.26	6.741	1.58E-11
fkl	0.04	0.01	4.533	5.82E-06
day	0.00	0.00	-1.132	0.257434
seasonsummer	0.36	0.15	2.462	0.013827

Offspring by season and cross types, males



Offspring by season and cross types, females



Attachment B

Wenatchee vs. Other Steelhead RRS Studies

Sex	Cross	Wenatchee	Hood River	Little Sheep Creek
Male	HH	0.17	--	--
	HW	0.37	0.39	--
	WW	0.56	0.71	--
	Mixed H	--	--	0.44
Female	HH	0.17	--	--
	HW	0.50	0.50	--
	WW	1.10	0.91	--
	Mixed H	--	--	0.39

Life History Traits Summary

- Many differences detected between hatchery and natural fish
  - Younger fresh and ocean age
  - Greater proportion of adults are male
  - Female more fecund at a given size
  - WW fish generally more similar to natural fish than HH
- No apparent differences in spawn timing
- Spawning distribution similar, but can be changed if warranted.

RRS Summary

- HH fish have the lowest RRS
- WW fish females have similar RRS to wild females, WW males have RRS < in 3 of 4 years
- WH males and females have RRS < 1
- Results are very similar to Hood River study
- Size and season also contribute to variation in RRS among individuals (bigger = better; summer = better).

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees	**Date:**	November 19, 2015
From:	Tracy Hillman, HCP Hatchery Committees Chairman		
Cc:	Sarah Montgomery		
Re:	Final Minutes of the October 21, 2015, HCP Hatchery Committees Meeting		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees meeting was held at Chelan PUD headquarters in Wenatchee, Washington, on Wednesday, September 21, 2015, from 9:30 a.m. to 1:00 p.m. Attendees are listed in Attachment A to these meeting minutes.

ACTION ITEM SUMMARY

- The Hatchery Evaluation Technical Team (HETT) will develop a method for calculating hatchery replacement rate (HRR) targets before the next Hatchery Committees meeting on November 18, 2015 (Item III-A).
- The Hatchery Committees will discuss Objective 4 (HRR) and Objective 5 (stray rates) of the prioritized 5-Year Hatchery Monitoring and Evaluation (M&E) Report objectives flagged for Methow spring Chinook salmon during the next Hatchery Committees meeting on November 18, 2015 (Item III-A).
- Keely Murdoch will provide Craig Busack with Goat Wall Acclimated Release documents for review (Item III-B).
- Craig Busack will discuss with Keely Murdoch any further documentation needed for National Marine Fisheries Service (NMFS) consultation on Goat Wall Acclimated Releases (Item III-B).
- The Hatchery Committees representatives will discuss internally the Washington Department of Fish and Wildlife (WDFW) proposal that Douglas PUD authorize the Yakama Nation (YN) to perform Goat Wall Acclimated Release activities as an extension under WDFW activities (Item III-B).

- Keely Murdoch will discuss with Tom Scribner the proposal by WDFW to release excess hatchery-by-hatchery origin steelhead into lakes (non-anadromous waters) in the Methow and Okanogan basins (Item III-C).
- Mike Tonseth will add contingencies for overages to the Broodstock Collection Protocols (Item III-C).
- Sarah Montgomery and Matt Cooper will send a Doodle poll to the Hatchery Committees in order to convene a conference call to discuss gene flow standards for Methow spring Chinook salmon (Item VI-A).
- Sarah Montgomery will put the NMFS consultation update first on the agenda for the Hatchery Committees meeting on November 18, 2015 (Item VII-A).
- Craig Busack will request that Amilee Wilson (NMFS) and Karl Halupka (U.S. Fish and Wildlife Service [USFWS]) attend the next Hatchery Committees meeting on November 18, 2015 (Item VII-A).

DECISION SUMMARY

- There were no decisions approved during today's meeting.

AGREEMENTS

- The Hatchery Committees representatives present, except YN, agreed to WDFW's proposal to release excess hatchery-by-hatchery origin steelhead into lakes (non-anadromous waters) in the Methow and Okanogan basins. YN provided agreement to the proposal via email on October 22, 2015 (Item III-C).

REVIEW ITEMS

- There are no items currently out for review.

FINALIZED DOCUMENTS

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda, Review Last Meeting Action Items, Approve the September 16, 2015, Meeting Minutes (Tracy Hillman)

Tracy Hillman welcomed the Hatchery Committees and asked for any additions or changes to the agenda. The following revisions were requested:

- Mike Tonseth added excess hatchery-by-hatchery origin steelhead as a joint Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC)/ HCP Hatchery Committees item.
- Alene Underwood added a Rock Island Dam refurbishment update.

The Hatchery Committees reviewed the revised draft September 16, 2015, meeting minutes. Sarah Montgomery said there are several outstanding comments to be discussed. The Hatchery Committees discussed the outstanding comments and made revisions.

Hatchery Committees members present approved the draft September 16, 2015, meeting minutes, as revised.

Action items from the Hatchery Committees meeting on September 16, 2015, and follow-up discussions, were as follows (*italicized* text below correspond to action items from the meeting on September 16, 2015):

- *Andrew Murdoch (WDFW) will provide the presentation titled "Wenatchee River Relative Reproductive Success Studies" (Attachment B) presented during today's meeting to Sarah Montgomery for distribution to the Hatchery Committees (Item II-B).*

  Murdoch sent the presentation to Sarah Montgomery on September 22, 2015, and she distributed it to the Hatchery Committees the same day.
- *Matt Cooper will calculate HRR for Winthrop National Fish Hatchery (NFH) for discussion during the next Hatchery Committees meeting on October 21, 2015 (Item III-A).*

  Bill Gale sent the HRR spreadsheet to Sarah Montgomery on October 19, 2015, and she distributed it to the Hatchery Committees the same day.

- *Greg Mackey will develop a HRR calculation spreadsheet for discussion during the next Hatchery Committees meeting on October 21, 2015 (Item III-A).*
  Mackey sent the spreadsheet to Montgomery on October 13, 2015, and she distributed it to the Hatchery Committees the same day.
- *The Hatchery Committees will discuss Objective 4 (HRR) of the prioritized 5-Year Hatchery Monitoring and Evaluation (M&E) Report objectives flagged for Methow spring Chinook salmon during the next Hatchery Committees meeting on October 21, 2015 (Item III-A).*
- *Sarah Montgomery will update the 5-Year Hatchery M&E Report objectives flagged for Methow spring Chinook salmon and distribute the updated list to the Hatchery Committees for review (Item III-A).*
  Montgomery updated the flagged objectives document on October 14, 2015, and distributed it to the Hatchery Committees the same day.
- *Keely Murdoch will discuss with Cory Kamphaus (YN) the timing of passive integrated transponder (PIT)-tagging fish for the Goat Wall acclimated release (Item III-B).*
  Murdoch said YN is performing the PIT-tagging for the acclimated release, so there is flexibility in the schedule. She said January to February would be a good time for tagging the fish.
- *The Hatchery Committees will discuss Goat Wall Acclimated Release during the next Hatchery Committees meeting on October 21, 2015 (Item III-B).*
- *Tracy Hillman will request Craig Busack's attendance at the next Hatchery Committees meeting on October 21, 2015, for discussion of Goat Wall Acclimated Release (Item III-B).*
  On October 9, 2015 Hillman requested Busack's attendance and received confirmation on the same day that Busack would attend.

II. Chelan PUD

A. Rock Island Dam Refurbishment Update (Alene Underwood)

Alene Underwood said this update was requested by Jeff Korth (WDFW). Underwood said Chelan PUD will rehabilitate units B5 through B8 in Powerhouse 1 at Rock Island Dam with higher efficiency turbine runners. She said Chelan PUD has been planning to rehabilitate units B5 through B10 (either new higher efficiency turbine runners and/or new turbine blades) for over 10 years, but as of yet only turbine runner replacements, changing from five blades to four blades, have occurred in B9 and B10. She said, now, the turbine runners in B5 through B8 will be replaced by the year 2020, resulting in a more efficient unit both in terms of power generation efficiency and assumed fish passage efficiency. Keely Murdoch asked whether survival studies are affected by the rehabilitation. Underwood replied that because efficiency curves will be increased by 2 to 8% with the new units which also presume higher fish survival efficiency, Chelan PUD doesn't believe additional survival studies will be warranted. Underwood said most fish prefer to use Powerhouse 2, and the rehabilitation completion will coincide with the 10-year study check in 2020-21. Mike Tonseth said survival studies are the nexus to the Hatchery Committees for this topic, as dam passage survival is used to calculate the hatchery component of NNI. Kirk Truscott said he had asked Keith Truscott, Chelan PUD Natural Resources Director, whether turbine replacement would affect spill configuration at Rock Island Dam, and Truscott had replied that it would not.

III. Joint HCP Hatchery Committees/PRCC HSC

A. Five-Year Hatchery M&E Review Planning – Objective 4 (Greg Mackey)

Greg Mackey shared a spreadsheet titled "HRR Target Calculation" (Attachment C), which Sarah Montgomery distributed to the Hatchery Committees on October 13, 2015. Mackey said the calculation is based on spawning escapement, and the sliding scale in the spreadsheet shows a minimum spawning escapement of 500 hatchery fish. He said the proportionate natural influence (PNI) target constantly changes depending on how many wild fish return, but 500 is used as a target escapement because more than 500 hatchery fish are rarely needed. Mackey said HRR is calculated as escapement divided by broodstock (3.85 in the example shown). Todd Pearsons said that the old target was 4.5 (from the latest Snow et al. report[1]), which is similar to Mackey's calculated target. Pearsons said the goal of this

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[1] Snow, C., C. Frady, D. Grundby, B. Goodman, and A. Murdoch. 2015. Monitoring and evaluation of the Wells Hatchery and Methow Hatchery programs: 2014 annual report. Report to Douglas PUD, Grant PUD, and the Wells HCP Hatchery Committee, East Wenatchee, WA.

discussion is to relate HRR to management objectives that the Hatchery Committees are trying to meet, and an unachievable target would not meet that goal. Mackey said the target of 3.85 represents the minimum. Bill Gale said Charlie Snow (WDFW) usually uses total adult return, including harvest, to calculate HRR, and Mackey's calculation does not factor in prespawn mortality or harvest. Mike Tonseth said HRR is calculated with and without harvest, so more refinement may be needed if prespawn mortality should be accounted for. Gale asked whether the target is for a subbasin HRR, or if it is an HRR from total adult return. Mackey said the 500 represents spawners, not returns, and the topics are mixed here because HRR measures return. Mackey presented another way for calculating HRR targets using the Hatchery and Genetic Management Plan (HGMP) for Methow spring Chinook salmon. Mackey said the minimum escapement is 500 spawners, and with the pHOS-based sliding scale, 500 is also approximately the greatest number of hatchery spawners that would ever be needed. So, a HRR calculated on 500 spawners serves as the minimum necessary HRR value. Tracy Hillman said the M&E Plan consists of two targets or goals: 1) HRR being greater than the set target; and 2) HRR being greater than the natural replacement rate (NRR). He said hatchery returns to the entire subbasin are included in the calculation, and HRR is estimated with and without freshwater harvest. Hillman said surplused fish are included in the HRR calculation.

Gale shared a spreadsheet titled, "Winthrop NFH Spring Chinook Yearling Release Metrics" (Attachment D), which Montgomery distributed to the Hatchery Committees on October 19, 2015. Gale said when USFWS prepared the Winthrop NFH HRR data, it discussed comparing HRR to other programs. Gale asked whether it is appropriate to do subbasin-level HRR calculations, because one set of data includes adipose (ad)-clipped fish and might compromise future comparisons. Kirk Truscott said in the HGMP there is 24% prespawn mortality, so if no wild fish return, the amount of hatchery fish that would have to return in order to meet the HRR target, including the prespawn mortality component, would equal 666, which differs from 525 based on the proportion of hatchery origin spawners (pHOS). Truscott said Methow spring Chinook salmon contribute to harvest (tribal, especially) in the lower Columbia River, so identifying an HRR target that would not provide the opportunity for harvest benefits of surplus would not be advantageous. Mackey said the current HRR target (4.5) and the one calculated using his spreadsheet (3.85) do not differ greatly, but it would be better to have a rational method for calculating HRR so that it can be easily adjusted in the future. Mackey asked what the 10-year HRR average is. Pearsons listed data from the most recent Snow et al. report[1]: from 2001 to 2008, Methow River HRR was 5.1, Twisp River HRR was 4.39, and Chewuch River HRR was 4.15. He said the Winthrop NFH HRR was 3.27 from 2001 to 2008, as presented in Gale's spreadsheet. Mackey said the aggregate average HRR for the Methow River with all three programs combined was 4.6. Gale said the HRR for the MetComp Methow River program was 4.17.

Hillman asked what happens if the HRR target is not met. Hillman said for the Chiwawa River spring Chinook salmon program, the HRR target was only met in 8 out of 18 years. He said a target can be set, but what does it mean or what happens if the target is not met? Tonseth said one issue is that there is not much to do to change HRR, as it depends primarily on ocean survival. He said producing more smolts would increase abundance, but it would not change the HRR, so maintaining at or near the 5-year average should be considered achieving the objective. Catherine Willard said if the HRR is low due to hatchery effects, it can be controlled. Gale said the factors predominantly driving HRR are mostly outside of the hatchery.

Craig Busack said it appears that the Winthrop NFH HRR is one-third lower than the Methow Basin hatchery programs. Gale said that care should be taken in comparing HRRs from certain programs, because many factors are program-specific. Tonseth added that transition years, such as from 2002 to 2006, should be accounted for, because they are not reflective of expected future performance. Tonseth said HRR is driven by broodstocking, and because hatchery fish can be over-collected and culled, wild-driven broodstocking programs are stricter, thus the number of broodstock used is important. He said comparing programs becomes difficult when the broodstocking policies are different. Gale said Winthrop NFH collects extra fish, which is reflected in the HRR. Truscott said the point of HRR is to calculate the parent brood that contributes to production. Gale said the point of HRR is to determine how many fish were collected and subsequently produced. Tonseth said the calculation is based on what is collected and retained. Gale said culling is included in the calculation of HRR. Tom Kahler said HRR takes into account the number of fish from which gametes were collected. Tonseth said using that number is not an accurate representation of the adults collected in order to collect gametes. Hillman said the denominator of the HRR calculation is total broodstock collected, which includes pre-spawn loss, surplused fish, and those spawned.

Pearsons shared data from 2006 to 2008 from the Snow et al. report, showing that Winthrop NFH would still have a lower HRR (5.7) than the Methow programs (average HRR of 7.9). Gale said the difference could be a result of performance or a result of difference in broodstock collection. Truscott said it also depends on how the fish perform; because Methow Fish Hatchery (FH) is supported by natural-origin recruits, equal performance would not be expected. Tonseth added that different disease-management strategies at Winthrop NFH would also result in a lower HRR. Pearsons said the point is to compare HRRs to other hatcheries and see if Methow FH is anomalous. Tonseth said recalculating HRR using the number of adults contributing to juveniles (by removing culled fish and prespawn mortalities) would eliminate bias.

Hillman asked why the Hatchery Committees think a target is necessary. He said the programs currently calculate internal hatchery performance metrics and smolt-to-adult returns (SARs), which are all components of HRR. These are evaluated by the Hatchery Committees in concert with HRRs. He said given that the Hatchery Committees have not reacted to the lack of HRRs meeting program targets in the past, HRR targets may have little bearing on adaptive management. Mackey said there are three components to HRR: 1) fecundity varies, 2) in-hatchery survival is generally maximized; and 3) SARs are uncontrollable due to ocean conditions. Hillman agreed and said the Hatchery M&E Plan calls for comparing HRRs to the derived targets and NRRs. He said HRRs are nearly always greater than the NRRs, but HRRs rarely meet HRR targets. Willard said the HRR target exercise was part of the HETT assignment for appendices, but the values in the appendices come from the Biological Assessment and Management Plan. Keely Murdoch said the Hatchery Committees should use the established values, or task HETT to come up with new values. Tonseth said this relates back to the purpose of the programs; if the natural population catastrophically failed, the hatchery programs can help in recovery. He said the HRR target is a check-in so the program is performing at the right level in case of a natural population failure. Mackey said the PUD programs for No Net Impact (NNI) are set by survival studies and are not directly related to the number of hatchery fish that need to return to meet spawning escapement. He said the programs can change size, but if the spawning escapement number is static, HRR would change. He said holding the program to a target is an objective but a difficult one, and more importantly, HRR should be higher than the NRR. Hillman said the productivity standards for the supplementation programs are well above the levels needed to avoid extinction based on quasi-extinction risk modeling. He said the question is how to calculate the target and determine the information needed to include in the calculation of the target. Truscott said HRR targets for summer Chinook salmon need to include harvest objectives, and pre-spawn mortality also needs to be accounted for in summer Chinook salmon. Tonseth said distinct calculations should be maintained, because looking at just HRR with harvest included might hide other impacts. He said different harvest components should be included in order to discover which harvest component has the largest impact. Truscott said if HRR is calculated for a brood year, the benefit of the doubt is afforded to the hatchery program. Mackey said interceptions of fish en route to their final destination should be accounted for. Busack said HRR should be calculated before and after harvest, and conservation fisheries should be excluded from the harvest calculation. Truscott said conservation fisheries should be included in HRR calculations because they are fish that return to the subbasin. Hillman said harvest varies greatly by year and location, and the average from 1989 to 2008 for Chiwawa spring Chinook salmon has been about 25 fish per year.

Gale asked whether an annual target or a 10-year running average target should be calculated. Gale said an HRR target would be meaningful in the 5-year reports, but should also be included in the annual reports. Hillman indicated that HRRs are presented in the annual and 5-year reports. Tonseth said HRR is like PNI or SARs, so the 5-year average is more valuable. Hillman said a running average has not previously been calculated. Busack recommended calculating a running average. Hillman suggested using the geometric mean given that replacement rates represent a multiplicative process. He also recommended assigning this task to the HETT, which will be meeting soon. Truscott said one method could be to pick a long-term average and try to improve on it. As a side note, Hillman said the Wenatchee River steelhead HRR target is 19.2, which has only been met once.

The Committees agreed the HETT will develop a method for calculating HRR targets before the next Hatchery Committees meeting on November 18, 2015.

Hillman suggested discussing Objective 5, in addition to continuing the discussion of Objective 4, at the next Hatchery Committees meeting. Hillman said the Hatchery Committees will discuss Objective 4 (HRR) and Objective 5 (stray rates) of the prioritized 5-Year Hatchery M&E Report objectives flagged for Methow spring Chinook salmon during the next Hatchery Committees meeting on November 18, 2015.

B. Goat Wall Acclimated Release (Keely Murdoch)

Keely Murdoch said, based on the agreed-upon Goat Wall Acclimation Plan and Statement of Agreement (SOA), the first Goat Wall acclimated release is supposed to occur in the spring of 2016. Murdoch said the YN is in the process of acquiring its own permits instead of being an authorized agent on the Grant and Douglas PUD permits, but contingency plans should be put in place in case permits are not ready by the fish-transfer date. She asked whether YN could be covered under an 1196 extension letter, because the Goat Wall Acclimation Plan and SOA have been agreed to, and said that permit coverage will affect PIT-tagging plans. Craig Busack said because this falls under 1196 coverage, it can move forward with the approval of the Hatchery Committees. Murdoch said the Goat Wall Acclimation Plan may not have been included as an appendix or addendum to the HGMP or sent to NMFS directly, but it is an approved Hatchery Committees document. Mike Tonseth suggested submitting the Goat Wall Acclimation Plan to Busack as an addendum to the HGMP, along with the SOA. Busack said he would need to know enough about the facility to assess whether it is within the scope of the permit. Murdoch replied that facility information is included in the coho salmon Biological Opinion (BiOp) and in the Goat Wall Acclimation Plan. Busack said NMFS may need additional documentation.

Alene Underwood said the concern in permit coverage is an attempt to be clear about roles, responsibilities, and allocation of take in the case that something happened to the fish. Tom Kahler said the PUDs relinquish Endangered Species Act (ESA) responsibility for the fish upon transfer to the YN. Busack asked if the PUDs would be uncomfortable letting YN release the fish unless explicit permits are written. Kahler replied that it would depend on where ESA responsibility lies. Underwood agreed with Kahler and said she would prefer if NMFS could write a letter similar to letters in the past that have addressed program modifications. Busack said the tone of a letter transferring liability to YN could be scrutinized in a negative way, even though it seems straightforward to the PUDs from a liability standpoint. Murdoch said 25,000 fish are planned for release. Busack said 25,000 fish represents 10% of the program, and language in 1196 allows for this release. He said this has been allowed in the past, and with verbal support from Chris Peterson (NMFS). Murdoch said it has been done for Grant PUD. Kahler said that for those Grant PUD releases, Douglas PUD was not aware that the YN had no permits for acclimating the fish. Murdoch said that is not true. Kahler disagreed. Murdoch said Wolf Creek and Heath Pond have both been used for remote acclimation, but people think about the situation differently now. Tonseth said the discussion about remote site activities was precipitated by a lot of mortality at Heath Pond. He said it affected the PUDs' mitigation obligation, causing future discomfort and apprehension about liability associated with fish they do not have custody of. Murdoch disagreed and said the numbers of fish lost at Heath Pond were not different, but the proportion of fish lost was higher.

Tracy Hillman asked if Murdoch needs to provide Busack with further information about the facility at Goat Wall. Murdoch said the plan has already been approved by the Hatchery Committees, and YN waited until 2016 to begin releases because the permits were not in place for 2015. Busack asked what the PIT-tagging deadline is for fish at Goat Wall. Murdoch replied there is flexibility because YN is performing the PIT tagging, but it is looking at January to February, although a date has not yet been decided. Murdoch said the approved Goat Wall Acclimation Plan should contain all needed information for consultation, but she will need to know if that is not the case. Busack said the way for acclimated release activities to move forward if consultation is not complete is for the Hatchery Committees to agree to it, but that seems improbable. Kirk Truscott asked if it matters who does the acclimation if the point of the activity is to get fish acclimated higher in the basin. He asked whether WDFW could perform the acclimation and YN compensate them for the work. Murdoch said she would have to vet that idea internally.

Tonseth suggested that an approach similar to what WDFW did in the Okanogan Basin with the Colville Confederated Tribes (CCT) could be taken. He said the PUDs could issue YN authorization to conduct the activity as an extension under WDFW activity and liability. Kahler asked if that is possible under the current permit. Tonseth said WDFW submitted a letter to CCT and the National Oceanic and Atmospheric Administration (NOAA) for concurrence. Murdoch said she would have to vet the idea internally first, but she thinks that it would be okay. Tonseth said that it is not a long-term solution, but rather a one-time event that affords more time to acquire other permits. Truscott said his interpretation is that the permitting landscape has changed since this action was approved in January or February, 2015. He said he would take this idea back to CCT for discussion. Greg Mackey said when Douglas PUD approved the YN proposal, the ESA ties of the PUD to the fish would be cut upon transfer. He said distancing this link is a good idea but would need to be discussed further internally. Underwood said Chelan PUD's fish for this brood year are going to the Chewuch acclimation facility, so Chelan PUD does not need to provide input on this decision.

Murdoch will provide Busack with Goat Wall Acclimated Release documents for review. Busack will discuss with Murdoch any further documentation needed for NMFS consultation on Goat Wall Acclimated Releases.

The Hatchery Committees representatives will discuss internally the WDFW proposal that would give Grant and Douglas PUDs the ability to authorize YN to perform Goat Wall Acclimated Release activities as an extension under WDFW activities.

C. Excess Hatchery-by-Hatchery Origin Steelhead (Mike Tonseth)

Mike Tonseth said the 2014 Broodstock Collection Protocols include contingency broodstock collection for the safety net component. He said WDFW collected additional fish in the fall, and for the Okanogan program, CCT collected additional broodstock. At Wells Dam, fish collected in the fall have typically been spawned by February, prior to spring broodstock collections. Therefore, this collection strategy will produce surpluses until the fall collections are reduced to compensate for the spring collections. Tonseth said WDFW has a 24,000-fish overage in the Methow safety net program, and a 35,000-fish overage in the

Okanogan program. He said Ringold FH has no capacity for these fish. He said Kirk Truscott had internal discussions, and CCT have no use for the fish and they cannot be culled, thus the option is to put them into resident fishery opportunities. He said WDFW proposes to take 12,000 of the Methow safety net fish to Alta Lake and 12,000 to Patterson Lake in the Methow Valley. He said WDFW also proposes to take 17,500 of the Okanogan program excess fish to Bonaparte Lake and 17,500 to Crawfish Lake, both of which are in the north half of the Okanogan Basin, providing a potential tribal benefit. Tonseth said the only caveat is that he needs to check with the district fish biologist to ensure stocking levels are not exceeded in those lakes. Tonseth said the fish are all ad-clipped. Keely Murdoch asked how the conservation program is doing. Tonseth said these fish cannot be part of the anadromous component because they are above 110% of the permit value. He said the program is set up for overages, because adults are over-collected if spring collection is successful. He said the broodstock collection protocol was still set up this way for the 2015 brood, but in the future, Okanogan fish in the Okanogan Basin can be acquired and pulled out of the collection goals. Todd Pearsons asked if these fish are above surpluses at Ringold FH. Tonseth replied yes; the permit identified Ringold FH as a back-up location for excess fish, but it also collected fish on site and has already accepted 100,000 fish, placing them at the 110% permit limit. Pearsons suggested cutting back on collection in the coming year, but that it depends on how comfortable everyone is on relying on spring collection. Bill Gale said, in 2014, the bulk of the fish were Wells FH volunteers, so with only 1 year of data, caution should be taken to not pull back too soon or too much. Greg Mackey asked if a number has been calculated for how many excess fish Ringold FH can accept in the coming year. Tonseth replied the program smolt release is 180,000, and the FH can collect some of its own brood. He said if he has an expectation of how many excess fish WDFW will have, he can tell Ringold FH so that it does not collect as many adults. Gale asked if there is a reason to preferentially collect broodstock at Ringold FH. Tonseth replied WDFW intends to make Ringold FH self-supporting, but if it has capacity and the Methow or Okanogan programs have excess, fish will be transferred.

Tracy Hillman asked the Hatchery Committees if it approves WDFW's proposal to distribute excess steelhead into the four lakes. Murdoch replied that she needs more time to decide and discuss internally. Craig Busack said NMFS cannot support releasing these fish into anadromous waters, and the 110% overages are a problem because they are being treated like a baseline by programs. Tonseth said WDFW cannot support culling the fish. Gale said the 110% value is still much lower than what the programs were previously releasing. Tonseth said the programs have decreased releases by 40,000 after NNI, but under NOAA's 2015 extension letter, it must follow the program release goals, which provide limited options. Busack said releasing more than 110% would affect public perception of the agencies meeting their agreements. Truscott said in this instance, the overages are a result of purposeful over-collection. Murdoch said excess fish are a better problem than not meeting production goals. Tonseth said these fish were removed and did not contribute to natural production. Douglas PUD, Grant PUD, WDFW, USFWS, CCT, Chelan PUD, and NMFS all agreed to the WDFW's proposal. Murdoch said she will discuss with Tom Scribner the proposal by WDFW to release excess hatchery-by-hatchery origin steelhead into lakes (non-anadromous waters) in the Methow and Okanogan basins.

Gale said one of the management objectives at Winthrop NFH and Wells FH is that fish that are volitionally released do not residualize. Gale said he wants to make sure this agreement does not preclude the ability to perform other management actions. Mackey said it would be good to have a contingency plan for the excess fish every year until the programs are more predictable. Tonseth said he will add contingencies for overages to the Broodstock Collection Protocols.

IV. Douglas PUD

A. Wells Hatchery Modernization (Greg Mackey)

Greg Mackey shared a presentation titled, "Wells Hatchery Modernization" (Attachment E). The presentation included descriptions of ongoing construction at Wells FH to the spawning channel, dirt ponds, adult holding ponds, volunteer trap and channel, new adult handling facility, pollution abatement pond, and new hatchery building. Questions and comments were discussed as follows:

Alene Underwood asked if the spawning channel was dug out or filled in. Mackey replied that the old 5,000-foot-long channel was crushed and graded.

Tracy Hillman asked how much modernization costs. Mackey replied there is a $37-million contract in place with Lydig Construction, Inc., from Spokane, Washington.

V. HETT

A. HETT Update (Greg Mackey/Catherine Willard)

Greg Mackey said the HETT will convene on October 29, 2015, to discuss the Hatchery M&E Plan appendices.

VI. NMFS

A. Consultation Update (Craig Busack)

Craig Busack said he has transitioned into a chief scientist role in his group, providing technical help, BiOp development, and National Environmental Policy Act document development. Busack said he is still working on the Methow spring Chinook salmon consultation, and he recognizes that calling into each Hatchery Committees meeting is not an ideal situation. He said NMFS is proceeding to hire someone to replace him on the Hatchery Committees.

Busack said administrative records for the Leavenworth FH lawsuit are due on November 20, 2015, and previous NOAA involvement in helping get the program permitted resulted in the plaintiffs amending their suit to include NMFS, along with USFWS and the U.S. Bureau of Reclamation (USBR). He said they are trying to get the Wenatchee steelhead consultation completed, and Amilee Wilson is continuing to work on the amended environmental assessment for the Methow and Okanogan FHs steelhead programs.
Kirk Truscott said CCT have submitted comments on the draft Environmental Assessment.
Busack said Sharlene Hurst (NMFS) will be working on the 1347 projects.

Busack said for the Methow spring Chinook salmon consultation, he has a new HGMP from Chelan PUD. He said there are two issues at hand before the consultation can be completed; the first includes research, monitoring, and evaluation (RME), which has been elevated up to the federal level with USBR and USFWS. He said the PUDs requested to meet with the regional director on November 13, 2015, which will help work through the RME problem. He said the second issue is gene flow standards. Busack said there was a sliding scale, which people wanted to modify to a Ford model with basin-wide PNI. Busack suggested moving forward on creating the standards using this model, and that the spawning ground data will be available next week. Bill Gale said that would have to wait until USFWS counts fish heads with coded wire tags (CWTs) in the winter after summer Chinook salmon are done spawning. Busack said the plan for gene flow standards is to use a multi-population Ford model and specify a pHOS and proportion natural-origin broodstock for the separate PUD operations that, combined, provide standards that meet the Hatchery Committees' needs. Todd Pearsons said using general runs of PNI and weighted PNI in the PNI calculation spreadsheet for comparison, Busack's approach had a higher PNI than the other approaches. Busack said a workgroup should be set up to calculate the gene flow standards. Mike Tonseth said pHOS is needed to calculate PNI; therefore, WDFW needs snout counts and scales to confirm the origin of spawners for input to gene flow standards calculations. Gale said for the Methow-to-Winthrop program comparisons, if Winthrop NFH 4-year-old fish distribute the in the same manner as Winthrop NFH 5-year-old fish, the 4-year-old fish could be used as an estimate of distribution because they are ad-clipped. He said by using expansion, inferences could be made about the 5-year-old fish. He added coded wire tag data were also needed from hatchery recoveries this year.

Sarah Montgomery and Matt Cooper will send a Doodle poll to the Hatchery Committees in order to convene a conference call to discuss gene flow standards for Methow spring Chinook salmon.

VII. USFWS

A. USFWS Bull Trout Consultation Update (Bill Gale)

Craig Busack said NMFS has issued permits without completing bull trout consultation in the past. He said, for example, Amilee Wilson thought there was enough programmatic information for Wenatchee spring Chinook salmon to issue permits. He said if the Hatchery Committees have to wait for Karl Halupka to complete a Methow BiOp, it could take a few months. Bill Gale said the Wells BiOp and Federal Energy Regulatory Commission licensing effort provide bull trout coverage for these programs, and unlike the Wenatchee program, there are no new programs such as Nason Creek being added. Gale said he thinks the program is largely covered for bull trout, but Halupka should see if there is

anything that falls outside that umbrella of coverage. Greg Mackey said all hatchery operations and M&E activities are in the bull trout BiOp in the Wells program.
Mike Tonseth asked if the YN Goat Wall acclimation component has the necessary bull trout coverage. Keely Murdoch said the remote sites are being covered under coho salmon or multispecies BiOps.

Alene Underwood said Chelan PUD has a concern that if a coordination meeting were set up, conversations similar to those in previous meetings would occur. She said Chelan PUD would like to ensure the meeting is productive. Gale asked if the Hatchery Committees had responded to Halupka with comments on the Incidental Take Statement (ITS). Tonseth said WDFW has not responded. Gale said that Halupka was waiting for comments, and did not want to make changes that would be contradicted in later comments. Underwood said many comments had been provided on the ITS, and Chelan PUD was under the impression that he would continue to work on the ITS even though not all comments had been received, but a timeline was not made clear. Underwood said if there is substantive progress on the consultation, then Chelan PUD would like to have a coordination meeting. Tonseth said that with the tight timeline, maybe time would be better spent working on issues related to the consultations instead of having a coordination meeting. Kirk Truscott suggested Wilson send an email with the status update of things on the agenda, so meeting time is saved. Busack proposed that Wilson attend the next Hatchery Committees meeting on November 18, 2015, because there is a lot of overlap in material, and the NMFS consultation update could be one of the first topics. Underwood said it would be helpful if Halupka provided more regular updates.

Sarah Montgomery will put the NMFS consultation update first on the agenda for the Hatchery Committees meeting on November 18, 2015.

Busack will request that Amilee Wilson and Karl Halupka attend the next
Hatchery Committees meeting on November 18, 2015.

Following the bull trout consultation discussion, Tracy Hillman reported that many adult bull trout were observed in the Chiwawa River this year during snorkel surveys (Figure 1).

He said the number of bull trout was surprisingly high, and most were found in deep pools. Hillman said Nason Creek and the Little Wenatchee River were also surveyed, but not many bull trout were observed in those areas. Busack said the observations could be a result of displacement, similar to the White River. Tonseth said lacustrine bull trout are spawning above Little Wenatchee Falls.

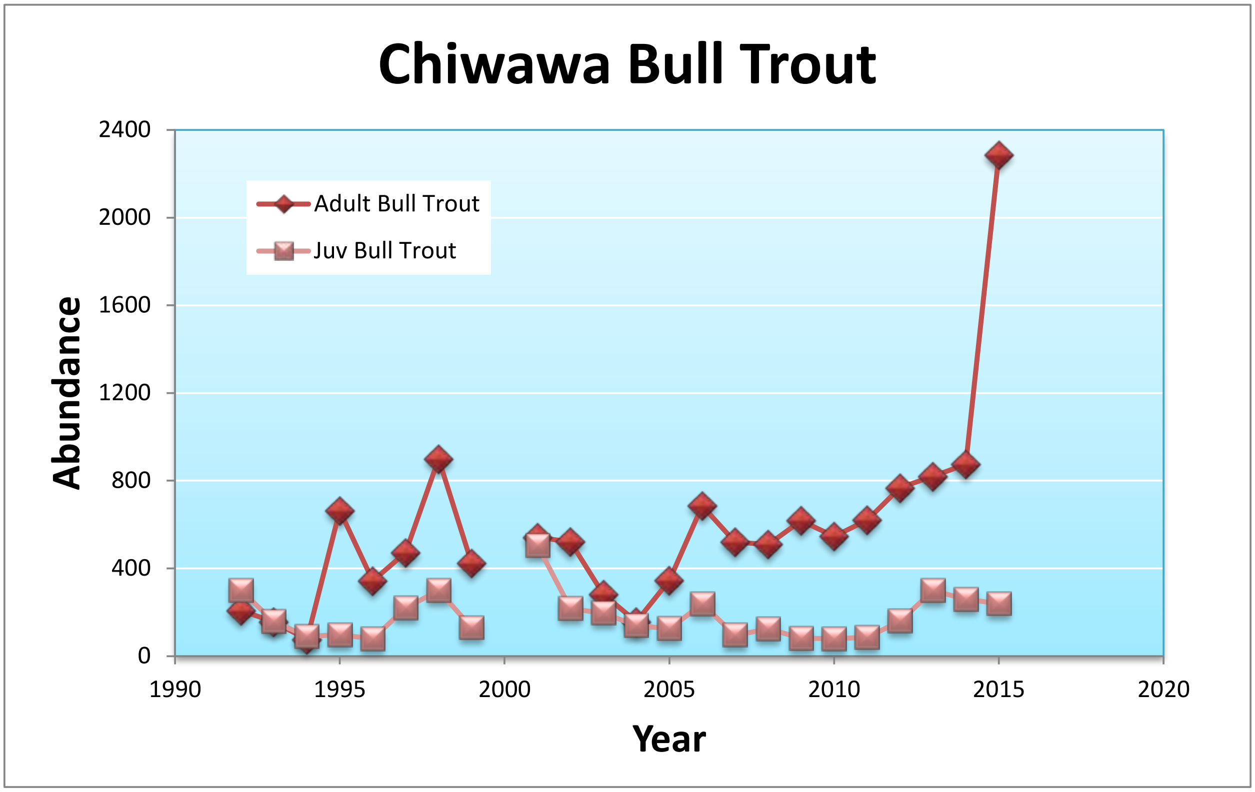


Figure 1
Bull Trout Abundance in Chiwawa River

VIII. HCP Administration

A. Next Meetings

The next scheduled Hatchery Committees meetings are on November 18, 2015 (Douglas PUD), December 16, 2015 (Chelan PUD), and January 20, 2016 (Douglas PUD).

List of Attachments

Attachment A	List of Attendees

Attachment B	Wenatchee River Relative Reproductive Success Studies
Attachment C	HRR Target Calculation
Attachment D	Winthrop NFH Spring Chinook Yearling Release Metrics
Attachment E	Wells Hatchery Modernization

Attachment A
List of Attendees

Name	Organization
Tracy Hillman	BioAnalysts, Inc.
Sarah Montgomery	Anchor QEA, LLC
Catherine Willard*	Chelan PUD
Alene Underwood*	Chelan PUD
Greg Mackey*	Douglas PUD
Tom Kahler*	Douglas PUD
Todd Pearsons	Grant PUD
Bill Gale*	U.S. Fish and Wildlife Service
Craig Busack*†	National Marine Fisheries Service
Mike Tonseth*	Washington Department of Fish and Wildlife
Matt Cooper*	U.S. Fish and Wildlife Service
Kirk Truscott*	Colville Confederated Tribes
Keely Murdoch*	Yakama Nation

Notes:
* Denotes Hatchery Committees member or alternate
† Joined by phone

Wenatchee River Relative Reproductive Success Studies

Michael Ford (NOAA)
Andrew Murdoch (WDFW)

Acknowledgements

Initial funding for this study was provided by NOAA, but CCPUD funded the majority of the work as part of their requirements under the Rock Island and Rocky Reach HCPs. WDFW MGL provided broodstock genotypes that greatly added to the study and were also funded by CCPUD under their Hatchery M & E program.

Background

- Hood River RRS Studies (Araki 2008)
  - Adult life stage only
  - Domesticated programs
    - Summer run = 31-45%
    - Winter run = 6-11%
  - Local broodstock (winter run)
    - 1st Gen(e.g., W x W) = 85%
    - 2nd Gen (e.g., H x W) = 38%
- Little Sheep Creek (Bernston et al. 2011)
  - Adult and juvenile life stages
  - Hatchery program started in 1982 uses both hatchery and wild broodstock
  - RRS = 30 to 60% no difference between life stages

Study Objective

- Measure the relative reproductive success of hatchery-origin steelhead in the natural environment
- Determine the degree to which any differences in reproductive success between hatchery and natural steelhead can be explained by measurable biological characteristics

Study Design

- 4 brood years (2008 – 2011)
  - Adult (parents) sampled at Tumwater Dam
    - W; WW; WH; HH; UH
  - Juveniles (progeny) sampled at smolt traps and rearing areas
  - Multiple juvenile life stages (parr and smolt)
    - Age 1 (parr and smolt)
    - Age 2 (parr and smolt)

Agenda

- Differences in traits (Andrew)
  - Migration timing
  - Age at maturity
  - Size at age
  - Fecundity
  - Spawn timing
  - Spawning location
- Relative Reproductive Success (Mike)
  - Overview
  - Influence of biological traits
  - Influence of parental origin

Attachment B

Steelhead at Tumwater Dam

Brood Year	Hatchery	Wild	Total	% of Run Escapement	Run escapement
2008	842	454	1296	0.999	1297
2009	1196	349	1545	0.998	1548
2010	1456	776	2232	0.997	2238
2011	312	811	1123	0.990	1134
All years	3806	2390	6196	0.997	6217

Attachment B

Hatchery/Wild Ratios

Brood Year	Sex	Hatchery	Wild	H/W Ratio
2008	**All**	**842**	**454**	**1.85**
	Male	580	252	2.30
	Female	262	202	1.30
2009	**All**	**1196**	**349**	**3.43**
	Male	549	167	3.29
	Female	647	182	3.55
2010	**All**	**1456**	**776**	**1.88**
	Male	885	391	2.26
	Female	571	385	1.48
2011	**All**	**312**	**811**	**0.38**
	Male	171	325	0.53
	Female	141	486	0.29

Attachment B

Sex Ratios

Year	Sex	Hatchery			Natural	
		Number	M:F		Number	M:F
2008	F	252	2.15:1.0		207	1.33:1.0
	M	542			276	
2009	F	634	0.86:1.0		181	0.93:1.0
	M	544			168	
2010	F	565	1.56:1.0		385	1.02:1.0
	M	884			392	
2011	F	140	1.23:1.0		481	0.67:1.0
	M	172			322	
All	F	1,591	1.35:1.0		1,254	0.92:1.0
	M	2,142			1,158	

Male hatchery steelhead return in relatively greater abundance than male natural steelhead

Ocean Age (Males)

Salt age	HH	HW	WW	Wild
1	66	729	576	657
2	35	254	299	453
1	0.65	0.74	0.66	0.59
2	0.35	0.26	0.34	0.41

Male hatchery steelhead have a younger ocean age

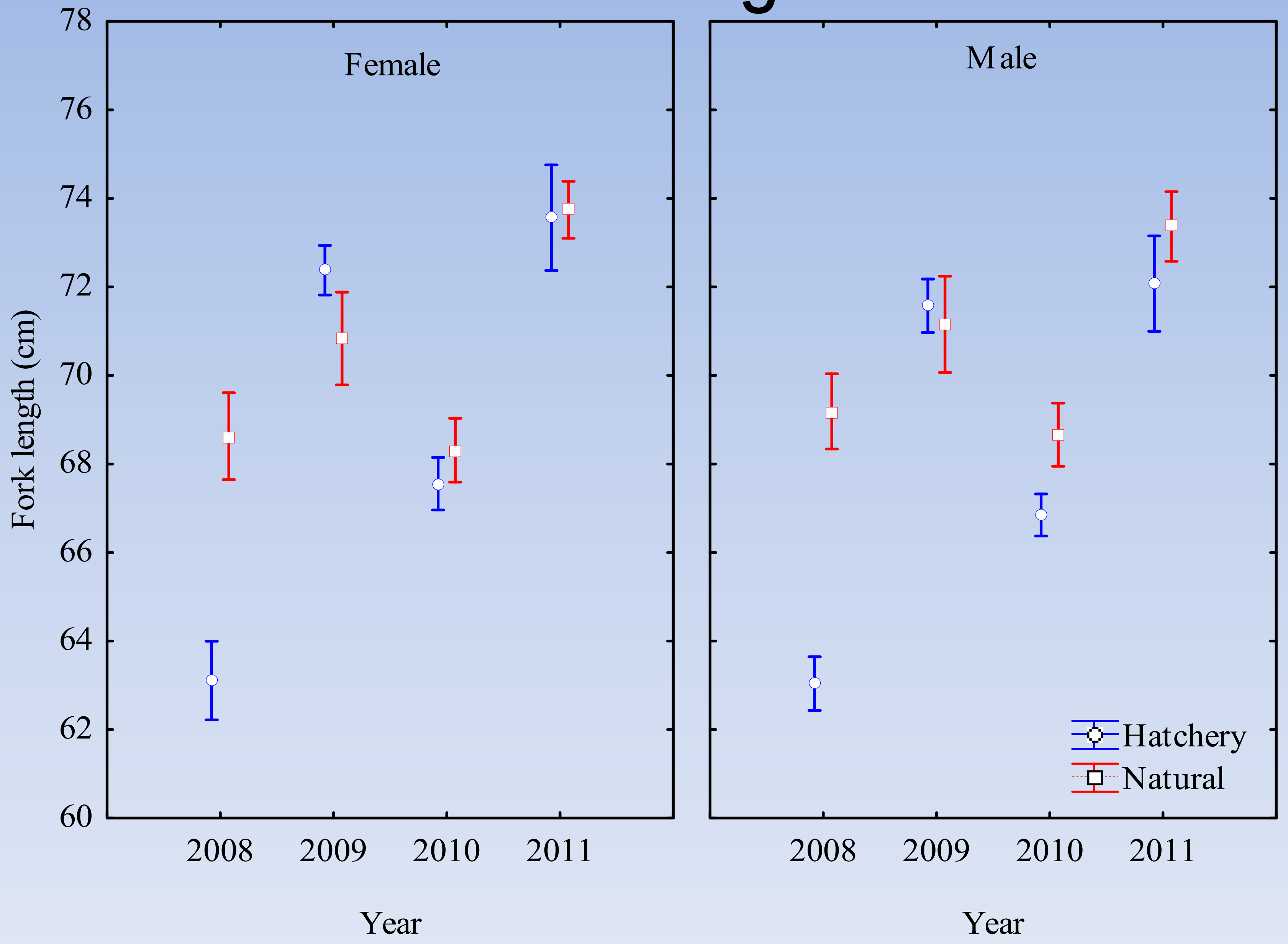
Ocean Age (Females)

Salt age	HH	HW	WW	Wild
1	21	338	226	421
2	58	397	433	833
1	0.27	0.46	0.34	0.34
2	0.73	0.54	0.66	0.66

Female hatchery steelhead have a more similar ocean age

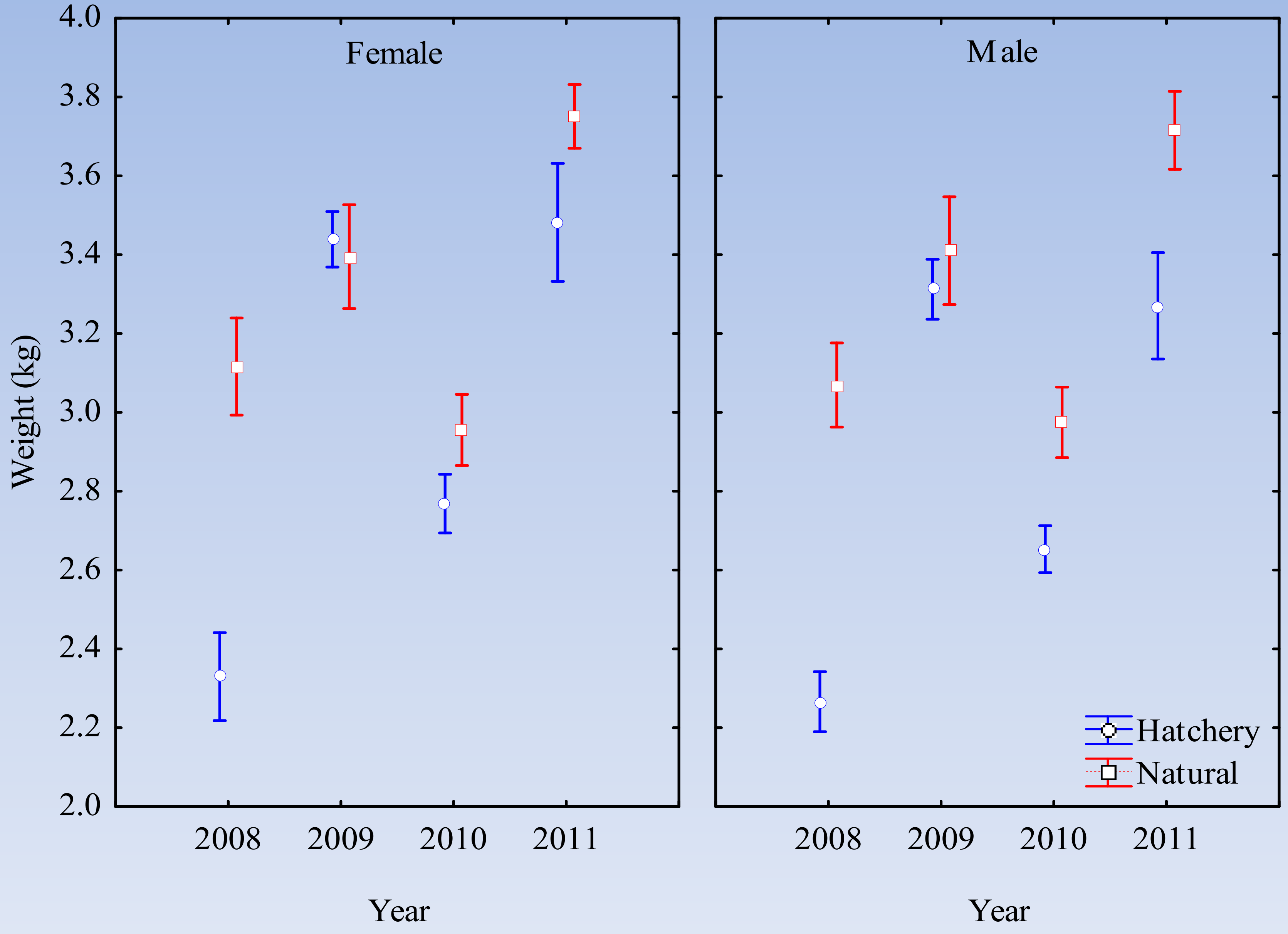
Attachment B

Fork Length

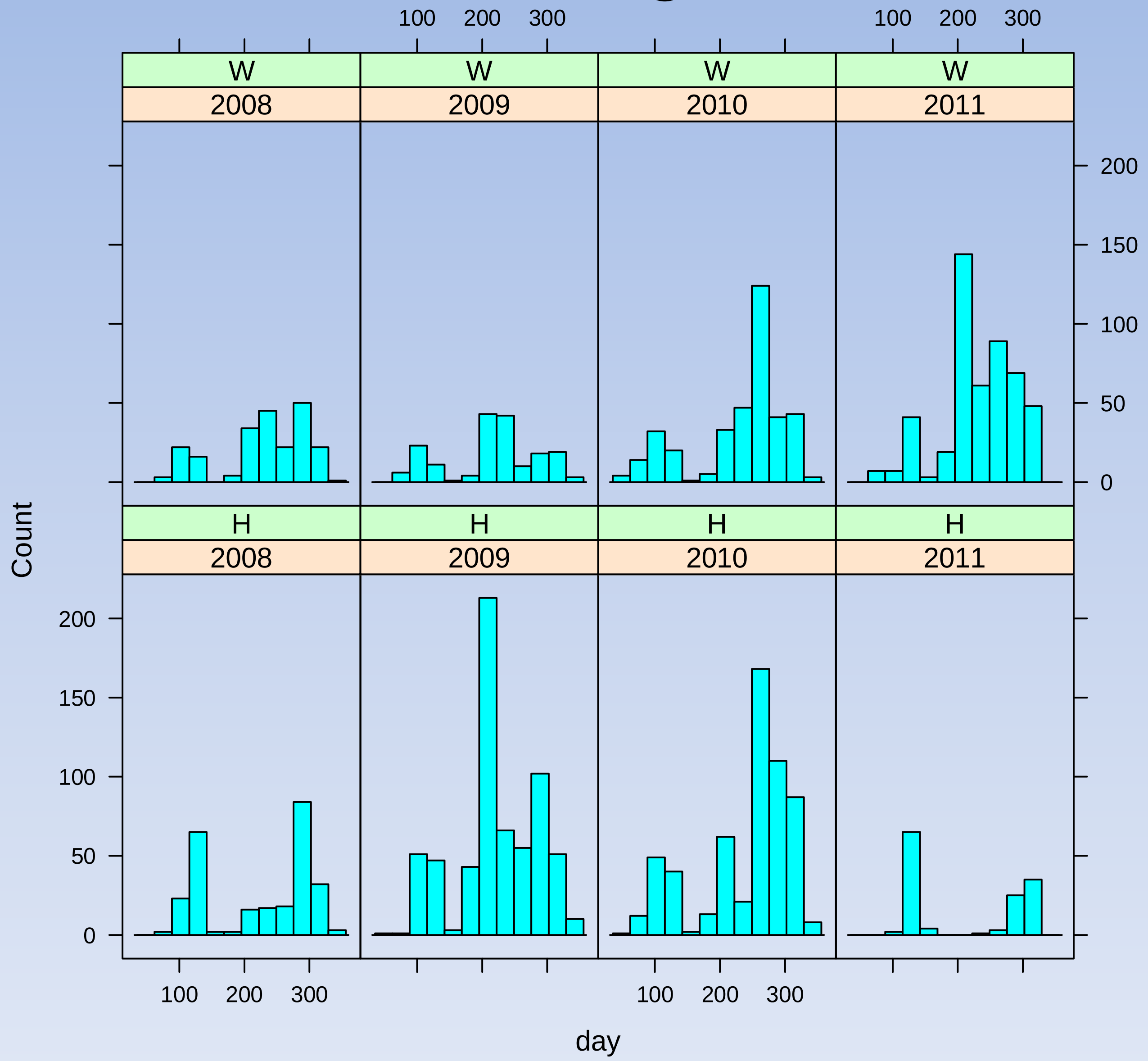


Attachment B

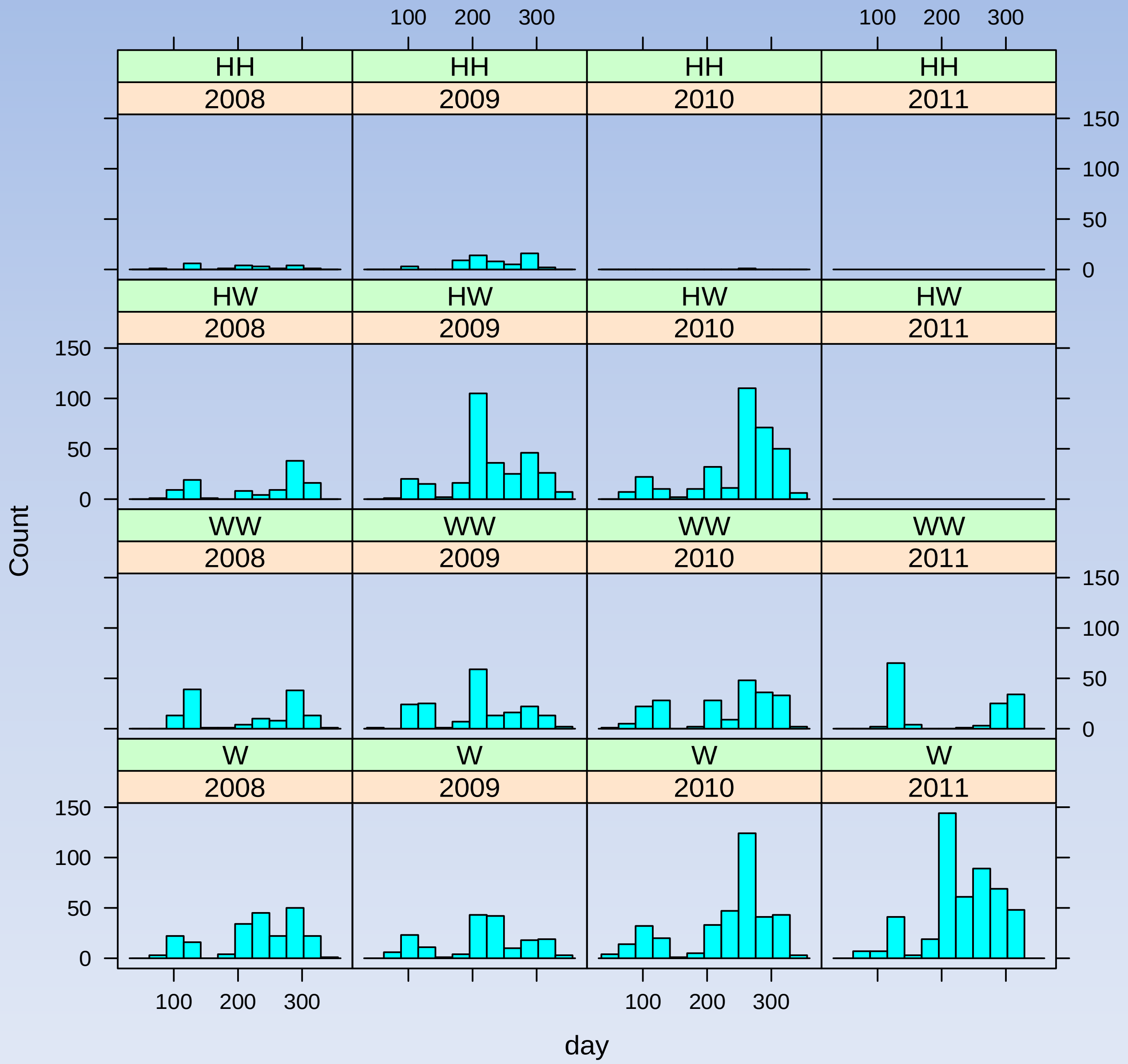
Weight



Arrival Timing - females



Arrival Timing - females



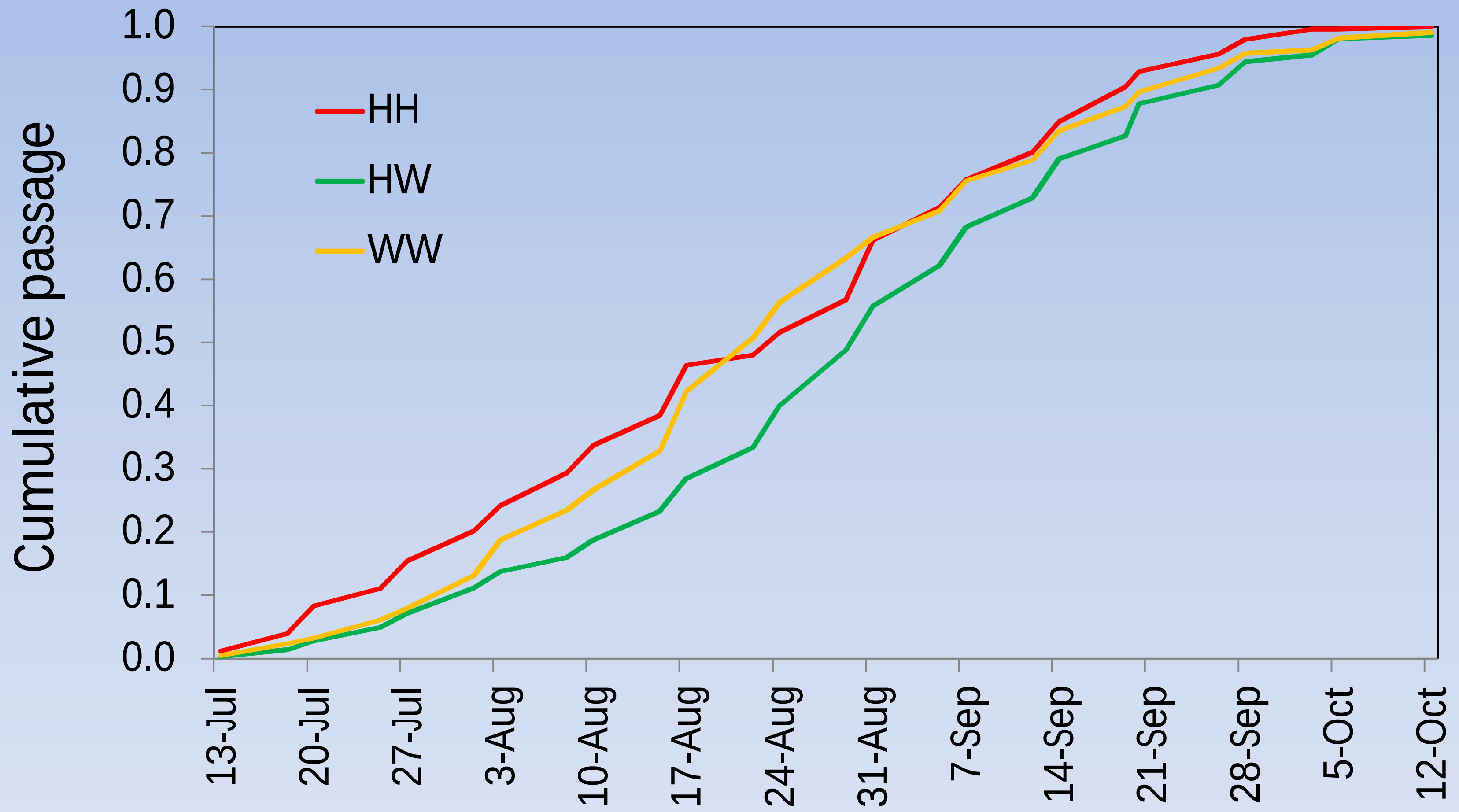
13% spring

15% spring

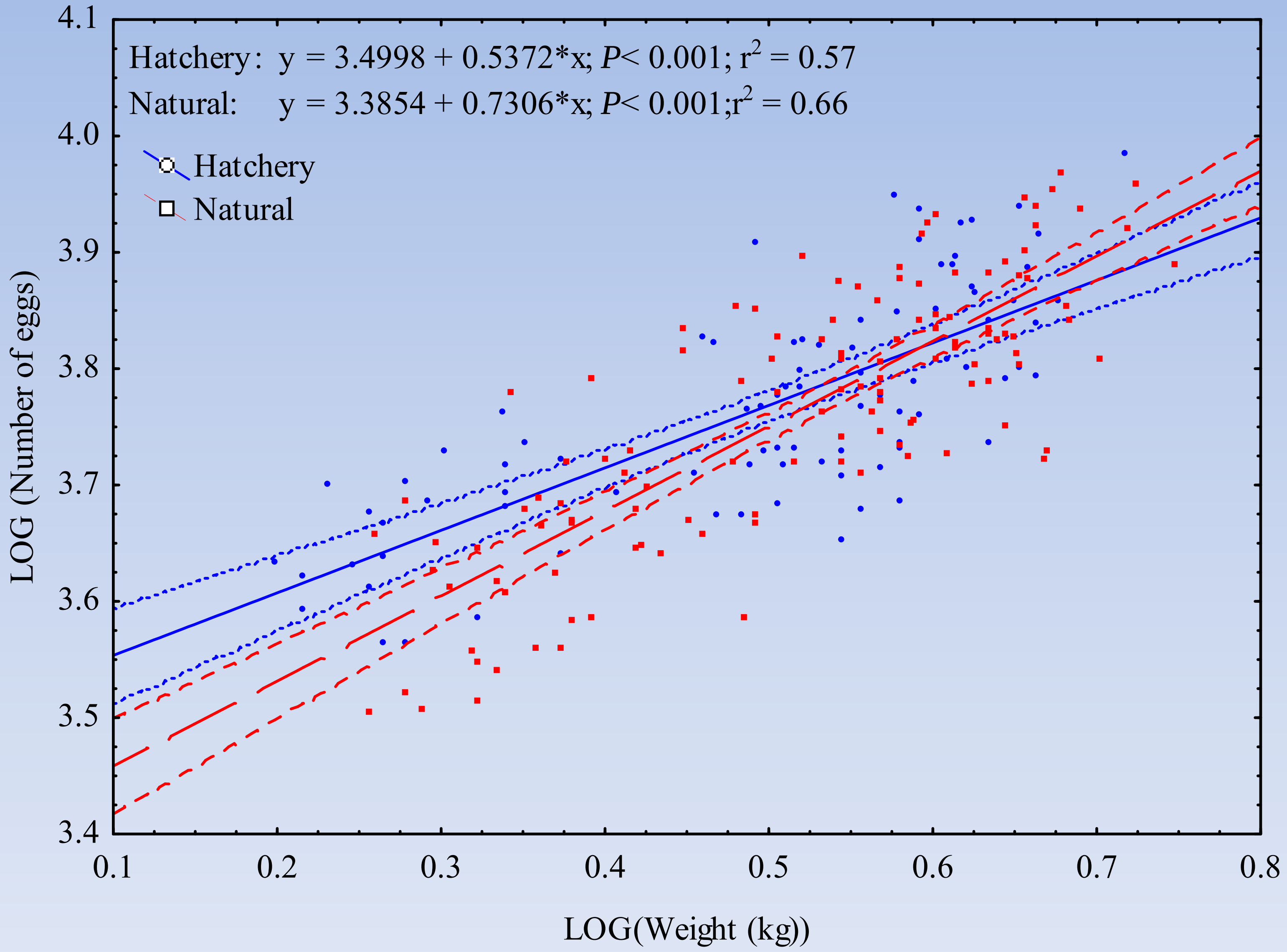
35% spring

17% spring

PRD Run Timing (2007-2010)



Fecundity

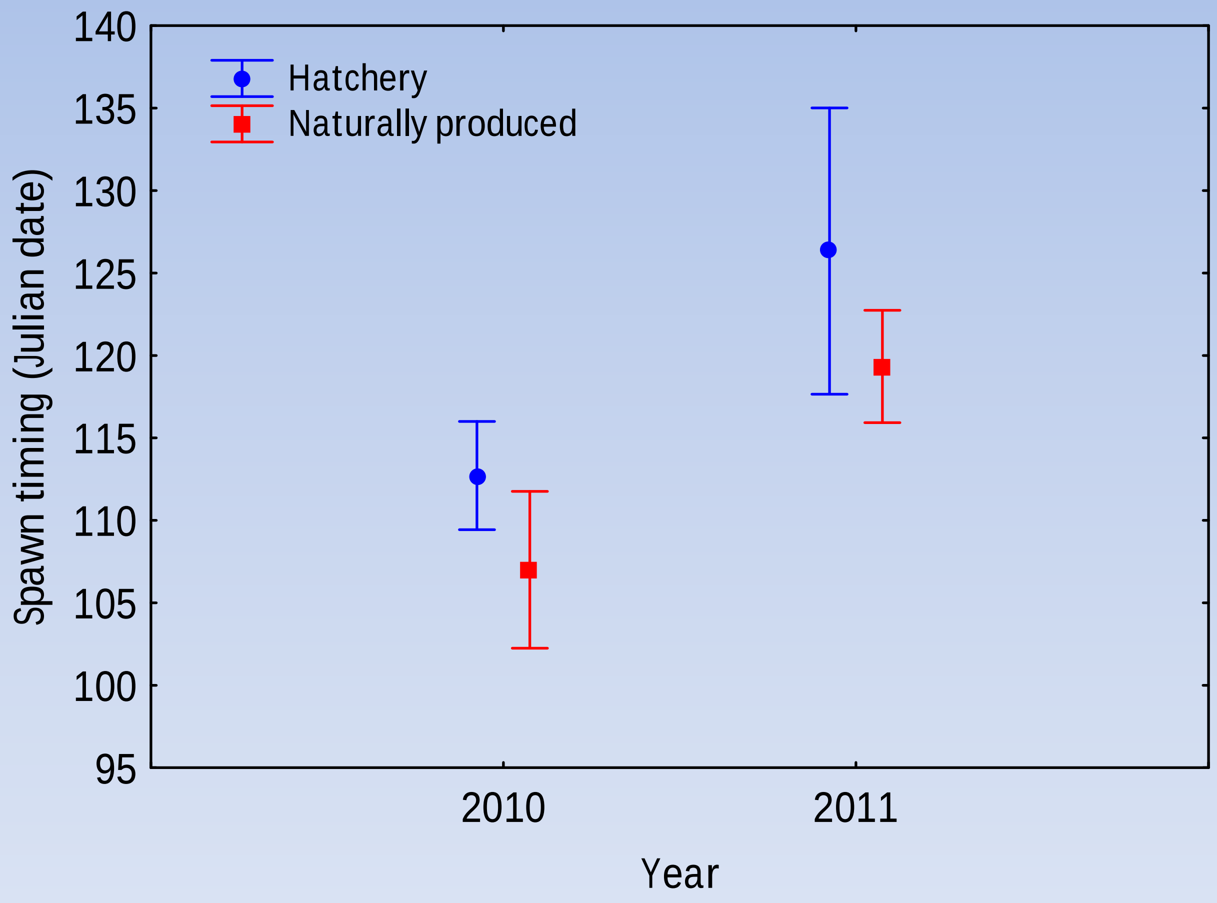

Hatchery: y = 3.4998 + 0.5372*x; P< 0.001; r2 = 0.57
Natural: y = 3.3854 + 0.7306*x; P< 0.001;r2 = 0.66
Hatchery
Natural
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
LOG (Number of eggs)
LOG(Weight (kg))

Attachment B

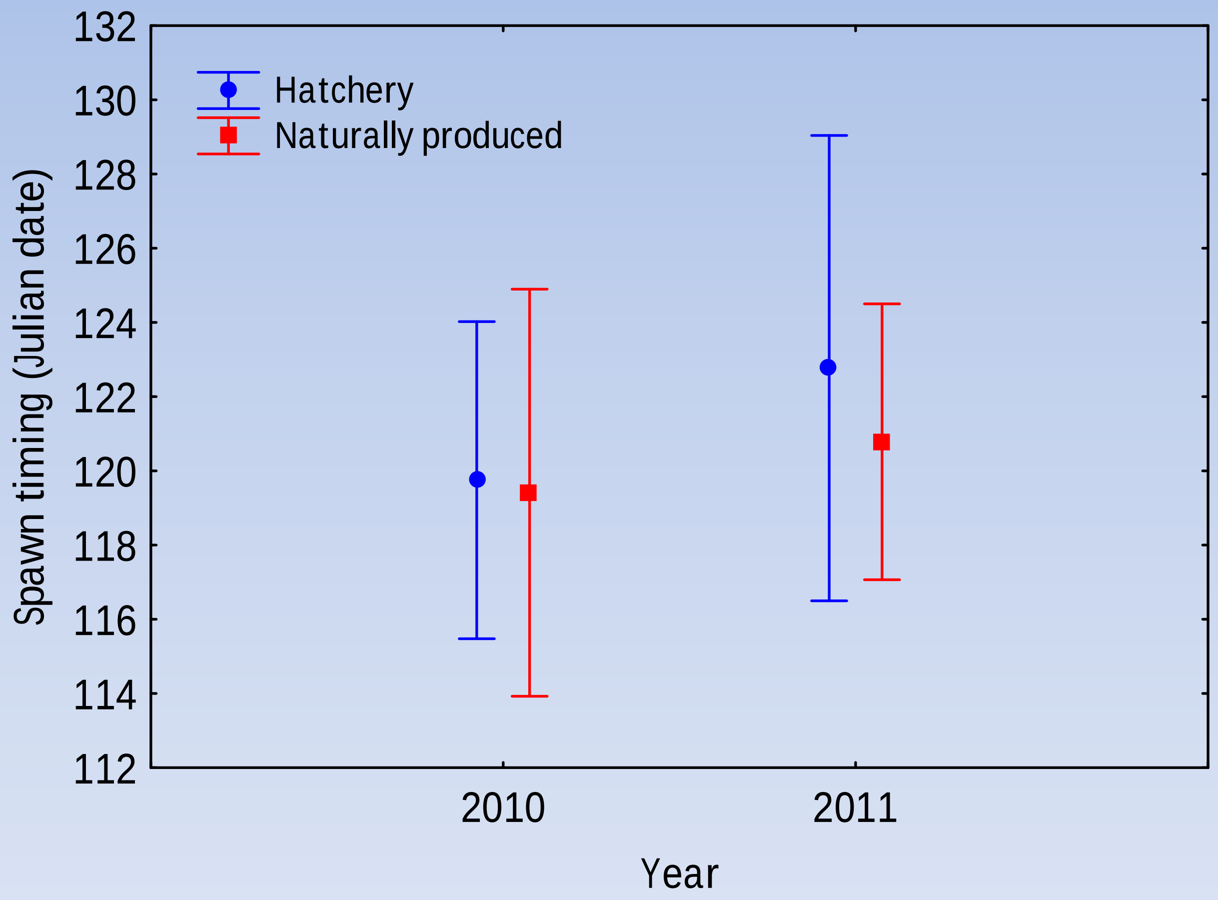
Potential Egg Deposition

Year	Origin	N	Mean	SE	Total	Difference
2008	Hatchery	252	4,932	59	1,242,912	8.8%
	Natural	207	5,516	65	1,141,864	
2009	Hatchery	634	6,105	37	3,870,739	263.7%
	Natural	181	5,880	70	1,064,211	
2010	Hatchery	565	5,409	39	3,056,076	49.6%
	Natural	384	5,319	48	2,042,466	
2011	Hatchery	140	6,134	79	858,817	-71.9%
	Natural	481	6,349	43	3,053,653	

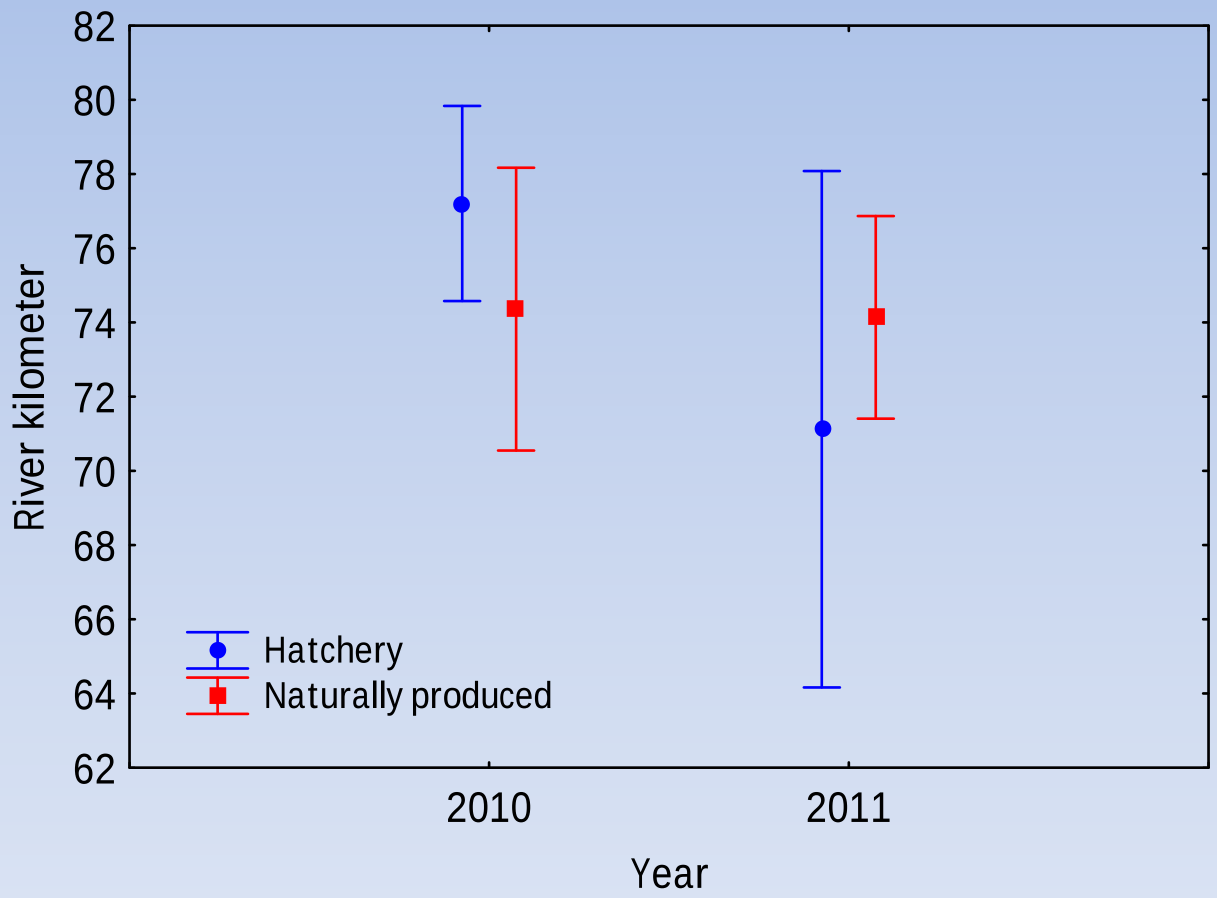
Wenatchee River



Nason Creek

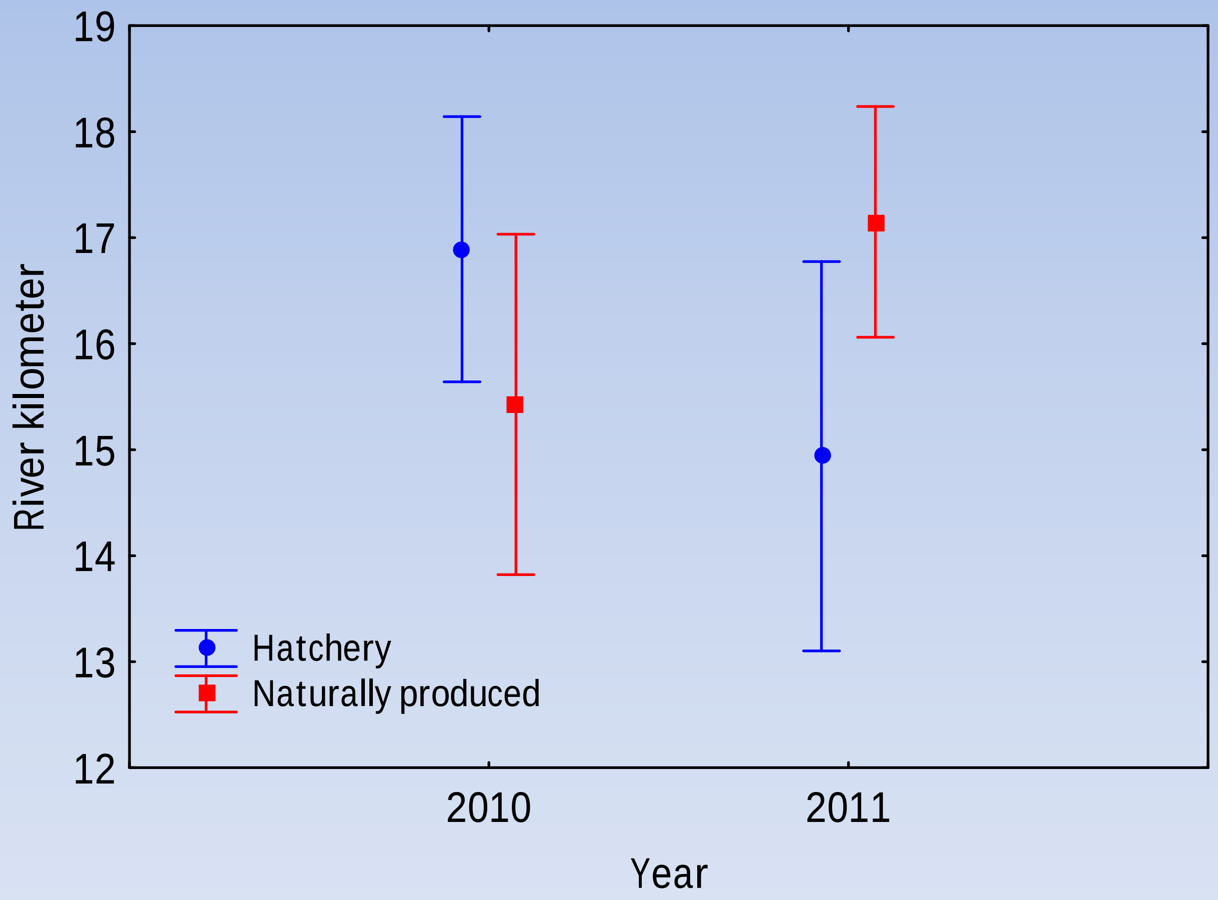

Hatchery
Naturally produced
Spawn timing (Julian date)
132
130
128
126
124
122
120
118
116
114
112
2010
2011
Year

Wenatchee River



Attachment B

Nason Creek

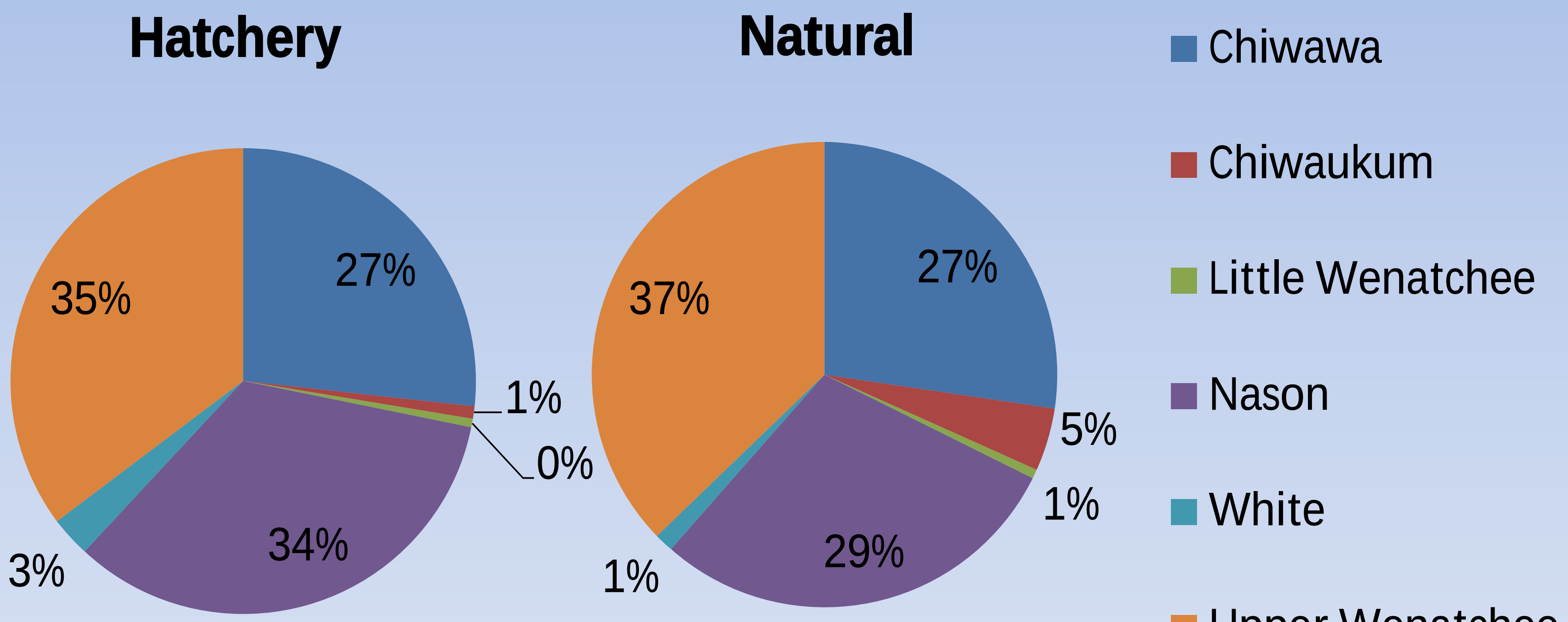


Spawning location

- Elevation was not a significant factor
  - Wenatchee River
    - No difference was detected between or within years (Kruskal – Wallis ANOVA: P = 0.07)
  - Nason Creek
    - Differences were detected between years (Kruskal – Wallis ANOVA: P = 0.05), but not between origins in 2010 (P = 1.0) or 2011 (P = 0.09).

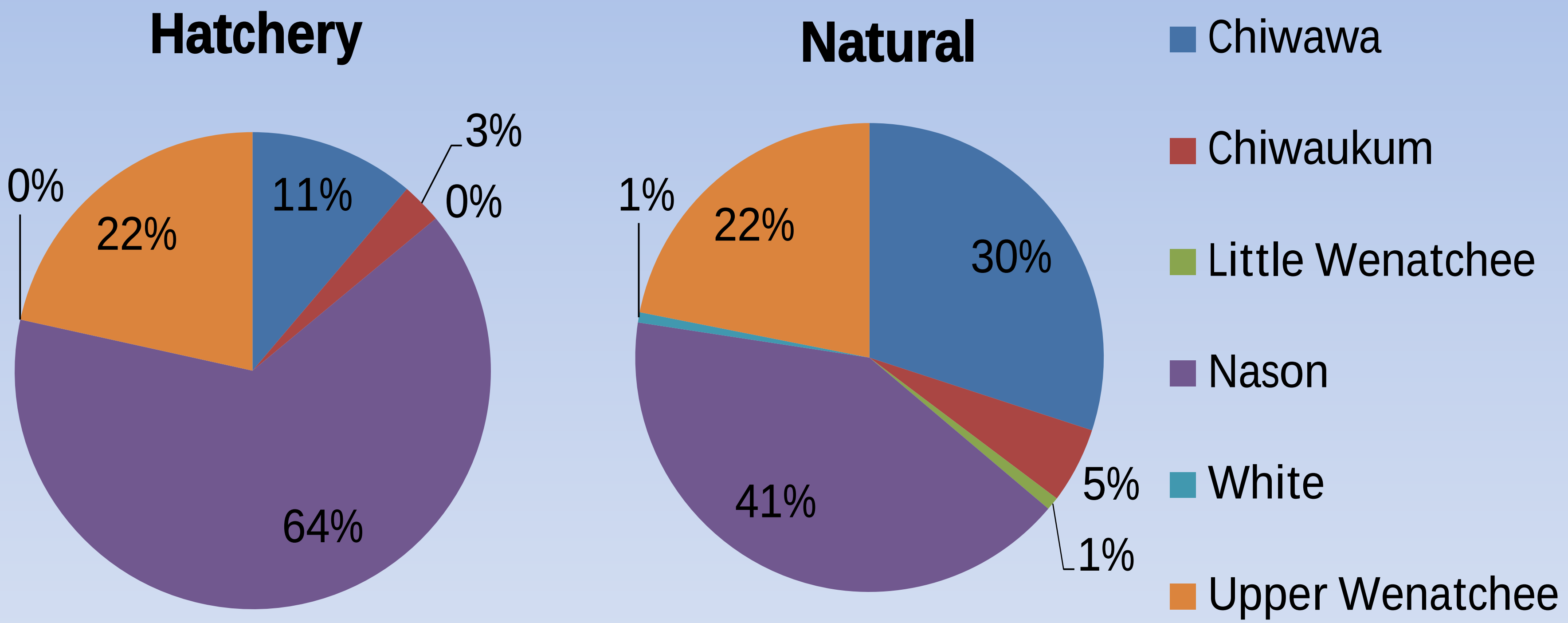
Attachment B

Spawner Distribution 2008-2010



Similar distributions among spawning areas with natural fish using Chiwaukum more and Nason Creek less compared to hatchery fish

Spawner Distribution 2011



Hatchery fish were predominating spawning in Nason Creek

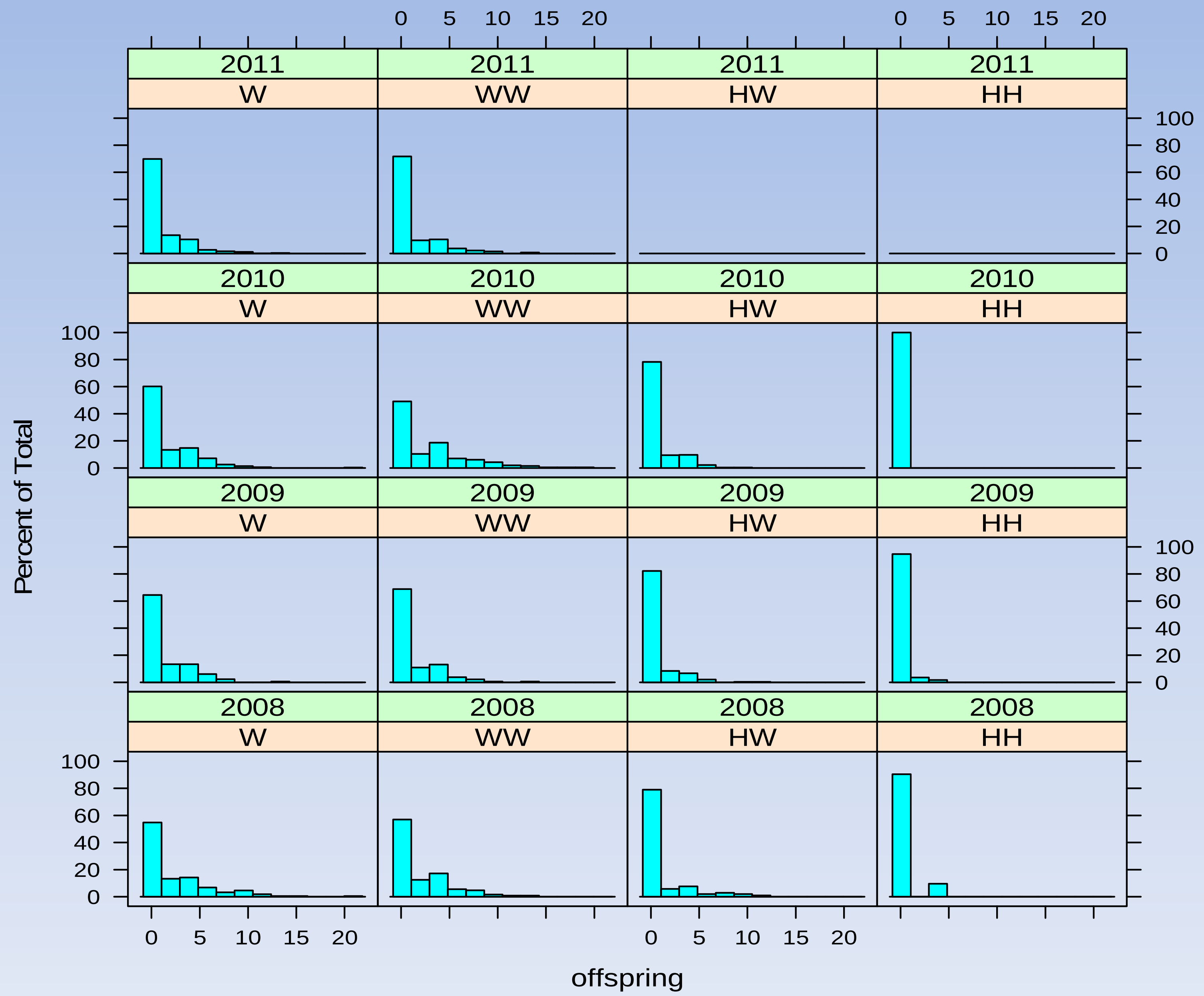
Attachment B

Pedigree Assignment Rates

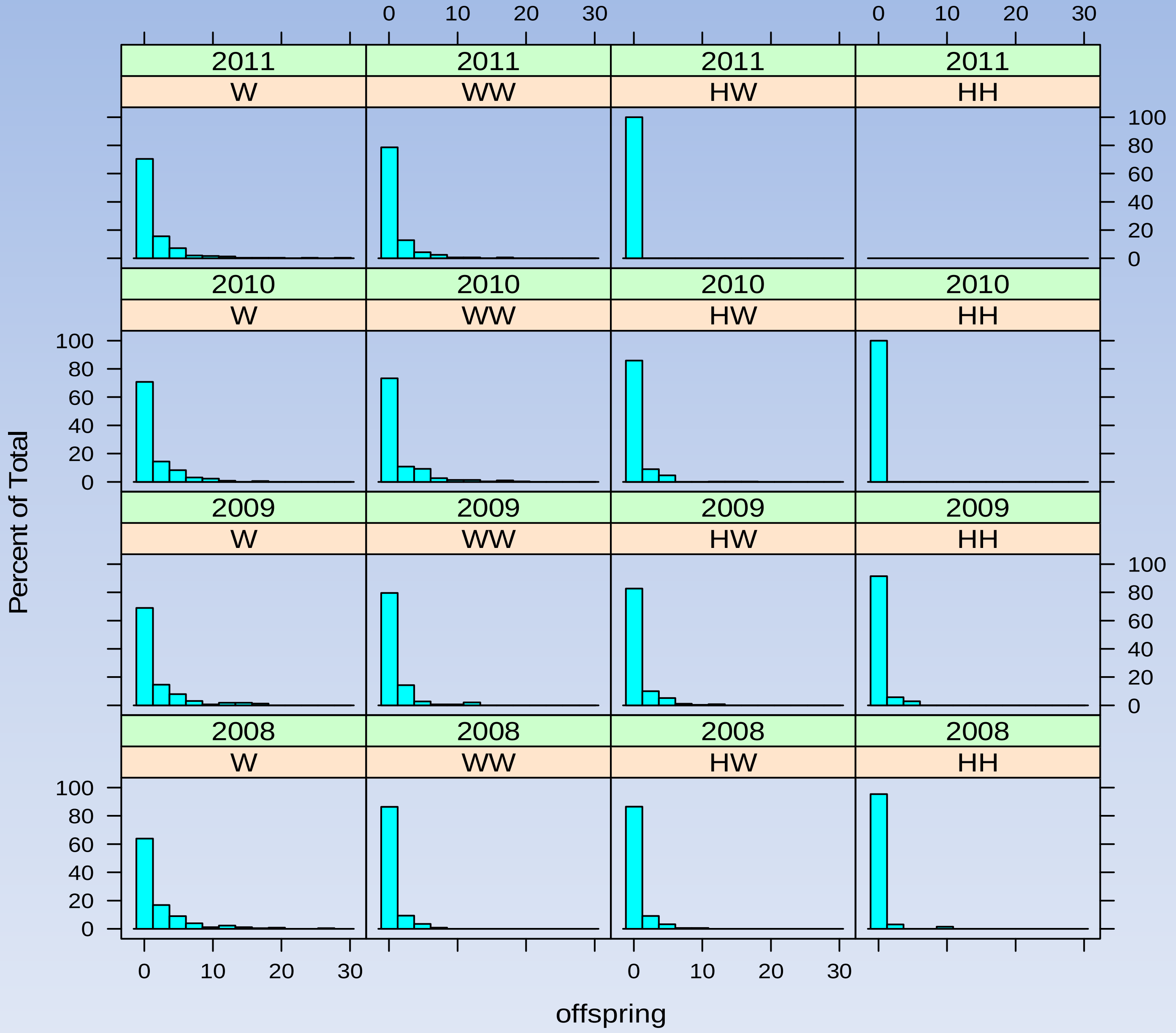
96 Single Nucleotide Polymorphism loci

Parents	N	Proportion
Two parents	4,296	0.540
Mom only	1,648	0.212
Dad only	1,169	0.150
Neither parent	788	0.100

Progeny Distribution by Cross - females

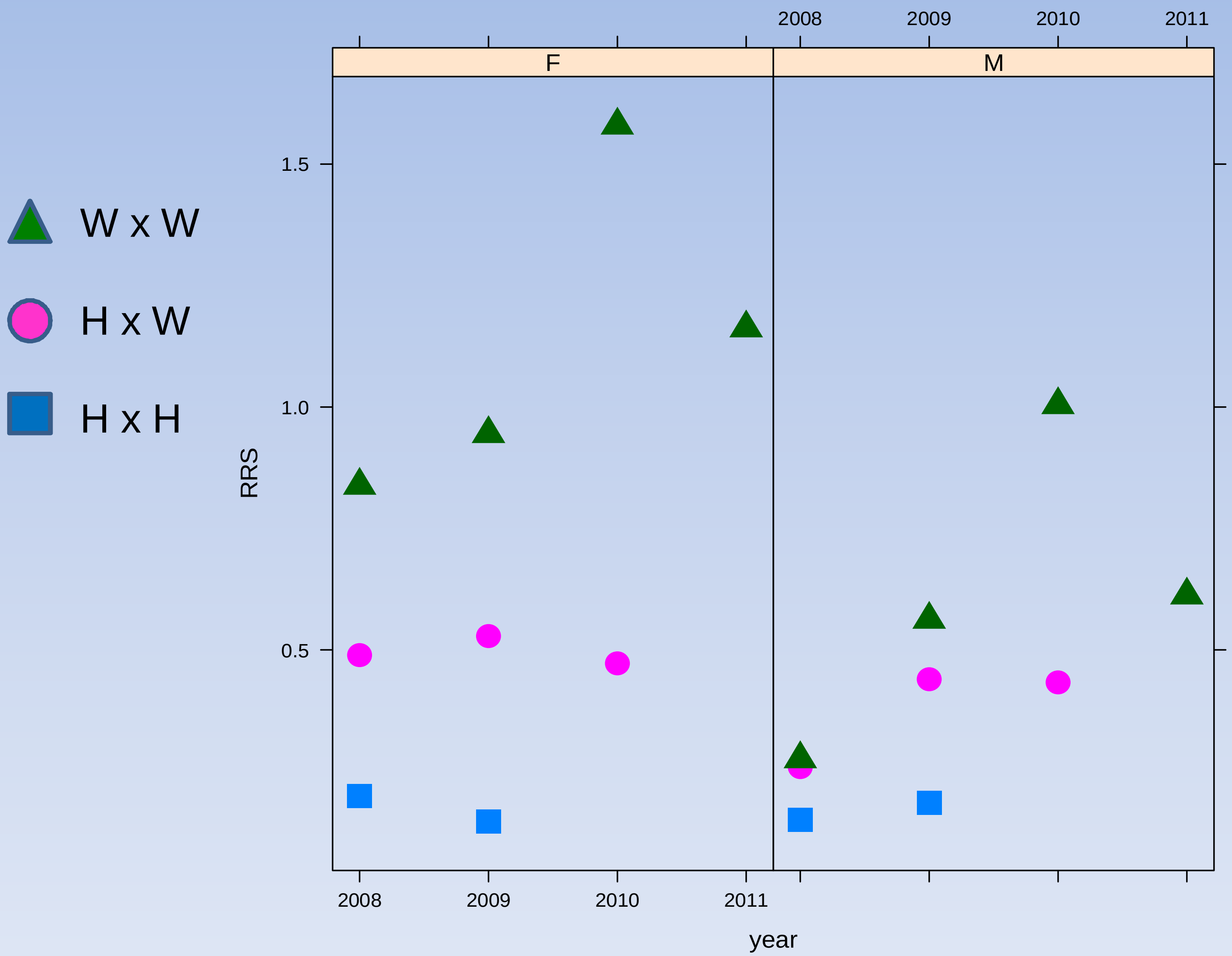


Progeny Distribution by Cross - males



Attachment B

RRS by Year and Cross



Factors Influencing the Number of Progeny (H vs. W) - males

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-6.17	1.25	-4.918	8.75E-07
as.factor(salt.age)2	-0.55	0.34	-1.585	0.113
originW	0.42	0.18	2.384	0.0171
fkl	0.09	0.02	4.331	1.49E-05
seasonsummer	0.29	0.46	0.634	0.5258
day	0.00	0.00	0.036	0.9712

Factors Influencing the Number of Progeny (HW vs. WW vs. W) -- males

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-7.62	0.60	-12.798	< 2e-16
as.factor(salt.age)2	-0.71	0.15	-4.756	1.97E-06
conscrossHW	0.70	0.26	2.743	0.00609
conscrossW	1.34	0.25	5.301	1.15E-07
conscrossWW	1.02	0.26	3.988	6.67E-05
fkl	0.09	0.01	10.639	< 2e-16
seasonsummer	0.44	0.21	2.116	0.03437
day	0.00	0.00	-0.274	0.78422

Factors Influencing the Number of Progeny (H vs. W) - females

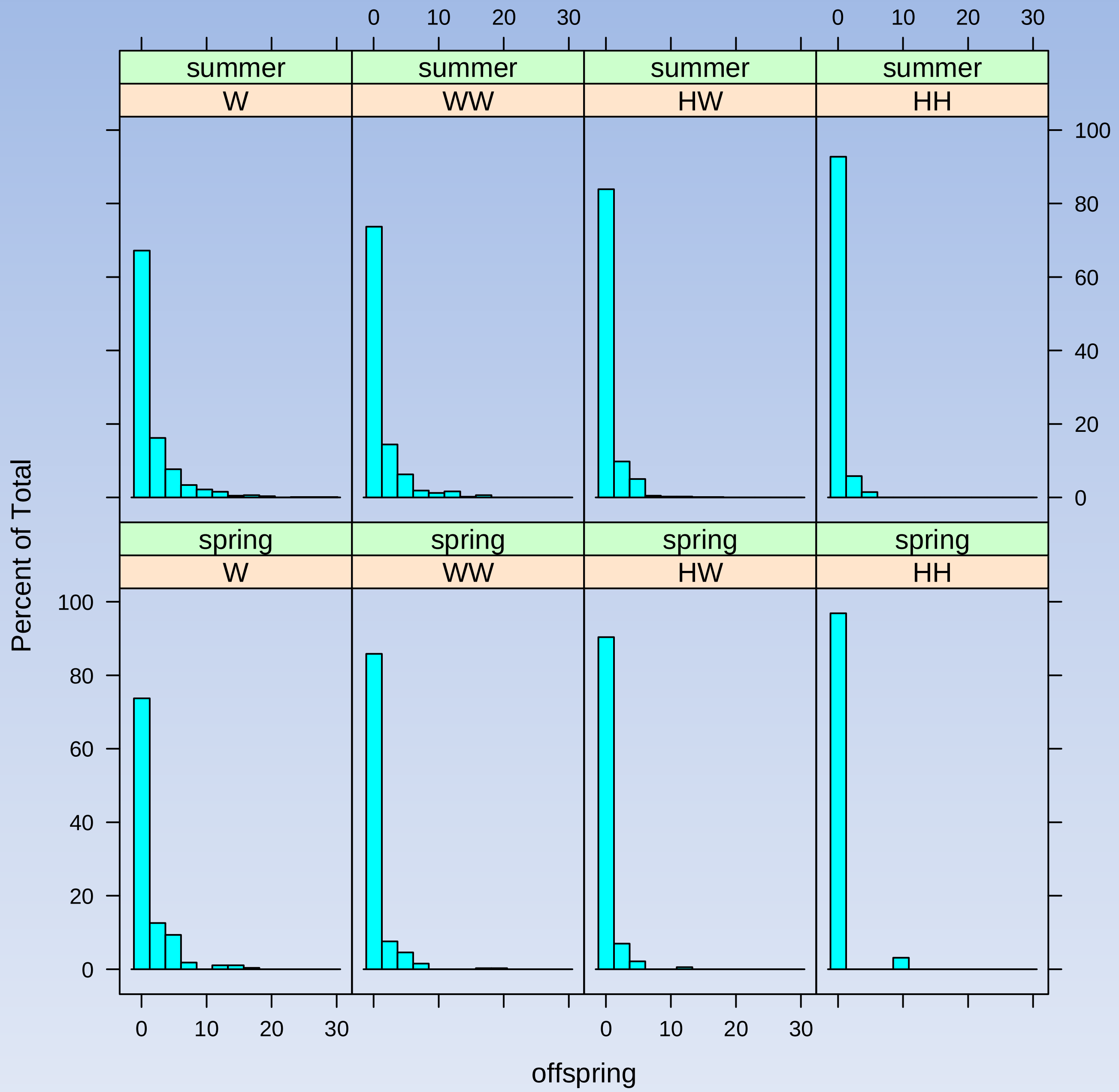
	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-3.17	0.51	-6.276	3.48E-10
originW	0.10	0.06	1.596	0.111
as.factor(salt.age)2	-0.17	0.12	-1.414	0.157
seasonsummer	0.12	0.14	0.821	0.412
fkl	0.05	0.01	5.567	2.60E-08
day	0.00	0.00	-0.281	0.779

Factors Influencing the Number of Progeny (HW vs. WW vs. W) -- females

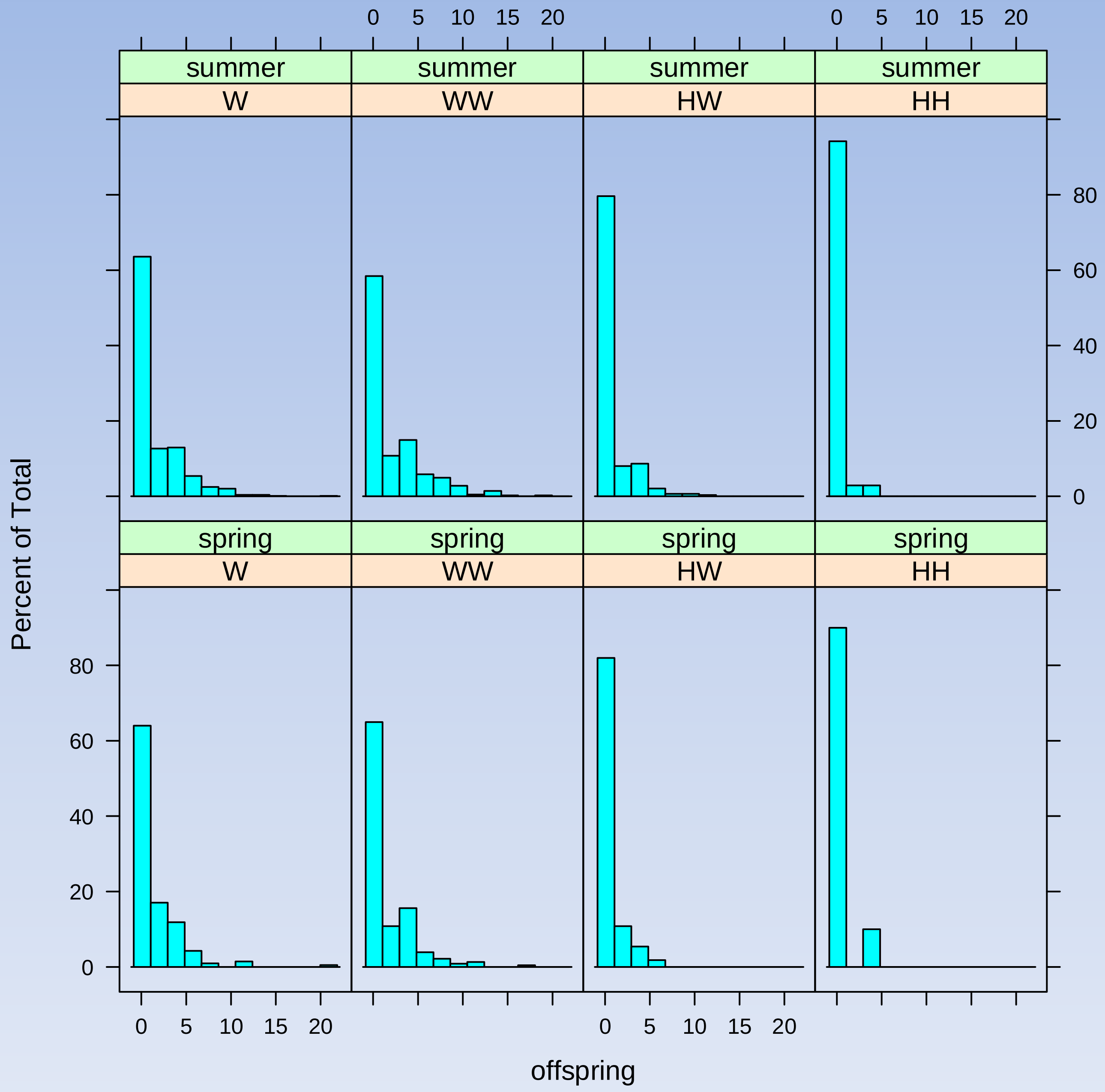
	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-4.04	0.56	-7.183	6.84E-13
as.factor(salt.age)2	-0.14	0.12	-1.184	0.236359
conscrossHW	0.98	0.26	3.758	0.000171
conscrossW	1.50	0.26	5.808	6.33E-09
conscrossWW	1.76	0.26	6.741	1.58E-11
fkl	0.04	0.01	4.533	5.82E-06
day	0.00	0.00	-1.132	0.257434
seasonsummer	0.36	0.15	2.462	0.013827

Attachment B

Offspring by season and cross types, males



Offspring by season and cross types, females



Attachment B

Wenatchee vs. Other Steelhead RRS Studies

Sex	Cross	Wenatchee	Hood River	Little Sheep Creek
Male	HH	0.17	--	--
	HW	0.37	0.39	--
	WW	0.56	0.71	--
	Mixed H	--	--	0.44
Female	HH	0.17	--	--
	HW	0.50	0.50	--
	WW	1.10	0.91	--
	Mixed H	--	--	0.39

Life History Traits Summary

- Many differences detected between hatchery and natural fish
  - Younger fresh and ocean age
  - Greater proportion of adults are male
  - Female more fecund at a given size
  - WW fish generally more similar to natural fish than HH
- No apparent differences in spawn timing
- Spawning distribution similar, but can be changed if warranted.

RRS Summary

- HH fish have the lowest RRS
- WW fish females have similar RRS to wild females, WW males have RRS < in 3 of 4 years
- WH males and females have RRS < 1
- Results are very similar to Hood River study
- Size and season also contribute to variation in RRS among individuals (bigger = better; summer = better).

Attachment C

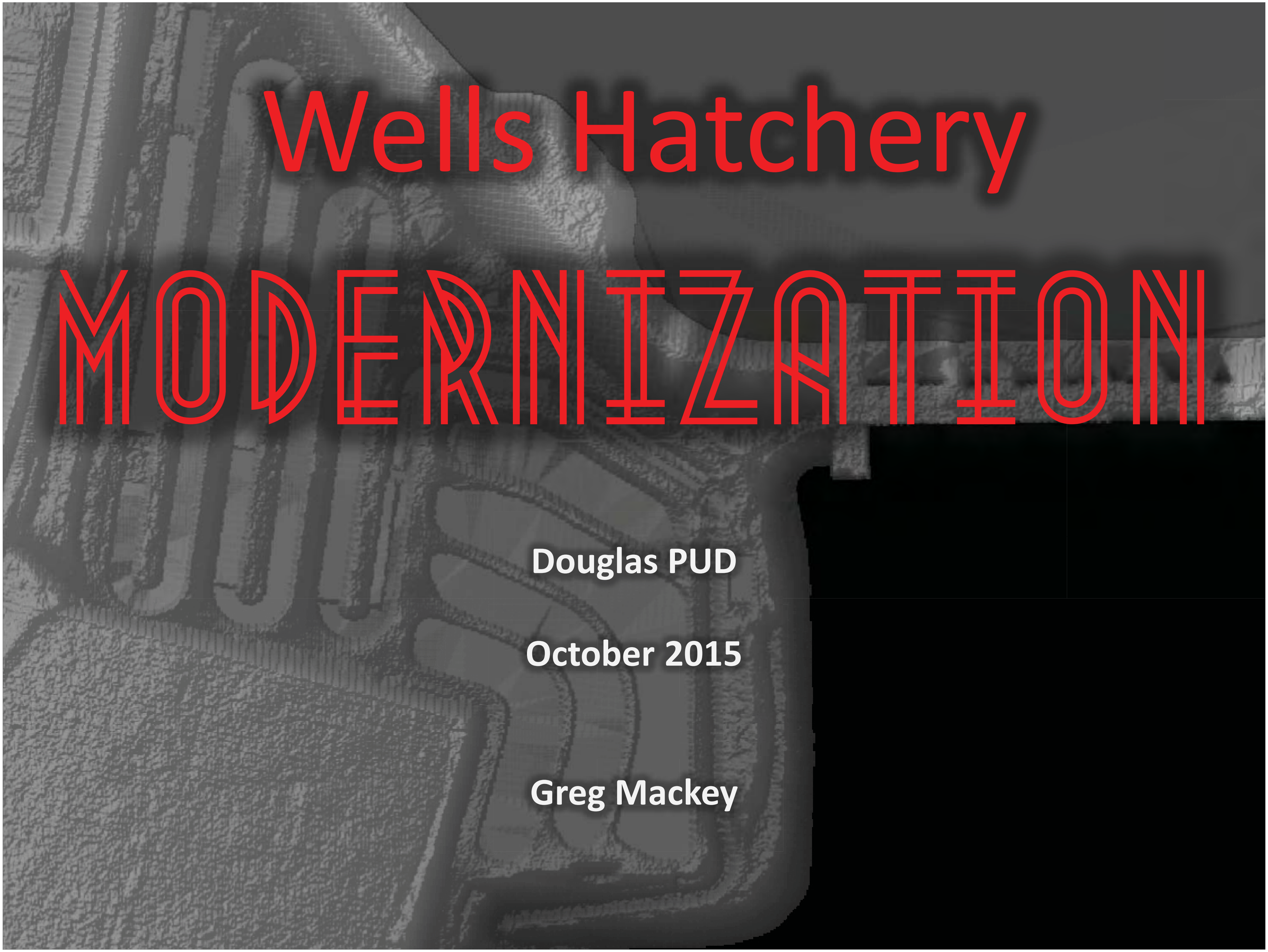
HRR Calculation Approach

Max Hatchery Fish Escapement	500	Minimum spawning escapement is 500. If zero wild fish we would need 500 hatchery fish. This is the max hatchery fish that would be required
Broodstock	130	Number of broodstock required by program. From 2015 Broodstock Protocol
HRR Target	3.846154	Calculated HRR included spawning escapement and broodstock needs

Table X. Winthrop NFH spring Chinook yearling release metrics

Brood Year	**Broodstock Retained** *(excludes transfers, adult mgmt (surplus), etc.)*	**Smolts Released** *(Yearling groups only)*	**Basin Return** *(CWT returns to WNFH, MFH, and SpnGrnds)*	**Total Adult Return** *(Basin Return plus all fishery CWT recoveries, etc.)*	**SAR** *(based on total adult rtn, col F)*	**Smolts per adult** *(Brood retained)*	**Subbasin HRR** *(Brood retained)*	**Total HRR** *(Brood retained)*	*MetComp Methow River Program (WDFW data) HRR*
2001	383	461,678	437	465	0.0010	1,205	1.14	1.21	*4.50*
2002	388	578,307	552	562	0.0010	1,490	1.42	1.45	*4.14*
2003	433	550,214	625	638	0.0012	1,271	1.44	1.47	*0.65*
2004	344	484,090	693	790	0.0016	1,407	2.02	2.30	*1.18*
2005	404	589,693	1,072	1,117	0.0019	1,460	2.65	2.77	*1.81*
2006	391	509,045	2,211	2,576	0.0051	1,302	5.65	6.59	*4.84*
2007	340	371,959	1,210	1,356	0.0036	1,094	3.56	3.99	*8.28*
2008	417	495,978	2,405	2,659	0.0054	1,189	5.77	6.38	*7.92*
2009	367	426,980	1,086	1,116	0.0026	1,163	2.96	3.04	- -
2010	432	499,959	- -	- -	- -	- -	- -	- -	- -
2011	426	328,636	- -	- -	- -	- -	- -	- -	- -
2012	468	560,379	- -	- -	- -	- -	- -	- -	- -
2013	500	403,510	- -	- -	- -	- -	- -	- -	- -
2014	517								
2015	445								

Attachment E



Wells Hatchery

MODERNIZATION

Douglas PUD

October 2015

Greg Mackey

Attachment E

Attachment E

Attachment E

Attachment E

Attachment E

Attachment E

ANCHOR QEA

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FINAL MEMORANDUM

To: Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees
Date: December 17, 2015
From: Tracy Hillman, HCP Hatchery Committees Chairman
Cc: Sarah Montgomery, Anchor QEA, LLC
Re: Final Minutes of the November 18, 2015, HCP Hatchery Committees Meeting

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees meeting was held at Douglas PUD headquarters in East Wenatchee, Washington, on Wednesday, November 18, 2015, from 9:30 a.m. to 3:00 p.m. Attendees are listed in Attachment A to these meeting minutes.

ACTION ITEM SUMMARY

- Craig Busack will discuss with Keely Murdoch any further documentation needed for NMFS consultation on Goat Wall Acclimated Releases (Item I-A).
- Mike Tonseth will add contingencies for overages to the Broodstock Collection Protocols (Item I-A).
- Tonseth and Andrew Murdoch (WDFW) will develop a timeline for conducting genetic sampling for HCP program species (Item I-A).
- Andrew Murdoch will keep the Hatchery Committees updated on the WDFW moratorium on hexacopter use (Item I-A).
- Washington Department of Fish and Wildlife (WDFW), Chelan PUD, and the National Marine Fisheries Service (NMFS) will provide comments or written feedback regarding the Draft Wenatchee River Basin Biological Opinion (BiOp) to Karl Halupka (U.S. Fish and Wildlife Service) before December 25, 2015 (Item II-A).
- Keely Murdoch will discuss, internally, the potential delay of Goat Wall Acclimated Release activities until 2017 (Item III-A).
- The Hatchery Evaluation Technical Team (HETT) will recalculate hatchery replacement rate (HRR) targets using recent smolt-to-adult return (SAR) data (Item II-B).
- The HETT will calculate the variability in regional program HRRs and evaluate if

standard deviation can be used as a measure of tolerance for identifying low HRRs for spring Chinook salmon programs (Item II-B).

- The HETT will review potential methods for increasing homing fidelity of spring Chinook salmon in the Methow basin (Item II-B).
- Tracy Hillman will ask Kirk Truscott if the Colville Confederated Tribes (CCT) agree to adopt the three-population gene flow model for calculating proportionate natural influence (PNI; Item III-C). *(Note: Hillman followed up with Truscott, who provided CCT agreement on December 10, 2015.)*

DECISION SUMMARY

- The Hatchery Committees representatives present approved the WDFW and University of Idaho study proposal titled, "Supplemental Radio-Tagging of Summer Steelhead" (Item IV-A).

AGREEMENTS

- The Hatchery Committees representatives present agreed to adopt the three-population gene flow model for calculating PNI for the Methow spring Chinook and Summer Steelhead HGMPs consultations. CCT agreed to adopt the model via email on December 10, 2015 (Item III-C).

REVIEW ITEMS

- There are no items that are currently out for review.

FINALIZED DOCUMENTS

- There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda, Review Last Meeting Action Items, and Approve the October 21, 2015, Meeting Minutes (Tracy Hillman)

Tracy Hillman welcomed the Hatchery Committees and asked for any additions or changes to the agenda. Keely Murdoch added Goat Wall Pond Acclimation as an agenda item.

The Hatchery Committees reviewed the revised draft October 21, 2015, meeting minutes. Sarah Montgomery said there are several outstanding comments to be discussed. The Hatchery Committees discussed the outstanding comments and made revisions.

Hatchery Committees members present approved the draft October 21, 2015, meeting minutes, as revised.

Action items from the Hatchery Committees meeting on October 21, 2015, and follow-up discussions were as follows *(note: italicized text below corresponds to agenda items from the meeting on October 21, 2015)*:

- *The Hatchery Evaluation Technical Team (HETT) will develop a method for calculating hatchery replacement rate (HRR) targets before the next Hatchery Committees meeting on November 18, 2015 (Item III-A).*
  This will be discussed during today's meeting. This item is ongoing.
- *The Hatchery Committees will discuss Objective 4 (HRR) and Objective 5 (stray rates) of the prioritized 5-Year Hatchery Monitoring and Evaluation (M&E) Report objectives flagged for Methow spring Chinook salmon during the next Hatchery Committees meeting on November 18, 2015 (Item III-A).*
  This will be discussed during today's meeting.
- *Keely Murdoch will provide Craig Busack with Goat Wall Acclimated Release documents for review (Item III-B).*
  This item was completed via email on October 22, 2015.
- *Craig Busack will discuss with Keely Murdoch any further documentation needed for National Marine Fisheries Service (NMFS) consultation on Goat Wall Acclimated Releases (Item III-B).*
  Keely Murdoch said this item is ongoing.
- *The Hatchery Committees representatives will discuss internally the Washington Department of Fish and Wildlife (WDFW) proposal that Douglas PUD authorize the Yakama Nation (YN) to perform Goat Wall Acclimated Release activities as an extension under WDFW activities (Item III-B).*

This will be discussed during today's meeting.

- *Keely Murdoch will discuss with Tom Scribner the proposal by WDFW to release excess hatchery-by-hatchery origin steelhead into lakes (non-anadromous waters) in the Methow and Okanogan basins (Item III-C).*
  Keely Murdoch provided YN support for the proposal via email on October 22, 2015.
- *Mike Tonseth will add contingencies for overages to the Broodstock Collection Protocols (Item III-C).*
  This action item is ongoing. Tonseth said the changes will be made in February 2016.
- *Sarah Montgomery and Matt Cooper will send a Doodle poll to the Hatchery Committees in order to convene a conference call to discuss gene flow standards for Methow spring Chinook salmon (Item VI-A).*
  This item was added to today's agenda due to scheduling constraints and will be discussed during today's meeting.
- *Sarah Montgomery will put the NMFS consultation update first on the agenda for the Hatchery Committees meeting on November 18, 2015 (Item VII-A).*
  This item was completed, and the consultation update will be discussed during today's meeting.
- *Craig Busack will request that Amilee Wilson (NMFS) and Karl Halupka (U.S. Fish and Wildlife Service [USFWS]) attend the next Hatchery Committees meeting on November 18, 2015 (Item VII-A).*
  This item was completed. Busack said Halupka is in attendance at today's meeting, and Wilson is unable to attend.

II. Joint HCP-HC/PRCC HSC

A. Consultation Coordination (Craig Busack and Karl Halupka)

Craig Busack said Amilee Wilson is working on the comments to the Wenatchee River Steelhead BiOp, and Charlene Hurst (NOAA) is working on the 1347 consultation. Busack said he has been working on the Methow spring Chinook salmon consultation, and there have been many discussions between NMFS and Chelan, Douglas, and Grant PUDs. Alene Underwood said the most recent meeting included a discussion of spring Chinook salmon and steelhead consultations in the Methow basin, and Chelan PUD, Douglas PUD, Grant

PUD, and NMFS agreed on a tentative date of May 2016 for the spring Chinook salmon BiOp. Busack said the most important things for spring Chinook salmon consultation are gene flow standards and bull trout consultation. He said NMFS has previously issued permits to many programs without completed bull trout consultation, but with strong litigation pressure in Puget Sound, NMFS is no longer allowed to issue permits in that manner. He said there is a possibility that the Wenatchee River steelhead permit could be issued without a completed bull trout consultation, but it would likely be the last one.

Karl Halupka said the adult management plan for steelhead in the Methow basin is currently incomplete and consultation is necessary. Mike Tonseth said that the draft steelhead adult management plan is about three-quarters complete. Halupka said reviewing all existing consultation-covering activities and components of the programs (which he called a gap analysis) is the first step in deciding what consultation is needed in the Methow basin. He said the Bull Trout BiOp written for the Federal Energy Regulatory Commission relicensing of Wells Dam is comprehensive but appears to have a gap. Halupka said tangle netting for broodstock in the Chewuch River is the only feature not currently covered under the Wells Bull Trout BiOp that could result in adverse effects. Tonseth said monitoring during tangle netting is well documented, and the encounter rate of bull trout is zero. Halupka said tangle netting may have a “Not Likely to Adversely Affect” determination, but further analysis needs to be completed. He proposed that he could provide a draft gap analysis for the Methow basin before December 25, 2015, in preparation for the coordination group meeting on January 14, 2016. Halupka added that there was debate whether the Methow or Okanogan consultation should be completed next. Mackey stated that tangle netting was a stop gap measure that was employed prior to Chelan PUD reinstating their program at Methow Fish Hatchery. He said the sharing agreement for the Chelan PUD program includes broodstock collection from the Douglas PUD facilities, so tangle netting would no longer be an action required by Chelan PUD, hence this item should not be an issue for bull trout consultation.

Busack said there is no mention of YN remote acclimation sites in the 2013 BiOp. Mackey said the 2010 HGMP says that fish may be acclimated in acclimation sites developed by others but it does not say that they are part of the proposed action. Keely Murdoch said Goat

Wall and Mid-Valley acclimation sites are covered in the coho salmon BiOp, and the impacts to bull trout would be the same if other fish were in the ponds. She said the new pond, Early Winters, is currently under consultation under the expanded acclimation project, which will be an addendum to the BiOp, but has not been completed and is not proposed for use in 2016. Busack said NMFS expects some sites to arise after consultation and permit issuance are completed, so NMFS defers to the Hatchery Committees to ensure affects not analyzed in the BiOp are not greater than those covered in the BiOp. Halupka said he appreciates that NMFS can afford flexibility to the Hatchery Committees, and USFWS would like to follow suit, but it has more constraints and a different style of consultation. He said describing as many potential acclimation sites as possible in the BiOp for use in the 10-year permit period is a priority. Keely Murdoch said YN is in the process of making an addendum to the coho salmon BiOp that includes new sites, some of which are multi-species. She said YN is identifying all acclimation sites it expects to use in the next 10 years, but sometimes sites change due to landowner decisions.

Kirk Truscott said the CCT would not be enamored with prioritization of the Methow basin over the Okanogan basin. He said CCT have an important steelhead program that is trying to shift to a local production component, and without proceeding with the HGMP permitting process, they are unable to make requisite program changes. He said, ideally, the permitting processes for both the Methow and Okanogan basins would proceed concurrently on an expedited timeline. Busack said a coordination meeting is scheduled for January 14, 2016. He said Hurst is a new staff member; she is working on the 1347 consultation because it is relatively straightforward, and this does not signify priority over the Okanogan or other consultations. He said when the 1347 consultation is finished she will work on others such as the Okanogan consultation. Busack said both the Methow and Okanogan basins are expected to be simpler than the Wenatchee basin. Halupka agreed, and said he is not sure if the process will be expedited. Mackey said fishery or adult management plans are actions outside the Douglas PUD HGMP, but the plans would need bull trout consultation because it is part of the BiOp and overall management strategy.

Halupka said the NMFS and USFWS draft BiOps contain differences in measures aimed at reducing residualization. He said, if the NMFS' Wenatchee River steelhead BiOp needs bull trout consultation before it is issued, it might take a while because WDFW, NMFS, and Chelan PUD have not provided comments on the draft. Halupka suggested that WDFW, NMFS, and Chelan PUD provide comments or written feedback before December 25, 2015, so the January 14, 2016, meeting can focus on the response to comments, with a target BiOp finalization date at the end of January or in February. WDFW, Chelan PUD, and NMFS will provide comments or written feedback regarding the Draft Wenatchee River Steelhead BiOp to Halupka before December 25, 2015.

B. 5-Year Hatchery M&E Review Planning- Objectives 4 and 5

Objective 4

Catherine Willard said the HETT met on October 29, 2015, and came up with different approaches to calculating an HRR target. Tracy Hillman summarized the approaches as follows:

> The HETT considered several methods for estimating HRR targets for each hatchery program. The HETT proposes the following approach for setting HRR targets:
>
> $$HRR_T = \left\{ \begin{matrix} >1.0 & \text{if } NRR<1.0 \\ NRR\times(\Theta) & \text{if } NRR\geq1.0 \end{matrix} \right\}$$
>
> where:
>
> HRR_T = a program-specific HRR target
>
> NRR = natural replacement rate
>
> Θ = a program-specific multiplier
>
> The HETT identified several methods for identifying a program-specific multiplier:
>
> - Calculate the average HRR/NRR ratio during the historic time series for each program. Use the highest average ratio and apply it to all programs of the same species. For example, if the Chiwawa spring Chinook salmon program has the highest average ratio, that ratio is then used as the multiplier for all spring Chinook salmon programs.
> - Calculate the average HRR/NRR ratio during the historic time series for each program. Use that average as the multiplier for the specific hatchery program. That is, the average ratio for Chiwawa spring Chinook salmon would be used as the

multiplier for the Chiwawa spring Chinook salmon program, and the average ratio for Twisp spring Chinook salmon would be used as the multiplier for the Twisp spring Chinook salmon program.

- Calculate the average HRR/NRR ratio during the historic time series for each program. Calculate the mean (or weighted) mean of the average ratios for each species. This mean average ratio is used as the multiplier for all programs of the same species. For example, all spring Chinook salmon programs would use the same multiplier.
- Calculate the ratio of the hatchery egg-smolt survival rate to wild egg-smolt survival rate for each program. Multiply this ratio by an estimated correction factor for hatchery fish SARs for each program. These estimates are then used as the multiplier for each specific program.
- Select program-specific multipliers based on management interests.

Questions and comments were discussed as follows:
Hillman said the HETT recommends using a fixed multiplier instead of a fixed target. As such, the target changes yearly. He said if the adaptive management implications of not meeting a target are limited, another option would be to set a simpler target, such as HRR greater than 1.

Andrew Murdoch said the objective in the original M&E program was targeted at post-release performance, and the HRR target was calculated based on broodstock and SAR rates. He said, because the broodstock part of the program is captured in hatchery survival rates, the equation is much improved. He said the HETT should try to anchor the natural variation in hatchery SARs by comparing it to wild SARs in order to understand how HRRs change over time. He said he has assessed SARs for wild Chiwawa spring Chinook salmon after adjusting differential in-basin survival, and he found that hatchery fish have approximately 70% of the SAR of wild fish. He said this has changed and increased over time, partly due to noise in estimation of adult returns. He said data collection for adult returns of spring Chinook salmon are focused on the spawning grounds, so it is important to understand how the data have been collected over time given that sampling effort has varied widely across the years. Craig Busack asked if hatchery SAR rates were much lower than wild SAR rates, and if a pattern holds true across other basins. Andrew Murdoch said that earlier on in the time series, hatchery SAR rates were approximately half of wild SAR rates.

Kirk Truscott asked how to assess comparison of natural and hatchery SARs in the Chiwawa River when a known number of hatchery fish are released and only an estimate of smolt production that has some degree of error. Andrew Murdoch replied there is a survival model that takes into account the size and abundance of emigrants, and wild Chiwawa River smolt survival can be estimated to the mouth of the Wenatchee River. Truscott said there is an error in the natural-origin smolt estimate. Andrew Murdoch replied he has not figured out how to capture that uncertainty, but the method for calculating emigrant estimates is relatively precise. He said in-hatchery survival is not an objective of the M&E Plan; it just supports other objectives. He said there are enough data to look at SAR rates for wild and hatchery fish over time to see how they compare.

Todd Pearsons said there are not concerns about in-hatchery survival, but adults still return in variable numbers. Pearsons said a lot of data are being collected and asked what objective criteria SARs should be measured against. He asked what the purpose of an HRR target is, and said HRRs should exceed NRRs and should also exceed 1. Andrew Murdoch said the original intent of the M&E Plan was to use HRRs in order to signal that something is wrong in the hatchery, outside environment, release strategy, or other area. He said a better way of determining an HRR target is needed in order to identify a problem. Pearsons said it would help to identify if post-release survival is a significant problem. He asked why a manufactured HRR target is needed when these comparisons can already be made with the data that are being collected for SAR. He said the key pieces are whether or not a program is mining the wild population, and if the program is sustainable. Hillman said there is a specific performance objective for HRR (unlike SARs and in-hatchery survival metrics), which drives the assessment of hatchery performance and SARs. He asked if it would be better to identify specific objectives for within-hatchery performance, and perhaps SARs, rather than identifying HRR targets. Andrew Murdoch said, after looking at the data and the wild SAR rates, he thinks a simple expansion is not relevant because there is a lot of variability. Greg Mackey said SAR data for hatcheries is more reliable than for wild populations because there are more measurement error factors in wild SARs. He said the point of having an HRR target is to assess the program and determine whether a minimum standard is being met. Hillman said there were a few years when HRRs were less than NRRs. When this happened, the monitoring team examined within-hatchery performance and SARs to see if the problem could be identified. Because this happened rarely and did not occur over several consecutive years, the source of the problem was not identified. He said it was likely related to carcass sampling.

Mackey said, referring to adult management practices, setting an HRR or SAR target would be nonsensical when 80% of the hatchery fish are removed. He said setting an HRR target makes sense if it is above the minimum level and is set in the context of how fish are managed. Hillman said comparing NRRs to HRRs is confusing because NRRs are based only on spawning escapement, and HRRs would be based on both spawning escapement and hatchery fish surplused. Mackey said a regional comparison in the M&E Report would be useful so that SAR and NRR can be seen for each program.

Truscott said comparing SAR rates between programs is a reasonable process to assess efficacy of individual programs and is a good idea. He said CCT wants to ensure that just meeting the minimum HRR does not preclude harvest opportunities. Hillman asked if data are available to calculate natural-origin SAR rates for every program and said SAR rates are often estimated for natural fish based on tagged hatchery fish. Andrew Murdoch said reliable natural-origin SAR is only available for Chiwawa spring Chinook salmon.

Mike Tonseth said Chelan, Douglas, and Grant PUDs have an obligation to meet mitigation responsibilities, and Joint Fisheries Program management objectives and expectations are above that. Tonseth said the settlement agreement and HCPs outline that the main objectives are that the Program contributes to recovery, augments natural populations, and contributes to harvest, with priority given to recovery, and excess fish going to harvest. He said part of the scope of the Hatchery Committees is to maximize the efficiency of the program so that if adults are taken in, products from those adults are optimized. Pearsons asked what the escapement objectives should be for different basins. Tonseth replied that has only been done for Wenatchee River spring Chinook salmon. Truscott said the total spring Chinook salmon escapement to the Wenatchee basin should account for target plus harvest. Pearsons said targeting a harvest on a listed population, other than a conservation fishery, is a troublesome concept. Andrew Murdoch said there is always surplus for every hatchery program because mitigation is not spread across the landscape, and the safety-net programs can be used for harvest. He said all fish produced by appropriately sized conservation programs ideally would be needed and allowed to spawn naturally on spawning grounds.

Hillman asked if everyone agrees that the HRR target should at least be greater than 1. Keely Murdoch asked how often HRR has been less than 1. Andrew Murdoch replied that HRR has been less than 1 only a few times as a result of major disease issues or weird outliers in the data. Busack said HRR could be below 1 for non-hatchery reasons. Hillman agreed, and said not meeting the HRR target is a trigger to look at each of the metrics making up HRRs. Tonseth asked if comparing HRRs to NRRs should be an objective rather than a standard. He said real-time adaptive management tools are not readily available because at least 2 years go by before information becomes available to make a change. He said the ratio between HRR and NRR might be more important than absolute values, especially considering the potential period of poor ocean conditions likely ahead. He said, in order to compare the values, a complete brood year is needed, and by the time change can be affected in the causal factor, several generations would have passed.

Hillman said the HETT proposed that the 5-year geometric mean of HRRs should be greater than or equal to 1 in order to ensure reaction to a single year does not occur. This provides the lower target. The higher target would be based on a multiplier applied to the NRRs. If HRRs fall below the lower target, the program is in need of change. If the HRRs fall between the upper and lower targets, the program is doing well. Andrew Murdoch said tying HRR targets to NRRs is a good idea, and if there is introgression, it may be simple to come up with more realistic SAR rates for these programs. Hillman said other options for identifying HRR targets include using the old approach with more up-to-date SAR estimates or using the approach that Mackey presented during the November 18, 2015, meeting. Mackey said a deviation metric could also be used to flag HRR values that are out of the ordinary. Pearsons agreed and said HRR can be compared across programs and against earlier time periods. He said HRRs outside of one standard deviation from the norm should be flagged for assessing causation. Hillman said the HETT could provide those results using spring Chinook salmon as an example. Truscott added that the minimum HRR value should not be identified as the target. The HETT will recalculate HRR targets using revised SAR calculations. The variability in HRRs will also be calculated and evaluated if one standard deviation can be used as a measure of tolerance for identifying low HRRs for spring Chinook salmon programs.

Willard said the HETT is setting up a conference call for December to discuss these items, and setting up a monthly recurring meeting time to discuss Appendices 1 through 6 starting in January 2016.

Objective 5

Willard summarized flagged topics from previous discussions about Objective 5.
Keely Murdoch said there are high stray rates for Chewuch Acclimation Facility spring Chinook releases, which are intended to supplement Chewuch River populations. She said the YN hoped that their proposed plan to overwinter spring Chinook salmon in acclimation ponds at Carlton Ponds, with short-term acclimation at Chewuch Acclimation Facility, would provide information on homing back to the Chewuch River. She said, in the current arrangement, with fish overwintering at Methow Fish Hatchery (FH), the homing sequence is not linear; fish are getting familiar inputs from multiple directions (Methow FH and Chewuch River), and some of the fish choose the wrong input to follow. She said the numbers of stray rates in the annual and 5-year report do not match, but both are too high. She said her understanding is that in the new annual reports, Chewuch-acclimated fish that return to Methow FH are not counted as strays, but they should be counted as strays because they are not returning to their release site. Busack asked if the conversation is about fish not returning to the tributary in which they were acclimated. Keely Murdoch replied yes, and that stray rates are not meeting the standards. She said the YN thought there would be benefit to the alternative arrangement that was conceived for overwintering fish in circular ponds at Carlton Acclimation Facility in order to improve stray rates. She said the YN has previously brought this up as a concern, because rearing at Methow FH and acclimating at Chewuch Acclimation Facility is not linear, and the fish do not spend much time in the Chewuch River. She said she would like the Hatchery Committees to come up with a study

plan to address these issues. She said some study plan ideas could be a 5-year study where two groups of fish are acclimated at Chewuch Acclimation Facility, or a side-by-side study with Methow-FH-reared and Wells-FH-reared fish using short term acclimation. She said the homing failure of 80% of fish is not achieving the objectives of supplementation.

Pearsons asked if the report indicates that fish returning to the Chewuch River increase the number of natural-origin fish. Keely Murdoch replied the 5-year report states that the number of natural-origin fish has not increased. Pearsons asked if an increase in natural-origin fish is apparent in the Methow and Chewuch rivers. He suggested an alternative of not supplementing the Chewuch River. Keely Murdoch said the YN would not agree to not supplementing the Chewuch River. Pearsons asked if it makes sense to spread the risk and not supplement all different populations in the Methow basin. Keely Murdoch said if fish are acclimated in the Chewuch River, and return to the Methow River, they do not have the option of contributing to natural-origin recruits (NORs). Pearsons asked how many hatchery-origin recruits are in the Chewuch River. Andrew Murdoch said there is a fundamental issue in spawner density over available habitat. He asked if the objective of the Goat Wall proposal, for example, is to redistribute some adults that currently spawn in the Methow River up into higher quality spawner habitat. Keely Murdoch said the fish released in the Chewuch River are similar but in a different tributary, and the difference is that fish released in the Chewuch River are not supplementing the Chewuch River population. Andrew Murdoch said the Twisp program brood year stray rate also exceeds the target. Tonseth said one issue is that the hatchery program may or may not increase natural productivity. He said another issue is, despite the intent for adults to return to the intended tributary, there is an issue with site fidelity.

Pearsons said focusing on each M&E objective individually is a problem because multiple objectives can be achieved with a single solution such as not supplementing the Chewuch, and that a solution to one objective (e.g., lack of homing in the Chewuch River) might be undone with a solution for another (e.g., not supplementing the Chewuch River). He asked how or when the concept of not supplementing the Chewuch River would be addressed. Tonseth asked how to improve site fidelity regardless of location. Hillman said there are three different stray-rate calculations. In one case, strays from fish short term acclimated in the Chewuch Pond cannot make up more than 10% of the spawning escapement within other major spawning areas of the Methow basin. He said, additionally, brood year stray rates identified in the M&E plan cannot be greater than 5%. In this case, the brood year stray rates are much greater than 10%. Keely Murdoch said the Chewuch River is the most extreme example of stray rates, and therefore a study design should be conceived to address site fidelity issues. Busack said this issue appears like an imprinting and acclimation issue rather than just a general stray-rate issue. Keely Murdoch said that the issue is the location of Methow FH compared to the acclimation sites; it is not linearly arranged. She said the Twisp River is a separate gene flow issue, but the issue for Chewuch River is homing.

Truscott said this has importance for the way Methow programs are stocked (predominantly NOR-based). He said a fraction of NORs are being removed for broodstock and if the adult returns from this production return to the Methow FH rather than contribute to the natural spawning population to support attainment of the escapement target and natural production, this could have a mining effect and adversely affect future natural production. Busack said the implicit assumption is that Chewuch, Methow, and Twisp rivers have three different gene pools, but are all considered the same population from a population genetic standpoint. He said the treatment of the three rivers as separate may be inappropriate given what is known about natural gene flow rates between the areas. Tonseth said the Methow and Chewuch rivers are managed similarly, and the Twisp River is managed as a separate component. Hillman said, when the Upper Columbia Recovery Plan was written, the authors followed the Interior Columbia Basin Technical Recovery Team recommendations, which identified major and minor spawning areas and stray rate targets. These recommendations were carried over into the Hatchery M&E Plan. He said, according to the Recovery Plan and the Hatchery M&E Plan, the upper Methow River, Chewuch River, and Twisp River are considered separate spawning aggregates (major spawning areas). As such, the recommendations within the Recovery Plan call for allowing local adaptation of the spawning aggregates. Keely Murdoch said broodstock for the Methow and Chewuch is composite, so local adaptation is not occurring. She said when the YN agreed to supplement the Chewuch River, the intent was for supplemented fish to spawn there.

Pearsons asked why more hatchery fish are needed in the Chewuch River. Keely Murdoch replied, in many years, 80 to 90% of the supplemental fish do not return to the Chewuch River. She said a standard was agreed to, and is not being met. She said using 10 years of historic SAR rates and assuming 100% of fish from a 60,000-fish release would return to the Chewuch River, PNI would not be affected. Mackey said, regardless of stray rate, more than half of the spawners in the Chewuch River have been hatchery fish, so supplementation targets are being met. Keely Murdoch disagreed that the historic spawning composition was an appropriate argument in that the current release number has been reduced to about 60,000 so the numbers of hatchery fish returning to the Chewuch to begin with will be significantly reduced. Mackey asked if the final destination of the of fish matters, as long as the Chewuch River is supplemented. He said the question is if the number of fish returning to the Chewuch River is within the bounds of a prudent management number. Hillman said the way broodstock are collected for these programs may preclude local adaptation, unless the Hatchery Committees have redefined subpopulation structure, which would change this discussion from a straying issue to a spawning distribution issue. Keely Murdoch said the genetic composite issue means these fish are not strays, but the point is that more fish should be returning to habitat in the Chewuch River. Pearsons said, from 2004 to 2013, the proportion of hatchery origin spawners (pHOS) in the Chewuch River was high. Tonseth said, in the context of programs, there have been sufficient hatchery fish in the Chewuch River to meet escapement objectives, but those are based on larger smolt releases.

Keely Murdoch said pHOS is 0.25 when calculated using historic hatchery SARs, a release size of 60,000, and historic natural-origin run sizes. She said if 80% of those fish go back to the hatchery, then pHOS would be much less. Keely Murdoch said that it would not be unreasonable for the Hatchery Committees to come up with a study plan. Andrew Murdoch suggested focusing on improving imprinting and homing in the Twisp River, because that is a site everyone can agree on. Keely Murdoch said the YN may agree to that arrangement. Andrew Murdoch also suggested an option could be building long-term acclimation sites in the Twisp River where homing fidelity is a problem. Mackey said the number of strays from a brood year is actually quite low, even if it exceeds 5 to 10%, and it may not make much of a population-level difference for the level of effort that may be needed to investigate and attempt to address the issue. Andrew Murdoch said if survival was better in the Chiwawa River, there would be more fish for investigating this issue. Keely Murdoch said one benefit the YN thought would come from using circular tanks at Carlton is higher SAR rates. Willard asked if more than 60,000 fish could be acclimated at the Chewuch Acclimation Facility. Keely Murdoch said yes, and that the capacity of the pond is the only constraint. Truscott said CCT would be okay with a larger program at Chewuch Acclimation Facility. Andrew Murdoch asked if the Methow FH has a hatchery-by-hatchery program. Tonseth said no, but the program could have a safety-net component designed to prevent mining if the conservation program is deemed too large. He said pulling out large numbers of wild fish and not meeting related goals would not be acceptable. Truscott said a few things have been identified, which help prevent straying: incubation on natal water source and acclimation in the tributary to which homing is desired.

Pearsons said a larger-scale discussion about adaptive management of supplementation across the basin is needed. He said risk management and decreasing the amount of supplementation should be considered if strong evidence is not presented to support it. Pearsons said, if the monitoring plans are designed to help the Chewuch River, but the better thing would be to not supplement in the first place, then ending supplementation there should be considered. Pearsons asked if no increase, or a decrease in NOR fish would change Keely Murdoch's mind about supplementation in the Chewuch River. Keely Murdoch replied that no data have been presented yet that would change her mind. She said the program has not been operated in a manner that gives supplementation a chance to work as designed. She said adaptive management should figure out a way to fix the homing fidelity problem. Tom Kahler said increasing homing could decrease the proportion of natural origin spawners to hatchery origin spawners. Keely Murdoch replied that the input of fish could be adjusted. Kahler suggested that supplementing the Methow basin with fewer hatchery fish, or supplementing less often, might increase the productivity of natural populations. He said the PUD Hatchery Programs are supposed to contribute to recovery. Keely Murdoch suggested adjusting the release numbers instead of ending the program. Busack said he does not see a way to solve the homing problem except to incubate fish elsewhere in the basin. He said if the Methow tributaries were the focus, Chewuch River could be a control, which may result in allowing diversity to development and lead to greater success. Keely Murdoch said fish should not be reared at Methow FH, or an incubator should be set up at Chewuch Acclimation Facility, and the program changes could be tested on a small scale.

The HETT will discuss potential methods for increasing homing fidelity of spring Chinook salmon in the Methow basin.

C. Gene Flow Standards for Methow Spring Chinook Salmon (Matt Cooper)

Matt Cooper said he worked with WDFW to gather preliminary estimates regarding the effectiveness of collaborative spring Chinook salmon pHOS management in the Methow basin in 2015, presented in a document titled "Methow SCS Adult Management Summary," which Sarah Montgomery sent to the Hatchery Committees on November 17, 2015. He said 2015 is the first year that both federal and local operators worked together in an effort to aggressively manage pHOS. He said the data shared today are provisional data that should only be used for establishing gene flow standards to parameterize the three-population PNI model. Mike Tonseth verbally corrected one item in the document—PNI for total estimated spawners in the Methow basin should be 0.386 using the conventional method, not 0.518 as reported. Tonseth reviewed the basic assumptions of the provisional estimates:

- Winthrop National Fish Hatchery (NFH) production assumed adipose fin-clipped (regardless of coded wire tag[CWT])
- Methow FH production assumed adipose fin present plus CWT
- Wild production assumed adipose fin present only

Tonseth said data auditing for the total run escapement over Wells Dam is not yet completed. He said there was overlap between the summer and spring runs, so for the purposes of this discussion he identified a natural break in the runs on June 10, 2015, resulting in a provisional estimate of 9,500 spring Chinook salmon.

Tonseth said many hatchery fish were removed at both the Methow FH and Winthrop NFH. He said Winthrop NFH pulled in many fish from both programs, and Methow FH primarily collected fish from its own program releases. He said facilities operated an average of 6 days per week, but a provisional extraction rate of 77% is good. Tonseth said the Methow River had the highest pHOS, the Chewuch River had the second highest pHOS, and the

Twisp River had the lowest pHOS. Tonseth said many hatchery fish were spread out from M6 to M8 around Methow FH. He said using Craig Busack's three-population gene flow model results in a PNI of 0.499 using the provisional data. He said the PNI is higher when adult management is implemented, and this will become more distinct in 2016 and 2017, as releases were reduced for those years.

Tom Kahler said future results may be confounded by poor ocean conditions. Tonseth said once the CWT and scale data are available, WDFW can calculate pHOS at the reach level. He said, even with improvements to trap operation, he does not think that management goals are entirely achievable by trap operations alone. He suggested selective fisheries could remove additional fish, particularly in hatchery stretches, by extending the fishery boundary to include those reaches. He said the first step is to finish the Adult Management Plan and get it written into the permit. He said the spawning distribution this year could have been influenced by drought conditions, and fish may have sought cold-water refugia in the hatchery outfalls. Todd Pearsons asked if the risks of impacts to NOR and the potential benefit of reducing hatchery-origin fish on the spawning grounds are compared when deciding whether to have a fishery. Tonseth replied yes, and the effects analysis by the National Oceanic and Atmospheric Administration would also account for that. He said the spring Chinook salmon management plan is approximately halfway complete, and he anticipates that it will be ready for review by December 4, 2015. Pearsons asked if it would be viable to consider having a fishery just in reaches with high-proportion hatchery-origin fish. Tonseth replied yes, but it would be different than the Wenatchee River, for example, because the first year would probably be a trial year to study species encounters and effectiveness and PIT-tag data and instream arrays. Tonseth said that Winthrop NFH fish are being targeted because they are part of the safety-net component and are the only hatchery fish ad-clipped in the Methow basin. He said a fishery would have no direct benefit to the conservation program at Methow FH, but it could help pull out more hatchery fish overall.

Tonseth said one way to potentially improve the programs in a way that affects proportion of natural origin broodstock, and therefore PNI, would be to live-spawn wild males at Methow FH and ship excess natural origin milt to Winthrop NFH, so that part of the Winthrop NFH program could be hatchery-by-wild. Andrew Murdoch asked how PNI changes if Winthrop NFH is eliminated. Busack said the PNI would rise from 0.499 to 0.56. Andrew Murdoch said that extraction of adults would change, but the Winthrop NFH fish are already mostly being taken out of the system, so PNI would not be greatly affected.

Tonseth said a major uncertainty in this discussion is whether adult management could be used to effectively manage pHOS in the Methow basin. Busack said the Hatchery Committees should consider ideas conceived last year when discussing the minimum number of spawners, and the program should be modeled similarly to the Wenatchee program. Tonseth said the Hatchery Committees need to formalize adopting the three-population model approach to calculating PNI before moving forward with consultation. The Hatchery Committees representatives present agreed to adopt the three-population gene flow model for calculating PNI. Tracy Hillman will ask Kirk Truscott if the CCT agree to adopt the three-population gene flow model for calculating PNI.

III. YN

A. Goat Wall Pond Acclimation

Keely Murdoch said Tonseth had proposed a solution to Goat Wall Acclimated Release permitting similar to one used earlier for Okanogan steelhead. Tonseth said because WDFW is a co-permittee on 1196, it could issue a letter to NMFS that authorizes YN as an agent to operate the Goat Wall acclimation site. Tom Kahler said Goat Wall is not a Douglas PUD facility and therefore is not covered under 1196. He said Douglas PUD's approach has been to relinquish Endangered Species Act (ESA) responsibility for the fish when they leave the facility, and the way this proposal works would not relinquish responsibility because the fish are still under Douglas PUD's permit. Mackey said internal discussions resulted in Douglas PUD being uncomfortable with YN serving as an agent on the permit Douglas PUD holds, and the original agreement to operate Goat Wall was under the proviso that YN would obtain permits. He said Douglas PUD supports delaying release at Goat Wall by 1 year, but keeping the full 5 years of releases. Truscott asked if spring Chinook salmon are the only fish in the acclimation ponds. Keely Murdoch said yes, and the site is covered under the coho salmon consultation, but that does not allow YN to acclimate spring Chinook salmon in the ponds. Truscott suggested that WDFW could be the operator of the pond as a co-permittee under the existing permit, which would serve the purpose of getting fish acclimated farther upstream in the basin. Mackey said Douglas PUD does not have funding set up for that arrangement. Tracy Hillman asked if the Hatchery Committees could relinquish Douglas PUD of ESA responsibility upon fish transfer. Mackey said the Hatchery Committees could not, and that NMFS and USFWS would have to do that. He said without a solution, Goat Wall activities for 2016 cannot move forward.

Busack said activities could be permitted before the 2016 release, but NMFS does not know when the consultation would be completed. Tonseth said it would probably be unrealistic for the consultation to be completed before March 2016, when the fish need to be transferred. Busack said he thinks he could have it complete by then, but NMFS cannot complete the permit without bull trout consultation, which could be a limitation. Halupka said it would be unlikely for bull trout consultation to be complete by March 2016. Keely Murdoch said YN would not acclimate any other fish in the ponds because the coho salmon expansion in the Methow basin is delayed. She said there is flexibility that can be worked out with the hatchery in moving the fish, and frozen ponds would be a delay, but fish need to be tagged with Passive Integrated Transponders (PIT) in January or early February. Keely Murdoch will discuss internally the potential delay of Goat Wall Acclimated Release activities until 2017.

IV. WDFW

A. DECISION: Supplemental Radio-Tagging of Summer Steelhead (Mike Tonseth)

Mike Tonseth shared a document titled, “Supplemental Radio-Tagging of Summer Steelhead at Tumwater Dam and Twisp weir in 2016 and 2017” (Attachment B), which Sarah Montgomery distributed to the Hatchery Committees on November 4, 2015. Tonseth said WDFW radio tags a percentage of steelhead at Priest Rapids Dam, but this year, fish did not return in the expected number or at the expected time. He said the target number of radio-tagged steelhead was not met, therefore, WDFW and the University of Idaho propose to radio tag steelhead in tributaries (at Twisp Weir and Tumwater Dam) in order to answer more specific questions and increase the number of tags in the system.

Catherine Willard said Tumwater Dam is already shut down for the season. Tonseth said that would move the radio-tagging activities to springtime in 2016 and 2017 for both sites, which is advantageous because fish would already be on hand and other activities also need to be performed. Andrew Murdoch said 500 radio tags have been budgeted for this project. He said there are three frequencies for the tags used this year (which will turn off in June, 2016), and 100 are currently ready to be used. He said the study will provide information on the number of redds constructed by females, spawning behavior, and location effects, which will add data to the ongoing study in the Twisp River. He said radio-tagging fish in spring would provide more information than tagging in the fall, because groups of hatchery, wild, male, and female fish could be tagged. He said nine reconditioned kelts have already been radio-tagged.

Andrew Murdoch said this research would be part of Nate Fuch's (University of Idaho) graduate thesis, and the information obtained would be just as important as the primary objective. Andrew Murdoch said Lotek Wireless will provide a new tag for evaluation during this study. Todd Pearsons asked how this would affect the reproductive success study in the Twisp and asked if radio tags affect spawning success. Andrew Murdoch said differences in spawning success by default could be evaluated, because at least half of the population will not be radio-tagged. Mackey said tagging a balance of male, female, hatchery, and wild fish would help the reproductive success study. Andrew Murdoch said the return rates of radio-tagged steelhead versus non-radio-tagged steelhead could inform long-term fitness.

Willard said the timeframe for tagging fish at Tumwater Dam is incorrect. Andrew Murdoch agreed, and said the Tumwater Dam tagging could be augmented to look at the number of redds per female and redds per male. He said the data would provide information on spawning densities in different habitat types. Kirk Truscott asked how the study would be different if the tags were used at Wells Dam, providing information on the Okanogan and Twisp rivers. Andrew Murdoch said it is important to concentrate the tags in locations where they can be tracked, and this study is in addition to those already occurring in the upper basin.

The Hatchery Committees representatives present approved the WDFW and University of Idaho study proposal titled, "Supplemental Radio-Tagging of Summer Steelhead at Tumwater Dam and Twisp weir in 2016 and 2017."

V. HCP Administration

A. Next Meetings

The next scheduled Hatchery Committees meetings are on December 16, 2015 (Douglas PUD), January 20, 2016 (Douglas PUD), and February 17, 2016 (Chelan PUD).

VI. List of Attachments

Attachment A	List of Attendees
Attachment B	Supplemental Radio-Tagging of Summer Steelhead at Tumwater Dam and Twisp Weir in 2016 and 2017

Attachment A
List of Attendees

Name	Organization
Tracy Hillman	BioAnalysts, Inc.
Sarah Montgomery	Anchor QEA, LLC
Alene Underwood*	Chelan PUD
Catherine Willard*	Chelan PUD
Greg Mackey*	Douglas PUD
Tom Kahler*	Douglas PUD
Todd Pearsons	Grant PUD
Peter Graf†	Grant PUD
Craig Busack*†	National Marine Fisheries Service
Matt Cooper*	U.S. Fish and Wildlife Service
Karl Halupka	U.S. Fish and Wildlife Service
Mike Tonseth*	Washington Department of Fish and Wildlife
Andrew Murdoch	Washington Department of Fish and Wildlife
Charlie Snow†	Washington Department of Fish and Wildlife
Kirk Truscott*	Colville Confederated Tribes
Keely Murdoch*	Yakama Nation

Notes:
* Denotes Hatchery Committees member or alternate
† Joined by phone

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To: HCP Hatchery Committee

From: Nate Fuchs and Chris Caudill, University of Idaho, and Andrew Murdoch, WDFW.

Date: 11/3/2015

Subject: Supplemental Radio-tagging of summer steelhead at Tumwater Dam and Twisp weir, spring 2016 and 2017

Background and Objectives of the steelhead migration study:

Three current management concerns for the Upper Columbia steelhead are 1) estimation of tributary specific escapement rates, 2) straying to non-natal tributaries, particularly those that involve overshoot and fallback at mainstem dams, and 3) overwinter distribution and survival rates within the mainstem Columbia River and tributaries. We (Fuchs and Caudill) are conducting a telemetry study to address these objectives in collaboration with the Washington Department of Fish and Wildlife (Murdoch) and with funding from Bonneville power. The study combines PIT- and radio-telemetry to simultaneously monitor migration behavior, survival, and estimate detection efficiency on existing PIT-antennas in the upper Columbia Basin tributaries. Secondarily we hope to use the study to enhance knowledge of steelhead spawning distribution and behavior. The study aims to double-tag 500 steelhead with PIT- and radio-tags at Priest Rapids Dam in 2015 and again in 2016. However, due to a lower than expected run size and a shift in run timing, we will tag approximately 400 adults during 2015.

Consequently we are writing to request the use of Tumwater Dam and the Twisp River weir trapping facilities to augment sample sizes at upstream PIT and fixed radio telemetry sites. Data from the proposed additional tagging will 1) improve sample sizes for estimates of tributary escapement above Tumwater Dam; 2) provide improved estimates of stray rates and overshoot and fallback events; 3) improve estimates of overwinter survival rates; 4) provide a better understanding of steelhead spawning behavior, interactions, and habitat preferences which may inform the ongoing pedigree analysis being conducted on the Twisp River and 5) estimate the number of redds constructed per female to improve the accuracy of redd based escapement estimates. A subset of adults tagged at the Twisp Weir would be tagged with a combination accelerometer-radio-telemetry tag recently developed by Lotek

(Newmarket, ON) to characterize spawning location, timing, behavior and duration. This new technology will allow us to distinguish spawning activity (high frequency movements) from holding (low to zero frequency movement) and post-spawn mortality (extended zero frequency movement of the tag). These data could eventually be linked to estimates of individual fitness obtained by the pedigree study. The telemetry study is scheduled to take place during 2015-2016 (2015 run year) and 2016-2017 (2016 run year).

Specific Methods*:*

Trapping/Tagging:

Radio Tagging: The tagging study design calls for 500 radio tags across 3 channels to be implanted in fish at Priest Rapids Dam at a ratio of 1 for every 7 fish collected for both hatchery and wild that passed though the OLAFT sampling facility. These tags are implanted gastrically (do not require surgical methods of being implanted) and have been used successfully in tracking adult fish at basin scales, with low tagging mortality and infrequent tag loss (e.g., Keefer et al. 2004; Caudill et al. 2007). Fixed radio telemetry sites have been installed at Priest, Wanapum and Rock Island dams as well as in the major tributaries at existing in-stream PIT antenna sites. Mobile tracking will be used to augment detection efficiency estimation and refine movement histories and fates. At present, the summer steelhead run has slowed and there are approximately 100 tags yet to be utilized.

In order to augment this ongoing migration study, we would like to tag fish 1) beginning immediately at Tumwater Dam (until the facility is closed for the winter) and in early spring (preferably February-March 2016 and 2017) in the Wenatchee River Basin, and 2) in the spring at the Twisp Weir at a time of transition from winter holding behavior in mainstem habitats to final upriver/tributary migration for spawning. Augmenting our ongoing study by tagging fish at these sites will afford us the opportunity to achieve our original tagging sample size for our primary study objectives and boost the number of radio tagged spawning fish to be observed in the spawning behavior study.

Spawning Behavior in Wenatchee and Twisp Rivers:

Adults tagged at Tumwater and Twisp River Weir will be tracked to spawning grounds with the intent of intensively monitoring spawning behavior in order to better understand 1) spawning timing and duration, 2) preferred spawning habitat 3) the number of redds constructed per female.

Location	Tagging time frame	Number of tags	Proportion of run
Tumwater Dam	November- February 2015,2016	Less than 60	No more than 50%
Twisp River Weir	March-April 2015, 2016	Less than 60	No more than 50%

We would like to commence Tumwater Dam tagging as early as possible in November provided fish are still moving in sufficient numbers and the facility has not yet been winterized and resume tagging in the spring prior to spawning in February/early March. Tagging at the Twisp River Weir will begin when adult fish arrive at the weir prior to spawning in March through April during operation of the weir. At both tagging locations no more than 60 individual fish will be tagged (systematic random sample in proportion to the run) and no more than 50 percent of the run will be tagged at either location.

Monitoring:

Quantifying the number of redds constructed per female is of particular interest. Currently there is not a solid model for accurate estimation of redds per female given spring high flow, which limits redd visibility during surveys. Tracking fish will involve a combination of mobile tracking by vehicle to spawning grounds and then tracking individuals on foot to locate redd construction sites. Unlike other salmon, steelhead are known for abandoning redds very soon after completing construction so it will be important to actively track and be present during the time of spawning. This spawning behavior research will be conducted in the Twisp River in the mainstem Methow and in the upper Wenatchee River and Nason Creek and possibly other streams like Peshastin Creek depending on the final distribution of radio tagged females. These rivers and tributaries offer relatively easy mobile tracking access via road and close proximity from the road to the water so as to visualize spawning behavior and construction of redds.

The pedigree analysis being conducted at the Twisp Weir affords an excellent opportunity to link spawning behavior and redd size and number to individual post-spawn fitness. Redd location, preferred habitat and number of redds constructed can be linked to relative reproductive success, pending genetic assignments of smolts and adult offspring to 2016 and 2017 spawners. We hope that the additional tagging will provide added value to the pedigree study by linking behavior directly to subsequent fitness on the Twisp River.

We emphatically recognize the need to maintain the integrity of ongoing studies, need for broodstock collection, and other activities associated with monitoring, evaluating and managing programs currently in place. We do not want to interfere with Washington Department of Fish and Wildlife operations. We will be working in close collaboration with Ben Goodman in the Twisp River and Ben Truscott in the Wenatchee. Thank you in advance for considering this request and please let us know if you have any questions, concerns or suggestions.

References:

M. L. Keefer , C. A. Peery , R. R. Ringe , T. C. Bjornn. 2004. Regurgitation Rates of Intragastric Radio Transmitters by Adult Chinook Salmon and Steelhead during Upstream Migration in the Columbia and Snake Rivers. North American Journal of Fisheries Management **24**(1): 47-54.

Caudill, C. C., W. R. Daigle, M. L. Keefer, C. T. Boggs, M. A. Jepson, B. J. Burke, R. W. Zabel, T. C. Bjornn, and C. A. Peery. 2007. Slow dam passage in adult Columbia River salmonids associated with unsuccessful migration: delayed negative effects of passage obstacles or condition-dependent mortality? Canadian Journal of Fisheries and Aquatic Sciences **64**: 979-995.

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Hatchery Committees	**Date:**	January 20, 2016
From:	Tracy Hillman, HCP Hatchery Committees Chairman		
Cc:	Sarah Montgomery, Anchor QEA, LLC		
Re:	Final Minutes of the December 16, 2015, HCP Hatchery Committees Meeting		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Hatchery Committees meeting was held at Douglas PUD headquarters in East Wenatchee, Washington, on Wednesday, December 16, 2015, from 9:30 a.m. to 12:30 p.m. Attendees are listed in Attachment A to these meeting minutes.

ACTION ITEM SUMMARY

- Mike Tonseth will add contingencies for overages to the Broodstock Collection Protocols (Item I-A). *(Note: this item is ongoing.)*
- Mike Tonseth and Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) will develop a timeline for conducting genetic sampling for HCP program species (Item I-A). *(Note: this item is ongoing.)*
- Andrew Murdoch will keep the Hatchery Committees updated on the WDFW moratorium on hexacopter use (Item I-A). *(Note: this item is ongoing.)*
- WDFW, Chelan PUD, and the National Marine Fisheries Service (NMFS) will provide comments or written feedback regarding the Draft Wenatchee River Basin Biological Opinion (BiOp) to Karl Halupka (U.S. Fish and Wildlife Service [USFWS]) before December 25, 2015 (Item II-C). *(Note: this item is ongoing.)*
- The Hatchery Evaluation Technical Team (HETT) will review potential methods for increasing homing fidelity of spring Chinook salmon in the Methow Basin (Item II-A). *(Note: this item is ongoing.)*
- Todd Pearsons will discuss internally whether Grant PUD approves using the new method for calculating hatchery replacement rate (HRR) targets (Item II-A). *(Note: Pearsons provided Grant PUD agreement to using this methodology on December 17, 2015.)*

- Tracy Hillman will ask Craig Busack if NMFS approves the new method for calculating HRR targets (Item II-A). *(Note: Hillman asked Busack, who provided agreement to using this methodology on December 22, 2015.)*
- Sarah Montgomery will distribute meeting materials related to the methods for calculating HRR targets to the Hatchery Committees and the Priest Rapids Coordinating Committee's Hatchery Sub-Committee (PRCC HSC; Item II-A). (*Note: Montgomery distributed three documents on December 17, 2015: 1) Hatchery Replacement Rate Targets Methodology; 2) Chiwawa Spring Chinook HRRs and Natural Replacement Rates (NRRs); and 3) Smolt-to-adult HRR Update.)*
- Tom Kahler will request that Andrew Dittman (National Oceanic and Atmospheric Administration [NOAA]) attend the Hatchery Committees February 17, 2016, meeting (Item II-A).
- Keely Murdoch will outline study plan options to address homing fidelity of spring Chinook salmon in the Methow Basin for discussion at the January 7, 2016, HETT meeting (Item II-A). *(Note: Keely Murdoch provided the outline to Sarah Montgomery, which she distributed to the HETT on January 6, 2016.)*
- Catherine Willard will summarize the available data on size-at-release targets for spring Chinook salmon in the Chiwawa River, and will coordinate with Douglas PUD, Grant PUD, and WDFW to summarize available size at release data for Nason Creek and Methow River spring Chinook salmon (Item II-A).
- Tracy Hillman and Sarah Montgomery will add Objective 1 of the 5-Year Monitoring and Evaluation (M&E) Report to the list of objectives flagged for further discussion, and will develop a strategy to ensure all flagged objectives are discussed before the 1-year review timeline ends on March 31, 2016 (Item II-A).
- Tracy Hillman will ask Craig Busack if NMFS approves Douglas PUD's Means of Satisfying No Net Impact (NNI) for Methow River Coho Statement of Agreement (SOA; Item III-A). *(Note: Hillman asked Busack, who provided NMFS approval of the SOA on December 22, 2015.)*
- Kirk Truscott will forward permit materials he recently sent to NMFS to the Hatchery Committees (Item II-C). *(Note: Truscott sent the 2016 NOAA Smolt Release Notification to Sarah Montgomery on January 20, 2016, which she forwarded to the Hatchery Committees that same day.)*

- Alene Underwood will provide an update on the future acclimation of Chelan PUD's approximately 60,000 spring Chinook salmon in the Methow Basin at the next Hatchery Committees meeting on January 20, 2016 (Item IV-A).
- Sarah Montgomery will add the update on Chelan PUD's spring Chinook salmon acclimation in the Methow Basin to the Hatchery Committees' January 20, 2016, meeting agenda (Item IV-A). *(Note: Sarah Montgomery distributed the January 20, 2016 Hatchery Committees meeting agenda including this item on January 9, 2016.)*
- Tracy Hillman will request that the HCP Coordinating Committees approve email distribution and Extranet access to Deanne Pavlik-Kunkel (Grant PUD) regarding items related to joint HCP-HC/PRCC HSC discussions (Item V-A). *(Note: Hillman sent a request to John Ferguson (HCP Coordinating Committees Chair; Anchor QEA) on December 28, 2015, which Kristi Geris (Anchor QEA) distributed to the HCP Coordinating Committees that same day.)*

DECISION SUMMARY

- The Hatchery Committees and PRCC HSC representatives present approved using the new method for calculating HRR targets. Chelan PUD, Douglas PUD, USFWS, WDFW, the Yakama Nation (YN), and the Colville Confederated Tribes (CCT) approved the new method on December 16, 2015. Grant PUD approved on December 17, 2015, and NMFS approved on December 22, 2015 (Item II-A).
- The Wells HCP Hatchery Committees representatives present approved Douglas PUD's Means of Satisfying NNI for Methow River Coho SOA. Douglas PUD, USFWS, WDFW, YN, and CCT approved on December 16, 2015, and NMFS approved on December 22, 2015 (Item III-A).

AGREEMENTS

- There were no agreements discussed during today's meeting.

REVIEW ITEMS

- Sarah Montgomery sent an email to the Hatchery Committees on December 22, 2015 notifying them that the draft 2016 Douglas PUD Wells HCP Action Plan is available for review, with edits and comments to Tom Kahler. The plan will be discussed at the

Hatchery Committees' January 20, 2016 meeting.

FINALIZED DOCUMENTS

- Sarah Montgomery sent an email to the Hatchery Committees on December 29, 2015 notifying them that the final Douglas PUD Means of Satisfying NNI for Methow River Coho SOA is now available for download from the Hatchery Committees Extranet site.

I. Welcome

A. Review Agenda, Review Last Meeting Action Items, and Approve the November 18, 2015, Meeting Minutes (Tracy Hillman)

Tracy Hillman welcomed the Hatchery Committees and asked for any additions or changes to the agenda. The following revisions were requested:

- Todd Pearsons moved the HETT Update and USFWS Bull Trout Consultation Update to the joint HCP-HC/PRCC HSC section of the agenda.
- Kirk Truscott added an update on the acclimation of Chelan PUD's 60,000 spring Chinook salmon in the Methow Basin.

The Hatchery Committees reviewed the revised draft November 18, 2015, meeting minutes. Sarah Montgomery said there are several outstanding comments to be discussed. The Hatchery Committees discussed the outstanding comments and made revisions.

Hatchery Committees members present approved the draft November 18, 2015, meeting minutes, as revised.

Action items from the Hatchery Committees meeting on November 18, 2015, and follow-up discussions, were as follows *(note: italicized text below corresponds to agenda items from the meeting on October 21, 2015)*:

- *Craig Busack will discuss with Keely Murdoch any further documentation needed for NMFS consultation on Goat Wall Acclimated Releases (Item I-A).*
  Keely Murdoch said she and Busack discussed documentation, and this item is

complete.

- *Mike Tonseth will add contingencies for overages to the Broodstock Collection Protocols (Item I-A).*
  This item is ongoing.
- *Tonseth and Andrew Murdoch will develop a timeline for conducting genetic sampling for HCP program species (Item I-A).*
  Tonseth said the timeline is being worked on, and he may have an update at the January 20, 2016, Hatchery Committees meeting. This item is ongoing.
- *Andrew Murdoch will keep the Hatchery Committees updated on the WDFW moratorium on hexacopter use (Item I-A).*
  Tonseth said, now that scientists are using hexacopters more often, the moratorium discussion might move forward. This item is ongoing.
- *WDFW, Chelan PUD, and NMFS will provide comments or written feedback regarding the Draft Wenatchee River Basin BiOp to Karl Halupka before December 25, 2015 (Item II-A).*
  This item is ongoing.
- *Keely Murdoch will discuss, internally, the potential delay of Goat Wall Acclimated Release activities until 2017 (Item III-A).*
  Keely Murdoch said she communicated the delay to Tom Scribner.
- *The Hatchery Evaluation Technical Team (HETT) will recalculate hatchery replacement rate (HRR) targets using recent smolt-to-adult return (SAR) data (Item IV-A).*
  The HETT met on December 14, 2015, and completed this item, which will be discussed today.
- *The HETT will calculate the variability in regional program HRRs and evaluate whether standard deviation can be used as a measure of tolerance for identifying low HRRs for spring Chinook salmon programs (Item IV-A).*
  The HETT met on December 14, 2015, and completed this item, which will be discussed today.
- *The HETT will review potential methods for increasing homing fidelity of spring Chinook salmon in the Methow basin (Item IV-A).*
  The HETT met on December 14, 2015, and discussed this item. This item will be

discussed today and is ongoing.

- *Tracy Hillman will ask Kirk Truscott if CCT agree to adopt the three-population gene flow model for calculating proportionate natural influence (PNI; Item IV-B).* Truscott provided agreement via email on December 10, 2015.

II. Joint HCP-HC/PRCC HSC

A. 5-Year Hatchery M&E Review Planning- Objectives 4, 5, 6, and 1 (All)

Objective 4

Tracy Hillman said the HETT met on December 14, 2015, and discussed methods for calculating HRR. As a bit of background, Hillman stated that the HRR is a productivity metric, so survival rates figure into its calculation. He said it is a multiplicative process where broodstock is multiplied by HRR to calculate the hatchery adults returning to a system. Because it is multiplicative, a geometric mean, rather than an arithmetic mean, should be used. He added that the egg-to-smolt survival rate is directly influenced by the hatchery, and the smolt-to-adult survival rate is influenced by the hatchery and out-of-basin effects. Thus, any changes in the hatchery could affect HRRs by affecting egg-to-smolt survival rates, SARs, or both. With that in mind, Hillman described the different methods the HETT evaluated for setting HRR targets.

Approach Linking HRR Targets to NRRs

Hillman said that during the first meeting of the HETT, a method was devised that would link HRR targets to NRRs. In other words, the HRR target should be greater than 1 if NRRs are less than 1. However, if NRRs are greater than 1, HRR targets would be some number multiplied by the natural replacement rate (NRR). This can be shown as the following:

$$HRR_T = \begin{Bmatrix} >1.0 & \text{if NRR}<1.0 \\ \text{NRR}\times(\Theta) & \text{if NRR}\geq 1.0 \end{Bmatrix}$$

where:

HRR_T = a program-specific HRR target

NRR = natural replacement rate

Θ = a program-specific multiplier

Hillman explained the HETT identified several ways to calculate the multiplier. Those were discussed during the last Hatchery Committees meeting. At that time, this method did not gain much traction. Therefore, the Hatchery Committees asked the HETT to evaluate two other methods for calculating HRR targets. One is to use the previous method, but include revised SARs (not SARs identified in the Biological Assessment and Management Plan [BAMP]), and the other is to use some measure of spread (e.g., 1 standard deviation) as a measure of tolerance. Hillman said the HETT evaluated both methods.

Previous Approach Using Revised SARs

Hillman said the previous method estimated HRR targets as the product of the number of smolts released multiplied by SAR, divided by the number of broodstock needed. This is shown as the following:

$$HRR_T = \frac{Smolts\ x\ SAR}{Broodstock}$$

where:

HRR_T = a program-specific HRR target

SAR = smolt-to-adult return rate

Catherine Willard shared a document titled "Hatchery Replacement Rate Targets Methodology" (Attachment B), which Sarah Montgomery distributed to the Hatchery Committees on December 17, 2015. Hillman said the HETT discussed whether to use hatchery or wild fish SARs. He noted wild fish SARs (for Wenatchee spring Chinook salmon) are typically higher than hatchery fish SARs, as shown in the gravel-to-gravel SARs table in the document. Given that there are no wild fish SARs for most programs, the HETT calculated possible targets based on hatchery fish SARs. This was accomplished using the entire time series of SARs available for each program and with only the 5 most-recent years of SARs. Hillman said the number of smolts released and broodstock needed are now mostly fixed. As such, HRR is primarily influenced by SAR.

Standard Deviation Approach

Hillman said the HETT calculated arithmetic and geometric averages and standard deviations for Chiwawa spring Chinook HRRs. McLain Johnson (WDFW) shared a spreadsheet titled "SAR HRR Update" (Attachment C), which Montgomery distributed to the

Hatchery Committees on December 17, 2015. The HETT found that the average SAR does not change much if the entire time series of HRRs (1989 to 2008) is used, or only the most recent HRRs (2000 to 2008). On the other hand, the variability in HRRs differs substantially between the two time series. Variation in HRRs is much greater if the entire time series is used. Hillman said this is probably because of the limited effort used to sample carcasses in the early years.

Hillman shared a spreadsheet titled "Chiwawa Spring Chinook HRRs and NRRs" (Attachment D), which Montgomery distributed to the Hatchery Committees on December 17, 2015. He said, under this approach for the Chiwawa spring Chinook salmon program, the HRR target would be 1 standard deviation below the mean, which is 0.75 if the entire time series of HRRs is used. In contrast, if the shorter time series is used, the HRR target would be 4.75. Hillman commented that these estimates were based on using arithmetic means. Using geometric means, the target for the shorter time series would be 4.29, which is slightly less than using the arithmetic mean. Hillman commented that it is easier to calculate variance for the arithmetic mean than the geometric mean. Therefore, he suggested the evaluation of percentiles.

Percentile Method

Hillman noted, if the Hatchery Committees want to avoid calculating variance for the geometric mean, they can set targets based on percentiles. He said, for example, if HRRs fall below a certain percentile of the existing time series of data, then the Hatchery Committees could take some adaptive management action. For example, using the 2000 to 2008 time series, the 5th percentile is 4.62 (not including harvest) for Chiwawa spring Chinook salmon. This means, if HRRs fall below 4.62, the Hatchery Committees could take some action. Hillman said one can select the percentile that makes the most sense, but a key step is to decide what will be done if the target is not met. Keely Murdoch said not meeting the HRR target should trigger the Hatchery Committees to look closely at each component and find out why the target is not being met (e.g., disease outbreaks or ocean conditions). Mackey said if the HRR target is the 20th percentile, the target would not be met in 1 out of every 5 years, or about 20% of the years. Keely Murdoch said meeting the HRR standard in 4 out of 5 years for the 5-year analytical report would show that there is likely not a huge problem with HRR. She recalled a red-light, yellow-light, and green-light system related to meeting targets each year. Hillman said the red-light, yellow-light, and green-light system was used to assess when a management action would be warranted, and that would certainly apply in this case. He urged the Hatchery Committees to decide on a method for calculating HRR targets, because the SOA says the review of the 5-Year Hatchery M&E Report should be complete by March 31, 2016.

Mackey said the BAMP HRR target was 4.5, which is functionally close to the 20th percentile targets in Hillman's spreadsheet (all near 4.5 or 5 for the Chiwawa program). He said there are two options: 1) use the Chiwawa program as a standard to compare to other programs; or 2) fit each program with its own target. Hillman recalled that the HETT voiced concern about using a "gold standard" approach (such as the Chiwawa program) for HRR targets because each program would have to be weighted differently. He said it would be easier to develop an approach for calculating the HRR target and then apply it to each basin or program. Keely Murdoch said the HRR target should be applied basin-wide instead of for each program in order to avoid giving poorly performing programs low targets. She said, because the Chiwawa program performs well, its calculated HRR target may be an appropriate target for the entire Wenatchee Basin. She said the Methow Basin has lower SARs than the Wenatchee Basin due to longer migrations, and explained that survival standards could be used to inform the HRR target. She said the Chiwawa program can be used to develop an HRR target for spring Chinook salmon programs in the Wenatchee Basin, and a similar technique could be used to develop values in other basins (like the Methow Basin) and for other species.

Hillman asked if data before brood year (BY) 2000 should be used in calculating HRR targets. Mike Tonseth said he favors using data from BY 2000 to present because from 1989 to 2000, in-hatchery survival standards from the BAMP were significantly lower than current program survival standards, and they have subsequently been updated. Hillman added that the more recent time series has less variance in HRRs and consistent sampling effort across years. Keely Murdoch said the Methow Fish Hatchery (FH) SARs are slightly higher than the Chiwawa SARs, so perhaps the standard could be the same. Hillman said if the Hatchery Committees decide on a method for developing the standard, the HETT or Hillman and Andrew Murdoch could calculate the targets. Keely Murdoch said the 5-year Methow FH HRR is higher than the Chiwawa FH HRR. Matt Cooper asked why harvest is separated in the Chiwawa HRR and NRR spreadsheet. Hillman replied the monitoring plan states that HRR and NRR should be calculated with and without harvest. Cooper asked if separate targets should be developed for harvest and no harvest. Mackey said only one target should be used. Tonseth said harvest should be included because there may be a significant harvest effect on adult returns to the tributaries. Cooper said excluding harvest may better show whether HRR is poor due to out-of-basin effects. Tonseth agreed, and said excluding harvest gives a better basin-wide benchmark, but that does not mean that HRR, including harvest, will not also be examined.

Hillman said there appears to be consensus that HRR targets should be calculated for each species and by basin, using data from BY 2000 to present. He asked if the Hatchery Committees preferred the percentile method for calculating HRR targets. Mackey said 1 standard deviation below the mean is approximately the 16th percentile, so using a target between the 15th and 20th percentile would roughly correspond to the standard deviation method. Keely Murdoch asked if using the mean and variance of the HRRs throughout the time series would mean that HRRs would not meet the target 50% of the time. Hillman said using the median (not mean) would indicate that, on average, the threshold value would be exceeded 50% of the time. He said he calculated the variance for the geometric mean by hand. He said he discussed the calculation of variance for the geometric mean with Rich Hinrichsen (Hinrichsen Environmental), who verified his calculations. Kirk Truscott asked if the Hatchery Committees decide to use the red-light, yellow-light, and green-light system, would the 20th percentile be considered a yellow light or a red light. Hillman said it would be up to the Hatchery Committees, but it could be stated that one instance out of five would be green, two out of five would be yellow, and three out of five would be red. Each color would require a different response from the Hatchery Committees. He added, that because the programs changed about 2 years ago, the 5-Year M&E Report due in 2018 will have little adult information resulting from the program changes. Truscott agreed, and said this process should be in a rolling 5-year review. Mackey said 5 years are already done, so in 2 years there will be another report, at which time the dataset will have 10 years of information. Hillman said the percentile approach would not use a rolling 5-year average, but rather simply compare HRRs to the target annually.

Todd Pearsons asked if the proposal is to use the 20th percentile approach to calculating HRR targets instead of the previous approach (i.e., BAMP-based SAR targets). He said Grant PUD will need more time to review the information before providing a decision on this. He asked if the targets would increase over time, which would make it more difficult to reach the target in a given year. Hillman confirmed the proposal and said the targets would be set for at least a 5-year period. Keely Murdoch said there is always the option to revisit the HRR targets (like the Hatchery Committees are doing now) or decide if the target is appropriate for any 5-year period. She said a target should be set that does not automatically reset, in order to ensure the target does not react to drastic changes in SARs (e.g. due to ocean conditions or other factors). Hillman said the percentile approach does two things: 1) sets a target value that is greater than 1, which means the hatchery programs need to do better than just replace themselves; and 2) uses recent past performance, so it must perform at least as well as it did in the past. Tonseth said the values in the BAMP were set as a starting point because the Hatchery Committees did not know what to expect from the programs, and many changes have occurred since then because programs have exceeded initial expectations.

Hillman asked the Hatchery Committees if they agree to implement the 20th percentile method for calculating HRR targets for each basin and species using data from BY 2000 to present. Keely Murdoch said the method is good, but the targets should not be automatically adjusted every 5 years; rather, the target should only be changed if the Hatchery Committees decide that the target is no longer appropriate. Truscott asked if this method includes harvest. Hillman said no, but because HRRs are calculated with and without harvest, one can determine if harvest is precluding a program from meeting its HRR target. Tonseth asked if it can be determined whether or not harvest drives the HRR down. Truscott said all returning adults are accounted for when harvest is included, so if harvest decreases, the fish not harvested would show up at the hatchery or spawning grounds. Keely Murdoch agreed, and said if the program is intended to be harvested, harvest should be included in the calculation of HRR. Tonseth said HRRs to the tributary would be insufficient if harvest is included, but HRR will be calculated with and without harvest, regardless. Mackey said even if HRR changes significantly, the reason for not meeting the HRR target can still be deduced by looking at with and without harvest information. Truscott said the assessment is designed to evaluate the survival performance of hatchery program fish after they are released, not to assess if they return to the basin or sub-basin; therefore, harvest should be included. Hillman said the HRR target for conservation programs should not include harvest; if harvest were to be included, the HRR target might be met, but basin escapement might be insufficient.

The Hatchery Committees representatives present (Chelan PUD, Douglas PUD, USFWS, WDFW, YN, and CCT) approved using the 20th percentile method for calculating HRR targets (harvest not included).

Pearsons said he will discuss internally whether Grant PUD approves using the percentile method for calculating HRR targets. *(Note: Pearsons provided Grant PUD agreement to using this methodology on December 17, 2015.)*

Hillman said he will ask Craig Busack if NMFS approves the new method for calculating HRR targets. *(Note: Hillman asked Busack, who provided NMFS agreement to using this methodology on December 22, 2015.)*

Objective 5

Keely Murdoch said the HETT briefly discussed Objective 5 on December 14, 2015. She said the HETT listed different ways in which homing fidelity of spring Chinook salmon in the Methow Basin could be studied, including egg incubation, passive integrated transponder tag versus coded-wire tag studies, and comparing the Chewuch River to the Twisp River. She said the HETT has not decided on a study plan to address homing fidelity, but she will outline study plan options for discussion at the HETT January 7, 2016, meeting.

She said the HETT also discussed engaging Andrew Dittman in discussions on homing fidelity. Tom Kahler said he has talked to Dittman, who expressed potential availability for the Hatchery Committees meeting in February 2016. Kahler will request that Dittman attend the Hatchery Committees February 17, 2016, meeting.

Objective 6

Truscott said Objective 6 of the 5-Year Hatchery M&E Report, which accounts for size-at-release targets for juvenile fish, was flagged for further discussion because smolt-to-smolt survival data are available, but not smolt-to-adult survival data. Catherine Willard said smolt outmigration survival data are available for two brood years of the Chiwawa spring Chinook salmon program at the smaller size at release (18 fish per pound from 20 fish per pound), but they have not yet been summarized. Tonseth said growth modulation was analyzed for the White River program. Pearsons said there can be competing tradeoffs between the production of precocious males and returning adults. He said the focus has been on reducing the numbers of precocious males, which generally prescribes reducing size-at-release. However, it may be that larger smolts may have higher survival to adulthood, so both minimization of precocious males and production of adults cannot be optimized independently. He asked if the goal is to maximize returning adults or returning females, or reduce precocious males, which all factor into assessing the target size-at-release. Hillman said length-weight relationship targets, which came out of Piper et al.[1], do not work for Upper Columbia stocks. He said the monitoring team has developed appropriate length-weight relationships for Upper Columbia stocks (those in the last 5-year reports). Those relationships can be used to set appropriate length, weight, and condition targets. Hillman asked if the SOA calls for the evaluation of all PUD-funded programs, or just the Methow spring Chinook salmon program. Alene Underwood said the SOA calls for the evaluation of just the Methow program. Tonseth said it would be good to compare the Wenatchee River data to Methow River and Nason Creek data. Willard will summarize the available data on size-at-release targets for spring Chinook salmon in the Chiwawa River, and will coordinate with Douglas PUD, Grant PUD, and WDFW to summarize available size at release data for Nason Creek and Methow River spring Chinook salmon.

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[1] Piper, R., I. McElwain, L. Orme, J. McCraren, L. Fowler, and J. Leonard, 1982. *Fish hatchery management*. U.S. Department of the Interior Fish and Wildlife Service, Washington D.C.

Objective 1

Mackey said Objective 1 should be added to the list of flagged objectives. He said it was not initially flagged because the proper data are being collected, and it is not an objective that assesses an action that can be directly addressed from a management perspective.

Keely Murdoch agreed, and said there are PNI targets and release numbers. Hillman asked the representatives if they want to add Objective 1 to the list of flagged objectives. Mackey said Objectives 1 and 7 are the population dynamics assessments that Objectives 2 through 6 are supposed to inform and provide information to institute program changes. Pearsons said it is important to discuss Objective 1 relative to the overall goal of the program.

Keely Murdoch disagreed and said it has been reviewed and discussed, and significant changes have already been made to the program. She said there is not much to discuss in regards to ending acclimation in the Chewuch River, because adult management is being performed, the conservation program has been reduced significantly, and other major changes have also been made. Mackey said Objective 1 should be discussed again because it needs the write-up of the adaptive management feedback loop assessment needs to be written in the context of Objectives 1 and 7. Keely Murdoch asked for whom and in what document it needs to be written up. Mackey replied that the review of objectives will need to be synthesized. Tonseth said Objective 2 has already been addressed with the ongoing discussions about Goat Wall Acclimated Release activities, and changes to the implementation of adult management cannot be made until adult return numbers from Goat Wall Acclimated Release activities are available for discussion. Hillman said he and Montgomery will add Objective 1 of the 5-Year M&E Report to the list of objectives flagged for further discussion, and will develop a strategy to ensure all flagged objectives are discussed before the 1-year review timeline ends on March 31, 2016.

B. Tumwater Dam Upcoming Stakeholder Meeting (Keely Murdoch)

Keely Murdoch said Jason Lundgren of Cascade Columbia Fisheries Enhancement Group (CCFEG) is launching a process to engage stakeholders in a discussion about the removal of Tumwater Dam. She said the first meeting is on January 13, 2016, and he is also meeting individually with stakeholders. She said the removal of Tumwater Dam would result in many changes for the hatchery programs, and asked the Hatchery Committees representatives at what level they or their agencies are engaging in the discussion.

Mike Tonseth said WDFW has met with George Schneider (George Schneider and

Associates), who is contracted as a facilitator for the stakeholder meeting, in order to ensure that WDFW interests are maintained throughout the discussions. He said some of the stakeholder parties may not have enough background to identify how the removal of Tumwater Dam would impact the management of Wenatchee Basin programs. Keely Murdoch said CCFEG is in favor of removing Tumwater Dam, and one alternative she heard is building a new trapping structure farther upstream. She said YN has had experience with weirs that do not work well at high flows, and although YN does not have an official position yet, there may not be much benefit in removing one concrete structure and putting in another.

Tonseth said Lundgren said another alternative involves building individual tributary weirs, which Tonseth said may not be sufficient for the needs of the Wenatchee Basin programs. Tracy Hillman asked what the primary reason is for removing the dam and if it was to improve lamprey or bull trout passage. Keely Murdoch said habitat restoration in Lake Jolanda is the driving factor. Tonseth said the area upstream of Tumwater Dam is an incised canyon, and there is little side-channel habitat present. Hillman said the money might be better spent on restoring off-channel and side-channel habitat in the lower Wenatchee River.

Alene Underwood said Chelan PUD also does not have an official position yet, but its primary concern is meeting the requirements of the HCPs. She said Chelan PUD has hatchery production and adult-management obligations, which require using Tumwater Dam unless the Hatchery Committees, NOAA, and other permitting entities are part of the conversation and agree to another permitted way to meet obligations. Underwood said Chelan PUD will emphasize at the stakeholder meeting why Tumwater Dam is used, its passage effectiveness for salmon and steelhead, and the obligations of the HCPs. She said feedback from the stakeholder meeting will determine whether or not CCFEG moves forward with the project. Tom Kahler said the removal of Tumwater Dam was also discussed in 2005 or 2006. Underwood added that it was going to cost too much, so it was decided not to move forward at that time.

Kirk Truscott said Tumwater Dam is not used for its intended purpose: power generation. Hillman said he recognizes dam removal is in vogue, but there is not much habitat to be gained immediately upstream of Tumwater Dam. In fact, removal of the dam could reduce rearing habitat in Tumwater Canyon. Karl Halupka said USFWS also does not have a firm position yet, but he thinks bull trout and Pacific lamprey passage factor into the consideration of alternatives. He said there is a lot of uncertainty about whether a technological replacement for Tumwater Dam is available, but there are more compelling reasons than habitat to discuss an alternative approach and facility.

C. USFWS Bull Trout Consultation Update (Bill Gale/Karl Halupka)

Karl Halupka said he currently has more availability and is hoping to work on the Draft Wenatchee River Basin BiOp. He said he hopes WDFW, Chelan PUD, and NMFS will provide comments or written feedback regarding the Draft Wenatchee River Basin BiOp to him before December 25, 2015.

Halupka said, at the November 18, 2015, Hatchery Committees meeting, members discussed trying to batch the Methow Basin consultations, which is the preferred USFWS approach. He said, since that meeting, Douglas PUD, NMFS, and USFWS have discussed the adequacy of the Wells Federal Energy Regulatory Commission relicensing BiOp covering Methow spring Chinook salmon. He said there is a project element in the BiOp called "Implementation of Hatchery HGMPs," which analyzes the effects of implementing hatchery and genetic management plans (HGMPs). He said there is concern about litigation risk in deciding whether that level of coverage is adequate. He said, if Douglas PUD agrees to accept that level of risk for the sake of expediting consultation, USFWS can say the coverage has been reviewed and is sufficient. Tom Kahler asked if the effects of implementing HGMPs are also analyzed in the take table of the BiOp, and if that provides an additional layer of risk assessment. Halupka said he focused on the sweeping implementation element because it could provide an umbrella for unmentioned specific items.

Halupka said there has also been discussion about which consultation NMFS will complete once the Draft Wenatchee River Basin BiOp is finished—Okanogan Basin or Methow Basin. He said USFWS has used Section 10 permits (research permits) instead of Section 7 permits in the past to cover some operational aspects of the Okanogan Chief Joe programs, which have encountered bull trout. He said, now that USFWS has revised its approach to issuing Section 10 permits, activities that may contribute to the recovery of bull trout can be covered by a Section 10 permit; however, if the activity is not directed toward recovery of bull trout and just encounters bull trout, a Section 7 permit must be issued. He said USFWS has previously issued two 1-year extensions to the Section 10 permit covering the Chief Joe program, but said he is not sure that USFWS can continue extending that permit because it does not align with current permit-issuing guidance. He said USFWS is attempting to find timely Endangered Species Act coverage for the program if formal consultation cannot be completed in time. He said Amilee Wilson (NMFS) is not optimistic that Okanogan permits will be completed before 2017.

Mike Tonseth said he, Alene Underwood, and Wilson settled final details for the Wenatchee River steelhead permit, which should be available for signature soon.

Truscott said he will forward permit materials he recently sent to NMFS to the Hatchery Committees.

III. Douglas PUD

A. *DECISION: Coho NNI Hatchery-compensation SOA (Tom Kahler)*

Greg Mackey shared a document titled “Coho NNI Hatchery-compensation SOA” (Attachment E), which Sarah Montgomery distributed to the Hatchery Committees on December 3, 2015. Tom Kahler said it was established in 2007 that coho salmon are a Plan Species requiring mitigation, and a compensation plan with YN was developed and approved in March 2008. He said a new compensation plan is being developed, and the first step was the Coordinating Committees establishing a compensation rate of 3.7% (finalized at the October 27, 2015, HCP Coordinating Committees meeting). Kahler said the Coho NNI Hatchery Compensation SOA establishes that Douglas PUD will provide hatchery production in the Twisp as compensation for unavoidable mortality of Methow Basin coho.

Tracy Hillman asked if the rate of 3.7% was established by the Coordinating Committees. Kahler said yes, this rate is the current four-year average survival rate for yearling spring

migrants through the Wells Project, but it is subject to change with each future survival-verification study, under the Coordinating Committees' supervision. Mike Tonseth said, because this is an extended agreement through the duration of the HCP, and four more recalculations are expected (every 10 years), it could affect future rearing capacity, particularly with spring Chinook salmon at Twisp Pond. Kahler said, in the production example at the bottom of the SOA, the maximum YN release number is 1 million, and when multiplied by a value not to exceed 7% (the maximum hatchery compensation level in the HCP), the maximum potential release during this agreement is 70,000 coho salmon. He said compensation for natural production of coho could also be added to this value, so it could be greater than 70,000. He said the capacity of Twisp Pond is 223,000, and there are currently 30,000 spring Chinook salmon and 48,000 steelhead released annually. Including the number of coho salmon under this SOA would not exceed the maximum capacity of the pond under any circumstances. Kirk Truscott said this SOA allows YN coho salmon production to be reared in other Douglas PUD facilities with some constraints.
Keely Murdoch agreed, and said it would be at YN's own cost.

The Hatchery Committees representatives present (Douglas PUD, USFWS, WDFW, YN, and CCT) approved Douglas PUD's Means of Satisfying NNI for Methow River Coho SOA. Hillman will ask Craig Busack if NMFS approves Douglas PUD's Means of Satisfying NNI for Methow River Coho SOA. *(Note: Craig Busack provided NMFS approval on December 22, 2015.)*

IV. CCT

A. Acclimation of 60,000 Spring Chinook Salmon in the Methow Basin (Kirk Truscott)

Kirk Truscott asked if there is a plan for acclimating Chelan PUD's approximately 60,000 spring Chinook salmon in the Methow Basin. Alene Underwood said Chelan PUD tentatively plans to acclimate the fish at Chewuch Acclimation Facility, but an operator has not been decided upon, and the agreement with Douglas PUD does not include acclimation. She said the intent of the 2013 SOA was to have fish released for the first several years in the Chewuch River. Keely Murdoch said the intent was to get fish acclimated in the Chewuch River. Truscott said the landscape of tribal issues in the Methow Basin has changed since the 2013 SOA was approved. Truscott said CCT would be amenable to Chelan PUD acclimating the 60,000 spring Chinook salmon at the Chewuch Acclimation Facility and releasing the fish in the Chewuch River, if WDFW is the operator. He said his concern for the current inter-local agreement is only regarding rearing in the Methow Hatchery. Underwood said she will provide an update on the future acclimation of approximately 60,000 spring Chinook salmon in the Methow Basin at the next Hatchery Committees meeting on January 20, 2016. Sarah Montgomery said she will add the spring Chinook salmon acclimation in the Methow Basin update to the Hatchery Committees January 20, 2016, meeting agenda.

Mike Tonseth said the current *US v. Oregon* agreement does not specify whose production obligation is accounted for in the 60,000 fish. Underwood said *United States v. Oregon* does not affect the Hatchery Committees because Chelan PUD has no stake in the management agreement. Tonseth said the agreement is a production and harvest agreement, and negotiation has already begun for the next management agreement to begin in 2018. He said fish released into the Chewuch River would be considered production as part of the agreement by which the YN and WDFW are bound.

V. HCP Administration

A. Joint HCP-HC/PRCC HSC Items Check-in (Tracy Hillman)

Tracy Hillman said the joint HCP-HC/PRCC HSC meetings seem to be working well, and that Sarah Montgomery, Elizabeth McManus (Ross Strategic), Andy Chinn (Ross Strategic), and he should continue to coordinate on agenda items and meeting minutes review. He said moving forward, the HETT and consultation updates will be joint items. Hillman said he will request that the HCP Coordinating Committees approve providing Deanne Pavlik-Kunkel with email distribution access to items related to joint HCP-HC/PRCC HSC discussions. *(Note: Hillman sent a request to John Ferguson on December 28, 2015, which Kristi Geris distributed to the Coordinating Committees that same day.)*

Greg Mackey said broodstock collection protocols will be another upcoming joint discussion item.

B. Next Meetings

The next scheduled Hatchery Committees meetings are on January 20, 2016 (Douglas PUD), February 17, 2016 (Chelan PUD), and March 16, 2016 (Douglas PUD).

VI. List of Attachments

Attachment A	List of Attendees
Attachment B	Hatchery Replacement Rate Targets Methodology
Attachment C	SAR HRR Update
Attachment D	Chiwawa Spring Chinook HRRs and NRRs
Attachment E	Coho NNI Hatchery-compensation SOA

Attachment A
List of Attendees

Name	Organization
Tracy Hillman	BioAnalysts, Inc.
Sarah Montgomery	Anchor QEA, LLC
Alene Underwood*	Chelan PUD
Catherine Willard*	Chelan PUD
Greg Mackey*	Douglas PUD
Tom Kahler*	Douglas PUD
Todd Pearsons	Grant PUD
Peter Graf†	Grant PUD
Deanne Pavlik-Kunkel	Grant PUD
Matt Cooper*	U.S. Fish and Wildlife Service
Karl Halupka	U.S. Fish and Wildlife Service
Mike Tonseth*	Washington Department of Fish and Wildlife
Charlie Snow†	Washington Department of Fish and Wildlife
Kirk Truscott*	Colville Confederated Tribes
Keely Murdoch*	Yakama Nation

Notes:
* Denotes Hatchery Committees member or alternate
† Joined by phone

Hatchery Replacement Rate Targets

The NRR multiplier method:

The HETT considered several methods for estimating Hatchery Replacement Rate (HRR) targets for each hatchery program. The HETT proposes the following approach for setting HRR targets:

$$\mathrm{HRR_T} = \begin{cases} >1.0 & \text{if NRR} < 1.0 \\ \mathrm{NRR} \times (\mathrm{Y}) & \text{if NRR} \geq 1.0 \end{cases}$$

where $\mathrm{HRR_T}$ is a program-specific HRR target, NRR is Natural Replacement Rate, and Y is a program-specific multiplier.

The HETT identified several methods for identifying a program-specific multiplier.

1. Calculate the average HRR/NRR ratio over the historic time series for each program. Use the highest average ratio and apply it to all programs of the same species. For example, if the Chiwawa spring Chinook program has the highest average ratio, that ratio is then used as the multiplier for all spring Chinook programs.
2. Calculate the average HRR/NRR ratio over the historic time series for each program. Use that average as the multiplier for the specific hatchery program. That is, the average ratio for Chiwawa spring Chinook would be used as the multiplier for the Chiwawa spring Chinook program and the average ratio for Twisp spring Chinook would be used as the multiplier for the Twisp spring Chinook program.
3. Calculate the average HRR/NRR ratio over the historic time series for each program. Calculate the mean (or weighted) mean of the average ratios for each species. This mean average ratio is used as the multiplier for all programs of the same species. For example, all spring Chinook programs would use the same multiplier.
4. Calculate the ratio of the hatchery egg-smolt survival rate to wild egg-smolt survival rate for each program. Multiply this ratio by an estimated correction factor for hatchery fish SARs for each program. These estimates are then used as the multiplier for each specific program.
5. Select program-specific multipliers based on management interests.

During the November Hatchery Committee meeting, the following were identified as potential methods for developing HRR targets:

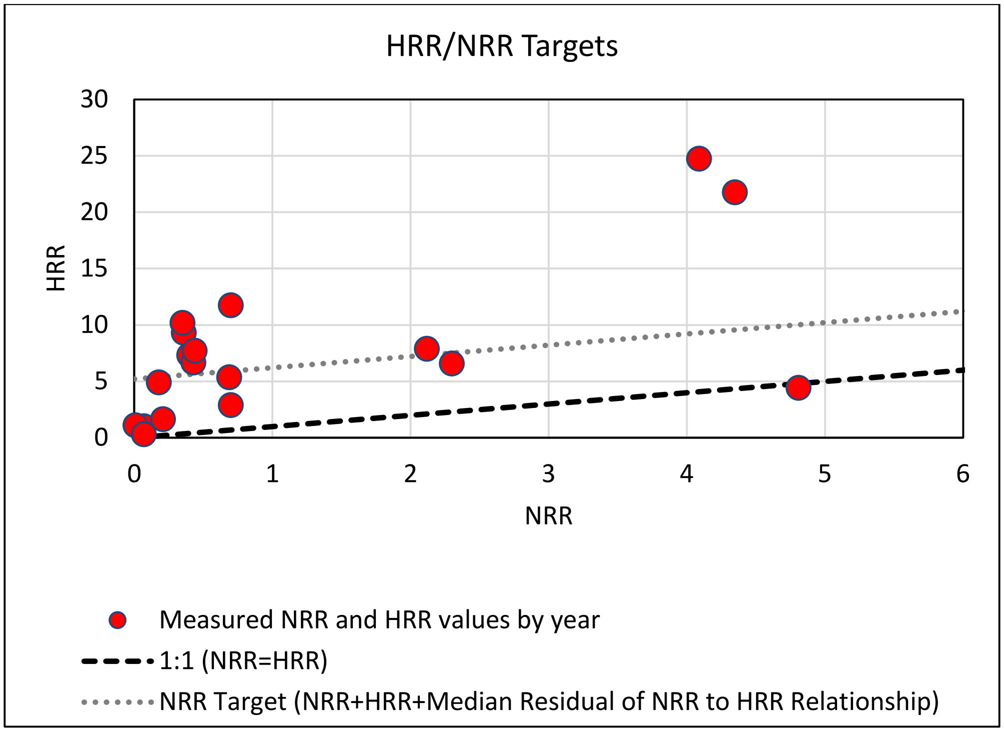
6. Calculate the variability in regional program HRRs and evaluate if standard deviation can be used as a measure of tolerance for identifying low HRRs for spring Chinook salmon programs.
7. Calculate HRR targets using recent smolt-to-adult return data.

Additive method:

8. The basic idea is that HRR should be some value above NRR most of the time, or some percent of the time (we won't hit the target every year). To get that value I looked at the difference between HRR and NRR in the Chiwawa since BY 1989 (from Annual Report).

The median difference between HRR and NRR is about 5.2. So, if we agree that Chiwawa is the way things should be run, then we could say HRR should be NRR+5.2 at least 50% of the time (median = 50%). Instead of median we could use something like the 75th percentile, and say HRR should be above that value 3 out of 4 years, for example.

A benefit of this method is that it's additive, rather than multiplicative. An issue with the NRR multiplier is that when we have a good NRR year, our HRR standard balloons. The other positive is that it includes a metric of 'how often', e.g. 50% of the time.



Brood year	Gravel to gravel SARs (w/ harvest)		H/W SAR ratio
	Chiwawa Hatchery	Wenatchee Wild	
1998	0.0156	0.0298	0.52
1999		0.0013	
2000	0.0080	0.0150	0.53
2001	0.0049	0.0030	1.63
2002	0.0052	0.0045	1.16
2003	0.0036	0.0037	0.97
2004	0.0061	0.0097	0.63
2005	0.0031	0.0031	1.00
2006	0.0048	0.0197	0.24
2007	0.0044	0.0165	0.27
2008	0.0063	0.0223	0.28
11 yr Mean	**0.0062**	**0.0117**	**0.72**
5 yr Mean	**0.0049**	**0.0143**	**0.48**

Attachment C

Species	Owner	Program (Hatchery)	Basin (Purpose)	Smolt Release Goal[2]	Brood Collection[3]	BAMP SAR[4]	BAMP Expected Adults	BAMP HRR	5 YR SAR[5]	5 YR Expected Adults	5 YR HRR	Total SAR[5]	Total Expected Adults	Total HRR
Steelhead	CCPUD	Eastbank (Chiwawa)	Wenatchee (Conservation)	123,650	66	0.0100	1237	18.7	0.0117	1447	21.9	0.0097	1199	18.2
Steelhead	CCPUD	Eastbank (Chiwawa)	Wenatchee (Safety Net)	123,650	64	0.0100	1237	19.3	0.0117	1447	22.6	0.0097	1199	18.7
Steelhead	DCPUD	Wells (Wells)	Columbia (Safety Net)	160,000	96	0.0100	1600	16.7	0.0173	2768	28.8	0.0136	2176	22.7
Steelhead	DCPUD	Wells (Wells)	Methow (Safety Net)	100,000	46	0.0100	1000	21.7	0.0173	1730	37.6	0.0136	1360	29.6
Steelhead	DCPUD	Wells (Wells)	Twisp (Conservation)	48,000	26	0.0100	480	18.5	0.0173	830	31.9	0.0136	653	25.1
Steelhead	GCPUD	Wells (Omak)	Okanogan (Conservation)	100,000	42	0.0100	1000	23.8	0.0173	1730	41.2	0.0136	1360	32.4
SUM Chinook	CCPUD	Eastbank (Chelan Falls)	Chelan (Conservation)	176,000	106	0.0030	528	5.0	0.0154	2710	25.6	0.0150	2640	24.9
SUM Chinook	CCPUD	Eastbank (Chelan Falls)	Chelan (Harvest)	400,000	244	0.0030	1200	4.9	0.0154	6160	25.2	0.0150	6000	24.6
SUM Chinook	CCPUD, GCPUD	Eastbank (Dryden)	Wenatchee (Conservation)	500,000	252	0.0030	1500	6.0	0.0064	3200	12.7	0.0055	2750	10.9
SUM Chinook[1]	DCPUD	Wells (Wells)	Columbia (Harvest)	484,000	302	0.0012	581	1.9	0.0022	1065	3.5	0.0012	581	1.9
SUM Chinook	DCPUD	Wells (Wells)	Columbia (Harvest)	320,000	192	0.0030	960	5.0	0.0096	3072	16.0	0.0104	3328	17.3
SUM Chinook	GCPUD	Eastbank (Carlton)	Methow (Conservation)	200,000	98	0.0030	600	6.1	0.0096	1920	19.6	0.0104	2080	21.2
SPR Chinook	CCPUD	Eastbank (Chiwawa)	Wenatchee (Conservation)	144,026	116	0.0030	432	3.7	0.0049	706	6.1	0.0047	677	5.8
SPR Chinook	CCPUD, DCPUD, GCPUD	Eastbank (Methow)	Methow (Conservation)	193,765	110	0.0030	581	5.3	0.0052	1008	9.2	0.0033	639	5.8
SPR Chinook	DCPUD, GCPUD	Eastbank (Twisp)	Methow (Conservation)	30,000	20	0.0030	90	4.5	0.0032	96	4.8	0.0022	66	3.3
SPR Chinook	GCPUD	Eastbank (Nason)	Wenatchee (Conservation)	149,114	144	0.0030	447	3.1	0.0049	731	5.1	0.0047	701	4.9

1 Subyearling release
2 Release goal established by HCP's and adjusted by HC
3 Derived from Annual Broodstock Protocols
4 Standard (see tab "BAMP Survival")
5 Derived from Annual Reports (e.g. M and E Reports)

BAMP Calculation
5YR Program Calculation
Program History Calculation

Table A2.2. Historic survival standards from Mid-Columbia Hatcheries (derived from Table 3 in BAMP [1998]).

Species	Life State at Release	Size at Release (fpp)	Release to adult survival (%)
Spring Chinook	yearling	15	0.3
Summer Chinook	yearling	10	0.3
Fall Chinook	yearling	10	0.5
Fall Chinook	subyearling	40-50	0.12
Sockeye	unknown	20	0.7
Steelhead	yearling	8	1.0

Attachment D

Chiwawa Spring Chinook HRRs and NRRs

Brood year	**Harvest not included**			**Harvest included**		
	HRR	**NRR**	**HRR/NRR**	**HRR**	**NRR**	**HRR/NRR**
1989	6.43	0.27	23.81	7.29	0.40	18.23
1990	0.05	0.06	0.83	1.00	0.07	14.29
1991	1.00	0.01	100.00	1.09	0.01	109.00
1992	0.27	0.07	3.86	0.28	0.07	4.00
1993	2.82	0.68	4.15	2.86	0.70	4.09
1994	1.62	0.20	8.10	1.62	0.21	7.71
1995		2.00			2.09	
1996	4.28	4.40	0.97	4.39	4.81	0.91
1997	18.60	3.92	4.74	21.74	4.35	5.00
1998	20.65	3.84	5.38	24.71	4.09	6.04
1999		0.11			0.12	
2000	7.38	2.02	3.65	7.85	2.12	3.70
2001	4.73	0.18	26.28	4.88	0.18	27.11
2002	8.44	0.35	24.11	9.29	0.36	25.81
2003	5.94	0.40	14.85	6.65	0.43	15.47
2004	8.54	0.32	26.69	10.15	0.35	29.00
2005	4.90	0.66	7.42	5.35	0.69	7.75
2006	4.62	1.83	2.52	6.57	2.30	2.86
2007	5.22	0.37	14.11	7.70	0.44	17.50
2008	7.49	0.63	11.89	11.73	0.70	16.76
Statistics on Time Series 1989-2008						
Average	***6.28***	***1.12***	***15.74***	***7.51***	***1.22***	***17.51***
Lower SD	***0.75***	***-0.30***	***-7.11***	***0.90***	***-0.32***	***-6.99***
Statistics on Time Series 2000-2008						
Average	***6.36***	***0.75***	***14.61***	***7.80***	***0.84***	***16.22***
Lower SD	***4.75***	***0.07***	***5.27***	***5.54***	***0.05***	***6.32***

Chiwawa Spring Chinook HRRs and NRRs

Brood year	Harvest not included			Harvest included		
	HRR	NRR	HRR/NRR	HRR	NRR	HRR/NRR
1989	6.43	0.27	23.81	7.29	0.40	18.23
1990	0.05	0.06	0.83	1.00	0.07	14.29
1991	1.00	0.01	100.00	1.09	0.01	109.00
1992	0.27	0.07	3.86	0.28	0.07	4.00
1993	2.82	0.68	4.15	2.86	0.70	4.09
1994	1.62	0.20	8.10	1.62	0.21	7.71
1995		2.00			2.09	
1996	4.28	4.40	0.97	4.39	4.81	0.91
1997	18.60	3.92	4.74	21.74	4.35	5.00
1998	20.65	3.84	5.38	24.71	4.09	6.04
1999		0.11			0.12	
2000	7.38	2.02	3.65	7.85	2.12	3.70
2001	4.73	0.18	26.28	4.88	0.18	27.11
2002	8.44	0.35	24.11	9.29	0.36	25.81
2003	5.94	0.40	14.85	6.65	0.43	15.47
2004	8.54	0.32	26.69	10.15	0.35	29.00
2005	4.90	0.66	7.42	5.35	0.69	7.75
2006	4.62	1.83	2.52	6.57	2.30	2.86
2007	5.22	0.37	14.11	7.70	0.44	17.50
2008	7.49	0.63	11.89	11.73	0.70	16.76
Statistics on Time Series 1989-2008						
Geomean	***3.56***	***0.45***	***8.01***	***4.80***	***0.49***	***9.84***
Lower SD	***-0.77***	***-4.40***	***4.61***	***1.70***	***-4.43***	***6.82***
Statistics on Time Series 2000-2008						
Geomean	***6.18***	***0.55***	***11.25***	***7.51***	***0.60***	***12.52***
Lower SD	***4.29***	***-1.75***	***8.72***	***5.77***	***-1.78***	***10.06***

Wells HCP Hatchery Committee
Statement of Agreement Determining Douglas PUD's Means of Satisfying NNI for Methow River Coho

Date of Approval: December 16, 2015

Statement:

The Wells HCP Hatchery Committee (HC) agrees that, beginning with brood year (BY) 2018, DPUD shall rear yearling coho at Wells Hatchery to satisfy the hatchery-compensation component of No-Net-Impact (NNI) for Methow River coho. On October 27, 2015, the Wells HCP Coordinating Committee (CC) agreed that Douglas PUD (DPUD) shall provide NNI hatchery compensation for Methow River coho at a rate equivalent to the multi-year-average project passage-loss value measured for yearling Chinook and steelhead (currently 3.7%, and subject to change with future survival verification studies as approved by the CC). Thus, until the next scheduled hatchery compensation recalculation (2023), DPUD shall produce yearling coho at 3.7% (subject to change, as noted above) of the Yakama Nation's (YN) Methow River coho Basin Release Goals for each respective BY (see examples below). Beginning with the recalculation in 2023, NNI production values for Methow River coho shall also take into account natural production in the Methow using the same methods for calculating production for other HCP Plan Species. The term of this agreement shall extend through the term of the Wells HCP.

DPUD shall acclimate their NNI coho production in the Twisp acclimation pond, and will accommodate the YN's actions to modify that pond to allow co-acclimation of coho with spring Chinook and steelhead in a manner that allows the separate release of co-acclimated species. The YN may acclimate additional coho at the Twisp pond at their own expense, subject to annual HC approval, and provided that the combined density index does not exceed that for spring Chinook or steelhead while those species remain in the pond. The Washington Department of Fish and Wildlife (WDFW; or DPUD's future hatchery-production contractor) shall operate the Twisp facility, and the YN shall directly reimburse the operator for any acclimation costs above those necessary for DPUD's NNI fish. Additionally, DPUD shall allow the acclimation of coho in the Chewuch acclimation pond without cost to DPUD, by WDFW or a third-party contractor approved by DPUD. Finally, DPUD shall allow collection of adult coho broodstock (prohibiting collection for other uses), without cost to DPUD, at Wells Dam, Wells Hatchery, and Methow Hatchery.

Background

The Wells HCP defines coho as a Plan Species without specifying NNI hatchery-compensation requirements because coho, as a locally extirpated species, were the subjects of a reintroduction-feasibility study when the HCP was signed. Section 8.4.5.1 of the Wells HCP describes the necessary circumstances under which the HC shall determine whether Methow River coho warrant NNI hatchery compensation, and gives the HC discretion over the program(s) by which DPUD shall meet that obligation. In December 2007 the HC determined that Methow River coho warranted NNI hatchery compensation, and in early 2008, they approved a 10-year hatchery-compensation agreement between DPUD and the YN whereby DPUD provided monetary support for the YN coho reintroduction program at the then 96.2% survival level. As the term of that agreement nears completion, DPUD and the YN hereby establish a new long-term hatchery-compensation agreement to take effect in 2018, based upon the coho hatchery-compensation rate determined by the CC (currently 3.7%).

Production Examples: If the YN's Basin Release Goal of yearling Methow River coho for BY 2018 is 1,000,000, then DPUD would produce 37,000 (1,000,000 x 0.037) yearling coho for the 2018 BY; should the Basin Release Goals drop to 700,000, and then 350,000 yearling coho in subsequent BYs, DPUD NNI coho hatchery production would change proportionally, to 25,900, and 12,950, respectively for those BYs. Production following 2023 recalculation will also account for natural production, as noted above.

APPENDIX C
HABITAT CONSERVATION PLAN TRIBUTARY COMMITTEES 2015 MEETING MINUTES

Wells, Rocky Reach, and Rock Island HCP
Tributary Committees Notes
12 February 2015

Members Present:	Lee Carlson (Yakama Nation), Chris Fisher (Colville Tribes), Steve Hays (Chelan PUD), Kate Terrell (USFWS), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees Chair).
Members Absent:	Jeremy Cram (WDFW) and Tom Kahler (Douglas PUD).[1]

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees met at Grant PUD in Wenatchee, Washington, on Thursday, 12 February 2015 from 9:30 am to 12:00 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 Committees reviewed and approved the 11 December 2014 meeting notes.

III. Monthly Update on Ongoing Projects

Tracy Hillman and Kate Terrell gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Large Wood Atonement Project – This project is complete and the Rock Island Tributary Committee received a final report.
- Coulter Creek Barrier Replacement Project – This project is complete and the Rocky Reach Tributary Committee received a final report.
- Upper Beaver Habitat Improvement Channel Restoration Project – The project sponsor (Methow Salmon Recovery Foundation; MSRF) continues to coordinate with landowners on fire damage repairs, landowner access, and securing matching funds. The sponsor continues to inspect and monitor different channel sites.
- Okanogan Basin Stream Discharge Monitoring – The sponsor (Colville Tribes) indicated that the gauging stations continue to monitor stream flows.
- Fish Passage at Shingle Creek Dam Project – This project is complete and the Wells and Rocky Reach Tributary Committees received a final report.
- Methow/Chewuch Shallow Groundwater Monitoring Project – This project is complete and the Wells Tributary Committee will soon receive a final report.
- MVID Instream Flow Improvement Project – The project sponsor (Trout Unlimited; TU) is making good progress on the MVID Instream Flow Improvement Project. Tapani Contracting has

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[1] Jeremy and Tom provided their votes on decision items after the meeting.

completed 80% of the Eastside piping project. They have pulled out of the field until the first part of March when they will install the services connections and do final clean-up. Bach Drilling completed drilling the production wells and they have also pulled out of the field until spring. They are currently working on pump screens in their shop and plan to return to the field in early March to install the screens, develop the wells, and conduct pump testing. In addition, they continue to work on submittals for the pump station for the engineer's approval. The E-1 lateral mandatory bids were submitted and the sponsor expects a strong turnout. Bidding will open on 3 March; construction will start soon thereafter. Bidding on the Lower East Lateral will open mid-March. The sponsor continues to make good progress on individual wells and they have developed a strong plan to have them all installed on time. They have received five different estimates from well drillers. The sponsor is in the process of setting up site visits with well drillers and landowners. They are also working on identifying dates for drilling. The sponsor intends to have 22 wells installed before the MVID Westside ditch begins diverting water on 1 May.

- Silver Side Channel Design Project – The project sponsor (Cascade Columbia Fisheries Enhancement Group; CCFEG) and IMA have been working with WDFW on WDFW's comments and on addressing feedback from BPA, Tributary Committees, WDNR, USFWS, Kent Woodruff, and the CCFEG Board. A regulatory meeting was held to identify what each agency will require to issue permits for implementing the project. In addition, a landowner meeting was held to provide updates on the designs. The sponsor is working with the landowner on some of their concerns. Next steps include finalizing preliminary designs.
- Twisp-to-Carlton Reach Assessment Project – The sponsor (CCFEG) and Cardno Entrix have been developing a prioritization framework for restoration and protection actions. The sponsor held a meeting with Cardno, MSRF, and the Methow Conservancy to discuss the approach for protection and restoration actions. Cardno and CCFEG are working to address all stakeholder feedback. A draft Reach Assessment report will be available for review in early March.
- Similkameen RM 3.8 Project – The project sponsor (Okanogan Conservation District) and Cardno Entrix have been working on the final design plans, specifications, and estimates. The 30% design was delivered to the sponsor in February. Completed plans are expected by late February or early March.
- Entiat Stillwaters Gray Reach Acquisition – The sponsor (Chelan-Douglas Land Trust) received the appraisal on the Crone property. Mark Noble conducted the appraisal on the entire 16.47 acres and Larry Rees will conduct the review. As of earlier this week, Crone is only willing to sell the portion on the west side of the river, releasing the access easement and making it possible to do the restoration project involving removal of the bridge and fill on the CDLT Cottonwood parcel.
- Icicle Irrigation Flow Structure Project – This project is complete and the Rock Island Tributary Committee received a final report.
- Post-Fire Landowner Assistance/Habitat Protection in Beaver and Frazer Creeks Project – The project sponsor (MSRF) completed inspection/monitoring at all five bridge sites in January. They are trying to secure additional funding for three more bridges and one riparian/floodplain setback agreement.
- Lehman Riparian Restoration Project – There is no new update on this project.
- Clear Creek Fish Passage and Instream Flow Project – The sponsor (TU) spent the first part of January 2015 finishing a formal proposal for Thousand Trails Corporate Management regarding the Clear Creek Fish Passage and Instream Flow Enhancement Project. The proposal was submitted to the local resort manager mid-January, and in turn was forwarded to both the

northwest regional manager and head of western operations. A response is expected by early March. The sponsor also began researching the required applications/permitting for well installation, construction, diversion dam removal, and the water right change. Permit preparation will be the primary focus in February and March 2015, along with answering any questions about project plans from Thousand Trails Corporate Management.

- Barkley Irrigation – Under Pressure Project – In January, the sponsor (TU) worked with surveyors and the engineers to rectify the survey data, outline specs for the mainline, and coordinate the design process. The sponsor concentrated their efforts on the 30% design plans for the pump station. This included a coordination meeting with the engineers, the BOR, and some permitters. The 30% design was delivered on 23 February and TU met with the Barkley Directors. The sponsor also prepared a memo for the directors that laid out information on their water rights and the water right process. Barkley directed TU to initiate the water right change process. TU intends to move forward on this piece of the project immediately. The sponsor prepared multiple proposals for funding in January and presented the project to the PRCC. They expect that the full 30% design package will be completed and ready for permit submittal in March. A cultural resource RFP was developed and will be sent out to start the process of contracting. Cultural resource surveys should start following snowmelt this spring. Finally, the sponsor is working to develop all aspects of the project and is hoping that everything aligns for construction this fall.

IV. Review of HCP Tributary Committees Action Plans

Wells Action Plan

Tom Kahler (via email) provided the Committees with the Draft Wells HCP Tributary Committee Action Plan for 2015. The 2015 Draft Action Plan for the Wells Tributary Committee is as follows:

Plan Species Account Annual Contribution

• $176,178 in 1998 dollars:	January 2015

Annual Report – Plan Species Account Status

• Draft to Tributary Committee (TC):	January 2015
• Approval Deadline:	February 2015
• Integration into HCP Annual Report:	February 2015

2015 Funding-Round: General Salmon Habitat Program

• Request for Project Pre-proposals	March
• Pre-proposal to TC	May
• Tours of Proposed Projects	late May
• Final Project Proposals to TC	late June
• RTT Project Rating Decision	July
• Supplemental Sponsor Presentations	*To be determined*
• TC Final Funding Decisions	August

Small Projects Program

• Project Review and Funding Decision	January – December 2015

After reviewing the Draft Action Plan, the Wells Tributary Committee recommended that Douglas PUD revise the General Salmon Habitat Program plan to reflect the fact that the Committee accepts project applications anytime during the year. The Wells Tributary Committee recommended the following Draft Action Plan:

Plan Species Account Annual Contribution

- $176,178 in 1998 dollars: January 2015

Annual Report – Plan Species Account Status

- Draft to Tributary Committee (TC): January 2015
- Approval Deadline: February 2015
- Integration into HCP Annual Report: February 2015

General Salmon Habitat Program

- Project Review and Funding Decision January – December 2015

Small Projects Program

- Project Review and Funding Decision January – December 2015

The Wells Tributary Committee approved the revised Wells Action Plan for 2015.

Rocky Reach and Rock Island Action Plans

Steve Hays provided the Committees with the Draft Rocky Reach and Rock Island HCP Tributary Committees Action Plans for 2015. The 2015 Action Plans for both Rocky Reach and Rock Island Tributary Committees is as follows:

- Plan Species Account Deposit: January 2015
- GSHP Project Solicitation: Ongoing
- GSHP Project Approval: Ongoing
- GSHP Project Implementation: Ongoing
- Small Project Review and Approval: Ongoing
- Small Project Implementation: Ongoing

The Rocky Reach and Rock Island Tributary Committees recommended that Chelan PUD remove the GSHP Project Solicitation bullet. They recommended the following Rocky Reach and Rock Island Action Plans:

- Plan Species Account Deposit: January 2015
- GSHP Project Review and Approval: Ongoing
- GSHP Project Implementation: Ongoing
- Small Project Review and Approval: Ongoing
- Small Project Implementation: Ongoing

The Rocky Reach and Rock Island Tributary Committees approved the revised Rocky Reach and Rock Island Action Plans for 2015.

V. Review of Tributary Committees' Policies and Procedures

Policies and Procedures for Funding Projects

Tracy Hillman asked if the Committees had any changes or edits to the Policies and Procedures for Funding Projects document. After reviewing the document, members had no changes to the Policies and Procedures. However, they did note that Section 6.9 (External Financial Review) no longer applies to the Wells Plan Species Account. State Auditors will audit the Wells Account annually. At some point, State Auditors may require annual auditing of the Rocky Reach and Rock Island Plan Species Accounts. When that occurs, Section 6.9 can be removed from the Policies and Procedures document.

Tributary Committee Operating Procedures

Tracy Hillman asked if the Committees had any changes or edits to the Tributary Committee Operating Procedures document. After reviewing the document, members had no changes to the Operating Procedures. However, given Dale Bambrick's current schedule, members asked if Justin Yeager should become the designated representative on the Wells, Rocky Reach, and Rock Island Tributary Committees. Justin said that he will check with Dale to see if Dale is okay with the change. Tracy will check with Mike Schiewe, Chair of the Coordinating Committees, to see if NOAA Fisheries needs to submit an official letter to the Coordinating Committees indicating the change in representation.

VI. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests in December, January, and February:

   Rock Island Plan Species Account:

   - $3,411.92 to Cascade Columbia Fisheries Enhancement Group for the Twisp to Carlton Reach Assessment Project.
   - $1,505.50 to Cascade Columbia Fisheries Enhancement Group for the White River large Wood Atonement Project (final invoice).
   - $112,437.74 to Trout Unlimited – Washington Water Project for the MVID Instream Flow Improvement Project.
   - $25,992.76 to the Methow Salmon Recovery Foundation for the Post-Fire Landowner Assistance Project.
   - $30,653.16 to the Chelan County Treasurer for the Icicle Irrigation Flow Control Structure Project (final invoice).
   - $225.00 to Clifton Larson Allen for Rock Island financial administration during the fourth quarter 2014.
   - $923.36 to Chelan PUD for project coordination and administration during the fourth quarter of 2014.

   Rocky Reach Plan Species Account:

   - $12,407.50 to Cascade Columbia Fisheries Enhancement Group for the Silver Side Channel Design Project (for work in December).
   - $1,048.50 to Cascade Columbia Fisheries Enhancement Group for the Silver Side Channel Design Project (for work in January).

- $5,609.87 to the Okanogan Conservation District for the Similkameen RM 3.8 Design Project (for work in December).
- $13,628.98 to the Okanogan Conservation District for the Similkameen RM 3.8 Design Project (for work in January).
- $6,186.17 to the Methow Salmon Recovery Foundation for the Upper Beaver Habitat Improvement Project (for work in December).
- $12,468.98 to the Chelan County Treasurer for the Nason Creek Lower White Pine Coulter Creek Barrier Replacement Project (final invoice).
- $225.00 to Clifton Larson Allen for Rocky Reach financial administration during the fourth quarter 2014.
- $1,190.59 to Chelan PUD for project coordination and administration during the fourth quarter of 2014.

Wells Plan Species Account:

- $6,186.16 to the Methow Salmon Recovery Foundation for the Upper Beaver Habitat Improvement Project (for work in December).
- $875.74 to Chelan PUD for project coordination and administration during the fourth quarter of 2014.

2. Last December the Committees received a proposal from Chelan County Natural Resources Department (CCNRD) titled, *Nason Creek Upper White Pine Floodplain Reconnection Project*. The Committees declined funding for the proposal because they believed the cost of the project was too high. CCNRD estimated a total cost of $3,037,136, which included $721,136 for powerline relocation. After extracting the budget from the proposal, Chris Fisher asked an independent contractor to estimate the cost to implement the project. Chris stated that the contractor estimated the cost of the work at $854,000 (does not include the cost of relocating the powerline) with a 25% contingency. This independent estimate supports the conclusion by the Tributary Committees that the proposed budget from CCNRD was too high.
3. Tracy Hillman reported that he and Becky Gallaher completed Section 2.6 (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. Members of the Committees should soon receive the draft reports from their Coordinating Committee representatives for their review. The PUDs will submit the final reports to the Federal Energy Regulatory Commission in April.
4. Tracy Hillman shared with the Committees the 2014 Plan Species Account Financial Reports (see Attachment 1). Tracy noted that the beginning balance for the Rock Island Account in 2014 was $4,308,006.34. At the end of 2014, that account had $4,837,822.51. The beginning balance for the Rocky Reach Account in 2014 was $2,217,802.36 and the ending balance was $2,206,420.74. For the Wells Account, the beginning balance in 2014 was $1,096,267.79 and the ending balance was $1,321,590.37. Tracy said that the financial reports for each account will be included in the 2014 Annual Reports of Activities under the Anadromous Fish Agreement and Habitat Conservation Plan.
5. Tracy Hillman reported that the PUDs deposited funds into each of the Plan Species Accounts at the end of January. Chelan PUD deposited $711,794 into the Rock Island Account and $337,119 into the Rocky Reach Account. Douglas PUD deposited $258,455 into the Wells Account. As of mid-January 2015, the unallocated balances within each account were $4,829,005 in the Rock Island Account, $2,143,226 in the Rocky Reach Account, and $1,321,590 in the Wells Account.

Tracy said that he would check with Becky to see if the unallocated amounts included the 2015 deposits. Finally, Tracy shared with the Committees a summary of the different projects funded by the different Plan Species Accounts and the status of those projects (see Attachment 2).

6. Tracy Hillman shared with the Committees the draft Upper Columbia 2015 SRFB/TC Funding Schedule (see Attachment 3). Presentations will be given to the Regional Technical Team (RTT) on 8 April (members of the Tributary Committees are encouraged to attend the presentations). Draft proposals will be delivered to the Tributary Committees on 17 April and the Committees will review the draft proposals during their 11 June meeting. Project tours are scheduled for 6-7 May (Methow and Okanogan) and 13-14 May (Wenatchee and Entiat). Final proposals will be delivered to the Tributary Committees on 19 June. The Committees will make funding decisions on 9 July. This gives the Committees about three weeks to review the final proposals.
7. Tracy Hillman said that the Tributary Committees will continue to meet on the second Thursday of each month in 2015. Those meeting dates are as follows:
    - Jan 8 Cancelled
    - Feb 12
    - Mar 12
    - Apr 9
    - May 14
    - Jun 11
    - Jul 9
    - Aug 13
    - Sep 10
    - Oct 8
    - Nov 12
    - Dec 10

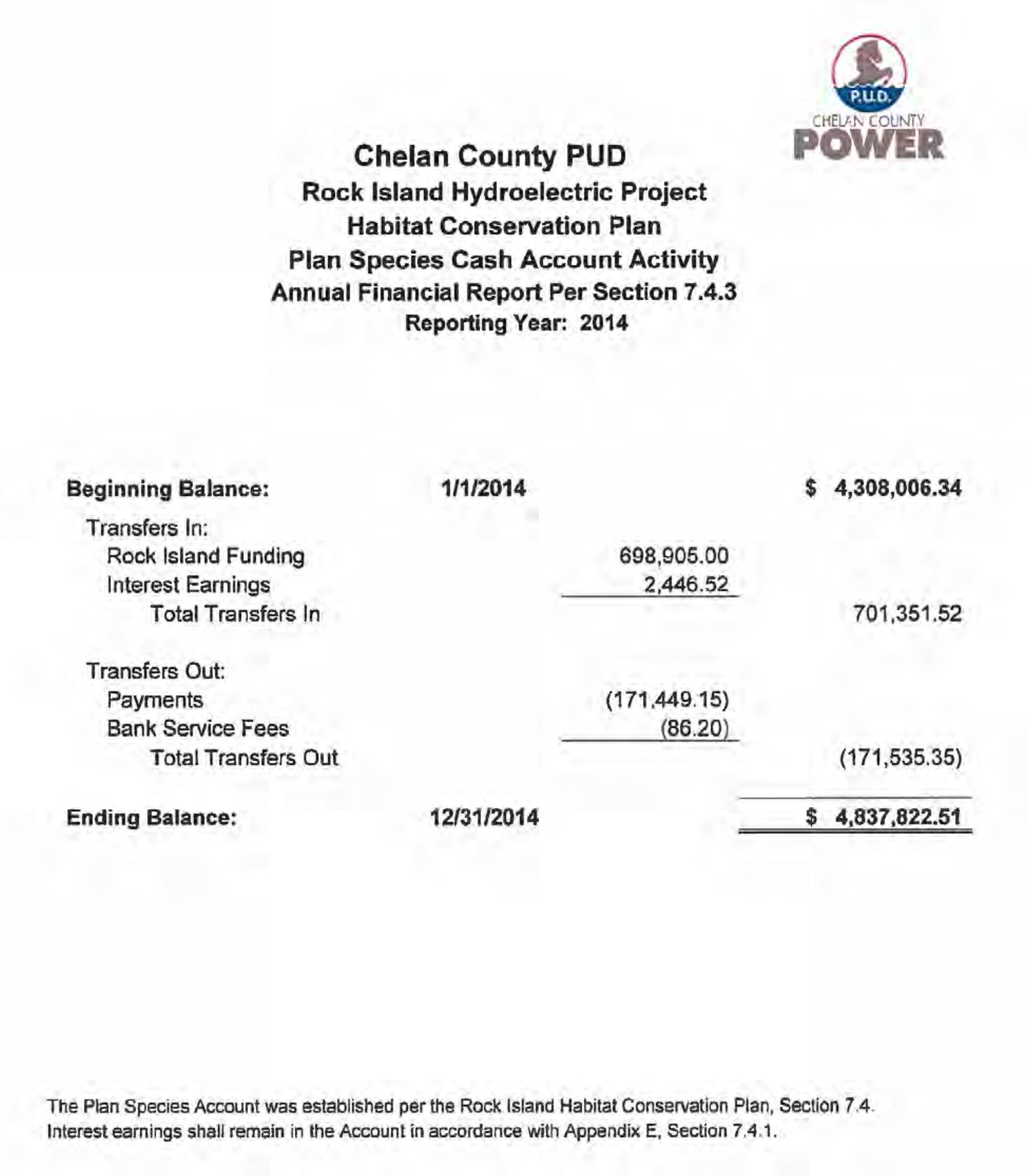
VII. Next Steps

The next meeting of the Tributary Committees will be on Thursday, 12 March 2015 at Grant PUD in Wenatchee.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Attachment 1

Rock Island 2014 Plan Species Account Financial Report



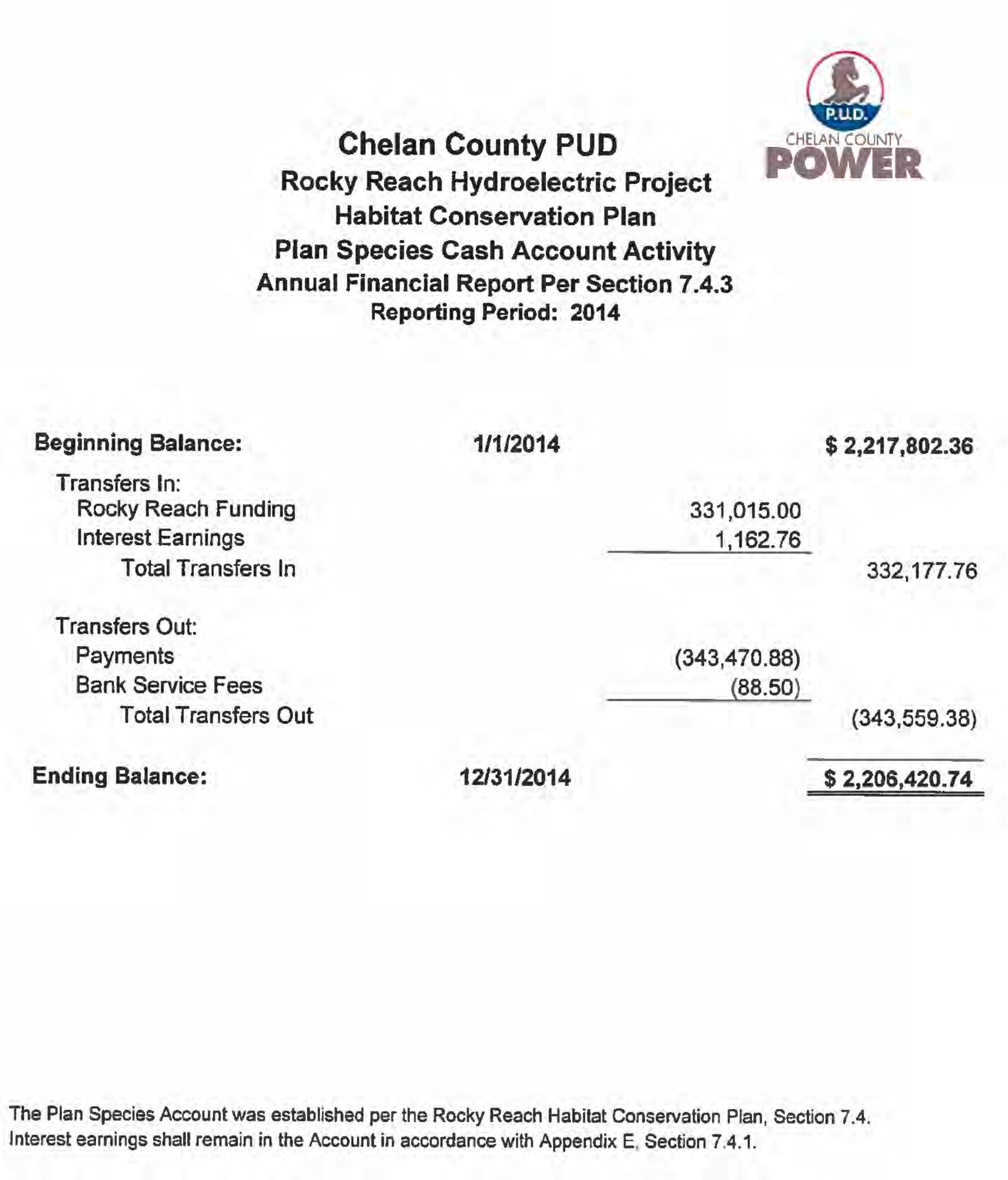
Chelan County PUD
Rock Island Hydroelectric Project
Habitat Conservation Plan
Plan Species Cash Account Activity
Annual Financial Report Per Section 7.4.3
Reporting Year: 2014

Beginning Balance:	**1/1/2014**		**$ 4,308,006.34**
Transfers In:			
Rock Island Funding		698,905.00	
Interest Earnings		2,446.52	
Total Transfers In			701,351.52
Transfers Out:			
Payments		(171,449.15)	
Bank Service Fees		(86.20)	
Total Transfers Out			(171,535.35)
Ending Balance:	**12/31/2014**		**$ 4,837,822.51**

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.

Attachment 1

Rocky Reach 2014 Plan Species Account Financial Report

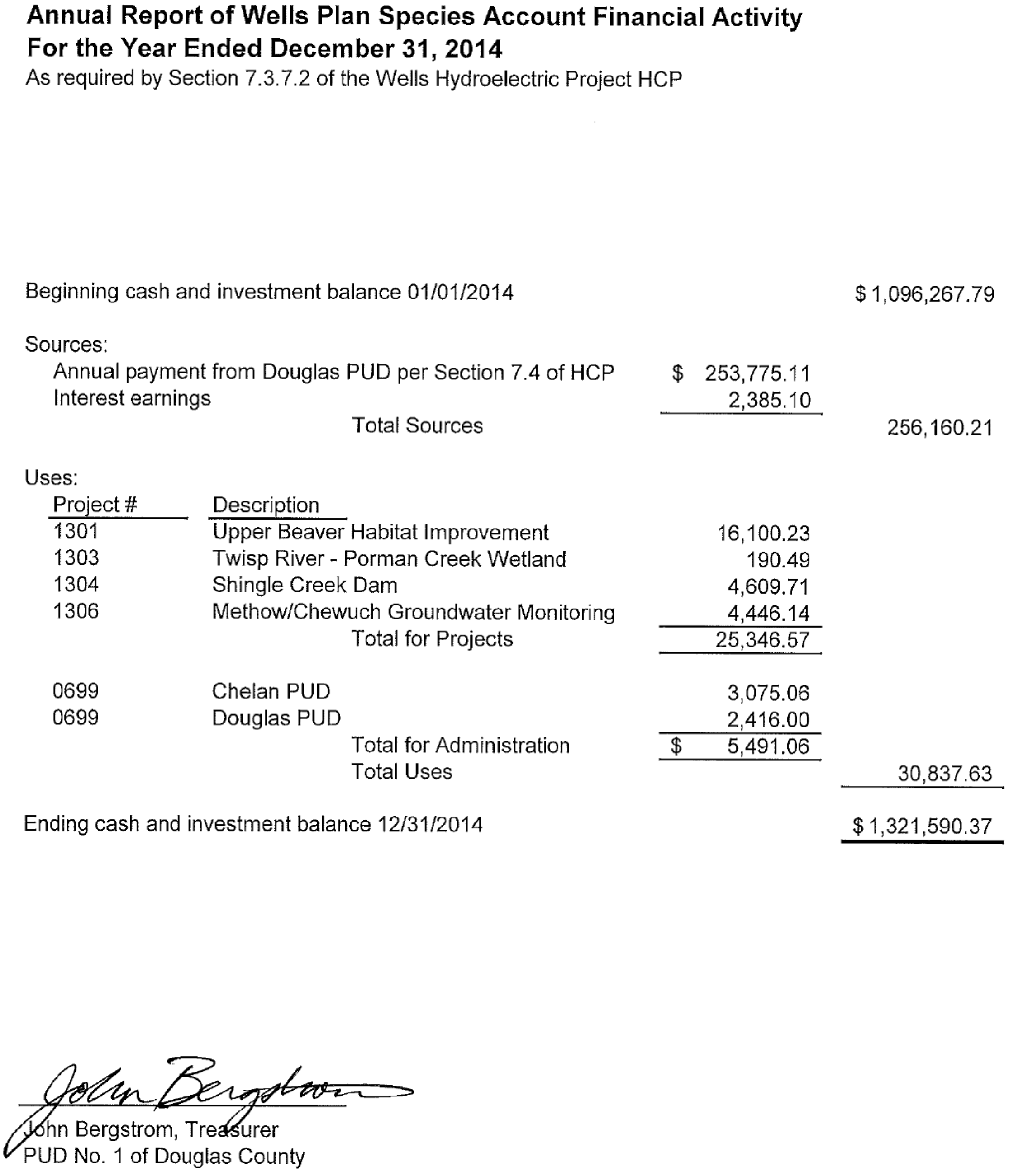


Chelan County PUD
Rocky Reach Hydroelectric Project
Habitat Conservation Plan
Plan Species Cash Account Activity
Annual Financial Report Per Section 7.4.3
Reporting Period: 2014

Beginning Balance:	**1/1/2014**		**$ 2,217,802.36**
Transfers In:			
Rocky Reach Funding		331,015.00	
Interest Earnings		1,162.76	
Total Transfers In			332,177.76
Transfers Out:			
Payments		(343,470.88)	
Bank Service Fees		(88.50)	
Total Transfers Out			(343,559.38)
Ending Balance:	**12/31/2014**		**$ 2,206,420.74**

The Plan Species Account was established per the Rocky Reach Habitat Conservation Plan, Section 7.4. Interest earnings shall remain in the Account in accordance with Appendix E, Section 7.4.1.

Wells 2014 Plan Species Account Financial Report



Annual Report of Wells Plan Species Account Financial Activity
For the Year Ended December 31, 2014
As required by Section 7.3.7.2 of the Wells Hydroelectric Project HCP

Beginning cash and investment balance 01/01/2014			$ 1,096,267.79
Sources:			
Annual payment from Douglas PUD per Section 7.4 of HCP		$ 253,775.11	
Interest earnings		2,385.10	
	Total Sources		256,160.21
Uses:			
Project #	Description		
1301	Upper Beaver Habitat Improvement	16,100.23	
1303	Twisp River - Porman Creek Wetland	190.49	
1304	Shingle Creek Dam	4,609.71	
1306	Methow/Chewuch Groundwater Monitoring	4,446.14	
	Total for Projects	25,346.57	
0699	Chelan PUD	3,075.06	
0699	Douglas PUD	2,416.00	
	Total for Administration	$ 5,491.06	
	Total Uses		30,837.63
Ending cash and investment balance 12/31/2014			$ 1,321,590.37

John Bergstrom

John Bergstrom, Treasurer
PUD No. 1 of Douglas County

Attachment 2

Projects Funded by Plan Species Accounts

Rock Island Plan Species Account

Project Name	Sponsor	Fund Type	Project Type	Total Cost	Tributary Contribution	Tributary Contribution (actual to date)	Project Status
05 White River Floodplain & Habitat Protection	Chelan-Douglas Land Trust	General	Protection	$1,986,200	$693,548	$693,548	Complete
05 Nason Creek Off-Channel Habitat Restoration	Chelan County NRD	General	Off-Channel Habitat	$125,034	$18,787	$18,787	Complete
05 Alder Creek Culvert Replacement	Chelan County NRD	General	Fish Passage	$89,804	$89,804	$89,804	Complete
05 McDevitt Diversion Project	Cascadia Conservation District	Small	Fish Passage	$5,278	$5,278	$2,831	Complete
07 LWD Removal and Relocation	Chelan County NRD	Small	Instream Structures	$5,000	$5,000	$871	Complete
07 WRIA's 45/46 Riparian Restoration	Cascadia Conservation District	Small	Riparian Habitat	$50,000	$25,000	$24,779	Complete
07 Entiat PUD Canal System Conversion	Cascadia Conservation District	General	Instream Flows	$496,584	$99,360	$99,360	Complete
07 Roaring Creek Flow Enhancement	Cascadia Conservation District	General	Instrm Flows/Fish Passage	$147,069	$25,000	$987	Cancelled
07 Wildhorse Spring Creek Conservation Easement	Colville Confederated Tribes	General	Protection	$67,826	$62,826	$62,826	Complete
08 Twisp River Conservation Acquisition II	Methow Salmon Recovery Found	General	Protection	$481,814	$220,000	$200,500	Complete
08 Twisp River Riparian Protection (Zinn)	Methow Conservancy	General	Protection	$349,988	$104,996	$104,996	Complete
08 Cashmere Pond Off-Channel Habitat Project	Chelan County NRD	General	Off-Channel Habitat	$914,076	$249,110	$240,139	Complete
08 Keystone Canyon Habitat Project	Cascadia Conservation District	General	Off-Channel Habitat	$0	$0	$0	Cancelled
09 LWD/Rootwad Acquisition and Transport II	Cascadia Conservation District	Small	Instream Structures	$35,000	$35,000	$35,000	Complete
09 Sleepy Hollow Reserve Protection Feasibility	Chelan-Douglas Land Trust	Small	Assessment	$25,000	$20,000	$16,599	Complete

Rock Island Plan Species Account

Project Name	Sponsor	Fund Type	Project Type	Total Cost	Tributary Contribution	Tributary Contribution (actual to date)	Project Status
09 White River Nason View Acquisition	Chelan-Douglas Land Trust	General	Protection	$639,000	$76,635	$76,635	Complete
09 Upper Methow II (Tawlks) Riparian Protection	Methow Conservancy	General	Protection	$411,943	$61,948	$61,948	Complete
09 Nason Creek UWP Floodplain Reconnection - PUD Powerline Reconnection Alternatives Analysis	Chelan County NRD	General	Assessment	$53,500	$53,500	$45,569	Complete
09 Lower Wenatchee Instream Flow Enhancement	Washington Rivers Conservancy	General	Instream Flows	$4,954,466	$167,500	$167,499	Complete
10 White River Dally-Wilson Conservation Easement	Chelan-Douglas Land Trust	General	Protection	$194,000	$120,000	$120,000	Complete
10 Mission Creek Fish Passage	Cascadia Conservation District	Small	Fish Passage/Instrm Structures	$0	$0	$0	Cancelled
10 Assessing Nutrient Enhancement	CC Fisheries Enhancement Group	Small	Assessment	$9,875	$9,875	$6,670	Complete
11 Boat Launch Off-Channel Pond Reconnection	Chelan County NRD	General	Off-Channel Habitat	$136,500	$62,000	$62,000	Complete
11 White River Van Dusen Conservation Easement	Chelan-Douglas Land Trust	General	Protection	$440,000	$60,000	$60,000	Complete
12 Wenatchee Nutrient Enhancement - Treatment Design	CC Fisheries Enhancement Group	General	Assessment/Instream Structures	$240,000	$80,000	$80,000	Complete
12 White River Large Wood Atonement	CC Fisheries Enhancement Group	General	Instream Structures	$352,392	$100,000	$100,000	Complete
12 Lower White Pine Upper Connection B+	Chelan County NRD	General	Off-Channel Habitat	$2,162,290	$250,000	$0	On hold
12 Wenatchee Levee Removal & Riparian Restoration	Chelan County NRD	Small	Off-Channel Habitat	$67,450	$56,700	$20,386	Complete
14 Twisp to Carlton Reach Assessment	CC Fisheries Enhancement Group	General	Assessment	$173,016	$46,500	$38,806	In progress
14 Post Fire Landowner Assist/Habitat Protection	Methow Salmon Recovery Found	Small	Fish Passage	$100,000	$57,328	$8,817	In progress
14 Icicle Irrigation District Flow Control Structure	Chelan County NRD	General	Instream Flows	$140,633	$70,000	$30,653	Complete
14 Lehman Riparian Restoration	Methow Conservancy	Small	Riparian Habitat	$40,267	$9,053	$0	In progress
14 MVID Instream Flow Improvement	TU - Washington Water Project	General	Instream Flows	$9,747,000	$300,000	$112,438	In progress

Rock Island Plan Species Account

Project Name	Sponsor	Fund Type	Project Type	Total Cost	Tributary Contribution	Tributary Contribution (actual to date)	Project Status
15 Barkley Irrigation Company - Under Pressure	TU - Washington Water Project	General	Instream Flows	$3,293,180	$300,000	$0	In progress
Total				**$27,934,185**	**$3,534,748**	**$2,582,447**	

Current Rock Island Plan Species Account Balance (unallocated): $4,829,005
Contribution to the Rock Island Account is made annually (January 31): $485,200 (in 1998 dollars)

Rocky Reach Plan Species Account							
Project Name	**Sponsor**	**Fund Type**	**Project Type**	**Total Cost**	**Tributary Contribution**	**Tributary Contribution (actual to date)**	**Project Status**
05 Entiat Instream Structure Engineering	Cascadia Conservation District	General	Instream Structures	$59,340	$59,340	$48,659	Complete
05 Twisp River Conservation Acquisition	Methow Salmon Recovery Found	General	Protection	$200,835	$40,000	$40,000	Complete
05 Clees Well and Pump	Okanogan Conservation District	General	Instream Flows	$40,875	$15,000	$14,924	Complete
05 Entiat Instream Habitat Improvements	Chelan County NRD	General	Instream Structures	$250,000	$37,500	$37,500	Complete
06 Entiat PUD Canal Juv Habitat Enhancement	Cascadia Conservation District	Small	Instream Structures	$23,640	$23,640	$3,059	Complete
07 LWD Removal & Relocation	Chelan County NRD	Small	Instream Structures	$5,000	$5,000	$871	Complete
07 LWD/Rootwad Acquisition & Transport	Cascadia Conservation District	Small	Instream Structures	$24,600	$24,600	$24,600	Complete
07 Harrison Side Channel	Chelan County NRD	General	Off-Channel Habitat	$797,300	$90,105	$68,647	Complete
08 Entiat PUD Canal Log-Boom Installation	Cascadia Conservation District	Small	Instream Structures	$10,660	$7,160	$4,526	Complete
08 Twisp River Riparian Protection (Buckley)	Methow Conservancy	General	Protection	$299,418	$89,825	$89,825	Complete
08 Below the Bridge	Cascadia Conservation District	General	Instream Structures	$398,998	$150,000	$115,353	Complete
09 Foreman Floodplain Reconnection	Chelan County NRD	General	Off-Channel Habitat	$0	$0	$0	Cancelled
09 Entiat NFH Habitat Improvement Project	Cascadia Conservation District	General	Off-Channel Habitat	$285,886	$61,373	$61,373	Complete
10 Methow Subbasin LWD Acquisition & Stockpile	Methow Salmon Recovery Found	Small	Instream Structures	$50,000	$50,000	$49,914	Complete
11 Chewuch River Permanent Instream Flow Project	TU – Washington Water Project	General	Instream Flow	$1,200,000	$325,000	$306,752	Complete
11 Christianson Conservation Easement	Methow Conservancy	Small	Protection	$16,350	$15,000	$15,000	Complete
12 Entiat Stormy Reach Phase 2 Acquisition	Chelan-Douglas Land Trust	General	Protection	$165,000	$46,800	$44,003	Complete
12 Silver Protection	WA Dept. of Fish & Wildlife	General	Protection	$660,000	$0	$0	Cancelled

Rocky Reach Plan Species Account

Project Name	Sponsor	Fund Type	Project Type	Total Cost	Tributary Contribution	Tributary Contribution (actual to date)	Project Status
12 Nason Creek Lower White Pine Coulter Creek Barrier Replacement	Chelan County NRD	General	Fish Passage	$83,126	$12,469	$0	On hold
12 Nason Creek LWP Alcove Acquisition	Chelan-Douglas Land Trust	General	Protection	$353,000	$72,000	$72,000	Complete
13 Fish Passage at Shingle Creek Dam	Okanagan Nation Alliance	General	Fish Passage	$59,225	$180,950	$59,225	Complete
13 Upper Beaver Habitat Improvement Channel Restoration	Methow Salmon Recovery Found	General	Channel Restoration	$674,600	$102,613	$50,625	In Progress
13 Okanogan Basin Stream Discharge Monitoring	Colville Confederated Tribes	Small	Instream Flows	$90,954	$74,984	$37,120	In Progress
14 Silver Side Channel Design	CC Fisheries Enhancement Group	General	Design	$180,733	$132,000	$86,311	In Progress
14 Similkameen RM 3.8 Design	Okanogan Conservation District	General	Design	$84,640	$84,640	$34,142	In Progress
14 Entiat Stillwaters Gray Reach Acquisition	Chelan-Douglas Land Trust	General	Protection	$559,625	$174,000	$30,000	In progress
14 Clear Creek Fish Passage & Flow Enhancement	TU – Washington Water Project	Small	Fish Passage/Instrm Flows	$96,116	$69,500	$0	In progress
14 MVID Instream Flow Improvement	TU – Washington Water Project	General	Instream Flows	$9,747,000	$300,000	$0	In progress
15 Methow Watershed Beaver Reintroduction	Methow Salmon Recovery Found	General	Channel Restoration	$216,000	$33,500	$0	In progress
Total				**$16,632,921**	**$2,276,999**	**$1,294,429**	

Current Rocky Reach Plan Species Account Balance (unallocated): $2,143,226
Contribution to the Rocky Reach Account is made annually (January 31): $229,800 (in 1998 dollars)

Attachment 2

Wells Plan Species Account

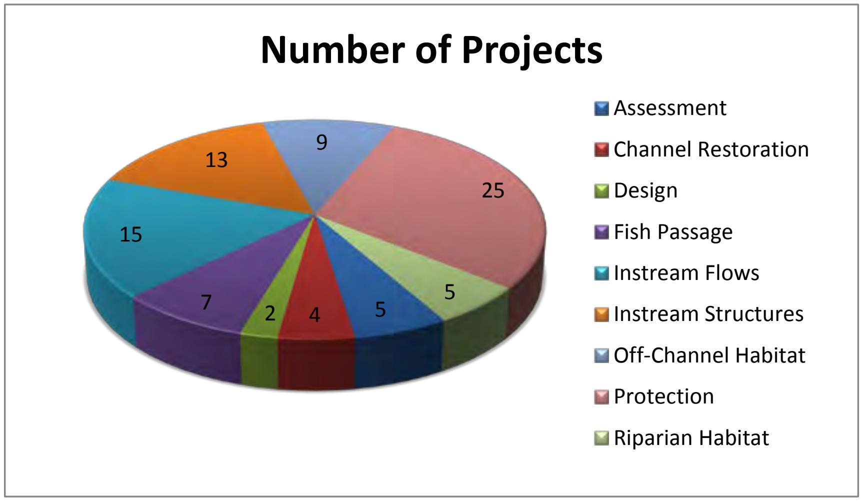
Project Name	Sponsor	Fund Type	Project Type	Total Cost	Tributary Contribution	Tributary Contribution (actual to date)	Project Status
05 Okanagan River Restoration – Phase III	Okanagan Nation Alliance	General	Instream Structures	$219,121	$219,121	$197,681	Complete
05 Methow Riparian Protection (Heath)	Methow Conservancy	General	Protection	$2,684,500	$1,177,500	$812,700	Complete
05 Methow Riparian Protection (Prentice)	Methow Conservancy	General	Protection			$1,749	Complete
05 Methow Riparian Protection (MacDonald)	Methow Conservancy	General	Protection			$345,400	Complete
07 Lower Beaver Creek Livestock Exclusion	Okanogan Conservation District	Small	Riparian Habitat	$24,670	$18,559	$16,561	Complete
07 Heath Floodplain Restoration	Methow Salmon Recovery Found	Small	Off-Channel Habitat	$48,695	$48,695	$43,915	Complete
07 Okanogan River Restoration – Phase IV	Okanagan Nation Alliance	General	Instream Structures	$1,022,000	$411,000	$411,000	Complete
08 Riparian Regeneration & Restoration Initiative	Methow Conservancy	Small	Riparian Habitat	$22,737	$15,537	$15,537	Complete
08 Fort Thurlow Pump Project	Methow Salmon Recovery Found	Small	Instream Flows	$48,150	$7,000	$7,009	Complete
08 Goodman Livestock Exclusion Project	Okanogan Conservation District	Small	Riparian Habitat	$8,080	$7,980	$6,829	Complete
08 Poorman Creek Barrier Removal	Methow Salmon Recovery Found	General	Fish Passage	$191,579	$53,748	$53,748	Complete
08 Twisp River Riparian Protection (Pampanin)	Methow Conservancy	General	Protection	$119,720	$48,649	$48,649	Complete
08 Twisp River Riparian Protection (Neighbor)	Methow Conservancy	General	Protection	$260,000	$55,000	$55,000	Complete
08 Twisp River Riparian Protection (Speir)	Methow Conservancy	General	Protection	$79,976	$23,993	$23,993	Complete
10 Prevent Fish Entrainment on Inkaneep Creek	Okanagan Nation Alliance	Small	Instream Flows	$24,000	$0	$0	Cancelled
11 Methow River Acquisition MR 39.5 (Hoffman)	Methow Salmon Recovery Found	General	Protection	$195,048	$74,415	$74,415	Complete
11Methow River Acquisition MR 48.7 (Bird)	Methow Salmon Recovery Found	General	Protection	$292,140	$111,680	$109,786	Complete
11 Methow River Acquisition MR 41.5 (Risley)	Methow Salmon Recovery Found	General	Protection	$148,210	$31,854	$26,518	Complete

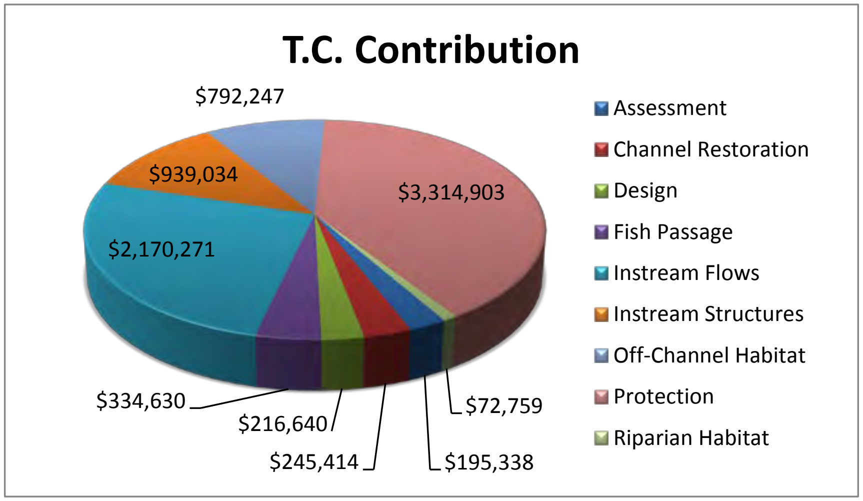
Wells Plan Species Account							
Project Name	**Sponsor**	**Fund Type**	**Project Type**	**Total Cost**	**Tributary Contribution**	**Tributary Contribution (actual to date)**	**Project Status**
12 Twisp River Acquisition 2011 (Hovee)	Methow Salmon Recovery Found	General	Protection	$140,700	$29,000	$1,074	Complete
12 Silver Protection	WA Dept. of Fish & Wildlife	General	Protection	$660,000	$0	$0	Cancelled
12 Twisp River Well Conversion	Trout Unlimited	Small	Instream Flows	$87,739	$68,023	$68,023	Complete
13 Twisp River Poorman Crk Wetland Acquisition	Methow Salmon Recovery Found	General	Protection	$423,000	$338	$338	Cancelled
13 Fish Passage at Shingle Creek Dam	Okanagan Nation Alliance	General	Fish Passage	$180,950	$59,225	$59,224	In Progress
13 Methow/Chewuch Groundwater Monitoring	Cascade Columbia Fisheries Enhancement	Small	Instream Flows	$34,180	$30,580	$29,962	In Progress
13 Upper Beaver Habitat Improvement Channel Restoration	Methow Salmon Recovery Found	General	Channel Restoration	$674,600	$102,613	$50,625	In Progress
13 Lower Chewuch Beaver Restoration	Methow Conservancy	General	Off-Channel Habitat	$247,985	$27,000	$27,000	Complete
13 MVID Instream Flow Improvement Project	Trout Unlimited	General	Instream Flows	$9,747,000	$400,000	$0	In progress
14 Remove Collapsed Bridge from Shingle Creek	Okanagan Nation Alliance	Small	Channel Restoration	$8,193	$6,693	$6,689	Complete
Total				**$17,592,973**	**$3,028,202**	**$2,493,425**	

Current Wells Plan Species Account Balance (unallocated): $1,321,590

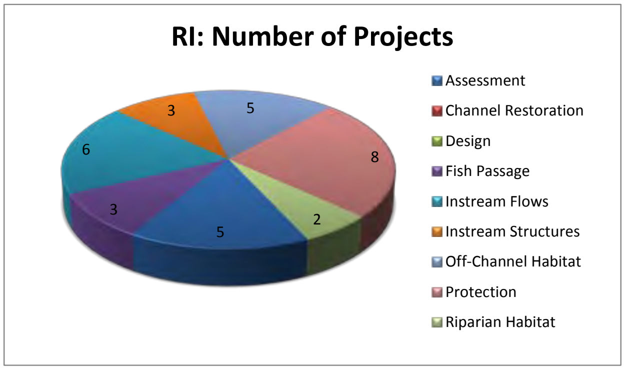
Contribution to the Wells Account will be made annually beginning in 2010: $176,178 (in 1998 dollars)

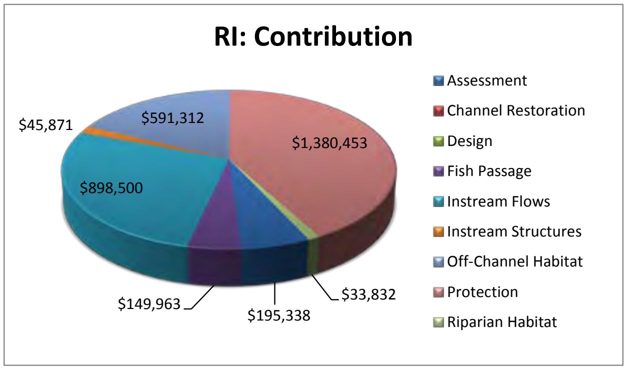
Projects Funded by the Tributary Committees

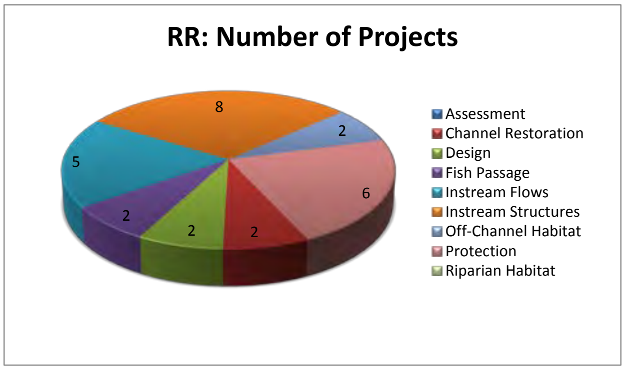




Projects Funded by each Plan Species Account


RI: Number of Projects


RI: Contribution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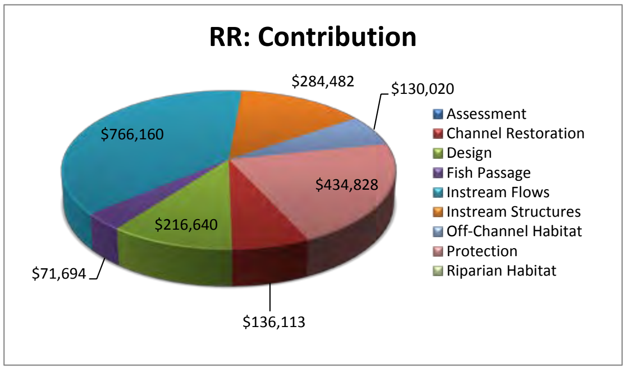
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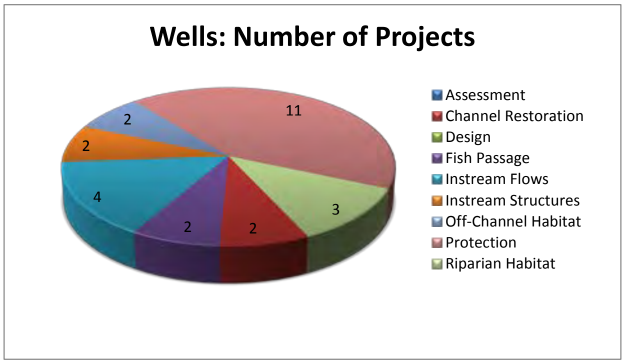
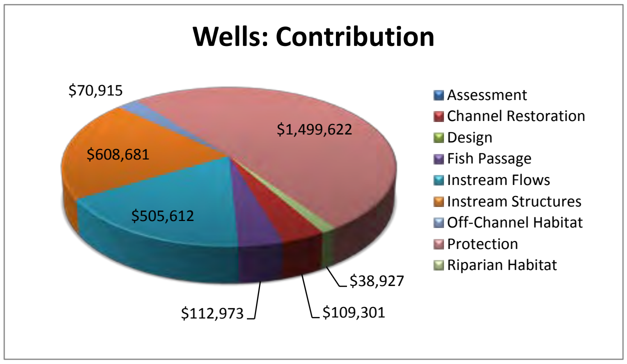

Wells: Number of Projects


Wells: Contribution

Attachment 3

Proposed 2015 SRFB/GSHP/BPA Process Schedule

UPPER COLUMBIA SRFB/TRIB
2015 FUNDING SCHEDULE

DATE	ACTIVITY/MILESTONE	PARTICIPANTS	LOCATION	FACILITATOR/ COORDINATOR
FEBRUARY				
Feb 24	Meeting: SRFB/TRIB Kick-Off Meeting	LE, RTT, TRIB, BPA, Sponsors, RCO	Chelan, WA. Fire District	LE/RCO
MARCH				
March 11	Meeting *Optional*: RTT project preview	Sponsors, RTT, TRIB	Wenatchee, TBD	RTT Chair
March 31	**Deadline:** ▪ **All 2014/2015 projects updated in HWS** ▪ ***New* - One paragraph project abstracts submitted to Lead Entity**	Sponsors	HWS	LE/WATs
APRIL				
April 8	RTT Project Presentations	Sponsors, LE, RCO, SRP, RTT, CAC, TRIB, BPA		
April 17	**Deadline: Draft proposals due**	Sponsors, LE, RCO, SRP, RTT, CAC, TRIB, BPA	PRISM	LE
MAY				
May 6 & 7	Meeting/Tours: SRFB/TRIB Project Tours Okanogan (Wed) Methow (Thur)	Sponsors, LE, RTT, TRIB, BPA, SRFB SRP	TBD	LE
May 13 & 14	Meeting/Tours: SRFB/TRIB Project Tours Wenatchee (Wed)	Sponsors, LE, RTT, TRIB, BPA, SRFB SRP	TBD	LE

UPPER COLUMBIA SRFB/TRIB
2015 FUNDING SCHEDULE

DATE	ACTIVITY/MILESTONE	PARTICIPANTS	LOCATION	FACILITATOR/ COORDINATOR
	Entiat (Thur)			
(BACK UP - TOUR DATES ARE THE MAY 21, 22)				
JUNE				
June tbd	Meeting: RTT meets and provides questions and comments to sponsors and/or	RTT	Email via LE	RTT Chair
June tbd	Action: SRP provides comments	SRP	Email via LE	RCO
June 11	Action: TRIB reviews draft proposals	TRIB	TRIB	TRIB
June 16	Action: RTT and TRIB provide comments	SRP, TRIB	Email via LE	RCO, TRIB
June 19	**DEADLINE: Final proposals due for Regional scoring and ranking**	Sponsors, LE, RTT, CAC, TRIB, BPA	PRISM	LE
JULY				
July 8	Action: RTT technical scoring	RTT, CAC, LE, BPA, BOR	RTT Meeting (TBD)	RTT
July 9	Action: TRIB reviews final proposals	TRIB	TRIB	TRIB
July 15	Action: TRIB Decisions	TRIB	Email/Letter	TRIB
July tbd	Meeting/Presentations CAC: Chelan CAC - xxth Okanogan CAC - xxnd	Sponsors, CAC, RTT, LE	Wenatchee Reclamation Dist. & River Bank, Twisp	LE
July tbd	Meeting: CAC Project Rankings Chelan CAC - xxth Okanogan CAC - xxth	CAC, LE	Wenatchee Reclamation Dist. & River Bank, Twisp	LE
AUGUST				

UPPER COLUMBIA SRFB/TRIB
2015 FUNDING SCHEDULE

DATE	ACTIVITY/MILESTONE	PARTICIPANTS	LOCATION	FACILITATOR/ COORDINATOR
August tbd	Meeting: joint CAC approves Final Ranked Project List	Joint CAC, LE	Chelan PUD, Chelan WA	LE
August 12	Deadline: Sponsors PRISM upload	Sponsors, LE	PRISM	LE
August 14	Deadline: Regional List	LE	PRISM	LE/RCO
SEPTEMBER				
Sept 4	Deadline: Regional Submittal	LE	Email	LE
OCTOBER				
Oct x	Action: SRP provide comments	SRP	Email via LE	SRP
Oct 13	Deadline: Response to comments from project sponsors to SRP	Sponsors, LE	Email via LE	LE
Oct 26-28	Meeting/Presentations: Sponsors present projects to SRP (*only projects identified*)	Select Sponsors, LE	Olympia, Washington	RCO
Nov 4	Action: SRP finalizes comments	SRP	Email via LE	SRP
NOVEMBER				
Nov 18	Final report by SRP to SRFB	RCO		RCO
DECEMBER				
Dec 9-10	Action: SRFB Decisions	SRFB	Olympia, WA	RCO

Acronyms

CAC- Citizen's Advisory Committee
BPA- Bonneville Power Administration
LE- Lead Entity Coordinator/Program
RCO- Recreation and Conservation Office
RTT- Upper Columbia Regional Technical Team
SRP- State Review Panel
SRFB- Salmon Recovery Funding Board
TRIB- Tributary Committee
UC- Upper Columbia Region
UCSRB- Upper Columbia Salmon Recovery Board

Timeline Legend	
Meetings	Blue
Deadlines	Red
Actions	Black

Wells, Rocky Reach, and Rock Island HCP
Tributary Committees Notes
9 April 2015

Members Present: Lee Carlson (Yakama Nation), Jeremy Cram (WDFW), Chris Fisher (Colville Tribes), Steve Hays (Chelan PUD), Tom Kahler (Douglas PUD), Kate Terrell (USFWS), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees Chair).

Others Present: Becky Gallaher (Tributary Project Coordinator). David Morgan (CDLT), Mickey Fleming (CDLT), Bob Bugert (CDLT), Denny Rohr (PRCC HSC Chair), and David Duvall (Grant PUD) joined the meeting at 11:30 am.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees met at Grant PUD in Wenatchee, Washington, on Thursday, 9 April 2015 from 9:30 am to 1:00 pm.

I. Review and Adopt Agenda

Tracy Hillman welcomed everyone to the meeting and the Committees adopted the proposed agenda with the addition of the Chelan County Natural Resources Department request for feedback on a funding commitment on Icicle Irrigation District O&M costs.

II. Review and Approval of Meeting Minutes

The Committees reviewed and approved the 12 February 2015 meeting notes.

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.

- Upper Beaver Habitat Improvement Channel Restoration Project – The project sponsor (Methow Salmon Recovery Foundation; MSRF) has been monitoring the channel realignment area, the upper Channel complexity area, and the irrigation diversion features. Lloyd Logging completed corrective work at the sluice and waste-way. The sponsor continues to repair the burned pipe segment, make minor adjustments to the weir, assist with ditch startup to insure fish passage, evaluate post-fire plant survival, and develop replanting plan.
- Okanogan Basin Stream Discharge Monitoring – The sponsor (Colville Tribes) indicated that the gauging stations continue to monitor stream flows.
- Methow/Chewuch Shallow Groundwater Monitoring Project – This project is complete and the Wells Tributary Committee received the final report.
- MVID Instream Flow Improvement Project – The project sponsor (Trout Unlimited; TU) is making good progress on the MVID Instream Flow Improvement Project. Tapani Construction is finishing the Eastside piping project. They are installing service connections, doing clean up, and manufacturing the bubbler that will be placed at the Mill Hill site. In addition, the sponsor spread grass seed along the right-of-way. The project is on schedule for an early start up. Bach Drilling

completed drilling the production wells and they are currently doing pump tests and draw-downs. Following this work, Bach will start the construction of the pump station. The sponsor hired Hurst Construction to complete the East Lower Lateral and Lloyd Logging to complete the E1 lateral. Hurst will complete the East Lower Lateral by early May and Lloyd will complete E-1 by mid-May. The sponsor continues to make good progress on individual wells and they have developed a plan to have them all installed on time. The sponsor intends to have 25 wells installed before the MVID Westside ditch begins diverting water on 1 May.

- Silver Side Channel Design Project – The project sponsor (Cascade Columbia Fisheries Enhancement Group; CCFEG) is waiting for the 2D model results from the Bureau of Reclamation (BOR). The results should be available in early April. Once the sponsor receives the model results, they will evaluate the output and update WDFW on the results. The landowners upslope from the WDFW property do not have any design changes; however, Margaret Smith is concerned with changes around her house. As a result, CCFEG is working with her and her son (Larry) on that issue. CCFEG has decided to postpone implementation until 2016.
- Twisp-to-Carlton Reach Assessment Project – The sponsor (CCFEG) and Cardno Entrix completed the draft assessment, which can be downloaded at: https://ftp.entrix.com; Username: **ttoc_stakeholders;** Password: **restoration.** Comments are due to CCFEG by 28 April. Comments can be provided in the Word document with track changes or bubble comments on the pdf version. CCFEG sent the draft to stakeholders and will present the work to the MRC during their April meeting.
- Similkameen RM 3.8 Project – Chris Fisher reported that the project sponsor (Okanogan Conservation District), Cardno Entrix, and the landowner reviewed two different conceptual designs and selected the cheapest one to implement. The preferred design consists of log groins that will deflect flows from the bank. Chris said that the Conservation District has made no attempt to secure funds or permits for the project. Therefore, the Colville Tribes will try to implement the project. Chris indicated that the Tribes will use BPA funds to purchase materials and they will seek additional funding from the Tributary Committees. The cost of the project will be about $416,000. They would like to implement the project in August.
- Entiat Stillwaters Gray Reach Acquisition – The sponsor (Chelan-Douglas Land Trust; CDLT) provided no new update on this project.
- Post-Fire Landowner Assistance/Habitat Protection in Beaver and Frazer Creeks Project – The project sponsor (MSRF) continued inspection of bridges, documented down-cutting of the streambed, worked with landowners to address and restore irrigation infrastructure, assembled a multi-entity group to conduct fish presence/absence surveys, and initiated grant applications for expanded restoration of riparian plantings and appropriate channel restoration actions. The sponsor will meet with Washington Department of Transportation to coordinate treatments within the stream adjacent to Highway 20. They will also meet with landowners to assess bridges and debris removal, and they will meet with contractors to initiate seed and plan installation.
- Lehman Riparian Restoration Project – There is no new update on this project.
- Clear Creek Fish Passage and Instream Flow Project – In March, the sponsor (TU) focused on planning the drilling of the well. They communicated with the Washington Department of Health Office of Drinking Water and confirmed that the preferred well location will meet state regulations. Chelan-Douglas Health District is aware of the plan for drilling the well this fall. The sponsor is now researching an appropriate engineer to prepare and submit the required Source Approval Package. Additionally, they contacted staff from several state and federal agencies regarding what permits will be required to remove the diversion dam, which will occur in 2017. The sponsor plans to select an engineer and begin the source approval process. They will also

continue their communications with Thousand Trails corporate management as the project moves toward implementation.

- Barkley Irrigation – Under Pressure Project – The sponsor (TU) provided no new update on this project.

IV. Budget Amendment: Clear Creek Fish Passage and Instream Flow Enhancement Project

The Rocky Reach Tributary Committee received a budget amendment request from Trout Unlimited on the *Clear Creek Fish Passage and Instream Flow Enhancement Project*. The sponsor would like to move $5,000 from "Excavation/Heavy Equipment Work" to "Sponsor Salaries and Benefits." Thus, the final amount allocated for Excavation/Heavy Equipment Labor would be $49,000 and the final amount allocated for Sponsor Salaries and Benefits would be $5,000. After careful consideration, **the Rocky Reach Tributary Committee approved the budget amendment**. The total budget amount will not change as a result of this amendment.

V. Scope Change: Chiwawa Nutrient Enhancement Project

The Rock Island Tributary Committee received a request from Cascade Columbia Fisheries Enhancement Group to change the scope on the *Chiwawa Nutrient Enhancement Project*. The sponsor asked to change the scope of the project from a four-year effort to a two-year effort, with the expectation that the sponsor will secure necessary funding to extend the project to the original four-year period. After much discussion, the **Rock Island Tributary Committee elected not to support the change in scope at this time**. They requested that the sponsor do the following before the Committee reconsiders the change in scope:

1. Acquire the necessary permits.
2. Secure the additional funding needed to complete the project in four years.
3. Submit a Small Projects Application to the Committees seeking the funds necessary to develop an effectiveness monitoring plan.

The Committee noted that if the sponsor is unable to secure the additional funds needed to complete the four-year project, the project may fail to demonstrate any treatment effects. That is, with only two years of data, it is unlikely that the sponsor will be able to determine if nutrient enhancement is a cost-effective method for boosting fish survival and productivity within the Chiwawa River basin. The Committee encourages the sponsor to secure additional funds and the necessary permits. They also asked the sponsor to submit an application seeking funds to develop an effectiveness monitoring plan.

VI. Presentations

Thermal Blob

Tracy Hillman gave a presentation to the Committees title, "Ocean Conditions in 2014; Potential Consequences for Salmon." Tracy stated that the presentation was given by Brian Burke with NOAA Fisheries to the Federal Columbia River Power System Adaptive Management Implementation Plan's (FCRPS AMIP) Life-Cycle Modeling Group. Tracy received permission from Bryan to share the presentation with the Committees.

Tracy described the different ecosystem indicators that oceanographers, meteorologists, and climatologists evaluate, including Pacific Decadal Oscillation (PDO), Oceanic Nino Index (ONI), Sea Surface Temperatures (SST), Upwelling Indices, Chlorophyll *a*, Zooplankton, Ichthyoplankton, juvenile salmon catches, and various anomalies. These indicators are often correlated with salmon runs and are used in forecast modeling. Tracy showed that measures of PDO, ONI, SST, Zooplankton, Ichtyoplankton, and oddities in 2014 suggest bad news for future runs of salmon. On the other hand, measures of Chlorophyll *a* indicate good news for salmon. The Upwelling Index and juvenile salmon surveys are open to several interpretations. Forecasting models indicate decreased salmon runs in the future; however, the confidence intervals associated with the estimates are very large, indicating much uncertainty in the estimates. The large uncertainty is primarily because of the unique patterns observed in the ecosystem indicators in 2014. Most of the patterns documented in 2014 have never before been observed.

Pinnipedageddon

Tracy Hillman gave another presentation to the Committees titled, "Estimation of Survival and Run Timing of Adult Spring/Summer Chinook from the Columbia River Estuary to Bonneville Dam." Tracy stated that the presentation was given by Rich Zabel, NOAA Fisheries, to the FCRPS AMIP Life-Cycle Modeling Group. Tracy received permission from Rich to share the presentation with the Committees.

Tracy began the presentation by identifying the numbers of pinnipeds counted in the estuary from 2010 through 2014. He then showed the early 2015 estimate, which is about four times greater than the number estimated last year. Tracy described the mark-recapture studies conducted by NOAA Fisheries in cooperation with commercial fishermen. He stated that of the more than 2,200 Chinook PIT tagged since 2010, average annual survival has ranged from 55-90%. Mortality was highest and travel times to Bonneville Dam were longest for fish tagged in March and April. The higher mortality and longer travel times coincided with peak numbers of sea lions. Tracy also noted that the average annual survival of Chinook decreased from 2010-2014, which correlates with the number of sea lions hauled out near Astoria. Finally, Tracy indicated that parent-based genetics testing shows promise for evaluating hatchery and tributary-level information on Chinook survival and movement. The increasing numbers of pinnipeds in the estuary could create bottlenecks for some runs of salmon.

VII. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests in February, March, and April:

   Rock Island Plan Species Account:

   - $292.50 to Clifton Larson Allen for Rock Island financial reports and budget updates.
   - $650.67 to Chelan PUD for project coordination and administration during the first quarter of 2015.

   Rocky Reach Plan Species Account:

   - $20,662.50 to Cascade Columbia Fisheries Enhancement Group for the Silver Side Channel Design Project (for work in January).
   - $19,078.93 to Cascade Columbia Fisheries Enhancement Group for the Silver Side Channel Design Project (for work in March).
   - $15,603.27 to the Okanogan Conservation District for the Similkameen RM 3.8 Design Project.
   - $9,465.00 to the Colville Tribes for the Okanogan Basin Stream Discharge Monitoring Project.
   - $292.50 to Clifton Larson Allen for Rocky Reach financial reports and budget updates.
   - $530.88 to Chelan PUD for project coordination and administration during the first quarter of 2015.

   Wells Plan Species Account:

- $313.83 to Chelan PUD for project coordination and administration during the first quarter of 2015.

2. Tracy Hillman reported that he and Mike Schiewe (Chair of the HCP Coordinating Committees) received a letter from William Dobbins, General Manager of Douglas PUD, stating that Chas Kyger will replace Shane Bickford as Douglas PUD's designated alternative representative for the Wells HCP Tributary Committee. Tom Kahler will continue his current duties as Douglas PUD's representative on the Wells Tributary Committee.
3. Becky Gallaher reported that the unallocated balances within each account were $4,722,682 in the Rock Island Account, $1,759,935 in the Rocky Reach Account, and $1,321,590 in the Wells Account.
4. Tracy Hillman said that draft SRFB/TC proposals are due on 17 April and the Committees will review the draft proposals during their 11 June meeting. Project tours are scheduled for 7 May (Methow) and 13 May (Wenatchee). Final proposals will be delivered to the Tributary Committees on 19 June. The Committees will make funding decisions on 9 July. This gives the Committees about three weeks to review the final proposals.
5. Tracy Hillman reported that he received an email from Mike Kaputa, Chelan County Natural Resources Department, describing different pumpback alternatives and associated O&M costs that the Icicle Work Group (IWG) is considering for water management within the Icicle Creek drainage. Mike provided the Committees with a letter, a table comparing Dryden and Leavenworth siphon alternatives, and the IWG Operating Procedures. In the letter, Mike asked the Committees three questions:

   - Are pumpback O&M costs an eligible expense for your organization?
   - How much funding could your organization provide?
   - Please describe your organization's limitations and constraints on providing pumpback O&M funding.

   Tracy pointed out that in 2013, the Committees elected not to contribute funds for the Icicle Peshastin Irrigation District Pump Exchange Preliminary Design Project Proposal, because, among other things, it lacked O&M costs.

   The Committees reviewed the information that Mike provided and after much discussion concluded that they are unable to respond to Mike's three questions without further information. They asked that Mike provide responses to the following questions:

   - What are the current O&M costs?
   - How many shareholders are there?
   - What is the cost per shareholder?

   The Committees directed Tracy to share these questions with Mike. Once the Committees receive responses, they will discuss their level of commitment to the project.

VIII. Chelan-Douglas Land Trust Presentation and Discussions

During the end of the meeting, the PRCC Habitat Subcommittee and Bob Bugert, Mickey Fleming, and David Morgan with CDLT joined the Tributary Committees to discuss CDLT's commitment to restoration work on their properties and to describe the Enlow Acquisition Project.

Commitment to Restoration Work

Some members of the Committees questioned CDLT's commitment to restoring habitat on properties purchased with Plan Species Account funds and PRCC funds. Bob Bugert explained that the CDLT is strongly committed to the Salmon and Steelhead Recovery Plan and to protecting and restoring habitat for ESA-listed species. Bob indicated that with regard to restoration work proposed by the FCRPS Action Agencies on the Entiat River, there are three areas of commitment.

1. Technical Aspects – The CDLT is comfortable with the technical aspects of the proposed restoration designs and is working with the BOR on completing the 30% designs by June.
2. Property Damage – The CDLT is comfortable with the risk-based designs being developed by the BOR.
3. Personal Injury – This is the most vexing problem for CDLT. There is no legislative relief on this issue and the CDLT must live with this risk. Bob said that the CDLT Board is made up of volunteers who are personally liable if someone is hurt or killed in a habitat structure on their property. Bob said that he is working with the Washington Land Trusts to see if there are ways to protect the Boards. He is also working with BPA to develop a two-party agreement that will indemnify or hold harmless the Board. Bob indicated that on navigable waters, Washington Department of Natural Resources is liable for mishaps in habitat structures below the ordinary high water mark, while the property owner is liable for mishaps in structures above the high water mark. Bob noted that liability insurance would cost about $40,000 per year, which is far too expensive for CDLT. Bob will continue to search for ways to protect the Board.

Bob concluded by stating that CDLT is committed to restoring habitat on their properties.

Enlow Acquisition Project

David Morgan gave a brief presentation on the Enlow Acquisition Project on the Entiat River. David indicated that CDLT would purchase, permanently protect, and encourage significant floodplain restoration on the Enlow property located in the Entiat Stillwaters Reach near river mile 16.3. He noted that CDLT owns the Beatley property on river right, as well as the inlet to a left-bank alcove that extends into the south end of the Enlow property. The Enlow property includes about 1,300 feet of riverbank and over 13 acres of low floodplain, most of which is inundated by overbank flow during a 10-year event. The home, built in 1993 on imported fill with a six-foot high "crawl space" to accommodate flooding, becomes an island at high flows. David said the total cost of the project is $512,700. CDLT is seeking $437,700 for the project.

David said the primary goal of the acquisition is permanent protection and enhancement of a large stretch of riverbank, floodplain, and side channel/alcove habitat. If CDLT acquires the property, Cascadia Conservation District will oversee removal of the house (preferably via relocation or salvage), septic system, and two outbuildings. Additional habitat restoration will occur in conjunction with the 2016-2017 Entiat restoration projects, funded by Bonneville Power Administration (BPA). David noted that BPA will not fund house removal or property acquisition. He showed that up to 3-5 acres of former wetland currently used for haying, and about 1000-3000 feet of side channels that once was connected to the river, would be restored. CDLT would request that the reconnections be perennial rather than seasonal. David also noted that no floodplain restoration would be possible unless the house is removed.

David indicated that there is no high ground on the property to which the house could be moved. If this proposal is not funded, the property will be sold and restoration opportunities will be lost. The property is currently on the market and could be subdivided into two additional houses. Two properties nearby sold recently, including the immediate upstream neighbor (3.3 acres for $165,000), despite the high flood risk to the manufactured home on the property. The landowners offered it to CDLT before putting it on the market, but the owners could not wait long enough for the funding process.

Following the Tributary Committees' meeting, the PRCC Habitat Subcommittee agreed to fund the project.

IX. Next Steps

If necessary, the next meeting of the Tributary Committees will be on Thursday, 14 May 2015 at Grant PUD in Wenatchee.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Wells, Rocky Reach, and Rock Island HCP
Tributary Committees Notes
11 June 2015

Members Present: Lee Carlson (Yakama Nation), Jeremy Cram (WDFW), Chris Fisher (Colville Tribes), Steve Hays (Chelan PUD), Tom Kahler (Douglas PUD), Kate Terrell (USFWS), 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 met at Grant PUD in Wenatchee, Washington, on Thursday, 11 June 2015 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 budget amendment.

II. Review and Approval of Meeting Minutes

The Committees reviewed and approved the 9 April 2015 meeting notes.

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.

- Upper Beaver Habitat Improvement Channel Restoration Project – The project sponsor (Methow Salmon Recovery Foundation; MSRF) completed repairs to the sluice gate and concrete splitter wall. The irrigation system is currently operating. The sponsor will continue to evaluate plant survival and develop a replanting plan if necessary.
- Okanogan Basin Stream Discharge Monitoring – The sponsor (Colville Tribes) indicated that the gauging stations continue to monitor stream flows.
- MVID Instream Flow Improvement Project – The project sponsor (Trout Unlimited; TU) is making good progress on the MVID Instream Flow Improvement Project. The Eastside Piping System is up and running and everything appears to be working as designed. Tapani Construction will finish a couple of punch-list items during the week of 8 June. The East Lower Lateral is also up and running and is working as designed. Lloyd Logging has been working on the E1 Lateral and has made good progress. The E1 Lateral should be completed mid-June. Bach drilling continues to work through the submittal process for the pump station design with the engineer and TU staff. They also have one more well to develop. Bach is shooting for a 30 July completion date. Bianchi Construction mobilized in late May and is planning an early June start date for the phase I portion of the West Distribution System. All piping has been delivered and is sitting in the staging areas. Phase I should be completed mid-July. Bianchi will return in the fall after the irrigation season is over to complete phase II. To date, TU has completed 30 wells; they have 10

in the que and 30 more to organize. Ten landowners have chosen the buyout option. TU is on track for the phase II target date of 1 July and continues to make good progress.

- Silver Side Channel Design Project – The project sponsor (Cascade Columbia Fisheries Enhancement Group; CCFEG) reported that because of a lack of private landowner willingness, the focus of restoration work will be on the downstream portion of the WDFW property. This approach will enhance the current 1,800 feet of channel and create an additional 1,000 feet of channel. The sponsor is working with SRFB and BPA on a scope and budget reduction for implementation in 2016. They are hopeful the private landowner will support the project once they see the finished project. The sponsor will submit the final report, design, design report, and other data by 30 June.
- Twisp-to-Carlton Reach Assessment Project – The sponsor (CCFEG) reported that they received comments from the Upper Columbia Regional Technical Team (RTT) on the Twisp-to-Carlton Reach Assessment draft report. Cardno Entrix is working on a scope of work to address the deficiencies outlined by the RTT. In order to complete the assessment work, the sponsor asked the Rock Island Tributary Committee if CCFEG could move $3,585.76 from Sponsor Salaries and Benefits and $4,108.62 from Indirect, Overhead, and Administration to Professional Services. Thus, the budget for Professional Services would increase from $30,000.00 to $37,694.38. The total budget amount will not change as a result of this budget amendment. ***The Rock Island Tributary Committee approved the budget amendment.***
- Similkameen RM 3.8 Project – Chris Fisher reported that the Rocky Reach Tributary Committee approved funding for the Similkameen RM 3.8 Project. The Rocky Reach Tributary Committee will contribute $67,370 to the project. The total cost of the project is $392,370.
- Entiat Stillwaters Gray Reach Acquisition – The sponsor (Chelan-Douglas Land Trust; CDLT) provided no new update on this project.
- Post-Fire Landowner Assistance/Habitat Protection in Beaver and Frazer Creeks Project – The project sponsor (MSRF) continued to monitor vertical erosion of the channel in the areas adjacent to Highway 20. They also began seeding some of the burned areas and held landowner meetings to discuss temporary irrigation options.
- Lehman Riparian Restoration Project – The sponsor (Methow Conservancy) reported that the majority of the riparian work was completed by early May. The sponsor used a mini-excavator to dig holes for 30, five-gallon willows in deep pots and 400 mixed riparian species plants in 1-gallon-deep pots. The sponsor placed mulch around each plant. They also installed four enclosures of 7.5-feet high deer fencing. They caged individual plants in the wildlife movement corridors between enclosures. They repaired a frost-free hydrant near the project site so water could be brought to the area for supplemental watering if necessary. Monitoring will continue for the remainder of the summer and early fall.
- Clear Creek Fish Passage and Instream Flow Project – The sponsor (TU) reported that they received formal permission from Thousand Trails to proceed with the Clear Creek project. The sponsor submitted an application for a water right change to the Chelan County Water Conservancy Board. TU is now coordinating project site visits with Thousand Trails water resources engineer and project management staff, a well driller, a civil engineer, and a permitting specialist from the Army Corps of Engineers.
- Barkley Irrigation – Under Pressure Project – The sponsor (TU) concentrated efforts on rectifying the survey data so the consultants could complete the preliminary pipeline design. The design work was completed and TU received the first full plan for the project, which included 30% design for the pipeline and 70% design for the pump station. The sponsor is currently conducting

internal reviews and asked BOR to conduct an external review. They are still anticipating the design report and revised opinion of cost. Other activities included coordination with Okanogan County on storm-water issues at Davis Creek. TU is also working to address the Fulton Irrigation Canal return into the Barkley ditch above where the new pump station will be located. They are working on the water rights determination and are beginning to formulate the draft material for the point of diversion changes. The sponsor is also working with BPA and a contractor on the cultural consultation and expects the letters to go out sometime soon, with field work to follow.

- Methow Watershed Beaver Reintroduction Project – The sponsor (MSRF) initiated a cooperative relationship with Chelan PUD to assist with beaver removal at a recreational development site. To date, the sponsor has released 12 beaver into five sites. At two sites, beaver have already established dams, which are impounding water. The sponsor is collecting data from instream data loggers.

IV. General Salmon Habitat Program Draft Proposals

The Committees received eight General Salmon Habitat Program draft proposals. The Committees reviewed each draft proposal and selected those that they believe warranted a final proposal. Projects that 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. The Committees assigned draft proposals to one of two categories: Fundable and Not Fundable. 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.

M2 Right Sugar Acquisition Project (Fundable)

The Committees recommend that the project sponsor (Methow Salmon Recovery Foundation) address the following comment/suggestion as they develop the final proposal:

- Confirm that the adjacent landowner is willing to cooperate in restoration if the proposed property is acquired. A signed landowner willingness form from the adjacent landowner would be sufficient.

Twisp River Floodplain Lower Acquisition Project (Fundable)

The Committees recommend that the project sponsor (Methow Salmon Recovery Foundation) address the following comment/suggestion as they develop the final proposal:

- Include language in the proposal indicating that MSRF will sell the uplands once the restoration work is complete. Money from the sale of the uplands would then be returned to the Tributary Committees.

Icicle Creek – Boulder Field – Wild Fish to Wilderness Project (Fundable)

The Committees recommend that the project sponsor (Trout Unlimited) address the following comment/suggestion as they develop the full proposal:

- Identify the amount of funding the City of Leavenworth will contribute to this project.

Wenatchee Basin Barrier and Diversion Assessment Project (Fundable)

The Committees would entertain a final proposal **if** the project sponsor (Cascade Columbia Fisheries Enhancement Group) addresses the following comments/suggestions:

- The Committees believe that a lot of information currently exists on barriers within the Wenatchee River basin. Therefore, they recommend that the sponsor develop a phased approached in which they first compile existing information on all known barriers within the Wenatchee River basin and prioritize that information. Then, if necessary, identify a watershed within the basin (e.g., Icicle Creek) and conduct an intensive survey of the watershed for barriers. The sponsor should use this information to determine if more intensive surveys are necessary in other watersheds.

- Describe how this project will coordinate or cooperate with the barrier analysis that may be conducted by Chelan County.
- The sponsor needs to understand that Plan Species (Chinook salmon, sockeye salmon, coho salmon, and steelhead) occur within the anadromous zone and therefore Plan Species Account funds can only be used to support projects within the distribution of these species.

CDLT Lower Nason Creek KG Protection Project (Fundable)

The Committees recommend that the project sponsor (Chelan-Douglas Land Trust) address the following comment/suggestion as they develop the full proposal:

- Identify all the potential threats to the property.

Nason Creek Upper White Pine Floodplain Reconnection Project (Not Fundable)

The Committees recommend that this project, sponsored by Chelan County Natural Resources Department, should not be submitted as a full proposal to the Tributary Committees for the following reasons:

- Although the Committees believe this project has biological benefit to Plan Species and addresses an important concern in the Nason Creek watershed, the project is too expensive. As the Committees reported to the sponsor last December when the Committees reviewed the earlier proposal, which had a budget that was less expensive than the current draft proposal, the Committees do not believe the potential benefits justify the total cost of the project, even when the cost of re-routing the Chelan PUD powerlines is ignored. The Committees base this conclusion on the cost of other comparable projects funded by the Committees and the fact that some members of the Committees have implemented similar projects at a reduced cost. The Committees do believe the sponsor should move forward with re-routing the powerlines.

Monitor Side Channel Restoration Project (Not Fundable)

The Committees recommend that this project, sponsored by Chelan County Natural Resources Department, should not be submitted as a full proposal to the Tributary Committees for the following reasons:

- The Committees believe that the project is over-engineered and that the pools will likely fill with fine sediments. They believe a less expensive approach, such as adding a few pilings to collect woody materials and adding some large wood is more appropriate for this particular side channel.

Lower Wenatchee Instream Flow Enhancement Phase II Project (Fundable)

The Committees have no comments for the project sponsor (Trout Unlimited-Washington Water Project) and recommend that they develop a final proposal.

Tracy will share this information with project sponsors by Monday, 15 June. The Committees hope this feedback will help sponsors develop full proposals, which are due on 19 June. The Committees will evaluate final proposals on Thursday, 9 July.

V. General Salmon Habitat Program Application

Similkameen River 3.8 RM Habitat Rehabilitation Project

In May, the Committees reviewed a General Salmon Habitat Program application from the Okanogan Conservation District and the Colville Confederated Tribes titled *Similkameen River 3.8 RM Habitat Rehabilitation Project*. The purpose of the project is to improve instream habitat and reduce bank erosion within a quarter-mile section of the Similkameen River near RM 3.8. This will be accomplished by installing four flow deflection structures made of large woody material and planting native species along the bank to accelerate reestablishment of riparian vegetation. This work should improve localized spawning and rearing habitat for summer Chinook. In addition, the completion of this project should encourage partnerships with private landowners throughout the basin. The total cost of the project is $392,370. The sponsor requested $67,370 from HCP Tributary Funds. After careful consideration, ***the Rocky Reach Tributary Committee elected to fund the project***.

VI. Small Projects Program Applications

Permitting Nutrient Enhancement in the Chiwawa

The Committees reviewed a Small Projects Program application from Cascade Columbia Fisheries Enhancement Group titled *Permitting Nutrient Enhancement in the Chiwawa*. The purpose of the project is to develop a treatment and effectiveness monitoring plan, and obtain permits from the U.S. Forest Service and Washington Department of Ecology to conduct a four-year, nutrient-enhancement pilot project in the Chiwawa River. The total cost of the project is $40,250. The sponsor requested $40,250 from HCP Tributary Funds. After careful consideration, ***the Committees declined the opportunity to fund the project***.

Although the Committees asked the sponsor to submit a proposal to develop a monitoring plan, they did not expect the cost to be so high. They were assuming the cost would be closer to the $10,000 that the sponsor asked for in their request for a scope change in April. In addition, the Committees are beginning to question the benefit/cost of implementing a nutrient enhancement program in the Chiwawa River basin. The Committees believe their limited funds would be better spent on other restoration projects in the Upper Columbia Basin.

White River Floodplain Connection (RM 3.4) Project

The Committees reviewed a Small Projects Program application from Cascade Columbia Fisheries Enhancement Group titled *White River Floodplain Connection (RM 3.4)*. The purpose of the project is to remove a culvert that limits floodplain connectivity along the lower White River. This project will improve fish access to a side channel and a large (40 acres) wetland. The total cost of the project is $35,500. The sponsor requested $35,500 from HCP Tributary Funds. After careful consideration, ***the Rock Island Tributary Committee elected to fund the project***.

VII. Tributary Assessment Program Application

Purchase-Installation of Passive Integrated Transponder Tag Array in Shingle Creek

In May, the Committees reviewed a Tributary Assessment Program application from the Okanagan Nation Alliance titled *Purchase-Installation of Passive Integrated Transponder Tag Array in Shingle Creek Project*. The purpose of the project is to purchase and install a permanent PIT-tag interrogation system near the mouth of Shingle Creek to monitor recolonization of the stream by steelhead and spring Chinook salmon. The site will include remote communications hardware. The total cost of the project is $42,422. The sponsor requested $35,867 from HCP Assessment Funds. After careful review of the proposal, ***the Wells Tributary Committee chose to fund the project through their Tributary Assessment Program***. As a requirement of the funding, the Committee will receive a brief annual report or memo that summarizes findings.

VIII. Review Middle Entiat 30% Restoration Designs

Chelan-Douglas Land Trust asked the Committees to review 30% designs for proposed restoration projects to be implemented on lands purchased with Plan Species Account funds. The Committees reviewed projects proposed to be implemented on the Troy and Bockoven South parcels.

In general, the Committees questioned why it is necessary to anchor fish structures in side channels. They also questioned what flows were used to guide the design of structures in the side channels. They noted that they understand the need to anchor large structures that are used to force stream meander, but questioned why extensive anchoring of fish structures is necessary. ***The Committees will continue to evaluate the 30% designs and provide their comments to Tracy Hillman by Tuesday, 23 June. Tracy will compile the comments and forward them to CDLT and the Bureau of Reclamation.***

IX. Icicle Workgroup Pumpback Costs

In March, the Committees received an email from Mike Kaputa, Chelan County Natural Resources Department, describing different pumpback alternatives and associated O&M costs that the Icicle Work Group (IWG) is considering for water management within the Icicle Creek drainage. Mike asked the Committees three questions:

- Are pumpback O&M costs an eligible expense for your organization?
- How much funding could your organization provide?
- Please describe your organization's limitations and constraints on providing pumpback O&M funding.

After reviewing the information that Mike provided, the Committees concluded that they were unable to respond to Mike's three questions without further information. They asked that Mike provide responses to the following questions:

- What are the current O&M costs?
- How many shareholders are there?
- What is the cost per shareholder?

In April, Mike provided the Committees with the following response:

> *I appreciate the committees' responsiveness to the O&M funding request.*
>
> *Just to clarify a few points…..The Icicle and Peshastin Irrigation District boards recently voted unanimously to pull from future consideration the pumpback alternatives that only benefited Icicle Creek, i.e. the partial and full season alternatives at the McDevitt property near the Leavenworth Safeway. The only pumpback project that Icicle and Peshastin will consider is the Dryden pumpback project that benefits both Icicle and Peshastin Creeks during low flow periods, which could be from two to six+ weeks. The districts have stated their preference for that project for some time, so, from their perspective, there has been no change in their position. Chelan County will continue to work with the districts on this project under a task order we have with the Bureau of Reclamation. Second, there are other pumpback projects that the Icicle Work Group is considering that do not involve Icicle and Peshastin Irrigation Districts, including a possible pumpback with Cascade Orchards Irrigation Company and a possible pumpback at the Leavenworth hatchery. The COIC alternatives analysis will likely be completed late summer 2015.*
>
> *I understand the committees' questions to be asking if any of the Icicle and Peshastin districts' current O&M costs will be offset by a new pumpback facility (and not how much more can district customers afford to pay for their water). The answer is no, there will be no cost offset,*

only additive costs since the pumpback will be partial (i.e. only operating for part of the irrigation season). The districts will still need to maintain their existing gravity systems for the entire season; in fact, there could be additional costs for the gravity system from shutting down and re-starting it due to switching between the gravity system and the new pumpback facility mid-season.

After reviewing Mike's response, the Committees talked about holding a meeting with IPID and Trout Unlimited to discuss O&M costs and to relay the Committees' preferences and requirements. After further discussion, the Committees decided to table this matter until they receive a memo from the IWG. That is, Mike Kaputa noted in one of his emails that the IWG is evaluating other "non-conventional" ways to cover O&M costs. Mike indicated in his email that he will share a memo from the IWG with the Tributary Committees describing IWG findings.

X. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests in April, May, and June:

   Rock Island Plan Species Account:

   - $9,053.00 to the Methow Conservancy for the Lehman Riparian Restoration Project.
   - $7,026.50 to the Methow Salmon Recovery Foundation for the Post-Fire Landowner Assistance/Habitat Protection Project.
   - $7,677.50 to Cascade Columbia Fisheries Enhancement Group for the Twisp-to-Carlton Reach Assessment Project. Ten percent of the payment request will be withheld until the Committees receive the final report.
   - $181.75 to Clifton Larson Allen for Rock Island financial administration during the first quarter, 2015.

   Rocky Reach Plan Species Account:

   - $4,899.33 to Cascade Columbia Fisheries Enhancement Group for the Silver Side Channel Design Project. Ten percent of the payment request will be withheld until the Committees receive the final report.
   - $12,031.51 to the Okanogan Conservation District for the Similkameen RM 3.8 Design Project (April Invoice).
   - $1,693.98 to the Okanogan Conservation District for the Similkameen RM 3.8 Design Project (May Invoice).
   - $9,465.00 to the Colville Confederated Tribes for the Okanogan Basin Stream Discharge Project.
   - $2,384.06 to the Methow Salmon Recovery Foundation for the Upper Beaver Habitat Improvement Channel Restoration Project.
   - $181.75 to Clifton Larson Allen for Rock Island financial administration during the first quarter, 2015.

   Wells Plan Species Account:

   - $2,384.05 to the Methow Salmon Recovery Foundation for the Upper Beaver Habitat Improvement Channel Restoration Project.

XI. Next Steps

The next meeting of the Tributary Committees will be on Thursday, 9 July 2015 at Grant PUD in Wenatchee.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Wells, Rocky Reach, and Rock Island HCP
Tributary Committees Notes
9 July 2015

Members Present:	Lee Carlson (Yakama Nation), Jeremy Cram (WDFW), Chris Fisher (Colville Tribes), Kate Terrell (USFWS), and Tracy Hillman (Committees Chair).
Members Absent:	Steve Hays (Chelan PUD), Tom Kahler (Douglas PUD), and Justin Yeager (NOAA Fisheries).[1]
Others Present:	Becky Gallaher (Tributary Project Coordinator).

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees met at Grant PUD in Wenatchee, Washington, on Thursday, 9 July 2015 from 10:00 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 two information updates.

II. Review and Approval of Meeting Minutes

The Committees reviewed and approved the 11 June 2015 meeting notes.

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.

- Upper Beaver Habitat Improvement Channel Restoration Project – The project sponsor (Methow Salmon Recovery Foundation; MSRF) completed additional surveys on the reconstructed channel to evaluate function. They found minor bank erosion in the archeological area where plantings were not allowed. The erosion is not considered a threat. Visual surveys of revegetated areas continue to show good recovery. The irrigation system is working as designed.
- Okanogan Basin Stream Discharge Monitoring – The sponsor (Colville Tribes) indicated that the gauging stations continue to monitor stream flows.
- MVID Instream Flow Improvement Project – The project sponsor (Trout Unlimited; TU) reported that Tapani Construction completed the punch list items for the Eastside Piping Project. The new pipe system is running and MVID shareholders are happy with the added pressure. The E1 Lateral is up and running. Lloyd Logging is working on the remaining punch list items and those should be completed by 30 June. The pump station design has been approved. Bach drilling has one more well to develop. They are shooting for a 30 July completion date. Bianchi Construction completed about 25% of the Westside Phase 1 Piping Project. They are shooting for a 19 July completion date for Phase I and will return in the fall after the irrigation season is over to

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[1] These members provided their votes on decision items before the meeting.

complete Phase II. TU is on track to have all individual wells completed by the 1 July deadline, allowing for the ramp down of the Twisp River head gate. To date, 50 of the 80 wells have been installed.

- Silver Side Channel Design Project – This project is complete. The project sponsor (Cascade Columbia Fisheries Enhancement Group; CCFEG) submitted the final report.
- Twisp-to-Carlton Reach Assessment Project – This project is complete. The sponsor (CCFEG) will submit the final report soon.
- Similkameen RM 3.8 Project – This project is complete. The project sponsor (Okanogan Conservation District) submitted the final report.
- Entiat Stillwaters Gray Reach Acquisition – The sponsor (Chelan-Douglas Land Trust; CDLT) provided no new update on this project.
- Post-Fire Landowner Assistance/Habitat Protection in Beaver and Frazer Creeks Project – The project sponsor (MSRF) contacted four landowners with passage barriers. The sponsor believes these passage barriers will be addressed this summer.
- Lehman Riparian Restoration Project – This project is complete. The sponsor (Methow Conservancy) submitted the final report.
- Clear Creek Fish Passage and Instream Flow Project – The sponsor (TU) continues to work on the water right change due diligence and water right change process. They visited the site with Thousand Trails corporate staff, the project engineer, and well driller to confirm and finalize the preferred well location, preliminary design, and project timeline.
- Barkley Irrigation – Under Pressure Project – The sponsor (TU) focused efforts on review and changes to the designs on the permanent pump station and pipeline. They will submit final permits the week of 29 June.
- Methow Watershed Beaver Reintroduction Project – The sponsor (MSRF) released seven beavers at four sites. They monitored 20 release sites for the presence of beavers. They found one new establishment where beavers were released earlier this season and six establishments that have grown or are still active since they were last monitored earlier this season.
- White River Floodplain (RM 3.4) Connection Project – The Tributary Committee/Sponsor Agreement is ready for signature.

IV. General Salmon Habitat Program Proposals

The Committees received six General Salmon Habitat Program proposals. Before reviewing the proposals, Becky Gallaher reported that the unallocated balances within each account were $4,722,682 in the Rock Island Plan Species Account, $1,759,935 in the Rocky Reach Plan Species Account, and $1,321,590 in the Wells Plan Species Account. In addition, and consistent with the Committees' Operating Procedures, members of the Committees identified potential conflicts of interest. Kate Terrell recused herself from voting on the Icicle Creek – Boulder Field – Wild Fish to Wilderness project and Jeremy Cram recused himself from voting on the Wenatchee Basin Barrier and Diversion Assessment project.

Wenatchee Basin Barrier and Diversion Assessment Project

Cascade Columbia Fisheries Enhancement Group is the sponsor of the Wenatchee Basin Barrier and Diversion Assessment Project. The purpose of this project is to complete a comprehensive fish barrier and diversion inventory throughout the Wenatchee River basin and to prioritize sites for voluntary remedies. The total cost of the project is $361,589. The sponsor requested $40,000 from HCP Tributary Funds.

The Committees believe that a lot of information currently exists on barriers within the Wenatchee River basin. As a result, they believe the sponsor should develop a phased approached in which they first compile existing information on all known barriers within the Wenatchee River basin and prioritize that information. Then, if necessary, identify a watershed within the basin (e.g., Icicle Creek) and conduct an intensive survey of the watershed for barriers. Based on these concerns, ***the Tributary Committees elected not to fund this project***.

Lower Wenatchee Instream Flow Enhancement Phase II Project

Trout Unlimited – Washington Water Project is the sponsor of the Lower Wenatchee Instream Flow Enhancement Phase II Project. The purpose of this project is to improve stream flows (add between 7.69 and 15 cfs) in the lower Wenatchee River between RM 5 and 7. This will be accomplished by building a permanent pressurized irrigation system. The total cost of the project is $1,760,759. The sponsor requested $125,000 from HCP Tributary Funds. Because of the low biological benefit and high cost of the project, ***the Tributary Committees elected not to fund this project***.

Icicle Creek – Boulder Field – Wild Fish to Wilderness Project

Trout Unlimited – Washington Water Project is the sponsor of the Icicle Creek – Boulder Field – Wild Fish to Wilderness Project. The purpose of this project is to enhance fish passage at the Boulder Field (RM 5.6) on Icicle Creek and thereby provide access to more than 23 miles of high quality habitat. This will be accomplished by creating a 160-foot fishway (14% slope, step-pool channel) along the left bank. This project is likely to have a large positive effect on abundance, productivity, and spatial structure of Plan Species. The total cost of the project is $1,571,189. The sponsor requested $250,000 from HCP Tributary Funds. ***The Rock Island Committee approved funding for this project.***

M2 Right Sugar Acquisition Project

The Methow Salmon Recovery Foundation is the sponsor of the M2 Right Sugar Acquisition Project. The purpose of this project is to permanently protect floodplain function, preserve restoration options, and prevent insensitive development on about 12 acres near RM 42.2 on the Methow River. The total cost of the project is $122,903. The sponsor requested $18,435 from HCP Tributary Funds. ***The Wells Committee approved funding for this project.***

The Wells Committee pointed out that the Committee will order and pay for the appraisal and review. Even if the sponsor elects to use their own appraiser, the Committees will only honor the assessment conducted by their appraiser. Because the sponsor asked for $3,250 for appraisal and review, the Committee subtracted this amount from the Tributary Committee request. Thus, the amount the Wells Committee will pay the sponsor for this project is $15,185 ($18,435 - $3,250).

Nason Creek Upper White Pine Floodplain Reconnection Project

Chelan County Natural Resources Department is the sponsor of the Nason Creek Upper White Pine Floodplain Reconnection Project. The purpose of this project is to reestablish hydrogeomorphic connectivity between Nason Creek and its floodplain, and restore and enhance stream channel functions to increase productivity and survival of ESA-listed fish. This will be accomplished by removing about 0.5 miles of levee and relocating 1,500 feet of straightened mainstem to restore sinuosity and habitat complexity. The total cost of the project is $2,845,107. The sponsor requested $400,000 from HCP Tributary Funds.

Although the Committees generally support floodplain reconnection projects and they recognize that the proposed project is a priority action in a priority area that would benefit Plan Species, the Committees cannot support the total cost of the proposed project. They do not believe the potential benefits to Plan Species justify the total cost of the project, even when the cost of re-routing the Chelan PUD powerlines is ignored. In addition, they believe the Upper White Pine site has great potential to produce a relatively large biological effect, but constraints placed on the project do not allow the full potential of the site to be realized. Based on these concerns, ***the Tributary Committees elected not to fund this project***.

Lower Nason Creek KG Protection Project

The Chelan-Douglas Land Trust is the sponsor of the Lower Nason Creek KG Protection Project. The purpose of this project is to protect permanently 3,900 feet of riverbank and 16.32 acres of high quality riparian/floodplain/wetland habitat on lower Nason Creek (RM 1.2-1.8). The total cost of the project is $197,500. The sponsor requested $29,625 from HCP Tributary Funds. ***The Rocky Reach Committee approved funding for this project.***

The Rocky Reach Committee pointed out that the Committee will order and pay for the appraisal and review. Because the sponsor asked for $5,000 for appraisal and review, the Committee subtracted this amount from the Tributary Committee request. Thus, the amount the Rocky Reach Committee will pay the sponsor for this project is $24,625 ($29,625 - $5,000).

Summary of Review of 2015 General Salmon Habitat Program Projects.

Project Name	Sponsor[1]	Total Cost	Request from T.C.	T.C. Contribution[2]
Wenatchee Basin Barrier and Diversion Assessment	CCFEG	$361,589	$40,000	$0
Lower Wenatchee Instream Flow Enhancement Phase II	TU-WWP	$1,760,759	$125,000	$0
Icicle Creek – Boulder Field – Wild Fish to Wilderness	TU-WWP	$1,571,189	$250,000	RI: $250,000
M2 Right Sugar Acquisition	MSRF	$122,903	$18,435	W: $15,185
Nason Creek UWP Floodplain Reconnection	CCNRD	$2,845,107	$400,000	$0
Lower Nason Creek KG Protection	CDLT	$197,500	$29,625	RR: $24,625
Total:		**$6,859,047**	**$863,060**	**$289,810**

[1] CCNRD = Chelan County Natural Resource Department; CCFEG = Cascade Columbia Fisheries Enhancement Group; MSRF = Methow Salmon Recovery Foundation; CDLT = Chelan-Douglas Land Trust, and TU-WWP = Trout Unlimited – Washington Water Project.

[2] RI = Rock Island Plan Species Account; RR = Rocky Reach Plan Species Account; W = Wells Plan Species Account.

V. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests in April, May, and June:

   Rock Island Plan Species Account:

   - $805.33 to Chelan PUD for project coordination and administration during the second quarter of 2015.

   Rocky Reach Plan Species Account:

   - $489.93 to Cascade Columbia Fisheries Enhancement Group for the Silver Side Channel Design Project.
   - $1,393.42 to the Okanogan Conservation District for the Similkameen RM 3.8 Design Project.
   - $3,232.81 to Trout Unlimited for the Clear Creek Fish Passage and Instream Flow Enhancement Project.

- $755.30 to Chelan PUD for project coordination and administration during the second quarter of 2015.

Wells Plan Species Account:

- $603.66 to Chelan PUD for project coordination and administration during the second quarter of 2015.

2. Chris Fisher reported that he will talk with Kari Alex with the Okanagan Nation about a possible field trip in Canada in October.
3. Tracy Hillman said that Jason Lundgren met with him to discuss funding for developing a monitoring plan designed to assess the nutrient-enhancement pilot study in the Chiwawa River basin. Recall that in April the Committees asked CCFEG to submit a Small Projects application seeking funds to develop a nutrient enhancement monitoring plan. In June, CCFEG submitted an application asking for financial support to develop a treatment and effectiveness monitoring plan, and to obtain permits from the U.S. Forest Service and Washington Department of Ecology. The total cost of the project was $40,250. The Committees elected not to fund the project, because it included permitting and was more expensive than anticipated. Jason asked Tracy if they could revise the application and only ask for funding to develop the monitoring plan (no permitting). After sharing this information with the Committees, the Committees agreed that Jason could submit a Small Projects application seeking funding for only developing the monitoring plan.

VI. Next Steps

If necessary, the next meeting of the Tributary Committees will be on Thursday, 13 August 2015 at Grant PUD in Wenatchee.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Wells, Rocky Reach, and Rock Island HCP
Tributary Committees Notes
10 September 2015

Members Present: Lee Carlson (Yakama Nation), Jeremy Cram (WDFW), Chris Fisher (Colville Tribes)[1], Steve Hays (Chelan PUD), Tom Kahler (Douglas PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees Chair).

Members Absent: Kate Terrell (USFWS).[2]

Others Present: Becky Gallaher (Tributary Project Coordinator).

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees met at Grant PUD in Wenatchee, Washington, on Thursday, 10 September 2015 from 10:00 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 Committees reviewed and approved the 9 July 2015 meeting notes with edits.

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.

- Upper Beaver Habitat Improvement Channel Restoration Project – The project sponsor (Methow Salmon Recovery Foundation; MSRF) continues landowner outreach and channel surveys. The irrigation system is operating as designed. Visual surveys of the revegetated areas indicate good recovery.
- Okanogan Basin Stream Discharge Monitoring – The sponsor (Colville Tribes) indicated that the gauging stations continue to monitor stream flows.
- MVID Instream Flow Improvement Project – The project sponsor (Trout Unlimited; TU) reported that Lloyd Logging has completed all punch list items for the E1 Lateral. There was one change order for the Airport Road irrigation-line extension. Completion of the extension was delayed because of the fires. The estimated completion date is mid-September. Construction on the production wells is scheduled to be complete by the end of October. Phase II on the West Distribution System is finished. The contractor will return on 1 October to complete the ditch work. No new activity has occurred on individual wells. The sponsor did not meet the 1 August deadline because of some difficult geology and lower than normal water tables. The sponsor and

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[1] Chris participated via conference line.

[2] Kate provided her votes on decision items before the meeting. She recused herself from voting on the Silver Side Channel Revival - Phase I proposal.

MVID have been working with landowners to keep water flowing until the wells are drilled. Wells should be completed by mid-August. So far, 60 of the 80 wells have been installed.

- Twisp-to-Carlton Reach Assessment Project – This project is complete. The sponsor (Cascade Columbia Fisheries Enhancement Group; CCFEG) will submit the final report soon.
- Entiat Stillwaters Gray Reach Acquisition – The sponsor (Chelan-Douglas Land Trust; CDLT) provided no new update on this project.
- Post-Fire Landowner Assistance/Habitat Protection in Beaver and Frazer Creeks Project – The project sponsor (MSRF) indicated that there has been no new activity with this project.
- Clear Creek Fish Passage and Instream Flow Project – In August, the sponsor (TU) focused on the water-right change process and well drilling preparation. The sponsor conducted a site visit with the Chelan County Water Conservancy Board and began working on the Report of Examination for the water-right change. A temporary change has been requested through Ecology so that the well can be drilled before the formal change. The design engineer continues working on the drawings and floor plan for a new pump station. A second site visit was held with the engineer to discuss pipeline-storage tank interconnection and to review the existing connection.
- Barkley Irrigation – Under Pressure Project – The sponsor (TU) indicated that the 90% design is complete. A site visit was held with the engineers and fish-screen manufacturers and it was determined that the screens are suitable for the location. Most permits have been submitted. The water-rights change will be completed in December. The sponsor also began working on pipeline easements and individual landowner meetings. The sponsor expects the cultural resource survey to commence sometime in September.
- Methow Watershed Beaver Reintroduction Project – The sponsor (MSRF) released five beavers at two sites and downloaded data from the data-loggers.
- Similkameen RM 3.8 Project – No update on this project was provided.
- White River Floodplain (RM 3.4) Connection Project – The sponsor (CCFEG) initiated a cultural resource investigation and has been coordinating with Chelan-Douglas Land Trust, WDFW (landowner), and the adjacent private landowners.

IV. General Salmon Habitat Program Application

Silver Side Channel Revival – Phase I

The Committees reviewed a General Salmon Habitat Program application from Cascade Columbia Fisheries Enhancement Group titled *Silver Side Channel Revival – Phase I Project*. The purpose of the project is to enhance aquatic habitat within the lower 2,000 feet of the Silver Side Channel located in the middle reach on the Methow River about five miles downstream from Twisp. The original intent was to enhance the entire 6,500 feet of the side channel, but because of landowner permission issues, only the lower third of the channel can be enhanced at this time. Although salmonids use the lower portion of the side channel, the habitat there is degraded and therefore offers large opportunities for enhancement. This phase of the project will provide an increase in off-channel rearing habitat, high-flow and thermal refugia, and winter habitat for juvenile salmonids. The total cost of the project is $575,435. The sponsor requested $287,717.50 from HCP Tributary Funds. After careful consideration, ***the Committees declined the opportunity to fund the project***.

The Committees believe the proposed project would provide some biological benefit; however, restoring only the lower third of the channel will not achieve the benefits that the Committees believe are possible at a reasonable cost. The lack of restoration in the middle or upper third of the side channel could reduce the potential benefits of actions implemented in the lower third of the channel. In addition, the total cost of the project will be much higher if the actions are implemented piecemeal. Thus, after the sponsor receives landowner permission, the Committees would like to see a proposal to enhance the lower two-thirds of the channel, or the entire length of the channel, rather than just the lower third of the channel.

V. Small Projects Program Applications

Bank Stabilization at Shingle Dam Removal Site

The Committees reviewed a Small Projects Program application from Okanagan Nation Alliance titled *Bank Stabilization at Shingle Dam Removal Site*. The purpose of the project is to help stabilize stream banks following the removal of Shingle Creek dam. The dam was removed in 2014 and a two-year flood destabilized a bank resulting in the erosion of about 2,000 m^2 of riparian habitat. Bank stabilization will be accomplished by installing a waddle fence and planting native riparian vegetation. The total cost of the project is $14,012.75. The sponsor requested $14,012.75 from HCP Tributary Funds. After careful consideration, ***the Committees declined the opportunity to fund the project***.

The Committees believe the channel will continue to evolve as it adjusts to the removal of the dam. As such, they do not believe it is necessary to try to stabilize the bank, especially given that the bedrock on river left will eventually preclude further bank erosion.

VI. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests in August and September:

   Rock Island Plan Species Account:

   - $1,212.42 to Cascade Columbia Fisheries Enhancement Group for the White River Floodplain Connection (July Invoice).
   - $872.07 to Cascade Columbia Fisheries Enhancement Group for the White River Floodplain Connection (August Invoice).

   Rocky Reach Plan Species Account:

   - $989.36 to the Okanogan Conservation District for the Similkameen RM 3.8 Design Project (final invoice).
   - $2,617.61 to Trout Unlimited for the Clear Creek Fish Passage and Instream Flow Enhancement Project (August invoice).

2. Tracy Hillman reported that in late July the Rocky Reach Tributary Committee received a budget amendment request from Trout Unlimited on the *MVID Instream Flow Improvement Project*. The sponsor asked to move $300,000 from “Project Materials” to “Contract Labor.” In August, **the Rocky Reach Tributary Committee approved the budget amendment**. The total budget amount will not change as a result of this amendment.
3. Chris Fisher reported that the HCP Tributary Committees and the PRCC Habitat Subcommittee will visit projects in Canada during 14 and 15 October. Chris said that he will provide a draft agenda for the trip later this month.
4. Tracy Hillman said that Phil Roni, Cramer Fish Sciences, contacted him to see if he could discuss the importance of prioritizing research, monitoring, and evaluation work in the Methow River basin. Phil told Tracy that he sees an incredible amount of work occurring in the Methow River basin with apparently little overall guidance or direction. That is, studies in the Methow include CHaMP, PIBO, AREMP, food-web modeling, life-cycle modeling, SRFB Effectiveness Monitoring, BOR Effectiveness Monitoring, hatchery evaluation and assessments, relative

reproductive success studies, reach assessments, and a proposal to do EDT modeling in the basin. Phil said that as an outsider it appears that a prioritization framework for monitoring and evaluation is needed in the basin. Once specific questions and objectives are identified, appropriate monitoring tools can be selected. Phil suggested setting up a Multi-Criteria Decision Analysis (MCDA), which uses a simple scoring and weighting system to help prioritize monitoring activities. He would like to discuss this approach with the Committees.

Although members of the Committees tend to concur with Phil's observations, they believe a discussion with the Committees is not appropriate. A more appropriate venue would be the Upper Columbia Salmon Recovery Board (UCSRB). That is, Phil should discuss his observations and recommendations with the UCSRB. The Committees directed Tracy to share these thoughts with Phil.

VII. Next Steps

If necessary, the next meeting of the Tributary Committees will be on Thursday, 8 October 2015 at Grant PUD in Wenatchee. The Committees will tour projects in the Okanagan in Canada on 14 and 15 October.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Wells, Rocky Reach, and Rock Island HCP
Tributary Committees Notes
12 November 2015

Members Present:	Lee Carlson (Yakama Nation), Jeremy Cram (WDFW), Chris Fisher (Colville Tribes), Steve Hays (Chelan PUD), Tom Kahler (Douglas PUD), Kate Terrell (USFWS), 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 met at Grant PUD in Wenatchee, Washington, on Thursday, 12 November 2015 from 10:00 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 following additions:

- Discussion on riparian vegetation planting.
- Review of Middle Entiat 60% Restoration Plans.
- Discussion on purchasing the Silver Side Channel property.

II. Review and Approval of Meeting Minutes

The Committees reviewed and approved the 10 September 2015 meeting notes.

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.

- Upper Beaver Habitat Improvement Channel Restoration Project – The project sponsor (Methow Salmon Recovery Foundation; MSRF) continues to identify adaptive management measures to implement before winter. This includes inspection of screens, fish return, sluiceway, and the diversion structure.
- Okanogan Basin Stream Discharge Monitoring – The sponsor (Colville Tribes) indicated that the gauging stations continue to monitor stream flows.
- MVID Instream Flow Improvement Project – The project sponsor (Trout Unlimited; TU) reported that the E1 Lateral is complete. Construction on the production wells is scheduled to be complete by the end of October. All piping is complete on the West Distribution System. The contractor demobilized in late September and will remobilize in early November. Ten additional wells and two landowner buyouts were completed in October. The remaining seven wells will be completed in November.

- Twisp-to-Carlton Reach Assessment Project – This project is complete. The sponsor (Cascade Columbia Fisheries Enhancement Group; CCFEG) will submit the final report soon.
- Entiat Stillwaters Gray Reach Acquisition – The sponsor (Chelan-Douglas Land Trust; CDLT) provided no new update on this project. Becky noted that the contract ends on 31 December 2015. She will contact CDLT to see if they want to extend the contract timeline or terminate the contract.
- Post-Fire Landowner Assistance/Habitat Protection in Beaver and Frazer Creeks Project – The project sponsor (MSRF) completed and submitted permit applications for implementing beaver dam analogue structures. The purpose of the structures is to restore grade between the Bauer Bridge and the Lazy K culvert.
- Clear Creek Fish Passage and Instream Flow Project – In October, the sponsor (TU) received the preliminary permit from Ecology to drill. The sponsor and the landowner are working with the drilling contractor to schedule the test well. Given the onset of winter, project construction will likely begin spring 2016. The sponsor is preparing the water right report of examination. They will submit it to Chelan County Water Conservancy Board in November. If well drilling can occur in November, the sponsor and engineer will prepare and submit the Source Approval Package to the Washington State Department of Health.
- Barkley Irrigation – Under Pressure Project – The sponsor (TU) has been working on the Wilson Acquisition and preparing for the possibility of moving the pump station downstream to the most accommodating location. They continue to work on permitting and coordinating cultural resource work. Fieldwork will start in November. The sponsor submitted the water rights change application to Ecology in October.
- Methow Watershed Beaver Reintroduction Project – The sponsor (MSRF) provided no new updates on this project.
- Similkameen RM 3.8 Project – Because of permitting delays, the sponsor (Okanogan Conservation District) is requesting a time extension on this project. They asked the Rocky Reach Tributary Committee to extend the period of the project to 31 October 2016. ***The Rocky Reach Tributary Committee approved the time extension.*** Chris Fisher stated that he will be meeting with the Bureau of Reclamation and the Bonneville Power Administration to discuss the project with them.
- White River Floodplain (RM 3.4) Connection Project – The sponsor (CCFEG) indicated that there was no new activity on this project.

IV. Small Projects Program Applications

Peshastin Creek RM 10.5 PIT-Tag Detection Site

The Committees reviewed a Small Projects Program application from WDFW titled *Peshastin Creek RM 105 PIT-Tag Detection Site*. The purpose of the project is to install a permanent instream PIT-tag detection site in Peshastin Creek just upstream from the Ruby Creek slide. The site will be used to evaluate steelhead passage at the Ruby Creek slide before and after restoration, help manage suction dredging, and better understand movement and distribution of bull trout and steelhead. The total cost of the project is $66,859. The sponsor requested $36,256 from HCP Tributary Funds. After careful consideration, ***the Rock Island Tributary Committee elected to contribute $32,269 to the project***.

The Committee was unable to fund the full amount requested from them because the Policies and Procedures for the HCP Tributary Committees require that indirect costs cannot exceed 15% of the total cost. Thus, the Rock Island Tributary Committee contributed only $4,209 for WDFW indirect costs

($28,060 x 0.15 = $4,209), not the $8,196 requested by the project sponsor. The agreement to fund this project requires that the sponsor provide the Committee with annual results from the monitoring work.

If WDFW is unable to implement the project with the 15% indirect costs, they will try to transfer the work to West Fork Environmental. If this happens, the contract will be with West Fork Environmental with no change in scope of work or cost. That is, West Fork Environmental will do the proposed work for $32,269 as approved by the Rock Island Tributary Committee.

V. Scope of Work Change

The Committees received as change-of-scope request from Trout Unlimited (TU) on the *MVID Instream Flow Improvement Project*. TU requested a scope change that includes tree removal along the abandoned west-side ditch and also provides the sponsor with the opportunity to negotiate buy-outs of liability with the few larger landowners for dead trees. This change will help TU remain within budget as they near completion of the project. After careful consideration, ***the Wells, Rocky Reach, and Rock Island Tributary Committees approved the scope change***.

VI. Review of Middle Entiat 60% Restoration Plans

The Committees received a request from Chelan-Douglas Land Trust and the Bureau of Reclamation to review and approve the 60% middle Entiat River restoration plans. Recall that the Committees have to approve restoration projects proposed on properties purchased with Plan Species Account Funds. In this case, the Committees were asked to review projects proposed on the Troy and Bockoven South parcels.

Given the volume of information provided and the short time period in which to review the plans, the Committees were unable to provide complete reviews during the meeting. Therefore, they directed Tracy Hillman to contact Steve Kolk with the Bureau of Reclamation and ask for additional time to review the plans. In addition, they asked if the Bureau could provide the Committees with a brief summary of changes between the 30% and 60% plans. The Committees asked to receive the summary before Thanksgiving. They will then hold a joint conference call with the Priest Rapids Coordinating Committee Habitat Subcommittee on 30 November 2015 from 10:00 am to 12:00 pm to review and discuss the 60% plans.

VII. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests in October and November:

   Rock Island Plan Species Account:

   - $259.86 to Cascade Columbia Fisheries Enhancement Group for the White River Floodplain Connection (October Invoice).
   - $301.14 to Cascade Columbia Fisheries Enhancement Group for the White River Floodplain Connection (November Invoice).
   - $1,000.00 to the Upper Columbia Salmon Recovery Board for sponsorship in the 2016 Science Conference.
   - $4,211.82 to the Methow Salmon Recovery Foundation for the Post-Fire Landowner Assistance/Habitat Protection in Beaver and Frazer Creeks Project.
   - $160.13 to Clifton Larson Allen for Rock Island financial administration during the second quarter 2015.

- $765.00 to Chelan PUD for project coordination and administration during the third quarter of 2015.

Rocky Reach Plan Species Account:

- $4,252.21 to the Methow Salmon Recovery Foundation for the Upper Beaver Habitat Improvement Channel Restoration Project.
- $9,465.00 to the Confederated Tribes of the Colville Reservation for the Okanogan Basin Stream Discharge Monitoring Project.
- $1,000.00 to the Upper Columbia Salmon Recovery Board for sponsorship in the 2016 Science Conference.
- $160.12 to Clifton Larson Allen for Rocky Reach financial administration during the second quarter 2015.
- $767.09 to Chelan PUD for project coordination and administration during the third quarter of 2015.

Wells Plan Species Account:

- $4,252.21 to the Methow Salmon Recovery Foundation for the Upper Beaver Habitat Improvement Channel Restoration Project.
- $3,986.31 to Trout Unlimited for the MVID Instream Flow Improvement Project.
- $1,000.00 to the Upper Columbia Salmon Recovery Board for sponsorship in the 2016 Science Conference.
- $2,416.00 to Douglas PUD for Wells financial administration for FY 2015.
- $358.24 to Chelan PUD for project coordination and administration during the third quarter of 2015.

2. Tracy Hillman reported that the Committees received the following annual monitoring reports from the Okanagan Nation Alliance (ONA).

   - Dunn, M., K. Alex, C. Rivard-Sirois, and J. Enns. 2015. Aquatic Monitoring 2014 for the Penticton Channel salmon spawning restoration work. Prepared for the Habitat Conservation Committee. Prepared by Okanagan Nation Alliance Fisheries Department, Westbank, BC.
   - Machin, D., K. Alex, C. Louie, C. Mathieu, and C. Rivard-Sirois. 2015. Aquatic monitoring of the Okanagan River Restoration Initiative (ORRI) – Post-construction 2014. Prepared by Okanagan Nation Alliance Fisheries Department. Westbank, BC.

   The Committees had no comments on the reports.

3. Chris Fisher said that he is beginning to question if it is necessary to include riparian plantings as a line item in habitat restoration proposals. He shared an example where natural recovery of riparian vegetation was as good as or better than riparian plantings. He suggested that in many areas, riparian plantings are unnecessary and therefore the Committees may not need to fund these line-item requests. Other members commented that in many cases the plantings are permit driven. That is, the permits require replanting disturbed areas. However, the Committees did agree that this is something that can be evaluated on a case-by-case basis.
4. Kate Terrell reported that Chris Johnson with the Methow Salmon Recovery Foundation has indicated that he would be interested in pursuing the purchase of the Silver Side Channel

property. Kate asked if the Committees would be interested in supporting financially the purchase of the property. She said Chris would include a stewardship plan with the acquisition of the property. Kate indicated that the value of the property in 2014 was about $1,100,000. With the conservation easement, the purchase price would be about $550,000. Given the concerns with the existing landowner and their reluctance to allow restoration work on the side channel, the Committees agreed that it would be appropriate for Chris to look into the purchase of the Silver Side Channel property.

VIII. Next Steps

The Tributary Committees will hold a joint conference call with the PRCC Habitat Subcommittee on 30 November 2015 to discuss the middle Entiat 60% restoration plans. The next scheduled meeting will be on Thursday, 7 January 2016 at Grant PUD in Wenatchee.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

APPENDIX D
HABITAT CONSERVATION PLAN POLICY COMMITTEES 2015 MEETING MINUTES

HCP Policy Committee Conference Call Final Meeting Notes

1/14/15

Policy members present on the call:

Keith Truscott - Chelan PUD
Jim Craig - USFWS
Steve Parker – Yakama Nation
Ritchie Graves – NOAA
Jeff Korth – WDFW
Shane Bickford – Douglas PUD
Kirk Truscott – Colville Confederated Tribes

Policy Committee members opened the call with a recognition that there was a proposal brought forward on January 9, 2015 to investigate the option of selecting a qualified candidate that would be acceptable to all signatory parties thereby resolving the current differing selection opinions of the Policy Committee representatives. The proposal directed the PUD's to initiate a discussion with Tracy Hillman to see if he had an interest and would be willing to accept the responsibility of chairperson for the Douglas and Chelan HCP Hatchery Committees and/or HCP Coordinating Committees.

Chelan and Douglas PUD updated the Policy Committee regarding their conversations with Tracy and the outcome that Tracy was definitely interested in the chairperson duties for the HCP Hatchery Committees and/or HCP Coordinating Committees. There were 2 points raised by Tracy that he wanted the Policy Committee members to be aware of and discuss as part of the selection process:

1) His interest in HCP Committee chairperson responsibilities was open to chairing Hatchery or Coordinating committees independently or as a combined responsibility.
2) He would need concurrence from the Policy Committee that the perceived or potential for conflict of interest with BioAnalysts, Inc. work associated with hatchery M&E or other work product would not be an issue; i.e., BioAnalysts would still be able to competitively bid work stemming from the HCP Hatchery Committees provided sufficient controls are in place to ensure equal opportunity and a competitive selection process.

None of the HCP Policy Committee members thought that BioAnalysts' or Tracy's role in the hatchery M&E programs presented a conflict of interest.

The following conflict of interest and full-disclosure statement was developed to provide clarification and written documentation to support the administrative record of the selection process:

The Parties to the Wells, Rocky Reach, and Rock Island Anadromous Fish Agreements and Habitat Conservation Plans (HCPs) have unanimously selected Dr. Tracy Hillman to be the chair of the HCP Hatchery Committees. The Policy representatives of the Parties have made this decision with the full knowledge that BioAnalysts, Inc. participates in the HCP hatchery monitoring and evaluation (M&E) programs in both the Wenatchee and Methow basins, that Dr. Tracy Hillman co-leads the implementation of Chelan PUD's hatchery M&E program, and that Dr. Hillman participates in the Hatchery Effectiveness Technical Team (an ad-hoc subcommittee of the HCP Hatchery Committees, convened by assignment of the Hatchery Committees). In these roles, BioAnalysts, Inc. currently performs the following activities:

- Systematic snorkel surveys for juvenile abundance in the Chiwawa River and reference rivers.

- Spawning surveys for summer Chinook in the Methow and Wenatchee basins and in the Chelan River and Tailrace.
- Data review and analysis, and final reporting on M&E activities.
- Monthly reporting on M&E activities.
- Development of HCP M&E Plans and Reports.

The Parties to the HCPs have agreed that BioAnalysts, Inc., and specifically, Dr. Hillman's role in the aforementioned programs does not present a conflict of interest precluding Dr. Hillman from performing the functions required as the Chair of the HCPs Hatchery Committees. It is important to note that none of the HCP Committees chairs are a voting member in any of the HCP Committees. To guard against the perception of conflicts of interest in the future, Dr. Hillman, as the HCP Hatchery Committees chair may be asked to recuse himself from Hatchery Committees decisions that may affect the outcome or may provide a perceived effect on the outcome associated with awarding future M&E contracts.

The HCP Policy Committee members indicated that it would be in the best interest of the vital HCP administrative record and annual report to have Tracy chair the Hatchery Committee and have John Ferguson chair the Coordinating Committee. Policy Committee members acknowledged the benefit of this arrangement and maintaining the effectiveness of Anchor QEA support for the administrative record through John Ferguson and associated Anchor QEA support staff.

The formal proposal to select Tracy Hillman as HCP Hatchery Committee chair and John Ferguson as HCP Coordinating Committee chair was requested for a vote. Policy Committee members voted unanimous approval.

As a post approval action, the Policy Committee engaged in a discussion about the coordination of effort between the HCP Hatchery Committees and the Priest Rapids Hatchery Subcommittee; recognizing it is important and appropriate at times to have well coordinated efforts yet maintaining the unique attributes of each of the committees. Specifically Policy Committee members valued the momentum and working relationship currently in place with the Priest Rapids Hatchery Subcommittee and were greatly in favor of that continuing forward. Policy Committee members requested a follow-up with Tracy Hillman to determine whether he had any interest or intent to compete for the facilitator role under the Priest Rapids process (hatchery or coordinating) should that opportunity present itself in the future.

Chelan and Douglas PUD's pledged to have that discussion with Tracy and would get back to the Policy Committee on the outcome of that discussion (follow-up e-mail stating Tracy had no interest in facilitation of the Priest Rapids committees was sent to Policy Committee members 1/14/15).

APPENDIX E
LIST OF ROCK ISLAND HCP COMMITTEES MEMBERS

Rock Island Mid-Columbia HCP Committees, 2015

Policy Committee

Name	Organization
Michael Schiewe (Chairman, retired) (Jan-Apr) John Ferguson (Chairman) (May-Dec)	Anchor QEA, LLC
Randy Friedlander	Colville Confederated Tribes
Keith Truscott	Chelan PUD
Ritchie Graves	National Marine Fisheries Service
Jessica Gonzales	U.S. Fish and Wildlife Service
Jim Brown	Washington Department of Fish and Wildlife
Steve Parker	Yakama Nation

Coordinating Committee

Name	Organization
Michael Schiewe (Chairman, retired) (Jan-Apr) John Ferguson (Chairman) (May-Dec)	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
Jeff Korth	Washington Department of Fish and Wildlife
Bob Rose	Yakama Nation

Hatchery Committee

Name	Organization
Michael Schiewe (Chairman, retired) (Jan-Apr)	Anchor QEA, LLC
Tracy Hillman (Chairman) (May-Dec)	BioAnalysts, Inc.
Kirk Truscott	Colville Confederated Tribes
Alene Underwood	Chelan PUD
Lynn Hatcher (Jan-Feb) Craig Busack (Mar-Dec)	National Marine Fisheries Service
Bill Gale	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
Steve Hays	Chelan PUD
Dale Bambrick (Jan-Apr) Justin Yeager (May-Dec)	National Marine Fisheries Service
Kate Terrell	U.S. Fish and Wildlife Service
Jeremy Cram	Washington Department of Fish and Wildlife
Lee Carlson	Yakama Nation

APPENDIX F
STATEMENTS OF AGREEMENT FOR HATCHERIES COMMITTEES

Rocky Reach, Rocky Island, and Wells HCPs Hatchery Committees
Statement of Agreement
Regarding Timeline for Review of "Evaluation of Hatchery Programs Funded by Douglas County PUD 5-Year Report 2006-2010"
27 March 2015

Statement

The Rocky Reach, Rock Island, and Wells Habitat Conservation Plans (HCP) Hatchery Committees (HC) agree to review results of "Evaluation of Hatchery Programs Funded by Douglas County PUD 5-year Report 2006-2010" and more current data regarding Methow Basin spring Chinook and identify, develop and implement investigations to address elements of the Methow FH spring Chinook programs to improve program performance. The HC will begin the evaluation in 2015. Within a year of the SOA approval, the Parties will have identified and prioritized potential studies or other actions to address program deficiencies. Implementation of selected actions or studies will occur as soon as practicable following development and agreement on those actions/studies.

Background

The HCP Hatchery Committee (HCP HC) is responsible for developing the monitoring and evaluation program (M&E Plan) to assess overall performance of Chelan and Douglas PUDs hatchery programs. The first M&E plans were approved in 2005 (Murdoch and Peven 2005; DCPUD HCP HC 2005) with revisions to one regional objective in 2007 (Murdoch and Peven 2007; DCPUD HCP HC 2007). The first 5-year analytical reports finalized in 2012 (Murdoch et al. 2012, Hillman et al., 2012). The M&E plan has clearly defined metrics and targets and is intended to be used to adaptively manage hatchery programs so that they may achieve stated goals (Murdoch and Peven, 2005; DCPUD HCP HC 2007).

1. Support the recovery of ESA listed species[1] by increasing the abundance of the natural adult population, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity.

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.

3. Provide salmon for harvest and increase harvest opportunities, while segregating returning adults from natural tributary spawning populations.

Following the approval of the first 5-year analytical report (Murdoch et al, 2012), the Committees followed through on revisions to the M&E plan but never took the action (for various reasons including

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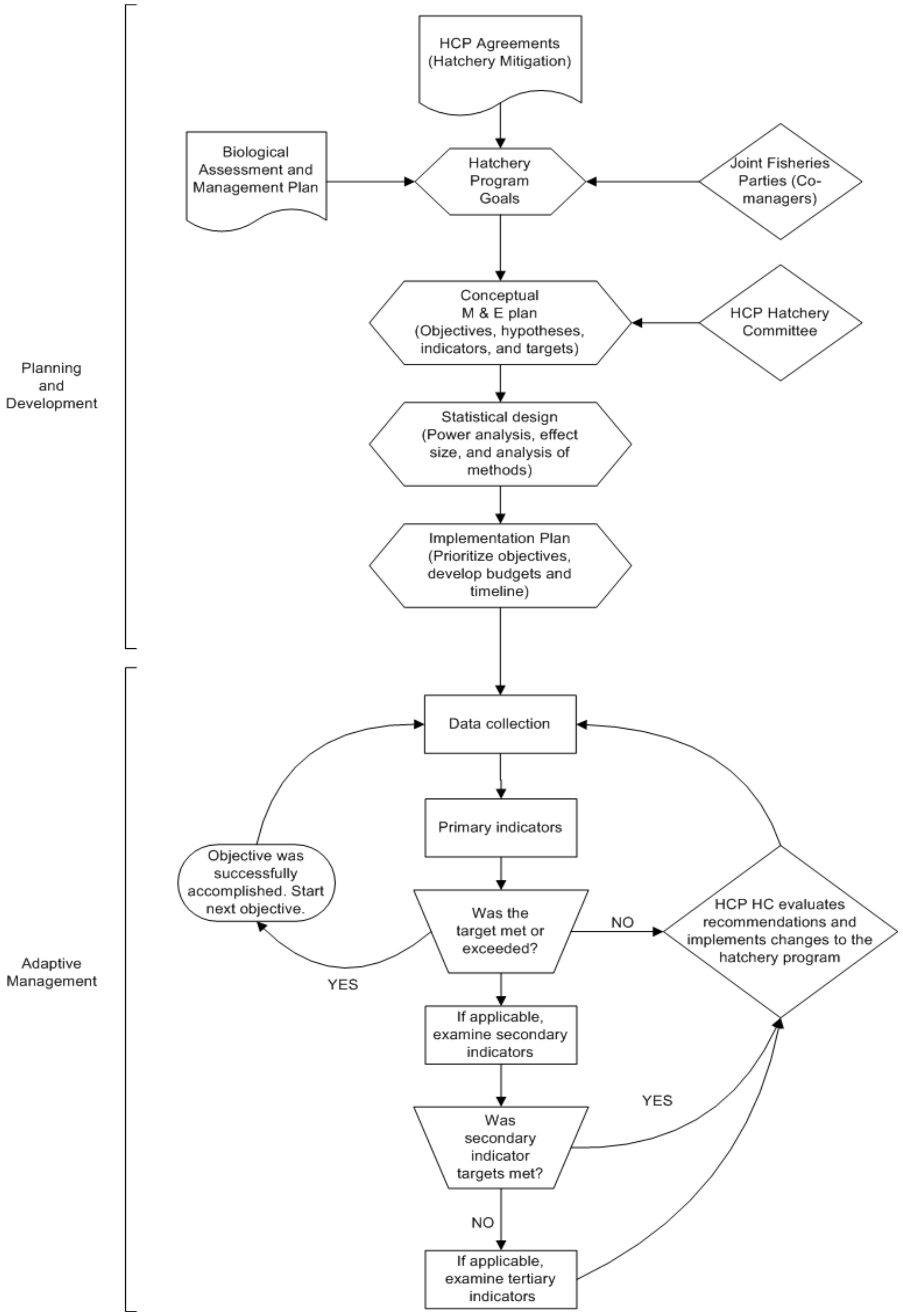
[1] While the HCP is not a recovery plan into itself, the hatchery component of it must be consistent with hatchery goals and objectives through the ESA, and as such should aid in the recovery of listed fish.

recalculation of hatchery program release numbers) to address hatchery metrics that were not meeting committee agreed to targets.

Now that programs have been reduced in size, it is important that the HCP Hatchery Committees review which metrics are not achieving desired targets and prepare plans to address these metrics as illustrated in Figure 1 (Murdoch and Peven, 2005).



Murdoch, A., and C. Peven. 2005. Conceptual Approach to Monitoring and Evaluating the Chelan County Public Utility District Hatchery Programs. *Prepared for:* Chelan PUD Habitat Conservation Plan's Hatchery Committee.

Douglas County PUD Habitat Conservation Plan Hatchery Committee. 2005. Conceptual approach to monitoring and evaluation for hatchery programs funded by Douglas County Public Utility District. *Prepared for:* Douglas PUD Habitat Conservation Plan Hatchery Committee.

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Hillman, T., M. Miller, A. Murdoch, T. Miller, J. Murauskas, S. Hays, and J. Miller. 2012 Monitoring and evaluation of the Chelan County PUD hatchery programs: five-year (2006-2010) report. *Report to:* HCP Hatchery Committee, Wenatchee, WA.

Murdoch, A., C. Snow, C. Frady, A. Repp, M. Small, S. Blankenship. 2012. Evaluation of hatchery programs funded by Douglas County PUD 5-year report 2006-2010. *Prepared for:* Wells HCP Hatchery Committee.

APPENDIX G
2015 ROCKY REACH AND ROCK ISLAND HCP ACTION PLANS

2015 Rocky Reach and Rock Island
HCP Action Plan ***Final***

COORDINATING COMMITTEE

	Jan 2015			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec		
Activity	1	15	31	1	15	29	1	15	31	1	15	30	1	15	31	1	15	30	1	15	31	1	15	31	1	15	30	1	15	31	1	15	30	1	15	31
Deliver 2014 RR Bypass Evaluation Report				D	▨	▨	▨	F																												
Deliver 2015 RR Bypass Operations Plan				D	▨	▨	▨	▨	F																											
Deliver 2014 RI Bypass Evaluation Report				D	▨	▨	▨	▨	F																											
Deliver 2015 RIS Bypass Operations Plan				D	▨	▨	▨	F																												
Pikeminnow long-line control programs				S	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	C			
Pikeminnow angling control programs													S	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	C							
Avian Predation programs										S	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	C												
Piscivorous Bird Monitoring and Report										S	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	C
Northern Pikeminnow Ladder Trapping RI/RR																S	▨	▨	▨	▨	▨	▨	▨	C												
Deliver 2015 RI/RR Fish Passage Plan					D	▨	▨	F																												
Deliver 2015 RR/RI Spill Plan							D	▨	▨	F																										
Deliver 2015 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												
2014 HCP Annual Report							D	▨	▨	F																										

HATCHERY COMMITTEE

	Jan 2015			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec		
Activity	1	15	31	1	15	29	1	15	31	1	15	30	1	15	31	1	15	30	1	15	31	1	15	31	1	15	30	1	15	31	1	15	30	1	15	31
2014 Hatchery M & E Report								D	▨	▨	▨	▨	▨	▨	▨	F																				
2016 Hatchery M & E work plans																						D	▨	▨	▨	▨	▨	F								
Dryden Water Quality Monitoring (Year 4)							S	▨	▨	▨	▨	▨	C																							
Dryden OW Feasibility and TMDL check-in																				S	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Summer Chinook Size Target Study (Year 2)	→ Ongoing	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	F
Chelan Hatchery Rehabilitation Design	S	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	C
Chiwawa Acclimation Facility Office Rehab Const										S	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	C												
Eastbank Hatchery Office Rehab Const							S	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	C					
Tumwater Fishway Concrete Repair					S	▨	C																													
Hatchery Program Broodstock Collection													S	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	C	
Hatchery Releases											S	▨	C																							

TRIBUTARY COMMITTEE

	Jan 2015			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec		
Activity	1	15	31	1	15	29	1	15	31	1	15	30	1	15	31	1	15	30	1	15	31	1	15	31	1	15	30	1	15	31	1	15	30	1	15	31
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 H
2015 ROCK ISLAND BYPASS MONITORING PLAN

Rock Island Dam
Smolt Monitoring and Gas Bubble Trauma Evaluation Plan
2015

Public Utility District #1 of Chelan County

Final Plan

Prepared By:

Lance Keller

February 2015

Introduction:

The primary objective of the Rock Island Smolt Monitoring Project (RISMP) is to provide information on Mid-Columbia juvenile salmonid out-migration timing to the Fish Passage Center (FPC). Another objective of this project is to provide information to the Columbia River basin-wide database for passive integrated transponder (PIT) tagged fish in coordination with Pacific States Marine Fish Commission (PSMFC). This data will improve the fish managers understanding of smolt out-migration timing and survival in the Columbia River System. A further objective of the project is to monitor downstream migrating juvenile salmonids for signs of gas bubble trauma (GBT).

This program is designed to measure the migration characteristics of emigrating salmonids. It also provides a comparison and evaluation of year-to-year migration information such as travel time and peak abundance. Monitoring at Rock Island Dam is ideal for indexing juvenile salmonid emigration and travel time because the trap site is located down river from four major tributaries and several hatcheries that release fish to the mid-Columbia Basin. Daily collections will be used to compute the 10%, 50%, and 90% dates of passage at the collection site.

Bypass Monitoring Requirements:

Sampling will begin on 1 April 2015 and will be completed on 31 August 2015. Data summary, analysis and report writing will occur throughout the sampling period and be completed by 31 January 2016.

A. Tasks

Public Utility District #1 of Chelan County, hereafter referred to as the District, will monitor the gatewell orifice bypass trap from 1 April to through 31 August 2015. Personnel monitoring the bypass trap at Rock Island Dam will consist of District employees. A District Fish and Wildlife Specialist will supervise the onsite crew at the bypass trap. A permanent District Biologist will oversee the monitoring program.

Fish will be collected continuously during the monitoring period. Fish will be examined during regular work hours (0700–1530 hrs), unless large numbers of fish are entering the flume of the bypass trap, in which case fish would be removed and recorded as the appropriate sample days catch. Fish will be delivered via the bypass elevator to a 12' x 4'x 3.5' aluminum holding tank in the sampling facility, which is plumbed for continuous flow of river water. Small samples (40-60) of fish will be pre-anesthetized using a pre-mixed solution of MS-222 (1.8 ml per gal. of water) before being moved by net into the sorting holding tank with a solution of MS-222 (3.6 ml per gal of water). *** See MS-222 stock solution mixing rates below.** Fish will be identified by species and examined for fork length, marks indicating hatchery origin, PIT tags, and descaling/injury. Anesthetized fish will recover in a separate holding tank and be released after they have recovered from anesthesia.

Sub-samples of up to 100 Chinook and steelhead will be examined for signs of GBT twice weekly. The unpaired fins and eyes will be examined for the presence of bubbles. Absence or presence of GBT symptoms as well as the location and severity of symptoms will be reported to the FPC daily throughout the sampling season.

Insertion of PIT tags will begin when an increase in the number of juvenile salmon being captured in the bypass trap is observed, usually around mid-April, and will continue throughout the monitoring season as appropriate for each species. The target of the PIT tagging operation will be the middle 80%, of both the Wenatchee, Methow and Okanogan runs that pass the dam during April and May respectively. Beginning in June, subyearling Chinook will be marked until 4,800 fish have been tagged.

Fish will be injected with PIT tags by hand using a medical syringe/push rod mechanism with a sterile 12-gauge veterinary needle. Tagged fish will be placed on a plastic covered measuring board where the information and length measurements will be recorded by touching the stylus directly on the digitizing board. Data for PIT tagged fish and the number of tagged fish will be recorded directly into a computer via a digitizing board.

Standard PIT tagging procedures will be followed and PIT tags, equipment, and other miscellaneous tagging supplies will be purchased under the RISMP contract. Data will be entered into a computer and supplied to the FPC daily by modem.

B. RIJSF Sampling

Run-of-river fish collected at the Rock Island Juvenile Sampling Facility (RIJSF) to evaluate 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 spring and summer fish spill
        i. Currently spring and summer fish spill occurs at Rock Island Dam

2. Fish species composition:
    a. Guide decisions about starting or stopping spill
        i. Currently spring (10%) and summer (20%) fish spill occurs at Rock Island Dam.
        ii. Report counts and condition of all salmonid species to the FPC daily.

3. Fish condition:
    a. Evaluate run-of-river fish condition for migrating juvenile salmon and steelhead.
        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
        iv. Examine juvenile salmonid emigrants for symptoms of GBT twice weekly. Report GBT examination results to FPC when collected.

4. Origin of fish stocks and identification of marked individuals:
    a. PIT tags
    b. Fin clips
    c. Acoustic tags
    d. Other external marks or tags

5. PIT tagging:
    a. Insert PIT tags into between 200 and 600 unclipped Chinook yearlings, unclipped sockeye, hatchery steelhead and wild steelhead weekly (Table 1).

    b. Insert PIT tags into as many unclipped subyearling Chinook daily as necessary to reach 600 fish per week over an 8-week period between mid-June and mid-August (seasonal total of 4,800 fish).
    c. Transfer PIT tag generated data to PSMFC PITAGIS system daily.

6. Daily reporting:
    a. Report counts and condition of all salmonid species to the FPC daily.
    b. Report the average river flow, average flow through Powerhouse No.1, average flow through Powerhouse No. 2, and average spill daily.
    c. Report GBT examination results to FPC when collected.

Table 1. Weekly PIT tagging quotas at Rock Island Dam during the 2015 smolt monitoring season.

	Weekly Quotas				
Week Starting	Unclipped Chinook Yearling	Unclipped Chinook Subyearling	Unclipped Sockeye	Hatchery Steelhead	Wild Steelhead
06 Apr					
13 Apr					
20 Apr	600		600	200	
27 Apr	600		600	400	200
04 May	600		600	400	200
11 May	600		600	400	200
18 May	600		600	400	200
25 May	600		600	400	200
01 Jun	200			400	200
08 Jun				200	
15 Jun					
22 Jun		600			
29 Jun		600			
06 Jul		600			
13 Jul		600			
20 Jul		600			
27 Jul		600			
03 Aug		600			
10 Aug		600			
17 Aug					
Season Totals	**3,800**	**4,800**	**3,600**	**2,800**	**1,200**

Daily Protocol for Fish Collection:

Standard Operations:

1. Fish will be collected continuously during the monitoring period 0900-0900 (24 hours).

2. Fish will be examined during regular work hours (0700–1530 hrs), unless large numbers of fish are entering the flume of the bypass trap, in which case fish would be removed and recorded as the appropriate sample days catch.
3. Dewatering screens are raised and fish crowded into the transport elevator.
    a. If large numbers of fish are present in the sampling raceway, use more than one elevator trip.
4. Fish will be delivered via the bypass elevator to a 12' x 4'x 3.5' aluminum holding tank in the sampling facility.
    a. Ensure continuous flow of river water to holding tank..
5. Small samples of fish will be moved into the sorting holding tank with a solution of MS-222 (3.6 ml per gal of water). *** See MS-222 stock solution mixing rates below.**
6. Fish will be identified by species and condition.
    a. Evaluate fish condition (first 100 fish per species).
7. Scan each fish for PIT tags, fin clips, external tags and acoustic tags.
8. If needed, collect and hold fish for PIT tagging, acoustic tagging and/or marked releases (Special Operations).
9. Allow anesthetized fish (examined for species composition and fish condition) to recover in the facility’s holding tank for at least 1.0 hours.
    a. Release fish after they have recovered from anesthesia.

2015 - MS-222 Recommended Knockdown & Maintenance Dosage

(CCPUD) Stock Solution Mix Ratio MS-222:

1000 grams per 5 gals. of water (18.925 liters per 5 gals.)
200 grams per 1 gal. of water (3.785 liters per 1 gal.)
53 grams per 1 liter of water

(CCPUD) Stock Solution Used for Fish Examination:

Pre-anesthetized Dose:

Use 1.8 ml of stock solution per gal of water for pre-anesthetized dose
Use 9 ml of stock solution per 5 gals. of water

(CCPUD) Stock Solution Used for Fish Examination:

Knockdown Dose:

Use 3.6 ml of stock solution per 1 gal. of water in knockdown tank <u>OR</u>
Use 18 ml of stock solution per 5 gals. of water

*** The amount of MS-222® used, however, varies throughout the season depending upon temperature, the number of fish in each chamber and the species of fish being sedated**.

Other Operations:

1. PIT tagging:
    a. Insert PIT tags into between 200 and 600 unclipped Chinook yearlings, unclipped sockeye, hatchery steelhead and wild steelhead weekly (Table 1).

   b. Insert PIT tags into as many unclipped subyearling Chinook daily as necessary to reach 600 fish per week over an 8-week period between mid-June and mid-August (seasonal total of 4,800 fish).
   c. Transfer PIT tag generated data to PSMFC PITAGIS system daily.
2. Return to step 8 under Standard Operations.

Steelhead Kelts:

1) Should steelhead kelts be collected in the bypass trap, fish should be evaluated based on the Yakima Nation flowchart to determine if the fish is suitable for the Yakama Nation's kelt reconditioning program.

2) If kelts do not meet the criteria for the reconditioning program, they are to be documented and released back into the adult ladder.

Bull Trout:

1) Columbia River bull trout are a **federally threatened species** and have federal protection under the **Endangered Species Act (ESA).** The US Fish and Wildlife Service (USFWS) issued a Biological Opinion on the effects to bull trout for incorporating Chelan's HCPs into the Rock Island Project license. The USFWS issued an annual incidental take (injure or kill) level of no more than 2% of the bull trout passing through the juvenile fish bypass per year. In 2015, if a bull trout is incidentally captured during daily sampling at the Rock Island juvenile sampling facility, please follow these protocols:

2) ***Healthy bull trout:*** If you capture a bull trout during sampling, take a fork length measurement, document condition; note the collection time and water temperature. After a bull trout is incidentally subjected to anesthesia and identified in the sorting trough, allow for normal recovery time in fresh water and then release the fish back to the pipe.

3) ***Sick or injured bull trout:*** If you capture a sick or injured bull trout during sampling operations, do not retain it unless you are *absolutely positive* that it is destined to die if released (for example, the fish is unable to right itself, is upside down and barely gilling, pupil is non-responsive). If the fish has a possible chance to survive, take a *fork length* measurement, document any apparent physical injury or descale, and note the time. If a bull trout is incidentally subjected to anesthesia and identified in the sorting trough, allow for normal recovery time in fresh water and then release the fish back to the pipe.

4) ***Bull trout mortalities:*** If you encounter a bull trout mortality, please save, identify, and preserve (bag, identify and freeze) the fish, and ***inform Steve Hemstrom ext. 4281 following completion of the Index sampling that day***. Please document and communicate the circumstances in which the fish was found, and any apparent physical injury (including descale) you observe. Make arrangements to deliver the specimen to the Fish and Wildlife building at headquarters. If the fish is mortally injured, retain the fish in a sample bag and preserve in the refrigerator or freezer. Please notify Steve Hemstrom at the end of the day's sampling and arrange for delivery or pick-up of the fish to District Fish and Wildlife department.

5) ***Sub-adult bull trout PIT Tagging:*** No PIT tagging will occur in 2015.

6) ***Sub-adult bull trout tissue sample:*** No tissue samples will be taken in 2015.

Contingencies:

1. If, after start-up of the bypass system, we encounter any unforeseen problem(s) with fish collection, we will immediately work to correct the problem(s) and consult with the HCP Coordinating Committee.

C. Statement of BPA's involvement in the Project

The RISMP is a cooperative study between The District, Bonneville Power Administration (BPA), and the FPC. The District will provide supervisory costs for the project as it relates to District personnel, while BPA will pay for the remaining costs of the project. These costs include (but are not limited to) labor, benefits, transportation, miscellaneous materials and administrative overhead (see attached budget).

D. Time Schedule

Sampling will begin on 1 April 2015 and will be completed on 31 August 2015. Samples will be collected from 0900 hrs to 0900 hrs the following day throughout the sampling period.

E. Reporting Tasks

Fieldwork for this project occurs in the 6-month period between April and September. A final report on the 2015 Smolt Monitoring Program will be issued by 31 January 2016.

Place of Operations:

All sampling will take place at the Rock Island Dam Powerhouse No. 2, which is located 15 miles southeast of the city of Wenatchee, at Columbia River mile 453.

Personnel Involved:

The Senior Fisheries Biologist for Chelan County P.U.D. is Steve Hemstrom. He can be reached at (509) 661-4281, Fax (509) 661-8108, Email steven.hemstrom@chelanpud.org or mail P.O. Box 1231, Wenatchee WA, 98807.

The Fisheries Biologist for Chelan County P.U.D. is Lance Keller. He can be reached at (509) 661-4299, fax (509) 661-8108, Email lance.keller@chelanpud.org or mail P.O. Box 1231, Wenatchee WA, 98807.

Fish &Wildlife Operations Superintendant for Chelan County P.U.D. is Todd West. He can be reached during normal working hours at (509) 661-4559, Email todd.west@chelanpud.org or mail P.O. Box 1231, Wenatchee WA, 98807.

The District crew working at Rock Island Dam will be supervised by a Fish & Wildlife Specialist/Foreman.

Fish and Wildlife Helpers who will be working on the project will be hired in the spring of 2015.

APPENDIX I
2015 ROCKY REACH AND ROCK ISLAND FISH SPILL PLAN

2015 Fish Spill Plan

Rock Island and Rocky Reach Dams

Public Utility District No. 1 of Chelan County

Prepared By:

Thad Mosey
Hydro Fisheries Biologist

Public Utility District No. 1 of Chelan County
Wenatchee, Washington

Final
February 2015

Introduction and Summary

In 2015, 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 (Steelhead, sockeye, yearling Chinook), 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 2020. Rocky Reach 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 NOAA Fisheries (NOAA) and the United States Fish and Wildlife Service (USFWS) for HCP fish spill operations at Rocky Reach and Rock Island.

For the 2015 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 2015, 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 2015, 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 2015, Rock Island will spill 20 percent of the day-average river flow for the outmigration of sub-yearling 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 outmigration for yearling Chinook, steelhead, sockeye, and subyearling Chinook in 2015.

Rocky Reach Spring Juvenile Bypass Operations

Rocky Reach will operate its JFBS continuously through the spring outmigration period, beginning 1 April 2015. Daily index sampling (for juvenile 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, 8 am to 11am. Spring spill for fish passage is not required at Rocky Reach in addition to the JFBS operation, 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.

Sampling protocols at the Rocky Reach bypass system in 2015 will remain consistent with those used in 2004-2014. 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 flume 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 in 2015. 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 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 spill 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. S*ubyearling* Chinook will be defined as any Chinook having a fork length from 76 mm to 110 mm in late May to June, 76 mm to 120 mm from early June to mid June, 76 mm to 130 mm from mid June to early July, 76 mm to 140 mm from early to late July, and 75 mm to 150 mm from early August to August 31. Bypass crews will also use body formation to distinguish between yearling and subyearling Chinook.

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 2004-2014) and Program RealTime is estimating that the 95th percentile passage point has been reached and spill passage has covered at least 95% of the subyearling outmigration

Diel Spill Shaping at Rocky Reach and Rock Island

Daily spill volumes will be shaped within each 24-hour period at Rocky Reach during the summer, and at Rock Island 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 (for instance spill at 9 percent day-average river flow at Rocky Reach with no shaping). The hourly spill shape in 2015 will remain consistent with previous years, 2004-2014.

Table 2. Fish spill percentages and spill shape for the Rocky Reach spill program, 2015.

Project	Season	Daily Spill Average	Within-Day Spill Levels	Duration (# of hours each day)	Time of Day	Spill Shape %
Rocky Reach	Spring	none	--	--	--	--
Rocky Reach	Summer*	9%	Med	1	00:00-01:00	9.0%
			Low	6	01:00-07:00	6.0%
			Med	2	07:00-09:00	9.0%
			High	6	09:00-15:00	12.0%
			Med	9	15:00-00:00	9.0%

*Spill for subyearling Chinook

2015 Run-Timing Predictions

Chelan PUD utilizes 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 Chinook, sockeye, and subyearling Chinook at both Rocky Reach and Rock Island. 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 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 dam passage dates (first percentile to the 95th percentile) for each species at Rocky Reach and Rock Island are summarized in Table 3. Run-timing dates are estimated from daily index sample counts at the Rocky Reach JFBS, 2004-2014, and from the Rock Island Dam smolt bypass trap, 2002-2014 (Table 3). At Rocky Reach, the subyearling Chinook run generally begins the first week of June, with the one-percentile passage date on 31 May (mean date for years 2004-2014). Rocky Reach subyearling passage reaches the 95th percentile, on average, around 10-August (2004-20l4, range: 27-July to 24-August).

Rock Island Dam juvenile salmon and steelhead sampling from the Smolt Monitoring Program (SMP), 2002-2014, 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 spring spill start date for Rock Island 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 9-August (range: 31- July to 19-August, 2002-2014).

Table 3. Spill percentages, bypass operation dates, and mean passage percentile dates (2002-2014) for the 1st and 95th percentile passage points for HCP spring and summer outmigrants at Rocky Reach and Rock Island.

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, 5/30	5/6, 5/26	5/31, 8/10
RR Bypass Operating?	Yes 4/1 – 8/31	Yes 4/1 – 8/31	Yes 4/1 – 8/31	Yes 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	4/23, 6/8	4/15, 6/4	4/18, 6/9	6/3, 8/9
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 2015 Spring Spill

In 2015, 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) and spill passage has been provide 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 Smolt Monitoring Program (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 the spring and summer outmigration periods. HCP SOA guidelines to start and end the spring spill program at Rock Island are as follows:

1. The Rock Island spring spill program will begin when the Rock Island 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 following completion of the spring outmigration (95 percent passage point), and subyearling summer Chinook have arrived at the Project.

Rock Island 2015 Summer Spill

Rock Island will spill 20 percent of the estimated daily average river flow for a duration covering 95 percent of the summer out migration of subyearling Chinook. Daily smolt counts from the Rock Island bypass trap will inform decisions on when to start and stop spill. The HCP Coordinating Committee's (HCPCC) agreement guidelines to start and stop the summer spill at Rock Island are outlined as follows:

1. Rock Island summer spill in 2015 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 outmigration.

2. Summer spill will generally end no later than 15-August, or when subyearling counts from the Rock Island trap are 0.3 percent or less of the cumulative run total for any three out of five consecutive-day period, and UW's Program RealTime is estimating 95 percent run completion (same protocol used in 2004-2014).

Table 4. Spill percentages and hourly spill shape for the Rock Island spring and summer fish spill program, 2015.

Project/Season	**Daily Spill Average**	With-in Day **Spill Levels**	**Duration (# of hours each day)**	**Time of Day**	**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 fish spill coordinator will notify the HCP Coordinating Committee (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.

Literature Cited

Skalski, J.R., R.L. Townsend, T.W. Steig, and P.A. Nealson. 2012. Survival, Diel Passage, and Migration Dynamics of Yearling Chinook Salmon Smolts at Rocky Reach Dam in 2011. Prepared for Public Utility District of Chelan County, Wenatchee, WA. Columbia Basin Research School of Aquatic and Fishery Sciences, University of Washington. Final Report, January 2012.

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Steig, T.W., P.A. Nealson, K.K. Kumagai, B.J. Rowdon, J.R. Selleck and C. Tunnicliffe. 2009. Route specific passage of juvenile Chinook, sockeye and steelhead salmon using acoustic tag methodologies at Rocky Reach and Rock Island Dams in 2009. Draft report for Chelan County Public Utility District No. 1, Wenatchee, WA, by Hydroacoustic Technology, Inc. Seattle, WA.

Steig, T.W., P.A. Nealson, K.K. Kumagai, B.J. Rowdon, J.R. Selleck and C. Tunnicliffe. 2010. Route specific passage of yearling Chinook and steelhead salmon using acoustic tag methodologies at Rocky Reach and Rock Island Dams in 2010. Draft report for Chelan County Public Utility District No. 1, Wenatchee, WA, by Hydroacoustic Technology, Inc. Seattle, WA.

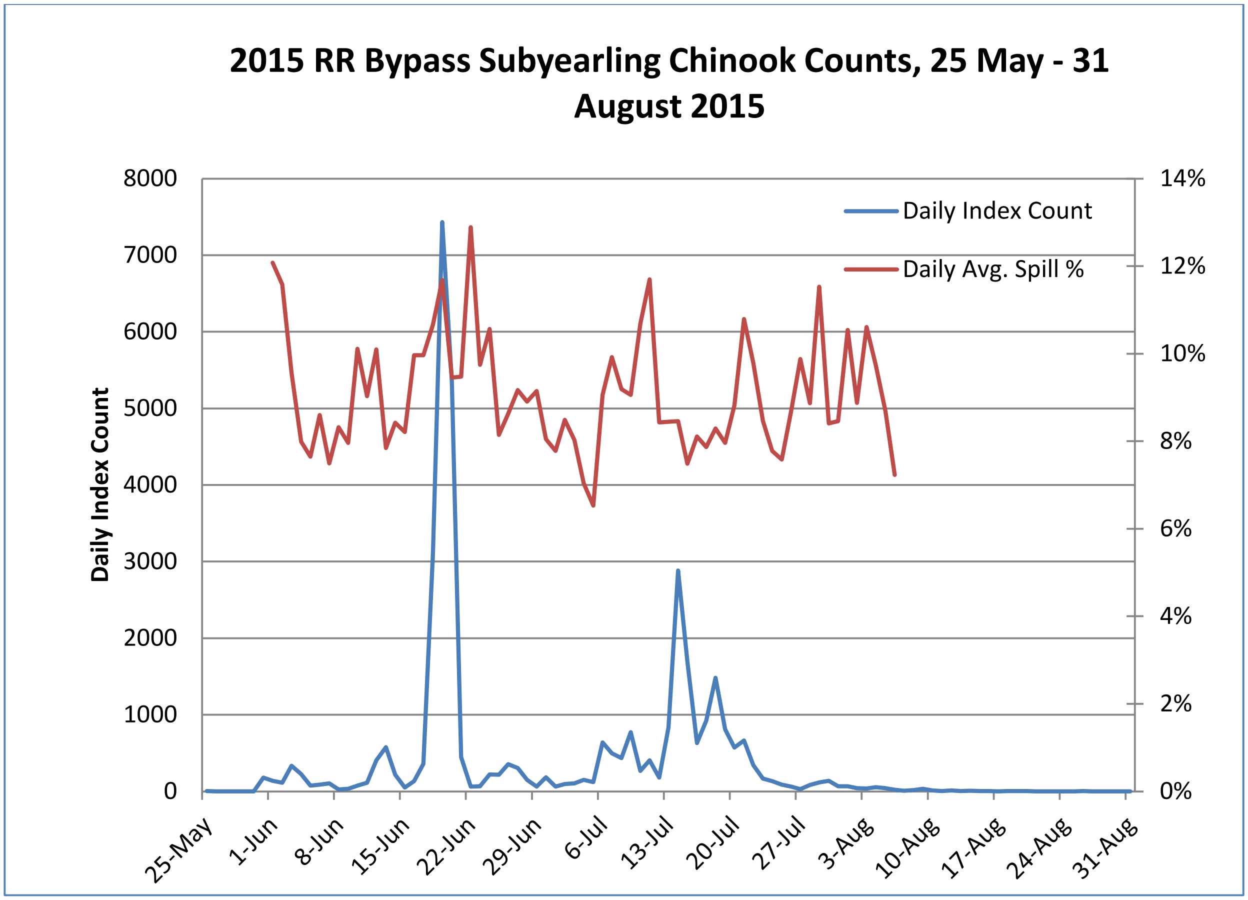
APPENDIX J
2015 ROCKY REACH AND ROCK ISLAND FISH SPILL REPORT

Chelan PUD
Rocky Reach and Rock Island HCPs
Final 2015 Fish Spill Report

2015 ROCKY REACH

Summer Spill

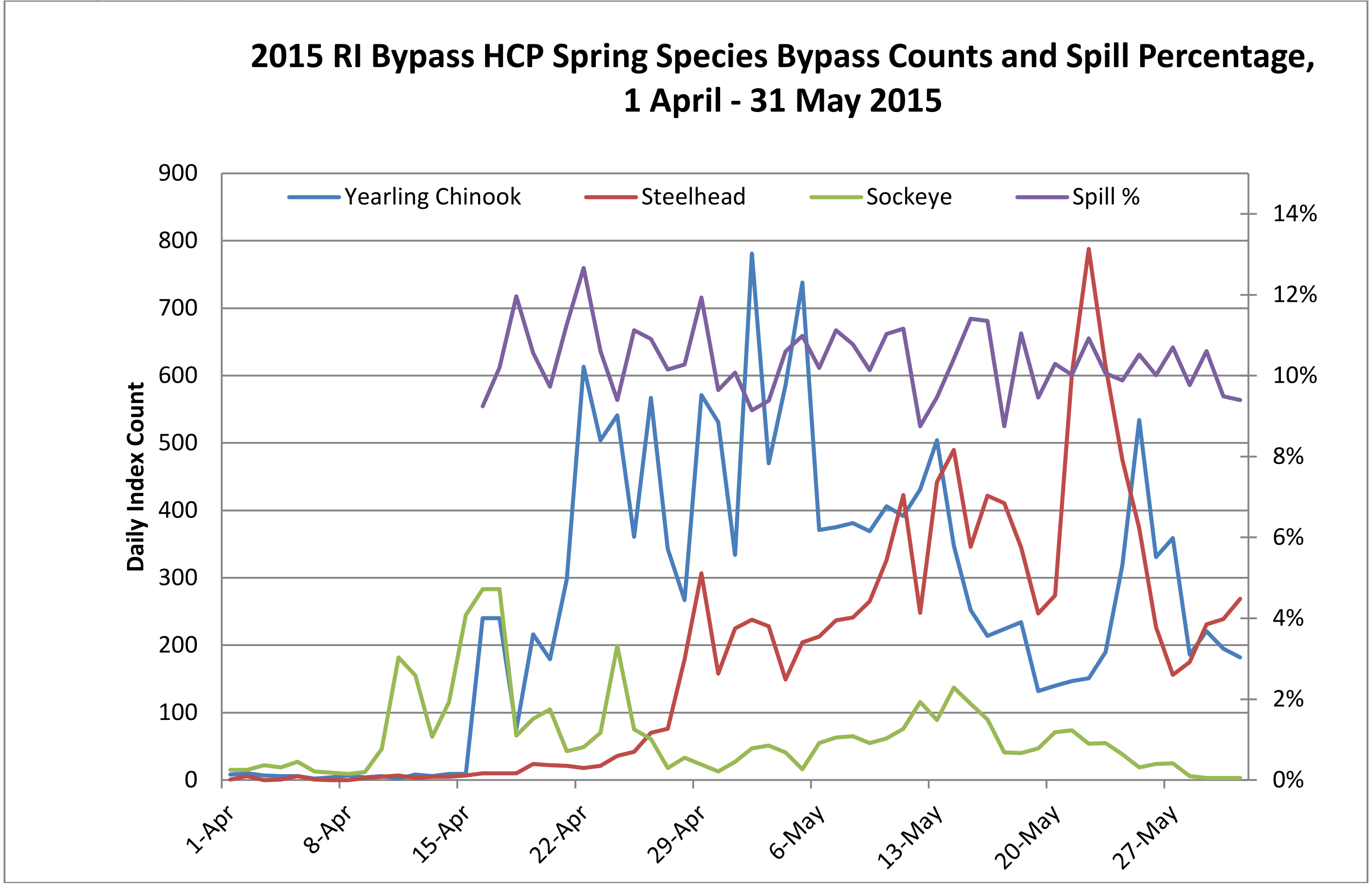
Target species:	Subyearling Chinook
Spill target percentage:	9% of day average river flow
Spill start date:	1 June, 0001 hrs
Spill stop date:	7 August, 2400 hrs
95% Est. passage date:	4 August
Percent of run with spill:	99.1% on 7 August (estimated as of 31 August)
Cumulative index count:	37,104 subyearling Chinook (as of 31 August)
Summer spill percentage:	9.00% (8.88% fish spill, plus 0.12% forced spill)
Avg river flow at RR:	100,901 cfs (1 June - 7 August)
Avg spill rate at RR:	9,086 cfs (1 June - 7 August)
Total spill days:	68



2015 ROCK ISLAND

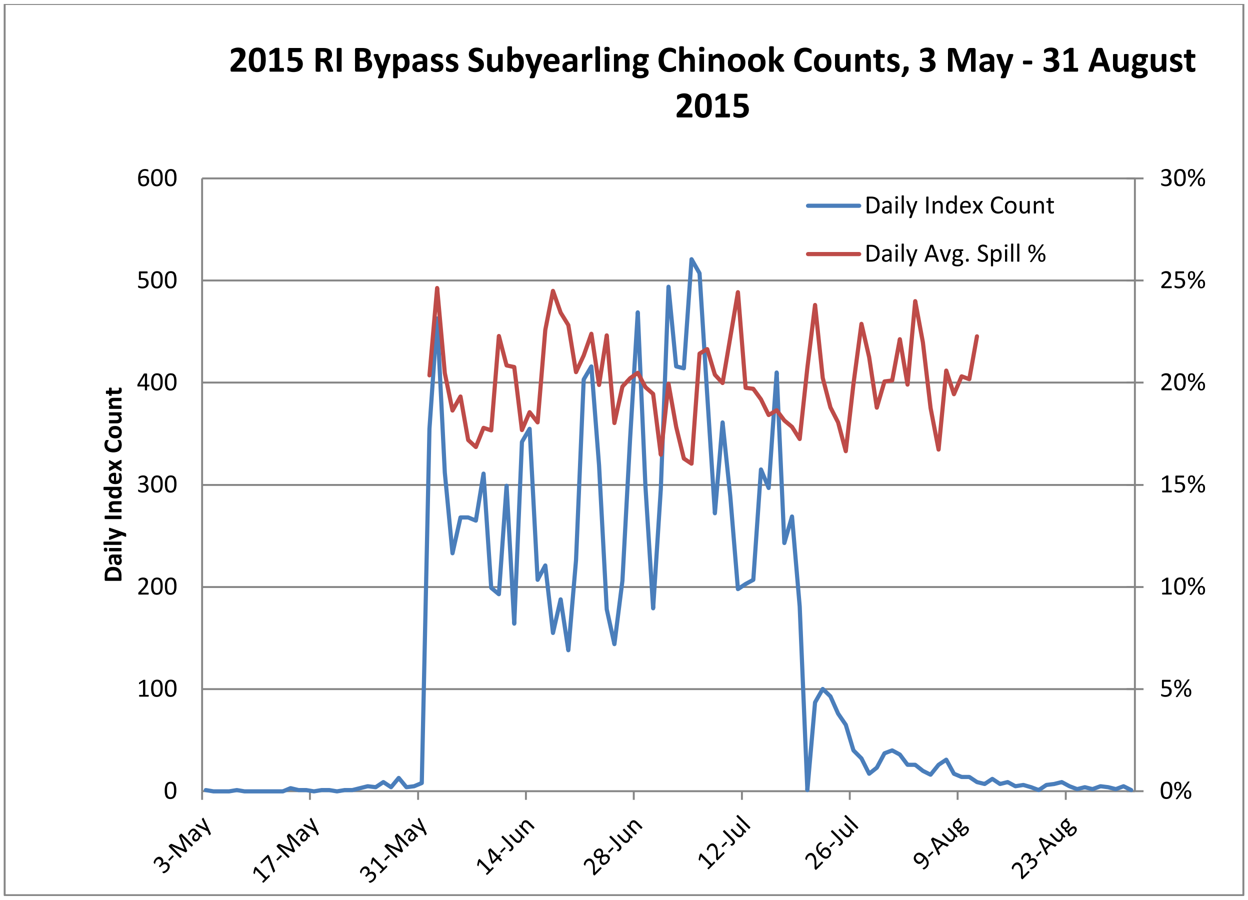
Spring Spill

Target species: Yearling Chinook, steelhead, sockeye
Spill target percentage: 10% of day average river flow
Spill start date: 16 April, 0001 hrs
Spill stop date: 31 May, 2400 hrs (immediate increase to 20% summer spill)
Percent of run with spill: Yearling Chinook - 99.4%; steelhead - 99.6%; sockeye - 76.6%
Cumulative index count: 16,762 yearling Chinook**;** 12,549 steelhead**;** 4,128 sockeye
Spring spill percentage: 10.29% fish spill
Avg river flow at RI: 108,333 cfs (16 April – 31 May)
Avg spill flow at RI: 11,144 cfs (16 April – 31 May)
Total spill days: 46


2015 RI Bypass HCP Spring Species Bypass Counts and Spill Percentage, 1 April - 31 May 2015

Summer Spill

Target species: Subyearling Chinook
Spill target percentage: 20% of day average river flow
Spill start date: 1 June, 0001 hrs
Spill stop date: 11 August, 2400 hrs
95% Est. passage date: 2 August
Percent of run with spill: Subyearling Chinook 99.2% (estimated as of 31 August)
Cumulative index count: 15,349 subyearling Chinook (as of 31 August)
Summer spill percentage**:** 19.86% fish spill
Avg river flow at RI: 102,557 cfs (1 June - 11 August)
Avg spill flow at RI: 20,370 cfs (1 June - 11 August)
Total spill days: 72



Juvenile Index Counts 2004-2015 from the Rocky Reach Juvenile Fish Bypass Sampling Facility and Rock Island Bypass Trap Smolt Monitoring Program (SMP) 1 April – 31 August.

Table 1. Rocky Reach Juvenile Bypass index sample counts, 2005-2015

Species	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014***	**2015**
Sockeye	17,575	239,185	169,937	136,206	40,758	724,394	67,879	384,224	199,497	553,645	**53,575**
Steelhead	5,821	4,329	4,532	8,721	6,309	4,931	5,683	4,902	2,528	5,270	**4,157**
Yearling Chinook	27,611	23,461	18,080	38,394	18,946	33,840	24,400	95,207	29,018	15,871	**32,220**
Subyearling Chinook	10,978	19,996	13,496	11,820	11,944	59,751	17,246	5,774	22,073	22,327	**37,104**

Table 2. Rock Island Smolt Monitoring Program index sample counts, 2005-2015

Species	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014***	**2015**
Sockeye	1,991	34,604	16,410	38,965	4,926	37,404	18,697	46,788	25,111	38,596	**4,128**
Steelhead	15,974	26,930	18,482	22,780	17,636	17,194	28,408	16,957	15,099	28,299	**12,549**
Yearling Chinook	14,797	37,267	23,714	22,562	9,225	11,802	26,407	25,759	28,324	26,429	**16,762**
Subyearling Chinook	18,710	27,106	15,686	15,940	8,189	23,205	27,397	27,298	17,170	34,527	**15,349**

***** 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 K
ROCK ISLAND PROJECT NO. 943
INTERIM FISH PASSAGE PLAN MONTHLY REPORT DATED JANUARY 1, 2015



PUBLIC UTILITY DISTRICT NO. 1 *of* CHELAN COUNTY
P.O. Box 1231, Wenatchee, WA 98807-1231 • 327 N. Wenatchee Ave., Wenatchee, WA 98801
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December 31, 2014

VIA ELECTRONIC FILING

Honorable Kimberly D. Bose, Secretary, and
Nathaniel J. Davis, Sr., Deputy Secretary
Federal Energy Regulatory Commission
888 First Street NE
Washington, D.C. 20426

Re: **Rock Island Project No. 943**
Interim Fish Passage Plan – (Final) Monthly Report dated January 1, 2015

Dear Secretary Bose and Deputy Secretary Davis:

Chelan PUD is filing its final monthly report related to implementation of the Interim Fish Passage Plan (IFPP) in response to Grant PUD's Wanapum Dam emergency spillway repair and reservoir drawdown that warranted initiating emergency consultation under Section 7 of the Endangered Species Act ("ESA") and 50 CFR § 402.05.

Throughout this informal emergency consultation, Chelan PUD has provided FERC monthly reports on the implementation of the IFPP. The purpose of this report was to document the ongoing informal emergency consultation pursuant to 50 CFR § 402.05 and coordination with the FERC, National Marine Fisheries Service, US Fish and Wildlife Service, and members of the Habitat Conservation Plan Coordinating Committee, as well as with other interested parties regarding the ongoing efforts to implement the IFPP.

During the implementation of the IFPP, Chelan PUD monitored adult fish passage and determined that adult anadromous fish passage has occurred during lower tailwater elevations before and after ladder entrance modifications. Annual fish counting was completed on November 15, 2014. Adult steelhead, spring Chinook, sockeye, coho, lamprey, bull trout and whitefish all successfully passed Rock Island during ladder extension construction and operations under the IFPP, consistent with Chelan PUD's Rock Island Habitat Conservation Plan (HCP) under Section 10 of the ESA.

We are encouraged with Grant PUD's progress as they begin an intermediate reservoir raise at the Wanapum project. We understand that Grant PUD's current plan for the interim pool raise is to operate the Wanapum reservoir at an elevation range of 558 to 562 feet and remain there until

COMMISSIONERS: Carnan Bergren, Dennis S. Bolz, Ann Congdon, Norm Gutzwiler, Randy Smith GENERAL MANAGER: Steve Wright

such time the reservoir can be raised to a final upper operating range of 560 to 571 feet (normal operating range), which is forecasted for May 2015.

As a next step, Chelan PUD, as FERC's non-federal representative, will be preparing a summary of the emergency and its evaluation of the effects on listed species in the form of a draft biological assessment for FERC's review and approval.

A copy of this letter and report is being concurrently sent to the Commission's Division of Dam Safety and Inspections Portland Regional Office.

If you have any questions or need further information, please do not hesitate to contact me.

Sincerely,

Michelle Smith
License & Compliance Manager
(509)661-4180
michelle.smith@chelanpud.org

Attachment: (Final) January 1, 2015 IFPP Monthly Report

c: Habitat Conservation Plan Coordinating Committee
Rocky Reach Fish Forum
Commission's Division of Dam Safety and Inspections, Portland Regional Office

ATTACHMENT

Denil at Right Bank Fishway

Interim Fish Passage Plan
Monthly Report
January 1, 2015

Rock Island Hydroelectric Project
FERC No. 943
Chelan County Public Utility District
Wenatchee, WA

Contents

List of Figures

Purpose of Report

The purpose of this report is to document the ongoing emergency consultation pursuant to 50 CFR § 402.05 and coordination with the FERC, NMFS, USFWS, and members of the HCP Committee, as well as with other interested parties during the month of December regarding the ongoing efforts to implement the Interim Fish Passage Plan (IFPP), including the construction and operation of temporary denil fishway extensions. As a precaution due to the potential of lower river flows in the late summer, Chelan PUD has constructed and installed denil fishway extensions before the spring adult migration in 2014 to support adult passage at the right bank adult fishway tailrace entrance (TRE) and the left powerhouse entrance (LPE), as well as left bank adult fishway at the Rock Island Project. Chelan PUD also completed a modification to a side entrance of the center adult fishway (see Figure 1). Early/mid summer runoff conditions have generally allowed the adult returns normal access to adult fish ladder entrances, however, river flows in the month of December continued to be low resulting in intermittent daily operation of the denil ladder extensions to support adult upstream passage. Adult and juvenile fish passage at Chelan PUD's Rocky Reach Project, FERC No. 2145, has not been impacted by the Wanapum drawdown.

Documentation of Chelan PUD's consultation with the Rock Island HCP Committee and resource agencies, including meeting minutes and copies of correspondence, is provided in Appendix B.

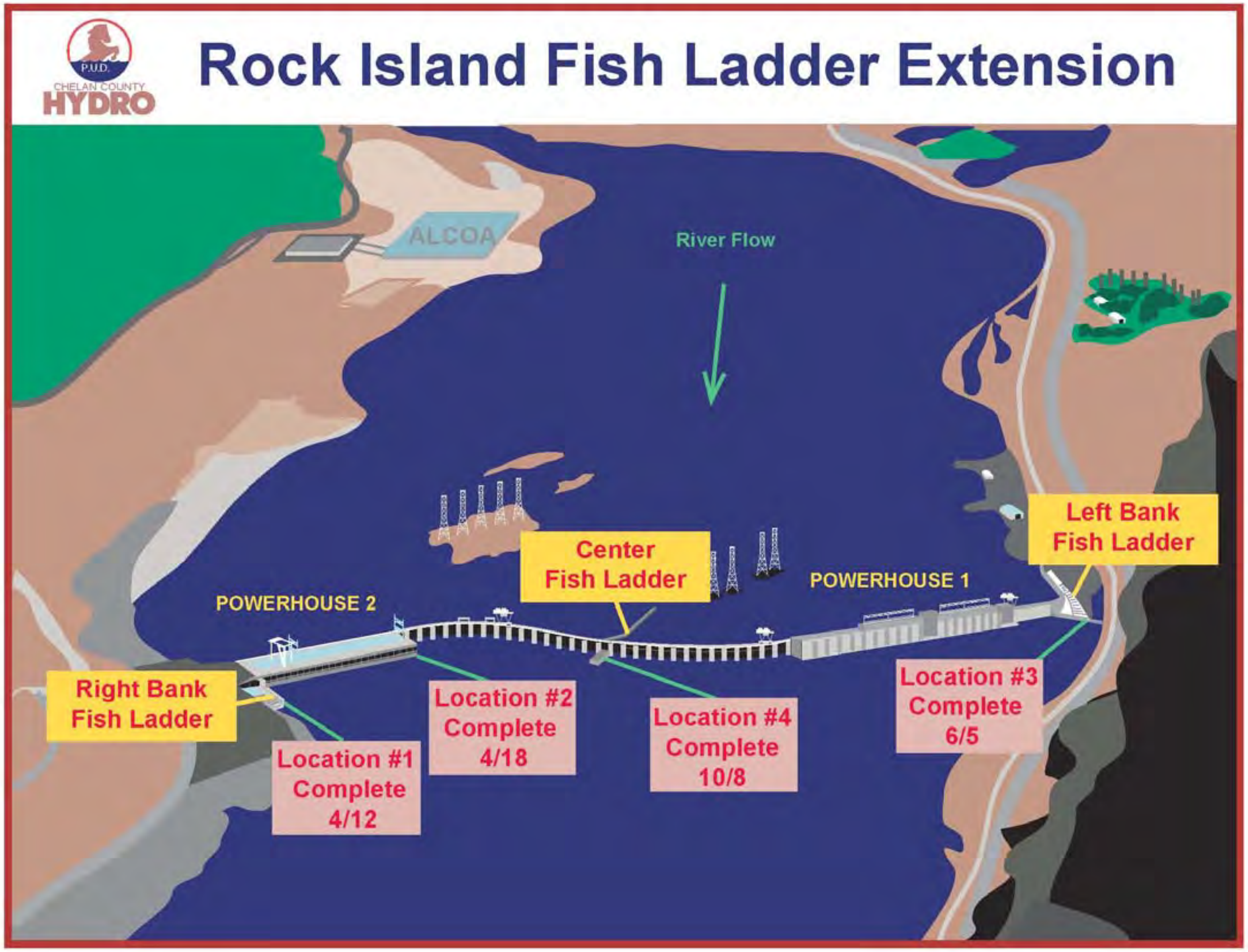

Figure 1: Rock Island Fish Ladder Extension and Modification Diagram

Progress of Work

All adult ladder entrances for the 3-ladder system during the month of December at the Rock Island Project were functional and within operating criteria when tailwater elevations were equal to 560 feet or greater. Due to periods of intermittent low tailwater elevations at Rock Island from June 14 through December 23, 2014, the installed denil extensions were operated (within criteria) to provide adult passage when tailwater elevations were below 560 feet (Appendix D).

Grant PUD received approval from FERC to initiate a partial refill of the Wanapum Dam reservoir to an interim elevation range of 558 to 562 feet on November 25, 2014, with an elevation of 561.8 feet being reached on December 1, 2014. The return of the Wanapum forebay to an operational range near normal elevation (560 to 571.5 feet) has allowed all units in both powerhouses at Rock Island to return to normal operations. A summary of Rock Island Powerhouse 1, Powerhouse 2, and spill flows, as well as headwater and tailwater elevations are attached in Appendix E.

Adult Passage Measures

The interim pool raise for the Wanapum reservoir is a positive sign of Grant PUD's progress toward completion of necessary repairs to Wanapum Dam yet still presents Chelan PUD with decisions associated with whether to leave the denil fishways in place as a cautionary measure for adult fish passage. The current interim pool raise has brought the Wanapum reservoir to an operating elevation range of 558 to 562 feet until such time yet to be determined that the reservoir would be raised to final upper operating range (565 to 568 feet forecasted May 2015). The upper limit of the interim reservoir operating range (562 feet) has effectively raised the tailwater elevation at Rock Island Dam sufficiently to allow all adult fishway entrances to function without need for denil ladder extension operation. The lower interim operating level (558 feet) presents the possibility that during low flow river conditions the Rock Island adult fishway entrances could be exposed (entrance sills at 559 feet) and require the use of the temporary denil ladder extensions to facilitate upstream passage. Due to uncertainties associated with when the Wanapum reservoir will be operated at the upper limit of the interim level, and to have the ability to meet Rock Island adult passage needs for any Wanapum reservoir condition encountered over the course of the 2015 adult migration period, Chelan PUD is recommending as a precaution to leave the temporary denil fishway extensions in place during the 2015 adult fish migration. This recommendation is a conservative and precautionary measure to ensure that proper adult fish passage would be available throughout the entire 2015 adult passage season should an unanticipated condition or event affect the current plan to fully raise the Wanapum reservoir by May of 2015.

AS part of the emergency consultation process, on December 11, 2014, Chelan PUD had a conference call with FERC, NMFS, and USFWS that resulted in an agreed upon schedule for drafting a biological assessment of the IFPP that anticipates ESA coverage for removing the denils after the 2015 adult fish passage season. A schedule for FERC approval to exit interim operation and return to normal fish passage operation, and to file a draft biological assessment, will be submitted to FERC by January 30, 2015.

A copy of FERC's schedule for the Interim Fish Passage and ESA Consultation Process is attached in Appendix A.

Juvenile Fish Passage

As mentioned in the previous monthly reports, juvenile outmigration run-timing and abundance resulted in spill programming for downstream migration purposes to cease on August 24, 2014. Daily samples of juvenile fish are counted and reported to Fish Passage Center for use in monitoring the spring and summer outmigration of juvenile salmon and steelhead and to determine when to initiate spring and summer fish spill at Rock Island. Juvenile Bypass Trap operations ended on September 15, 2014

Construction Status

TRE and LPE Construction Status:

Construction and installation of both the TRE and LPE denil extensions were completed on April 12 and April 18, 2014, respectively. For more information, refer to the May IFPP monthly report (Chelan 2014a).

Left Adult Fishway Construction Status:

Construction of the left adult fishway denil extension was completed on June 5, 2014. For more information, refer to the June IFPP monthly report (Chelan 2014b).

Center Ladder Side Entrance Modification Status:

Construction activities required to modify the side entrance of the middle fishway were completed on October 8, 2014. For more information, refer to the November IFPP monthly report (Chelan 2014c).

Photo: Rock Island center ladder side entrance modification.

Adult Passage Results

During the implementation of the IFPP, Chelan PUD biologists have continued reviewing video counts (Table C.1) at Rock Island adult fishways to verify adult anadromous fish passage occurred during lower tailwater elevations before and after ladder entrance modifications. These data show that adult steelhead, spring Chinook, sockeye, coho, lamprey, bull trout and whitefish have successfully passed Rock Island during ladder extension construction and operations under the IFPP. Annual fish counting was completed on November 15, 2014. Due to a lack of an ongoing PIT tag study to evaluate Wanapum fishway modifications, PIT tag detections have not been included as in previous reports. Complete video counts are provided in Appendix C.

Implementation Schedule

With the completion of the center adult fishway entrance modification completed on October 9, 2014, no other construction of denil ladder extensions or modifications are planned to implement the Rock Island IFPP.

Schedule for Future Monthly Reports

Chelan PUD is proposing that the January 2015 monthly IFPP Report be the last monthly report filed with the FERC. On January 30, 2015, Chelan PUD will submit for FERC approval a schedule and plan to exit interim operation and return to normal fish passage operation and to file a draft biological assessment that evaluates the emergency consultation.

Literature Cited

Chelan PUD. 2014. Interim Fish Passage Plan Monthly Report, May 2 2014. Public Utility District No. 1 of Chelan County, Fish and Wildlife Department, Wenatchee, Washington.

Chelan PUD. 2014. Interim Fish Passage Plan Monthly Report, June 1 2014. Public Utility District No. 1 of Chelan County, Fish and Wildlife Department, Wenatchee, Washington.

Chelan PUD. 2014. Interim Fish Passage Plan Monthly Report, November 1 2014. Public Utility District No. 1 of Chelan County, Fish and Wildlife Department, Wenatchee, Washington.

Appendix A – Interim Fish Passage and ESA Consultation Process (revised December 16, 2014)

Action	Completed Date	Comments
FERC issues letters designating Grant and Chelan PUDs (licensees) non-federal representatives for ESA purposes	Grant PUD: 3/19/14 Chelan PUD: 3/19/14	FERC is lead agency for ESA consultation.
Licensees develop separate Interim Fish Passage Plans (Interim Plans) for Wanapum and Rock Island Dams	Initial plans completed	Licensees use existing technical committees/workgroups under each license.
Licensees file Interim Plans for FERC approval	Grant PUD: 3/21/14 Chelan PUD: 3/24/14	
FERC issues orders addressing Interim Plans	Grant PUD: 3/26/14 Chelan PUD: 3/26/14	Orders issued prior to completing formal consultation pursuant to 50 CFR 402.05
FERC determined emergency consultation procedures necessary	Completed in FERC order and documentation submitted by licensees	Document that the response to Grant's dam safety incident will likely prevent full compliance with Grant's 2008 license conditions, NOAA BiOp and ITS/ITP.
Emergency consultation procedures continue until dam safety incident and the full extent of the response are known	Ongoing Documentation: - Proposed actions. - Relation to existing BiOp and license (e.g. consistent, new etc. - Relevant data, science. - NOAA/FWS provide conservation recommendation. Licensees response to each conservation recommendation. - Actions implemented. - Effects on listed species. - Grant and Chelan will document in monthly reports. - On 1/30/15 Grant and Chelan PUDs will each file a schedule for FERC approval to: (1) exit interim operation and return to normal fish passage operation and (2) file a draft Biological Assessment that evaluates the effects of interim operations and how the conservation recommendations addressed these effects.	The decisions made and actions implemented will form the basis for any formal consultation required after the emergency response is under control, if formal consultation is necessary. Effects on listed species and critical habitat will be added to the environmental baseline for any formal consultation to follow. -Grant and Chelan's schedules will be coordinated to the extent possible but may differ. Grant and Chelan will develop their respective schedules in consultation with FERC and in coordination with NMFS and FWS.
FERC determines emergency response is under control and ready for ESA analysis	-FERC order for each project issued 3/2/15	The full extent of the response to correct Grant's dam safety incident is determined, effects can be estimated, and the situation is sufficiently stable to allow preparation of a biological assessment (BA). -The FERC orders would terminate interim operations and approve the schedule for filing separate draft BAs
Licensees file separate draft BAs for each project	Grant PUD: May? Chelan PUD: May?	Licensees use existing technical committees/workgroups under each license.
FERC submits final BAs to NMFS and FWS and requests concurrence to conclude informal consultation or reinitiates formal consultation through Section 7 emergency consultation regulations	TBD	
NMFS and FWS issue separate Biological Opinions (BO) for each project revising the BOs and ITS/ITP as appropriate, if necessary.	TBD	
FERC issues any orders incorporating RPMs and BO terms and conditions into each, if necessary.	TBD	

Appendix B - Consultation with HCP Committee and Other Agencies

List of HCP Committee and other resource agencies consulted

Name	Organization	Address
Jim Craig	USFWS	jim_l_craig@fws.gov
Brian Nordlund	NMFS	bryan.nordlund@noaa.gov
Kirk Truscott	Colville Tribes	kirk.truscott@colvilletribes.com
Bob Rose	Yakama Nation	rosb@yakamafish-nsn.gov
Jeff Korth	WDFW	Jeff.Korth@dfw.wa.gov
Lance Keller	Chelan PUD	lance.keller@chelanpud.org
Tom Kahler	Douglas PUD	tomk@dcpud.org
Mike Schiewe (Facilitator)	Anchor QEA	mschiewe@anchorqea.com
Steve Lewis	USFWS	stephen_lewis@fws.gov
Scott Carlon	NMFS	Scott.Carlon@noaa.gov

Comments

November 18, 2014: HCP Coordinating Committee Conference Call (Enclosure 1)

Organization/Contact/Date/Comment	Chelan PUD Response
Scott Carlon (NMFS): Are there any structural issues with leaving the denils in place?	No there are not. At an operational range of 558 to 562 feet (Wanapum interim pool raise elevation), fish passage at Rock Island Dam will be similar to what was experienced from May through July of this year (2014). Based on fish counts from those months, there did not appear to be any passage issues. At that elevation, fish would not have to ascend the denil structures. The denils are anchored to concrete and other structures to account for varying tailwater elevation.

December 15, 2014: HCP-PRCC Wanapum Briefing Conference Call (Enclosure 4)

Organization/Contact/Date/Comment	Chelan PUD Response
Steve Lewis (USFWS): Is Rock Island now operating in a full generation configuration?	Yes it is. There is sufficient submergence to avoid head constraints such as those required in September through November 2014.
Steve Lewis (USFWS): When will the right bank fish ladder at Rock Island Dam be brought back online?	The return date of the right bank fishway is currently uncertain. Each year one of the three fish ladders at Rock Island Dam undergoes a more intensive maintenance and overhaul period (i.e., longer outage), which is scheduled for the right bank fish ladder this year. The outage will most likely last at least through the month of December 2014.

Documentation of Consultation

Enclosure 1: November 18, 2014: HCP Coordinating Committee Conference Call Minutes.

Enclosure 2: December 1, 2014: HCP-PRCC Wanapum Briefing Conference Call Minutes.

Enclosure 3: December 15, 2014: HCP-PRCC Wanapum Briefing Conference Call Minutes.

Enclosure 1

ANCHOR QEA

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DRAFT MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Coordinating Committees	**Date:**	December 2, 2014
From:	Michael Schiewe, Chair		
Cc:	Kristi Geris		
Re:	Draft Minutes of the November 18, 2014 HCPs Coordinating Committees Conference Call		

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Coordinating Committees met by conference call, on Tuesday, November 18, 2014, from 9:30 am to 11:30 am. Attendees are listed in Attachment A of these meeting minutes.

ACTION ITEM SUMMARY

- Anchor QEA will coordinate with U.S. Fish and Wildlife Service (USFWS) to resolve the last pending item from the Coordinating Committees revised draft October 28, 2014 conference call minutes; once resolved Kristi Geris will finalize the minutes and distribute them to the Coordinating Committees (Item I-B). *(Note: Geris obtained clarification from Jim Craig on November 21, 2014, and distributed the final October 28, 2014 conference call minutes that same day.)*
- Kristi Geris will contact Julene McGregor (Douglas PUD Information System Staff) to request read-only access to the final document library on the HCP Hatchery Committees Extranet site for Peter Graf (Grant PUD), as approved by the Coordinating Committees (Item I-D). *(Note: Geris sent an email to McGregor on November 18, 2014, requesting access for Graf, as discussed.)*
- Chelan PUD will provide 2013 and 2014 adipose (ad)-present steelhead and yearling Chinook salmon fish passage data for Rock Island and Rocky Reach dams to Kristi Geris for distribution to the Coordinating Committees (Item II-A).
- Chelan PUD will request from the Washington State Department of Ecology (Ecology) an extension of the review period for the draft Rocky Reach Total Dissolved Gas (TDG) Year Five Report from 30 to 60 days, and will notify the Coordinating Committees whether the extension is granted (Item II-D).

- Coordinating Committees representatives will provide initial comments on the draft Rocky Reach TDG Year Five Report to Chelan PUD prior to the next Coordinating Committees meeting on December 16, 2014 (Item II-D).
- Douglas PUD will provide the draft 2014 Wells Post-Season Bypass Report for review to Kristi Geris for distribution to the Coordinating Committees (Item III-C).
- **The next Coordinating Committees meeting will be on December 16, 2014, and will be held by conference call (Item V-A).**

DECISION SUMMARY

- The Coordinating Committees representatives present approved the Rocky Reach and Rock Island 2014 Fish Spill Report (Item II-A). *(Note: Jim Craig and Kirk Truscott provided USFWS' and the Colville Confederated Tribe's [CCT's] approval of the report via email on November 12 and November 18, 2014, respectively.)*
- The Coordinating Committees representatives present approved the Rocky Reach and Rock Island September 2014 Juvenile Bypass Operations Statement of Agreement (SOA; Item II-B). *(Note: Jim Craig and Kirk Truscott provided USFWS' and the CCT's approval of the SOA via email on November 12 and November 18, 2014, respectively.)*
- The Coordinating Committees representatives present approved Douglas PUD's proposed modifications to the low-level fishway entrance to improve lamprey passage at Wells Dam (Item III-B). *(Note: Jim Craig and Kirk Truscott provided USFWS' and the CCT's approval of the modifications via email on November 12 and November 18, 2014, respectively.)*

AGREEMENTS

- Coordinating Committees representatives present agreed to provide Peter Graf read-only access to the final document library on the HCP Hatchery Committees Extranet site (Item I-D).
- Coordinating Committees representatives present agreed to reschedule the Coordinating Committees meeting on December 23 to December 16, 2014 (Item V-A).

REVIEW ITEMS

- Kristi Geris sent an email to the Coordinating Committees on November 17, 2014, notifying them that the draft Rocky Reach TDG Year Five Report is available for review. Initial comments on the draft report are due to Chelan PUD prior to the next Coordinating Committees meeting on December 16, 2014 (Item II-D).
- Kristi Geris sent an email to the Coordinating Committees on November 18, 2014, notifying them that the draft Passage Dates Analysis (Skalski and Townsend 2014) is available for review. The draft analysis is available for a 60-day review period with comments due to Tom Kahler by Friday, January 16, 2015 (Item III-C).

DOCUMENTS FINALIZED

- The Broodstock Collection Protocols SOA that was approved by the HCP Hatchery Committees on September 17, 2014, and approved by the Coordinating Committees on October 28, 2014, was finalized and distributed to the Coordinating Committees by Kristi Geris on October 28, 2014.

I. Welcome

A. Review Agenda (Mike Schiewe)

Mike Schiewe welcomed the Coordinating Committees and asked for any additions or other changes to the agenda. No additions or changes were requested.

B. Meeting Minutes Approval (Mike Schiewe)

The Coordinating Committees reviewed the revised draft October 28, 2014 conference call minutes. Kristi Geris said that there is one comment remaining to be discussed regarding a comment that Jim Craig made during Douglas PUD's discussion of the draft 2014 Wells Dam Post-Season Bypass Report. Tom Kahler requested clarification regarding Craig's question about the percentage for adipose (ad)-only yearling Chinook salmon. Geris said that she will coordinate with USFWS to resolve this last pending item, and once resolved, she will finalize the minutes and distribute them to the Coordinating Committees. Jeff Korth also requested, regarding Douglas PUD's Twisp River population assessment discussion, to indicate that the new hatchery permits "will" require a population estimate of the juveniles.

Coordinating Committees members present approved the October 28, 2014 conference call minutes, as revised. *(Note: Craig and Kirk Truscott provided USFWS' and the CCT's approval of the October 28, 2014 conference call minutes via email on November 12 and November 18, 2014, respectively, and Geris obtained clarification from Craig resolving the last pending item on November 21, 2014, and she distributed the final October 28, 2014 conference call minutes that same day.)*

C. Last Meeting's Action Items (Mike Schiewe)

Action items from the Coordinating Committees conference call on October 28, 2014, and follow-up discussions were as follows: *(Note: italicized item numbers below correspond to agenda items from the October 28, 2014 meeting.)*

- *Coordinating Committees representatives will submit comments or an email confirming "no comments" on the Bailey Douglas PUD Land Use Permit Application to Tom Kahler no later than November 5, 2014 (Item I-C).*
  Kristi Geris sent an email to the Coordinating Committees on November 6, 2014, notifying them that no comments were received on the Bailey Douglas PUD Land Use Permit Application following a 60-day review period, which ended on November 5, 2014. As noted in the email, Douglas PUD will proceed with this application.
- *Douglas PUD will provide a revised Methow River Coho Salmon Phase Designation SOA, with the CCT's edits incorporated, to Kristi Geris for distribution to the Coordinating Committees; Douglas PUD will request approval of the revised SOA during the Coordinating Committees meeting on November 18, 2014 (Item II-A).*
  Douglas PUD provided the revised SOA to Geris on November 7, 2014, which Geris distributed to the Coordinating Committees that same day. This will be discussed further during today's conference call.
- *Douglas PUD will provide the draft 2014 Wells Post-Season Bypass Report for review to Kristi Geris for distribution to the Coordinating Committees (Item II-B).*
  This will be discussed further during today's conference call.

- *Douglas PUD will provide the draft conceptual box design for the Wells Dam low-level fishway entrances to Kristi Geris for distribution to the Coordinating Committees (Item II-D).*
  Douglas PUD provided the draft design to Geris on November 3, 2014, which Geris distributed to the Coordinating Committees that same day. This will be discussed further during today's conference call.
- *Douglas PUD will provide the original HCP Chair position Scope of Work and Qualifications document to Kristi Geris for distribution to the Coordinating Committees (Item II-F).*
  Douglas PUD provided the original Scope of Work to Geris on October 31, 2014, which Geris distributed to the Coordinating Committees that same day. Tom Kahler had indicated in the email that he could not locate the original Qualifications document.
- *Douglas PUD will provide the current HCP Hatchery Committees and Coordinating Committees Chair candidate lists, including whether the respective candidate is also an Aquatic Settlement Workgroup (SWG) Chair candidate, to Kristi Geris for distribution to the Coordinating Committees (Item II-F).*
  An updated HCP Chair candidate table was distributed to the Coordinating Committees by Geris on October 31, 2014.
- *Coordinating Committees representatives will review the HCP Coordinating Committees Chair position documents and will: 1) contact any additional qualified candidates to gauge interest in the position; 2) have interested candidates contact Mike Schiewe to discuss the responsibilities of the position; and 3) provide a résumé or curriculum vitae (CV) from interested candidates to Tom Kahler, Lance Keller, and Kristi Geris by November 4, 2014 (Item II-F).*
  This action item was completed.
- *Chelan PUD will provide a draft SOA outlining completion of the Rocky Reach and Rock Island HCP requirements for conducting additional run-timing and species composition monitoring to verify that the normal bypass operating period (April 1 through August 31) is adequately protecting 95% of the spring and summer migrations of juvenile Plan Species (Item III-A).*

Chelan PUD provided the draft SOA to Kristi Geris on November 17, 2014, which Geris distributed to the Coordinating Committees that same day.

- *Kristi Geris will contact Julene McGregor (Douglas PUD Information System Staff) to request read-only access to the final document library on the HCP Hatchery Committees Extranet site for John Penny and Denise McCarver (Eastbank Hatchery Staff), as approved by the Coordinating Committees (Item IV-A).*
  Geris sent an email to McGregor following the meeting on October 28, 2014, requesting access for Penny and McCarver, as discussed, and McGregor set up access for Penny and McCarver on October 29, 2014, as requested.
- *The next Coordinating Committees meeting will be on November 18, 2014, and will be held by conference call (Item VI-A).*
  This action item was completed today.
- *The Coordinating Committees meeting scheduled for December 23, 2014, may be rescheduled to December 16, 2014, and may be held by conference call, which will be further discussed during the Coordinating Committees meeting on November 18, 2014 (Item VI-A).*
  This will be discussed further during today's conference call.

D. HCP Hatchery Committees Extranet Site Access Request – Peter Graf (Mike Schiewe)

Mike Schiewe said that Peter Graf, Grant PUD Biologist, requested via email on October 30, 2014, access to the HCP Hatchery Committees Extranet site. Schiewe said that Grant PUD has had a representative attending the HCP Hatchery Committees meetings for the past 8 years. He added that obtaining access to the HCP Hatchery Committees Extranet site will require Coordinating Committees approval. Coordinating Committees representatives present agreed to provide Graf read-only access to the final document library on the HCP Hatchery Committees Extranet site. Kristi Geris will contact Julene McGregor to request read-only access to the final document library on the HCP Hatchery Committees Extranet site for Graf, as approved by the Coordinating Committees. *(Note: Geris sent an email to McGregor on November 18, 2014, requesting access for Graf, as discussed.)*

II. Chelan PUD

A. DECISION: Rocky Reach and Rock Island 2014 Fish Spill Report (Lance Keller)

Lance Keller said that Kristi Geris sent an email to the Coordinating Committees on October 28, 2014, notifying them that the draft 2014 Rocky Reach and Rock Island Fish Spill Report was available for review, with edits and comments due to Keller prior to the Coordinating Committees meeting on November 18, 2014. Keller said that no edits or comments were received on the draft report.

Bob Rose asked how 20% spill is calculated at Rock Island Dam. Keller explained that flow estimates; comprised of flow from Chief Joseph Dam, tributary side flows, and daily average river flow; are used to develop a spill shape. He said that this information is included in a memorandum that the Chelan PUD Fish and Wildlife Department provides to the Spill Operators 2 days before spill is scheduled to occur. He said that RealTime monitoring also takes place to help shape spill. Rose noted the big spike in late-May to early-June, and asked if that is included in the average spill through August. He said that he wanted to make sure that spill was 20% when the majority of the run passes through. Keller agreed, and said that this is why RealTime monitoring takes place on a daily basis—to achieve as close to 20% as possible. He added that the variability on the tail end of the spill season was due primarily to changing river flow due to the drawdown of the Wanapum Reservoir, and the variability at the beginning of the spill season was attributed to gate maintenance when there was a defective seal, and the gate was opened to replace the seal. He said that following that maintenance, spill was immediately returned to the 20% range.

Rose asked, regarding Table 1 in the draft report, if the fish counts are reflective of both hatchery and wild populations. Keller replied that those numbers include both ad-clipped and ad-present fish through the bypass system. Rose asked if any trends were observed for steelhead based on 2014 data. Keller said that he would need to review those data, and noted that the numbers fluctuated a bit. Jeff Korth also noted the low steelhead numbers in 2013, and asked if Keller knew the reason. Keller said that he would need to review those data as well. Rose said that he was interested in the possible influence of hatchery releases above Rock Island Dam on bypass numbers; Keller said that Chelan PUD will provide 2013 and

2014 ad-present steelhead and yearling Chinook salmon fish passage data for Rock Island and Rocky Reach dams to Geris for distribution to the Coordinating Committees.

The Coordinating Committees representatives present approved the Rocky Reach and Rock Island 2014 Fish Spill Report. *(Note: Jim Craig and Kirk Truscott provided USFWS' and the CCT's approval of the report via email on November 12 and November 18, 2014, respectively; and the final report [Attachment C] was distributed to the Coordinating Committees by Geris on November 25, 2014*[KG1]*.)*

B. *Draft Rocky Reach and Rock Island September 2014 Juvenile Bypass Operations SOA (Lance Keller)*

Lance Keller reviewed the draft SOA outlining completion of the Rocky Reach and Rock Island HCP requirements for conducting additional run-timing and species composition monitoring to verify that the normal bypass operating period (April 1 through August 31) is protecting 95% of the spring and summer migrants. The draft SOA was distributed to the Coordinating Committees by Kristi Geris on November 17, 2014. Keller recalled the additional monitoring that took place from September 1 to 15, 2014, at Rocky Reach and Rock Island dams, which indicated that there did not appear to be a significant component (greater than 5%) of the juvenile emigrants present outside the normal bypass operating period. He also noted the Columbia River Data Access in Real Time (DART) database expanded value that was applied at Rock Island Dam. Keller said that Kirk Truscott provided the CCT's approval of the SOA via email, with the comment that if the September 1 to 15 index counts represented 3 to 4% of the total index counts, Truscott would have recommended an additional year of extended bypass operations. Keller said that, however, because the percentages were so low, that the end date of August 31 is sufficient, as Truscott also noted.

The Coordinating Committees representatives present approved the Rocky Reach and Rock Island September 2014 Juvenile Bypass Operations SOA. *(Note: Jim Craig and Truscott provided USFWS and the CCT approval of the SOA via email on November 12 and November 18, 2014, respectively; and the final SOA [Attachment B] was distributed to the Coordinating Committees by Geris on November 25, 2014.)*

C. Wanapum Drawdown Update (Lance Keller)

Lance Keller said that the latest Wanapum briefing was held yesterday, November 17, 2014. He said that during the briefing, Jim Craig had asked about plans to remove the denil structures at Rock Island Dam. Keller explained that removal of those structures is still under discussion, and that Chelan PUD is uncertain whether the denil structures may be needed again if the Rock Island tailrace is lowered. He added that if the structures are removed, if even possible, reinstalling them would require a substantial amount of time, and high flows would make re-installation impossible. He said that Chelan PUD is discussing this further with Grant PUD and the Federal Energy Regulatory Commission, and he said that Chelan PUD will keep the Coordinating Committees apprised of the outcome of these discussions.

Keller said that river flow at Rock Island Dam is increasing, and is currently 127,000 cubic feet per second (127 kcfs). He said that this translates to an average tailrace elevation of 563.63 feet. He said that all fishway entrances at Rock Island Dam are available, and all denils are fully submerged. He said that additional units have been brought online, and that Powerhouses 1 and 2 are running at full capacity, with no spill.

Keller said that the Rock Island Dam 2014 fish counting season, which started April 15, ended on November 15, 2014. He said that the 2014 annual totals include: 150,030 steelhead, 145,101 Chinook salmon, 81 bull trout, 581,121 sockeye salmon, 2,452 lamprey, and 47,580 coho salmon. Keller noted that the lamprey number only includes those fish passing the count window, and does not include fish transported via Grant PUD's trap and haul effort. He said that Chelan PUD is working to get the lamprey count, as reported on the DART database, to include those lamprey that were trapped and hauled above Rock Island Dam.

Keller said that the next Rock Island Interim Fish Passage Plan monthly report will be available by December 1, 2014. He said that the report will largely be the same as previous reports, only with updated fish counts and flow past the Project for the month of November, and also some details about possibly leaving the denil structures in place.

Scott Carlon asked if there would be any structural issues with leaving the denils in place. Keller replied that there would not. He said that at an operational range of 558 to 562 feet (Wanapum interim pool raise elevation), fish passage at Rock Island Dam will be similar to what was experienced from May through July of this year. He said that based on fish counts from those months, there did not appear to be any passage issues. He added that at that elevation, fish would not have to ascend the denil structures. He also added that the denils are anchored to concrete and other structures to account for varying tailwater.

D. Draft Rocky Reach TDG Year Five Report (Marcie Steinmetz and Steve Hays)

Marcie Steinmetz reviewed the draft Rocky Reach TDG Year Five Report (Attachment D), which was distributed to the Coordinating Committees by Kristi Geris on November 17, 2014. Steinmetz said that the Rocky Reach Hydroelectric Project 401 Water Quality Certification requires that Chelan PUD submits a 5-year TDG check-in report to Ecology, the Rocky Reach Fish Forum (RRFF), and the HCP Coordinating Committees. Steinmetz said that the report covers the years 2008 to 2013, and does not include 2014 data. She said that also as required by the 401 Water Quality Certification and addressed within this report, is the requirement to evaluate alternative spillway operations, using any of gates 2 through 12, to determine whether TDG levels can be reduced. She said that Chelan PUD addresses spill configuration as a phased approach, as further described on page 16 in Attachment D.

Steve Hays said that fish passage data will be evaluated once obtained (i.e., post-hoc analyses). He recalled spill configurations that were studied in 2011 and 2012, particularly the high level spill patterns (above 50 kcfs), at which time the desired V-shaped pattern tended to distort and appeared to have less value for enhancing fish guidance to the fishway entrances. He said that spill was also spread to more gates than usual, which created a whitewater pattern below the dam that the fish have to navigate through, but the tapered pattern led fish to the powerhouse collection system, which is the entrance where most fish enter when into a non-spill configuration. He said that both Chinook and sockeye salmon were passing in optimal numbers, and he noted that steelhead and coho salmon had not yet reached Rocky Reach Dam. He noted Figures 2-3 and 2-4 in Attachment D, where daily fish counts by species are plotted along with the spill pattern in effect for that day. He also noted that the figures do not account for fish that passed through the ladders, but did not pass the count window. He said that the spill patterns were not refined enough to correlate fish entry by ladder. He added that the 2011 and 2012 studies were an attempt to identify any obvious problems, and he noted that none were observed. He also noted that the proposed alternative spillway operations summarized in this draft report are not necessarily final.

Mike Schiewe asked when Chelan PUD is required to submit a final report to Ecology. Steinmetz replied that a final report is due to Ecology by the end of 2014; however, she reiterated that the proposed operations summarized in this report are not necessarily final. She said, for example, that the use of automated gates may change. Hays further explained that the gates are currently not capable of automatically adjusting as spill level increases and decreases, and may not be ready for testing next summer. Steinmetz estimated that the system would be automated in 2015, and ready to test in 2016. She also stated that, as further described under Phase 4 on page 20 of Attachment D, Chelan PUD will develop a schedule to make the necessary changes to perform the new spill configurations. She also noted that while operating under a new configuration, adaptive management may be implemented based on review of data. Hays added that operations can be stopped at any time.

Schiewe said that the typical comment period for HCP documents is 60 days; however, a shortened comment period has been approved in the past under special circumstances. Steinmetz noted that the portion of the report that discusses flat spill is subject to change. Jeff Korth asked if only the TDG portion needs to be reviewed and not the spill configuration portion. Steinmetz said that review of the entire report would be preferred; however, the non-TDG portions are a work in progress. Hays said that, specifically, he would like for the Coordinating Committees to review the section on effect on fish. Steinmetz said that any portion of the report that the Coordinating Committees are not comfortable with approving can be removed from the report. Schiewe asked if Chelan PUD could draft an abbreviated version of the report that only includes those elements that require Coordinating Committees approval, as required by the 401 Water Quality Certification. Steinmetz said that she could do that. She also suggested requesting an extension from

Ecology to allow for HCP 60-day review, and she said that Chelan PUD will request from Ecology an extension of the review period for the draft Rocky Reach TDG Year Five Report from 30 to 60 days, and will notify the Coordinating Committees whether the extension is granted.

Coordinating Committees representatives will provide initial comments on the draft Rocky Reach TDG Year Five Report to Chelan PUD prior to the next Coordinating Committees meeting on December 16, 2014.

III. Douglas PUD

A. DECISION: Methow River Coho Salmon Phase Designation SOA (Tom Kahler)

Tom Kahler said that the Yakama Nation (YN) made a request to postpone the decision on the revised Methow River Coho Salmon Phase Designation SOA, which was distributed to the Coordinating Committees by Kristi Geris on November 7, 2014. Kahler said that the YN indicated that they had not yet had the opportunity to internally discuss this SOA, and that Douglas PUD agreed to postpone the decision until the Coordinating Committees meeting on December 16, 2014.

B. DECISION: Wells Dam Low-Level Fishway Entrance (Tom Kahler)

Tom Kahler said that the most recent draft conceptual box design for the Wells Dam low-level fishway entrance (Attachment E) was provided to Kristi Geris this morning, which she will distribute to the Coordinating Committees following the meeting. *(Note: Geris distributed the draft design to the Coordinating Committees following the meeting on November 18, 2014, as discussed.)*

Kahler recalled that reopening the low-level fishway entrance at Wells Dam and installing a modification to improve lamprey passage has been under discussion for the past couple of months. He said that the Aquatic SWG recently agreed to seek approval from the Coordinating Committees to install a structure in the low-level fishway entrance area that prevents access to salmonids but allows lamprey to pass. He recalled that Bryan Nordlund had expressed concerns about salmonids accessing the area, and also about high velocity through the area. Kahler said that the structure is also designed to reduce flow through the area, which addresses Nordlund's concerns. Kahler said that no significant changes have been made to Attachment E compared to past iterations of the design. He said that Attachment E includes more details about the structure itself. He noted that no exit is shown on the structure in Attachment E; however, he said that an orifice will be drilled into the structure. He said that Biomark is installing half-duplex (HD) and full-duplex (FD) PIT-tag detection antennae throughout the structure. He said that flow exiting the structure will only be about 1.5 cubic feet per second (cfs). He said that Douglas PUD plans to continue discussing velocities with Aaron Beavers (National Marine Fisheries Service [NMFS] Engineer), with the objective of attracting lamprey and not salmonids; however, Kahler noted that these discussions would not change the design of the structure. He added that all modifications will be performed behind a bulkhead, which can be left in place, if requested. He said that Douglas PUD would like to obtain approval of the design in order to move forward with fabrication and plans to install the modification during the annual winter maintenance period at Wells Dam.

Mike Schiewe asked if Attachment E addresses Kirk Truscott's concerns about salmonids accessing the structure. *(Note: Truscott's comments were distributed to the Coordinating Committees by Geris prior to the meeting on November 18, 2014.)* Kahler said that by installing HD and FD PIT-tag detection inside the structure, PIT-tagged salmonids will be detected if they access the structure. He said that radio telemetry antennas will be installed throughout the Project for Douglas PUD's 2015 Lamprey Passage and Enumeration Study, and the Washington Department of Fish and Wildlife (WDFW) is implementing a Steelhead Radio Telemetry Study, which will contribute additional information on salmonid behavior.

The Coordinating Committees representatives present approved the Douglas PUD proposed modifications to the low-level fishway entrance to improve lamprey passage at Wells Dam. *(Note: Jim Craig and Truscott provided USFWS' and the CCT's approval of the modifications via email on November 12 and November 18, 2014, respectively.)* Schiewe noted that Truscott's approval was contingent on ongoing monitoring of the area.

C. Draft 2014 Wells Dam Post-Season Bypass Report (Tom Kahler)

Tom Kahler recalled discussing a draft Passage Dates Analysis, being developed by Drs. John Skalski and Richard Townsend of Columbia Basin Research, during the last Coordinating Committees meeting on October 28, 2014. Kahler said that Skalski and Townsend were evaluating the performance of Wells Dam bypass operations based on travel times between Wells and Rocky Reach dams. Kahler recalled that all preliminary migration proportions were compliant (passage was provided for 95% of the migration) except for yearling Chinook salmon, which appeared to be heavily influenced by hatchery releases. He said that Douglas PUD asked Townsend to further evaluate passage data separating hatchery from wild spring migrants; his results suggested that there were differences among years. Kahler said that data from 2012, 2013, and 2014 were reviewed, which are the years when the new bypass dates were in effect at Wells Dam. He said that passage data for 2012 and 2013 were compliant (i.e., greater than 95% coverage for all species); however, 2014 fell short. He explained that the date at which more than 5% of the run passed Wells Dam was the same for hatchery and wild in 2012 and 2013, but different in 2014 (more than 5% wild fish passed earlier than hatchery). He said that he also reviewed data from 2010 and 2011, and that the same situation occurred in 2010[KG2], but not in 2011. He said he thought that by reviewing hatchery releases, it would be clear that in years when there were early hatchery releases above Rocky Reach Dam that Wells Dam would be below the 95% standard. He added that it was clear that hatchery releases, because they are numerically dominant, drive compliance with the 95% bypass standard, but for years when wild fish arrive much earlier than hatchery fish, the April 9 start date is still too late to cover wild (ad-present) outmigrants. He said, to this end, that Douglas PUD believes that it is important to start evaluating the ad-present component of the run annually. He added that considering this, Douglas PUD also thinks that an earlier bypass start date may be needed.

Kahler said that he shared these data with Townsend, and Townsend noted that the numbers that he and Skalski typically use for the program RealTime are spill adjusted; whereas, the numbers Kahler reviewed are not. Kahler said that Townsend wants to apply a spill adjustment on those numbers and run them again. Kahler asked Townsend to redo the analysis, adding the fish that were not included due to an outage[KG3]. Kahler said that Skalski and Townsend's draft Passage Dates Analysis (Attachment F) was provided to Kristi

Geris this morning, which she will distribute to the Coordinating Committees following the meeting; however, Kahler noted that a revised draft will be provided when it is available. *(Note: Geris distributed the draft analysis to the Coordinating Committees following the meeting on November 18, 2014, as discussed, and Kahler later clarified via email on November 26, 2014, that no revisions are needed as originally thought and that the draft distributed to the Committees on November 18, 2014, is the final draft for review.)*

Kahler said that Douglas PUD wants the Coordinating Committees to consider a revised bypass start date for 2015. Mike Schiewe suggested that the Coordinating Committees first review the draft analysis, and after the revised analysis is provided, follow up later to evaluate whether adjustments are needed to meet HCP requirements for wild fish.
Lance Keller clarified that there is no spill adjustment applied to Rocky Reach Dam counts. Kahler added, and Keller concurred, that the expansion of the bypass counts at Rocky Reach would not affect the ratio of wild to hatchery migrants.

D. HCP Coordinating Committees Chair Position (Tom Kahler)

Tom Kahler said that the HCP Policy and Coordinating Committees held a joint conference call on November 6, 2014. He said that the following HCP signatory representatives were identified to select the HCP Chairs for the Hatchery and Coordinating Committees:
Steve Parker for the YN, Kirk Truscott for the CCT, Jim Craig for USFWS, Ritchie Graves for NMFS, Jeff Korth for WDFW, Keith Truscott for Chelan PUD, and Shane Bickford for Douglas PUD. Kahler said that a ranking system was also approved for narrowing the HCP Chair candidate lists to a “short list” for interviews, where each Party ranks the candidates first to last (1 to 6 for Hatchery Committees candidates, and 1 to 8 for Coordinating Committees candidates) for filling the Chair positions, and those rankings were to be provided to Kristi Geris by November 17, 2014, so that she could compile the results for discussion at the joint HCP Policy and Coordinating Committees conference call scheduled for November 18, 2014 at 3:00 p.m. Kahler said that the goal of today’s joint HCP Policy and Coordinating Committees conference call is to develop an interview list and establish a date, time, place, and process for conducting the interviews.

IV. HCP Hatchery and Tributary Committees Update (Mike Schiewe)

Mike Schiewe said that the HCP Hatchery Committees will meet at Douglas PUD tomorrow, November 19, 2014, most notably, to discuss approval of the YN's proposed SOA for expanded acclimation of spring Chinook salmon (2014 broodstock origin) at Goat Wall in 2016.

Schiewe updated the Coordinating Committees on the following actions and discussions that occurred at the last HCP Tributary Committees meeting on November 13, 2014:

- *Small Projects Program Application: Clear Creek Fish Passage and Instream Flow Enhancement Project*: The Rocky Reach Tributary Committee approved a Small Projects Program application from Trout Unlimited that involves removing barriers and accessing a well in order to increase flow by 0.45 cfs, improving spawning and rearing habitat from May 13 to September 30. The contribution was for about $70,000 of the approximately $95,000 project.
- *Small Projects Program Application: Lehman Riparian Restoration Project*: The Rock Island Tributary Committee approved a Small Projects Program application from the Methow Conservancy that involved restoring riparian zone in four areas. The contribution was for about $9,000 of the approximately $40,000 project.
- *Okanagan Project Tours*: The Tributary Committees toured habitat restoration projects on the Okanagan River in Canada.
- *Entiat River Restoration Projects Presentation*: The Bureau of Reclamation (Reclamation) presented restoration actions proposed for the Entiat River Gray and Stormy Reaches. The Tributary Committees will have additional opportunities to provide comments on the 30 and 60% designs.
- *Upper White Pine Presentation*: Chelan County Natural Resources Department, Interfluve, and Reclamation presented to the Tributary Committees and the Priest Rapids Coordinating Committee Habitat Subcommittee (PRCC HSC) updated information on the proposed approach for the Nason Creek Upper White Pine Restoration Project. The Tributary Committees and the PRCC HSC were alerted that there will be an additional request for funds. The Tributary Committees and the PRCC HSC provided early feedback to help with preparation of the application.

- *Next Steps*: The next HCP Tributary Committees meeting will be held on December 11, 2014.

V. HCP Committees Administration

A. Next Meetings (Mike Schiewe)

Mike Schiewe suggested, in consideration of the holiday, to reschedule the Coordinating Committees December meeting to December 16, 2014, and to hold the meeting via conference call. He said that the PRCC is planning to hold their meeting on December 17, 2014. Coordinating Committees representatives present agreed to reschedule the Coordinating Committees meeting on December 23 to December 16, 2014.

The next scheduled Coordinating Committees meeting is on December 16, 2014, to be held by conference call. The January 27 and February 18, 2015 meetings will be held either by conference call or in person at the Radisson Hotel in SeaTac, Washington, as is yet to be determined.

List of Attachments

Attachment A	List of Attendees
Attachment B	Final Rocky Reach and Rock Island September 2014 Juvenile Bypass Operations SOA
Attachment C	Final [KG4]Rocky Reach and Rock Island 2014 Fish Spill Report
Attachment D	Draft Rocky Reach TDG Year Five Report
Attachment E	Draft Conceptual Box Design for the Wells Dam Low-Level Fishway Entrance
Attachment F	Skalski and Townsend's Draft Passage Dates Analysis

Attachment A
List of Attendees

Name	Organization
Mike Schiewe	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Lance Keller*	Chelan PUD
Steve Hays	Chelan PUD
Tom Kahler*	Douglas PUD
Marcie Steinmetz	Chelan PUD
Scott Carlon*	National Marine Fisheries Service
Jeff Korth*	Washington Department of Fish and Wildlife
Bob Rose*	Yakama Nation

Note:
* = Denotes Coordinating Committees member or alternate

Enclosure 2

ANCHOR QEA

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Coordinating Committees, and Priest Rapids Coordinating Committee	**Date:**	December 6, 2014
From:	Michael Schiewe, HCP Coordinating Committees Chair		
Cc:	Kristi Geris		
Re:	Final Summary of the December 1, 2014 HCP-PRCC Wanapum Briefing		

Members of the Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Coordinating Committees and the Priest Rapids Coordinating Committee (PRCC) met by conference call on Monday, December 1, 2014, from 8:00 a.m. to 8:30 a.m., to participate in a joint briefing on the progress and implementation of the Wanapum and Rock Island Interim Fish Passage Plans (IFPPs) that were developed in response to the Wanapum Dam emergency spillway repair and reservoir drawdown. Organizations represented are listed in Attachment A.

ACTION ITEM SUMMARY

- No action items were discussed during today's conference call.

I. Welcome and Introductions

Denny Rohr (DRohr and Associates), PRCC Facilitator, and Mike Schiewe (Anchor QEA, LLC), HCP Coordinating Committees Chair, welcomed those in attendance.

II. Grant PUD

A. Wanapum IFPP Update (Tom Dresser)

Tom Dresser (Grant PUD) said that the refilling of the Wanapum Reservoir began on November 24, 2014. At that time, the goal was to reach a pool elevation of 558 to 562 feet (approximately a 17.2-foot increase from the drawdown elevation) by November 30, 2014, which would require raising the pool by about 2.7 feet per day. As of yesterday, November 30, 2014, at about 10:00 a.m., the Wanapum Reservoir reached an elevation of

561.1 feet. The goal today is to raise the elevation to 561.8 feet, which will achieve the intermediate pool raise. Initially, achieving the intermediate pool raise was projected to require between 7 to 20 days, and if achieved today, this will have been achieved in 7 days. Julie Piper (Grant PUD) will provide an update later today, which will also be distributed to the usual Wanapum briefings distribution lists. Based on discussions with Grant PUD Engineers, the refill planning and scheduling and monitoring and evaluation is proceeding as planned.

On November 17, 2014, the spiral chute and supporting infrastructure were removed from the right bank Wanapum Fishway Exit Passage System, as described in an email distributed on November 26, 2014. Fish passage at the right bank at Wanapum Dam was then fully restored, and on November 18, 2014, all passage infrastructure was removed from the left bank Wanapum Fishway Exit Passage System, which is now out of service. On December 8, 2014, demobilization will begin at the remaining right bank Wanapum Fishway Exit Passage System, which may require a 2-week outage. The outage could be as brief as 7 to 10 days; however, contingencies built into the 2-week schedule include the additional time required for: 1) in-water work (i.e., work completed by divers); 2) the possible difficulty in removing the right bank system, which was difficult to install due to limited space; and 3) weather (i.e., high winds). Once all infrastructure is removed, fish passage at the right bank at Wanapum Dam will be fully restored.

B. Questions (All)

Lance Keller (Chelan PUD) asked about the standard range for Federal Energy Regulatory Commission forebay elevation at Wanapum Dam. Tom Dresser replied that it is 560.0 to 571.5 feet.

Scott Bettin (Bonneville Power Administration) asked if a schedule has been developed for a full pool raise, and Dresser replied that it has not.

III. Chelan PUD

A. Rock Island IFPP Update (Lance Keller)

Lance Keller said that between the increased elevation of the Wanapum Reservoir and the consistent river flow, conditions at Rock Island Dam have been favorable for fish passage and generation. During the past 2 weeks, the daily average river flow past Rock Island Dam was 104,100 cubic feet per second (104.1 kcfs), which translates to an average tailrace elevation of 560.6 feet. Currently, the tailrace elevation is at 566.0 feet, and all denils are fully submerged and all ladders are available for fish passage. Also, during the past 2 weeks, headwater at Rock Island Dam has increased to an average forebay elevation of 611.1 feet, and has been as high as 613.0 feet.

The Rock Island Dam 2014 fish counting season ended on November 15, 2014. As of today, December 1, 2014, the annual fish ladder maintenance at Rock Island Dam started, beginning with the right ladder. During the winter maintenance period, at least one ladder at Rock Island Dam will remain open for fish passage at all times.

B. Questions (All)

There were no questions for Chelan PUD during today's briefing.

IV. Next Steps

Denny Rohr said that the next HCP-PRCC Wanapum Briefing is scheduled 2 weeks from now on Monday, December 15, 2014, to be held by conference call. He said that he will distribute a notification for the call prior to the briefing, and added that attendees can contact him or Mike Schiewe by email or phone with additional questions.

List of Attachments

Attachment A	List of Attendee Organizations

Attachment A
List of Attendees

Organization
Anchor QEA, LLC
Bonneville Power Administration
Chelan PUD
Columbia River Inter-Tribal Fisheries Commission
DRohr and Associates
Grant PUD
National Marine Fisheries Service
Washington State Department of Ecology
Yakama Nation

Enclosure 3

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FINAL MEMORANDUM

To:	Wells, Rocky Reach, and Rock Island HCPs Coordinating Committees, and Priest Rapids Coordinating Committee	**Date:**	December 19, 2014
From:	Michael Schiewe, HCP Coordinating Committees Chair		
Cc:	Kristi Geris		
Re:	Final Summary of the December 15, 2014 HCP-PRCC Wanapum Briefing		

Members of the Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Coordinating Committees and the Priest Rapids Coordinating Committee (PRCC) met by conference call on Monday, December 15, 2014, from 8:00 a.m. to 8:30 a.m., to participate in a joint briefing on the progress and implementation of the Wanapum and Rock Island Interim Fish Passage Plans (IFPPs) that were developed in response to the Wanapum Dam emergency spillway repair and reservoir drawdown. Organizations represented are listed in Attachment A.

ACTION ITEM SUMMARY

- No action items were discussed during today's conference call.

AGREEMENTS

- HCP Coordinating Committees and PRCC representatives present agreed to discontinue the biweekly Wanapum briefings, and instead, distribute monthly email updates around the beginning of each month, and hold additional briefings on an as-needed basis (Item IV).

I. Welcome and Introductions

Denny Rohr (DRohr and Associates), PRCC Facilitator, and Mike Schiewe (Anchor QEA, LLC), HCP Coordinating Committees Chair, welcomed those in attendance.

II. Grant PUD

A. Wanapum IFPP Update (Tom Dresser)

Tom Dresser (Grant PUD) said that last Friday, December 12, 2014, all remaining right bank Wanapum Fishway Exit Passage System infrastructure were removed by 12:00 p.m., and the right bank fish ladder was back online by 6:45 p.m. that same evening. The demobilization process went better than expected with regard to in-water work, weather, and removal of the weir box.

Last week, Grant PUD began discussions with the Federal Energy Regulatory Commission (FERC), the Board of Consultants, U.S. Fish and Wildlife Service (USFWS), and the National Oceanic and Atmospheric Administration (NOAA) regarding ending emergency consultation. The tentative plan forward is for Grant PUD to provide a letter by January 30, 2015, requesting to end consultation, including a description of the current status at Wanapum Dam, and a timeline for submitting a Biological Assessment (BA). The BA will be reviewed by USFWS and NOAA before it is sent to FERC. Ultimately, FERC will work with NMFS and USFWS on a Biological Opinion (BiOp). Grant PUD engineers are continuing their evaluation of the intermediate pool raise, and continuing options for additional pool raise during the 1st quarter of 2015.

B. Questions (All)

Scott Carlon (National Marine Fisheries Service) asked how much Grant PUD is considering to raise the Wanapum Reservoir in the 1st quarter of 2015. Tom Dresser said that this is still undecided; however, 5 feet is being considered. He added that another option is to complete all proposed repairs and return to the full pool elevation of 570.5 feet by mid-April 2015. He said that if everything goes well this is a possibility.

Kirk Truscott (Colville Confederated Tribes) asked about the status of the left bank Wanapum fish ladder. Dresser said that the left bank fish ladder was taken out of service on November 17, 2014. He recalled Grant PUD's requirement to maintain at least one fish passage route year-round, under their USFWS BiOp and NOAA BiOp, and added that the left bank ladder is still offline for maintenance and will probably be brought back online by December 31, 2014, as which time the right bank fish ladder will be taken offline for maintenance. He assured Truscott that at least one fish ladder at Wanapum Dam will remain operational at all times.

Truscott asked when access to the shoreline will be available, and Dresser replied that he is unsure. Dresser added that this week, Grant PUD Cultural Resource Staff will be discussing this, and he speculated that a decision will be made by the end of the week.

III. Chelan PUD

A. Rock Island IFPP Update (Lance Keller)

Lance Keller (Chelan PUD) said that over the past 2 weeks, operations at Rock Island Dam remained consistent. Current river flow past Rock Island Dam is 141,400 cubic feet per second (141.4 kcfs), which translates to a tailrace elevation of 568.0 feet. All denils are fully submerged, the slide gate on the left bank denil is up, the central ladder entrances are open, and the right bank fish ladder was taken offline on December 1, 2014, for annual winter maintenance; which means that two entrance channels at Rock Island Dam are operational as usual, with no denil access. Since December 1, 2014, the daily average river flow past Rock Island Dam has been 110.6 kcfs, ranging from 85.6 to 130.0 kcfs. This translates to an average tailwater elevation of 565.6 feet, ranging from 563.9 to 567.2 feet, and an average forebay elevation of 612.4 feet, ranging from 611.2 to 612.8 feet.

Chelan PUD is beginning the same process as Grant PUD with USFWS, NOAA, and FERC (i.e., drafting a letter request to end the declaration of emergency, and developing a schedule for drafting follow up consultation documents for review).

B. Questions (All)

Steve Lewis (USFWS) asked if Rock Island Dam is now operating in a full generation configuration. Lance Keller replied that it is. He added that there is sufficient submergence to avoid head constraints such as those encountered in September through November 2014.

Lewis asked when the right bank fish ladder at Rock Island Dam will be brought back online, and Keller replied that he is not certain at this time. Keller added that each year, one of the three fish ladders at Rock Island Dam undergoes a more extensive maintenance and overhaul period (i.e., longer outage), which is scheduled for the right bank fish ladder this year. He said that the outage will likely last at least through the month of December 2014.

IV. Next Steps

Denny Rohr suggested that, considering the current progress of the Wanapum refill and the subsequent declining information needing to be discussed on a biweekly basis, information regarding the Wanapum refill and Rock Island drawdown, from this point forward, be conveyed via monthly emails, with conference calls convened, as needed. Steve Lewis asked when the monthly emails can be expected, and Rohr suggested around the beginning of each month, starting January 2015. HCP Coordinating Committees and PRCC representatives present agreed to discontinue the bi-weekly Wanapum briefings, and instead, distribute monthly email updates around the beginning of each month, and hold additional briefings on an as needed basis.

Rohr asked that attendees contact him or Mike Schiewe by email or phone with additional questions.

List of Attachments

Attachment A	List of Attendee Organizations

Attachment A
List of Attendees

Organization
Anchor QEA, LLC
Bonneville Power Administration
Chelan PUD
Colville Confederated Tribes
DRohr and Associates
Grant PUD
National Marine Fisheries Service
U.S. Fish and Wildlife Service
Washington Department of Fish and Wildlife

Appendix C – Adult Passage Counts

Table C.1: Adult passage counts at Rock Island from March 22 through November 15, 2014.

	Species						
Date	**Steelhead**	**Chinook**[1]	**Sockeye**	**Coho**	**Lamprey**	**Bull Trout**	**Whitefish**
22-Mar	1	0	0	0	0	0	0
25-Mar	1	0	0	0	0	0	0
29-Mar	1	0	0	0	0	0	0
30-Mar	1	0	0	0	0	0	0
4-Apr	1	0	0	0	0	0	1
6-Apr	2	0	0	0	0	0	2
7-Apr	1	0	0	0	0	0	0
8-Apr	1	0	0	0	0	0	5
9-Apr	1	0	0	0	0	0	2
10-Apr	2	0	0	0	0	0	8
11-Apr	0	0	0	0	0	0	4
12-Apr	3	0	0	0	0	0	3
13-Apr	2	0	0	0	0	0	1
14-Apr	3	0	0	0	0	0	8
15-Apr	4	0	0	0	0	0	1
16-Apr	2	0	0	0	0	0	12
17-Apr	21	0	0	0	0	0	9
18-Apr	11	0	0	0	0	0	4
19-Apr	29	0	0	0	0	0	31
20-Apr	11	0	0	0	0	0	7
21-Apr	23	2	0	0	0	0	19
22-Apr	20	0	0	0	0	0	18
23-Apr	7	1	0	0	0	0	43
24-Apr	9	3	0	0	0	0	37
25-Apr	9	3	0	0	0	0	46
26-Apr	13	4	0	0	0	0	93
27-Apr	9	5	0	0	0	0	68
28-Apr	8	9	0	0	0	0	58
29-Apr	9	12	0	0	0	0	134
30-Apr	7	23	0	0	0	0	102
1-May	4	21	0	0	0	0	148
2-May	4	38	0	0	0	0	81

3-May	5	40	0	0	0	0	88
4-May	4	64	0	0	0	0	59
5-May	5	33	0	0	0	0	50
6-May	6	118	0	0	0	0	21
7-May	9	223	0	0	0	0	38
8-May	5	452	0	0	0	0	31
9-May	5	1119	0	0	0	0	5
10-May	3	886	0	0	0	0	15
11-May	2	392	0	0	0	1	12
12-May	1	833	0	0	0	1	12
13-May	2	487	0	0	0	0	28
14-May	2	506	0	0	0	2	29
15-May	5	714	0	0	0	0	10
16-May	2	794	0	0	0	0	27
17-May	2	1465	1	0	0	2	9
18-May	1	2897	0	0	0	1	6
19-May	1	834	0	0	0	0	4
20-May	1	468	0	0	0	4	8
21-May	2	945	0	0	0	2	7
22-May	2	654	1	0	0	4	8
23-May	2	623	0	0	0	1	4
24-May	2	1047	0	0	0	1	8
25-May	2	915	0	0	0	4	2
26-May	1	457	0	0	0	2	4
27-May	0	413	0	0	0	4	2
28-May	0	467	0	0	0	4	1
29-May	1	367	0	0	0	0	3
30-May	0	477	0	0	0	0	9
31-May	0	480	0	0	0	1	9
1-Jun	1	491	0	0	0	1	3
2-Jun	0	390	0	0	0	4	1
3-Jun	3	404	0	0	0	0	6
4-Jun	2	279	0	0	0	2	4
5-Jun	1	447	0	0	0	0	6
6-Jun	1	364	0	0	0	3	2
7-Jun	1	283	1	0	0	2	6
8-Jun	1	231	0	0	0	1	23
9-Jun	2	235	2	0	0	1	10
10-Jun	0	273	0	0	0	0	18
11-Jun	2	300	0	0	0	0	6
12-Jun	1	241	0	0	0	1	15

13-Jun	2	222	1	0	0	0	12
14-Jun	3	98	1	0	0	0	22
15-Jun	2	157	6	0	0	0	4
16-Jun	4	1193	26	0	0	1	8
17-Jun	1	1282	37	0	0	0	24
18-Jun	7	1027	76	0	0	0	14
19-Jun	3	303	107	0	0	3	9
20-Jun	5	1156	220	0	0	0	8
21-Jun	0	1075	560	0	0	1	16
22-Jun	0	1438	825	0	0	0	11
23-Jun	4	2313	1786	0	0	0	7
24-Jun	4	1697	2075	0	0	2	8
25-Jun	8	2087	2692	0	0	2	12
26-Jun	7	2210	3489	0	1	1	3
27-Jun	9	1154	3768	0	0	3	7
28-Jun	8	1590	3840	0	0	0	7
29-Jun	6	1750	5962	0	0	2	4
30-Jun	10	1850	8066	0	0	0	7
1-Jul	8	2681	11688	0	0	0	12
2-Jul	11	1875	15286	0	0	1	8
3-Jul	22	2558	19270	0	0	0	9
4-Jul	11	2235	21022	0	0	1	5
5-Jul	25	2238	23259	0	0	0	16
6-Jul	11	2045	17477	0	2	0	17
7-Jul	16	4198	34545	0	0	3	16
8-Jul	14	2620	32402	0	2	2	14
9-Jul	20	2221	28631	0	1	1	16
10-Jul	21	2236	26852	0	0	0	22
11-Jul	26	2640	24101	0	2	1	33
12-Jul	35	2741	26284	0	1	1	22
13-Jul	31	2863	26534	0	0	0	25
14-Jul	35	2372	34290	0	0	0	38
15-Jul	34	2053	33117	0	0	0	86
16-Jul	45	1901	29699	0	1	0	74
17-Jul	48	1943	25426	0	3	0	57
18-Jul	52	1428	18299	0	7	0	34
19-Jul	52	1859	18242	0	4	0	36
20-Jul	45	1650	13646	0	2	1	22
21-Jul	46	1123	11407	0	4	0	43
22-Jul	52	1396	9989	0	2	1	34
23-Jul	45	638	6808	0	8	1	39

24-Jul	49	849	6089	0	4	0	22
25-Jul	70	1135	5698	0	5	0	21
26-Jul	66	931	5046	0	9	0	15
27-Jul	53	646	3683	0	3	0	15
28-Jul	56	1039	3522	0	8	0	8
29-Jul	63	919	2949	0	19	0	14
30-Jul	81	423	2505	0	11	0	8
31-Jul	50	623	1498	0	17	0	20
1-Aug	70	673	1265	0	13	0	9
2-Aug	82	1140	2171	0	19	0	5
3-Aug	104	590	1002	0	19	0	3
4-Aug	91	452	804	0	8	1	10
5-Aug	103	406	698	0	25	0	5
6-Aug	113	454	501	0	32	0	4
7-Aug	106	576	421	0	59	2	7
8-Aug	113	375	234	0	39	0	7
9-Aug	97	605	184	0	61	0	8
10-Aug	129	587	167	0	49	0	2
11-Aug	123	695	107	0	35	0	2
12-Aug	126	494	66	0	43	0	4
13-Aug	142	380	112	0	29	0	3
14-Aug	55	372	87	0	129	0	1
15-Aug	58	188	56	0	89	0	3
16-Aug	107	340	40	0	41	0	0
17-Aug	136	420	30	0	24	0	0
18-Aug	193	324	84	0	17	0	2
19-Aug	132	322	27	0	76	0	12
20-Aug	128	225	17	0	59	0	7
21-Aug	150	565	23	0	45	0	7
22-Aug	216	590	33	0	16	0	18
23-Aug	120	450	15	0	83	0	3
24-Aug	106	393	18	0	210	0	1
25-Aug	150	271	3	0	133	0	0
26-Aug	108	282	10	0	408	0	13
27-Aug	103	345	14	0	188	0	8
28-Aug	127	234	10	0	95	0	13
29-Aug	92	153	4	0	77	0	2
30-Aug	183	445	9	0	14	0	5
31-Aug	214	376	6	0	13	0	2
1-Sep	69	144	2	0	5	0	0
2-Sep	108	197	7	0	16	0	0

3-Sep	158	178	5	0	6	0	1
4-Sep	126	164	4	0	5	0	1
5-Sep	63	105	3	0	9	0	1
6-Sep	72	146	3	0	3	0	0
7-Sep	56	122	2	0	1	0	2
8-Sep	157	375	1	0	1	0	1
9-Sep	93	309	3	0	2	0	0
10-Sep	235	551	0	2	0	0	2
11-Sep	254	792	7	8	0	0	2
12-Sep	42	63	1	2	11	0	1
13-Sep	27	24	1	0	0	0	1
14-Sep	52	84	0	1	0	0	0
15-Sep	739	1477	10	95	1	0	9
16-Sep	329	852	8	102	2	0	23
17-Sep	421	945	4	228	9	0	2
18-Sep	14	36	0	23	0	0	0
19-Sep	587	1573	2	512	0	0	1
20-Sep	348	1147	2	640	2	0	0
21-Sep	276	778	1	543	7	0	1
22-Sep	384	1282	3	748	5	0	2
23-Sep	270	772	2	492	2	0	3
24-Sep	473	1396	2	1602	1	0	2
25-Sep	378	1630	7	2142	4	0	0
26-Sep	282	965	0	2121	0	0	3
27-Sep	280	746	1	1356	2	0	3
28-Sep	274	835	0	1500	6	0	9
29-Sep	366	1082	1	2441	5	0	3
30-Sep	159	216	0	1227	0	0	4
1-Oct	428	932	0	2172	0	0	3
2-Oct	291	1611	1	4533	8	0	5
3-Oct	134	405	0	2796	10	0	17
4-Oct	132	245	0	1180	9	0	11
5-Oct	91	247	1	742	3	0	9
6-Oct	111	292	0	1373	8	0	26
7-Oct	130	335	3	2110	4	0	26
8-Oct	118	354	0	1441	4	0	17
9-Oct	79	333	4	1214	1	0	18
10-Oct	79	363	1	995	3	0	20
11-Oct	30	72	0	241	3	0	4
12-Oct	93	306	0	569	1	0	21
13-Oct	117	858	1	1404	3	0	12

14-Oct	59	478	0	1044	2	0	11
15-Oct	47	376	0	852	6	0	3
16-Oct	46	226	1	612	2	0	20
17-Oct	31	206	0	569	1	0	26
18-Oct	53	162	0	365	0	0	8
19-Oct	8	46	0	151	0	0	4
20-Oct	44	157	0	658	0	0	40
21-Oct	43	127	1	719	0	0	7
22-Oct	33	96	1	515	0	0	5
23-Oct	51	85	0	633	0	0	29
24-Oct	14	103	0	549	1	0	22
25-Oct	19	80	0	366	5	0	19
26-Oct	17	45	0	167	0	0	5
27-Oct	24	116	0	682	0	0	51
28-Oct	17	87	0	559	1	0	61
29-Oct	21	321	0	329	0	0	39
30-Oct	14	281	0	414	0	0	24
31-Oct	15	228	0	279	0	0	15
1-Nov	17	138	0	292	5	0	22
2-Nov	11	104	1	47	0	0	8
3-Nov	33	146	0	335	0	0	10
4-Nov	21	197	0	251	0	0	37
5-Nov	11	56	0	177	0	0	26
6-Nov	20	71	0	127	1	0	36
7-Nov	14	48	0	90	1	0	46
8-Nov	8	39	0	62	0	1	33
9-Nov	13	30	0	45	1	0	25
10-Nov	13	14	0	29	0	0	38
11-Nov	12	16	0	30	0	0	105
12-Nov	8	8	0	36	0	0	81
13-Nov	22	17	0	23	0	0	122
14-Nov	5	21	0	15	0	0	81
15-Nov[2]	4	8	0	10	0	0	22
Totals	**15054**	**145104**	**581121**	**47587**	**2452**	**81**	**4051**

[1:] Chinook counted from March 22 through June 19, 2014 were recorded as spring Chinook. All Chinook counted after June 19, 2014 are recorded as summer Chinook.

2 Annual adult fish counting was completed on November 15, 2014

Table C2: Year to date adult fish counts of Chinook, steelhead, sockeye, coho, lamprey, and bull trout passed Rock Island Dam through November 15, 2014.

Chinook	145,104
Steelhead	15,054
Sockeye	581,121
Coho	47,587
Lamprey	2,,452
Bull Trout	81

Appendix D – Adult Ladder Denil Extension Operations Log

Table D1: Operations log for the left and right adult ladder denil extensions installed at Rock Island Dam from June 14 through December 23, 2014.

	Left Adult Ladder Denil		Right Adult Ladder Denils	
Date	**Time Denil Operation Started**	**Time Denil Operation Ended**	**Time Denil Operation Started**	**Time Denil Operation Ended**
6/14/14			1:30 AM	9:30 AM
			4:00 PM	12:00 AM
6/15/14			6:00 AM	10:30 AM
6/16/14	6:45 AM	10:30 AM	2:30 AM	10:00 AM
7/8/14	2:30 AM	5:00 AM	3:30 AM	4:00 AM
7/9/14	12:50 AM	3:15 AM	12:30 AM	3:00 AM
7/13/14	2:30 AM	5:30 AM	2:15 AM	5:00 AM
7/14/14	5:15 AM	8:30 AM	5:30 AM	8:15 AM
7/18/14			6:30 AM	7:00 AM
7/19/14	2:30 AM	8:30 AM	3:45 AM	5:45 AM
	10:15 PM	11:30 PM		
7/20/14	3:00 AM	11:45 AM	3:50 AM	7:30 AM
			11:00 AM	11:20 AM
7/21/14	12:00 AM	10:00 AM	1:00 AM	2:30 AM
			3:15 AM	7:00 AM
7/22/14	12:30 AM	9:00 AM	12:30 AM	7:45 AM
7/27/14	4:50 AM	7:45 AM	4:30 AM	7:15 AM
7/28/14	5:00 AM	8:00 AM	4:45 AM	6:45 AM
7/29/14	3:20 AM	5:10 AM	11:45 PM	10:00 AM (7/30)
	11: 15 PM	10:15 AM (7/30)		
7/30/14	11:30 PM	5:00 AM (7/31)	11:30 PM	5:30 AM (7/31)
8/1/14	4:30 AM	10:00 AM	2:00 AM	9:15 AM
8/2/14	3:00 AM	12:30 PM	2:30 AM	10:00 AM
			10:20 AM	11:15 AM
			11:15 PM	12:00 PM (8/3)
8/3/14	12:00 AM	12:30 PM	9:00 PM	12:20 PM (8/4)
	9:00 PM	12:50 PM (8/4)		
8/4/14	9:30 PM	12:15 PM (8/5)	7:30 PM	12:00 PM (8/5)
8/5/14	9:15 PM	12:15 AM (8/6)	8:55 PM	12:00 AM
8/6/14	2:30 AM	7:15 AM	2:00 AM	7:00 AM
	11:30 PM	8:30 AM (8/7)		
8/7/14			12:00 AM	1:30 AM
			5:00 AM	11:00 AM

	Left Adult Ladder Denil		Right Adult Ladder Denils	
Date	**Time Denil Operation Started**	**Time Denil Operation Ended**	**Time Denil Operation Started**	**Time Denil Operation Ended**
8/8/14	2:15 AM	2:15 PM	2:30 AM	7:30 AM
8/9/14	3:15 AM	1:30 PM		
8/10/14	12:15 AM	4:15 PM	2:15 PM	4:00 PM
8/11/14	12:15 PM	1:45 PM	6:45 AM	1:45 PM
8/12/14	1:15 AM	1:30 PM	2:15 AM	11:15 AM
8/13/14	1:00 AM	3:00 PM	12:45 AM	2:00 PM
	10:15 PM	12:00 AM	10:00 PM	12:00 AM
8/14/14	5:00 AM	12:30 PM	4:45 AM	12:15 PM
8/15/14	2:15 AM	12:15 PM (8/18)	3:00 AM	7:00 PM
			8:00 PM	5:30 PM (8/16)
8/16/14			6:45 PM	11:15 (8/18)
8/18/14	11:30 PM	9:30 AM (8/19)	11:00 PM	9:00 AM (8/19)
8/19/14	11:30 PM	1:00 PM (8/20)	11:15 PM	12:45 PM (8/20)
8/20/14	7:15 PM	9:30 PM (8/25)		
8/21/14			8:15 PM	11:00 AM (8/22)
8/22/14			10:45 PM	12:00 PM (8/23)
8/24/14			1:15 AM	9:15 PM
8/25/14			12:15 AM	4:00 PM
8/26/14	12:45 AM	3:00 AM	2:45 AM	12:30 PM
	11:00 PM	6:05 AM (12/1)		
8/27/14			1:00 AM	10:20 AM (12/1)[1]
12/1/14	9:40 PM	6:15 AM (12/2)		
12/2/14	11:00 PM	3:00 AM (12/3)		
12/10/14	1:45 AM	4:45 AM		
12/11/14	3:00 AM	6:30 AM		
12/12/14	2:00 AM	6:30 AM		
12/13/14	2:30 AM	5:45 AM		
	3:00 PM	4:00 PM		
12/14/14	2:15 AM	4:30 AM		
12/15/14	2:00 AM	6:00 AM		
12/16/14	12:30 AM	3:00 AM		
12/17/14	1:15 AM	3:00 AM		
12/21/14	12:15 AM	2:30 AM		
	5:30 AM	8:30 AM		
	2:00 PM	3:00 PM		
12/22/14	2:00 AM	6:15 AM		
12/23/14	1:15 AM	4:00 AM		

[1] The right adult ladder at Rock Island was taken out of operation for annual maintenance on December 1, 2014.

Appendix E – Rock Island Hourly Flow and Elevation Log

Table E1: Rock Island hourly flow and elevation data from August 1 through December 23, 2014.

Date and Time (Hour Ending)	Powerhouse 1 Flows (kcfs)	Powerhouse 2 Flows (kcfs)	Spill (kcfs)	Headwater Elevation (ft)	Tailwater Elevation (ft)
8/1/2014 1:00	16.6	88.1	29.1	612.8	565.1
8/1/2014 2:00	15	79.9	23.6	612.8	563.4
8/1/2014 3:00	15.7	87.7	19.2	612.8	563.4
8/1/2014 4:00	15.5	84.5	19.2	612.8	563.3
8/1/2014 5:00	15	79.1	19.1	612.8	562.6
8/1/2014 6:00	15	79	19.1	612.8	562.4
8/1/2014 7:00	14.5	75.1	19.1	612.7	562
8/1/2014 8:00	14.7	76.8	18.6	612.3	562
8/1/2014 9:00	14.9	78.8	19	612.7	562.2
8/1/2014 10:00	16.4	93.8	19.5	612.8	563.7
8/1/2014 11:00	16.4	95.6	23.9	612.8	564.6
8/1/2014 12:00	15.8	88.5	28.8	612.8	564.7
8/1/2014 13:00	16.4	86.5	29	612.8	564.6
8/1/2014 14:00	22.4	83.9	31.3	612.8	564.8
8/1/2014 15:00	32.3	113	31.2	612.8	567.6
8/1/2014 16:00	33	119.4	27.9	612.8	568.6
8/1/2014 17:00	31.5	103.2	27.5	612.8	567.5
8/1/2014 18:00	30.4	90.8	29	612.8	566.4
8/1/2014 19:00	31	93	28.9	612.8	566.3
8/1/2014 20:00	31.1	88.4	28.9	612.8	566
8/1/2014 21:00	31.2	88.6	28.9	612.8	565.9
8/1/2014 22:00	31.7	94	28.9	612.8	566.3
8/1/2014 23:00	31.1	88.1	28.9	612.8	566
8/2/2014 0:00	25.4	80.1	28.9	612.8	564.8
8/2/2014 1:00	17.2	81.6	28.7	612.8	564.2
8/2/2014 2:00	15.1	79.3	23.7	612.8	563.2
8/2/2014 3:00	14.8	75.7	18.8	612.6	562.3
8/2/2014 4:00	13.3	66.5	18.6	612.5	561
8/2/2014 5:00	13.1	66.6	18.5	612.3	560.7
8/2/2014 6:00	13.3	68	18.6	612	560.8
8/2/2014 7:00	13.2	66.7	18.4	611.9	560.7
8/2/2014 8:00	13.3	67.1	18.4	611.9	560.7
8/2/2014 9:00	13.8	72.4	18.7	612.2	561.2

8/2/2014 10:00	14.5	80	19.1	612.5	562.1
8/2/2014 11:00	14.3	77.7	24.1	612.6	562.5
8/2/2014 12:00	15	85.3	29.1	612.6	563.7
8/2/2014 13:00	15.6	92.3	29.3	612.8	564.6
8/2/2014 14:00	15.8	93.6	29.1	612.8	565
8/2/2014 15:00	16	96.2	29	612.8	565.3
8/2/2014 16:00	15.4	89.4	29	612.8	564.7
8/2/2014 17:00	16	95.7	29	612.8	565.1
8/2/2014 18:00	16.4	100.2	29	612.8	565.5
8/2/2014 19:00	16.6	102.2	29	612.8	565.8
8/2/2014 20:00	16.2	98.3	29	612.8	565.6
8/2/2014 21:00	14.9	84.8	29	612.8	564.5
8/2/2014 22:00	14	75.8	28.9	612.7	563.3
8/2/2014 23:00	13.7	72.1	28.3	612.3	562.6
8/3/2014 0:00	13.6	71.1	28.1	612.2	562.3
8/3/2014 1:00	13.5	69.6	28.4	612.1	562.2
8/3/2014 2:00	13.5	70.5	23.7	611.8	561.8
8/3/2014 3:00	8.9	66.8	19.2	612	560.8
8/3/2014 4:00	7.7	66.9	19.2	611.9	560.4
8/3/2014 5:00	8.3	66.6	19.1	611.9	560.4
8/3/2014 6:00	8.2	66.7	19.1	611.8	560.4
8/3/2014 7:00	8.2	66.6	19	611.8	560.4
8/3/2014 8:00	8.2	66.4	19	611.7	560.3
8/3/2014 9:00	8.3	67.4	18.9	611.8	560.4
8/3/2014 10:00	8.4	66.9	19.1	611.8	560.4
8/3/2014 11:00	8.2	65.9	24.2	612	560.6
8/3/2014 12:00	8.8	77.8	29.2	612.6	562.1
8/3/2014 13:00	10.7	100.8	29.6	612.8	564.6
8/3/2014 14:00	11.7	111.5	29.6	612.8	566.1
8/3/2014 15:00	11.1	105.3	29.6	612.8	566
8/3/2014 16:00	9.9	94.1	29.5	612.8	564.9
8/3/2014 17:00	9.4	88.8	28.8	612.8	564.2
8/3/2014 18:00	8.9	82	28.8	612.8	563.3
8/3/2014 19:00	9.1	84.8	28.8	612.8	563.4
8/3/2014 20:00	8.8	81.9	28.8	612.8	563.3
8/3/2014 21:00	8.1	74.8	28.8	612.8	562.5
8/3/2014 22:00	8.2	75.4	28.8	612.8	562.2
8/3/2014 23:00	8.2	75.1	28.8	612.8	562.4
8/4/2014 0:00	7.6	69.3	29.1	612.8	561.6
8/4/2014 1:00	7	63.4	31	612.7	561.1
8/4/2014 2:00	7.3	67.1	25.7	612.6	561
8/4/2014 3:00	7.8	71.9	20.2	612.4	561
8/4/2014 4:00	7.6	70.1	20	612.2	560.7

8/4/2014 5:00	7.7	70.2	19.8	612.1	560.7
8/4/2014 6:00	7.7	70.7	20.2	611.9	560.8
8/4/2014 7:00	7.8	70.9	20	611.7	560.8
8/4/2014 8:00	7.8	70.4	19.8	611.6	560.8
8/4/2014 9:00	7.4	68.2	19.7	611.6	560.5
8/4/2014 10:00	7.4	68.6	19.8	611.5	560.5
8/4/2014 11:00	7.5	68.9	26.1	611.6	560.9
8/4/2014 12:00	8.1	74.1	31.5	612.3	561.8
8/4/2014 13:00	11.3	107.8	31.6	612.8	565.1
8/4/2014 14:00	23.9	114.9	31.2	612.8	565
8/4/2014 15:00	24.9	102.1	31.2	612.8	567
8/4/2014 16:00	23.8	90.7	31.2	612.8	565.9
8/4/2014 17:00	23.6	87.3	31.2	612.8	565.4
8/4/2014 18:00	23.8	89.4	31.1	612.8	565.5
8/4/2014 19:00	23.5	86.3	31.1	612.8	565.2
8/4/2014 20:00	20	83	31.1	612.8	564.8
8/4/2014 21:00	14.1	70.7	31.1	612.8	563.1
8/4/2014 22:00	14	69.8	31.1	612.8	562.3
8/4/2014 23:00	14.4	73.5	31.1	612.7	562.8
8/5/2014 0:00	8.6	73.6	31	612.7	562.4
8/5/2014 1:00	7	64.4	30.7	612.6	561.3
8/5/2014 2:00	8.3	76.3	25.2	612.6	561.9
8/5/2014 3:00	8.4	77.8	20.3	612.5	561.8
8/5/2014 4:00	8.3	76.6	20.2	612.4	561.6
8/5/2014 5:00	8.3	76.3	20.1	612.3	561.5
8/5/2014 6:00	8.3	76.8	20	612.1	561.6
8/5/2014 7:00	7.6	69.6	19.8	612	560.9
8/5/2014 8:00	11.3	67.5	19.7	611.9	560.7
8/5/2014 9:00	13.4	67	19.9	612.1	560.8
8/5/2014 10:00	13.6	68.2	20.3	612.2	560.9
8/5/2014 11:00	13.8	71.2	25.6	612.4	561.9
8/5/2014 12:00	14.3	76.6	31.2	612.8	562.9
8/5/2014 13:00	16	97	30.9	612.8	565.2
8/5/2014 14:00	16.8	105.7	31	612.8	566.1
8/5/2014 15:00	18.4	116.7	31	612.8	567.4
8/5/2014 16:00	18.6	108.2	31	612.8	567.1
8/5/2014 17:00	18.1	102.3	31.9	612.8	566.6
8/5/2014 18:00	15.3	80.1	32	612.8	564.6
8/5/2014 19:00	19.8	84	31.5	612.7	564.2
8/5/2014 20:00	28.9	78.4	31.4	612.7	565.1
8/5/2014 21:00	16.7	65.2	31.6	612.8	563
8/5/2014 22:00	13.5	65.4	31.2	612.8	561.9
8/5/2014 23:00	13.5	65.1	31	612.8	561.7

8/6/2014 0:00	14.7	77.2	31.1	612.8	562.6
8/6/2014 1:00	16.1	93.8	30.4	612.8	564.9
8/6/2014 2:00	14.8	79.5	25	612.8	563.6
8/6/2014 3:00	14.2	72.1	19.7	612.8	561.9
8/6/2014 4:00	14	69.4	19.6	612.6	561.2
8/6/2014 5:00	14	69.9	20	612.6	561.2
8/6/2014 6:00	14.3	72.5	20.1	612.8	561.5
8/6/2014 7:00	15.6	85.9	20	612.8	562.8
8/6/2014 8:00	16.4	95.8	19.9	612.8	564.1
8/6/2014 9:00	16.2	104.9	19.9	612.8	565.2
8/6/2014 10:00	11.4	89.1	19.9	612.8	563.8
8/6/2014 11:00	14.1	71.6	25.4	612.8	562.3
8/6/2014 12:00	14.1	71.4	30.6	612.8	562.6
8/6/2014 13:00	16	91.7	30.6	612.8	564.4
8/6/2014 14:00	17.6	110.1	30.6	612.8	566.3
8/6/2014 15:00	18.4	119.2	30.6	612.8	567.4
8/6/2014 16:00	18.4	119.6	30.6	612.8	567.7
8/6/2014 17:00	17.9	114	30.6	612.8	567.4
8/6/2014 18:00	17.2	106.2	30.6	612.8	566.7
8/6/2014 19:00	17.3	106.1	30.6	612.8	566.5
8/6/2014 20:00	16.8	102.1	30.6	612.8	566.2
8/6/2014 21:00	16.3	95.9	30.6	612.8	565.6
8/6/2014 22:00	15.8	91.2	30.6	612.8	565.1
8/6/2014 23:00	14.7	78.2	30.6	612.8	563.9
8/7/2014 0:00	13.6	66.9	30.5	612.8	562.4
8/7/2014 1:00	13.8	68.7	28.6	612.8	561.9
8/7/2014 2:00	15.9	89.1	23.1	612.8	563.6
8/7/2014 3:00	15.7	88	19	612.8	563.5
8/7/2014 4:00	15.5	85.9	19	612.8	563.5
8/7/2014 5:00	14.5	75.1	18.9	612.8	562.2
8/7/2014 6:00	14.3	73	18.9	612.7	561.7
8/7/2014 7:00	14.5	74.3	18.8	612.8	561.6
8/7/2014 8:00	15.5	85.2	18.7	612.8	562.6
8/7/2014 9:00	17.4	107.3	18.7	612.8	565.1
8/7/2014 10:00	17.6	108.9	18.7	612.8	565.6
8/7/2014 11:00	16.9	102.4	22.8	612.8	565.6
8/7/2014 12:00	15	81.8	28.7	612.8	564.3
8/7/2014 13:00	18.8	85.7	28.8	612.8	564.5
8/7/2014 14:00	31.5	99.2	28.7	612.8	566.6
8/7/2014 15:00	31.4	101.3	28.7	612.7	567.2
8/7/2014 16:00	31.5	101.5	28.7	612.8	567.3
8/7/2014 17:00	31.4	100.4	28.7	612.8	567.3
8/7/2014 18:00	31	94.6	28.8	612.8	566.8

8/7/2014 19:00	26.3	94.9	29.8	612.8	566.4
8/7/2014 20:00	22.7	83.8	29.1	612.8	565.2
8/7/2014 21:00	22.6	82	28.6	612.8	564.6
8/7/2014 22:00	23	87	28.6	612.8	564.9
8/7/2014 23:00	21.8	72.7	28.6	612.8	563.7
8/8/2014 0:00	23.4	90.8	28.6	612.8	565.1
8/8/2014 1:00	20.8	70.4	27.6	612.8	563.4
8/8/2014 2:00	14.8	77.6	22.5	612.8	562.7
8/8/2014 3:00	14.5	74.7	18.2	612.8	561.9
8/8/2014 4:00	14.2	71.9	18.1	612.8	561.4
8/8/2014 5:00	14.3	72.8	18	612.7	561.4
8/8/2014 6:00	14.3	72.8	17.9	612.7	561.4
8/8/2014 7:00	14.8	78.3	17.8	612.5	561.9
8/8/2014 8:00	11.2	78.5	17.7	612.4	562
8/8/2014 9:00	8.5	78.4	17.5	612.2	561.7
8/8/2014 10:00	8.2	76.1	17.3	612	561.3
8/8/2014 11:00	7.9	72.8	21.4	611.8	561.3
8/8/2014 12:00	7.5	68.2	27.6	611.8	553.8
8/8/2014 13:00	7.4	67.8	27.7	612	561.2
8/8/2014 14:00	10.6	76.8	27.8	612.4	562.1
8/8/2014 15:00	28.7	93	28.2	612.8	565.2
8/8/2014 16:00	32.3	107	28.2	612.8	567.2
8/8/2014 17:00	32	99.1	28.2	612.8	567.1
8/8/2014 18:00	30.5	81.3	28.3	612.8	565.5
8/8/2014 19:00	29.4	73.9	28.3	612.8	564.3
8/8/2014 20:00	27.5	82.2	28.3	612.8	564.7
8/8/2014 21:00	20.4	95.6	28.3	612.8	565.4
8/8/2014 22:00	20.4	95.2	28.2	612.8	565.4
8/8/2014 23:00	20.3	95	28.2	612.8	565.5
8/9/2014 0:00	20.3	95	28.1	612.8	565.5
8/9/2014 1:00	20	85.6	28.1	612.8	564.8
8/9/2014 2:00	19.8	78.5	23.2	612.8	563.5
8/9/2014 3:00	19.2	72.2	18.3	612.8	562.3
8/9/2014 4:00	19.1	72.1	18.1	612.7	561.8
8/9/2014 5:00	19.1	71.7	18	612.6	561.8
8/9/2014 6:00	19.1	72.3	17.9	612.5	561.8
8/9/2014 7:00	10.8	78.1	17.8	612.4	561.8
8/9/2014 8:00	4.4	82.1	17.7	612.3	561.7
8/9/2014 9:00	4.4	82.5	17.5	612.2	561.6
8/9/2014 10:00	4.3	81.6	17.7	612.2	561.6
8/9/2014 11:00	4.2	79.1	23.1	612.3	561.7
8/9/2014 12:00	7.1	77.2	27.8	612.4	562.1
8/9/2014 13:00	8.6	78.7	28	612.8	562.4

8/9/2014 14:00	10	94.5	27.6	612.8	564
8/9/2014 15:00	10.5	99.3	27.4	612.8	564.7
8/9/2014 16:00	11.6	108.2	27.4	612.8	565.6
8/9/2014 17:00	19	112.2	27.4	612.8	566.6
8/9/2014 18:00	18.1	103.1	27.4	612.8	566.1
8/9/2014 19:00	15.1	107.5	27.4	612.8	566.1
8/9/2014 20:00	12.8	105.6	27.4	612.8	565.9
8/9/2014 21:00	12.7	104.2	27.4	612.8	565.7
8/9/2014 22:00	12.5	104.3	27.4	612.8	565.6
8/9/2014 23:00	11.9	96.6	27.3	612.8	565.1
8/10/2014 0:00	12.8	79.1	27.3	612.8	563.5
8/10/2014 1:00	14.1	71.4	23.8	612.7	562.2
8/10/2014 2:00	14	73.4	20	612.7	561.7
8/10/2014 3:00	13	73.7	19.7	612.6	561.6
8/10/2014 4:00	12.9	73.3	19.6	612.6	561.5
8/10/2014 5:00	13	73.5	19.6	612.6	561.6
8/10/2014 6:00	13	73.4	19.5	612.5	561.5
8/10/2014 7:00	14.2	74.5	15.7	612.3	561.5
8/10/2014 8:00	14.3	73.2	14.7	611.9	561.2
8/10/2014 9:00	14.3	72.8	14.7	612	561.1
8/10/2014 10:00	14.2	72.1	15	612.1	561
8/10/2014 11:00	14.2	71.8	19.7	612	561.4
8/10/2014 12:00	14	70	21	612	561.3
8/10/2014 13:00	13.7	68	24	612	561.4
8/10/2014 14:00	13.5	66	24	612	561.2
8/10/2014 15:00	9.7	69.1	24.1	612	561.2
8/10/2014 16:00	8	74.2	24.1	612.2	561.5
8/10/2014 17:00	20.9	89.3	24.7	612.8	563.6
8/10/2014 18:00	31	115.1	24.9	612.8	567.1
8/10/2014 19:00	33.2	119.5	24.9	612.8	568.2
8/10/2014 20:00	32.3	109.1	24.9	612.8	567.8
8/10/2014 21:00	30.7	91.2	24.8	612.8	566.1
8/10/2014 22:00	30	82.1	24.8	612.8	564.9
8/10/2014 23:00	28.9	69	24.8	612.8	563.6
8/11/2014 0:00	28.7	65.3	24.9	612.8	562.7
8/11/2014 1:00	28.3	65.1	25.1	612.8	562.6
8/11/2014 2:00	8.4	77.7	19.9	612.8	561.9
8/11/2014 3:00	8.7	79.4	16	612.9	561.5
8/11/2014 4:00	8.9	82.3	15.9	612.8	561.7
8/11/2014 5:00	8.9	82.9	15.9	612.7	561.9
8/11/2014 6:00	9	83	15.8	612.7	561.9
8/11/2014 7:00	8.8	81.1	15.7	612.6	561.7
8/11/2014 8:00	8.8	81.6	15.7	612.6	561.7

8/11/2014 9:00	8.8	81.1	15.6	612.5	561.6
8/11/2014 10:00	8.8	80.6	15.7	612.5	561.6
8/11/2014 11:00	8.6	79	20.7	612.4	561.8
8/11/2014 12:00	4.8	78.2	24.5	612.4	561.8
8/11/2014 13:00	10.9	92.4	25.8	612.8	563.4
8/11/2014 14:00	30	103.7	24.9	612.8	565.9
8/11/2014 15:00	44	108	24.8	612.7	567.9
8/11/2014 16:00	45.3	103.3	24.9	612.8	568
8/11/2014 17:00	44.3	92.7	25	612.8	567.2
8/11/2014 18:00	40.3	80.5	25.1	612.8	565.9
8/11/2014 19:00	30.7	85.5	25.1	612.8	565.3
8/11/2014 20:00	29.8	74.3	25	612.8	564.2
8/11/2014 21:00	30	76.7	24.9	612.8	564.2
8/11/2014 22:00	30.6	83.7	24.9	612.8	564.6
8/11/2014 23:00	30.1	78.3	25	612.8	564.6
8/12/2014 0:00	29.2	72.2	25	612.8	563.6
8/12/2014 1:00	28.7	66.9	24.8	612.8	563.2
8/12/2014 2:00	28.1	61	20.6	612.7	561.8
8/12/2014 3:00	26.7	65	17.2	612.6	561.6
8/12/2014 4:00	22.5	67.5	16.9	612.3	561.5
8/12/2014 5:00	12.3	71.8	16.6	612	561.1
8/12/2014 6:00	8.2	74.4	16.4	611.9	560.9
8/12/2014 7:00	7.6	79.1	16.8	612.2	561.3
8/12/2014 8:00	4.3	79.2	17	612.5	561.4
8/12/2014 9:00	4.2	77.9	19	612.7	561.4
8/12/2014 10:00	4.5	83.9	15.9	612.6	561.6
8/12/2014 11:00	4.4	79.3	20.9	612.6	561.6
8/12/2014 12:00	4	72.3	25.2	612.5	561.2
8/12/2014 13:00	9.5	88.5	25.3	612.8	562.9
8/12/2014 14:00	17.3	94.5	25.1	612.8	564.4
8/12/2014 15:00	17.8	100.3	25.2	612.8	565.3
8/12/2014 16:00	17.1	93.1	25.2	612.8	564.9
8/12/2014 17:00	16.3	83.8	25.2	612.8	563.8
8/12/2014 18:00	16.1	81.8	25	612.8	563.5
8/12/2014 19:00	15.5	74.2	25	612.7	562.7
8/12/2014 20:00	16.9	89	25.1	612.8	563.6
8/12/2014 21:00	18	101	25.1	612.8	565.3
8/12/2014 22:00	19.1	113.3	25.1	612.8	566.6
8/12/2014 23:00	17.7	98.4	25.1	612.8	565.6
8/13/2014 0:00	16.8	88.6	25.1	612.8	564.6
8/13/2014 1:00	10.8	75.4	24.3	612.7	562.7
8/13/2014 2:00	8.2	74.7	19.7	612.4	561.5
8/13/2014 3:00	8.3	75.9	15.1	612.2	561

8/13/2014 4:00	8.4	76.5	14.7	612	561
8/13/2014 5:00	8.5	77.3	14.3	611.6	561
8/13/2014 6:00	8.5	78.1	13.9	611.2	561.1
8/13/2014 7:00	8.1	75	13.4	610.8	560.8
8/13/2014 8:00	7.3	66.3	12.8	610.4	559.6
8/13/2014 9:00	7.2	64.8	12.4	610.2	559.1
8/13/2014 10:00	7.4	67.9	12.8	610.4	559.4
8/13/2014 11:00	7.5	65.3	20.6	610.5	559.9
8/13/2014 12:00	8.7	72.9	24.5	610.3	560.7
8/13/2014 13:00	6.8	54.7	26	611.1	559.5
8/13/2014 14:00	8.5	73.7	27.5	612	560.4
8/13/2014 15:00	10.5	100	27.9	612.2	563.2
8/13/2014 16:00	11.5	114.4	28	612.3	565.9
8/13/2014 17:00	10.8	104.7	25.2	612.8	565.2
8/13/2014 18:00	10.8	104	25.3	612.8	565.1
8/13/2014 19:00	9.1	85.7	24.8	612.7	563.3
8/13/2014 20:00	8.6	82.1	24.3	612.4	562.3
8/13/2014 21:00	8.3	79.2	23.9	612.1	561.9
8/13/2014 22:00	8	76.1	23.9	612.2	561.4
8/13/2014 23:00	7.9	75.1	24.2	612.4	561.2
8/14/2014 0:00	8	75.9	24.5	612.5	561.2
8/14/2014 1:00	10.5	84.9	33.4	612.7	563.3
8/14/2014 2:00	10.8	76.8	45.2	612.6	564
8/14/2014 3:00	10.1	85.3	22.7	612.1	562.9
8/14/2014 4:00	10	87	18.5	611.5	562.5
8/14/2014 5:00	7.6	71.2	18.2	611.4	560.8
8/14/2014 6:00	7.2	69	18.1	611.4	559.7
8/14/2014 7:00	8.9	86.9	17.6	611.1	561.3
8/14/2014 8:00	9	86.4	16.9	610.5	562
8/14/2014 9:00	8.3	79.9	16.9	610.3	561.3
8/14/2014 10:00	6.7	57.6	17.4	610.7	558.8
8/14/2014 11:00	6.8	57.8	22.2	611	558.5
8/14/2014 12:00	6.1	58.8	26.6	611.4	558.7
8/14/2014 13:00	26.9	89.5	26	610.8	563.6
8/14/2014 14:00	28.7	61.1	27.4	611.7	562.5
8/14/2014 15:00	28.9	74.2	27	612.3	563.5
8/14/2014 16:00	15.3	73.7	27.8	612.8	562.3
8/14/2014 17:00	16.6	87.2	26.6	612.8	563.4
8/14/2014 18:00	16.3	84.2	26.6	612.8	563.3
8/14/2014 19:00	16.4	84.6	26.6	612.8	563.4
8/14/2014 20:00	13.1	73.6	26.6	612.8	562.1
8/14/2014 21:00	9.3	89.9	26.5	612.8	563
8/14/2014 22:00	8.5	80.6	26.5	612.8	562.2

8/14/2014 23:00	9	86.9	26.5	612.8	562.6
8/15/2014 0:00	8.9	85	26.4	612.8	562.7
8/15/2014 1:00	8.3	79.2	25.4	612.8	561.9
8/15/2014 2:00	8.5	81.4	20.9	612.8	561.8
8/15/2014 3:00	8	76.2	15.5	612.6	560.8
8/15/2014 4:00	7.9	75.4	15.3	612.3	560.3
8/15/2014 5:00	7.9	74.6	15	612.2	560.1
8/15/2014 6:00	7.9	75.4	14.6	611.8	560.2
8/15/2014 7:00	7.9	75	13.3	611.1	560.1
8/15/2014 8:00	8.4	77.6	6.6	610.9	559.8
8/15/2014 9:00	9.2	76.1	14.8	610.2	561.7
8/15/2014 10:00	8.3	48.1	31.7	610.5	559.2
8/15/2014 11:00	0	53.3	32.2	610.8	557.9
8/15/2014 12:00	0	60.9	32.6	611.3	558.5
8/15/2014 13:00	0	61	32.8	611.6	558.8
8/15/2014 14:00	0	67.5	33.4	612.1	559.5
8/15/2014 15:00	0	72.4	33.5	612.2	560.5
8/15/2014 16:00	0	73.1	33.4	612	560.7
8/15/2014 17:00	0	72.4	33.6	612.2	560.6
8/15/2014 18:00	0	73	33.9	612.5	560.7
8/15/2014 19:00	7.9	89.8	31.5	612.9	562.6
8/15/2014 20:00	9.8	92.6	27	612.8	564
8/15/2014 21:00	9.7	92.1	25.4	612.8	563.6
8/15/2014 22:00	8.4	79.9	25.2	612.8	562.3
8/15/2014 23:00	7.7	73.4	25.1	612.7	561.3
8/16/2014 0:00	7.6	72.7	25	612.6	560.9
8/16/2014 1:00	7.7	73	24.7	612.3	560.9
8/16/2014 2:00	7.7	73.2	20.8	612.1	560.6
8/16/2014 3:00	7.7	72.6	14.8	612	560
8/16/2014 4:00	7.8	73.8	14.8	611.9	559.9
8/16/2014 5:00	7.7	72.3	14.8	611.8	559.7
8/16/2014 6:00	2.3	74	14.8	611.9	559.6
8/16/2014 7:00	0	70.4	14.8	611.9	558.9
8/16/2014 8:00	0	69.7	14.7	611.8	558.6
8/16/2014 9:00	0	77.5	14.8	611.9	559.4
8/16/2014 10:00	0	77.3	16.4	612.2	559.7
8/16/2014 11:00	0	90.4	23.6	611.9	561.8
8/16/2014 12:00	0	79.2	24.9	611.9	561.5
8/16/2014 13:00	0	75.5	25	611.9	560.9
8/16/2014 14:00	0	75	25	611.8	560.8
8/16/2014 15:00	0	74.3	24.9	611.8	560.7
8/16/2014 16:00	0	72.8	24.8	611.8	560.5
8/16/2014 17:00	0	73.2	25	611.9	560.4

8/16/2014 18:00	0	83.5	25.4	612.2	561.5
8/16/2014 19:00	0	74.8	25.3	612.1	560.9
8/16/2014 20:00	0	73.2	25.3	612	560.6
8/16/2014 21:00	0	70.6	25.3	612.1	560.3
8/16/2014 22:00	0	69.4	25.3	612.2	560.1
8/16/2014 23:00	0	70.1	25.3	612.2	560.1
8/17/2014 0:00	0	69.7	25.2	612.2	560.1
8/17/2014 1:00	0	73.8	21.5	612.1	560.1
8/17/2014 2:00	0	71.8	18.3	612	559.5
8/17/2014 3:00	0	74.8	14.7	611.8	559.3
8/17/2014 4:00	0	74.5	14.4	611.6	559.3
8/17/2014 5:00	0	74.4	14.2	611.4	559.2
8/17/2014 6:00	0	67.2	12.2	611.5	558.5
8/17/2014 7:00	0	67.6	11.8	611.2	558.1
8/17/2014 8:00	0	67.8	11.4	611	558.1
8/17/2014 9:00	0	63.8	11.3	610.9	557.7
8/17/2014 10:00	0	63.9	11.3	610.8	557.5
8/17/2014 11:00	0	64.2	16.9	610.9	558.1
8/17/2014 12:00	0	65.4	20.5	611	558.8
8/17/2014 13:00	0	65.3	21.2	611	559.1
8/17/2014 14:00	0	65.1	21.3	611	559.1
8/17/2014 15:00	0	69	21.5	611.3	559.6
8/17/2014 16:00	0	69.4	21.9	611.6	559.7
8/17/2014 17:00	0	76.7	22.3	612	560.5
8/17/2014 18:00	0	76.4	22.8	612.3	560.7
8/17/2014 19:00	0	74.9	22.1	612.5	560.5
8/17/2014 20:00	0	69.6	21.8	612.3	559.9
8/17/2014 21:00	0	68.4	21.6	612	559.6
8/17/2014 22:00	0	67.5	21.3	611.8	559.4
8/17/2014 23:00	0	67.4	21	611.6	559.3
8/18/2014 0:00	0	66.7	21	611.5	559.2
8/18/2014 1:00	0	68	26.3	611.4	559.9
8/18/2014 2:00	0	68.8	21.8	612	559.7
8/18/2014 3:00	0	73.3	17	612.2	559.5
8/18/2014 4:00	0	73.6	16.8	611.9	559.5
8/18/2014 5:00	0	74.1	16.5	611.7	559.6
8/18/2014 6:00	0	69.3	16.3	611.5	559.1
8/18/2014 7:00	0	67.8	16	611.3	558.7
8/18/2014 8:00	0	68.3	15.9	611.2	558.7
8/18/2014 9:00	0	69.6	17.7	611.2	559
8/18/2014 10:00	0.2	67.6	21.5	611.7	559.4
8/18/2014 11:00	0	67.9	29	612.3	560.1
8/18/2014 12:00	6.2	69.4	47.1	612.8	562.1

8/18/2014 13:00	44	70.7	30.5	612.8	564.8
8/18/2014 14:00	44.9	65.1	36.7	612.8	565.3
8/18/2014 15:00	45.5	69.5	44.7	612.8	566.3
8/18/2014 16:00	45.6	71	40.3	612.8	566.4
8/18/2014 17:00	45	93.1	35.2	612.7	567.5
8/18/2014 18:00	43.9	103.3	26.7	612.7	568.1
8/18/2014 19:00	44.4	101.8	26.6	612.8	568
8/18/2014 20:00	43.9	93.9	26.7	612.8	567.6
8/18/2014 21:00	41.9	72	26.6	612.8	565.7
8/18/2014 22:00	37.4	66.7	26.6	612.8	564.4
8/18/2014 23:00	20	69.8	26.6	612.8	563.1
8/19/2014 0:00	17	73.3	26.1	612.4	562.3
8/19/2014 1:00	17.7	79.7	26.4	612.6	563.1
8/19/2014 2:00	5.4	74.4	21.6	612.5	561.6
8/19/2014 3:00	0	71	18.5	612.3	559.8
8/19/2014 4:00	0	70.7	18.2	612	559.4
8/19/2014 5:00	0	69.2	17.9	611.8	559.1
8/19/2014 6:00	0	38	34.8	611.3	557.8
8/19/2014 7:00	0	0	44.1	611.1	555.1
8/19/2014 8:00	0	0	47.1	611.7	554.8
8/19/2014 9:00	0.9	22	127.9	611.5	560.2
8/19/2014 10:00	21.5	70.9	29.3	611.2	564.1
8/19/2014 11:00	26.7	66.5	30.5	612.7	562.8
8/19/2014 12:00	37.9	68.7	32.9	612.7	564.3
8/19/2014 13:00	43.8	71	29.7	612.7	565
8/19/2014 14:00	41.3	85	29.8	612.7	566
8/19/2014 15:00	42	93.8	29.2	612.7	566.9
8/19/2014 16:00	42.3	96.5	28.4	612.8	567.3
8/19/2014 17:00	47.4	84.3	27.6	612.8	566.8
8/19/2014 18:00	47.3	81.5	27.1	612.8	566.5
8/19/2014 19:00	47.3	81.8	27.1	612.8	566.4
8/19/2014 20:00	46.7	74.8	27.1	612.8	565.7
8/19/2014 21:00	46.5	72.6	27.1	612.8	565.6
8/19/2014 22:00	27.1	79.3	27.1	612.8	564.7
8/19/2014 23:00	6.8	79.3	27.1	612.8	563
8/20/2014 0:00	0	67.3	26.5	612.7	560.5
8/20/2014 1:00	0	69.5	25.6	612.5	560.3
8/20/2014 2:00	0	70.2	21.9	612.1	559.9
8/20/2014 3:00	0	70.7	17.7	612.3	559.4
8/20/2014 4:00	0	63.4	16.9	611.9	558.5
8/20/2014 5:00	0	62.8	16.1	610.8	558
8/20/2014 6:00	0	59.9	15.2	610	557.4
8/20/2014 7:00	0	55.9	14.6	609.3	556.7

8/20/2014 8:00	0	55.9	14.6	609.3	556.5
8/20/2014 9:00	0	66.5	15.1	609.9	557.7
8/20/2014 10:00	0	67.3	15.8	610.7	558.3
8/20/2014 11:00	0	67.2	20.7	611.4	558.8
8/20/2014 12:00	0	67.9	26.7	612.2	559.6
8/20/2014 13:00	2	81.1	26.7	612.8	561
8/20/2014 14:00	15.1	99.8	27	612.8	564.2
8/20/2014 15:00	24.2	102.9	26.9	612.8	565.9
8/20/2014 16:00	23.7	97.1	26.9	612.8	565.8
8/20/2014 17:00	23.5	95.6	26.3	612.8	565.6
8/20/2014 18:00	22.4	82.2	26.3	612.8	564.4
8/20/2014 19:00	12.7	79.7	26.4	612.8	563.1
8/20/2014 20:00	8	75.7	26.5	612.8	562
8/20/2014 21:00	8.3	78.1	26.4	612.8	561.9
8/20/2014 22:00	9.2	88.7	26.4	612.8	562.9
8/20/2014 23:00	9.6	92.5	26.3	612.8	563.6
8/21/2014 0:00	8.9	84.1	26.2	612.7	563
8/21/2014 1:00	1.9	71.8	24.8	612.7	561.2
8/21/2014 2:00	0	64.9	20.6	612.5	559.2
8/21/2014 3:00	0	69.9	16.1	612.1	558.8
8/21/2014 4:00	0	74.2	16	612.1	559.3
8/21/2014 5:00	0	71.6	16	612	559.2
8/21/2014 6:00	0	70.6	15.6	611.7	559
8/21/2014 7:00	0	70.4	15.1	611.2	558.9
8/21/2014 8:00	0	67	14.5	610.6	558.5
8/21/2014 9:00	0	66.1	14.5	610.7	558.2
8/21/2014 10:00	0.1	70.8	16.6	611.1	558.8
8/21/2014 11:00	0.1	74.6	21.1	611.5	559.9
8/21/2014 12:00	0.2	78.4	24.4	611.8	560.7
8/21/2014 13:00	3.7	79.9	25.1	611.9	561.5
8/21/2014 14:00	4.7	84.5	24.9	611.6	562.2
8/21/2014 15:00	4.7	81	25.1	611.8	562.1
8/21/2014 16:00	4.5	76	28.2	612.2	561.5
8/21/2014 17:00	4.7	79.4	27.2	612.5	562
8/21/2014 18:00	8.7	79.3	26.5	612.7	562.1
8/21/2014 19:00	10.2	86.2	26.8	612.8	562.9
8/21/2014 20:00	8.8	71.7	26.7	612.8	561.8
8/21/2014 21:00	7.9	65.3	26.6	612.7	560.7
8/21/2014 22:00	7.8	64.4	26.3	612.5	560.2
8/21/2014 23:00	8	65.5	25.9	612.2	560.2
8/22/2014 0:00	7.9	64.8	26	612.3	560.1
8/22/2014 1:00	8.1	66.9	25	612.7	560.2
8/22/2014 2:00	8.2	67.9	19.8	612.5	559.9

8/22/2014 3:00	8.5	70.4	17.1	612.3	559.8
8/22/2014 4:00	8.6	72.4	16.7	612	560.1
8/22/2014 5:00	1	69.4	16.5	611.9	559.2
8/22/2014 6:00	0	70.3	16.3	611.8	558.9
8/22/2014 7:00	0	70.2	16.1	611.7	558.8
8/22/2014 8:00	0	72.3	15.9	611.5	559.1
8/22/2014 9:00	0	77.8	16	611.7	559.6
8/22/2014 10:00	0	78.4	16.1	611.7	559.8
8/22/2014 11:00	0	79.1	20.8	612	560.3
8/22/2014 12:00	0	78.3	25.4	612	560.9
8/22/2014 13:00	0	78.7	25.1	611.7	561
8/22/2014 14:00	0.1	80.8	24.9	611.6	561.1
8/22/2014 15:00	8	84.2	24.9	611.6	562.1
8/22/2014 16:00	9.1	86.9	25.4	612.1	562.8
8/22/2014 17:00	9.5	91	26	612.5	563.3
8/22/2014 18:00	9.9	95.2	26.2	612.6	563.9
8/22/2014 19:00	9.3	88	25.9	612.3	563.5
8/22/2014 20:00	8.8	83.5	25.7	612.1	562.8
8/22/2014 21:00	8.4	79.5	25.6	612.2	562.2
8/22/2014 22:00	8.3	78.2	25.7	612.1	561.9
8/22/2014 23:00	7.8	74	25.5	612.1	561.5
8/23/2014 0:00	7.6	71	25.3	612	560.9
8/23/2014 1:00	7.5	72.5	23.2	612.4	560.7
8/23/2014 2:00	9.4	91.4	18.9	612.8	562.2
8/23/2014 3:00	9.2	87.7	16.4	612.8	562.2
8/23/2014 4:00	8.3	77.9	15.1	612.7	561
8/23/2014 5:00	1.7	77.5	14.7	612.3	560.1
8/23/2014 6:00	0	75.7	14.1	611.7	559.6
8/23/2014 7:00	0	70	13.6	611.4	558.8
8/23/2014 8:00	0	67.4	13.3	611.2	558.2
8/23/2014 9:00	0	69.4	13.5	611.4	558.3
8/23/2014 10:00	0	72.1	13.9	611.7	558.7
8/23/2014 11:00	0	74.6	19.2	612.1	559.4
8/23/2014 12:00	0	78.3	22.2	612.7	560.2
8/23/2014 13:00	0	88	22.5	612.8	561.5
8/23/2014 14:00	0	81.5	22.5	612.8	561.2
8/23/2014 15:00	0	87.1	22.4	612.8	561.5
8/23/2014 16:00	0	91.5	22.3	612.8	562.1
8/23/2014 17:00	0	96.1	22.3	612.7	562.5
8/23/2014 18:00	0	94.5	22.3	612.7	562.6
8/23/2014 19:00	0	101.8	22.4	612.8	563.2
8/23/2014 20:00	0	95.2	22.4	612.8	562.8
8/23/2014 21:00	0	95.6	22.4	612.8	562.7

8/23/2014 22:00	0	97.8	22.4	612.8	562.8
8/23/2014 23:00	0	100.6	22.4	612.8	563.1
8/24/2014 0:00	0	93.9	22.4	612.8	562.7
8/24/2014 1:00	0	82.4	20.2	612.8	561.3
8/24/2014 2:00	0	76.3	16.8	612.3	560.2
8/24/2014 3:00	0	65.4	14.8	611.7	558.6
8/24/2014 4:00	0	42.7	32.9	610.7	557.6
8/24/2014 5:00	0	31.2	32.5	610.2	556.7
8/24/2014 6:00	0	0	32.3	611.1	554.5
8/24/2014 7:00	0	0	64.6	611.8	554.9
8/24/2014 8:00	3.9	0	96.9	611.3	557.8
8/24/2014 9:00	11	37.7	51.7	611	560
8/24/2014 10:00	10.7	61.2	13.8	611.2	559
8/24/2014 11:00	10.6	58.4	16.8	610.8	558.6
8/24/2014 12:00	10.1	55.4	20.2	610.5	558.4
8/24/2014 13:00	5.4	56.4	19.9	610.1	558
8/24/2014 14:00	5.4	55.8	20.4	609.8	557.8
8/24/2014 15:00	5.4	58.4	20.6	610.1	558.1
8/24/2014 16:00	5.4	63.1	20.9	610.7	558.7
8/24/2014 17:00	5.4	68.8	21.1	611.4	559.6
8/24/2014 18:00	9.8	67.7	21	611.8	559.9
8/24/2014 19:00	10.7	66	21.6	612.2	560
8/24/2014 20:00	10.7	69.1	21.8	612.3	560.3
8/24/2014 21:00	10.7	69.6	22.3	612.7	560.5
8/24/2014 22:00	10.8	78.6	22.6	612.8	561.4
8/24/2014 23:00	12.2	86.4	22.5	612.8	562.5
8/25/2014 0:00	12.1	72.2	22.3	612.7	561.5
8/25/2014 1:00	11.8	75.6	9.5	612.1	560.3
8/25/2014 2:00	11	76.4	6.3	611	559.9
8/25/2014 3:00	0	43.1	5.9	610.4	557
8/25/2014 4:00	0.1	0	19.3	611.7	554.4
8/25/2014 5:00	0.1	0	76.1	612.2	555
8/25/2014 6:00	0.1	0	108.1	612	558
8/25/2014 7:00	9	25.4	74.9	611.8	560.6
8/25/2014 8:00	0.8	84.1	4.4	612.2	559.8
8/25/2014 9:00	0	85.2	0.4	612.2	558.9
8/25/2014 10:00	0	86.2	0	611.7	558.7
8/25/2014 11:00	0	86.4	0	611.2	558.7
8/25/2014 12:00	0	85.2	0	610.3	558.6
8/25/2014 13:00	0	83.6	0	610.2	558.3
8/25/2014 14:00	0	84.5	0	610.5	558.4
8/25/2014 15:00	0	91.2	0	611.4	559
8/25/2014 16:00	4.2	99.4	6.7	612	560.4

8/25/2014 17:00	31.9	98.5	0.3	611.8	563.2
8/25/2014 18:00	32	95.8	0	612.1	563.2
8/25/2014 19:00	32.1	97	0	612.1	563.4
8/25/2014 20:00	32.1	97.1	0	612.1	563.4
8/25/2014 21:00	32.1	98.5	0	611.8	563.5
8/25/2014 22:00	32.1	97.1	0	612.2	563.4
8/25/2014 23:00	32.3	99.9	0	612.2	563.7
8/26/2014 0:00	32.3	100.7	0	611.9	563.9
8/26/2014 1:00	31.1	87.5	0	611.5	562.9
8/26/2014 2:00	30.2	80.3	0	610.8	561.6
8/26/2014 3:00	15.2	81.6	0	609.6	560.3
8/26/2014 4:00	15	81.1	0	609.6	559.6
8/26/2014 5:00	15.6	87.5	0	609.7	560.4
8/26/2014 6:00	15.6	87.2	0	609.7	560.5
8/26/2014 7:00	6.9	82.8	0	609.8	559.6
8/26/2014 8:00	0	77.7	0	610.2	558
8/26/2014 9:00	0	77.5	0	610.2	557.6
8/26/2014 10:00	0	78.4	0	610.3	557.6
8/26/2014 11:00	0.9	86.4	0	610.6	558.5
8/26/2014 12:00	9.6	89.8	0	611.1	559.6
8/26/2014 13:00	11.2	105.3	0	611.5	561.7
8/26/2014 14:00	23	95.1	0	612.1	562
8/26/2014 15:00	32.2	101	0	612.5	563.3
8/26/2014 16:00	43.9	111	0	612.3	565.5
8/26/2014 17:00	44	109.7	0	612.4	565.9
8/26/2014 18:00	43.7	106.2	0	612.7	565.6
8/26/2014 19:00	44.7	103.5	0	612.8	565.5
8/26/2014 20:00	44.1	96.4	0	612.8	564.9
8/26/2014 21:00	44.2	97	0	612.8	564.8
8/26/2014 22:00	43.2	86	0	612.7	563.8
8/26/2014 23:00	35.3	83.3	0	612.7	562.9
8/27/2014 0:00	33.5	94.4	0	612	562.7
8/27/2014 1:00	28.3	80.6	0	611.9	561.8
8/27/2014 2:00	19.9	86.7	0	611.6	561.1
8/27/2014 3:00	9.7	84	0	611.8	559.9
8/27/2014 4:00	9.3	86.4	0	611.9	559.8
8/27/2014 5:00	9.3	86.6	0	611.8	559.9
8/27/2014 6:00	9.4	87.8	0	611.8	559.9
8/27/2014 7:00	0.1	90.9	0	611.3	559.7
8/27/2014 8:00	0.1	91.2	0	610.9	559.5
8/27/2014 9:00	11	89.2	1.1	611.2	559.9
8/27/2014 10:00	43.7	107.3	0	610.7	564.5
8/27/2014 11:00	43.9	100.3	0	610.4	565.3

8/27/2014 12:00	41.9	78	0	610.8	562.9
8/27/2014 13:00	43.1	90.7	0	611.2	563.2
8/27/2014 14:00	45	110.7	0	610.9	565.7
8/27/2014 15:00	45	111.9	0	610.9	566.1
8/27/2014 16:00	45	111	0	611	566.1
8/27/2014 17:00	45	111.4	0	610.9	566.1
8/27/2014 18:00	44.3	105.1	0	610.6	565.7
8/27/2014 19:00	42.1	81.3	0	610.8	563.7
8/27/2014 20:00	31	70.7	0	611.6	560.9
8/27/2014 21:00	32.2	76.4	0	611.9	560.9
8/27/2014 22:00	32.4	87.6	0	612.2	561.8
8/27/2014 23:00	33.1	94.2	0	612.5	563.1
8/28/2014 0:00	32.6	83	0	612.4	562.2
8/28/2014 1:00	27.6	80.8	0	611.9	561.4
8/28/2014 2:00	10.9	84.3	0	611.7	560.1
8/28/2014 3:00	3.5	79.7	0	611.2	558.7
8/28/2014 4:00	0	76.8	0	610.9	557.6
8/28/2014 5:00	0	75.7	0	610.7	557.4
8/28/2014 6:00	0	76.3	0	610.4	557.4
8/28/2014 7:00	0	77.5	0	610.2	557.4
8/28/2014 8:00	1.6	83.9	0	610.5	558.3
8/28/2014 9:00	12.1	91	0	610.6	559.8
8/28/2014 10:00	23.2	100.6	0	610.7	562.2
8/28/2014 11:00	23.1	104.8	0	610.8	563.1
8/28/2014 12:00	23.2	105.3	0	610.8	560.2
8/28/2014 13:00	23.9	112.6	0	610.7	561
8/28/2014 14:00	24	113.5	0	610.9	563
8/28/2014 15:00	24	112.4	0	611.1	562.5
8/28/2014 16:00	26.6	109.3	0	611.2	564.2
8/28/2014 17:00	41.9	104.8	0	611.2	565
8/28/2014 18:00	47.4	103	0	611.2	565.5
8/28/2014 19:00	48.8	90.4	0	611.7	564.8
8/28/2014 20:00	49	85.1	0	612.3	563.9
8/28/2014 21:00	50.4	95	0	612	564.9
8/28/2014 22:00	50.3	84.2	0	612.1	564.2
8/28/2014 23:00	50.3	80.9	0	612.1	563.7
8/29/2014 0:00	43.1	74.5	0	611.3	562.6
8/29/2014 1:00	15.2	77.1	0	611.1	560
8/29/2014 2:00	10.4	75.5	0	610.8	558.7
8/29/2014 3:00	11.1	73	0	610.5	558.2
8/29/2014 4:00	11	70.6	0	610.3	557.9
8/29/2014 5:00	11.1	71.2	0	610	557.9
8/29/2014 6:00	11.2	71.3	0	609.9	557.9

8/29/2014 7:00	11.2	71.7	0	609.7	558
8/29/2014 8:00	11.2	66.5	0	609.6	557.5
8/29/2014 9:00	11.2	70.1	0	609.7	557.6
8/29/2014 10:00	11.2	73.1	0	609.9	558
8/29/2014 11:00	11.2	73.9	0	609.9	558.2
8/29/2014 12:00	10.8	75	0	610	558.3
8/29/2014 13:00	9.8	77	0	610.1	558.5
8/29/2014 14:00	11.7	77.2	0	610.5	558.6
8/29/2014 15:00	11.8	83.4	0	610.8	559.3
8/29/2014 16:00	11.9	85.8	0	610.9	559.8
8/29/2014 17:00	11.9	88	0	611.6	560
8/29/2014 18:00	11.8	94.8	2	612.4	560.8
8/29/2014 19:00	30.3	92.9	4.2	612.2	562.8
8/29/2014 20:00	31.2	92.3	0	612.2	562.6
8/29/2014 21:00	31.6	97.8	0	612.1	563.3
8/29/2014 22:00	30.8	86.3	0	612.2	562.4
8/29/2014 23:00	12	79	0	612	559.9
8/30/2014 0:00	8.6	78.4	0	611.6	558.9
8/30/2014 1:00	0	78.6	0	611.6	557.9
8/30/2014 2:00	0	78.9	0	611.5	557.8
8/30/2014 3:00	0	79.2	0	611.5	557.7
8/30/2014 4:00	0	79	0	611.4	557.8
8/30/2014 5:00	0	78.7	0	611.4	557.7
8/30/2014 6:00	0	79.9	0	611.4	557.8
8/30/2014 7:00	0	80.9	0	611.3	557.9
8/30/2014 8:00	0	81.8	0	611.2	558.1
8/30/2014 9:00	0	81	0	611.1	558
8/30/2014 10:00	0	84.7	0	611.4	558.3
8/30/2014 11:00	0	91.1	0	611.8	559.1
8/30/2014 12:00	15.3	91.9	11.1	611.6	561.2
8/30/2014 13:00	33.6	85.1	0	611.7	562
8/30/2014 14:00	33.5	73.1	0	611.2	560.9
8/30/2014 15:00	18.8	77.9	0	610.7	559.9
8/30/2014 16:00	13	83.5	0	610.7	559.7
8/30/2014 17:00	11.9	82.9	0	610.9	559.5
8/30/2014 18:00	11.8	86.4	0	611.2	559.8
8/30/2014 19:00	24.6	86.6	0	611.3	560.9
8/30/2014 20:00	32.9	78.4	0	611.8	561.2
8/30/2014 21:00	32.9	84.1	0	612.3	561.7
8/30/2014 22:00	30.1	85.2	0	612.3	562
8/30/2014 23:00	6.1	86.7	0	612.3	560.1
8/31/2014 0:00	0	81.8	0	612.1	558.5
8/31/2014 1:00	0	81.6	4.6	611.9	558.5

8/31/2014 2:00	0	85.1	5.8	611.2	559.4
8/31/2014 3:00	0	83.1	0	610.9	558.5
8/31/2014 4:00	0	77.1	0	610.8	557.6
8/31/2014 5:00	0	79.3	0	610.6	557.8
8/31/2014 6:00	0	77.9	0	610.7	557.6
8/31/2014 7:00	0	77.8	0	610.7	557.7
8/31/2014 8:00	0	78.3	0	610.6	557.7
8/31/2014 9:00	0	78	0	610.6	557.7
8/31/2014 10:00	0	77.8	0	610.7	557.6
8/31/2014 11:00	0	78.8	0	610.6	557.7
8/31/2014 12:00	0	78.3	0	610.6	557.7
8/31/2014 13:00	0	78.3	0	610.6	557.7
8/31/2014 14:00	0	77.7	0	610.6	557.6
8/31/2014 15:00	0	78.3	0	610.6	557.6
8/31/2014 16:00	0	81	0	610.7	557.8
8/31/2014 17:00	0	95.1	0	611.3	559.5
8/31/2014 18:00	5.3	98	3.2	612	560.6
8/31/2014 19:00	23.9	93.9	1.7	612.4	562
8/31/2014 20:00	25.4	94.3	0	612.3	562.4
8/31/2014 21:00	16	83.8	0	612.2	560.8
8/31/2014 22:00	11.7	86.2	0	612.1	559.9
8/31/2014 23:00	26.8	92.1	0	611.5	561.6
9/1/2014 0:00	32.4	78.2	0	611.4	561.4
9/1/2014 1:00	12.2	80.6	0	611.8	559.9
9/1/2014 2:00	0	79.1	0	611.6	558.1
9/1/2014 3:00	0	73.9	6.3	611	557.8
9/1/2014 4:00	0	70.6	2.7	610.4	557
9/1/2014 5:00	0	72.7	0.2	610.5	557
9/1/2014 6:00	0	76.4	0	610.6	557.3
9/1/2014 7:00	0	78	0	610.6	557.6
9/1/2014 8:00	0	78.2	0	610.6	557.6
9/1/2014 9:00	0	78.2	0	610.6	557.6
9/1/2014 10:00	0	78.8	0	610.5	557.7
9/1/2014 11:00	0	79.3	0	610.5	557.8
9/1/2014 12:00	0	78.7	0	610.5	557.8
9/1/2014 13:00	0	77.1	0	610.5	557.7
9/1/2014 14:00	0	77.1	0	610.5	557.6
9/1/2014 15:00	0	77.4	0	610.5	557.6
9/1/2014 16:00	0	77.1	0	610.6	557.6
9/1/2014 17:00	0	77.4	0	610.6	557.7
9/1/2014 18:00	0	76.8	0	610.6	557.6
9/1/2014 19:00	0	75	0	610.7	557.4
9/1/2014 20:00	0	76	0	610.7	557.3

9/1/2014 21:00	0	76.6	0	610.7	557.5
9/1/2014 22:00	0	77.1	0	611	557.5
9/1/2014 23:00	0	78.9	0	611.2	557.7
9/2/2014 0:00	0	78.5	0	611.1	557.7
9/2/2014 1:00	0	79	0	611.1	557.8
9/2/2014 2:00	0	79	0	611.1	557.8
9/2/2014 3:00	0	57	22.9	611	557.6
9/2/2014 4:00	0	51	29.1	611	557.5
9/2/2014 5:00	0	51.2	29	610.9	557.6
9/2/2014 6:00	0	51.8	29.2	610.9	557.6
9/2/2014 7:00	10.7	69.8	18.2	610.4	559.2
9/2/2014 8:00	32.2	65	0.3	610.6	559.8
9/2/2014 9:00	32.1	62.2	0	610.5	559.3
9/2/2014 10:00	31.8	62.9	0	610.3	559.2
9/2/2014 11:00	31.8	63.2	0	610.2	559.3
9/2/2014 12:00	31.8	62.8	0	610.1	559.2
9/2/2014 13:00	31.8	59.6	0	610	558.8
9/2/2014 14:00	31.8	60.8	0	609.9	558.9
9/2/2014 15:00	30.2	59.4	0	610	558.7
9/2/2014 16:00	8	68.1	0	610.2	557.7
9/2/2014 17:00	0	70.1	0	610.4	556.9
9/2/2014 18:00	0	71	0	610.5	556.8
9/2/2014 19:00	0	17.6	44.4	610.9	554.6
9/2/2014 20:00	0	0	73	610.9	555.3
9/2/2014 21:00	0	0	73.6	611.1	555.4
9/2/2014 22:00	0	0	84.9	612.2	556
9/2/2014 23:00	0	8.9	115.6	611.9	560
9/3/2014 0:00	0	39	70.2	612.3	560.9
9/3/2014 1:00	0	44.8	56.6	611.9	560.3
9/3/2014 2:00	0	42.6	49.6	611.5	559
9/3/2014 3:00	0	0.5	69	611.1	555.7
9/3/2014 4:00	0	0	44.1	610.7	552.3
9/3/2014 5:00	0	0	41.9	610.4	550.9
9/3/2014 6:00	0	0	41.8	610.2	550.7
9/3/2014 7:00	0	0	41.7	610.3	550.7
9/3/2014 8:00	0	0	41.8	610.3	550.7
9/3/2014 9:00	0.8	1.1	96.2	610.2	555.5
9/3/2014 10:00	5.3	60	19.9	610.4	558.4
9/3/2014 11:00	5.3	72.6	9.7	610.6	558.7
9/3/2014 12:00	5.4	72.2	10.1	610.8	558.8
9/3/2014 13:00	5.4	72.8	9.1	610.6	558.7
9/3/2014 14:00	5.4	73	7.8	610.4	558.6
9/3/2014 15:00	9.2	71.6	2.1	610.3	558.2

9/3/2014 16:00	11.5	70.5	0	610.2	557.9
9/3/2014 17:00	5.2	74.6	0	610.1	557.8
9/3/2014 18:00	0	75.4	0	610.2	557.4
9/3/2014 19:00	0	74.9	0	610.3	557.2
9/3/2014 20:00	0	77.2	0	610.3	557.4
9/3/2014 21:00	0	76.6	0	610.4	557.4
9/3/2014 22:00	0	76	0	610.4	557.3
9/3/2014 23:00	0	80.7	0	610.7	557.8
9/4/2014 0:00	0	81.2	0	611	558
9/4/2014 1:00	0	80.2	0.6	610.9	558
9/4/2014 2:00	0	69.9	10.2	610.8	557.7
9/4/2014 3:00	0	70.3	9.3	610.6	557.7
9/4/2014 4:00	0	70.7	8	610.5	557.6
9/4/2014 5:00	0	59	23.5	610.1	557.9
9/4/2014 6:00	0	59	21.3	609.8	557.8
9/4/2014 7:00	9.7	47.6	20.2	609.6	557.2
9/4/2014 8:00	11.1	46.2	19.8	609.3	557
9/4/2014 9:00	11.1	61.9	3.3	609.2	557
9/4/2014 10:00	11.1	67	0	609.4	557.2
9/4/2014 11:00	11.1	67.2	0	609.5	557.3
9/4/2014 12:00	11.1	68.8	0	609.6	557.5
9/4/2014 13:00	11.1	68.8	0	609.7	557.6
9/4/2014 14:00	11.1	71.2	0	609.8	557.8
9/4/2014 15:00	11.1	69.3	0	609.9	557.7
9/4/2014 16:00	4.9	72.8	0	609.9	557.6
9/4/2014 17:00	0	74.9	0	610	557.3
9/4/2014 18:00	0	75.6	0	610.3	557.3
9/4/2014 19:00	0	77	0	610.4	557.4
9/4/2014 20:00	0	77.3	0	610.4	557.4
9/4/2014 21:00	0	76.9	0	610.4	557.5
9/4/2014 22:00	0	76.6	0	610.4	557.4
9/4/2014 23:00	0	77.2	0	610.3	557.5
9/5/2014 0:00	0	77.2	0	610.2	557.5
9/5/2014 1:00	0	76.7	0	610	557.5
9/5/2014 2:00	0	73.9	0	610.1	557.1
9/5/2014 3:00	0	73.9	0	610.2	557.1
9/5/2014 4:00	0	58.7	20.9	610	557.2
9/5/2014 5:00	0	15.4	40.2	610	554.3
9/5/2014 6:00	0	0	35.3	610.4	550.1
9/5/2014 7:00	0	0	38.6	610.4	549.7
9/5/2014 8:00	0	0	40.4	610.7	549.9
9/5/2014 9:00	0	0	39.6	610.8	549.7
9/5/2014 10:00	0	0	40.3	611	549.6

9/5/2014 11:00	0	0	46.1	611.1	550.2
9/5/2014 12:00	0	0	50.2	611.3	550.8
9/5/2014 13:00	0	0	54.4	611.5	551.6
9/5/2014 14:00	0	8.5	83.3	611.3	555.3
9/5/2014 15:00	0	83.3	13.3	611.3	559.9
9/5/2014 16:00	0	81.6	0	611.4	558.4
9/5/2014 17:00	0	79.8	0	611.3	557.9
9/5/2014 18:00	0	80.5	0	611.2	557.9
9/5/2014 19:00	0	79.9	0	610.7	557.9
9/5/2014 20:00	0	81.5	0	610.6	558
9/5/2014 21:00	0	81.6	0	610.9	558
9/5/2014 22:00	0	82.5	0	610.7	558.2
9/5/2014 23:00	0	78.3	0	610	557.8
9/6/2014 0:00	0	72.9	2.1	609.6	557.2
9/6/2014 1:00	0	28	26.1	609.3	554.6
9/6/2014 2:00	0	0	41.1	609.4	551.3
9/6/2014 3:00	0	0	43.5	609.5	551.4
9/6/2014 4:00	0	0	43.6	609.5	551.5
9/6/2014 5:00	0	0	43.5	609.3	551.6
9/6/2014 6:00	0	0	43.5	609.4	551.6
9/6/2014 7:00	0	0	43.5	609.4	551.6
9/6/2014 8:00	0	0	43.6	609.5	551.6
9/6/2014 9:00	0	0	43.6	609.5	551.5
9/6/2014 10:00	0	0	43.7	609.5	551.5
9/6/2014 11:00	0	0	43.7	609.5	551.5
9/6/2014 12:00	0	0	43.8	609.6	551.5
9/6/2014 13:00	0	0	44.3	610	551.5
9/6/2014 14:00	0	0	57.3	610.9	552.2
9/6/2014 15:00	0	55.9	38.1	611	558.3
9/6/2014 16:00	0	87.7	0	611.6	558.9
9/6/2014 17:00	0	80.3	0	611.5	558.1
9/6/2014 18:00	0	83.6	0	611.7	558.4
9/6/2014 19:00	0	84.2	0	611.5	558.5
9/6/2014 20:00	0	85.2	0	611.3	558.6
9/6/2014 21:00	0	83.4	1.5	611.1	558.6
9/6/2014 22:00	0	37.4	44.9	611	557.6
9/6/2014 23:00	0	0.1	49.5	611.6	553
9/7/2014 0:00	0	0	43.6	611.3	550.7
9/7/2014 1:00	0	0	43.3	611.1	550.3
9/7/2014 2:00	0	0	43.2	610.9	550.2
9/7/2014 3:00	0	0	43	610.7	550.2
9/7/2014 4:00	0	0	42.7	610.5	550.1
9/7/2014 5:00	0	0	42.5	610.2	550.1

9/7/2014 6:00	0	0	42.2	610	550.1
9/7/2014 7:00	0	0	42.1	609.9	550.1
9/7/2014 8:00	0	0	42.1	609.9	550.1
9/7/2014 9:00	0	0	42.1	609.9	550.1
9/7/2014 10:00	0	0	42.2	610	550.1
9/7/2014 11:00	0	0	42.2	610	550.2
9/7/2014 12:00	0	0	42.3	610.1	550.2
9/7/2014 13:00	0	0	42.4	610.2	550.2
9/7/2014 14:00	0	0	42.4	610.3	550.1
9/7/2014 15:00	0	0	42.5	610.4	550.1
9/7/2014 16:00	0	0	50.5	610.6	550.7
9/7/2014 17:00	0	62.5	31.9	610.2	557.9
9/7/2014 18:00	0	76.5	0	610.9	557.7
9/7/2014 19:00	0	78.3	0	611	557.7
9/7/2014 20:00	0	55.4	27.9	610.9	557.7
9/7/2014 21:00	0	11	51.5	611.2	555.1
9/7/2014 22:00	0	0	43.5	611.7	551.5
9/7/2014 23:00	0	0	43.1	611.4	550.9
9/8/2014 0:00	0	0	43.2	611.5	550.9
9/8/2014 1:00	0	0	43.2	611.4	550.9
9/8/2014 2:00	0	0	43.1	611.3	550.9
9/8/2014 3:00	0	0	43.1	611.4	550.8
9/8/2014 4:00	0	0	43	611.1	550.8
9/8/2014 5:00	0	0	42.8	610.7	550.8
9/8/2014 6:00	0	0	42.8	610.4	550.7
9/8/2014 7:00	0	0	42.9	610.2	550.7
9/8/2014 8:00	0	0	42.8	610.1	550.7
9/8/2014 9:00	0	0	43.1	609.9	550.6
9/8/2014 10:00	0	0	71.3	609.7	553.4
9/8/2014 11:00	1.2	63.7	33.4	608.9	559
9/8/2014 12:00	0	74.2	0	609.9	557.4
9/8/2014 13:00	0	74.8	0	610.2	557.2
9/8/2014 14:00	0	73.9	0	610.2	557.1
9/8/2014 15:00	0	65.8	4.9	609.7	556.5
9/8/2014 16:00	0	69.3	2.3	609.9	556.6
9/8/2014 17:00	0	71.6	0	610.2	556.7
9/8/2014 18:00	0	74.6	0	610.5	557.1
9/8/2014 19:00	0	73.4	1.4	610.7	557.2
9/8/2014 20:00	0	37.1	41.8	610.8	557
9/8/2014 21:00	0	0.2	43.3	610.8	552.7
9/8/2014 22:00	0	0	42.7	610.5	551.2
9/8/2014 23:00	0	0	43.1	610.6	550.7
9/9/2014 0:00	0	0	43.1	610.5	550.6

9/9/2014 1:00	0	0	43.1	610.5	550.6
9/9/2014 2:00	0	0	43.1	610.5	550.7
9/9/2014 3:00	0	0	43.1	610.5	550.6
9/9/2014 4:00	0	0	43.1	610.5	550.6
9/9/2014 5:00	0	0	43	610.5	550.6
9/9/2014 6:00	0	0	43	610.4	550.6
9/9/2014 7:00	0	0	43	610.4	550.7
9/9/2014 8:00	0	0	43	610.4	550.7
9/9/2014 9:00	0	0	44.4	610.5	550.8
9/9/2014 10:00	0	12.8	61.5	609.9	553.8
9/9/2014 11:00	0	60.6	17.1	609.6	557.3
9/9/2014 12:00	0	67.4	0	609.3	556.3
9/9/2014 13:00	0	68.8	0	609.3	556.2
9/9/2014 14:00	0	69.5	0	609.6	556.4
9/9/2014 15:00	0	70.7	0	609.8	556.6
9/9/2014 16:00	0	71.8	0	610	556.8
9/9/2014 17:00	0	72.5	0	610.1	557
9/9/2014 18:00	0	59.2	12.2	610.1	556.7
9/9/2014 19:00	0	0	62.1	610.2	554.4
9/9/2014 20:00	0	0	45	610	552.1
9/9/2014 21:00	0	0	43.4	609.9	550.9
9/9/2014 22:00	0	0	43.4	609.9	550.8
9/9/2014 23:00	0	0	43.4	610	550.9
9/10/2014 0:00	0	0	43.4	610	550.9
9/10/2014 1:00	0	0	43.4	610	550.9
9/10/2014 2:00	0	0	43.4	610	550.9
9/10/2014 3:00	0	0	43.4	610	550.9
9/10/2014 4:00	0	0	43.4	610	551
9/10/2014 5:00	0	0	43.4	610	551
9/10/2014 6:00	0	0	43.4	610	550.9
9/10/2014 7:00	0	0	43.4	610	550.9
9/10/2014 8:00	0	0	43.5	610	550.9
9/10/2014 9:00	0	1.3	61.7	609.7	552.2
9/10/2014 10:00	1.9	65.8	7	609.6	556.9
9/10/2014 11:00	0	73.2	0	610.1	556.9
9/10/2014 12:00	0	71.5	0	610.2	556.7
9/10/2014 13:00	0	72.8	0	610.3	556.8
9/10/2014 14:00	0	74.7	0	610.4	557.1
9/10/2014 15:00	0	74.7	0	610.5	557.2
9/10/2014 16:00	0	43	42	610.3	557.5
9/10/2014 17:00	0	55.6	33.8	610.1	558.6
9/10/2014 18:00	0	80.9	0	610.3	558.4
9/10/2014 19:00	0	79.8	0	610.1	558

9/10/2014 20:00	0	79.3	0	610.1	557.9
9/10/2014 21:00	0	76.8	0	610.2	557.6
9/10/2014 22:00	0.1	55.4	11.2	610.1	556.3
9/10/2014 23:00	0.1	0	44	610	551.6
9/11/2014 0:00	0.1	0	44	610	550.7
9/11/2014 1:00	0.1	0	44	609.9	550.5
9/11/2014 2:00	0.1	0	44	609.9	550.6
9/11/2014 3:00	0	0	44	609.9	550.6
9/11/2014 4:00	0	0	44	609.9	550.6
9/11/2014 5:00	0	0	44	609.9	550.6
9/11/2014 6:00	0	0	44	609.9	550.6
9/11/2014 7:00	0	0	43.9	609.9	550.6
9/11/2014 8:00	0	0	43.9	609.9	550.6
9/11/2014 9:00	0	0	45	609.9	550.7
9/11/2014 10:00	0	3.4	74.7	610.3	554.2
9/11/2014 11:00	3.5	76.6	7.2	610.1	558.5
9/11/2014 12:00	2.6	81.4	0	610	558.2
9/11/2014 13:00	0	79.5	0	610	557.8
9/11/2014 14:00	0	79.1	0	610	557.6
9/11/2014 15:00	0	76.9	0	610	557.4
9/11/2014 16:00	0	78	0	610	557.5
9/11/2014 17:00	0	77.7	0	610.2	557.4
9/11/2014 18:00	2.6	81.8	0	610.3	558
9/11/2014 19:00	9.6	78.6	0	610.5	558.3
9/11/2014 20:00	15	86.2	0	610.5	559.8
9/11/2014 21:00	23.6	87.7	0	610.3	560.9
9/11/2014 22:00	12.8	71.3	0	610.4	558.8
9/11/2014 23:00	4.1	48.4	24.4	610.3	557.4
9/12/2014 0:00	0	0	42.3	610.3	552
9/12/2014 1:00	0	0	41.8	610.3	550.8
9/12/2014 2:00	0	0	42.9	610.2	550.7
9/12/2014 3:00	0	0	43.5	610.2	550.8
9/12/2014 4:00	0	0	32.1	610.2	549.7
9/12/2014 5:00	0	0	35	610	549.6
9/12/2014 6:00	0	0	37.2	610.3	549.7
9/12/2014 7:00	0	0	40.4	610.2	549.8
9/12/2014 8:00	0	0	41.8	610.2	549.9
9/12/2014 9:00	0	0	43.1	610.3	550.2
9/12/2014 10:00	0	0	42.9	610.3	550.2
9/12/2014 11:00	0	0	45.5	610.3	550
9/12/2014 12:00	0	0	43.9	610.2	550.1
9/12/2014 13:00	0	0	44	610.2	550.1
9/12/2014 14:00	0	0	45.8	610.2	550.2

9/12/2014 15:00	0	0	59.1	610.7	552.2
9/12/2014 16:00	0	0	43.8	611.7	550.7
9/12/2014 17:00	0	0	79.2	611.4	552.9
9/12/2014 18:00	0	48.4	59.6	610.5	559.9
9/12/2014 19:00	0	55.1	32	610.7	558.2
9/12/2014 20:00	0	59.1	21	610.4	557.5
9/12/2014 21:00	0	68.4	1.1	610.6	556.8
9/12/2014 22:00	0	0	54.6	610.4	555.1
9/12/2014 23:00	0	0	46.3	610.3	552.3
9/13/2014 0:00	0	0	43.8	610.1	551.5
9/13/2014 1:00	0	0	42.6	610	551.3
9/13/2014 2:00	0	0	41.1	610	550.9
9/13/2014 3:00	0	0	41.1	610	550.7
9/13/2014 4:00	0	0	41.1	610	550.7
9/13/2014 5:00	0	0	41	610	550.7
9/13/2014 6:00	0	0	41	610	550.8
9/13/2014 7:00	0	0	40.9	610	550.7
9/13/2014 8:00	0	0	40.6	610	550.6
9/13/2014 9:00	0	0	40.6	610	550.4
9/13/2014 10:00	0	0	40.7	610	550.3
9/13/2014 11:00	0	0	40.8	610.1	550.4
9/13/2014 12:00	0	0	40.8	610.1	550.3
9/13/2014 13:00	0	0	40.9	610.2	550.3
9/13/2014 14:00	0	0	41	610.2	550.3
9/13/2014 15:00	0	0	40.9	610.3	550.2
9/13/2014 16:00	0	0	44	610.3	549.7
9/13/2014 17:00	0	0	44.1	610.3	549.8
9/13/2014 18:00	0	0	44.4	610.3	549.7
9/13/2014 19:00	0	0	44.8	610.6	549.7
9/13/2014 20:00	0	0	47.5	610.9	550
9/13/2014 21:00	0	0	55.7	611	551.1
9/13/2014 22:00	0	0	55.5	610.9	551.6
9/13/2014 23:00	0	0	47.3	610.7	550.6
9/14/2014 0:00	0	0	47.4	610.7	550.2
9/14/2014 1:00	0	0	47.5	610.8	550.2
9/14/2014 2:00	0	0	47.5	610.8	550.2
9/14/2014 3:00	0	0	47.4	610.7	550.1
9/14/2014 4:00	0	0	47.3	610.6	550.2
9/14/2014 5:00	0	0	47.2	610.5	550.2
9/14/2014 6:00	0	0	47.1	610.4	550.2
9/14/2014 7:00	0	0	44.1	610.4	550
9/14/2014 8:00	0	0	43.1	610.2	549.8
9/14/2014 9:00	0	0	43.1	610.2	549.7

9/14/2014 10:00	0	0	43.1	609.9	549.7
9/14/2014 11:00	0	0	43.2	610.1	549.7
9/14/2014 12:00	0	0	43	610	549.7
9/14/2014 13:00	0	0	41.8	610.1	549.9
9/14/2014 14:00	0	0	43.6	610.3	550
9/14/2014 15:00	0	0	43.4	610.7	549.9
9/14/2014 16:00	0	0	43.2	610.7	549.9
9/14/2014 17:00	0	0	43.9	610.8	549.7
9/14/2014 18:00	0	0	49.5	611	550.2
9/14/2014 19:00	0	0	51.2	611.1	550.7
9/14/2014 20:00	0	0	51.3	611	550.8
9/14/2014 21:00	0	0	51.3	611.1	550.8
9/14/2014 22:00	0	0	53.8	611	551.1
9/14/2014 23:00	0	0	53.7	610.9	551.2
9/15/2014 0:00	0	0	53.5	610.8	551.3
9/15/2014 1:00	0	0	53.4	610.7	551.3
9/15/2014 2:00	0	0	48.2	610.6	550.9
9/15/2014 3:00	0	0	43.4	610.6	550
9/15/2014 4:00	0	0	43.5	610.6	549.9
9/15/2014 5:00	0	0	43.5	610.7	549.9
9/15/2014 6:00	0	0	43.5	610.7	549.9
9/15/2014 7:00	0	0	43.6	610.7	549.9
9/15/2014 8:00	0	0.1	58.8	610.5	551.4
9/15/2014 9:00	6.4	57.3	26.8	610.4	558.1
9/15/2014 10:00	9.8	68.7	2.7	610.4	557.9
9/15/2014 11:00	9.6	66.1	4.8	610.3	557.7
9/15/2014 12:00	9.4	65.5	6.5	610.2	557.6
9/15/2014 13:00	9.1	63.2	6.9	610.2	557.4
9/15/2014 14:00	8.9	61.7	10.2	610.1	557.5
9/15/2014 15:00	7.2	67.8	4.1	610	557.5
9/15/2014 16:00	0.1	77.5	0.4	610	557.6
9/15/2014 17:00	11.9	76.1	11.3	609.8	559.1
9/15/2014 18:00	31.5	81.5	0	609.8	560.8
9/15/2014 19:00	39.1	70.6	0	610.3	561
9/15/2014 20:00	22.8	79.2	0	610.9	560.4
9/15/2014 21:00	22.9	80.3	0	611.1	560.3
9/15/2014 22:00	11.9	83.4	0	610.8	559.8
9/15/2014 23:00	1.7	77	0	610.8	558.3
9/16/2014 0:00	0	75.8	0	610.9	557.4
9/16/2014 1:00	0	34.7	40.5	610.8	556.8
9/16/2014 2:00	0	0	44.1	610.7	553
9/16/2014 3:00	0	0	39.4	610.5	551.5
9/16/2014 4:00	0	0	37.6	610.5	551

9/16/2014 5:00	0	0	37.6	610.5	551
9/16/2014 6:00	0	0	37.6	610.5	550.9
9/16/2014 7:00	0	0	37.6	610.5	550.9
9/16/2014 8:00	0	0.4	49.6	610.3	551.7
9/16/2014 9:00	5.7	71.1	14.3	610.3	558.3
9/16/2014 10:00	9.2	74.4	0	610.4	558
9/16/2014 11:00	8.9	73.4	0	610.3	557.8
9/16/2014 12:00	9.1	74.4	0	610.3	557.9
9/16/2014 13:00	9	73	0	610.2	557.8
9/16/2014 14:00	9	72.7	0	610.1	557.7
9/16/2014 15:00	8.9	72.6	0	610.1	557.7
9/16/2014 16:00	10	69.6	0	610.1	557.4
9/16/2014 17:00	10.7	76.6	0	610	558.1
9/16/2014 18:00	10.9	77.5	0	610	558.7
9/16/2014 19:00	10.7	74.4	0	610.3	558.2
9/16/2014 20:00	11.7	75.6	0	610.5	558.4
9/16/2014 21:00	11.6	76.4	0	610.6	558.4
9/16/2014 22:00	11.7	77.6	0	610.5	558.7
9/16/2014 23:00	11.5	76.6	0	610.3	558.5
9/17/2014 0:00	2.6	58.6	12.7	610.3	557.4
9/17/2014 1:00	0	0	44.1	610.4	551.7
9/17/2014 2:00	0	0	42.6	610.3	550.5
9/17/2014 3:00	0	0	43	610.4	550.2
9/17/2014 4:00	0	0	43.1	610.4	550.3
9/17/2014 5:00	0	0	43.5	610.5	550.3
9/17/2014 6:00	0	0	43.6	610.5	550.4
9/17/2014 7:00	0	0	43.8	610.6	550.4
9/17/2014 8:00	0	3.7	62.3	610.3	552
9/17/2014 9:00	0	78.3	3.7	610.7	557.8
9/17/2014 10:00	0	77.6	0	610.8	557.6
9/17/2014 11:00	0	77.2	0	610.9	557.4
9/17/2014 12:00	0	79.3	0	610.9	557.6
9/17/2014 13:00	0	81.4	0	610.9	557.9
9/17/2014 14:00	0	81.2	0	610.8	557.9
9/17/2014 15:00	0	80.6	0	610.8	557.9
9/17/2014 16:00	0	81	0	610.7	557.9
9/17/2014 17:00	0	82.1	0	610.7	558
9/17/2014 18:00	15.8	82.2	0	610.3	559.1
9/17/2014 19:00	15.2	76.1	0	610.2	559.2
9/17/2014 20:00	2.1	80.7	0	610.3	558.3
9/17/2014 21:00	0	22.6	22.5	610.7	555.2
9/17/2014 22:00	0	0	46.5	610.3	552.7
9/17/2014 23:00	0	0	44	610.4	551.6

9/18/2014 0:00	0	0	44	610.5	551.5
9/18/2014 1:00	0	0	44	610.5	551.5
9/18/2014 2:00	0	0	44	610.6	551.4
9/18/2014 3:00	0	0	44	610.6	551.3
9/18/2014 4:00	0	0	44	610.6	551.4
9/18/2014 5:00	0	0	44	610.6	551.3
9/18/2014 6:00	0	0	44	610.6	551.3
9/18/2014 7:00	0	0	44	610.6	551.4
9/18/2014 8:00	0	0	44	610.7	551.3
9/18/2014 9:00	0	0	44	610.6	551.2
9/18/2014 10:00	0	0	44	610.6	551.2
9/18/2014 11:00	0	0	44	610.6	551.3
9/18/2014 12:00	0	0	43.9	610.6	550.9
9/18/2014 13:00	0	0	44.2	610.6	550.2
9/18/2014 14:00	0	0	44.9	610.6	550.1
9/18/2014 15:00	0	0	44.8	610.6	550.1
9/18/2014 16:00	0	0	45.2	610.6	549.7
9/18/2014 17:00	0	0	45.6	610.5	549.8
9/18/2014 18:00	0	0	45.7	610.7	549.8
9/18/2014 19:00	0	0	45.7	610.7	549.7
9/18/2014 20:00	0	0	45.7	610.6	549.7
9/18/2014 21:00	0	0	45.7	610.7	549.8
9/18/2014 22:00	0	0	45.7	611	549.8
9/18/2014 23:00	0	0	46.9	610.8	549.9
9/19/2014 0:00	0	0	52.4	611.6	550.6
9/19/2014 1:00	0	0	47.3	611.5	550.4
9/19/2014 2:00	0	0	46	611.4	549.9
9/19/2014 3:00	0	0	46	611.4	549.9
9/19/2014 4:00	0	0	46	611.3	549.9
9/19/2014 5:00	0	0	46	611.3	549.9
9/19/2014 6:00	0	0	46	611.3	549.9
9/19/2014 7:00	0	0	46	611.3	549.9
9/19/2014 8:00	0	0	46	611.3	549.9
9/19/2014 9:00	0	0	66.2	611.2	552.2
9/19/2014 10:00	0	50	51.6	610.7	558.9
9/19/2014 11:00	0	80.8	0	610.8	558.2
9/19/2014 12:00	0	73	0	610.5	557
9/19/2014 13:00	0	71	0	610.3	556.6
9/19/2014 14:00	0	69.8	0	610.3	556.3
9/19/2014 15:00	0	71.3	0	610.4	556.5
9/19/2014 16:00	0	71.9	0	610.5	556.6
9/19/2014 17:00	0	72.3	0	610.5	556.6
9/19/2014 18:00	0	73	0	610.7	556.8

9/19/2014 19:00	0	74.1	0	610.6	556.9
9/19/2014 20:00	0	75.8	0	610.5	557.1
9/19/2014 21:00	0	75.1	0	610.5	557.1
9/19/2014 22:00	0	75.2	0	610.4	557.1
9/19/2014 23:00	0	31.2	32.8	610.2	555.2
9/20/2014 0:00	0	0	44.7	610.2	551
9/20/2014 1:00	0	0	44.7	610.1	550.3
9/20/2014 2:00	0	0	44.7	610.2	550.1
9/20/2014 3:00	0	0	44.7	610.2	550.2
9/20/2014 4:00	0	0	44.8	610.2	550.2
9/20/2014 5:00	0	0	44.8	610.3	550.2
9/20/2014 6:00	0	0	44.8	610.3	550.2
9/20/2014 7:00	0	0	44.9	610.3	550.3
9/20/2014 8:00	0	0	44.9	610.3	550.3
9/20/2014 9:00	0	0	54.8	610.4	551.3
9/20/2014 10:00	0	28.8	65.5	610.3	557.3
9/20/2014 11:00	0	78.7	0	610.9	557.8
9/20/2014 12:00	0	76.3	0	610.6	557.3
9/20/2014 13:00	0	75.6	0	610.6	557.2
9/20/2014 14:00	0	76.5	0	610.5	557.3
9/20/2014 15:00	0	76.8	0	610.4	557.4
9/20/2014 16:00	0	75.5	0	610.3	557.3
9/20/2014 17:00	0	81.5	0	610.3	557.7
9/20/2014 18:00	0	88.9	0	610.5	558.8
9/20/2014 19:00	0	86.5	0	610.6	558.7
9/20/2014 20:00	0.2	88.8	0	610.7	558.9
9/20/2014 21:00	9.6	85.2	0	611.1	559.3
9/20/2014 22:00	6.5	79.5	0	611	558.7
9/20/2014 23:00	0	78.7	0	610.9	557.9
9/21/2014 0:00	0	55.6	21.7	610.7	557.1
9/21/2014 1:00	0	0	47.7	610.6	552.1
9/21/2014 2:00	0	0	45.8	610.5	550.5
9/21/2014 3:00	0	0	45.2	610.6	550
9/21/2014 4:00	0	0	45.3	610.6	550.1
9/21/2014 5:00	0	0	45.3	610.6	550.1
9/21/2014 6:00	0	0	45.4	610.6	550.1
9/21/2014 7:00	0	0	45.4	610.7	550.2
9/21/2014 8:00	0	0	45.5	610.7	550.2
9/21/2014 9:00	0	0	45.5	610.7	550.2
9/21/2014 10:00	0	0	62.4	610.4	552.2
9/21/2014 11:00	0	42.3	51.5	610.4	557.7
9/21/2014 12:00	0	76.9	0	610.7	557.6
9/21/2014 13:00	0	77.3	0	610.5	557.5

9/21/2014 14:00	0	77.3	0	610.4	557.4
9/21/2014 15:00	0	76.8	0	610.4	557.4
9/21/2014 16:00	0	77.4	0	610.3	557.4
9/21/2014 17:00	0	77.6	0	610.3	557.5
9/21/2014 18:00	0	77.1	0	610.2	557.4
9/21/2014 19:00	0	76.7	0	610.2	557.4
9/21/2014 20:00	0	75.9	0	610.3	557.3
9/21/2014 21:00	0	74.6	0	610.4	557.1
9/21/2014 22:00	0	75.3	0	610.5	557.1
9/21/2014 23:00	0	54.8	21.3	610.5	556.7
9/22/2014 0:00	0	0	46.1	610.4	551.9
9/22/2014 1:00	0	0	45	610.3	550.4
9/22/2014 2:00	0	0	45	610.4	550
9/22/2014 3:00	0	0	45.1	610.4	550.1
9/22/2014 4:00	0	0	45.1	610.4	550.1
9/22/2014 5:00	0	0	45.1	610.5	550
9/22/2014 6:00	0	0	45.1	610.5	550
9/22/2014 7:00	0	0	45.2	610.5	550
9/22/2014 8:00	0	0	60.9	610.8	551.4
9/22/2014 9:00	0	73	19.1	610.7	558.4
9/22/2014 10:00	0	83.6	2	610.6	558.4
9/22/2014 11:00	0	82.1	2	610.5	558.3
9/22/2014 12:00	0	82.5	1.3	610.4	558.3
9/22/2014 13:00	0	83.5	0	610.3	558.2
9/22/2014 14:00	0	83	0	610.2	558.2
9/22/2014 15:00	0	81.7	0	610.2	558
9/22/2014 16:00	0	80.5	0	610.2	557.9
9/22/2014 17:00	0	77.1	0	610.2	557.5
9/22/2014 18:00	0	76.7	0	610.3	557.3
9/22/2014 19:00	0	75.5	0	610.4	557.2
9/22/2014 20:00	0	76.6	0	610.5	557.3
9/22/2014 21:00	0	76.2	0	610.6	557.3
9/22/2014 22:00	0	56.6	18	610.6	556.8
9/22/2014 23:00	0	0	44.4	610.5	551.5
9/23/2014 0:00	0	0	44.5	610.4	550.2
9/23/2014 1:00	0	0	44.5	610.5	549.9
9/23/2014 2:00	0	0	44.6	610.5	550
9/23/2014 3:00	0	0	44.6	610.5	550
9/23/2014 4:00	0	0	44.6	610.5	550
9/23/2014 5:00	0	0	44.7	610.6	550
9/23/2014 6:00	0	0	44.7	610.6	550
9/23/2014 7:00	0	0	44.8	610.6	550
9/23/2014 8:00	0	0	44.6	610.7	550

9/23/2014 9:00	0	29.5	69.5	610.8	556.6
9/23/2014 10:00	0	85.7	0	610.7	558.7
9/23/2014 11:00	0	84.5	0	610.5	558.4
9/23/2014 12:00	0	81.2	0	610.5	557.9
9/23/2014 13:00	0	81.4	0	610.5	557.9
9/23/2014 14:00	0	83.7	0	610.3	558.2
9/23/2014 15:00	0	83.2	0	610.2	558.3
9/23/2014 16:00	0	82.3	0	610.2	558
9/23/2014 17:00	0	83.2	0	610.1	558.1
9/23/2014 18:00	0	82.6	0	610	558.1
9/23/2014 19:00	0	80.7	0	610	557.8
9/23/2014 20:00	0	80.5	0	610	557.8
9/23/2014 21:00	0	80.7	0	610	557.7
9/23/2014 22:00	0	80.1	0	610	557.7
9/23/2014 23:00	0	27.3	47.3	610.1	556.4
9/24/2014 0:00	0	0	43.5	610.1	551.6
9/24/2014 1:00	0	0	42.1	610	549.9
9/24/2014 2:00	0	0	42.2	610.2	549.6
9/24/2014 3:00	0	0	42.3	610.3	549.6
9/24/2014 4:00	0	0	42.3	610.4	549.6
9/24/2014 5:00	0	0	42.4	610.5	549.6
9/24/2014 6:00	0	0	42.4	610.6	549.6
9/24/2014 7:00	0	0	42.5	610.7	549.7
9/24/2014 8:00	0	0	42.5	566.7	549.7
9/24/2014 9:00	0	0	43.4	610.7	549.6
9/24/2014 10:00	0	0	47	611.2	549.9
9/24/2014 11:00	0	0	57.3	611.6	551.3
9/24/2014 12:00	0	8.6	82.7	611.5	555
9/24/2014 13:00	0	89.8	10.6	610.8	560.5
9/24/2014 14:00	0	89.7	2	610.7	559.3
9/24/2014 15:00	0	88.2	2	610.3	559
9/24/2014 16:00	0	85.3	1.7	610.1	558.7
9/24/2014 17:00	0	81.1	0	610	558.1
9/24/2014 18:00	0	79.7	0	609.9	557.7
9/24/2014 19:00	0	76.9	0	609.9	557.4
9/24/2014 20:00	0	76.2	0	610	557.3
9/24/2014 21:00	0	76	0	610	557.2
9/24/2014 22:00	0	75.3	0	610.1	557.1
9/24/2014 23:00	0	18.7	45.7	610.2	554.8
9/25/2014 0:00	0	0	45.9	610.1	551.4
9/25/14 1:00:00	0.0	0.0	43.1	610.1	550.1
9/25/14 2:00:00	0.0	0.0	43.1	610.1	550.0
9/25/14 3:00:00	0.0	0.0	43.1	610.2	550.0

9/25/14 4:00:00	0.0	0.0	43.1	610.2	550.0
9/25/14 5:00:00	0.0	0.0	43.2	610.2	550.0
9/25/14 6:00:00	0.0	0.0	43.2	610.2	550.0
9/25/14 7:00:00	0.0	0.0	43.0	610.3	550.1
9/25/14 8:00:00	0.0	8.1	36.2	610.4	550.5
9/25/14 9:00:00	0.0	8.7	34.3	610.8	550.7
9/25/14 10:00:00	0.0	44.3	55.2	611.0	557.0
9/25/14 11:00:00	0.0	85.5	0.0	611.2	558.7
9/25/14 12:00:00	0.0	83.7	0.0	611.0	558.3
9/25/14 13:00:00	0.0	82.7	0.0	610.9	558.1
9/25/14 14:00:00	0.0	82.3	0.0	610.9	558.0
9/25/14 15:00:00	0.0	82.9	0.0	610.8	558.1
9/25/14 16:00:00	0.0	82.7	0.0	610.7	558.1
9/25/14 17:00:00	0.0	82.9	0.0	610.7	558.1
9/25/14 18:00:00	0.0	83.3	0.0	610.5	558.1
9/25/14 19:00:00	0.0	83.2	0.0	610.5	558.1
9/25/14 20:00:00	0.0	83.8	0.0	610.4	558.2
9/25/14 21:00:00	0.0	85.1	0.0	611.0	558.3
9/25/14 22:00:00	0.0	86.7	0.0	611.2	558.6
9/25/14 23:00:00	0.0	34.2	35.7	610.8	556.3
9/26/14 0:00:00	0.0	0.0	42.9	610.8	550.9
9/26/14 1:00:00	0.0	0.0	42.8	610.8	549.9
9/26/14 2:00:00	0.0	0.0	42.8	610.8	549.8
9/26/14 3:00:00	0.0	0.0	42.8	610.8	549.9
9/26/14 4:00:00	0.0	0.0	42.9	610.9	549.9
9/26/14 5:00:00	0.0	0.0	42.9	610.9	549.9
9/26/14 6:00:00	0.0	0.0	42.9	610.9	550.0
9/26/14 7:00:00	0.0	0.0	43.0	610.9	550.1
9/26/14 8:00:00	0.0	11.9	64.1	610.8	553.6
9/26/14 9:00:00	0.0	80.2	2.1	611.1	558.1
9/26/14 10:00:00	0.0	81.3	0.0	611.0	557.9
9/26/14 11:00:00	0.0	81.4	0.0	610.9	557.9
9/26/14 12:00:00	0.0	82.8	0.0	610.8	558.1
9/26/14 13:00:00	0.0	79.0	0.0	610.8	557.7
9/26/14 14:00:00	0.0	78.1	0.0	610.8	557.5
9/26/14 15:00:00	0.0	74.9	0.0	610.8	557.5
9/26/14 16:00:00	0.0	78.2	0.0	610.7	557.9
9/26/14 17:00:00	0.0	77.7	0.0	610.8	557.6
9/26/14 18:00:00	0.0	77.6	0.0	610.8	557.5
9/26/14 19:00:00	0.0	78.6	0.0	610.8	557.5
9/26/14 20:00:00	0.0	79.7	0.0	610.8	557.7
9/26/14 21:00:00	0.0	79.2	0.0	610.8	557.6
9/26/14 22:00:00	0.0	79.2	0.0	610.8	557.6

9/26/14 23:00:00	0.0	78.8	0.0	610.8	557.6
9/27/14 0:00:00	0.0	39.7	26.1	610.9	555.5
9/27/14 1:00:00	0.0	0.0	49.2	610.9	551.5
9/27/14 2:00:00	0.0	0.0	47.8	610.8	550.7
9/27/14 3:00:00	0.0	0.0	47.8	610.8	550.5
9/27/14 4:00:00	0.0	0.0	47.7	610.7	550.6
9/27/14 5:00:00	0.0	0.0	47.7	610.6	550.6
9/27/14 6:00:00	0.0	0.0	46.7	610.6	550.5
9/27/14 7:00:00	0.0	0.0	45.7	610.6	550.4
9/27/14 8:00:00	0.0	0.0	45.7	610.6	550.4
9/27/14 9:00:00	0.0	0.0	52.6	610.5	550.9
9/27/14 10:00:00	0.0	48.3	45.0	610.7	557.4
9/27/14 11:00:00	0.0	78.5	0.0	610.9	557.8
9/27/14 12:00:00	0.0	77.0	0.0	610.8	557.5
9/27/14 13:00:00	0.0	77.8	0.0	610.9	557.5
9/27/14 14:00:00	0.0	78.4	0.0	610.9	557.6
9/27/14 15:00:00	0.0	78.6	0.0	610.9	557.7
9/27/14 16:00:00	0.0	78.9	0.0	610.9	557.7
9/27/14 17:00:00	0.0	79.3	0.0	610.9	557.7
9/27/14 18:00:00	0.0	80.7	0.0	610.9	557.9
9/27/14 19:00:00	0.0	81.6	0.0	611.1	558.0
9/27/14 20:00:00	0.0	79.1	0.0	611.1	557.8
9/27/14 21:00:00	0.0	79.0	0.0	611.2	557.7
9/27/14 22:00:00	0.0	80.6	0.0	611.1	557.9
9/27/14 23:00:00	0.0	80.4	0.0	611.2	557.9
9/28/14 0:00:00	0.0	80.7	0.0	611.1	557.9
9/28/14 1:00:00	0.0	37.5	28.4	611.3	555.6
9/28/14 2:00:00	0.0	0.0	50.9	611.0	551.8
9/28/14 3:00:00	0.0	0.0	50.7	610.9	551.3
9/28/14 4:00:00	0.0	0.0	50.5	610.7	551.2
9/28/14 5:00:00	0.0	0.0	50.0	610.6	551.2
9/28/14 6:00:00	0.0	0.0	48.2	610.5	551.0
9/28/14 7:00:00	0.0	0.0	46.8	610.4	550.8
9/28/14 8:00:00	0.0	0.0	45.7	610.4	550.5
9/28/14 9:00:00	0.0	0.0	45.6	610.4	550.4
9/28/14 10:00:00	0.0	0.0	45.7	610.4	550.4
9/28/14 11:00:00	0.0	0.0	45.8	610.7	550.3
9/28/14 12:00:00	0.0	0.0	46.4	611.2	550.6
9/28/14 13:00:00	0.0	0.0	50.2	611.4	554.0
9/28/14 14:00:00	0.0	62.2	38.3	611.1	558.3
9/28/14 15:00:00	0.0	88.8	0.0	611.2	559.1
9/28/14 16:00:00	0.0	86.5	0.0	611.0	558.7
9/28/14 17:00:00	0.0	83.2	0.0	610.9	558.4

9/28/14 18:00:00	0.0	79.2	0.0	610.8	557.9
9/28/14 19:00:00	0.0	78.4	0.0	610.8	557.7
9/28/14 20:00:00	0.0	78.1	0.0	610.8	557.6
9/28/14 21:00:00	0.0	78.5	0.0	610.8	557.6
9/28/14 22:00:00	0.0	78.6	0.0	610.8	557.7
9/28/14 23:00:00	0.0	78.4	0.0	610.8	557.7
9/29/14 0:00:00	0.0	42.5	24.9	611.0	555.9
9/29/14 1:00:00	0.0	0.0	45.2	610.9	551.7
9/29/14 2:00:00	0.0	0.0	44.5	610.8	550.8
9/29/14 3:00:00	0.0	0.0	44.5	610.8	550.6
9/29/14 4:00:00	0.0	0.0	44.5	610.8	550.6
9/29/14 5:00:00	0.0	0.0	44.4	610.7	550.7
9/29/14 6:00:00	0.0	0.0	44.4	610.7	550.6
9/29/14 7:00:00	0.0	0.0	44.4	610.6	550.6
9/29/14 8:00:00	0.0	14.5	61.4	610.7	554.2
9/29/14 9:00:00	0.0	74.8	1.9	610.8	557.9
9/29/14 10:00:00	0.0	72.9	0.0	610.8	556.9
9/29/14 11:00:00	0.0	73.7	0.0	610.9	557.0
9/29/14 12:00:00	0.0	74.2	0.0	611.0	557.1
9/29/14 13:00:00	0.0	73.7	0.0	611.1	556.9
9/29/14 14:00:00	0.0	73.5	0.0	610.8	556.9
9/29/14 15:00:00	0.0	72.4	0.0	610.6	556.8
9/29/14 16:00:00	0.0	72.4	0.0	610.3	556.7
9/29/14 17:00:00	0.0	9.6	47.6	610.3	553.8
9/29/14 18:00:00	0.0	23.3	48.7	610.5	554.6
9/29/14 19:00:00	0.0	81.9	0.0	610.7	558.0
9/29/14 20:00:00	0.0	75.4	0.0	610.5	557.4
9/29/14 21:00:00	0.0	37.3	18.3	610.3	554.5
9/29/14 22:00:00	0.0	0.0	42.8	610.3	550.7
9/29/14 23:00:00	0.0	0.0	41.6	610.3	550.1
9/30/14 0:00:00	0.0	0.0	41.6	610.3	550.1
9/30/14 1:00:00	0.0	0.0	41.7	610.4	550.2
9/30/14 2:00:00	0.0	0.0	41.7	610.4	550.2
9/30/14 3:00:00	0.0	0.0	41.7	610.4	550.2
9/30/14 4:00:00	0.0	0.0	41.7	610.4	550.3
9/30/14 5:00:00	0.0	0.0	41.8	610.4	550.3
9/30/14 6:00:00	0.0	0.0	41.8	610.5	550.3
9/30/14 7:00:00	0.0	0.0	41.9	610.5	550.3
9/30/14 8:00:00	0.0	0.0	45.4	610.7	550.8
9/30/14 9:00:00	0.0	0.0	45.5	610.7	550.8
9/30/14 10:00:00	0.0	0.0	44.0	610.8	552.4
9/30/14 11:00:00	0.0	0.0	47.1	611.0	550.5
9/30/14 12:00:00	0.0	0.0	47.3	611.2	550.6

9/30/14 13:00:00	0.0	0.0	47.8	611.2	550.6
9/30/14 14:00:00	0.0	0.0	59.3	611.2	551.8
9/30/14 15:00:00	0.0	0.0	62.3	611.3	552.7
9/30/14 16:00:00	0.0	0.0	59.2	611.1	552.6
9/30/14 17:00:00	0.0	0.0	52.0	611.0	551.5
9/30/14 18:00:00	0.0	0.0	51.0	611.2	551.1
9/30/14 19:00:00	0.0	0.0	51.0	611.1	551.1
9/30/14 20:00:00	0.0	0.0	51.0	611.0	551.0
9/30/14 21:00:00	0.0	0.0	51.3	611.5	551.1
9/30/14 22:00:00	0.0	0.0	51.7	611.9	551.1
9/30/14 23:00:00	0.0	0.0	52.0	612.1	551.1
10/1/14 0:00:00	0.0	0.0	50.8	612.0	551.1
10/1/14 1:00:00	0.0	0.0	46.8	612.0	550.4
10/1/14 2:00:00	0.0	0.0	46.1	611.9	550.1
10/1/14 3:00:00	0.0	0.0	46.0	611.9	550.1
10/1/14 4:00:00	0.0	0.0	45.7	611.9	550.1
10/1/14 5:00:00	0.0	0.0	45.1	611.9	550.0
10/1/14 6:00:00	0.0	0.0	45.1	611.9	550.0
10/1/14 7:00:00	0.0	0.0	50.9	611.8	550.5
10/1/14 8:00:00	0.0	43.5	52.0	610.8	558.6
10/1/14 9:00:00	0.0	96.6	0.0	610.8	560.2
10/1/14 10:00:00	0.0	87.0	0.0	610.4	559.1
10/1/14 11:00:00	0.0	79.9	0.0	610.3	558.1
10/1/14 12:00:00	0.0	8.7	49.4	610.1	554.7
10/1/14 13:00:00	0.0	0.0	46.7	610.0	551.2
10/1/14 14:00:00	0.0	0.0	38.6	610.2	549.4
10/1/14 15:00:00	0.0	0.0	36.4	610.4	548.4
10/1/14 16:00:00	0.0	0.0	39.3	610.8	548.6
10/1/14 17:00:00	0.0	0.0	66.3	611.1	551.6
10/1/14 18:00:00	0.0	79.6	14.2	611.2	558.9
10/1/14 19:00:00	0.0	81.9	0.0	611.4	558.3
10/1/14 20:00:00	0.0	84.5	0.0	611.6	558.5
10/1/14 21:00:00	0.0	84.0	0.0	611.8	558.4
10/1/14 22:00:00	0.0	82.2	0.0	611.6	558.3
10/1/14 23:00:00	0.0	74.0	7.6	611.2	558.0
10/2/14 0:00:00	0.0	0.0	45.4	611.0	552.1
10/2/14 1:00:00	0.0	0.0	44.8	610.9	550.3
10/2/14 2:00:00	0.0	0.0	44.7	610.9	549.9
10/2/14 3:00:00	0.0	0.0	44.7	610.9	550.0
10/2/14 4:00:00	0.0	0.0	44.7	610.9	550.0
10/2/14 5:00:00	0.0	0.0	44.8	610.9	550.0
10/2/14 6:00:00	0.0	0.0	44.8	610.9	549.9
10/2/14 7:00:00	0.0	0.0	44.8	611.0	550.0

10/2/14 8:00:00	0.0	0.0	46.8	611.0	550.2
10/2/14 9:00:00	0.0	18.5	78.7	610.5	556.1
10/2/14 10:00:00	0.0	77.6	0.2	610.8	558.2
10/2/14 11:00:00	0.0	77.2	0.0	610.7	557.6
10/2/14 12:00:00	0.0	77.1	0.0	610.6	557.5
10/2/14 13:00:00	0.0	76.2	0.0	610.6	557.4
10/2/14 14:00:00	0.0	77.2	0.0	610.5	557.5
10/2/14 15:00:00	0.0	76.6	0.0	610.7	557.4
10/2/14 16:00:00	0.0	77.5	0.0	610.8	557.5
10/2/14 17:00:00	0.0	83.5	0.0	610.8	558.2
10/2/14 18:00:00	0.0	94.8	0.0	611.0	559.5
10/2/14 19:00:00	0.0	95.0	0.0	611.2	559.8
10/2/14 20:00:00	0.0	94.5	0.0	611.3	559.8
10/2/14 21:00:00	0.0	93.0	0.0	611.5	559.7
10/2/14 22:00:00	0.0	89.7	0.0	611.3	559.3
10/2/14 23:00:00	0.0	84.1	0.0	611.1	558.6
10/3/14 0:00:00	0.0	77.5	0.0	611.0	557.7
10/3/14 1:00:00	0.0	15.0	42.2	610.8	553.9
10/3/14 2:00:00	0.0	0.0	47.0	610.7	550.7
10/3/14 3:00:00	0.0	0.0	47.0	610.6	550.3
10/3/14 4:00:00	0.0	0.0	46.9	610.6	550.2
10/3/14 5:00:00	0.0	0.0	46.8	610.5	550.2
10/3/14 6:00:00	0.0	0.0	46.7	610.5	550.2
10/3/14 7:00:00	0.0	0.0	61.3	610.3	552.0
10/3/14 8:00:00	0.0	87.3	12.0	609.8	559.7
10/3/14 9:00:00	0.0	84.8	0.0	610.3	558.7
10/3/14 10:00:00	0.0	85.8	0.0	610.3	558.5
10/3/14 11:00:00	0.0	89.2	0.0	610.7	559.0
10/3/14 12:00:00	0.0	87.2	0.0	610.6	558.9
10/3/14 13:00:00	0.0	86.3	0.0	610.6	558.8
10/3/14 14:00:00	0.0	86.3	0.0	610.7	558.7
10/3/14 15:00:00	0.0	86.7	0.0	610.7	558.8
10/3/14 16:00:00	0.0	84.6	0.0	610.6	558.6
10/3/14 17:00:00	0.0	85.7	0.0	610.3	558.6
10/3/14 18:00:00	0.0	83.3	0.0	610.3	558.3
10/3/14 19:00:00	0.0	80.6	0.0	610.2	558.0
10/3/14 20:00:00	0.0	73.7	0.0	610.4	557.1
10/3/14 21:00:00	0.0	76.5	0.0	610.8	557.2
10/3/14 22:00:00	0.0	78.1	0.0	611.1	557.5
10/3/14 23:00:00	0.0	79.2	0.0	611.1	557.6
10/4/14 0:00:00	0.0	55.8	16.7	611.0	556.7
10/4/14 1:00:00	0.0	0.0	49.4	610.9	552.0
10/4/14 2:00:00	0.0	0.0	42.7	610.9	550.0

10/4/14 3:00:00	0.0	0.0	42.4	610.9	549.4
10/4/14 4:00:00	0.0	0.0	42.5	611.0	549.5
10/4/14 5:00:00	0.0	0.0	42.5	611.0	549.5
10/4/14 6:00:00	0.0	0.0	42.5	611.1	549.5
10/4/14 7:00:00	0.0	0.0	43.3	611.2	549.6
10/4/14 8:00:00	0.0	0.0	44.5	611.2	549.8
10/4/14 9:00:00	0.0	0.0	45.0	611.2	549.8
10/4/14 10:00:00	0.0	0.0	44.6	611.2	549.8
10/4/14 11:00:00	0.0	0.0	45.4	611.3	549.8
10/4/14 12:00:00	0.0	0.0	46.9	611.3	550.0
10/4/14 13:00:00	0.0	0.0	48.8	611.5	550.2
10/4/14 14:00:00	0.0	0.0	56.9	611.6	551.4
10/4/14 15:00:00	0.0	0.5	79.2	611.3	554.1
10/4/14 16:00:00	0.0	87.0	12.5	611.4	559.9
10/4/14 17:00:00	0.0	91.4	0.0	611.2	559.5
10/4/14 18:00:00	0.0	85.2	0.0	611.0	558.7
10/4/14 19:00:00	0.0	81.9	0.0	610.9	558.2
10/4/14 20:00:00	0.0	79.3	0.0	610.9	557.9
10/4/14 21:00:00	0.0	78.8	0.0	610.9	557.7
10/4/14 22:00:00	0.0	80.6	0.0	610.8	557.9
10/4/14 23:00:00	0.0	79.8	2.4	610.8	558.2
10/5/14 0:00:00	0.0	0.7	42.0	610.8	551.9
10/5/14 1:00:00	0.0	0.0	44.1	610.7	550.2
10/5/14 2:00:00	0.0	0.0	44.1	610.8	549.9
10/5/14 3:00:00	0.0	0.0	44.2	610.9	549.9
10/5/14 4:00:00	0.0	0.0	44.2	610.9	549.9
10/5/14 5:00:00	0.0	0.0	44.3	611.0	549.9
10/5/14 6:00:00	0.0	0.0	44.3	611.0	549.8
10/5/14 7:00:00	0.0	0.0	45.8	611.1	549.8
10/5/14 8:00:00	0.0	0.0	61.4	611.1	551.7
10/5/14 9:00:00	0.0	0.0	86.6	611.1	555.7
10/5/14 10:00:00	0.0	0.0	88.0	611.1	557.0
10/5/14 11:00:00	0.0	0.0	67.0	610.9	555.2
10/5/14 12:00:00	0.0	0.0	50.1	610.7	551.7
10/5/14 13:00:00	0.0	0.0	49.4	610.5	551.0
10/5/14 14:00:00	0.0	0.0	50.1	610.4	551.1
10/5/14 15:00:00	0.0	0.0	55.3	610.3	551.5
10/5/14 16:00:00	0.0	51.5	47.5	610.4	558.0
10/5/14 17:00:00	0.0	97.8	0.0	610.8	560.0
10/5/14 18:00:00	0.0	99.0	0.0	610.7	560.3
10/5/14 19:00:00	0.0	98.6	0.0	610.7	560.3
10/5/14 20:00:00	11.0	94.7	0.0	610.4	560.7
10/5/14 21:00:00	12.5	93.2	0.0	610.4	560.9

10/5/14 22:00:00	12.6	89.3	0.0	610.4	560.5
10/5/14 23:00:00	7.6	88.2	0.0	610.3	560.0
10/6/14 0:00:00	0.0	76.7	0.0	610.4	558.1
10/6/14 1:00:00	0.0	28.6	22.8	610.5	554.6
10/6/14 2:00:00	0.0	0.0	38.2	610.6	549.7
10/6/14 3:00:00	0.0	0.0	39.9	610.7	549.3
10/6/14 4:00:00	0.0	0.0	47.6	610.9	550.2
10/6/14 5:00:00	0.0	0.0	49.9	610.9	550.9
10/6/14 6:00:00	0.0	0.0	51.3	610.8	551.2
10/6/14 7:00:00	0.0	0.0	51.3	610.7	551.2
10/6/14 8:00:00	0.0	0.0	62.2	610.9	552.2
10/6/14 9:00:00	0.0	75.4	27.8	610.8	559.2
10/6/14 10:00:00	0.0	85.8	0.0	611.1	558.8
10/6/14 11:00:00	0.0	79.5	0.0	611.1	558.0
10/6/14 12:00:00	0.0	80.3	0.0	611.1	557.9
10/6/14 13:00:00	0.0	80.2	0.0	611.1	557.9
10/6/14 14:00:00	0.0	81.7	0.0	611.1	558.1
10/6/14 15:00:00	0.0	88.4	0.0	611.2	558.9
10/6/14 16:00:00	0.0	88.1	0.0	611.5	559.0
10/6/14 17:00:00	0.0	88.2	0.0	611.6	559.1
10/6/14 18:00:00	0.0	91.8	0.0	611.8	559.4
10/6/14 19:00:00	0.0	92.0	0.0	611.9	559.6
10/6/14 20:00:00	0.0	87.1	0.0	611.7	559.0
10/6/14 21:00:00	0.8	91.7	0.0	611.8	559.4
10/6/14 22:00:00	4.8	92.0	0.0	611.7	559.8
10/6/14 23:00:00	4.4	89.0	0.0	611.2	559.8
10/7/14 0:00:00	0.0	63.2	9.7	611.2	557.6
10/7/14 1:00:00	0.0	0.0	41.8	611.1	551.1
10/7/14 2:00:00	0.0	0.0	41.8	611.1	549.7
10/7/14 3:00:00	0.0	0.0	44.3	611.2	549.6
10/7/14 4:00:00	0.0	0.0	45.7	611.2	550.0
10/7/14 5:00:00	0.0	0.0	45.7	611.2	550.1
10/7/14 6:00:00	0.0	0.0	45.7	611.3	550.0
10/7/14 7:00:00	0.0	8.1	75.0	611.0	553.9
10/7/14 8:00:00	5.1	86.0	2.1	611.2	559.3
10/7/14 9:00:00	6.0	95.7	0.0	611.4	560.2
10/7/14 10:00:00	20.5	98.5	0.0	611.3	561.9
10/7/14 11:00:00	20.6	82.7	0.0	611.0	560.9
10/7/14 12:00:00	20.5	71.5	0.0	610.6	559.4
10/7/14 13:00:00	20.2	67.6	0.4	610.2	559.1
10/7/14 14:00:00	20.3	63.3	0.0	609.9	558.6
10/7/14 15:00:00	20.3	62.9	0.0	609.6	558.4
10/7/14 16:00:00	20.8	64.2	0.0	609.7	558.5

10/7/14 17:00:00	19.6	66.4	0.0	609.6	558.2
10/7/14 18:00:00	11.0	71.7	0.0	609.7	557.9
10/7/14 19:00:00	11.0	71.7	0.0	609.8	557.8
10/7/14 20:00:00	11.0	74.4	0.0	609.9	558.0
10/7/14 21:00:00	11.0	75.9	0.0	610.1	558.4
10/7/14 22:00:00	10.9	73.6	0.0	610.0	558.1
10/7/14 23:00:00	10.9	72.6	0.0	609.9	557.9
10/8/14 0:00:00	3.7	20.5	33.0	610.2	554.3
10/8/14 1:00:00	0.0	0.0	43.2	610.1	550.4
10/8/14 2:00:00	0.0	0.0	41.5	610.2	549.6
10/8/14 3:00:00	0.0	0.0	41.6	610.3	549.5
10/8/14 4:00:00	0.1	0.0	41.7	610.4	549.6
10/8/14 5:00:00	0.1	0.0	41.8	610.5	549.6
10/8/14 6:00:00	0.1	0.0	47.0	610.5	550.0
10/8/14 7:00:00	4.7	56.9	38.0	610.1	558.2
10/8/14 8:00:00	10.1	89.3	0.0	610.7	559.8
10/8/14 9:00:00	10.5	84.2	0.0	610.5	559.5
10/8/14 10:00:00	10.4	82.2	0.0	610.1	559.4
10/8/14 11:00:00	10.4	78.7	0.0	609.9	559.0
10/8/14 12:00:00	10.4	75.6	0.0	609.6	558.6
10/8/14 13:00:00	10.3	69.5	0.0	609.6	557.7
10/8/14 14:00:00	10.2	68.0	0.0	609.6	557.3
10/8/14 15:00:00	10.2	67.4	0.0	609.6	557.2
10/8/14 16:00:00	10.5	66.4	0.0	609.6	557.1
10/8/14 17:00:00	10.6	66.5	0.0	609.7	557.2
10/8/14 18:00:00	10.6	69.1	0.0	609.7	557.4
10/8/14 19:00:00	10.6	69.3	0.0	609.6	557.5
10/8/14 20:00:00	10.6	68.9	0.0	609.6	557.5
10/8/14 21:00:00	10.6	68.8	0.0	609.5	557.4
10/8/14 22:00:00	9.5	69.8	0.0	609.5	557.4
10/8/14 23:00:00	0.0	74.1	0.0	609.6	557.2
10/9/14 0:00:00	0.0	66.1	3.1	609.8	556.6
10/9/14 1:00:00	0.0	0.0	44.2	610.1	551.2
10/9/14 2:00:00	0.0	0.0	39.8	610.0	549.7
10/9/14 3:00:00	0.0	0.0	39.6	610.2	549.3
10/9/14 4:00:00	0.0	0.0	41.1	610.2	549.4
10/9/14 5:00:00	0.0	0.0	45.2	610.2	550.0
10/9/14 6:00:00	0.0	0.0	45.4	610.2	550.3
10/9/14 7:00:00	0.0	0.0	74.6	609.9	553.3
10/9/14 8:00:00	7.5	79.6	10.8	610.3	559.1
10/9/14 9:00:00	11.3	80.8	0.0	610.6	559.2
10/9/14 10:00:00	11.2	76.8	0.0	610.6	558.6
10/9/14 11:00:00	11.1	82.8	0.0	611.0	559.2

10/9/14 12:00:00	11.2	79.6	0.0	610.8	559.1
10/9/14 13:00:00	11.1	74.1	0.0	610.5	558.3
10/9/14 14:00:00	11.0	69.7	0.0	610.3	557.7
10/9/14 15:00:00	11.0	71.8	0.0	610.1	557.9
10/9/14 16:00:00	11.1	71.5	0.0	609.9	557.8
10/9/14 17:00:00	11.1	71.5	0.0	609.7	557.8
10/9/14 18:00:00	11.1	68.3	0.0	609.6	557.5
10/9/14 19:00:00	5.3	73.4	0.0	609.5	557.4
10/9/14 20:00:00	0.0	74.9	0.0	609.6	557.2
10/9/14 21:00:00	0.0	73.4	0.0	610.0	556.9
10/9/14 22:00:00	0.0	75.3	0.0	610.2	557.1
10/9/14 23:00:00	0.0	74.5	0.0	610.4	557.0
10/10/14 0:00:00	0.0	73.7	1.0	610.3	557.0
10/10/14 1:00:00	0.0	36.3	29.4	610.3	555.5
10/10/14 2:00:00	0.0	0.0	44.8	610.3	551.2
10/10/14 3:00:00	0.0	0.0	44.2	610.2	550.3
10/10/14 4:00:00	0.0	0.0	44.2	610.3	550.1
10/10/14 5:00:00	0.0	0.0	44.2	610.3	550.1
10/10/14 6:00:00	0.0	0.0	44.2	610.3	550.2
10/10/14 7:00:00	0.0	0.0	46.4	610.3	550.3
10/10/14 8:00:00	0.6	43.4	49.1	610.1	556.9
10/10/14 9:00:00	4.9	95.6	0.0	610.5	559.9
10/10/14 10:00:00	5.0	95.3	0.0	610.5	560.2
10/10/14 11:00:00	4.5	82.8	0.0	610.3	559.1
10/10/14 12:00:00	4.5	75.3	0.0	610.2	557.8
10/10/14 13:00:00	4.4	74.8	0.0	610.1	557.7
10/10/14 14:00:00	0.0	72.0	0.0	610.2	557.0
10/10/14 15:00:00	0.0	72.3	0.0	610.2	556.8
10/10/14 16:00:00	0.0	73.9	0.0	610.3	556.9
10/10/14 17:00:00	0.0	74.3	0.0	610.3	557.0
10/10/14 18:00:00	0.0	74.3	0.0	610.3	557.0
10/10/14 19:00:00	0.0	75.1	0.0	610.3	557.1
10/10/14 20:00:00	0.0	75.6	0.0	610.3	557.2
10/10/14 21:00:00	0.0	75.8	0.0	610.2	557.2
10/10/14 22:00:00	0.0	76.0	0.0	610.2	557.3
10/10/14 23:00:00	0.0	57.4	12.6	610.1	556.5
10/11/14 0:00:00	0.0	0.0	43.1	610.1	551.4
10/11/14 1:00:00	0.0	0.0	42.1	610.0	550.2
10/11/14 2:00:00	0.0	0.0	42.1	610.0	549.9
10/11/14 3:00:00	0.0	0.0	42.1	610.0	550.1
10/11/14 4:00:00	0.0	0.0	42.1	610.0	550.1
10/11/14 5:00:00	0.0	0.0	42.1	610.0	550.1
10/11/14 6:00:00	0.0	0.0	42.1	610.1	550.2

10/11/14 7:00:00	0.0	0.0	42.1	610.1	550.3
10/11/14 8:00:00	0.0	0.0	42.2	610.1	550.2
10/11/14 9:00:00	0.0	0.0	42.2	610.1	550.0
10/11/14 10:00:00	0.0	0.0	42.2	610.1	550.0
10/11/14 11:00:00	0.0	0.0	42.2	610.1	549.9
10/11/14 12:00:00	0.0	0.0	42.3	610.2	549.9
10/11/14 13:00:00	0.0	0.0	42.3	610.2	549.9
10/11/14 14:00:00	0.0	0.0	41.9	610.4	549.8
10/11/14 15:00:00	0.0	0.0	41.5	610.7	549.4
10/11/14 16:00:00	0.0	0.0	41.2	610.7	549.5
10/11/14 17:00:00	0.0	0.0	42.0	611.0	549.6
10/11/14 18:00:00	0.0	0.0	42.2	611.0	549.6
10/11/14 19:00:00	0.0	0.0	52.9	611.3	550.4
10/11/14 20:00:00	0.0	0.0	64.0	611.6	552.3
10/11/14 21:00:00	0.0	0.0	60.6	611.8	552.4
10/11/14 22:00:00	0.0	0.0	59.7	611.5	552.3
10/11/14 23:00:00	0.0	0.0	51.6	611.2	551.6
10/12/14 0:00:00	0.0	0.0	43.6	611.2	549.9
10/12/14 1:00:00	0.0	0.0	44.4	611.2	549.7
10/12/14 2:00:00	0.0	0.0	44.0	611.3	549.6
10/12/14 3:00:00	0.0	0.0	44.2	611.2	549.7
10/12/14 4:00:00	0.0	0.0	43.3	611.3	549.5
10/12/14 5:00:00	0.0	0.0	43.4	611.4	549.5
10/12/14 6:00:00	0.0	0.0	43.8	611.3	550.0
10/12/14 7:00:00	0.0	0.0	43.7	611.3	550.1
10/12/14 8:00:00	0.0	0.0	43.9	611.5	550.1
10/12/14 9:00:00	0.0	0.0	59.7	611.6	551.1
10/12/14 10:00:00	0.0	79.1	11.9	611.7	558.5
10/12/14 11:00:00	0.0	79.3	13.7	611.7	559.1
10/12/14 12:00:00	0.0	13.6	42.1	611.4	554.8
10/12/14 13:00:00	0.0	0.0	43.8	611.3	551.0
10/12/14 14:00:00	0.0	0.0	43.7	611.3	550.4
10/12/14 15:00:00	0.0	0.0	43.7	611.2	550.3
10/12/14 16:00:00	0.0	0.0	43.1	611.3	550.2
10/12/14 17:00:00	0.0	0.0	67.4	611.2	555.2
10/12/14 18:00:00	0.0	0.0	44.9	611.5	552.0
10/12/14 19:00:00	0.0	0.0	54.0	611.0	551.7
10/12/14 20:00:00	5.4	53.4	45.9	610.7	558.7
10/12/14 21:00:00	7.3	86.3	0.0	610.8	559.6
10/12/14 22:00:00	0.0	77.5	0.0	610.7	558.0
10/12/14 23:00:00	0.0	75.2	0.0	610.5	557.3
10/13/14 0:00:00	0.0	56.2	12.0	610.3	556.4
10/13/14 1:00:00	0.0	0.0	43.0	610.2	551.3

10/13/14 2:00:00	0.0	0.0	41.9	610.0	550.3
10/13/14 3:00:00	0.0	0.0	41.9	610.1	549.9
10/13/14 4:00:00	0.0	0.0	43.2	610.1	550.1
10/13/14 5:00:00	0.0	0.0	42.5	610.2	550.1
10/13/14 6:00:00	0.0	0.0	42.9	610.3	550.3
10/13/14 7:00:00	2.6	64.6	25.4	610.0	558.0
10/13/14 8:00:00	4.5	83.0	0.0	610.4	558.8
10/13/14 9:00:00	4.4	78.9	0.0	610.4	558.5
10/13/14 10:00:00	0.0	80.6	0.0	610.2	557.9
10/13/14 11:00:00	0.0	80.4	0.0	610.2	557.9
10/13/14 12:00:00	0.0	80.5	0.0	610.2	557.9
10/13/14 13:00:00	0.0	81.0	0.0	610.2	557.9
10/13/14 14:00:00	0.0	81.5	0.0	610.1	558.0
10/13/14 15:00:00	0.0	79.6	0.0	610.1	557.8
10/13/14 16:00:00	0.0	80.4	0.0	610.0	557.9
10/13/14 17:00:00	0.0	80.2	0.0	610.0	557.8
10/13/14 18:00:00	2.0	86.5	0.0	610.4	558.5
10/13/14 19:00:00	5.0	94.0	0.0	610.8	559.8
10/13/14 20:00:00	5.5	98.2	0.0	611.4	560.5
10/13/14 21:00:00	5.4	100.4	0.0	611.8	561.0
10/13/14 22:00:00	5.4	95.5	0.0	611.6	560.7
10/13/14 23:00:00	5.0	85.4	0.0	611.3	559.4
10/14/14 0:00:00	0.0	50.7	20.1	611.0	557.6
10/14/14 1:00:00	0.0	0.0	45.0	610.9	550.8
10/14/14 2:00:00	0.0	0.0	44.8	610.8	550.6
10/14/14 3:00:00	0.0	0.0	44.3	610.9	550.5
10/14/14 4:00:00	0.0	0.0	43.9	610.9	550.8
10/14/14 5:00:00	0.0	0.0	43.9	611.0	550.7
10/14/14 6:00:00	0.0	0.0	44.5	611.0	550.6
10/14/14 7:00:00	0.0	0.0	44.2	611.0	550.5
10/14/14 8:00:00	0.1	35.1	42.5	610.2	555.3
10/14/14 9:00:00	0.6	84.9	0.0	610.9	558.4
10/14/14 10:00:00	0.0	82.3	0.0	611.1	558.3
10/14/14 11:00:00	0.0	79.1	0.0	611.1	557.8
10/14/14 12:00:00	0.0	79.2	0.0	611.1	557.8
10/14/14 13:00:00	0.0	80.7	0.0	610.9	557.9
10/14/14 14:00:00	0.0	77.9	0.0	610.7	557.7
10/14/14 15:00:00	0.0	76.8	0.0	610.7	557.4
10/14/14 16:00:00	0.0	77.3	0.0	610.5	557.5
10/14/14 17:00:00	0.0	76.4	0.0	610.5	557.4
10/14/14 18:00:00	0.0	75.4	0.0	610.4	557.3
10/14/14 19:00:00	0.0	74.6	0.0	610.4	557.1
10/14/14 20:00:00	0.0	76.8	0.0	610.5	557.3

10/14/14 21:00:00	0.9	86.4	0.0	610.6	558.3
10/14/14 22:00:00	5.0	99.0	0.0	610.7	560.4
10/14/14 23:00:00	5.1	96.0	0.0	610.6	560.6
10/15/14 0:00:00	1.6	75.1	0.0	610.6	558.1
10/15/14 1:00:00	0.0	39.0	21.3	610.4	555.4
10/15/14 2:00:00	0.0	0.0	42.1	610.4	550.9
10/15/14 3:00:00	0.0	0.0	41.7	610.4	550.8
10/15/14 4:00:00	0.0	0.0	42.6	610.5	550.9
10/15/14 5:00:00	0.0	0.0	42.7	610.6	550.9
10/15/14 6:00:00	0.0	10.6	51.3	610.3	553.2
10/15/14 7:00:00	0.0	80.9	0.3	611.0	557.7
10/15/14 8:00:00	0.0	80.6	0.0	611.0	557.9
10/15/14 9:00:00	0.0	82.9	0.0	611.3	558.1
10/15/14 10:00:00	0.0	85.2	0.0	611.4	558.4
10/15/14 11:00:00	0.0	85.5	0.0	611.3	558.6
10/15/14 12:00:00	0.0	82.4	0.0	610.9	558.3
10/15/14 13:00:00	0.0	79.6	0.0	610.9	558.0
10/15/14 14:00:00	0.0	77.6	0.0	610.8	557.7
10/15/14 15:00:00	0.0	79.3	0.0	610.6	557.8
10/15/14 16:00:00	0.0	77.1	0.0	610.5	557.7
10/15/14 17:00:00	0.0	73.9	0.0	610.6	557.4
10/15/14 18:00:00	0.0	71.7	0.0	610.6	556.9
10/15/14 19:00:00	0.0	73.3	0.0	610.7	557.1
10/15/14 20:00:00	0.0	84.9	0.0	610.8	558.2
10/15/14 21:00:00	0.0	83.3	0.0	610.9	558.6
10/15/14 22:00:00	0.0	77.1	0.0	610.9	557.6
10/15/14 23:00:00	0.0	69.4	7.7	610.7	557.7
10/16/14 0:00:00	0.0	0.0	44.6	610.5	552.7
10/16/14 1:00:00	0.0	0.0	43.5	610.4	550.7
10/16/14 2:00:00	0.0	0.0	42.0	610.5	550.0
10/16/14 3:00:00	0.0	0.0	40.5	610.6	549.9
10/16/14 4:00:00	0.0	0.0	40.7	610.7	549.9
10/16/14 5:00:00	0.0	0.0	40.8	610.7	549.9
10/16/14 6:00:00	0.0	0.0	40.9	610.8	549.8
10/16/14 7:00:00	0.0	7.0	59.1	610.7	551.9
10/16/14 8:00:00	0.0	102.1	4.2	610.5	560.2
10/16/14 9:00:00	0.0	98.8	0.0	611.0	560.2
10/16/14 10:00:00	0.0	82.3	0.0	611.2	558.7
10/16/14 11:00:00	0.0	78.2	0.0	611.1	557.7
10/16/14 12:00:00	0.0	78.9	0.0	611.0	557.6
10/16/14 13:00:00	0.0	79.4	0.0	610.9	557.7
10/16/14 14:00:00	0.0	79.3	0.0	610.8	557.7
10/16/14 15:00:00	0.0	81.4	0.0	610.8	557.9

10/16/14 16:00:00	0.0	77.5	0.0	610.6	557.6
10/16/14 17:00:00	0.0	74.7	0.0	610.4	557.2
10/16/14 18:00:00	0.0	73.1	0.0	610.1	557.0
10/16/14 19:00:00	0.0	72.5	0.0	610.2	556.8
10/16/14 20:00:00	0.0	72.6	0.0	610.2	556.8
10/16/14 21:00:00	0.0	72.8	0.0	610.2	556.8
10/16/14 22:00:00	0.0	23.2	34.9	610.2	554.2
10/16/14 23:00:00	0.0	0.0	43.0	610.1	550.5
10/17/14 0:00:00	0.0	0.0	40.8	610.1	549.5
10/17/14 1:00:00	0.0	0.0	39.9	610.1	549.1
10/17/14 2:00:00	0.0	0.0	40.0	610.2	549.1
10/17/14 3:00:00	0.0	0.0	40.1	610.4	549.0
10/17/14 4:00:00	0.0	0.0	46.0	610.6	549.5
10/17/14 5:00:00	0.0	0.0	52.6	610.7	551.0
10/17/14 6:00:00	0.0	0.0	49.9	610.7	551.0
10/17/14 7:00:00	0.0	0.0	46.5	610.5	550.4
10/17/14 8:00:00	0.0	39.5	47.5	610.7	556.0
10/17/14 9:00:00	0.0	90.8	0.0	611.2	559.0
10/17/14 10:00:00	0.0	90.4	0.0	611.2	559.1
10/17/14 11:00:00	0.0	83.0	0.0	611.2	558.6
10/17/14 12:00:00	0.0	81.4	0.0	611.2	558.0
10/17/14 13:00:00	0.0	79.5	0.0	610.8	557.7
10/17/14 14:00:00	0.0	78.9	0.0	610.7	557.6
10/17/14 15:00:00	0.0	77.7	0.0	610.6	557.5
10/17/14 16:00:00	0.0	76.8	0.0	610.5	557.3
10/17/14 17:00:00	0.0	76.8	0.0	610.4	557.3
10/17/14 18:00:00	0.0	75.6	0.0	610.4	557.2
10/17/14 19:00:00	0.0	76.2	0.0	610.3	557.3
10/17/14 20:00:00	0.0	62.7	13.1	610.2	557.1
10/17/14 21:00:00	0.0	0.0	52.0	610.3	552.9
10/17/14 22:00:00	0.0	0.0	52.5	609.9	552.0
10/17/14 23:00:00	0.0	0.0	48.2	609.9	551.2
10/18/14 0:00:00	0.0	0.0	46.7	609.8	550.7
10/18/14 1:00:00	0.0	0.0	44.1	610.0	550.4
10/18/14 2:00:00	0.0	0.0	41.3	610.0	549.8
10/18/14 3:00:00	0.0	0.0	41.4	610.1	549.7
10/18/14 4:00:00	0.0	0.0	41.6	610.2	549.7
10/18/14 5:00:00	0.0	0.0	41.7	610.6	549.8
10/18/14 6:00:00	0.0	0.0	41.9	610.6	549.7
10/18/14 7:00:00	0.0	0.0	43.1	610.7	549.8
10/18/14 8:00:00	0.0	0.0	53.7	611.2	551.2
10/18/14 9:00:00	0.0	0.0	54.7	611.1	551.9
10/18/14 10:00:00	0.0	0.0	54.5	611.0	551.9

10/18/14 11:00:00	0.0	0.0	47.3	610.9	551.0
10/18/14 12:00:00	0.0	0.0	70.4	610.6	552.6
10/18/14 13:00:00	0.0	73.0	24.4	610.6	559.2
10/18/14 14:00:00	0.0	78.8	0.0	610.6	557.8
10/18/14 15:00:00	0.0	77.6	0.0	610.4	557.5
10/18/14 16:00:00	0.0	77.4	0.0	610.4	557.4
10/18/14 17:00:00	0.0	78.1	0.0	610.2	557.5
10/18/14 18:00:00	0.0	69.1	6.5	610.2	557.2
10/18/14 19:00:00	0.0	0.0	53.4	610.5	552.5
10/18/14 20:00:00	0.0	0.0	53.8	610.5	551.6
10/18/14 21:00:00	0.0	0.0	51.8	610.3	551.3
10/18/14 22:00:00	0.0	0.0	47.8	610.2	550.9
10/18/14 23:00:00	0.0	0.0	45.3	610.2	550.5
10/19/14 0:00:00	0.0	0.0	44.0	610.2	550.2
10/19/14 1:00:00	0.0	0.0	44.1	610.2	550.1
10/19/14 2:00:00	0.0	0.0	44.1	610.3	550.1
10/19/14 3:00:00	0.0	0.0	44.1	610.3	550.1
10/19/14 4:00:00	0.0	0.0	44.2	610.3	550.2
10/19/14 5:00:00	0.0	0.0	44.2	610.4	550.1
10/19/14 6:00:00	0.0	0.0	44.2	610.4	550.1
10/19/14 7:00:00	0.0	0.0	44.3	610.4	550.1
10/19/14 8:00:00	0.0	0.0	44.3	610.5	550.1
10/19/14 9:00:00	0.0	0.0	44.3	610.5	550.1
10/19/14 10:00:00	0.0	0.0	44.6	610.7	550.1
10/19/14 11:00:00	0.0	0.0	44.7	610.7	550.1
10/19/14 12:00:00	0.0	0.0	44.7	610.8	550.2
10/19/14 13:00:00	0.0	0.0	44.8	610.8	550.2
10/19/14 14:00:00	0.0	0.0	45.7	610.8	552.1
10/19/14 15:00:00	0.0	0.0	45.4	610.8	553.1
10/19/14 16:00:00	0.0	0.0	45.5	610.8	550.7
10/19/14 17:00:00	0.0	0.0	45.5	610.8	550.4
10/19/14 18:00:00	0.0	0.0	45.5	610.8	550.6
10/19/14 19:00:00	0.0	0.0	45.6	611.1	555.5
10/19/14 20:00:00	0.0	0.0	45.9	611.3	551.7
10/19/14 21:00:00	0.0	0.0	46.4	611.9	550.4
10/19/14 22:00:00	0.0	0.0	70.0	612.1	553.0
10/19/14 23:00:00	0.0	0.0	71.9	612.2	554.7
10/20/14 0:00:00	0.0	0.0	66.0	612.0	554.0
10/20/14 1:00:00	0.0	0.0	47.4	611.9	551.9
10/20/14 2:00:00	0.0	0.0	44.4	611.7	550.5
10/20/14 3:00:00	0.0	0.0	43.5	611.8	550.1
10/20/14 4:00:00	0.0	0.0	43.5	611.7	550.1
10/20/14 5:00:00	0.0	0.0	43.5	611.8	550.1

10/20/14 6:00:00	0.0	0.0	43.5	611.8	550.2
10/20/14 7:00:00	0.0	0.0	50.9	611.7	550.7
10/20/14 8:00:00	0.0	59.2	38.1	611.6	557.8
10/20/14 9:00:00	0.0	90.5	0.0	611.8	559.3
10/20/14 10:00:00	0.0	98.9	0.0	611.2	560.0
10/20/14 11:00:00	0.0	93.5	0.0	610.6	559.9
10/20/14 12:00:00	0.0	76.1	0.0	610.4	557.9
10/20/14 13:00:00	0.0	75.2	0.0	610.5	557.4
10/20/14 14:00:00	0.0	75.3	0.0	610.6	557.3
10/20/14 15:00:00	0.0	72.7	0.0	610.3	557.0
10/20/14 16:00:00	0.0	73.6	0.0	610.4	557.1
10/20/14 17:00:00	0.0	75.5	0.0	610.5	557.3
10/20/14 18:00:00	0.0	83.4	0.0	610.5	558.2
10/20/14 19:00:00	0.0	89.1	0.0	610.7	559.1
10/20/14 20:00:00	0.0	90.2	0.0	610.3	559.3
10/20/14 21:00:00	0.0	79.9	0.0	610.1	558.3
10/20/14 22:00:00	0.0	73.7	0.0	610.3	557.3
10/20/14 23:00:00	0.0	53.8	17.6	610.2	556.4
10/21/14 0:00:00	0.0	0.0	48.4	610.2	552.2
10/21/14 1:00:00	0.0	0.0	46.6	610.4	551.1
10/21/14 2:00:00	0.0	0.0	46.6	610.2	550.7
10/21/14 3:00:00	0.0	0.0	46.5	610.1	550.7
10/21/14 4:00:00	0.0	0.0	46.5	610.1	550.7
10/21/14 5:00:00	0.0	0.0	46.4	610.0	550.6
10/21/14 6:00:00	0.0	0.0	46.3	610.0	550.6
10/21/14 7:00:00	0.0	0.0	45.3	610.1	550.3
10/21/14 8:00:00	0.0	39.5	43.5	610.1	555.8
10/21/14 9:00:00	0.0	78.5	0.0	611.0	557.5
10/21/14 10:00:00	0.0	78.5	0.0	610.9	557.6
10/21/14 11:00:00	0.0	78.2	0.0	610.9	557.5
10/21/14 12:00:00	0.0	77.7	0.0	610.8	557.5
10/21/14 13:00:00	0.0	76.4	0.0	610.7	557.3
10/21/14 14:00:00	0.0	76.4	0.0	610.6	557.3
10/21/14 15:00:00	0.0	77.4	0.0	610.5	557.5
10/21/14 16:00:00	0.0	78.7	0.0	610.4	557.6
10/21/14 17:00:00	0.0	76.7	0.0	610.5	557.4
10/21/14 18:00:00	0.0	84.3	0.0	611.1	558.3
10/21/14 19:00:00	0.0	82.2	0.0	610.9	558.1
10/21/14 20:00:00	0.0	80.3	0.0	610.8	557.9
10/21/14 21:00:00	0.0	12.9	50.9	610.6	554.9
10/21/14 22:00:00	0.0	0.0	49.9	610.6	551.9
10/21/14 23:00:00	0.0	0.0	44.0	610.5	550.4
10/22/14 0:00:00	0.0	0.0	43.8	610.5	550.0

10/22/14 1:00:00	0.0	0.0	43.8	610.5	549.9
10/22/14 2:00:00	0.0	0.0	43.8	610.6	549.9
10/22/14 3:00:00	0.0	0.0	43.8	610.5	550.0
10/22/14 4:00:00	0.0	0.0	43.9	610.6	550.0
10/22/14 5:00:00	0.0	0.0	43.9	610.5	550.0
10/22/14 6:00:00	0.0	0.0	43.9	610.6	550.0
10/22/14 7:00:00	0.0	0.0	44.1	610.9	550.0
10/22/14 8:00:00	0.0	0.0	47.1	611.4	550.3
10/22/14 9:00:00	0.0	0.0	38.1	611.4	549.5
10/22/14 10:00:00	0.0	0.0	38.7	611.5	549.0
10/22/14 11:00:00	0.0	0.0	40.0	611.6	548.9
10/22/14 12:00:00	0.0	0.0	50.0	611.4	550.5
10/22/14 13:00:00	0.0	0.0	52.2	611.5	551.1
10/22/14 14:00:00	0.0	37.8	44.2	611.6	555.4
10/22/14 15:00:00	0.0	93.4	0.0	611.7	559.2
10/22/14 16:00:00	0.0	98.9	0.0	611.0	560.0
10/22/14 17:00:00	0.0	88.2	0.0	610.9	559.2
10/22/14 18:00:00	0.0	74.6	9.6	610.6	558.3
10/22/14 19:00:00	0.0	0.0	51.2	610.5	553.2
10/22/14 20:00:00	0.0	0.0	45.6	610.5	551.0
10/22/14 21:00:00	0.0	0.0	45.0	610.5	550.4
10/22/14 22:00:00	0.0	0.0	45.2	610.8	550.3
10/22/14 23:00:00	0.0	0.0	45.3	610.7	550.3
10/23/14 0:00:00	0.0	0.0	45.3	610.8	550.2
10/23/14 1:00:00	0.0	0.0	45.3	610.8	550.3
10/23/14 2:00:00	0.0	0.0	45.4	610.9	550.3
10/23/14 3:00:00	0.0	0.0	45.4	610.8	550.3
10/23/14 4:00:00	0.0	0.0	45.4	610.8	550.3
10/23/14 5:00:00	0.0	0.0	45.4	610.8	550.2
10/23/14 6:00:00	0.0	0.0	45.5	611.0	550.3
10/23/14 7:00:00	0.0	1.2	65.4	610.8	551.9
10/23/14 8:00:00	0.0	88.2	6.3	610.9	559.1
10/23/14 9:00:00	0.0	95.0	0.0	610.8	559.8
10/23/14 10:00:00	0.0	83.7	0.0	610.7	558.6
10/23/14 11:00:00	0.0	76.9	0.0	610.9	557.6
10/23/14 12:00:00	0.0	80.4	0.0	610.8	557.8
10/23/14 13:00:00	0.0	77.8	0.0	610.8	557.6
10/23/14 14:00:00	0.0	77.5	0.0	610.8	557.6
10/23/14 15:00:00	0.0	78.1	0.0	610.8	557.6
10/23/14 16:00:00	0.0	79.0	0.0	610.7	557.8
10/23/14 17:00:00	0.0	87.0	0.0	610.8	558.6
10/23/14 18:00:00	0.0	84.2	0.0	610.8	558.4
10/23/14 19:00:00	0.0	71.2	13.9	611.0	558.4

10/23/14 20:00:00	0.0	0.0	51.1	611.2	553.1
10/23/14 21:00:00	0.0	0.0	45.3	610.9	550.8
10/23/14 22:00:00	0.0	0.0	45.2	611.1	550.4
10/23/14 23:00:00	0.0	0.0	46.2	611.0	550.3
10/24/14 0:00:00	0.0	0.0	53.3	611.3	551.4
10/24/14 1:00:00	0.0	0.0	53.3	611.3	551.7
10/24/14 2:00:00	0.0	0.0	53.2	611.0	551.7
10/24/14 3:00:00	0.0	0.0	51.8	611.0	551.6
10/24/14 4:00:00	0.0	0.0	45.2	611.0	550.6
10/24/14 5:00:00	0.0	0.0	45.0	610.9	550.3
10/24/14 6:00:00	0.0	0.0	45.0	611.0	550.2
10/24/14 7:00:00	0.0	0.0	53.0	611.1	550.8
10/24/14 8:00:00	0.0	65.8	41.5	610.8	558.8
10/24/14 9:00:00	0.0	84.8	5.5	611.2	559.2
10/24/14 10:00:00	0.0	73.8	3.0	611.1	557.8
10/24/14 11:00:00	0.0	78.2	0.0	610.3	557.5
10/24/14 12:00:00	0.0	80.0	0.0	610.3	557.7
10/24/14 13:00:00	0.0	85.5	0.0	611.1	558.3
10/24/14 14:00:00	0.0	87.0	0.0	611.0	558.7
10/24/14 15:00:00	0.0	94.3	0.0	610.9	559.5
10/24/14 16:00:00	0.0	94.0	0.0	611.1	559.7
10/24/14 17:00:00	0.0	90.6	0.0	610.9	559.4
10/24/14 18:00:00	0.0	85.1	0.0	610.7	558.6
10/24/14 19:00:00	0.0	84.0	0.0	610.5	558.5
10/24/14 20:00:00	0.0	83.7	0.0	610.4	558.3
10/24/14 21:00:00	0.0	83.6	0.0	610.4	558.3
10/24/14 22:00:00	0.0	83.8	0.0	610.4	558.3
10/24/14 23:00:00	0.0	83.4	0.0	610.4	558.3
10/25/14 0:00:00	0.0	83.4	0.0	610.4	558.3
10/25/14 1:00:00	0.0	83.7	0.0	610.4	558.3
10/25/14 2:00:00	0.0	47.2	21.1	610.2	556.6
10/25/14 3:00:00	0.0	0.0	45.0	610.2	551.5
10/25/14 4:00:00	0.0	0.0	45.0	610.1	550.6
10/25/14 5:00:00	0.0	0.0	45.0	610.2	550.5
10/25/14 6:00:00	0.0	0.0	45.1	610.2	550.5
10/25/14 7:00:00	0.0	0.0	63.9	610.4	552.1
10/25/14 8:00:00	0.0	74.7	14.3	610.4	558.4
10/25/14 9:00:00	0.0	82.9	0.0	610.8	558.3
10/25/14 10:00:00	0.0	76.5	0.0	610.6	557.6
10/25/14 11:00:00	0.0	74.7	0.0	610.6	557.2
10/25/14 12:00:00	0.0	74.6	0.0	610.6	557.1
10/25/14 13:00:00	0.0	75.0	0.0	610.6	557.2
10/25/14 14:00:00	0.0	77.8	0.0	610.5	557.5

10/25/14 15:00:00	0.0	76.7	0.0	610.5	557.4
10/25/14 16:00:00	0.0	76.3	0.0	610.5	557.4
10/25/14 17:00:00	0.0	77.2	0.0	610.4	557.5
10/25/14 18:00:00	0.0	76.3	0.0	610.4	557.5
10/25/14 19:00:00	0.0	67.2	5.7	610.3	555.4
10/25/14 20:00:00	0.0	0.0	44.7	610.3	555.4
10/25/14 21:00:00	0.0	0.0	44.7	610.2	555.4
10/25/14 22:00:00	0.0	0.0	44.8	610.3	555.4
10/25/14 23:00:00	0.0	0.0	44.8	610.3	555.4
10/26/14 0:00:00	0.0	0.0	44.9	610.5	555.4
10/26/14 1:00:00	0.0	0.0	44.9	610.4	555.4
10/26/14 2:00:00	0.0	0.0	44.9	610.5	555.4
10/26/14 3:00:00	0.0	0.0	45.0	610.5	555.4
10/26/14 4:00:00	0.0	0.0	45.0	610.6	555.4
10/26/14 5:00:00	0.0	0.0	45.1	610.6	555.4
10/26/14 6:00:00	0.0	0.0	45.2	610.6	555.4
10/26/14 7:00:00	0.0	0.0	45.3	610.7	555.4
10/26/14 8:00:00	0.0	0.0	45.4	611.0	555.4
10/26/14 9:00:00	0.0	0.0	45.4	611.0	555.4
10/26/14 10:00:00	0.0	0.0	45.5	611.0	555.4
10/26/14 11:00:00	0.0	0.0	45.6	611.1	555.4
10/26/14 12:00:00	0.0	0.0	45.6	611.1	555.4
10/26/14 13:00:00	0.0	0.0	48.8	611.1	555.4
10/26/14 14:00:00	0.0	0.0	49.4	611.0	555.4
10/26/14 15:00:00	0.0	0.0	49.3	611.0	555.4
10/26/14 16:00:00	0.0	0.0	49.2	610.9	555.4
10/26/14 17:00:00	0.0	0.0	49.2	610.8	555.4
10/26/14 18:00:00	0.0	0.0	49.1	610.8	555.4
10/26/14 19:00:00	0.0	0.0	48.6	610.7	555.4
10/26/14 20:00:00	0.0	0.0	47.9	610.7	555.4
10/26/14 21:00:00	0.0	0.0	46.8	610.7	555.4
10/26/14 22:00:00	0.0	0.0	46.8	610.9	555.4
10/26/14 23:00:00	0.0	0.0	46.8	610.9	555.4
10/27/14 0:00:00	0.0	0.0	46.9	610.9	555.4
10/27/14 1:00:00	0.0	0.0	47.0	611.0	550.9
10/27/14 2:00:00	0.0	0.0	47.1	611.1	550.9
10/27/14 3:00:00	0.0	0.0	47.1	611.2	550.9
10/27/14 4:00:00	0.0	0.0	47.2	611.3	551.0
10/27/14 5:00:00	0.0	0.0	47.3	611.3	550.9
10/27/14 6:00:00	0.0	0.0	47.4	611.4	550.9
10/27/14 7:00:00	0.0	0.0	47.5	611.5	551.0
10/27/14 8:00:00	0.0	0.0	47.7	611.8	550.9
10/27/14 9:00:00	0.0	0.0	74.9	611.1	552.3

10/27/14 10:00:00	0.0	83.0	55.7	610.6	561.4
10/27/14 11:00:00	16.4	99.9	3.8	610.6	561.5
10/27/14 12:00:00	3.5	88.9	0.0	610.6	560.4
10/27/14 13:00:00	0.0	87.1	0.0	610.4	559.1
10/27/14 14:00:00	0.0	87.8	0.0	610.4	559.0
10/27/14 15:00:00	0.0	89.1	0.0	610.3	559.1
10/27/14 16:00:00	0.0	94.6	0.0	610.5	559.7
10/27/14 17:00:00	0.0	94.5	0.0	610.6	559.8
10/27/14 18:00:00	0.0	94.8	0.0	610.7	559.9
10/27/14 19:00:00	0.0	106.0	0.0	611.1	560.8
10/27/14 20:00:00	0.0	102.6	0.0	611.0	560.8
10/27/14 21:00:00	0.0	102.0	0.0	610.8	560.7
10/27/14 22:00:00	0.0	93.4	0.0	610.6	560.0
10/27/14 23:00:00	0.0	87.9	0.0	610.4	559.1
10/28/14 0:00:00	0.0	84.9	0.0	610.5	558.6
10/28/14 1:00:00	0.0	82.0	0.0	610.4	558.3
10/28/14 2:00:00	0.0	38.5	26.7	610.4	555.9
10/28/14 3:00:00	0.0	0.0	45.2	610.3	551.3
10/28/14 4:00:00	0.0	0.0	45.1	610.3	550.5
10/28/14 5:00:00	0.0	10.9	52.6	610.2	552.6
10/28/14 6:00:00	0.0	85.9	0.0	610.9	558.2
10/28/14 7:00:00	0.0	87.6	0.0	611.0	558.7
10/28/14 8:00:00	0.1	88.3	0.0	611.0	558.9
10/28/14 9:00:00	0.1	88.3	0.0	611.2	559.0
10/28/14 10:00:00	0.1	88.9	0.0	611.3	559.0
10/28/14 11:00:00	0.1	101.8	0.0	611.4	560.3
10/28/14 12:00:00	4.0	104.6	0.0	610.2	561.1
10/28/14 13:00:00	5.1	107.3	0.0	610.9	561.6
10/28/14 14:00:00	5.1	107.9	0.0	610.7	561.8
10/28/14 15:00:00	5.1	102.7	0.0	610.7	561.4
10/28/14 16:00:00	5.1	91.4	0.0	610.4	560.3
10/28/14 17:00:00	5.0	88.5	0.0	610.2	559.7
10/28/14 18:00:00	1.9	85.5	0.0	610.1	559.1
10/28/14 19:00:00	0.0	83.1	0.0	610.1	558.5
10/28/14 20:00:00	0.0	82.2	0.0	610.2	558.2
10/28/14 21:00:00	0.0	81.2	0.0	610.3	558.1
10/28/14 22:00:00	0.0	28.3	42.5	610.3	556.0
10/28/14 23:00:00	0.0	0.0	55.1	610.5	552.9
10/29/14 0:00:00	0.0	0.0	51.7	610.4	551.8
10/29/14 1:00:00	0.0	0.0	50.9	610.3	551.4
10/29/14 2:00:00	0.0	0.0	45.0	610.3	550.6
10/29/14 3:00:00	0.0	0.0	43.2	610.3	549.9
10/29/14 4:00:00	0.0	0.0	43.3	610.4	549.8

10/29/14 5:00:00	0.0	0.0	43.3	610.5	549.8
10/29/14 6:00:00	0.0	0.0	43.4	610.4	549.8
10/29/14 7:00:00	0.0	0.0	44.5	610.6	549.9
10/29/14 8:00:00	0.0	15.8	96.9	610.8	555.7
10/29/14 9:00:00	0.0	93.5	2.1	610.9	559.5
10/29/14 10:00:00	0.0	98.4	0.0	610.6	560.1
10/29/14 11:00:00	0.0	94.6	0.0	610.7	559.8
10/29/14 12:00:00	0.0	93.2	0.0	610.6	559.6
10/29/14 13:00:00	0.0	94.6	0.0	610.9	559.7
10/29/14 14:00:00	0.0	95.3	0.0	610.9	559.9
10/29/14 15:00:00	0.0	94.2	0.0	610.5	559.8
10/29/14 16:00:00	0.0	88.2	0.0	610.4	559.2
10/29/14 17:00:00	0.0	84.4	0.0	610.4	558.6
10/29/14 18:00:00	0.0	83.8	0.0	610.4	558.4
10/29/14 19:00:00	0.0	83.8	0.0	610.3	558.4
10/29/14 20:00:00	0.0	83.1	0.0	610.1	558.3
10/29/14 21:00:00	0.0	78.8	0.0	610.1	557.8
10/29/14 22:00:00	0.0	76.3	0.0	610.1	557.3
10/29/14 23:00:00	0.0	85.5	0.0	610.4	558.3
10/30/14 0:00:00	0.0	91.9	0.0	610.9	559.1
10/30/14 1:00:00	0.0	97.6	0.0	610.9	560.0
10/30/14 2:00:00	0.0	94.3	0.0	610.8	559.9
10/30/14 3:00:00	0.0	82.1	0.0	610.7	558.5
10/30/14 4:00:00	0.0	79.9	0.0	610.9	557.8
10/30/14 5:00:00	0.0	83.8	0.0	610.8	558.2
10/30/14 6:00:00	0.0	83.4	0.0	610.7	558.2
10/30/14 7:00:00	0.0	86.5	0.0	610.8	558.5
10/30/14 8:00:00	0.0	92.5	0.0	610.5	559.3
10/30/14 9:00:00	0.0	89.8	0.0	610.1	559.1
10/30/14 10:00:00	0.0	86.1	0.0	610.2	558.7
10/30/14 11:00:00	0.0	84.5	0.0	611.0	558.3
10/30/14 12:00:00	0.0	102.9	0.0	611.3	560.2
10/30/14 13:00:00	0.0	103.1	0.0	611.6	560.7
10/30/14 14:00:00	0.0	103.7	0.0	611.8	560.9
10/30/14 15:00:00	0.6	103.3	0.0	611.8	560.9
10/30/14 16:00:00	5.4	102.7	0.0	612.1	561.2
10/30/14 17:00:00	5.8	101.4	0.0	612.5	561.3
10/30/14 18:00:00	6.0	101.4	0.0	612.6	561.2
10/30/14 19:00:00	6.1	101.5	0.0	612.5	561.3
10/30/14 20:00:00	6.1	104.7	0.0	611.6	561.5
10/30/14 21:00:00	6.2	106.8	0.0	611.1	561.8
10/30/14 22:00:00	6.1	84.2	0.0	610.7	559.9
10/30/14 23:00:00	5.8	76.4	0.0	610.8	558.2

10/31/14 0:00:00	5.8	76.0	0.0	610.7	558.0
10/31/14 1:00:00	5.8	72.8	0.0	610.6	557.5
10/31/14 2:00:00	1.3	74.9	0.0	610.6	557.4
10/31/14 3:00:00	0.0	75.7	0.0	610.6	557.2
10/31/14 4:00:00	0.0	76.2	0.0	610.6	557.3
10/31/14 5:00:00	0.0	76.5	0.0	610.6	557.3
10/31/14 6:00:00	0.0	76.6	0.0	610.6	557.3
10/31/14 7:00:00	0.0	76.9	0.0	610.5	557.4
10/31/14 8:00:00	0.0	76.5	0.0	610.5	557.4
10/31/14 9:00:00	0.0	79.3	0.0	610.5	557.6
10/31/14 10:00:00	0.3	81.6	0.0	610.2	558.3
10/31/14 11:00:00	5.0	83.7	0.0	610.2	558.7
10/31/14 12:00:00	5.1	88.3	0.0	610.6	559.4
10/31/14 13:00:00	5.1	88.6	0.0	610.9	559.6
10/31/14 14:00:00	5.1	86.0	0.0	610.8	559.4
10/31/14 15:00:00	5.1	82.8	0.0	610.7	558.9
10/31/14 16:00:00	5.1	84.1	0.0	610.6	559.0
10/31/14 17:00:00	5.1	87.0	0.0	610.5	559.2
10/31/14 18:00:00	5.1	88.6	0.0	610.5	559.5
10/31/14 19:00:00	4.5	87.0	0.0	610.4	559.4
10/31/14 20:00:00	0.0	78.1	0.0	610.4	558.0
10/31/14 21:00:00	0.0	78.6	0.0	610.4	557.7
10/31/14 22:00:00	0.0	79.0	0.0	610.5	557.7
10/31/14 23:00:00	0.0	85.2	0.0	610.9	558.3
11/1/14 0:00:00	0.0	102.6	0.0	611.0	560.3
11/1/14 1:00:00	0.0	101.2	0.0	611.2	560.6
11/1/14 2:00:00	0.0	84.5	0.0	610.9	559.0
11/1/14 3:00:00	0.0	78.1	0.0	610.9	557.8
11/1/14 4:00:00	0.0	77.5	0.0	610.8	557.5
11/1/14 5:00:00	0.0	78.0	0.0	610.8	557.5
11/1/14 6:00:00	0.0	77.9	0.0	610.7	557.6
11/1/14 7:00:00	0.0	77.3	0.0	610.6	557.5
11/1/14 8:00:00	0.0	77.3	0.0	610.5	557.5
11/1/14 9:00:00	0.0	76.4	0.0	610.4	557.3
11/1/14 10:00:00	0.0	75.8	0.0	610.4	557.3
11/1/14 11:00:00	0.0	74.9	0.0	610.4	557.2
11/1/14 12:00:00	0.0	75.0	0.0	610.3	557.2
11/1/14 13:00:00	0.0	74.8	0.0	610.3	557.2
11/1/14 14:00:00	0.0	74.9	0.0	610.4	557.2
11/1/14 15:00:00	0.0	75.3	0.0	610.3	557.3
11/1/14 16:00:00	0.0	75.2	0.0	610.3	557.3
11/1/14 17:00:00	0.0	75.0	0.0	610.2	557.2
11/1/14 18:00:00	0.0	75.8	0.0	610.2	557.3

11/1/14 19:00:00	0.0	75.5	0.0	610.1	557.3
11/1/14 20:00:00	0.0	75.0	0.0	610.1	557.3
11/1/14 21:00:00	0.0	74.7	0.0	610.1	557.2
11/1/14 22:00:00	0.0	74.6	0.0	610.3	557.1
11/1/14 23:00:00	0.0	74.6	0.0	610.3	557.1
11/2/14 0:00:00	0.0	62.0	10.4	610.3	556.6
11/2/14 1:00:00	0.0	0.0	44.0	610.6	551.5
11/2/14 2:00:00	0.0	0.0	44.0	610.6	551.5
11/2/14 3:00:00	0.0	0.0	43.6	610.5	550.2
11/2/14 4:00:00	0.0	0.0	43.7	610.5	550.2
11/2/14 5:00:00	0.0	0.0	43.8	610.5	550.2
11/2/14 6:00:00	0.0	0.0	51.7	610.6	551.0
11/2/14 7:00:00	0.0	0.0	48.5	610.8	551.2
11/2/14 8:00:00	0.0	0.0	46.4	610.9	550.8
11/2/14 9:00:00	0.0	0.0	42.8	610.7	549.9
11/2/14 10:00:00	0.0	0.0	42.7	610.7	549.9
11/2/14 11:00:00	0.0	0.0	42.6	610.6	549.9
11/2/14 12:00:00	0.0	0.0	42.6	610.5	549.9
11/2/14 13:00:00	0.0	0.0	42.5	610.4	549.9
11/2/14 14:00:00	0.0	0.0	42.4	610.4	549.8
11/2/14 15:00:00	0.0	0.0	42.4	610.4	549.8
11/2/14 16:00:00	0.0	0.0	42.4	610.4	549.8
11/2/14 17:00:00	0.0	0.0	42.4	610.5	549.8
11/2/14 18:00:00	0.0	0.0	42.5	610.4	549.8
11/2/14 19:00:00	0.0	0.0	42.5	610.5	549.8
11/2/14 20:00:00	0.0	0.0	42.5	610.5	549.7
11/2/14 21:00:00	0.0	0.0	42.5	610.4	549.7
11/2/14 22:00:00	0.0	0.0	42.5	610.5	549.8
11/2/14 23:00:00	0.0	0.0	42.6	610.6	549.8
11/3/14 0:00:00	0.0	0.0	45.4	611.0	550.0
11/3/14 1:00:00	0.0	0.0	45.9	610.9	550.2
11/3/14 2:00:00	0.0	0.0	45.9	610.9	550.3
11/3/14 3:00:00	0.0	0.0	46.0	611.1	550.3
11/3/14 4:00:00	0.0	0.0	46.1	611.2	550.3
11/3/14 5:00:00	0.0	0.0	46.3	611.3	550.4
11/3/14 6:00:00	0.0	0.0	71.1	611.0	553.1
11/3/14 7:00:00	7.0	79.8	26.6	611.1	560.1
11/3/14 8:00:00	9.6	88.9	0.0	611.3	560.4
11/3/14 9:00:00	0.4	78.9	0.0	611.3	558.3
11/3/14 10:00:00	0.0	76.7	0.0	611.0	557.5
11/3/14 11:00:00	0.0	74.3	0.0	611.0	557.1
11/3/14 12:00:00	0.0	74.3	0.0	610.6	557.1
11/3/14 13:00:00	0.0	77.5	0.0	610.6	557.4

11/3/14 14:00:00	0.0	93.0	0.0	610.6	559.1
11/3/14 15:00:00	0.0	100.1	0.0	610.6	560.3
11/3/14 16:00:00	0.0	97.9	0.0	610.6	560.4
11/3/14 17:00:00	0.0	92.2	0.0	610.6	559.6
11/3/14 18:00:00	0.0	97.9	0.0	610.6	560.1
11/3/14 19:00:00	0.0	103.5	0.0	610.4	560.7
11/3/14 20:00:00	8.1	94.2	0.0	610.1	560.6
11/3/14 21:00:00	10.2	90.3	0.0	610.4	560.3
11/3/14 22:00:00	5.9	90.7	0.0	610.0	560.0
11/3/14 23:00:00	0.0	87.8	0.0	609.9	559.3
11/4/14 0:00:00	0.0	13.4	33.5	609.8	553.5
11/4/14 1:00:00	0.0	0.0	42.9	610.1	550.7
11/4/14 2:00:00	0.0	0.0	43.5	610.7	550.3
11/4/14 3:00:00	0.0	0.0	62.8	611.3	552.3
11/4/14 4:00:00	0.0	0.0	55.0	611.5	552.3
11/4/14 5:00:00	0.0	0.0	66.7	611.4	552.9
11/4/14 6:00:00	4.1	69.4	31.4	611.0	559.3
11/4/14 7:00:00	12.6	103.5	0.0	610.9	561.6
11/4/14 8:00:00	12.7	96.6	0.0	610.6	561.5
11/4/14 9:00:00	12.4	89.1	0.0	610.5	560.7
11/4/14 10:00:00	12.1	84.0	0.0	610.4	559.9
11/4/14 11:00:00	12.0	82.4	0.0	610.5	559.6
11/4/14 12:00:00	12.0	81.9	0.0	610.3	559.4
11/4/14 13:00:00	12.0	81.8	0.0	610.3	559.4
11/4/14 14:00:00	11.8	73.9	0.0	610.5	558.6
11/4/14 15:00:00	11.8	84.7	0.0	610.7	559.4
11/4/14 16:00:00	12.3	93.6	0.0	610.7	560.6
11/4/14 17:00:00	12.9	109.2	0.0	610.5	562.3
11/4/14 18:00:00	11.1	93.2	0.0	610.6	561.4
11/4/14 19:00:00	0.0	77.9	0.0	610.8	558.3
11/4/14 20:00:00	0.0	79.1	0.0	610.9	557.9
11/4/14 21:00:00	0.0	81.8	0.0	610.7	558.0
11/4/14 22:00:00	0.0	85.7	0.0	611.2	558.6
11/4/14 23:00:00	0.0	85.1	0.0	611.4	558.6
11/5/14 0:00:00	0.0	83.5	0.0	611.2	558.4
11/5/14 1:00:00	0.0	78.9	0.0	610.9	557.8
11/5/14 2:00:00	0.0	77.4	0.0	610.6	557.6
11/5/14 3:00:00	0.0	76.4	0.0	610.4	557.4
11/5/14 4:00:00	0.0	75.8	0.0	610.3	557.3
11/5/14 5:00:00	0.0	75.1	0.0	610.2	557.2
11/5/14 6:00:00	0.0	71.7	0.0	610.1	556.7
11/5/14 7:00:00	0.0	70.8	0.0	610.1	556.6
11/5/14 8:00:00	0.0	76.2	0.0	610.2	557.1

11/5/14 9:00:00	0.0	78.9	0.0	610.3	557.6
11/5/14 10:00:00	0.9	86.1	0.0	610.5	558.3
11/5/14 11:00:00	10.9	103.5	0.0	610.6	561.1
11/5/14 12:00:00	11.1	103.7	0.0	610.8	561.9
11/5/14 13:00:00	6.0	84.0	0.0	610.9	559.8
11/5/14 14:00:00	0.1	83.3	0.0	610.7	558.6
11/5/14 15:00:00	0.1	82.9	0.0	610.6	558.3
11/5/14 16:00:00	0.0	83.1	0.0	610.5	558.3
11/5/14 17:00:00	0.0	88.9	0.0	610.5	558.8
11/5/14 18:00:00	0.0	94.0	0.0	610.6	559.8
11/5/14 19:00:00	0.0	76.9	0.0	610.8	557.8
11/5/14 20:00:00	0.0	76.5	0.0	610.9	557.5
11/5/14 21:00:00	0.0	77.6	0.0	610.9	557.5
11/5/14 22:00:00	0.0	78.4	0.0	610.9	557.6
11/5/14 23:00:00	0.0	80.0	0.0	610.8	557.8
11/6/14 0:00:00	0.0	80.3	0.0	610.8	557.8
11/6/14 1:00:00	0.0	83.3	0.0	610.6	558.2
11/6/14 2:00:00	0.0	84.8	0.0	611.1	558.5
11/6/14 3:00:00	0.0	84.4	0.0	611.2	558.5
11/6/14 4:00:00	0.0	84.7	0.0	611.4	558.5
11/6/14 5:00:00	0.0	82.3	0.0	611.1	558.2
11/6/14 6:00:00	0.0	81.1	0.0	610.8	558.0
11/6/14 7:00:00	0.0	80.8	0.0	610.8	558.0
11/6/14 8:00:00	0.0	93.2	0.0	610.7	559.1
11/6/14 9:00:00	0.0	106.7	0.0	610.3	560.9
11/6/14 10:00:00	0.0	105.1	0.0	610.7	561.1
11/6/14 11:00:00	0.0	98.2	0.0	610.5	560.5
11/6/14 12:00:00	0.0	84.0	0.0	610.4	559.0
11/6/14 13:00:00	0.0	92.2	0.0	610.6	559.3
11/6/14 14:00:00	0.0	99.8	0.0	610.9	560.3
11/6/14 15:00:00	0.0	108.6	0.0	610.9	561.2
11/6/14 16:00:00	0.0	108.7	0.0	610.9	561.5
11/6/14 17:00:00	0.0	104.7	0.0	610.8	561.3
11/6/14 18:00:00	0.0	83.3	0.0	610.6	559.0
11/6/14 19:00:00	12.4	95.9	0.0	609.9	560.5
11/6/14 20:00:00	25.5	89.1	0.0	610.2	561.6
11/6/14 21:00:00	22.8	75.6	0.0	610.4	560.3
11/6/14 22:00:00	7.0	80.9	0.0	611.0	559.3
11/6/14 23:00:00	0.0	77.6	0.0	611.1	557.9
11/7/14 0:00:00	0.0	78.4	0.0	610.9	557.7
11/7/14 1:00:00	0.0	78.3	0.0	610.9	557.7
11/7/14 2:00:00	0.0	74.8	0.0	610.6	557.2
11/7/14 3:00:00	0.0	72.5	0.0	610.3	556.9

11/7/14 4:00:00	0.0	72.6	0.0	610.0	556.8
11/7/14 5:00:00	0.0	73.2	0.0	610.3	556.8
11/7/14 6:00:00	0.0	74.9	0.0	610.3	557.1
11/7/14 7:00:00	0.0	74.7	0.0	610.4	557.1
11/7/14 8:00:00	0.0	97.4	0.0	610.3	559.2
11/7/14 9:00:00	0.0	96.5	0.0	610.1	560.1
11/7/14 10:00:00	0.0	88.0	0.0	610.1	559.1
11/7/14 11:00:00	0.0	87.3	0.0	609.9	558.9
11/7/14 12:00:00	0.0	84.0	0.0	609.8	558.5
11/7/14 13:00:00	0.0	81.4	0.0	609.7	558.1
11/7/14 14:00:00	0.0	80.1	0.0	609.6	557.9
11/7/14 15:00:00	0.0	77.9	0.0	609.7	557.7
11/7/14 16:00:00	0.0	78.0	0.0	609.7	557.5
11/7/14 17:00:00	0.0	77.6	0.0	609.8	557.5
11/7/14 18:00:00	0.0	77.9	0.0	609.9	557.5
11/7/14 19:00:00	3.3	89.3	0.0	610.5	558.7
11/7/14 20:00:00	11.1	105.2	0.0	610.6	561.5
11/7/14 21:00:00	10.2	94.9	0.0	610.5	561.1
11/7/14 22:00:00	9.1	83.6	0.0	610.6	559.6
11/7/14 23:00:00	9.0	83.3	0.0	610.8	559.2
11/8/14 0:00:00	8.9	83.0	0.0	610.7	559.2
11/8/14 1:00:00	8.8	82.2	0.0	610.8	559.0
11/8/14 2:00:00	9.0	84.5	0.0	610.6	559.3
11/8/14 3:00:00	18.3	91.6	0.0	610.2	560.6
11/8/14 4:00:00	24.4	94.5	0.0	610.1	561.9
11/8/14 5:00:00	22.3	88.7	0.0	610.2	561.5
11/8/14 6:00:00	9.5	88.9	0.0	610.3	560.4
11/8/14 7:00:00	7.9	83.0	0.0	610.4	559.3
11/8/14 8:00:00	0.0	81.9	0.0	610.3	558.4
11/8/14 9:00:00	0.0	80.3	0.0	610.5	558.0
11/8/14 10:00:00	0.0	81.4	0.0	610.9	558.0
11/8/14 11:00:00	0.0	81.8	0.0	610.9	558.0
11/8/14 12:00:00	0.0	82.4	0.0	611.2	558.1
11/8/14 13:00:00	0.0	84.0	0.0	611.7	558.4
11/8/14 14:00:00	0.0	87.3	0.0	611.7	558.8
11/8/14 15:00:00	0.0	87.4	0.0	611.9	559.0
11/8/14 16:00:00	0.0	89.9	0.0	611.9	559.2
11/8/14 17:00:00	0.0	95.8	0.0	612.0	559.8
11/8/14 18:00:00	0.0	101.4	0.0	612.1	560.6
11/8/14 19:00:00	0.0	101.8	0.0	611.6	560.7
11/8/14 20:00:00	5.0	95.7	0.0	611.4	560.5
11/8/14 21:00:00	9.4	87.3	0.0	611.2	559.9
11/8/14 22:00:00	9.5	88.9	0.0	611.2	560.0

11/8/14 23:00:00	9.8	91.6	0.0	611.2	560.3
11/9/14 0:00:00	9.5	88.1	0.0	611.0	560.1
11/9/14 1:00:00	8.7	79.4	0.0	611.0	558.9
11/9/14 2:00:00	8.8	81.1	0.0	611.1	558.9
11/9/14 3:00:00	8.9	82.4	0.0	611.2	559.0
11/9/14 4:00:00	9.0	84.8	0.0	611.1	559.3
11/9/14 5:00:00	9.0	83.7	0.0	610.7	559.4
11/9/14 6:00:00	3.8	77.6	0.0	610.6	558.2
11/9/14 7:00:00	0.0	78.0	0.0	610.6	557.7
11/9/14 8:00:00	0.0	76.8	0.0	610.6	557.4
11/9/14 9:00:00	0.0	77.6	0.0	610.8	557.5
11/9/14 10:00:00	0.0	79.6	0.0	611.2	557.7
11/9/14 11:00:00	0.0	82.4	0.0	611.9	558.1
11/9/14 12:00:00	0.0	84.0	0.0	612.1	558.3
11/9/14 13:00:00	0.0	83.1	0.0	612.0	558.3
11/9/14 14:00:00	0.0	79.0	0.0	611.7	558.0
11/9/14 15:00:00	0.0	76.8	0.0	610.8	557.4
11/9/14 16:00:00	0.0	80.3	0.0	611.0	557.8
11/9/14 17:00:00	0.0	81.0	0.0	610.9	558.0
11/9/14 18:00:00	0.0	81.7	0.0	610.7	558.1
11/9/14 19:00:00	0.0	78.6	0.0	610.7	557.7
11/9/14 20:00:00	0.0	79.3	0.0	610.9	557.8
11/9/14 21:00:00	0.0	82.0	0.0	611.0	557.9
11/9/14 22:00:00	9.2	99.3	0.0	610.9	560.4
11/9/14 23:00:00	10.7	99.3	0.0	610.9	561.4
11/10/14 0:00:00	8.8	81.0	0.0	610.8	559.4
11/10/14 1:00:00	0.0	82.0	0.0	610.7	558.3
11/10/14 2:00:00	0.0	83.7	0.0	610.9	558.3
11/10/14 3:00:00	0.0	84.1	0.0	611.1	558.3
11/10/14 4:00:00	0.0	78.6	0.0	611.0	557.7
11/10/14 5:00:00	0.0	82.0	0.0	610.9	557.9
11/10/14 6:00:00	0.0	82.4	0.0	610.8	558.1
11/10/14 7:00:00	0.0	84.0	0.0	610.8	558.3
11/10/14 8:00:00	0.0	83.8	0.0	610.8	558.3
11/10/14 9:00:00	0.0	83.2	0.0	611.0	558.3
11/10/14 10:00:00	0.0	82.9	0.0	611.1	558.2
11/10/14 11:00:00	0.0	84.0	0.0	611.2	558.3
11/10/14 12:00:00	0.0	85.2	0.0	611.1	558.5
11/10/14 13:00:00	0.0	84.7	0.0	611.1	558.5
11/10/14 14:00:00	0.0	85.5	0.0	611.0	558.6
11/10/14 15:00:00	0.0	86.0	0.0	611.1	558.6
11/10/14 16:00:00	0.0	94.4	0.0	611.2	559.5
11/10/14 17:00:00	10.5	95.2	0.0	611.5	560.6

11/10/14 18:00:00	11.0	94.7	0.0	611.8	560.9
11/10/14 19:00:00	10.9	87.2	0.0	611.3	560.3
11/10/14 20:00:00	10.7	82.3	0.0	611.3	559.5
11/10/14 21:00:00	4.1	80.0	0.0	611.1	558.6
11/10/14 22:00:00	0.0	82.0	0.0	611.0	558.2
11/10/14 23:00:00	0.0	85.9	0.0	610.9	558.4
11/11/14 0:00:00	0.0	94.5	0.0	610.7	559.6
11/11/14 1:00:00	0.0	84.2	0.0	610.7	558.6
11/11/14 2:00:00	0.0	79.9	0.0	611.1	557.9
11/11/14 3:00:00	0.0	83.9	0.0	611.2	558.2
11/11/14 4:00:00	0.0	80.0	0.0	611.1	557.9
11/11/14 5:00:00	0.0	79.3	0.0	611.1	557.7
11/11/14 6:00:00	0.0	76.8	0.0	611.0	557.4
11/11/14 7:00:00	0.0	79.1	0.0	611.0	557.6
11/11/14 8:00:00	0.0	79.3	0.0	611.0	557.7
11/11/14 9:00:00	0.0	81.6	0.0	610.9	557.9
11/11/14 10:00:00	1.3	89.3	0.0	611.3	558.8
11/11/14 11:00:00	16.5	98.9	0.0	611.5	561.3
11/11/14 12:00:00	19.5	99.7	0.0	611.6	562.2
11/11/14 13:00:00	19.6	96.8	0.0	611.4	562.1
11/11/14 14:00:00	13.9	93.6	0.0	611.0	561.4
11/11/14 15:00:00	9.4	87.5	0.0	610.7	560.2
11/11/14 16:00:00	0.0	90.1	0.0	610.4	559.4
11/11/14 17:00:00	0.0	92.0	0.0	610.5	559.4
11/11/14 18:00:00	0.0	87.5	0.0	610.6	559.1
11/11/14 19:00:00	0.0	84.2	0.0	610.5	558.5
11/11/14 20:00:00	0.0	82.4	0.0	610.5	558.2
11/11/14 21:00:00	0.0	82.1	0.0	610.3	558.1
11/11/14 22:00:00	0.0	78.6	0.0	610.4	557.7
11/11/14 23:00:00	0.0	79.2	0.0	610.3	557.7
11/12/14 0:00:00	0.0	79.3	0.0	610.3	557.7
11/12/14 1:00:00	0.0	79.1	0.0	610.7	557.7
11/12/14 2:00:00	0.1	78.8	0.0	610.6	557.6
11/12/14 3:00:00	0.1	79.8	0.0	610.7	557.7
11/12/14 4:00:00	0.1	79.2	0.0	610.6	557.7
11/12/14 5:00:00	0.1	79.4	0.0	610.6	557.7
11/12/14 6:00:00	0.1	81.2	0.0	610.6	557.9
11/12/14 7:00:00	3.9	88.1	0.0	610.9	558.9
11/12/14 8:00:00	10.9	94.6	0.0	611.2	560.5
11/12/14 9:00:00	11.1	97.7	0.0	611.2	561.2
11/12/14 10:00:00	11.2	90.8	0.0	610.8	560.6
11/12/14 11:00:00	11.1	85.0	0.0	610.6	559.9
11/12/14 12:00:00	11.0	84.0	0.0	610.4	559.6

11/12/14 13:00:00	11.0	91.2	0.0	610.7	560.2
11/12/14 14:00:00	11.2	97.1	0.0	611.0	561.2
11/12/14 15:00:00	11.3	99.9	0.0	611.2	561.6
11/12/14 16:00:00	11.4	99.9	0.0	611.0	561.7
11/12/14 17:00:00	11.4	97.4	0.0	610.9	561.4
11/12/14 18:00:00	11.5	95.7	0.0	610.8	561.2
11/12/14 19:00:00	11.4	96.6	0.0	610.5	561.3
11/12/14 20:00:00	11.3	98.4	0.0	610.8	561.5
11/12/14 21:00:00	11.2	98.3	0.0	611.5	561.5
11/12/14 22:00:00	11.2	100.6	0.0	611.7	561.7
11/12/14 23:00:00	11.3	103.7	0.0	611.6	562.0
11/13/14 0:00:00	11.4	106.2	0.0	611.5	562.3
11/13/14 1:00:00	11.4	102.9	0.0	611.6	562.1
11/13/14 2:00:00	11.4	102.5	0.0	611.7	562.0
11/13/14 3:00:00	11.3	101.9	0.0	611.9	561.9
11/13/14 4:00:00	11.2	101.2	0.0	611.6	561.8
11/13/14 5:00:00	11.1	91.4	0.0	611.4	560.8
11/13/14 6:00:00	11.1	95.5	0.0	611.5	560.9
11/13/14 7:00:00	11.1	96.8	0.0	611.4	561.1
11/13/14 8:00:00	11.2	96.7	0.0	611.1	561.1
11/13/14 9:00:00	13.2	101.0	0.0	611.1	561.6
11/13/14 10:00:00	19.6	106.9	0.0	611.1	562.8
11/13/14 11:00:00	19.6	101.4	0.0	610.9	562.7
11/13/14 12:00:00	19.6	103.8	0.0	611.0	562.9
11/13/14 13:00:00	19.6	100.2	0.0	611.0	562.6
11/13/14 14:00:00	19.2	94.6	0.0	610.9	562.0
11/13/14 15:00:00	11.5	88.5	0.0	610.4	560.7
11/13/14 16:00:00	11.1	87.2	0.0	610.3	560.2
11/13/14 17:00:00	21.6	100.6	0.0	610.4	561.8
11/13/14 18:00:00	36.0	109.9	0.0	610.4	564.8
11/13/14 19:00:00	39.5	100.8	0.0	611.4	564.6
11/13/14 20:00:00	39.5	98.8	0.0	611.5	564.5
11/13/14 21:00:00	39.4	93.1	0.0	611.4	564.0
11/13/14 22:00:00	39.4	90.7	0.0	611.4	563.6
11/13/14 23:00:00	39.4	90.5	0.0	611.2	563.5
11/14/14 0:00:00	31.2	93.0	0.0	611.2	563.1
11/14/14 1:00:00	20.0	89.4	0.0	611.5	561.7
11/14/14 2:00:00	18.7	91.2	0.0	611.7	561.3
11/14/14 3:00:00	14.3	89.4	0.0	611.5	560.9
11/14/14 4:00:00	10.1	87.7	0.0	611.1	560.2
11/14/14 5:00:00	0.0	91.2	0.0	610.8	559.6
11/14/14 6:00:00	0.0	89.2	0.0	610.9	559.2
11/14/14 7:00:00	2.2	89.2	0.0	610.6	559.1

11/14/14 8:00:00	36.9	97.5	0.0	610.1	562.8
11/14/14 9:00:00	41.2	94.1	0.0	610.1	563.7
11/14/14 10:00:00	37.7	102.1	0.0	611.0	564.4
11/14/14 11:00:00	36.9	93.9	0.0	611.0	563.8
11/14/14 12:00:00	15.7	95.8	0.0	610.9	562.3
11/14/14 13:00:00	10.4	84.4	0.0	610.7	560.1
11/14/14 14:00:00	11.9	88.3	0.0	610.8	560.1
11/14/14 15:00:00	23.7	98.7	0.0	610.6	563.0
11/14/14 16:00:00	16.3	101.6	0.0	610.5	562.9
11/14/14 17:00:00	9.5	77.6	0.0	610.4	559.8
11/14/14 18:00:00	12.1	78.6	0.0	610.3	558.6
11/14/14 19:00:00	38.9	105.8	0.0	610.1	563.9
11/14/14 20:00:00	38.3	95.5	0.0	610.4	564.0
11/14/14 21:00:00	29.8	86.4	0.0	610.5	562.5
11/14/14 22:00:00	27.0	90.0	0.0	610.5	561.9
11/14/14 23:00:00	27.0	91.4	0.0	610.6	562.1
11/15/14 0:00:00	25.1	83.1	0.0	610.2	561.2
11/15/14 1:00:00	11.2	85.5	0.0	610.2	560.1
11/15/14 2:00:00	11.0	84.1	0.0	610.2	559.6
11/15/14 3:00:00	10.9	79.7	0.0	610.1	559.0
11/15/14 4:00:00	10.9	79.9	0.0	610.2	558.9
11/15/14 5:00:00	10.8	79.5	0.0	610.3	558.8
11/15/14 6:00:00	10.7	80.1	0.0	610.4	558.9
11/15/14 7:00:00	10.6	75.8	0.0	610.3	558.4
11/15/14 8:00:00	11.0	95.1	0.0	610.6	560.1
11/15/14 9:00:00	11.4	106.6	0.0	610.8	561.9
11/15/14 10:00:00	11.7	108.3	0.0	610.8	562.4
11/15/14 11:00:00	11.4	96.1	0.0	610.7	561.5
11/15/14 12:00:00	11.0	80.3	0.0	610.6	559.7
11/15/14 13:00:00	6.2	73.3	0.0	610.4	558.1
11/15/14 14:00:00	0.0	76.7	0.0	610.5	557.6
11/15/14 15:00:00	0.0	83.8	0.0	610.8	558.2
11/15/14 16:00:00	3.3	92.8	0.0	610.8	559.5
11/15/14 17:00:00	11.4	107.6	0.0	610.6	561.9
11/15/14 18:00:00	24.5	98.1	0.0	610.6	562.6
11/15/14 19:00:00	31.8	102.2	0.0	611.0	563.6
11/15/14 20:00:00	33.3	105.9	0.0	611.5	564.4
11/15/14 21:00:00	33.5	107.4	0.0	611.1	564.6
11/15/14 22:00:00	33.5	106.0	0.0	610.8	564.6
11/15/14 23:00:00	32.8	98.7	0.0	610.6	564.0
11/16/14 0:00:00	27.3	89.1	0.0	610.6	562.4
11/16/14 1:00:00	27.2	86.9	0.0	610.7	561.8
11/16/14 2:00:00	27.2	86.3	0.0	610.6	561.6

11/16/14 3:00:00	27.1	83.7	0.0	610.6	561.3
11/16/14 4:00:00	22.1	84.8	0.0	610.6	561.0
11/16/14 5:00:00	11.0	79.1	0.0	610.3	559.4
11/16/14 6:00:00	10.8	76.7	0.0	610.2	558.6
11/16/14 7:00:00	10.7	78.8	0.0	610.2	558.6
11/16/14 8:00:00	24.6	87.2	0.0	610.6	560.5
11/16/14 9:00:00	25.8	107.3	0.0	610.8	563.4
11/16/14 10:00:00	31.3	91.0	0.0	610.7	562.9
11/16/14 11:00:00	31.7	87.5	0.0	611.0	562.4
11/16/14 12:00:00	29.6	96.6	0.0	611.0	563.0
11/16/14 13:00:00	25.7	92.5	0.0	610.9	562.5
11/16/14 14:00:00	25.5	77.3	0.0	610.7	561.0
11/16/14 15:00:00	25.4	81.7	0.0	611.0	560.7
11/16/14 16:00:00	25.7	104.6	0.0	611.2	563.1
11/16/14 17:00:00	31.9	110.3	0.0	611.3	564.4
11/16/14 18:00:00	33.1	110.0	0.0	611.4	564.9
11/16/14 19:00:00	33.8	107.9	0.0	611.4	564.8
11/16/14 20:00:00	34.3	107.0	0.0	611.6	564.8
11/16/14 21:00:00	35.3	105.9	0.0	611.9	564.7
11/16/14 22:00:00	35.2	104.0	0.0	612.0	564.5
11/16/14 23:00:00	24.1	96.6	0.0	611.3	563.3
11/17/14 0:00:00	11.3	86.6	0.0	610.8	560.7
11/17/14 1:00:00	10.9	78.0	0.0	610.6	559.2
11/17/14 2:00:00	1.0	83.8	0.0	610.4	558.6
11/17/14 3:00:00	0.0	84.1	0.0	610.3	558.4
11/17/14 4:00:00	0.1	85.8	0.0	610.2	558.5
11/17/14 5:00:00	0.1	93.6	0.0	610.2	559.4
11/17/14 6:00:00	0.1	95.2	0.0	610.4	559.7
11/17/14 7:00:00	0.1	98.7	0.0	610.7	560.1
11/17/14 8:00:00	15.2	101.8	0.0	610.9	561.4
11/17/14 9:00:00	32.6	115.8	0.0	610.9	564.5
11/17/14 10:00:00	30.7	103.7	0.0	610.5	564.3
11/17/14 11:00:00	20.8	95.2	0.0	610.3	562.6
11/17/14 12:00:00	5.2	90.5	0.0	610.3	560.6
11/17/14 13:00:00	0.0	80.0	0.0	610.5	558.4
11/17/14 14:00:00	0.1	78.4	0.0	610.5	557.8
11/17/14 15:00:00	0.2	91.2	0.0	611.0	558.9
11/17/14 16:00:00	20.8	96.5	0.0	611.0	561.4
11/17/14 17:00:00	26.1	100.9	0.0	611.2	562.9
11/17/14 18:00:00	26.4	104.8	0.0	611.0	563.5
11/17/14 19:00:00	28.2	109.0	0.0	611.3	564.1
11/17/14 20:00:00	28.4	111.2	0.0	611.7	564.5
11/17/14 21:00:00	25.1	100.4	0.0	611.2	563.6

11/17/14 22:00:00	11.5	88.3	0.0	610.7	561.0
11/17/14 23:00:00	11.0	85.8	0.0	610.7	560.1
11/18/14 0:00:00	10.3	77.8	0.0	610.5	559.1
11/18/14 1:00:00	0.0	80.7	0.0	610.3	558.2
11/18/14 2:00:00	0.0	81.8	0.0	610.5	558.1
11/18/14 3:00:00	1.0	88.2	0.0	611.2	558.6
11/18/14 4:00:00	11.1	105.0	0.0	611.6	561.4
11/18/14 5:00:00	11.4	103.6	0.0	611.4	562.0
11/18/14 6:00:00	11.6	102.3	0.0	611.3	561.9
11/18/14 7:00:00	11.5	98.7	0.0	610.8	561.7
11/18/14 8:00:00	13.9	90.3	0.0	610.6	560.8
11/18/14 9:00:00	18.7	98.7	0.0	611.1	561.8
11/18/14 10:00:00	18.9	105.9	0.0	611.3	562.8
11/18/14 11:00:00	19.0	109.5	0.0	611.7	563.3
11/18/14 12:00:00	19.0	111.3	0.0	611.6	563.5
11/18/14 13:00:00	19.0	107.0	0.0	611.6	563.4
11/18/14 14:00:00	18.7	97.0	0.0	611.7	562.3
11/18/14 15:00:00	18.8	99.2	0.0	611.8	562.4
11/18/14 16:00:00	13.5	93.7	0.0	612.2	561.5
11/18/14 17:00:00	11.0	95.8	0.0	611.9	561.4
11/18/14 18:00:00	11.0	90.8	0.0	611.4	560.8
11/18/14 19:00:00	24.5	107.0	0.0	611.3	562.9
11/18/14 20:00:00	26.7	113.4	0.0	611.2	564.4
11/18/14 21:00:00	26.8	111.4	0.0	611.0	564.5
11/18/14 22:00:00	26.6	99.5	0.0	610.9	563.5
11/18/14 23:00:00	26.8	111.3	0.0	610.6	564.0
11/19/14 0:00:00	26.9	114.8	0.0	610.3	564.7
11/19/14 1:00:00	26.8	104.4	0.0	610.6	564.0
11/19/14 2:00:00	26.6	95.7	0.0	611.0	562.9
11/19/14 3:00:00	26.6	97.8	0.0	611.1	562.9
11/19/14 4:00:00	26.4	85.2	0.0	611.1	561.8
11/19/14 5:00:00	23.9	76.2	0.0	611.0	560.3
11/19/14 6:00:00	25.7	85.9	0.0	610.8	561.0
11/19/14 7:00:00	25.8	90.2	0.0	611.2	561.6
11/19/14 8:00:00	18.6	89.7	0.0	610.9	561.3
11/19/14 9:00:00	18.1	88.4	0.0	611.1	560.9
11/19/14 10:00:00	18.2	90.1	0.0	611.1	561.1
11/19/14 11:00:00	18.7	97.3	0.0	611.4	561.8
11/19/14 12:00:00	31.0	100.4	0.0	611.5	563.2
11/19/14 13:00:00	33.2	107.1	0.0	611.5	564.3
11/19/14 14:00:00	43.9	104.3	0.0	611.5	565.3
11/19/14 15:00:00	31.7	101.5	0.0	611.4	564.3
11/19/14 16:00:00	26.0	90.5	0.0	611.3	562.6

11/19/14 17:00:00	25.8	86.0	0.0	611.3	561.7
11/19/14 18:00:00	25.7	86.2	0.0	611.3	561.5
11/19/14 19:00:00	26.0	110.9	0.0	611.5	563.6
11/19/14 20:00:00	26.0	113.6	0.0	611.5	564.4
11/19/14 21:00:00	26.2	111.5	0.0	611.3	564.4
11/19/14 22:00:00	26.0	98.5	0.0	611.1	563.4
11/19/14 23:00:00	20.3	80.3	0.0	611.0	560.8
11/20/14 0:00:00	10.4	91.1	0.0	610.8	560.5
11/20/14 1:00:00	10.5	90.3	0.0	610.9	560.3
11/20/14 2:00:00	10.5	95.2	0.0	611.1	560.8
11/20/14 3:00:00	10.4	89.7	0.0	611.0	560.4
11/20/14 4:00:00	8.3	79.0	0.0	611.0	558.9
11/20/14 5:00:00	0.0	81.5	0.0	611.2	558.2
11/20/14 6:00:00	0.0	86.4	0.0	611.2	558.5
11/20/14 7:00:00	2.2	92.4	0.0	611.2	559.4
11/20/14 8:00:00	19.7	100.2	0.0	611.1	561.6
11/20/14 9:00:00	32.1	105.8	0.0	611.1	563.8
11/20/14 10:00:00	32.1	94.4	0.0	611.0	563.3
11/20/14 11:00:00	32.5	91.8	0.0	611.1	562.9
11/20/14 12:00:00	25.5	91.8	0.0	611.1	562.5
11/20/14 13:00:00	15.8	86.5	0.0	611.2	560.8
11/20/14 14:00:00	18.4	85.5	0.0	611.1	560.7
11/20/14 15:00:00	15.9	84.6	0.0	610.9	560.4
11/20/14 16:00:00	11.1	88.4	0.0	610.7	560.3
11/20/14 17:00:00	11.1	84.5	0.0	610.5	559.8
11/20/14 18:00:00	10.9	80.4	0.0	610.3	559.3
11/20/14 19:00:00	10.8	77.5	0.0	610.5	558.8
11/20/14 20:00:00	10.8	79.1	0.0	610.7	558.9
11/20/14 21:00:00	10.8	85.4	0.0	610.8	559.5
11/20/14 22:00:00	10.9	86.3	0.0	610.9	559.8
11/20/14 23:00:00	10.9	87.0	0.0	610.9	559.9
11/21/14 0:00:00	10.3	80.6	0.0	610.6	559.3
11/21/14 1:00:00	9.4	77.1	0.0	610.5	558.5
11/21/14 2:00:00	10.1	82.6	0.0	611.0	559.0
11/21/14 3:00:00	10.6	87.9	0.0	611.0	559.8
11/21/14 4:00:00	10.5	99.1	0.0	610.9	561.0
11/21/14 5:00:00	10.3	95.6	0.0	610.6	561.1
11/21/14 6:00:00	9.2	81.4	0.0	610.8	559.4
11/21/14 7:00:00	10.1	78.0	0.0	610.8	558.7
11/21/14 8:00:00	12.5	98.5	0.0	610.5	560.6
11/21/14 9:00:00	17.6	110.6	0.0	610.5	562.9
11/21/14 10:00:00	17.9	106.4	0.0	610.2	563.0
11/21/14 11:00:00	17.9	102.8	0.0	610.2	562.7

11/21/14 12:00:00	13.9	98.2	0.0	610.0	562.0
11/21/14 13:00:00	11.9	92.2	0.0	610.0	560.9
11/21/14 14:00:00	11.6	91.5	0.0	610.3	560.7
11/21/14 15:00:00	11.6	95.6	0.0	610.7	561.0
11/21/14 16:00:00	11.7	105.3	0.0	611.0	562.0
11/21/14 17:00:00	11.9	102.6	0.0	611.0	562.1
11/21/14 18:00:00	11.7	95.3	0.0	610.9	561.4
11/21/14 19:00:00	11.5	88.1	0.0	610.4	560.4
11/21/14 20:00:00	11.3	86.7	0.0	610.2	559.9
11/21/14 21:00:00	11.8	99.5	0.0	610.2	561.3
11/21/14 22:00:00	11.8	98.7	0.0	610.4	561.5
11/21/14 23:00:00	11.8	97.7	0.0	610.6	561.4
11/22/14 0:00:00	10.2	96.5	0.0	610.6	561.4
11/22/14 1:00:00	0.0	97.2	0.0	610.4	560.4
11/22/14 2:00:00	0.0	100.4	0.0	610.5	560.5
11/22/14 3:00:00	0.0	100.3	0.0	610.3	560.5
11/22/14 4:00:00	0.0	99.0	0.0	610.6	560.4
11/22/14 5:00:00	0.0	99.6	0.0	610.4	560.4
11/22/14 6:00:00	0.0	101.8	0.0	610.1	560.6
11/22/14 7:00:00	0.0	86.2	0.0	610.4	559.3
11/22/14 8:00:00	0.0	76.2	0.0	610.4	557.6
11/22/14 9:00:00	0.0	75.7	0.0	610.5	557.6
11/22/14 10:00:00	0.0	79.3	0.0	610.4	558.6
11/22/14 11:00:00	0.0	91.2	0.0	610.6	560.4
11/22/14 12:00:00	0.0	97.3	0.0	611.0	561.9
11/22/14 13:00:00	0.0	99.8	0.0	611.1	562.5
11/22/14 14:00:00	0.0	94.5	0.0	611.4	561.7
11/22/14 15:00:00	0.0	81.6	0.0	611.2	560.2
11/22/14 16:00:00	0.0	77.6	0.0	611.1	559.0
11/22/14 17:00:00	0.0	74.9	0.0	611.1	558.7
11/22/14 18:00:00	0.0	78.7	0.0	611.0	559.2
11/22/14 19:00:00	0.0	94.4	0.0	611.0	560.3
11/22/14 20:00:00	0.0	96.6	0.0	610.6	561.0
11/22/14 21:00:00	0.0	76.2	0.0	610.5	558.9
11/22/14 22:00:00	0.0	75.6	0.0	610.5	558.2
11/22/14 23:00:00	0.0	76.5	0.0	610.4	558.1
11/23/14 0:00:00	0.0	76.5	0.0	610.4	558.0
11/23/14 1:00:00	0.0	85.9	0.0	610.5	559.1
11/23/14 2:00:00	0.0	79.0	0.0	610.7	558.7
11/23/14 3:00:00	0.0	77.5	0.0	610.6	558.2
11/23/14 4:00:00	0.0	77.5	0.0	610.5	558.1
11/23/14 5:00:00	0.0	78.6	0.0	610.4	557.9
11/23/14 6:00:00	0.0	79.0	0.0	610.3	558.0

11/23/14 7:00:00	0.0	78.1	0.0	610.2	558.0
11/23/14 8:00:00	0.0	77.8	0.0	610.1	557.8
11/23/14 9:00:00	0.0	82.0	0.0	610.7	558.2
11/23/14 10:00:00	0.0	93.7	0.0	611.2	559.7
11/23/14 11:00:00	0.0	97.9	0.0	611.4	560.4
11/23/14 12:00:00	0.0	93.7	0.0	611.0	560.2
11/23/14 13:00:00	0.0	92.7	0.0	610.9	559.9
11/23/14 14:00:00	0.0	92.1	0.0	611.1	559.8
11/23/14 15:00:00	0.0	92.4	0.0	610.7	559.9
11/23/14 16:00:00	0.0	92.9	0.0	610.8	559.9
11/23/14 17:00:00	0.0	91.1	0.0	610.6	559.7
11/23/14 18:00:00	0.0	86.1	0.0	610.3	559.1
11/23/14 19:00:00	0.0	79.9	0.0	610.1	558.4
11/23/14 20:00:00	0.0	76.7	0.0	610.1	557.6
11/23/14 21:00:00	0.0	76.5	0.0	610.0	557.5
11/23/14 22:00:00	0.0	75.8	0.0	610.0	557.4
11/23/14 23:00:00	0.0	75.8	0.0	610.0	557.3
11/24/14 0:00:00	0.0	92.6	0.0	610.4	559.2
11/24/14 1:00:00	0.0	82.2	0.0	610.7	558.5
11/24/14 2:00:00	0.0	76.5	0.0	610.7	557.6
11/24/14 3:00:00	0.0	77.0	0.0	610.6	557.5
11/24/14 4:00:00	0.0	77.5	0.0	610.6	557.5
11/24/14 5:00:00	0.0	77.8	0.0	610.6	557.6
11/24/14 6:00:00	0.0	77.8	0.0	610.6	557.6
11/24/14 7:00:00	0.3	76.8	0.0	610.6	557.4
11/24/14 8:00:00	10.2	83.7	0.0	610.6	559.0
11/24/14 9:00:00	11.2	95.3	0.0	610.8	560.5
11/24/14 10:00:00	21.9	100.8	0.0	610.8	562.3
11/24/14 11:00:00	30.0	105.1	0.0	611.0	563.8
11/24/14 12:00:00	28.4	100.2	0.0	610.9	563.6
11/24/14 13:00:00	28.2	98.0	0.0	610.8	563.3
11/24/14 14:00:00	28.0	95.9	0.0	610.8	563.1
11/24/14 15:00:00	16.9	95.0	0.0	610.8	562.0
11/24/14 16:00:00	29.9	110.3	0.0	610.2	563.8
11/24/14 17:00:00	38.2	99.6	0.0	610.3	564.7
11/24/14 18:00:00	32.1	91.4	0.0	610.5	563.4
11/24/14 19:00:00	25.5	90.0	0.0	610.7	562.3
11/24/14 20:00:00	25.4	90.0	0.0	610.5	562.0
11/24/14 21:00:00	25.4	90.1	0.0	610.7	562.0
11/24/14 22:00:00	25.2	88.1	0.0	610.6	561.8
11/24/14 23:00:00	19.1	82.8	0.0	610.6	560.8
11/25/14 0:00:00	14.4	82.2	0.0	610.6	560.1
11/25/14 1:00:00	10.9	81.7	0.0	610.5	559.6

11/25/14 2:00:00	10.9	80.1	0.0	610.5	559.3
11/25/14 3:00:00	4.1	74.0	0.0	610.4	558.2
11/25/14 4:00:00	0.0	74.6	0.0	610.4	557.4
11/25/14 5:00:00	0.0	77.0	0.0	610.6	557.5
11/25/14 6:00:00	0.0	80.5	0.0	610.7	558.0
11/25/14 7:00:00	1.1	83.9	0.0	610.6	558.4
11/25/14 8:00:00	22.8	102.6	0.0	610.0	562.0
11/25/14 9:00:00	30.2	114.8	0.0	609.9	564.5
11/25/14 10:00:00	30.9	109.5	0.0	610.0	564.7
11/25/14 11:00:00	30.4	97.2	0.0	610.4	563.9
11/25/14 12:00:00	29.7	95.4	0.0	610.6	563.1
11/25/14 13:00:00	29.8	97.1	0.0	610.8	563.7
11/25/14 14:00:00	29.4	89.6	0.0	611.4	562.8
11/25/14 15:00:00	29.7	102.2	0.0	610.9	563.5
11/25/14 16:00:00	29.8	93.2	0.0	611.1	563.7
11/25/14 17:00:00	21.4	93.2	0.0	611.2	562.4
11/25/14 18:00:00	11.4	97.0	0.0	611.0	562.0
11/25/14 19:00:00	10.1	93.7	0.0	611.1	561.3
11/25/14 20:00:00	11.0	96.9	0.0	611.0	561.5
11/25/14 21:00:00	23.8	105.9	0.0	610.8	563.3
11/25/14 22:00:00	33.3	107.9	0.0	611.0	564.8
11/25/14 23:00:00	33.4	103.9	0.0	611.2	564.9
11/26/14 0:00:00	33.1	97.0	0.0	611.3	564.2
11/26/14 1:00:00	23.7	95.1	0.0	611.4	563.3
11/26/14 2:00:00	4.7	84.7	0.0	611.1	560.7
11/26/14 3:00:00	0.0	81.1	0.0	611.0	559.2
11/26/14 4:00:00	0.0	79.1	0.0	611.0	558.7
11/26/14 5:00:00	0.0	78.6	0.0	611.0	558.6
11/26/14 6:00:00	0.0	78.6	0.0	611.1	558.7
11/26/14 7:00:00	0.0	89.0	0.0	611.2	559.6
11/26/14 8:00:00	0.0	93.9	0.0	611.1	560.4
11/26/14 9:00:00	0.1	98.2	0.0	611.2	560.9
11/26/14 10:00:00	18.3	101.6	0.0	610.7	562.5
11/26/14 11:00:00	25.5	103.0	0.0	610.6	563.8
11/26/14 12:00:00	25.1	102.5	0.0	610.7	564.0
11/26/14 13:00:00	21.7	92.5	0.0	610.6	563.2
11/26/14 14:00:00	11.4	82.5	0.0	610.4	560.8
11/26/14 15:00:00	11.5	87.5	0.0	610.5	561.0
11/26/14 16:00:00	11.6	91.9	0.0	610.6	561.3
11/26/14 17:00:00	16.3	105.8	0.0	610.6	563.0
11/26/14 18:00:00	19.4	107.5	0.0	610.7	563.7
11/26/14 19:00:00	16.3	110.1	0.0	610.7	564.0
11/26/14 20:00:00	12.0	101.6	0.0	610.6	562.9

11/26/14 21:00:00	11.9	95.7	0.0	610.5	562.1
11/26/14 22:00:00	11.8	98.9	0.0	610.8	562.2
11/26/14 23:00:00	11.8	102.6	0.0	611.1	562.7
11/27/14 0:00:00	11.8	103.1	0.0	611.2	563.0
11/27/14 1:00:00	11.7	94.7	0.0	610.9	562.5
11/27/14 2:00:00	5.7	80.7	0.0	610.7	560.8
11/27/14 3:00:00	0.0	72.7	0.0	610.9	559.1
11/27/14 4:00:00	0.0	70.9	0.0	610.9	558.9
11/27/14 5:00:00	0.0	70.8	0.0	611.1	558.8
11/27/14 6:00:00	0.0	72.9	0.0	611.2	559.0
11/27/14 7:00:00	0.0	74.6	0.0	611.2	559.2
11/27/14 8:00:00	0.0	75.8	0.0	611.2	559.3
11/27/14 9:00:00	0.0	79.2	0.0	611.2	559.4
11/27/14 10:00:00	4.0	93.2	0.0	611.3	561.0
11/27/14 11:00:00	10.7	98.5	0.0	611.4	562.2
11/27/14 12:00:00	10.5	94.2	0.0	611.4	562.4
11/27/14 13:00:00	8.8	69.2	0.0	611.6	559.7
11/27/14 14:00:00	9.0	72.4	0.0	611.4	559.7
11/27/14 15:00:00	9.0	71.9	0.0	611.3	559.7
11/27/14 16:00:00	8.9	71.3	0.0	611.2	559.7
11/27/14 17:00:00	8.8	70.2	0.0	611.2	559.6
11/27/14 18:00:00	8.7	68.2	0.0	611.2	559.4
11/27/14 19:00:00	8.7	68.4	0.0	611.2	559.3
11/27/14 20:00:00	8.7	68.3	0.0	611.2	559.4
11/27/14 21:00:00	8.7	68.3	0.0	611.3	559.4
11/27/14 22:00:00	8.8	69.6	0.0	611.3	559.6
11/27/14 23:00:00	8.9	70.0	0.0	611.7	559.9
11/28/14 0:00:00	9.5	71.0	0.0	611.6	560.0
11/28/14 1:00:00	11.4	76.2	0.0	612.0	560.7
11/28/14 2:00:00	11.5	73.9	0.0	612.0	560.8
11/28/14 3:00:00	11.6	74.8	0.0	612.1	561.0
11/28/14 4:00:00	11.6	75.1	0.0	612.0	561.2
11/28/14 5:00:00	11.5	72.8	0.0	611.8	561.0
11/28/14 6:00:00	10.6	72.5	0.0	611.7	561.1
11/28/14 7:00:00	10.7	71.0	0.0	611.6	561.0
11/28/14 8:00:00	10.7	71.0	0.0	611.6	560.9
11/28/14 9:00:00	10.8	70.9	0.0	611.6	560.9
11/28/14 10:00:00	10.8	77.2	0.0	611.8	561.5
11/28/14 11:00:00	11.0	91.4	0.0	612.3	562.9
11/28/14 12:00:00	11.2	97.7	0.0	611.9	563.7
11/28/14 13:00:00	11.3	86.5	0.0	611.4	563.0
11/28/14 14:00:00	4.2	84.6	0.0	611.0	562.2
11/28/14 15:00:00	0.0	85.4	0.0	610.7	561.6

11/28/14 16:00:00	0.0	84.0	0.0	610.4	561.5
11/28/14 17:00:00	0.0	80.5	0.0	610.3	561.2
11/28/14 18:00:00	0.0	78.3	0.0	610.1	560.9
11/28/14 19:00:00	0.0	71.4	0.0	610.3	560.3
11/28/14 20:00:00	0.0	65.6	0.0	610.5	559.7
11/28/14 21:00:00	0.0	64.4	0.0	610.6	559.5
11/28/14 22:00:00	0.0	64.8	0.0	610.9	559.7
11/28/14 23:00:00	0.0	67.1	0.0	611.5	559.9
11/29/14 0:00:00	0.0	75.3	0.0	612.5	560.7
11/29/14 1:00:00	15.3	89.6	0.0	612.8	563.1
11/29/14 2:00:00	16.8	85.2	0.0	612.6	563.4
11/29/14 3:00:00	16.7	84.2	0.0	612.5	563.3
11/29/14 4:00:00	16.9	86.4	0.0	612.5	563.7
11/29/14 5:00:00	10.9	83.7	0.0	612.4	563.3
11/29/14 6:00:00	9.2	83.0	0.0	612.4	563.0
11/29/14 7:00:00	10.3	93.1	0.0	612.3	563.9
11/29/14 8:00:00	10.2	92.7	0.0	612.4	563.9
11/29/14 9:00:00	11.2	102.3	0.0	612.3	565.0
11/29/14 10:00:00	11.4	105.0	0.0	612.4	565.3
11/29/14 11:00:00	12.5	115.4	0.0	612.5	566.1
11/29/14 12:00:00	12.7	116.5	0.0	612.6	566.2
11/29/14 13:00:00	12.7	117.2	0.0	612.5	566.3
11/29/14 14:00:00	11.3	103.7	0.0	612.3	565.4
11/29/14 15:00:00	11.7	108.0	0.0	612.4	565.4
11/29/14 16:00:00	11.1	102.8	0.0	612.3	565.1
11/29/14 17:00:00	11.5	105.3	0.0	612.4	565.2
11/29/14 18:00:00	12.3	112.7	0.0	612.5	565.7
11/29/14 19:00:00	16.7	113.6	0.0	612.7	566.1
11/29/14 20:00:00	30.1	115.3	0.0	612.7	567.2
11/29/14 21:00:00	32.9	115.7	0.0	612.8	567.7
11/29/14 22:00:00	38.8	111.6	0.0	612.7	567.9
11/29/14 23:00:00	40.0	108.5	0.0	612.7	567.9
11/30/14 0:00:00	40.1	109.2	0.0	612.7	568.0
11/30/14 1:00:00	39.9	107.5	0.0	612.7	568.0
11/30/14 2:00:00	39.2	101.1	0.0	612.7	567.7
11/30/14 3:00:00	38.8	96.2	0.0	612.7	567.4
11/30/14 4:00:00	27.4	84.9	0.0	612.7	566.1
11/30/14 5:00:00	21.7	88.3	0.0	612.8	565.6
11/30/14 6:00:00	22.0	93.7	0.0	612.8	565.9
11/30/14 7:00:00	23.2	104.7	0.0	612.8	567.0
11/30/14 8:00:00	24.2	113.9	0.0	612.8	567.7
11/30/14 9:00:00	24.2	113.8	0.0	612.8	567.8
11/30/14 10:00:00	23.6	107.4	0.0	612.7	567.6

11/30/14 11:00:00	20.8	81.7	0.0	612.7	565.7
11/30/14 12:00:00	20.7	80.8	0.0	612.7	565.3
11/30/14 13:00:00	20.5	79.4	0.0	612.8	565.3
11/30/14 14:00:00	22.1	94.5	0.0	612.8	566.1
11/30/14 15:00:00	22.2	94.5	0.0	612.7	566.4
11/30/14 16:00:00	21.6	89.7	0.0	612.8	565.8
11/30/14 17:00:00	22.2	95.5	0.0	612.8	566.1
11/30/14 18:00:00	21.9	91.9	0.0	612.8	566.0
11/30/14 19:00:00	21.0	83.0	0.0	612.7	565.4
11/30/14 20:00:00	19.8	72.4	0.0	612.5	564.1
11/30/14 21:00:00	20.3	77.9	0.0	612.4	564.6
11/30/14 22:00:00	21.1	85.1	0.0	612.4	565.1
11/30/14 23:00:00	20.8	81.4	0.0	612.5	564.9
12/1/14 0:00:00	22.0	93.5	0.0	612.6	565.6
12/1/14 1:00:00	21.7	89.6	0.0	612.6	565.8
12/1/14 2:00:00	11.9	71.5	0.0	612.6	564.3
12/1/14 3:00:00	6.8	52.4	0.0	612.6	562.1
12/1/14 4:00:00	8.8	59.5	0.0	612.4	562.8
12/1/14 5:00:00	4.0	42.1	0.0	612.4	561.3
12/1/14 6:00:00	4.5	60.1	0.0	612.5	562.0
12/1/14 7:00:00	10.5	91.7	0.0	612.0	564.8
12/1/14 8:00:00	13.3	104.8	0.0	611.9	566.3
12/1/14 9:00:00	12.8	91.7	0.0	611.7	565.3
12/1/14 10:00:00	12.3	87.6	0.0	611.8	564.8
12/1/14 11:00:00	12.2	81.5	0.0	611.7	564.6
12/1/14 12:00:00	12.3	79.6	0.0	611.6	564.6
12/1/14 13:00:00	4.6	80.7	0.0	611.6	564.4
12/1/14 14:00:00	0.0	77.4	0.0	611.6	564.1
12/1/14 15:00:00	0.0	71.9	0.0	611.6	563.9
12/1/14 16:00:00	0.0	57.2	0.0	611.6	563.2
12/1/14 17:00:00	8.7	95.5	0.0	611.1	565.5
12/1/14 18:00:00	13.0	89.7	0.0	611.0	566.2
12/1/14 19:00:00	12.6	89.9	0.0	611.4	565.5
12/1/14 20:00:00	12.5	101.2	0.0	611.9	565.9
12/1/14 21:00:00	12.1	87.1	0.0	612.3	565.5
12/1/14 22:00:00	9.5	63.8	0.0	612.4	563.1
12/1/14 23:00:00	9.3	54.4	0.0	612.3	562.0
12/2/14 0:00:00	9.3	41.3	0.0	612.1	561.3
12/2/14 1:00:00	9.4	55.2	0.0	612.3	562.3
12/2/14 2:00:00	11.0	66.4	0.0	612.3	563.4
12/2/14 3:00:00	11.0	48.6	0.0	612.3	562.3
12/2/14 4:00:00	10.9	39.7	0.0	612.2	561.8
12/2/14 5:00:00	10.7	34.1	0.0	612.3	561.4

12/2/14 6:00:00	10.8	38.4	0.0	612.2	561.4
12/2/14 7:00:00	11.2	78.9	0.0	612.4	563.9
12/2/14 8:00:00	26.1	109.7	0.0	612.5	566.8
12/2/14 9:00:00	30.4	122.0	0.0	612.6	568.3
12/2/14 10:00:00	25.9	111.3	0.0	612.5	567.7
12/2/14 11:00:00	13.4	85.8	0.0	612.4	565.2
12/2/14 12:00:00	12.5	78.9	0.0	612.5	564.1
12/2/14 13:00:00	12.4	68.4	0.0	612.1	563.5
12/2/14 14:00:00	10.8	52.7	0.0	611.8	562.2
12/2/14 15:00:00	10.6	53.8	0.0	612.0	562.1
12/2/14 16:00:00	11.0	64.5	0.0	612.0	562.8
12/2/14 17:00:00	13.2	115.8	0.0	611.9	566.5
12/2/14 18:00:00	23.2	121.1	0.0	612.0	567.9
12/2/14 19:00:00	26.8	117.2	0.0	611.9	568.2
12/2/14 20:00:00	26.2	98.2	0.0	612.1	566.7
12/2/14 21:00:00	25.6	77.9	0.0	612.4	565.3
12/2/14 22:00:00	23.7	86.7	0.0	612.5	565.4
12/2/14 23:00:00	7.2	82.9	0.0	612.5	564.4
12/3/14 0:00:00	0.0	51.1	0.0	612.3	561.6
12/3/14 1:00:00	0.0	54.9	0.0	612.6	562.1
12/3/14 2:00:00	0.0	58.8	0.0	612.5	562.0
12/3/14 3:00:00	0.0	59.9	0.0	612.3	561.8
12/3/14 4:00:00	0.0	78.7	0.0	612.4	563.1
12/3/14 5:00:00	0.0	83.3	0.0	612.2	563.7
12/3/14 6:00:00	0.0	83.5	0.0	612.0	563.8
12/3/14 7:00:00	1.6	97.2	0.0	612.2	564.5
12/3/14 8:00:00	28.9	102.6	0.0	612.2	566.7
12/3/14 9:00:00	32.0	107.0	0.0	612.5	567.4
12/3/14 10:00:00	32.3	117.1	0.0	612.8	568.2
12/3/14 11:00:00	31.2	98.5	0.0	612.8	567.3
12/3/14 12:00:00	11.1	97.7	0.0	612.8	565.8
12/3/14 13:00:00	10.9	75.3	0.0	612.8	564.3
12/3/14 14:00:00	10.7	71.8	0.0	612.9	563.8
12/3/14 15:00:00	10.8	79.1	0.0	612.9	564.3
12/3/14 16:00:00	17.6	91.2	0.0	612.9	565.5
12/3/14 17:00:00	30.1	105.1	0.0	612.8	567.4
12/3/14 18:00:00	34.6	111.3	0.0	612.8	568.1
12/3/14 19:00:00	40.2	115.1	0.0	612.7	568.8
12/3/14 20:00:00	40.1	104.2	0.0	612.7	568.3
12/3/14 21:00:00	39.9	96.5	0.0	612.7	567.7
12/3/14 22:00:00	33.7	81.3	0.0	612.7	566.4
12/3/14 23:00:00	19.3	74.0	0.0	612.7	564.8
12/4/14 0:00:00	12.5	70.5	0.0	612.7	564.1

12/4/14 1:00:00	12.8	80.4	0.0	612.7	565.3
12/4/14 2:00:00	13.0	94.4	0.0	612.7	566.3
12/4/14 3:00:00	12.9	87.5	0.0	612.7	565.4
12/4/14 4:00:00	13.4	111.9	0.0	612.7	567.2
12/4/14 5:00:00	13.2	94.3	0.0	612.7	566.5
12/4/14 6:00:00	1.4	60.2	0.0	612.7	563.2
12/4/14 7:00:00	4.2	91.8	0.0	612.7	564.6
12/4/14 8:00:00	21.6	106.5	0.0	612.7	567.2
12/4/14 9:00:00	32.8	117.2	0.0	612.6	568.6
12/4/14 10:00:00	32.7	112.2	0.0	612.7	568.3
12/4/14 11:00:00	32.3	108.8	0.0	612.7	568.3
12/4/14 12:00:00	30.3	91.0	0.0	612.7	567.1
12/4/14 13:00:00	30.2	88.7	0.0	612.7	566.7
12/4/14 14:00:00	30.2	96.8	0.0	612.7	567.1
12/4/14 15:00:00	37.2	109.3	0.0	612.7	568.3
12/4/14 16:00:00	40.6	119.2	0.0	612.7	569.4
12/4/14 17:00:00	40.9	121.9	0.0	612.7	569.6
12/4/14 18:00:00	41.2	109.5	0.0	612.7	569.0
12/4/14 19:00:00	41.0	100.9	0.0	612.7	568.5
12/4/14 20:00:00	40.7	86.7	0.0	612.7	567.6
12/4/14 21:00:00	40.5	96.2	0.0	612.7	567.9
12/4/14 22:00:00	40.6	99.3	0.0	612.7	568.3
12/4/14 23:00:00	40.4	82.6	0.0	612.7	567.4
12/5/14 0:00:00	40.2	79.2	0.0	612.7	566.7
12/5/14 1:00:00	40.4	90.5	0.0	612.7	567.6
12/5/14 2:00:00	40.1	70.8	0.0	612.7	566.4
12/5/14 3:00:00	40.0	69.2	0.0	612.7	566.0
12/5/14 4:00:00	13.6	92.4	0.0	612.7	565.8
12/5/14 5:00:00	12.8	91.7	0.0	612.7	565.6
12/5/14 6:00:00	12.7	88.3	0.0	612.7	565.2
12/5/14 7:00:00	15.1	105.5	0.0	612.7	566.2
12/5/14 8:00:00	27.3	111.5	0.0	612.7	567.6
12/5/14 9:00:00	32.6	105.0	0.0	612.7	567.6
12/5/14 10:00:00	32.8	114.0	0.0	612.7	568.1
12/5/14 11:00:00	32.8	111.0	0.0	612.8	568.0
12/5/14 12:00:00	32.7	107.5	0.0	612.7	567.9
12/5/14 13:00:00	32.5	100.6	0.0	612.7	567.4
12/5/14 14:00:00	32.5	100.4	0.0	612.8	567.3
12/5/14 15:00:00	28.5	107.0	0.0	612.8	567.5
12/5/14 16:00:00	26.7	116.3	0.0	612.8	567.9
12/5/14 17:00:00	26.7	114.6	0.0	612.7	568.0
12/5/14 18:00:00	26.7	114.9	0.0	612.8	567.9
12/5/14 19:00:00	26.4	100.6	0.0	612.7	567.2

12/5/14 20:00:00	25.9	84.9	0.0	612.7	565.9
12/5/14 21:00:00	26.0	99.8	0.0	612.8	566.6
12/5/14 22:00:00	26.4	104.0	0.0	612.7	567.1
12/5/14 23:00:00	26.5	107.9	0.0	612.7	567.3
12/6/14 0:00:00	26.2	93.9	0.0	612.7	566.6
12/6/14 1:00:00	25.8	81.6	0.0	612.7	565.7
12/6/14 2:00:00	15.9	78.3	0.0	612.8	564.6
12/6/14 3:00:00	12.4	74.2	0.0	612.7	564.1
12/6/14 4:00:00	12.3	71.9	0.0	612.8	563.6
12/6/14 5:00:00	12.7	93.8	0.0	612.8	565.3
12/6/14 6:00:00	13.0	107.7	0.0	612.8	566.3
12/6/14 7:00:00	17.3	107.1	0.0	612.7	566.7
12/6/14 8:00:00	27.1	108.2	0.0	612.8	567.4
12/6/14 9:00:00	27.6	104.5	0.0	612.7	567.4
12/6/14 10:00:00	27.4	94.1	0.0	612.8	566.6
12/6/14 11:00:00	27.4	97.1	0.0	612.7	566.8
12/6/14 12:00:00	27.5	99.9	0.0	612.8	566.9
12/6/14 13:00:00	27.6	108.0	0.0	612.8	567.4
12/6/14 14:00:00	27.7	108.0	0.0	612.7	567.5
12/6/14 15:00:00	27.6	104.4	0.0	612.8	567.3
12/6/14 16:00:00	27.5	95.7	0.0	612.7	566.9
12/6/14 17:00:00	13.9	87.3	0.0	612.7	565.3
12/6/14 18:00:00	11.6	98.0	0.0	612.8	565.5
12/6/14 19:00:00	11.8	105.1	0.0	612.8	566.0
12/6/14 20:00:00	37.2	106.4	0.0	612.8	567.7
12/6/14 21:00:00	39.9	112.5	0.0	612.8	568.5
12/6/14 22:00:00	39.9	111.1	0.0	612.7	568.6
12/6/14 23:00:00	33.6	99.2	0.0	612.7	567.6
12/7/14 0:00:00	25.8	80.1	0.0	612.8	565.6
12/7/14 1:00:00	25.9	88.4	0.0	612.7	565.9
12/7/14 2:00:00	25.8	82.2	0.0	612.7	565.6
12/7/14 3:00:00	11.7	77.6	0.0	612.7	564.4
12/7/14 4:00:00	11.2	64.9	0.0	612.7	563.3
12/7/14 5:00:00	11.2	66.6	0.0	612.8	563.3
12/7/14 6:00:00	11.4	83.4	0.0	612.8	564.3
12/7/14 7:00:00	22.7	104.0	0.0	612.8	566.5
12/7/14 8:00:00	26.2	112.6	0.0	612.8	567.5
12/7/14 9:00:00	26.3	113.3	0.0	612.7	567.9
12/7/14 10:00:00	26.1	101.1	0.0	612.7	567.1
12/7/14 11:00:00	25.8	86.8	0.0	612.7	566.0
12/7/14 12:00:00	25.7	85.3	0.0	612.8	565.7
12/7/14 13:00:00	25.6	75.8	0.0	612.7	565.1
12/7/14 14:00:00	20.3	83.9	0.0	612.8	565.2

12/7/14 15:00:00	19.9	84.5	0.0	612.7	565.3
12/7/14 16:00:00	19.9	87.3	0.0	612.8	565.4
12/7/14 17:00:00	20.0	95.0	0.0	612.8	565.9
12/7/14 18:00:00	24.5	114.1	0.0	612.8	567.4
12/7/14 19:00:00	27.7	121.8	0.0	612.8	568.3
12/7/14 20:00:00	42.1	106.3	0.0	612.7	568.4
12/7/14 21:00:00	42.1	98.3	0.0	612.7	567.9
12/7/14 22:00:00	42.0	89.9	0.0	612.7	567.4
12/7/14 23:00:00	27.1	76.6	0.0	612.7	565.7
12/8/14 0:00:00	18.3	76.1	0.0	612.8	564.6
12/8/14 1:00:00	17.5	76.6	0.0	612.8	564.5
12/8/14 2:00:00	12.0	81.5	0.0	612.8	564.5
12/8/14 3:00:00	12.0	77.4	0.0	612.7	564.3
12/8/14 4:00:00	12.0	72.7	0.0	612.7	564.1
12/8/14 5:00:00	12.0	73.9	0.0	612.8	564.1
12/8/14 6:00:00	12.0	89.8	0.0	612.8	565.1
12/8/14 7:00:00	12.3	96.4	0.0	612.8	565.6
12/8/14 8:00:00	23.9	110.9	0.0	612.8	567.3
12/8/14 9:00:00	25.1	116.6	0.0	612.8	567.8
12/8/14 10:00:00	25.1	117.2	0.0	612.8	567.9
12/8/14 11:00:00	31.6	115.8	0.0	612.8	568.3
12/8/14 12:00:00	38.5	113.6	0.0	612.7	568.8
12/8/14 13:00:00	38.4	105.2	0.0	612.7	568.3
12/8/14 14:00:00	38.2	100.1	0.0	612.7	567.9
12/8/14 15:00:00	38.2	107.3	0.0	612.8	568.2
12/8/14 16:00:00	38.6	114.6	0.0	612.6	568.9
12/8/14 17:00:00	38.9	124.9	0.0	611.9	569.5
12/8/14 18:00:00	39.2	117.0	0.0	611.1	569.4
12/8/14 19:00:00	38.9	99.8	0.0	611.0	568.2
12/8/14 20:00:00	38.7	95.5	0.0	611.0	567.8
12/8/14 21:00:00	38.7	96.1	0.0	611.2	567.9
12/8/14 22:00:00	38.7	97.4	0.0	611.1	568.0
12/8/14 23:00:00	30.1	94.0	0.0	611.0	567.3
12/9/14 0:00:00	12.6	68.9	0.0	611.0	564.6
12/9/14 1:00:00	12.4	76.2	0.0	611.0	564.4
12/9/14 2:00:00	12.6	81.5	0.0	611.0	565.0
12/9/14 3:00:00	12.0	57.8	0.0	611.0	563.1
12/9/14 4:00:00	12.0	63.7	0.0	611.3	563.3
12/9/14 5:00:00	12.0	65.4	0.0	611.3	563.7
12/9/14 6:00:00	12.1	64.0	0.0	611.0	563.4
12/9/14 7:00:00	12.2	74.2	0.0	611.0	563.9
12/9/14 8:00:00	31.3	97.5	0.0	611.0	566.6
12/9/14 9:00:00	35.2	121.0	0.0	611.0	568.7

12/9/14 10:00:00	36.0	127.8	0.0	611.0	569.5
12/9/14 11:00:00	36.1	127.5	0.0	611.0	569.7
12/9/14 12:00:00	35.8	111.6	0.0	610.9	568.8
12/9/14 13:00:00	35.6	104.0	0.0	610.9	568.2
12/9/14 14:00:00	35.3	95.6	0.0	611.0	567.6
12/9/14 15:00:00	35.3	91.8	0.0	610.9	567.4
12/9/14 16:00:00	35.1	83.6	0.0	611.0	566.7
12/9/14 17:00:00	22.5	103.3	0.0	611.0	567.1
12/9/14 18:00:00	12.8	86.1	0.0	611.0	565.5
12/9/14 19:00:00	13.1	114.4	0.0	611.1	566.8
12/9/14 20:00:00	13.5	115.1	0.0	611.2	567.3
12/9/14 21:00:00	19.2	111.3	0.0	611.7	567.2
12/9/14 22:00:00	20.4	115.0	0.0	612.0	567.3
12/9/14 23:00:00	34.1	112.9	0.0	612.1	568.3
12/10/14 0:00:00	29.0	102.4	0.0	612.0	567.8
12/10/14 1:00:00	26.4	83.1	0.0	612.0	566.2
12/10/14 2:00:00	11.8	52.0	0.0	612.0	562.9
12/10/14 3:00:00	11.5	46.5	0.0	611.6	561.9
12/10/14 4:00:00	11.4	27.9	0.0	611.6	560.8
12/10/14 5:00:00	11.7	55.8	0.0	611.7	562.5
12/10/14 6:00:00	12.2	88.1	0.0	611.7	564.8
12/10/14 7:00:00	28.4	86.1	0.0	611.2	566.1
12/10/14 8:00:00	29.6	123.4	0.0	611.2	568.3
12/10/14 9:00:00	29.7	112.8	0.0	611.3	568.3
12/10/14 10:00:00	29.2	107.8	0.0	611.8	567.7
12/10/14 11:00:00	29.1	106.4	0.0	612.5	567.7
12/10/14 12:00:00	29.1	108.7	0.0	612.7	567.9
12/10/14 13:00:00	29.0	100.2	0.0	612.7	567.3
12/10/14 14:00:00	28.9	93.6	0.0	612.7	566.9
12/10/14 15:00:00	28.8	82.2	0.0	612.8	566.0
12/10/14 16:00:00	28.7	83.2	0.0	612.7	566.0
12/10/14 17:00:00	28.8	100.0	0.0	612.8	566.8
12/10/14 18:00:00	29.1	112.2	0.0	612.7	567.9
12/10/14 19:00:00	29.0	97.0	0.0	612.7	567.2
12/10/14 20:00:00	14.2	82.6	0.0	612.7	565.1
12/10/14 21:00:00	12.0	87.4	0.0	612.6	564.7
12/10/14 22:00:00	12.3	99.0	0.0	612.7	565.8
12/10/14 23:00:00	12.2	92.9	0.0	612.8	565.2
12/11/14 0:00:00	19.3	106.9	0.0	612.8	566.5
12/11/14 1:00:00	20.0	102.7	0.0	612.7	566.7
12/11/14 2:00:00	12.0	74.6	0.0	612.7	564.4
12/11/14 3:00:00	11.8	64.8	0.0	612.4	563.4
12/11/14 4:00:00	11.3	34.1	0.0	612.0	561.2

12/11/14 5:00:00	11.2	33.3	0.0	612.0	561.0
12/11/14 6:00:00	11.3	42.0	0.0	612.3	561.7
12/11/14 7:00:00	11.9	87.6	0.0	612.5	564.5
12/11/14 8:00:00	23.7	113.4	0.0	612.7	567.2
12/11/14 9:00:00	35.3	122.8	0.0	612.8	568.9
12/11/14 10:00:00	35.8	122.1	0.0	612.7	569.1
12/11/14 11:00:00	35.3	92.0	0.0	612.7	567.4
12/11/14 12:00:00	30.5	87.2	0.0	612.7	566.7
12/11/14 13:00:00	26.4	69.3	0.0	612.7	565.2
12/11/14 14:00:00	13.0	73.3	0.0	612.8	564.3
12/11/14 15:00:00	12.2	94.3	0.0	612.8	565.7
12/11/14 16:00:00	12.4	93.8	0.0	612.7	566.0
12/11/14 17:00:00	11.9	66.5	0.0	612.8	563.8
12/11/14 18:00:00	12.2	99.3	0.0	612.8	565.7
12/11/14 19:00:00	12.1	71.4	0.0	612.7	564.6
12/11/14 20:00:00	12.0	86.3	0.0	612.8	564.8
12/11/14 21:00:00	12.3	99.6	0.0	612.7	566.1
12/11/14 22:00:00	12.1	78.2	0.0	612.7	564.9
12/11/14 23:00:00	11.6	58.0	0.0	612.7	563.2
12/12/14 0:00:00	11.6	55.7	0.0	612.7	563.0
12/12/14 1:00:00	11.7	64.5	0.0	612.7	563.5
12/12/14 2:00:00	11.5	45.4	0.0	612.7	562.5
12/12/14 3:00:00	11.5	44.8	0.0	612.6	562.2
12/12/14 4:00:00	11.3	31.5	0.0	612.2	561.3
12/12/14 5:00:00	11.3	32.8	0.0	611.9	561.2
12/12/14 6:00:00	11.4	34.6	0.0	611.6	561.1
12/12/14 7:00:00	17.0	78.8	0.0	611.8	564.1
12/12/14 8:00:00	27.0	98.4	0.0	612.3	566.7
12/12/14 9:00:00	39.0	119.5	0.0	612.8	568.7
12/12/14 10:00:00	39.0	108.2	0.0	612.8	568.5
12/12/14 11:00:00	39.1	114.2	0.0	612.8	568.8
12/12/14 12:00:00	38.9	99.7	0.0	612.8	568.1
12/12/14 13:00:00	16.2	87.9	0.0	612.8	565.9
12/12/14 14:00:00	12.1	92.4	0.0	612.8	565.5
12/12/14 15:00:00	12.1	82.4	0.0	612.8	565.1
12/12/14 16:00:00	11.8	62.4	0.0	612.8	563.6
12/12/14 17:00:00	18.4	100.6	0.0	612.7	565.9
12/12/14 18:00:00	42.0	107.6	0.0	612.8	568.2
12/12/14 19:00:00	49.0	113.7	0.0	612.8	569.4
12/12/14 20:00:00	48.2	89.0	0.0	612.8	568.0
12/12/14 21:00:00	21.6	90.5	0.0	612.8	566.3
12/12/14 22:00:00	8.0	47.8	0.0	612.6	562.6
12/12/14 23:00:00	7.6	33.6	0.0	612.1	560.8

12/13/14 0:00:00	8.7	49.0	0.0	612.5	561.8
12/13/14 1:00:00	11.0	87.7	0.0	612.8	564.7
12/13/14 2:00:00	8.4	64.7	0.0	612.8	563.5
12/13/14 3:00:00	7.2	52.2	0.0	612.6	562.2
12/13/14 4:00:00	6.9	38.2	0.0	612.3	561.5
12/13/14 5:00:00	7.5	41.4	0.0	612.3	561.6
12/13/14 6:00:00	7.5	47.2	0.0	612.6	561.8
12/13/14 7:00:00	10.2	81.1	0.0	612.9	564.4
12/13/14 8:00:00	24.9	109.2	0.0	612.8	567.3
12/13/14 9:00:00	23.8	99.2	0.0	612.8	566.7
12/13/14 10:00:00	23.1	92.6	0.0	612.8	566.1
12/13/14 11:00:00	25.2	112.2	0.0	612.7	567.4
12/13/14 12:00:00	23.7	98.8	0.0	612.8	566.8
12/13/14 13:00:00	21.4	93.5	0.0	612.7	566.2
12/13/14 14:00:00	9.3	83.8	0.0	612.7	564.8
12/13/14 15:00:00	9.4	72.1	0.0	612.6	564.0
12/13/14 16:00:00	8.9	58.9	0.0	612.5	562.9
12/13/14 17:00:00	10.7	93.7	0.0	612.8	565.0
12/13/14 18:00:00	24.4	107.6	0.0	612.8	566.9
12/13/14 19:00:00	25.5	116.1	0.0	612.8	567.8
12/13/14 20:00:00	31.1	114.9	0.0	612.6	568.1
12/13/14 21:00:00	31.3	99.3	0.0	612.3	567.4
12/13/14 22:00:00	30.7	93.4	0.0	612.3	566.8
12/13/14 23:00:00	29.7	86.4	0.0	612.6	566.4
12/14/14 0:00:00	10.0	85.0	0.0	612.8	565.0
12/14/14 1:00:00	9.4	85.0	0.0	612.8	564.7
12/14/14 2:00:00	8.9	72.0	0.0	612.8	563.9
12/14/14 3:00:00	7.7	45.2	0.0	612.7	561.8
12/14/14 4:00:00	7.8	42.6	0.0	612.7	561.4
12/14/14 5:00:00	9.2	62.1	0.0	612.8	562.8
12/14/14 6:00:00	10.5	89.4	0.0	612.8	564.8
12/14/14 7:00:00	27.4	93.6	0.0	612.8	566.4
12/14/14 8:00:00	45.2	69.8	0.0	612.8	566.1
12/14/14 9:00:00	47.0	84.4	0.0	612.3	567.0
12/14/14 10:00:00	47.5	89.1	0.0	611.7	567.5
12/14/14 11:00:00	47.1	85.7	0.0	610.8	567.5
12/14/14 12:00:00	46.6	53.0	0.0	610.8	565.1
12/14/14 13:00:00	46.1	51.2	0.0	610.9	564.7
12/14/14 14:00:00	46.3	52.0	0.0	610.9	564.8
12/14/14 15:00:00	46.5	53.0	0.0	611.1	564.9
12/14/14 16:00:00	46.9	53.8	0.0	611.1	565.1
12/14/14 17:00:00	46.5	53.4	0.0	611.3	565.1
12/14/14 18:00:00	45.5	73.3	0.0	612.0	566.0

12/14/14 19:00:00	47.8	84.9	0.0	612.6	567.0
12/14/14 20:00:00	49.5	89.6	0.0	612.8	567.6
12/14/14 21:00:00	49.5	90.5	2.9	613.0	567.9
12/14/14 22:00:00	50.6	89.8	4.6	612.9	568.0
12/14/14 23:00:00	50.7	88.2	0.0	612.8	567.8
12/15/14 0:00:00	50.6	79.5	0.0	612.7	567.3
12/15/14 1:00:00	41.4	69.2	0.0	612.7	565.9
12/15/14 2:00:00	19.9	62.1	0.0	612.8	564.1
12/15/14 3:00:00	12.0	33.2	0.0	612.5	561.2
12/15/14 4:00:00	8.4	37.0	0.0	612.0	561.0
12/15/14 5:00:00	8.0	35.3	0.0	612.0	560.9
12/15/14 6:00:00	14.8	53.0	0.0	612.6	561.9
12/15/14 7:00:00	42.1	82.0	0.1	612.7	566.0
12/15/14 8:00:00	49.7	91.5	9.4	612.8	568.1
12/15/14 9:00:00	50.1	89.7	3.7	612.9	567.9
12/15/14 10:00:00	50.1	89.6	6.3	612.9	568.0
12/15/14 11:00:00	50.2	91.0	5.4	612.9	568.1
12/15/14 12:00:00	50.2	94.7	0.0	612.5	568.1
12/15/14 13:00:00	50.4	93.3	0.0	611.7	568.1
12/15/14 14:00:00	46.8	78.5	0.0	611.1	565.3
12/15/14 15:00:00	40.9	67.7	0.0	611.0	566.1
12/15/14 16:00:00	33.5	73.8	0.0	611.0	565.8
12/15/14 17:00:00	36.6	76.3	0.0	611.0	566.1
12/15/14 18:00:00	42.1	76.1	0.0	611.0	566.5
12/15/14 19:00:00	42.1	71.3	0.0	611.0	566.3
12/15/14 20:00:00	42.0	70.7	0.0	611.0	566.1
12/15/14 21:00:00	42.1	91.6	0.0	611.0	567.1
12/15/14 22:00:00	42.2	94.4	0.0	611.3	567.5
12/15/14 23:00:00	38.2	81.8	0.0	611.6	567.0
12/16/14 0:00:00	17.2	60.7	0.0	612.1	564.6
12/16/14 1:00:00	12.8	44.6	0.0	612.0	563.7
12/16/14 2:00:00	12.4	26.3	0.0	611.9	562.6
12/16/14 3:00:00	12.8	52.5	0.0	611.6	563.5
12/16/14 4:00:00	31.8	87.5	0.0	611.0	566.3
12/16/14 5:00:00	41.0	75.5	0.0	610.9	566.7
12/16/14 6:00:00	40.7	61.7	0.0	611.0	566.0
12/16/14 7:00:00	40.7	67.6	0.0	611.0	566.2
12/16/14 8:00:00	41.3	84.5	0.0	611.0	567.0
12/16/14 9:00:00	44.5	86.1	0.0	611.0	567.2
12/16/14 10:00:00	44.6	85.2	0.0	611.0	567.2
12/16/14 11:00:00	42.9	89.2	0.0	611.0	567.3
12/16/14 12:00:00	41.5	77.0	0.0	611.0	566.8
12/16/14 13:00:00	27.5	76.6	0.0	611.0	565.9

12/16/14 14:00:00	39.6	87.0	0.0	611.0	566.8
12/16/14 15:00:00	43.9	85.8	0.0	611.0	567.2
12/16/14 16:00:00	51.0	83.8	0.0	611.0	567.4
12/16/14 17:00:00	51.0	83.6	0.0	611.0	567.5
12/16/14 18:00:00	51.5	95.4	0.0	611.0	568.0
12/16/14 19:00:00	51.6	92.5	0.0	611.1	568.0
12/16/14 20:00:00	51.5	91.7	0.0	611.2	567.9
12/16/14 21:00:00	51.5	93.1	0.0	611.5	568.0
12/16/14 22:00:00	51.4	92.2	0.0	611.7	568.0
12/16/14 23:00:00	51.5	93.5	0.0	611.3	568.0
12/17/14 0:00:00	39.7	75.6	0.0	610.7	566.9
12/17/14 1:00:00	9.9	70.3	0.0	611.2	564.7
12/17/14 2:00:00	9.6	42.9	0.0	611.0	563.2
12/17/14 3:00:00	9.5	40.9	0.0	611.0	563.0
12/17/14 4:00:00	12.0	69.1	0.0	611.1	564.4
12/17/14 5:00:00	28.3	83.9	0.0	611.2	566.1
12/17/14 6:00:00	42.0	83.4	0.0	611.2	566.8
12/17/14 7:00:00	42.0	75.5	0.0	610.9	566.6
12/17/14 8:00:00	42.0	83.2	0.0	611.0	566.7
12/17/14 9:00:00	42.0	75.6	0.0	611.0	566.6
12/17/14 10:00:00	42.1	86.5	0.0	611.0	567.0
12/17/14 11:00:00	42.1	83.7	0.0	611.0	567.1
12/17/14 12:00:00	35.7	75.0	0.0	611.0	566.5
12/17/14 13:00:00	21.4	74.6	0.0	611.1	565.5
12/17/14 14:00:00	6.8	51.9	0.0	612.0	563.0
12/17/14 15:00:00	10.4	79.9	0.0	612.7	564.7
12/17/14 16:00:00	17.9	99.7	0.0	612.8	566.7
12/17/14 17:00:00	40.0	107.7	0.0	612.7	568.4
12/17/14 18:00:00	48.0	118.9	0.0	612.6	569.9
12/17/14 19:00:00	46.2	100.6	0.0	612.7	568.9
12/17/14 20:00:00	45.9	97.3	0.0	612.7	568.5
12/17/14 21:00:00	45.2	89.5	0.0	612.6	568.0
12/17/14 22:00:00	44.7	84.2	0.0	612.6	567.6
12/17/14 23:00:00	44.7	84.9	0.0	612.7	567.5
12/18/14 0:00:00	44.3	80.8	0.0	612.5	567.3
12/18/14 1:00:00	40.4	90.1	0.0	612.6	567.9
12/18/14 2:00:00	26.2	89.4	0.0	612.7	566.9
12/18/14 3:00:00	19.7	85.1	0.0	612.6	566.4
12/18/14 4:00:00	9.0	81.0	0.0	612.6	565.3
12/18/14 5:00:00	12.4	81.8	0.0	612.7	565.3
12/18/14 6:00:00	26.2	87.6	0.0	612.7	566.5
12/18/14 7:00:00	26.9	96.4	0.0	612.7	567.1
12/18/14 8:00:00	29.7	108.2	0.0	612.7	568.0

12/18/14 9:00:00	34.2	99.4	0.0	612.7	567.9
12/18/14 10:00:00	34.2	104.2	0.0	612.7	568.1
12/18/14 11:00:00	33.0	107.0	0.0	612.7	568.2
12/18/14 12:00:00	32.7	104.3	0.0	612.6	568.1
12/18/14 13:00:00	32.6	92.4	0.0	612.6	567.4
12/18/14 14:00:00	32.5	89.4	0.0	612.6	567.2
12/18/14 15:00:00	32.5	90.3	0.0	612.6	567.2
12/18/14 16:00:00	30.8	95.3	0.0	612.7	567.4
12/18/14 17:00:00	31.4	107.5	0.0	612.7	568.2
12/18/14 18:00:00	31.8	111.3	0.0	612.8	568.5
12/18/14 19:00:00	31.2	105.5	0.0	612.7	568.3
12/18/14 20:00:00	30.6	99.1	0.0	612.8	567.7
12/18/14 21:00:00	33.9	95.6	0.0	612.7	567.6
12/18/14 22:00:00	34.1	96.9	0.0	612.7	567.7
12/18/14 23:00:00	28.2	92.1	0.0	612.7	567.0
12/19/14 0:00:00	20.5	101.3	0.0	612.8	567.0
12/19/14 1:00:00	20.4	98.7	0.0	612.8	567.0
12/19/14 2:00:00	10.5	88.0	0.0	612.7	565.9
12/19/14 3:00:00	10.0	81.8	0.0	612.6	565.4
12/19/14 4:00:00	9.9	81.2	0.0	612.8	565.3
12/19/14 5:00:00	11.7	94.4	0.0	612.8	566.3
12/19/14 6:00:00	10.7	88.4	0.0	612.8	566.0
12/19/14 7:00:00	11.6	104.9	0.0	612.8	566.9
12/19/14 8:00:00	19.0	111.9	0.0	612.8	567.8
12/19/14 9:00:00	23.7	115.4	0.0	612.8	568.3
12/19/14 10:00:00	27.2	116.5	0.0	612.8	568.7
12/19/14 11:00:00	26.9	113.0	0.0	612.7	568.5
12/19/14 12:00:00	31.1	111.4	0.0	612.6	568.6
12/19/14 13:00:00	31.8	95.9	0.0	612.7	567.9
12/19/14 14:00:00	31.4	92.0	0.0	612.8	567.4
12/19/14 15:00:00	31.3	91.2	0.0	612.7	567.5
12/19/14 16:00:00	31.2	91.6	0.0	612.8	567.2
12/19/14 17:00:00	32.4	103.8	0.0	612.8	568.1
12/19/14 18:00:00	34.1	120.4	0.0	612.8	569.2
12/19/14 19:00:00	34.4	123.1	0.0	612.7	569.5
12/19/14 20:00:00	34.6	124.2	0.0	612.7	569.6
12/19/14 21:00:00	33.7	116.2	0.0	612.8	569.1
12/19/14 22:00:00	34.2	121.0	0.0	612.8	569.3
12/19/14 23:00:00	34.4	122.9	0.0	612.8	569.4
12/20/14 0:00:00	33.1	111.1	0.0	612.7	568.8
12/20/14 1:00:00	31.9	98.4	0.0	612.7	567.9
12/20/14 2:00:00	9.7	84.2	0.0	612.7	565.6
12/20/14 3:00:00	9.3	82.9	0.0	612.7	565.2

12/20/14 4:00:00	9.1	81.1	0.0	612.8	565.0
12/20/14 5:00:00	10.1	90.9	0.0	612.8	565.6
12/20/14 6:00:00	12.0	108.8	0.0	612.8	566.9
12/20/14 7:00:00	15.0	117.2	0.0	612.8	567.7
12/20/14 8:00:00	27.9	114.7	0.0	612.8	568.2
12/20/14 9:00:00	28.8	120.7	0.0	612.8	568.6
12/20/14 10:00:00	34.8	119.0	0.0	612.7	568.9
12/20/14 11:00:00	35.2	118.9	0.0	612.7	568.8
12/20/14 12:00:00	35.5	121.4	0.0	612.7	569.0
12/20/14 13:00:00	35.7	123.0	0.0	612.7	569.1
12/20/14 14:00:00	35.3	120.3	0.0	612.6	569.0
12/20/14 15:00:00	34.6	112.9	0.0	612.7	568.5
12/20/14 16:00:00	34.0	107.2	0.0	612.7	568.1
12/20/14 17:00:00	33.3	99.4	0.0	612.8	567.5
12/20/14 18:00:00	33.5	101.0	0.0	612.7	567.5
12/20/14 19:00:00	33.8	104.6	0.0	612.8	567.7
12/20/14 20:00:00	34.2	108.8	0.0	612.8	568.1
12/20/14 21:00:00	34.3	109.4	0.0	612.7	568.3
12/20/14 22:00:00	33.3	98.7	0.0	612.7	567.6
12/20/14 23:00:00	16.3	96.8	0.0	612.7	566.5
12/21/14 0:00:00	10.0	89.3	0.0	612.7	565.5
12/21/14 1:00:00	6.6	57.6	0.0	612.7	563.0
12/21/14 2:00:00	7.4	64.4	0.0	612.7	563.3
12/21/14 3:00:00	9.5	85.1	0.0	612.7	564.8
12/21/14 4:00:00	10.2	91.9	0.0	612.6	565.8
12/21/14 5:00:00	9.3	83.4	0.0	612.6	565.3
12/21/14 6:00:00	6.9	48.7	0.0	612.6	562.7
12/21/14 7:00:00	3.6	40.1	0.0	612.5	561.6
12/21/14 8:00:00	6.9	53.0	0.0	612.7	562.9
12/21/14 9:00:00	11.4	91.4	0.0	612.8	565.5
12/21/14 10:00:00	42.0	95.8	0.0	612.6	567.4
12/21/14 11:00:00	46.2	108.1	0.0	612.6	568.9
12/21/14 12:00:00	34.5	102.1	0.0	612.7	568.1
12/21/14 13:00:00	22.1	87.8	0.0	612.7	566.5
12/21/14 14:00:00	10.7	63.2	0.0	612.7	563.9
12/21/14 15:00:00	10.5	51.3	0.0	612.8	562.6
12/21/14 16:00:00	11.0	82.8	0.0	612.8	565.0
12/21/14 17:00:00	32.0	102.3	0.0	612.7	567.5
12/21/14 18:00:00	34.2	114.5	0.0	612.6	568.6
12/21/14 19:00:00	35.6	114.5	0.0	612.8	568.7
12/21/14 20:00:00	35.7	116.8	0.0	612.7	568.9
12/21/14 21:00:00	35.5	102.3	0.0	612.7	568.1
12/21/14 22:00:00	35.2	87.4	0.0	612.8	566.9

12/21/14 23:00:00	35.3	98.0	0.0	612.7	567.5
12/22/14 0:00:00	35.0	78.5	0.0	612.8	566.2
12/22/14 1:00:00	34.8	88.7	0.0	612.7	567.0
12/22/14 2:00:00	12.7	69.1	0.0	612.7	564.6
12/22/14 3:00:00	0.9	45.5	0.0	612.6	561.9
12/22/14 4:00:00	0.0	44.3	0.0	612.4	561.7
12/22/14 5:00:00	0.0	46.9	0.0	612.3	562.0
12/22/14 6:00:00	0.0	58.6	0.0	612.5	562.3
12/22/14 7:00:00	1.6	91.0	0.0	612.8	564.6
12/22/14 8:00:00	13.9	112.5	0.0	612.8	566.9
12/22/14 9:00:00	14.0	108.9	0.0	612.7	566.9
12/22/14 10:00:00	13.9	104.3	0.0	612.8	566.5
12/22/14 11:00:00	14.0	107.2	0.0	612.7	566.8
12/22/14 12:00:00	13.5	83.0	0.0	612.7	565.3
12/22/14 13:00:00	11.2	74.2	0.0	612.7	564.3
12/22/14 14:00:00	9.6	63.6	0.0	612.8	563.4
12/22/14 15:00:00	6.4	83.7	0.0	612.8	564.4
12/22/14 16:00:00	12.6	97.3	0.0	612.8	565.7
12/22/14 17:00:00	26.8	112.1	0.0	612.8	567.5
12/22/14 18:00:00	36.9	115.6	0.0	612.8	568.8
12/22/14 19:00:00	50.3	108.9	0.0	612.7	569.4
12/22/14 20:00:00	48.4	85.8	0.0	612.7	568.0
12/22/14 21:00:00	29.8	84.4	0.0	612.8	566.5
12/22/14 22:00:00	30.1	102.7	0.0	612.8	567.4
12/22/14 23:00:00	30.0	92.5	0.0	612.8	567.0
12/23/14 0:00:00	29.5	71.1	0.0	612.8	565.4
12/23/14 1:00:00	21.0	85.5	0.0	612.8	566.0
12/23/14 2:00:00	2.7	56.9	0.0	612.7	563.2
12/23/14 3:00:00	0.0	54.5	0.0	612.8	562.2
12/23/14 4:00:00	0.0	68.0	0.0	612.8	563.2
12/23/14 5:00:00	0.0	93.8	0.0	612.8	565.0
12/23/14 6:00:00	8.8	101.9	0.0	612.8	566.1
12/23/14 7:00:00	12.0	71.2	0.0	612.8	564.3
12/23/14 8:00:00	12.8	102.6	0.0	612.8	566.3
12/23/14 9:00:00	13.0	94.2	0.0	612.8	566.3
12/23/14 10:00:00	15.6	100.9	0.0	612.8	566.2
12/23/14 11:00:00	30.7	104.2	0.0	612.8	567.4
12/23/14 12:00:00	32.3	104.5	0.0	612.8	567.8
12/23/14 13:00:00	32.2	98.4	0.0	612.8	567.5
12/23/14 14:00:00	32.1	91.3	0.0	612.8	567.0
12/23/14 15:00:00	32.0	86.9	0.0	612.8	566.7
12/23/14 16:00:00	26.8	82.2	0.0	612.8	565.9
12/23/14 17:00:00	26.4	88.9	0.0	612.6	566.2

12/23/14 18:00:00	26.3	81.7	0.0	612.7	565.9
12/23/14 19:00:00	26.6	102.4	0.0	612.6	567.0
12/23/14 20:00:00	25.3	109.8	0.0	612.6	567.7
12/23/14 21:00:00	20.3	108.3	0.0	612.6	567.4
12/23/14 22:00:00	20.2	102.2	0.0	612.6	567.1
12/23/14 23:00:00	20.1	83.2	0.0	612.6	565.8
12/24/14 0:00:00	20.1	90.8	0.0	612.6	566.3

APPENDIX L
FINAL 2015 BROODSTOCK COLLECTION PROTOCOLS

STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE
Wenatchee Research Office
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April 14, 2015

To: HCP HC and PRCC HSC

From: Mike Tonseth, WDFW

Subject: ***Revised 4-14-15*** **- FINAL UPPER COLUMBIA RIVER SALMON AND STEELHEAD BROODSTOCK OBJECTIVES AND SITE-BASED BROODSTOCK COLLECTION PROTOCOLS**

The attached protocol was developed for hatchery programs rearing spring Chinook salmon, summer Chinook salmon and summer steelhead associated with the mid-Columbia HCPs; spring Chinook salmon, summer Chinook salmon and steelhead programs associated with the 2008 Biological Opinion for the Priest Rapids Hydroelectric Project (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, Grant County Public Utility Districts (PUDs), and ACOE and are operated by the Washington Department of Fish and Wildlife (WDFW), with the exception of 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).

This protocol is intended to be a guide for 2015 collection of salmon and steelhead 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, Priest Rapids Salmon and Steelhead Settlement Agreement), changes to programs as approved by the HCP-HC and PRCC-HSC, and to comply with ESA permit provisions, the USFWS 2008 Rocky Reach Biological Opinion (Service reference number 13260-2008-F-0116) and consultation requirements.

Notable in this year’s protocols are:

- Continuing for 2015, no age-2 or 3 males will be incorporated into spring or summer Chinook programs unless necessary to maintain effective population size (minimum female to male ratio of 1:0.75; conservation programs only).

- Use of ultrasonography to determine the sex of each fish retained for brood to better ensure achieving the appropriate number of females for program production (Does not include Priest Rapids Hatchery).

- Utilization of genetic sampling/assessment to differentiate Twisp River and Methow River Basin natural-origin spring Chinook adults collected at Wells Dam, and CWT interrogation during spawning of hatchery spring Chinook collected at the Twisp Weir and Methow FH to differentiate Twisp and Methow Composite hatchery fish for discrete management of Twisp and Methow Composite production components for the GPUD, CPUD and DPUD programs.

- Collection of only hatchery adult steelhead at Wells Dam/Hatchery for the Lower Methow safety-net (WFH/MFH), and Wells Hatchery Okanogan and mainstem Columbia safety-net programs.

- Collection of spring Chinook for the Nason Creek and Chiwawa programs using combination of Tumwater Dam and the Chiwawa Weir.

- Targeted collection of 100% of the Wenatchee summer Chinook and Wenatchee hatchery origin steelhead broodstock at Dryden Dam to reduce the number of activities that may contribute to delays in fish passage at Tumwater Dam (some adult collections at Tumwater may be necessary if sufficient adults cannot be acquired at Dryden Dam).

- Targeted collection of 100% of the natural origin steelhead broodstock at Tumwater Dam.

- Collection of summer Chinook broodstock from the Eastbank outfall, sufficient to meet a 576K yearling juvenile Chelan Falls program.

- Collection of surplus hatchery origin steelhead from the Twisp Weir (up to 25% of the required broodstock) to produce the 100K Methow safety-net on-station-released smolts (up to 14 adults). The remainder of the broodstock (46) will be WNFH returns collected at WNFH (or by angling/trapping/tangle netting 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 2016.

- Summer Chinook collections at Wells Dam to support the CJH program may occur if CCT broodstock collection efforts fail to achieve broodstock collection objectives.

- Collection from the Wells Hatchery volunteer channel of Wells summer Chinook to support the YN, Yakima River summer Chinook program.

- Targeted collection of 1,000 adipose present, non-coded wire tagged fall Chinook from the PRD OLAFT.

- Targeted collection of about 400 adipose present, non-coded wire tagged fall Chinook using hook and line efforts in the Hanford Reach.

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 2015 Broodstock Collection Protocols are:

Appendix A:	2015 Biological Assumptions for UCR Spring, Summer, and Fall Chinook and 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

Methow River Basin

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) Permit 1196.

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 with natural origin fish. . Based on historical Methow FH spring Chinook ELISA levels above 0.12, the hatchery origin spring Chinook broodstock collection will include hatchery origin spring Chinook in excess to broodstock requirements by approximately 20.5% (based upon the most recent 5-year mean ELISA results for the Methow/Chewuch program; 29.7% for the Twisp program). For purposes of BKD management and to comply with maximum production levels and other take provisions specified in ESA Section 10 permit 1196, 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 production at 223,765 yearling smolts. Culling of eggs from natural-origin females will not occur unless their ELISA levels are determined by WDFW Fish Health 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 (combined, these make up the entire Methow Basin spring Chinook population) will either be released back into the Columbia River. Based on the broodstock-collection schedule at Wells Dam (3-day/week, 16 hours/day, up to 48 hours per week cumulatively), extraction of natural-origin spring Chinook is expected to be approximately 33% or less.

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%. Trapping at the Winthrop NFH will be included, if needed, because of broodstock shortfalls.

Pre-season run-escapement of Methow-origin spring Chinook to Wells Dam during 2015 is estimated at 3,185 spring Chinook, including 2,678 hatchery and 507 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.

The following broodstock collection protocol was developed based on BKD management strategies, projected return for BY 2015 Methow Basin spring Chinook at Wells Dam (Table 1 and Table 2), and assumptions listed in Appendix A.

The 2015 aggregate Methow spring Chinook broodstock collection will target up to 130 adult spring Chinook (20 Twisp, 110 Methow; Table 3). Based on the pre-season run forecast, Twisp fish are expected to represent 3% of the adipose present, CWT tagged hatchery adults and 13% of the natural origin spring Chinook passing above Wells Dam (Tables 1 and 2). Based on this proportional contribution and a collection objective to limit extraction to no greater than 33% of the age-4 and age-5 natural-origin spawning escapement to the Twisp, the 2015 Twisp origin broodstock collection will total 20 wild fish, representing 100% of the broodstock necessary to meet Twisp program production of 30,000 smolts. Methow Composite fish are expected to represent 57% of the adipose present CWT tagged hatchery adults and 87% of the natural origin spring Chinook passing above Wells Dam (Tables 1 and 2). Based on this proportional contribution and a collection objective to limit extraction to no greater than 33% of the age-4 and age-5 natural-origin recruits, the 2015 aggregate Methow broodstock collection will total 110 natural origin spring Chinook. Broodstock collected for the aggregate Methow 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 1196. The Grant/Douglas/Chelan PUD 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.

Table 1. Brood year 2010-2012 age class-at-return projection for wild spring Chinook above Wells Dam, 2015.

			Age-at-return								
Brood year	**Smolt Estimate**		**Twisp Basin**				**Methow Basin**				
	Twisp[1]	Methow Basin[2]	Age-3	Age-4	Age-5	Total	Age-3	Age-4	Age-5	Total	SAR[3]
2010	8,927	50,165	5	45	**9**	59	62	403	**102**	567	0.00662
2011	10,047	36,344	6	**52**	9	67	45	**292**	74	411	0.00662
2012	12,277	35,976	**7**	62	12	81	**45**	289	73	407	0.00662
Estimated 2015 Return			**7**	**52**	**9**	**68**	**45**	**292**	**102**	**439**	

[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] *Mean Twisp NOR spring Chinook SAR to Wells Dam estimated using natural origin PIT tag returns (BY 2003-2007; Charlie Snow, personal communication).*

Table 2. Brood year 2010-2012 age class and origin run escapement projection for UCR spring Chinook at Wells Dam, 2015.

	Projected 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	102	1,299	133	**1,534**	45	292	102	**439**	147	1,591	235	**1,973**
%Total				57%				87%				62%
Twisp	19	30	18	**67**	7	52	9	**68**	26	82	27	**135**
%Total				3%				13%				4%
Winthrop (MetComp)	275	696	106	**1,077**					275	696	106	**1,077**

%Total				40%								34%
Total	396	2,025	257	**2,678**	52	344	111	**507**	448	2,369	368	**3,185**

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		**Total**		
		Hatchery	Wild			
Chelan PUD	60,516		18F/18M	**36**		
Douglas PUD	29,123		8F/8M	**16**		
Grant PUD	134,126		39F/39/M	**78**		
Total	**223,765**		**65F/65/M**	**130**		
By program		Number of Adults			Collection location	Mating protocol
		Hatchery	Wild	**Total**		
Twisp	**30,000**		**10F/10M**	**20**	Wells Dam/Twisp Weir	2x2 factorial
MetComp	**193,765**		**55F/55M**	**110**	Wells Dam/Methow Hatchery	2x2 factorial
Total	**223,765**		**65F/65M**	**130**		

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 20, 2015. Broodstock collection and stock assessment sampling activities authorized through the 2015 Douglas PUD Hatchery M&E Implementation Plan will occur simultaneously up to 3-days/week, up to 16 hours/day (not to exceed 48 cumulative hours per week). 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 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 Well FH pending genetic results and then transferred to Methow FH. Fish collected at MFH will remain at MFH or transferred to WNFH.

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 22. The trap may be operated up to five days per week/24 hours per day (provided it is manned during active trapping).

Trapping at the Methow Outfall trap and Winthrop NFH ladder operations will run concurrent with the Twisp Weir. Pending development of an adult management plan for spring Chinook in the Methow basin, hatchery-origin adults captured at the Methow Outfall (surplus to the Methow

Hatchery program) will be transferred to the WNFH for incorporation into WNFH brood as supported by the HGMP's of both facilities.

Steelhead

Douglas PUD and Grant PUD steelhead mitigation programs above Wells Dam utilize adult broodstock collections from multiple sources and locations such as at Wells Dam, Twisp Weir, Methow Hatchery volunteer trap, WNFH volunteer trap, Okanogan River Basin and angling in Methow River (Table 5). Generally incubation/rearing occur for the Methow safety net, Okanogan, and Columbia River release at Wells Fish Hatchery (FH) with incubation/early rearing at Methow Hatchery for the Twisp conservation program. The USFWS collects broodstock via hook-and-line in the Methow Basin, returns to WNFH and surplus fish removed at Methow Hatchery and the Twisp Weir.

Specific program brood sources are structured as follows:

Well Hatchery – Twisp River Release

The Wells Hatchery Twisp River release has shifted to a locally collected Twisp wild broodstock conservation program. Adults are collected in the spring of the current spawn year at the Twisp Weir.

Wells Hatchery – Methow River Release

The Wells Hatchery Methow River release (Methow safety net program) has shifted to 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 activities at the Twisp Weir, Methow Hatchery, WNFH, and through hatchery fish intercepted during natural origin brood hook and line collection for the USWFS Winthrop conservation program.

Wells Hatchery-Columbia River Release

The Wells Hatchery Columbia River releases will use returns to the Methow Hatchery volunteer trap to the extent possible, and will be augmented with Wells stock as required to fulfill the program. To ensure the safety-net programs have broodstock, 96 broodstock will be collected at Wells Dam in the fall of 2015, and held at Wells Hatchery (Table 5). These fall-collected Wells stock fish will be considered surplus to the spring-collected Methow and Okanogan broodstock, and eggs and/or fry from these surplus broodstock may be utilized for other programs in the upper Columbia.

Winthrop NFH – Methow River Release

The USFWS Methow River release will primarily use natural origin fish collected through hook and line collection efforts in the Methow River each spring. In the event NO collection falls short of the target, hatchery origin returns to WNFH will prioritized, followed by excess hatchery fish at the Twisp Weir then from excess hatchery returns to Methow Hatchery. Transfer of adult and/or gametes/eggs between program will be carefully choreographed to ensure fish are being utilized in the most efficient and effective manner.

Okanogan River releases

The Okanogan River uses a combination of natural origin adults collected in Omak Creek and hatchery origin adults collected in Omak Creek or elsewhere in the Okanogan Basin through CCT collection efforts. As a backup to potential collection shortfalls in the Okanogan, the Okanogan program will be augmented with collection of hatchery origin adults occurs in the fall at Wells Dam. These fall-collected Wells stock fish will be considered surplus to the spring-collected Methow and Okanogan broodstock, and eggs and/or fry from these surplus broodstock may be utilized for other programs in the upper Columbia.

Steelhead programs located upstream of Wells Dam and at Wells Hatchery are presented in Table 4.

Table 4. 2016 brood year Steelhead Programs at Wells Hatchery and Upstream of Wells Dam

Program	Hatchery	Owner	Release Location	Release Target	Broodstock Collection Locations
Twisp Conservation	Methow Hatchery (incubation); Wells Hatchery (rearing)	Douglas PUD	Twisp Acclimation Pond	48,000	Twisp WxW
Methow Safety-Net	Wells Hatchery	Douglas PUD	Methow Hatchery	100,000	HxH: Twisp Weir (up to 25%) + WNFH Hatchery (75%) or WNFH to make up balance
Mainstem Columbia Safety-Net	Wells Hatchery	Douglas PUD	Wells Hatchery	160,000	HxH: Methow Hatchery returns (1st option); Wells Hatchery/Dam (Wells Stock) (2nd option)
WNFH Conservation Program	WNFH	USFWS	WNFH	Up to 200,000	Maximize use of NOR, up to 55 pair captured by hook and line in the Methow River above Twisp, volunteers to WNFH, and tangle netting in Spring Creek.
Omak Creek	Wells Hatchery	Grant PUD	Omak Creek	Up to 40,000[1]	Okanogan Basin/Omak Creek (up to 16 wild or hatchery)
Okanogan	Wells Hatchery	Grant PUD	Okanogan Basin	Up to 90,000[1]	Wells Stock collected at Wells Dam/Hatchery or at tributary locations in the Okanogan Basin operated by the CCT

[1] The Grant PUD programs will total 100,000 smolts, +-10% (58 broodstock). Broodstock collection number, origin, location, and smolt numbers will be consistent with those detailed in National Marine Fisheries Service (NMFS) letter to Randall Friedlander (CCT) and Jeff Grizzel (GPUD) dated February 27, 2014 and detailed in Table 4 and Table 5 herein.

The following broodstock collection protocol was developed based on mitigation program production objectives (Table 6), biological assumptions (Appendix A), and the probability that sufficient adult steelhead will return in 2015/2016 to meet production objectives absent a preseason forecast at the present time.

For the 2016 brood steelhead programs operating above Wells Dam, a total of 350 adults (152 natural origin and 198 hatchery origin adults) are estimated to be needed to fulfill the respective mitigation obligations (Table 6). To support these obligations and to ensure sufficient backup adults are on hand in the event tributary based collection efforts fall short of targets, trapping at Wells Dam and/or Wells FH will selectively retain up to 310 hatchery origin steelhead (west [and east, as necessary] ladder and volunteer trap collection; Table 5).

Twisp Conservation Program

In the spring of 2016, 26 wild steelhead will be targeted at the Twisp Weir and transferred to the Methow Hatchery for spawning, incubation, and early rearing (up to 60-d post ponding to facilitate viral testing of progeny resulting from live spawning females for the YN kelt reconditioning program), after which they will be moved to Wells Hatchery for the balance of rearing (Table 5).

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) will be targeted at the Twisp Weir and moved to Wells Hatchery for spawning. No less than 46 hatchery adults will be targeted at Methow Hatchery and if needed/available, WNFH volunteer traps to meet the balance of the program needs (Table 6). Up to 60 hatchery origin Wells stock held at the Wells Hatchery will be used as a final option if broodstock collection at the Twisp Weir, and WNFH and MH traps are unsuccessful (Table 5).

Methow Conservation Program (USFWS)

Approximately 110 natural origin adults (55 pair) will 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 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.

Okanogan Hatchery/Endemic Program

Fifty-eight (58) adult steelhead will be targeted in the Okanogan Basin, including up to 16 natural-origin adults collected from Omak Creek for a 40K endemic program operated by the CCT and funded by GCPUD as part of their 100K UCR steelhead mitigation obligation (Table 5). Additionally, up to 52 hatchery adult steelhead will be targeted at Wells Dam/Hatchery as a back-up collection contingency due to unknown broodstock collection efficiencies in the Okanogan River Basin (Table 5).

Table 5. Broodstock collection locations, number, and origin by program.

Program	Number of Adults[1]		Primary collection location	Number of backup adults[2]	Backup collection location(s)	Total adult collection[1]	
	Hatchery	Wild				Hatchery	Wild
DPUD Columbia R.	96		Methow FH Wells Dam	Up to 96	Wells Dam	192	
DPUD Methow R.	60		Twisp weir (14) Methow FH (46)	Up to 60	WNFH[3] Wells Dam	120	
DPUD Twisp R.		26	Twisp weir	NA	NA		26
GPUD Okanogan R.	42	16	Omak Cr. Okanogan R.	52	Wells Dam	94	16
USFWS Methow R.		110	Methow R. WNFH[4]	NA	Methow FH		110
Total (PUD programs)	**198**	**42**		**208**		**406**	**42**
Total (All programs)	**198**	**152**		**208**		**406**	**152**

[1] Assumes a 1:1 sex ration (see table 6).
[2] All backup broodstock are hatchery origin adults.
[3] May include hatchery origin adults collected via the USFWS hook and line efforts for natural origin fish in the Methow River and adult returns to WNFH.
[4] May also include excess hatchery origin adults collected at Methow FH and the Twisp Weir.

Table 6. Number of broodstock needed to produce approximately 608,000 smolts for the above Wells Dam 2016 brood summer steelhead programs. Includes primary collection location(s) and mating strategy. *Broodstock totals* <u>*do not*</u> *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	48F/48M		**96**	MFH/Twisp Weir/Wells Dam	1:1
DPUD[2] Methow R.	100,000	30F/30M		**60[4]**	Twisp Weir, MFH, WNFH, Wells Dam	1:1
DPUD Twisp R.	48,000		13F/13M	**26**	Twisp Weir	2x2 Factorial
GPUD Okanogan R.[3]	100,000	21F/21M	8F/8M	**58[5]**	Okanogan R./Omak Creek	1:1
USFWS	200,000		55F/55M	**110[6]**		
Total[4]	**608,000**	**99F/99M**	**76F/76M**	**350**		

[1] Mainstem Columbia releases at Wells Dam. Target HxH parental adults as the hatchery component.
[2] Methow hatchery 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.
[3] Okanogan Basin releases, including Omak Creek is100,000 smolts as part of GCPUD's 100K summer steelhead obligation and targets 58 adults in the Okanogan Basin, including up to 16 natural origin adults to fulfill the Okanogan Basin Production of 100,000 smolts comprised of natural

origin and locally-adapted steelhead returning to the Okanogan River. Up to an additional 52 adults will be targeted at Wells dam to secure the production goal. Retention of progeny from these fish will be dependent upon success of CCT trapping efforts in Okanogan Basin tributaries.

[4] Up to an additional 60 hatchery adults will be collected at Well FH as a fall back to shortfalls in collections at the Twisp Weir, MFH.[5] Up to an additional 52 hatchery origin adults will be collected at Wells Dam as backup to potential 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.

Overall collection for the PUD programs will be 442 fish (a combination of program specific and back-up adults; Table 5) and 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 run-timing of hatchery and natural origin steelhead at Wells Dam and the Twisp Weir. Trapping at the Wells Dam ladders will occur between 01 August and 31 October, up to three days per week, and up to 16 hours per day, as required to meet broodstock objectives. Trapping will be concurrent with summer Chinook broodstocking efforts through 15 September on the west ladder (Appendix D). Operational criteria and dates for the Twisp Weir are still under construction.

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 Carlton Pond.

The TAC 2015 Columbia River UCR summer Chinook return projection to the Columbia River (Appendix D) and BY 2010, 2011, and 2012 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 2015, up to 98 natural-origin summer Chinook at Wells Dam west (and east, if necessary) ladder(s), including 49 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.

Should use of Wells Dam be needed to meet any shortfalls in broodstock for summer/fall Chinook programs occurring in the Okanogan Basin, 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 broodstock collection efforts for the Methow summer Chinook program and or steelhead collection efforts for steelhead programs above 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.

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		49F/49M	**98**	Wells Dam	1:1
Total	**200,000**		**98**	**98**		

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 following broodstock collection protocol was developed based on mitigation objectives and program assumptions (Appendix A).

WDFW will target 494 run-at-large summer Chinook from the volunteer ladder trap at Wells Fish Hatchery outfall for the Wells sub-yearling and yearling programs, 70 adults for the Lake Chelan triploid program, and up to 174 for the YN 275K-350K green egg request for the Yakima summer Chinook program (Table 8). Due to fish health concerns associated with the volunteer collection site (warming Columbia River water during late August), the volunteer collection will begin July 11 and terminate by August 31.

Summer/fall Chinook mitigation programs that release juveniles directly into the Columbia River between Wells and Rocky Reach dams have traditionally been supported through adult broodstock collections at the Wells Hatchery volunteer channel. For 2015, broodstock collection for the Chelan Falls summer Chinook program will be prioritized at the Eastbank Outfall (EBO) using in-channel seining/netting beginning July 1 (or earlier if summer Chinook are detected in the outfall) through September 15. Collection efforts in the EBO in 2013 and 2014 were sufficient to meet the adult requirements for the Chelan Falls program. 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 from the Wells Volunteer channel to make up the difference. The 2015 broodstock target for the Chelan Falls program is 350 adults (Table 8). The total production level supported by this collection is up to 576,000 yearlings for the Chelan Falls program.

Table 8. Number of broodstock needed 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. Also includes broodstock necessary for outside programs that rely on adult collection at Well Hatchery in 2015.

Program	Production target	Number of Adults[2]		Total	Collection location	Mating protocol
		Hatchery	Wild			
Wells 1+	320,000	96F/96M		**192**	Wells VC[3]	1:1
Wells 0+	484,000	151F/151M		**302**	Wells VC[3]	1:1
Lk. Chelan Triploid	NA	35F/35M		**70**	Wells VC[3]	1:1
Chelan Falls 1+	576,000	175F/175M		**350**	EB outfall	1:1
Yakama Nation	350,000[1]	87F/87M		**174**	Wells VC[3]	NA
Total	**1,730,000**	**544F/544M**		**1,088**		

[1] The YN request is for between 275K and 350 green eggs to support the Yakima River summer Chinook program.
[2] 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.
[3] Wells Hatchery volunteer channel trap.

Wenatchee River Basin

In 2015 the Eastbank Fish Hatchery (FH) is expecting to 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 2015 is 144,026 smolts, and based upon the biological assumptions (Appendix A) will require a total broodstock collection of about 80 natural origin spring Chinook (Table 10). The spring Chinook production obligation 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 142 adults (70 natural origin and 62 hatchery origin; Table 10).

Pre-season run-escapement of Wenatchee spring Chinook to Tumwater Dam during 2015 is estimated at 3,851 spring Chinook, including 2,915 hatchery and 935 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%.

Table 9. Age-4 and age-5 class return projection for wild and hatchery spring Chinook to Tumwater Dam during 2015.

	Chiwawa Basin			Nason Cr. Basin			Wenatchee Basin to Tumwater Dam		
	Age-4	Age-5	Total	Age-4	Age-5	Total	Age-4	Age-5	Total
Estimated wild return	497	158	**655**	123	39	**162**	710	225	**935**
Estimated hatchery return	2,749	166	**2,915**				2,749	166	**2,915**
Total	3,246	324	**3,570**	123	39	**162**	**3,459**	**391**	**3,851**

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	18F/18M	40F/40M	**116**[1]	Chiwawa Weir and Tumwater Dam[4]	2x2 factorial
Nason Conservation	125,000		35F/35M	**78**[2]	Tumwater Dam[4]	2x2 factorial
Nason Safety net	98,670	33F/33M[3]		**66**	Tumwater Dam	1:1
Total	**367,969**	**102**	**150**	**260**[2]		

[1] Includes 36 hatchery origin adults (represents ~50% of the adult target) to ensure the Chiwawa production goal is met if insufficient NO adults are collected).

[2] Includes ~10% additional NO fish to account for fish that may assign back to the White River spawning aggregate. No more than 70 NO fish will be retained for spawning.

[3] Due to the lack of returning hatchery fish from the Nason program (first age-4 returns are expected in 2017), Chiwawa hatchery fish will be collected to satisfy the Nason Cr. safety net program.

[4] 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).

Chiwawa River Conservation Program Broodstocking:

- Based upon estimates of returning previously PIT tagged NO fish to Tumwater Dam (Table 11), approximately 30 previously PIT-tagged NO spring Chinook from the Chiwawa River would 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 ~70 total or ~35 females) would be collected at the Chiwawa Weir.
  - Weir operations would be on a 24 hour up/24 hour down schedule from about June 15 through August 1 (not to exceed 15 cumulative trapping days). 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.

- Additionally, no more than 10 percent of the estimated mean number of adult bull trout in the Chiwawa Basin (using a rolling five year average derived from expanded redd counts) may be encountered during broodstock collection without concurrence from the USFWS.
- In the absence of adequate redd count data to calculate the 10% threshold, if after 15-days of weir operation, 67 bull trout encounters, or 15 August, the NO broodstock target is not reached, the balance of the mitigation obligation will be met through hatchery fish already retained for the Chiwawa program at TWD.
- To ensure the production target is met for the Chiwawa program, in the event that insufficient NO adults are collected for the conservation program, HO adults (presently estimated at 50% 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.
- 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 (2010-2014) with conversion rates from Bonneville Dam.

	Detections at Bonneville Dam		Detections at Tumwater Dam			
Return year	Nason	Chiwawa	Nason	Conversion rate	Chiwawa	Conversion rate
2010	15	78	2	0.133	62	0.795
2011	16	115	12	0.750	81	0.704
2012	7	60	5	0.714	52	0.867
2013	2	29	2	1.000	22	0.759
2014	6	66	1	0.167	29	0.439
Mean	9.2	69.6	4.4	0.553	49.2	0.713
Geomean	7.3	63.5	3.0	0.412	44.1	0.695

Nason Creek Conservation Program Broodstocking:

- Up to ~78 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 70 NO adults will be retained to produce the necessary Nason Conservation program.
  - Collection of HO fish may occur in the event NO collection/retention falls short of expectation.
  - 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 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 Wenatchee Population or Leavenworth), will be released upstream of Tumwater Dam..
  - In the event more fish assign to Nason or Chiwawa than are needed to meet the conservation program, the excess with the lowest assignment probabilities will be return to the river upstream of Tumwater Dam.

Nason Creek Safety Net Program Broodstocking:

- Up to ~66 HO spring Chinook adults 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.

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 1395 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 130 mixed origin steelhead for broodstock for a smolt release objective of 247,300 smolts (Table 12). The 64 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. Hatchery x wild and hatchery x hatchery parental cross and unknown hatchery parental cross adults will be excluded from the broodstock collection. Hatchery steelhead parental origins will be determined through evaluation of VIE tags, adipose/CWT presence/absence, and PIT tag interrogation during collection. 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 females 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.

Table 12. Number of broodstock needed for the combined 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		33F/33M	**66**	TWD[3]/Dryden LBT-RBT[4]	2x2 factorial
Wenatchee Safety net[2]	123,650	32F/32M		**64**	Dryden LBT-RBT[4] /TWD[4]	1:1
Total	**247,300**	**64**	**66**	**130**		

[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 minimizes 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 2015 is 500,001 smolts (181,816 GCPUD mitigation and 318,185 CCPUD mitigation).

The TAC 2015 Columbia River UCR summer Chinook return projection to the Columbia River (Appendix D) and BY 2010, 2011 and 2012 spawn escapement to the Wenatchee River indicate sufficient summer Chinook will 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 dam 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 252 natural-origin, summer Chinook at Dryden and/or Tumwater dams, including 126 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 01 July 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.

Table 13. Number of broodstock needed for the combined Chelan and Grant PUD Wenatchee summer Chinook production obligations of 500,001 smolts, collection location, and mating strategy.

Program	Production target	Number of Adults		Total	Collection location	Mating protocol
		Hatchery	Wild			
Chelan PUD	318,185		80F/80M	**160**	Dryden LBT-RBT[1] /TWD[2]	1:1
Grant PUD	181,816		46F/46M	**92**		
Total	**500,001**		**126F/126M**	**252**		

[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-November. 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 2015, up to 1,000 adipose present, non-coded wire tagged (high proportion of natural origin) fall Chinook adults will be targeted at the OLAFT (as approved by the PRCC-HSC). Additional NO adults targeted as a continued pilot evaluation through hook-and-line angling efforts in the Hanford Reach to increase the proportion of natural origin adults in the broodstock to meet integration of the hatchery program will also be incorporated into the program. It is estimated that approximately 400 adults may be collected through the hook-and-line efforts. Close coordination between broodstock collections at the volunteer channel, the OLAFT and through hook-and-line efforts in the Hanford Reach will need to occur so over collection is minimized. Fish surplus to production needs will be culled at the earliest possible life-stage (e.g, brood collected, brood spawned, eggs). Presumed NOR's collected and spawned from either hook-and-line caught broodstock or OLAFT collections will be prioritized for PRH programs (i.e. OLAFT and Hanford Reach anger caught fish will be externally marked, 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 OLAFT and angling collected adults at spawning and through incubation/early rearing.

Based upon the biological assumptions in Appendix A, an estimated 4,000 females will need to be collected (3,280 spawned) 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, hook-and-line efforts on the Hanford Reach, and/or the Priest Rapids Dam off ladder trap (OLAFT; Table 14).

To increase the probability of incorporating a higher percentage of NOR's from the volunteer channel, adipose present, non-CWT males and females will be prioritized for retention and males older than 3 will be prioritized.

<u>Implementation Assumptions</u>

1) Broodstock may be collected at any or all of the following locations/means: the PRD off ladder trap (OLAFT – operated 4-days per week/8 hrs/day to collect up to 1,000 presumed NOR's), 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 ≥ 75 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.

4) Only adipose present, non-CWT males and females will be retained for broodstock from volunteer channel collected broodstock unless a shortage is expected.

5) Only progeny of adipose present, non-wired fish encountered through hook-and-line angling and at the OLAFT will be prioritized for retention into the program.

6) Broodstock collected from the OLAFT and by hook-and-line will exclude age-2 and to the degree possible age-3 fish (<75 cm) 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 NOR's in the collection (e.g. collection of 1 in 5 age-3 fish for broodstock from the OLAFT).

7) All gametes of fish spawned from hook-and-line broodstocking efforts and/or OLAFT collections will be incorporated into the PRH based program.

8) Real time otolith reading and an alternative mating strategy will be implemented in 2015 similar to 2014. Otoliths from males from the OLAFT and ABC collections will be collected during the peak spawning week and read prior to spawning. If the male is natural origin, then it will be spawned with 4 females, otherwise it will be spawned with two.

9) All eggs or juveniles leaving PRH (including surplus) will have a unique otolith mark so that returning adults can be identified.

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.

Program	Production target	Number of Adults	**Total**	Collection location	Mating protocol
Grant PUD	5,599,504	2,074F/977M	**3,051**		
ACOE-PRH	1,700,000	630F/296M	**926**		
ACOE – Ringold[1]	3,500,000	1,296F/611M	**1,907**		
Total	**10,799,504**	**4,000F/1,884M**	**5,884**		

Collection location	Estimated number of adults		Total		
	Hatchery	Wild			
Priest Rapids Hatchery	**3,088F/1,242M**	**109F/45M**	**4,484**	PRH volunteer trap	1:2
OLAFT[2]	**307F/153M**	**360F/180M**	**1,000**	PRD off-ladder trap	1:2, 1:4
ABC[3]	**23F/45M**	**113F/219M**	**400**	Hanford Reach	1:2, 1:4
Total	**3,418F/1,440M**	**582F/444M**	**5,884**		

(4,858; 82.6%)	(1,026; 17.4%)

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[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] Estimated number of fall Chinook females and males to be acquired from the OLAFT in 2015. F/M ratios were derived through run at large data. Estimates of H/W were derived through otolith results.

[3] ABC fish are adults collected from hook and line collection efforts on the Hanford Reach. Estimates of F/M were derived through 2012-2014 spawn numbers. Estimates of and H/W were derived through otolith results from 2012 and 2013.

Appendix A

2015 Biological Assumptions for UCR spring, summer, and Fall Chinook and Summer Steelhead Hatchery Programs

Program	Mean Values for 2009-2013								Mean Values 2007-2011 Brood G-E-R Survival[3]
	ELISAs		Fecundity		Prespawn Survival				
	H	W			H		W		
	≥ 0.12	≥ 0.2	H	W	M	F	M	F	
Methow SPC	0.205	0.000	3,671	4,058	0.980	0.993	0.979	0.997	0.878
Twisp SPC	0.297	0.040	3,557	4,153	0.980	1.000	0.980	0.898	0.884
Twisp SHD	[redacted]	[redacted]	[redacted]	5,610	[redacted]	[redacted]	1.000	0.975	0.713
Wells SHD	[redacted]	[redacted]	6,022	5,864	0.957	0.936	0.975	0.942	0.609
Okanogan SHD Safety Net	[redacted]	[redacted]	6,022	[redacted]	[redacted]	0.936	[redacted]	[redacted]	0.609
Wells SUC 1+	0.012	0.000	4,183	4,552	0.964	0.972	0.959	0.938	0.836
Wells SUC 0+	0.012	0.000	4,183	4,552	0.964	0.972	0.959	0.938	0.798
YN Green Eggs	0.012		4,183		0.964	0.972			
Methow SUC	0.000	0.004	[redacted]	4,861	[redacted]	[redacted]	0.968	0.963	0.887
Chelan Falls 1+[1]	0.051	[redacted]	4,372	[redacted]	0.985	0.944	[redacted]	[redacted]	0.844
Wenatchee SUC	0.000	0.005	[redacted]	5,031	[redacted]	[redacted]	0.974	0.958	0.825
Wenatchee SHD	[redacted]	[redacted]	6,014	5,839	0.974	0.921	0.965	0.941	0.690
Nason SPC[2]	0.000	0.044	[redacted]	4,662	[redacted]	[redacted]	0.986	0.948	0.842
Chiwawa SPC	0.087	0.039	4,159	4,699	0.978	0.995	0.989	0.948	0.842
Priest Rapids FAC 0+	[redacted]	[redacted]	3,829	[redacted]	0.870	0.820	[redacted]	[redacted]	0.860
ACOE @PRH	[redacted]	[redacted]	3,829	[redacted]	0.870	0.820	[redacted]	[redacted]	0.860
ACOE @Ringold	[redacted]	[redacted]	3,829	[redacted]	0.870	0.820	[redacted]	[redacted]	0.860

[1] Fecundities, ELISA's and prespawn survival values are based upon only two years data due to the shift in broodstock collection location from the Wells volunteer channel to the Eastbank Outfall.

[2] Green egg to release survival is based upon survival performance of fish acclimated and released from the Chiwawa program. Spring 2015 will be the first juvenile release from the Nason Creek program.

[3] Green egg to release survival.

Appendix B

Projected Brood Year Juvenile Production Targets, Marking Methods, Release Locations

Brood Year	Production Group	Program Size	Marks/Tags[3]	Additional Tags	Release Location	Release Year
Summer Chinook						
2015	Methow SUC 1+ (GPUD)	200,000	Ad +CWT	5,000 PIT minimum	Methow River at CAF	2017
2015	Wells SUC 0+ (DPUD)	480,000	Ad + CWT		Columbia R. at Wells Dam	2016
2015	Wells SUC 1+ (DPUD)	320,000	Ad + CWT		Columbia R. at Wells Dam	2017
2015	Chelan Falls SUC 1+ (CPUD)	576,000	Ad + CWT	10,000 PIT	Columbia R. at CFAF	2017
2015	Wenatchee SUC 1+ (CPUD/GPUD)	500,001	Ad + CWT	5,000 PIT minimum	Wenatchee R. at DAF	2017
2015	CJH SUS 1+	500,000	Ad + 100K CWT	5,000 PIT	CJH	2017
2015	CJH SUS 0+	400,000	Ad + 100K CWT	5,000 PIT	CJH	2016
2015	Okanogan SUS 1+	266,666	Ad + CWT	5,000 PIT	Omak Pond	2017
2015	Okanogan SUS 1+	266,666	Ad + CWT	5,000 PIT	Riverside Pond	2017
2015	Okanogan SUS 1+	266,666	Ad + CWT		Similkameen Pond	2017
2015	Okanogan SUS 0+	300,000	Ad + CWT	5,000 PIT	Omak Pond	2016
Spring Chinook						
2015	Methow SPC (PUD)	108,249	CWT only	7,000 PIT	Methow R. at MFH	2017
2015	Methow SPC (PUD)	25,000[1]	CWT only	7,000 PIT	Methow R. at GWP (YN)	2017
2015	Methow SPC (PUD)	60,516	CWT only	TBD	Chewuch R. at CAF	2017
2015	Twisp SPC (PUD)	30,000	CWT only	5,000 PIT	Twisp R. at TAF	2017
2015	Methow SPC (USFWS)	400,000	Ad + CWT	10,000 PIT	Methow River at WNFH	2017
2015	Okanogan SPC[4] (CCT)	200,000	CWT only	5,000 PIT	Okanogan R. at Tonasket Pond	2017
2015	Chief Joe SPC[5] (CCT)	700,000	Ad + 200K CWT	5,000 PIT?	Columbia R. at CJH	2017
2015	Chiwawa R. SPC (CPUD)	144,026	CWT only	5,000 PIT minimum	Chiwawa River at CPD	2017

	(conservation)					
2015	Nason Cr. SPC (GPUD) (conservation)	125,000	CWT + blank body tag	5,000 PIT	Nason Cr. at NAF	2017
2015	Nason Cr. SPC (GPUD) (safety net)	98,670	Ad + CWT		Nason Cr. at NAF[9]	2017
Fall Chinook						
2015	Priest Rapids FAC 0+ (ACOE)	1.7M	Ad + Oto	Approximately 43,000 spread across the fish released from PRH	Columbia River at PRH	2016
2015	Priest Rapids FAC 0+ (GPUD)	600,000	Ad+CWT+ Oto		Columbia River at PRH	2016
2015	Priest Rapids FAC 0+ (GPUD)	600,000	CWT + Oto		Columbia River at PRH	2016
2015	Priest Rapids FAC 0+ (GPUD)	1M[2]	Ad + Oto		Columbia River at PRH	2016
2015	Priest Rapids FAC 0+ (GPUD)	3.4M	Oto only		Columbia River at PRH	2016
2015	Ringold Springs FAC 0+ (ACOE)	3.5M	Ad + Oto		Columbia River at RSH	2016
Steelhead						
2016	Wenatchee Mixed (HxH/WxW) (CPUD)	66,771	Ad + CWT (HxH) CWT only (WxW)	5,400 PIT	Nason Cr. direct release	2017
2016	Wenatchee Mixed (HxH/WxW) (CPUD)	53,170	Ad + CWT (HxH) CWT only (WxW)	4,300 PIT	Chiwawa R. direct release	2017
2016	Wenatchee Mixed (HxH/WxW) (CPUD)	102,359	Ad + CWT (HxH) CWT only (WxW)	8,278 PIT	Wenatchee R. direct release	2017
2016	Wenatchee HxH (CPUD)	25,000	Ad + CWT	2,022 PIT	Wenatchee R. at BBP	2017
2016	Twisp WxW (DPUD)	48,000	CWT only	5,000 PIT	Twisp River at TAF	2017
2016	Wells HxH (DPUD)	100,000	Ad only	5,000 PIT	Methow River at MFH	2017
2016	Wells HxH (DPUD)	160,000	Ad only	5,000 PIT	Columbia R. at Wells Dam	2017
2016	Methow WxW (USFWS)	200,000	Ad + CWT	10,000 PIT	Methow R. at WNFH	2017

2016	Okanogan HxH/HxW (CCT/GPUD)	Up to 100K [6]	Ad /CWT (TBD) [7]	Up to 20,000 PIT [8]	Okanogan/Similkameen Omak, Salmon, Antoine, other tribs. (TBD)	2017
2016	Okanogan WxW (CCT/GPUD)	Up to 100K [6]	Body/snout CWT/Alternate fin clip (TBD)[7]	Up to 20,000 PIT [8]	Okanogan/Similkameen Omak, Salmon, Antoine, other tribs. (TBD)	2017

[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 2015.

[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] Dependent upon conditions in pending Section 10 Permit.

[8] Total PIT tag release in the Okanogan 20,000

[9] For brood years 2015 and 2016, Chiwawa hatchery fish will be collected at TWD to satisfy the Nason Creek safety net program and released from the NAF. These two brood years will be adipose fin clipped and snout CWT'd and will be targeted for 100% removal at TWD as adults consistent with the Wenatchee Basin Spring Chinook Management Plan. 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 and snout CWT so that they can be differentiated and prioritized at TWD..

Appendix C

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 for cast may be available to lay out what the expected surplus is, how many can 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 3,851 (935 natural origin [24.3%] and 2,915 hatchery origin [75.7%]) spring Chinook back to Tumwater Dam in the Wenatchee Basin. Approximately 3,517 Chiwawa spring Chinook are to reach Tumwater Dam in 2015, of which about 655 (18.6%) and 2,915 fish (81.4%) are expected to be natural and hatchery origin spring Chinook, respectively. Additionally, about 162 natural origin spring Chinook are expected back to Nason Creek with the balance 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 2015. Estimates were generated by recently developed run prediction and pre-spawn mortality models (WDFW unpublished data).

	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	497	158	**655**	123	39	**162**	710	225	**935**
Estimated hatchery return	2,749	166	**2,915**				2,749	166	**2,915**
Total	3,246	324	**3,570**	123	39	**162**	**3,459**	**391**	**3,851**

[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 conservation fisheries or adult removal at Tumwater Dam (TWD), the expected number of age- 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 (NORs; 4.5 times the number of NOR’s in the Chiwawa River). The combined HO and NO returns will represent about 4 times the number of adults needed to meet the interim Chiwawa run escapement to TWD of 900 fish indicating a disproportion number of hatchery origin spring Chinook will be on the spawning grounds in the fall of 2015. The conservation fishery is estimated to remove about 259 HOR Chiwawa adults (Table 3) which will require additional adult management to occur at TWD.

Additional Adult Management

2015 adult management actions are intended to provide for near 100% removal of age-3 hatchery males (jacks) and up to about 50% of the age-4 and age-5 hatchery origin adults (about 399 males and 680 females according to current models, Table 2). In addition to the conservation fishery, approximately 252 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, the balance will be surplused at TWD and used for tribal and/or food bank disbursements or nutrient enhancement projects (Table 3).

Table 2. Run escapement and spawning escapement of Chiwawa River hatchery and natural origin fish to Tumwater Dam and the Chiwawa River in 2015.

	To Tumwater Dam		To Chiwawa River		Adults surplused at TWD[3]	Total Chiwawa spawners
	Wild	Hatchery	Wild[1]	Hatchery[2]		
Females[4]	496	1,836	258	195	680	**453**
Males[4]	439	1,079	225	114	399	**339**
Sub-total	935	2,915	483	309	1,079	**792**
Pre-spawn survival[6]			0.831	0.287		
Expected PNI						**0.39**
Expected pHOS						**0.72**

[1] Wild broodstock needs of 80 wild NO fish (32 females/32 males) for the Chiwawa conservation program have already been accounted for in this total as well as pre-spawn mortality.
[2] Adjusted for pre-spawn mortality.
[3] Does not include age-3 hatchery males "jacks" removed during adult management activities at TWD and through the conservation fishery.
[4] Age-4 and age-5 fish only. Gender proportions were made based upon a 5-year average sex ration for hatchery and wild fish of the same age class.
[5] This should result in approximately 452 redds in the Chiwawa Basin under the assumption that each female produces only one redd.
[6] Estimated survival from Tumwater to spawn. Due to the expected poor environmental conditions expected in the Wenatchee Basin in 2015, prespawn survival values applied to the 2015 estimate is based upon the lowest observed survival to date (2001). 2001 was a water year very similar to how 2015 is shaping up.

Table 3. Estimated returns of Icicle Hatchery, Chiwawa Hatchery, and Chiwawa wild adults and estimated number of adults removed through adult management activities in the Wenatchee Basin in 2015.

	Estimated Returns			
	Icicle	Chiwawa HO	Chiwawa NO	Total
Estimated return	7,332	2,916	655	10,903
% of return	0.672	0.267	0.061	
Harvest at2% take limit[1]	270	259	13[2]	542
	Estimated Chiwawa Hatchery Fish Removed			
	Fishery	Broodstock	TWD removal	Total

Number of HO adults removed by method[3]	259	98	722	1,079

[1] For Wenatchee River fishery area only. Does not include Icicle River fishery harvest.

[2] While included as harvest, it is NO incidental hooking mortality associated with HO fish removal.

[3] Only includes age-4 and age-5 adults

Wenatchee Summer Steelhead

Depending on the outcome of preseason and in-season estimates of hatchery and natural origin steelhead to the Wenatchee Basin during the annual run cycle monitoring at the Priest Rapids Dam Off Ladder Trap (OLAFT), removal of surplus adult steelhead may occur at Tumwater Dam or in combination with a conservation fishery.

A more detailed run forecast will be available in September 2015. Adult management plans will be finalized then and appended to this document.

Methow Spring Chinook

Pre-season estimates project a total of 3,185 (507 natural origin [15.9%] and 2,678 hatchery origin [84.1%]) spring Chinook back to Methow Basin. Of the 2,678 hatchery returns, about 1,537 are estimated to from the conservation program with the balance of 1,077 from the WNFH safety net program (Table 4).

Table 4. Brood year 2010-2012 age class and origin run escapement projection for UCR spring Chinook at Wells Dam, 2015.

	Projected 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	102	1,299	133	**1,534**	45	292	102	**439**	147	1,591	235	**1,973**
%Total				57%				87%				62%
Twisp	19	30	18	**67**	7	52	9	**68**	26	82	27	**135**
%Total				3%				13%				4%
Winthrop (MetComp)	275	696	106	**1,077**					275	696	106	**1,077**
%Total				40%								34%
Total	396	2,025	257	**2,678**	52	344	111	**507**	448	2,369	368	**3,185**

It is likely that some level of adult management will be required to limit the number of hatchery spring Chinook on the spawning grounds. Because a conservation fishery is not yet possible under current permit limitations, adult management will need to occur through operation of the volunteer channel traps located at both the Methow Hatchery (MH) and Winthrop NFH (WNFH).

Presently hatchery fish from MH fish 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 in natural origin brood for the MH conservation program, and c) to support the 400K safety net program at WNFH. As such WNFH will operate their return channel to support removal of excess safety net fish. MH will operate its volunteer trap and will provide surplus hatchery adults (in excess to the MH needs) to WNFH to support the safety net program or retain adults to facilitate testing translocation of conservation fish to under seeded spawning areas as approved by the HCP HC and PRCC HSC.

In-season assessment of the magnitude and origin composition of the spring Chinook return above Wells Dam will be used to provide in-season adjustments to hatchery/wild composition and total broodstock collection, consistent with ESA Section 10 Permit 1196.

Methow Summer Steelhead

Depending on the outcome of preseason and in-season estimates of hatchery and natural origin steelhead to the Methow Basin during the annual run cycle monitoring at the Priest Rapids Dam Off Ladder Trap (OLAFT), removal of surplus adult steelhead may occur at the Twisp Weir (primarily as an action related to the steelhead RSS to meet a 1:1 hatchery:wild spawning composition upstream of the weir), the Wells Hatchery Volunteer Channel, volunteer returns to the Methow Hatchery and Winthrop NFH, or in combination with a conservation fishery.

A more detailed run forecast will be available in September 2015. Adult management plans will be finalized then and appended to this document.

Okanogan Summer Steelhead

Depending on the outcome of preseason and in-season estimates of hatchery and natural origin steelhead to the Okanogan Basin during the annual run cycle monitoring at the Priest Rapids Dam Off Ladder Trap (OLAFT), removal of surplus adult steelhead may utilize a conservation fishery or in combination with removal through spring Okanogan tributary weir operations.

A more detailed run forecast will be available in September 2015. Adult management plans will be finalized then and appended to this document.

Appendix D

Site Specific Trapping Operation Plans

Tumwater Dam

For 2015, 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:** Throughout all trapping activities described in this plan, the two PIT tag antennae arrays within the Tumwater Dam ladder (weir 15 and 18, see Appendix 2), will be monitored by WDFW and Chelan PUD and detections of previously PIT tagged fish will be evaluated to determine the median passage time of fish between first detection at weir 15 and last detection at weir 15 or weir 18. Median passage estimates will be updated with every 10 PIT-tagged fish encountering weir 15. 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) **Improved Fish Handling Efficiency**: Several infrastructure improvements at Tumwater allow WDFW and other operators to cycle through sampled fish more quickly. These improvements consist of an additional holding tank and an improved conveyance system between the trap and holding tank. The facility improvements and additional staffing by WDFW (3 operators instead of 2) during peak spring Chinook and sockeye passage (i.e. June 1 and July 15), will ensure that the trapping denil is operated constantly allowing unimpeded passage through the trap. Historically, the trapping denil has been periodically shut down while fish were being processed.

3) **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).

4) **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.

5) **Planned Tumwater trapping operations from September 1 until mid-December:** The trap will return to a 24 hours/7day/week manned or unmanned active trapping for steelhead and Coho broodstock collection and adult steelhead management. During this time period bull trout are rare and spring Chinook are not present at Tumwater. For this trapping period, real-time monitoring will continue to be implemented.

6) **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.

7) **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 2015. 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					
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 2015 brood will end in June 2015. However it is anticipated that adult management will occur for the 2016 brood 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 2015, 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 five days per week, 24 hours per day beginning July 1 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° 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 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 2015. 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
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	30Nov

[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.

[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 5d/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 5d/week 24hr/day 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.

Wells Dam Ladder and Hatchery Volunteer Traps

For 2015, WDFW and Douglas PUD are proposing the following plan (A summary of activities by month for the Wells Dam East/West ladder and Wells FH volunteer traps is summarized in Table 3):

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 construction activities on the hatchery modernization preclude use of either the West ladder or volunteer traps.

If the East ladder trap is used, it may begin as early as May 1 and 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. Anticipated trap operation is not expected to go beyond November 15.

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 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 East ladder trap. Anticipated trap operation is not expected to go beyond November 15.

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 July 1 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.

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.

Table 3. 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 2015. Blue denotes steelhead, brown spring Chinook, pink summer Chinook, and green Coho.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
East/West Ladders												
Su. SHD BS collection[1]									1 Sep		15 Nov	
Su. SHD run comp.									1 Sep		15 Nov	
Su. SHD Spawner Esc. Tagging[2]									1 Sep		15 Nov	
Sp Chinook BS collection					1 May		15 Jul					
Sp Chinook run comp					1 May		15 Jul					
Su. Chin BS collection[3]							1 Jul		15 Sep			
Coho BS collection[5]									1 Sep		15 Nov	
Wells Volunteer Trap												
Su. SHD BS collection[1]									1 Sep		15 Nov	
SHD pHOS mgt.[6]		15 Feb				15 June			1 Sep			15 Dec
Su. Chin BS collection[4]							1 Jul		15 Sep			
Su. Chin Surplussing							1 Jul			30 Oct		

[1] Summer steelhead broodstock collection will be prioritized at West ladder and volunteer traps. However if broodstock objectives cannot be met at either of those two locations then trapping may occur at the East ladder concurrent with other activities.

[2] SHD spawner composition tagging at Wells Dam will run concurrent with other (broodstock or M&E) activities at Wells Dam.

[3] 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.

[4] 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.

[5] Coho trapping may be conducted at both East and/or West ladders. Trapping at Wells Dam ladder traps for Coho broodstock will follow an up to 3d/week 16hr/day trapping schedule and may run concurrent with other broodstock collection, run sampling, or adult management activities. Trapping at the Wells Dam ladder will cease no later than November 15.

[6] Adult management of the 2015 brood will end in June 2015. However it is anticipated that adult management will occur for the 2016 brood beginning 1 September or earlier if conducted in conjunction with broodstock collection activities at the Wells Hatchery volunteer channel for other species.

Methow Hatchery Volunteer and Twisp Weir Traps

For 2015, WDFW and Douglas PUD are proposing the following plan (A summary of activities by month for Methow Hatchery volunteer trap and the Twisp Weir is summarized in Table 4):

Specific operation details for the Methow Hatchery volunteer trap and Twisp Weir are still being worked through. Once those details have been fleshed out more thoroughly, this section will be updated.

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.

Table 4. 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 2015. Blue denotes steelhead, brown spring Chinook, and green Coho.

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				1-30 Apr								
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 2015 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.

Table 5. Summary of broodstock collection, VSP monitoring, and/or run composition sampling activities anticipated to be conducted at the Priest Rapids Dam Off Ladder Trap (OLAFT) in 2015. Blue denotes steelhead, purple fall Chinook, and orange sockeye.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
SHD VSP Monitoring[1]							1 Jul	🟦	🟦	🟦	15 Nov	
Fall Chin. BS collection[2]									1 Sep	🟪	15 Nov	
Fall Chinook Run Comp.[3]									1 Sep	🟪	15 Nov	
Sockeye BS Collection						22 Jun	10 Jul					

[1] Steelhead VSP monitoring targets 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] To acquire the target 1,000 adipose present, non-CWT adult fall Chinook for broodstock, the OLAFT is operated up to 5 days per week, 8 hours per day. Three of the five days are concurrent with the SHD VSP monitoring. The trap is opened to passage each night.

[3] Fall Chinook run composition runs concurrent with SHD VSP monitoring and/or fall Chinook broodstock collection activities.

[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

Columbia River TAC Forecast

Table 1. 2015 Columbia River at mouth salmon and steelhead returns – actual and forecast.

			2014 Forecast	2014 Return	2015 Forecast
Spring Chinook	**Total Spring Chinook**		**308,000**	**315,600**	**312,600**
	Willamette		58,700	51,800	55,400
	Sandy		5,500	6,000	5,500
	Cowlitz*		7,800	10,500	11,200
	Kalama*		500	1,000	1,900
	Lewis*		1,100	1,500	1,100
	Select Areas		7,400	2,200	5,000
	Lower River Total		**81,000**	**73,000**	**80,100**
	Wind*		8,500	4,000	4,800
	Drano Lake*		13,100	8,700	7,800
	Klickitat*		2,500	2,900	2,700
	Yakima*		9,100	8,800	9,300
	Upper Columbia	Total	24,100	33,100	27,500
	Upper Columbia	*Wild*	3,700	5,700	4,500
	Snake River Spr/Sum	Total	125,000	137,900	140,800
	Snake River	*Wild*	42,200	46,000	45,300
	Upriver Total		**227,000**	**242,600**	**232,500**
Summer Chinook	**Upper Columbia**		**67,500**	**78,300**	**73,000**
Sockeye	**Total Sockeye**		**347,100**	**645,100**	**394,000**
	Wenatchee		63,400	118,500	106,700
	Okanogan		282,500	523,700	285,500
	Snake River		1,200	2,900	1,800

Appendix F

Annual Chelan, Douglas, and Grant County PUD RM&E Implementation Plans

Chelan PUD
The 2015 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 2015 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

2015 GPUD Hatchery ME Implementation Plan for the Wenatchee Basin
https://grantpud.box.com/s/qkx0lhv7qmkvcn1jandrz1ahvbkv5rx1

2015 Priest Rapids Hatchery Implementation Plan
https://grantpud.box.com/s/xhmr8ajpmfkt3vyzo6fjghy84od8nkxi

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.

Improved Fecundity Estimates

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.

Adult Collection Adjustments

C) Make in-season adjustments to adult collections based upon a fecundity-at-length regression model for each population/program and origin composition needs (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.

Within-Hatchery Program Adjustments

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:

  - 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:

- 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
- 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.

APPENDIX M
COMPREHENSIVE SUMMARY OF PARTIAL WATER REUSE AND CIRCULAR POND REARING SYSTEMS AT CHELAN PUD HATCHERIES

Comprehensive Summary of Partial Water Reuse and Circular Pond Rearing Systems at Chelan PUD Hatcheries

Prepared by:

Alene Underwood and Catherine Willard

February 2015

Table of Contents

Agreements

1. Executive Summary

The enclosed documents represent over eight years of study design, implementation, and evaluation of partial water reuse systems as compared with standard flow through raceway hatchery rearing vessels, as well as performance of circular rearing ponds without partial water reuse. These vessels have been evaluated at Chelan County PUD- (PUD) owned facilities including Eastbank Hatchery, Chiwawa Acclimation Facility, and Chelan Falls Acclimation Facility with funding from both Chelan and Grant County PUDs and by approval of the Habitat Conservation Plan Hatchery Committees for Rock Island and Rocky Reach and the Priest Rapids Coordinating Committee Hatchery Subcommittee.

A COMPREHENSIVE SUMMARY OF CHELAN COUNTY PUBLIC UTILITY DISTRICT'S REUSE/CIRCULAR HATCHERY REARING VESSELS

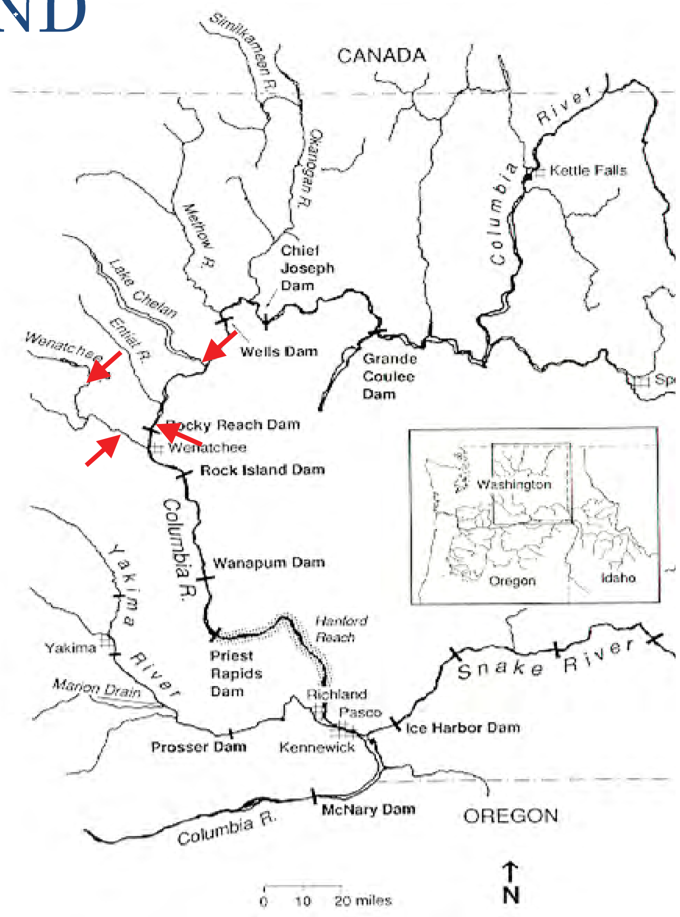
PREPARED BY ALENE UNDERWOOD AND CATHERINE WILLARD

CHELAN COUNTY PUBLIC UTILITY DISTRICT
GRANT COUNTY PUBLIC UTILITY DISTRICT

ROCK ISLAND, ROCKY REACH, AND WELLS HCP HC
PRIEST RAPIDS CC HSC
FEBRUARY 18, 2015

PROGRAM BACKGROUND

- Summer Chinook
  - **Chelan River**[1]
    - **RY2009 and RY2010**
      - Eastbank Hatchery (RAS/FT)
      - Acclimation (Chelan River netpens) and release to the Chelan River
    - **RY2012-RY2014**
      - Eastbank Hatchery
      - Acclimation Chelan Falls (Circulars)
  - **Wenatchee River**
    - **RY2011 and RY2014**
      - Eastbank Hatchery (RAS/FT)
      - Acclimation (Dryden Pond) and release to the Wenatchee River
- Steelhead
  - **RY2010**
    - Chiwawa Hatchery (RAS)
    - Turtle Rock Island (FT)
  - **RY2011-Present**
    - Chiwawa Hatchery (RAS/FT)



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[1] *No RY2011 Chelan River RAS /FT evaluations were completed.*

EASTBANK PARTIAL WATER REUSE FACILITY

- (2) 30-foot diameter dual drain fiberglass tanks
- (2) radial flow clarifiers
- Gas management tower
- 60 micron drum filter
- Pump sump
- (3) 5 hp pumps (2 lead, 1 lag)
  - Makeup flow rate = 324 gpm
  - Reuse flow rate = 971 gpm
  - Total flow rate = 1,295 gpm
- Liquid & high pressure reserve oxygen supply and monitoring
- Alarming & water quality monitoring

CHIWAWA PARTIAL WATER REUSE FACILITY

- (3) 20-foot diameter dual drain fiberglass tanks
- Gas management tower
- 60 micron drum filter
- Solids handling waste clarifier and holding tank
- Pump sump
- (2) 5 hp pumps (1 lead, 1 lag)
  - Makeup flow rate = 120 gpm
  - Reuse flow rate = 420 gpm
  - Total flow rate = 540 gpm
- Liquid & high pressure reserve oxygen supply and monitoring
- CLA valve modulating backup system (automatically switches from resuse to flow through in the event of a power outage)
- Alarming & water quality monitoring

CHELAN FALLS CIRCULAR VESSEL TECHNOLOGY ACCLIMATION FACILITY

Period of Operation	November-May
Number of Fish	576,000
Vessel and volume	4 round concrete rearing ponds, each roughly 12,000 cf
Diameter and Depth	45’, 7.5’
Water Supply	Chelan Powerhouse Tailrace
Water supply, each pond	5.9 cfs
Cleaning waste handling	One radial flow settler per pond, lift station; solids removal offsite

PARTIAL WATER REUSE CIRCULAR VESSELS

- Known Operational Benefits
  - Use less water! 1/4 of a standard raceway.
  - Rotation of water ensures consistent velocities and oxygen.
  - Better waste capture and removal of TSS.

FISH PERFORMANCE?

- Fish health
- Post-release survival
- Travel time downstream
- Smolt-to-adult returns
- Age structure

STATEMENT OF AGREEMENT

Rocky Reach and Rock Island HCP Hatchery Committees

Statement of Agreement

February 20th, 2008

Regarding Pilot Study for Partial Water Reuse

"Determine if circular ponds with 75% reuse can be used to rear Chinook from ponding to yearling size at Eastbank, while producing fish with growth, health and vigor desired for the supplementation programs"

FISH HEALTH

- Survival
- Bacterial and viral fish pathogens
- Coefficient of variation
- Condition factor
- Fat

FISH HEALTH ASSESSMENTS
GOOD AND VINCI 2009, 2010, AND 2011

- Objective:

  Compare growth and health of fish raised in raceways vs. partial reuse systems

- Hypothesis:

  Fish growth and health will be equivalent or better in a partial reuse environment vs. a raceway environment

FISH HEALTH ASSESSMENTS
GOOD AND VINCI 2009, 2010, AND 2011

- Bacterial and viral pathogens screening
  - 60 fish/cohort sent to WADDL
- Daily mortality and feed data; monthly length and weight assessments
- Histology
  - 10-30 fish/cohort fixed in formalin for multiple tissue assessment
- Fin Condition
  - Fin index: length of longest fin ray standardized to fish fork length
  - Dorsal and caudal fins
- Blood chemistry / blood gas measurements
  - Caudal venipuncture; i-Stat 1 portable analyzer

FISH HEALTH ASSESSMENTS
RESULTS-GOOD AND VINCI 2009, 2010, AND 2011

Brood Year	Species	Rearing Vessel	Survival	Bacterial and/or Viral Fish Pathogens	Condition Factor	Coefficient of Variation	Fin Indices	Fat
BY2007	Summer Chinook	Reuse	99.3%	Negative	1.15	24.01	Dorsal-Lower* Caudal-Lower*	NM
		Raceway	99.0%	Negative	1.28	32.92	Dorsal-Higher* Caudal-Higher*	NM
BY2008	Summer Chinook	Reuse	98.9%	Negative	1.30	13.76	Dorsal-Lower* Caudal-no difference	Lower*
		Raceway	99.1%	Negative	1.41	17.10	Dorsal-Higher* Caudal-no difference	Higher*
BY2009	Summer Chinook	Reuse	99.4%	Negative	1.20	15.8	Dorsal-no difference Caudal-no difference	Lower*
		Raceway	99.7%	Negative	1.23	15.3	Dorsal-no difference Caudal-no difference	Higher*
BY2009	Steelhead	Reuse	NM	Bacterial coldwater disease	NM	9.17	Dorsal-Higher* Caudal-no difference	NM
		Raceway	NM	Bacterial coldwater disease	NM	10.86	Dorsal-Lower* Caudal-no difference	NM

BY2007 and BY2008 summer Chinook study occurred from ponding in June to November (6 months).
BY2009 summer Chinook study occurred from ponding in June to March (10 months).
BY2009 steelhead study occurred from January to March (3 months).
NM=not measured; *=statistically significant.

FISH HEALTH ASSESSMENTS

CONCLUSIONS-GOOD AND VINCI 2009, 2010, AND 2011

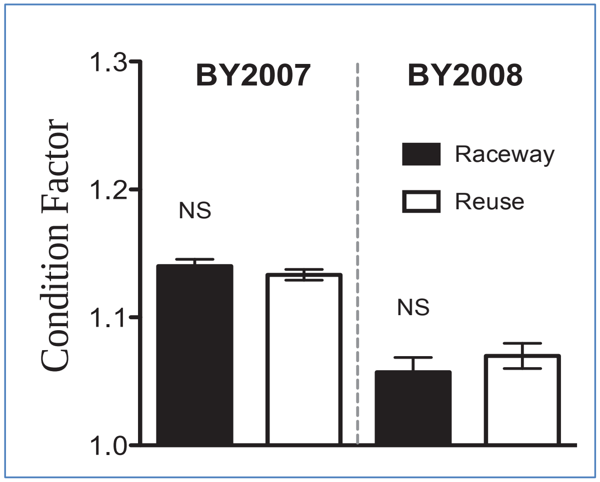
- Differences noted in health parameters between raceway and reuse fish tended to be mild and subclinical in nature
- Three years (summer Chinook) and one year (steelhead) of pilot study data indicate that fish reared in a partial water reuse environment are comparable to fish raised in raceways

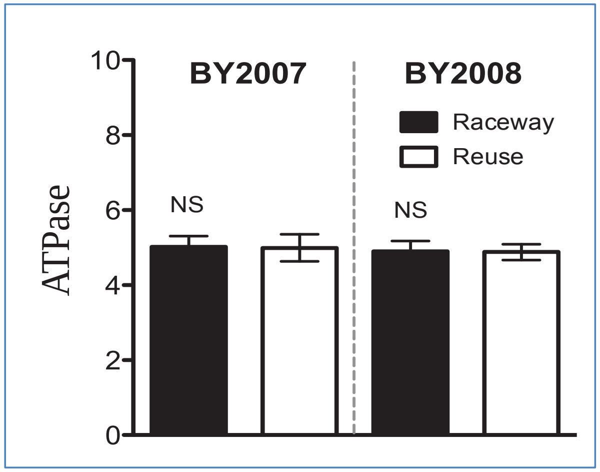
FISH HEALTH ASSESSMENTS
HARSTAD ET AL. (PERSONNEL COMMUNICATION)

- Eastbank RAS vs FT
- Sampled just before release April 2009 and 2010
- Size
- Condition factor
- Gill Na^+/K^+ ATPase activity
- Precocity (mini-jacks)
  - Visual inspection of gonads
  - Blood 11-ketotestosterone level

FISH HEALTH ASSESSMENTS

RESULTS-HARSTAD ET AL.

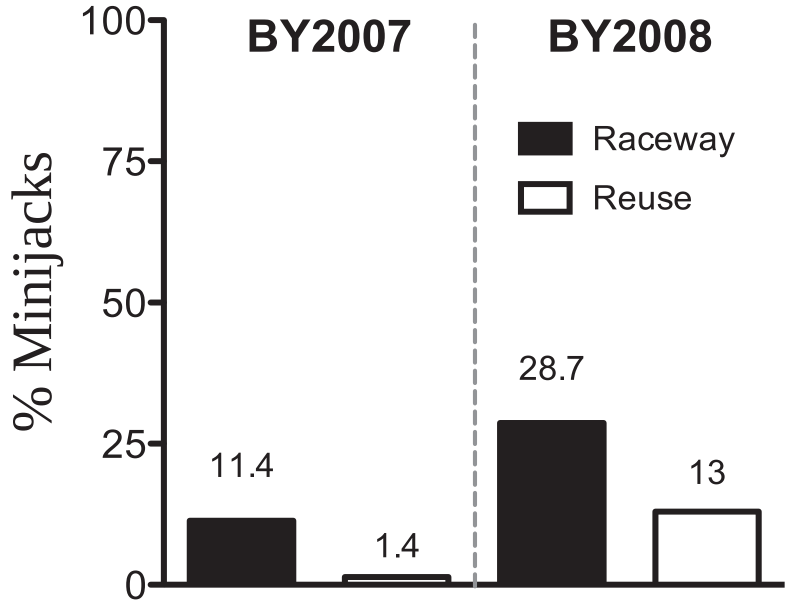




- No difference in condition factor
- No difference in gill ATPase

FISH HEALTH ASSESSMENTS
RESULTS-HARSTAD ET AL.

- A statistically significant greater proportion of fish were mini-jacks in the raceway group.



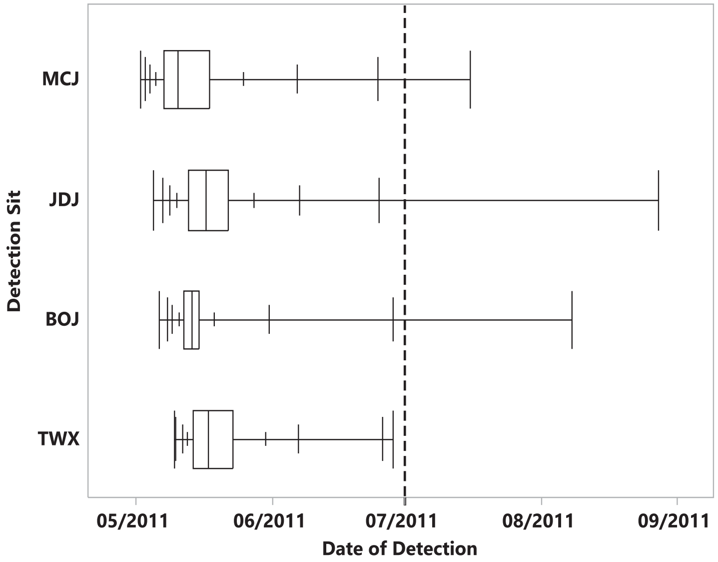
FISH HEALTH ASSESSMENTS

METHODS-JUVENILE SURVIVAL AND TRAVEL TIME

- PIT data for the analyses were queried using PTAGIS. Data queries were structured using formatting described by Westhagen and Skalski (2009) for input into the program PITPRO. Four input files can be used in generating Cormack/Jolly-Seber estimates of survival and mean travel times to downstream locations: tagging, interrogation, recapture, and mortality files. The latter two optional queries were omitted from the analyses here for efficiency; inclusion of these data would likely result in negligible differences.

FISH HEALTH ASSESSMENTS
METHODS-SMOLT TO ADULT RETURN RATES

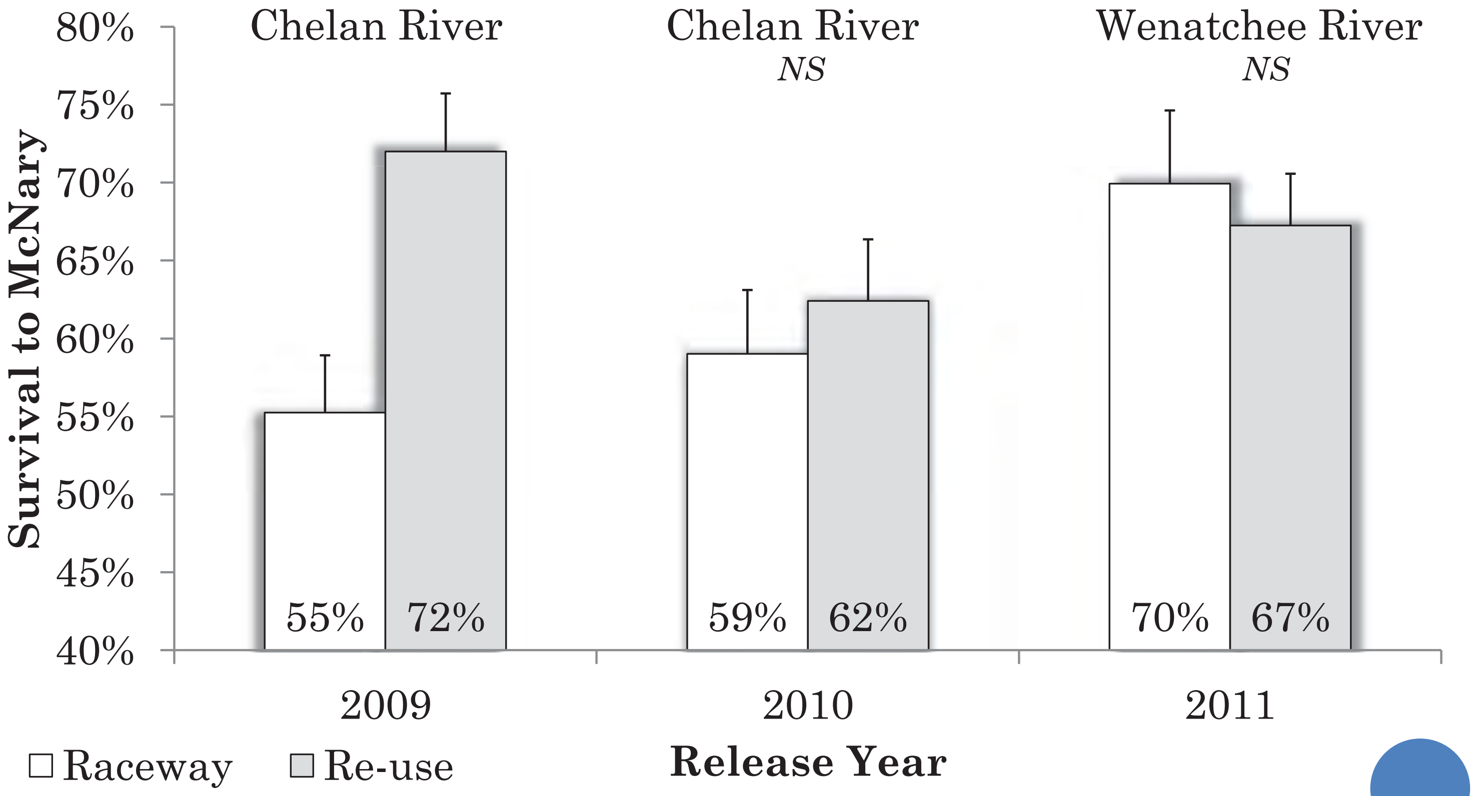
- PTAGIS interrogation summaries were used as a basis for examining adult returns. Detections in mainstem fishways (Bonneville, McNary, Priest Rapids, and Rock Island dams) were used to indicate survival to maturity. For steelhead, detections prior to July 1 of the year of release were excluded in order to eliminate spurious detections of juvenile migrants in fishways (i.e., potential residuals). Summer Chinook detected in ladders after July 1 of the year of release were assumed to be mini-jacks (justification below).



At all juvenile detection locations, 99.5% of spring Chinook juvenile outmigrants were interrogated before July 1 (example release year 2011 above); therefore, fish detected after July 1 in the mainstem Columbia juvenile detection facilities were assumed to be mini-jacks.

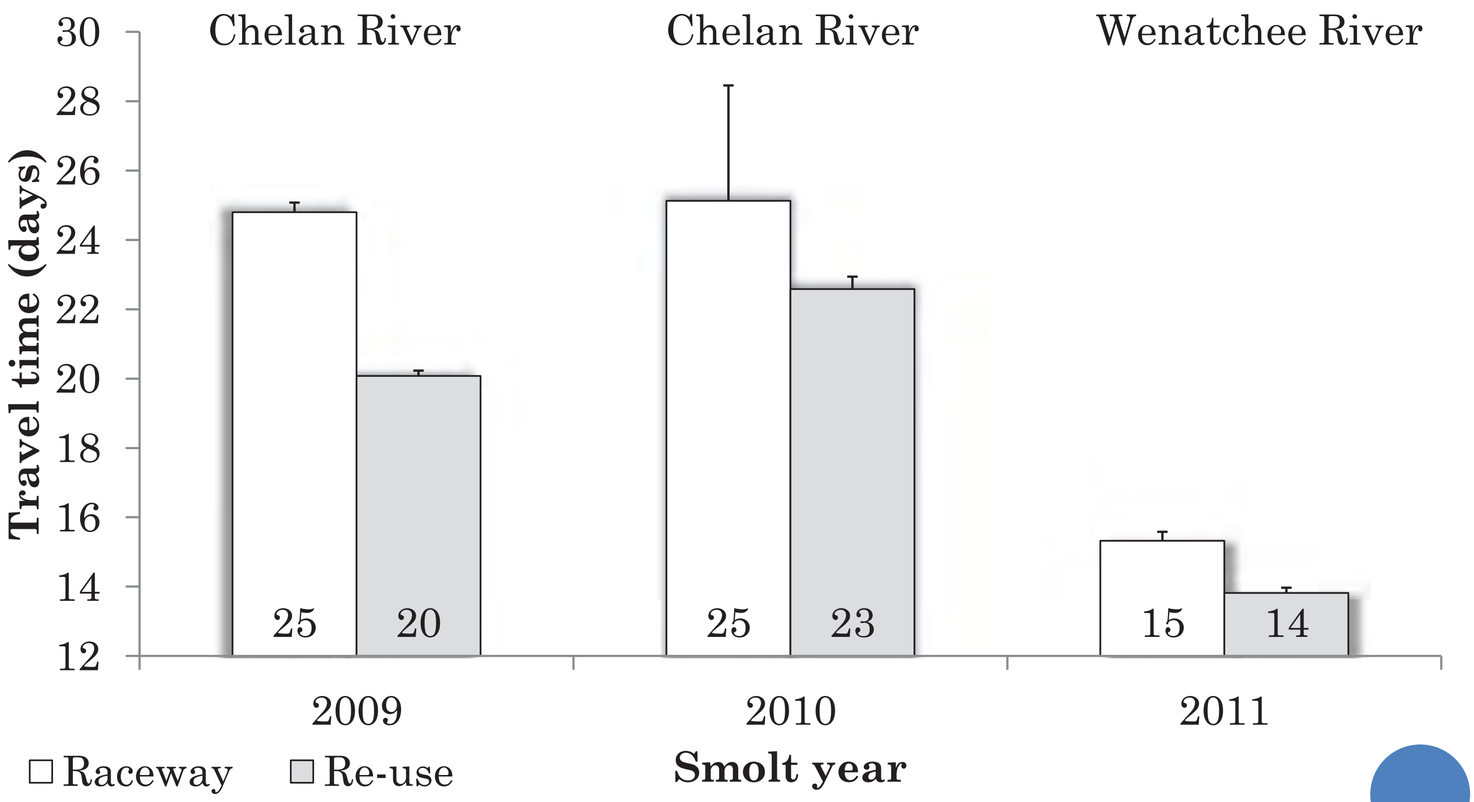
SUMMER CHINOOK

SMOLT SURVIVAL TO MCNARY



NS=Not Statistically Significant

SUMMER CHINOOK
TRAVEL TIME TO MCNARY



STATEMENT OF AGREEMENT

Rocky Reach and Rock Island HCP Hatchery Committees

Statement of Agreement

Regarding the use of Circular Culture Tanks at Chelan Falls

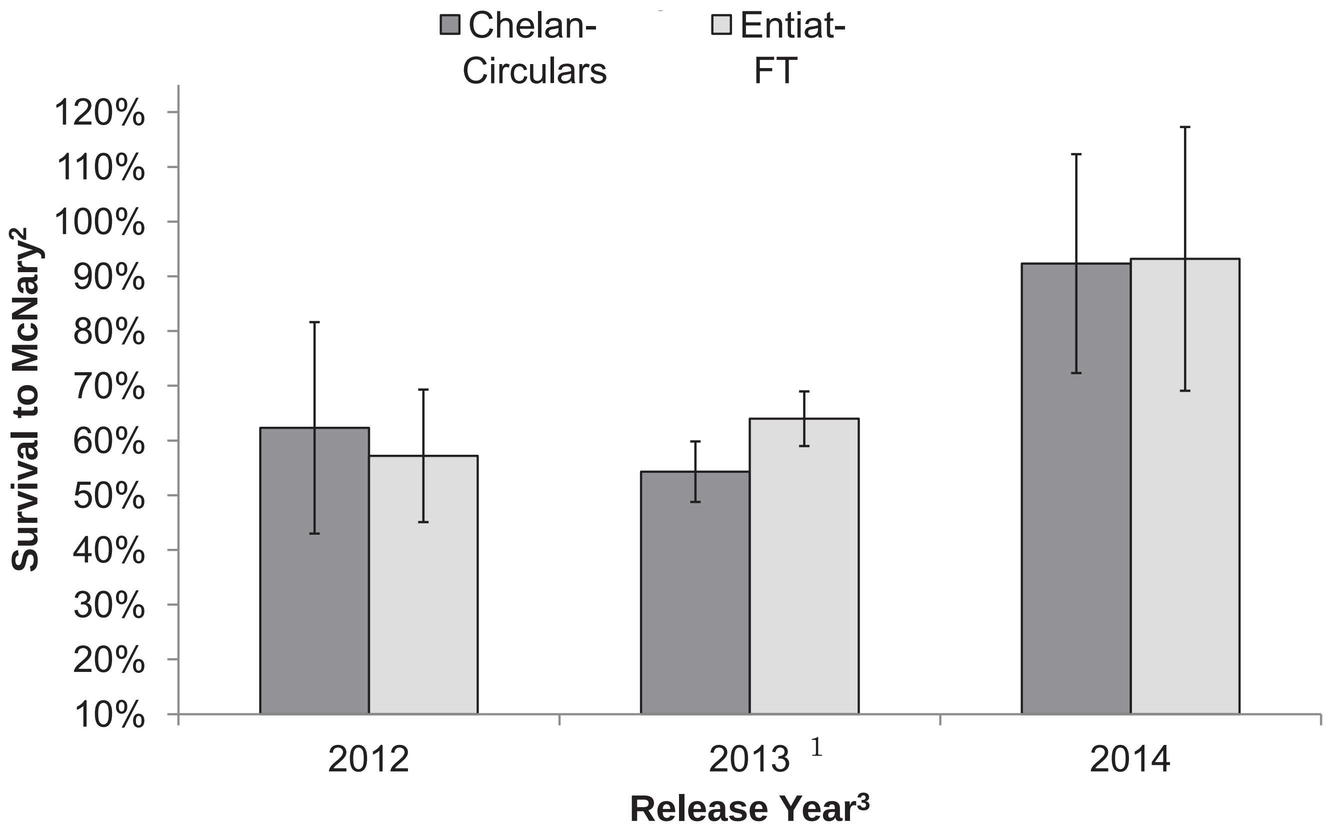
May 19, 2010

"The absolute survival of summer Chinook reared and acclimated in circulars at 0.2 DI would be compared against the performance of other smolts (from the same origin broodstock-Entiat summer Chinook) released above Rocky Reach Dam during the initial years of implementation. Key metrics would include survival from release to McNary and migration time to McNary. Success would require that Chelan Falls smolts perform as well or better than the existing programs (e.g., statistically no detectable difference or significantly better using the same parameters as the existing re-use comparisons). The overall purpose of the comparison is to measure performance against an existing, approved hatchery program."

Summer Chinook

Survival to McNary

NS=Not Statistically Significant



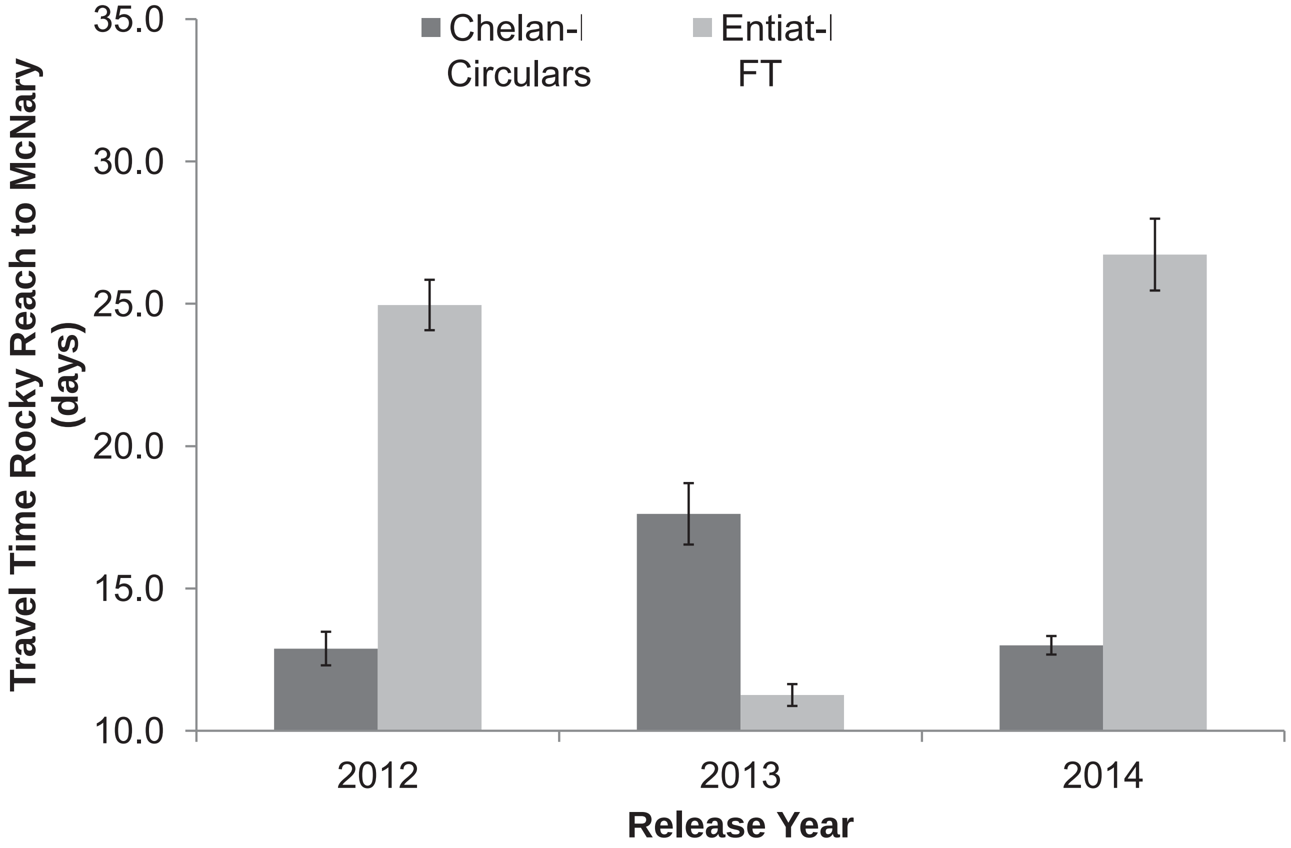
[1] RY2013 - Chelan Falls fish experienced high mortality due to fungus, bacterial cold water disease, bacterial gill diseaase, erythrocytic inclusion body syndrome during April 2013 (approximately 23,000 died in April).

[2] Survival for RY2012 and RY2014 is from Rocky Reach to McNary; due to invalid survival estimates for RY2013 from Rocky Reach to McNary, release location to McNary survival estimates were used.

[3] Survival estimates were not significantly different for any release year.

SUMMER CHINOOK

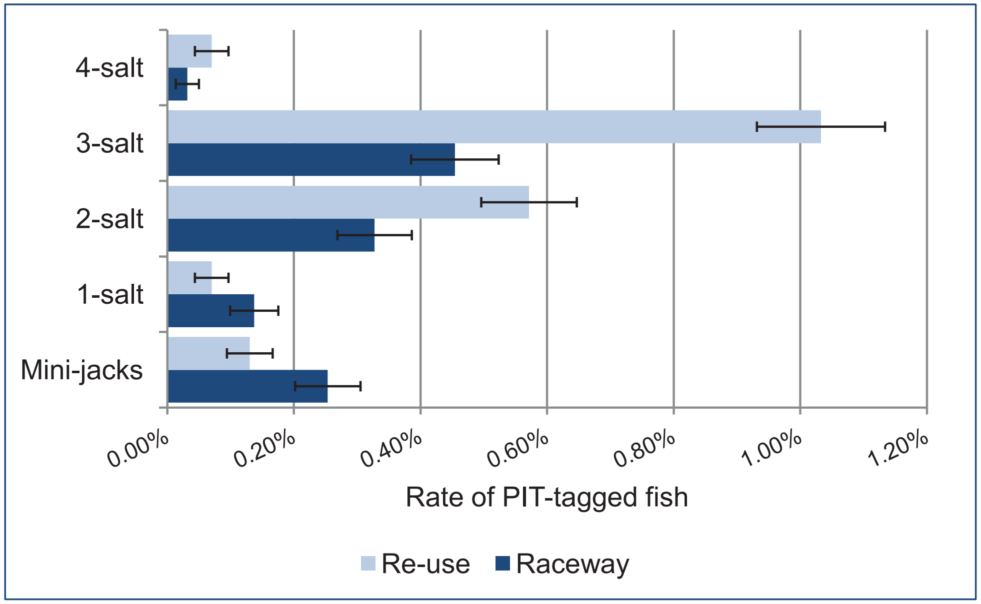
TRAVEL TIME TO MCNARY

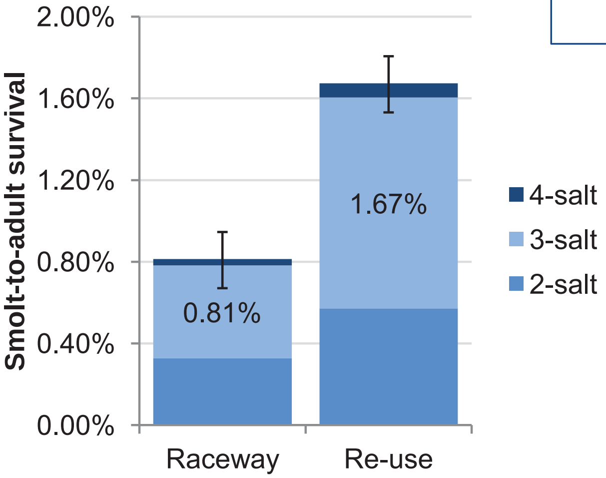


[1]RY2013 - Chelan Falls fish experienced high mortality due to fungus, bacterial cold water disease, bacterial gill diseaase, erythrocytic inclusion body syndrome during April 2013 (approximately 23,000 died in April).

SUMMER CHINOOK ADULT RETURNS

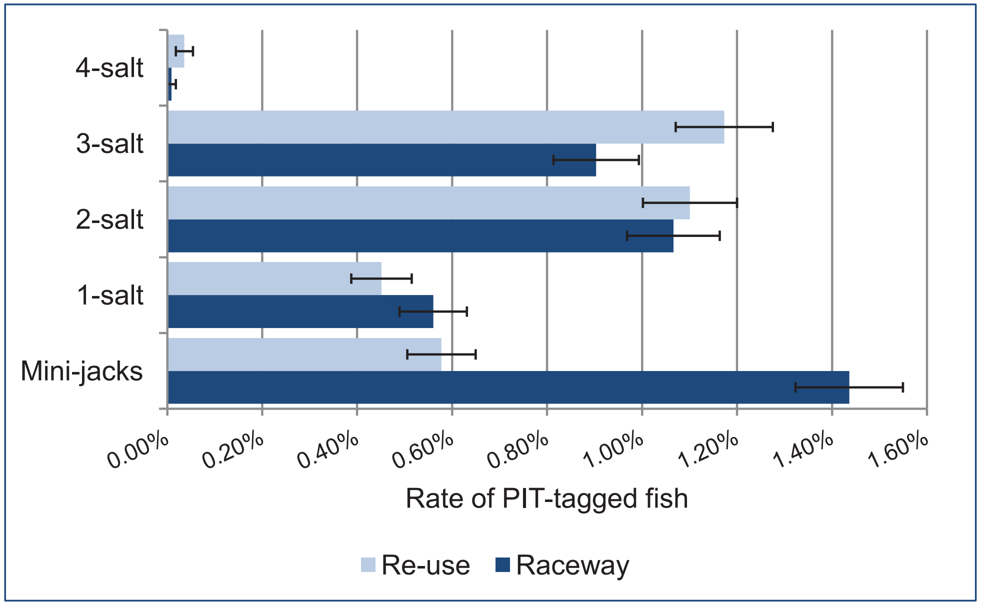
RELEASE YEAR 2009 CHELAN RIVER

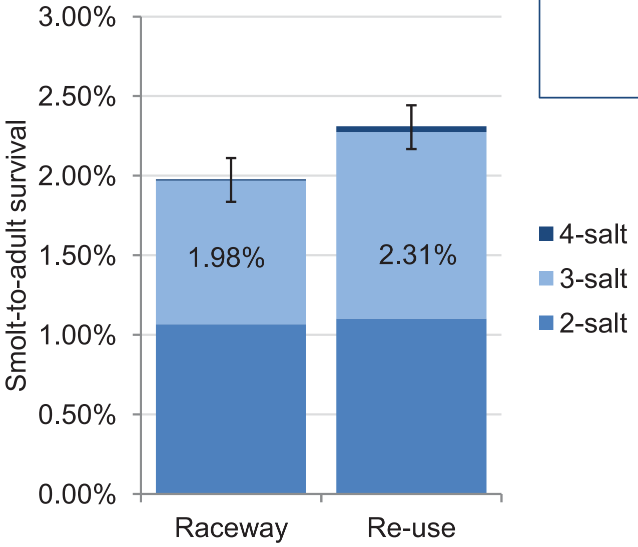




SUMMER CHINOOK ADULT RETURNS

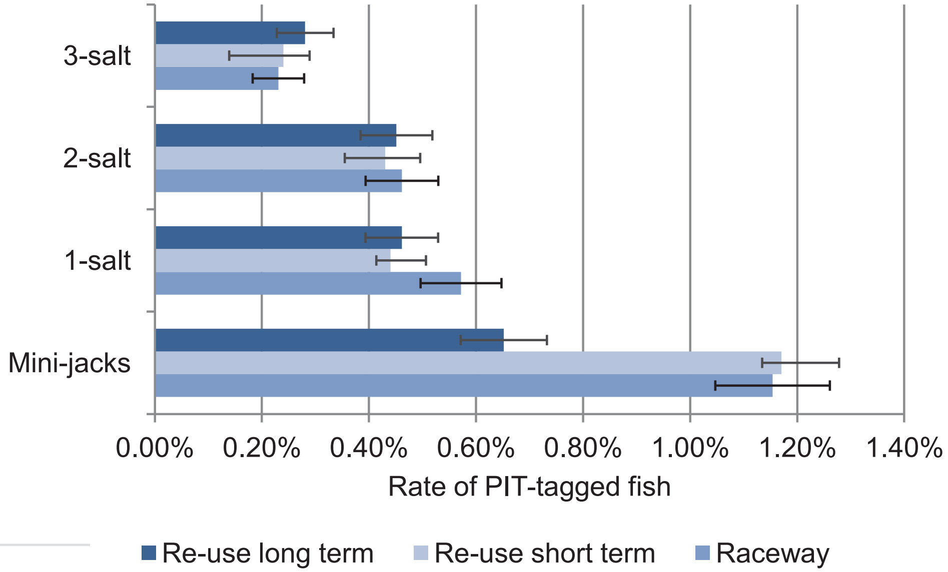
RELEASE YEAR 2010 CHELAN RIVER

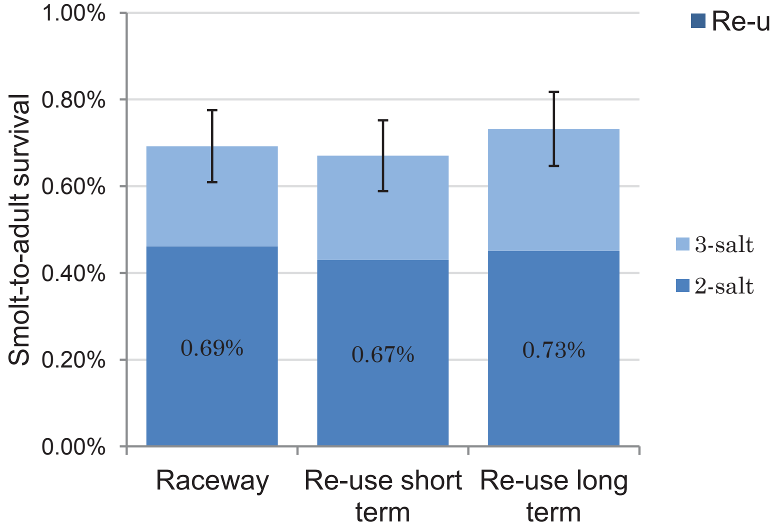




SUMMER CHINOOK ADULT RETURNS

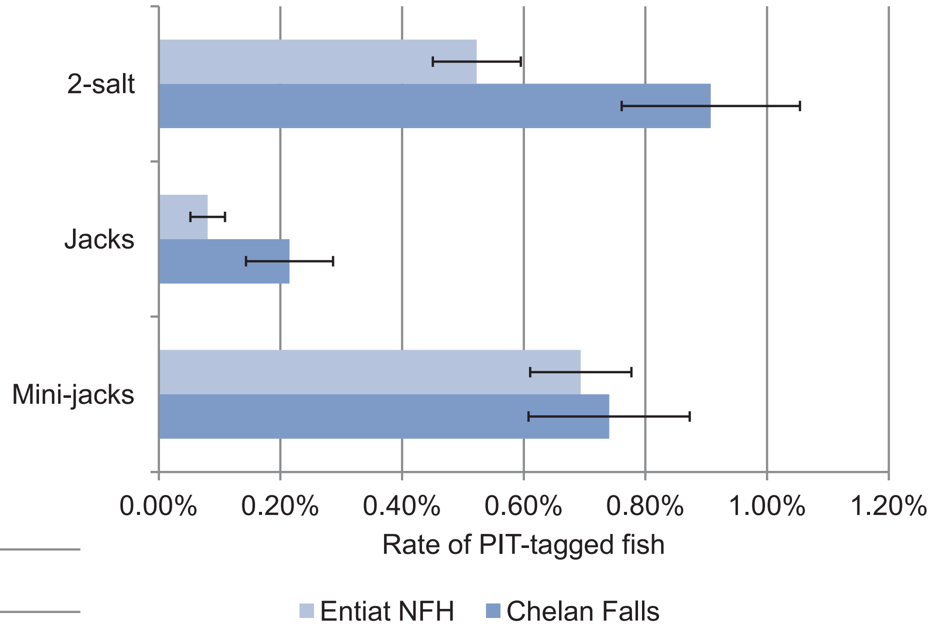
RELEASE YEAR 2011 WENATCHEE RIVER

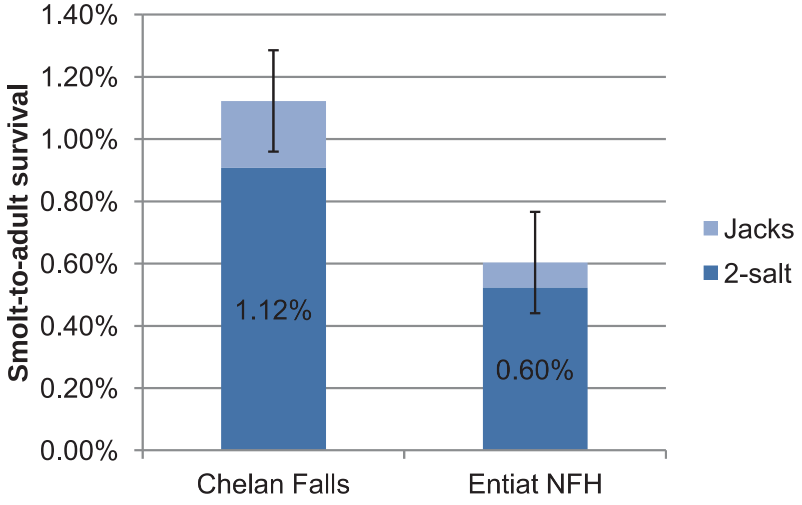




SUMMER CHINOOK ADULT RETURNS

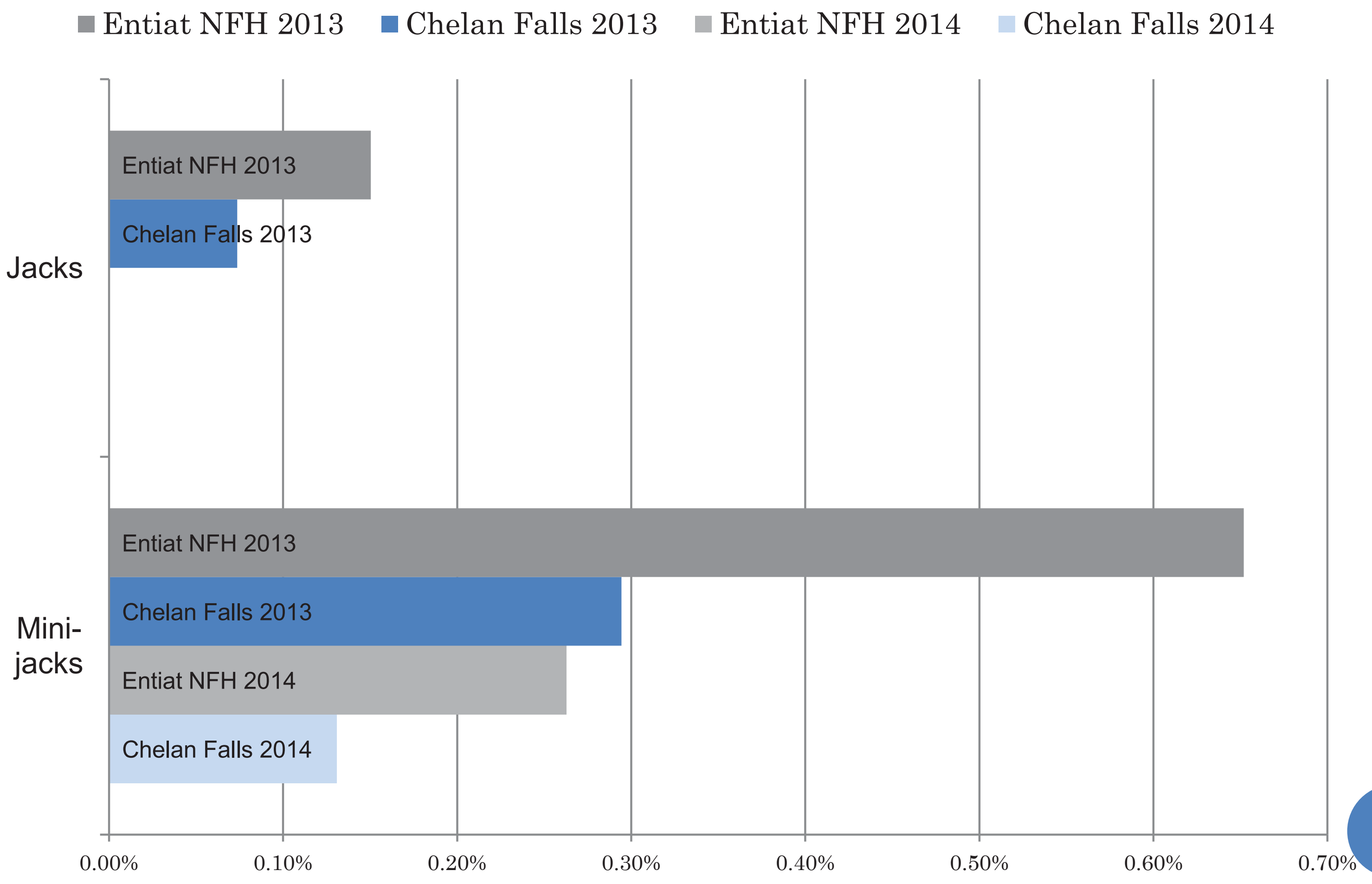
RELEASE YEAR 2012 CHELAN FALLS AND ENTIAT NFH



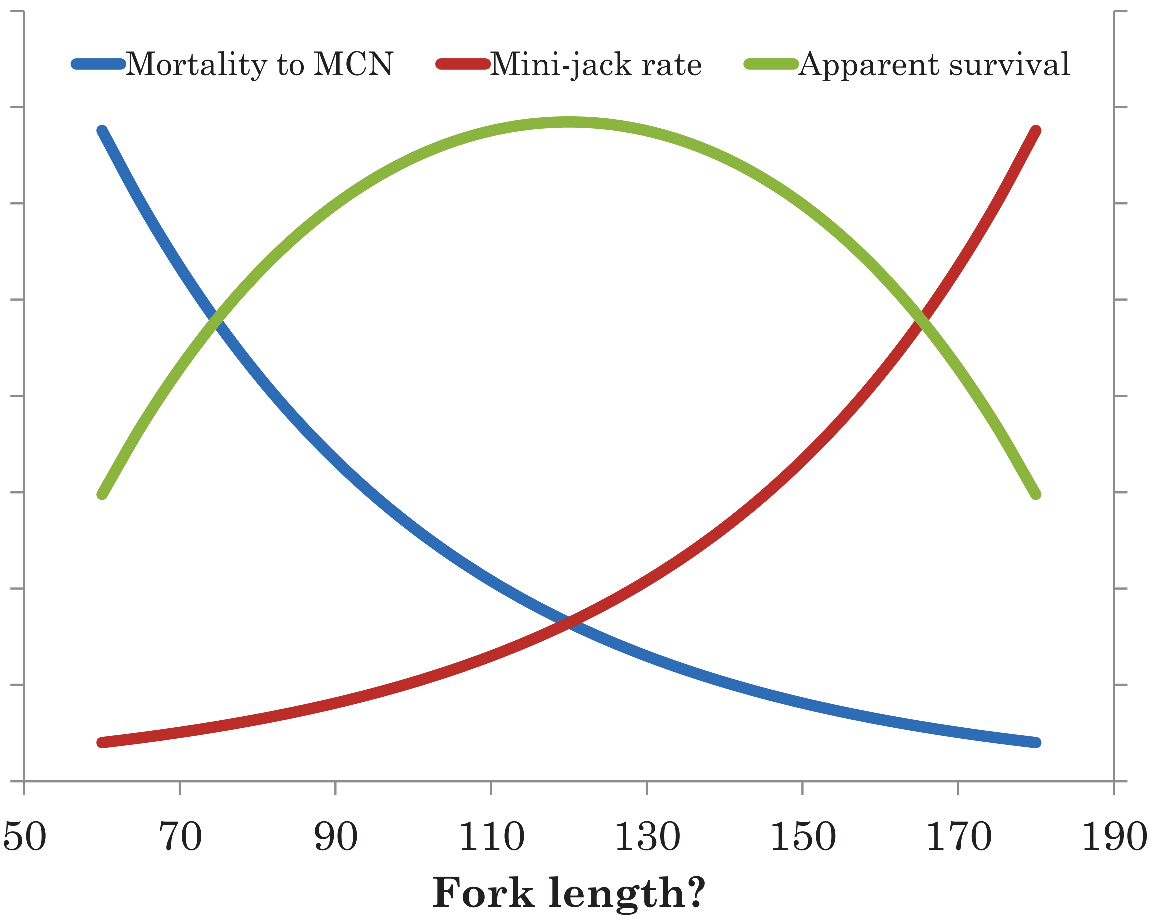


SUMMER CHINOOK ADULT RETURNS

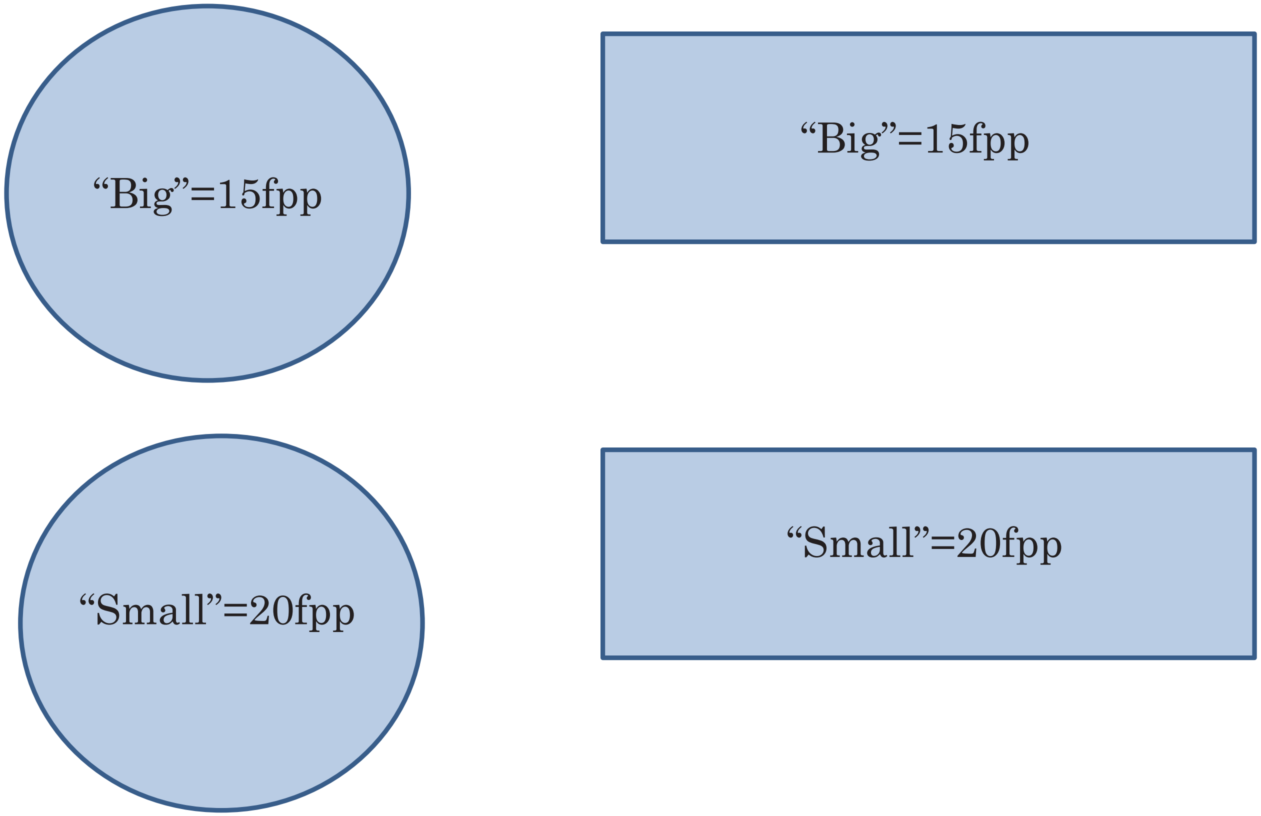
RELEASE YEAR 2013 AND 2014 CHELAN FALLS AND ENTIAT NFH



TRADEOFF BETWEEN SURVIVAL AND PRECOCITY



TRADEOFF BETWEEN SURVIVAL AND PRECOCITY
SIZE TARGET STUDY



“Big”=15fpp

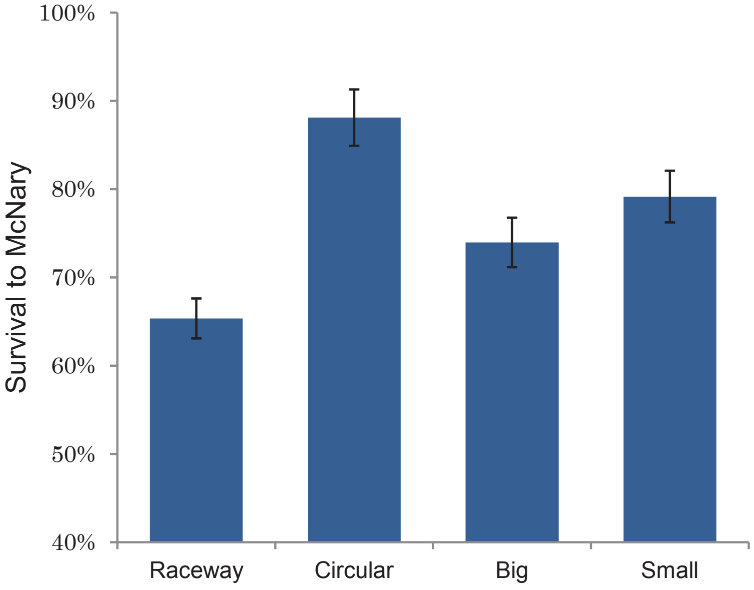
“Big”=15fpp

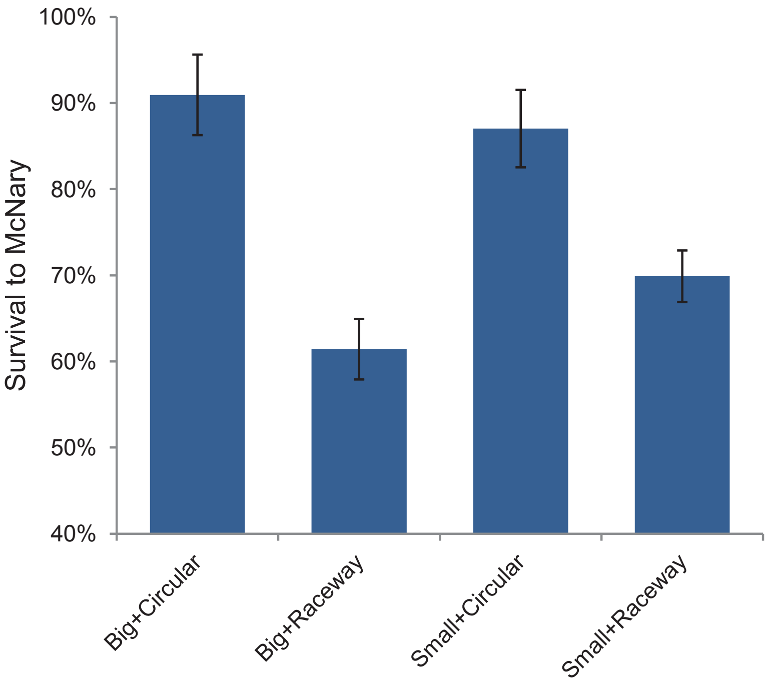
“Small”=20fpp

“Small”=20fpp

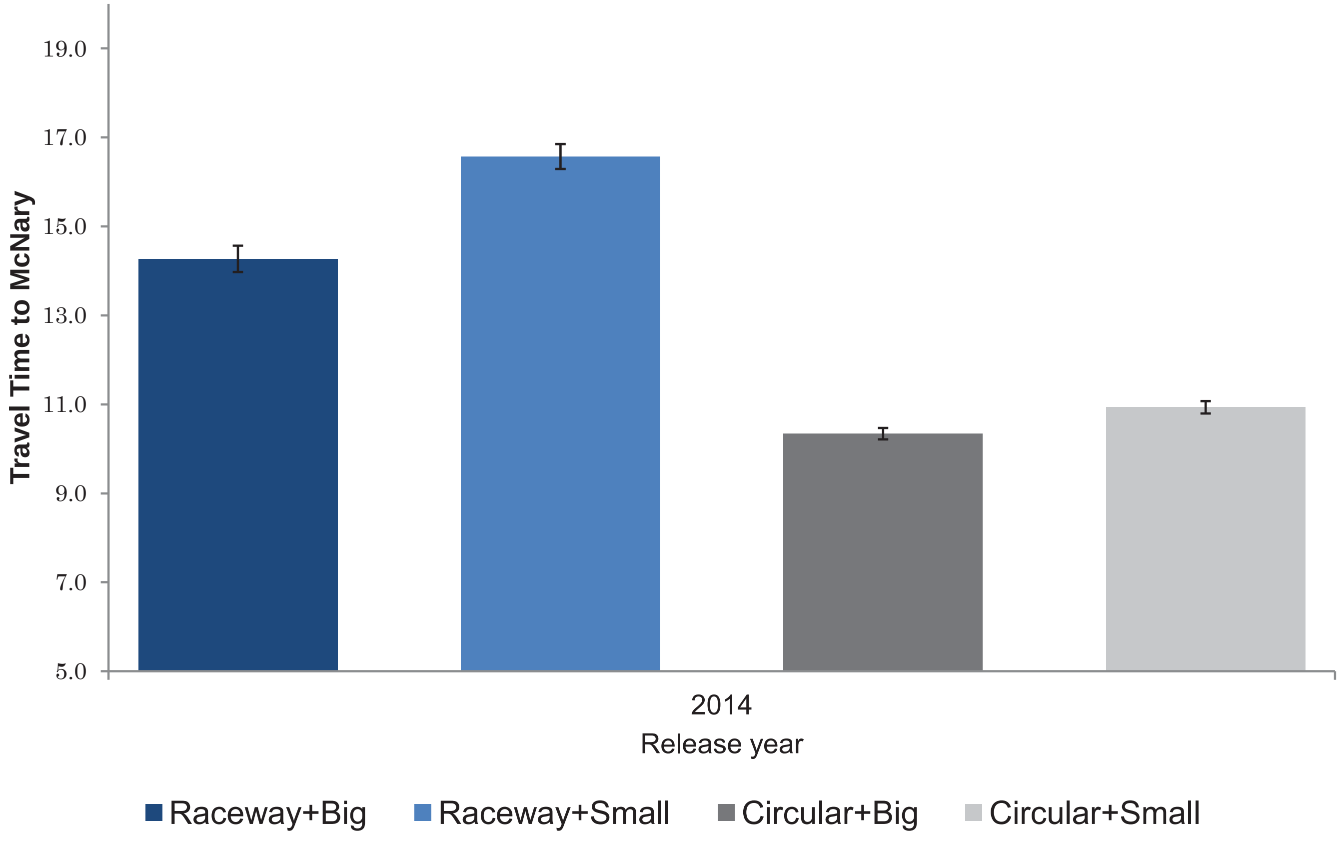
SUMMER CHINOOK

RELEASE YEAR 2014 WENATCHEE RIVER

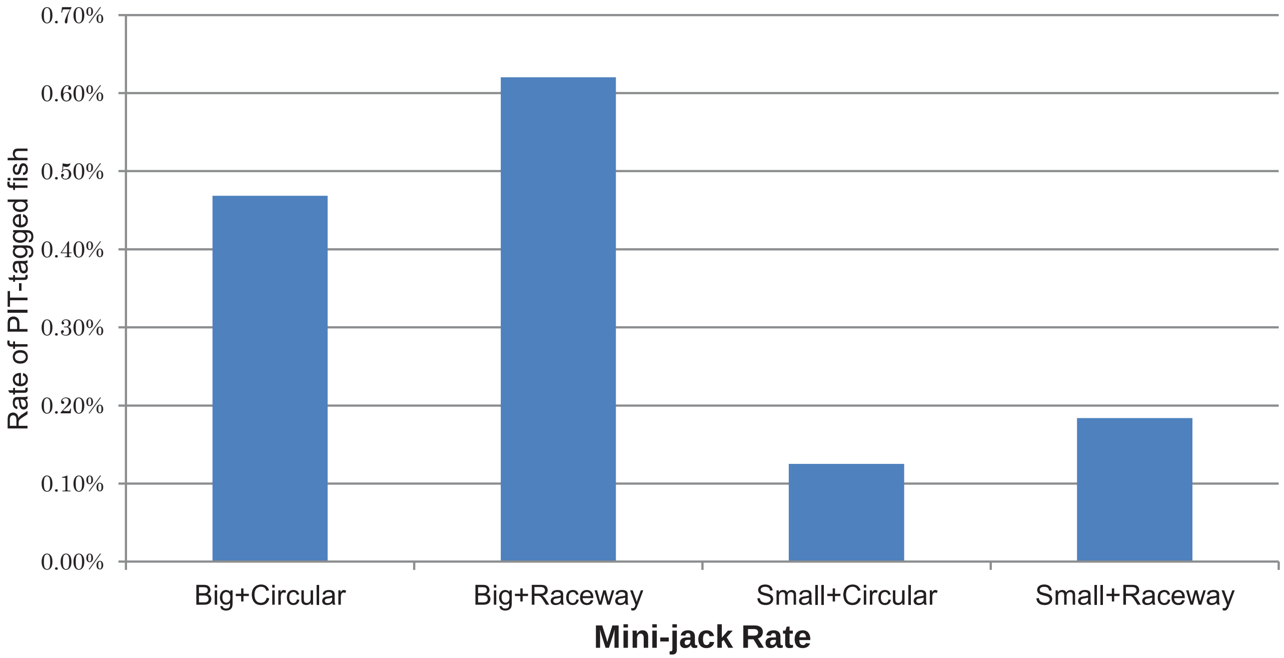




SUMMER CHINOOK
RELEASE YEAR 2014 WENATCHEE RIVER



SUMMER CHINOOK
RELEASE YEAR 2014 WENATCHEE RIVER



CONCLUSIONS
SUMMER CHINOOK

- Partial water reuse is promising for summer Chinook
- Regulatory compliance
  - Use less water
- Fish performance
  - Equal or better survival & quality fish
  - Improved age structure for adult returns
- Next steps
  - Determining the optimal size of out-migrants

STATEMENT OF AGREEMENT

Rocky Reach and Rock Island HCP Hatchery Committees

Statement of Agreement

Regarding the Evaluation of Water Reuse for Steelhead Rearing and Acclimation at Chiwawa

October 20th, 2010

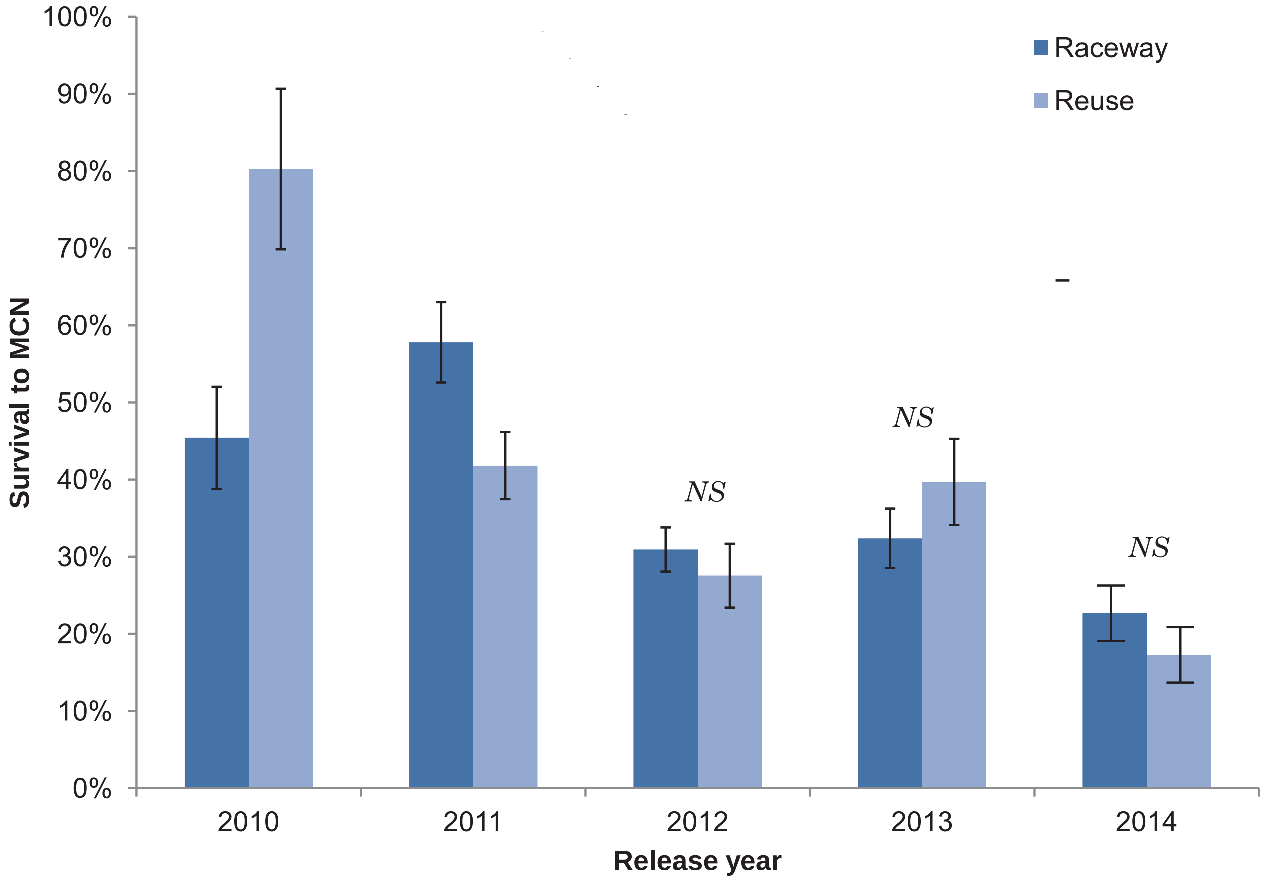
"The success or failure of the second year juvenile pilot will be determined through outmigration analysis, fish health monitoring, and evaluation of within hatchery growth parameters (length, weightand coefficient of variation) as performed in the first year pilot. A statistically valid number of reuse steelhead will be PIT tagged prior to release for comparisons against other release groups in the Wenatchee River and its tributaries. Success would be defined as (1) survival to McNary by reuse steelhead is equal or better than the average of the District's other Wenatchee steelhead releases, (2) within hatchery survival is equal to or better than the average of the District's other Wenatchee steelhead releases."

WENATCHEE STEELHEAD PROGRAM

CHIWAWA HATCHERY

WENATCHEE STEELHEAD PROGRAM

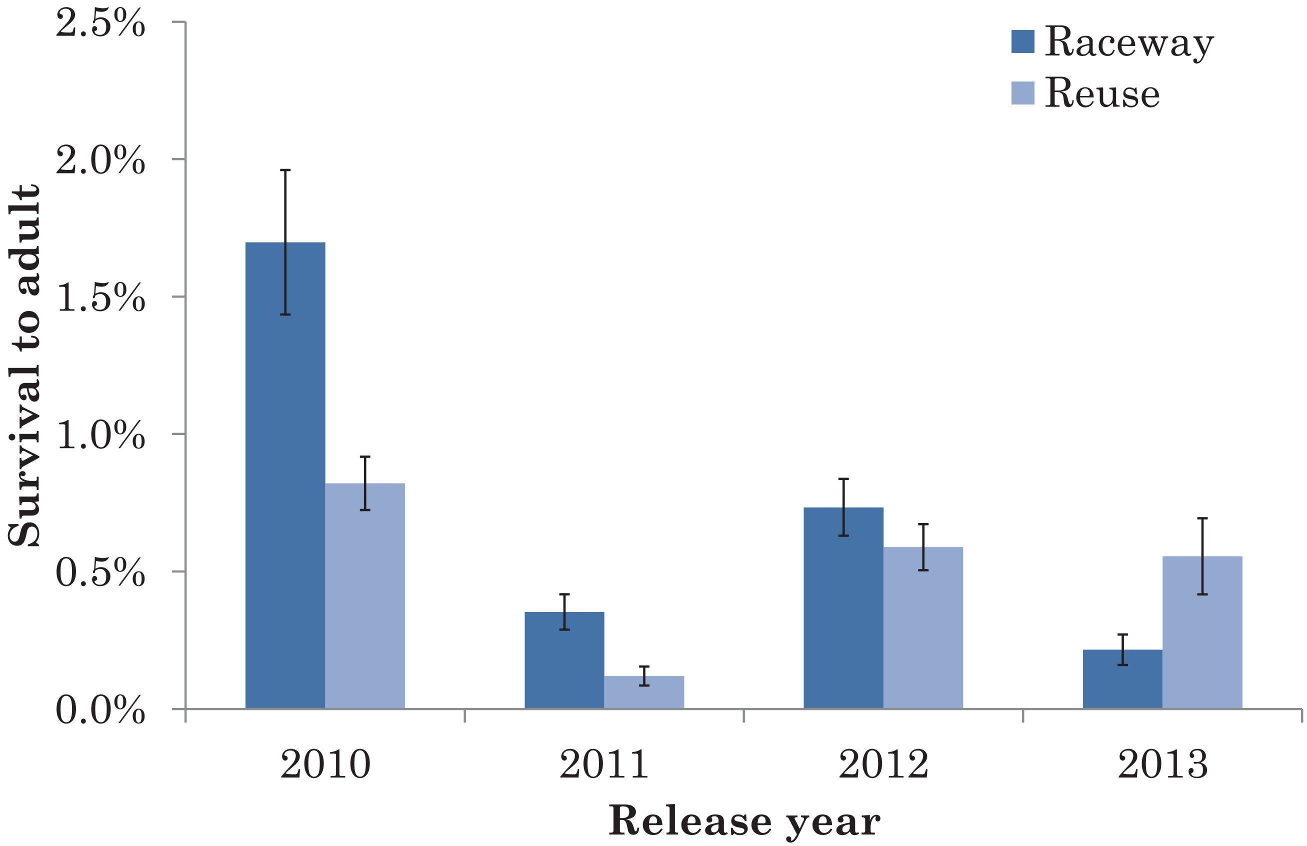
JUVENILE SURVIVAL



NS=Not Statistically Significant

WENATCHEE STEELHEAD PROGRAM

ADULT SURVIVAL



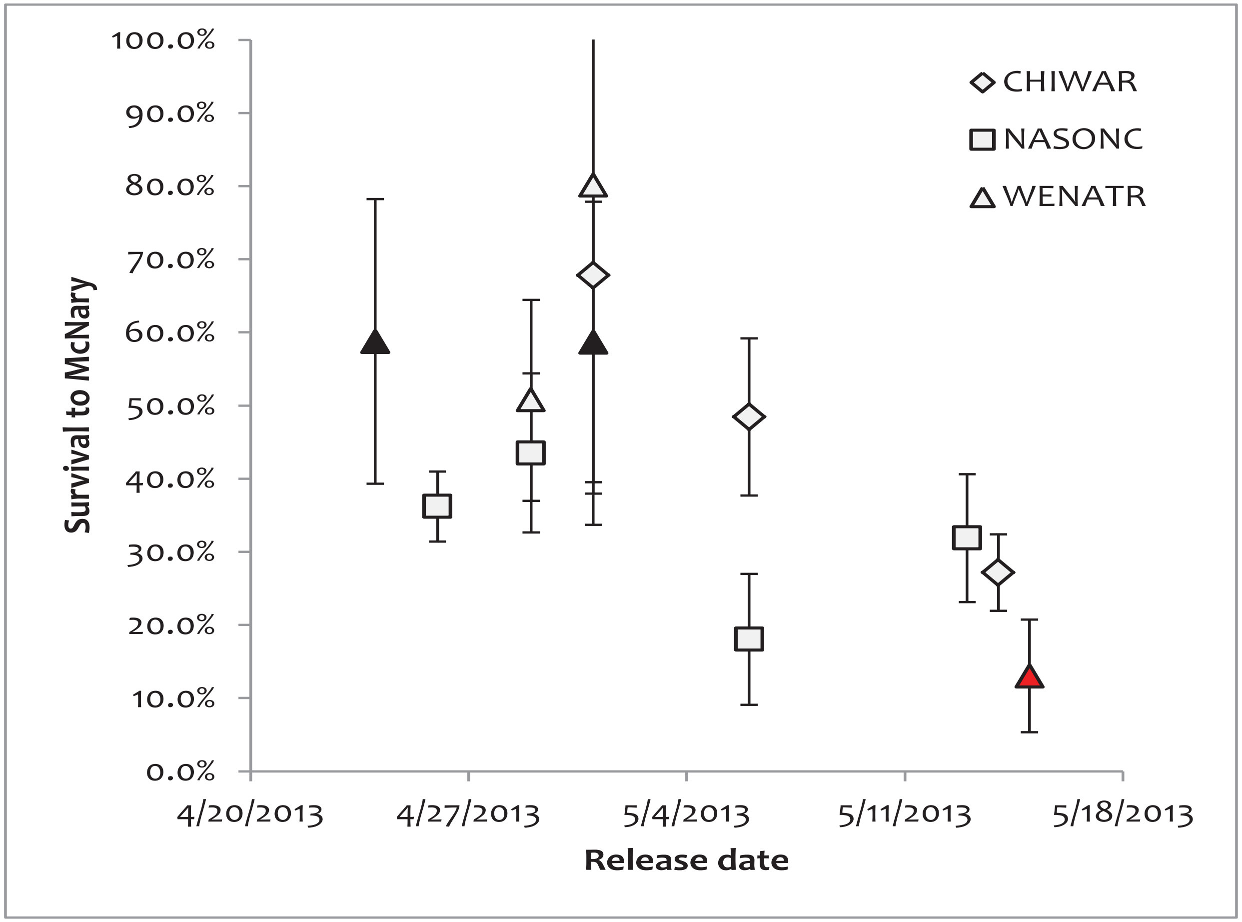
WENATCHEE STEELHEAD PROGRAM

CONFOUNDING VARIABLES

- Origin of brood
- Acclimation site and duration
- Release site
- Release timing
- Smolt size and CV
- Release strategy
- Number in release group

WENATCHEE STEELHEAD PROGRAM

SURVIVAL VERSUS RELEASE DATE (EXAMPLE OF CONFOUNDING FACTOR)



WENATCHEE STEELHEAD PROGRAM

CONCLUSIONS

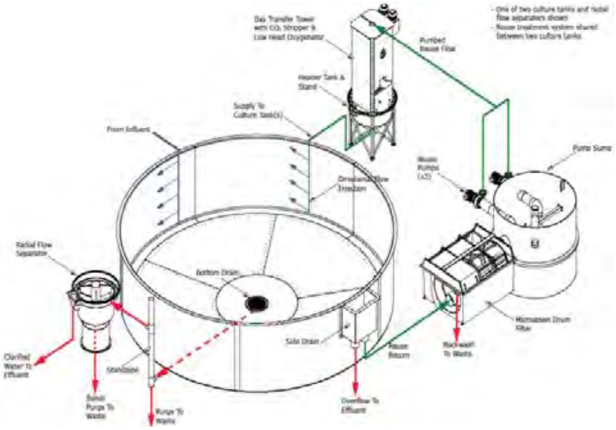
- Partial water reuse is promising for steelhead
- Steelhead reared in circular vessels display migratory behavior
- Mixed results but unable to identify drivers

PARTIAL WATER REUSE/CIRCULAR TECHNOLOGY

NEXT STEPS

- Continue to evaluate Wenatchee and Chelan summer Chinook
- Determining PIT sample sizes to evaluate RAS versus FT for steelhead program
- Biologically based size targets

ACKNOWLEDGEMENTS



- Chelan County PUD
  - Ian Adams, Sam Dilly, Alene Underwood
- Grant County PUD
  - Peter Graf and Todd Pearsons
- Washington Department of Fish and Wildlife
  - Eastbank Hatchery staff, Chelan Hatchery Staff and Chiwawa Hatchery Staff
- The Conservation Fund’s Freshwater Institute
  - Brian Vinci and Christopher Good
- Anchor QEA, LLC
  - Joshua Murauskas and Dalton Hance
- NOAA Fisheries
  - Donald Larsen, Brian Beckman, and Deborah Harstad

QUESTIONS?

An observational cohort study to assess the performance, health, and welfare of juvenile Chinook salmon *Oncorhynchus tshawytscha* reared in partial water reuse vs. raceway environments

Eastbank Hatchery • Wenatchee, Washington

March 2009

Prepared by:

Christopher Good & Brian Vinci
The Conservation Fund's Freshwater Institute
Shepherdstown, West Virginia

EXECUTIVE SUMMARY

In anticipation of future improvements to its existing fish rearing facilities, the Chelan County Public Utility District installed a pilot partial water reuse system at the Eastbank Hatchery in Wenatchee, Washington for comparison to its routine fish rearing practices. To assess the suitability of this new technology for raising quality Pacific salmonids for stocking, The Conservation Fund's Freshwater Institute was requested to evaluate the performance, health, and welfare of juvenile Chinook salmon *Oncorhynchus tshawytscha* reared in the partial water reuse environment relative to those from the same spawn reared in a traditional flow-through raceway. The hypothesis to be examined was that fish reared in the partial water reuse system would have comparable growth, survival, and overall health to fish reared in the facility's flow-through environment.

The observational study described in this report began in June, 2008 once the fish were ponded, and involved repeated assessments of each cohort over a 21-week period before all fish were moved off-site in November. Reuse and raceway fish were sampled on three occasions and screened for subclinical infections with important bacterial and viral fish pathogens. During the same assessment events, fish from each cohort were sampled and fixed in formalin for histological evaluation of multiple tissues, including gill, heart, liver, spleen, and kidney. To assess fin erosion, at 4- and 21-weeks post-ponding the dorsal and caudal fins of fish sampled from each cohort were measured and standardized to fork length to compare fin indices. Finally, during the last sampling event at 21-weeks a sample of fish from each cohort was bled via caudal venipuncture for evaluation of blood gas (pO_2, pCO_2, O_2 saturation, etc.) and chemistry (sodium, chloride, glucose, etc.) parameters.

No listed bacterial or viral fish pathogens were isolated from either cohort during the three sampling events. By 21-weeks post-ponding, length and weight were comparable between the reuse and raceway cohorts (114.07mm and 110.72mm, and 16.98g and 17.39g, respectively), and survival was excellent in both groups (99.3% and 99.0%, respectively). Condition factor was higher in raceway fish (1.28 vs. 1.14 in reuse fish), as reuse fish tended to be grossly leaner and more "torpedo-shaped" in conformation; length coefficient of variation was higher in raceway fish. Fin indices were lower in reuse fish compared to raceway fish, although fin erosion was not grossly apparent on either cohort. Histological evaluation revealed a higher prevalence of liver lesions in raceway fish; however, the most noticeable histological difference between the two cohorts was epithelial hypertrophy of the gills in reuse fish. Blood chemistry and gas measurements revealed differences consistent with the histological findings (e.g. higher total CO_2 in reuse fish), and that acid-base compensation had occurred (e.g. higher bicarbonate) in response to this chronic gill tissue change. Overall, by study's end both cohorts were generally comparable in performance, health, and welfare indices, suggesting that partial water reuse technology for rearing juvenile anadromous salmonids can be employed without negatively affecting fish quality.

INTRODUCTION

The Chelan County Public Utility District (PUD) in Washington State produces over four million juvenile anadromous and resident Pacific salmonids annually for stocking the Upper Columbia River and surrounding waters. These fish are currently raised in a series of facilities that employ traditional flow-through rearing units; however, as water usage and discharge permits in the region become increasingly restricted, PUD managers are looking ahead at the possibility of adopting new technologies, such as partial water reuse systems, for raising fish. Such water reuse systems are capable of conserving water, concentrating waste for ease in removal, and increasing overall production capacity (Timmons and Ebeling, 2007). In order for new technologies to replace traditional raceway rearing units, however, it must be demonstrated that fish reared in the new systems are comparable, if not superior to, fish reared in raceways, in terms of overall performance and health. The PUD therefore commissioned a pilot partial water reuse system to be constructed to evaluate the feasibility of this technology for raising quality salmonids for stocking. While water reuse technology has been successfully adopted in whole or in part at numerous flow-through facilities throughout the United States, limited observational research has been carried out to compare the health of salmonids raised in water reuse and flow-through environments.

During the winter of 2008, a partial water reuse system was installed at the Eastbank Hatchery in Wenatchee, Washington, and professionals from The Conservation Fund’s Freshwater Institute were commissioned as a third party to evaluate the health of fish reared in the pilot system relative to those raised in the older flow-through units. An observational cohort study was carried out between June and November to assess the performance, health, and welfare of juvenile Chinook salmon *Oncorhynchus tshawytscha* reared in the new reuse system relative to salmon from the same spawn reared in a nearby raceway. In addition to routine performance data collected on a regular basis, fish health data were collected at three separate sampling events to assess the quality and condition of fish in the two cohorts, and findings from these data analyses were the basis for the evaluation detailed in this final report.

MATERIALS AND METHODS

From an initial spawn producing several hundred thousand Chinook salmon fry, approximately 170,000 of these were allotted for the pilot study project for inclusion in either the partial reuse or raceway cohorts. Fry were ponded in late June, 2008 at approximately 0.5 grams in size, with 50,000 entering the raceway and 60,000 entering each tank of the partial water reuse system (120,000 fry in total). Fish were maintained in these cohorts for a 21-week period at comparable densities, although due to the desire to produce fish of a uniform size for stocking, the cohorts were fed at different rates depending on their respective growth rates (i.e. if fish from one cohort were deemed to be growing too quickly relative to fish in the other cohort, feed was restricted in the faster growing cohort to allow for equalization in fish size). At the end of the 21-week period (November, 2008), average fish size was approximately 17 grams, and all fish were removed from the raceway and partial water reuse system and were moved off-site for acclimation to river water prior to stocking.

Rearing environments

For the initial pilot study assessment, the Eastbank Hatchery partial water reuse system was designed to raise approximately 120,000 Chinook salmon to 16 grams in size at a maximum density of 8.7 kg/m^3 in two 30-ft diameter, 29,000 gallon (110 m^3) circular dual-drain tanks using 324 gallons per minute (gpm) of makeup water. The circular tanks were designed to be completely covered for enhanced biosecurity and sun protection. The total volume for the partial reuse system was 58,117 gallons, with a total reuse flow of 1,295 gpm. The reuse rate for this system was therefore 75%, with a hydraulic retention time of 45 minutes and a system exchange rate of approximately 800% per day. Supplemental oxygen was added to the influent water to maintain adequate dissolved oxygen levels in the tanks. In contrast, the comparison raceway had a total volume of 28,125 gallons and received a supply of 603 gpm (initially 354 gpm until October 9th, 2008); therefore, raceway hydraulic retention time was 46.6 minutes and the exchange rate was approximately 3,100% per day.

Early in the study period, high winds removed the covers from the two circular tanks of the partial water reuse system, and hence at 4-weeks post-ponding new, lower profile covers were fitted to these tanks. These new covers were eventually removed by high winds as well; therefore, for the majority of the study period the partial water reuse system was not covered as designed, resulting in significant algal growth on the sides and bottom of the fiberglass tanks and requiring increased brushing by facility personnel to keep clean. Reuse fish were therefore exposed to higher levels of algal detritus in their tank water, although the relative difference between reuse and raceway exposure to such irritants was not quantified.

Data collection

Routine data collected during the 21-week study period for both cohorts included daily feeding and mortality data, as well as weekly bulk weight sampling and monthly fork length assessments. Data on water quality parameters (e.g. temperature, pH, total ammonia nitrogen, dissolved carbon dioxide, and alkalinity) were periodically assessed, and a journal was maintained to record any abnormalities related to water quality, higher-than-normal mortalities, additional work carried out, etc. Fish health and welfare data were collected during three sampling events at 0-, 13-, and 21-weeks post-ponding, with additional data on fin quality being taken at 4-weeks post-ponding.

Fish pathogen screening

Random dip-net samples from each cohort were taken at 0-, 13-, and 21-weeks post-ponding and were sent to the Washington Animal Disease Diagnostic Laboratory (WADDL) (Pullman, WA) for screening of listed, important bacterial and viral fish pathogens. For the most part, sampling and testing were carried out according to protocols in the American Fisheries Society Blue Book (AFS-FHS, 2007), which recommend a sample of 60 fish from each cohort for bacteriology, and an equal sized sample for virology; this provides a 95% confidence in detecting a pathogen in an infected group of fish that has a minimum 5% apparent prevalence of infection. Due to the small size of the study fish during the first and second sampling events, however, routine bacteriology protocols could not be employed, and therefore samples of ten fish from each cohort were fixed in formalin and sent for histological assessment for evidence of bacterial infection. Otherwise, for all other testing samples of 60 fish were euthanized with an overdose (200mg/L) of MS-222 (Western Chemicals, Inc.), placed on ice and shipped overnight to WADDL for immediate pathogen screening.

Histology

At each sampling point, groups of ten fish were randomly collected from each cohort, euthanized with MS-222, and fixed in 10% neutral buffered formalin. A ventral midline incision was carefully administered to ensure whole body fixation (Figure 1). The samples were sent in jars to WADDL for histopathological assessment by a board-certified aquatic veterinary pathologist. Organs and tissues evaluated for each fish included gill, head kidney, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, vestibular apparatus, brain, pancreas, stomach, pyloric cecae, intestine, gonads, posterior kidney, skeletal muscle, vertebrae, cartilage, skin and spleen. All lesions observed were described in detail and were summarized in a final report.

Fin assessment

At 4- and 21-weeks post-ponding, 30 fish and 70 fish from each cohort, respectively, were randomly selected, euthanized, and measured to the nearest 0.1mm for fork length, dorsal fin length, and lengths of the top and bottom poles of the caudal fin, using a digital micro caliper. Fin indices for all three measured fins were then calculated by dividing their individual lengths the fork length, and were assessed statistically for treatment (rearing environment) effect using the non-parametric Kruskal-Wallis test due to lack of normality in the dataset.

Whole blood gas and chemistry assessment

At the end of the study period, 25 fish from each cohort were randomly sampled and bled via caudal venipuncture using a 21.5-guage needle. Whole blood samples were then analyzed on-site using an i-Stat 1 portable analyzer (Abbott) with CG4+ and CHEM8+ cartridges. Parameters assessed with the CG4+

Figure 1. Images of partial water reuse system juvenile Chinook salmon, taken during the 13-weeks post-ponding sampling event.

Top: ventral midline incision for whole body formalin fixation.

Bottom: typical lean, elongated conformation observed in sampled pilot system fingerlings.

cartridge included pH, pCO_2, pO_2, HCO_3, total CO_2, O_2 saturation, and lactate, while CHEM8+ cartridges provided data for whole blood sodium, potassium, chloride, calcium, glucose, creatinine, hematocrit, and hemoglobin. Data obtained from individual fish were then assessed statistically for treatment effect using analyses of variance.

RESULTS

No observable disease outbreaks occurred in either cohort during the 21-week study period; survival was quite acceptable and comparable between the partial water reuse and raceway groups (99.3% and 99.0%, respectively). Subclinical infections were highly unlikely in either cohort, as no viral or bacterial fish pathogens were isolated from any sampling event over the course of the study (Table 1). No evidence of bacterial infection was observed through histopathological assessments of smaller fish during the 0- and 13-weeks post-ponding samplings.

By study's end, managers had been able to grow both cohorts to acceptable and comparable sizes prior to movement off-site for acclimation. Length and weight for reuse and raceway cohorts were 114.1mm and 110.7mm, and 16.98g and 17.39g, respectively (Figure 2). Condition factor (weight / length^3) was noticeably different between the reuse and raceway cohorts (1.15 and 1.28, respectively), with reuse fish qualitatively appearing leaner and more "torpedo-shaped" compared to the more rotund raceway fish (Figure 1.). There was also higher variation in final length in the raceway cohort (coefficient of variation = 32.92, vs. 24.01 in reuse fish), and therefore fingerlings from the reuse cohort tended to be more uniform in size.

Results of the histological evaluations (Table 2) indicated that the majority of tissues examined were normal during all three sampling events. No lesions were noted on any sampled fish at the beginning of the study. At 13-weeks post-ponding, branchial (gill) epithelial hypertrophy was noted at a higher prevalence in the reuse cohort (40%, vs. 10% in the raceway cohort), and by 21-weeks post-ponding this lesion type was observed on all reuse fish examined. Figure 3 illustrates the hypertrophy (relative enlargement) of epithelial cells lining the

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Table 1. Results of fish pathogen screening of juvenile Chinook salmon carried out by the Washington Animal Disease Diagnostic Laboratory.

Study week	Sample size per cohort	Bacteriology		Virology*	
		Reuse	Raceway	Reuse	Raceway
0	10 whole fish formalin-fixed + 60 fish on ice	No evidence of bacterial infection	No evidence of bacterial infection	Negative	Negative
13	10 whole fish formalin-fixed + 60 fish on ice	No evidence of bacterial infection	No evidence of bacterial infection	Negative	Negative
21	60 + 60 fish on ice	No bacterial pathogens cultured	No bacterial pathogens cultured	Negative	Negative

* Comprehensive aquatic viral culture testing screens for all viruses causing cytopathic effects on susceptible cell lines; these viruses include Oncorhynchus Masou Virus, Infectious Pancreatic Necrosis Virus, Infectious Hematopoietic Virus, Viral Hemorrhagic Septicemia Virus, Epizootic Hematopoietic Necrosis Virus, and Spring Viremia of Carp.

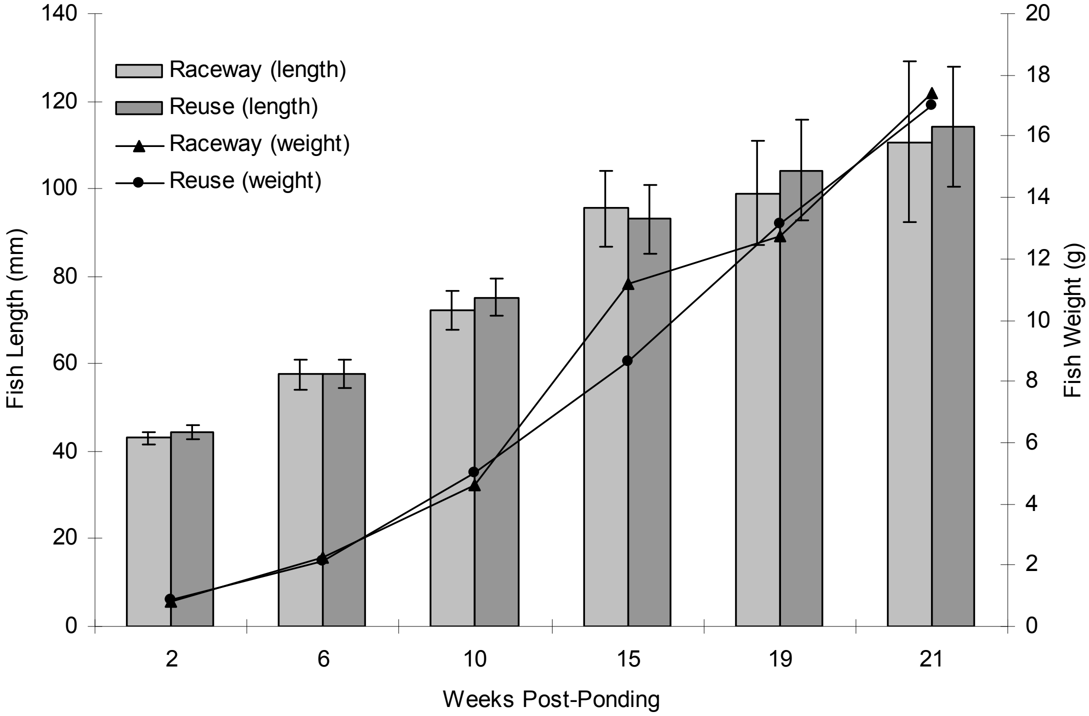

Figure 2. Comparison of raceway- and reuse-reared juvenile Chinook salmon length and weight at six sampling points during the course of the pilot study. Error bars for fish length represent standard deviations.

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respiratory interface of reuse fish gills. The majority of lesions noted in the raceway cohort at the 13-weeks post-ponding sampling were seen in a single, moribund fish which had most likely been off-feed for some time prior to its collection for assessment. At 21-weeks post-ponding, raceway fish demonstrated a higher prevalence of liver lesions, which corresponded to visual observations at the time of sampling that raceway fish tended to have larger, paler livers. Only 30% of raceway fish sampled, however, demonstrated any form of histologically observable liver pathology.

Fin erosion assessment revealed that, at 4-weeks post-ponding, the bottom pole of the caudal fin had a significantly higher fin index in raceway fish compared to the same fin in reuse fish. This trend continued at the 21-weeks post-ponding, where all fins (dorsal and both poles of the caudal fin) had significantly higher indices in raceway fish relative to those from reuse fish (Figure 4). It should be noted that qualitatively, fins observed in both cohorts were in good condition with no visual signs of erosion, and that the indices calculated were within the range of normal, healthy fins despite the differences upon analysis.

Table 2. Summary of pathologies noted on histological examination of raceway- and reuse-reared juvenile Chinook salmon over three sampling events during the pilot study period.

			Lesion Prevalence	
Week	Tissue	Lesion Type	Raceway	Reuse
0		No lesions noted on any fish		
13	Gill	Moderate, diffuse branchial epithelial hypertrophy	1/10	4/10
	Mesentery, skeletal muscle	Severe, multifocal, subacute-to-chronic histiocytic steatitis	1/10	0/10
	Mesentery	Minimal, focal, subacute-to-chronic histiocytic steatitis	1/10	0/10
	Skin	Moderate, diffuse lymphocytic dermatitis	1/10	0/10
	Pseudobranch	Unilateral, diffuse, moderate-to-severe lymphocytic pseudobranchitis	1/10	0/10
	Liver	Minimal, focal lymphocytic hepatitis	1/10	0/10
21	Gill	Moderate-to-pronounced branchial epithelial hypertrophy	0/10	10/10
	Liver	Hepatocellular megalocytosis with karyomegaly	1/10	0/10
	Liver	Mild-to-moderate hepatocellular hydropic degeneration with minimal lipidosis	2/10	0/10

The analyses of blood parameters revealed several significant differences between the two cohorts (Table 3). Blood glucose, pH, bicarbonate, and total CO_2 were all higher in sampled reuse fish compared to those from the raceway cohort.

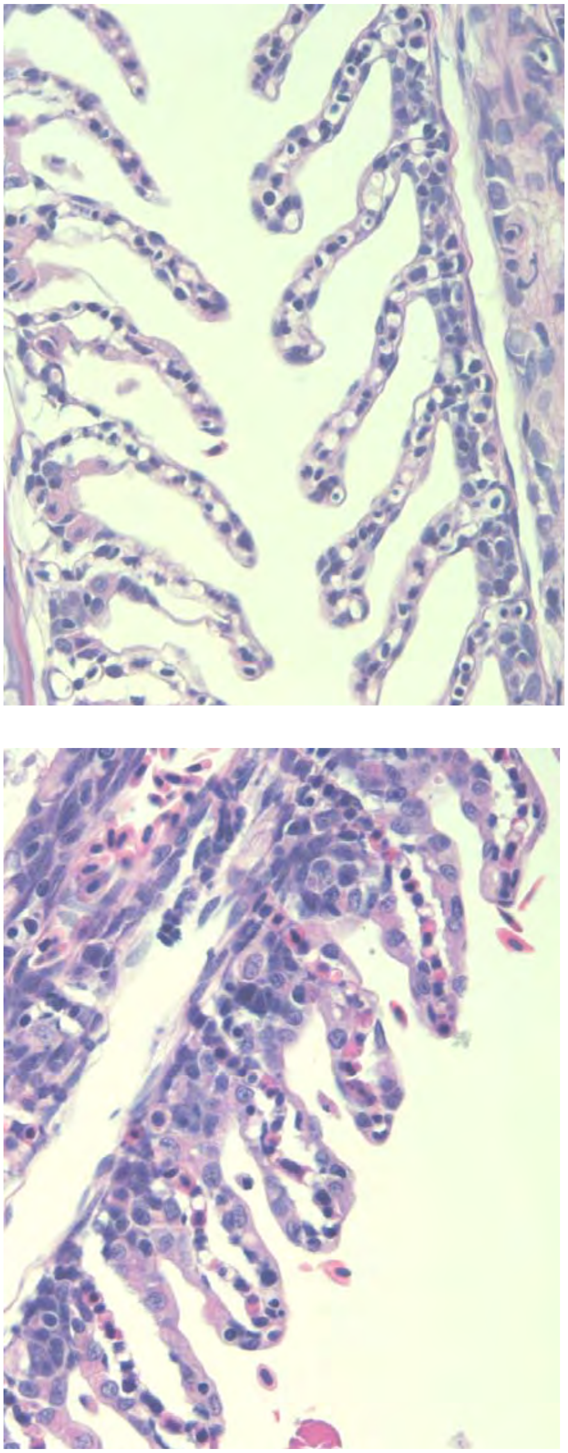
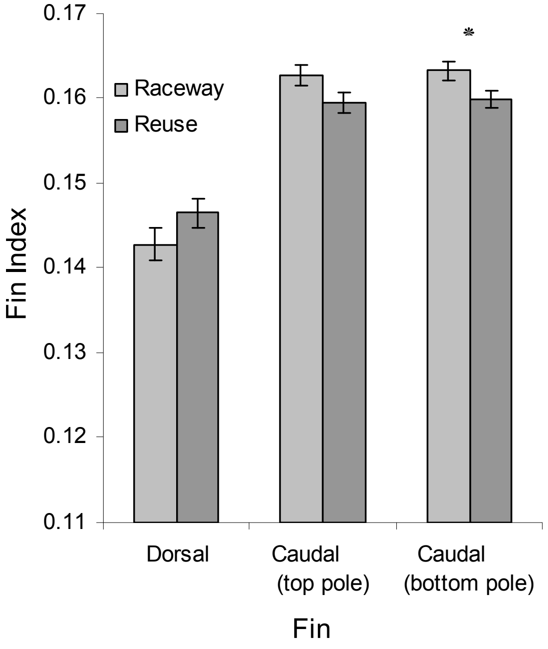
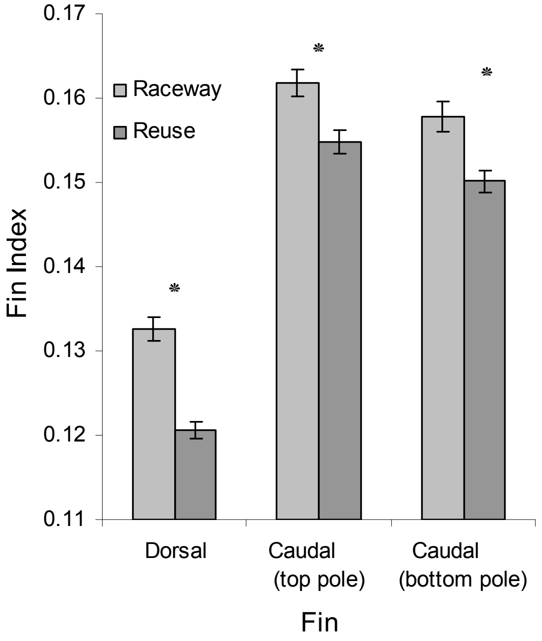


Figure 3. Histological comparison of juvenile Chinook salmon gill tissue (primary and secondary lamellae) from fish reared in the raceway (top) and reuse (bottom) environments. Raceway specimens typically demonstrated normal lamellar architecture while moderate, diffuse epithelial hypertrophy was prevalent in sampled reuse fish.



4-weeks post-ponding



21-weeks post-ponding

Figure 4. Comparisons of raceway- and reuse-reared juvenile Chinook salmon indices for dorsal and caudal fins, measured at 4- (top) and 21-weeks (bottom) post-ponding. Asterisks (*) indicate significant (p<0.05) differences between cohorts.

Table 3. Whole blood gas and chemistry parameter means from sampled raceway and reuse Chinook salmon. Parameters with asterisk (*) indicate significant ($p<0.05$) differences between cohorts.

	Mean ± SE	
Parameter	Raceway	Reuse
Sodium (nmol/L)	147.9 ± 0.6777	146.1 ± 1.103
Potassium (nmol/L)	4.106 ± 0.1702	4.244 ± 0.1441
Chloride (nmol/L)	129.9 ± 0.9569	127.9 ± 1.103
Calcium (nmol/L)	1.622 ± 0.0258	1.638 ± 0.0252
Glucose (mg/dL) *	65.59 ± 2.716	75.29 ± 3.019
Creatinine (mg/dL)	1.027 ± 0.2598	1.723 ± 0.3853
Hematocrit (%PCV)	30.88 ± 0.7616	31.94 ± 0.6087
Hemoglobin (g/dL)	10.49 ± 0.2583	10.86 ± 0.2086
pH *	7.025 ± 0.0231	7.108 ± 0.0192
pCO_2 (mmHg)	28.25 ± 1.261	30.69 ± 0.8603
pO_2 (mmHg)	12.69 ± 1.346	9.500 ± 1.018
HCO_3 (mmol/L) *	7.555 ± 0.4829	9.700 ± 0.2879
Total CO_2 (mmol/L) *	8.571 ± 0.4709	10.83 ± 0.2973
O_2 saturation (%)	8.308 ± 1.216	6.750 ± 1.319
Lactate (mmol/L)	9.674 ± 0.3458	8.710 ± 0.9331

DISCUSSION

The results of this pilot study demonstrate that juvenile Chinook salmon can be raised in a partial water reuse system environment with comparable performance and survival to those reared in traditional flow-through raceways. Minor health and welfare differences (fin condition, gill tissue pathology) were detected between the two cohorts, but these changes did not have any apparent effect on growth and mortality in affected fish. While the long-term effects, if any, of the observed differences are a matter of speculation, the overall study findings support the feasibility of adopting partial water reuse technology for raising Pacific salmonids for stocking purposes. Despite the successful demonstration of its usage, it should be noted that the pilot partial water reuse system was not operated optimally during the study in two major ways. First, the covers that were designed for the circular tanks were unfortunately susceptible to the location's high wind velocities, and hence for the majority of the 21-week period reuse fish were exposed to sunlight, tank algal growth, and the resultant suspended solids and stress associated with brushing to maintain tank hygiene. Second, pilot tanks were operated at slower-than-optimal rotational velocities, and while attempts were made to remedy this issue, at no point during the study was the tank rotational period within the 60-90 second range necessary for tank self-cleaning (Davidson and Summerfelt, 2004). Therefore, future demonstrations of the pilot system should employ effective tanks covers and increased rotational velocities in order to achieve tank self-cleaning and to reduce the exposure of fish to chronic irritants related to algal growth.

While assessing fin erosion, measured indices were found to be uniformly higher in the raceway cohort compared to fish raised in the partial water reuse system. Fin condition is an established indicator of fish welfare (Ellis et al., 2008), and is perceived to affect the quality of fish raised for stocking purposes (Ronsholdt and McClean, 1999). The etiology of fin erosion is not completely understood, and research suggests that it is a complex, multifactorial process (Latremouille, 2003). Among other things, increased stocking densities and high levels of suspended solids are considered to be associated with fin erosion (Wedemeyer, 1996). While there are numerous methods for assessing fin condition, the fin index (length of longest ray standardized by fork length) (Kindschi, 1987) is considered to be the most objective and accurate method (Latremouille, 2003). Although reuse fish tended to be longer on average, isometric growth (i.e. a constant ratio of fin length to total length) has been demonstrated in rainbow trout between 100 and 300mm in length (Bosakowski and Wagner, 1994), and therefore it is likely that the detected differences in fin indices were not a product of differences in average fish length between cohorts. As densities in this study were relatively low, it is possible that the lower fin indices in reuse fish were related to chronic exposure to higher levels of suspended solids. On the whole, however, all fins assessed in this study were deemed to be of excellent quality compared to other populations observed by the authors, and it is unlikely that lower fin indices in the reuse cohort represented any meaningful compromise to fish welfare for this group.

The major finding made through histopathological evaluation was the consistent diagnosis of branchial epithelial hypertrophy in partial water reuse fish. Epithelial hypertrophy of gill tissue in general is often a consequence of chronic exposure to high levels of particulates in the water (Sutherland and Meyer, 2007), and results in an increased distance for the exchange of gases and metabolites between the fish and water (Ferguson, 1989). There appears to have been little consequence in reuse fish, however, as lesions associated with hypoxia (a decrease in blood oxygen), such as renal tubular hydropic degeneration (Kevin Snekvik, personal communication), were not observed in affected fish, and overall performance appears to have been unaffected. Data from blood gas and chemistry analyses demonstrated differences between the cohorts that were consistent with the histological changes noted. Oxygen partial pressure was decreased in reuse fish while carbon dioxide was increased, and this was most likely the result of the observed increased diffusion distance at the gill epithelium. The reuse fish, however, appear to have compensated for this change by increasing uptake of bicarbonate, thereby countering CO_2-associated acidosis by elevating blood pH, with a mild associated loss of chloride ions due to chloride/bicarbonate exchangers found in gill tissue (Wedemeyer, 1996). There is therefore little evidence, both histologically and through blood parameter assessment, that branchial epithelial hypertrophy affected fish in the reuse cohort in any significant way. The higher blood glucose observed in reuse fish might also have been related to gill tissue changes, as has been previously observed by Albassan et al. (1987); however, mean blood glucose values in either cohort were within published normal ranges for salmonids (Stoskopf, 1993; Wedemeyer, 1996), and therefore the differences noted between cohorts were most likely of little clinical significance.

Finally, there were certain limitations to this study that should be noted. The assessment of a single pilot system did not lend itself to full experimental evaluation due to the lack of treatment replication, and an observational cohort study approach was necessary for this particular scenario; however, care must be taken in the interpretation of results obtained. While experimental research emphasizes, among other things, the repeatability of findings, the results of the cohort study described in this report cannot be validly extrapolated to other locations or study populations, and should best be viewed as an observational case study of the specific fish populations assessed. Further construction of partial water reuse systems, if possible, could provide the necessary replication for experimental evaluation of these new technologies.

CONCLUSIONS

Juvenile Chinook salmon reared in the partial water reuse system at Eastbank Hatchery performed comparably to fish from the same spawn in a nearby flow-through raceway, and while subclinical differences were noted between the two cohorts (lower fin indices and gill epithelial hyperplasia in reuse fish) these differences did not affect survival. The partial water reuse system produced fish of approximately equal size to the raceway fish, but with lower condition factor and less variation in length. This pilot study therefore demonstrates the feasibility of partial reuse technology in raising Pacific salmonids for stocking; however, the limitations of observational research need to be considered, and further study is warranted to support the findings presented in this report.

ACKNOWLEDGEMENTS

The authors wish to thank the Washington Department of Fish & Wildlife, particularly John Penny and the Eastbank Hatchery staff for all of their assistance, and Bob Rogers for his fish health observations of pilot study populations. Thanks is also extended to KC Hosler and Kevin Graham from PRAqua, and to Ian Adams of the Chelan County PUD for assistance with data collection and reuse system maintenance.

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APPENDIX

Compiled reports from Dr. Kevin Snekvik, Senior Pathologist
Washington Animal Disease Diagnostic Laboratory
June – December, 2008

WASHINGTON ANIMAL DISEASE DIAGNOSTIC LABORATORY
P.O. Box 647034
Pullman, WA 99164-7034
Phone: (509) 335-9696
Fax: (509) 335-7424

Veterinarian:	Dr. Christopher Good	Owner:	Eastbank Hatchery
Clinic:	The Freshwater Institute	Animal:	
Address:	1098 Turner Rd.	Species:	Chinook Salmon
		Breed:	
	Shepherdstown, WV 25443	Age:	4 Months
Phone:	(304) 876-2815	Sex:	Not Reported

HISTOPATHOLOGY REPORT **03/23/09** **WADDL #2008-7426**
Received: 06/12/08

<u>Container 1: Labeled “Partial Reuse” (June 11, 2008):</u>

Ten fish are submitted in 10% neutral buffered formalin. Individual fish, minus their tail, are fully embedded and evaluated in three serial sections stained with an H&E stain and a fourth serial section is stained with a Brown and Hopps tissue gram stain. Two fish are loaded per cassette.

The following tissues are normal: brain, eye, pseudobranch, gills, liver, stomach, pyloric cecae, pancreas, intestine, spinal cord, skeletal muscle, bone, thymus, spleen, swim bladder, yolk sac remnant, kidney, reproductive tract, choroid gland and thyroid gland.

<u>Container 2: Labeled “Raceway” (June 11, 2008):</u>

Ten fish are submitted in 10% neutral buffered formalin. Individual fish, minus their tail, are fully embedded and evaluated in three serial sections stained with an H&E stain and a fourth serial section is stained with a Brown and Hopps tissue gram stain. Two fish are loaded per cassette.

The following tissues are normal: brain, eye, pseudobranch, gills, liver, stomach, pyloric cecae, pancreas, intestine, spinal cord, skeletal muscle, bone, thymus, spleen, swim bladder, yolk sac remnant, kidney, reproductive tract, choroid gland and thyroid gland.

HISTOLOGIC DIAGNOSIS:

1. Normal tissue

COMMENTS: There is no evidence of an inflammatory process or infectious pathogen within the examined sections.

WORK PENDING: Virology

Dr. Kevin Snekvik/KRS/krs
0490
Phone contact: Email of results sent to Dr. Good on July 11, 2008 at 12:55 a.m.

WASHINGTON ANIMAL DISEASE DIAGNOSTIC LABORATORY

P.O. Box 647034
Pullman, WA 99164-7034
Phone: (509) 335-9696
Fax: (509) 335-7424

Veterinarian:	Dr. Christopher Good	Owner:	Eastbank Hatchery
Clinic:	The Freshwater Institute	Animal:	
Address:	1098 Turner Rd.	Species:	Chinook Salmon
		Breed:	
	Shepherdstown, WV 25443	Age:	
Phone:	(304) 876-2815	Sex:	Not Reported

HISTOPATHOLOGY REPORT **03/23/09** **WADDL #2008-11753**
Received: 09/17/08

Reuse System:

Five containers each contain two Chinook salmon fingerlings fixed in formalin. Grossly representative transverse sections are collected and examined from each fish.

Container 1

Fish A: (Slides 1-4)

The following tissues are normal: head kidney, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, gills, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, ovary, posterior kidney, skeletal muscle, vertebrae, cartilage, skin and spleen.

Fish B: (Slides 5-7)

Gill: There is diffuse hypertrophy of the brachial epithelial cells and the chloride cells are prominent.

The following tissues are normal: head kidney, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, ovary, posterior kidney, skeletal muscle, vertebrae, cartilage, skin and spleen.

Container 2:

Fish A: (Slides 8-11)

Gill: There is diffuse hypertrophy of the brachial epithelial cells and the chloride cells are prominent.

The following tissues are normal: head kidney, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, ovary, posterior kidney, skeletal muscle, vertebrae, cartilage, skin and spleen.

Fish B: (slides 12-15)
The following tissues are normal: gill, head kidney, adrenal gland, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, posterior kidney, skeletal muscle, vertebrae, cartilage, skin and spleen.

Container 3:
Fish A: (Slides 16-19)
Gill: There is diffuse hypertrophy of the brachial epithelial cells and the chloride cells are prominent.

The following tissues are normal: head kidney, adrenal gland, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, stomach, pancreas, pyloric cecae, posterior kidney, skeletal muscle, vertebrae, cartilage, skin and spleen.

Fish B: (slides 20-23)
The following tissues are normal: gill, head kidney, adrenal gland, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, posterior kidney, skeletal muscle, vertebrae, cartilage, ovary, skin and spleen.

Container 4:
Fish A: (Slides 24-27)
Skeletal muscle: There is a focal area of hemorrhage that moderately dissects the myocytes within the skeletal muscle along the ventrum at the level of the heart.

The following tissues are normal: head kidney, gill, adrenal gland, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, ovary, stomach, pancreas, pyloric cecae, intestine, posterior kidney, vertebrae, cartilage, skin and spleen.

Fish B: (slides 28-31)
The following tissues are normal: gill, head kidney, adrenal gland, thymus, esophagus, pseudobranch, spinal cord, liver, heart, swim bladder, brain, pancreas, stomach, pyloric cecae, intestine, posterior kidney, skeletal muscle, vertebrae, cartilage, ovary, skin and spleen.

Container 5:
Fish A: (Slides 32-35)
Gill: There is diffuse hypertrophy of the brachial epithelial cells and the chloride cells are prominent.

The following tissues are normal: eye, head kidney, adrenal gland, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, stomach, pancreas, pyloric cecae, posterior kidney, skeletal muscle, vertebrae, cartilage, skin, gonad (undifferentiated) and spleen.

Fish B: (slides 36-39)
The following tissues are normal: gill, head kidney, adrenal gland, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, brain, pancreas, stomach, pyloric cecae, intestine, posterior kidney, skeletal muscle, vertebrae, cartilage, ovary, skin and spleen.

Raceway System:
Five containers each contain two Chinook salmon fingerlings fixed in formalin. Grossly representative transverse sections are collected and examined from each fish.

Container 1:
Fish A: (Slides 40-41)
The following tissues are normal: gill, head kidney, thymus, spinal cord, liver, heart, swim bladder, stomach, pancreas, pyloric cecae, posterior kidney, skeletal muscle, spinal cord, vertebrae, cartilage, skin and ovary.

Fish B: (slides 42-43)
Gill: There is diffuse hypertrophy of the brachial epithelial cells and the chloride cells are prominent.

Adipose tissue: Approximately 90% of the mesentery and locally extensive regions of the adipose tissue within the skeletal muscle along the dorsum of the body and ventral midline are disrupted by extensive infiltrates of macrophages and fewer multinucleated giant cells with foamy cytoplasm. The inflammatory cells often surround accumulations of necrotic to saponified fat (steatitis).

Pseudobranch: Unilaterally, the connective tissue within and around one pseudobranch is infiltrated by moderate numbers of lymphocytes and fewer macrophages. The inflammatory cells moderately disrupt the normal laminar architecture of the pseudobranch.

Skin: Diffusely, the dermis is infiltrated by low to moderate numbers of lymphocytes and fewer plasma cells with frequent transcytosis of inflammatory cells into the epidermis.

The following tissues are normal: gill, head kidney, adrenal gland, thymus, esophagus, pneumatic duct, spinal cord, liver, heart, swim bladder, thyroid gland, brain, vestibular apparatus, pancreas, stomach, pyloric cecae, intestine, posterior kidney, skeletal muscle, vertebrae, cartilage, ovary, and spleen.

Container 2:
Fish A: (Slides 44-48)
The following tissues are normal: gill, head kidney, adrenal gland, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, brain, stomach, pancreas, pyloric cecae, posterior kidney, skeletal muscle, vertebrae, cartilage, skin, ovary and spleen.

Fish B: (slides 49-51)
Mesentery: There is a small focal area of steatitis within the adipose tissue between a group of pyloric cecae.

The following tissues are normal: gill, head kidney, adrenal gland, thymus, esophagus, pneumatic duct, pseudobranch, vestibular apparatus, spinal cord, liver, heart, swim bladder, thyroid gland, brain, pancreas, stomach, pyloric cecae, intestine, posterior kidney, skeletal muscle, vertebrae, cartilage, ovary, skin and spleen.

Container 3:

Fish A: (Slides 52-55)

The following tissues are normal: gill, head kidney, adrenal gland, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, stomach, pancreas, pyloric cecae, intestine, posterior kidney, skeletal muscle, vertebrae, cartilage, skin, ovary and spleen.

Fish B: (slides 56-57)

The following tissues are normal: gill, head kidney, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, stomach, pancreas, pyloric cecae, intestine, posterior kidney, skeletal muscle, vertebrae, cartilage, skin, ovary and spleen.

Container 4:

Fish A: (Slides 58-61)

The following tissues are normal: gill, head kidney, adrenal gland, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, stomach, pancreas, pyloric cecae, intestine, posterior kidney, skeletal muscle, vertebrae, cartilage, skin, ovary and spleen.

Fish B: (slides 56-57)

Liver: A small focal infiltrate of lymphocytes and rare macrophages disrupt the hepatic cords.

The following tissues are normal: gill, head kidney, adrenal gland, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, stomach, pancreas, pyloric cecae, intestine, posterior kidney, skeletal muscle, vertebrae, cartilage, skin, ovary and spleen.

Container 5:

Fish A: (Slides 66-69)

The following tissues are normal: gill, head kidney, adrenal gland, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, stomach, pancreas, pyloric cecae, intestine, posterior kidney, skeletal muscle, vertebrae, cartilage, skin, ovary and spleen.

Fish B: (slides 70-71)

The following tissues are normal: gill, head kidney, adrenal gland, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, stomach, pancreas, pyloric cecae, intestine, posterior kidney, skeletal muscle, vertebrae, cartilage, skin, ovary and spleen.

HISTOLOGIC DIAGNOSES:

1. Branchial epithelial hypertrophy, diffuse, moderate, gill, Reuse fish 1B, 2A, 3A, 5A and Raceway fish 1B
2. Steatitis, histiocytic, subacute to chronic, multifocal, severe, mesentery and skeletal muscle, Raceway fish 1B
3. Steatitis, histiocytic, subacute, to chronic, focal, minimal, Raceway fish 2B
4. Dermatitis, lymphocytic, diffuse, moderate, skin, Raceway fish 1B
5. Pseudobranchitis, lymphocytic, diffuse, moderate to severe, unilateral, Raceway fish 1B
6. Hepatitis, lymphocytic, focal, minimal, liver, Raceway fish 4B

COMMENTS: The diffuse epithelial hypertrophy, likely due to irritation to the epithelial cells, could be caused by many factors involved with water quality including increased particulates or ammonia or reduced pH. The steatitis in fish 1B is pronounced. The lesion is often associated with rancid feed but can be due to other causes that would reduce normal intake or increased consumption of antioxidants such as vitamin E. Given the small body size of the affected fish and the restriction of the lesions to this fish and only minimal lesions in Raceway fish 2B could be from reduced feed intake or chronic debilitation. There is no evidence of an infectious pathogen in any of the examined sections.

WORK PENDING: Virology

Dr. Kevin Snekvik/KRS/krs
0647, 1153
Phone contact: Email of results sent to Dr. Good on October 16, 2008.

WASHINGTON ANIMAL DISEASE DIAGNOSTIC LABORATORY

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Veterinarian:	Dr. Christopher Good	Owner:	Eastbank Hatchery
Clinic:	The Freshwater Institute	Animal:	
Address:	1098 Turner Rd.	Species:	Chinook Salmon
		Breed:	
	Shepherdstown, WV 25443	Age:	
Phone:	(304) 876-2815	Sex:	Not Reported

HISTOPATHOLOGY REPORT **03/23/09** **WADDL #2008-14111**
Received: 11/05/08

Reuse System:

Gills: Sections of gill from all reuse fish have moderate to pronounced hypertrophy of the epithelial cells lining the secondary lamellae. Between 75-90% of the secondary lamellae are affected. There is no evidence of epithelial cell hyperplasia. Gills are otherwise normal within all fish.

Fish 1 (slides 1-2):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, brain, pseudobranch, thyroid gland, heart, semicircular canals, head kidney, ovary, stomach, pyloric cecae, pancreas, intestine, liver, gall bladder, pneumatic duct, posterior kidney

Fish 2 (slides 3-4):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, brain, pseudobranch, semicircular canals, head kidney, ovary, stomach, pyloric cecae, pancreas, intestine, liver, gall bladder, pneumatic duct, posterior kidney, swim bladder, heart

Fish 3 (slides 5-6):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, brain, pseudobranch, thyroid gland, semicircular canals, head kidney, reproductive tract, stomach, pyloric cecae , pancreas, intestine, liver, gall bladder, pneumatic duct, posterior kidney, spleen, swim bladder

Fish 4 (slides 7-8):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus , brain, thyroid gland, semicircular canals, head kidney, ovary, stomach, pyloric cecae, pancreas, intestine, liver, swim bladder, posterior kidney, eye, choroid gland, adrenal gland

Fish 5 (slides 9-10):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, heart, thymus, brain, pseudobranch, thyroid gland, semicircular canals, head kidney, ovary, stomach, pyloric cecae, pancreas, intestine, liver, gall bladder, posterior kidney, swim bladder, spleen

Fish 6 (slides 11-12):
Liver: There is diffuse, mild to rarely moderate hepatocellular lipidosis.
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, heart, thymus, brain, pseudobranch, thyroid gland, semicircular canals, head kidney, reproductive tract, stomach, pyloric cecae, pancreas, intestine, swim bladder, posterior kidney

Fish 7 (slides 13-14):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, heart, thymus, brain, pseudobranch, thyroid gland, semicircular canals, head kidney, reproductive tract, stomach, pyloric cecae, pancreas, intestine, liver, swim bladder, posterior kidney

Fish 8 (slides 15-16):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, brain, pseudobranch, thyroid gland, semicircular canals, head kidney, adrenal gland, ovary, stomach, pyloric cecae, pancreas, intestine, liver, swim bladder, posterior kidney

Fish 9 (slides 17-19):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, brain, thyroid gland, semicircular canals, head kidney, heart, adrenal gland, ovary, stomach, pyloric cecae, pancreas, intestine, liver, gall bladder, swim bladder, posterior kidney

Fish 10 (slides 20-22):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, heart, brain, pseudobranch, semicircular canals, head kidney, adrenal gland, ovary, stomach, pyloric cecae, pancreas, intestine, liver, swim bladder, posterior kidney

Raceway:

Fish 1 (slides 23-24):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, heart, gill, brain, pseudobranch, thyroid gland, semicircular canals, head kidney, adrenal gland, ovary, stomach, pyloric cecae, pancreas, intestine, liver, swim bladder, posterior kidney, eye, spleen

Fish 2 (slides 25-26):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, gill, brain, eye, semicircular canals, heart, head kidney, adrenal gland, ovary, stomach, pyloric cecae, pancreas, intestine, liver, swim bladder, posterior kidney, spleen

Fish 3 (slides 27-28):
Liver: There is mild to moderate variation in hepatocellular size with mild disruption of the hepatic cords. The cellular size corresponds to moderate to severe variation in nuclear size and morphology with relative common hepatocytes with large oval to indented nuclei with loose chromatin (hepatocellular karyomegally). Occasional hepatocytes are binucleate. Low numbers of hepatocytes have single small to large, clear intracytoplasmic vacuoles (lipidosis). Rarely there are small aggregates of lymphocytes and fewer neutrophils that disrupt the hepatic cords.

The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, heart, gill, brain, semicircular canals, thyroid gland, head kidney, adrenal glands, reproductive tract, stomach, pyloric cecae, pancreas, intestine, posterior kidney, spleen

Fish 4 (slides 29-30):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, gill, brain, pseudobranch, semicircular canals, heart, head kidney, ovary, stomach, pyloric cecae, pancreas, intestine, liver, posterior kidney

Fish 5 (slides 31-35):
Liver: The majority of the hepatocytes within the section are mildly swollen, slightly disorganized and have minimal to mild hydropic degeneration. Scattered individual hepatocytes have intracytoplasmic lipid vacuoles.

The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, gill, brain, pseudobranch, thyroid gland, semicircular canals, heart, head kidney, reproductive tract, stomach, pyloric cecae, pancreas, intestine, swim bladder, posterior kidney, spleen

Fish 6 (slides 36-40):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, gill, brain, pseudobranch, thyroid gland, head kidney, adrenal gland, heart, reproductive tract, stomach, pyloric cecae, pancreas, intestine, liver, gall bladder, swim bladder, posterior kidney, eye, choroid gland, spleen

Fish 7 (slides 41-43):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, gill, brain, pseudobranch, thyroid gland, semicircular canals, heart, adrenal gland, head kidney, ovary, stomach, pyloric cecae, pancreas, intestine, liver, swim bladder, posterior kidney, spleen

Fish 8 (slides 44-46):
Liver: There are hepatocellular changes similar to those described in Raceway fish #5.

The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, gill, brain, pseudobranch, thyroid gland, semicircular canals, heart, head kidney, adrenal gland, ovary, stomach, pyloric cecae, pancreas, intestine, gall bladder, pneumatic duct, posterior kidney, eye, spleen

Fish 9 (slides 47-48):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, gill, brain, pseudobranch, thyroid gland, semicircular canals, heart, head kidney, reproductive tract, stomach, pyloric cecae, pancreas, intestine, liver, swim bladder, posterior kidney, spleen

Fish 10 (slides 49-50):
The following tissues are normal: skin, skeletal muscle, spinal cord, vertebrae, thymus, gill, brain, pseudobranch, thyroid gland, semicircular canals, heart, head kidney, reproductive tract, stomach, pyloric cecae, pancreas, intestine, liver, swim bladder, posterior kidney

HISTOLOGIC DIAGNOSES:

1. Epithelial cell hypertrophy, locally extensive, gill, all fish (Reuse system)
2. Hepatocellular megalocytosis with karyomegaly, moderate to severe, liver, fish 3 (Raceway)
3. Hepatocellular hydropic degeneration, mild to moderate, with minimal lipidosis, liver, fish 5 and 8 (Raceway)

COMMENTS: The most evident change is the epithelial cell hypertrophy noted in the gills of the fish in the reuse system compared to the raceway. This is likely due to chronic irritation to the gill lamellar epithelium. The biologic effect of this change would most likely be low level hypoxia; however there are no additional histological changes that support the presence of hypoxia (renal tubular hydropic degeneration, etc). The hepatic changes in fish 3 are suggestive of aflatoxin exposure; however the fact that only one fish out of the group is affected is an odd presentation as toxin exposure would most likely be feed related. The additional hepatic changes in fish 5 and 8 in the raceway group is not determined.

WORK PENDING: None

Dr. Kevin Snekvik/KRS/krs
6462
Phone contact: Email sent to Dr. Good on December 16, 2008.

Washington Animal Disease Diagnostic Lab

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Dr. Christopher Good
The Freshwater Institute
1098 Turner Rd.

Shepherdstown, WV 25443

Case#: 2008-7426
Report Date: 07/11/08

Submittal Date: 06/12/08
Owner: Eastbank Hatchery

Species: Chinook Salmon

Age: 4 Months
Sex:

Final Report:

Aquaculture- Reported on 07/11/08 Authorized by Kevin Snekvik, Section Head

Aquatic viral culture SOP: 938.05.04.29

Animal	Specimen	Result	Isolate
1-Chin. 5F mid-sections Reuse	Tissue Pool	Negative	
2	Tissue Pool	Negative	
3	Tissue Pool	Negative	
4	Tissue Pool	Negative	
5	Tissue Pool	Negative	
6	Tissue Pool	Negative	
7	Tissue Pool	Negative	
8	Tissue Pool	Negative	
9	Tissue Pool	Negative	
10	Tissue Pool	Negative	
11	Tissue Pool	Negative	
12	Tissue Pool	Negative	
13-Chin. 5F mid-sections Racew	Tissue Pool	Negative	
14	Tissue Pool	Negative	
15	Tissue Pool	Negative	
16	Tissue Pool	Negative	
17	Tissue Pool	Negative	
18	Tissue Pool	Negative	
19	Tissue Pool	Negative	
20	Tissue Pool	Negative	
21	Tissue Pool	Negative	
22	Tissue Pool	Negative	
23	Tissue Pool	Negative	
24	Tissue Pool	Negative	

Aquatic viral culture test comment: All samples submitted on this case were negative for Oncorhynchus Masou Virus, Infectious Pancreatic Necrosis Virus, Infectious Hematopoietic Necrosis Virus, Viral Hemorrhagic Septicemia Virus, Epizootic Hematopoietic Necrosis Virus, and Spring Viremia of Carp on CHSE-214 & EPC cell lines.

Aquatic histopathology SOP: Not yet posted

Animal	Specimen	Result
1-Chin. 5F mid-sections Reuse	Tissue Pool	See Attached Report

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Dr. Christopher Good
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Shepherdstown, WV 25443

Case#: 2008-11753
Report Date: 10/16/08

Submittal Date: 09/17/08
Owner: Eastbank Hatchery
Species: Chinook Salmon
Age:
Sex:

Final Report:

Aquaculture- Reported on 10/16/08 Authorized by Kevin Snekvik, Section Head

Aquatic viral culture SOP:938.05.04.29

Animal	Specimen	Result	Isolate
1-Chhinook 5F k/s Raceways	Tissue Pool	Negative	
2	Tissue Pool	Negative	
3	Tissue Pool	Negative	
4	Tissue Pool	Negative	
5	Tissue Pool	Negative	
6	Tissue Pool	Negative	
7	Tissue Pool	Negative	
8	Tissue Pool	Negative	
9	Tissue Pool	Negative	
10	Tissue Pool	Negative	
11	Tissue Pool	Negative	
12	Tissue Pool	Negative	
13-Chinook 5F k/s Reuse	Tissue Pool	Negative	
14	Tissue Pool	Negative	
15	Tissue Pool	Negative	
16	Tissue Pool	Negative	
17	Tissue Pool	Negative	
18	Tissue Pool	Negative	
19	Tissue Pool	Negative	
20	Tissue Pool	Negative	
21	Tissue Pool	Negative	
22	Tissue Pool	Negative	
23	Tissue Pool	Negative	
24	Tissue Pool	Negative	

Aquatic viral culture test comment: All samples submitted on this case were negative for Oncorhynchus Masou Virus, Infectious Pancreatic Necrosis Virus, Infectious Hematopoietic Necrosis Virus, Viral Hemorrhagic Septicemia Virus, Epizootic Hematopoietic Necrosis Virus, and Spring Viremia of Carp on CHSE-214 & EPC cell lines.

Aquatic histopathology SOP:Not yet posted

Animal	Specimen	Result
	Container of Tissue(s)	See Attached Report

Washington Animal Disease Diagnostic Lab

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Dr. Christopher Good
The Freshwater Institute
1098 Turner Rd.

Shepherdstown, WV 25443

Case#: 2008-14111
Report Date: 12/16/08

Submittal Date: 11/05/08
Owner: Eastbank Hatchery

Species: Chinook Salmon

Age:
Sex:

Final Report:

Aquaculture- Reported on 12/16/08 Authorized by Kevin Snekvik, Section Head

Aquatic viral culture SOP: 938.05.04.29

Animal	Specimen	Result	Isolate
1-Chinook 5F k/s Raceway	Tissue Pool	Negative	
2	Tissue Pool	Negative	
3	Tissue Pool	Negative	
4	Tissue Pool	Negative	
5	Tissue Pool	Negative	
6	Tissue Pool	Negative	
7	Tissue Pool	Negative	
8	Tissue Pool	Negative	
9	Tissue Pool	Negative	
10	Tissue Pool	Negative	
11	Tissue Pool	Negative	
12	Tissue Pool	Negative	
13-Chinook 5F k/s Reuse	Tissue Pool	Negative	
14	Tissue Pool	Negative	
15	Tissue Pool	Negative	
16	Tissue Pool	Negative	
17	Tissue Pool	Negative	
18	Tissue Pool	Negative	
19	Tissue Pool	Negative	
20	Tissue Pool	Negative	
21	Tissue Pool	Negative	
22	Tissue Pool	Negative	
23	Tissue Pool	Negative	
24	Tissue Pool	Negative	

Aquatic viral culture test comment: All samples submitted on this case were negative for Oncorhynchus Masou Virus, Infectious Pancreatic Necrosis Virus, Infectious Hematopoietic Necrosis Virus, Viral Hemorrhagic Septicemia Virus, Epizootic Hematopoietic Necrosis Virus, and Spring Viremia of Carp on CHSE-214 & EPC cell lines.

Aquatic histopathology SOP: Not yet posted

Animal	Specimen	Result
1-Chinook 5F k/s Raceway	Tissue Pool	See Attached Report

Previously reported results:

Aquaculture- Last reported on 11/10/08 Authorized by Kevin Snekvik, Section Head

Aquatic bacterial screen SOP: 936.05.04.29

Animal	Specimen	Result	Isolate
Chinook "Partial Reuse"	Culture Medium	See comment.	

Result Comment: All samples submitted on this lot were negative for Aeromonas salmonicida and Yersinia ruckeri. Comment: Bacterial contaminants are present in less than 20% of the 60 samples submitted. This low degree of contamination results in rapid, reliable laboratory screening for bacterial pathogens.

Animal	Specimen	Result	Isolate
Chinook "Raceway"	Culture Medium	See comment.	

Result Comment: All samples submitted on this lot were negative for Aeromonas salmonicida and Yersinia ruckeri. Comment: Bacterial contaminants are present in less than 20% of the 60 samples submitted. This low degree of contamination results in rapid, reliable laboratory screening for bacterial pathogens.

Eastbank Hatchery Pilot Project
YEAR II

Assessing performance, health, and welfare of juvenile Chinook salmon in water reuse and raceway environments

Eastbank Hatchery • Wenatchee, Washington

March 2010

Prepared by:

Christopher Good & Brian Vinci
The Conservation Fund's Freshwater Institute
Shepherdstown, West Virginia

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Chelan County Public Utility District installed a partial water reuse culture system at the Eastbank Hatchery in Wenatchee, Washington for the purpose of assessing this technology for raising anadromous salmonids compared to conventional flow-through culture systems. For a formal, third-party assessment of the pilot water reuse system, The Conservation Fund's Freshwater Institute was requested in 2008 to evaluate the performance, health, and welfare of juvenile Chinook salmon *Oncorhynchus tshawytscha* reared in both systems. The hypothesis is that fish reared in the partial water reuse system exhibit growth, survival, and overall health comparable to fish reared in flow-through raceways. The study concluded that the reuse system is equal or better than the flow-through culture system. To further validate the first year's results, the study was conducted for a second year; however, the rearing density was doubled (from 12 to 25 kg/m^3). The Year II study data and conclusions are described this report.

In October, 2009, both cohorts were screened for important bacterial and viral fish pathogens. Histopathology, fin measurements, blood gas and chemistry analyses, and whole body proximate analysis were also performed. Overall results were as follows:

- Length and weight were comparable between the reuse and raceway cohorts (111.2mm and 110.2mm, and 17.8g and 18.9g, respectively)
- Survival was high in both groups: 98.9% (reuse) and 99.1% (raceway)
- Condition factor was higher in raceway fish (1.41 vs. 1.30 in reuse fish)
- Coefficient of variation was higher in raceway fish (17.1, vs. 13.8 in reuse)
- Caudal fin indices were similar in both cohorts; dorsal fin index was slightly lower in reuse fish (fin erosion was not grossly apparent)
- Prevalence of gill epithelial hypertrophy was low (3/10), and its severity very mild, in reuse fish
- Several differences in blood chemistry and gas values were noted, although all parameters were within normal salmonid range

- Raceway fish had higher levels of whole body fat; both cohorts had comparable protein content

Overall, by study's end both cohorts were generally comparable in performance, health, and welfare indices. Test data lead to the conclusion that higher rearing density resulted in no detrimental outcomes. Similar to the 2008 pilot study, the partial water reuse system was able to produce juvenile anadromous salmonids equivalent to those from flow-through raceway systems.

INTRODUCTION

The Chelan County Public Utility District (PUD) in Washington State produces over four million juvenile anadromous and resident Pacific salmonids annually for stocking the Upper Columbia River and its tributaries. The existing hatchery system uses flow-through technology; however, the PUD is considering water reuse systems for their multiple benefits (Timmons and Ebeling, 2007). For new technologies to replace traditional rearing methods it must be demonstrated that water reuse systems are comparable for raising quality salmonids for stocking. While water reuse technology has been successfully adopted in whole or in part at numerous flow-through facilities throughout the United States, limited observational research has been carried out to compare the health of salmonids raised in water reuse and flow-through environments.

During the winter of 2008, a partial water reuse system (see Figure 1 for system schematic) was installed at the Eastbank Hatchery in Wenatchee, Washington, and professionals from The Conservation Fund's Freshwater Institute were commissioned as a third party to evaluate the health of fish reared in the pilot system relative to those raised in the older flow-through units. An observational cohort study was carried out between June and November, 2008 to assess the performance, health, and welfare of juvenile Chinook salmon *Oncorhynchus tshawytscha* reared in the new reuse system relative to salmon from the same spawn reared in a nearby raceway. The study concluded that the pilot system was able to raise healthy and similarly performing juvenile Chinook salmon. The primary subclinical difference between study populations was diffuse epithelial hypertrophy of gill tissue in reuse fish. It was hypothesized that high algae levels and lower-than-optimal tank rotational velocities lead to higher than expected particulate matter in the reuse system water, and that gill irritation was a reaction to the elevated particulate matter. The gill pathology did not appear to affect the population's overall survival and performance. Furthermore, upon completing an acclimation period at the Turtle Rock facility, no differences in subclinical gill pathology were noted between raceway and reuse cohort fish, and the latter group demonstrated excellent out-migration including downstream migration speed, numbers, survival, and mini-jack prevalence.

To examine the repeatability of the findings from 2008, a second observational study comparing pilot system fish with a raceway cohort was carried out by The Conservation Fund's Freshwater Institute in 2009. Primary differences in the 2009 study were the use of pond covers to eliminate algae growth, increased tank rotational velocities to reduce particulate matter, and rearing fish at twice the density compared to the 2008 study. Assessments of raceway and reuse fish once again included performance, survival, fin condition, blood chemistry, pathogen screening, and histopathology, along with whole body proximate analysis, and these evaluations were carried out over an approximately five-month period (June – October, 2009) before fish were moved off-site for acclimation. For the 2009 study, target fish densities in all study rearing units were doubled from those maintained in 2008.

MATERIALS AND METHODS

From an initial spawn of Chinook salmon fry, approximately 300,000 fish were allotted for the second year pilot study project, and were ponded in two circular reuse system tanks and a comparison flow-through raceway in June, 2009 (100,000 fry for each study rearing unit). At the time of ponding, fish were approximately 0.5 grams in size and at an initial density of approximately 0.5 kg/m^3. Fish were maintained in these cohorts until mid-November, 2009, and were raised at comparable densities throughout the study period. Due to the desire to produce fish of a uniform size for stocking, the cohorts were fed at different rates depending on their respective growth rates (i.e. if fish from one cohort were deemed to be growing too quickly relative to fish in the other cohort, feed was restricted in the faster growing cohort to allow for equalization in fish size). At the end of the study period, average fish weight was approximately 18 grams, and all study fish were subsequently removed from the raceway and reuse system and moved off-site for acclimation to river water prior to stocking.

Data collection

Routine data collected during the June-October study period for both cohorts included daily feeding and mortality data, as well as monthly length and weight assessments. Data on water quality parameters (e.g. temperature, pH, total ammonia nitrogen, dissolved carbon dioxide, and alkalinity) were periodically assessed, and a journal was maintained to record any abnormalities related to water quality, higher-than-normal mortalities, additional work carried out, etc. In addition, tank velocity profiles were assessed at study's end to evaluate the circular tanks' capacity for self-cleaning and the range of swimming speeds available for reuse fish. All fish health and welfare data were collected in mid-October, 2009, and included the following:

<u>Fish pathogen screening</u>

Random dip-net samples were collected from each cohort, and sampled fish were euthanized with an overdose (200 mg/L) of MS-222 (Western Chemicals, Inc.) and sent whole on ice overnight to the Washington Animal Disease Diagnostic Laboratory (WADDL) (Pullman, WA) for screening of listed, important bacterial and viral fish pathogens. Sampling and testing were carried out according to protocols in the American Fisheries Society Blue Book (AFS-FHS, 2007), which recommend a sample of 60 fish from each group being screened for bacteriology, and an equal sized sample for virology; this provides a 95% confidence in detecting a pathogen in an infected group of fish that has a minimum 5% apparent prevalence of infection.

<u>Histology</u>

Ten fish were randomly collected from each cohort, euthanized with MS-222, and fixed in 10% neutral buffered formalin. A ventral midline incision was carefully administered to ensure whole body fixation (Figure 2). The samples were sent in jars to WADDL for histopathological assessment by the board-certified aquatic veterinary pathologist, Dr. Kevin Snekvik. Organs and tissues evaluated for each fish included gill, head kidney, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, vestibular apparatus, brain, pancreas, stomach, pyloric cecae, intestine, gonads, posterior kidney, skeletal muscle, vertebrae, cartilage, skin and spleen. All lesions observed were described in detail, quantified on a 0- to 5-point scale, and summarized in a final laboratory report.

Fin assessment

Thirty fish from each cohort were randomly selected, euthanized, and measured to the nearest 0.1mm for fork length, dorsal fin length, and lengths of the top and bottom poles of the caudal fin, using a digital microcaliper. Fin indices for all three measured fins were then calculated by dividing their individual lengths the fork length, and were assessed statistically for treatment (rearing environment) effect using the non-parametric Kruskal-Wallis test due to lack of normality in the dataset.

Whole blood gas and chemistry assessment

At the end of the study period, 25 fish from each cohort were randomly sampled and bled via caudal venipuncture using a 21.5-guage needle. Whole blood samples were then analyzed on-site using an i-Stat 1 portable analyzer (Abbott) with CG4+ and CHEM8+ cartridges. Parameters assessed with the CG4+ cartridge included pH, pCO_2, pO_2, HCO_3, total CO_2, O_2 saturation, and lactate, while CHEM8+ cartridges provided data for whole blood sodium, potassium, chloride, calcium, glucose, creatinine, hematocrit, and hemoglobin. Data obtained from individual fish were then assessed statistically for treatment effect using analyses of variance.

Whole body proximate analysis

At study's end, all fish involved were requested to be held off-feed for 24-hours, after which three separate samples of twenty fish from each cohort (120 fish total) were collected, euthanized (MS-222), and sent to Barrow-Agee Laboratories (Memphis, TN) on ice for whole body proximate analysis to assess the relative whole body moisture, fat, and protein content.

RESULTS

Similar to observations made in the 2008 study, no clinical disease outbreaks occurred in either cohort during the 2009 study period; survival was acceptable and comparable between the partial water reuse and raceway groups (98.9% and 99.1%, respectively). Subclinical infections were highly unlikely in either cohort, as no viral or bacterial fish pathogens were isolated from any sampling event over the course of the study. No evidence of bacterial infection was observed through histopathological assessment. Tank velocity profiles (Figure 3) indicated that reuse tanks had optimal rotational velocities, leading to improved tank self-cleaning (relative to the 2008 study) and a good range of swimming speeds, e.g. at study's end, fish were able to select tank regions for swimming speeds ranging from approximately 0.3 to 3.5 body-lengths per second.

By study's end, managers had been able to grow both cohorts to acceptable and comparable sizes prior to movement off-site for acclimation. Length and weight for reuse and raceway cohorts were 111.2mm and 110.2mm, and 17.8g and 18.9g, respectively (Figure 4). Condition factor was noticeably different between the reuse and raceway cohorts in 2008 (1.15 and 1.28, respectively); however, in 2009 condition factors differences were grossly less apparent (Figure 3), although reuse fish were once again relatively leaner than raceway fish (condition factors of 1.30 and 1.41, respectively) (Figure 5). Also visible in Figure 3 is the difference in appearance between the two cohorts, with reuse fish appearing almost uniformly silver and raceway fish exhibiting darker and more prominent markings. In terms of consistency in size, once again reuse fish had a lower coefficient of variation (13.76, vs. 17.1 in raceway fish) and were therefore more uniform in size (Figure 5). Feed conversion was comparable between the two cohorts, with raceway and reuse FCRs for the entire study period calculated as 0.75 and 0.82, respectively.

Results of the histological evaluations (Table 1) indicated that the majority of tissues examined were normal, with mild pathologies only noted in gill, liver, skeletal muscle and mesentery. Gill epithelial hypertrophy was not observed in reuse fish to the same degree as seen in 2008; in this study, only 3/10 reuse fish exhibited this pathology and only at a very minimal level. Similarly, very mild lymphocytic branchitis was observed in a few reuse fish. Minimal liver lesions were also present in a small proportion of both study cohorts. Acute myositis was observed in one sampled raceway fish, and this was most likely due to handling at the time of sample collection. Very minimal mesenteric peritonitis in one fish from each cohort appeared to be associated with the presence of PIT tags in the coelomic cavities.

Fin erosion assessment revealed no significant differences between cohorts in the indices of either pole of the caudal fin; however, as in 2008 the dorsal fin indices of reuse fish were statistically lower than the same indices in raceway fish (Figure 6). Despite the statistical difference in this parameter, no fin erosion was grossly apparent on any sampled fish from either study cohort.

The analyses of blood parameters revealed several significant differences between the two cohorts (Table 2). Sodium, glucose, hematocrit, hemoglobin, and lactate were all higher in the whole blood of raceway fish, while reuse fish had higher potassium, pCO_2, bicarbonate, and total CO_2. All parameters assessed were within expected salmonid ranges for both study cohorts.

Proximate analysis (Figure 7) demonstrated statistical differences in whole body fat and moisture, with sampled raceway fish having significantly more fat and moisture content relative to reuse fish. However, the results also indicated 7-8% of total body composition in reuse fish was not included in the moisture, fat, protein, and ash results, indicating that these fish likely contained residual feed in their digestive tracts.

DISCUSSION

The results of this second pilot system study demonstrate that juvenile Chinook salmon can be raised in a partial water reuse environment with comparable performance and survival to those reared in traditional flow-through raceways. Very minor differences (e.g. fin condition, condition factor, subclinical pathologies observed, etc.) were detected between the two cohorts, but these changes did not have any apparent effect on growth and mortality in study fish, and the overall findings support the feasibility of adopting partial water reuse technology for raising Pacific salmonids for stocking purposes.

In 2008, the pilot partial water reuse system was not operated optimally during the study in two major ways – tanks lacked covers to protect fish from the effects of sunlight (i.e. algal growth), and they were operated at slower-than-optimal rotational velocities. These factors combined to produce tank water quality that, while not necessarily poor, was not at a level for which these normally self-cleaning tanks have the potential. With effective sunlight coverage installed for the 2009 study, the excessive algal growth seen before was no longer an issue. Rotational velocity analyses in 2009 indicated that the tank rotational period was approximately 75 seconds, which falls within the 60-90 second range necessary for tank self-cleaning (Davidson and Summerfelt, 2004). Therefore, tank water quality was greatly improved for the 2009 study. The major finding in 2008 was the consistent diagnosis of diffuse branchial epithelial hypertrophy in partial water reuse fish, which in general is often a consequence of chronic exposure to high levels of particulates in the water (Sutherland and Meyer, 2007) and leads to an increased distance for the exchange of gases and metabolites between the fish and water (Ferguson, 1989). While epithelial hypertrophy was observed in 2009 in reuse fish, its prevalence was low (3/ 10) and its distribution and severity were comparatively very minimal. The other histopathological lesions observed in the 2009 raceway and reuse cohorts were mild and at low prevalence, and were most likely of very little consequence to the health of affected fish. Differences between the cohorts in measured whole blood parameters were likewise of little consequence, with mean values for all parameters falling within expected limits for salmonids. Higher pCO_2 in reuse fish (along with higher bicarbonate to buffer the resultant decrease in blood pH, and a mild loss of chloride ions due to chloride/bicarbonate exchangers (Wedemeyer, 1996) found in gill tissue) was likely the result of prolonged moderate exercise in the circular tanks. Other differences, particularly the higher glucose and hematocrit found in raceway fish, were likely related to the relative ease of capturing study fish. Reuse fish were comparatively effortless to sample, whereas capturing raceway fish usually required chasing the fish up and down the rearing unit before a sample could be collected. Such acute exercise in animals can be associated with a reduction in blood volume (Okuno, 1992), leading to a relatively elevated hematocrit, as well as a sharp increase in blood glucose due to cortisol release. Therefore, differences between blood parameters measured in reuse and raceway fish could at least in part be attributed to acute stress at capture.

While assessing fin erosion, measured dorsal fin indices were found to be higher in the raceway cohort compared to fish raised in the partial water reuse system. Fin condition is an established indicator of fish welfare (Ellis et al., 2008), and is perceived to affect the quality of fish raised for stocking purposes (Ronsholdt and McClean, 1999). The etiology of fin erosion is not completely understood, and research suggests that it is a complex, multifactorial process (Latremouille, 2003). Among other things, increased stocking densities and high levels of suspended solids are considered to be associated with fin erosion (Wedemeyer, 1996).

While there are numerous methods for assessing fin condition, the fin index (length of longest ray standardized by fork length) (Kindschi, 1987) is considered to be the most objective and accurate method (Latremouille, 2003). Although reuse fish tended to be slightly longer on average, isometric growth (i.e. a constant ratio of fin length to total length) has been demonstrated in rainbow trout between 100 and 300mm in length (Bosakowski and Wagner, 1994), and therefore it is likely that the detected difference in dorsal fin indices was not a product of differences in average fish length between cohorts. It is unknown at present why reuse fish continue to have lower dorsal fin indices despite not being exposed to the relatively poor water quality seen in 2008. Overall, however, all fins assessed in this study were deemed to be of excellent quality compared to other populations observed by the authors, and it is unlikely that lower dorsal fin indices of the reuse cohort represented any meaningful compromise to fish welfare for this group.

Results of the proximate analysis should be viewed with caution, as measured compositions for all three 20-fish pooled samples from the reuse cohort totaled only 91-93% of the whole body weight, the remaining percentage being (most likely) unmeasured carbohydrate. These results indicate the probable presence of residual feed in the digestive tracts of the reuse fish, meaning that either i) fish were inadvertently fed in the 24-hour period prior to sampling, or ii) reuse fish retain feed in their digestive tracts for a longer period than raceway fish. In either case, the possibility that residual feed contributed to the proximate analysis results for the reuse fish must be considered when reviewing these findings. Future samplings for proximate analysis should have fish off-feed for a minimum of 48-hours prior to sample collection.

Finally, as with the 2008 study there are certain limitations to this research scenario that should be noted. The assessment of a single pilot system did not lend itself to full experimental evaluation due to the lack of treatment replication, and an observational cohort study approach was necessary in this particular setting; however, care must be taken in the interpretation of results obtained. While experimental research emphasizes, among other things, the repeatability of findings, the results of the cohort study described in this report cannot be validly extrapolated to other locations or study populations, and should best be viewed as an observational case study of the specific fish populations assessed. Further construction of partial water reuse systems, if possible, could provide the necessary replication for experimental evaluation of these new technologies.

CONCLUSIONS

Juvenile Chinook salmon reared in the partial water reuse system at Eastbank Hatchery performed comparably to fish from the same spawn in a nearby flow-through raceway, and while subclinical differences were noted between the two cohorts these differences did not affect survival. The partial water reuse system produced fish of approximately equal size to the raceway fish, but with lower condition factor and less variation in length. This pilot study therefore demonstrates the feasibility of partial reuse technology in raising Pacific salmonids for stocking; however, the limitations of observational research need to be considered, and further study is warranted to support the findings presented in this report.

ACKNOWLEDGEMENTS

The authors wish to thank the Washington Department of Fish & Wildlife, particularly John Penny and the Eastbank Hatchery staff for all of their assistance, and Bob Rogers for his fish health observations of pilot study populations. Thanks are also extended to Ian Adams of the Chelan County PUD for assistance with data collection and reuse system maintenance.

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Table 1. Summary of pathologies noted on histological examination of raceway- and reuse-reared juvenile Chinook salmon over three sampling events during the pilot study period.

Tissue	Lesion Type	Score [a]	Lesion Prevalence	
			Raceway	Reuse
Gill	Lymphocytic branchitis	1	0/10	3/10
	Epithelial hypertrophy	1	0/10	3/10
Liver	Lymphocytic hepatitis, random	1	1/10	3/10
	Lipidosis	2	0/10	2/10
Skeletal muscle	Acute myositis	1	1/10	0/10
Mesentery	Pyogranulomatous peritonitis	1	1/10	1/10

[a] Lesion score key:

1	Very minimal	<5% of examined tissue or microanatomical regions affected/ corresponding very minimal numbers of inflammatory infiltrates
2	Minimal	25% of examined tissue or microanatomical regions affected/ corresponding minimal numbers of inflammatory infiltrates
3	Moderate	50% of examined tissue or microanatomical regions affected/ corresponding moderate numbers of inflammatory infiltrates
4	Marked	75% of examined tissue or microanatomical regions affected/ corresponding very marked numbers of inflammatory infiltrates
5	Severe	Essentially 100% of examined tissue affected/ obliteration of normal architecture/ numerous inflammatory infiltrates

Table 2. Whole blood gas and chemistry parameter means from sampled raceway and reuse Chinook salmon. Parameters with asterisk (*) indicate significant ($p<0.05$) differences between cohorts.

Parameter	Treatment	Mean	S.E.
Sodium (mmol/L) *	Raceway	149.2	0.895
	Reuse	145.7	0.707
Potassium (mmol/L) *	Raceway	3.673	0.249
	Reuse	4.857	0.177
Chloride (mmol/L)	Raceway	135.1	0.774
	Reuse	134.5	0.888
Calcium (mmol/L)	Raceway	1.778	0.028
	Reuse	1.756	0.018
Glucose (mg/dL) *	Raceway	78.87	4.306
	Reuse	63.93	1.092
Hematocrit (%PCV) *	Raceway	33.07	0.881
	Reuse	24.71	0.714
Hemoglobin (g/dL) *	Raceway	11.24	0.297
	Reuse	8.400	0.242
pH	Raceway	6.944	0.013
	Reuse	6.967	0.013
pCO_2 (mmHg) *	Raceway	24.79	1.162
	Reuse	29.65	1.445
pO_2 (mmHg)	Raceway	8.875	1.060
	Reuse	8.667	1.189
Bicarbonate (mmol/L) *	Raceway	5.313	0.168
	Reuse	6.733	0.223
Total CO_2 (mmol/L) *	Raceway	6.125	0.239
	Reuse	7.667	0.284
O_2 saturation (%)	Raceway	6.000	1.054
	Reuse	6.667	1.116
Lactate (mmol/L) *	Raceway	13.51	0.285
	Reuse	10.77	0.386

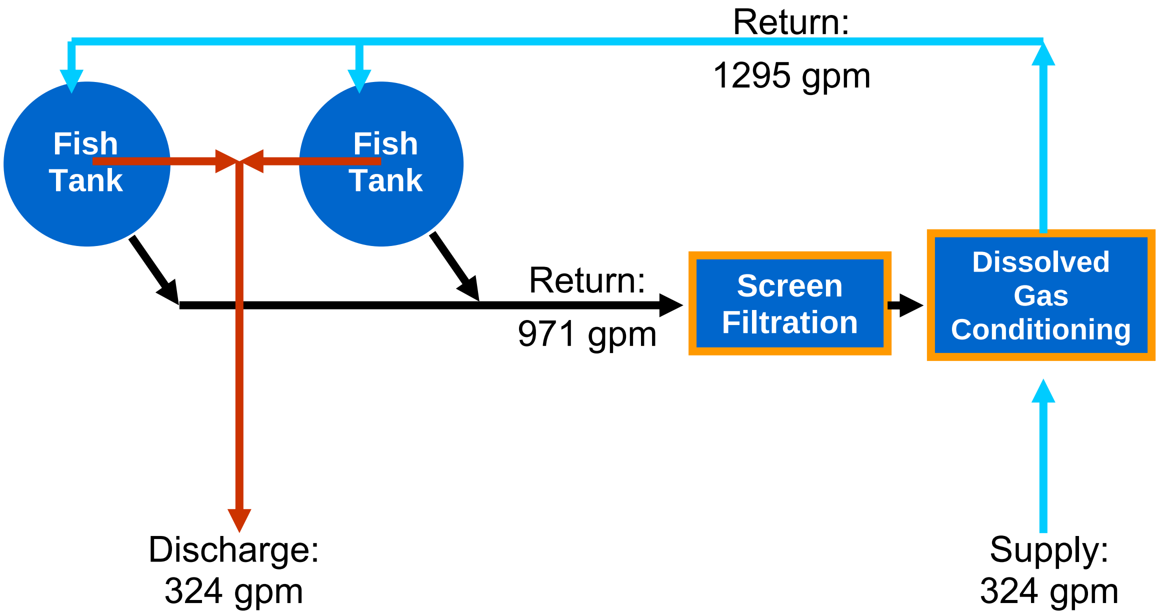

Figure 1. Schematic of the partial water reuse system installed at the Eastbank Hatchery in Wenatchee, WA. The system includes two circular 30-ft diameter dual-drain tanks, microscreen filtration and gas conditioning of influent and recirculating water.

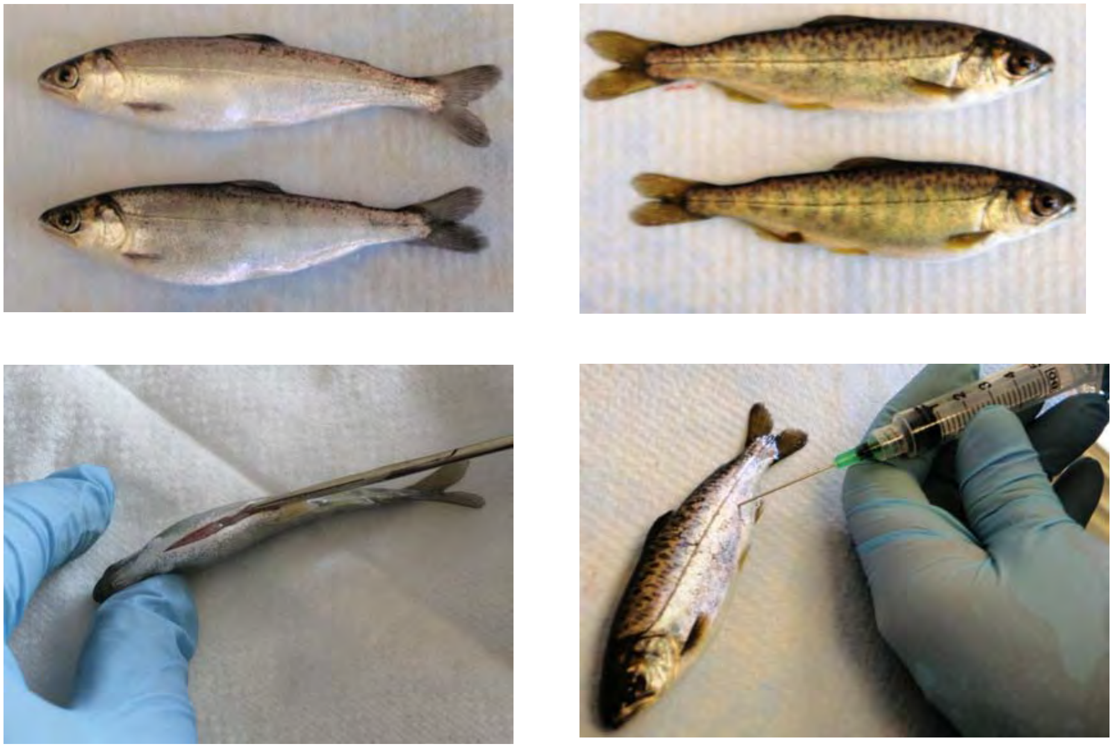

Figure 2. Sampling images taken during the final fish health assessment in October, 2009. Top: reuse (left) and raceway (right) fish demonstrating relatively similar morphologies but different marking patterns. Bottom left: ventral midline incision made prior to whole body fixation in buffered formalin for histopathology evaluation. Bottom right: whole blood sampling via caudal venipuncture.

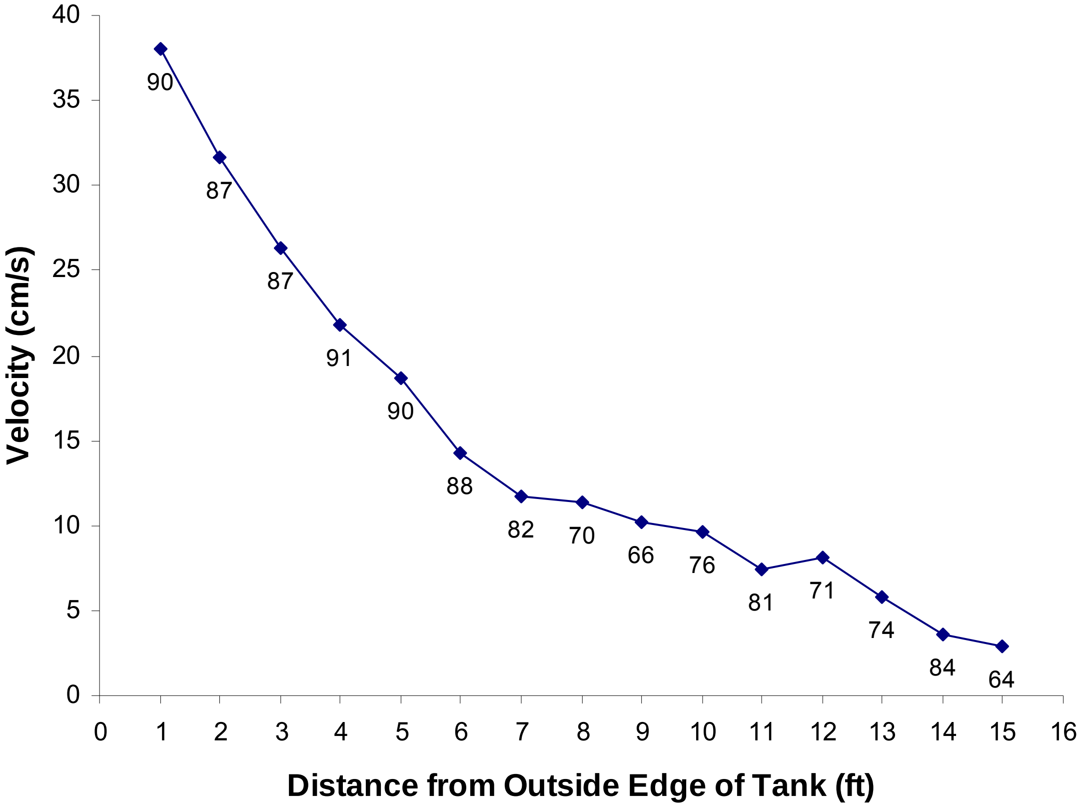

Figure 3. Circular tank velocity profile measured in late October, 2009. Velocities ranged from approximately 38 cm/s at the outside wall to less than 5 cm/s near the center of the tank. Numbers appearing beside each data point represent the resultant angle of measurement (relative to the 90-degree tangent at the tank wall).

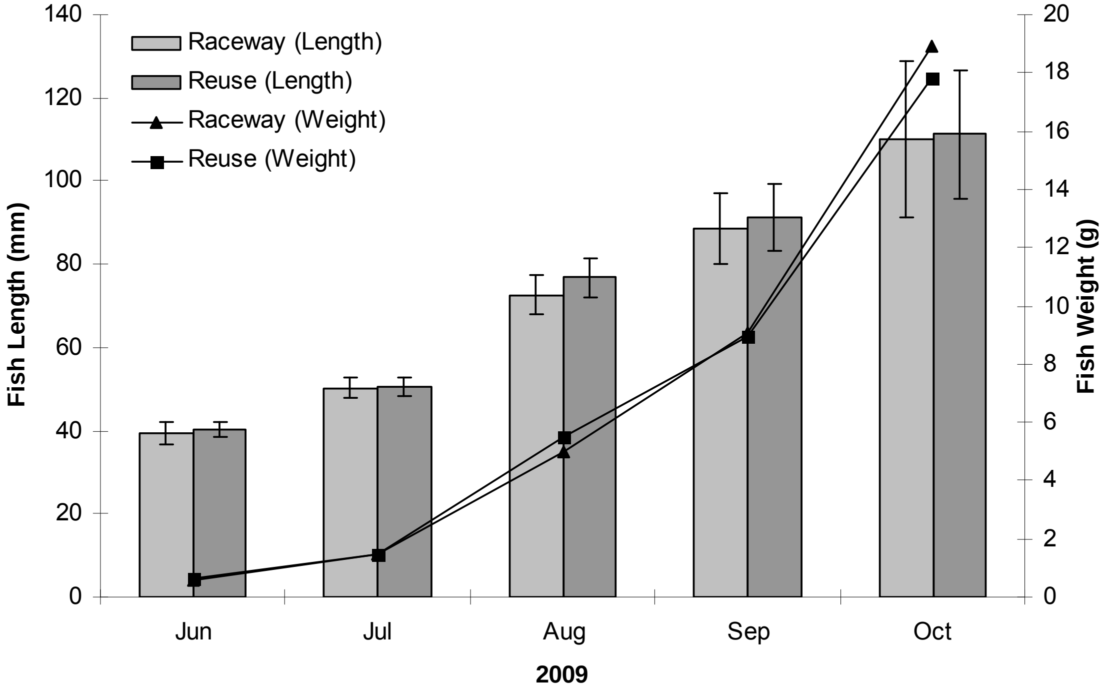

Figure 4. Comparison of raceway- and reuse-reared juvenile Chinook salmon monthly length and weight measurements during the course of the 2009 pilot study. Error bars for fish length represent standard deviations.

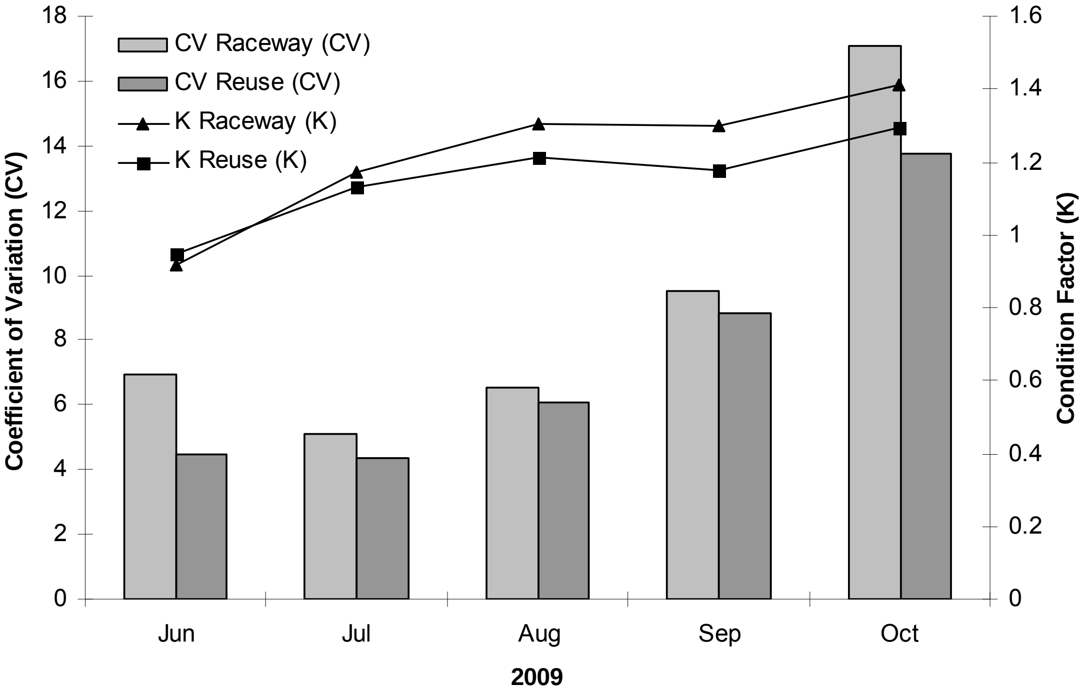

Figure 5. Comparison of raceway- and reuse-reared juvenile Chinook salmon condition factors and coefficients of variation calculated from monthly length and weight sampling data collected during the course of the pilot study.

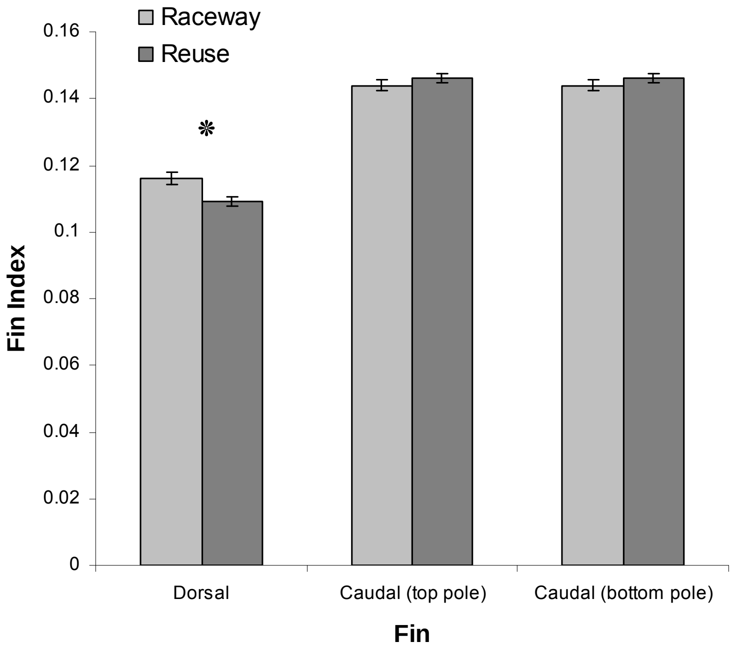

Figure 6. Comparisons of raceway- and reuse-reared juvenile Chinook salmon indices for dorsal and caudal fins, measured during end-of-study sampling (October, 2009). Asterisk (*) indicates significant ($p<0.05$) difference between cohorts.

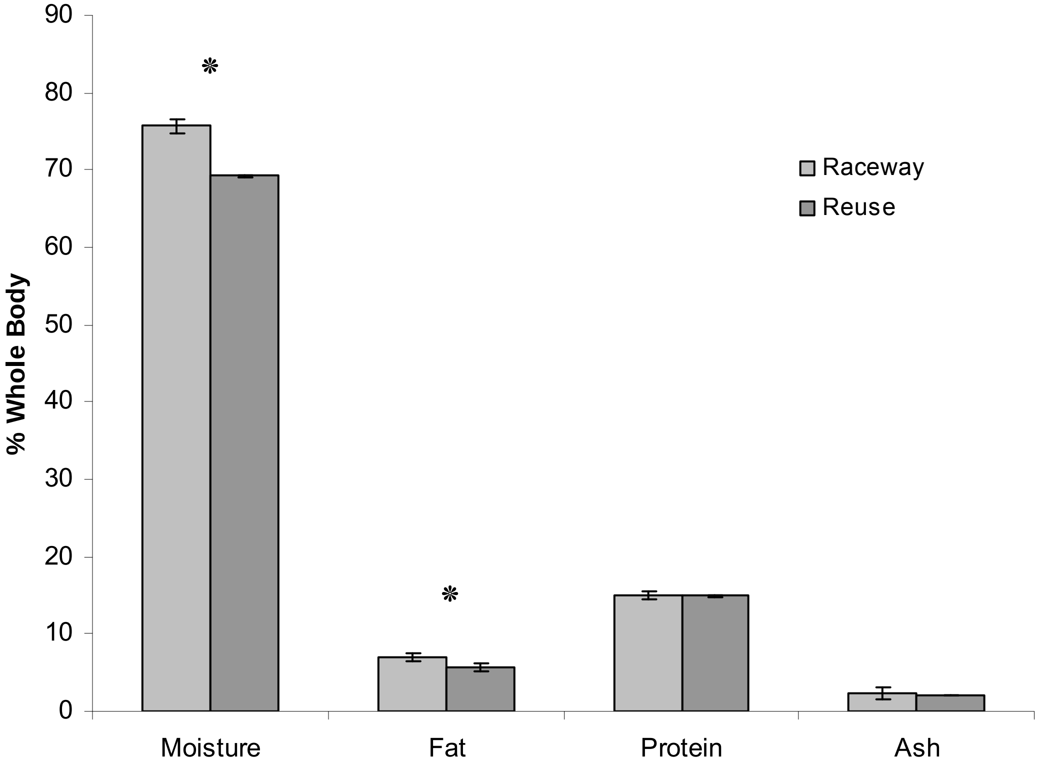

Figure 7. Comparisons of raceway- and reuse-reared juvenile Chinook salmon whole body proximate analysis measured from end-of-study pooled 20-fish samples (October, 2009). Asterisk (*) indicates significant ($p<0.05$) difference between cohorts.

APPENDICES

Compiled laboratory reports from the Washington Animal Disease Diagnostic Laboratory (Pullman, WA) and Barrow-Agee Laboratories (Memphis, TN)

Washington Animal Disease Diagnostic Lab

P.O. Box 647034
Pullman, WA 99164-7034
Telephone : (509) 335-9696
Fax : (509) 335-7424

Dr. Christopher Good
The Freshwater Institute
1098 Turner Rd.

Shepherdstown, WV 25443

Case#: 2009-12030
Report Date: 11/20/09

Submittal Date: 10/21/09
Species: Fish sp.
Age:
Owner: Eastbank Hatchery
Sex:

Tests still outstanding:

Aquaculture- Aquatic Histopathology is due on 10/29/09

Current Results:

Aquaculture- Reported on 11/20/09 Authorized by Kevin Snekvik, Section Head

Aquatic viral culture SOP: 938.05.04.29

Animal	Specimen	Result	Isolate
1-Chinook 5F k/s ”Raceway”	Tissue Pool	Negative	
2	Tissue Pool	Negative	
3	Tissue Pool	Negative	
4	Tissue Pool	Negative	
5	Tissue Pool	Negative	
6	Tissue Pool	Negative	
7	Tissue Pool	Negative	
8	Tissue Pool	Negative	
9	Tissue Pool	Negative	
10	Tissue Pool	Negative	
11	Tissue Pool	Negative	
12	Tissue Pool	Negative	
13-Chinook 5F k/s ”Reuse”	Tissue Pool	Negative	
14	Tissue Pool	Negative	
15	Tissue Pool	Negative	
16	Tissue Pool	Negative	
17	Tissue Pool	Negative	
18	Tissue Pool	Negative	
19	Tissue Pool	Negative	
20	Tissue Pool	Negative	
21	Tissue Pool	Negative	
22	Tissue Pool	Negative	

Aquatic viral culture SOP: 938.05.04.29

Animal	Specimen	Result	Isolate
23	Tissue Pool	Negative	
24	Tissue Pool	Negative	

Aquatic viral culture test comment: All samples submitted on this case were negative for Oncorhynchus Masou Virus, Infectious Pancreatic Necrosis Virus, Infectious Hematopoietic Necrosis Virus, Viral Hemorrhagic Septicemia Virus, Epizootic Hematopoietic Necrosis Virus, and Spring Viremia of Carp on CHSE-214 & EPC cell lines.

Previously reported results:

Aquaculture- Last reported on 10/29/09 Authorized by Kevin Snekvik, Section Head

Aquatic bacterial screen SOP: 936.05.04.29

Animal	Specimen	Result	Isolate
Chinook "Reuse"	Culture Medium	See comment.	

Result Comment: All samples submitted on this case were negative for Aeromonas salmonicida and Yersinia ruckeri. Comment: Bacterial contaminants are present in 20 to 40% of the 60 samples submitted. This contamination level is acceptable for inspection purposes, but reducing contaminant levels would allow for simpler, faster laboratory screening.

Animal	Specimen	Result	Isolate
Chinook "Raceway"	Culture Medium	See comment.	

Result Comment: All samples submitted on this case were negative for Aeromonas salmonicida and Yersinia ruckeri. Comment: Bacterial contaminants are present in less than 20% of the 60 samples submitted. This low degree of contamination results in rapid, reliable laboratory screening for bacterial pathogens.

WASHINGTON ANIMAL DISEASE DIAGNOSTIC LABORATORY

P.O. Box 647034
Pullman, WA 99164-7034
Phone: (509) 335-9696
Fax: (509) 335-7424

HISTOPATHOLOGY REPORT **02/22/10** **WADDL #2009-12030**
Received: 10/21/09

Raceway System:
Three containers each contain three to four Chinook salmon fingerlings fixed in formalin. Four gill arches, the second and third gill arches from both sides of the fish, were collected, placed flat in a cassette and examined in a single cross section. Grossly representative transverse sections, that included approximately 11-13 full body cross sections from each fish, are collected and examined.

Fish 1: (Slides 1-4)
The following tissues are normal: head kidney, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, gills, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, reproductive tract, posterior kidney, skeletal muscle, vertebrae, eye, choroid gland, cartilage and skin.

Fish 2: (Slides 5-8)
The following tissues are normal: gill, head kidney, thymus, esophagus, pneumatic duct, spinal cord, liver, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, ovary, posterior kidney, skeletal muscle, vertebrae, eye, choroid gland, cartilage and skin.

Fish 3: (Slides 9-12)
Mesentery: There is a single small, well formed granuloma characterized by a central accumulation of cellular debris surrounded by epithelioid macrophages in turn bordered by a delicate band of collagen.

The following tissues are normal: gill, head kidney, thymus, esophagus, pneumatic duct, pseudobranch, spinal cord, liver, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, posterior kidney, skeletal muscle, vertebrae, cartilage, eye, choroid gland, and skin.

Fish 4: (Slides 13-18)
The following tissues are normal: gill, head kidney, thymus, esophagus, pneumatic duct, spinal cord, liver, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, posterior kidney, skeletal muscle, vertebrae, cartilage, eye, choroid gland, spleen and skin.

Fish 5: (Slides 19-22)
The following tissues are normal: gill, head kidney, thymus, esophagus, pneumatic duct, spinal cord, liver, heart, swim bladder, thyroid gland, brain, pancreas, stomach, pyloric cecae, intestine, ovary, posterior kidney, skeletal muscle, vertebrae, cartilage, eye, choroid gland, spleen and skin.

Fish 6: (Slides 23-26)
The following tissues are normal: head kidney, thymus, esophagus, pseudobranch, spinal cord, liver, heart, swim bladder, gills, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae,

intestine, reproductive tract, posterior kidney, skeletal muscle, vertebrae, cartilage, eye, choroid gland, spleen and skin.

Fish 7: (Slides 27-30)
Liver: There is a focal, small accumulation of lymphocytes and rare plasma cells that minimally disrupt adjacent hepatic cords.

The following tissues are normal: head kidney, thymus, esophagus, pseudobranch, spinal cord, heart, swim bladder, gills, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, reproductive tract, posterior kidney, skeletal muscle, vertebrae, cartilage, eye, choroid gland, spleen and skin.

Fish 8: (Slides 31-34)
Skeletal muscle: At the level of the heart, a myotome of skeletal muscle along the ventral body immediately subjacent to the subcutis is disrupted by a small, focal accumulation of lymphocytes and fewer plasma cells and macrophages.

The following tissues are normal: head kidney, thymus, esophagus, liver, spinal cord, heart, swim bladder, gills, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, reproductive tract, posterior kidney, vertebrae, cartilage, eye, choroid gland, spleen and skin.

Fish 9: (Slides 35-38)
The following tissues are normal: head kidney, thymus, esophagus, pseudobranch, liver, spinal cord, heart, swim bladder, gills, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, reproductive tract, posterior kidney, skeletal muscle, vertebrae, eye, choroid gland, cartilage and skin.

Fish 10: (Slides 39-42)
The following tissues are normal: head kidney, thymus, esophagus, pseudobranch, liver, spinal cord, heart, swim bladder, gills, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, reproductive tract, posterior kidney, skeletal muscle, vertebrae, eye, choroid gland, cartilage and skin.

Reuse System:
Three containers each contain three to four Chinook salmon fingerlings fixed in formalin. Four gill arches, the second and third gill arches from both sides of the fish, were collected, placed flat in a cassette and examined in a single cross section. Grossly representative transverse sections, that included approximately 11-13 full body cross sections from each fish, are collected and examined.

Fish 11: (Slides 43-46)
The following tissues are normal: head kidney, thymus, esophagus, pseudobranch, liver, spinal cord, heart, swim bladder, gills, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, reproductive tract, posterior kidney, skeletal muscle, vertebrae, eye, choroid gland, cartilage and skin.

Fish 12: (Slides 47-51)
Liver: The hepatic cords are very minimally disrupted by two small accumulations of lymphocytes.

The following tissues are normal: head kidney, thymus, esophagus, pseudobranch, spinal cord, heart, swim bladder, gills, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, reproductive tract, posterior kidney, skeletal muscle, vertebrae, cartilage, eye, choroid gland, spleen and skin.

<u>Fish 13: (Slides 52-56)</u>
Gill: There are rare, multifocal groups of secondary lamellae which are lined by groups of slightly plump, hypertrophied epithelial cells.

The following tissues are normal: head kidney, thymus, esophagus, pseudobranch, liver, spinal cord, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, reproductive tract, posterior kidney, skeletal muscle, vertebrae, cartilage, eye, choroid gland, spleen and skin.

<u>Fish 14: (Slides 57-60)</u>
Gill: There are very rare (one per gill arch) infiltrates of low numbers of lymphocytes and fewer macrophages that mildly expand small groups of secondary lamellae and extend into the underlying connective tissue of the primary lamellae.

The following tissues are normal: head kidney, thymus, esophagus, pseudobranch, liver, spinal cord, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, reproductive tract, posterior kidney, skeletal muscle, vertebrae, cartilage, eye, choroid gland, spleen and skin.

<u>Fish 15: (Slides 61-64)</u>
The following tissues are normal: head kidney, thymus, esophagus, liver, spinal cord, heart, swim bladder, gills, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, reproductive tract, posterior kidney, skeletal muscle, vertebrae, cartilage, eye, choroid gland, spleen and skin.

<u>Fish 16: (Slides 65-68)</u>
Gill: There are very rare (one per gill arch) infiltrates of low numbers of lymphocytes and fewer macrophages that mildly expand small groups of secondary lamellae and extend into the underlying connective tissue of the primary lamellae.

The following tissues are normal: head kidney, thymus, esophagus, pseudobranch, liver, spinal cord, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, reproductive tract, posterior kidney, skeletal muscle, vertebrae, eye, choroid gland, cartilage and skin.

<u>Fish 17: (Slides 69-72)</u>
Gill: Diffusely in all four pieces of gill, the epithelial cells lining the secondary lamellae are mildly hypertrophied.

Liver: Throughout the liver, the hepatocytes have moderate intracytoplasmic accumulations of lipid.

Mesentery: Next to but not associated with the stomach, the mesentery is focally disrupted by a large aggregate of macrophages and multinucleated giant cells. The inflammatory focus is composed of numerous small densely packed accumulations of multinucleated giant cells that surround central aggregates of lipid and cellular debris. These accumulations are surrounded and separated from each other by delicate strands of collagen, fibroblasts and macrophages.

The following tissues are normal: head kidney, thymus, esophagus, pseudobranch, spinal cord, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, reproductive tract, posterior kidney, skeletal muscle, vertebrae, cartilage, eye, choroid gland, spleen and skin.

Fish 18: (Slides 73-76)
Gill: Diffusely in all four pieces of gill, the epithelial cells lining the secondary lamellae are mildly hypertrophied. There are very rare (one per gill arch) infiltrates of low numbers of lymphocytes that mildly expand small groups of secondary lamellae.

Liver: Throughout the liver, the hepatocytes have moderate intracytoplasmic accumulations of lipid. The hepatic cords are minimally disrupted by a small focus of lymphocytes.

The following tissues are normal: head kidney, thymus, esophagus, pseudobranch, spinal cord, heart, swim bladder, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, reproductive tract, posterior kidney, skeletal muscle, vertebrae, eye, choroid gland, cartilage and skin.

Fish 19: (Slides 77-80)
The following tissues are normal: head kidney, thymus, esophagus, liver, spinal cord, heart, swim bladder, gills, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, reproductive tract, posterior kidney, skeletal muscle, vertebrae, cartilage, eye, choroid gland, spleen and skin.

Fish 20: (Slides 81-84)
Liver: The hepatic cords are minimally disrupted by a small focus of lymphocytes.

The following tissues are normal: head kidney, thymus, esophagus, spinal cord, heart, swim bladder, gills, thyroid gland, semicircular canals (vestibular apparatus), brain, pancreas, stomach, pyloric cecae, intestine, reproductive tract, posterior kidney, skeletal muscle, vertebrae, cartilage, eye, choroid gland, spleen and skin.

Dr. Kevin Snekvik/KRS/krs

Phone contact:

BARROW-AGEE
LABORATORIES, LLC

1555 THREEPLACE • MEMPHIS, TN 38116 • (901) 332-1590 • FAX (901) 398-1518

Freshwater Institute
ATTN: Christopher Good
P.O. Box 1889
Shepherdstown, WV, 25443

Reporting Date: 11/06/2009

Certificate of Analysis

Barrow-Agee Laboratory Number: 34038
Sample Of: Fish
Sample Identification: RACEWAY 20 FISH POOL #1 10/21/09

Sample Received: 10/27/2009
Sample Analyzed: 11/05/2009

Ship Date:

Assay Name:	Expected:	Result:	
Moisture in Meat Products		74.8	%
Fat		7.4	%
Protein		15.6	%
Ash		3.1	%

Approved,

Jim Bell

Technical Director

BARROW-AGEE
LABORATORIES, LLC

1555 THREEPLACE • MEMPHIS, TN 38116 • (901) 332-1590 • FAX (901) 398-1518

Freshwater Institute
ATTN: Christopher Good
P.O. Box 1889
Shepherdstown, WV, 25443

Reporting Date: 11/06/2009

Certificate of Analysis

Barrow-Agee Laboratory Number: 34039
Sample Of: Fish
Sample Identification: RACEWAY 20 FISH POOL #2 10/21/09

Sample Received: 10/27/2009
Sample Analyzed: 11/05/2009

Ship Date:

Assay Name:	Expected:	Result:	
Moisture in Meat Products		75.6	%
Fat		6.4	%
Protein		15.0	%
Ash		1.8	%

Approved,

Jim Bell

Technical Director

BARROW-AGEE
LABORATORIES, LLC

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Freshwater Institute
ATTN: Christopher Good
P.O. Box 1889
Shepherdstown, WV, 25443

Reporting Date: 11/06/2009

Certificate of Analysis

Barrow-Agee Laboratory Number: 34040
Sample Of: Fish
Sample Identification: RACEWAY 20 FISH POOL #3 10/21/09

Sample Received: 10/27/2009
Sample Analyzed: 11/05/2009

Ship Date:

Assay Name:	Expected:	Result:	
Moisture in Meat Products		76.7	%
Fat		6.9	%
Protein		14.4	%
Ash		1.8	%

Approved,

Jim Bell
Technical Director

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Freshwater Institute
ATTN: Christopher Good
P.O. Box 1889
Shepherdstown, WV, 25443

Reporting Date: 11/06/2009

Certificate of Analysis

Barrow-Agee Laboratory Number: 34041
Sample Of: Fish
Sample Identification: REUSE 20 FISH POOL #1 10/21/09

Sample Received: 10/27/2009
Sample Analyzed: 11/05/2009

Ship Date:

Assay Name:	Expected:	Result:	
Moisture in Meat Products		69.1	%
Fat		5.2	%
Protein		14.7	%
Ash		2.1	%

Approved,

Jim Bell
Technical Director

ANALYTICAL CHEMISTS SINCE 1917

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Freshwater Institute
ATTN: Christopher Good
P.O. Box 1889
Shepherdstown, WV, 25443

Reporting Date: 11/06/2009

Certificate of Analysis

Barrow-Agee Laboratory Number: 34042
Sample Of: Fish
Sample Identification: RACEWAY 20 FISH POOL #2 10/21/09

Sample Received: 10/27/2009
Sample Analyzed: 11/05/2009

Ship Date:

Assay Name:	Expected:	Result:	
Moisture in Meat Products		69.3	%
Fat		5.7	%
Protein		15.0	%
Ash		2.1	%

Approved,

Jim Bell
Technical Director

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Freshwater Institute
ATTN: Christopher Good
P.O. Box 1889
Shepherdstown, WV, 25443

Reporting Date: 11/06/2009

Certificate of Analysis

Barrow-Agee Laboratory Number: 34043
Sample Of: Fish
Sample Identification: RACEWAY 20 FISH POOL #3 10/21/09

Sample Received: 10/27/2009
Sample Analyzed: 11/05/2009

Ship Date:

Assay Name:	Expected:	Result:	
Moisture in Meat Products		69.3	%
Fat		6.2	%
Protein		15.0	%
Ash		2.1	%

Approved,

Jim Bell
Technical Director

ANALYTICAL CHEMISTS SINCE 1917

Eastbank Hatchery Pilot Project
YEAR III

Performance, health, and welfare assessments of juvenile Chinook salmon from water reuse and raceway environments

Eastbank Hatchery • Wenatchee, Washington

July 2011

Prepared by:

Christopher Good & Brian Vinci
The Conservation Fund's Freshwater Institute
Shepherdstown, West Virginia

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Conservation Fund's Freshwater Institute has carried out yearly assessments of juvenile Chinook salmon *Oncorhynchus tshawytscha* raised by The Chelan County Public Utility District in either the partial water reuse culture system at the Eastbank Hatchery (Wenatchee, WA) or in a nearby flow-through raceway at the same facility. This report summarizes the findings of the third and final year of these evaluations. The issue being examined in these studies is whether or not fish reared in the water reuse system demonstrate comparable performance, health and welfare to fish reared in flow-through raceways. While subtle, subclinical differences have been detected between the reuse and raceway cohorts, results from Years I and II evaluations have shown that, overall, fish have been similar in quality whether raised in water reuse of flow-through rearing units.

In the Year III study presented, fish remained in the reuse and raceway rearing units for an additional five months compared to previous years, in order to expand the environmental exposure period. As well, a third "mixed" cohort was created mid-study by combining reuse and raceway fish in a separate flow-through raceway; however, only approximately 10% of fish in the mixed cohort were of water reuse system origin.

General performance data were collected monthly for all study cohorts. In September, 2010 (prior to creating the mixed cohort), and at study's end in February, 2011, histopathology, fin measurements, blood gas and chemistry analyses, and whole body proximate analysis were also performed. In summary:

- Final length and weight were comparable between the reuse, raceway, and mixed cohorts (136.1mm, 133.9mm, and 135.0mm, respectively, and 30.2g, 29.6g, and 31.1g, respectively)

- Survival was high in all groups: 99.4% (reuse), 99.7% (raceway), and 99.6% (mixed)
- Condition factor for reuse, raceway, and mixed cohort fish was 1.20, 1.23, and 1.26, respectively
- Coefficient of variation for reuse, raceway, and mixed cohort fish was 15.8, 15.3, and 16.1, respectively
- Fin indices were comparable between the reuse and raceway cohorts at end-of-study; however, fish in the mixed cohort had statistically more fin erosion compared to both reuse and raceway fish
- The most prevalent lesions noted on histopathology evaluation at end-of-study were associated with skin, heart, and liver tissues in all cohorts, although pathologies were rarely more than very minimal in severity. Gill epithelial hypertrophy, as noted in previous years, was virtually absent in all cohorts during the Year III study
- Several differences in blood chemistry and gas values were noted, although all parameters were within normal salmonid ranges; differences noted were likely due to differences in swimming activity in circular vs. raceway rearing units
- Whole body proximate analysis revealed that reuse fish had significantly less fat levels than raceway and mixed cohort fish; all cohorts had comparable protein content

Overall, by study's end all cohorts were generally healthy and did not demonstrate vital differences in terms of measured performance, health, and welfare indices. Similar to pilot study Years I and II, Eastbank Hatchery managers and personnel were successfully able to use the partial water reuse system to produce quality juvenile Chinook salmon for wild stocking.

INTRODUCTION

Water reuse technology is employed at aquaculture facilities for its multiple benefits, including increased fish production per unit of water, increased control of the culture environment, and improved capture of solids in the effluent stream (Timmons and Ebeling, 2007). Numerous flow-through facilities in the United States have been retrofitted to incorporate water reuse technology (e.g. Vinci et al., 2004); however, limited research has been carried out towards comparing the overall quality of salmonids raised in water reuse systems versus traditional flow-through rearing units.

The Chelan County Public Utility District (PUD) in Washington State produces millions of juvenile Pacific salmonids for annual stocking of the Upper Columbia River and its tributaries. During the winter of 2008, a partial water reuse system (see Figure 1 for system schematic) was installed at the Eastbank Hatchery in Wenatchee, Washington, and The Conservation Fund's Freshwater Institute (TCFFI) was commissioned to evaluate the performance, health, and welfare of fish reared in the pilot system relative to those raised in the older flow-through raceways. If water reuse technology were to be incorporated on a larger scale in PUD fish production, it must first be demonstrated that water reuse systems are comparable for raising quality salmonids for stocking; therefore, observational cohort studies have been carried out for three successive years (2008-2010) to assess juvenile Chinook salmon *Oncorhynchus tshawytscha* reared in the new reuse system, relative to raceway-reared salmon.

The Year I study concluded that Chinook raised in the pilot water reuse system were, overall, comparable to those raised in the study raceway, with no important differences noted in the health, performance, and welfare indices assessed (Good et al., 2011). The primary subclinical difference between study populations was diffuse epithelial hypertrophy of gill tissue in reuse fish. It was hypothesized that high algae levels (due to the absence of rearing unit covers for much of the study period) and lower-than-optimal tank rotational velocities lead to higher than expected particulate matter in the reuse system water, and that gill irritation was a reaction to the elevated particulate matter. The gill pathology did not appear to affect the population's overall survival and performance. Furthermore, upon completing an acclimation period at the Turtle Rock facility, no differences in subclinical gill pathology were noted between raceway and reuse cohort fish, and the latter group demonstrated excellent out-migration including downstream migration speed, numbers, survival, and mini-jack prevalence.

For the Year II study, fish were raised with target densities approximately twice as high as target densities in the initial study. Additionally, a well-constructed enclosure was built to reduce the reuse system's fiberglass tanks' exposure to sunlight. Results of the second year evaluation were consistent with those of the previous year, in that not vital differences in performance, health, and welfare were detected between reuse- and raceway-reared cohorts. Gill epithelial hypertrophy, while still noted in the reuse fish examined, was at a much lower prevalence and severity than observed during the previous year.

For the third and final year of the pilot system assessment, fish were maintained in their study cohorts for an additional five months to determine if longer-term exposure to the water reuse environment produced any important differences in fish relative to those raised only in flow-through. In addition, a separate "mixed" cohort was included in the study, where reuse and raceway fish were combined in a flow-through raceway during mid-study and observed for the remainder of the study period. As in Years I and II, Year III assessments of reuse, raceway, and mixed cohort fish included performance, survival, fin condition, blood chemistry, pathogen screening, and histopathology, along with whole body proximate analysis. These evaluations were carried out over an approximately 10-month period (June, 2010 – March, 2011), with major fish health samplings carried out in late September, 2010 and late February, 2011.

MATERIALS AND METHODS

Chinook salmon fry (0.5 grams in size) were randomly allocated to either a study raceway or one of two circular tanks in the pilot partial reuse system at the Eastbank hatchery in June, 2010. Fish were maintained in these cohorts until October, 2010, at which time a portion of each cohort was combined in a single raceway to produce a third, “mixed” reuse & raceway cohort. Although originally intended to be composed of 50% reuse and 50% raceway fish, the mixed cohort received only 10% reuse fish with the remainder being made up of fish from the raceway cohort. Throughout the entire study period, all cohorts were raised at comparable densities. Due to the desire to produce fish of a uniform size for stocking, the cohorts were fed at different rates depending on their respective growth rates (i.e. if fish from one cohort were deemed to be growing too quickly relative to fish in the other cohort, feed was restricted in the faster growing cohort to allow for equalization in fish size). At end-of-study (March, 2011), all fish were harvested from the raceways and reuse system and moved to Dryden for stocking.

Data collection

Routine fish performance data for all study cohorts were collected by Eastbank Hatchery personnel during the June, 2010 – March, 2011 period, and included daily mortality counts and monthly length and weight (bulk) assessments. All intensive fish health and welfare sampling was carried out by TCFFI staff in late September, 2010 and late February, 2011; these assessments included the following:

Histopathology

During both sampling events, 25 fish were randomly collected from each cohort, euthanized with MS-222, and fixed in 10% neutral buffered formalin. A ventral midline incision was carefully administered to ensure whole body fixation. The samples were sent to the Washington Animal Disease Diagnostic Laboratory for histopathology assessment by a board-certified aquatic veterinary pathologist. Organs and tissues evaluated for each fish included gill, anterior and posterior kidney, liver, heart, swim bladder, pancreas, pyloric cecae, skin and spleen. All lesions observed were described in detail, quantified on a 0- to 5-point scale of severity, and summarized in a final laboratory report. Prevalences for each lesion type identified, and the lesion's mean severity score, were calculated for both study sampling events.

Whole blood gas and chemistry assessment

During both sampling events, 50 fish from each cohort were randomly collected, euthanized, and bled via caudal venipuncture using a 3 ml syringe with 21.5-guage needle. Whole blood samples were then analyzed on-site using an i-Stat 1 portable analyzer (Abbott Industries, Abbott Park, IL) with either CG4+ (25 fish) or CHEM8+ (25 fish) cartridges. Parameters assessed with the CG4+ cartridge included pH, pCO_2, pO_2, HCO_3, total CO_2, O_2 saturation, and lactate; CHEM8+ cartridges provided data for whole blood sodium, potassium, chloride, calcium, glucose, hematocrit, and hemoglobin. Data obtained from individual fish were then assessed statistically for treatment effect using analysis of variance (ANOVA). For the final assessment data, individual post-ANOVA t-tests were used to determine significant differences among the three study cohorts.

Fin assessment

During both sampling events, the same fish collected for blood gas and chemistry assessments were also measured to the nearest 0.1mm for fork length, dorsal fin length, and lengths of the top and bottom poles of the caudal fin, using digital microcalipers. Fin indices for all three measured fins were then calculated by dividing their individual lengths by the fork length, and were assessed statistically for treatment (rearing environment) effect using ANOVA. For the final assessment data, individual post-ANOVA t-tests were used to determine significant differences among the three study cohorts.

Whole body proximate analysis

At study's end, all fish involved were requested to be held off-feed for 48-hours, after which three separate samples of 10 fish from each cohort (90 fish total) were collected, euthanized, and sent to Midwest Laboratories (Omaha, NE) on ice for proximate analysis to assess whole body percentage moisture, protein, fat, and carbohydrate content. Data were assessed statistically for the effect of rearing environment using ANOVA, with individual post-ANOVA t-tests used to determine significant differences among the three study cohorts.

RESULTS

As during the previous two years, no clinical disease outbreaks occurred in study fish populations throughout the June, 2010 – March, 2011 period. Survival was acceptable and comparable between the reuse, raceway, and mixed cohorts (99.4%, 99.7%, and 99.6%, respectively). At mid-study, reuse and raceway cohorts were on average 87.3mm and 81.5mm in length, and 7.26g and 5.74g in weight, respectively (Figure 2). Coefficient of variation at mid-study for reuse and raceway cohorts was 6.57 and 6.46, and condition factor for these groups was 1.11 and 1.06, respectively. By study's end, managers had been able to grow all cohorts to target sizes prior to stocking. Length and weight for reuse, raceway, and mixed cohorts were 136.1mm, 133.9mm, and 135.0mm, and 30.2g, 29.6g, and 31.1g, respectively (Figure 3). Coefficient of variation at study's end for reuse, raceway, and mixed cohorts was 15.8, 15.3, and 16.1, and condition factor for these groups was 1.20, 1.23, and 1.26, respectively.

Results of the mid-study histopathology evaluations (Table 1) demonstrated a variety of lesions in gill, skin, heart and liver tissues of both cohorts; the severity of these lesions, however, was rarely above "very minimal" (i.e., affecting less than 5% of the examined microanatomical regions). The most prevalent lesions noted at this sampling point were mild epidermal inflammation types seen in raceway cohort fish. At study's end, once again lesions of very minimal severity were noted in gill, skin, heart, and liver tissues, with the majority of pathologies at low prevalence within each cohort. Very minimally severe skin lesions (e.g., lymphocytic epidermitis) were most common in the reuse cohort, while the prevalence of minor heart tissue inflammation (e.g., lymphocytic endocarditis) was highest in the raceway and mixed cohorts (Table 2). Overall, no lesions noted at either sampling point in any cohort were deemed to be more than normal "background" pathologies commonly observed in the tissues of intensely cultured fish.

Fin condition assessment at mid-study revealed significantly longer dorsal fins in the raceway cohort, while caudal fins (bottom pole) were significantly longer in the reuse cohort (Figure 4). At study's end, fins were comparable between the reuse and raceway cohorts; however, all fins assessed were significantly shorter in the mixed cohort. At both sampling points, visual assessment of all cohorts did not reveal anything more than occasional and very minimal fin erosion.

The analyses of blood parameters (Tables 3 and 4) revealed several significant differences between the study cohorts. At mid-study, chloride, hematocrit, hemoglobin, pO_2 and O_2 saturation were all significantly higher in the whole blood of raceway fish, while reuse fish had significantly higher pH, pCO_2, bicarbonate, and total CO_2. At study's end, reuse fish had significantly higher hematocrit, hemoglobin, pH, pCO_2, bicarbonate, total CO_2, and O_2 saturation.

Proximate analysis (Figure 5) demonstrated statistical differences in whole body moisture and fat, with sampled reuse having significantly more moisture and less fat content relative to reuse fish. No differences in whole body protein or carbohydrate levels were noted.

DISCUSSION

Together with study conclusions from Years I and II, the results of the third pilot partial water reuse system evaluation demonstrate that juvenile Chinook salmon can be raised using water reuse technology with no vital differences in performance and survival compared to those reared in traditional flow-through raceways. Once again, very minor differences in health and welfare metrics were detected between the study cohorts, but these differences did not appear to have any substantial effect on growth, mortality, and the overall quality of the fish observed. The major novel finding of the Year III study was that juvenile Chinook salmon can be raised in a partial reuse system from fry right to up to stocking (i.e., a 9-month period) without any major impact on performance, health, and welfare outcomes. This finding is an extension of the two previous studies which found no significant impacts on these outcomes when raising salmon up to acclimation off-site (i.e., a 4-month period). No important differences were noted between the "mixed" raceway-reuse cohort and the other two groups; however, with the predominance of raceway-origin fish in this cohort, its utility in this study as a truly mixed cohort is unfortunately limited.

During the Year I study it was determined that fish sampled from the reuse cohort were universally affected, albeit mildly, by diffuse hypertrophy of the gill epithelium. Although these fish did not demonstrate any signs or clinical pathology related to respiratory distress, it was hypothesized that the hypertrophy noted through histopathology was related to both increased tank algal growth (related to lack of sunlight cover) and improperly managed tank hydrodynamics (i.e. rotational periods of less than the optimal 60-90 second range (Davidson and Summerfelt, 2005)). Either or both of these factors would have led to increased particulate matter in the rearing unit water, the chronic exposure to which has been shown to be related to gill epithelial hypertrophy (Sutherland and Meyer, 2007). In Year II, the reuse system tanks were covered and rotational velocities were correctly managed; end-of-study histopathology assessments determined that while there was still gill epithelial hypertrophy in this cohort, it was at a much lower prevalence and severity than was noted during the previous year. By study's end in the Year III assessment, gills from all cohorts were in good to excellent condition and no epithelial hypertrophy was noted in the reuse system cohort. It is therefore likely that the combination of tank water maintenance and sunlight cover has greatly reduced the prevalence and severity of the gill lesions noted in Year I. Similar to the previous two studies, by study's end lesions of varying prevalence but mostly of very minimal severity were noted in the gill, liver, heart, and skin of all three cohorts. It is most likely that, given the authors' experience from the three Eastbank Hatchery studies and numerous other investigations employing histopathology, such lesions represent a normal "background" level of very mild pathologies observed in intensively cultured fish, and that such findings are of little, if any, consequence to the health of affected fish.

Likewise, end-of-study differences between the cohorts in measured whole blood parameters appeared to be of little consequence to the health and performance of the fish populations, and in general all measurements fell within published normal ranges for salmonids (Stoskopf, 1993; Wedemeyer, 1996). Higher pCO_2 in reuse fish (along with higher bicarbonate to buffer the resultant decrease in blood pH) was likely the result of prolonged moderate exercise in the circular tanks. Prolonged exercise might also have been related to the increased hematocrit, hemoglobin, and O_2 saturation seen in reuse fish during the final sampling; however, these three parameters were actually lower in reuse fish at mid-study, as well as during the final sampling for Year II, so exercise is likely not the sole factor influencing these findings. It was hypothesized in Year II that stress at capture for raceway fish may have led to a reduction in blood volume (Okuna, 1992) leading to the relatively elevated hematocrit determined for these fish. This might have been the case during the mid-study sampling for Year III, but it is uncertain why these parameters were higher at the end-of-study sampling. It is possible that these changes could be associated with exercise in conjunction with physiological changes in fish as they prepare to migrate downriver; however, this hypothesis needs further, controlled study to adequately investigate.

Similar to findings in Years I and II, measured dorsal fin indices at the September-October sampling point were found to be higher in the raceway cohort compared to fish raised in the partial water reuse system. Fin condition is an established indicator of fish welfare (Ellis et al., 2008), and is perceived to affect the quality of fish raised for stocking purposes (Ronsholdt and McClean, 1999). The etiology of fin erosion is not completely understood, and research suggests that it is a complex, multifactorial process (Latremouille, 2003). Among other things, increased stocking densities and high levels of suspended solids are considered to be associated with fin erosion (Wedemeyer, 1996). While there are numerous methods for assessing fin condition, the fin index (length of longest ray standardized by fork length) (Kindschi, 1987) is considered to be the most objective and accurate method (Latremouille, 2003). In the Year III study, it was determined at study's end that dorsal fin indices were not significantly different between raceway and reuse cohorts; however, all three measured fins had lower indices in mixed cohort fish. It is possible that additional handling of the mixed cohort prior to the final sampling resulted in fin damage, but the exact reason for this finding is unknown at present. Overall, despite the measurement differences noted during the final sampling, all fins assessed in this study were deemed to be of excellent quality compared to other populations observed by the authors, and it is unlikely that lower fin indices within the ranges measured in this study represented any significant compromise to fish welfare.

Results of the proximate analysis demonstrated that reuse fish had significantly less whole body fat than either the raceway or mixed cohorts, which is likely related to the prolonged exercise to which reuse fish were exposed. Reduced adipose tissue in exercised fish has been shown to be associated with less early-onset male maturation, and may be related to the findings made by National

Oceanographic and Atmospheric Administration researchers carrying out parallel studies on these fish populations – specifically, to the higher levels of precocious males found in the raceway populations (as determined by relatively higher levels of plasma 11-ketotestosterone in unexercised fish).

Finally, as with the Years I and II studies, there are certain limitations to this research scenario that should be noted. The assessment of a single pilot system did not lend itself to full experimental evaluation due to the lack of treatment replication, and an observational cohort study approach was necessary in this particular setting; however, care must be taken in the interpretation of results obtained. While experimental research emphasizes, among other things, the repeatability of findings, the results of the cohort study described in this report cannot be validly extrapolated to other locations or study populations, and should best be viewed as an observational case study of the specific fish populations assessed. Further construction of partial water reuse systems, if possible, could provide the necessary replication for experimental evaluation of these new technologies.

CONCLUSIONS

Juvenile Chinook salmon reared in the partial water reuse system at Eastbank Hatchery performed comparably to fish from the same spawn in a nearby flow-through raceway, and while subclinical differences were noted between the two cohorts these differences did not affect survival. The partial water reuse system produced fish of approximately equal size and overall health compared to those in both raceway and mixed cohorts. This third pilot study therefore continues to validate the feasibility of partial reuse technology in raising Pacific salmonids for stocking; however, the limitations of observational research need to be considered, and further replicated study would be very useful to support the findings presented in this report.

ACKNOWLEDGEMENTS

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Table 1. Summary of histopathology evaluations for raceway- and reuse-reared juvenile Chinook salmon at mid-study (September, 2010).

Tissue	Lesion Type	Raceway		Reuse	
		Prevalence	Mean Score [a]	Prevalence	Mean Score [a]
Gill	Lymphocytic branchitis	3/25	1	4/25	1
	Epithelial hyperplasia	1/25	1	1/25	1
	Epithelial hypertrophy	1/25	1	1/25	1
Skin	Neutrophilic epidermitis	20/25	1.3	0/25	n/a
	Lymphocytic epidermitis	10/25	1.1	6/25	1
Heart	Lymphocytic myocarditis	2/25	1	0/25	n/a
Liver	Lymphocytic hepatitis, random	1/25	1	0/25	n/a
	Lymphocytic hepatitis, portal	3/25	1	3/25	1

[a] Lesion score key:

1	Very minimal	<5% of examined tissue or microanatomical regions affected/ corresponding very minimal numbers of inflammatory infiltrates
2	Minimal	25% of examined tissue or microanatomical regions affected/ corresponding minimal numbers of inflammatory infiltrates
3	Moderate	50% of examined tissue or microanatomical regions affected/ corresponding moderate numbers of inflammatory infiltrates
4	Marked	75% of examined tissue or microanatomical regions affected/ corresponding very marked numbers of inflammatory infiltrates
5	Severe	Essentially 100% of examined tissue affected/ obliteration of normal architecture/ numerous inflammatory infiltrates

Table 2. Summary of histopathology evaluations for raceway-, mixed-, and reuse-reared juvenile Chinook salmon at end-of-study (February, 2011).

Tissue	Lesion Type	Raceway		Mixed		Reuse	
		Prev.	Mean Score [a]	Prev.	Mean Score [a]	Prev.	Mean Score [a]
Gill	Lymphocytic branchitis	0/25	n/a	2/25	1	2/25	1
	Epithelial hyperplasia	6/25	1	0/25	n/a	3/25	1
	Epithelial hypertrophy	1/25	1	0/25	n/a	0/25	n/a
	Capillary thrombosis	0/25	n/a	0/25	n/a	3/25	1
Skin	Lymphocytic epidermitis	3/25	1.3	8/25	1.3	12/25	1.1
	Lymphocytic dermatitis	0/25	n/a	0/25	n/a	2/25	1
Heart	Lymphocytic epicarditis	2/25	1	0/25	n/a	0/25	n/a
	Lymphocytic myocarditis	2/25	1	0/25	n/a	0/25	n/a
	Lymphocytic endocarditis	15/25	1	10/25	1	5/25	1
Liver	Hydropic degeneration	0/25	n/a	23/25	2	0/25	n/a
	Lymphocytic hepatitis, random	11/25	1	0/25	n/a	9/25	1.1
	Lymphocytic hepatitis, portal	3/25	1	2/25	1	3/25	1

[a] Lesion score key:

1	Very minimal	<5% of examined tissue or microanatomical regions affected/ corresponding very minimal numbers of inflammatory infiltrates
2	Minimal	25% of examined tissue or microanatomical regions affected/ corresponding minimal numbers of inflammatory infiltrates
3	Moderate	50% of examined tissue or microanatomical regions affected/ corresponding moderate numbers of inflammatory infiltrates
4	Marked	75% of examined tissue or microanatomical regions affected/ corresponding very marked numbers of inflammatory infiltrates
5	Severe	Essentially 100% of examined tissue affected/ obliteration of normal architecture/ numerous inflammatory infiltrates

Table 3. Whole blood gas and chemistry values from sampled raceway and reuse Chinook salmon during the mid-study (September, 2010) evaluation.

Parameter	Treatment	Mean	SE	p-value
Sodium (mmol/L)	Raceway	146.8	3.172	0.176
	Reuse	142.3	1.544	
Potassium (mmol/L)	Raceway	4.325	0.359	0.693
	Reuse	4.113	0.320	
Chloride (mmol/L)	Raceway	131.5	2.500	0.047
	Reuse	125.0	1.604	
Calcium (mmol/L)	Raceway	1.743	0.056	0.157
	Reuse	1.654	0.031	
Glucose (mg/dL)	Raceway	91.75	9.232	0.577
	Reuse	99.13	7.715	
Hematocrit (%PCV)	Raceway	32.75	0.854	<0.001
	Reuse	24.50	0.845	
Hemoglobin (g/dL)	Raceway	11.13	0.295	<0.001
	Reuse	8.325	0.294	
pH	Raceway	6.962	0.027	0.037
	Reuse	7.034	0.019	
pCO_2 (mmHg)	Raceway	23.54	1.466	<0.001
	Reuse	34.53	1.025	
pO_2 (mmHg)	Raceway	18.33	2.001	0.009
	Reuse	11.44	1.480	
Bicarbonate (mmol/L)	Raceway	5.217	0.175	<0.001
	Reuse	9.231	0.338	
Total CO_2 (mmol/L)	Raceway	6.000	0.213	<0.001
	Reuse	10.19	0.319	
O_2 saturation (%)	Raceway	14.75	2.606	0.0241
	Reuse	7.875	1.543	
Lactate (mmol/L)	Raceway	11.46	0.761	0.096
	Reuse	13.30	0.720	

Table 4. Whole blood gas and chemistry values from sampled raceway and reuse Chinook salmon during the end-of-study (February, 2011) evaluation.

Parameter	Treatment	Mean	SE	p-value
Sodium (mmol/L)	Raceway	145.4	1.280	0.703
	Mixed	145.7	0.959	
	Reuse	146.6	0.983	
Potassium (mmol/L)	Raceway	3.147	0.165	0.356
	Mixed	2.962	0.186	
	Reuse	3.413	0.280	
Chloride (mmol/L)	Raceway	134.3	1.065	0.149
	Mixed	132.9	0.991	
	Reuse	131.6	0.844	
Calcium (mmol/L)	Raceway	1.693	0.018	0.109
	Mixed	1.729	0.016	
	Reuse	1.668	0.025	
Glucose (mg/dL)	Raceway	86.44	5.365	0.692
	Mixed	77.10	4.266	
	Reuse	72.04	3.473	
Hematocrit (%PCV)	Raceway	25.26	1.051	0.009†
	Mixed	26.86	0.725	
	Reuse	28.79	0.593	
Hemoglobin (g/dL)	Raceway	8.584	0.357	0.009†
	Mixed	9.124	0.246	
	Reuse	9.783	0.203	
pH	Raceway	6.966	0.014	<0.001†
	Mixed	6.947	0.015	
	Reuse	7.071	0.018	
pCO_2 (mmHg)	Raceway	27.28	0.689	<0.001†
	Mixed	28.53	0.578	
	Reuse	32.47	1.205	
pO_2 (mmHg)	Raceway	10.29	1.268	0.999
	Mixed	9.240	0.849	
	Reuse	9.217	1.033	
Bicarbonate (mmol/L)	Raceway	6.228	0.161	<0.001†
	Mixed	6.260	0.175	
	Reuse	9.404	0.284	
Total CO_2 (mmol/L)	Raceway	7.160	0.170	<0.001†
	Mixed	7.080	0.172	
	Reuse	10.52	0.280	
O_2 saturation (%)	Raceway	8.444	2.407	0.020†
	Mixed	6.222	0.838	
	Reuse	9.583	1.240	
Lactate (mmol/L)	Raceway	6.596	0.539	0.063
	Mixed	7.384	0.399	
	Reuse	8.199	0.442	

Post-ANOVA t-tests:
† Reuse values significantly ($p<0.05$) different from mixed and raceway cohorts; no significant difference between mixed and raceway cohorts

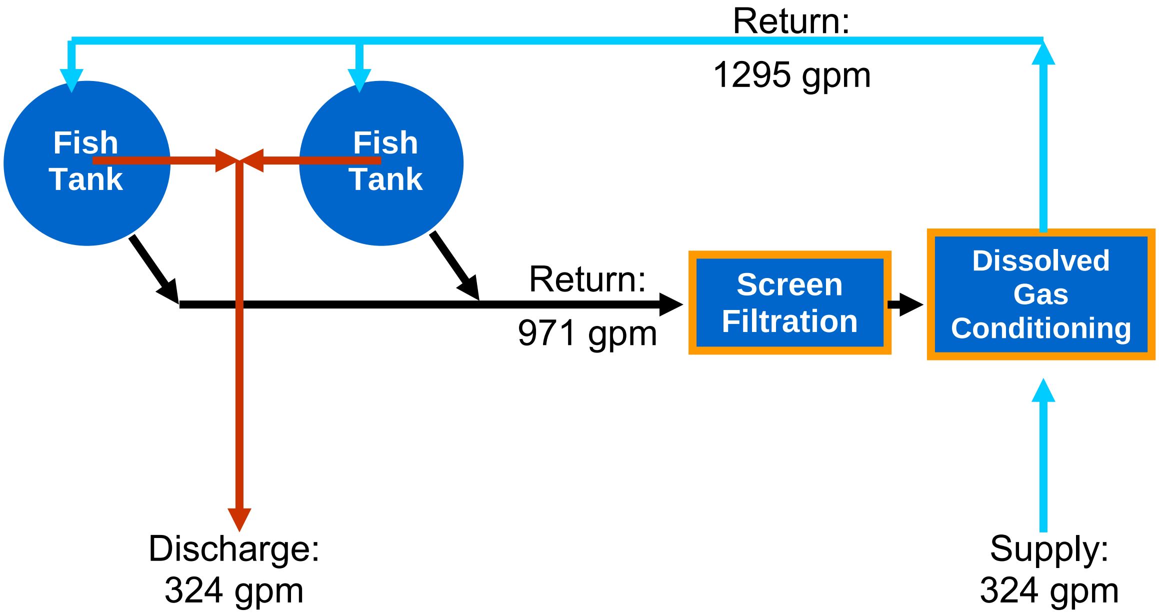
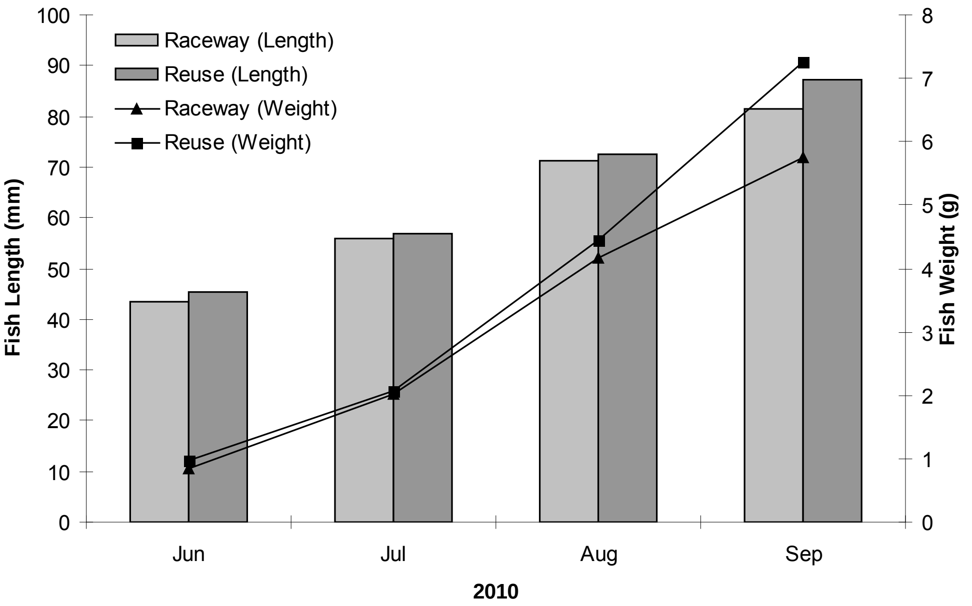


Figure 1. Schematic of the partial water reuse system installed at the Eastbank Hatchery in Wenatchee, WA. The system includes two circular 30-ft diameter dual-drain tanks, microscreen filtration and gas conditioning of influent and recirculating water.



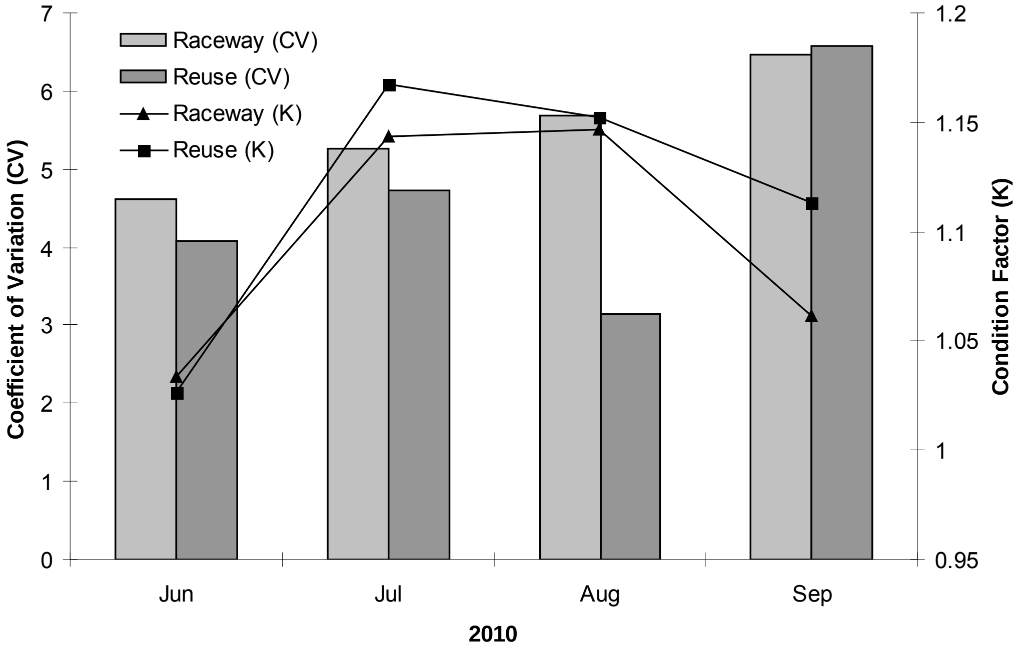
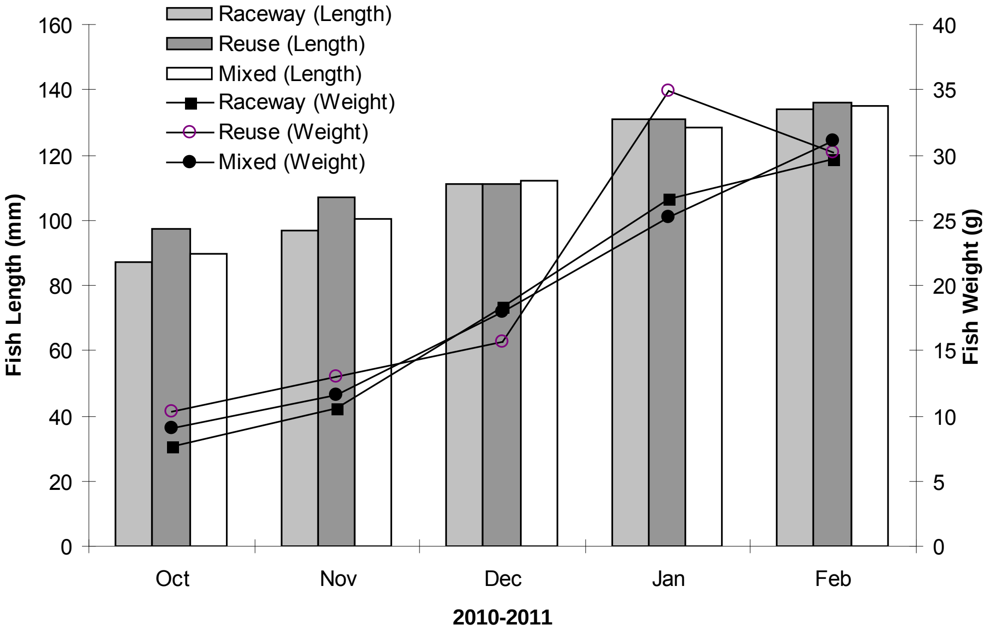


Figure 2. Comparison of raceway- and reuse-reared juvenile Chinook salmon monthly length and weight measurements (top) and condition factor and coefficient of variation (bottom) during the initial portion of the study (June – September, 2010).



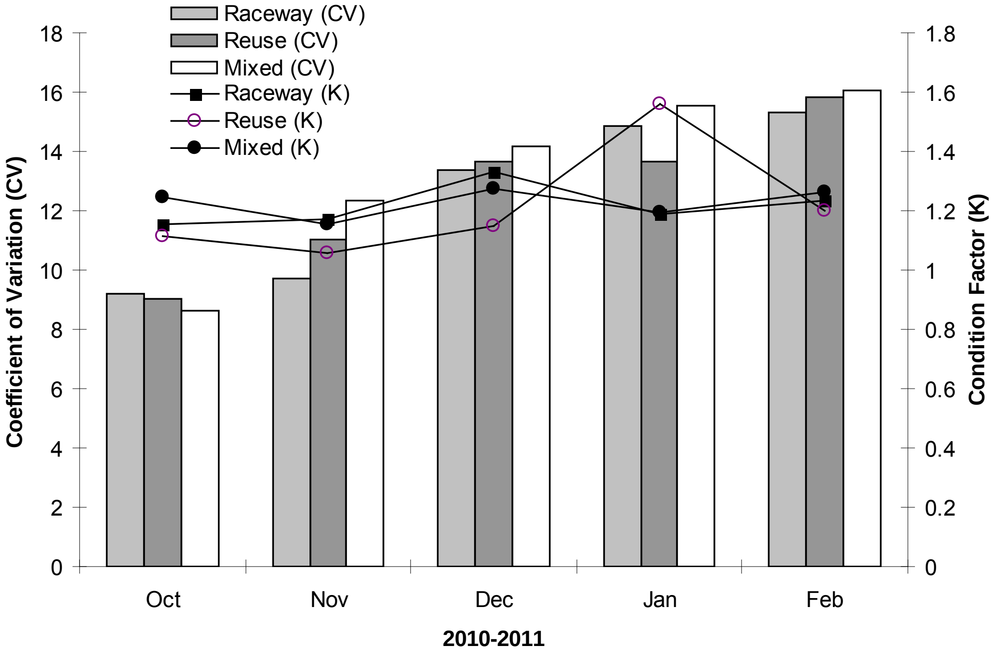


Figure 3. Comparison of raceway, reuse, and mixed juvenile Chinook salmon cohorts' monthly length and weight measurements (top) and condition factor and coefficient of variation (bottom) during the final portion of the study (October, 2010 – February, 2011).

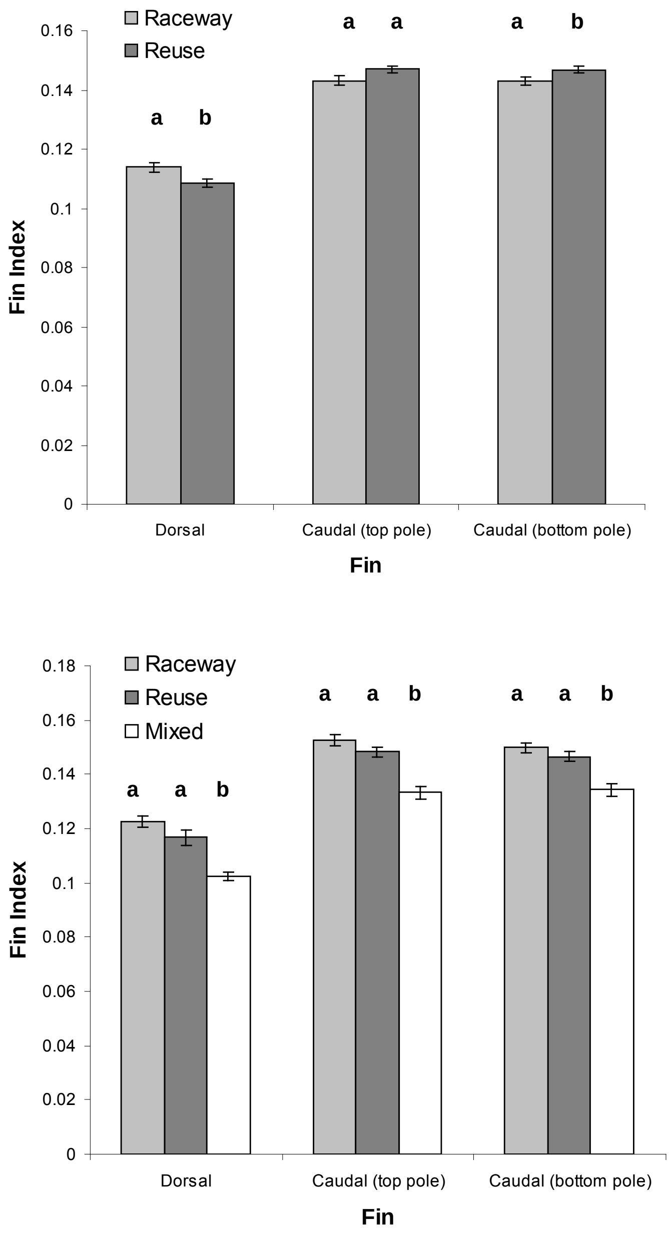


Figure 4. Comparisons of juvenile Chinook salmon cohort indices for dorsal and caudal fins, measured during mid- (top) and end-of-study (bottom) samplings (September, 2010 and February, 2011, respectively). Differing letters over graph bars indicate significant ($p<0.05$) differences between cohorts.

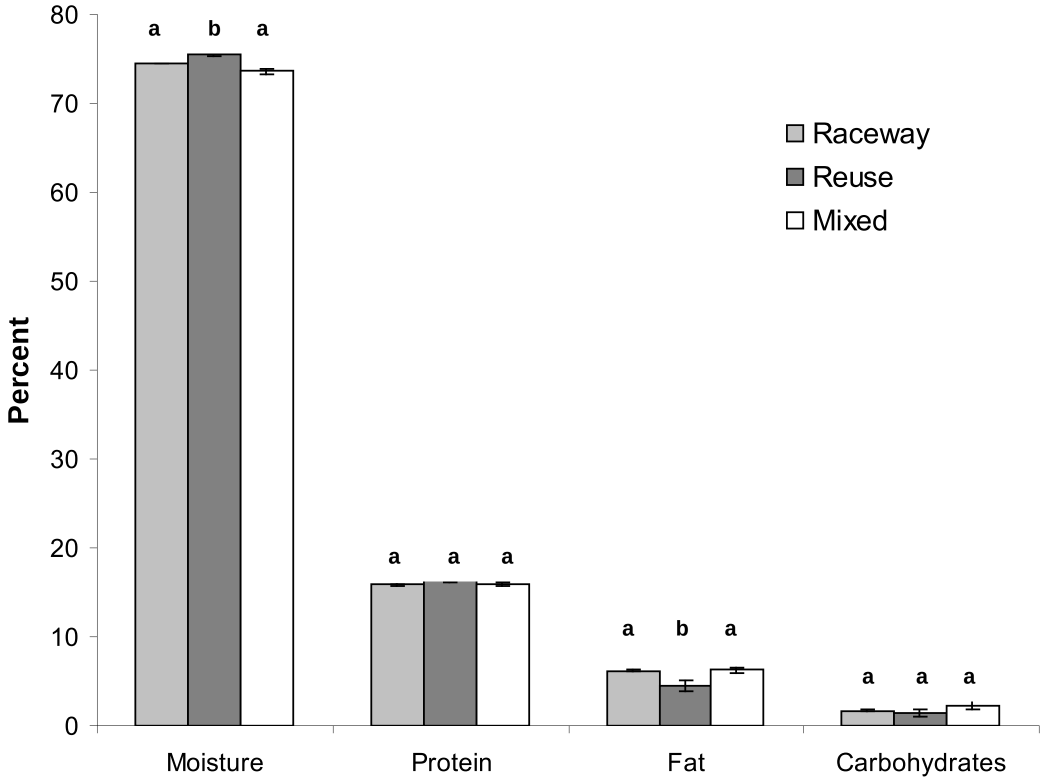


Figure 5. Comparisons of raceway, reuse, and mixed juvenile Chinook salmon cohorts' whole body proximate analysis measured at end-of-study (February, 2011). Differing letters over graph bars indicate significant ($p<0.05$) differences between cohorts.

APPENDICES

Compiled laboratory reports from the Washington Animal Disease Diagnostic Laboratory (Pullman, WA) and Midwest Laboratories (Omaha, NE)

Eastbank raceway vs reuse cohort study
WADDL 2011-2138 Arrived at WADDL Feb 25, 2011

Raceway September 29, 2010

Fish	**1**		**2**		**3**		**4**		**5**		**6**	
Slides	1-5		1-5		1-5		1-5		1-5		6-10	
	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
Gill	3033	1		0		0		0	3032	1		0
Skin	1298	1	1299	2	1299	1	1299	1	1299	1	1299	1
			1298	1	1298	1	1298	1	1298	1	1298	1
Heart	4201	1		0		0		0		0		0
Liver	6505	1		0		0		0		0		0
Spleen		0		0		0		0		0		0
Pancreas		0		0		0		0		0		0
Pyl cecae												
Swim blad												
Head Kid												
Post Kid												

3032	Gill, branchitis, lymphocytic
6503	Liver, hepatitis, portal, lymphocytic
3034	Gill, epithelial hypertrophy
6773	Swim bladder, air saculitis, lymphocytic
1298	Epidermitis, neutrophilic
1299	Epidermitis, lymphocytic
7204	Kidney, tubular hydropic degeneration
3033	Gill, epithelial hyperplasia
4201	Heart, myocarditis, lymphocytic/ histiocytic
7393	Kidney, increased melanomacrophages/ melanomacrophage centers
4178	Heart, epicarditis, lymphocytic
1127	Dermatitis, lymphocytic
3036	Gill, capillary ectasia
3037	Gill, capillary thrombosis
6505	Liver, hepatitis, random, lymphocytic
6164	Intestine, enteritis, lymphocytic-plasmacytic
6522	Liver, lipidosis (fatty)
3038	Gill, branchitis, nodular, lymphohistiocytic
6462	Liver, degeneration, hydropic

Raceway September 29, 2010

7		**8**		**9**		**10**		**Fish**	**11**		**12**	
6-10		6-10		6-10		6-10		Slides	11-15		11-15	
Code	Severity	Code	Severity	Code	Severity	Code	Severity		Code	Severity	Code	Severity
3034	1		0		0		0	Gill		0		0
1299	1	1298	2	1299	1	1299	1	Skin	1299	1		0
				1298	1	1298	2					
	0		0		0		0	Heart		0		0
	0		0		0		0	Liver	6505	1		0
	0		0		Absent		Absent	Spleen		0		0
	0		0		Absent		0	Pancreas		0		0
								Pyl cecae				
								Swim blad				
								Head Kid				
								Post Kid				

Raceway September 29, 2010

13		14		15		16		17		18		19	
11-15		11-15		11-15		16-20		16-20		16-20		16-20	
Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
	0		0		0		0		0		0		0
1298	1	1298	1	1298	1	1299	1	1298	2	1298	1	1298	1
						1298	1						
	0		0		0	4201	1		0		0		0
	0		0		0		0		0		0		0
	0		0		0		0		0		0		0
	0		0		0		0		0		0		0

Raceway September 29, 2010

20		**Fish**	**21**		**22**		**23**		**24**		**25**	
16-20		Slides	21-25		21-25		21-25		21-25		21-25	
Code	Severity		Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
	0	Gill	3032	1		0		0		0	3032	1
1298	2	Skin	1298	1	1298	2		0	1298	2	Absent	
	0	Heart		0		0		0		0		0
	0	Liver	6505	1		0		0	6503	1		0
	0	Spleen		0		0		0		0		0
	0	Pancreas		0		0		0		0		0
		Pyl cecae										
		Swim blad										
		Head Kid										
		Post Kid										

Eastbank raceway vs reuse cohort study
WADDL 2011-2138 Arrived at WADDL Feb 25, 2011

Reuse September 29, 2010

Fish	**1**		**2**		**3**		**4**		**5**		**6**	
Slides	26-30		26-30		26-30		26-30		26-30		31-35	
	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
Gill	3033	1	3032	1		0		0	3034	1	3032	1
											3034	1
Skin	1299	1	1299	1	1299	1		0		0	1299	1
Heart		0		0		0		0		0		0
Liver		0		0		0		0		0	6505	1
Spleen		0		0		0		0		0		0
Pancreas		0		0		0		0		0		0
Pyl cecae												
Swim blad												
Head Kid												
Post Kid												

3032	Gill, branchitis, lymphocytic
6503	Liver, hepatitis, portal, lymphocytic
3034	Gill, epithelial hypertrophy
6773	Swim bladder, air saculitis, lymphocytic
1298	Epidermitis, neutrophilic
1299	Epidermitis, lymphocytic
7204	Kidney, tubular hydropic degeneration
3033	Gill, epithelial hyperplasia
4201	Heart, myocarditis, lymphocytic/ histiocytic
7393	Kidney, increased melanomacrophages/ melanomacrophage centers
4178	Heart, epicarditis, lymphocytic
1127	Dermatitis, lymphocytic
3036	Gill, capillary ectasia
3037	Gill, capillary thrombosis
6505	Liver, hepatitis, random, lymphocytic
6164	Intestine, enteritis, lymphocytic-plasmacytic
6522	Liver, lipidosis (fatty)
3038	Gill, branchitis, nodular, lymphohistiocytic
6462	Liver, degeneration, hydropic

Reuse September 29, 2010

7		**8**		**9**		**10**		**Fish**	**11**		**12**	
31-35		31-35		31-35		31-35		Slides	36-40		36-40	
Code	Severity	Code	Severity	Code	Severity	Code	Severity		Code	Severity	Code	Severity
3032	1	3032	1		0		0	Gill		0	3730	1
	0		0		0		0	Skin		0		0
	0		0		0		0	Heart		0		0
	0		0	6505	1		0	Liver		0		0
	0		0		0		0	Spleen		0		0
	0		0		0		0	Pancreas		0		0
								Pyl cecae				
								Swim blad				
								Head Kid				
								Post Kid				

Reuse September 29, 2010

13		14		15		16		17		18		19	
36-40		36-40		36-40		41-45		41-45		41-45		41-45	
Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
	0		0		0		0		0		0		0
	0		0		0	1299	1	1299	1		0		0
	0		0		0		0		0		0		0
	0		0	Absent		6505	1		0		0		0
	0		0		0		0		0		0		0
	0		0		0		0		0		0		0

Reuse September 29, 2010

20		**Fish**	**21**		**22**		**23**		**24**		**25**	
41-45		Slides	46-50		46-50		46-50		46-50		46-50	
Code	Severity		Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
	0	Gill		0		0		0	Absent		Absent	
epidermis absent		Skin		0		0		0		0	epidermis absent	
	0	Heart		0		0		0	Absent		Absent	
	0	Liver		0		0		0		0		0
Absent		Spleen		0		0		0		0	Absent	
	0	Pancreas		0		0		0		0		0
		Pyl cecae										
		Swim blad										
		Head Kid										
		Post Kid										

Eastbank raceway vs reuse cohort study
WADDL 2011-2138 Arrived at WADDL Feb 25, 2011

Reuse Feb 21, 2011

Fish	**1**		**2**		**3**		**4**		**5**		**6**	
Slides	51-86		51-86		51-86		51-86		51-86		51-86	
	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
Gill	3033	1		0		0		0		0		0
	3037	1										
	3032	1										
Skin		0		0		0		0	1299	1	1299	2
											1127	1
Heart	Absent		Absent		4165	1		0	4165	1		0
Liver	6503	1		0		0		0		0	6505	1
Spleen		0		0		0		0		0		0
Pancreas		0		0		0		0		0		0
Pyl cecae												
Swim blad												
Head Kid												
Post Kid		0		0		0		0		0		0

3032	Gill, branchitis, lymphocytic
6503	Liver, hepatitis, portal, lymphocytic
3034	Gill, epithelial hypertrophy
6773	Swim bladder, air saculitis, lymphocytic
1298	Epidermitis, neutrophilic
1299	Epidermitis, lymphocytic
7204	Kidney, tubular hydropic degeneration
3033	Gill, epithelial hyperplasia
4201	Heart, myocarditis, lymphocytic/ histiocytic
7393	Kidney, increased melanomacrophages/ melanomacrophage centers
4178	Heart, epicarditis, lymphocytic
1127	Dermatitis, lymphocytic
3036	Gill, capillary ectasia
3037	Gill, capillary thrombosis
6505	Liver, hepatitis, random, lymphocytic
6164	Intestine, enteritis, lymphocytic-plasmacytic
6522	Liver, lipidosis (fatty)
3038	Gill, branchitis, nodular, lymphohistiocytic
4165	Heart, endocarditis, lymphohistiocytic
6462	Liver, degeneration, hydropic

Reuse Feb 21, 2011

7		**8**		**9**		**10**		**Fish**	**11**		**12**	
51-86 Code	Severity	51-86 Code	Severity	51-86 Code	Severity	51-86 Code	Severity	Slides	51-86 Code	Severity	51-86 Code	Severity
	0		0		0	3033	1	Gill		0		0
						3037	1					
1299	1	1299	1		0		0	Skin	0		1299	1
	0	4165	1	4165	1	4165	1	Heart		0		0
6505	1	6505	1		0		0	Liver	6505	1	6505	1
	0		0		0		0	Spleen		0		0
	0		0		0		0	Pancreas		0		0
								Pyl cecae				
								Swim blad				
								Head Kid				
	0		0		0		0	Post Kid		0		0

Reuse Feb 21, 2011

13		**14**		**15**		**16**		**17**		**18**		**19**	
51-86 Code	Severity	51-86 Code	Severity	51-86 Code	Severity	51-86 Code	Severity	51-86 Code	Severity	51-86 Code	Severity	51-86 Code	Severity
3033	1		0		0		0		0		0		0
3037	1												
1299	1	1299	1	1299	1		0	1299	1		0	1299	1
				1127	1								
	0		0		0		0		0		0		0
6505	2		0		0		0	6505	1		0	6505	1
	0		0		0		0		0		0		0
	0		0		0		0		0		0		0
	0		0		0		0		0		0		0

Reuse Feb 21, 2011

20		**Fish**		**21**		**22**		**23**		**24**		**25**
51-86 Code	Severity	Slides	51-86 Code	Severity	51-86 Code	Severity	51-86 Code	Severity	51-86 Code	Severity	51-86 Code	Severity
	0	Gill	3032	1		0		0		0		0
	0	Skin	1299	1	1299	1		0		0		0
	0	Heart		0		0		0		0		0
6503	1	Liver		0	6503	1	6505	1		0		0
	0	Spleen		0		0		0		0	Absent	
	0	Pancreas		0		0		0		0		0
		Pyl cecae										
		Swim blad										
		Head Kid										
	0	Post Kid		0		0		0		0		0

Eastbank raceway vs reuse cohort study
WADDL 2011-2138 Arrived at WADDL Feb 25, 2011

Raceway Cohort Feb 21, 2011

Fish	**1**		**2**		**3**		**4**		**5**		**6**	
Slides	87-121		87-121		87-121		87-121		87-121		87-121	
	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
Gill		0		0		0	3033	1		0		0
Skin		0		0		0		0		0		0
Heart	4178	1	4201	1	4201	1		0	4165	1	4165	1
Liver	6505	1		0	6505	1		0	6505	1	6505	1
Spleen		0		0		0		0		0		0
Pancreas		0		0		0		0		0		0
Pyl cecae												
Swim blad												
Head Kid												
Post Kid		0		0		0		0		0		0

3032	Gill, branchitis, lymphocytic	4201	Heart, myocarditis, lymphocytic/ histiocytic
6503	Liver, hepatitis, portal, lymphocytic	7393	Kidney, increased melanomacrophages/ melanomacrophage centers
3034	Gill, epithelial hypertrophy	4178	Heart, epicarditis, lymphocytic
6773	Swim bladder, air saculitis, lymphocytic	1127	Dermatitis, lymphocytic
1298	Epidermitis, neutrophilic	3036	Gill, capillary ectasia
1299	Epidermitis, lymphocytic	3037	Gill, capillary thrombosis
7204	Kidney, tubular hydropic degeneration	6505	Liver, hepatitis, random, lymphocytic
3033	Gill, epithelial hyperplasia	6164	Intestine, enteritis, lymphocytic-plasmacytic
4165	Heart, endocarditis, lymphohistiocytic	6522	Liver, lipidosis (fatty)
6462	Liver, degeneration, hydropic	3038	Gill, branchitis, nodular, lymphohistiocytic

Raceway Cohort Feb 21, 2011

7		**8**		**9**		**10**		**Fish**	**11**		**12**	
87-121		87-121		87-121		87-121		Slides	87-121		87-121	
Code	Severity	Code	Severity	Code	Severity	Code	Severity		Code	Severity	Code	Severity
|	0	|	0	|	0		0	Gill	|	0	|	0
	0		0		0		0	Skin		0		0
	0	4165	1	4165	1		0	Heart	4165	1	4165	1
	0	6505	1	6505	1		0	Liver	6505	1	6503	1
	0		0		0		0	Spleen		0		0
	0		0		0		0	Pancreas		0		0
								Pyl cecae				
								Swim blad			|	
								Head Kid				
	0		0		0		0	Post Kid		0		0

Raceway Cohort Feb 21, 2011

13		14		15		16		17		18		19	
87-121		87-121		87-121		87-121		87-121		87-121		87-121	
Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
3034	1		0		0		0		0		0		0
	0		0	1299	2		0	1299	1		0		0
	0	4165	1	4165	1		0	4165	1	4165	1	4165	1
				4178	1								
				4201	1								
6505	1		0		0	6503	1		0		0		0
	0		0		0		0		0		0		0
	0		0		0		0		0		0	absent	
	0		0		0		0		0		0		0

Raceway Cohort Feb 21, 2011

20		**Fish**	**21**		**22**		**23**		**24**		**25**	
87-121		Slides	87-121		87-121		87-121		87-121		87-121	
Code	Severity		Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
	0	Gill		0	3033	1	3033	1	3033	1	3033	1
	0	Skin		0		0		0		0	1299	1
	0	Heart	4165	1	4165	1	0		4165	1	4165	1
6505	1	Liver	6505	1		0	6505	1	6503	1	Absent	
	0	Spleen		0		0		0		0		0
absent		Pancreas	absent		absent		absent		absent		absent	
		Pyl cecae										
		Swim blad										
		Head Kid										
	0	Post Kid		0		0		0		0		0

Eastbank raceway vs reuse cohort study
WADDL 2011-2138 Arrived at WADDL Feb 25, 2011

Mixed Cohort Feb 21, 2011

Fish	**1**		**2**		**3**		**4**		**5**		**6**	
Slides	122-157		122-157		122-157		122-157		122-157		122-157	
	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
Gill		0		0		0		0		0		0
Skin	1299	2		0		0		0		0	1299	1
Heart		0	4165	1		0	4165	1		0		0
Liver	6462	2	6462	2	6462	2	6462	2	6462	2		0
Spleen		0		0		0		0		0		0
Pancreas		0		0		0		0		0		0
Pyl cecae												
Swim blad												
Head Kid												
Post Kid		0		0		0		0		0		0

3032	Gill, branchitis, lymphocytic
6503	Liver, hepatitis, portal, lymphocytic
3034	Gill, epithelial hypertrophy
6773	Swim bladder, air saculitis, lymphocytic
1298	Epidermitis, neutrophilic
1299	Epidermitis, lymphocytic
7204	Kidney, tubular hydropic degeneration
3033	Gill, epithelial hyperplasia
4201	Heart, myocarditis, lymphocytic/ histiocytic
7393	Kidney, increased melanomacrophages/ melanomacrophage centers
4178	Heart, epicarditis, lymphocytic
1127	Dermatitis, lymphocytic
3036	Gill, capillary ectasia
3037	Gill, capillary thrombosis
6505	Liver, hepatitis, random, lymphocytic
6164	Intestine, enteritis, lymphocytic-plasmacytic
6522	Liver, lipidosis (fatty)
3038	Gill, branchitis, nodular, lymphohistiocytic
4165	Heart, endocarditis, lymphohistiocytic
6462	Liver, degeneration, hydropic

Mixed Cohort Feb 21, 2011

7		**8**		**9**		**10**		**Fish**	**11**		**12**	
122-157		122-157		122-157		122-157		Slides	122-157		122-157	
Code	Severity	Code	Severity	Code	Severity	Code	Severity		Code	Severity	Code	Severity
|	0	|	0	|	0		0	Gill	|	0	|	0
	0	1299	1		0	1299	1	Skin		0		0
4165	1		0	4165	1		0	Heart	4165	1		0
6462	2	6462	2	6462	2	6462	2	Liver	6462	2	6462	1
									6503	1		
	0		0		0		0	Spleen		0		0
	0		0		0		0	Pancreas		0		0
								Pyl cecae				
								Swim blad			|	
								Head Kid				
	0		0		0		0	Post Kid		0		0

Mixed Cohort Feb 21, 2011

13		14		15		16		17		18		19	
122-157		122-157		122-157		122-157		122-157		122-157		122-157	
Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
	0		0		0		0		0		0		0
	0		0	1299	1		0		0		0	1299	1
4165	1	4165	1		0	0		4165	1		0		0
6462	2	6462	2	6462	2		0	6462	1	6462	1	6462	2
	0		0		0		0		0		0		0
	0		0		0		0		0		0		0
	0		0		0		0		0		0		0

Mixed Cohort Feb 21, 2011

20		**Fish**	**21**		**22**		**23**		**24**		**25**	
122-157		Slides	122-157		122-157		122-157		122-157		122-157	
Code	Severity		Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
	0	Gill		0		0		0		0		0
	0	Skin		0		0		0	1299	2	1299	1
absent		Heart		0	4165	1		0	4165	1		0
6462	2	Liver	6462	2	6462	2	6462	2	6462	2	6462	2
							6503	1				
	0	Spleen		0		0		0		0		0
	0	Pancreas		0	absent		absent		absent		absent	
		Pyl cecae										
		Swim blad										
		Head Kid										
	0	Post Kid		0		0		0		0		0

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Report Number
11-061-2120
Account 26222

CONSERVATION FUND FRESHWTR INS
CHRIS GOOD
1098 TURNER ROAD
SHEPHERDSTOWN WV 25443

CHINOOK SALMON-FRESH

FOOD NUTRIENT ANALYSIS

Date Sampled	Received	Reported	Lab #
	02/24/11	03/02/11	1817010

Sue Ann Seitz
Client Service Representative
sueann@midwestlabs.com (402)829-9892

Sample ID: #1 MIXED
Serving size:

ANALYSIS RESULTS

Analysis	Found	per serving	Method	Analyst
Moisture	73.31 %	73.31 g	AOAC	kll-03/01
Protein	16.19 %	16.19 g	AOAC 990.03	ems4-02/28
Fat	6.61 %	6.61 g	AOAC	msl-03/02
Ash	1.58 %	1.58 g	AOAC	ems4-02/28
Carbohydrates	2.31 %	2.31 g	CALCULATION	
Calories		133 Cal	21 CFR PART 101.9 (CALC)	

Report Number
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CHRIS GOOD
1098 TURNER ROAD
SHEPHERDSTOWN WV 25443

CHINOOK SALMON-FRESH

FOOD NUTRIENT ANALYSIS

Date Sampled	Received	Reported	Lab #
	02/24/11	03/02/11	1817011

Sue Ann Seitz
Client Service Representative
sueann@midwestlabs.com (402)829-9892

Sample ID: #2 MIXED
Serving size:

ANALYSIS RESULTS

Analysis	**Found**	**per serving**	**Method**	**Analyst**
Moisture	74.27 %	74.27 g	AOAC	kll-03/01
Protein	15.57 %	15.57 g	AOAC 990.03	ems4-02/28
Fat	6.56 %	6.56 g	AOAC	msl-03/02
Ash	2.04 %	2.04 g	AOAC	ems4-02/28
Carbohydrates	1.56 %	1.56 g	CALCULATION	
Calories		128 Cal	21 CFR PART 101.9 (CALC)	

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CONSERVATION FUND FRESHWTR INS
CHRIS GOOD
1098 TURNER ROAD
SHEPHERDSTOWN WV 25443

CHINOOK SALMON-FRESH

FOOD NUTRIENT ANALYSIS

Date Sampled	Received	Reported	Lab #
	02/24/11	03/02/11	1817012

Sue Ann Seitz
Client Service Representative
sueann@midwestlabs.com (402)829-9892

Sample ID: #3 MIXED
Serving size:

ANALYSIS RESULTS

Analysis	Found	per serving	Method	Analyst
Moisture	73.16 %	73.16 g	AOAC	kll-03/01
Protein	15.89 %	15.89 g	AOAC 990.03	ems4-02/28
Fat	5.73 %	5.73 g	AOAC	msl-03/02
Ash	2.10 %	2.10 g	AOAC	ems4-02/28
Carbohydrates	3.12 %	3.12 g	CALCULATION	
Calories		128 Cal	21 CFR PART 101.9 (CALC)	

Report Number
11-062-2124
Account 26222

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CHRIS GOOD
1098 TURNER ROAD
SHEPHERDSTOWN WV 25443

CHINOOK SALMON-FRESH

FOOD NUTRIENT ANALYSIS

Date Sampled	Received	Reported	Lab #
	02/24/11	03/03/11	1817004

Sue Ann Seitz
Client Service Representative
sueann@midwestlabs.com (402)829-9892

Sample ID: #1 RACEWAY
Serving size:

ANALYSIS RESULTS

Analysis	Found	per serving	Method	Analyst
Moisture	74.55 %	74.55 g	AOAC	kll-03/01
Protein	15.70 %	15.70 g	AOAC 990.03	ems4-02/28
Fat	6.21 %	6.21 g	AOAC	msl4-03/03
Ash	2.02 %	2.02 g	AOAC	ems4-02/28
Carbohydrates	1.52 %	1.52 g	CALCULATION	
Calories		125 Cal	21 CFR PART 101.9 (CALC)	

Report Number
11-062-2126
Account 26222

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SHEPHERDSTOWN WV 25443

CHINOOK SALMON-FRESH

FOOD NUTRIENT ANALYSIS

Date Sampled	Received	Reported	Lab #
	02/24/11	03/03/11	1817005

Sue Ann Seitz
Client Service Representative
sueann@midwestlabs.com (402)829-9892

Sample ID: #2 RACEWAY
Serving size:

ANALYSIS RESULTS

Analysis	**Found**	**per serving**	**Method**	**Analyst**
Moisture	74.33 %	74.33 g	AOAC	kll-03/01
Protein	16.14 %	16.14 g	AOAC 990.03	ems4-02/28
Fat	6.33 %	6.33 g	AOAC	msl4-03/03
Ash	1.64 %	1.64 g	AOAC	ems4-02/28
Carbohydrates	1.56 %	1.56 g	CALCULATION	
Calories		128 Cal	21 CFR PART 101.9 (CALC)	

Report Number
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SHEPHERDSTOWN WV 25443

CHINOOK SALMON-FRESH

FOOD NUTRIENT ANALYSIS

Date Sampled	Received	Reported	Lab #
	02/24/11	03/02/11	1817006

Sue Ann Seitz
Client Service Representative
sueann@midwestlabs.com (402)829-9892

Sample ID: #3 RACEWAY
Serving size:

ANALYSIS RESULTS

Analysis	Found	per serving	Method	Analyst
Moisture	74.59 %	74.59 g	AOAC	kll-03/01
Protein	15.66 %	15.66 g	AOAC 990.03	ems4-02/28
Fat	6.09 %	6.09 g	AOAC	msl-03/02
Ash	1.72 %	1.72 g	AOAC	ems4-02/28
Carbohydrates	1.94 %	1.94 g	CALCULATION	
Calories		125 Cal	21 CFR PART 101.9 (CALC)	

Report Number
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SHEPHERDSTOWN WV 25443

CHINOOK SALMON-FRESH

FOOD NUTRIENT ANALYSIS

Date Sampled	Received	Reported	Lab #
	02/24/11	03/02/11	1817007

Sue Ann Seitz
Client Service Representative
sueann@midwestlabs.com (402)829-9892

Sample ID: #1 REUSE
Serving size:

ANALYSIS RESULTS

Analysis	Found	per serving	Method	Analyst
Moisture	75.51 %	75.51 g	AOAC	kll-03/01
Protein	16.11 %	16.11 g	AOAC 990.03	ems4-02/28
Fat	5.38 %	5.38 g	AOAC	msl-03/02
Ash	2.27 %	2.27 g	AOAC	ems4-02/28
Carbohydrates	0.73 %	0.73 g	CALCULATION	
Calories		116 Cal	21 CFR PART 101.9 (CALC)	

Report Number
11-062-2128
Account 26222

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CHRIS GOOD
1098 TURNER ROAD
SHEPHERDSTOWN WV 25443

CHINOOK SALMON-FRESH

FOOD NUTRIENT ANALYSIS

Date Sampled	Received	Reported	Lab #
	02/24/11	03/03/11	1817008

Sue Ann Seitz
Client Service Representative
sueann@midwestlabs.com (402)829-9892

Sample ID: #2 REUSE
Serving size:

ANALYSIS RESULTS

Analysis	Found	per serving	Method	Analyst
Moisture	75.24 %	75.24 g	AOAC	kll-03/01
Protein	16.37 %	16.37 g	AOAC 990.03	ems4-02/28
Fat	4.54 %	4.54 g	AOAC	msl4-03/03
Ash	2.40 %	2.40 g	AOAC	ems4-02/28
Carbohydrates	1.45 %	1.45 g	CALCULATION	
Calories		112 Cal	21 CFR PART 101.9 (CALC)	

Report Number
11-061-2121
Account 26222

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SHEPHERDSTOWN WV 25443

CHINOOK SALMON-FRESH

FOOD NUTRIENT ANALYSIS

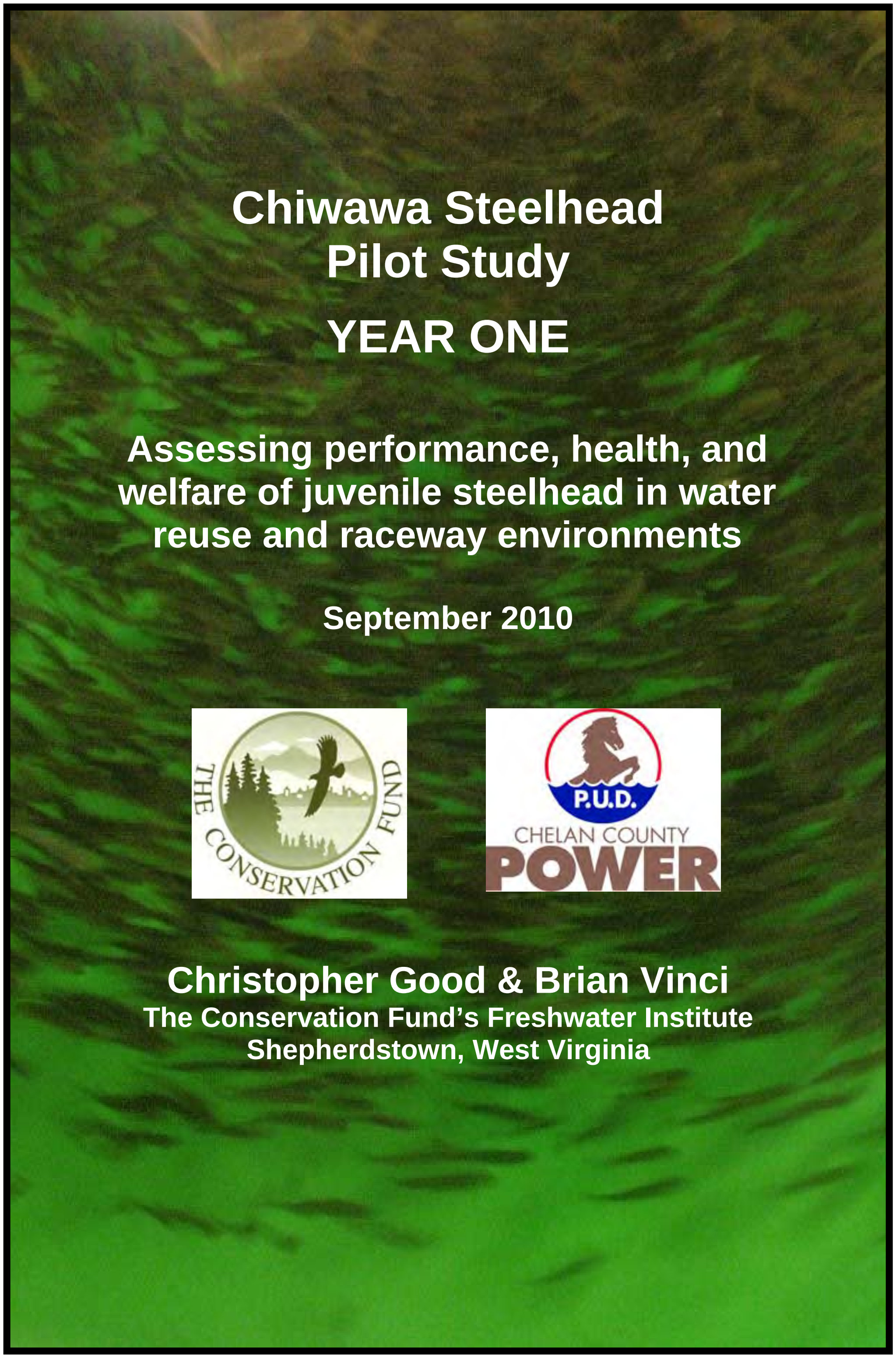
Date Sampled	Received	Reported	Lab #
	02/24/11	03/02/11	1817009

Sue Ann Seitz
Client Service Representative
sueann@midwestlabs.com (402)829-9892

Sample ID: #3 REUSE
Serving size:

ANALYSIS RESULTS

Analysis	Found	per serving	Method	Analyst
Moisture	75.71 %	75.71 g	AOAC	kll-03/01
Protein	16.47 %	16.47 g	AOAC 990.03	ems4-02/28
Fat	3.47 %	3.47 g	AOAC	msl-03/02
Ash	2.14 %	2.14 g	AOAC	ems4-02/28
Carbohydrates	2.21 %	2.21 g	CALCULATION	
Calories		106 Cal	21 CFR PART 101.9 (CALC)	



Chiwawa Steelhead
Pilot Study

YEAR ONE

Assessing performance, health, and welfare of juvenile steelhead in water reuse and raceway environments

September 2010

Christopher Good & Brian Vinci
The Conservation Fund's Freshwater Institute
Shepherdstown, West Virginia

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Chelan County Public Utility District installed a partial water reuse culture system at the Chiwawa Ponds Hatchery in Leavenworth, Washington as a means to in-basin acclimation for juvenile steelhead with limited water and space resources. The District was required to assess this technology compared to conventional flow-through culture systems for raising steelhead *Oncorhynchus mykiss*. The Conservation Fund's Freshwater Institute was contracted in 2009 to evaluate the performance, health, and welfare of steelhead raised at Chiwawa Ponds versus a portion of this population raised in flow-through earthen-bottom raceways on Turtle Rock Island. In March and May, 2010, both cohorts were assessed, and the overall results were as follows:

- Final fish length for the reuse and raceway cohorts was (209.3 ± 19.2mm and 205.3 ± 22.3mm, respectively)
- Coefficient of variation was similar for reuse and raceway cohorts (9.170 and 10.86, respectively)
- Dorsal fin erosion was present in the population at Eastbank Hatchery prior to separation into raceway and reuse study cohorts; dorsal fins were significantly less eroded in the reuse cohort at mid- and end-of-study samplings, although reuse fish exhibited mild but statistically significant caudal fin erosion at mid- and end-of-study
- Reuse fish exhibited relatively higher prevalences of subclinical gill epithelial hypertrophy and lymphocytic epidermitis, while raceway fish exhibited relatively higher prevalences of subclinical gill epithelial hyperplasia and random lymphocytic hepatitis
- Several statistically significant differences in blood chemistry and gas values were noted, although all parameters were within expected ranges for salmonids

Similar to previous findings for Chinook salmon *Oncorhynchus tshawytscha*, the partial water reuse system at Chiwawa Ponds was found to be capable of producing juvenile steelhead that were acceptable in terms of the fish health metrics employed.

INTRODUCTION

The Chelan County Public Utility District (PUD) in Washington State produces millions of juvenile anadromous salmonids each year, including Chinook salmon (*Oncorhynchus tshawytscha*), sockeye salmon (*O. nerka*) and steelhead (*O. mykiss*), for stocking the Upper Columbia River and its tributaries. The hatcheries employed predominantly utilize flow-through raceways for these purposes; however, since 2008 the PUD has been considering water reuse technology for its multiple benefits (Timmons and Ebeling, 2007), and has built two pilot partial water reuse systems (at the Eastbank and Chiwawa Ponds Hatcheries). The PUD must be satisfied that reuse systems are capable of producing quality salmonids that are comparable to those produced in flow-through rearing units in order to consider reuse a viable technology for rearing juvenile salmonids. Water reuse technology has been successfully adopted in whole or in part at numerous flow-through facilities throughout the United States; however at present, informative studies comparing the health of salmonids raised in water reuse versus flow-through environments are lacking.

During 2009, a partial water reuse system (see Figure 1 for system schematic) was installed at the Chiwawa Ponds Hatchery in Leavenworth, Washington. Professionals from The Conservation Fund's Freshwater Institute were commissioned to evaluate the health of steelhead reared in the reuse system relative to fish from the same spawn raised in flow-through raceways at the Turtle Rock Island facility. An observational cohort study was carried out between January and May 2010, while the steelhead were acclimating to river water (i.e. observation of these cohorts began after early rearing at the Eastbank Hatchery when fish were approximately 150g in size). The objective of this study was to assess the performance, health, and welfare of juvenile steelhead reared in reuse water versus flow-through conditions. The hypothesis to be studied was that steelhead raised in the reuse system would be comparable to flow-through raceway-reared steelhead in terms of the performance, health, and welfare metrics examined.

MATERIALS AND METHODS

The study population of steelhead was raised at the Eastbank Hatchery in a flow-through raceway until October, 2009, at which point the test groups of steelhead were separated and moved off-site for river water acclimation at either the Chiwawa Ponds Hatchery or Turtle Rock Island facility. Steelhead at Chiwawa Ponds were raised in the newly constructed partial water reuse system while the remaining fish at Turtle Rock were raised in a flow-through earthen-bottom raceway. Both cohorts were reared until May, 2010, after which the fish were released into the Columbia River basin. The water reuse system at Chiwawa consisted of two large circular dual-drain tanks (with a third, central circular tank solely used for volitional release at stocking), a gas-conditioning tower for influent surface water, and oxygen supplementation to raise fish at DO saturation. The reuse rate for this system was approximately 70%.

Data collection

Preliminary histopathological and fin condition assessments were carried out by Freshwater Institute investigators in late October, 2009 at the Eastbank Hatchery prior to the population being split into reuse and raceway cohorts. All subsequent fish health and welfare data were collected in March and May, 2010, and included the following.

Fish pathogen screening

Random dip-net samples were collected from each cohort in May, 2010, and sampled fish were euthanized with an overdose (200 mg/L) of MS-222 (Western Chemicals, Inc.) and sent whole on ice overnight to the Washington Animal Disease Diagnostic Laboratory (WADDL) (Pullman, WA) for screening of listed, important bacterial and viral fish pathogens. Sampling and testing were carried out according to protocols in the American Fisheries Society Blue Book (AFS-FHS, 2007), which recommend a sample of 60 fish from each group being screened for bacteriology, and an equal sized sample for virology; this provides a

95% confidence in detecting a pathogen in an infected group of fish that has a minimum 5% apparent prevalence of infection.

Histology

Twenty-five fish were randomly collected from each cohort in May, 2010, euthanized with MS-222, and target tissues (gill, heart, liver, spleen, kidney, pyloric cecae, skin, and skeletal muscle) were carefully removed and fixed in 10% neutral buffered formalin. The samples were sent in jars to WADDL for histopathological assessment by the board-certified aquatic veterinary pathologist, Dr. Kevin Snekvik. All lesions observed were described in detail, quantified on a 0- to 5-point scale, and summarized in a final laboratory report.

Fin assessment

In March and May, 2010, 30 fish from each cohort were randomly selected, euthanized, and measured to the nearest 0.1mm for fork length, dorsal fin length, and lengths of the top and bottom poles of the caudal fin, using a digital microcaliper. Fin indices for all three measured fins were then calculated by dividing their individual lengths the fork length, and were assessed statistically for treatment (i.e., rearing environment) effect using analysis of variance (ANOVA).

Whole blood gas and chemistry assessment

During the March and May, 2010 samplings, 25 fish from each cohort were randomly sampled and bled via caudal venipuncture using a 21.5-guage needle and 1-ml syringes. Whole blood samples were then analyzed on-site using an i-Stat 1 portable analyzer (Abbott) with CG4+ and CHEM8+ cartridges. Parameters assessed with the CG4+ cartridge included pH, pCO_2, pO_2, HCO_3, total CO_2, O_2 saturation, and lactate, while CHEM8+ cartridges provided data for whole blood sodium, potassium, chloride, calcium, glucose, hematocrit, and hemoglobin. Data obtained from individual fish were then assessed statistically for treatment effect using ANOVA.

RESULTS

Performance

By study's end, managers had grown both cohorts to acceptable and comparable sizes prior to stocking. Fish lengths for reuse and raceway cohorts were approximately 209.3 ± 19.2mm and 205.3 ± 22.3mm, respectively. Fish length coefficient of variation was 9.17 and 10.86 for the reuse and raceway cohorts, respectively.

Health

No listed bacterial or viral pathogens were detected during pathogen screening for each of the cohorts, and only one active infection (an opportunistic fungal infection in a single raceway fish) was observed during histopathological evaluation at study's end. During December, 2009 and January, 2010, WDFW fish health professionals were called to the Chiwawa Ponds facility to evaluate health issues in the reuse cohort; bacterial coldwater disease (an opportunistic infection) was suspected, and then confirmed, during the respective site visits. Mortalities were low during this episode, and therefore no treatments were recommended. See Appendices for complete evaluation summaries. During the final sampling event in May, 2010, a higher-than-normal number of mortalities were observed on the raceway pond bottom at Turtle Rock Island by Freshwater Institute personnel; however, facility personnel did not consider the apparent fish health issue as warranting investigation by WDFW fish health professionals, and therefore no diagnostics were carried out at that time.

Results of pre-study (October, 2009) histological evaluations (Table 1) indicated that specific subclinical pathologies existed in the study population prior to splitting and moving into separate raceway and reuse cohorts. The most prevalent lesion (40%) observed was lymphocytic branchitis (gill), although the extent of this pathology on individual fish was never more than minimal. Other pathologies observed were gill epithelial hyperplasia and hypertrophy, lymphocytic portal hepatitis (liver), hemopericardium (heart), and lymphocytic epidermitis (skin). These latter pathologies were low in prevalence and severity, although the hemopericardium observed was extensive and likely related to trauma at capture.

At the end-of-study (May, 2010) histopathology sampling (Table 2), very minimal lymphocytic branchitis was observed in both cohorts at similar prevalences (44% in reuse fish, 52% in raceway fish) to pre-study findings. Very minimal to moderate gill epithelial hypertrophy was more prevalent in reuse fish (96%, vs. 40% in raceway fish), although only one reuse fish exhibited this lesion above minimal levels. Very minimal to moderate lymphocytic epidermitis was also more prevalent (84% vs. 48%) in reuse fish; only two of the affected reuse fish demonstrated this lesion at greater than minimal levels. Very minimal gill epithelial hyperplasia and (random) lymphocytic hepatitis were twice as prevalent (40% vs. 20%) in the raceway cohort. Other, less prevalent lesions observed at this sampling point included portal lymphocytic hepatitis, lymphocytic dermatitis and suppurative dermatitis. The only lesion of immediate consequence that was observed at this time was a severe fungal infection of the epicardium of one raceway fish, and it is likely that this individual fish would not have survived this pathology if it had remained in the raceway.

The whole blood analyses carried out in March, 2010 were ultimately reduced in scope due to the CG4+ blood gas cartridges not operating satisfactorily during this sampling event. However, blood chemistry analyses revealed significantly ($p<0.05$) higher calcium, glucose, hematocrit, and hemoglobin levels in raceway fish relative to the reuse cohort (Table 3). In May, 2010, raceway fish demonstrated significantly higher hematocrit and hemoglobin levels, while reuse fish had significantly higher pH, bicarbonate, and total CO_2 levels (Table 4). All parameters assessed were within expected salmonid ranges for both study cohorts.

Welfare

Pre-study (October, 2009) Eastbank Hatchery fin condition assessments revealed dorsal erosion for nearly all fish examined. Subsequent evaluations in March and May of 2010 demonstrated that the dorsal fins of reuse fish were significantly less eroded compared to raceway fish; however, both assessments also revealed mild but statistically significant caudal fin erosion in the reuse cohort compared to caudal fins of raceway fish (Figure 2).

DISCUSSION

Results of the histopathology assessments indicate that minor subclinical pathologies are a relatively normal finding in cultured fish from a variety of rearing environments, as has been suggested by previous evaluations of Chelan PUD salmonids (Good and Vinci, 2009; Good and Vinci, 2010). The most prevalent lesions observed in this study were branchial epithelial hypertrophy and lymphocytic epidermitis. As in the previous studies cited above, branchial epithelial hypertrophy appears to be associated with the water reuse environment, although this lesion type was also exhibited by steelhead in the raceway cohort in the present study. It was hypothesized that the branchial epithelial hypertrophy observed previously was related to higher total suspended solids in the reuse water; in general, this lesion is often a consequence of chronic exposure to high levels of particulates in the water (Sutherland and Meyer, 2007). However, this hypothesis cannot be explored in the present study given the absence of data comparing the water quality of the reuse and raceway rearing units. At any rate, despite the prevalence of gill hypertrophy in the reuse cohort none of these fish exhibited signs of labored respiration and no further histological lesions associated with hypoxia (e.g. hydropic changes in the kidney) were observed, and therefore it is unlikely that these mild, subclinical lesions were affecting the fish in any significant manner. Lymphocytic epidermitis was also relatively prevalent in the reuse cohort. Lymphocytes in varying numbers are a normal finding in the epidermis of fish, and are involved in local immune responses (Ferguson, 1989). Again, the high prevalence but very low severity of this lesion in reuse fish suggests a chronic response to external conditions, and although it cannot be confirmed in this study due to the absence of water quality data this mild pathology may have been the results of long-term exposure to higher particulates in the water. The acceptable growth of the reuse fish and the absence of significant disease episodes indicate that the observed pathology was insignificant overall. Finally, from the end-of-study histopathology findings it can be hypothesized that the higher-than-normal mortalities observed in the flow-through rearing unit at Turtle Rock Island may have been the result of a mild outbreak of Saprolegniasis, as evidenced by the randomly sampled moribund fish with severe fungal epicarditis. A purposive sampling of moribund fish from this population, however, would have been required to confirm this hypothesis.

Blood gas and chemistry values obtained during both sampling events generally fell within published reference ranges for salmonids (Stoskopf, 1993; Wedemeyer, 1996), although normal blood parameter data are, at present, lacking in the published literature for anadromous steelhead, as well as for other Pacific salmonid species. Nonetheless, most blood values obtained were consistent with previous findings by Good and Vinci (2009; 2010) when evaluating Chinook salmon *Oncorhynchus tshawytscha* in reuse and raceway environments. Statistically significant differences noted between reuse and raceway fish in the present study were most likely related to i) stress at capture, and ii) differences in long-term activity level. Regarding the former, higher glucose, hemoglobin and hematocrit concentrations were generally found in raceway fish, and this finding is most likely associated with difficulties in capturing raceway fish relative to those in the reuse system. For example, reuse fish were comparatively effortless to sample given their even distribution in the rearing unit and the ability of the sampler to approach them from the side, relatively unnoticed. Capturing raceway fish, on the other hand, required crowding the fish at one end of the rearing unit to facilitate netting and to avoid having to chase the fish up and down the raceway. Acute stress (e.g., from crowding) in animals can be associated with a reduction in blood volume (Okuno, 1992), leading to a relatively elevated hematocrit and hemoglobin, as well as a sharp increase in blood glucose due to cortisol release. Therefore, differences between these blood parameters in reuse and raceway fish could at least in part be attributed to acute stress at capture. Regarding differences related to long-term exercise, between ponding and stocking the reuse fish were exposed to constant average swimming speeds of approximately two body-lengths per second, and hence an elevated level of blood CO_2 is expected in this scenario relative to unexercised fish due to constant exertion. To avoid metabolic acidosis and buffer blood pH, a considerable portion of this molecular CO_2 has been converted to bicarbonate via carbonic anhydrase, and this can be seen in the significantly higher bicarbonate and total CO_2 levels found in reuse fish, leading to a relatively neutral blood pH. Therefore, it is most likely that the findings related to acid-base balance in reuse fish were the result of prolonged moderate exercise in the circular tanks.

While assessing fin erosion, measured dorsal fin indices were found to be low in the Eastbank raceway rearing unit prior to splitting the cohorts to Chiwawa Ponds and Turtle Rock Island, and in the authors' experience, this is a common finding for intensively cultured *O. mykiss*. By study's end, dorsal fin condition had improved in the reuse cohort but had worsened in the raceway cohort; the latter fish demonstrated marked dorsal fin erosion. Fin condition is an established indicator of fish welfare (Ellis et al., 2008), and is perceived to affect the quality of fish raised for stocking purposes (Ronsholdt and McClean, 1999). The etiology of fin erosion is not completely understood, and research suggests that it is a complex, multifactorial process (Latremouille, 2003). Among other things, increased stocking densities and high levels of suspended solids are considered to be associated with fin erosion (Wedemeyer, 1996). While there are numerous methods for assessing fin condition, the fin index (length of longest ray standardized by fork length) (Kindschi, 1987) is considered to be the most objective and accurate method (Latremouille, 2003). It is unknown at present why raceway fish had relatively poor dorsal fin indices in this study, and what ramifications, if any, this fin erosion will have on long-term performance and survival post-stocking. The lower caudal fin indices in the reuse cohort may have been related to the bacterial coldwater disease that affected this population earlier in the study period; however, by study's end there was no visible caudal fin erosion in this cohort despite the demonstration of lower caudal fin indices.

Finally, as with the studies carried out for Chinook salmon at the Eastbank Hatchery (Good and Vinci, 2009; Good and Vinci, 2010), there are certain limitations to this research scenario that should be noted. The assessment of a single pilot system did not lend itself to full experimental evaluation due to the lack of treatment replication, and an observational cohort study approach was necessary in this particular setting; however, care must be taken in the interpretation of results obtained. While experimental research emphasizes, among other things, the repeatability of findings, the results of the cohort study described in this report cannot be validly extrapolated to other locations or study populations, and should best be viewed as an observational case study of the specific fish populations assessed. Further construction of partial water reuse systems, if possible, could provide the necessary replication for experimental evaluation of these new technologies.

CONCLUSIONS

Juvenile steelhead acclimating in the partial water re use system at the Chiwawa Ponds Hatchery grew comparably to fish from the same spawn acclimating in a flow-through earthen-bottom raceway, and while subclinical differences were noted between the two cohorts these differences did not appear to affect overall performance. This study therefore demonstrates the feasibility of partial reuse technology in raising and acclimating steelhead prior to stocking; however, the limitations of observational research need to be considered, and further study is warranted to support the findings presented in this report.

ACKNOWLEDGEMENTS

The authors wish to thank the Washington Department of Fish & Wildlife, particularly John Penny and the Eastbank Hatchery staff for all of their assistance with Turtle Rock Island sampling, Marc Babiar, Diedre Pfundt, and Andrew Brown at the Chiwawa Ponds Hatchery, and Bob Rogers for his fish health observations of pilot study populations.

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Table 1. Summary of pathologies noted on histological examination of Eastbank Hatchery raceway-reared juvenile steelhead in October, 2009, prior to study initiation.

Tissue	Lesion Type	Max. Score [a]	Lesion Prevalence
Gill	Lymphocytic branchitis	1	4/10
	Epithelial hypertrophy	1	1/10
	Epithelial hyperplasia	1	1/10
Liver	Lymphocytic portal hepatitis	1	1/10
Heart	Hemopericardium	4	2/10
Skin	Lymphocytic epidermatitis	2	1/10

[a] Lesion score key:

1	Very minimal	<5% of examined tissue or microanatomical regions affected/ corresponding very minimal numbers of inflammatory infiltrates
2	Minimal	25% of examined tissue or microanatomical regions affected/ corresponding minimal numbers of inflammatory infiltrates
3	Moderate	50% of examined tissue or microanatomical regions affected/ corresponding moderate numbers of inflammatory infiltrates
4	Marked	75% of examined tissue or microanatomical regions affected/ corresponding very marked numbers of inflammatory infiltrates
5	Severe	Essentially 100% of examined tissue affected/ obliteration of normal architecture/ numerous inflammatory infiltrates

Table 2. Summary of pathologies noted on histological examination of raceway- and reuse-reared steelhead at study's end (May, 2010).

		Reuse		Raceway	
Tissue	Lesion Type	Lesion Prevalence	Max. Score [a]	Lesion Prevalence	Max. Score [a]
Gill	Lymphocytic branchitis	11/25	1	13/25	1
	Epithelial hypertrophy	24/25	3	10/25	1
	Epithelial hyperplasia	5/25	1	10/25	1
Liver	Portal lymphocytic hepatitis	4/25	1	0/25	-
	Random lymphocytic hepatitis	5/25	1	10/25	2
Skin	Lymphocytic epidermitis	21/25	3	12/25	2
	Lymphocytic dermatitis	1/25	1	1/25	1
	Suppurative dermatitis	1/25	3	0/25	-
Heart	Fungal epicarditis	0/25	-	1/25	5

[a] Lesion score key:

1	Very minimal	<5% of examined tissue or microanatomical regions affected/ corresponding very minimal numbers of inflammatory infiltrates
2	Minimal	25% of examined tissue or microanatomical regions affected/ corresponding minimal numbers of inflammatory infiltrates
3	Moderate	50% of examined tissue or microanatomical regions affected/ corresponding moderate numbers of inflammatory infiltrates
4	Marked	75% of examined tissue or microanatomical regions affected/ corresponding very marked numbers of inflammatory infiltrates
5	Severe	Essentially 100% of examined tissue affected/ obliteration of normal architecture/ numerous inflammatory infiltrates

Table 3. Whole blood chemistry parameter means from raceway and reuse steelhead, sampled in March, 2010. Parameters with asterisk (*) indicate significant ($p<0.05$) differences between cohorts.

Parameter	Treatment	Mean	St. Dev.
Sodium (mmol/L)	Raceway	148.9	5.301
	Reuse	145.7	3.798
Potassium (mmol/L)	Raceway	4.100	0.665
	Reuse	4.392	1.852
Chloride (mmol/L) *	Raceway	136.8	4.417
	Reuse	131.1	2.429
Calcium (mmol/L) *	Raceway	1.826	0.093
	Reuse	1.465	0.065
Glucose (mg/dL) *	Raceway	120.5	32.21
	Reuse	65.42	4.907
Hematocrit (%PCV) *	Raceway	34.90	3.573
	Reuse	22.00	2.629
Hemoglobin (g/dL) *	Raceway	11.87	1.203
	Reuse	7.483	0.906

Table 4. Whole blood gas and chemistry parameter means from raceway and reuse steelhead, sampled in May, 2010. Parameters with asterisk (*) indicate significant ($p<0.05$) differences between cohorts.

Parameter	Treatment	Mean	St. Dev.
Sodium (mmol/L)	Raceway	143.8	6.191
	Reuse	142.6	3.308
Potassium (mmol/L)	Raceway	3.032	0.367
	Reuse	3.138	0.281
Chloride (mmol/L)	Raceway	132.5	7.439
	Reuse	132.3	2.615
Calcium (mmol/L)	Raceway	1.516	0.167
	Reuse	1.410	0.111
Glucose (mg/dL)	Raceway	206.7	96.17
	Reuse	93.88	23.40
Hematocrit (%PCV) *	Raceway	32.20	3.617
	Reuse	25.33	2.259
Hemoglobin (g/dL) *	Raceway	10.94	1.237
	Reuse	8.613	0.759
pH *	Raceway	6.924	0.067
	Reuse	7.161	0.069
pCO_2 (mmHg)	Raceway	37.88	4.349
	Reuse	33.58	4.172
pO_2 (mmHg)	Raceway	9.750	3.096
	Reuse	10.62	4.105
Bicarbonate (mmol/L) *	Raceway	7.876	1.334
	Reuse	12.06	1.895
Total CO_2 (mmol/L) *	Raceway	8.952	1.359
	Reuse	13.00	1.958
O_2 saturation (%)	Raceway	5.000	2.708
	Reuse	8.300	3.401
Lactate (mmol/L)	Raceway	4.893	1.446
	Reuse	0.608	0.221

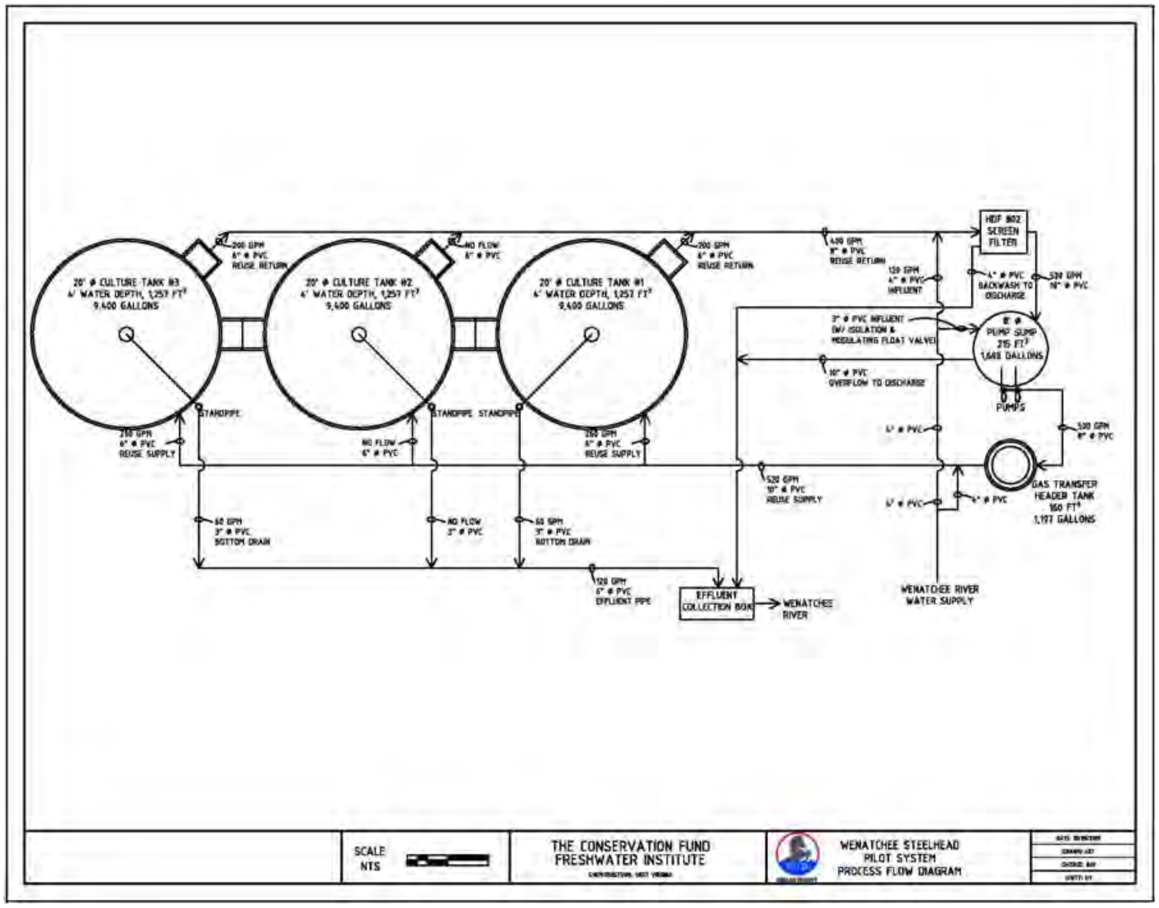

Figure 1. Schematic of the partial water reuse system installed at the Chiwawa Ponds Hatchery in Leavenworth, WA. The system includes three circular 20-ft diameter dual-drain tanks, and micro screen filtration and gas conditioning of influent and recirculating water.

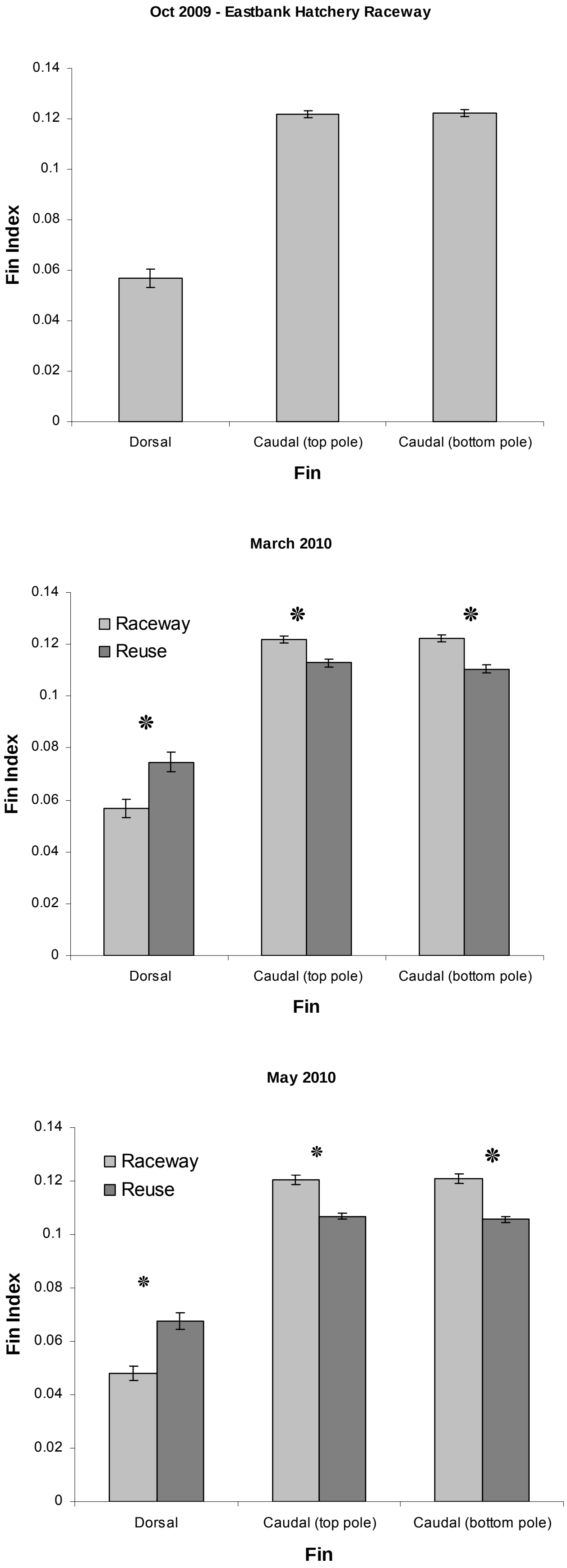

Figure 2. Comparisons of raceway- and reuse-reared juvenile steelhead indices for dorsal and caudal fins, measured during: (i) pre-study (October 2009) (top) while the population was still at Eastbank Hatchery in a flow-through raceway; in March 2010 (middle); and at end-of-study (May, 2010) (bottom). Asterisks (*) denote significant ($p<0.05$) differences in fin indices between cohorts.

APPENDICES

Compiled reports from the Washington Department of Fish and Wildlife for fish health monitoring, and from the Washington Animal Disease Diagnostic Laboratory (Pullman, WA) for fish health assessments

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE **FISH HEALTH MONITORING REPORT**

Location Chiwawa **Date** December 7, 2009

Lot Description: Sum STHD (**species**) Wenatchee (**stock**) 09 (**BY**) (**sub-group**)

Exam Type: M D (Monit-M,Diag-D,Pre-P,Cert-C) **Lifestage:** J (Egg-E,Juv-J,Smolt-S,Adult-A) **Mortality:** N (Nor-N,Inc-I,Epiz-E)

TISSUE	PATH/COND	# SAMPLED		# POSITIVE		TISSUE	PATH/COND	# SAMPLED		# POSITIVE	
		HLTHY	MORB	HLTHY	MORB			HLTHY	MORB	HLTHY	MORB
skin	fungus										
fin	biting										
ext	lesion										

NOTES:

Initial phone calls and emails with Ian (CPUD) and Andy (Chiwawa) in late November raised concern that the sum sthd at Chiwawa had an external fungal infection. After review of observations of the fish prior to transfer from EB to CHiwawa, the “fungal” problem was suspected to be a previously noted “fin biting” problem (typical of steelhead).

Exam on December 1, 2009 confirmed that this lot did not have an ongoing fungal infection, and that the observations were from fin biting. I did observe a few fish with suspect “BCWD lesions” on the caudal peduncle, but Marc and I could not catch them for exam.

At present, no treatment of any kind in warranted. However, if we do need to treat the pond inflow at some later date, we will need to know the inflow to the tanks without the recirc tower in use (flow meters presently not functional).

I have included, for comparison, a photo of a spring chinook yearling with external fungus and a steelhead with a bitten dorsal fin.

Please call if you have questions.

EXAMINER: Bob Rogers **CASE NO.**

120109ChiwawaSTHD.doc

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE **FISH HEALTH MONITORING REPORT**

Location Chiwawa **Date** January 12, 2010

Lot Description: Sum STHD (species) Wenatchee (stock) 09 (BY) WxW in Reuse (sub-group)

Exam Type: M D (Monit-M,Diag-D,Pre-P,Cert-C) **Lifestage:** J (Egg-E,Juv-J,Smolt-S,Adult-A) **Mortality:** N+ (Nor-N,Inc-I,Epiz-E)

TISSUE	PATH/COND	# SAMPLED		# POSITIVE		TISSUE	PATH/COND	# SAMPLED		# POSITIVE	
		HLTHY	MORB	HLTHY	MORB			HLTHY	MORB	HLTHY	MORB
gills	parasites		3		0	Grm stain	Flavobacteri		3		3
Gills/skin	fungus		6		0	Grm stain	spleen		3		0
tails	eroded		6		5						
skin	lesion		6		2						
Ext scrape	Flavobacteria		6		5						

POND	TEMP	FISH/Pd	LOSS AVE 10d	% LOSS	F/LB	LBS	FLOW	OD Value	#/GPM	FI or DI	FEED TYPE	% BW/D
1	38F	18013	2-3	0.016	12	1501	200				BTr	
2	Wena	1346	1		12		140				2.0	
3	River	15933	1-2	**0.013**	13	1226	200					

Initial pond populations (2 circs) were incorrectly set at 20K per pond. As a result Marc and Andy are hand sorting fish w/o PIT tags from the population for transfer back to TRock. Exam of moribund fish today, plus several frozen fish from previous days, showed extensive caudal fin/caudal peduncle erosion. 5 of 6 fish had completely eroded tails/pectoral fins; 1 of 6 had gross lesion adjacent to the pectoral fin; all fish had flavobacteria present – Bacterial Coldwater Disease. Discussions with Marc and Andy revealed that nearly all mortalities collected to date have been w/o tails. We (they) will collect and freeze all morts for examination.

It is not surprising that there is some level of loss in the steelhead from BCWD given the surface water supply in use and the susceptibility of this species of fish to this pathogen. At present, the level of loss does not warrant any treatment, but please call if losses do increase. It is possible that the additional stress associated with the on-going sorting activity will precipitate an increase in loss. I will send you photos of affected fish that can be used for comparison of future loss.

DIAGNOSIS: Early identification of Bacterial Coldwater Disease.

RECOMMENDATIONS: Call if average daily losses increase (double).

EXAMINER: Bob Rogers

Jan 12 Fish Health Monitoring Report from Bob Rogers

Eastbank raceway vs reuse cohort study
WADDL 2009-12030 Arrived at WADDL October 21, 2009

Steelhead Initial Evaluation **

Fish	**21**		**22**		**23**		**24**		**25**		**26**
Slides	85-91		92-95		96-99		100-106		107-111		112-118
	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code
Gill		0	3032	1		0		0		0	3032
Skin		0	1299	1		0	1299	2		0	
Heart		0	4275	4		0	4275	4		0	
Liver		0	6505	1		0		0		0	
Spleen		0	Absent			0		0		0	
Pancreas		0		0		0		0		0	
Pyl cecae		0		0		0		0		0	
Swim blad		0		0		0		0		0	
Head Kid		0		0		0		0		0	
Post Kid		0		0		0		0		0	
Thymus		0		0		0		0		0	
Esophagus		0		0		0		0		0	
Pseduobranch		0		0		0		0		0	
Spinal cord		0		0		0		0		0	
Thyroid gland		0		0		0		0		0	
Semicircular canals		0		0		0		0		0	
Brain		0		0		0		0		0	
Stomach		0		0		0		0		0	
Intestine		0		0		0		0		0	
Skeletal muscle		0		0		0		0		0	
Vertebrae		0		0		0		0		0	
Eye and optic nerve		0		0		0		0		0	
Choroid gland		0		0		0		0		0	

****

	27		28		29		30		**Fish**
	119-122		123-126		127-132		133-138		Slides
Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	
1		0	3032	1	3032	1		0	Gill
		0		0	3034	1			
					3033	1			
0		0		0		0		0	Skin
0		0		0		0		0	Heart
0		0		0		0		0	Liver
				0					
0		0	Absent			0		0	Spleen
0		0		0		0		0	Pancreas
0		0		0		0		0	Pyl cecae
0		0		0		0		0	Swim blad
0		0		0		0		0	Head Kid
0		0		0		0		0	Post Kid
0		0		0		0		0	Thymus
0		0		0		0		0	Esophagus
0		0		0		0		0	Pseduobranch
0		0		0		0		0	Spinal cord
0		0		0		0		0	Thyroid gland
0		0		0		0		0	Semicircular canals
0		0		0		0		0	Brain
0		0		0		0		0	Stomach
0		0		0		0		0	Intestine
0		0		0		0		0	Skeletal muscle
0		0		0		0		0	Vertebrae
0	10275	5		0		0		0	Eye and optic nerve
0		0		0		0		0	Choroid gland

Cartilage	0	0	0	0	0
Reproductive tract	0	0	0	0	0
Mesentery	0	0	0	0	0

3032	Gill, branchitis, lymphocytic
6503	Liver, hepatitis, portal, lymphocytic
3034	Gill, epithelial hypertrophy
6773	Swim bladder, air saculitis, lymphocytic
1299	Epidermitis, lymphocytic
7204	Kidney, tubular hydropic degeneration
3033	Gill, epithelial hyperplasia
4201	Heart, myocarditis, lymphocytic/ histiocytic
7393	Kidney, increased melanomacrophages/ melanomacrophage centers
4178	Heart, epicarditis, lymphocytic
1127	Dermatitis, lymphocytic
3036	Gill, capillary ectasia
3037	Gill, capillary thrombosis
6505	Liver, hepatitis, random, lymphocytic
6164	Intestine, enteritis, lymphocytic-plasmacytic
6522	Liver, lipidosis (fatty)
3038	Gill, branchitis, nodular, lymphohistiocytic
0532	Peritonitis, pyogranulomatous
2220	Myositis, acute
4275	Hemopericardium
10275	Eye, phthisis bulbi

Snekvik Epithelial Hyperplasia and Inflammation Grading Scale:

Grade 0: No epithelial changes. Propria mucosa of the secondary and primary lamellae lack inflammatory cells or have rare scattered inflammatory

0	0	0	0	0	Cartilage
0	0	0	0	0	Reproductive tract
0	0	0	0	0	Mesentery

cells.

Grade 1:	Multifocal areas of mild epithelial hyperplasia with or without lamellar fusion that involve less than 10% of the evaluated section. Mild inf
Grade 2:	Moderate epithelial hyperplasia with multifocal fusion of secondary lamellae having involvement of 10-25% of the examined gill. Modera
Grade 3:	Moderate epithelial hyperplasia with multifocal fusion of secondary lamellae having involvement of 25-50% of the examined gill. Modera
Grade 4:	Severe epithelial hyperplasia with extensive fusion of secondary lamellae and/or involvement of 50-75% of the examined gill. Moderate to
Grade 5:	Reserved for the most severe lesions with entire involvement of the examined section by severe epithelial hyperplasia with extensive fusion

flammatory infiltrates in the primary and secondary lamellae.
te inflammatory infiltrates of the primary and secondary lamellae.
te inflammatory infiltrates of the primary and secondary lamellae.
abundant inflammatory infiltrates of the primary and secondary lamellae.
of primary and secondary lamellae. Moderate to abundant inflammatory infiltrates of the primary and secondary lamellae.

WADDL 2010-5106 Sampled 03 May 2010; Arrived at WADDL 04 May 2010
Steelhead
Chiwawa Ponds-Reuse_Submission #1 of 2

Grading 0-5 with 0= normal and 5 being the most severe lesion.

Fish	1		2		3		4		5		6		7	
Slides														
	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
Gill	3034	2	3034	1	3034	1	3034	2	3034	1	3034	2	3034	2
	3033	1					3032	1	3032	1			3033	1
	3032	1											3032	1
Skin	1299	1	1299	1	1299	1	1299	1	1299	1	1299	2	1299	2
Heart		0		0		0		0		0		0		0
Liver	6503	1	6505	1		0		0		0		0		0
Spleen		0		0		0		0		0		0		0
Pancreas		0		0		0		0		0		0		0
Pyl cecae		0		0		0		0		0		0		0
Post Kid		0		0		0		0		0		0		0
Intestine		0		0		0		0		0		0		0
Skeletal muscle		0		0		0		0		0		0		0

3032	Gill, branchitis, lymphocytic
6503	Liver, hepatitis, portal, lymphocytic
3034	Gill, epithelial hypertrophy
1299	Epidermitis, lymphocytic
3033	Gill, epithelial hyperplasia
1127	Dermatitis, lymphocytic
6505	Liver, hepatitis, random, lymphocytic
1273	Dermatitis, suppurative

8		9		10		Fish Slides	11		12		13		14	
Code	Severity	Code	Severity	Code	Severity		Code	Severity	Code	Severity	Code	Severity	Code	Severity
3034	2	3034	2	3034	1	Gill	3034	3	3034	2	3034	2	3034	2
3032	1												3032	1
1299	1		0	1299	1	Skin	1299	2	1299	3	1299	2	1299	1
1127	1													
	0		0		0	Heart		0		0		0		0
6503	1	6503	1	6503	1	Liver	6505	1	6505	1	6505	1		0
	0		0		0	Spleen		0		0		0		0
	0		0		0	Pancreas		0		0		0		0
	0		0		0	Pyl cecae		0		0		0		0
	0		0		0	Post Kid		0		0		0		0
	0		0		0	Intestine		0		0		0		0
	0		0		0	Skeletal muscle		0		0		0		0

3032	Gill, branchitis, lymphocytic
6503	Liver, hepatitis, portal, lymphocytic
3034	Gill, epithelial hypertrophy
1299	Epidermitis, lymphocytic
3033	Gill, epithelial hyperplasia
1127	Dermatitis, lymphocytic
6505	Liver, hepatitis, random, lymphocytic
1273	Dermatitis, suppurative

15		16		17		18		19		20		**Fish** Slides	21	
Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity		Code	Severity
3034	1	3034	1	3034	1	3034	1	3034	1	3034	1	Gill	3034	2
3032	1					3032	1	3032	1	3032	1			
						3033	1	3033	1	3033	1			
1299	1	1299	1		NA	1299	1		0	1299	1	Skin	1299	3
													1273	3
	0		0		0		0		0		0	Heart		0
	0		0	6505	1		0		0		0	Liver		0
	0		0		0		0		0		0	Spleen		0
	0		0		0		0		0		0	Pancreas		0
	0		0		0		0					Pyl cecae		
	0		0		0		0		0		0	Post Kid		0
	0		0		0		0		0			Intestine		
	0		0		0		0		0		0	Skeletal muscle		0

3032	Gill, branchitis, lymphocytic
6503	Liver, hepatitis, portal, lymphocy
3034	Gill, epithelial hypertrophy
1299	Epidermitis, lymphocytic
3033	Gill, epithelial hyperplasia
1127	Dermatitis, lymphocytic
6505	Liver, hepatitis, random, lymphoc
1273	Dermatitis, suppurative

22		**23**		**24**		**25**		**Fish** Slides
Code	Severity	Code	Severity	Code	Severity	Code	Severity	
3034	1	3034	2	3034	1			Gill
3032	1							
1299	1	1299	1		0	1299	1	Skin
	0		0		0		0	Heart
	0							Liver
	0		0		0		0	Spleen
	0		0		0		0	Pancreas
								Pyl cecae
	0		0		0		0	Post Kid
								Intestine
	0		0		0		0	Skeletal muscle

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Snekvik Epithelial Hyperplasia and Inflammation Grading Scale:

Grade 0:	No epithelial changes. Propria mucosa of the secondary and primary lamellae lack inflammatory cells or have rare scattered inflammatory cells.
Grade 1:	Multifocal areas of mild epithelial hyperplasia with or without lamellar fusion that involve less than 10% of the evaluated section. Mild inflammat
Grade 2:	Moderate epithelial hyperplasia with multifocal fusion of secondary lamellae having involvement of 10-25% of the examined gill. Moderate inflan
Grade 3:	Moderate epithelial hyperplasia with multifocal fusion of secondary lamellae having involvement of 25-50% of the examined gill. Moderate inflan
Grade 4:	Severe epithelial hyperplasia with extensive fusion of secondary lamellae and/or involvement of 50-75% of the examined gill. Moderate to abunda
Grade 5:	Reserved for the most severe lesions with entire involvement of the examined section by severe epithelial hyperplasia with extensive fusion of prim

ory infiltrates in the primary and secondary lamellae.
matory infiltrates of the primary and secondary lamellae.
matory infiltrates of the primary and secondary lamellae.
nt inflammatory infiltrates of the primary and secondary lamellae.
ary and secondary lamellae. Moderate to abundant inflammatory infiltrates of the primary and secondary lamellae.

WADDL 2010-5203 Sampled 04 May 2010; Arrived at WADDL 05 May 2010
Steelhead
Chiwawa Ponds Second sample: Turtle Rock Raceway

Grading 0-5 with 0= normal and 5 being the most severe lesion.

Fish	1		2		3		4		5		6	
Slides												
	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
Gill	3034	1	3034	1	3034	1		0		0	3033	1
	3033	1	3032	1	3032	1					3032	1
Skin	1299	1	1299	1	1299	1	1299	1		0		0
			1127	1								
Heart		0		0		0		0		0		0
Liver	6505	1	6505	1		0	6505	2		0	6505	2
Spleen		0		0		0		0		0		0
Pancreas		0		0		0		0		0		0
Pyl cecae		0		0		0		0				
Head Kid												
Post Kid		0		0		0		0		0		0
Intestine		0		0		0		0		0		0
Skel Musc		0		0		0		0		0		0

3032	Gill, branchitis, lymphocytic
6503	Liver, hepatitis, portal, lymphocytic
3034	Gill, epithelial hypertrophy
6773	Swim bladder, air saculitis, lymphocytic
1299	Epidermitis, lymphocytic
7204	Kidney, tubular hydropic degeneration
3033	Gill, epithelial hyperplasia
4201	Heart, myocarditis, lymphocytic/ histiocytic

7		8		9		10		**Fish**	11		12
Code	Severity	Code	Severity	Code	Severity	Code	Severity	Slides	Code	Severity	Code
3032	1	3034	1	3032	1	3033	1	Gill		0	3033
		3033	1	3033	1						
		3032	1								
	0		0		0		0	Skin		0	1299
	0	4178†	5		0		0	Heart		0	
	0		0		0	6505	1	Liver	6505	1	
	0		0		0		0	Spleen		0	
	0		0		0		0	Pancreas		0	
								Pyl cecae			
								Head Kid			
	0		0		0		0	Post Kid		0	
	0		0		0		0	Intestine		0	
	0		0		0		0	Skeletal muscle		0	

† Fungal (Saprolegnia) epicarditis

	13		14		15		16		17		18	
Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity	Code	Severity
1	3034	1		0	3034	1	3032	1	3034	1	3034	1
	3033	1									3032	1
	3032	1										
1	1299	2	1299	1	1299	1		0	1299	1	1299	2
0		0		0		0		0		0		0
0	6505	1	6505	1		0		0		0	6505	1
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		0

19		20		**Fish**	21		22		23		24
				Slides							
Code	Severity	Code	Severity		Code	Severity	Code	Severity	Code	Severity	Code
3032	1	3032	1	Gill	3034	1		0	3034	1	3032
3033	1	3034	1		3033	1			3032	1	3033
	0			Skin		0	1299	1		0	
	0		0	Heart		0		0		0	
	0	6505	1	Liver		0					
	0		0	Spleen		0		0			
				Pancreas							
				Pyl cecae							
				Head Kid							
	0		0	Post Kid		0		0		0	
	0		0	Intestine		0		0		0	
	0		0	Skeletal muscle		0		0		0	

	25		**Fish** Slides
Severity	Code	Severity	
1	3032	1	Gill
1			
0	1299	1	Skin
0		0	Heart
			Liver
			Spleen
			Pancreas
			Pyl cecae
			Head Kid
0		0	Post Kid
0		0	Intestine
0		0	Skeletal muscle

7393	Kidney, increased melanomacrophages/ melanomacrophage centers
4178	Heart, epicarditis, lymphocytic/ histiocytic
1127	Dermatitis, lymphocytic
3036	Gill, capillary ectasia
3037	Gill, capillary thrombosis
6505	Liver, hepatitis, random, lymphocytic
6164	Intestine, enteritis, lymphocytic-plasmacytic
6522	Liver, lipidosis (fatty)
3038	Gill, branchitis, nodular, lymphohistiocytic
0532	Peritonitis, pyogranulomatous
2220	Myositis, acute
4275	Hemopericardium
10275	Eye, phthisis bulbi

Snekvik Epithelial Hyperplasia and Inflammation Grading Scale:

Grade 0:	No epithelial changes. Propria mucosa of the secondary and primary lamellae lack inflammatory cells or have rare scattered inflammatory cells.
Grade 1:	Multifocal areas of mild epithelial hyperplasia with or without lamellar fusion that involve less than 10% of the evaluated section. Mild inflammatory i
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Grade 5:	Reserved for the most severe lesions with entire involvement of the examined section by severe epithelial hyperplasia with extensive fusion of primary

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and secondary lamellae. Moderate to abundant inflammatory infiltrates of the primary and secondary lamellae.

PILOT WATER REUSE
FISH REARING CRITERIA

DATE: February 18, 2015

TO: Hatchery Committee

FROM: Sam Dilly

RE: Pilot Study Rearing Criteria

This draft Pilot Water Reuse Fish Rearing Criteria was developed in collaboration with WDFW staff and Chelan PUD representatives January 23, 2008. WDFW staff reviewed the criteria and provided recommendations that were accepted by the District and are included in the pilot program. These final criteria will be part of the pilot study covered in the Statement of Agreement February 2008.

Pilot study disease and rearing criteria

1. Juvenile summer Chinook disease identification and treatment requires consideration of multiple variables and conditions. The pilot water reuse study will track water quality and study conditions per the attached monitoring and evaluation paper. The Fish Health Monitoring and Evaluation is structured adequately, contains the correct magnitude of testing and observation and will be followed. However, rearing conditions, test duration, and further discussion among WDFW staff and Chris Good, fish veterinarian with Freshwater Institute, may lead to additional testing or other testing to improve the pilot test data. The data will create the basis for disease identification and treatment.
2. Observed fish disease and sickness among pilot study fish will be treated. Upon observation of abnormal fish behavior or physical condition, the Complex Manager, John Penny, will contact Bob Rogers (WDFW Fish Pathologist) and the District. In coordination, Bob Rogers, John Penny, and Chris Good will develop:
    a. Possible cause of the fish health condition

    - b. Recommended changes to pilot conditions
    - c. Recommended treatments and
    - d. Record of observations and actions to resolve the conditions
3. An acute fish health event (epizootic) could be defined as 0.08 percent mortality for three consecutive days (0.0008 X 50,000 fish = 40 fish). The District and WDFW recognize waiting to observe continued fish health deterioration to this point is not recommended or practical. Upon observing as few as five daily mortalities, WDFW and the District will begin discussions. Upon documenting sickness, disease, or causative conditions, and group consultation, WDFW will prepare treatment recommendations and may take action. Anticipated actions include:
    - a. Changing the reuse water proportion
    - b. Changing water quality
    - c. Treatment with medications (water treatment or feed)
4. WDFW and the District will inspect pilot study fish, compile data, and create recommendations for final fish rearing and release. At the September 2008 HC meeting there will be a data review and recommendation for final rearing conditions. Location, cohort co-mingling, and possible continued cohort biological analysis will be decided at that time.
5. Fish mortality among pilot study fish will be compared to survival standards per Table 1. Mortality will be compared to cohorts in a standard raceway as well. Wenatchee Summer Chinook have been reared in Eastbank raceways for over 17 years. Historical survival rates will provide a general basis for comparison at the study's end.
6. If mortality exceeds life stage standards the study will be terminated unless extenuating circumstances exist. Standards are contained in Table 1.

Table 1
Pilot Study Survival Standard

Standard	Ponding To 30-days	Ponding To 100-days	Ponding To Release	Transport To Release
Percent Survival	97	93	90	95

Temporary equipment failures, acute treatable fish illness, and unforeseen conditions that affect fish will not give cause to stop the study. Conditions that can not be changed or remedied will give cause to stop the study. Chronic illness, with mortality (approaching survival standards), and poor performance compared to cohorts in raceways will give cause to stop the study. If necessary either a flow through system in the circular ponds or transfer to annex raceways will occur.

PILOT WATER REUSE

FISH REARING CRITERIA (2009)

DATE: February 18, 2015

TO: Hatchery Committee

FROM: Shaun Seaman

RE: Pilot Study Rearing Criteria

This is a copy of the criteria memo that was accepted by the HC for the 2008 reuse pilot study. The dates in this document have been modified for the 2009 rearing season but the original criteria remain as written for the first year of study and will apply to the 2009 study.

This draft Pilot Water Reuse Fish Rearing Criteria was developed in collaboration with WDFW staff and Chelan PUD representatives January 23, 2008. WDFW staff reviewed the criteria and provided recommendations that were accepted by the District and are included in the pilot program. These final criteria will be part of the 2009 pilot study covered in the Statement of Agreement October 2008.

Pilot study disease and rearing criteria

1. Juvenile summer Chinook disease identification and treatment requires consideration of multiple variables and conditions. The pilot water reuse study will track water quality and study conditions per the attached monitoring and evaluation paper. The Fish Health Monitoring and Evaluation is structured adequately, contains the correct magnitude of testing and observation and will be followed. However, rearing conditions, test duration, and further discussion among WDFW staff and Chris Good, fish veterinarian with Freshwater Institute, may lead to additional testing or other testing to improve the pilot test data. The data will create the basis for disease identification and treatment.
2. Observed fish disease and sickness among pilot study fish will be treated. Upon observation of abnormal fish behavior or physical condition, the Complex Manager, John Penny, will contact Bob Rogers (WDFW Fish Pathologist) and the District. In

Partial Water Reuse Pilot Study
Monitoring and Evaluation

The District will investigate a partial reuse aquaculture system incorporating circular culture tanks with dual drains. Such technologies have been successfully applied elsewhere to improve rearing volume use, reduce site footprint, improve control over culture conditions, and reduce water consumption and energy costs.

The pilot project at the Eastbank Hatchery will use Chelan River (A.K.A. TRI Yearling) Summer Chinook. The following piloting parameters have been defined but may be subject to change:

Table 1:
Pilot Project Parameters[1]

Parameter	Criteria
Per tank volume	3884.6 ft3
Total tank volume	7769.2 ft3
Density index	0.125 lb/cf-in
Max rearing density	9.2 kg/m3 (1.24 lb/gal)
Minimum Flow Index	0.75 lb/gpm-in
Tank exchange rate	calculated
Condition factor	0.0121 g/cm3
Release length	4.6 in (11.7 cm)
Release weight	23.5 fish/lb (19.4 g)
Total number of fish	104,500
Total fish biomass	4,467 lb (9848.7 kg)
Maximum temperature	59 °F (15 °C)
Reuse rate	75%
Total flow rate (2 tanks, flow index based)[2]	1295 gpm (4902 lpm)
Influent flow rate (2 tanks)	323 gpm (1222 lpm)

1 Based upon moving fish in November to acclimation facility
2 Single pass water use provisions will be provided

To facilitate an effective piloting process, the District will use a hatchery consultant to design an aquaculture systems, supply and support equipment, perform training, and assist with data analysis during the pilot.

Design Concept

Based on design parameters, the estimated equipment requirements are:

1. **30 ft Diameter Circular Culture Tank System (Qty = 2)**
    a. 30 ft diameter x 6 ft wall height circular culture tank, FRP walls and floor, sectional
    b. Bottom drain sump and screen
    c. Side drain (Cornell style) and screen
    d. Bottom drain standpipe

    e. Spraybar assembly
2. **Partial Reuse Aquaculture System**
    a. Drum filter (Qty = 1)
    b. 89 micron screens
    c. Pump sump (Qty = 1)
    d. Reuse pumps (Qty = 2 or 3)
    e. Oxytower Gas Transfer System (Qty = 2)
        i. CO2 stripper and Low Head Oxygenator (LHO)
        ii. Gas transfer media
3. **Motor Control Panel (Qty = 1)**
    a. Alarm relays
4. **Water Quality Monitoring System**
    a. Analyzers (4-DO, 1-Temperature, 1-pH)
    b. Flow meter (1 for influent 1 for reuse)
    c. Multi-channel transmitter unit with local display and alarm relays
    d. Data logging capabilities
    e. Software package for PC
5. **Effluent Treatment**
    a. Radial Flow Settlers (Qty = 2)
6. **Ancillary Equipment**
7. **Culture tank jump screens or covers**
8. **Feeding systems will be manual (to make a consistent comparison)**
9. **Spare parts and materials as needed or related tools.**

Scope of Work

The pilot study work is organized into the following tasks:

1. **Scoping and concept design**
    a. Site review and layout analysis.
    b. Identify design constraints and preferences.
    c. Production parameters.
    d. Rearing parameters.
    e. Water quality parameters.
    f. Calculate mass balance and verify flow and treatment requirements.
    g. Develop process and layout drawings.
    h. Check equipment list and performance criteria.
    i. Calculate influent and effluent water quality.
    j. Prepare water quality report template.
2. **Detailed system design and design coordination**
    a. Aquaculture system process design.
    b. Layout of aquaculture systems.
    c. Detailed design analysis and design calculations
    d. Prepare detailed list of electrical loads, mechanical loads, and other service requirements.
    e. Integrate aquaculture system to site.

    f. Develop construction drawing

3. **Equipment supply**
4. **Construction**
5. **Commissioning**
6. **Training**
    a. Prepare and provide Operation and Maintenance Manual for System and for Components.
    b. Prepare training program for O&M personnel.
    c. Coordinate and conduct O&M personnel training.
7. **Operational support**
    a. Provide qualified personnel for operational advice and water quality troubleshooting.
8. **Monitoring Parameters**
    a. The following parameters will be monitored continuously with analyzers and meters:
        i. Dissolved Oxygen (DO) in each of the tank side drains (2 places).
        ii. Dissolved Oxygen (DO) in the header tank.
        iii. Dissolved Oxygen (DO) in the pump sump.
        iv. Water temperature in the header tank.
        v. Water pH in the header tank.
        vi. Water flow rate on influent water supply (make-up water).
        vii. Water flow rate on the reuse flow directly downstream of the pumps.
    b. The following parameters are to be monitored using a colorimetric test kit or laboratory methods (frequency to be determined):
        i. Dissolved carbon dioxide at the pump sump and the header tank.
        ii. Dissolved total ammonia nitrogen (TAN) at the pump sump.
        iii. Alkalinity (as calcium carbonate) at the pump sump.
        iv. Biological Oxygen Demand (BOD) in the culture tanks and in the effluent.
        v. Total Suspended Solids (TSS) in the culture tanks and in the effluent.
    c. The following additional parameters are examples of additional parameters that will be read and/or recorded manually (frequency to be determined):
        i. Pressure as measured with gauges upstream and downstream of pumps.
        ii. Flow split between bottom and side drain of tank (using portable flow meter)
        iii. Rotational period at perimeter of the culture tanks (using a float)
        iv. Oxygen use rate (at oxygen flow meter on LHO inlet)
        v. Daily feed usage and feeding time of day
9. **Data analysis and reporting**
    a. Provide analysis and trend development for water quality data. Track dissolved oxygen, dissolved CO_2, ph, temperature, Total Ammonia Nitrogen, BOD, and TSS. Analysis will be performed monthly but may be more frequent if so required for troubleshooting purposes.
    b. Prepare a monthly summary report of system performance and water quality.

The following schedule of milestones is estimated:

Table 2:
Pilot Project Parameters

Milestone	Estimated Completion Date
Scoping and concept design	2008-01-31
Detailed design documents	2008-02-29
Equipment delivery	2008-03-31
Pilot equipment installation	2008-04-30
Commissioning	2008-05-15
O&M training	2008-05-30
Piloting period	2008-06-01 (start) to 2009-05-31 (end)
Decommissioning or contract renewal	2009-06-01

Note: All dates assume initiation of contract by December 20, 2007.

Partial Water Reuse Fish Health Monitoring and Evaluation

Background

Modern partial reuse aquaculture systems have the capacity to reuse up to 85% while maintaining water quality parameters (e.g. DO, CO_2, ammonia) within safe limits. The capacity to reuse water makes the technology applicable to those who are investigating methods to reduce source water usage. One of the most important concerns for using any different technology is how fish health might be affected.

The pilot study purpose is to investigate and document fish health differences among fish raised in traditional raceways compared to fish raised in a partial reuse system.

A partial water reuse system will be constructed at the Eastbank Hatchery to rear approximately 100,000 Summer Chinook salmon for a 5-month period (June 2008–November 2008) while the remainder of this population will be raised for the same period at Eastbank Hatchery in traditional flow-through raceway units. Both groups will be differentially marked and transferred to the acclimation pond prior to release. In addition, 10,000 fish of the test and the same number of control fish will be PIT tagged for evaluation of survival and travel time comparison to McNary dam (see attached correspondence). Fish health and welfare will be evaluated according to the below plan.

Proposed Study Details

Start date: June, 2008
End date: November, 2008

(For a complete time-line of the proposed study, see Appendix A)

Hypothesis – Fish growth and health$_{\text{partial reuse}}$ ≥ Fish growth and health$_{\text{traditional raceway}}$

Study design – This study follows a prospective cohort epidemiological design, and will assess specific health and welfare indicators between two cohorts of fish of the same background (genetic strain, early rearing environment, etc.) exposed to two different rearing systems, with other exposures (water source, management, feeding rates, etc.) being equal.

Methodology

1. **Performance** – Fish will be sampled from both cohorts at regular monthly intervals for length and weight, from which growth curves and (with feeding data) feed conversion ratios will be generated. These data will be analyzed for statistically significant differences over time between the two cohorts.

2. **Fish Health** – There will be multiple assessments:
    a. Mortality data will be collected throughout the study period, and a proportional hazards survival analysis will be carried out at the end of the study to determine differences in overall survival between the two cohorts.
    b. Samples of 60 fish from each cohort (120 fish total per sampling event) will be collected at the start, middle, and end of the rearing period. These fish will be euthanized, packed in ice and shipped overnight to an accredited fish disease diagnostic laboratory for screening of listed viral, bacterial, and parasitic pathogens, following Blue Book protocols (see Appendix B). This testing will reveal the presence or absence of subclinical infections, and will be used to assess changes in subclinical infection over time between the two cohorts.
    c. In the event of clinical disease outbreaks during the study period, WDFW fish pathologist will diagnose and treat the study populations with support from a fish pathologist. Diagnostic and treatment records for each cohort will be summarized at the end of the study, and compared statistically.
    d. At the end of the study, 50 fish from each cohort will be euthanized, and samples of multiple tissues (gill, heart, liver, spleen, pyloric cecae, intestine, swim bladder, anterior and posterior kidney, skin, and fillet) will be sent to a fish pathologist for histopathological assessment to determine the extent of organ pathology within each cohort.
    e. At the end of the study, 50 fish from each cohort will be bled, and frozen plasma samples will be sent to a diagnostic laboratory for biochemistry profiles as agreed upon with WDFW for further comparison of pathological processes, as well as indictors of long-term stress (see Appendix C).
    f.

3. **Fish Welfare** – At the end of the study, 50 fish from each cohort will have their fin condition assessed. This will be carried out for all rayed fins, with measurements by digital calipers to calculate the overall fin indices (i.e. length of longest ray of each fin standardized to fork length) for each fish. Differences in fin indices between the two cohorts will be assessed statistically. This work will be coordinated with WDFW to insure proper techniques and methods are used.

Table 1:
Estimated Effort and Time

Task	Effort
Field Work	
Site Visits and Field Work (Principal Investigator)	15 days
Site Visits and Field Work (Technician)	5 days
Field Work TOTAL	**20 days**
Laboratory Analyses – Allowances	
Pathogen Screening: 6 samples	
Diagnostic pathology (blood chemistry)	
Sample Shipment, Field Work Equipment, etc.	
Laboratory Analyses TOTAL	
Data Analysis and Report Preparation	
Monthly Data Collection and Study Coordination	5 days
Analysis and Report Writing	15 days
Data Analysis TOTAL	**20 days**
PROJECT TOTAL[1]	**40 Days**

[1] Diagnostic veterinary services to address clinical disease are not included in this estimate. These services are assumed to be part of the normal hatchery program.

Appendix A:
Detailed Project Time-Line

Date	Activity

June 2008	• Chris Good to travel to Eastbank Hatchery
	• First sampling of 60 fish per system for **pathogen screening** (see Appendix B) as cohorts begin early rearing at Eastbank
	<u>Details:</u>
	  • Sampling for pathogen screening requires MS-222 for euthanasia, and hard-sided coolers packed with ice for shipment
	  • Purposive sampling is employed (as opposed to random sampling), in that smaller, unthrifty fish or those exhibiting clinical signs will be targeted

August 2008	• Chris Good to travel to Eastbank Hatchery • Second sampling of 60 fish per system for **pathogen screening**

November 2008	• Chris Good plus technician final visit to Eastbank Hatchery
	• Final sampling of 60 fish per system for **pathogen screening**
	• Blood sample collection from 50 fish per system for **biochemistry profile analysis**
	<u>Details:</u>
	  • Blood collection will require 3ml syringes with 22-guage needles, blood collection tubes and freezer space to freeze samples prior to shipment (hard-sided cooler plus ice).
	• **Tissue collection** from 50 fish per system for histological assessment
	<u>Details:</u>
	  • Tissue collection requires dissection kits, histological grade formalin, and plastic jars for specimen fixation
	  • Once fixation is complete (48 hours), tissues are removed, placed in Whirlpak bags with small amounts of formalin, and shipped to the pathologist in a hard-sided cooler
	• **Fin data collection** for 50 fish per system for fin health assessment, and this requires use of a digital microcaliper

Throughout study period	• Routine mortality data collection following established facility protocols • Routine feeding data collection • Routine performance (length, weight, etc.) data collection • As needed veterinary sampling and diagnoses for clinical disease conditions as they arise

Appendix B Listed Pathogen Screening

The following fish pathogens will be screened in samples of 60 fish from each system according to Blue Book guidelines. The sample size of 60 fish in populations greater than 100,000 provides a 95% confidence of pathogen detection when pathogen apparent prevalence is at least 5%.

Pathogen	**Disease**	**Detection Method**
Bacteria		
Aeromonas salmonicida	Furunculosis	Culture
Yersinia ruckeri	Enteric redmouth disease	Culture
Renibacterium salmoninarum	Bacterial kidney disease	ELISA
Viruses		
IHNV	Infectious hematopoietic necrosis	Cell culture on CHSE, EPC
IPNV	Infectious pancreatic necrosis	Same
VHSV	Viral hemorrhagic septicemia	Same
Parasites		
Myxobolus cerebralis	Whirling disease	Tissue digestion / light microscopy
Additional Screening		**As determined by WDFW**

Appendix C Plasma Chemistry Analysis

The following plasma chemistry parameters are typical of a small animal panel as performed by a veterinary diagnostic laboratory. Specific parameters, such as the electrolytes, glucose, and liver enzymes, provide useful data for interpreting fish stress and underlying pathological processes.

Sodium	Albumin	Cholesterol
Potassium	Globulin	Creatine kinase
Chloride	Glucose	Iron
Bicarbonate	ALT	Total iron binding capacity
Anion gap	AST	Saturation
Urea nitrogen	Alkaline Phosphatase	Lipemia
Creatinine	GGT	Hemolysis
Calcium	Total bilirubin	Icterus
Phosphate	Direct bilirubin	Plasma Protien
Magnesium	Indirect bilirubin	hematocrits
Total protein	Amylase	Blood Osmolatity
Cortisol	Lactate	

REPRINTED E-MAIL FROM STEVE HAYS

OK - here we have it for adults.

These statistical powers are based on PIT tag recoveries at Columbia River fishways, assuming about a 0.5% SAR for Turtle Rock adults escaping ocean harvest and making it to Bonneville Dam, and using all PIT recoveries (3, 4, 5, and 6 year old returns).

With PIT tag releases of 10,000 fish each for reuse and control, a 2x1 survival difference beween control and test fish has a high power of being detected, a 1.5x1 survival difference has a power of .70 (not bad) if you are willing to use a .10 alpha level of significance, and only a 1-in-5 chance of detecting a 10% (1.08x1) SAR reduction from reuse rearing conditions with a .10 alpha level

To put this into perspective, if your PIT tag returns actually do equal 0.00499 for the controls, then the table below gives an idea of how many fewer fish could return from the reuse group before you would fail to reject the null hypothesis when, in fact, there was a difference in SAR. So, from a conservative viewpoint of do no harm and we detected 50 PIT tagged controls, then if we detected fewer than 33 adults we could conclude that the SAR was reduced because of rearing on reuse water (with a 1 in 10 chance of having convicted an innocent rearing technology). With control returns greater than 50, the likelihood of rejecting the null hypothesis (no difference in SAR) gets progressively closer to the Test .91 column.

Control	Test .91	Test .67	Test .50
100	91	67	50
90	82	60	45
80	73	53	40
70	64	47	35
60	55	40	30
50	45	33	25
40	36	27	20
30	27	20	15
20	18	13	10
10	9	7	5

Steven Hays
Fish and Wildlife Senior Advisor
Chelan County Public Utility District
PO Box 1231
Wenatchee, Washington 98807
(509) 661-4181

-----Original Message-----
From: John Skalski [mailto:skalski@u.washington.edu]
Sent: Monday, February 04, 2008 10:52 AM
To: Hays, Steve
Subject: Re: Statistical power

Steve,
Here is the updated table with the SAR values you suggested.

Power calculations for estimates of $SAR_C = 0.00499$, tested against $SAR_T = 0.00454$ and 0.00333, and 0.00250.

Release Size		% S_C greater than	α-level	Power
R_C	R_T	S_T	1-tailed	(1-β)
10,000	10,000	10%	0.05	0.1184
10,000	10,000	50%	0.05	0.5710
10,000	10,000	100%	0.05	0.8922
10,000	10,000	10%	0.10	0.2063
10,000	10,000	50%	0.10	0.7062
10,000	10,000	100%	0.10	0.9454
20,000	20,000	10%	0.05	0.1607
20,000	20,000	50%	0.05	0.8250
20,000	20,000	100%	0.05	0.9925
20,000	20,000	10%	0.10	0.2650
20,000	20,000	50%	0.10	0.9028
20,000	20,000	100%	0.10	0.9974

John

Rocky Reach and Rock Island HCP Hatchery Committees
Statement of Agreement
Regarding Pilot Study for Partial Water Reuse
February 20, 2008

Statement

The Rocky Reach and Rock Island HCP Hatchery Committees (hereafter "Committees") agree that Chelan County PUD (hereafter "District) can perform a partial water reuse pilot study. Approximately 100,000 Wells Summer Chinook from the District's hatchery compensation program will be reared on partial water reuse water utilizing circular ponds. The Committees agree to allow the District to perform the study as outlined in the attached *Pilot Water Reuse Fish Rearing Criteria* and the *Partial Water Reuse Pilot Study Monitoring and Evaluation*. The study will be for one (1) year and the Committees will decide whether to pursue additional years of study based on the results of the first year of the pilot study.

The study will continue as long as the health of the fish remains comparable to the control group reared under protocols as detailed in the *Hatchery Facility Evaluation Suggested Guidelines for Anadromous Fish Hatchery Programs.* The pilot study will be discontinued if fish health criteria and mortality limits agreed to by the Committees prior to the start of the study are not met or if limits are exceeded.

A subset of the study (those in the circular ponds) and control fish will be PIT tagged to allow for evaluation of the study. All study fish will be differentially marked with coded wire tags. The number of study and control fish to be PIT tagged will be determined by the Committees.

Background

Background

Water and space are major limiting factors in hatchery facilities. The District would like to investigate alternative methods for using water, and potentially space, when revising either existing facilities or constructing new ones. One such method for conserving water during rearing is partial water re-use. Successful application of water re-use technology has been previously demonstrated with Atlantic Chinook using 75 % reuse water. Twenty-five percent of the water is instantaneously added and the 75% reused water is oxygenated and CO2 stripped before reentering the pond. The effluent (at the bottom of the pond) contains practically all of the waste products and unused fish food.

The District proposes to test this configuration at a rearing density (0.12 lbs./cu.ft.-in). Based on case studies from existing applications, this reuse technology may be practical and feasibility for application to Upper Columbia hatchery sites at this density.

Objective

Determine if circular ponds with 75% reuse can be used to rear Chinook from ponding to yearling size at Eastbank, while producing fish with growth, health and vigor desired for the supplementation programs.

Rocky Reach and Rock Island HCP Hatchery Committees
FINAL Statement of Agreement
Regarding Pilot Study for Partial Water Reuse
December 8, 2008

Statement

The Rocky Reach and Rock Island HCP Hatchery Committees (hereafter "Committees") agree that Chelan County PUD (hereafter "District) can perform the second year of the partial water reuse pilot study. Approximately 200,000 Wells Summer Chinook from the District's Turtle Rock Island program will be converted from the subyearling program (reducing the subyearling program by 200,000 fish) and will be reared on partial water reuse utilizing circular ponds. This effectively doubles the density from the 2008 pilot study. The Committees agree to allow the District to perform the study as outlined in the attached *Pilot Water Reuse Fish Rearing Criteria (2009)* and the *Partial Water Reuse Pilot Study Monitoring and Evaluation (2009) (*See Attachments A,B, and C to this document).

This action increases the Turtle Rock Island Summer Chinook yearling production to 400,000 fish.

The study will continue as long as the health of the fish remains comparable to the control group reared under protocols as detailed in the *Hatchery Facility Evaluation Suggested Guidelines for Anadromous Fish Hatchery Programs.* The pilot study will be discontinued if fish health criteria and mortality limits detailed in the *Pilot Water Reuse Fish Rearing Criteria (2009)* are not met (health criteria) or exceeded (mortality limits).

A subset of the study (those in the circular ponds) and control fish will be PIT tagged to allow for evaluation of the study. All study fish will be differentially marked with coded wire tags. The number of study and control fish to be PIT tagged will be determined by the Committees.

Implementation is subject to National Marine Fisheries Service (NMFS) concurrence that the impacts to Endangered Species Act (ESA) species remain within those that were contemplated in the existing ESA authorizations.

Background

2007 yearling Chinook reared in the pilot water reuse tanks at the Eastbank Hatchery are performing well. Generally, the fish reared in the circular ponds are larger, are more uniform in size, and have experienced fewer mortalities than the fish reared in conventional raceways. Data indicates the pilot study system has capacity to rear fish at a greater density than they are currently reared. Chelan PUD proposes to rear yearling Chinook at a greater density for the purpose of better understanding how the pilot system may perform before any full scale implementation of this hatchery technology. Chelan PUD recommends using subzero production as a donor broodstock for this program.

The District and WDFW have developed a plan for providing rearing capacity at District facilities for all life stages of this program. (See Attachments B and C to this document – "Pilot Water Reuse Rearing Criteria" and "2009 Partial Water Reuse Pilot Study").

Partial Water Reuse Pilot Study
Monitoring and Evaluation
(2009)

The District will investigate a partial reuse aquaculture system incorporating circular culture tanks with dual drains. Such technologies have been successfully applied elsewhere to improve rearing volume use, reduce site footprint, improve control over culture conditions, and reduce water consumption and energy costs.

The pilot project at the Eastbank Hatchery will use Chelan River (A.K.A. TRI Yearling) Summer Chinook. The following piloting parameters have been defined but may be subject to change:

Table 3:
Pilot Project Parameters[1]

Parameter	Criteria
Per tank volume	3884.6 ft3
Total tank volume	7769.2 ft3
Density index	0.226lb/cf-in
Max rearing density	16.3 kg/m3
Minimum Flow Index	1.4 lb/gpm-in
Tank exchange rate	Calculated
Condition factor	0.0121 g/cm3
Release length	4.5 in (114. cm)
Release weight	25fish/lb (18.1 g)
Total number of fish	200,000
Total fish biomass	7,980.7 lb (3,620 kg)
Maximum temperature	59 °F (15 °C)
Reuse rate	75%
Total flow rate (2 tanks, flow index based)[2]	1295 gpm (4902 lpm)
Influent flow rate (2 tanks)	323 gpm (1222 lpm)

1 Based upon moving fish in November 1, 2009 to acclimation facility
2 Single pass water use provisions will be provided

Based on experience gained during 2008, the District will install features to boost dissolved oxygen concentration continue training staff, and make adjustments as required to improve operation.

10. Operational support
   a. Provide qualified personnel for operational advice and water quality troubleshooting.

11. Monitoring Parameters
   a. The following parameters will be monitored continuously with analyzers and meters:
      i. Dissolved Oxygen (DO) in each of the tank side drains (2 places).
      ii. Dissolved Oxygen (DO) in the header tank.
      iii. Dissolved Oxygen (DO) in the pump sump.

        iv. Water temperature in the header tank.
        v. Water pH in the header tank.
        vi. Water flow rate on influent water supply (make-up water).
        vii. Water flow rate on the reuse flow directly downstream of the pumps.
    b. The following parameters are to be monitored using a colorimetric test kit or laboratory methods (frequency to be determined):
        i. Dissolved carbon dioxide at the pump sump and the header tank.
        ii. Dissolved total ammonia nitrogen (TAN) at the pump sump.
        iii. Alkalinity (as calcium carbonate) at the pump sump.
        iv. Biological Oxygen Demand (BOD) in the culture tanks and in the effluent.
        v. Total Suspended Solids (TSS) in the culture tanks and in the effluent.
    c. The following additional parameters are examples of additional parameters that will be read and/or recorded manually (frequency to be determined):
        i. Pressure as measured with gauges upstream and downstream of pumps.
        ii. Flow split between bottom and side drain of tank (using portable flow meter)
        iii. Rotational period at perimeter of the culture tanks (using a float)
        iv. Oxygen use rate (at oxygen flow meter on LHO inlet)
        v. Daily feed usage and feeding time of day

12. **Data analysis and reporting**
    a. Provide analysis and trend development for water quality data. Track dissolved oxygen, dissolved CO_2, ph, temperature, Total Ammonia Nitrogen, BOD, and TSS. Analysis will be performed monthly but may be more frequent if so required for troubleshooting purposes.
    b. Prepare a monthly summary report of system performance and water quality.

Partial Water Reuse Fish Health
Monitoring and Evaluation

Background

Modern partial reuse aquaculture systems have the capacity to reuse up to 85% while maintaining water quality parameters (e.g. DO, CO_2, ammonia) within safe limits. The capacity to reuse water makes the technology applicable to those who are investigating methods to reduce source water usage. One of the most important concerns for using any different technology is how fish health might be affected.

The pilot study purpose is to investigate and document fish health differences among fish raised in traditional raceways compared to fish raised in a partial reuse system.

The Eastbank Hatchery partial water reuse pilot system will rear 200,000 Summer Chinook salmon for a 4-month period (June 2009–November 2009) while 50,000 cohorts will be raised for the same period at Eastbank Hatchery in a traditional flow-through raceway units. Both groups will be differentially marked and transferred to the acclimation pond prior to release. In addition, 10,000 fish of the test and the same number of control fish will be PIT tagged for evaluation of survival and travel time comparison to McNary dam (see attached correspondence). Fish health and welfare will be evaluated according to the below plan.

Proposed Study Details

Start date: June, 2009
End date: November, 2009

(For a complete time-line of the proposed study, see Appendix A)

Hypothesis – Fish growth and health$_{\text{partial reuse}}$ ≥ Fish growth and health$_{\text{traditional raceway}}$

Study design – This study follows a prospective cohort epidemiological design, and will assess specific health and welfare indicators between two cohorts of fish of the same background (genetic strain, early rearing environment, etc.) exposed to two different rearing systems, with other exposures (water source, management, feeding rates, etc.) being equal.

Methodology

4. **Performance** – Fish will be sampled from both cohorts at regular intervals for length and weight, from which growth curves and (with feeding data) feed conversion ratios will be generated. These data will be analyzed for statistically significant differences over time between the two cohorts.

5. **Fish Health** – There will be multiple assessments:
    a. Mortality data will be collected throughout the study period, and a proportional hazards survival analysis will be carried out at the end of the study to determine differences in overall survival between the two cohorts.

    b. Samples of 60 fish from each cohort (120 fish total per sampling event) will be collected at the middle and end of the rearing period. These fish will be euthanized, packed in ice and shipped overnight to an accredited fish disease diagnostic laboratory for screening of listed viral, bacterial, and parasitic pathogens, following Blue Book protocols (see Appendix B). This testing will reveal the presence or absence of subclinical infections, and will be used to assess changes in subclinical infection over time between the two cohorts.
    c. In the event of clinical disease outbreaks during the study period, WDFW fish pathologist will diagnose and treat the study populations with support from a fish pathologist. Diagnostic and treatment records for each cohort will be summarized at the end of the study, and compared statistically.
    d. At the end of the study, 50 fish from each cohort will be euthanized, and samples of multiple tissues will be sent to a fish pathologist for histopathological assessment to determine the extent of organ pathology within each cohort.
    e. At the end of the study, fish from each cohort will be bled and tested as agreed upon with with WDFW for further comparison of pathological processes, as well as indictors of long-term stress. (see Appendix C)

6. **Fish Welfare** – At the end of the study, 50 fish from each cohort will have their fin condition assessed. This will be carried out for all rayed fins, with measurements by digital calipers to calculate the overall fin indices (i.e. length of longest ray of each fin standardized to fork length) for each fish. Differences in fin indices between the two cohorts will be assessed statistically. This work will be coordinated with WDFW to insure proper techniques and methods are used.

Appendix A:
Detailed Project Time-Line

Date	Activity
June 2009	• First sampling of 60 fish per system for **pathogen screening** as co**horts begin early** rearing at Eastbank •
August 2008	• Second sampling of 60 fish per system for **pathogen screening**
November 2008	• Final sampling of 60 fish per system for **pathogen screening** • Blood sample collection from 50 fish per system for **biochemistry profile analysis** •
Throughout study period	• Routine mortality data collection following established facility protocols • Routine feeding data collection • Routine performance (length, weight, etc.) data collection • As needed veterinary sampling and diagnoses for clinical disease conditions as they arise

Appendix B Listed Pathogen Screening

The following fish pathogens will be screened in samples of 60 fish from each system according to Blue Book guidelines. The sample size of 60 fish in populations greater than 100,000 provides a 95% confidence of pathogen detection when pathogen apparent prevalence is at least 5%.

Pathogen	**Disease**	**Detection Method**
Bacteria		
Aeromonas salmonicida	Furunculosis	Culture
Yersinia ruckeri	Enteric redmouth disease	Culture
Renibacterium salmoninarum	Bacterial kidney disease	ELISA
Viruses		
IHNV	Infectious hematopoietic necrosis	Cell culture on CHSE, EPC
IPNV	Infectious pancreatic necrosis	Same
VHSV	Viral hemorrhagic septicemia	Same
Parasites		
Myxobolus cerebralis	Whirling disease	Tissue digestion / light microscopy
Additional Screening		**As determined by WDFW**

Appendix C Plasma Chemistry Analysis

The following plasma chemistry parameters are typical of a small animal panel as performed by a veterinary diagnostic laboratory. Specific parameters, such as the electrolytes, glucose, and liver enzymes, provide useful data for interpreting fish stress and underlying pathological processes.

Sodium	Albumin	Cholesterol
Potassium	Globulin	Creatine kinase
Chloride	Glucose	Iron
Bicarbonate	ALT	Total iron binding capacity
Anion gap	AST	Saturation
Urea nitrogen	Alkaline Phosphatase	Lipemia
Creatinine	GGT	Hemolysis
Calcium	Total bilirubin	Icterus
Phosphate	Direct bilirubin	Plasma Protien
Magnesium	Indirect bilirubin	hematocrits
Total protein	Amylase	Blood Osmolatity
Cortisol	Lactate	

PILOT WATER REUSE

FISH REARING CRITERIA (2009)

DATE: February 18, 2015

TO: Hatchery Committee

FROM: Shaun Seaman

RE: Pilot Study Rearing Criteria

This is a copy of the criteria memo that was accepted by the HC for the 2008 reuse pilot study. The dates in this document have been modified for the 2009 rearing season but the original criteria remain as written for the first year of study and will apply to the 2009 study.

This draft Pilot Water Reuse Fish Rearing Criteria was developed in collaboration with WDFW staff and Chelan PUD representatives January 23, 2008. WDFW staff reviewed the criteria and provided recommendations that were accepted by the District and are included in the pilot program. These final criteria will be part of the 2009 pilot study covered in the Statement of Agreement October 2008.

Pilot study disease and rearing criteria

1. Juvenile summer Chinook disease identification and treatment requires consideration of multiple variables and conditions. The pilot water reuse study will track water quality and study conditions per the attached monitoring and evaluation paper. The Fish Health Monitoring and Evaluation is structured adequately, contains the correct magnitude of testing and observation and will be followed. However, rearing conditions, test duration, and further discussion among WDFW staff and Chris Good, fish veterinarian with Freshwater Institute, may lead to additional testing or other testing to improve the pilot test data. The data will create the basis for disease identification and treatment.

2. Observed fish disease and sickness among pilot study fish will be treated. Upon observation of abnormal fish behavior or physical condition, the Complex Manager, John Penny, will contact Bob Rogers (WDFW Fish Pathologist) and the District. In

coordination, Bob Rogers, John Penny, and Chris Good will develop:

   a. Possible cause of the fish health condition
   b. Recommended changes to pilot conditions
   c. Recommended treatments and
   d. Record of observations and actions to resolve the conditions

3. An acute fish health event (epizootic) could be defined as 0.08 percent mortality for three consecutive days (i.e. 0.0008 X 50,000 fish = 40 fish). The District and WDFW recognize waiting to observe continued fish health deterioration to this point is not recommended or practical. Upon observing as few as five daily mortalities, WDFW and the District will begin discussions. Upon documenting sickness, disease, or causative conditions, and group consultation, WDFW will prepare treatment recommendations and may take action. Anticipated actions include:
   a. Changing the reuse water proportion
   b. Changing water quality
   c. Treatment with medications (water treatment or feed)
4. WDFW and the District will inspect pilot study fish, compile data, and create recommendations for final fish rearing and release. At the September 2009 HC meeting there will be a data review and recommendation for final rearing conditions. Location, cohort co-mingling, and possible continued cohort biological analysis will be decided at that time.
5. Fish mortality among pilot study fish will be compared to survival standards per Table 1. Mortality will be compared to cohorts in a standard raceway as well. Wenatchee Summer Chinook have been reared in Eastbank raceways for over 17 years. Historical survival rates will provide a general basis for comparison at the study’s end.
6. If mortality exceeds life stage standards the study will be terminated unless extenuating

circumstances exist. Standards are contained in Table 1.

Table 1
Pilot Study Survival Standard

Standard	Ponding To 30-days	Ponding To 100-days	Ponding To Release	Transport To Release
Percent Survival	97	93	90	95

Temporary equipment failures, acute treatable fish illness, and unforeseen conditions that affect fish will not give cause to stop the study. Conditions that can not be changed or remedied will give cause to stop the study. Chronic illness, with mortality (approaching survival standards), and poor performance compared to cohorts in raceways will give cause to stop the study. If necessary either a flow through system in the circular ponds or transfer to annex raceways will occur.

2009 Partial Water Reuse Pilot Study

Chelan PUD and WDFW have observed no adverse affect on fish reared for 22-weeks in water reuse facilities. During this period the circular rearing pond flow has changed from flow through (0% reuse) to nearly 80% reuse. Based on this information the District hypothesizes that fish reared at higher density in the reuse system will perform equal to normal density fish reared in raceways. The District has proposed to rear 400,000 (200,000 in reuse tanks and 200,000 in standard raceways) yearling summer Chinook during 2008-2010 to test the hypothesis.

Chelan PUD met with WDFW staff and reviewed the necessary hatchery complex changes required to raise 400,000 yearling summer Chinook from the 2008 broodstock. John Penny and Sam Dilly met at Eastbank Hatchery on October 14, 2008 and identified changes to the fish management practices for the next year to accommodate the pilot test. The Table below identifies agreed upon program changes to accommodate the pilot study.

Life Stage	**Start-Finish**	**Program Modifications**	**Impacts**	**Mitigate Actions**
Incubation	Oct 2008 – June 2009	Place eggs from 2 females (double) in one tray for several stocks to create additional chilled incubation space for 200k eggs	Water hardening and chilled water source limit impacts of double loading	Reduce tray loads in February when space is available and test results provide health clearance
Early Rearing (Eastbank)	June 2009-Oct 2009	Place 200k fish in round ponds. Move Sockeye to occupy 4 RR annex troughs Place 53,000 Chinook in EBH standard raceway for comparison	Instead of rearing Sockeye at Eastbank Hatchery, Sockeye are reared at RR annex. Turtle Rock Chinook are reared at the annex, in one Eastbank standard raceway, and the pilot system	Provide adequate staff to move among facilities performing essential function Buy and plan for more CWTs
Final Rearing	Oct 2009-May 2010	Place 200k Chinook in net pens at Chelan Falls (100k of each cohort). Place 200,000 fish in Turtle Rock Island ponds	Requires more fish management at Chelan Falls Program requires more feed and staff activity	Secure additional net pens, provide adequate staff to manage essential functions

Based on the table information both WDWF and Chelan PUD are prepared to perform the 2009 pilot study.

FINAL Statement of Agreement
Regarding Summer Chinook Rearing at Ringold Hatchery and Eastbank Re-use Facility

Rocky Reach and Rock Island HCP Hatchery Committees
October 21, 2009

Statement of Agreement
The Rocky Reach and Rock Island HCP Hatchery Committees (Committees) agree that WDFW may produce up to 400,000 yearling Columbia River summer Chinook for acclimation and release at Chelan Falls and Turtle Rock (2009 brood year).

Secondly, the Committees agree that Chelan County Public Utility District No.1 (District) may proceed with rearing yearling summer Chinook using (1) the Re-use facility currently located at Eastbank Hatchery and (2) Ringold Hatchery according to the proposed path described in Attachment 1.

Background
This request represents a continuation of Turtle Rock/Chelan Falls yearling production from brood year 2008 (i.e., 400,000). The purpose of this effort is continue evaluation of rearing options to achieve the desired target of 600,000 yearling summer Chinook ultimately destined for acclimation at the proposed Chelan Falls acclimation facility. This decision is needed now because mating will be completed in the coming weeks and opportunity to create yearling fish (above the current 200,000 production plan target) will be eliminated. Broodstock have already been collected for 2009, but the fate of the eggs is in question (i.e., subyearling or yearling).

Secondly, The District has been testing the efficacy of (1) water Re-use at Eastbank Hatchery and (2) Ringold hatchery to rear summer Chinook for HCP production. The purpose of these alternative rearing methods is to reduce the demand for water at Eastbank and create additional space necessary for reaching the Districts' HCP production targets (including sockeye, spring Chinook and steelhead) in an expedient, efficient manner.

Previous SOAs have provided opportunities to evaluate both Re-use and Ringold approaches.

From the October 27, 2008, SOA: *Regarding Pilot Study For Partial Reuse*, the Committee agreed to evaluate rearing fish at higher densities in the Re-use system:

"The Rocky Reach and Rock Island HCP Hatchery Committees (hereafter "Committees") agree that Chelan County PUD (hereafter "District) can perform the second year of the partial water reuse pilot study. Approximately 200,000 Wells Summer Chinook from the District's Turtle Rock Island program will be converted from the subyearling program (reducing the subyearling program by 200,000 fish) and will be reared on partial water reuse utilizing circular ponds. This effectively doubles the density from the 2008 pilot study. The Committees agree to allow the District to perform the study as outlined in the attached Pilot Water Reuse Fish Rearing Criteria (2009) and the Partial Water Reuse Pilot Study Monitoring and Evaluation (2009)."

From the June 17, 2009, SOA: *Use of Ringold Springs Hatchery*, the Committee agreed to evaluate Ringold springs and alternative rearing densities to rear yearling summer Chinook:

"The Rocky Reach HCP Hatchery Committee (Committee) agrees that Chelan County Public Utility District No.1 (the District) can rear up to 200,000 summer Chinook (2008 brood) at the Ringold Springs Hatchery (Ringold) during the summer of 2009. The fish to be reared at Ringold in 2009 will be from the portion of the District's Similkameen River summer Chinook obligation that are reared during the winter and released at the Bonaparte Rearing Pond. Approximately one half of the fish will be reared at density index (DI) of 0.125 and the other half at 0.20. Each group of fish reared at the different density will be differentially coded wire tagged. After fish are transferred from Ringold to Bonaparte Pond, the Committee will review the fish rearing data and determine the District's ability to use Ringold in the future."

The Ringold SOA also identified several key opportunities provided by the additional space at Ringold, and subsequent reduced demand at Eastbank:

"If ultimately successful, this proposed program change may provide the following benefits (particularly if the 600,000 Turtle Rock Island yearling program is reared at Ringold):

- Freeing capacity at Eastbank Hatchery which could then be used for Lake Wenatchee Sockeye alleviating the need to provide biosecurity measures at Chelan Hatchery.
- Converting the Turtle Rock Island sub-yearling program to a yearling program more rapidly. Though the Chelan Falls rearing facility is not scheduled to be substantially complete until 2012, this would allow yearlings to be released from Turtle Rock Island and probably provide a higher smolt survival and adult return."

FINAL

Rocky Reach and Rock Island HCP Hatchery Committees
Statement of Agreement
Regarding the use of Circular Culture Tanks at Chelan Falls

May 19, 2010

The Rocky Reach and Rock Island Habitat Conservation Plans' (HCP) Hatchery Committees (hereafter "Committees") agree that the Chelan PUD (hereafter "District") may use circular culture tanks with a dual-drain system to rear and acclimate summer Chinook at the proposed Chelan Falls facility. The District proposes to acclimate these fish at or below 0 .2 density index (DI) unless the outcome of the 2010 evaluation of re-use at double density, scheduled for September 2010 (see 10/21/2009 SOA), indicates that fish reared at higher densities do not perform as well as single density counterparts. Under the latter scenario, fish would be reared at 0.1 DI or lower. The design would include four circular tanks to support a 0.2 DI or eight circular tanks to support a 0.1 DI. The water supplied to the acclimation tanks would be single-pass.

The following metrics for success would be met to maintain the proposed four tank design at Chelan Falls (i.e., these targets would need to be met or Chelan would build additional tanks):

- Hatchery acclimation survival rate exceeds 90% "Ponding to Release" standard from monitoring and evaluation plan.

- WDFW fish health supports post-release determination that fish health standards were met and not compromised by acclimation densities.

- The absolute survival of summer Chinook reared and acclimated in circulars at .2 DI would be compared against the performance of other smolts (from the same origin broodstock-Entiat summer Chinook) released above Rocky Reach Dam during the initial years of implementation. Key metrics would include survival from release to McNary and migration time from Rocky Reach to McNary. Success would require that Chelan Falls smolts perform as well or better than the existing programs (e.g., statistically no detectable difference or significantly better using the same parameters as the existing re-use comparisons). The overall purpose of the comparison is to measure performance against an existing, approved hatchery program.

- If Chelan Falls fish reared at 0.2 DI do not perform equal to an existing upper Columbia summer Chinook program, the District would rear fish at a lower HCP HC approved DI (e.g., .1 DI) and use net pens to hold excess fish quantities. Similar comparisons of survival and migration time to McNary (including net pens vs. low density re-use) would be performed to partition the effects of DI and location (e.g., is the survival of fish released at Chelan Falls influenced more by DI or the Chelan Falls location itself). If DI is the causative parameter in rearing success at Chelan Falls, then the District would create a 0.1 DI rearing system for the 600,000 fish.

This agreement does not change any survival targets or the District's obligation to meet NNI levels described in the HCP.

Background

The District proposes to use circular tanks for the following reasons:

- Capture of particulate waste is more efficient and rapid in dual-drain circular tanks when compared to raceways or earthen ponds. Total suspended solids (TSS) removal in a raceway is 25-51% and is mainly achieved through manual vacuuming. Comparatively, a circular bottom-drain (as a component of a dual drain system) can remove 79% of TSS. Additionally, circular tanks can self clean, removing waste within minutes of deposition[1].
  Significance: Wastewater management and effluent quality are major hatchery effects and are likely to be subject to additional regulatory control in the near future. The rapid removal of TSS prevents waste products from decomposing into soluble, toxic forms and improves effluent quality. From the District's perspective, being proactive on water quality issues is likely to be an important step to ensuring stable hatchery operations.
- The rotation of water in a dual-drain circular tank ensures uniform distribution of fish and reduction of major dissolved O_2 profiles.
  Significance: In a standard raceway dissolved O_2 levels are spatially heterogeneous resulting in microhabitats that possess variable water quality. Accordingly, fish distribute themselves in a non-homogenous fashion and experience different rearing conditions based on the relative position of a fish and the shape of the raceway.
- Opportunity to add reuse or treatment systems in the future.
  Significance: If water quantities become limited in the future, the circular tank design is amenable to re-use and subsequently, fish health treatments (e.g., UV disinfectant) that are only feasible under lower flow conditions. The water-use flexibility afforded by a circular tank design is another important consideration for program stability
- Potential for improved smolt survival and reduced precocity
  Significance: Smolts emigrating from the first year of the re-use pilot (using circular tanks) survived at 33% higher level and arrived several days sooner than their raceway counterparts migrating to McNary Dam. The incidence of male precocity was also lower among fish originating from the re-use system. The survival differential is highly significant and likely attributable to the rotational velocities and swimming performance required in the circular tanks. Precocity rates may also be related to swimming activity.
- Overall synopsis: From the District's perspective the potential benefits of using circular tanks outweigh the risks. From a water quality and survival standpoint, the District would rather take a proactive approach to achieve these benefits than adopt the standard approach which may

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[1] Steven T. Summerfelt, John W. Davidson, Thomas B. Waldrop, Scott M. Tsukuda, Julie Bebak-Williams, A partial-reuse system for coldwater aquaculture, Aquacultural Engineering, Volume 31, Issues 3-4, October 2004, Pages 157-181

ensure some short term certainty but is likely to encounter major regulatory hurdles down the road.

The District proposes to rear and acclimate at 0.20 DI for the following reasons:

- Successfully rearing at higher densities in circular tanks has been empirically demonstrated by Chelan PUD and in the literature[2]. Because of the waste management, water quality and fish distribution attributes of a dual-drain circular tank, fish experience different and better rearing conditions than a standard raceway. The acclimation densities for the HCP program were chosen on the basis of a standard raceway model and do not necessarily apply to a circular design that is fundamentally different. The findings, thus far, in the re-use pilot are encouraging and suggest that circular tanks may provide an efficient means to produce high quality smolts.
- The choice to rear and acclimate fish at 0.2 DI will be dependent on the successful health assessment and outmigration of fish reared in this year's double density pilot program. The facility will be plumbed to accommodate up to four additional tanks, in the event that any issues arise as a result of culturing fish at a 0.2 DI. Additionally, the adjacent net pen facilities would be available to provide an emergency reduction in density for the initial year of implementation.
- Ultimately the District accepts any risk of not meeting HCP targets that result from the use of new technology. With this in mind, the data available to the District suggest that the current proposal will succeed and survival may improve.

Additional considerations with respect to density:

- The District is focused on density index not flow index. The flow to 4 tanks is the same flow that would go to raceways or to six or eight tanks. The flow index was set when we applied for a water right in approximately spring of 2008.

- In circular ponds water flow is used to create a better rearing environment. In this design, flow rates are relatively high and there is a low hydraulic residence time. Low hydraulic residence time correlates to exchanging water and causing entrained waste and feed to be removed. The result is better water quality. If the District were to increase the number of tanks and keep the flow rate constant we would decrease the exchange rate. Thus the fish would be at a lower density but ultimately may experience worse water quality.

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[2] Ibid

APPENDIX N
FINAL BY 2014 WENATCHEE STEELHEAD RELEASE PLAN

Memorandum

Date: February 18th, 2015

To: HCP Hatchery Committees

From: Chris Moran (WDFW), McLain Johnson (WDFW) and Catherine Willard (CPUD)

Re: 2015 Wenatchee Steelhead Release Plan (Brood Year 2014)

Background

Chelan PUD is required to produce 247,300 steelhead smolts for release into the Wenatchee River Basin in 2015 as part of the Rock Island and Rocky Reach HCP requirements. As of February, approximately 266,000 Wenatchee summer steelhead (131,146 HxH and 134,429 WxW) are on station at the Facility.

Beginning in winter 2011 the Chelan PUD Wenatchee River steelhead program was relocated to the Chiwawa Acclimation Facility ("Facility") (Figure 1) following significant upgrades to accommodate tributary based overwinter acclimation for the Wenatchee steelhead program. Steelhead are transferred from Eastbank Hatchery to the Facility in November and released in April through May. The Facility consists of three, in line circular, dual-drain tanks within an enclosed building and are operated on a partial water reuse system (RAS). The two outer tanks hold steelhead during rearing and the center tank is used solely for receiving fish that are allowed to move from the outer tanks to the center tank during release. Fish are not provided the opportunity to move to the center tank until gates are removed (typically April 20th). When the center tank contains a pre-determined number of fish for a release, fish are loaded into a hatchery truck and truck-planted at one of five release locations. This "screening" method has been used to differentiate between apparent active migrants (fish that move from the outer tanks to the center tank) from apparent non-active migrants (fish that do not move from the outer tank to the center tank).

In addition to the circular vessels, there are three traditional flow-through raceways (RCY) located outside. The smaller of the three, Raceway Three (RCY3) is used to rear steelhead when it is not needed for rearing "high ELISA" spring Chinook juveniles. Raceways One (RCY1) and Two (RCY2) are located adjacent to each other. The wall between the two raceways contains a gated opening that when removed, allows fish to move between the raceways. In addition to removing the gate, the water is lowered in the receiving pond (typically April 20th) to establish a directional flow that apparent active migrant fish may cue to. Similar to the RAS vessels, this set-up allows for a screening method that attempts to differentiate between apparent active- and apparent non-active migrants. When RCY1 contains the pre-determined number of fish suitable for release, fish are loaded into a transport truck and truck-planted at one of five release locations. Historically, this screening method has been termed a volitional release but is currently termed a screening method as this more accurately describes the end result of the action.

2015 Release Strategy Objectives

- Evaluate best hatchery management practices for hatchery releases to optimize homing fidelity, minimize residualism, maximize out-migration survival, and minimize negative ecological interactions (Draft NMFS Wenatchee River Steelhead Section 10 Permit).
- Assess hatchery release practices to inform development of a residualism baseline for the Wenatchee steelhead program consistent with the Draft NMFS Wenatchee River Steelhead Section 10 Permit DRAFT Steelhead Residual Management Plan.
- Utilize data collected from the 2015 Wenatchee River Steelhead release to assess applicable monitoring and evaluation objectives (i.e., Objectives 4 and 6) for the Wenatchee River summer steelhead hatchery program (Hillman et al. 2013).

Methods

The 2015 release strategy will evaluate the effectiveness of the screening method, and the role of rearing vessel (RAS versus FT), and brood origin on fish performance (e.g., juvenile survival and SARS). A similar evaluation of this screening method (termed volitional release) was conducted in 2013, where approximately 20,000 passive integrated transponder (PIT) tagged juvenile steelhead were utilized for detailed monitoring and evaluation of post release performance. For 2015, the release numbers and locations identified in Table 1 will build on the 2013 release data and enable a more thorough investigation of the screening methodology at the program level.

Release Timing

Wagner et al. (1963) suggested that the optimal release date of hatchery steelhead is equal to the peak of the wild steelhead emigration in the same watershed. Additionally the Draft NMFS Wenatchee River Steelhead Section 10 Permit states the following "The Permit Holders will release hatchery origin smolts at 6 fish per pound when fish are ready to emigrate directly to the ocean and during the period in which natural origin smolts out-migrate from the Wenatchee Basin". Based on the last five years of Lower Wenatchee smolt trap outmigration data, natural origin Wenatchee steelhead emigration peaks the first week of May. In 2013 survival to McNary Dam for Wenatchee hatchery steelhead juveniles was found to be negatively related to release date (r=-0.506, p=0.04) and positively related to juveniles detected in the Wenatchee Basin after July 1 (Figure 1). In an effort to more closely align hatchery steelhead releases with the peak outmigration period for wild steelhead and potentially increase smolt to smolt survival, all fish located at the Facility will be released by May 8th; fish acclimated at Blackbird Island Pond will be allowed to volitionally move out of the pond through the end of June (after which time the pond outlet will be closed as in years past).

Release Location

In an effort to reduce potential steelhead residualism, consistent with objectives of this steelhead release plan and found in the Draft NMFS Wenatchee River Steelhead Section 10 permit, two historic hatchery steelhead release locations, RKM 15.6 of the Chiwawa River and RKM 19.3 of Nason Creek, will be eliminated for the 2015 release. Hausch and Melnychuk (2012) completed a meta-analysis of hatchery practices and residualization of hatchery steelhead and found that releases of fish located closer to a confluence with a major river produced fewer residuals than those located further upstream. The remaining release locations, one each in Nason Creek, Chiwawa River, upper Wenatchee River, and the lower Wenatchee River are included in Table 1 below.

Pre-release Monitoring and Evaluation

Throughout acclimation and release, established sampling, transfer and release protocols will be followed (Hillman et al. 2013). Additionally, assessment of precocial maturation will be conducted via lethal sampling from Raceways 1 and 2 (n=150 “first movers”; n=150 “late movers”, n= “150 non-movers”. Prior to transfer and release, WDFW and CCPUD will develop a detailed plan that ensures all procedures for assessing precocial maturation (e.g. lengths, weights, gonadal mass measurements, etc.) are followed.

Table 1. Steelhead release numbers and locations, 2015.

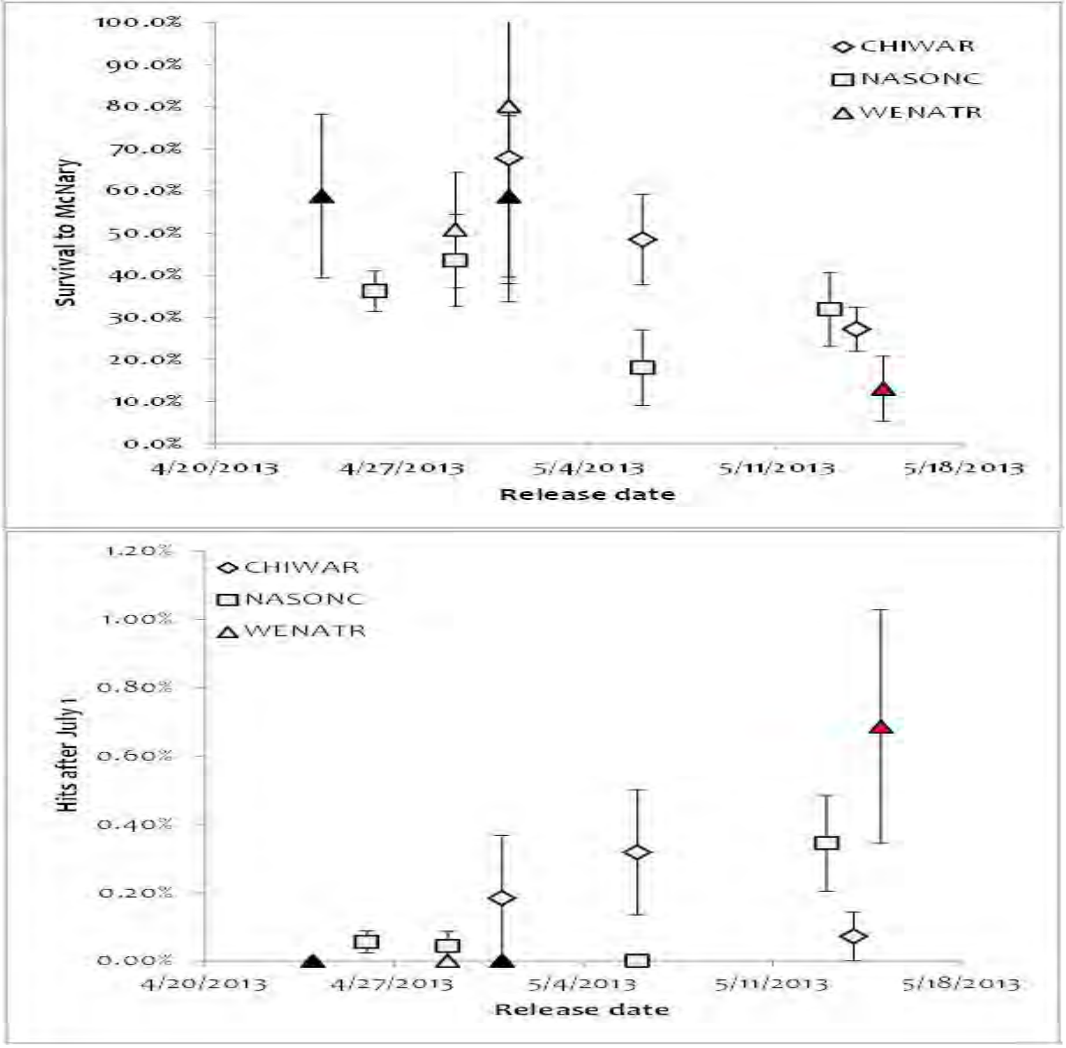
Vessel	Origin[1]	Number	Estimated # PIT-tagged	Destination	rkm	Screened or non-screened method
RAS1	WxW	6,250	1,225	Nason	7.0	Non-screened
RCY1	Mixed	29,640	1,667	Nason	7.0	Screened
RAS2	WxW	6,250	1,225	Nason	7.0	Screened
RCY2	Mixed	29,640	1,667	Nason	7.0	Non-screened
		71,780		**Total**		
RAS1	WxW	6,250	1,225	U. Wenatchee	79.2	Non-screened
RCY1	Mixed	49,000	2,756	U. Wenatchee	79.2	Screened
RAS2	WxW	6,250	1,225	U. Wenatchee	79.2	Screened
RCY2	Mixed	49,000	2,756	U. Wenatchee	79.2	Non-screened
		110,500		**Total**		
RCY2	Mixed	28,046	1,577	Chiwawa	11.4	Non-screened
RCY1	Mixed	28,046	1,577	Chiwawa	11.4	Screened
		56,092		**Total**		
RCY1	Mixed	TBD		L. Wenatchee	40.2	Non-movers
ELISA	HxH	28,196	2,100	Blackbird	40.5	N/A

[1] Mixed = HxH and WxW.

[2] Both forced and volitional releases will occur April 20 - May 8; any remaining non-migrants will be released by May 8.

Figure 1. Chiwawa Acclimation Facility site description.

Figure 2. Wenatchee yearling steelhead survival (top panel) and proportion of fish detected in-basin after July 1 (lower panel) by release sites and dates.



* Red fill represents the release of non-exiting fish, black fill represents fish forced-released, and open fill represents fish volitionally released.

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APPENDIX O
CHELAN PUD 2016 HATCHERY M&E IMPLEMENTATION PLAN

Chelan County PUD Hatchery Monitoring and Evaluation Implementation Plan 2016

Prepared by:

Alene Underwood and Catherine Willard

July 2015

Contents

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: 2013 Update"* (Hillman et al. 2013) and the "*Conceptual Approach to Monitoring and Evaluating the Chelan County Public Utility District Programs*" (Murdoch and Peven 2005).

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 2016. Additionally, monitoring and evaluation activities for Lake Wenatchee sockeye in 2016 are included in this document. As monitoring tasks are completed in 2015 and are evaluated for their efficacy, methodologies to accomplish the tasks defined in the 2016 Implementation Plan may be modified [with Habitat Conservation Plan's Hatchery Committee (HCP-HC) approval].

The work described in this plan has Endangered Species Act (ESA) coverage provided by NFMS Section 10(a)(1)(A) permits 18121 and 1395 and Section 10(a)(1)(B) permit 1347. All activities conducted under this Implementation Plan shall adhere to all terms and conditions as specified in the referenced permits. 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. 2013. 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.

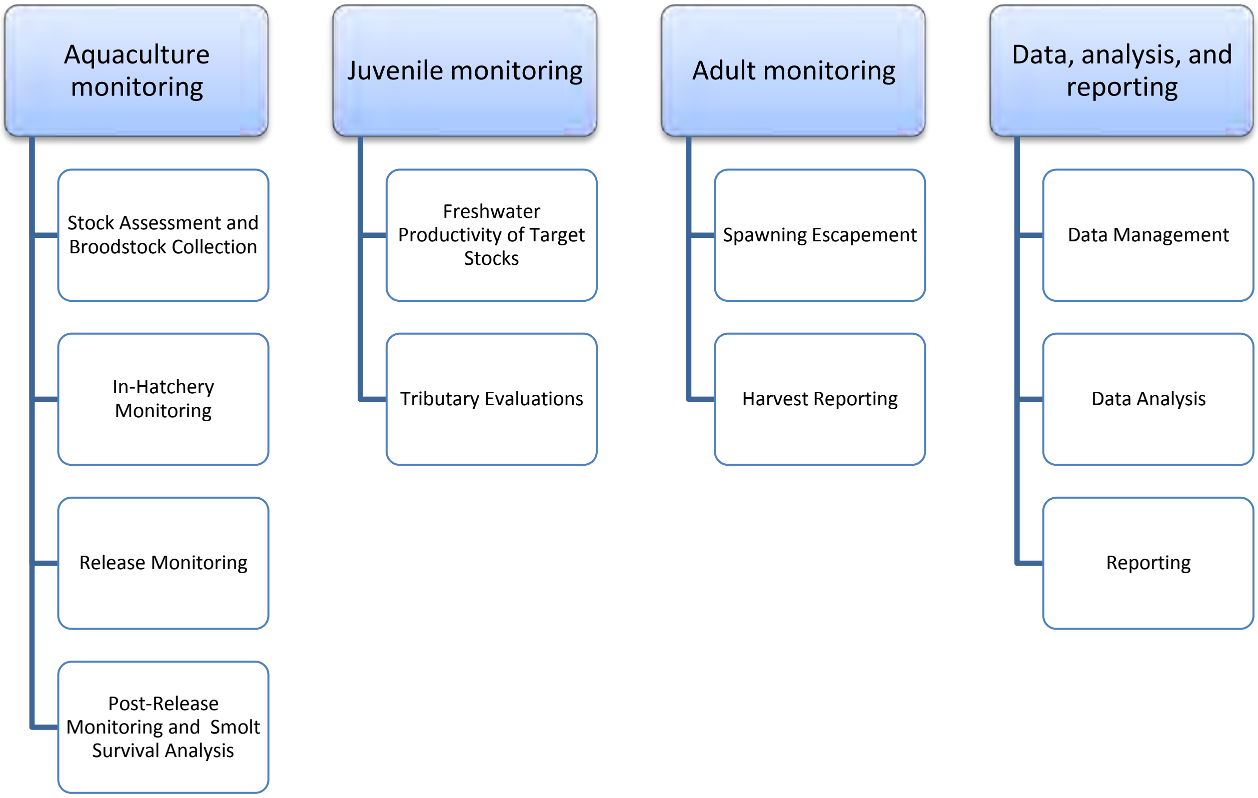

Figure 1. The four components of the hatchery monitoring and evaluation program and the study design elements within each component.

Table 1. Study design elements performed by entity, and the associated objectives for each study design element as referred to in Hillman et al. 2013.

Monitoring and evaluation component	**Objectives[1]**	**Study Design Elements**	**Chiwawa spring Chinook**	**Wenatchee summer Chinook**	**Methow spring Chinook[3]**	**Chelan Falls summer Chinook[4]**	**Wenatchee Steelhead**
Aquaculture Monitoring	3,5,8	Stock assessment and broodstock collection	WDFW	WDFW	WDFW	WDFW	WDFW
	5, 8	In-hatchery monitoring	WDFW CPUD[2]	WDFW CPUD[2]	WDFW CPUD[2]	WDFW CPUD[2]	WDFW CPUD[2]
	9	Release monitoring	WDFW	WDFW	WDFW	WDFW	WDFW
	9	Post-release monitoring and smolt survival analysis	WDFW	WDFW	WDFW	WDFW	WDFW
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
	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 addressed at the next 10 year HCP check-in.

[2] CPUD crews will PIT tag in-hatchery fish.

[3] In 2016, monitoring and evaluation for the Methow spring Chinook program is described in "Implementation of Comprehensive Monitoring and Evaluation of Wells Hatchery Complex Programs".

[4] Because the Chelan summer Chinook program is primarily an augmentation program, 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. 2013). Table 2 below provides a summary of the variables to be measured in 2016 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. 2013) 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 Broodstock Collection Protocol approved annually by the HCP-HC and relevant permits. Data collection during broodstock collection will be consistent with Murdoch and Peven (2005). A representative sample of fish trapped throughout the entire run, either collected for broodstock or released back to the river, will be sampled for origin, age, sex, size, and migration timing. Biological sampling of all fish trapped will include presence of internal (CWT or PIT) and external (VIE) tags or marks, scales, length, and sex (determined by ultrasound). PIT tags will be injected into all target species (Chinook and steelhead), whether collected for broodstock or released back to the river to monitor for potential fallbacks. All non-target species will be enumerated daily. Measures of central tendency and spread will be calculated and reported for each metric.

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. Life stage specific in-hatchery survival and growth rates, disease monitoring, and an estimate of the number of fish released will be collected and analyzed according to Murdoch and Peven (2005). Additional data to be collected includes individual lengths and weights of juveniles during monthly sampling, and the weight of gonadal mass and body of spawned broodstock. Measures of the central tendency and spread will be calculated and reported for each metric.

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 as an Addendum to this Plan. 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 (Table 3) at Eastbank Hatchery approximately two to four weeks before the fish are transferred to acclimation ponds or in the spring prior to release. 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.

Program	Release goals	Number of fish PIT tagged[1]	PIT tag rate (%)
Chiwawa spring Chinook	144,026	10,000	3.5
Wenatchee steelhead	247,300	20,000	8.0
Wenatchee summer Chinook	318,816 (CPUD Program) 181,184 (GPUD Program)	20,600[2]	4.1
Methow spring Chinook	60,516	10,000	16.6
Chelan Falls summer Chinook	576,000	10,000	1.7

[1] Additional PIT tagging may take place for Chelan PUD approved studies and/or comparisons.

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 Murdoch and Peven (2005), 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. 2013). 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 Murdoch and Peven (2005), 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. Monitoring of steelhead released in the Wenatchee River sub-basin will occur during loading of fish into transport trucks, unless fish are released directly into the Chiwawa River. Steelhead will pass through a series of PIT-tag antennas, each connected to a data logger, thereby allowing the creation of a PIT-tag observation file for each truckload of steelhead consisting of unique tag records. The release location (stream and rkm), release type (volitional or forced), and hatchery group (HxH or WxW) will be recorded for each tag file created. PIT-tagged fish in each observation (release) file are assumed to represent untagged fish. However, because PIT-detection efficiency during loading will not be 100%, 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 Murdoch and Peven (2005), 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. Should PIT tagging occur, a monitored release strategy consistent with other Chinook stocks (i.e., Chiwawa Spring Chinook) will be implemented. 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 (Murdoch and Peven 2005). 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 Murdoch and Peven (2005). 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. 2013). Table 4 below provides a summary of the variables to be measured in 2016 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. 2013) 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, parr [where appropriate], 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 newly 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 PIT tagged in the Chiwawa River in the fall, based on the spatial distribution and abundance estimated during parr snorkel surveys, to generate estimates of migration during the non-trapping periods. A random sample of a minimum of 10 percent of fish per remote site 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 the lower Wenatchee PIT tag array and analyses with the TribPit Survival software program and/or estimating survival of fall parr and spring smolts to McNary. PIT-tag mark-recapture trials conducted during the trapping period in the 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). Historical estimates will be revised using the new estimation techniques.

Specific actions to monitor the freshwater productivity of supplemented spring Chinook salmon in the Methow sub-basin have yet to be determined. As these become available, the plan will be amended and presented to the HC by December.

3.2 Tributary Evaluations

Chiwawa River

Snorkel surveys will be utilized to estimate parr abundance within the Chiwawa subwatershed during the summer. This approach has been used in the Chiwawa subwatershed since 1992. In parallel to addressing Objective 2, additional juvenile data can help to assess the habitat carrying capacity in each tributary. This information can add value to the overall M&E plans and help inform management decisions.

Sampling will follow a stratified random sampling design. Landscape classification will be used to stratify streams in the Chiwawa subwatershed that support juvenile Chinook salmon. In the Chiwawa subwatershed, WDFW found that classification "explained" most of the variability in fish numbers caused by geology, land type, valley bottom type, stream state condition, and habitat type (Hillman 2013). The same classification method was used to identify sections of the Little Wenatchee River (reference area) that corresponded to discrete reaches in the supplemented subwatersheds, but that had no release of hatchery Chinook. Consistent with previous efforts, habitat types within each land-class or reach will be identified and quantified annually. At least three units of each habitat type within each reach will be randomly selected for estimating densities of salmon and trout. Thus, overall sampling consists of a stratified-random sampling design, which increases the accuracy and precision of population estimates.

Densities of salmon and trout will be estimated in August and September by direct underwater observation within the randomly-selected habitat units. Underwater methods will follow those described by Thurow (1994), Dolloff et al. (1996), and O'Neal (2007). Habitat surface areas and volumes will be estimated during fish sampling. Numbers of fish counted will be adjusted for detection probabilities using the models published in Hillman et al. (1992). For each habitat type within a state type and reach stratum, the mean density of salmon and trout will be calculated as the ratio of mean numbers to mean area or volume sampled (Cochran 1977). Total numbers of fish will be estimated per habitat type within a state type and reach stratum as the product of mean density of fish in a given habitat type, times total area or volume of that habitat type within the stratum (Cochran 1977). Total numbers of fish within the supplemented subwatershed will be estimated as the sum of all population numbers per habitat type in state type/reach strata. Bootstrapping methods will be utilized to estimate variance and percent errors (based on 95% confidence interval) for total numbers of fish.

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 2016 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. 2013) 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 8: 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)*
Objective 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.	• 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 Murdoch and Peven (2005). 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

The number of hatchery and naturally produced steelhead returning to the Wenatchee sub-basin will be estimated using a PIT tag mark recapture model. The estimated spawner abundance for the Wenatchee steelhead population will be a combination of PIT tag-based tributary and redd-based mainstem Wenatchee River estimates. Steelhead redd counts will be conducted weekly in all major spawning areas in the mainstem Wenatchee River (see Appendix A for survey reaches); minor spawning areas in the mainstem Wenatchee River will be surveyed once, based on the spawn timing in adjacent major spawning areas, to estimate redd abundance at peak spawning. 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.

Chiwawa and Methow Spring Chinook

Chiwawa spring Chinook and Methow 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 Murdoch and Peven (2005). Weekly redd and carcass surveys will be conducted simultaneously from the first week of August through September (see Appendix A for 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 currently under development 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 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. In addition, all redds and female 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 counts will begin the last 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 Murdoch and Peven (2005). 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 currently under development by WDFW. Weekly ground-based estimates and the true number of redds determined via intensive surveys will be compared in order to determine observer efficiency. Weekly river characteristics (e.g., channel width, water depth, discharge, visibility, and habitat complexity), observer experience, and survey effort will be incorporated into a model to predict observer efficiency in all river reaches. Predicted redd observer efficiency for each river reach will be used to expand ground-based redd counts to estimate the total reach redd count. Ground-based surveys will also be used to estimate redd life for each river reach. The estimated spawner abundance in the Wenatchee River and an associated level of precision will be calculated using the estimated total redd count for each reach, mean redd life, and the sex ratio of the population similar to methods described in Millar et al. (2012). Salmon carcass data collected during spawning ground surveys will be consistent with Murdoch and Peven (2005). 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 (Murdoch and Peven 2005). 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: 2013 Update (Hillman et al. 2013). 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 is proposing to conduct monitoring and evaluation (M&E) activities to track key population attributes related to Lake Wenatchee sockeye salmon in 2016 (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) tagging up to 5,000 PIT tags for 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 proposed 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

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[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 COUNTY PUD HATCHERY PROGRAMS

MONITORING AND EVALUATION OF THE CHELAN AND GRANT COUNTY PUDs HATCHERY PROGRAMS

2014 ANNUAL REPORT

June 1, 2015

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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), and BioAnalysts, Inc. An extensive amount of work was conducted in 2006 through 2014 to collect the data needed to monitor the effects of the Chelan and Grant County PUD Hatchery Programs. This work was directed and coordinated by the Habitat Conservation Plan (HCP) Hatchery Committees, consisting of the following members: Bill Gale, U.S. Fish and Wildlife Service (USFWS); Rob Jones, Craig Busack, and Lynn Hatcher, National Marine Fisheries Service (NMFS); Catherine Willard and Alene Underwood, Chelan PUD; Tom Scribner and Keely Murdoch, the Yakama Nation; Mike Tonseth, WDFW; Kirk Truscott, Confederated Tribes of the Colville Reservation (Colville Tribes), and Mike Schiewe, Anchor QEA (Chair). This report also includes monitoring efforts funded by Grant County Public Utility District (Grant PUD). Grant PUD helps fund the spring and summer Chinook monitoring programs. 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 and Peter Graf.

The approach to monitoring the hatchery programs was guided by the updated monitoring and evaluation plan for PUD hatchery programs (Hillman et al. 2013). Technical aspects of the monitoring and evaluation program were developed by the Hatchery Evaluation Technical Team (HETT), which consisted of the following scientists: Carmen Andonaegui, WDFW; Matt Cooper, USFWS; Steve Hays, Chelan PUD; Tracy Hillman, BioAnalysts; Tom Kahler, Douglas PUD; Russell Langshaw, Grant PUD; Greg Mackey, Douglas PUD; Joe Miller, formerly Chelan PUD; Josh Murauskas, formerly Chelan PUD; Andrew Murdoch, WDFW; Keely Murdoch, Yakama Nation; Todd Pearsons, Grant PUD; and Mike Tonseth, WDFW. 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 comprehensive reports.

Most of the work reported in this paper was funded by Chelan and Grant PUDs. 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 also 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 ninth 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 hatchery fish returning to the spawning grounds are reproductively similar to naturally produced fish. 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 (Mackey et al. 2014; Pearsons et al. 2012).

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).

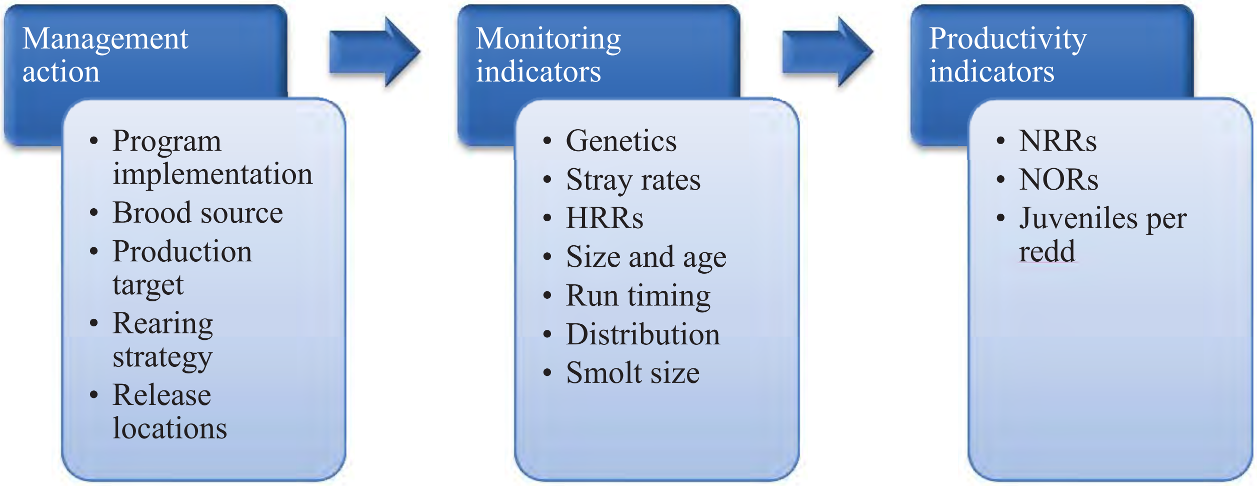

Figure 1.1. Relationship of indicators to the assessment of propagation programs. Management actions affect monitoring indicators, which influence productivity indicators. Monitoring indicators may be used to hypothesize the magnitude of influence on productivity.

Attending each objective is one or more testable hypotheses (see Hillman et al. 2013). 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. In the event that 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.

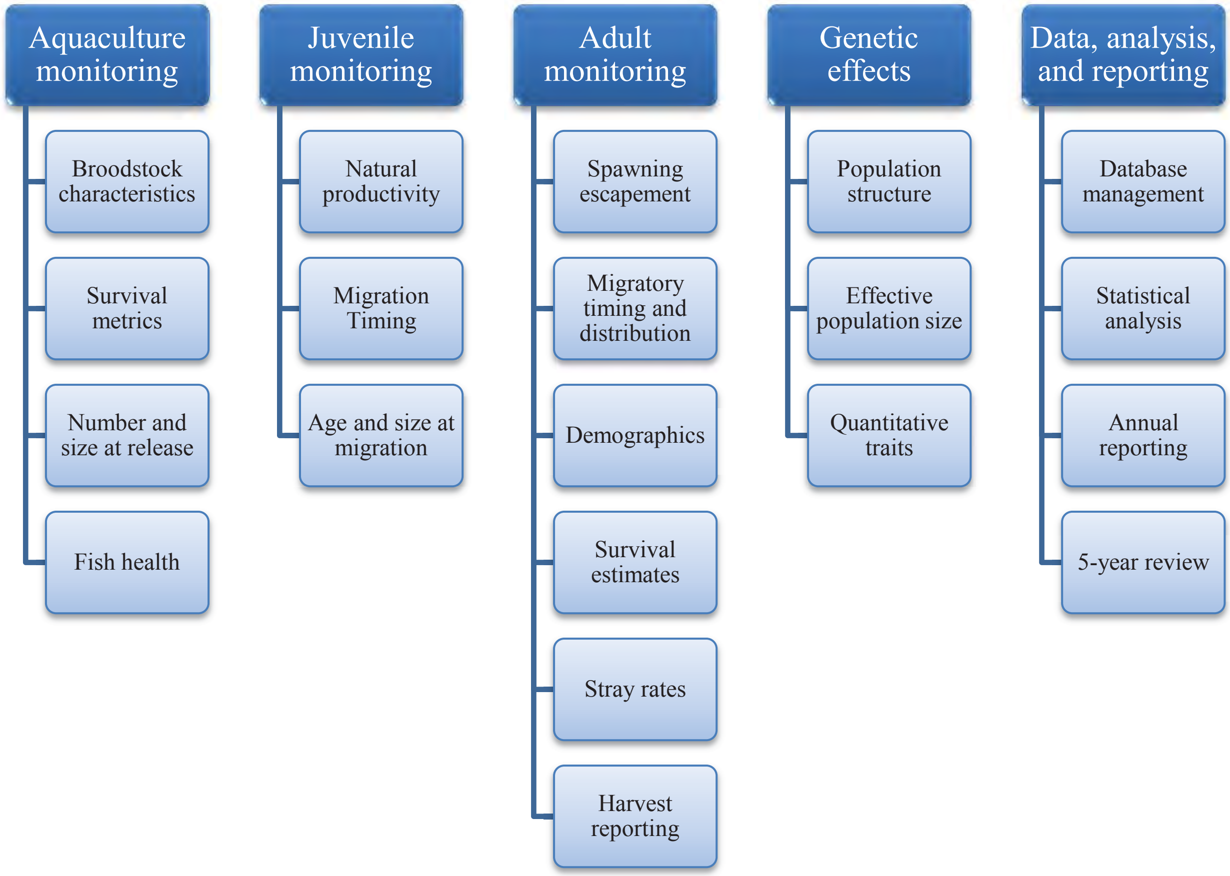

Figure 1.2. Overview of monitoring and evaluation plan categories and components (not including regional objectives).

Throughout each five-year monitoring period, annual reports will be generated that describe the monitoring and evaluation data collected during a specific year. This is the ninth annual report developed under the direction of the Hatchery Committees. The purpose of this report is to describe monitoring activities conducted in 2014. 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 reports). To the extent currently possible, we have included information collected before 2014.

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 salmon species, 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 (in lieu of Chelan PUD); however, we retained the Okanogan summer Chinook section in this report. The Okanogan summer Chinook section includes monitoring information up to 2013. Monitoring results for 2013 and beyond 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.

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) Permit No. 1395, which authorizes the annual take of adult and juvenile endangered upper Columbia River (UCR) spring Chinook and endangered UCR steelhead associated with implementing artificial propagation programs for the enhancement of UCR 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 UCR steelhead artificial propagation programs in the UCR region (NMFS 2003a).
2. ESA Section 10(a)(1)(A) Permit No. 18121, which authorizes the annual take of adult and juvenile endangered UCR spring Chinook and endangered 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 2004).
3. ESA Section 10(a)(1)(A) Permit No. 18118, which authorizes the annual take of adult and juvenile endangered UCR spring Chinook and endangered 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 2004).
4. ESA Section 10(a)(1)(A) Permit No. 18120, which authorizes the annual take of adult and juvenile endangered UCR spring Chinook and endangered 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 2004).

5. ESA Section 10(a)(1)(A) Permit No. 1347, which authorizes the annual incidental take of adult and juvenile endangered UCR spring Chinook and endangered 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 non-listed summer Chinook, fall Chinook, and sockeye salmon artificial propagation programs in the UCR region (NMFS 2003b).

SECTION 2: SUMMARY OF METHODS

Sampling in 2014 followed the methods and protocols described in Hillman et al. (2013). 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. 2013).

2.1 Broodstock Collection and Sampling

Methods for collecting broodstock are described in the Annual Broodstock Collection Protocols (Appendix A in WDFW 2014). 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 2014 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 2014.

Collection week beginning day	Chiwawa/Nason Spring Chinook[a]		Hatchery Chelan Falls Summer Chinook	Wild Wenatchee Summer Chinook	Methow Summer Chinook	Wenatchee Steelhead	
	Hatchery	Wild				Hatchery	Wild
29 June			90	120	18	1	1
6 Jul			70	12	16	1	1
13 Jul			70	30	16	2	2
20 Jul			40	66	12	3	3
27 Jul			36	30	10	3	3
3 Aug			22	10	10	3	3
10 Aug				6	8	2	3
17 Aug				4	6	2	2
24 Aug					6	2	2
31 Aug					4	2	3
7 Sep						3	3
14 Sep						5	5
21 Sep						5	5
28 Sep						5	5
5 Oct						6	6
12 Oct						6	6
19 Oct						6	8
26 Oct						6	6
Total	**66**	**138**	**328**	**278**	**106**	**63**	**67**

[a] Chiwawa/Nason Spring Chinook were collected from the Chiwawa Weir, Nason Creek (via tangle netting), and Tumwater from the week of June 22 through the week of August 10. No specific weekly objectives were generated.

Table 2.2. Biological and trapping assumptions associated with collecting broodstock for the Chelan and Grant PUD Hatchery Programs.[1]

Assumptions	Wenatchee Steelhead	Chiwawa Spring Chinook	Nason Spring Chinook (Conservation)	Nason Spring Chinook (Safety Net)	Wenatchee Summer Chinook	Methow Summer Chinook
Production level	247,300 yearling smolts	144,026 yearling smolts	125,000 yearling smolts	98,670 yearling smolts	500,001 yearling smolts	200,000 yearling smolts
Broodstock required	130 adults (not to exceed 33% of population)	74 adults (not to exceed 33% of population)	64 adults (not to exceed 33% of population)	66 adults	278 adults (not to exceed 33% of the population)	100 adults (not to exceed 33% of the population)
Trapping period	1 July-15 Nov	1 May – 15 July (Tumwater) 15 June-1 Aug (Chiwawa Weir)	23 June – 17 Aug	1 May – 15 July	1 July – 15 Sept	29 June – 30 Aug
# days/week	5	7 (Tumwater) Not to exceed 15 cumulative trapping days (Chiwawa Weir)	5	7	5	3
# hours/day	24	24 (Tumwater) 24 up/24 down (Chiwawa Weir)	24	24	24	16
Broodstock composition	50% HxH; 50% WxW	Sliding scale; minimum 33% wild (depends on the number of wild fish)	100% wild	100% hatchery	100% wild	100% wild
Trapping site	Dryden Dam for HxH; Tumwater for WxW. (Tumwater will be used if weekly quota not achieved for HxH at Dryden Dam; Dryden Dam will be used if weekly quota not achieved for WxW at Tumwater)	Tumwater Dam and Chiwawa Weir	Nason Creek Tangle Netting	Tumwater Dam	Dryden Dam (Tumwater will be used if weekly quota not achieved at Dryden Dam)	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

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[1] Throughout this document, "HxH" refers to hatchery by hatchery crosses and "WxW" refers to wild by wild crosses.

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 were estimated following procedures in Hillman et al. (2013). 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. (2013). 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 disease.

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. 2013).

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) or tagged (coded-wire tag) in 2014. Different combinations of marks and tags were used depending on the stock. In addition, in 2014, Chelan PUD personnel PIT tagged 10,114 juvenile hatchery Chiwawa spring Chinook and 20,234 juvenile Nason Creek spring Chinook in August; 15,180 Wenatchee steelhead (5,051 WxW steelhead and 10,129 HxH steelhead) during September; and 10,000 Chelan River summer Chinook in March, 10,159 Methow (Carlton) summer Chinook in August, and 20,641Wenatchee summer Chinook in September, November, and December. PIT tags will be 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. The goal of the program is that 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 met 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	10[a]
Methow Summer Chinook	200,000	163 (9.0)	45.4	15
Chelan Falls Summer Chinook (yearlings)	576,000	161 (9.0)	45.4	10[b]
Chiwawa Spring Chinook	144,026	155 (9.0)	37.8	18
Nason Spring Chinook	223,670	155 (9.0)	37.8	24
Wenatchee Steelhead	247,300	191 (9.0)	75.6	6

[a] An experimental release size of 30-45 grams (10-15 FPP) is in place for brood years 2012-2014.
[b] An experimental release size of 20-45 grams (10-22 FPP) is in place for brood years 2012-2014.

2.3 Juvenile Sampling

Juvenile sampling within streams included operation of rotary smolt traps, snorkel observations, and PIT tagging. Methods for sampling juvenile fish are described in Hillman et al. (2013).

A smolt trap was located on the Wenatchee River near the town of Cashmere at RM 8.3 (Lower Wenatchee Trap), in Nason Creek about 0.6 miles upstream from the mouth, in the White River, and in the Chiwawa River about 0.7 miles upstream from the mouth (Chiwawa Trap). All traps operated throughout the smolt migration period. The Chiwawa River, White River, and Nason Creek traps operated throughout most of the year (March through November), but not during icing or extreme high flow conditions. 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 by 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 the number of juvenile spring Chinook salmon, juvenile rainbow/steelhead, and bull trout within the Chiwawa River basin. 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. A total of 161 randomly selected sites were surveyed during August (Table 2.5). 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 fully explained in Hillman and Miller (2004).

Working in collaboration with the Comparative Survival Study (CSS) funded by BPA, crews PIT tagged juvenile wild Chinook, wild and hatchery steelhead, and wild sockeye salmon collected at the smolt 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 2.6. 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 of Chinook salmon 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 screw traps (e.g., fish passage during times when trapping is not possible).

Table 2.5. Location of strata and numbers of randomly sampled snorkel sites within each stratum that were sampled in the Chiwawa River Basin in 2014.

Reach/stratum	River miles (RM)	Number of randomly selected sites
Chiwawa River		
1	0.0-3.8	11
2	3.8-5.5	5
3	5.5-7.9	8
4	7.9-8.9	6
5	8.9-10.8	5
6	10.8-11.8	6
7	11.8-20.0	28
8	20.0-25.4	24
9	25.4-28.8	11
10	28.8-31.1	11
Phelps Creek		
1	0.0-0.4	1
Chikamin Creek (includes Minnow Creek)		
1	0.0-1.5	15
Rock Creek		
1	0.0-0.7	14
Unnamed stream on USGS map		
1	0.0-0.1	1
Big Meadow Creek		
1	0.0-1.0	7
Alder Creek		

Reach/stratum	River miles (RM)	Number of randomly selected sites
1	0.0-0.1	4
Brush Creek		
1	0.0-0.1	2
Clear Creek		
1	0.0-0.1	2

Table 2.6. Number of wild spring Chinook and steelhead proposed for tagging at different locations within the Wenatchee River basin, 2014.

Sampling location	Target sample size		
	Wild spring Chinook	Wild steelhead	Wild Sockeye
Chiwawa Trap	2,500-8,000	500-2,000	NA
Nason Creek Trap	2,500-8,000	500-2,000	NA
Lower Wenatchee Trap	500-1,000	50-250	3,000-5,000
Chiwawa Remote Sampling	3,000	NA	NA
Nason Remote Sampling	3,000	NA	NA

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. Fecundity was estimated from females collected for broodstock using an electronic egg counter. Numbers of emigrants and smolts were estimated at trapping sites and numbers of parr were estimated using snorkel observations only in the Chiwawa River basin. 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. (2013). Information collected during spawning surveys included spawn time, redd distribution, 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. Crews also conducted snorkel surveys to assess the incidence of precociously maturing fish spawning naturally in streams.

Steelhead surveys were conducted in major and minor spawning areas in the mainstem Wenatchee River and downstream from PIT-tag interrogation systems on the Chiwawa River,

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[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.

Nason Creek, and Peshastin Creek. These surveys were conducted during March through June in reaches and index areas described in Table 2.7. Total redd counts in these reaches were estimated by expanding counts within non-index areas by expansion factors developed within index areas.

Table 2.7. Description of reaches and index areas surveyed for steelhead redds in the Wenatchee River basin.

Stream	Code	Reach*	Index/reference area
Wenatchee River	W2	Sleepy Hollow Br to L. Cashmere Br	Sleepy Hollow Br to Cashmere Boat Rmp
	W6	Leavenworth Br to Icicle Rd Br	Leavenworth Boat Ramp to Icicle Ck
	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, and 5 (minor survey areas) are surveyed during peak spawning.

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. 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, but not in 2014 because of wildfires), 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 2.8.

Table 2.8. 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

Stream	Code	Reach	River mile (RM)
	N4	Lower RR Bridge to Whitepine Creek	13.2-15.4
Little Wenatchee River	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-Falls
White River	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
	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 2.9.

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.

Table 2.9. 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

Stream	Code	Reach	River mile (RM)
	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 2.10). Surveys were conducted weekly in all reaches. All redds were enumerated during weekly census counts.

Table 2.10. Description of reaches and index areas surveyed for summer Chinook redds in the Wenatchee River basin.

Code	Reach	River mile	Index/reference area (RM)
W1	Mouth to Sleepy Hollow Br	0.0-3.3	River Bend to Sleepy Hollow Br (1.7-3.3)
W2	Sleepy Hollow Br to L. Cashmere Br	3.3-9.5	L. Cashmere Br to Old Monitor Br (7.1-9.5)
W3	L. Cashmere Br to Dryden Dam	9.5-17.8	Williams Canyon to Dryden Dam (15.5-17.8)
W4	Dryden Dam to Peshastin Br	17.8-20.0	Dryden Dam to Peshastin Br (17.8-20.0)
W5	Peshastin Br to Leavenworth Br	20.0-23.9	Irrigation Flume to Leavenworth Br (22.8-23.9)
W6	Leavenworth Br to Icicle Rd Br	23.9-26.4	Icicle to Boat Takeout (24.5-25.6)
W7	Icicle Rd Br to Tumwater Dam	26.4-30.9	Icicle Br to Penstock Br (26.4-28.7)
W8	Tumwater Dam to Tumwater Br	30.9-35.6	Swiftwater Campgd to Tumwater Br (33.5-35.6)
W9	Tumwater Br to Chiwawa River	35.6-47.9	Swing Pool to Railroad Tunnel (36.7-39.3)
W10	Chiwawa River to Lake Wenatchee	47.9-54.2	Swamp to Bridge (52.7-53.6)

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 2.11 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 2.11. Description of reaches surveyed for summer Chinook redds and carcasses on the Methow, 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
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

Stream	Code	Reach	River mile (RM)
	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. Fish per redd ratios were estimated as the ratio of males to females sampled at broodstock collection sites and monitoring sites. 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 using mark-recapture methods. Adult sockeye were PIT tagged at Tumwater Dam and Bonneville Dam[3] 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 expected SARs and HRRs (from Peven and Murdoch 2005) for different stocks raised in the PUD hatchery programs are provided in Table 2.12. Methods for calculating these variables are described in Hillman et al. (2013) and in "White Papers" developed by the Hatchery Evaluation Technical Team (HETT) (see Appendices in Hillman et al. 2012).

Table 2.12. Expected smolt-to-adult (SAR) and hatchery replacement rates (HRR) for stocks raised in the PUD Hatchery Programs.

Program	Number of broodstock	Smolts released	SAR	Adult equivalents	Number of smolts/adult	HRR
Chiwawa Spring Chinook	74	144,026	0.003	432	333	5.8
Nason Creek Spring Chinook	66	125,000	0.003	375	333	5.7
Wenatchee Summer Chinook	278	500,001	0.003	1,500	333	5.4
Methow Summer Chinook	100	200,000	0.003	600	333	6.0
Wenatchee Steelhead	130	247,300	0.010	2,473	100	19.0

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 2008.

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[3] 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 Basin. Currently, HxH adult 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. Wild by wild (WxW) adult steelhead are collected from the run-at-large at Tumwater and Dryden dams if the weekly quotas cannot be achieved at Dryden 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 (beginning in 2012) is to collect 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 Dam and 1 September through 15 November at Tumwater Dam, with trapping occurring up to 24 hours per day, five days a week, at Dryden Dam left and right-bank traps and at Tumwater Dam. 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.

Prior to 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, spawning has occurred at Eastbank Fish Hatchery. 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 have also been 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, Nason, and Chiwawa basins.

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, since 2006, juvenile steelhead from different parental-cross groups (e.g., WxW, HxW, and HxH) have been PIT tagged annually.

3.1 Broodstock Sampling

This section focuses on results from sampling 2013 and 2014 brood years of Wenatchee steelhead, which were collected at Dryden and Tumwater dams. The 2013 brood begins the tracking of the life cycle of steelhead released in 2014. The 2014 brood is included because juveniles from this brood are still maintained within the hatchery.

Origin of Broodstock

A total of 147 Wenatchee steelhead from the 2012 return (2013 brood) were collected at Dryden and Tumwater dams (Table 3.1). About 43% of these were natural-origin (adipose fin present, no CWT, and no elastomer tags) fish and the remaining 57% were hatchery-origin (elastomer tagged and/or adipose fin absent) adults. Origin was determined by analyzing scales and/or otoliths. The total number of steelhead spawned from the 2013 brood was 117 adults (42% natural-origin and 58% hatchery-origin).

A total of 135 steelhead were collected from the 2013 return (2014 brood) at Dryden and Tumwater dams; 65 (48%) natural-origin (adipose fin present, no CWT, and no elastomer tags) and 70 (52%) hatchery-origin (elastomer tagged and adipose present or CWT and adipose fin present) adults. A total of 132 steelhead were spawned; 48.5% were natural-origin fish and 51.5% were hatchery 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 that died before spawning, and numbers of steelhead spawned, 1998-2014. Unknown origin fish (i.e., undetermined by scale analysis, no elastomer, CWT, or fin clips, and no additional hatchery marks) were considered naturally produced. Mortality includes fish that died of natural causes, fish killed at spawning, and surplus broodstock.

Brood year	Wild steelhead					Hatchery steelhead					Total number spawned
	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	
1998	35	0	0	35	0	43	4	2	37	0	72
1999	58	5	1	52	0	67	1	2	64	0	116
2000	39	2	1	36	0	101	9	12	60	20	96
2001	64	5	8	51	0	114	5	6	103	0	154
2002	99	0	1	96	2	113	1	0	64	48	160
2003	63	10	4	49	0	92	2	0	90	0	139
2004	85	3	0	75	7	132	1	0	61	70	136
2005	95	8	0	87	0	114	7	1	104	2	191
2006	101	5	0	93	3	98	0	0	69	29	162
2007	79	0	2	76	1	97	0	14	58	25	134
2008	104	0	3	77	22	107	0	28	54	25	131
2009	101	2	0	86	13	107	1	4	73	29	159
2010	106	1	1	96	8	105	2	23	75	5	171
2011	104	8	1	91	4	104	13	2	70	0	161
Average[b]	***81***	***4***	***2***	***71***	***4***	***100***	***3***	***7***	***70***	***18***	***142***
2012	63	3	0	59	1	66	0	1	65	0	124
2013	63	8	1	49	5	84	9	7	68	0	117

Brood year	Wild steelhead					Hatchery steelhead					Total number spawned
	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	Number collected	Prespawn loss[a]	Mortality	Number spawned	Number released	
2014	65	0	1	64	0	70	68	2	68	0	132
Average[c]	***64***	***4***	***1***	***57***	***2***	***73***	***26***	***3***	***67***	***0***	***124***

[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 represents the program before recalculation in 2011.

[c] This average represents the current program, which began in 2012.

Age/Length Data

Broodstock ages were determined from examination of scales and/or otoliths. For the 2013 brood year, both natural-origin and hatchery steelhead consisted primarily of 2-salt adults (Table 3.2). For the 2014 brood year, both hatchery and natural-origin steelhead consisted primarily of 2-salt adults (Table 3.2).

Table 3.2. Percent of hatchery and wild steelhead of different ages (saltwater ages) collected from broodstock, 1998-2014.

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
	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

Brood year	Origin	Saltwater age		
		1	2	3
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
Average	***Wild***	***45.9***	***53..1***	***1.0***
	Hatchery	***52.2***	***47.8***	***0.0***

There was little difference between mean lengths of hatchery and natural-origin steelhead in the 2013 and 2014 brood years (Table 3.3). Natural-origin fish were on average 1 to 3 cm larger than hatchery-origin fish of the same age.

Table 3.3. Mean fork length (cm) at age (saltwater ages) of hatchery and wild steelhead collected from broodstock, 1998-2014; 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	-

Brood year	Origin	Steelhead fork length (cm)								
		1-Salt			2-Salt			3-Salt		
		Mean	N	SD	Mean	N	SD	Mean	N	SD
	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	-
	Hatchery	60	20	3	72	48	4	-	0	-
Average	***Wild***	***63***	***34***	***5***	***76***	***39***	***5***	***77***	***1***	***1***
	Hatchery	***61***	***43***	***4***	***73***	***40***	***4***	***-***	***0***	***-***

Sex Ratios

Male steelhead in the 2013 brood year made up about 48% of the adults collected, resulting in an overall male to female ratio of 0.93:1.00 (Table 3.4). For the 2014 brood year, males made up about 49% of the adults collected, resulting in an overall male to female ratio of 0.96:1.00. On average (1998-2014), 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, 1998-2014. 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

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	
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
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
Total	***586***	***736***	***0.80:1:00***	***846***	***770***	***1.10:1.00***	***0.95:1.00***

Fecundity

Fecundities for Wenatchee steelhead in brood years 2013 and 2014 averaged 5,762 and 5,839 eggs per female, respectively (Table 3.5). Mean fecundities for the 2013 and 2014 brood years were also greater than the 5,678 eggs per female assumed in the broodstock protocol.

Table 3.5. Mean fecundity of wild, hatchery, and all female steelhead collected for broodstock, 1998-2014.

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
Average	***5,809***	***5,775***	***5,814***

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%. In 2012, the egg take target was reduced to 305,309, which is needed 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 3.6). Since 2011, the target has been reached or exceeded 100% of the time (Table 3.6).

Table 3.6. Numbers of eggs taken from steelhead broodstock, 1998-2014.

Brood year	Number of eggs taken
1998	224,315
1999	303,083
2000	280,872
2001	549,464
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***
2012	371,151
2013	339,949
2014	395,453
Average (2012-present)	***368,851***

Number of acclimation days

Juvenile WxW steelhead were transferred from Chelan Fish Hatchery to the Chiwawa Acclimation Facility in October 2013 and HxH steelhead were transferred from Eastbank Fish Hatchery to Chiwawa Acclimation Facility in November 2013. In April 2014, about 25,000 steelhead were transferred to Blackbird Pond near Leavenworth for acclimation on Wenatchee River water. Fish were acclimated for 7 d before a volitional release was initiated on 22 April.

The remainder stayed at the Chiwawa Acclimation Facility until they were volitionally and forced released from the facility during late April to mid-May.

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 3.7).

Table 3.7. Water source and mean acclimation period for Wenatchee steelhead, brood years 1998-2013.

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
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

Brood year	Release year	Parental origin	Water source	Number of Days
		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
		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	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	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	7-67
		H x H	Wenatchee	168-169
		W x W	Wenatchee	176-197
		W x W	Wenatchee	179-204

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.

The release of 2013 brood Wenatchee steelhead achieved 93% of the 247,300 target goal with about 229,836 smolts released into the Wenatchee and Chiwawa rivers and Nason Creek (Table 3.8). Distribution of juvenile steelhead released in each of the three subbasins was determined by the mean proportion of steelhead redds in each basin. About 38.9% and 10.2% of the steelhead were released in Nason Creek and the Chiwawa River, respectively. The balance of the program was split between the Wenatchee River downstream from Tumwater Dam (11.0%) and the Wenatchee River upstream from the dam (39.9%).

Table 3.8. Numbers of steelhead smolts released from the hatchery, brood years 1998-2013. 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***
2011	2012	206,397
2012	2013	249,004
2013	2014	229,836
Average (2011-present)		***228,412***

Numbers marked

Wenatchee hatchery steelhead from the 2013 brood were marked with coded wire tags (CWT) in the snout. About 58.0% of the juveniles released were also adipose fin clipped (Table 9).

Table 3.9. Release location and marking scheme for the 1998-2013 brood Wenatchee steelhead.

Brood year	Release location	Parental origin	Proportion Ad-clip	CWT or VIE color/side	Tag rate	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
	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

Brood year	Release location	Parental origin	Proportion Ad-clip	CWT or VIE color/side	Tag rate	Number released
	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
	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

Brood year	Release location	Parental origin	Proportion Ad-clip	CWT or VIE color/side	Tag rate	Number released
	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

Numbers PIT tagged

Table 3.10 summarizes the number of hatchery steelhead of different parental origins that have been PIT-tagged and released into the Wenatchee River basin.

Table 3.10. Summary of PIT-tagging activities for Wenatchee hatchery steelhead, brood years 2006-2013.

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

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
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
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 Brood Wenatchee HxH Summer Steelhead—A total of 10,129 Wenatchee HxH summer steelhead were tagged at Eastbank Hatchery on 15-18 September 2014. These fish were tagged in raceway #4. Fish were not fed during tagging or for two days before and after tagging. Fish averaged 74 mm in length and 5.9 g at time of tagging.

2014 Brood Wenatchee WxW Summer Steelhead—A total of 5,100 Wenatchee WxW summer steelhead were tagged at Chelan Hatchery on 2-4 September 2014. These fish were tagged in raceway #2. Fish were not fed during tagging or for two days before and after tagging. Fish averaged 97 mm in length and 11.0 g at time of tagging.

Fish size and condition at release

With the exception of the Blackbird Pond release, all 2013 brood steelhead were trucked and released as yearling smolts in April and May 2014. The Blackbird Pond group was released volitionally beginning on 22 April. The WxW fish did not meet the length or weight target, but exceeded the target for coefficient of variation (CV) for fork length (Table 3.11). The HxH group was combined with the WxW group in Pond 2 once they were transferred to Chiwawa Acclimation Facility. The HxH and the mixed WxW and HxH groups did not meet the length or weight targets and these fish were smaller than the WxW fish.

Table 3.11. Mean lengths (FL, mm), weight (g and fish/pound), and coefficient of variation (CV) of steelhead smolts released from the hatchery, brood years 1998-2013. Size targets are provided in the last row of the table.

Brood year	Release year	Parental origin	Fork length (mm)		Mean weight	
			Mean	CV	Grams (g)	Fish/pound
1998	1999	H x H	201	11.1	92.3	5
		H x W	190	12.8	76.9	6
		W x W	173	12.0	55.3	8
1999	2000	H x H	181	8.9	70.6	6
		H x W	187	7.2	75.3	6
		W x W	184	11.3	71.5	6
2000	2001	H x H	218	15.2	122.4	4
		H x W	209	10.6	107.5	4
		W x W	205	10.7	100.9	5
2001	2002	H x H	179	17.4	67.0	7
		H x W	192	15.6	82.8	6
		W x W	206	11.6	102.6	4
2002	2003	H x H	194	13.1	83.0	6
		H x W	191	13.0	77.4	6
		W x W	180	19.1	70.3	7
2003	2004	H x H	191	14.4	73.1	6
		H x W	199	12.9	83.9	5
		W x W	200	11.1	90.1	5
2004	2005	H x H	204	11.3	87.2	6
		H x W	202	13.5	71.9	5
		W x W	198	12.4	76.6	6
2005	2006	H x H	215	12.6	116.6	4
		H x W	198	11.8	86.3	5
		W x W	189	15.4	55.3	6
2006	2007	H x H (early)	213	12.1	109.6	4
		H x W (late)	186	11.8	68.3	7
		W x W	178	11.1	58.6	8
2007	2008	H x W (early)	192	17.4	77.1	6
		H x W (late)	179	19.3	63.8	7
		W x W	183	12.3	62.8	7
2008	2009	H x W (early)	184	11.6	68.0	7
		H x W (late)	186	11.6	73.5	6
		W x W	181	13.0	59.7	8

Brood year	Release year	Parental origin	Fork length (mm)		Mean weight	
			Mean	CV	Grams (g)	Fish/pound
2009	2010	H x W (early)	197	11.3	84.2	5
		H x W (late)	192	11.1	72.7	6
		W x W	190	9.6	70.5	6
2010	2011	H x H	183	14.1	68.9	4
		W x W	188	10.5	68.1	7
2011	2012	H x H	NA	NA	NA	NA
		W x W	156	17.1	45.2	10
2012	2013	H x H / W x W	150	16.1	40.8	11
		H x H / W x W	157	16.4	45.0	10
		W x W	156	18.7	49.0	9
2013	2014	H x H / W x W	157	14.5	49.4	9
		H x H	127	16.2	26.8	17
		W x W	162	20.4	55.8	8
Targets			***191***	***9.0***	***75.6***	***6***

Survival Estimates

Overall survival of Wenatchee steelhead (WxW and HxH) from green (unfertilized) egg to release was below the standard set for the program. This is in large part because of poor unfertilized egg to eyed egg survival (Table 3.12).

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.

Table 3.12. Hatchery life-stage survival rates (%) for steelhead, brood years 1998-2013. 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

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							
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
Average	***93.6***	***98.2***	***79.4***	***92.3***	***96.8***	***94.5***	***91.4***	***97.5***	***67.0***
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 2013 brood Wenatchee summer steelhead was similar to previous years with fish being held on Chelan spring water, Eastbank well water, and Chelan well water before being transferred for overwinter acclimation at the Chiwawa Acclimation Facility. Volitional and non-migratory released fish were released into Nason Creek, Chiwawa River, and the Wenatchee River. There were no major fish health concerns for brood year 2013.

3.4 Natural Juvenile Productivity

During 2014, juvenile steelhead were sampled at the Lower Wenatchee, Chiwawa, and Nason Creek traps and counted during snorkel surveys within the Chiwawa River basin. Because the snorkel surveys targeted juvenile Chinook salmon, the entire distribution of juvenile steelhead in the Chiwawa River basin was not surveyed. Therefore, the parr numbers presented below represent a minimum estimate.

Parr Estimates

A total of 16,083 (±10.0%) age-0 (<100 mm) and 5,084 (±12.0%) age-1+ (100-200 mm)[4] steelhead/rainbow were estimated in the Chiwawa River basin in August 2014 (Table 3.13 and 3.14). During the survey period 1992-2014, numbers of age-0 and 1+ steelhead/rainbow have ranged from 1,410 to 45,727 and 2,533 to 22,130, respectively, in the Chiwawa River basin (Table 3.13 and 3.14; Figure 3.1). Numbers of all fish counted in the Chiwawa River basin are reported in Appendix A.

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

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[4] A steelhead/rainbow trout larger than 200 mm (8 in) was considered a resident trout.

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 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 3.13. Total numbers of age-0 steelhead/rainbow trout estimated in different steams in the Chiwawa River basin during snorkel surveys in August 1992-2014; 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**
Average	***11,454***	***51***	***1,195***	***647***	***17***	***2,180***	***80***	***57***	***14***	***15,397***

Table 3.14. Total numbers of age-1+ steelhead/rainbow trout estimated in different steams in the Chiwawa River basin during snorkel surveys in August 1992-2014; 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**
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**
Average	***7,761***	***40***	***368***	***262***	***0***	***427***	***2***	***0***	***2***	***8,792***

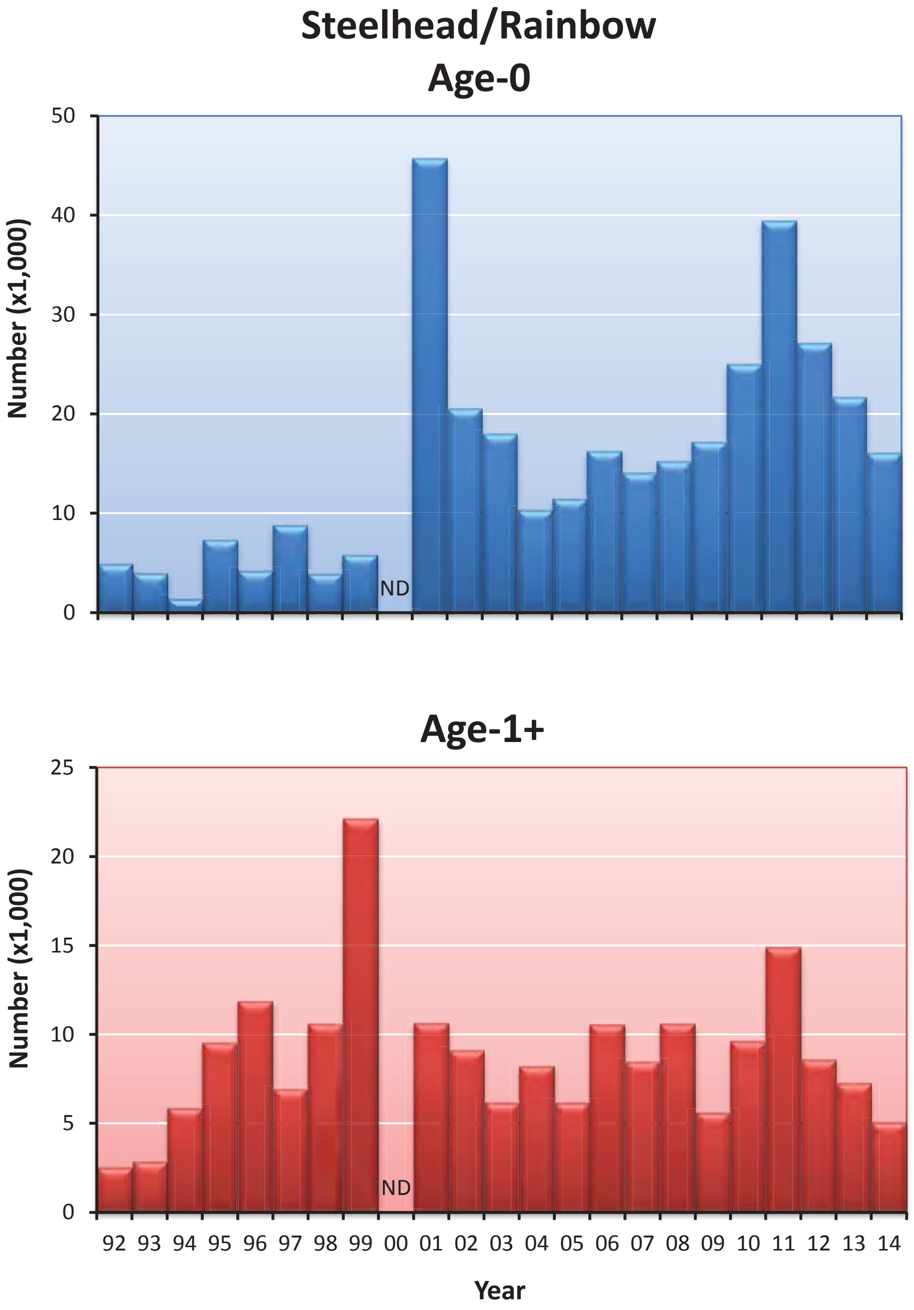

Figure 3.1. Numbers of subyearling and yearling steelhead/rainbow trout within the Chiwawa River basin in August 1992-2014; ND = no data.

Emigrant and Smolt Estimates

Numbers of steelhead smolts and emigrants were estimated at the Chiwawa, Nason, and Lower Wenatchee traps in 2014.

Chiwawa Trap

The Chiwawa Trap operated between 18 March and 13 November 2014. During the trapping period, the trap was inoperable for 21 days because of high river discharge, debris, snow/ice, or mechanical failure. The trap operated in two different positions depending on stream flow; lower position at flows greater than 12 m^3/s and an upper position at flows less than 12 m^3/s. Monthly captures of all fish collected at the Chiwawa Trap are reported in Appendix B.

A total of 49 wild steelhead/rainbow smolts, 290 hatchery smolts, and 1,889 wild parr were captured at the Chiwawa Trap. Most (74%) of the hatchery steelhead smolts were collected in April, while most (94%) of the wild steelhead smolts were captured from April through June (Figure 3.2). Although steelhead/rainbow parr emigrated throughout the sampling period, peaks in emigration were observed in May and June, and August through October (Figure 3.2). Of the total number of wild steelhead captured (smolt and parr) 97% were classified as parr. Because of low numbers of steelhead/rainbow captured (a capture of at least 250 fish is needed for a statistically valid trial), no mark-recapture efficiency trials could be conducted with steelhead/rainbow at the Chiwawa Trap to estimate total population abundance.

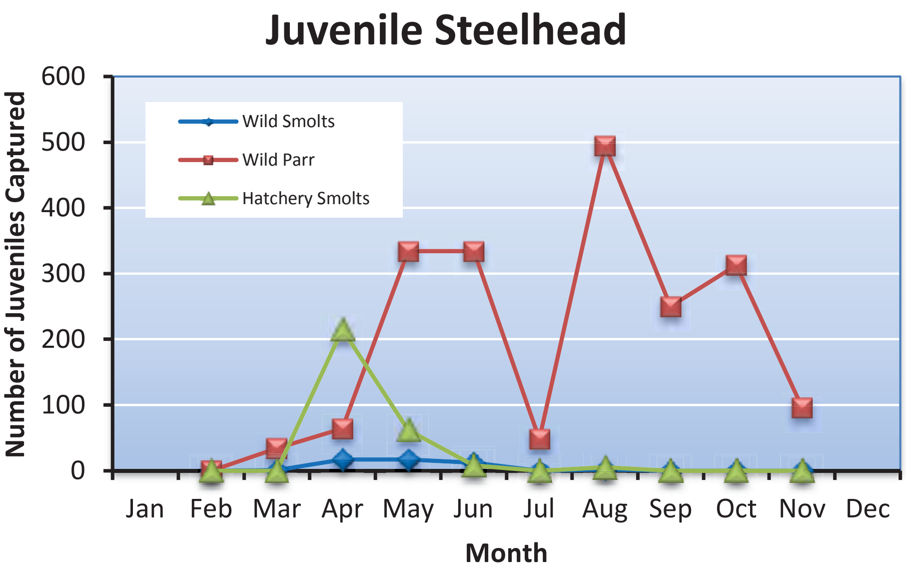

Figure 3.2. Monthly captures of wild smolts, wild parr, and hatchery smolt steelhead/rainbow at the Chiwawa Trap, 2014.

Nason Creek Trap

The Nason Creek Trap operated between 1 March and 30 November 2014. During the nine-month sampling period the trap was inoperable for 48 days because of low discharge and ice accumulation. The trap captured a total of 18 wild steelhead smolts, 1,571 hatchery smolts, 991 wild parr, and 258 wild fry.

Lower Wenatchee Trap

The Lower Wenatchee Trap operated between 12 February and 7 September 2014. During that time period the trap was inoperable for 12 days because of high river discharge, debris, snow/ice, or major hatchery releases. During the seven-month sampling period, a total of 102 wild steelhead parr, 80 wild steelhead smolts, and 494 hatchery steelhead were captured at the trap. Because of the low numbers of steelhead encountered daily at the trap, it was not possible to carry out mark-recapture trials using steelhead. To gain insight into capture efficiency, 473 WxW hatchery steelhead ("surrogates" for natural fish) were marked and transported from Chiwawa Acclimation Facility and released at Dryden Dam. Two separate trials were conducted, resulting in a pooled efficiency estimate (95% C.I.) of 6,149 (± 32,095) parr and smolt emigrants. Figure 3.3 shows the monthly captures of steelhead collected at the Lower Wenatchee Trap. All fish captured in the trap are reported in Appendix B.

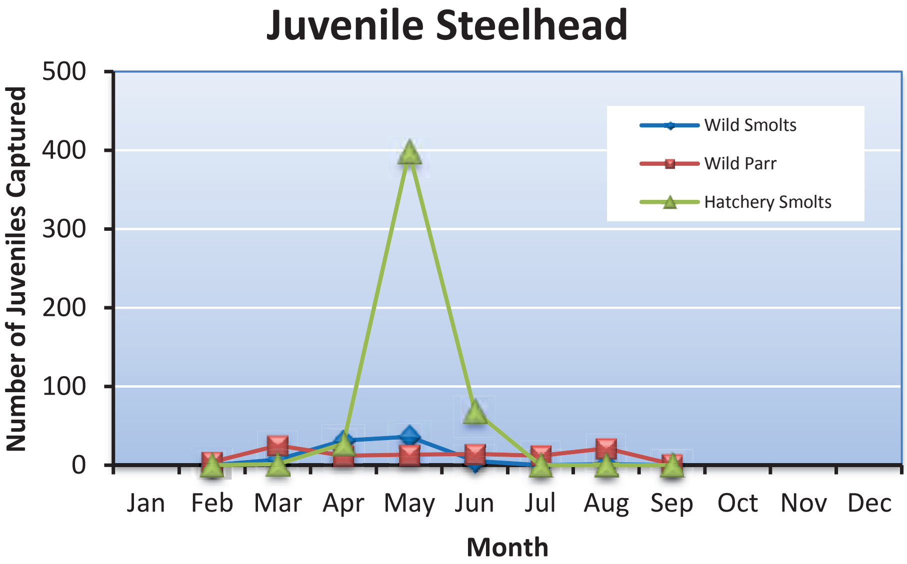

Figure 3.3. Monthly captures of wild smolts, wild parr, and hatchery smolt steelhead/rainbow at the Lower Wenatchee Trap, 2014.

PIT Tagging Activities

As part of the Comparative Survival Study (CSS), a total of 1,349 juvenile steelhead/rainbow trout (1,342 wild and seven hatchery) were PIT tagged and released in 2014 in the Wenatchee River basin (Table 3.15a). Most of these were tagged at the Chiwawa Trap. See Appendix C for a complete list of all fish captured, tagged, lost, and released.

Table 3.15a. Numbers of wild and hatchery steelhead/rainbow trout that were captured, tagged, and released at different locations within the Wenatchee River basin, 2014. Numbers of fish that died or shed tags are also given.

Sampling Location	Species and Life Stage	Number captured	Number of recaptures	Number tagged	Number died	Shed Tags	Total released	Percent mortality
Chiwawa Trap	Wild Steelhead/Rainbow	1,288	4	1,195	9	0	1,186	0.70
	Hatchery Steelhead/Rainbow	11	3	3	0	0	3	0.00
	Total	**1,299**	**7**	**1,198**	**9**	**0**	**1,189**	**0.69**
Chiwawa River (Electrofishing)	Wild Steelhead/Rainbow	94	0	23	0	0	23	0.00
	Hatchery Steelhead/Rainbow	0	0	0	0	0	0	--

Sampling Location	Species and Life Stage	Number captured	Number of recaptures	Number tagged	Number died	Shed Tags	Total released	Percent mortality
	Total	**94**	**0**	**23**	**0**	**0**	**23**	**0.00**
Lower Wenatchee Trap	Wild Steelhead/Rainbow	143	5	133	0	0	133	0.00
	Hatchery Steelhead/Rainbow	8	4	4	0	0	4	0.00
	Total	**151**	**9**	**137**	**0**	**0**	**137**	**0.00**
Total:	**Wild Steelhead/Rainbow**	**1,525**	**9**	**1,351**	**9**	**0**	**1,342**	**0.59**
	Hatchery Steelhead/Rainbow	**19**	**7**	**7**	**0**	**0**	**7**	**0.00**
Grand Total:		**1,544**	**16**	**1,358**	**9**	**0**	**1,349**	**0.58**

Numbers of steelhead/rainbow PIT-tagged and released as part of CSS during the period 2006-2014 are shown in Table 3.15b.

Table 3.15b. Summary of the numbers of wild and hatchery steelhead/rainbow trout that were tagged and released at different locations within the Wenatchee River basin, 2006-2014.

Sampling Location	Species and Life Stage		Numbers of PIT-tagged steelhead/rainbow released							
		2006	2007	2008	2009	2010	2011	2012	2013	2014
Chiwawa Trap	Wild Steelhead/Rainbow	1,366	832	1,431	1,127	930	1,012	1,011	1,228	1,186
	Hatchery Steelhead/Rainbow	0	3	2	1	2	1	2	0	3
	Total	**1,366**	**835**	**1,433**	**1,128**	**932**	**1,013**	**1,013**	**1,228**	**1,189**
Chiwawa River (Angling or Electrofishing)	Wild Steelhead/Rainbow	33	167	94	35	99	0	0	0	23
	Hatchery Steelhead/Rainbow	1	47	35	43	64	0	0	0	0
	Total	**34**	**214**	**129**	**78**	**163**	**0**	**0**	**0**	**23**
Upper Wenatchee Trap	Wild Steelhead/Rainbow	21	37	24	46	69	82	70	43	0
	Hatchery Steelhead/Rainbow	0	0	0	0	0	0	0	0	0
	Total	**21**	**37**	**24**	**46**	**69**	**82**	**70**	**43**	**0**
Nason Creek (Angling or Electrofishing)	Wild Steelhead/Rainbow	174	452	255	459	318	0	0	0	0
	Hatchery Steelhead/Rainbow	26	75	87	197	32	0	0	0	0
	Total	**200**	**527**	**342**	**656**	**350**	**0**	**0**	**0**	**0**
Upper Wenatchee (Angling or Electrofishing)	Wild Steelhead/Rainbow	413	1,001	21	7	30	0	0	0	0
	Hatchery Steelhead/Rainbow	2	64	26	23	9	0	0	0	0
	Total	**415**	**1,065**	**47**	**30**	**39**	**0**	**0**	**0**	**0**
Middle Wenatchee (Angling or Electrofishing)	Wild Steelhead/Rainbow	0	0	981	867	1,517	0	0	850	0
	Hatchery Steelhead/Rainbow	0	0	11	5	57	0	0	2	0
	Total	**0**	**0**	**992**	**872**	**1,574**	**0**	**0**	**852**	**0**
Lower Wenatchee (Angling or Electrofishing)	Wild Steelhead/Rainbow	0	0	102	69	0	0	0	0	0
	Hatchery Steelhead/Rainbow	0	0	10	9	0	0	0	0	0
	Total	**0**	**0**	**112**	**78**	**0**	**0**	**0**	**0**	**0**
Peshastin Creek (Angling or	Wild Steelhead/Rainbow	0	0	0	92	307	0	0	0	0
	Hatchery Steelhead/Rainbow	0	0	0	0	0	0	0	0	0

Sampling Location	Species and Life Stage		Numbers of PIT-tagged steelhead/rainbow released							
		2006	2007	2008	2009	2010	2011	2012	2013	2014
Electrofishing)	**Total**	**0**	**0**	**0**	**92**	**307**	**0**	**0**	**0**	**0**
Lower Wenatchee Trap	Wild Steelhead/Rainbow	131	461	285	227	465	0	0	613	133
	Hatchery Steelhead/Rainbow	0	0	0	1	0	0	0	0	4
	Total	**131**	**461**	**285**	**228**	**465**	**0**	**0**	**613**	**137**
Total:	**Wild Steelhead/Rainbow**	**2,138**	**2,950**	**3,193**	**2,929**	**3,735**	**1,094**	**1,081**	**2,734**	**1,342**
	Hatchery Steelhead/Rainbow	**29**	**189**	**171**	**279**	**164**	**1**	**2**	**2**	**7**
Grand Total:		**2,167**	**3,139**	**3,364**	**3,208**	**3,899**	**1,095**	**1,083**	**2,736**	**1,349**

3.5 Spawning Surveys

Surveys for steelhead redds were conducted during March through early June, 2014, in the mainstem Wenatchee River and 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 (see Appendix D for details).

Redd Counts

A total of 109 steelhead redds were counted in the Wenatchee River and the lower portions of select tributaries in 2014 (Table 3.16). 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 in 2014 were expanded based on estimates of observer efficiency. Thus, evaluation of trends in redd counts is appropriate only before 2014.

Table 3.16. Numbers of steelhead redds estimated within different streams/watersheds within the Wenatchee River basin, 2001-2014; NS = not surveyed. Redd counts from 2004-2013 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.

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**

Survey year	Number of steelhead redds							
	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River[a]	Icicle	Peshastin	Total
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**
2014	5	0	NS	NS	195[b]	NS	5	**205**

[a] Includes redds in Beaver and Chiwaukum creeks.

[b] Steelhead redd counts in the mainstem Wenatchee River were expanded based on estimated observer efficiency (see Appendix D).

Redd Distribution

Steelhead redds were not evenly distributed among reaches within survey reaches on the Wenatchee River in 2014 (Table 3.17). About 63.8% of the spawning in the Wenatchee River occurred upstream from Tumwater Dam (Table 3.17).

Table 3.17. Numbers and percentages of steelhead redds counted within different reaches on the Wenatchee River during March through early June, 2014; SE = standard error.

Reach	Reach type	Number of redds counted	Expanded redd counts		Percent of redds within stream/watershed
			Estimated	SE	
Wenatchee 1 (W1)	Non-index	0	0.1	0.0	0.1
Wenatchee 2 (W2)	Index	4	4.9	4.7	2.5
Wenatchee 3 (W3)	Non-index	2	2.2	0.8	1.1
Wenatchee 4 (W4)	Non-index	0	0.2	0.1	0.1
Wenatchee 5 (W5)	Non-index	0	0.2	0.1	0.1
Wenatchee 6 (W6)	Index	25	63.1	39.1	32.4
Wenatchee 7 (W7)	NS	NS	NS	NS	--
Wenatchee 8 (W8)	Index	4	16.1	7.5	8.3
Wenatchee 9 (W9)	Index	46	77.9	70.2	40.1
Wenatchee 10 (W10)	Index	16	29.9	21.7	15.4
Total		**97**	**194.5**	**83.8**	**100.0**

Spawn Timing

Steelhead began spawning during the third week of March in the Wenatchee River. Spawning activity appeared to begin once the mean daily stream temperature reached about 4.8°C and was observed in water temperatures ranging from 2.0 - 7.0°C. Steelhead spawning peaked during the fourth week of April in the Wenatchee River (Figure 3.4).

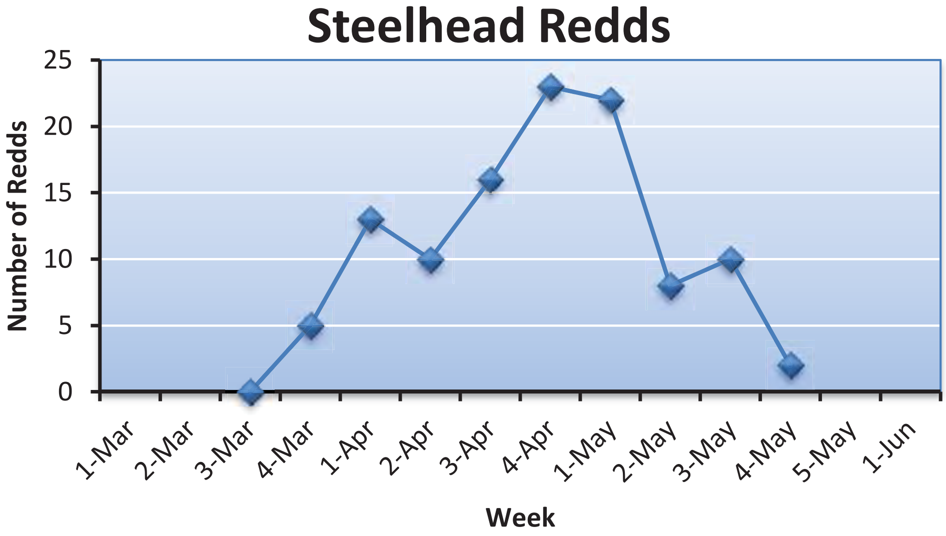

Figure 3.4. Numbers of steelhead redds counted during different weeks in different index areas within the Wenatchee River basin, March through early June 2014.

Spawning Escapement

Before 2014, steelhead spawning escapement upstream from Tumwater Dam was calculated as the number of redds (in the Wenatchee River and tributaries upstream from the dam) times the fish per redd ratio (based on sex ratios estimated at Tumwater Dam using video surveillance). Beginning in 2014, escapement in tributaries upstream from Tumwater Dam was estimated using PIT tag mark-recapture techniques, while observer efficiency expanded redd counts were used to estimate escapement in the mainstem Wenatchee River. Total redd counts were also used to estimate escapement in the lower portions of the main tributaries (downstream from the PIT interrogation sites).

The estimated fish per redd ratio for steelhead in 2014 was 1.70 (Table 3.18). Multiplying this ratio by the total number of redds estimated in the Wenatchee River upstream from the dam resulted in a spawning escapement of 210 steelhead (Table 3.18). Adding this estimate to the mark-recapture estimates of tributary escapement (260 hatchery + 369 wild = 629 total) indicates that 839 escaped to spawning areas upstream from Tumwater Dam in 2014. This assumes that all steelhead that escaped into tributaries (based on mark-recapture) spawned. Therefore, of the 863 steelhead counted at Tumwater, about 97% were estimated to have spawned upstream from the dam in the mainstem.

Table 3.18. Numbers of steelhead counted at Tumwater Dam, fish/redd estimates (based on male-to-female ratios estimated at Tumwater Dam), numbers of steelhead redds counted upstream from Tumwater Dam, total spawning escapement upstream from Tumwater Dam (estimated as the total number of redds times the fish/redd ratio), and the proportion of the Tumwater Dam count that made up the spawning escapement. Beginning in 2014, escapements include estimates from redd counts in the Wenatchee River and mark-recapture techniques in tributaries.

Survey year	Total count at Tumwater Dam	Fish/redd	Number of redds			Spawning escapement[a]	Proportion of Tumwater count that spawned
			Index area	Non-index area	Total redds		
2001	820	2.08	118	19	137	285	0.35
2002	1,720	2.68	296	179	475	1,273	0.74
2003	1,810	1.60	353	88	441	706	0.39
2004	1,869	2.21	277	92	369	815	0.44
2005	2,650	1.61	828	136	964	1,552	0.59
2006	1,053	2.05	192	34	226	463	0.44
2007	657	1.94	105	29	134	260	0.40
2008	1,328	2.81	124	35	159	447	0.34
2009	1,781	1.83	284	107	391	716	0.40
2010	2,270	2.33	546	95	641	1,494	0.66
2011	1,130	1.79	427	33	460	823	0.73
2012	1,055	2.00	273	22	295	590	0.56
2013	1,087	1.65	276	9	285	470	0.43
2014	863	1.70	124	0	124	839	0.97
Average[b]	***1,431***	***1.99***	***314***	***54***	***368***	***770***	***0.54***

[a] Escapement estimates before 2014 were based on expanded redd counts in the Wenatchee River and tributaries; escapement estimates beginning in 2014 were based on expanded redd counts within the Wenatchee River and mark-recapture techniques in tributaries.

[b] The average is based on estimates from 2004 to present.

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. Prior to brood year 2011, some statistics could not be calculated because few steelhead were tagged with CWTs. Since brood year 2011, all steelhead released from the hatchery program are tagged with CWTs. In addition, about 15,109 of the 2013 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 3.5). Most steelhead passed Tumwater Dam during July through October and April. The highest proportion of both wild and hatchery fish migrated during October.

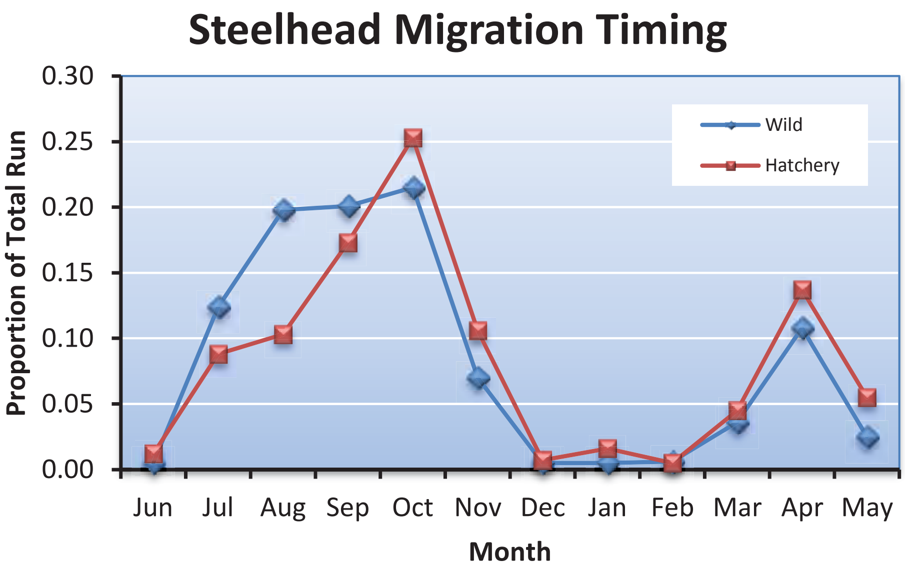

Figure 3.5. Proportion of wild and hatchery steelhead sampled at Tumwater Dam for the combined brood years of 1999-2014.

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). That is, 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.

Overall, there was little difference in migration timing of wild and hatchery fish enumerated at Tumwater Dam (Table 3.19a and b; Figure 3.5). For both the summer-autumn and winter-spring migration periods, wild and hatchery steelhead arrived at the dam during the same week and month. The mean and median migration timing for wild and hatchery steelhead were also similar. However, during the summer-autumn migration period, on average, wild steelhead appeared to end their migration about one week earlier than hatchery steelhead.

Table 3.19a. 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), 1999-2014. The average week is also provided for both migration periods. Migration timing is based on video sampling at Tumwater. The presence of eroded fins and/or missing adipose fins was used to distinguish hatchery fish from wild fish during video monitoring at Tumwater Dam. 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	1112	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	1133	13	16	19	16	229
2010	Wild	31	37	45	38	648	11	15	18	15	171
	Hatchery	31	40	45	40	1207	12	16	19	16	309
2011	Wild	29	36	44	36	797	13	17	19	17	118
	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

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	32	40	42	38	511	15	17	19	17	78
Average	***Wild***	***30***	***36***	***43***	***37***	***545***	***12***	***15***	***18***	***15***	***122***
	Hatchery	***30***	***38***	***44***	***38***	***638***	***12***	***16***	***18***	***15***	***228***

Table 3.19b. 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), 1999-2014. The average month is also provided for both migration periods. Migration timing is based on video sampling at Tumwater. The presence of eroded fins and/or missing adipose fins was used to distinguish hatchery fish from wild fish during video monitoring at Tumwater Dam. 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
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	1112	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	1133	3	4	5	4	229
2010	Wild	8	9	11	9	648	3	4	5	4	171
	Hatchery	8	10	11	10	1207	3	4	5	4	309

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
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
Average	***Wild***	***7***	***9***	***10***	***9***	***545***	***3***	***4***	***5***	***4***	***122***
	Hatchery	***7***	***9***	***11***	***9***	***638***	***3***	***4***	***5***	***4***	***228***

Age at Maturity

Nearly all steelhead broodstock collected at Tumwater and Dryden dams lived in saltwater 1 to 2 years (saltwater age) (Table 3.20). Very few saltwater age-3 fish returned and those that did were wild fish. On average, there was a difference between the saltwater age at return of wild and hatchery fish. A greater proportion of hatchery fish returned as saltwater age-1 fish than did wild fish. In contrast, a greater number of wild fish returned as saltwater-2 fish than did hatchery fish (Figure 3.6).

Table 3.20. Proportions of wild and hatchery steelhead broodstock of different ages collected at Tumwater and Dryden dams, 1998-2014. Age represents the number of years the fish lived in salt water.

Sample 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

Sample year	**Origin**	**Saltwater age**			**Sample size**
		1	**2**	**3**	
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
	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
Average	***Wild***	***0.46***	***0.53***	***0.02***	***75***
	Hatchery	***0.55***	***0.45***	***0.00***	***92***

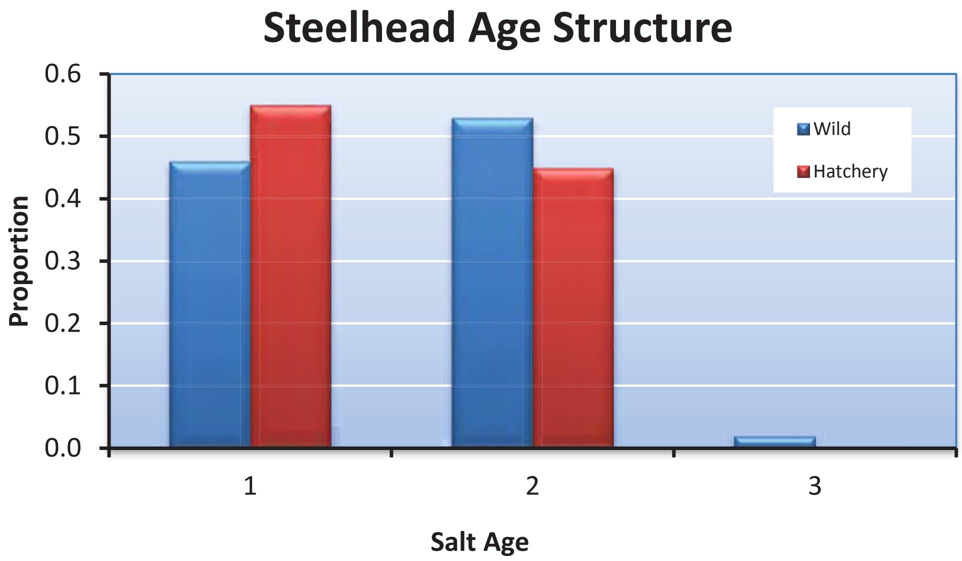

Figure 3.6. Proportions of wild and hatchery steelhead of different saltwater ages sampled at Tumwater Dam for the combined years 1998-2014.

Size at Maturity

On average, hatchery steelhead collected at Tumwater and Dryden dams were about 3 cm smaller than wild steelhead (Table 3.21). This may be related to the fact that more wild steelhead return as saltwater age-2 fish than hatchery steelhead.

Table 3.21. Mean fork length (cm) at age (saltwater ages) of hatchery and wild steelhead collected from broodstock, 1998-2014; N = sample size and SD = 1 standard deviation.

Return 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	-

Return year	Origin	Steelhead fork length (cm)								
		1-Salt			2-Salt			3-Salt		
		Mean	N	SD	Mean	N	SD	Mean	N	SD
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	-
Average	***Wild***	***63***	***34***	***5***	***76***	***39***	***5***	***77***	***1***	***1***
	Hatchery	***61***	***43***	***4***	***73***	***40***	***4***	***-***	***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). WDFW regulates steelhead harvest in the Upper Columbia. Under certain conditions, WDFW may allow a harvest on hatchery steelhead (adipose fin clipped fish). The intent is to reduce the number of hatchery steelhead that exceed habitat seeding levels in spawning areas and to increase the proportion of wild steelhead in spawning populations.

Origin on Spawning Grounds

At this time, origin of steelhead (wild or hatchery) on spawning grounds cannot be determined precisely. However, based on scales collected during steelhead run composition sampling at Dryden Dam in 2013 (2014 spawners), naturally produced steelhead made up about 53.1% of the escapement. The abundance of hatchery fish in the upper Wenatchee Basin was regulated at Tumwater Dam. A total of 219 hatchery fish were surplused resulting in an escapement of 863 steelhead comprising 62.3% (N = 538) wild-origin fish.

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 brood return. These data only provide estimates for brood years 2005 through 2010, because later brood years are still rearing in the ocean. The target for brood year stray rates should be less than 5%.

Based on PIT-tag analyses, on average, about 25% of the hatchery steelhead returns were last detected in streams outside the Wenatchee River basin (Table 3.22). The numbers in Table 3.22 should be considered rough estimates because they are not based on confirmed spawning (only last detections) and the numbers have not been adjusted for detection efficiencies, which currently do not exist for most PIT-tag detection arrays in tributaries. What these data do indicate is that large numbers of hatchery steelhead from the Wenatchee program have wandered or strayed into the Entiat and Methow rivers, and also into the Deschutes and Tucannon rivers. About 31% of the fish were last detected at Wells Dam.

Table 3.22. 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 to 2010. Estimates were based on last detections of PIT-tagged hatchery steelhead. Percent strays should be less than 5%.

Brood Year	Homing				Straying			
	Target streams		Target hatchery*		Non-target stream		Non-target hatchery	
	Number	%	Number	%	Number	%	Number	%
2005	76	75.5	0	0.0	27	24.5	0	0.0
2006	72	61.7	1	0.9	43	37.4	0	0.0
2007	171	60.6	0	0.0	110	39.4	0	0.0
2008	79	88.8	0	0.0	10	11.2	0	0.0
2009	185	84.3	0	0.0	35	15.7	0	0.0
2010	79	81.4	0	0.0	18	18.6	0	0.0
Average	***110***	***75.2***	***0***	***0.1***	***41***	***24.5***	***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.

At this time, we cannot estimate among population stray rates by return year, because we have no estimates of detection efficiencies for PIT-tag interrogation sites within different populations. These data are needed to estimate the total number of Wenatchee steelhead that stray into areas outside the Wenatchee River basin. Finally, for the same reason, we cannot evaluate within-population stray rates.

Genetics

Genetic studies were conducted 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 E). Temporal collections of tissue samples from Wenatchee hatchery-produced and natural-origin adults sampled at Dryden and Tumwater dams and from natural-origin juveniles from three Wenatchee River tributaries and the Entiat River were surveyed 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 time period and showed no temporal trend.

Proportion of 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). The ratio pNOB/(pHOS+pNOB) is the Proportion of Natural Influence (PNI). The larger the ratio (PNI), 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 important integrated populations should have a PNI of at least 0.67 (HSRG/WDFW/NWIFC 2004).

For brood years 2001-2014, the PNI was less than 0.67 (Table 3.23), suggesting that the hatchery environment has a greater influence on adaptation of Wenatchee steelhead than does the natural environment.

Table 3.23. Proportionate natural influence (PNI) of the Wenatchee steelhead supplementation program for brood years 2001-2014. PNI was calculated as the proportion of naturally produced steelhead in the hatchery broodstock (pNOB) divided by the proportion of hatchery steelhead on the spawning grounds (pHOS) plus pNOB. 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.

Brood year	Spawners[a]			Broodstock			PNI
	NOS	HOS	pHOS	NOB	HOB	pNOB	
2001	158	127	0.45	51	103	0.33	0.43
2002	731	542	0.43	96	64	0.60	0.59
2003	355	350	0.50	49	90	0.35	0.42
2004	371	445	0.55	75	61	0.55	0.50
2005	690	862	0.56	87	104	0.46	0.45
2006	253	210	0.45	93	69	0.57	0.56
2007	145	115	0.44	76	58	0.57	0.56
2008	168	279	0.62	77	54	0.59	0.48
2009	171	545	0.76	86	73	0.54	0.42
2010	524	970	0.65	96	75	0.56	0.46
2011	351	472	0.57	91	70	0.57	0.50
2012	381	209	0.35	59	65	0.48	0.57
2013	322	148	0.31	49	68	0.42	0.57
2014	476	363	0.43	64	68	0.48	0.53
Average	***364***	***403***	**0.51**	***75***	***73***	***0.50***	***0.50***

[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. The PNI estimates are appropriate for steelhead spawning upstream from Tumwater Dam. They may not represent PNI for steelhead spawning downstream from Tumwater 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 (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 1998-2007, NRR for summer steelhead in the Wenatchee River basin averaged 0.74 (range, 0.13-3.10) if harvested fish were included in the estimate (Table 3.24).

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 19.2 (the calculated target value in Hillman et al. 2013). In nearly all years, HRRs were greater than NRRs (Table 3.24). HRRs exceeded the estimated target value of 19.2 in one of the ten years.

Table 3.24. Broodstock collected, spawning escapements, 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 1998-2007.

Brood year	Broodstock Collected	Spawning Escapement	Harvest included			
			HOR	NOR	HRR	NRR
1998	78	602	148	1,867	1.89	3.10
1999	125	343	1,944	334	15.55	0.97
2000	120	1,030	312	878	2.60	0.85
2001	178	1,655	10,335	1,050	58.06	0.66
2002	162	5,000	1,905	515	11.76	0.13
2003	155	2,598	956	504	6.17	0.27
2004	217	2,949	2,538	728	11.70	0.25
2005	209	3,609	3,106	904	14.86	0.25
2006	199	2,219	1,454	1,007	7.31	0.45
2007	176	880	535	430	3.04	0.49
Average	***162***	***2,089***	***2,323***	***822***	***13.29***	***0.74***

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 will be based on CWT returns.

SARs (not adjusted for tag loss) for Wenatchee steelhead ranged from 0.0009 to 0.0315 (mean = 0.0097) for brood years 1996-2007 (Table 3.25).

Table 3.25. Smolt-to-adult ratios (SARs) for Wenatchee hatchery steelhead, 1996-2007. Estimates were based on elastomer tags recaptured at Priest Rapids Dam. SARs were not adjusted for tag loss after release.

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

Brood year	Number of tagged smolts released	SAR
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
Average	***302,920***	***0.0097***

3.7 ESA/HCP Compliance

Broodstock Collection

Collection of brood year 2013 broodstock for Wenatchee summer steelhead at Dryden and Tumwater dams began on 1 July and ended on 4 October 2013 at Dryden Dam and 17 November 2013 at Tumwater Dam consistent with the collection period identified in the 2013 broodstock collection protocol. The broodstock collection achieved a total collection of 147 steelhead, including 63 natural-origin steelhead identified in the annual broodstock collection protocols.

About 2,117 steelhead were handled and released (or surplused) at Tumwater and Dryden dams during brood year 2013 Wenatchee steelhead broodstock collection. Most were hatchery-origin fish handled at Tumwater Dam and ultimately surplused to meet the pHOS objective upstream from Tumwater Dam. 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 (red/green VIE tagged), 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 65 spring Chinook salmon were captured and released unharmed immediately upstream from the trap facility. Consistent with ESA Section 10 Permit 1395 impact minimization measures, all ESA species handled were subject of water-to-water transfers.

Hatchery Rearing and Release

The 2013 brood Wenatchee steelhead reared throughout all life stages without significant mortality (defined as >10% population mortality associated with a single event). However, the 2013 brood had both poor survival of females to spawn combined and poor fertilization to eyed-egg survival resulting in an unfertilized-to-release survival of 67.6%, which was less than the program target of 81% (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 2013 brood steelhead smolt release in the Wenatchee River basin totaled 229,836 smolts, representing about 92.9% of the program target of 247,300 smolts identified in the Rocky Reach and Rock Island Dam HCPs and in ESA Section 10 Permit 1395. As specified in ESA Section 10 Permit 1395, 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 Permits 1196, 1347, 1395, 18118, 18119, and 18121, permit holders shall monitor and report hatchery effluents in compliance with applicable National Pollution Discharge Elimination Systems (NPDES) (EPA 1999) permit limitations. There was one NPDES violation reported at PUD Hatchery facilities during the period 1 January 2014 through 31 December 2014. NPDES monitoring and reporting for Chelan PUD Hatchery Programs during 2014 are provided in Appendix F.

Smolt and Emigrant Trapping

Per ESA Section 10 Permit No. 1395, 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 2003). 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 2014 emigration complied with take provisions in the Section 10 permit and are detailed in Table 3.26. Additionally, juvenile fish captured at the trap locations were handled consistent with provisions in ESA Section 10 Permit 1395 Section B.

Table 3.26. Estimated take of Upper Columbia River steelhead resulting from juvenile emigration monitoring in the Wenatchee River basin, 2014. NA = not available.

Trap location	Population estimate				Number trapped				Total	Take allowed by Permit
	Wild	Hatchery[a]	Parr	Fry	Wild	Hatchery	Parr	Fry		
Chiwawa Trap										
Population	NA	23,400	NA	NA	49	239	1,889	529	2,706	
Encounter rate	NA	NA	NA	NA	NA	0.0102	NA	NA	NA	0.20
Mortality[b]	NA	NA	NA	NA	0	0	20	4	24	
Mortality rate	NA	NA	NA	NA	0.0000	0.0042	0.0106	0.0076	0.0089	0.02
Lower Wenatchee Trap										
Population	NA	229,836	NA	NA	80	494	102	117	793	
Encounter rate	NA	NA	NA	NA	NA	0.0022	NA	NA	NA	0.20
Mortality[b]	NA	NA	NA	NA	1	12	1	0	14	
Mortality rate	NA	NA	NA	NA	0.0125	0.0243	0.0098	0.0000	0.0177	0.02
Wenatchee River Basin Total										
Population	NA	229,836	NA	NA	129	733	1,991	646	3,499	
Encounter rate	NA	NA	NA	NA	NA	0.0032	NA	NA	NA	0.20

Trap location	Population estimate				Number trapped				Total	Take allowed by Permit
	Wild	Hatchery[a]	Parr	Fry	Wild	Hatchery	Parr	Fry		
Mortality[b]	NA	NA	NA	NA	1	12	21	4	38	
Mortality rate	NA	NA	NA	NA	0.0076	0.0164	0.0105	0.0062	0.0109	0.02

[a] 2014 smolt release data for the Wenatchee River basin.

[b] Mortality includes trapping and PIT-tag mortalities.

Spawning Surveys

Steelhead spawning ground surveys were conducted in the Wenatchee River basin during 2014, as authorized by ESA Section 10 Permit No. 1395. 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. 1395 (NMFS 2003). 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 2003). The 2012-2013 run-cycle report (BY 2013) for stock assessment sampling at Priest Rapids Dam was compiled under provisions of ESA Section 10 Permit 1395. Data and reporting information are included in Appendix G.

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. Since 2006, 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. Monitoring occurs annually to track the status of the natural 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. Therefore, this section presents the history of the program and tracks the juveniles from the 2011 brood that were released as parr into Lake Wenatchee in 2012. Some of these fish began their smolt migrations in 2013.

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	256
2011	204	0	8	196	0	0	0	0	0	0	196
Average	***263***	***18***	***10***	***203***	***33***	***6***	***0***	***0***	***5***	***1***	***210***

[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

Return year	**Origin**	**Total age**		
		4	**5**	**6**
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
Average	***Wild***	***56.8***	***41.5***	***1.7***
	Hatchery	***38.5***	***11.4***	***0.1***

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
	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	56	130	2	57	63	4	-	-	-
	Hatchery	-	-	-	-	-	-	-	-	-
2011	Wild	55	109	2	59	90	3	61	4	3

Return year	Origin	Sockeye fork length (cm)								
		Age-4			Age-5			Age-6		
		Mean	N	SD	Mean	N	SD	Mean	N	SD
	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
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 during the life 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***

4.2 Hatchery Rearing

Rearing History

Number of eggs taken

Numbers of eggs taken from sockeye broodstock during the life 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***

Number of acclimation days

During the life of the program, Wenatchee sockeye were only 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

Brood year	Release year	Transfer date	Release date	Number of Days	Water source
		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 during the life of the program are shown in Table 4.8a. Coded wire tag marking rates and numbers of PIT-tagged juvenile sockeye released are also shown in Table 4.8a.

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	14,859	172,923
2005	2006	0.9811	14,764	140,542
2006	2007	0.9735	14,947	225,670
2007	2008	0.9863	14,858	252,133
2008	2009	0.9576	14,486	154,772
2009	2010	0.9847	5,039	227,743
2010	2011	0.9564	5,074	243,260
2011	2012	0.9690	0	241,918
Average		***0.9379***	***11,994[b]***	***211,255***

[a] These groups were only adipose fin clipped.
[b] Average is 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 during the life of the 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
2009	2010	143	8.9	35.5	13
2010	2011	132	14.3	30.7	15
2011	2012	142	9.6	35.3	13

Brood year	Release year	Fork length (mm)		Mean weight	
		Mean	CV	Grams (g)	Fish/pound
Targets		***133***	***9.0***	***22.7***	***20***

Survival Estimates

Life-stage survival estimates for juvenile sockeye during the life 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***
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 was terminated in 2012, there are no disease-monitoring results.

4.4 Natural Juvenile Productivity

Sockeye smolt abundance was estimated at a 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.

Emigrant and Smolt Estimates

The Lower Wenatchee Trap operated between 12 February and 7 October 2014. During that time period the trap was inoperable for 12 days because of high river flows, debris, snow/ice, or major hatchery releases. During the eight-month sampling period, a total of 7,678 wild juvenile sockeye and 72 hatchery juvenile sockeye were captured at the Lower Wenatchee Trap. An emigrant estimate was calculated for juvenile sockeye salmon for the 2014 run year (Table 4.11). The same model used in calculation of this estimate was also used to calculate emigration of wild sockeye salmon for the 2013 run year. Figure 4.1 shows the monthly captures of sockeye collected at the Lower Wenatchee Trap in 2014. All fish captured in the Lower Wenatchee trap are reported in Appendix B.

Table 4.11. Estimated numbers of wild and hatchery sockeye smolts that emigrated from Lake Wenatchee during run years 1997-2011; ND = no data. Estimates for the run 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.

Run 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
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

Run year	Numbers of sockeye smolts	
	Wild smolts	**Hatchery smolts**
2012	ND	ND
2013	873,096	--
2014	1,275,027	--
Average	***1,837,661***	***116,235***

[a] Estimates refined based on PIT tag survival to McNary Dam.

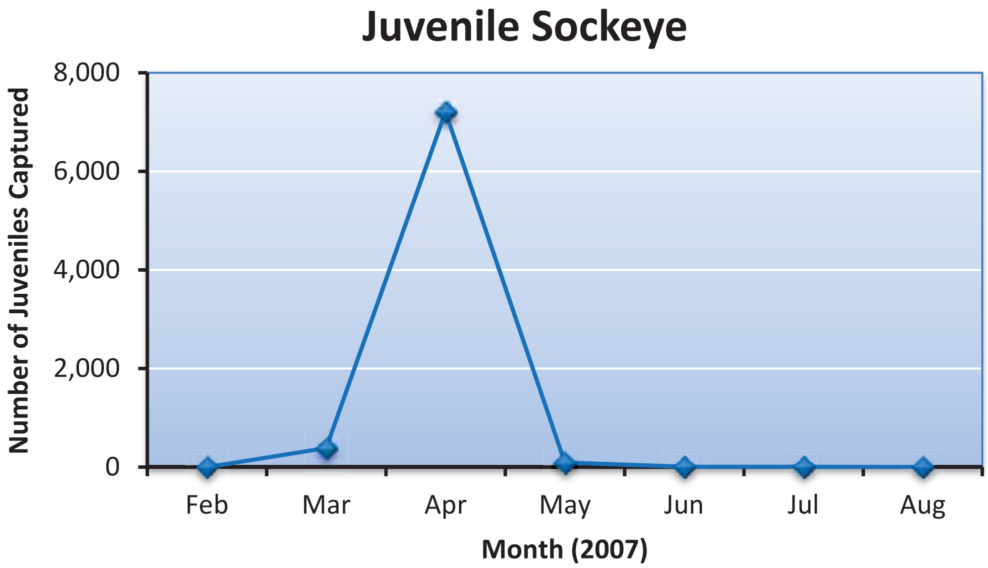

Figure 4.1. Monthly captures of wild sockeye salmon smolts at the Lower Wenatchee Trap, 2014.

Age classes of wild sockeye smolts were determined from a length frequency analysis based on scales collected randomly each year since 1997 (Table 4.12). 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, 1997-2014; ND = no data. Estimates for the run 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.

Run year	Proportion of wild smolts			Total wild emigrants
	Age 1+	**Age 2+**	**Age 3+**	
1997	0.075	0.906	0.019	55,359
1998	0.955	0.037	0.008	1,447,259
1999	0.619	0.381	0.000	1,944,966
2000	0.599	0.400	0.001	985,490
2001	0.943	0.051	0.006	39,353
2002	0.961	0.039	0.000	729,716

Run year	Proportion of wild smolts			Total wild emigrants
	Age 1+	Age 2+	Age 3+	
2003	0.740	0.026	0.000	5,439,032
2004	0.929	0.071	0.000	5,771,187
2005	0.230	0.748	0.022	723,413
2006	0.994	0.006	0.000	1,266,971
2007	0.996	0.004	0.000	2,797,313
2008	0.804	0.195	0.001	549,682
2009	0.927	0.073	0.000	355,549
2010	0.963	0.036	0.001	3,958,888
2011	0.786	0.214	0.000	1,500,730
2012	ND	ND	ND	ND
2013	0.933	0.067	0.000	873,096
2014	0.953	0.047	0.000	1,275,027
Average	***0.789***	***0.194***	***0.003***	***1,747,825***

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 the 2012 brood year (a year where brood was not collected), a linear relationship with post-orbital to hypural length as the independent variable was used to calculate average fecundity of sockeye sampled at Tumwater Dam ($r^2 = 0.40$, $P < 0.01$). Smolts for brood years 1995-2009 were based on captures at the Upper Wenatchee Trap. No smolt estimates are available for brood year 2010. Smolt estimates for brood years since 2012 are based on captures made at the Lower Wenatchee Trap. Egg-smolt survival rates for brood years 1995-2012 have ranged from 0.012 to 0.212 (mean = 0.091).

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, 1995-2012; NA = not available.

Brood year	Number of females	Mean fecundity	Total eggs	Numbers of wild smolts				Egg-smolt survival
				Age 1+	Age 2+	Age 3+	Total	
1995	2,136	2,295	4,902,120	4,174	53,549	0	57,723	0.012
1996	3,767	2,664	10,035,288	1,382,133	741,032	985	2,124,150	0.212
1997	5,404	2,447	13,223,588	1,203,934	394,196	236	1,598,366	0.121
1998	2,024	2,813	5,693,512	590,309	2,007	0	592,316	0.104
1999	513	2,319	1,189,647	37,110	28,459	0	65,569	0.055
2000	11,413	2,673	30,506,949	701,257	1,414,148	0	2,115,405	0.069
2001	21,685	2,960	64,187,600	4,024,884	409,754	15,915	4,450,553	0.069
2002	17,226	2,856	49,197,456	5,361,433	541,113	0	5,902,546	0.120
2003	2,158	3,511	7,576,738	166,385	7,602	0	173,987	0.023
2004	15,469	2,505	38,749,845	1,259,369	11,189	275	1,270,833	0.033

Brood year	Number of females	Mean fecundity	Total eggs	Numbers of wild smolts				Egg-smolt survival
				Age 1+	Age 2+	Age 3+	Total	
2005	5,867	2,718	15,946,506	2,786,123	107,243	0	2,893,366	0.181
2006	2,747	2,656	7,296,032	442,164	25,919	1,507	469,590	0.064
2007	2,001	3,115	6,232,804	329,629	142,916	594	473,139	0.076
2008	11,775	2,555	30,084,691	3,814,226	320,567	0	4,134,794	0.137
2009	3,939	2,459	9,684,965	1,179,569	NA	0	NA	NA
2010[a]	11,918	2,785	33,190,467	NA	58,136	0	NA	NA
2011[b]	9,722	2,970	28,873,491	814,960	60,382	NA	NA	NA
2012[b]	14,753	2,745	40,496,573	1,214,645	NA	NA	NA	NA
Average	***8,029***	***2,725***	***22,059,348***	***1,488,959***	***269,888***	***1,220***	***1,880,167***	***0.091***

[a] There is no emigrant estimate for trapping during 2012 or 2013.
[b] Emigrant estimates are based on captures at the Lower Wenatchee Trap.

Juvenile survival rates for hatchery sockeye salmon are provided in Table 4.14. Release-smolt survival rates for brood years 1995-2009 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 1995-2009.

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

Brood year	Number of eggs	Number of parr released	Date of release	Estimated number of smolts	Egg-smolt survival	Release-smolt survival
		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

[a] There is no emigrant estimate for the 2010 or 2011 brood years.

PIT Tagging Activities

A total of 4,821 wild juvenile sockeye salmon were PIT tagged and released in 2014 at the Lower Wenatchee Trap. Numbers of wild sockeye salmon PIT-tagged and released as part of the Comparative Survival Study during the period 2006-2014 are shown in Table 4.15. See Appendix C 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, 2006-2014.

Sampling Location	Numbers of PIT-tagged sockeye salmon released								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Upper Wenatchee Trap	0	0	3,165	3,683	10,006	0	0	0	0
Lower Wenatchee Trap	0	0	0	0	0	0	0	0	4,821

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 switched to monitoring the abundance and productivity of the natural population. Thus, estimation of spawn time and carcass surveys were discontinued.

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 the White River and Little Wenatchee watersheds (see Appendix H for more details).

Mark-Recapture Estimates

As noted above, spawning escapement of sockeye salmon in 2014 was estimated using mark-recapture methods. This method relied on PIT tags to estimate sockeye spawning escapement (see Appendix H for more details).

Using mark-recapture methods, the estimated total escapement of sockeye in the Upper Wenatchee River basin in 2014 was 53,412 (Table 4.16). About 92% 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 2009-2014. 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	16,255	4,391	49,021	53,412
Average	***44,320***	***6,840***	***2,749***	***22,530***	***25,279***

[a] Spawning escapements in 2011 and 2012 were calculated using AUC counts and a regression model (Keller and Murauskas 2012).

The spawning escapement of 53,412 Wenatchee sockeye was greater than the overall average of 17,282 (Table 4.17).

Table 4.17. Spawning escapements for sockeye salmon in the Wenatchee River basin for return years 1989-2014; 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**
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-Recapture	763	7,004	**7,767**

Return year	Escapement estimation method	Spawning escapement		
		Little Wenatchee	White	Total
2010	AUC and Mark-Recapture	2,543	19,157	**21,700**
2011	AUC and Mark-Recapture	2,431	14,582	**17,013**
2012	AUC and Mark-Recapture	4,607	23,866	**28,473**
2013	AUC and Mark-Recapture	2,426	14,294	**16,720**
2014	Mark-Recapture	4,391	49,021	**53,412**
Average		***2,375***	***16,893***	***17,282***

4.6 Carcass Surveys

As described earlier, carcass surveys were not conducted in 2014. 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**
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**

Survey year	**Numbers of sockeye carcasses**			
	Little Wenatchee	**White**	**Napeequa**	**Total**
2013	179	2,996	27	**3,202**
Average	***279***	***2,865***	***33***	***3,178***

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 2.9.

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**
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**

Survey year	**Origin**	**Numbers of sockeye carcasses**					
		Little Wenatchee		**White River**			**Total**
		L2	**L3**	**H1**	**H2**	**Q1**	
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***

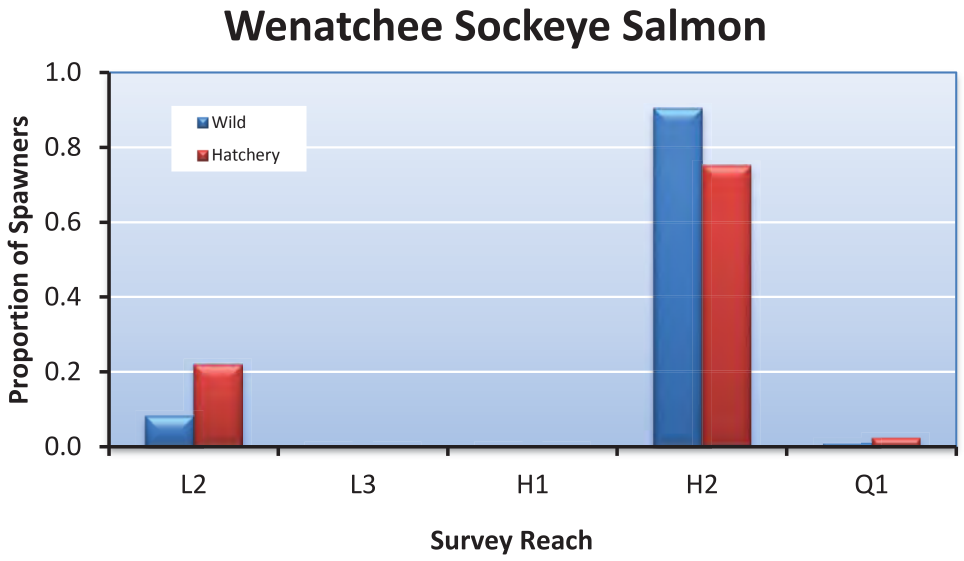

Figure 4.2. Distribution of wild and hatchery produced carcasses in different reaches in the Wenatchee River basin, pooled data from 1993-2013. Reach codes are described in Table 2.9; L = Little Wenatchee, H = White River, and Q = Napeequa River.

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, 1998-2014. 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.

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

Survey year	Origin	Sockeye Migration Time (days)								Sample size
		10 Percentile		50 Percentile		90 Percentile		Mean		
		Julian	Date	Julian	Date	Julian	Date	Julian	Date	
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
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
Average	Wild	***200***		***206***		***217***		***207***		***22,905***
	Hatchery	***201***		***208***		***224***		***211***		***737***

[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, 1998-2014. 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
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

Survey year	Origin	Sockeye Migration Time (week)				Sample size
		10 Percentile	50 Percentile	90 Percentile	Mean	
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
Average	Wild	***29***	***30***	***31***	***30***	***22,905***
	Hatchery	***29***	***30***	***32***	***30***	***737***

[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.

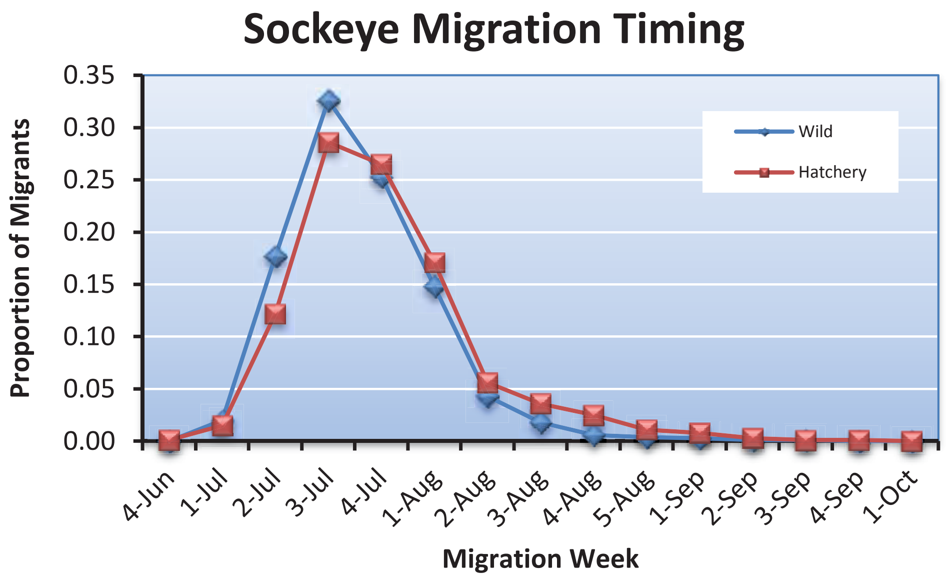

Figure 4.3. Proportion of wild and hatchery sockeye observed (using video) passing Tumwater Dam each week during their migration period late-June through early-October; data were pooled over survey years 1998-2014.

Age at Maturity

Although sample sizes are small, it appears that 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.

Table 4.21. Proportions of wild and hatchery sockeye of different ages (total age) sampled in broodstock and on spawning grounds, 1994-2013. Since 2012, only wild and hatchery sockeye sampled on spawning grounds were used to establish proportions.

Survey year	Origin	Total age						Sample size
		2	3	4	5	6	7	
1994	Wild	-	-	-	-	-	-	0
	Hatchery	0.00	0.00	0.88	0.13	0.00	0.00	16
1995	Wild	-	-	-	-	-	-	0
	Hatchery	0.00	0.00	0.00	1.00	0.00	0.00	1
1996	Wild	-	-	-	-	-	-	0
	Hatchery	0.00	0.00	1.00	0.00	0.00	0.00	82
1997	Wild	-	-	-	-	-	-	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
	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
	Hatchery	0.00	0.02	0.93	0.05	0.00	0.00	244
2005	Wild	-	-	-	-	-	-	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

Survey year	**Origin**	**Total age**						**Sample size**
		2	**3**	**4**	**5**	**6**	**7**	
	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	0.00	0.25	0.75	0.00	0.00	4
	Hatchery	0.00	0.00	0.89	0.11	0.00	0.00	44
Average	***Wild***	***0.00***	***0.00***	***0.57***	***0.41***	***0.02***	***0.00***	***79***
	Hatchery	***0.00***	***0.01***	***0.90***	***0.09***	***0.00***	***0.00***	***86***

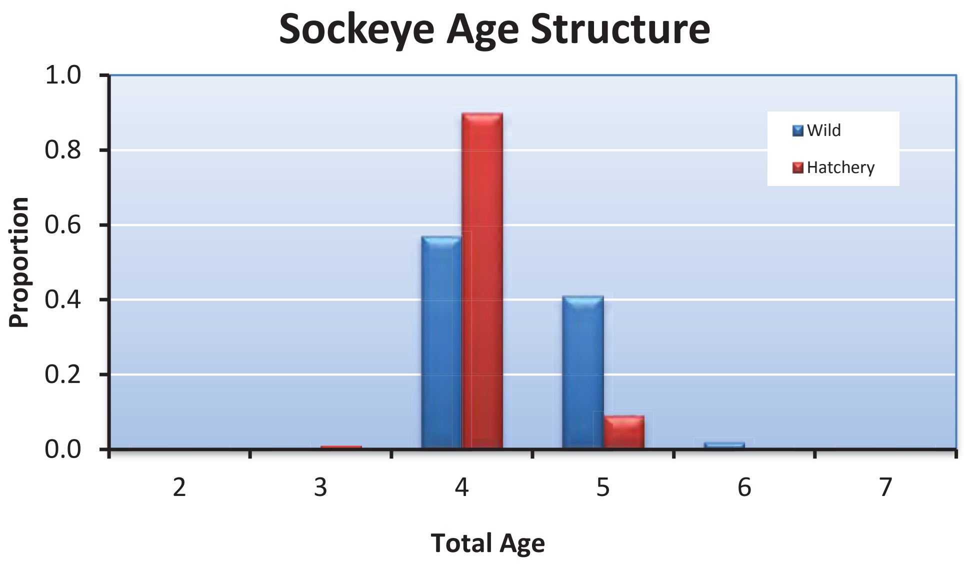

Figure 4.4. Proportions of wild and hatchery sockeye salmon of different total ages sampled at Tumwater Dam and on spawning grounds in the Wenatchee River basin for the combined years 1994-2013.

Size at Maturity

Although sample sizes are small, wild and hatchery sockeye were similar in size in 2013 (Table 4.22). In addition, the pooled data indicate that there is little difference in mean sizes of hatchery and wild sockeye salmon sampled in the Wenatchee River basin (Table 4.22). Analyses for the five-year 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, 1994-2013; SD = 1 standard deviation.

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
Pooled	***Wild***	***2,241***	***43***	***3***	***32***	***66***
	Hatchery	***1,634***	***45***	***4***	***30***	***65***

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, 1989-2008.

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)	61 (81)	9 (12)	5 (7)	75
1997	0 (0)	69 (73)	11 (12)	15 (16)	95
1998	0 (0)	7 (100)	0 (0)	0 (0)	7
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)	7 (4)	0 (0)	192 (96)	199
2005	0 (0)	61 (41)	7 (5)	79 (54)	147
2006	0 (0)	124 (23)	1 (0)	409 (77)	534
2007	0 (0)	95 (82)	12 (10)	9 (8)	116
2008	0 (0)	83 (20)	10 (2)	322 (78)	415
Average	***0 (0)***	***48 (64)***	***3 (2)***	***105 (34)***	***156***

[a] Includes the Lake Wenatchee fishery.

Table 4.24. Estimated number and percent (in parentheses) of wild Wenatchee sockeye captured in different fisheries, 1989-2008.

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 (86)	3 (4)	7 (10)	73
1996	0 (0)	1,554 (56)	247 (9)	993 (36)	2,794
1997	0 (0)	3,061 (54)	370 (6)	2,266 (40)	5,697
1998	0 (0)	938 (99)	4 (0)	10 (1)	952
1999	0 (0)	22 (19)	3 (3)	90 (78)	115
2000	0 (0)	1,189 (19)	162 (3)	4,881 (78)	6,232
2001	0 (0)	827 (100)	0 (0)	0 (0)	827
2002	0 (0)	379 (83)	2 (0)	73 (16)	454
2003	0 (0)	129 (25)	11 (2)	383 (73)	523
2004	0 (0)	1,559 (24)	147 (2)	4,825 (74)	6,531
2005	0 (0)	2,497 (44)	177 (3)	2,996 (53)	5,670
2006	0 (0)	2,844 (52)	107 (2)	2,505 (46)	5,456
2007	0 (0)	1,533 (57)	202 (8)	944 (35)	2,679
2008	0 (0)	5,446 (25)	648 (3)	15,414 (72)	21,508
Average	***0 (0)***	***1,293 (64)***	***106 (2)***	***2,011 (34)***	***3,411***

[a] Includes the Lake Wenatchee fishery.

Straying

Stray rates were determined by examining CWTs recovered on spawning grounds within and outside the Wenatchee River basin. In addition, PIT tagging of hatchery sockeye, which began with brood year 2005, allows estimation of stray rates by brood return. Targets for strays based on return year (recovery year) outside the Wenatchee River basin should be less than 5%. The target for brood year strays should also be less than 5%.

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 4.25). However, sockeye from brood years 2006 and 2007 strayed into the Entiat River and a few into the Methow River (non-target streams) and a non-target hatchery (Umpqua Trap) (Table 4.25). Stray rates of Wenatchee sockeye from brood year 2006 exceeded the target of 5%.

Table 4.25. 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 1990-2008. Hatchery-origin sockeye from brood years 1995-1998 were not tagged because of columnaris disease. Percent stays should be less than 5%.

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	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-
1997	-	-	-	-	-	-	-	-
1998	-	-	-	-	-	-	-	-
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	97.4	1	0.4	6	2.2	0	0.0
2008	85	90.4	0	0.0	9	9.6	0	0.0
Average	***139***	***94.4***	***1***	***0.9***	***12***	***4.6***	***0***	***0.1***

* 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-tag analyses, on average, about 9% of the hatchery sockeye returns were last detected in streams outside the Wenatchee River basin (Table 4.26). The numbers in Table 4.26 should be considered rough estimates because they are not based on confirmed spawning (only last detections) and the numbers have not been adjusted for detection efficiencies, which currently do not exist for PIT-tag detection arrays in tributaries. What these data do indicate is that some hatchery sockeye from the Wenatchee program have wandered or 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 4.26. 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 for brood years 2005-2009. Estimates were based on last detections of PIT-tagged hatchery sockeye. Percent strays should be less than 5%.

Brood Year	Homing				Straying			
	Target streams		Target hatchery*		Non-target stream		Non-target hatchery	
	Number	%	Number	%	Number	%	Number	%
2005	166	92.2	0	0	14	7.8	0	0
2006	440	94.6	0	0	25	5.4	0	0
2007	192	95.0	0	0	10	5.0	0	0
2008	127	89.4	0	0	15	10.6	0	0
2009	41	82.0	0	0	9	18.0	0	0
Average	***193***	***90.6***	***0***	***0***	***15***	***9.4***	***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 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 I). 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 and five temporally replicated collections of hatchery-origin sockeye. Paired natural-hatchery collections were available from return years 2000, 2001, 2004, 2006, and 2007.

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 was 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.

Proportion of 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). The ratio pNOB/(pHOS+pNOB) is the Proportion of Natural Influence (PNI). The larger the ratio (PNI), 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 important integrated populations should have a PNI of at least 0.67 (HSRG/WDFW/NWIFC 2004).

PNI values for the life of the program (brood years 1989-2011) are shown in Table 4.27. Throughout the program, PNI was consistently greater than 0.67. The hatchery program was terminated in 2012.

Table 4.27. Proportionate natural influence (PNI) of the Wenatchee sockeye supplementation program for brood years 1989-2011. PNI was calculated as the proportion of naturally produced sockeye in the hatchery broodstock (pNOB) divided by the proportion of hatchery sockeye counted at Tumwater Dam (pHOS) plus pNOB. 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.

Brood year	Spawners[a]			Broodstock			PNI
	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
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	0.90
2000	19,574	1,161	0.06	170	5	0.97	0.94
2001	28,288	815	0.03	200	7	0.97	0.97
2002	27,372	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	9,183	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	13,093	447	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
2012	18,214	296	0.02	--	--	--	--
2013	22,118	614	0.03	--	--	--	--
Average	***16,108***	***460***	***0.03***	***203***	***5***	***0.97***	***0.97***

[a] Proportions of natural-origin and hatchery-origin spawners were determined from video tape at Tumwater Dam.

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 4.28).[5] Over the seven brood years for which PIT-tagged hatchery fish were released, survival rates from Lake Wenatchee to McNary Dam 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 4.28. 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 2004-2010. 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 sockeye released with PIT tags	Survival to McNary Dam	Travel time to McNary Dam	SAR to Bonneville Dam
2004	14,859	0.334 (0.013)	176.4 (61.9)	0.020 (0.001)
2005	14,764	0.370 (0.030)	202.0 (9.1)	0.044 (0.002)
2006	14,947	0.312 (0.013)	199.9 (8.6)	0.024 (0.001)
2007	14,858	0.307 (0.020)	192.9 (35.7)	0.015 (0.001)
2008	14,486	0.211 (0.015)	194.2 (29.1)	0.005 (0.001)
2009	5,039	0.302 (0.048)	191.7 (26.6)	0.014 (0.002)
2010	5,074	0.315 (0.038)	196.7 (7.3)	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. 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 1989-2008, NRR in the Wenatchee averaged 1.51 (range, 0.13-5.30) if harvested fish were not included in the estimate and 1.79 (range, 0.14-6.42) if harvested fish were included in the estimate (Table 4.29).

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 5.40 (the calculated target value in Hillman et al. 2013). HRRs exceeded NRRs in 12 or 13 of the 20 years of data depending on if harvest was or was not included in the estimates (Table 4.29). Hatchery replacement rates for

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[5] 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.

Wenatchee sockeye have equaled or exceeded the estimated target value of 5.40 in four or five of the 20 years depending on if harvest was or was not included in the estimate (Table 4.29).

Table 4.29. 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 sockeye salmon in the Wenatchee River basin, 1989-2008.

Brood year	Broodstock Collected	Spawning Escapement	Harvest not included				Harvest included			
			HOR	NOR	HRR	NRR	HOR	NOR	HRR	NRR
1989	255	21,802	2757	23,616	10.81	1.08	3680	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	838	0.58	0.24	131	912	0.63	0.26
1996	227	6,573	1,348	28,049	5.94	4.27	1423	30,840	6.27	4.69
1997	226	8,444	739	36,097	3.27	4.27	834	41,794	3.69	4.95
1998	190	4,014	104	16,166	0.55	4.03	111	17,118	0.58	4.26
1999	147	1,025	68	566	0.46	0.55	83	682	0.56	0.67
2000	195	20,735	1,425	29,082	7.31	1.40	1907	35,314	9.78	1.70
2001	245	29,103	24	17,242	0.10	0.59	28	18,069	0.11	0.62
2002	257	27,565	281	5,752	1.09	0.21	297	6,206	1.16	0.23
2003	219	4,855	32	2,054	0.15	0.42	35	2,588	0.16	0.53
2004	202	27,555	94	23,599	0.47	0.86	293	30,130	1.45	1.09
2005	207	14,011	462	20,833	2.23	1.49	608	26,504	2.94	1.89
2006	220	9,438	1,145	26,966	5.20	2.86	1679	32,421	7.63	3.44
2007	228	2,379	911	12,604	4.00	5.30	1029	15,283	4.51	6.42
2008	260	23,023	11,072	33,346	42.58	1.45	14187	54,853	54.57	2.38
Average	***238***	***15,475***	***1,089***	***15,141***	***4.43***	***1.51***	***1379***	***18,552***	***5.62***	***1.79***

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 0.0254 (Table 4.30).

Table 4.30. Parr-to-adult ratios (PAR) and smolt-to-adult ratios (SAR) for Wenatchee hatchery sockeye salmon, brood years 1990-2007; 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	1,423	0.0050	0.0254
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
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	608	0.0043	0.0043
2006	225,670	121,843	1,679	0.0074	0.0138
2007	252,133	119,908	1,029	0.0041	0.0086
Average	***210,062***	***112,163***	***705***	***0.0041***	***0.0068***

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.

Spawning Surveys

Sockeye spawning ground surveys conducted in the Wenatchee River basin during 2014 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 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. Prior to 2012, 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 in 2012) 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 hatchery-origin Chiwawa spring Chinook are collected at Tumwater Dam, while the Chiwawa Weir is used to collect natural-origin brood for the Chiwawa spring Chinook program. Broodstock collection occurs from May through 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. They are released volitionally from the Chiwawa Acclimation Facility during April the following year.

Before 2012, the production goal for the Chiwawa spring Chinook supplementation program was to release 672,000 yearling smolts into the Chiwawa River at 12 fish per pound. Beginning with the 2014 brood, the revised production goal is to release 144,026 smolts as part of a conservation program at 18 fish per pound. The Wenatchee spring Chinook safety-net program is now part of the Nason Creek spring Chinook program. 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.

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 2012-2014 Chiwawa spring Chinook broodstock, which were collected at the Chiwawa Weir and at Tumwater Dam, consistent with methods in the broodstock collections protocols (Hillman et al. 2013). Some information for the 2014 return is not available at this time (e.g., age structure and final origin determination). This information will be provided in the 2015 annual report.

Origin of Broodstock

Hatchery-origin adults made up between 68% of the Chiwawa spring Chinook broodstock for return years 2012-2014 (Table 5.1). Natural and hatchery-origin adults were collected at Tumwater Dam and the Chiwawa Weir for return year 2014. Broodstock were trapped at Tumwater Dam from mid-June through mid-July of 2014, and at the Chiwawa Weir from mid-July through mid-August. Hatchery-origin broodstock were collected at Tumwater Dam in 2014 to meet the Nason Creek Safety Net requirements. Additional hatchery-origin broodstock were collected to ensure production obligations were achieved in the event that insufficient natural-origin collections could be made. A total of 67 hatchery-origin fish collected in 2014 were 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, 1989-2014. 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	
1989	28	0	0	28	0	0	0	0	0	0	28
1990	19	1	0	18	0	0	0	0	0	0	18
1991	32	0	5	27	0	0	0	0	0	0	27
1992	113	0	0	78	35	0	0	0	0	0	78
1993	100	3	3	94	0	0	0	0	0	0	94
1994	9	0	1	8	0	4	0	0	4	0	12
1995	No Program										
1996	8	0	0	8	0	10	0	0	10	0	18
1997	37	0	5	32	0	83	1	3	79	0	111
1998	13	0	0	13	0	35	1	0	34	0	47
1999	No Program										
2000	10	0	1	9	0	38	1	16	21	0	30
2001	115	2	0	113	0	267	8	0	259	0	372
2002	21	0	1	20	0	63	1	11	51	0	71
2003	44	1	2	41	0	75	2	20	53	0	94
2004	100	1	16	83	0	196	30	34	132	0	215
2005	98	1	6	91	0	185	3	1	181	0	279
2006	95	0	4	91	0	303	0	29	224	50	315
2007	45	1	1	43	0	124	2	18	104	0	147
2008	88	2	3	83	0	241	5	16	220	0	303
2009	113	6	11	96	0	151	3	37	111	0	207
2010	83	0	6	77	0	103	0	5	98	0	175
2011	80	0	0	80	0	101	2	6	93	0	173
Average[b]	***60***	***1***	***3***	***54***	***2***	***94***	***3***	***9***	***80***	***2***	***134***
2012	75	1	1	73	0	41	3	38	0	0	111

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	170	5	0	70	95	52	1	50	0	1	70
2014	61	0	0	61	0	203	1	68	134	0	195
Average[c]	***102***	***2***	***0***	***68***	***32***	***99***	***2***	***52***	***45***	***0***	***125***

[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 represents the program before recalculation in 2011.

[c] This average represents the current program, which began in 2012. 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 2012 and 2013 returns, most adults, regardless of origin, were age-4 Chinook (Table 5.2). A larger percentage of the age-5 Chinook were natural-origin fish, whereas a larger percentage of the age-3 fish were hatchery-origin fish.

Table 5.2. Percent of hatchery and wild spring Chinook of different ages (total age) collected from broodstock, 1991-2013.

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			
	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

Return year	Origin	Total age			
		2	3	4	5
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
Average	***Wild***	***0.0***	***6.0***	***62.1***	***31.8***
	Hatchery	***0.0***	***12.4***	***64.5***	***13.6***

There was little difference in mean lengths between hatchery and natural-origin broodstock of age-4 and 5 Chinook in 2012 and 2013 (Table 5.3).

Table 5.3. Mean fork length (cm) at age (total age) of hatchery and wild spring Chinook collected from broodstock, 1991-2013; 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	-

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
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												
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

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	-	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
Average	***Wild***	***47***	***0***	***-***	***53***	***3***	***5***	***80***	***38***	***6***	***95***	***10***	***7***
	Hatchery	***-***	***0***	***-***	***56***	***11***	***5***	***81***	***76***	***7***	***94***	***8***	***7***

Sex Ratios

Male spring Chinook in the 2012-2014 return years made up 49.5%, 49.1%, and 49.2%, respectively, of the adults collected. This resulted in overall male to female ratios of 0.90:1.00, 0.96:1.00, and 0.97:1.00, respectively (Table 5.4). For the 2014 return year, natural-origin and hatchery-origin fish both consisted of a slightly higher proportion of females than males (Table 5.4).

Table 5.4. Numbers of male and female wild and hatchery spring Chinook collected for broodstock, 1989-2014. 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
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

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	
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	29	32	0.91:1.00	101	102	0.99:1.00	0.97:100
Total	***746***	***776***	***0.96:1.00***	***1,077***	***1,197***	***0.91:1.00***	***0.92:1.00***

Fecundity

Mean fecundities for the 2012-2014 returns of spring Chinook ranged from 4,045-4,716 eggs per female (Table 5.5). These fecundities were generally less than the overall average of 4,654 eggs per female, but were close to the expected fecundity of 4,400 eggs per female assumed in the broodstock protocol. For the 2014 return year, natural-origin Chinook produced more eggs per female than did hatchery-origin fish. This could be attributed to differences in size and age of hatchery and natural-origin fish described above (Tables 5.2 and 5.3).

Table 5.5. Mean fecundity of wild, hatchery, and all female spring Chinook collected for broodstock, 1989-2014; 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		
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

Return year	Mean fecundity		
	Wild	Hatchery	Total
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	0	4,716
2014	4,467	3,834	4,045
Average	***4,819***	***4,226***	***4,654***

* Individual fecundities were not tracked with females until 1997.

[a] Estimated as the mean of fecundities two years before and two years after 1992.

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, 169,442 eggs have been required to achieve a release goal of 144,026 smolts for the Chiwawa spring Chinook Program. Between 1989 and 2014, the egg take goal was reached only in 2001 (Table 5.6). The green egg takes for 2012-2014 brood years were 99.3%, 97.4%, and 99.7% of program goals, respectively.

ESA Permit 18121 sets limits on the percentage of the total run and natural-origin fish in the broodstock to meet the conservation program. Applying these criteria to the low total abundance of spring Chinook salmon to the Chiwawa River basin and the low abundance of natural-origin fish returning to the basin has resulted in the program not meeting production goals.

Table 5.6. Numbers of eggs taken from spring Chinook broodstock, 1989-2014; NP = no program. Egg take for the Nason Creek Safety Net Program began in 2014.

Return year	Number of eggs taken	
	Chiwawa Program	Nason Creek Safety Net Program
1989	45,311	NP
1990	60,287	NP
1991	73,601	NP
1992	111,624	NP
1993	257,208	NP
1994	35,539	NP
1995	NP	NP

Return year	Number of eggs taken	
	Chiwawa Program	**Nason Creek Safety Net Program**
1996	18,579	NP
1997	312,182	NP
1998	90,521	NP
1999	NP	NP
2000	55,256	NP
2001	1,099,630	NP
2002	196,186	NP
2003	247,501	NP
2004	538,176	NP
2005	536,490	NP
2006	744,344	NP
2007	359,739	NP
2008	761,821	NP
2009	564,912	NP
2010	383,944	NP
2011	366,244	NP
Average (1989-2011)	***326,624***	***NP***
2012	250,695	NP
2013	165,047	NP
2014	169,007	217,290
Average (2012-present)	***227,843***	***217,290***

Number of acclimation days

Early rearing of the 2012 brood Chiwawa spring Chinook was similar to previous years with fish being held on well water before being transferred to 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 2012 brood, fish were acclimated for 204 to 211 days on Chiwawa River water, with 107 of those days containing a small percentage of Wenatchee River water to prevent freezing of hatchery intakes (Table 5.7).

Table 5.7. Number of days spring Chinook broods were acclimated and water source, brood years 1989-2012; 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
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]

[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 2012 brood Chiwawa spring Chinook program achieved 108.8% of the 204,452 target goal with about 222,504 smolts being released volitionally into the Chiwawa River in 2014 (Table 5.8).

Table 5.8. Numbers of spring Chinook smolts tagged and released from the hatchery, brood years 1989-2012. The release target for Chiwawa spring Chinook is 298,000 smolts.

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
1989	1991	Volitional	0.9932	0	43,000	43,000
1990	1992	Volitional	0.9931	0	53,170	53,170
1991	1993	Volitional	0.9831	0	62,138	62,138
1992	1994	Volitional	0.9747	0	85,113	85,113
1993	1995	Volitional	0.9892	0	223,610	223,610
1994	1996	Volitional	0.9967	0	27,226	27,226
1995	1997	No program				
1996	1998	Forced	0.8413	0	15,176	15,176
1997	1999	Volitional	0.9753	0	266,148	266,148
1998	2000	Volitional	0.9429	0	75,906	75,906
1999	2001	No program				
2000	2002	Volitional	0.9920	0	47,104	47,104
2001	2003	Forced	0.9961	0	192,490[a]	377,544
		Volitional	0.9856	0	185,054[a]	
2002	2004	Volitional	0.9693	0	149,668	149,668
2003	2005	Forced	0.9783	0	69,907	222,131
		Volitional	0.9743	0	152,224	
2004	2006	Forced	0.9533	0	243,505	494,517
		Volitional	0.9493	0	251,012	
2005	2007	Forced	0.9882	4,993	245,406	494,012
		Volitional	0.9864	4,988	248,606	
2006	2007	Direct	0.0000	0	12,977[b]	612,482
	2008	Volitional	0.9795	9,894	612,482	
2007	2008	Direct	0.0000	0	9,494	305,542
	2009	Volitional	0.9948	10,035	296,048	
2008	2010	Volitional	0.9835	10,006	609,789	609,789
2009	2011	Forced	0.9874	0	241,181	438,561
		Volitional	0.9874	9,412	197,380	

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
2010[c]	2012	Volitional	0.9904	5,020	346,248	346,248
2011	2013	Volitional	0.9902	9,945	281,821	281,821
2012	2014	Volitional	0.9841	5,061	222,504	222,504

[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.

Numbers tagged

The 2012 brood Chiwawa spring Chinook were 98% CWT and adipose fin clipped (Table 5.8).

In 2014, a total of 10,114 spring Chinook from the 2013 brood were PIT tagged at Eastbank Hatchery on 4 to 8 August. These fish were tagged in raceway #12. Fish were not fed the day before tagging, during tagging, or for two days after tagging. Fish averaged 98 mm in length and 12.0 g at time of tagging. These fish were transferred to the Chiwawa Raceway in September 2014. These fish will be released in the Chiwawa River during spring 2015.

Table 5.9 summarizes the number of hatchery spring Chinook that have been PIT-tagged and released into the Chiwawa River.

Table 5.9. Summary of PIT-tagging activities for Chiwawa hatchery spring Chinook, brood years 2005-2012.

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
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

[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 2012 brood were released as yearling smolts between 14 and 21 April 2014. Size at release (16 fpp) was larger than the target of 18 fpp established for the program. The CV for fork length was 26% short of the target (Table 5.10).

Table 5.10. Mean lengths (FL, mm), weight (g and fish/pound), and coefficient of variation (CV) of spring Chinook smolts released from the hatchery, brood years 1989-2012. 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	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
		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
Average		***139***	***6.9***	***35.4***	***17***
Targets		***155***	***9.0***	***37.8***	***18***

[a] Forced release group.
[b] Volitional release group.

Survival Estimates

Overall survival of Chiwawa spring Chinook from green (unfertilized) egg to release was above the standard set for the program (Table 5.11). There was higher than expected survivals throughout all stages contributing to increased program performance. Pre-spawn survival of adults was also above the standard set for the program.

Table 5.11. Hatchery life-stage survival rates (%) for spring Chinook, brood years 1989-2012. 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
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
Average	***98.2***	***98.0***	***92.9***	***97.0***	***98.5***	***98.0***	***91.6***	***94.3***	***82.8***
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.

5.3 Disease Monitoring

Results of 2014 adult broodstock bacterial kidney disease (BKD) monitoring indicated that all females had ELISA values less than 0.199. About 88.9% of females had ELISA values less than 0.120, which would have required about 11.1% of the progeny to be reared at densities not to exceed 0.06 fish per pound (Table 5.12).

For the 2012 brood, mortalities resulting from external fungal infections began increasing shortly after transfer to the Chiwawa Acclimation Facility. A formalin drip treatments was used to control the infection. No significant health issues were encountered for the remainder of juvenile rearing.

Table 5.12. Proportion of bacterial kidney disease (BKD) titer groups for the Chiwawa spring Chinook broodstock, brood years 1996-2014. 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)	
	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	0.0829	0.1429	0.0286	0.0000	0.8857	0.1143
2014	0.8282	0.1720	0.0000	0.0000	0.8889	0.1111
Average	***0.5316***	***0.3296***	***0.0411***	***0.0562***	***0.7026***	***0.2974***

[a] Individual ELISA samples were not collected before the 1996 brood.

5.4 Natural Juvenile Productivity

During 2014, juvenile spring Chinook were sampled at the Lower Wenatchee, Nason Creek, and Chiwawa traps and counted during snorkel surveys within the Chiwawa River basin. Results from sampling at the Nason Creek Trap are provided in Section 6.

Parr Estimates

Based on snorkel surveys, a total of 121,240 (±11%) subyearling and 939 (±28%) yearling spring Chinook were estimated in the Chiwawa River basin in August 2014 (Table 5.13 and 5.14).

During the survey period 1992-2014, 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 5.13 and 5.14; Figure 5.1). Numbers of all fish counted in the Chiwawa River basin are reported in Appendix A.

Table 5.13. Total numbers of subyearling spring Chinook estimated in different streams in the Chiwawa River basin during snorkel surveys in August 1992-2014; 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**
Average	***75,211***	***317***	***2,393***	***1,689***	***86***	***1,261***	***49***	***53***	***29***	***80,754***

Table 5.14. Total numbers of yearling spring Chinook estimated in different streams in the Chiwawa River basin during snorkel surveys in August 1992-2014; 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**

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**
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**
Average	***231***	***3***	***8***	***17***	***0***	***4***	***0***	***0***	***0***	***260***

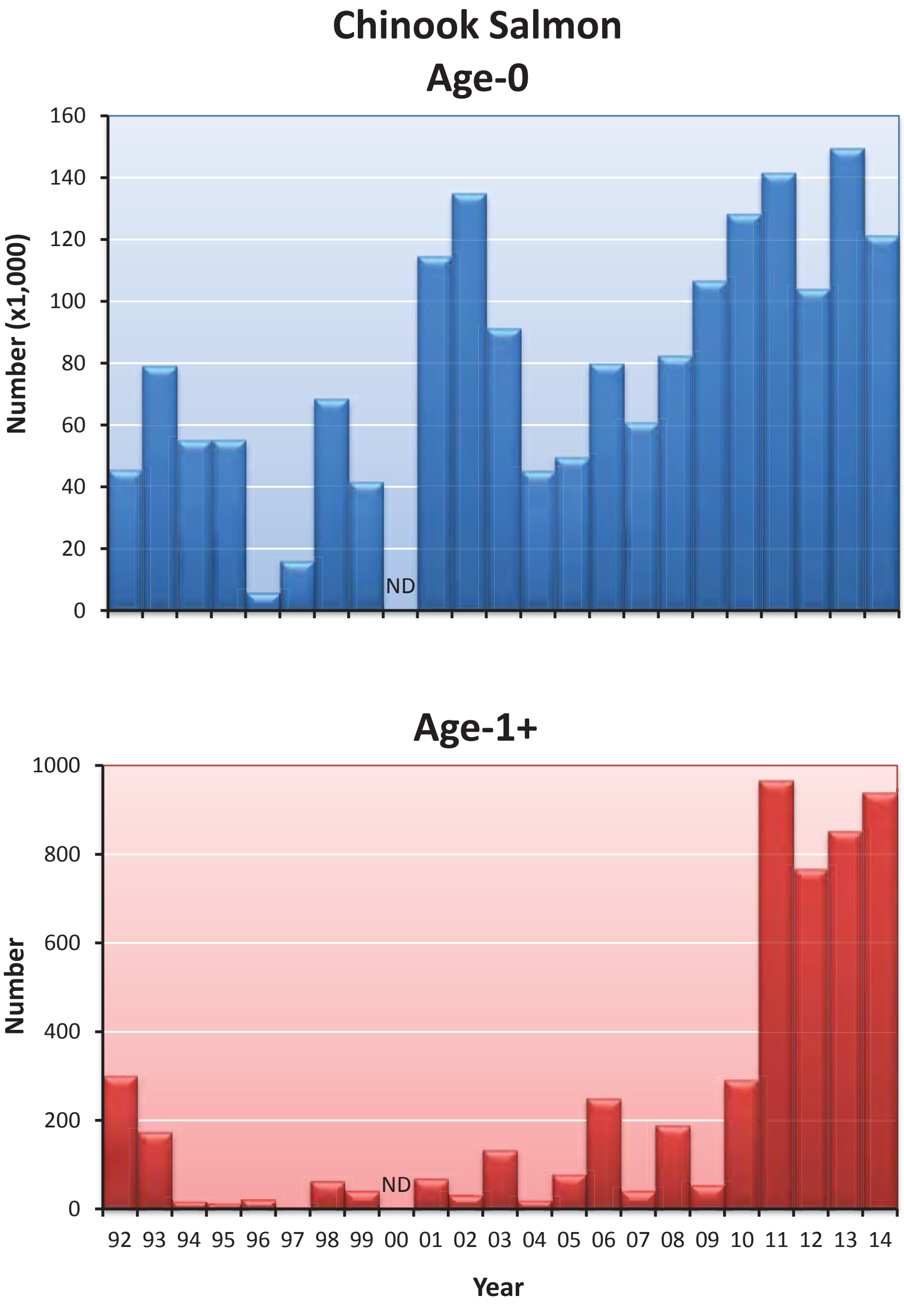


Figure 5.1. Numbers of subyearling and yearling Chinook salmon within the Chiwawa River Basin in August 1992-2014; ND = no data.

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 least abundant in glides and riffles. Most Chinook associated closely with woody debris in multiple channels. These sites (multiple channels) made up 17% of the total area of the Chiwawa River basin, but they provided habitat for 52% of all subyearling Chinook in the basin in 2014. In contrast, riffles made up 54% of the total area, but provided habitat for only 11% of all juvenile Chinook in the Chiwawa River basin. Pools made up 22% of the total area and provided habitat for 37% of all juvenile Chinook in the basin. Virtually no Chinook used glides that lacked woody debris.

Mean densities of juvenile Chinook in two reaches of the Chiwawa River were generally less than those in corresponding reference areas (Figure 5.2). Within both the Chiwawa River and its reference areas, pools and multiple channels consistently had the highest densities of juvenile Chinook.

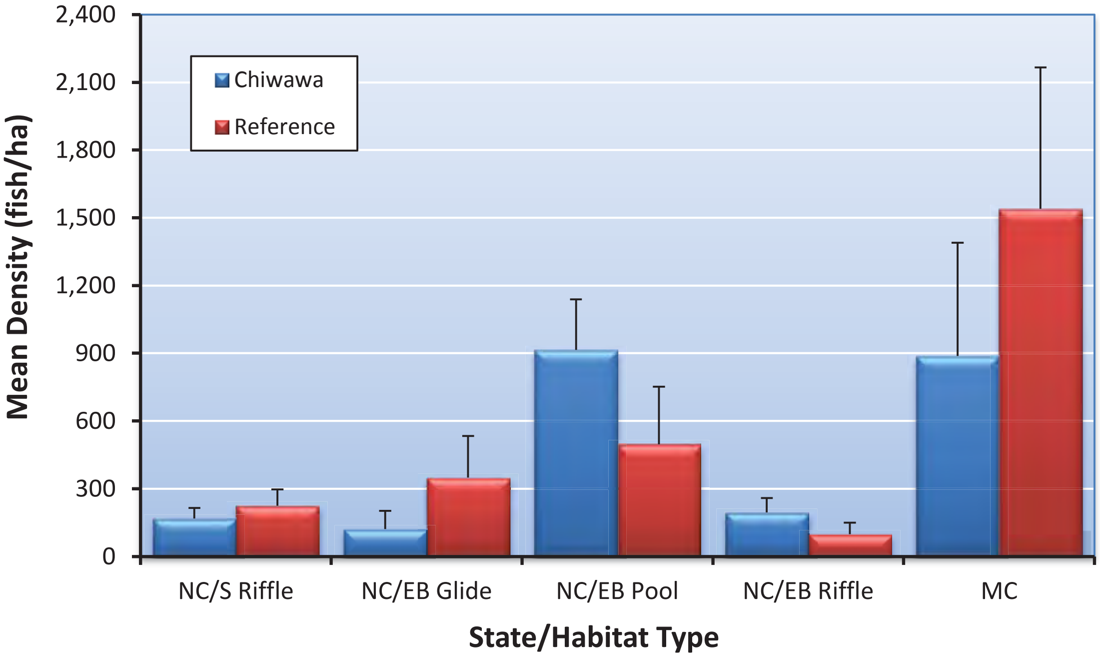


Figure 5.2. Comparison of the 21-year means of subyearling spring Chinook densities within state/habitat types in reaches 3 and 8 of the Chiwawa River and their matched reference areas on Nason Creek and the Little Wenatchee River. NC = natural channel; S = straight channel; EB = eroded banks; MC = multiple 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 2014.

Chiwawa Trap

The Chiwawa Trap operated between 18 March and 13 November 2014. During that time period the trap was inoperable for 21 days because of high river flows, debris, snow/ice, or mechanical failure. The trap operated in two different positions depending on stream flow; lower position at flows greater than 12 m^3/s and an upper position at flows less than 12 m^3/s. Daily trap efficiencies were estimated from two regression models depending on trap position and 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 B.

Wild yearling spring Chinook (2012 brood year) were primarily captured from March through June 2014 (Figure 5.3). Based on capture efficiencies estimated from the flow model, the total number of wild yearling Chinook emigrating from the Chiwawa River was 34,334 (±6,488). Combining the total number of subyearling spring Chinook (49,774) that emigrated during the fall of 2013 with the total number of yearling Chinook (34,334) that emigrated during 2014 and the number of estimated Chinook that were not trapped (25,305) resulted in a total emigrant estimate of 109,413 (±11,723) spring Chinook for the 2012 brood year (Table 5.15). The method for estimating emigration during the non-trapping period is explained in Appendix B.

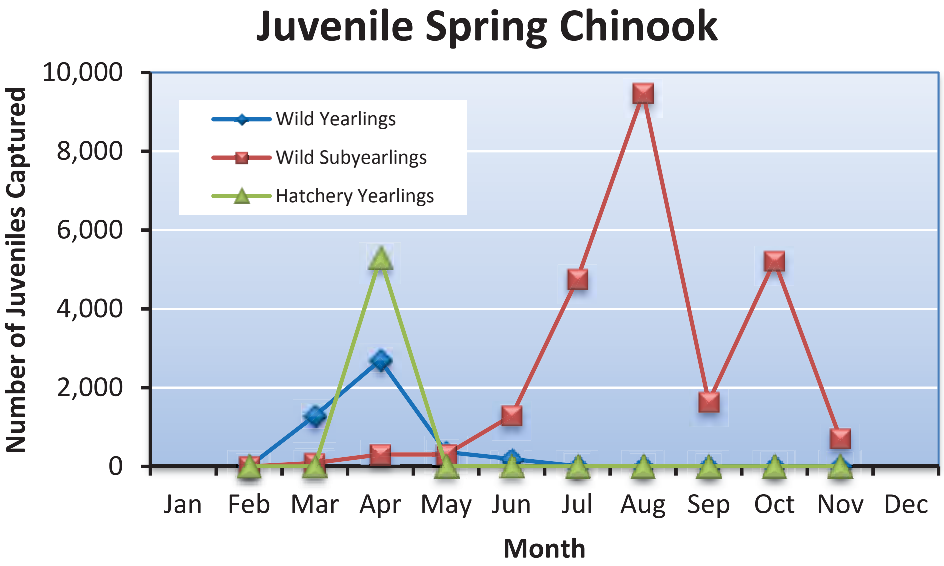


Figure 5.3. Monthly captures of wild subyearling, wild yearling, and hatchery yearling spring Chinook at the Chiwawa Trap, 2014.

Table 5.15. Numbers of redds and juvenile spring Chinook at different life stages in the Chiwawa River basin for brood years 1991-2014; NS = not sampled.

Brood year	Number of redds	Egg deposition	Number of parr	Number of smolts produced within Chiwawa River basin[a]	Total number of smolts[b]	Number of emigrants
1991	104	478,400	45,483[c]	42,525	42,525	NS
1992	302	1,570,098	79,113	39,723	56,763	65,541
1993	106	556,394	55,056	8,662	17,926	22,698
1994	82	485,686	55,240	16,472	22,145	25,067
1995	13	66,248	5,815	3,830	5,230	5,951
1996	23	106,835	16,066	15,475	17,922	19,183
1997	82	374,740	68,415	28,334	39,044	44,562

Brood year	Number of redds	Egg deposition	Number of parr	Number of smolts produced within Chiwawa River basin[a]	Total number of smolts[b]	Number of emigrants
1998	41	218,325	41,629	23,068	24,953	25,923
1999	34	166,090	NS	10,661	13,953	15,649
2000	128	642,944	114,617	40,831	50,634	55,685
2001	1,078	4,984,672	134,874	86,482	389,940	546,266
2002	345	1,605,630	91,278	90,948	152,547	184,279
2003	111	648,684	45,177	16,755	27,897	33,637
2004	241	1,156,559	49,631	72,080	101,172	116,158
2005	332	1,436,564	79,902	69,064	140,737	177,659
2006	297	1,284,228	60,752	45,050	86,579	107,972
2007	283	1,256,803	82,351	25,809	65,539	86,006
2008	689	3,163,888	106,705	35,023	91,229	120,184
2009	421	1,925,233	128,220	30,959	51,417	61,955
2010	502	2,165,628	141,510	47,511	82,911	101,130
2011	492	2,157,420	103,940	37,185	82,053	108,832
2012	808	3,412,184	149,563	34,334	92,490	109,413
2013	714	3,367,224	121,240	-	-	-
Average	***314***	***1,444,803***	***80,754***	***37,308***	***75,260***	***96,845***

[a] The estimated number of smolts (yearlings) that are produced entirely within the Chiwawa River basin. 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] These numbers represent Chiwawa smolts produced within the entire Wenatchee River basin. This assumes that 66% of the subyearling migrants from the Chiwawa River basin survive to smolt in the Wenatchee River basin, regardless of the number of subyearling migrants (i.e., no density dependence). Smolt estimates for brood years 1992-1996 were calculated with a mark-recapture model; brood years 1997-present were calculated with a flow model.

[c] Estimate only includes numbers of Chinook in the Chiwawa River. Tributaries were not sampled at that time.

Wild subyearling spring Chinook (2013 brood year) were captured between March and November 2014. Based on capture efficiencies estimated from the flow model for both the upper trap position and lower position, the total number of wild subyearling (fry and parr) Chinook from the Chiwawa River basin was 114,049 (±10,839). Removing fry from the estimate, a total of 73,695 (±8,464) parr emigrated from the Chiwawa River basin in 2014. Although subyearling parr migrated during most months of sampling, the majority (82%) migrated during July, August, and October (Figure 5.3).

Yearling spring Chinook sampled in 2014 averaged 89 mm in length, 7.7 g in weight, and had a mean condition of 1.05 (Table 5.16). These size estimates were less than the overall mean of yearling spring Chinook sampled in previous years (overall means: 93 mm, 9.1 g, and condition of 1.08). Subyearling spring Chinook sampled in 2014 at the Chiwawa Trap averaged 71 mm in length, averaged 3.7 g, and had a mean condition of 1.08 (Table 5.16). These sizes were less than the overall mean of subyearling spring Chinook sampled in previous years (overall means, 76 mm, 5.3 g, and condition of 1.09).

Table 5.16. Mean fork length (mm), weight (g), and condition factor of subyearling and yearling spring Chinook collected in the Chiwawa Trap, 1996-2014. 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)
Average	***Subyearling***	***4,731***	***76 (7)***	***5.3 (1.5)***	***1.09 (0.07)***
	Yearling	***3,385***	***93 (3)***	***9.0 (1.0)***	***1.08 (0.06)***

[a] Sample size represents the number of fish that were measured for both length and weight.

Lower Wenatchee Trap

The lower Wenatchee Trap operated in a new location beginning in 2013. Hence, historic flow-discharge relationships are invalid and new models to estimate trap efficiency must be developed for all species. Until new models are developed (2-3 years) all estimates of juvenile abundance should be considered preliminary.

The Lower Wenatchee Trap operated between 12 February and 7 September 2014. During that time period the trap was inoperable for 12 days because of high river flows, debris, snow/ice, or major hatchery releases. During the seven-month sampling period, a total of 1,700 wild yearling Chinook, 81,455 wild subyearling Chinook (mostly summer Chinook), and 31,290 hatchery yearling Chinook were captured at the Lower Wenatchee Trap. Based on capture efficiencies estimated from the pooled model, the total number of wild yearling Chinook that emigrated past the Lower Wenatchee Trap was 67,973 (±431,135). Monthly captures of all fish collected at the Lower Wenatchee Trap are reported in Appendix B.

PIT Tagging Activities

As part of the Comparative Survival Study (CSS), a total of 17,002 wild juvenile Chinook (12,103 subyearling and 4,899 yearlings) were PIT tagged and released in 2013 in the Wenatchee River basin (Table 5.17a). Most of these (71.6%) were tagged at the Chiwawa trap. See Appendix C for a complete list of all fish captured, tagged, lost, and released.

Table 5.17a. Numbers of wild Chinook that were captured, tagged, and released at different locations within the Wenatchee River basin, 2014. Numbers of fish that died or shed tags are also given.

Sampling Location	Species and Life Stage	Number captured	Number of recaptures	Number tagged	Number died	Shed Tags	Total released	Percent mortality
Chiwawa Trap	Wild Subyearling Chinook	11,803	3,782	11,375	14	3	11,358	0.12
	Wild Yearling Chinook	4,476	75	4,399	16	0	4,383	0.36
	Total	**16,279**	**3,857**	**15,774**	**30**	**3**	**15,741**	**0.48**
Chiwawa River (Electrofishing)	Wild Subyearling Chinook	1,082	2	1,034	0	2	1,032	0.00
	Wild Yearling Chinook	0	0	0	0	0	0	--
	Total	1,082	2	1,034	0	2	1,032	0.00
Nason Creek (Electrofishing)	Wild Subyearling Chinook	1,908	28	1,821	4	1	1,816	0.21
	Wild Yearling Chinook	0	0	0	0	0	0	--
	Total	1,908	28	1,821	4	1	1,816	0.21
Lower Wenatchee Trap	Wild Subyearling Chinook	36	0	36	0	0	36	0.00

Sampling Location	Species and Life Stage	Number captured	Number of recaptures	Number tagged	Number died	Shed Tags	Total released	Percent mortality
	Wild Yearling Chinook	1,631	107	1,521	15	0	1,506	0.92
	Total	**1,667**	**107**	**1,557**	**15**	**0**	**1,542**	**0.92**
Total:	**Wild Subyearling Chinook**	**14,829**	**3,812**	**14,266**	**18**	**6**	**14,242**	**0.12**
	Wild Yearling Chinook	**6,107**	**182**	**5,920**	**31**	**0**	**5,889**	**0.51**
Grand Total:		***20,936***	***3,994***	***20,186***	***49***	***6***	***20,131***	***0.63***

Numbers of wild Chinook salmon PIT-tagged and released as part of CSS during the period 2006-2014 are shown in Table 5.17b.

Table 5.17b. Summary of the numbers of wild Chinook that were tagged and released at different locations within the Wenatchee River basin, 2006-2014.

Sampling Location	Species and Life Stage	Numbers of PIT-tagged Chinook salmon released								
		2006	2007	2008	2009	2010	2011	2012	2013	2014
Chiwawa Trap	Wild Subyearling Chinook	5,130	6,137	8,755	8,765	3,324	6,030	7,644	9,086	11,358
	Wild Yearling Chinook	2,793	4,659	8,397	3,694	6,281	4,318	7,980	3,093	4,383
	Total	**7,923**	**10,796**	**17,152**	**12,459**	**9,605**	**10,348**	**15,624**	**12,179**	**15,741**
Chiwawa River (Angling or Electrofishing)	Wild Subyearling Chinook	111	20	43	128	531	0	3,181	3,017	1,032
	Wild Yearling Chinook	0	0	0	3	4	0	0	0	0
	Total	**111**	**20**	**43**	**131**	**535**	**0**	**3,181**	**3,017**	**1,032**
Upper Wenatchee Trap	Wild Subyearling Chinook	0	15	0	37	3	1	1	0	0
	Wild Yearling Chinook	81	1,434	159	296	486	714	75	94	0
	Total	**81**	**1,449**	**159**	**333**	**489**	**715**	**76**	**94**	**0**
Nason Creek (Angling or Electrofishing)	Wild Subyearling Chinook	68	6	4	701	595	0	0	0	1,816
	Wild Yearling Chinook	1	7	0	13	3	0	0	0	0
	Total	**69**	**13**	**4**	**714**	**598**	**0**	**0**	**0**	**1,816**
Upper Wenatchee (Angling or Electrofishing)	Wild Subyearling Chinook	0	61	1	0	2	0	0	0	0
	Wild Yearling Chinook	27	0	0	0	0	0	0	0	0
	Total	**27**	**61**	**1**	**0**	**2**	**0**	**0**	**0**	**0**
Middle Wenatchee (Angling or Electrofishing)	Wild Subyearling Chinook	0	0	65	284	233	0	0	0	0
	Wild Yearling Chinook	0	0	0	0	0	0	0	0	0
	Total	**0**	**0**	**65**	**284**	**233**	**0**	**0**	**0**	**0**
Lower Wenatchee (Angling or Electrofishing)	Wild Subyearling Chinook	0	0	0	0	0	0	0	0	0
	Wild Yearling Chinook	0	0	0	0	0	0	0	0	0
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Peshastin Creek (Angling or Electrofishing)	Wild Subyearling Chinook	0	0	0	0	1	0	0	0	0
	Wild Yearling Chinook	0	0	0	0	0	0	0	0	0
	Total	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
Lower Wenatchee	Wild Subyearling Chinook	0	0	2	0	0	0	0	0	36

Sampling Location	Species and Life Stage	Numbers of PIT-tagged Chinook salmon released								
		2006	2007	2008	2009	2010	2011	2012	2013	2014
Trap	Wild Yearling Chinook	522	1,641	506	468	917	0	0	1,712	1,506
	Total	**522**	**1,641**	**508**	**468**	**917**	**0**	**0**	**1,712**	**1,542**
Total:	**Wild Subyearling Chinook**	**5,309**	**6,239**	**8,870**	**9,915**	**4,689**	**6,031**	**10,826**	**12,103**	**14,242**
	Wild Yearling Chinook	**3,424**	**7,741**	**9,062**	**4,474**	**7,691**	**5,032**	**8,055**	**4,899**	**5,889**
Grand Total:		***8,733***	***13,980***	***17,932***	***14,389***	***12,380***	***11,063***	***18,881***	***17,002***	***20,131***

Freshwater Productivity

Both productivity and survival estimates for different life stages of spring Chinook in the Chiwawa River basin are provided in Table 5.18. Estimates for brood year 2012 generally fall within the ranges estimated over the period of brood years 1991-2011. During that period, freshwater productivities ranged from 125-1,015 parr/redd, 114-779 smolts/redd, and 135-834 emigrants/redd. Survivals during the same period ranged from 2.7-19.1% for egg-parr, 2.7-16.8% for egg-smolt, and 3.2-18.0% for egg-emigrants. Overwinter survival rates for juvenile spring Chinook within the Chiwawa River basin have ranged from 15.7-100.0%.

Table 5.18. Productivity (fish/redd) and survival (%) estimates for different juvenile life stages of spring Chinook in the Chiwawa River basin for brood years 1991-2013; ND = no data. These estimates were derived from data in Table 5.15.

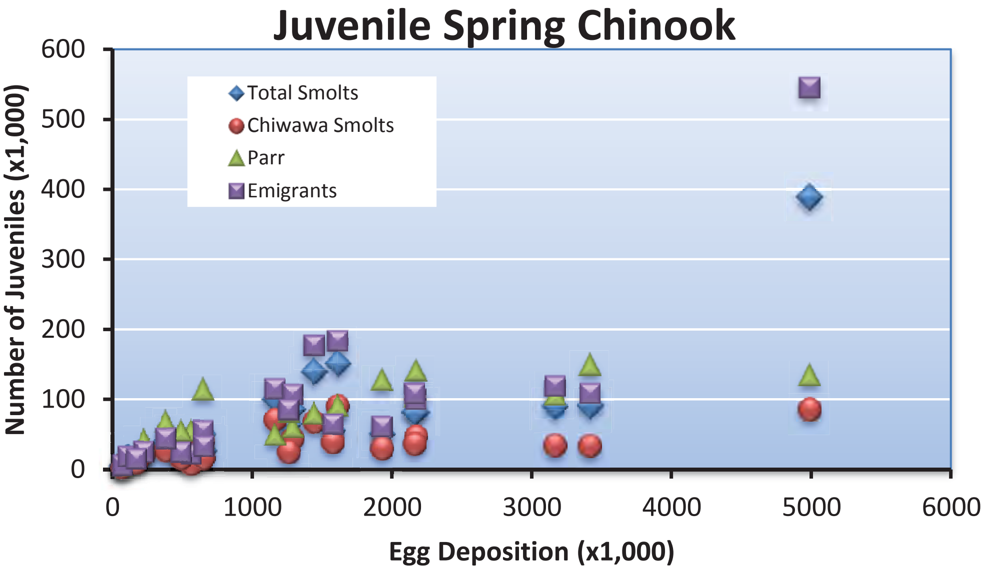
Brood year	Parr/Redd	Smolts/Redd[a]	Emigrants/ Redd	Egg-Parr (%)	Parr-Smolt[b] (%)	Egg-Smolt[a] (%)	Egg-Emigrant (%)
1991	437	409	ND	9.5	93.5	8.9	ND
1992	262	188	217	5.0	50.2	3.6	4.2
1993	519	169	214	9.9	15.7	3.2	4.1
1994	674	270	306	11.4	29.8	4.6	5.2
1995	447	402	458	8.8	65.9	7.9	9.0
1996	699	779	834	15.0	96.3	16.8	18.0
1997	834	476	543	18.3	41.4	10.4	11.9
1998	1,015	609	632	19.1	55.4	11.4	11.9
1999	ND	410	460	ND	ND	8.4	9.4
2000	895	396	435	17.8	35.6	7.9	8.7
2001	125	362	507	2.7	64.1	7.8	11.0
2002	265	442	534	5.7	99.6	9.5	11.5
2003	407	251	303	7.0	37.1	4.3	5.2
2004	206	420	482	4.3	100.0	8.7	10.0
2005	241	424	535	5.6	86.4	9.8	12.4
2006	205	292	364	4.7	74.2	6.7	8.4
2007	291	232	304	6.6	31.3	5.2	6.8
2008	155	132	174	3.4	32.8	2.9	3.8
2009	305	122	147	6.7	24.1	2.7	3.2

Brood year	Parr/Redd	Smolts/Redd[a]	Emigrants/ Redd	Egg-Parr (%)	Parr-Smolt[b] (%)	Egg-Smolt[a] (%)	Egg-Emigrant (%)
2010	282	165	201	6.5	33.6	3.8	4.7
2011	211	172	221	4.8	35.8	3.9	5.0
2012	185	114	135	4.4	23.0	2.7	3.2
2013	170	-	-	3.6	-	-	-
Average	***401***	***329***	***381***	***8.2***	***53.6***	***6.9***	***8.0***

[a] These estimates include Chiwawa smolts produced within the Wenatchee River basin. This assumes that 66% of the subyearling migrants survive to smolt, regardless of the number of subyearling migrants (i.e., no density dependence). The assumed 66% survival estimate is being revised; however, an additional year of data is needed to generate a more precise estimate. 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] These estimates represent overwinter survival within the Chiwawa River basin. It does not include Chiwawa smolts produced outside the Chiwawa River basin. As noted in footnote *a*, smolts/redd and egg-smolt survival include Chiwawa smolts produced in the Wenatchee 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 5.4). 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 smolts (i.e., Chiwawa smolts produced within the Wenatchee River basin) and total emigrants. However, one would expect the number of emigrants to increase as seeding levels exceed the rearing capacity of the Chiwawa River basin.



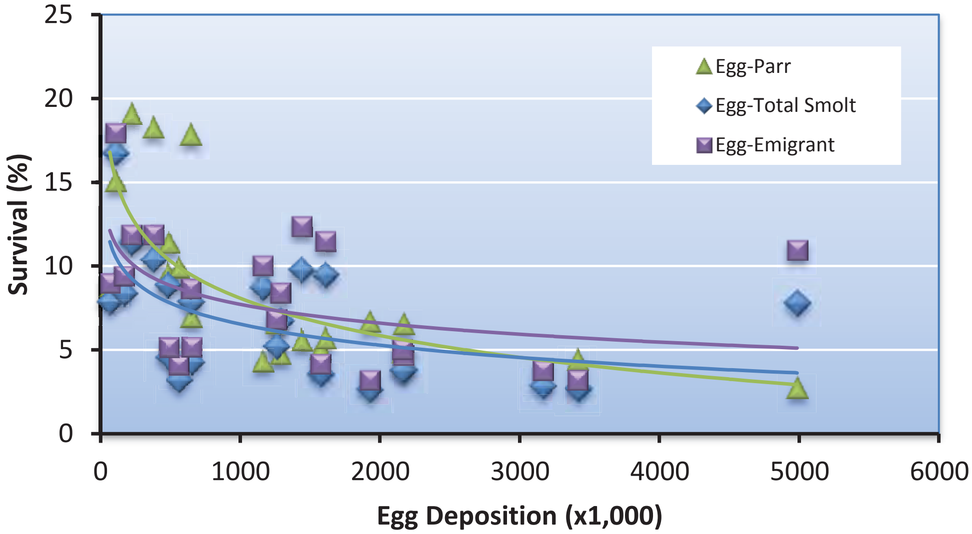


Figure 5.4. Relationships between seeding levels (egg deposition) and juvenile life-stage survivals and productivities for Chiwawa spring Chinook, brood years 1991-2012. Total smolts are Chiwawa smolts produced within and outside the Chiwawa River basin (assumes a 66% survival on subyearling emigrants; the survival estimate will be modified after next year). Chiwawa smolts are smolts produced only in the Chiwawa River basin.

5.5 Spawning Surveys

Surveys for spring Chinook redds were conducted during August through September, 2014, in the Chiwawa River (including Rock, Phelps, and Chikamin creeks), Nason Creek, Icicle Creek, Peshastin Creek, Upper Wenatchee River, Little Wenatchee River, and the White River (including the Napeequa River and Panther Creek). Ingalls Creek (tributary to Peshastin Creek) and Chiwaukum Creek (tributary to the upper Wenatchee) were not surveyed in 2014 because wildfires prevented access.

Spawning escapement for spring Chinook was calculated as the number of redds times the male-to-female ratio (i.e., fish per redd expansion factor) estimated from broodstock and fish sampled at adult trapping sites. In the future, spawning escapement will be estimated using the area-under-the-curve (AUC) method (Millar et al. 2012). WDFW is currently developing an observer efficiency model that will be used to estimate variance.

Redd Counts

A total of 885 spring Chinook redds were counted in the Wenatchee River basin in 2014 (Table 5.19). This is higher than the average of 665 redds counted during the period 1989-2014 in the Wenatchee River basin. Most spawning occurred in the Chiwawa River (54.8% or 485 redds) (Table 5.19; Figure 5.5). Nason Creek contained 13.0% (115 redds), Icicle Creek contained 23.8% (211 redds), White River contained 2.9% (26 redds), Little Wenatchee contained 2.8% (25 redds), the Upper Wenatchee River 2.6% (23 redds), and Peshastin Creek contained 0.0% (0 redds).

Table 5.19. Numbers of spring Chinook redds counted within different streams/watersheds within the Wenatchee River basin, 1989-2014. 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 total or average calculations. WDFW began full implementation of adult management in 2014.

Sample year	Number of spring Chinook redds							
	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River	Icicle	Peshastin	Total
1989	314	98	45	64	94	24	NS	**639**
1990	255	103	30	22	36	50	4	**500**
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	64	245	107*	**1,139**
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**

Sample year	Number of spring Chinook redds							
	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River	Icicle	Peshastin	Total
2010	502	188	38	33	47	155	5	**968**
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**
Average	***321***	***146***	***28***	***34***	***48***	***68***	***10***	***665***

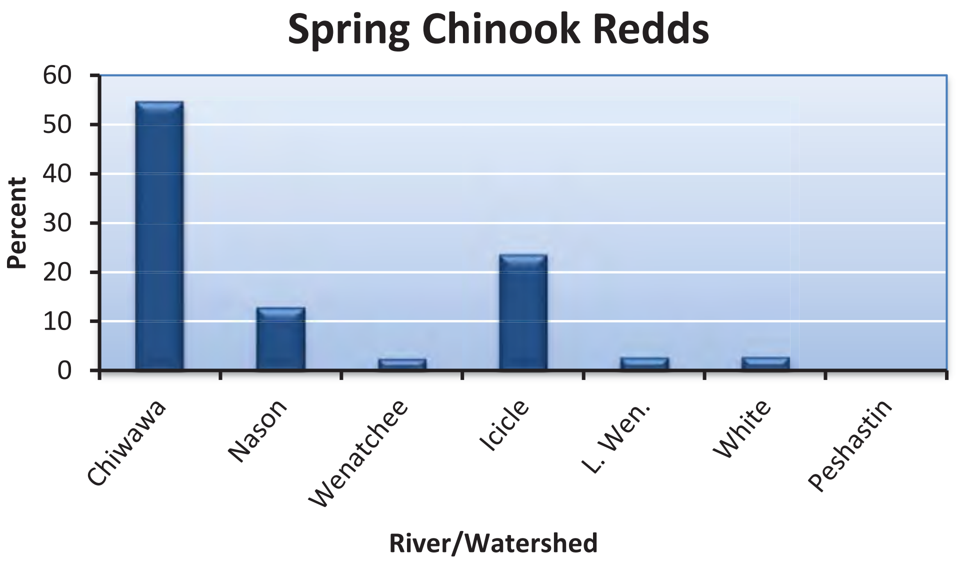


Figure 5.5. Percent of the total number of spring Chinook redds counted in different streams/watersheds within the Wenatchee River basin during August through September, 2014.

Redd Distribution

Spring Chinook redds were not evenly distributed among reaches within survey streams in 2014 (Table 5.20). Most of the spawning in the Chiwawa River basin occurred in Reaches 1 through 6. About 60% of the spawning in the Chiwawa River basin occurred in the lower two reaches (RM 0.0-19.3; 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 1, having 37% of the Nason Creek redds. In the Little Wenatchee River, 100% of all spawning occurred in Reach 3 (RM 5.2-9.2; Lost Creek to Rainy Creek). On the White River, 85% of the spawning occurred in Reach 3 (RM 11.0-12.9; Napeequa River to Grasshopper Meadows). About 75.7% of all the spawning in the Wenatchee River occurred upstream from the mouth of the Chiwawa River.

Table 5.20. Numbers and proportions of spring Chinook redds counted within different streams/watersheds within the Wenatchee River basin during August through September, 2014. NS = not surveyed. See Table 2.8 for description of survey reaches.

Stream/watershed	Reach	Number of redds	Proportion of redds within stream/watershed
Chiwawa	Chiwawa 1 (C1)	116	0.24
	Chiwawa 2 (C2)	175	0.36
	Chiwawa 3 (C3)	20	0.04
	Chiwawa 4 (C4)	51	0.11
	Chiwawa 5 (C5)	43	0.09
	Chiwawa 6 (C6)	62	0.13
	Chiwawa 7 (C7)	7	0.01
	Phelps 1 (S1)	0	0.00
	Rock 1 (R1)	5	0.01
	Chikamin 1 (K1)	6	0.01
	Total	**485**	**1.00**
Nason	Nason 1 (N1)	42	0.37
	Nason 2 (N2)	11	0.10
	Nason 3 (N3)	36	0.31
	Nason 4 (N4)	26	0.23
	Total	**115**	**1.00**
Little Wenatchee	Little Wen 2 (L2)	0	0.00
	Little Wen 3 (L3)	25	1.00
	Total	**25**	**1.00**
White	White 2 (H2)	1	0.04
	White 3 (H3)	22	0.85
	White 4 (H4)	0	0.00
	Napeequa 1 (Q1)	2	0.08
	Panther 1 (T1)	1	0.04
	Total	**26**	**1.00**
Wenatchee River	Wen 9 (W9)	4	0.17
	Wen 10 (W10)	19	0.83
	Chiwaukum (U1)	NS	--
	Total	**23**	**1.00**
Icicle	Icicle 1 (I1)	59	0.30
	Icicle 2 (I2)	127	0.60
	Icicle 3 (I3)	25	0.10
	Total	**211**	**1.00**
Peshastin	Peshastin 1 (P1)	0	0.00
	Peshastin 2 (P2)	0	0.00
	Ingalls (D1)	NS	--

Stream/watershed	Reach	Number of redds	Proportion of redds within stream/watershed
	Total	**0**	**1.00**
Grand Total		***885***	***1.00***

Spawn Timing

Spring Chinook began spawning during the first week of August in the Chiwawa River, the second week of August in Nason Creek, and the end of August in the White River, Little Wenatchee River, and the Wenatchee River (Figure 5.6). Spawning peaked the fourth week of August in the Chiwawa River, White River and the Little Wenatchee, and the fifth week of August in Nason Creek. Spawning in the Wenatchee River peaked the second week of September. All spawning was completed by the end of September.

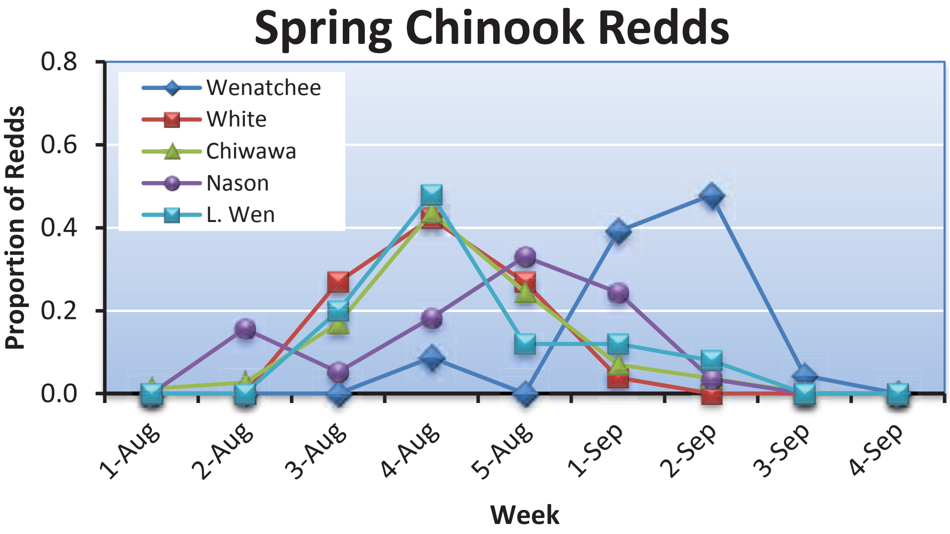


Figure 5.6. Proportion of spring Chinook redds counted during different weeks in different sampling streams within the Wenatchee River basin, August through September 2014.

Spawning Escapement

Spawning escapement for spring Chinook was calculated as the number of redds times the male-to-female ratio (i.e., fish per redd expansion factor) estimated from broodstock and fish sampled at adult trapping sites. The estimated fish per redd ratio for spring Chinook upstream from Tumwater in 2014 was 2.06 (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 2.01 (derived from broodstock collected at the Leavenworth National Fish Hatchery). Multiplying these ratios by the number of redds counted in the Wenatchee River basin resulted in a total spawning escapement of 1,813 spring Chinook (Table 5.21). The Chiwawa River basin had the highest spawning escapement (999 Chinook), while Peshastin Creek had the lowest.

Table 5.21. Number of redds, fish per redd ratios, and total spawning escapement for spring Chinook in the Wenatchee River basin, 2014. Spawning escapement was estimated as the product of redds times fish per redd.

Sampling area	Total number of redds	Fish/redd	Total spawning escapement*
Chiwawa	485	2.06	999
Nason	115	2.06	237
Upper Wenatchee River	23	2.06	47
Icicle	211	2.01	424
Little Wenatchee	25	2.06	52
White	26	2.06	54
Peshastin	0	2.01	0
Total	***885***	**--**	***1,813***

* Spawning escapement estimate is based on total number of 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 total spawning escapement of 1,813 spring Chinook in 2014 was greater than the overall average of 1,469 spring Chinook (Table 5.22). The escapement in the Chiwawa River basin in 2014 was 2.4 times the escapement in Icicle Creek, the second most abundant escapement in the Wenatchee River basin (Table 5.22).

Table 5.22. Spawning escapements for spring Chinook in the Wenatchee River basin for return years 1989-2014; NA = not available.

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	222	102	145	213	2.27	54	NA	**1,449**
1990	2.24	571	231	67	49	81	2.24	112	9	**1,120**
1991	2.33	242	156	42	49	96	2.33	93	2	**680**
1992	2.24	676	181	78	78	85	2.24	83	0	**1,181**
1993	2.20	233	491	134	145	189	2.20	117	11	**1,320**
1994	2.24	184	60	16	7	13	2.24	34	0	**314**
1995	2.51	33	18	0	5	3	2.51	23	0	**82**
1996	2.53	58	83	8	30	3	2.53	30	3	**215**
1997	2.22	182	122	18	33	33	2.22	73	2	**463**
1998	2.21	91	64	18	11	0	2.21	24	0	**208**
1999	2.77	94	22	8	3	6	2.77	17	0	**150**
2000	2.70	346	270	24	22	100	2.70	184	0	**946**
2001	1.60	1,725	598	118	166	349	1.60	141	277	**3,374**
2002	2.05	707	603	86	86	131	2.05	502	219	**2,334**
2003	2.43	270	202	29	36	58	2.43	44	146	**785**
2004[a]	3.56/3.00	851	507	39	66	138	1.79	54	98	**1,753**
2005	1.80	599	347	115	155	257	1.75	14	5	**1,492**
2006	1.78	529	271	37	55	48	1.80	90	18	**1,048**
2007	4.58	1,296	463	101	92	55	1.86	32	20	**2,059**
2008	1.68	1,158	565	64	52	302	1.77	205	37	**2,383**

Return year	Upper basin spawning escapement						Lower basin spawning escapement			Total
	Fish/redd	Chiwawa	Nason	Little Wenatchee	White	Wenatchee River	Fish/redd	Icicle	Peshastin	
2009	3.20	1,347	534	125	173	16	2.72	87	41	**2,323**
2010	2.18	1,094	410	83	72	102	2.72	422	14	**2,197**
2011	4.13	2,032	702	124	83	50	2.66	325	69	**3,385**
2012	1.68	1,478	694	72	144	123	1.90	378	19	**2,908**
2013	1.93	1,378	409	98	104	33	1.75	187	7	**2,216**
2014	2.06	999	237	52	54	47	2.01	424	0	**1,813**
Average	**--**	***726***	***325***	***64***	***74***	***97***	**--**	***144***	***40***	***1,469***

[a] In 2004 the fish/redd expansion estimate of 3.56 was applied to the Chiwawa River only and 3.00 fish/redd for the rest of the upper basin.

5.6 Carcass Surveys

Surveys for spring Chinook carcasses were conducted during August through September, 2014, in the Chiwawa River (including Rock, Phelps, and Chikamin creeks), Nason Creek, Icicle Creek, Peshastin Creek, Upper Wenatchee River, Little Wenatchee River, and White River (including the Napeequa River and Panther Creek). Ingalls Creek (tributary to Peshastin Creek) and Chiwaukum Creek (tributary to the upper Wenatchee) were not surveyed in 2014 because wildfires prevented access.

Number sampled

A total of 474 spring Chinook carcasses were sampled during August through September in the Wenatchee River basin (Table 5.23). Most were sampled in the Chiwawa River basin (68% or 320 carcasses) and Nason Creek (14% or 68 carcasses) (Figure 5.7). A total of 44 carcasses were sampled in Icicle Creek, 19 in the upper Wenatchee River, 15 in the Little Wenatchee, 8 in the White River, and none in Peshastin Creek.

Table 5.23. Numbers of spring Chinook carcasses sampled within different streams/watersheds within the Wenatchee River basin, 1996-2014.

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**

Survey year	**Number of spring Chinook carcasses**							
	Chiwawa	**Nason**	**Little Wenatchee**	**White**	**Wenatchee River**	**Icicle**	**Peshastin**	**Total**
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	**671**
2014	320	68	15	8	19	44	0	**474**
Average	***232***	***153***	***16***	***17***	***35***	***40***	***13***	***510***

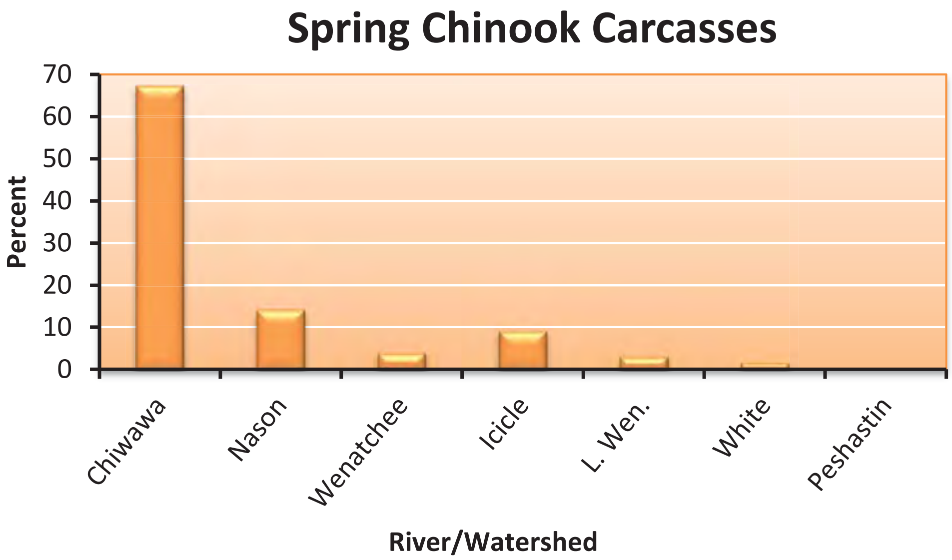


Figure 5.7. Percent of the total number of spring Chinook carcasses sampled in different streams/watersheds within the Wenatchee River basin during August through September, 2014.

Carcass Distribution and Origin

Spring Chinook carcasses were not evenly distributed among reaches within survey streams in 2014 (Table 5.24). Most of the carcasses in the Chiwawa River basin occurred in Reaches 1 and 2 (downstream from Rock Creek). In Nason Creek, most carcasses (65%) were collected in Reach 1 and the fewest (3%) in Reach 4. Most of the carcasses in the Little Wenatchee River were sampled in Reach 3 (Lost Creek to Rainy Creek). On the White River, all occurred in Reach 3 (Napeequa River to Grasshopper Meadows). On the Wenatchee River, 79% of the carcasses were found upstream from the confluence of the Chiwawa River and 21% were found below the confluence.

Table 5.24. Numbers and proportions of carcasses sampled within different streams/watersheds within the Wenatchee River basin during August through September, 2014. See Table 2.8 for description of survey reaches.

Stream/watershed	Reach	Number of carcasses	Proportion of redds within stream/watershed
Chiwawa	Chiwawa 1 (C1)	82	0.26
	Chiwawa 2 (C2)	128	0.40
	Chiwawa 3 (C3)	12	0.04
	Chiwawa 4 (C4)	38	0.12
	Chiwawa 5 (C5)	25	0.08
	Chiwawa 6 (C6)	30	0.09
	Chiwawa 7 (C7)	1	0.00
	Phelps 1 (S1)	0	0.00
	Rock 1 (R1)	2	0.01
	Chikamin 1 (K1)	2	0.01
	Total	**320**	**1.00**
Nason	Nason 1 (N1)	44	0.65
	Nason 2 (N2)	6	0.09
	Nason 3 (N3)	16	0.23
	Nason 4 (N4)	2	0.03
	Total	**68**	**1.00**
Little Wenatchee	Little Wen 2 (L2)	3	0.20
	Little Wen 3 (L3)	12	0.80
	Total	**15**	**1.00**
White	White 2 (H2)	0	0.00
	White 3 (H3)	8	1.00
	White 4 (H4)	0	0.00
	Napeequa 1 (Q1)	0	0.00
	Panther 1 (T1)	0	0.00
	Total	**8**	**1.00**
Wenatchee River	Wen 9 (W9)	4	0.21
	Wen 10 (W10)	15	0.79
	Chiwaukum 1	NS	--
	Total	**19**	**1.00**
Icicle	Icicle 1 (I1)	43	0.98
	Icicle 2 (I2)	0	0.00
	Icicle 3 (I3)	1	0.02
	Total	**44**	**1.00**
Peshastin	Peshastin 1 (P1)	0	0
	Peshastin 2 (P2)	0	0
	Ingalls (D1)	NS	--

Stream/watershed	Reach	Number of carcasses	Proportion of redds within stream/watershed
Grand Total		**474**	**1.00**

Of the 320 carcasses sampled in the Chiwawa River basin in 2014, 47% were hatchery fish (Table 5.25; these numbers may change after analysis of CWTs). In the Chiwawa River basin, the spatial distribution of hatchery and wild fish was not equal (Table 5.25). A larger percentage of hatchery fish were found in the lower reach (C1; i.e., Mouth to Grouse Creek) than were wild fish. This general trend was also apparent in the pooled data (Figure 5.8).

Table 5.25. Numbers of wild and hatchery spring Chinook carcasses sampled within different reaches in the Chiwawa River basin, 1993-2014. See Table 2.8 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**

Survey year	Origin	Survey Reach									Total
		C-1	C-2	C-3	C-4	C-5	C-6	C-7	Chikamin	Rock	
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**
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	**105**
	Hatchery	101	112	19	23	13	15	0	5	3	**291**
2014	Wild	18	78	8	28	19	21	0	0	0	**172**
	Hatchery	64	50	4	10	6	9	1	2	2	**148**
Average	***Wild***	***10***	***25***	***4***	***9***	***6***	***5***	***0***	***0***	***1***	***60***
	Hatchery	***57***	***56***	***5***	***8***	***5***	***7***	***0***	***2***	***2***	***142***

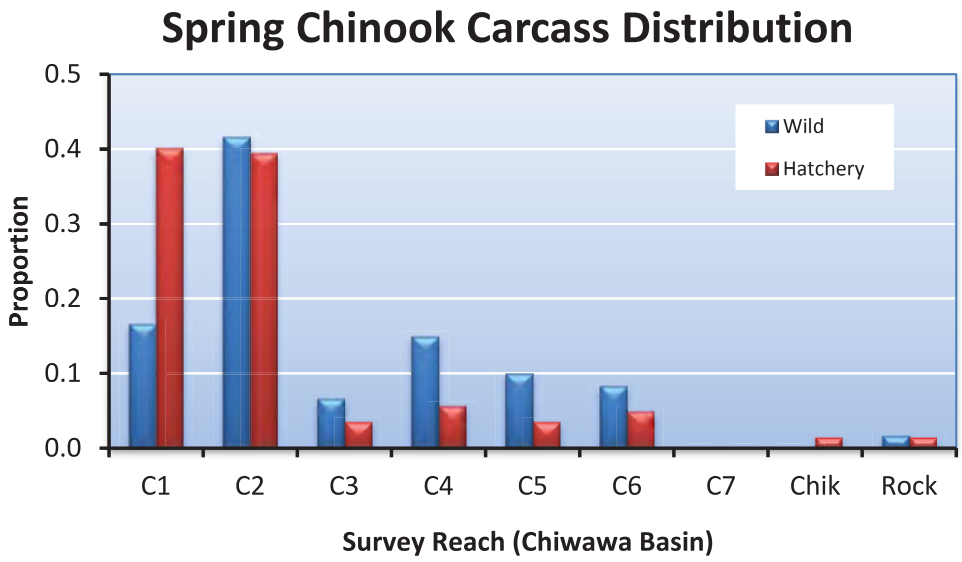


Figure 5.8. Distribution of wild and hatchery produced carcasses in different reaches in the Chiwawa River basin, 1993-2014; Chik = Chikamin Creek and Rock = Rock Creek. Reach codes are described in Table 2.8.

Sampling Rate

Overall, 26% of the estimated total spawning escapement of spring Chinook in the Wenatchee River basin was sampled in 2014 (Table 5.26). Sampling rates among streams/watershed varied from 10 to 40%.

Table 5.26. Number of redds and carcasses, total spawning escapement, and sampling rates for spring Chinook salmon in the Wenatchee River basin, 2014.

Sampling area	Total number of redds	Total number of carcasses	Total spawning escapement	Sampling rate
Chiwawa	485	320	999	0.32
Nason	115	68	237	0.29
Upper Wenatchee	23	19	47	0.40
Icicle	211	44	424	0.10
Little Wenatchee	25	15	52	0.29
White	26	8	54	0.15
Peshastin	0	0	0	--
Total	***885***	***474***	***1,813***	***0.26***

Length Data

Mean lengths (POH, cm) of male and female spring Chinook carcasses sampled during surveys in the Wenatchee River basin in 2014 are provided in Table 5.27. The average sizes of males and females sampled in the Wenatchee River basin were 60 and 62 cm, respectively.

Table 5.27. 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, 2014.

Stream/watershed	Mean lengths (cm)	
	Male	Female
Chiwawa	62 (9.9)	62 (4.7)
Nason	52 (9.7)	62 (4.5)
Upper Wenatchee	65 (5.8)	63 (4.9)
Icicle	65 (8.8)	59 (3.9)
Little Wenatchee	58 (10.6)	67 (5.8)
White	54 (0)	62 (6.4)
Peshastin	--	--
Total	***60 (10.6)***	***62 (4.8)***

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 2014, there was a difference in migration timing of hatchery and wild spring Chinook past Tumwater Dam (Table 5.28a and b; Figure 5.9). Hatchery fish arrived at the dam earlier than did wild fish. On average, however, early in the migration, wild Chinook arrived at Tumwater Dam slightly earlier than hatchery fish, but by the end of the migration, both were arriving at about the same time. Most hatchery and wild spring Chinook migrated upstream past Tumwater Dam during June and July (Figure 5.9).

Table 5.28a. The Julian day and date that 10%, 50% (median), and 90% of the wild and hatchery spring Chinook salmon passed Tumwater Dam, 1998-2014. 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.

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
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

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	
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
Average	Wild	***169***	-	***184***	-	***199***	-	***184***	-	***930***
	Hatchery	***172***	-	***185***	-	***198***	-	***186***	-	***2,626***

Table 5.28b. The week that 10%, 50% (median), and 90% of the wild and hatchery spring Chinook salmon passed Tumwater Dam, 1998-2014. 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.

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

Survey year	Origin	Spring Chinook Migration Time (week)				Sample size
		10 Percentile	50 Percentile	90 Percentile	Mean	
	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
Average	Wild	***25***	***27***	***29***	***27***	***930***
	Hatchery	***25***	***27***	***29***	***27***	***2,626***

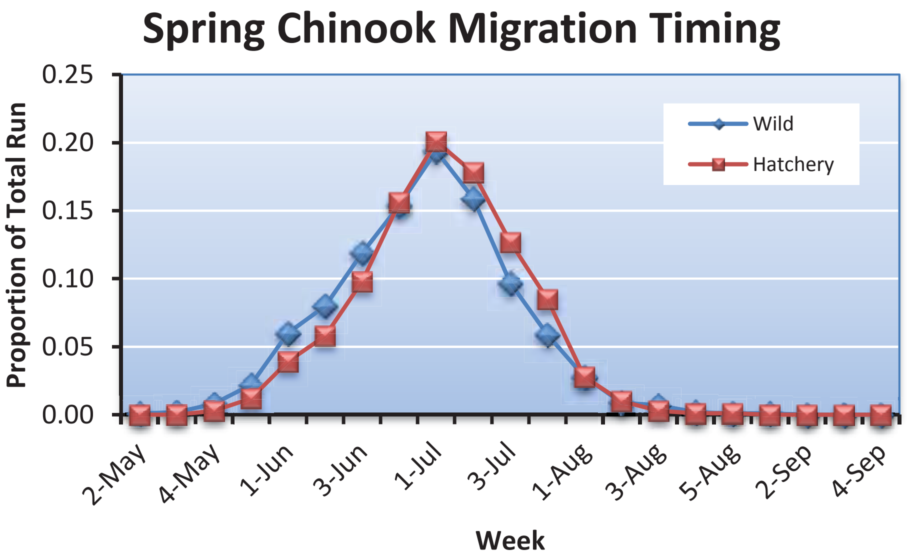


Figure 5.9. Proportion of wild and hatchery spring Chinook observed (using video) passing Tumwater Dam each week during their migration period May through September; data were pooled over survey years 1998-2014.

Age at Maturity

Most of the wild and hatchery spring Chinook sampled during the period 1994-2013 in the Chiwawa River basin were age-4 fish (total age) (Table 5.29; Figure 5.10). On average, hatchery fish made up a higher percentage of age-3 Chinook than did wild fish. In contrast, 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 5.29. Proportions of wild and hatchery spring Chinook of different ages (total age) sampled on spawning grounds in the Chiwawa River basin, 1994-2013.

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
	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

Sample year	**Origin**	**Total age**					**Sample size**
		2	**3**	**4**	**5**	**6**	
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	0.10	0.00	290
Average	***Wild***	***0.00***	***0.04***	***0.72***	***0.24***	***0.00***	***54***
	Hatchery	***0.00***	***0.11***	***0.83***	***0.06***	***0.00***	***147***

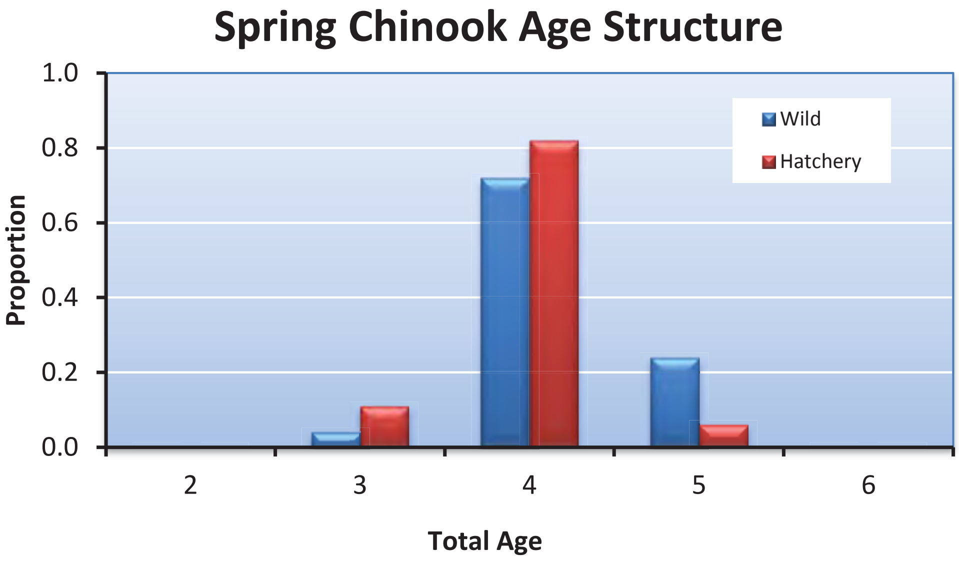


Figure 5.10. Proportions of wild and hatchery spring Chinook of different total ages sampled at the Chiwawa Weir and on spawning grounds in the Chiwawa River basin for the combined years 1994-2014.

Size at Maturity

On average, hatchery and wild spring Chinook of a given age differed slightly in length (Table 5.30). Differences were usually no more than 1-3 cm between hatchery and wild fish of the same age.

Table 5.30. 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, 1994-2013. Return years 2004-2014 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				

Return year	Total age	Mean length (cm)			
		Male		Female	
		Wild	Hatchery	Wild	Hatchery
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)		
	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)		

Return year	Total age	Mean length (cm)			
		Male		Female	
		Wild	Hatchery	Wild	Hatchery
	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 (33)	35 ±0 (1)	49 ±12 (3)
	4	60 ±6 (29)	63 ±7 (41)	61 ±6 (34)	61 ±4 (181)
	5	74 ±5 (9)	71 ±2 (7)	71 ±3 (24)	69 ±5 (22)
	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 virtually no 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. In 2014, a recreational fishery on spring Chinook occurred in Icicle Creek and on the lower Wenatchee River (up to 400 feet downstream from Dryden Dam).

The total number of hatchery-origin spring Chinook captured in different fisheries has been relatively low (Table 5.31). The largest harvests occurred on the 1997, 1998, and 2004-2008 brood years.

Table 5.31. Estimated number and percent (in parentheses) of hatchery-origin Chiwawa spring Chinook captured in different fisheries, brood years 1989-2008; NP = no hatchery program.

Brood year	Ocean fisheries	Columbia River Fisheries			Total
		Tribal	Commercial (Zones 1-5)	Recreational[a] (sport)	
1989	3 (13)	5 (21)	0 (0)	16 (67)	24
1990	0 (0)	0 (0)	0 (0)	18 (100)	18
1991	0 (0)	3 (100)	0 (0)	0 (0)	3
1992	0 (0)	1 (100)	0 (0)	0 (0)	1
1993	3 (75)	1 (25)	0 (0)	0 (0)	4
1994	0 (0)	0 (0)	0 (0)	0 (0)	0
1995	NP	NP	NP	NP	NP
1996	0 (0)	2 (100)	0 (0)	0 (0)	2
1997	1 (0)	193 (51)	68 (18)	115 (31)	377
1998	10 (5)	47 (24)	12 (6)	126 (65)	195
1999	NP	NP	NP	NP	NP
2000	0 (0)	17 (74)	0 (0)	6 (26)	23
2001	36 (64)	8 (14)	1 (2)	11 (20)	56
2002	12 (17)	11 (15)	22 (31)	26 (37)	71
2003	18 (21)	29 (35)	11 (13)	26 (31)	84
2004	3 (1)	188 (40)	31 (7)	253 (53)	475
2005	18 (14)	31 (24)	6 (5)	74 (57)	129
2006	32 (4)	469 (60)	77 (10)	201 (26)	779
2007	14 (3)	180 (43)	74 (18)	151 (36)	419
2008	8 (1)	298 (21)	41 (3)	1,047 (75)	1,394
Average	***9 (12)***	***82 (42)***	***19 (6)***	***115 (35)***	***225***

[a] Includes the Wanapum fishery.

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 target for brood year stray rates should be less than 5%.

The percentage of the spawning escapement made up of hatchery-origin Chiwawa spring Chinook in non-target spawning areas within the Wenatchee River basin has been high in some years and exceeded the target of 10% (Table 5.32). Chiwawa spring Chinook have strayed into spawning areas on Nason Creek, the White River, the Little Wenatchee River, and the Upper Wenatchee River. On average, Chiwawa spring Chinook made up the highest percentage of the spawning escapement within Nason Creek and the Upper Wenatchee River. Stray rates of hatchery-origin Chiwawa spring Chinook do not appear to have declined with the change in source water that was implemented in 2006 for the Chiwawa rearing ponds.

Table 5.32. 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 1992-2013. 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	11.0	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	27.3
2001	211	35.3	0	0.0	0	0.0	271	77.7	46	39.0	52	31.3
2002	188	31.2	10	2.0	0	0.0	60	45.8	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	50.0	0	0.0	256	99.6	106	68.4	65	56.5
2006	131	48.3	13	14.4	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	67.4	48	23.4	29	78.4	258	85.4	30	57.7	52	81.3
2009	289	54.1	8	9.2	0	0.0	16	100.0	63	36.4	56	44.8
2010	272	66.3	58	13.7	11	78.6	86	84.3	23	31.9	59	71.1
2011	397	56.6	61	18.8	0	0.0	41	82.0	0	0.0	53	42.7
2012	398	59.1	49	13.0	7	36.8	98	82.4	45	32.1	15	21.4
2013	281	68.4	15	8.0	0	0.0	24	72.7	5	4.8	10	10.1
Average	***157***	***34.9***	***13***	***7.4***	***2***	***8.8***	***60***	***48.3***	***16***	***14.7***	***19***	***20.4***

Hatchery-origin Chiwawa spring Chinook have strayed into the Methow and Entiat basins (Table 5.33). Based on return year analyses, rates of hatchery-origin Chiwawa spring Chinook straying into these populations have been low in most years. However, during return years 2002, 2006, 2008-2009, and 2011-2013, Chiwawa spring Chinook made up more than 5% of the spawning escapement in the Entiat River basin. In some years, Chiwawa spring Chinook hatchery fish made up more than 20% of the spawning escapement in the Entiat River basin.

Table 5.33. Number and percent of spawning escapements within other non-target basins that consisted of hatchery-origin Chiwawa spring Chinook, return years 1992-2013. For example, for return year 2002, 9.2% of the spring Chinook spawning escapement in the Entiat River basin consisted of hatchery-origin Chiwawa spring Chinook. 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	ns	ns	0	0.0
1997	0	0.0	0	0.0
1998	ns	ns	0	0.0
1999	0	0.0	0	0.0
2000	0	0.0	1	0.6
2001	0	0.0	1	0.2
2002	0	0.0	34	9.2
2003	0	0.0	6	2.3
2004	0	0.0	0	0.0
2005	10	0.7	15	4.2
2006	8	0.5	24	9.3
2007	9	0.8	4	1.6
2008	12	1.2	61	21.9
2009	9	0.3	15	5.4
2010	10	0.4	18	3.7
2011	51	1.7	190	31.9
2012	13	1.0	133	23.5
2013	9	0.8	24	10.1
Average	***7***	***0.4***	***24***	***5.6***

Based on brood year analyses, on average, about 31% of the hatchery returns have strayed into non-target spawning areas, exceeding the target of 5% (Table 5.34). Depending on brood year, percent strays into non-target spawning areas have ranged from 0-81%. In most years, few (<1%) have strayed into non-target hatchery programs. The change in source water that was implemented in 2006 for the Chiwawa rearing ponds does not appear to have decreased stray rates.

Table 5.34. 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 1989-2008. Percent strays should be less than 5%.

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	42.1	115	32.5	90	25.4	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	1104	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	47.1	62	2.5	1,144	46.4	99	4.0
Average	***423***	***47.7***	***98***	***20.0***	***339***	***31.4***	***11***	***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.

Recently, 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. 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 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 J). Microsatellite DNA allele frequencies collected from temporally replicated natural and hatchery-origin spring Chinook 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.

Proportion of 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). The ratio pNOB/(pHOS+pNOB) is the Proportion of Natural Influence (PNI). The larger the ratio (PNI), 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 important integrated populations should have a PNI of at least 0.67 (HSRG/WDFW/NWIFC 2004).

For brood years 1989-1994, the PNI was greater than or equal to 0.67 (Table 5.35). Since brood year 1994, the PNI has been less than 0.67.

Table 5.35. Proportionate natural influence (PNI) of the Chiwawa spring Chinook supplementation program for brood years 1989-2014. PNI was calculated as the proportion of naturally produced Chinook in the hatchery broodstock (pNOB) divided by the proportion of hatchery Chinook on the spawning grounds (pHOS) plus pNOB. 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
	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	0.67
1995	0	33	1.00	No Program			
1996	41	17	0.29	8	10	0.44	0.60
1997	60	122	0.67	32	79	0.29	0.30
1998	59	32	0.35	13	34	0.28	0.44
1999	87	7	0.07	No Program			
2000	233	113	0.33	9	21	0.30	0.48
2001	506	1,219	0.71	113	259	0.30	0.30
2002	255	452	0.64	20	51	0.28	0.30
2003	167	103	0.38	41	53	0.44	0.54
2004	573	278	0.33	83	132	0.39	0.54
2005	139	460	0.77	91	181	0.33	0.30
2006	115	413	0.78	91	224	0.29	0.27
2007	155	1,141	0.88	43	104	0.29	0.25
2008	197	961	0.83	83	220	0.27	0.25
2009	303	1,044	0.78	96	111	0.46	0.37
2010	418	676	0.62	77	98	0.44	0.42
2011	795	1,237	0.61	80	93	0.46	0.43
2012	576	902	0.61	73	0	1.00	0.62
2013	412	966	0.70	70	0	1.00	0.59
2014	533	466	0.47	61	134	0.31	0.40
Average	***315***	***412***	***0.47***	***51***	***70***	***0.51***	***0.50***

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 5.36).[6] Over the eight 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 0.003 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.

Table 5.36. 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 2005-2012. 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	SAR to Bonneville Dam
2005	4,993 (forced)	0.662 (0.027)	22.9 (6.6)	0.008 (0.001)
2005	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	0.548 (0.038)	18.9 (7.3)	NA
2011	9,987	0.458 (0.029)	14.2 (7.5)	NA
2012	5,061	0.478 (0.043)	30.9 (6.5)	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 1989-2008, NRR for spring Chinook in the Chiwawa averaged 1.11 (range, 0.01-4.40) if harvested fish were not include in the estimate and 1.22 (range, 0.01-4.81) if harvested fish were included in the estimate (Table 5.37). NRRs for more recent brood years will be calculated as soon as all tag recoveries and sampling rates have been loaded into the database.

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[6] 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.

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 5.30 (the calculated target value in Hillman et al. 2013). In nearly all years, HRRs were greater than NRRs, regardless if harvest was or was not included (Table 5.37). HRRs exceeded the estimated target value of 5.3 in 8 or 11 of the 18 years, depending on if harvested fish were or were not included in the estimates.

Table 5.37. 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 1989-2008; 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	113	676	31	46	0.27	0.07	32	48	0.28	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	--	66	--	2.00	--	69	--	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	792	21.74	4.35
1998	48	91	991	349	20.65	3.84	1,186	372	24.71	4.09
1999	NP	94	--	10	--	0.11	--	11	--	0.12
2000	48	346	354	699	7.38	2.02	377	733	7.85	2.12
2001	382	1,725	1,808	309	4.73	0.18	1,864	317	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	858	2,528	276	8.54	0.32	3,003	298	10.15	0.35
2005	283	598	1,386	396	4.90	0.66	1,515	412	5.35	0.69
2006	398	529	1,837	967	4.62	1.83	2,616	1,219	6.57	2.30
2007	169	1,296	883	474	5.22	0.37	1,302	570	7.70	0.44
2008	329	1,158	2,465	726	7.49	0.63	3,859	816	11.73	0.70
Average	***144***	***528***	***918***	***303***	***6.28***	***1.11***	***1,143***	***342***	***7.51***	***1.22***

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 5.38).

Table 5.38. Smolt-to-adult ratios (SARs) for Chiwawa hatchery spring Chinook, brood years 1989-2008.

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	2,604	0.00475
2007	292,682	1,300	0.00444
2008	609,286	3,859	0.00633
Average	***224,832***	***1,131***	***0.00474***

[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 2012 Brood Chiwawa River spring Chinook broodstock was consistent with the 2012 Upper Columbia River salmon and steelhead broodstock objectives and site-based broodstock collection protocols. Specifically, broodstock collection targeted hatchery and natural-origin fish at the Chiwawa Weir. In-season adjustments were made to the number of hatchery and 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 the Chiwawa Weir began on 1 June 2012 and concluded on 6 August 2012. Broodstock collection targeted natural-origin spring Chinook and hatchery-origin spring

Chinook as needed to attain a minimum 33% natural-origin broodstock and a maximum 33% extraction of the estimated natural-origin return to the Chiwawa River.

The 2012 brood collection retained a total of 116 spring Chinook, including 75 natural-origin fish, representing a 65% natural-origin broodstock. The brood successfully met the minimum targeted 33% natural-origin composition.

At the Chiwawa Weir, the trap was operated passively, checked several times per day, and fish were processed once daily. Trapping at the Chiwawa Weir generally followed a four-up and three-down schedule, and operated only as needed to meet weekly collection objectives consistent with the 2012 collection protocol or as adjusted based on in-season run escapement monitoring and ESA Section 10 Permit 1196 requirements. 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 comply with provisions of ESA Permit 1196 (expired).

No additional spring Chinook were handled and released as a function of maintaining, at minimum, 33% natural-origin spring Chinook in the broodstock. About 294 bull trout were captured and released. To minimize fallback or impingement on the weir, all spring Chinook and bull trout were released unharmed about 10 km upstream from the weir.

Hatchery Rearing and Release

The rearing and release of 2012 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 2012 brood Chiwawa spring Chinook smolts totaled 222,504 fish, representing 108.8% of program objectives and complied with the ESA Section 10 Permit 1196 program level of 204,452 smolts.

Hatchery Effluent Monitoring

Per ESA Permits 1196 (expired), 1347, 1395, 18118, 18119, and 18121, permit holders shall monitor and report hatchery effluents in compliance with applicable National Pollution Discharge Elimination Systems (NPDES) (EPA 1999) permit limitations. There was one NPDES violation reported at the Chelan PUD Hatchery facilities during the period 1 January through 31 December 2014. NPDES monitoring and reporting for Chelan PUD Hatchery Programs during 2014 are provided in Appendix F.

Smolt and Emigrant Trapping

Per ESA Section 10 Permit No. 1196 (expired) 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 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 2014 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 5.39. Additionally, juvenile fish captured at the trap locations were handled consistent with provisions in ESA Section 10 Permit 1196, Section B.

Table 5.39. Estimated take of Upper Columbia River spring Chinook resulting from juvenile emigration monitoring in the Wenatchee River basin, 2014.

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	34,334	222,504	73,695	4,519	5,293	23,755	33,567	
Encounter rate	NA	NA	NA	0.1316	0.0237	0.3223	0.1016	0.20
Mortality[e]	NA	NA	NA	28	0	84	112	
Mortality rate	NA	NA	NA	0.0062	0.0000	0.0035	0.0033	0.02
Lower Wenatchee Trap								
Population	67,973	222,504	11,936,928	1,700	31,290	81,445	114,435	
Encounter rate	NA	NA	NA	0.025	0.1406	0.0068	0.0096	0.20
Mortality[d]	NA	NA	NA	17	12	250	279	
Mortality rate	NA	NA	NA	0.0100	0.0004	0.0031	0.0024	0.02
Wenatchee River Basin Total								
Population	67,393	222,504	11,936,928	6,219	36,583	105,200	148,002	
Encounter rate	NA	NA	NA	0.0922	0.1644	0.0088	0.0121	0.20
Mortality[d]	NA	NA	NA	45	12	84	141	
Mortality rate	NA	NA	NA	0.0072	0.0003	0.0008	0.0010	0.02

[a] Smolt population estimate derived from juvenile emigration trap data.

[b] 2012BY 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..

[d] Combined trapping and PIT tagging mortality.

Spawning Surveys

Spring Chinook spawning ground surveys were conducted in the Wenatchee River basin during 2014, as authorized by ESA Section 10 Permits 18118, 18119, 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 1196 (expired) and new Section 10 Permits 18118, 18119, 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 2014, all spring Chinook passing Tumwater Dam were enumerated, anesthetize, 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 and 2014) for complete details on the methods and results of the spring Chinook reproductive success study for the period 2010-2014.

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 1997, 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. An adult-based supplementation program began with the collection of broodstock in 2013. The first releases of the program will take place 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 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 cannot exceed 33% of the natural-origin spring Chinook estimates to Tumwater Dam.

Adult spring Chinook 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 are released volitionally during April and May the following year.

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 will be 100% marked with CWTs and a minimum of 5,000 fish will be 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 Broodstock Sampling

This section focuses on results from sampling 2013-2014 Nason Creek spring Chinook broodstock, which were collected in Nason Creek and at Tumwater Dam. Some information for the 2014 return is not available at this time (e.g., age structure and final origin determination). This information will be provided in the 2015 annual report.

Origin of Broodstock

Natural-origin adults made up most of the Nason Creek spring Chinook broodstock for brood year 2013 and only natural-origin adults made up the broodstock for brood year 2014 (Table 6.1). For brood year 2013, natural-origin adults were collected at Tumwater Dam (N = 3) and in Nason Creek (N = 19). For brood year 2014, natural-origin adults were targeted for collection at

Tumwater Dam during trapping operations and in Nason Creek using tangle nets. Natural-origin fish collected at Tumwater Dam were used for broodstock if they had been previously PIT tagged in Nason Creek. No fish were identified using this method at Tumwater Dam; however, 28 natural-origin fish were acquired using tangle nets.

Table 6.1. Numbers of wild and hatchery Nason Creek spring Chinook collected for broodstock, numbers that died before spawning, and numbers of Chinook spawned, 2013-2014. 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	22	0	1	21	0	4	0	0	4	0	25
2014	28	2	5	21	0	0	0	0	0	0	21
Average[b]	***25***	***1***	***3***	***21***	***0***	***2***	***0***	***0***	***2***	***0***	***23***

[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] 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 the 2013 return, most adults were age-4 Chinook (Table 6.2).

Table 6.2. Percent of hatchery and wild spring Chinook of different ages (total age) collected from broodstock in 2013.

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
Average	***Wild***	0.0	14.3	85.7	0.0
	Hatchery	0.0	0.0	100.0	0.0

Length at age for Nason Creek wild spring Chinook are shown in Table 6.3.

Table 6.3. Mean fork length (cm) at age (total age) of hatchery and wild spring Chinook collected from broodstock in 2013; 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	18	6	-	0	-
	Hatchery	-	0	-	-	0	-	-	0	-	-	0	-
Average	***Wild***	-	0	-	56	3	2	75	18	6	-	0	-
	Hatchery	-	0	-	-	0	-	79	4	7	-	0	-

Sex Ratios

Male spring Chinook in the 2013-2014 return years made up 50% and 60%, respectively, of the adults collected. This resulted in an overall male to female ratios of 1.00:1.00 and 1.50:1.00, respectively (Table 6.4).

Table 6.4. Numbers of male and female wild and hatchery spring Chinook collected for broodstock, 2013-2014. 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	18	12	1.50:1.00	0	0	-	1.50:1.00
Total	***30***	***22***	***1.36:1.00***	***1***	***3***	***0.33:1.00***	***1.24:1.00***

Fecundity

The mean fecundities for the 2013-2014 returns of Nason Creek spring Chinook ranged from 4,052-4,484 eggs per female (Table 6.5). These fecundities were less than the expected fecundity of 4,400 eggs per female assumed in the broodstock protocol.

Table 6.5. Mean fecundity of wild, hatchery, and all female spring Chinook collected for broodstock, 2013-2014.

Return year	Mean fecundity		
	Wild	Hatchery	Total
2013	4,047	4,069	4,052
2014	4,484	-	4,484
Average	***4,266***	***4,069***	***4,268***

6.2 Hatchery Rearing

Rearing History

Number of eggs taken

Based on the unfertilized egg-to-release survival standard of 81%, a total of 147,059 eggs are required to meet the program release goal of 125,000 smolts (Table 6.6). The green egg take for the 2013 and 2014 brood years was 34% and 30% of program goal, respectively. This was largely because of the low number of Nason Creek broodstock collected at Tumwater Dam and Nason Creek.

ESA Permit 18118 sets limits on the percentage of the total run and total number of natural-origin fish in the broodstock to meet the conservation program. Applying these criteria to the low total abundance of spring Chinook salmon to the Nason Creek basin, and the low abundance of natural-origin fish returning to the basin, has resulted in the program not meeting production goals.

Table 6.6. Numbers of eggs taken from spring Chinook broodstock, 2013-2014.

Return year	Number of eggs taken
2013	49,720
2014	44,844
Average	***47,282***

Number of acclimation days

There is currently no juvenile release information because the Nason Creek spring Chinook program started with return year 2013. Juveniles from the 2013 brood will be released in 2015 (Table 6.7).

Table 6.7. Number of days spring Chinook broods were acclimated and water source, brood year 2013; NA = not available.

Brood year	Release year	Transfer date	Release date	Number of days and water source	
				Total	Nason Creek
2013	2015	NA	NA	NA	NA

Release Information

Numbers released

There is currently no juvenile release information because the Nason Creek spring Chinook program started with return year 2013. Juveniles from the 2013 brood will be released in 2015 (Table 6.8).

Table 6.8. Numbers of spring Chinook smolts tagged and released from the hatchery, brood year 2013. The release target for Nason Creek spring Chinook is 125,000 smolts.

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
2013	2015	NA	NA	NA	NA	NA

Numbers tagged

In 2014, a total of 20,234 Nason Creek spring Chinook from the 2013 brood were PIT tagged at Eastbank Hatchery on 18-22 August (Table 6.9). These fish were tagged in raceway #6. Fish were not fed during tagging or for two days before and after tagging. Fish averaged 95 mm in length and 11.0 g at time of tagging. These fish were transferred to the Nason Creek Acclimation Facility in October.

Table 6.9. Summary of PIT-tagging activities for Nason Creek hatchery spring Chinook, brood year 2013.

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	NA	NA	NA

Fish size and condition at release

There is currently no juvenile release information because the Nason Creek spring Chinook program started with return year 2013. Lengths and weights of juvenile spring Chinook from the 2013 brood will be measured in 2015 (Table 6.10).

Table 6.10. Mean lengths (FL, mm), weight (g and fish/pound), and coefficient of variation (CV) of spring Chinook smolts released from the hatchery, brood year 2013. 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
2013	2015	NA	NA	NA	NA
Average		***NA***	***NA***	***NA***	***NA***
Targets		***155***	***9.0***	***37.8***	***24***

Survival Estimates

There is currently limited juvenile survival information because the Nason Creek spring Chinook program started with return year 2013. Survival of juveniles from the 2013 brood will be assessed in 2015 (Table 6.11).

Table 6.11. Hatchery life-stage survival rates (%) for spring Chinook, brood year 2013. 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	96.2	93.0	99.4	98.1	NA	NA	NA
Average	***100.0***	***100.0***	***96.2***	***93.0***	***99.4***	***98.1***	***NA***	***NA***	***NA***
Standard	***90.0***	***85.0***	***92.0***	***98.0***	***97.0***	***93.0***	***90.0***	***95.0***	***81.0***

6.3 Disease Monitoring

Results of 2014 adult broodstock bacterial kidney disease (BKD) monitoring indicated that most females (80%) had ELISA values less than 0.199. About 80% of the females had ELISA values less than 0.120, which would have required about 20% of the progeny to be reared at densities not to exceed 0.06 fish per pound (Table 6.12).

Table 6.12. Proportion of bacterial kidney disease (BKD) titer groups for the Nason Creek spring Chinook broodstock, brood years 2013-2014. 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)			
	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)	
	Wild	Hatch	Wild	Hatch	Wild	Hatch	Wild	Hatch	Wild	Hatch	Wild	Hatch
2013	0.7000	0.3333	0.3000	0.6666	--	--	--	--	0.9231	0.1000	0.0769	--
2014[a]	0.5000	--	0.3000	--	--	--	0.2000	--	0.8000	--	0.2000	--
Average	0.6000	0.3333	0.3000	0.6666	--	--	0.2000	--	0.8616	0.1000	0.1385	--

[a] Origin determinations should be considered preliminary pending scale analyses.

6.4 Natural Juvenile Productivity

During 2014, 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 2014. A complete description of trapping operations on Nason Creek can be found in Appendix K.

Nason Creek Trap

The Nason Creek Trap operated between 1 March and 30 November 2014. During that time period the trap was inoperable for 48 days because of low stream discharge or ice accumulation. 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 daily total emigration. In the event that a viable flow-efficiency regression could not be developed, a pooled efficiency was used to expand daily catch.

Wild yearling spring Chinook (2012 brood year) were primarily captured from March through May 2014 (Figure 6.1). Based on capture efficiencies estimated from the flow model, the total number of wild yearling Chinook emigrating from Nason Creek was 4,561 (±1,540). Combining the total number of subyearling spring Chinook (28,110) that emigrated during the fall of 2013 with the total number of yearling Chinook (4,561) that emigrated during 2014 resulted in a total emigrant estimate of 32,671 (±4,863) spring Chinook for the 2012 brood year (Table 6.13).

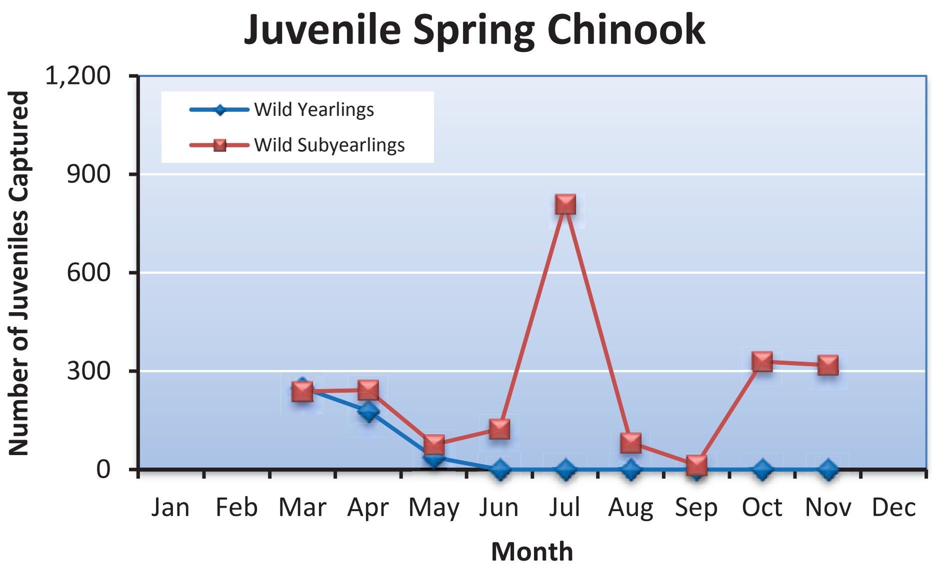

Figure 6.1. Monthly captures of wild subyearling and yearling spring Chinook at the Nason Creek Trap, 2014.

Table 6.13. Numbers of redds and juvenile spring Chinook at different life stages in the Nason Creek basin for brood years 2002-2013; 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
2002	294	1,368,276	ND	4,683	ND
2003	83	485,052	8,829	6,358	15,187
2004	169	811,031	11,822	2,597	14,419
2005	193	835,111	11,814	8,696	20,510
2006	152	657,248	4,144	7,798	11,942
2007	101	448,541	15,556	5,679	21,235
2008	336	1,542,912	23,182	3,611	26,793
2009	167	763,691	27,720	1,705	29,425
2010	188	811,032	8,491	3,535	12,026
2011	170	745,450	17,991	2,422	20,413
2012	413	1,744,099	28,110	4,561	32,671
2013	212	999,792	30,078	--	--
Average	***207***	***934,353***	***17,067***	***4,695***	***20,462***

[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.

Wild subyearling spring Chinook (2013 brood year) were captured between 3 March and 30 November 2014. Because a viable flow-efficiency regression model could not be established at the new downstream trap location (July-November), a pooled estimate was employed as a temporary method of expansion. Based on this pooled efficiency, the total number of wild subyearling Chinook from the Nason Creek basin was 30,078 (±32,238).

Yearling spring Chinook sampled in 2014 averaged 90 mm in length, 7.5 g in weight, and had a mean condition of 1.03 (Table 6.14). These size estimates were less than the overall mean of yearling spring Chinook sampled in previous years (overall means, 92 mm, 8.5 g, and condition of 1.06). Subyearling spring Chinook sampled in 2014 at the Nason Creek Trap averaged 69 mm in length, averaged 3.8 g, and had a mean condition of 1.05 (Table 6.14). These sizes were less than the overall mean of subyearling spring Chinook sampled in previous years (overall means, 75 mm, 4.9 g, and condition of 1.06).

Table 6.14. Mean fork length (mm), weight (g), and condition factor of subyearling and yearling spring Chinook collected in the Nason Creek Trap, 2004-2014. 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)
	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)
Average	***Subyearling***	***1,718***	***75 (4)***	***4.9 (0.9)***	***1.06 (0.07)***
	Yearling	***388***	***92 (3)***	***8.5 (1.0)***	***1.06 (0.04)***

[a] Sample size represents the number of fish that were measured for both length and weight.

Freshwater Productivity

Both productivity and survival estimates for different life stages of spring Chinook in the Nason Creek watershed are provided in Table 6.15. Estimates for brood year 2012 fall within the ranges estimated over the period of brood years 2002-2012. During that period, freshwater productivities ranged from 10-77 smolts/redd and 64-210 emigrants/redd. Survivals during the same period ranged from 0.2-1.3% for egg-smolt and 1.5-4.7% for egg-emigrants.

Table 6.15. Productivity (fish/redd) and survival (%) estimates for different juvenile life stages of spring Chinook in the Nason Creek watershed for brood years 2002-2013; ND = no data. These estimates were derived from data in Table 6.13.

Brood year	Smolts/Redd[a]	Emigrants/ Redd	Egg-Smolt[a] (%)	Egg-Emigrant (%)
2002	16	ND	0.3	ND
2003	77	183	1.3	3.1
2004	15	85	0.3	1.8
2005	45	106	1.0	2.5
2006	51	79	1.2	1.8
2007	56	210	1.3	4.7
2008	11	80	0.2	1.7
2009	10	176	0.2	3.9
2010	19	64	0.4	1.5
2011	14	120	0.3	2.7
2012	11	79	0.3	1.9
Average	***30***	***107***	***0.6***	***2.3***

[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, survival and productivity decreased as seeding levels increased (Figure 6.2). This suggests that density dependence regulates juvenile productivity and survival within the Nason Creek watershed.

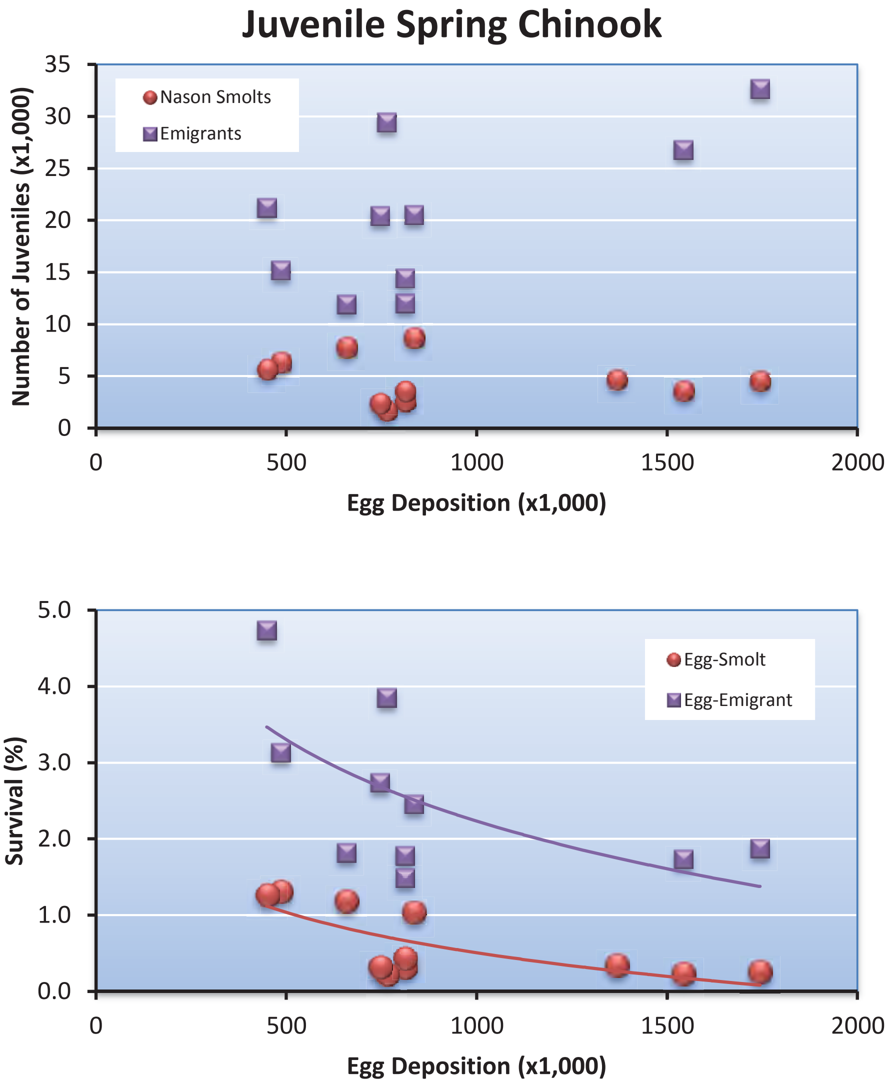

Figure 6.2. Relationships between seeding levels (egg deposition) and juvenile life-stage survivals and productivities for Nason Creek spring Chinook, brood years 2002-2012. Nason Creek smolts are smolts produced only in the Nason Creek watershed.

6.5 Spawning Surveys

Surveys for spring Chinook redds were conducted during August through September, 2014, in the Chiwawa River (including Rock, Phelps, Big Meadow, and Chikamin 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). See Section 5.5 for a complete coverage of spring Chinook redd surveys in the Wenatchee River basin. In the following section we describe the number and distribution of redds within the Nason Creek basin.

Redd Counts and Distribution

A total of 115 spring Chinook redds were counted in Nason Creek in 2014 (Table 6.16; see Table 5.19 for the complete time series of redd counts). This is lower than the average of 146 redds counted during the period 1989-2014 in Nason Creek. Redds were not distributed evenly among the four reaches in Nason Creek. Most were located in Reaches 1, 3, and 4 (Table 6.16).

Table 6.16. Numbers and proportions of spring Chinook redds counted within different reaches within Nason Creek during August through September, 2014. See Table 2.8 for description of survey reaches.

Stream/watershed	Reach	Number of redds	Proportion of redds within stream/watershed
Nason	Nason 1 (N1)	42	0.37
	Nason 2 (N2)	11	0.10
	Nason 3 (N3)	36	0.31
	Nason 4 (N4)	26	0.23
Total		***115***	***1.00***

Spawn Timing

Spring Chinook began spawning during the second week of August in Nason Creek and peaked the fifth week of August (Figure 6.3). Spawning in Nason Creek ended the third week of September.

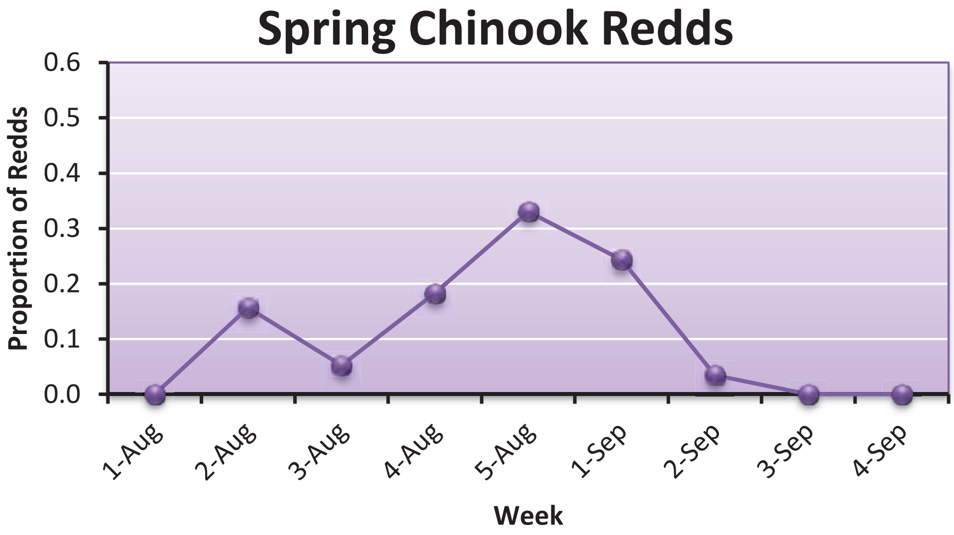

Figure 6.3. Proportion of spring Chinook redds counted during different weeks within Nason Creek, August through September 2014.

Spawning Escapement

Spawning escapement for spring Chinook was calculated as the number of redds times the male-to-female ratio (i.e., fish per redd expansion factor) estimated from broodstock and fish sampled at adult trapping sites. The estimated fish per redd ratio for spring Chinook upstream from Tumwater in 2014 was 2.06 (based on sex ratios estimated at Tumwater Dam). Multiplying this ratio by the number of redds counted in Nason Creek resulted in a total spawning escapement of

237 spring Chinook. The estimated total spawning escapement of spring Chinook in 2014 was less than the overall average of 325 spring Chinook in Nason Creek (see Table 5.22).

6.6 Carcass Surveys

Surveys for spring Chinook carcasses were conducted during August through September, 2014, in the Chiwawa River (including Rock, Phelps, and Chikamin creeks), Nason Creek, Icicle Creek, Peshastin Creek, Upper Wenatchee River, Little Wenatchee River, and White River (including the Napeequa River and Panther Creek). In 2014, 68 spring Chinook carcasses were sampled in Nason Creek. Most of these were sampled in Reaches 1 and 3. The number of carcasses sampled in 2014 was less than the overall average of 153 carcasses sampled during the period 1996-2014. See Section 5.6 for a complete coverage of spring Chinook carcass surveys in the Wenatchee River basin.

In the Nason Creek watershed, the spatial distribution of hatchery and wild fish was not equal among survey reaches (Table 6.17). In 2014, more wild fish were collected during surveys than hatchery fish (these numbers may change after analysis of CWTs). A similar percentage of hatchery and wild fish were found in the lower reaches (N1 and N2; Mouth to Highway 2). In upstream reaches, more wild fish were observed than hatchery fish. This general trend was also apparent in the pooled data (Figure 6.4). It should be noted that the hatchery fish spawning in Nason Creek are strays from the Chiwawa spring Chinook Program. Nason Creek hatchery fish will return to Nason Creek beginning in 2016 as age-3 fish.

Table 6.17. Numbers of wild and hatchery spring Chinook carcasses sampled within different reaches in the Nason Creek watershed, 1999-2014. See Table 2.8 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**
	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**

Survey year	Origin	Survey Reach				Total
		N-1	N-2	N-3	N-4	
	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	20	4	12	2	**38**
	Hatchery	24	2	3	0	**29**
Average	***Wild***	***14***	***14***	***12***	***13***	***53***
	Hatchery	***49***	***25***	***18***	***13***	***105***

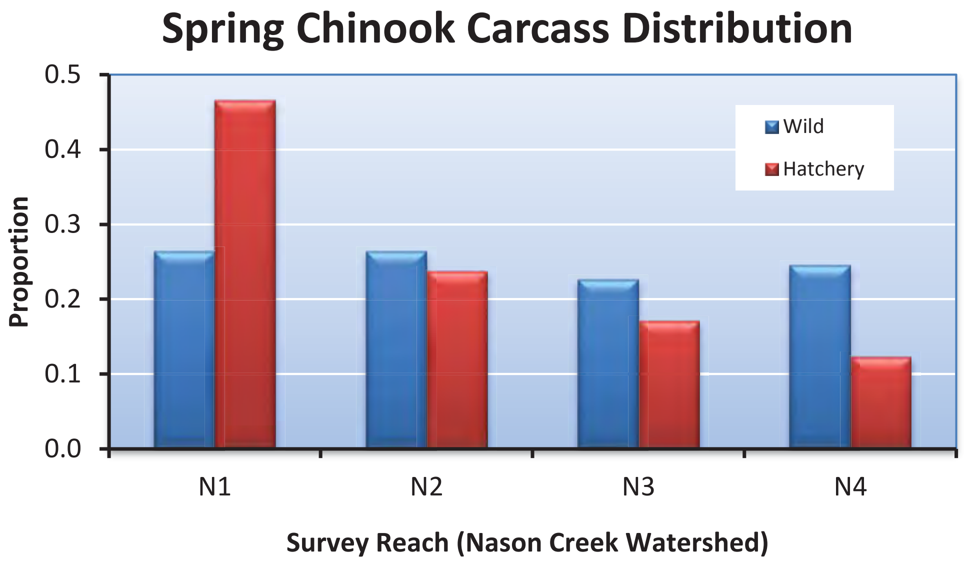

Figure 6.4. Distribution of wild and hatchery produced carcasses in different reaches in the Nason Creek watershed, 1999-2014. Reach codes are described in Table 2.8.

6.7 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

See Section 5.7 for a description of migration timing of spring Chinook at Tumwater Dam.

Age at Maturity

Most of the wild and hatchery spring Chinook sampled during the period 1999-2014 in the Nason Creek watershed were age-4 fish (total age) (Table 6.18; Figure 6.5). Until 2014, hatchery fish made up a higher percentage of age-3 Chinook than did wild fish. As 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 6.18. Numbers of wild and hatchery spring Chinook of different ages (total age) sampled on spawning grounds in the Nason Creek watershed, 1999-2014.

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**
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**

Sample year	Origin	Total age					Sample size
		2	**3**	**4**	**5**	**6**	
2014	Wild	0	12	17	2	0	**31**
	Hatchery	0	8	19	0	0	**27**
Average	***Wild***	***0***	***2***	***39***	***10***	***0***	***51***
	Hatchery	***0***	***22***	***77***	***5***	***0***	***104***

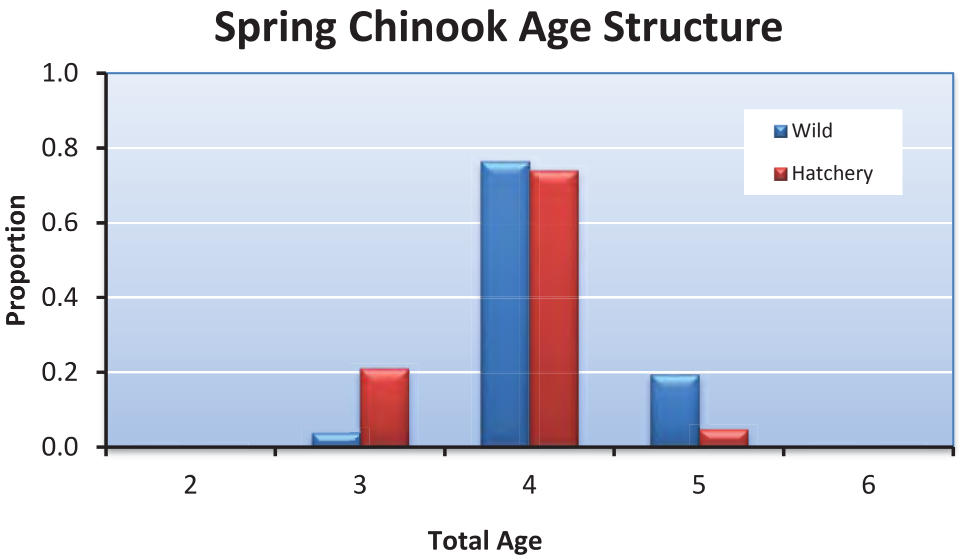

Figure 6.5. Proportions of wild and hatchery spring Chinook of different total ages sampled on spawning grounds in the Nason Creek watershed for the combined years 1999-2014.

Size at Maturity

On average, hatchery and wild spring Chinook of a given age differed little in length (Table 6.19). Differences were usually no more than 1-3 cm between hatchery and wild fish of the same age.

Table 6.19. Mean lengths (POH in cm; ±1SD) and sample sizes (in parentheses) of different ages (total age) of male and female spring Chinook of wild and hatchery-origin sampled in the Nason Creek watershed, 1999-2014.

Return year	Total age	Mean length (cm)			
		Male		Female	
		Wild	Hatchery	Wild	Hatchery
1999	3	0	0	0	0
	4	71 ±2 (2)	0	64 ±2 (3)	0
	5	0	0	0	0
	6	0	0	0	0
2000	3	46 ±0 (1)	44 ±4 (14)	0	52 ±10 (4)
	4	62 ±4 (19)	0	63 ±3 (25)	60 ±1 (3)
	5	0	0	0	0

Return year	Total age	Mean length (cm)			
		Male		Female	
		Wild	Hatchery	Wild	Hatchery
	6	0	0	0	0
2001	3	0	47 ±12 (5)	0	0
	4	65 ±4 (21)	66 ±5 (36)	63 ±4 (42)	63 ±4 (123)
	5	81 ±5 (3)	0	72 ±3 (10)	71 ±7 (3)
	6	0	0	0	0
2002	3	0	0	0	0
	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	0	0	0	0
2003	3	44 ±7 (3)	43 ±5 (3)	0	0
	4	58 ±7 (2)	79 ±0 (1)	67 ±0 (1)	0
	5	75 ±9 (11)	81 ±6 (2)	72 ±6 (25)	71 ±2 (3)
	6	0	0	0	0
2004	3	46 ±0 (1)	43 ±4 (56)	0	0
	4	61 ±4 (35)	60 ±3 (6)	61 ±3 (66)	62 ±4 (17)
	5	0	0	81 ±0 (1)	73 ±4 (2)
	6	0	0	0	0
2005	3	37 ±0 (1)	41 ±7 (3)	0	0
	4	59 ±6 (8)	63 ±4 (54)	61 ±3 (17)	61 ±3 (116)
	5	73 ±5 (4)	0	71 ±1 (13)	0
	6	0	0	0	0
2006	3	0	41 ±3 (12)	0	0
	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	0	0	0	0
2007	3	0	44 ±4 (122)	0	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	0	0	0	0
2008	3	51 ±21 (2)	45 ±5 (20)	0	45 ±0 (1)
	4	60 ±5 (15)	63 ±4 (42)	61 ±3 (31)	63 ±3 (121)
	5	0	77 ±2 (3)	71 ±3 (4)	64 ±7 (3)
	6	0	0	0	0
2009	3	41 ±0 (1)	46 ±5 (18)	0	65 ±0 (1)
	4	60 ±5 (12)	63 ±4 (19)	60 ±3 (24)	61 ±4 (46)
	5	0	71 ±1 (2)	72 ±4 (2)	73 ±3 (2)
	6	0	0	0	0
2010	3	44 ±0 (1)	45 ±5 (5)	0	0
	4	62 ±5 (7)	63 ±4 (42)	61 ±3 (10)	62 ±4 (74)
	5	0	75 ±0 (1)	0	0
	6	0	0	0	0

Return year	Total age	Mean length (cm)			
		Male		Female	
		Wild	Hatchery	Wild	Hatchery
2011	3	48 ±11 (3)	43 ±4 (31)	0	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	0	0	0	0
2012	3	41 ±0 (1)	42 ±3 (24)	0	0
	4	61 ±7 (35)	60 ±5 (45)	61 ±4 (54)	60 ±4 (151)
	5	77 ±4 (6)	0	66 ±5 (11)	70 ±3 (2)
	6	0	0	0	0
2013	3	0	42 ±4 (21)	0	0
	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	0	0	0	0
2014	3	44 ±5 (12)	47 ±5 (8)	0	0
	4	67 ±4 (6)	58 ±3 (8)	63 ±3 (11)	60 ±3 (11)
	5	0	0	65 ±1 (2)	0
	6	0	61 ±8 (2)	69 ±13 (2)	0

Contribution to Fisheries

Because the Nason Creek program began in 2013, there will be no harvest information on Nason Creek hatchery spring Chinook until about 2017.

Straying

Stray rates will be determined by examining CWTs and PIT tags 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 target for brood year stray rates should be less than 5%. Straying of Nason Creek spring Chinook will be estimated beginning in 2016 or 2017 when the 2013 brood fish return.

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 J). 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.

Proportion of 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). The ratio pNOB/(pHOS+pNOB) is the Proportion of Natural Influence (PNI). The larger the ratio (PNI), 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 important 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, PNI values ranged from 0.26 to 1.00 (Table 6.20). During this period, PNI values varied over time because of Chiwawa spring Chinook straying into Nason Creek. For brood years 2013-2014, a period when brood stock was collected for the Nason Creek Program, PNI for the Nason Creek Program (PNI_N) was 1.00. If hatchery strays are included in the PNI calculation (PNI_{N+S}), values were less than 0.67 (Table 6.20).

Table 6.20. Proportionate natural influence (PNI) of hatchery spring Chinook spawning in Nason Creek. See notes below the table for description of each metric.

Brood year	Spawners					Broodstock			PNI_N	PNI_{N+S}
	NOS	HOS_N	HOS_S	$pHOS_N$	$pHOS_{N+S}$	NOB_N	HOB_N	pNOB		
1989	222	0	0	0.00	0.00	0	0	*1.00*	--	1.00
1990	231	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*	--	0.89
1994	60	0	0	0.00	0.00	0	0	*0.67*	--	1.00
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*	--	0.59
1997	67	0	55	0.00	0.45	0	0	*0.29*	--	0.39
1998	61	0	3	0.00	0.05	0	0	*0.28*	--	0.85
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*	--	0.50
2001	257	0	341	0.00	0.57	0	0	*0.30*	--	0.34
2002	313	0	290	0.00	0.48	0	0	*0.28*	--	0.37
2003	152	0	50	0.00	0.25	0	0	*0.44*	--	0.64
2004	297	0	210	0.00	0.41	0	0	*0.39*	--	0.49
2005	81	0	266	0.00	0.77	0	0	*0.33*	--	0.30

Brood year	Spawners					Broodstock			PNI$_{N}$	PNI$_{N+S}$
	NOS	HOS$_{N}$	HOS$_{S}$	pHOS$_{N}$	pHOS$_{N+S}$	NOB$_{N}$	HOB$_{N}$	pNOB		
2006	117	0	154	0.00	0.57	0	0	*0.29*	--	0.34
2007	83	0	380	0.00	0.82	0	0	*0.29*	--	0.26
2008	139	0	426	0.00	0.75	0	0	*0.27*	--	0.26
2009	163	0	371	0.00	0.69	0	0	*0.46*	--	0.40
2010	59	0	351	0.00	0.86	0	0	*0.44*	--	0.34
2011	250	0	452	0.00	0.64	0	0	*0.46*	--	0.42
2012	220	0	474	0.00	0.68	0	0	*1.00*	--	0.60
Average*	***159***	***0***	***166***	***0.00***	***0.36***	***0***	***0***	***0.50***	--	***0.62***
2013	70	0	339	0.00	0.83	21	4	0.84	1.00	0.55
2014	169	0	68	0.00	0.29	21	0	1.00	1.00	0.52
Average**	***120***	***0***	***204***	***0.00***	***0.56***	***21***	***2***	***0.92***	***1.00***	***0.54***

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$_{N}$ = pNOB/(pNOB + pNOS$_{N}$); where pNOB is weighted 100% toward broodstock collection from the Nason Creek spring Chinook Supplementation Program. The purpose for this PNI value is to track the performance of the Nason Creek Program apart from the influence of strays and broodstock collection outside the Nason Creek watershed.
PNI$_{N+S}$ = pNOB/(pNOB + pHOS$_{N+S}$); where pNOB is weighted by the proportion of HOS$_{N}$ and HOS$_{S}$ observed in Nason Creek. This PNI value tracks the combined influence of broodstock selection from the Nason Program and/or Chiwawa Program according the proportion of HOS that return to Nason Creek from those programs.
* Average for the period 1989-2012, a period when no brood stock were collected for the Nason Creek Program.
** Average for the period 2013-present, a period when brood stock was collected for the Nason Creek Program.

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 1989-2008, NRR for spring Chinook in Nason Creek averaged 0.90 (range, 0.05-5.48) if harvested fish were not include in the estimate and 0.99 (range, 0.05-5.84) if harvested fish were included in the estimate (Table 6.21). 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 will be calculated as the ratio of hatchery-origin recruits (HOR) to the parent broodstock collected. These rates should be greater than the NRRs. HRRs will be calculated beginning with the return of 2013 brood fish.

Table 6.21. 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 1989-2008.

Brood year	Spawning Escapement	Harvest not included		Harvest included	
		NOR	NRR	NOR	NRR
1989	222	171	0.77	249	1.12
1990	231	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	339	2.78
1998	64	351	5.48	374	5.84
1999	22	14	0.64	15	0.68
2000	270	337	1.25	354	1.31
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	161	0.46
2006	271	118	0.44	149	0.55
2007	463	209	0.45	254	0.55
2008	565	239	0.42	270	0.48
Average	***274***	***138***	***0.90***	***154***	***0.99***

Smolt-to-Adult Survivals

Smolt-to-adult survival ratios (SARs) will be calculated as the number of hatchery adult recaptures divided by the number of tagged hatchery smolts released. SARs will be calculated with the return of the 2013 brood fish.

6.8 ESA/HCP Compliance

Broodstock Collection

The first broodstock were collected in 2013.

Hatchery Rearing and Release

The first broodstock were collected in 2013.

Hatchery Effluent Monitoring

Per ESA Permits 1196, 1347, 1395, 18118, 18119, and 18121, permit holders shall monitor and report hatchery effluents in compliance with applicable National Pollution Discharge Elimination

Systems (NPDES) (EPA 1999) permit limitations. There was one NPDES violation reported at PUD Hatchery facilities during the period 1 January through 31 December 2014. NPDES monitoring and reporting for PUD Hatchery Programs during 2014 are provided in Appendix F.

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 2013 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 6.22. Additionally, juvenile fish captured at the trap locations were handled consistent with provisions in ESA Section 10 Permit 1196, 18118, 18120, and 18121, Section B. Table 6.22 does not include incidental or direct take associated with the Nason Creek smolt trap operated by the Yakama Nation.

Table 6.22. Estimated take of Upper Columbia River spring Chinook resulting from juvenile emigration monitoring in the Wenatchee River basin, 2014.

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	34,334	222,504	73,695	4,519	5,293	23,755	33,567	
Encounter rate	NA	NA	NA	0.1316	0.0237	0.3223	0.1016	0.20
Mortality[e]	NA	NA	NA	28	0	84	112	
Mortality rate	NA	NA	NA	0.0062	0.0000	0.0035	0.0033	0.02
Lower Wenatchee Trap								
Population	67,973	222,504	11,936,928	1,700	31,290	81,445	114,435	
Encounter rate	NA	NA	NA	0.025	0.1406	0.0068	0.0096	0.20
Mortality[d]	NA	NA	NA	17	12	250	279	
Mortality rate	NA	NA	NA	0.0100	0.0004	0.0031	0.0024	0.02
Wenatchee River Basin Total								
Population	67,393	222,504	11,936,928	6,219	36,583	105,200	148,002	
Encounter rate	NA	NA	NA	0.0922	0.1644	0.0088	0.0121	0.20
Mortality[d]	NA	NA	NA	45	12	84	141	
Mortality rate	NA	NA	NA	0.0072	0.0003	0.0008	0.0010	0.02

[a] Smolt population estimate derived from juvenile emigration trap data.

[b] 2012 BYsmolt 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..

[d] Combined trapping and PIT tagging mortality.

Spawning Surveys

Spring Chinook spawning ground surveys were conducted in the Wenatchee River basin during 2014, as authorized by ESA Section 10 Permits 18118, 18119, 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 1196 (expired) and new Section 10 Permits 18118, 18119, 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 2014, 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, and 2014) for complete details on the methods and results of the spring Chinook reproductive success study for the period 2010-2014.

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 release in the upper Wenatchee Basin. The first large release of F_2 juveniles was in 2008. The last release of juveniles from the captive brood program will occur in 2015.

The production goal for the White River captive brood program following the 2013 hatchery recalculation is 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 have been manipulated to evaluate different approaches to reduce precocious maturation. All of the fish are marked with CWTs. In addition, since 2008, juvenile spring Chinook have been PIT tagged annually.

Since its inception, the captive brood program has undergone 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 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). Information on spring Chinook collected throughout the Wenatchee River basin is presented in Section 5.

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 in close proximity of 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 to 2007) or to the Little White Salmon Hatchery (brood years 2008 to 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
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 are spawned and their progeny are grown to smolt size for release into the White River.

During spawning, eggs and sperm are collected and those gametes are crossed based on a 2x2 factorial spawning matrix. That is, each female is spawned with two males and each male is spawned with two females. Using pedigree analysis, spawning crosses are arranged to maximize genetic diversity. Because incomplete ripening of ova has been an issue in the program, implementation of hormone treatments began in 2011 to facilitate ripening. 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. 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
	Male	NA	NA	NA	NA	NA
2009	Female	0	0	119	0	119

Spawning year	Sex	Total age				Total
		2	3	4	5	
	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***	***19***	***36***	***14***	***75***
	Male	***41***	***24***	***0***	***0***	***65***

* Included some unknown number of second-generation females.

Release Information

Numbers released

Several different acclimation and release scenarios have been 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. 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 11.5	Tanks	1,639	White River	4/4/2006	0
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
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

Brood year	Acclimation site	Acclimation vessel	Number of smolts released	Release scenario	Release date	Number of acclimation days
	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.[7] 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), 303,207 juvenile spring Chinook have been 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.

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	0.00	0	2,589
2003	WR RM 11.5	Tanks	White River	0.00	0	2,096
2004	WR RM 11.5	Tanks	White River	0.00	0	1,639
2005	Lake Wen	Net Pens	Lake Wen	1.00	0	69,032
2006	NA	NA	White River	0.00	29,881	139,644*
	NA	NA	White River	0.00		142,033
2007	Lake Wen	Net Pens	Lake Wen	1.00	29,863	87,671

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[7] 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
	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	34,905	31,000

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
	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

Brood year	Acclimation site	Release scenario	Fork length (mm)		Mean weight	
			Mean	CV	Grams (g)	Fish/pound
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

We used PIT-tagged fish to estimate survival rates 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.[8] 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). Because of uncertain release times for the different release scenarios, travel times could not be calculated for the different groups.

Table 7.6. Survival 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	SAR to Bonneville Dam
2006	White River	29,881	0.037 (0.008)	0.000 (0.000)
2007	Lake Wen Pens	29,863	0.096 (0.010)	0.000 (--)
	Lake Wenatchee	9,957	0.080 (0.015)	0.000 (--)

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[8] 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.

Brood year	Release scenario	Number of Chinook released with PIT tags	Survival to McNary Dam	SAR to Bonneville Dam
2008	Lake Wenatchee	38,146	0.065 (0.010)	0.001 (0.000)
2009	White and Wenatchee rivers	19,913	0.269 (0.027)	0.002 (0.000)
	White River	21,829	0.055 (0.013)	0.000 (0.000)
2010	Wenatchee River	12,283	0.267 (0.017)	NA
2011	Wenatchee River	2,490	0.385 (0.042)	NA
	White and Wenatchee rivers	51,697	0.434 (0.010)	NA
2012	Wenatchee River	52,440	0.351 (0.013)	NA

7.3 Disease Monitoring

First-Generation Health Maintenance

First-generation (F_1) adults are 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 receive a dose of 20 mg/kg of body weight. The fish also receive formalin treatments as needed throughout the year to prevent and treat fungus infections. This is especially important during the pre-spawning period when individual fish are maturing in preparation for spawning. Formalin treatments are 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 are shocked in October. Eggs are 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 end after hatching, and water flow is increased from three to five gallons per minute. Dead and deformed fry are removed before relocating the fry to nursery tanks in late January or early February. Fry are then relocated to raceways in July, where they remain until transfer to the White River for acclimation the following March. Coded-wire tagging is typically conducted in July, and PIT tagging occurs the following January or February, just before the fish are 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. 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 2014, the White River Trap operated between 1 March and 30 November 2014. During that time period the trap was inoperable for 20 days because of ice or debris accumulation, unsafe working conditions, or for maintenance and repairs. 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. In the event that 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 L.

Wild yearling spring Chinook (2012 brood year) were primarily captured from March through April 2014 (Figure 7.1). Based on a composite regression model, the total number of wild yearling Chinook emigrating from the White River was 3,995 (±3,616). Combining the total number of subyearling spring Chinook (3,905 ±1,456) that emigrated during the fall of 2013 with the total number of yearling Chinook (3,995) that emigrated during 2014 resulted in a total emigrant estimate of 7,900 (±3,898) spring Chinook for the 2012 brood year (Table 7.7).

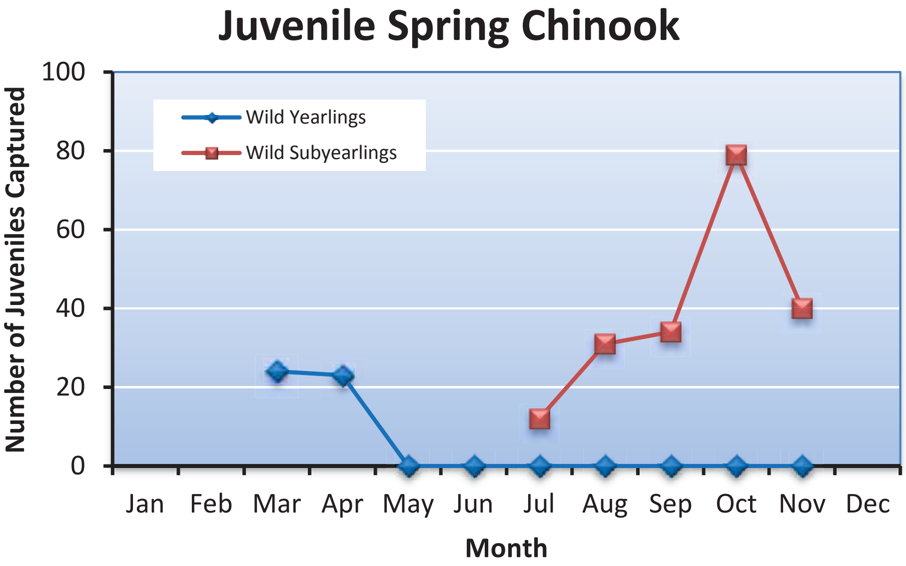

Figure 7.1. Monthly captures of wild subyearling (parr) and yearling spring Chinook at the White River Trap, 2014.

Table 7.7. Numbers of redds and juvenile spring Chinook at different life stages in the White River basin for brood years 2005-2013; 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	642	2,004	2,646
2007	20	88,820	2,293	3,399	5,692
2008	31	142,352	5,552	5,193	10,745
2009	54	246,942	2,485	2,939	5,424
2010	33	142,362	1,859	4,121	5,980
2011	20	87,700	3,128	1,659	4,787

Brood year	Number of redds	Egg deposition[a]	Number of subyearling emigrants[b]	Number of smolts produced within White River basin	Number of emigrants
2012	86	363,178	3,905	3,995	7,900
2013	54	254,664	2,482	--	--
Average[c]	***46***	***203,576***	***2,793***	***3,521***	***6,168***

[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 is based on the entire time series of data, not just the period 2006 through 2012.

Wild subyearling spring Chinook (2013 brood year) were captured between 7 July and 25 November 2014, with peak catch during October (Figure 7.1). Based on a composite regression model, the total number of wild subyearling Chinook emigrating from the White River was 2,482 (±851).

Yearling spring Chinook sampled in 2014 averaged 94 mm in length, 9.4 g in weight, and had a mean condition of 1.11 (Table 7.8). Length and weight estimates for these fish were less than the overall mean of yearling spring Chinook sampled in previous years (overall means, 99 mm and 10.9 g), while the estimated condition equaled the overall mean (overall mean, 1.11). Subyearling spring Chinook parr sampled in 2014 at the White River Trap averaged 86 mm in length, averaged 7.5 g, and had a mean condition of 1.10 (Table 7.8). Length and weight estimates for these fish were less than the overall mean of subyearling spring Chinook sampled in previous years (overall means, 90 mm and 8.3 g), while the estimated condition was similar to the overall mean (overall mean, 1.09).

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, 2007-2014. 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)

Sample year	Life stage	Sample size[a]	Mean size		
			Length (mm)	Weight (g)	Condition (K)
	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)
Average	***Subyearling***	***245***	***90 (5)***	***8.3 (1.2)***	***1.09 (0.03)***
	Yearling	***151***	***99 (4)***	***10.9 (1.3)***	***1.11 (0.04)***

[a] Sample size represents the number of fish that were measured for both length and weight.

Freshwater Productivity

Both productivity and survival estimates for different life stages of spring Chinook in the White River basin are provided in Table 7.9. Estimates for brood year 2012 fall near the lower end of the range of productivity and survival estimates for brood years 2005-2012. During that period, freshwater productivities ranged from 46-170 smolts/redd and 85-347 emigrants/redd. Survivals during the same period ranged from 1.1-3.8% for egg-smolt and 2.0-7.5% for egg-emigrants.

Table 7.9. Productivity (fish/redd) and survival (%) estimates for different juvenile life stages of spring Chinook in the White River basin for brood years 2005-2013. These estimates were derived from data in Table 7.7.

Brood year	Smolts/Redd[a]	Emigrants/ Redd	Egg-Smolt[a] (%)	Egg-Emigrant (%)
2005	56	ND	1.3	ND
2006	65	85	1.5	2.0
2007	170	285	3.8	6.4
2008	168	347	3.6	7.5
2009	54	100	1.2	2.2
2010	125	181	2.9	4.2
2011	83	239	1.9	5.5
2012	46	92	1.1	2.2
Average	***96***	***190***	***2.2***	***4.3***

[a] These estimates include Nason Creek smolts produced only within the Nason Creek 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.

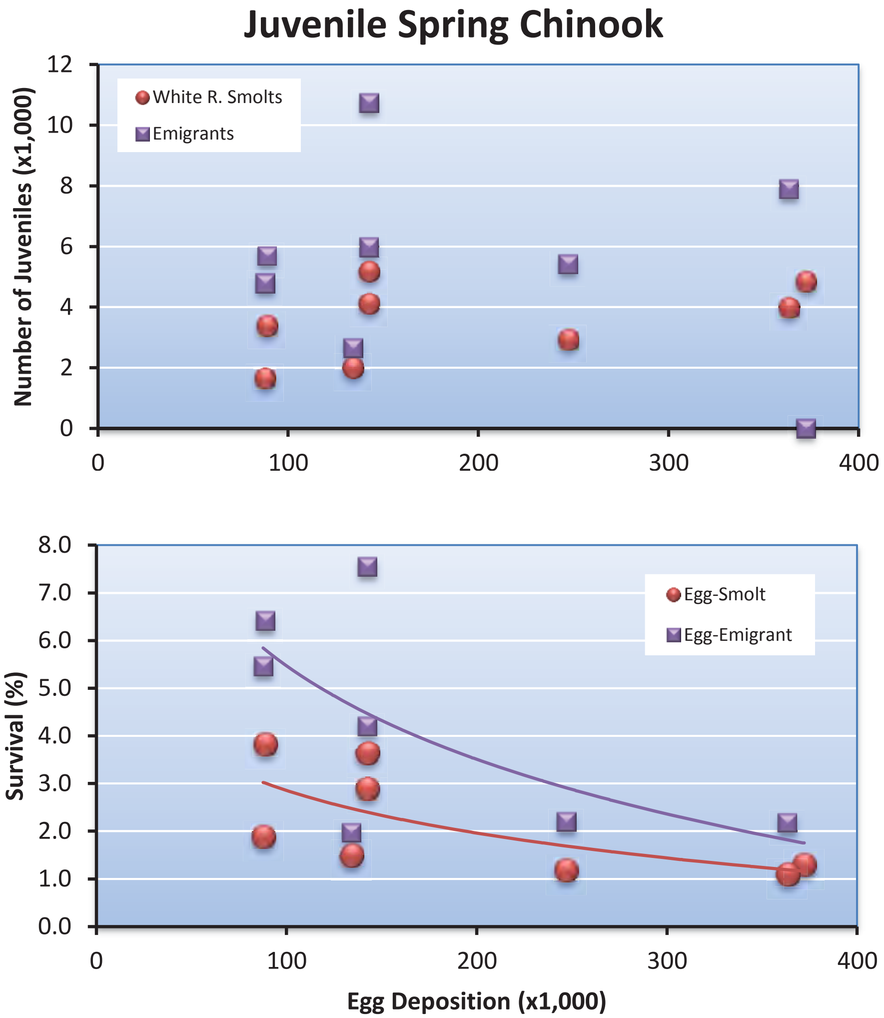

Figure 7.2. Relationships between seeding levels (egg deposition) and juvenile life-stage survivals and productivities for White River spring Chinook, brood years 2005-2012. White River smolts are smolts produced only within the White River basin.

7.5 Spawning Surveys

Surveys for spring Chinook redds were conducted during August through September, 2014, in the Chiwawa River (including Rock, Phelps, Big Meadow, and Chikamin 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). See Section 5.5 for a complete coverage of spring Chinook redd surveys in the Wenatchee River basin. In the following section we describe the number and distribution of redds within the White River basin.

Redd Counts and Distribution

A total of 26 spring Chinook redds were counted in the White River basin in 2014 (Table 7.10; see Table 5.19 for the complete time series of redd counts). This is lower than the average of 34 redds counted during the period 1989-2014 in the White River. Redds were not distributed evenly among the six survey areas in the White River basin. Most were located in Reach 3 (Napeequa River to Grasshopper Meadows) in the White River (Table 7.10).

Table 7.10. Numbers and proportions of spring Chinook redds counted within different survey areas within the White River basin during August through September, 2014. See Table 2.8 for description of survey reaches.

Stream/watershed	Reach	Number of redds	Proportion of redds within stream/watershed
White River	White 2 (H2)	1	0.04
	White 3 (H3)	22	0.85
	White 4 (H4)	0	0.00
	Napeequa 1 (Q1)	2	0.08
	Panther 1 (T1)	1	0.04
Total		***26***	***1.00***

Spawn Timing

Spring Chinook began spawning during the second week of August in the White River and peaked the four week of August (Figure 7.3). Spawning in the White River ended the second or third week of September.

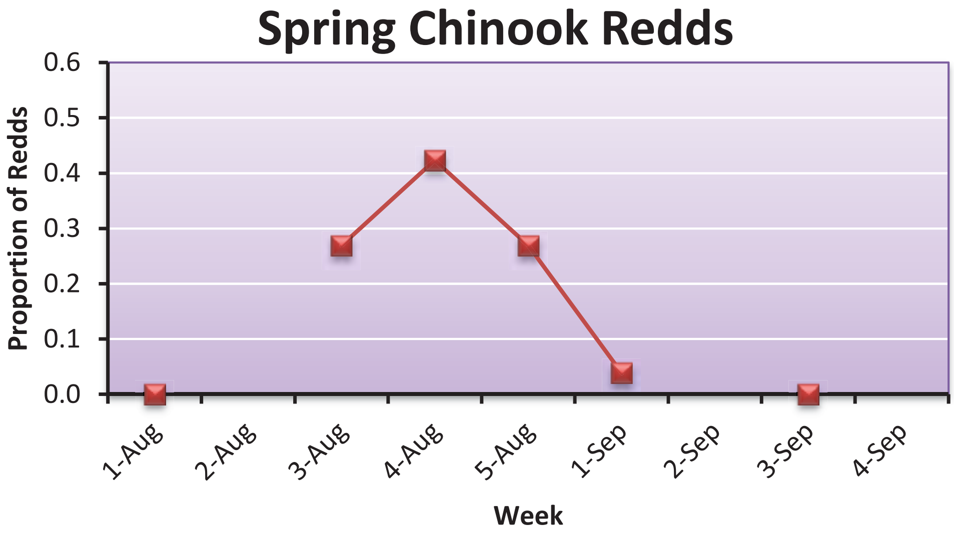

Figure 7.3. Proportion of spring Chinook redds counted during different weeks within the White River basin, August through September 2014.

Spawning Escapement

Spawning escapement for spring Chinook was calculated as the number of redds times the male-to-female ratio (i.e., fish per redd expansion factor) estimated from broodstock and fish sampled at adult trapping sites. The estimated fish per redd ratio for spring Chinook upstream from

Tumwater in 2014 was 2.06 (based on sex ratios estimated at Tumwater Dam). Multiplying this ratio by the number of redds counted in the White River basin resulted in a total spawning escapement of 54 spring Chinook. The estimated total spawning escapement of spring Chinook in 2014 was less than the overall average of 74 spring Chinook in the White River basin (see Table 5.22).

7.6 Carcass Surveys

Surveys for spring Chinook carcasses were conducted during August through September, 2014, in the Chiwawa River (including Rock, Phelps, and Chikamin creeks), Nason Creek, Icicle Creek, Peshastin Creek, Upper Wenatchee River, Little Wenatchee River, and White River (including the Napeequa River and Panther Creek). In 2014, eight spring Chinook carcasses were sampled in the White River basin. All of these were sampled in Reach 3. The total number of carcasses sampled in 2014 was less than the overall average of 17 carcasses sampled during the period 1996-2014. See Section 5.6 for a complete coverage of spring Chinook carcass surveys in the Wenatchee River basin.

In the White River basin, the spatial distribution of hatchery strays (primarily from the Chiwawa Spring Chinook program) and wild spring Chinook was similar among survey reaches (Table 7.11). In 2014, all carcasses were observed in the reach between the Napeequa River and Grasshopper Meadows (Reach 3) (Table 7.11). Over the years, spring Chinook have spawned more often in this reach than in other reaches (Figure 7.4). At this time, only two captive brood carcasses have been identified on the spawning grounds, both in Reach 3 in 2013. This may be because captive brood returns were not adipose-fin clipped and therefore any returns from the captive brood program may have been included inadvertently with wild fish.

Table 7.11. Numbers of wild, hatchery strays, and captive brood spring Chinook carcasses sampled within different reaches in the White River basin, 2000-2014. See Table 2.8 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**
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**

Survey year	Origin	Survey Reach					Total
		H-2	H-3	H-4	Napeequa	Panther	
2007	Wild	1	6	0	0	2	**9**
	Hatchery Strays	0	4	0	0	0	**4**
	Captive Brood	0	0	0	0	0	**0**
2008	Wild	1	3	0	0	1	**5**
	Hatchery Strays	2	5	0	0	1	**8**
	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	4	0	0	0	**4**
	Hatchery Strays	0	7	0	0	0	**7**
	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	8	0	0	0	**8**
	Hatchery Strays	0	10	0	0	3	**13**
	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**
Average	***Wild***	***1***	***10***	***0***	***0***	***0***	***12***
	Hatchery Strays	***0***	***8***	***0***	***0***	***1***	***9***
	Captive Brood	***0***	***0***	***0***	***0***	***0***	***0***

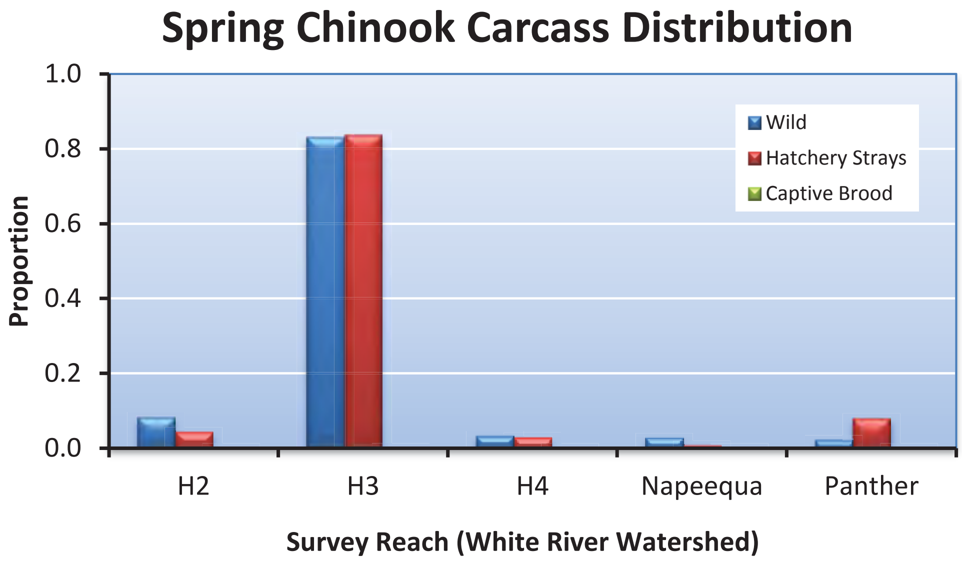

Figure 7.4. Distribution of wild, hatchery strays, and captive brood produced carcasses in different reaches in the White River basin, 2000-2014. Reach codes are described in Table 2.8.

7.7 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

See Section 5.7 for a description of migration timing of spring Chinook at Tumwater Dam.

Age at Maturity

Most of the wild and hatchery stray spring Chinook sampled during the period 2000-2014 in the White River basin were age-4 fish (total age) (Table 7.12; Figure 7.5). Hatchery strays made up a higher percentage of age-3 Chinook than did wild fish. In contrast, 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. At this time, only two captive brood carcasses have been identified on the spawning grounds; one was age-4 the other was age-5.

Table 7.12. Numbers of wild, hatchery strays, and captive brood spring Chinook of different ages (total age) sampled on spawning grounds in the White River basin, 2001-2014.

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**

Sample year	Origin	Total age					Sample size
		2	3	4	5	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**
	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	1	8	0	**9**
	Hatchery Strays	0	2	2	0	0	**4**
	Captive Brood	0	0	0	0	0	**0**
2008	Wild	0	0	4	1	0	**5**
	Hatchery Strays	0	0	8	0	0	**8**
	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	4	0	0	**4**
	Hatchery Strays	0	0	6	0	0	**6**
	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	6	2	0	**8**
	Hatchery Strays	0	0	11	1	0	**12**
	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**
Average	***Wild***	***0***	***0***	***9***	***3***	***0***	***12***
	Hatchery Strays	***0***	***0***	***9***	***0***	***0***	***10***
	Captive Brood	***0***	***0***	***0***	***0***	***0***	***0***

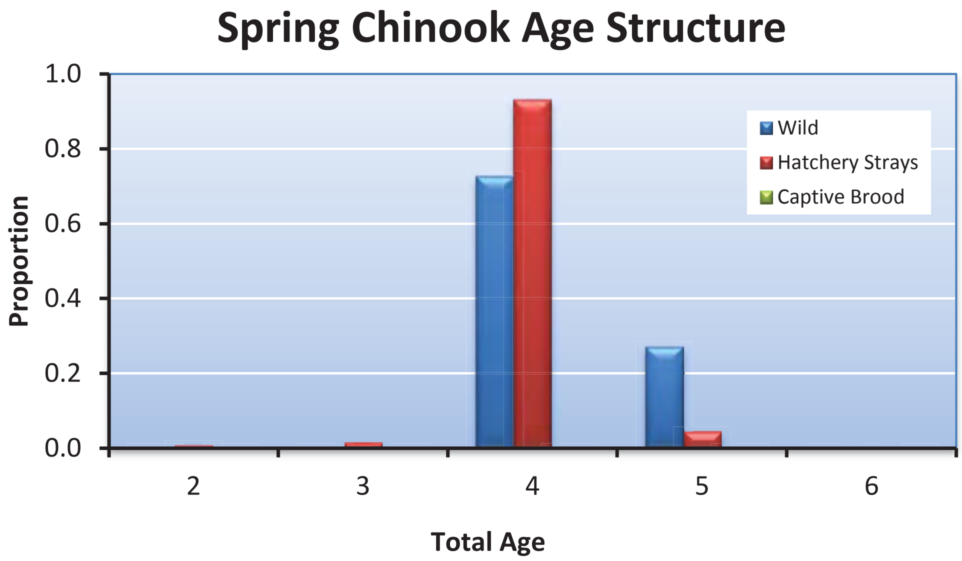

Figure 7.5. Proportions of wild, hatchery strays, and captive brood spring Chinook of different total ages sampled on spawning grounds in the White River basin for the combined years 2000-2014.

Size at Maturity

On average, hatchery strays and wild spring Chinook of a given age differed little in length (Table 7.13). Differences were usually no more than 1-4 cm between hatchery strays and wild fish of the same age. At this time, only two captive brood carcasses have been identified on the spawning grounds; both were females.

Table 7.13. 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, 2001-2014.

Return year	Total age	Mean length (cm)					
		Male			Female		
		Wild	Hatchery stray	Captive brood	Wild	Hatchery stray	Captive brood
2001	3	0	0	0	0	0	0
	4	65 ±3 (17)	66 ±4 (5)	0	63 ±3 (30)	63 ±4 (21)	0
	5	0	0	0	0	0	0
	6	0	0	0	0	0	0
2002	3	0	0	0	0	0	0
	4	66 ±0 (1)	69 ±0 (1)	0	63 ±4 (6)	59 ±6 (5)	0
	5	75 ±11 (2)	0	0	72 ±3 (9)	72 ±0 (1)	0
	6	0	0	0	0	0	0
2003	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	75 ±5 (6)	73 ±0 (1)	0
	6	0	0	0	0	0	0
2004	3	0	0	0	0	0	0
	4	68 ±3 (3)	0	0	63 ±3 (6)	59 ±2 (2)	0

Return year	Total age	Mean length (cm)					
		Male			Female		
		Wild	Hatchery stray	Captive brood	Wild	Hatchery stray	Captive brood
	5	0	0	0	0	0	0
	6	0	0	0	0	0	0
2005	3	0	0	0	0	0	0
	4	64 ±5 (3)	62 ±7 (5)	0	63 ±5 (8)	62 ±4 (33)	0
	5	0	0	0	0	0	0
	6	0	0	0	0	0	0
2006	3	0	0	0	0	0	0
	4	65 ±2 (3)	0	0	61 ±4 (4)	60 ±2 (3)	0
	5	69 ±4 (4)	0	0	67 ±5 (8)	70 ±5 (3)	0
	6	0	0	0	0	0	0
2007	3	0	49 ±5 (2)	0	0	0	0
	4	0	0	0	58 ±0 (1)	66 ±2 (2)	0
	5	75 ±5 (3)	0	0	75 ±1 (5)	0	0
	6	0	0	0	0	0	0
2008	3	0	0	0	0	0	0
	4	56 ±0 (1)	61 ±0 (1)	0	63 ±8 (2)	61 ±2 (7)	0
	5	0	0	0	75 ±0 (1)	0	0
	6	0	0	0	0	0	0
2009	3	0	0	0	0	0	0
	4	61 ±5 (3)	68 ±4 (2)	0	63 ±2 (5)	62 ±2 (8)	0
	5	0	0	0	78 ±0 (1)	0	0
	6	0	0	0	0	0	0
2010	3	0	0	0	0	0	0
	4	0	67 ±0 (1)	0	60 ±3 (3)	61 ±6 (5)	0
	5	0	0	0	0	0	0
	6	0	0	0	0	0	0
2011	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	73 ±5 (4)	0	0
	6	0	0	0	0	0	0
2012	3	0	0	0	0	0	0
	4	47 ±0 (1)	0	0	62 ±4 (12)	60 ±4 (8)	0
	5	0	0	0	0	0	0
	6	0	0	0	0	0	0
2013	3	0	0	0	0	0	0
	4	64 ±4 (3)	60 ±4 (2)	0	61 ±2 (3)	61 ±4 (7)	63 ±0 (1)
	5	0	0	0	67 ±1 (2)	71 ±0 (1)	71 ±0 (1)
	6	0	0	0	0	0	0
2014	3	0	0	0	0	0	0
	4	0	54 ±0 (1)	0	60 ±2 (5)	58 ±0 (1)	0
	5	0	0	0	74 ±0 (1)	0	0

Return year	Total age	Mean length (cm)					
		Male			Female		
		Wild	Hatchery stray	Captive brood	Wild	Hatchery stray	Captive brood
	6	0	0	0	0	0	0

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.

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%. The target for brood year stray rates should be less than 5%.

Based on PIT-tag analyses, on average, about 46% of the White River spring Chinook returns were last detected in streams outside the White River (Table 7.14). The numbers in Table 7.14 should be considered rough estimates because they are not based on confirmed spawning (only last detections) and the numbers have not been adjusted for detection efficiencies, which currently do not exist for most PIT-tag detection arrays in tributaries. 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 7.14 are at least age-3 fish (total age) and some of them may not have migrated to the ocean, but rather resided completely in freshwater.

Table 7.14. 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 to 2009. Only PIT-tagged fish demonstrating anadromy were included in the analysis. Estimates were based on last detections of PIT-tagged spring Chinook. Percent strays should be less than 5%.

Brood year	Homing				Straying			
	Target stream		Target hatchery*		Non-target streams		Non-target hatcheries	
	Number	%	Number	%	Number	%	Number	%
2006	1	100.0	0	0.0	0	0.0	0	0
2007	0	0.0	0	0.0	0	0.0	0	0
2008	0	0.0	0	0.0	15	100.0	0	0
2009	4	14.3	0	0.0	25	85.7	0	0
Average	***1***	***28.6***	***0***	***0.0***	***10***	***46.4***	***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 7.15. 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, Nason Creek, and the Chiwawa River. Few have strayed into spawning areas outside the Wenatchee River basin.

Table 7.15. 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 2010-2014. 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	1 (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	2 (16.7)	1 (8.3)	0 (0.0)	0 (0.0)	8 (66.7)	1 (8.3)	0 (0.0)	0 (0.0)	0 (0.0)
2013	2 (6.7)	8 (26.7)	1 (3.3)	2 (6.7)	7 (23.3)	8 (26.7)	0 (0.0)	2 (6.7)	0 (0.0)
2014	4 (8.3)	17 (35.4)	0 (0.0)	1 (2.1)	3 (6.3)	17 (35.4)	0 (0.0)	5 (10.4)	1 (2.1)
Average	***2 (26.3)***	***5 (14.1)***	***0 (0.7)***	***1 (1.8)***	***4 (29.3)***	***5 (24.1)***	***0 (0.0)***	***1 (3.4)***	***0 (0.4)***

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 J). 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.

Proportion of 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). The ratio pNOB/(pHOS+pNOB) is the Proportion of Natural Influence (PNI). The larger the ratio (PNI), 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 important 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 7.16). For brood years 2001-2013, PNI for the White River Program (PNI$_W$) averaged 0.90 (range, 0.65-1.00). If hatchery strays are included in the PNI calculation (PNI$_{W+S}$), values averaged 0.70 (range, 0.44-1.00) (Table 7.16).

Table 7.16. Proportionate natural influence (PNI) of hatchery spring Chinook spawning in the White River. See notes below the table for description of each metric.

Brood year	**Spawners**					**Broodstock**			**PNI$_W$**	**PNI$_{W+S}$**
	NOS	**HOS$_W$**	**HOS$_S$**	**pHOS$_W$**	**pHOS$_{W+S}$**	**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***
2001	111	0	55	0.00	0.33	5	0	1.00	1.00	0.48
2002	60	0	26	0.00	0.30	18	0	1.00	1.00	0.77
2003	31	0	5	0.00	0.14	7	0	1.00	1.00	0.88
2004	54	0	12	0.00	0.18	6	0	1.00	1.00	0.85
2005	38	11	106	0.07	0.75	103	73	0.59	0.89	0.44
2006	41	5	9	0.09	0.25	191	135	0.59	0.87	0.70
2007	62	23	7	0.25	0.33	254	6	0.98	0.80	0.75
2008	20	2	30	0.04	0.62	116	0	1.00	0.96	0.62
2009	81	29	63	0.17	0.53	238	0	1.00	0.85	0.65
2010	27	22	23	0.31	0.63	90	0	1.00	0.76	0.61
2011	83	0	0	0.00	0.00	306	0	1.00	1.00	1.00
2012	89	10	45	0.07	0.38	390	0	1.00	0.93	0.72
2013	44	55	5	0.53	0.58	383	0	1.00	0.65	0.63
Average**	***57***	***12***	***30***	***0.12***	***0.39***	***162***	***16***	***0.94***	***0.90***	***0.70***

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_W = pNOB/(pNOB + $pNOS_N$); where pNOB is weighted 100% toward broodstock collection from the White River spring Chinook Supplementation Program. The intent of this PNI value is to track the performance of the White River Program apart from the influence of strays and broodstock collection outside the White River watershed.
PNI_{W+S} = pNOB/(pNOB + $pHOS_{N+S}$); where pNOB is weighted by the proportion of HOS_W and HOS_S observed in the White River. This PNI value tracks the combined influence of broodstock selection from the White River Program and/or Chiwawa Program according the proportion of HOS that return to the White River from those programs.
* Average for the period 1989-2000.
** Average for the period 2001-present.

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 1989-2008, NRR for spring Chinook in the White River basin averaged 1.09 (range, 0.00-4.91) if harvested fish were not include in the estimate and 1.21 (range, 0.00-5.27) if harvested fish were included in the estimate (Table 7.17). 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) to the parent broodstock collected. For brood years 2006-2008, hatchery replacement rates averaged 0.08 (range, 0.02-0.20) (Table 7.17). Only for brood year 2007 was HRR greater than the NRR.

Table 7.17. 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 1989-2008.

Brood year	Brood stock spawned	Spawning Escapement	Harvest not included				Harvest included			
			HOR[1]	NOR[2]	HRR[1]	NRR[2]	NOR[3]	NOR[4]	HRR[3]	NRR[4]
1989	--	145	--	81	--	0.56	--	118	--	0.81
1990	--	49	--	2	--	0.04	--	2	--	0.04
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	--	164	--	4.97
1998	--	11	--	54	--	4.91	--	58	--	5.27
1999	--	3	--	0	--	0.00	--	0	--	0.00
2000	--	22	--	54	--	2.45	--	57	--	2.59

Brood year	Brood stock spawned	Spawning Escapement	Harvest not included				Harvest included			
			HOR[1]	NOR[2]	HRR[1]	NRR[2]	NOR[3]	NOR[4]	HRR[3]	NRR[4]
2001	5	166	--	64	--	0.39	--	66	--	0.40
2002	18	86	--	70	--	0.81	--	73	--	0.85
2003	7	36	--	11	--	0.31	--	12	--	0.33
2004	6	66	--	25	--	0.38	--	27	--	0.41
2005	176	155	--	72	--	0.46	--	75	--	0.48
2006	326	55	5	110	0.02	2.00	5	139	0.02	2.53
2007	260	92	0	0	0.00	0.00	0	0	0.00	0.00
2008	116	52	30	100	0.26	1.92	30	113	0.26	2.17
Average	**114**	**64**	**13**	**45**	**0.09**	**1.09**	**13**	**51**	**0.09**	**1.21**

[1] HOR and HRR values represented here are detections of PIT-tag hatchery fish detected at Tumwater Dam. These values have not been expanded based on the untagged proportion of fish released from the White River spring Chinook Program or the sampling rate at Tumwater Dam.

[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 rates on hatchery-origin White River spring Chinook have not yet been estimated but will be expanded based on harvest rates observed for Chiwawa spring Chinook.

[4] Expanded NORs for harvest were based on harvest rates from Chiwawa River spring Chinook.

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. SARs were based on both CWT returns and PIT-tag detections. For the available brood years, SARs have ranged from 0.00001 to 0.00025 based on CWTs and from 0.00008 to 0.00022 based on PIT-tag detections (Table 7.18).

Table 7.18. Smolt-to-adult ratios (SARs) for White River spring Chinook from the captive brood program, brood years 2005-2008.

Brood year	CWTs		PIT-tags	
	Recoveries	SAR	Detections	SAR
2005	16	0.00025	NA	NA
2006	9	0.00003	6	0.00020
2007	1	0.00001	3	0.00008
2008	NA	NA	9	0.00022
Average	***8.7***	***0.00010***	***6***	***0.00017***

7.8 ESA/HCP Compliance

Brood Collection

The last collection of eggs or fry for this program occurred in 2010 (brood year 2009). From 2011 to 2013, the White River Captive Brood Program has operated without ESA permit coverage. The hatchery program will sunset with the last release of juveniles in 2015 (brood year 2013).

Hatchery Rearing, Spawning, and Release

From 2011 to 2013, the White River Captive Brood Program has operated without ESA permit coverage. The hatchery program will sunset with the last release of juveniles in 2015 (brood year 2013). Release of juveniles in 2013 and 2014 were consistent with the terms and conditions of Section 10(a)(1)(A) Permit 18120.

Hatchery Effluent Monitoring

Per ESA Permits 1196 (expired), 1347, 1395, 18118, 18119, and 18121, permit holders shall monitor and report hatchery effluents in compliance with applicable National Pollution Discharge Elimination Systems (NPDES) (EPA 1999) permit limitations. There was one NPDES violation reported at PUD Hatchery facilities during the period 1 January through 31 December 2014. NPDES monitoring and reporting for Grant PUD Hatchery Programs during 2014 are provided in Appendix F.

This report does not cover hatchery rearing of the White River Captive Brood Program (adults and juveniles) at the Little White Salmon National Fish Hatchery, operated by the U.S. Fish and Wildlife Service.

Smolt and Emigrant Trapping

Per ESA Section 10 Permit No. 1196 (expired), 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 2014 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 7.19. Additionally, juvenile fish captured at the trap locations were handled consistent with provisions in ESA Section 10 Permit 1196 (expired), 18118, 18120, and 18121, Section B. Table 7.19 does not include incidental or direct take associated with the White River smolt trap operated by the Yakama Nation.

Table 7.19. Estimated take of Upper Columbia River spring Chinook resulting from juvenile emigration monitoring in the Wenatchee River basin, 2014.

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	34,334	222,504	73,695	4,519	5,293	23,755	33,567	
Encounter rate	NA	NA	NA	0.1316	0.0237	0.3223	0.1016	0.20
Mortality[e]	NA	NA	NA	28	0	84	112	
Mortality rate	NA	NA	NA	0.0062	0.0000	0.0035	0.0033	0.02
Lower Wenatchee Trap								
Population	67,973	222,504	11,936,928	1,700	31,290	81,445	114,435	
Encounter rate	NA	NA	NA	0.025	0.1406	0.0068	0.0096	0.20
Mortality[d]	NA	NA	NA	17	12	250	279	
Mortality rate	NA	NA	NA	0.0100	0.0004	0.0031	0.0024	0.02

Trap location	Population estimate			Number trapped			Total	Take allowed under Permit
	Wild[a]	Hatchery[b]	Sub-yearling[c]	Wild	Hatchery	Sub-yearling		
Wenatchee River Basin Total								
Population	67,393	222,504	11,936,928	6,219	36,583	105,200	148,002	
Encounter rate	NA	NA	NA	0.0922	0.1644	0.0088	0.0121	0.20
Mortality[d]	NA	NA	NA	45	12	84	141	
Mortality rate	NA	NA	NA	0.0072	0.0003	0.0008	0.0010	0.02

[a] Smolt population estimate derived from juvenile emigration trap data.

[b] 2012 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..

[d] Combined trapping and PIT tagging mortality.

Spawning Surveys

Spring Chinook spawning ground surveys were conducted in the Wenatchee River basin during 2014, as authorized by ESA Section 10 Permits 18118, 18119, 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 1196 (expired) and new Section 10 Permits 18118, 18119, 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 2014, 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, and 2014) for complete details on the methods and results of the spring Chinook reproductive success study for the period 2010-2014.

SECTION 8: WENATCHEE SUMMER CHINOOK

The goal of summer Chinook salmon supplementation in the Wenatchee Basin is to use artificial production to replace adult production lost because of mortality at Rock Island, Wanapum, and Priest Rapids 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 the weekly quotas cannot be achieved at Dryden Dam. Prior to 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 revised. 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. 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 make up the difference.

Adult summer Chinook are spawned and reared at Eastbank Fish Hatchery. Juvenile summer Chinook are transferred from the hatchery to Dryden Acclimation Pond in March. They are released from the pond in late April to early May.

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 10 and 15 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, about 10,000 juvenile summer Chinook have been PIT tagged annually.

8.1 Broodstock Sampling

This section focuses on results from sampling 2012-2013 Wenatchee summer Chinook broodstock, which were collected at Dryden and Tumwater dams. Complete information is not currently available for the 2014 brood (this information will be provided in the 2015 annual report).

Origin of Broodstock

Consistent with the broodstock collection protocol, both the 2012 and 2013 broodstock consisted primarily of natural-origin (adipose fin present and no CWT) summer Chinook (Table 8.1). Less than 1% of the 2013 broodstock was comprised of hatchery-origin fish (hatchery-origin was determined by examination of scales and/or CWTs).

Table 8.1. Numbers of wild and hatchery summer Chinook collected for broodstock, numbers that died before spawning, and numbers of Chinook spawned in the Wenatchee River basin, 1989-2013. 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	29	21	433	0	5	1	0	4	0	437
2007	415	53	99	263	0	4	0	1	3	0	266
2008	400	11	11	378	0	72	2	1	69	0	447
2009	482	22	8	452	0	9	1	0	8	0	460
2010	427	14	25	388	0	7	2	0	5	0	393
2011	398	11	11	376	0	7	0	0	7	0	405
Average[b]	***368***	***27***	***27***	***312***	***2***	***42***	***1***	***3***	***38***	***0***	***351***
2012	273	5	1	267	0	1	0	0	1	0	268
2013	256	12	10	234	0	2	0	0	2	0	236
Average[c]	***265***	***9***	***6***	***251***	***0***	***2***	***0***	***0***	***2***	***0***	***252***

[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 2012 return consisted primarily of age-4 and age-5 natural-origin Chinook (96%). Age-3 natural-origin fish made up 3% of the broodstock (Table 8.2). The one hatchery Chinook included in the broodstock was an age-5 fish.

Broodstock collected from the 2013 return consisted primarily of age-4 and age-5 natural-origin Chinook (86%). Age-3 and age-6 natural-origin fish made up 12% and 2% of the broodstock, respectively (Table 8.2). The two hatchery Chinook included in the broodstock were age-4 and age-5 fish.

Table 8.2. Percent of hatchery and wild Wenatchee summer Chinook of different ages (total age) collected from broodstock in the Wenatchee River basin, 1991-2013.

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
	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

Return Year	Origin	Total age				
		2	3	4	5	6
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
Average	***Wild***	***0.5***	***5.6***	***40.1***	***51.5***	***2.3***
	Hatchery	***0.0***	***5.3***	***36.8***	***50.6***	***7.2***

Mean lengths of natural-origin summer Chinook of a given age differed little between return years 2012 and 2013 (Table 8.3). The two hatchery fish that were included in broodstock were 2 and 9 cm smaller than their natural counterparts in the 2013 brood (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, 1991-2013; 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

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	-	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
	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	-
Average	***Wild***	***46***	***3***	***4***	***66***	***19***	***7***	***86***	***132***	***7***	***97***	***171***	***6***	***102***	***8***	***6***
	Hatchery	***-***	***0***	***-***	***53***	***5***	***5***	***78***	***17***	***7***	***94***	***20***	***7***	***99***	***5***	***7***

Sex Ratios

Male summer Chinook in the 2012 broodstock made up about 50% of the adults collected, resulting in an overall male to female ratio of 1.02:1.00 (Table 8.4.). In 2013, males made just under 50% of the adults collected, resulting in an overall male to female ratio of 0.98:1.00 (Table 8.4). The ratios in 2012 and 2013 were nearly equal to 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, 1989-2013. 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
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
Total	***4539***	***4350***	***1.04:1.00***	***574***	***423***	***1.36:1.00***	***1.07:1.00***

Fecundity

Fecundities for the 2012 and 2013 returns of summer Chinook averaged 4,801 and 4,990 eggs per female, respectively (Table 8.5). These values are close to the overall average of 5,143 eggs per female. Mean observed fecundities for the 2012 and 2013 returns were near the expected fecundity of 5,099 eggs per female assumed in the broodstock protocol.

Table 8.5. Mean fecundity of wild, hatchery, and all female summer Chinook collected for broodstock in the Wenatchee River basin, 1989-2013; 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
Average	***5,191***	***5,018***	***5,143***

* Individual fecundities were not tracked with females until 1997.

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 determined that 617,285 eggs are needed to meet the revised release goal of 500,001 smolts. This revised goal will begin with brood year 2012. From 1989 to 2011, the egg take goal was reached in seven of those years (Table 8.6). The egg take in 2012 exceeded the revised goal of 617,285 eggs, while the egg take in 2013 was lower than the revised goal.

Table 8.6. Numbers of eggs taken from Wenatchee summer Chinook broodstock, 1989-2013.

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
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***
2012	633,677
2013	578,513
Average (2012-present)	***606,095***

Number of acclimation days

The 2012 brood Wenatchee summer Chinook were transferred to Dryden Acclimation Pond between 17 and 27 March 2014. These fish received 34-44 days of acclimation on Wenatchee River water before being released on 30 April 2014 (Table 8.7).

Table 8.7. Number of days Wenatchee summer Chinook were acclimated at Dryden Acclimation Pond, brood years 1989-2012. 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

Release Information

Numbers released

The 2012 Wenatchee summer Chinook program achieved 110% of the 500,001 target goal with about 550,877 fish being released in 2014 (Table 8.8).

Table 8.8. Numbers of Wenatchee summer Chinook smolts released from the hatchery, 1989-2012. Up to 2012, the release target for Wenatchee summer Chinook was 864,000 smolts. Beginning in 2012, the release target is 500,001 smolts.

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***	***1,956***	***667,085***
2012	2014	0.9700	19,911	550,877
Average (2012-present)		***0.9700***	***19,911***	***550,877***

[a] Represents high ELISA group planted directly in the Wenatchee River at Leavenworth Boat Launch.

Numbers tagged

The 2012 brood Wenatchee summer Chinook were 99.0% CWT and adipose fin-clipped (Table 8.8).

In 2014, a total of 10,320 Wenatchee summer Chinook (brood year 2013) were tagged at Eastbank Hatchery in November and December. These fish were tagged in raceways #11 and #13. Those tagged in raceway #13 were designated as the "small-size fish" group (n = 5,160), while those tagged in raceway #11 were designated as the "big-size fish" group (n = 5,160). The two size groups were developed to identify techniques that maximize performance of hatchery-origin summer yearling Chinook salmon. This is part of the NOAA Fisheries, Grant PUD, and Chelan PUD size-target study. Fish were not fed during tagging or for two days before and after tagging. Fish in the small-size fish group averaged 102 mm in length and 13.8 g at time of tagging, while those in the big-size fish group averaged 95 mm in length and 10.8 g.

An additional 10,321 Wenatchee summer Chinook were tagged at Eastbank Hatchery in September 2014. These fish were tagged in water reuse circular ponds #1 and #2. Those tagged in circular pond #2 were designated as the "small-size fish" group (n = 5,161), while those tagged in circular pond #1 were designated as the "big-size fish" group (n = 5,160). This is also part of the size-target study. Fish were not fed during tagging or for two days before and after tagging. Fish in the small-size fish group averaged 75 mm in length and 6.0 g at time of tagging, while those in the big-size fish group averaged 75 mm in length and 6.0 g.

Table 8.9 summarizes the number of hatchery summer Chinook that have been PIT-tagged and released into the Wenatchee River.

Table 8.9. Summary of PIT-tagging activities for Wenatchee hatchery summer Chinook, brood years 2008-2013.

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
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
2012	2014 (Reuse Circular)	5,150 (small-size)	109	0	5,041
		5,151 (big-size)	69	0	5,082

Fish size and condition at release

About 550,877 summer Chinook from the 2012 brood were force-released from Dryden Acclimation Pond on 30 April 2014. Size at release was 96.9% and 89.6% of the target fork length and weight goals, respectively. This brood year was under the target CV for length (Table 8.10). One possible reason the fish did not meet the size targets is because of the size-target study. However, since the program began, Wenatchee summer Chinook have not met the target length and CV values. The target weight (fish/pound or FPP) of juvenile fish has been met occasionally.

Table 8.10. 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 1989-2012; NA = not available. Size targets are provided in the last row of the table.

Brood year	Release year	Fork length (cm)		Mean weight	
		Mean	CV	Grams (g)	Fish/pound
1989	1991	158	13.7	45.4	10
1990	1992	155	14.2	45.4	10
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
Average (2012-present)		***158***	***12.6***	***40.7***	***11***
Targets (2012-present)[a]		***163***	***9.0***	***45.4***	***10***

[a] For brood year 2012, the fish per pound (fpp) targets were 10 fpp and 15 fpp.

Survival Estimates

Overall survival of the 2012 brood Wenatchee summer Chinook from green (unfertilized) egg to release was higher than the standard set for the program. This was in part because of a high ponding to release survival (Table 8.11).

Table 8.11. Hatchery life-stage survival rates (%) for Wenatchee summer Chinook, brood years 1989-2012. 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
Average	***97.0***	***95.4***	***86.1***	***97.8***	***99.0***	***98.5***	***93.1***	***96.7***	***78.6***
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 2012 brood Wenatchee summer Chinook was similar to previous years with fish being held on well water before being transferred to Dryden Acclimation Pond for final acclimation in March 2014. Fish were transferred to Dryden Acclimation Pond from 17-27 March. Increased mortality caused by external fungus and bacterial cold water disease began to occur during the acclimation period at Dryden Acclimation Pond at which time a formalin treatment was initiated to prevent the fungus from proliferating in combination with initiation of an early release.

Results of the 2014 adult broodstock bacterial kidney disease (BKD) monitoring indicated that most females (94.6%) had ELISA values less than 0.199. The seven females that had an ELISA value greater than 0.120 were not included in the program and the eggs were culled. All remaining females had ELISA values less than 0.120, which means that none of the progeny needed to be reared at densities less than 0.06 fish per pound (Table 8.12).

Table 8.12. Proportion of bacterial kidney disease (BKD) titer groups for the Wenatchee summer Chinook broodstock, brood years 1997-2014. 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)**	
	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
Average	***0.8640***	***0.0480***	***0.0324***	***0.0553***	***0.8942***	***0.1058***

[a] Individual ELISA samples were not collected before the 1997 brood.

8.4 Natural Juvenile Productivity

During 2014, juvenile summer Chinook were sampled at the Lower Wenatchee Trap located near the Town of Cashmere. Because the Lower Wenatchee Trap began operation in a new location in 2013, the historic flow-discharge relationships are invalid and new models to estimate trap efficiency must be developed for all species. Until the new models are developed (2-3 years) all estimates of juvenile abundance should be considered preliminary.

Emigrant Estimates

Lower Wenatchee Trap

The Lower Wenatchee Trap operated between 12 February and 7 September 2014. During that time period the trap was inoperable for 12 days because of high river flows, debris, snow/ice, mechanical failure, or major hatchery releases. During the seven-month sampling period, a total of 81,445 wild subyearling Chinook were captured at the Lower Wenatchee Trap. Based on nineteen capture efficiencies estimated from the flow model, the total number of wild subyearling Chinook that emigrated past the Lower Wenatchee Trap was 11,936,928 (±2,448,536). Because 172 summer Chinook redds were observed downstream from the trap in 2013, the total number of summer Chinook emigrating from the Wenatchee River in 2014 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 12,605,925 fish. Most of these fish emigrated during early June (Figure 8.1). Monthly captures and mortalities of all fish collected at the Lower Wenatchee Trap are reported in Appendix B.

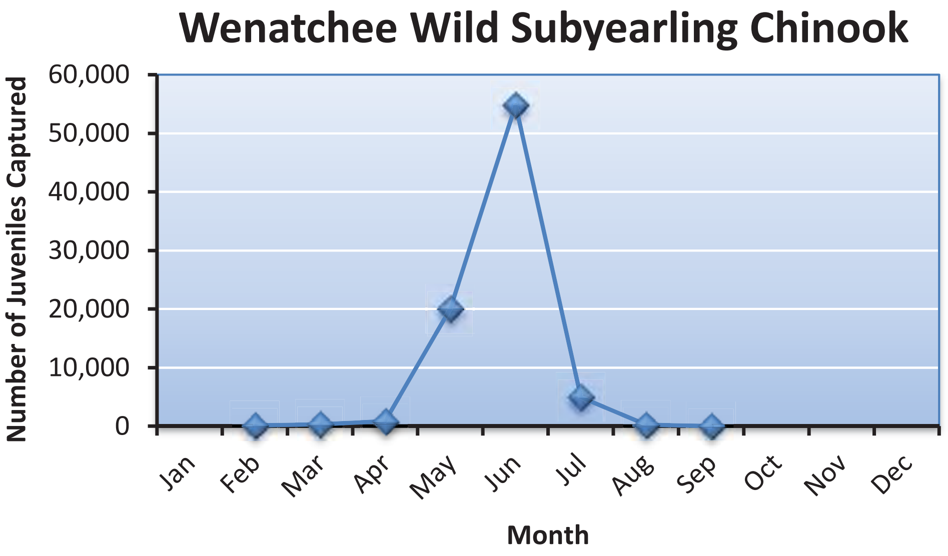

Figure 8.1. Numbers of wild subyearling Chinook captured at the Lower Wenatchee Trap during February through October, 2014.

8.5 Spawning Surveys

Surveys for Wenatchee summer Chinook redds were conducted from late 15 September to 17 November 2014 in the Wenatchee River and Icicle Creek.

Redd Counts

A total count of summer Chinook redds was estimated in 2014 based on weekly census surveys conducted in the Wenatchee River. Redds were counted in Icicle Creek when feasible (Table 8.13).

Table 8.13. Numbers of redds counted in the Wenatchee River basin, 1989-2014; ND = no data. From 1989-2013, numbers of redds were based on "peak counts." Total counts in those years were based on expanded peak counts. Since 2014, numbers of redds were based on census surveys.

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
Average			***3,428***

Redd Distribution

Summer Chinook redds were not evenly distributed among reaches within the Wenatchee River basin in 2014 (Table 8.14; Figure 8.2). Most of the spawning occurred upstream from the Leavenworth Bridge in Reaches 6, 9, and 10. The highest density of redds occurred in Reach 6 near the confluence of the Icicle River. In September, the counting of redds downstream from the confluence of Chiwaukum Creek (Reaches 1-8) was hampered because of recruitment of suspended sediments from the Chiwaukum Complex fire. High flows and turbidity also hampered redd surveys in November.

Table 8.14. Total numbers of summer Chinook redds counted in different reaches in the Wenatchee River basin during September through mid-November, 2014. Reach codes are described in Table 2.10.

Survey reach	Total redd count
Wenatchee 1 (W1)	3
Wenatchee 2 (W2)	98
Wenatchee 3 (W3)	172
Wenatchee 4 (W4)	27
Wenatchee 5 (W5)	78
Wenatchee 6 (W6)	1,144
Wenatchee 7 (W7)	222
Wenatchee 8 (W8)	344
Wenatchee 9 (W9)	842
Wenatchee 10 (W10)	453
Icicle Creek (I1)	75
Totals	***3,458***

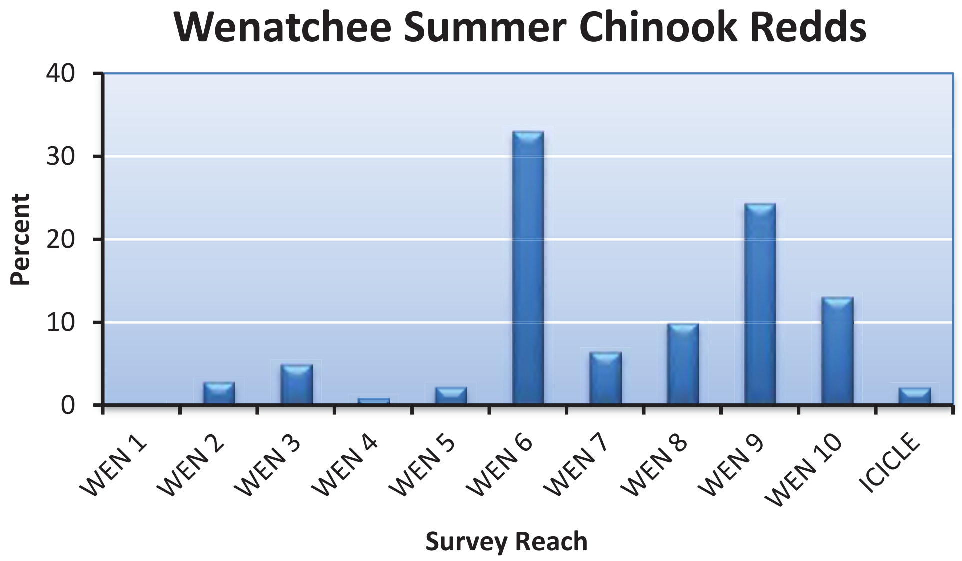

Figure 8.2. Percent of the total number of summer Chinook redds counted in different reaches in the Wenatchee River basin during September through early-November, 2014. Reach codes are described in Table 2.10.

Spawn Timing

In 2014, spawning in the Wenatchee River began during the third week in September, peaked in the second week of October, and ended in the fourth week of October (Figure 8.3).

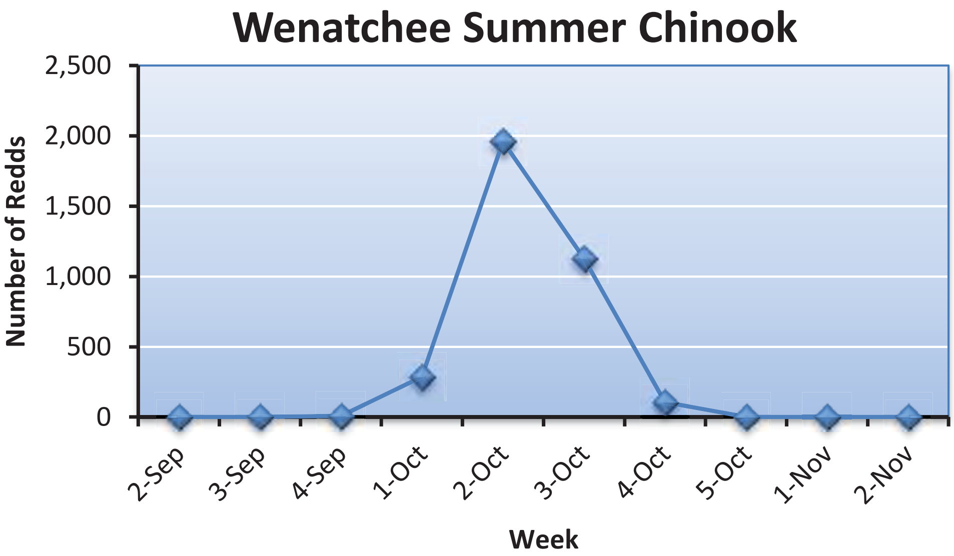

Figure 8.3. Number of new summer Chinook redds counted during different weeks in the Wenatchee River, September through mid-November 2014.

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. The estimated fish per redd ratio for summer Chinook in 2014 was 3.02. Multiplying this ratio by the number of redds counted in the Wenatchee River basin resulted in a total spawning escapement of 10,443 summer Chinook (Table 8.15).

Table 8.15. Spawning escapements for summer Chinook in the Wenatchee River basin, return years 1989-2014. Number of redds is based on expanded peak redd counts.

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
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

Return year	Fish/Redd	Redds	Total spawning escapement
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
Average	***2.86***	***3,428***	***10,443***

8.6 Carcass Surveys

Surveys for Wenatchee summer Chinook carcasses were conducted during late September to early November 2014 in the Wenatchee River and Icicle Creek.

Number sampled

A total of 1,723 summer Chinook carcasses were sampled during October through early November in the Wenatchee River basin in 2014 (Table 8.16).

Table 8.16. Numbers of summer Chinook carcasses sampled within each survey reach in the Wenatchee River basin, 1993-2014. Reach codes are described in Table 2.10.

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**

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
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	327	282	20	**1,723**
Average	***8***	***94***	***139***	***31***	***64***	***591***	***76***	***135***	***243***	***165***	***8***	***1,555***

Carcass Distribution and Origin

Summer Chinook carcasses were not evenly distributed among reaches within the Wenatchee River basin in 2014 (Table 8.16; Figure 8.4). Most of the carcasses in the Wenatchee River basin were found upstream from the Leavenworth Bridge. The highest percentage of carcasses (38%) was sampled in Reach 6 near the confluence of the Icicle River. As with redd surveys, in September, carcass surveys downstream from the confluence of Chiwaukum Creek (Reaches 1-8) were hampered because of recruitment of suspended sediments from the Chiwaukum Complex fire. High flows and turbidity also limited carcass surveys in November.

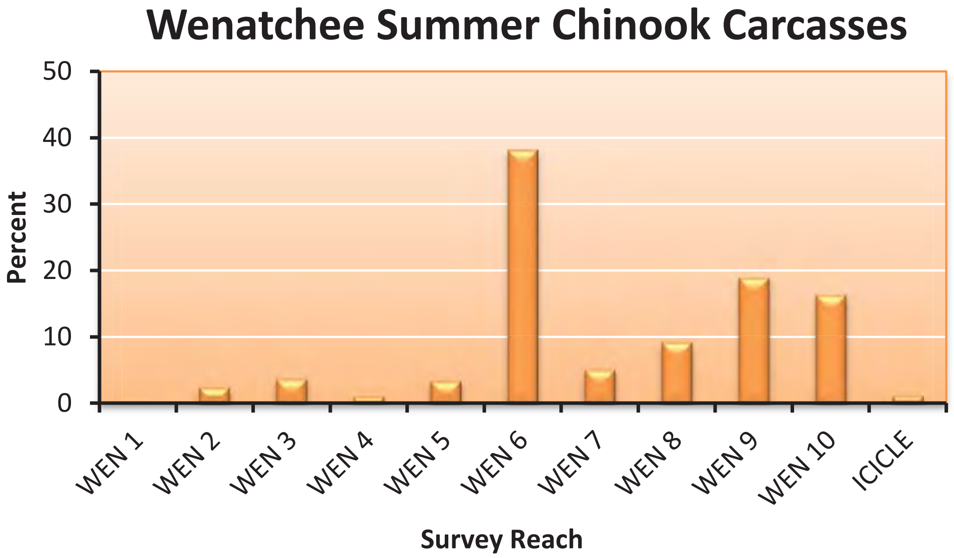

Figure 8.4. Percent of summer Chinook carcasses sampled within different reaches in the Wenatchee River basin during September through mid-November, 2014. Reach codes are described in Table 2.10.

Numbers of wild and hatchery-origin summer Chinook carcasses sampled in 2014 will be available after analysis of CWTs and scales. Based on the available data (1993-2013), most fish, regardless of origin, were found in Reach 6 (Leavenworth Bridge to Icicle Road Bridge) (Table 8.17). In general, a larger percentage of wild fish were found in the upper reaches than were hatchery fish (Figure 8.5). In contrast, a larger percentage of hatchery fish were found in reaches downstream from the Icicle Road Bridge.

Table 8.17. Numbers of wild and hatchery summer Chinook carcasses sampled within different reaches in the Wenatchee River basin, 1993-2013.

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**
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**

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	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	2	**1,279**
	Hatchery	2	52	60	6	40	395	0	1	12	4	12	**585**
Average	***Wild***	***6***	***65***	***111***	***21***	***41***	***390***	***69***	***126***	***229***	***153***	***2***	***1,213***
	Hatchery	***2***	***32***	***32***	***11***	***23***	***198***	***6***	***8***	***10***	***7***	***5***	***334***

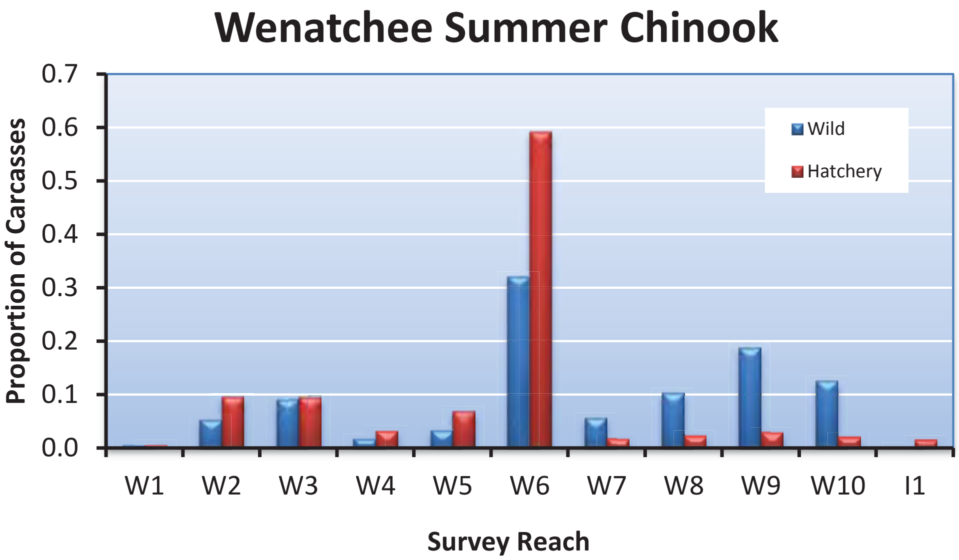

Figure 8.5. Distribution of wild and hatchery produced carcasses in different reaches in the Wenatchee River basin, 1993-2013. Reach codes are described in Table 2.10.

Sampling Rate

If escapement is based on total numbers of redds, then about 16% of the total spawning escapement of summer Chinook in the Wenatchee River basin was sampled in 2014 (Table 8.18). Sampling rates among survey reaches varied from 9 to 25%. Carcass surveys in 2014 were significantly influenced by poor weather conditions and unseasonable high flows.

Table 8.18. Number of redds and carcasses, total spawning escapement, and sampling rates for summer Chinook in the Wenatchee River basin, 2014.

Sampling reach	Total number of redds	Total number of carcasses	Total spawning escapement	Sampling rate
Wenatchee 1 (W1)	3	3	9	0.33
Wenatchee 2 (W2)	98	42	296	0.14
Wenatchee 3 (W3)	172	64	519	0.12
Wenatchee 4 (W4)	27	18	82	0.22
Wenatchee 5 (W5)	78	59	236	0.25
Wenatchee 6 (W6)	1,144	659	3,455	0.19
Wenatchee 7 (W7)	222	89	670	0.13
Wenatchee 8 (W8)	344	160	1,039	0.15
Wenatchee 9 (W9)	842	327	2,543	0.13
Wenatchee 10 (W10)	453	282	1,368	0.21
Icicle Creek (I1)	75	20	227	0.09
Total	***3,458***	***1,723***	***10,443***	***0.16***

Length Data

Mean lengths (POH, cm) of male and female summer Chinook carcasses sampled during surveys in the Wenatchee River basin in 2014 are provided in Table 8.19. The average size of males and females sampled in the Wenatchee River basin were 66 cm and 69 cm, respectively.

Table 8.19. 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, 2014.

Stream/watershed	Mean length (cm)	
	Male	Female
Wenatchee 1 (W1)	66.3 (2.3)	--
Wenatchee 2 (W2)	64.5 (12.3)	68.6 (3.3)
Wenatchee 3 (W3)	60.7 (10.3)	66.5 (6.7)
Wenatchee 4 (W4)	63.7 (9.1)	71.8 (4.8)
Wenatchee 5 (W5)	66.0 (10.2)	69.7 (3.6)
Wenatchee 6 (W6)	64.6 (8.5)	69.2 (4.8)
Wenatchee 7 (W7)	63.1 (10.2)	70.5 (6.2)
Wenatchee 8 (W8)	66.0 (10.4)	67.2 (5.2)
Wenatchee 9 (W9)	68.7 (7.6)	71.0 (5.0)
Wenatchee 10 (W10)	66.3 (8.1)	67.9 (5.1)
Icicle Creek (I1)	--	--
Total	***65.5 (9.0)***	***69.2 (5.2)***

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 early July through mid-October. On average, during the early part of the migration, hatchery summer Chinook arrived about one week later than wild Chinook (Table 8.20). This pattern carried through the migration distribution of summer Chinook at Dryden Dam. By the end of the migration, hatchery fish pass Dryden Dam about five weeks after 90% of the wild fish passed the dam.

Table 8.20. The week that 10%, 50% (median), and 90% of the wild and hatchery summer Chinook salmon passed Dryden Dam, 2007-2014. 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
Average	***Wild***	***28***	***31***	***36***	***32***	***2,911***
	Hatchery	***29***	***33***	***41***	***34***	***3,109***

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 1993-2013 in the Wenatchee River basin were salt age-3 fish (Table 8.21; Figure 8.6). 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 8.21. Proportions of wild and hatchery summer Chinook of different salt (ocean) ages sampled on spawning grounds in the Wenatchee River basin, 1993-2013.

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
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

Sample year	Origin	Salt age					Sample size
		1	2	3	4	5	
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	0.01	0.10	0.61	0.28	0.00	1,148
	Hatchery	0.00	0.01	0.15	0.83	0.00	487
Average	***Wild***	***0.01***	***0.13***	***0.53***	***0.32***	***0.00***	***1,111***
	Hatchery	***0.03***	***0.21***	***0.60***	***0.16***	***0.00***	***291***

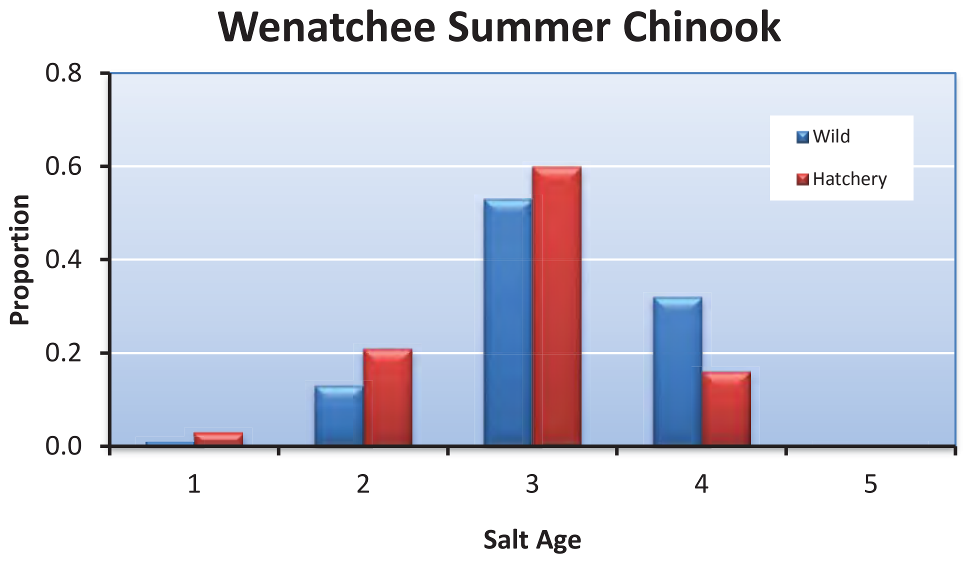

Figure 8.6. Proportions of wild and hatchery summer Chinook of different salt (ocean) ages sampled at broodstock collection sites and on spawning grounds in the Wenatchee River basin for the combined years 1993-2013.

Size at Maturity

On average, hatchery summer Chinook were about 4 cm smaller than wild summer Chinook sampled in the Wenatchee River basin (Table 8.22). 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 five-year reports will compare sizes of hatchery and wild fish of the same age groups and sex.

Table 8.22. Mean lengths (POH; cm) and variability statistics for wild and hatchery summer Chinook sampled in the Wenatchee River basin, 1993-2013; 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
	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

Sample year	Origin	Sample size	Summer Chinook length (POH; cm)			
			Mean	SD	Minimum	Maximum
	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	1,279	66	9	24	95
	Hatchery	584	67	7	5	85
Pooled	***Wild***	***1,221***	***71***	***8***	***32***	***94***
	Hatchery	***311***	***67***	***9***	***34***	***88***

[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 8.23). Ocean harvest has made up 47% to 100% of all hatchery Wenatchee summer Chinook harvested. Total harvest on early brood years (1990-1996 and 2007) was lower than for brood years 1997-2008.

Table 8.23. Estimated number and percent (in parentheses) of hatchery-origin Wenatchee summer Chinook captured in different fisheries, brood years 1989-2008.

Brood year	Ocean fisheries	Columbia River Fisheries			Total
		Tribal	Commercial (Zones 1-5)	Recreational (sport)	
1989	1,510 (51)	1,432 (48)	0 (0)	20 (1)	2,962
1990	30 (100)	0 (0)	0 (0)	0 (0)	30
1991	30 (63)	0 (0)	0 (0)	18 (38)	48
1992	147 (79)	39 (21)	0 (0)	0 (0)	186
1993	35 (58)	25 (42)	0 (0)	0 (0)	60
1994	641 (91)	62 (9)	2 (0)	0 (0)	706
1995	561 (98)	9 (2)	5 (1)	0 (0)	575
1996	195 (96)	3 (1)	0 (0)	6 (3)	205
1997	2,991 (95)	49 (2)	12 (0)	106 (3)	3,158
1998	4,985 (92)	128 (2)	15 (0)	287 (5)	5,415
1999	1,550 (84)	168 (9)	21 (1)	104 (6)	1,843
2000	7,959 (73)	1,248 (11)	447 (4)	1,224 (11)	10,878
2001	1,062 (60)	238 (13)	106 (6)	364 (21)	1,770
2002	1,489 (56)	557 (21)	189 (7)	430 (16)	2,665
2003	816 (50)	484 (30)	89 (5)	257 (16)	1,646
2004	409 (47)	218 (25)	70 (8)	167 (19)	864

Brood year	Ocean fisheries	Columbia River Fisheries			Total
		Tribal	Commercial (Zones 1-5)	Recreational (sport)	
2005	1,334 (58)	481 (21)	186 (8)	287 (13)	2,288
2006	3,812 (52)	1,969 (27)	406 (6)	1,142 (16)	7,329
2007	212 (60)	81 (23)	8 (2)	53 (15)	354
2008	3,874 (60)	1,010 (16)	225 (3)	1,364 (21)	6,473
Average	***1,682 (71)***	***410 (16)***	***89 (3)***	***291 (10)***	***2,473***

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) and brood year should be less than 5%.

Hatchery-origin Wenatchee summer Chinook have strayed into the Entiat, Chelan, Methow, and Okanogan River basins and into the Hanford Reach (Table 8.24). In five different years, Wenatchee summer Chinook strays have made up more than 5% of the spawning escapement in the Chelan Tailrace. They have made up more than 5% of the spawning escapement in the Entiat River basin in seven different years and in the Methow River basin in eight different years. Few have strayed into the Okanogan River basin or into the Hanford Reach.

Table 8.24. Number and percent of spawning escapements within other non-target basins that consisted of hatchery-origin Wenatchee summer Chinook, return years 1994-2011. 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 5%.

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
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	7.1	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	10.6	0	0.0
2007	127	9.3	5	0.1	9	4.8	18	7.3	20	0.1
2008	87	4.5	24	0.3	10	2.0	31	9.7	0	0.0
2009	101	5.7	13	0.2	2	0.3	12	4.8	0	0.0

Return year	Methow		Okanogan		Chelan		Entiat		Hanford Reach	
	Number	%	Number	%	Number	%	Number	%	Number	%
2010	208	8.3	35	0.6	55	4.9	34	7.8	0	0.0
2011	258	8.8	5	0.1	78	6.1	4	0.9	0	0.0
Average	***99***	***4.3***	***24***	***0.4***	***26***	***4.2***	***30***	***6.3***	***4***	***0.0***

Based on brood year analyses, on average, about 10% of the hatchery-origin Wenatchee summer Chinook returns have strayed into non-target spawning areas, exceeding the target of 5% (Table 8.25). Depending on brood year, percent strays into non-target spawning areas have ranged from 0-19%. In addition, on average, about 5% have strayed into non-target hatchery programs, but straying into non-target programs has declined over time.

Table 8.25. Number and percent of hatchery-origin Wenatchee summer 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 1989-2008. Percent stays should be less than 5%.

Brood year	Homing				Straying			
	Target stream		Target hatchery*		Non-target streams		Non-target hatcheries	
	Number	%	Number	%	Number	%	Number	%
1989	1,352	62.9	60	2.8	75	3.5	662	30.8
1990	74	84.1	1	1.1	0	0.0	13	14.8
1991	15	65.2	0	0.0	0	0.0	8	34.8
1992	375	84.8	7	1.6	0	0.0	60	13.6
1993	67	72.8	9	9.8	4	4.3	12	13.0
1994	890	71.8	207	16.7	61	4.9	81	6.5
1995	748	74.8	139	13.9	48	4.8	65	6.5
1996	261	70.4	42	11.3	53	14.3	15	4.0
1997	3,609	83.0	171	3.9	397	9.1	170	3.9
1998	1,790	78.2	11	0.5	416	18.2	72	3.1
1999	507	79.7	0	0.0	121	19.0	8	1.3
2000	2,745	82.3	0	0.0	545	16.3	44	1.3
2001	521	80.9	0	0.0	114	17.7	9	1.4
2002	1,521	84.6	10	0.6	259	14.4	8	0.4
2003	1,268	88.6	42	2.9	112	7.8	9	0.6
2004	497	84.2	3	0.5	72	12.2	18	3.1
2005	1,126	83.7	1	0.1	193	14.3	25	1.9
2006	2,693	79.6	0	0.0	612	18.1	78	2.3
2007	99	79.8	0	0.0	22	17.7	3	2.4
2008	3,224	85.3	0	0.0	419	11.1	135	3.6
Average	***1,169***	***78.8***	***35***	***3.3***	***176***	***10.4***	***75***	***7.5***

* Homing to the target hatchery includes Wenatchee hatchery summer Chinook 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 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 M). Samples from the Eastbank Hatchery – Wenatchee stock, Eastbank Hatchery – Methow/Okanogan (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 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.

Proportion of 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). The ratio pNOB/(pHOS+pNOB) is the Proportion of Natural Influence (PNI). The larger the ratio (PNI), 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 important integrated populations should have a PNI of at least 0.67 (HSRG/WDFW/NWIFC 2004).

For all brood years the PNI has been greater than or equal to 0.67 (Table 8.26). This suggests that the natural environment has a greater influence on adaptation of Wenatchee summer Chinook than does the hatchery environment.

Table 8.26. Proportionate natural influence (PNI) of the Wenatchee summer Chinook supplementation program for brood years 1989-2013. PNI was calculated as the proportion of naturally produced Chinook in the hatchery broodstock (pNOB) divided by the proportion of hatchery Chinook on the spawning grounds (pHOS) plus pNOB. 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
	NOS	HOS	pHOS	NOB	HOB	pNOB	
1989	14,331	0	0	290	0	1.00	1.00
1990	10,861	0	0	57	0	1.00	1.00
1991	10,168	0	0	105	0	1.00	1.00
1992	11,652	0	0	274	0	1.00	1.00
1993	8,849	600	0.06	406	44	0.9	0.94
1994	8,476	1,678	0.17	333	54	0.86	0.83
1995	6,862	894	0.12	363	16	0.96	0.89
1996	6,004	165	0.03	263	3	0.99	0.97
1997	5,408	505	0.09	205	13	0.94	0.91
1998	4,611	741	0.14	299	78	0.79	0.85
1999	4,101	1,375	0.25	242	236	0.51	0.67
2000	4,462	1,051	0.19	275	180	0.6	0.76
2001	9,414	1,946	0.17	210	136	0.61	0.78
2002	11,892	3,831	0.24	409	10	0.98	0.80
2003	10,025	1,775	0.15	337	7	0.98	0.87
2004	9,220	1,259	0.12	424	2	1.00	0.89
2005	6,862	1,841	0.21	397	3	0.99	0.83
2006	16,060	1,732	0.1	433	4	0.99	0.91
2007	3,173	1,417	0.31	263	3	0.99	0.76
2008	4,794	1,702	0.26	378	69	0.85	0.77
2009	7,113	1,214	0.15	452	8	0.98	0.87
2010	5,879	1,589	0.21	388	5	0.99	0.83
2011	8,155	1,695	0.17	376	7	0.98	0.85
2012	7,327	1,212	0.14	267	1	1.00	0.88
2013	7,449	2,760	0.27	234	2	0.99	0.79
Average	***8,126***	***1,239***	***0.14***	***307***	***35***	***0.92***	***0.87***

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 8.27).[9] Over the four brood years for which PIT-tagged hatchery fish were released, survival rates from the Wenatchee River to McNary Dam ranged from 0.619 to 0.910; SARs from release to detection at Bonneville Dam ranged from 0.004 to 0.017. Average travel time from the Wenatchee River to McNary Dam ranged from 11 to 29 days.

Much of the variation in survival rates and travel time resulted from releases of different experimental groups (Table 8.27). For example, brood year 2009 was split into three groups (control group, long-term raceway group (R1), and short-term raceway 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 experiment was conducted with brood year 2012. That brood year was split into four different treatment groups (small-size fish in raceway, large-size fish in raceway, small-size fish in circular, and large-size fish in circular). In general, releases from the circulars appeared to have higher survival rates to McNary Dam and faster travel times. Large-size fish from the circulars appeared to have the highest survival rates and fastest travel time.

Table 8.27. 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 2008-2012. 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	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)	0.004 (0.001)
2010	0	--	--	--
2011	5,018	0.753 (0.070)	20.9 (8.9)	NA
2012 (Raceway)	5,047 (small size)	0.724 (0.066)	18.9 (9.2)	NA
	4,740 (large size)	0.619 (0.061)	16.9 (8.6)	NA
2012 (Circular)	5,041 (small size)	0.784 (0.060)	11.8 (5.0)	NA
	5,082 (large size)	0.910 (0.077)	11.1 (4.6)	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

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[9] 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.

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 1989-2007, NRR for summer Chinook in the Wenatchee averaged 0.98 (range, 0.16-2.95) if harvested fish were not include in the estimate and 2.87 (range, 0.34-9.97) if harvested fish were included in the estimate (Table 8.28). 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 5.30 (the calculated target value in Hillman et al. 2013). HRRs exceeded NRRs in 14 of the 19 years of data, regardless if harvest was or was not included in the estimate (Table 8.28). Hatchery replacement rates for Wenatchee summer Chinook have exceeded the estimated target value of 5.30 in four or eight of the 19 years of data depending on if harvest was or was not included in the estimate.

Table 8.28. 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 1989-2007.

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	9,182	6.21	0.64	5,111	21,810	14.77	1.52
1990	87	10,861	88	9,597	1.01	0.88	118	12,986	1.36	1.20
1991	128	10,168	23	5,562	0.18	0.55	71	17,167	0.55	1.69
1992	341	11,652	442	5,865	1.30	0.50	628	8,403	1.84	0.72
1993	524	9,450	92	5,388	0.18	0.57	152	8,906	0.29	0.94
1994	418	10,154	1,239	4,219	2.96	0.42	1,945	6,644	4.65	0.65
1995	398	7,755	1,000	5,329	2.51	0.69	1,575	8,459	3.96	1.09
1996	334	6,168	371	4,440	1.11	0.72	576	6,948	1.72	1.13
1997	240	5,913	4,347	9,770	18.11	1.65	7,505	16,903	31.27	2.86
1998	472	5,352	2,289	15,795	4.85	2.95	7,704	53,361	16.32	9.97
1999	488	5,476	636	12,062	1.30	2.20	2,479	47,302	5.08	8.64
2000	492	5,512	3,334	3,885	6.78	0.70	14,212	16,603	28.89	3.01
2001	493	11,360	644	19,209	1.31	1.69	2,414	72,487	4.90	6.38
2002	482	15,723	1,798	4,955	3.73	0.32	4,463	12,388	9.26	0.79
2003	496	11,800	1,431	1,847	2.89	0.16	3,077	3,989	6.20	0.34
2004	496	10,479	590	7,429	1.19	0.71	1,454	18,434	2.93	1.76
2005	494	8,703	1,345	5,177	2.72	0.59	3,633	14,068	7.35	1.62
2006	488	17,792	3,383	6,802	6.93	0.38	10,712	21,594	21.95	1.21
2007	419	4,590	124	10,761	0.30	2.34	478	41,548	1.14	9.05
Average	***402***	***9,644***	***1,333***	***7,751***	***3.45***	***0.98***	***3,595***	***21,579***	***8.66***	***2.87***

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 0.00037 to 0.01554 for hatchery summer Chinook in the Wenatchee River basin (Table 8.29).

Table 8.29. Smolt-to-adult ratios (SARs) for Wenatchee hatchery summer Chinook, brood years 1989-2008.

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	1,920	0.00424
1995	668,409	1,541	0.00231
1996	585,590	568	0.00097
1997	480,418	7,465	0.01554
1998	641,109	7,631	0.01190
1999	988,328	2,457	0.00249
2000	903,368	13,858	0.01534
2001	596,618	2,400	0.00402
2002	805,919	4,333	0.00538
2003	639,381	3,029	0.00474
2004	603,942	1,439	0.00238
2005	631,492	3,586	0.00568
2006	931,880	10,532	0.01130
2007	453,719	478	0.00105
2008	859,401	9,945	0.01157
Average	***575,604***	***3,658***	***0.00545***

[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 2012 broodstock collection protocol, 274 natural-origin (adipose fin present) summer Chinook adults were targeted for collection at Dryden and Tumwater dams. The actual 2012 collection totaled 274 summer Chinook (273 natural-origin and one hatchery-origin; the hatchery-origin fish were not direct collections, but rather adipose present non-wired fish with a hatchery scale pattern) in combination from Dryden and Tumwater dams. Trapping began 1 July and ended 4 September 2012.

Summer Chinook and steelhead broodstock collections occurred concurrently at Dryden Dam; therefore, steelhead and spring Chinook encounters at Dryden Dam during Wenatchee summer Chinook broodstock collection were attributable to steelhead broodstock collections authorized under ESA Permit 1395 take authorizations. No steelhead or spring Chinook takes were associated with the Wenatchee summer Chinook collection.

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 2012 Wenatchee summer Chinook program released an estimated 550,877 smolts, representing 110% of the 500,001 programmed production, and was right at the 10% overage allowance identified in ESA permit 1347.

Hatchery Effluent Monitoring

Per ESA Permits 1196, 1347, 1395, 18118, 18119, and 18121, permit holders shall monitor and report hatchery effluents in compliance with applicable National Pollution Discharge Elimination Systems (NPDES) (EPA 1999) permit limitations. There was one NPDES violation reported at PUD Hatchery facilities during the period 1 January through 31 December 2014. NPDES monitoring and reporting for Chelan PUD Hatchery Programs during 2014 are provided in Appendix F.

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 2014 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 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[10], 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 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 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. Prior to 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 released from the new facility in late 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 15 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 2012-2013 Methow summer Chinook broodstock that were collected in the West Ladder of Wells Dam in 2012 and 2013. Summer Chinook adults collected at Wells Dam are also used in the Okanogan/Similkameen supplementation program.

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[10] The majority of the production at Carlton Acclimation Pond is initial production, which terminated in 2013, and is not necessarily tied to hydro facility mortality. The balance of the production is the result of a swap between spring and summer Chinook. That is, Chelan PUD is currently producing summer Chinook at Carlton for Douglas PUD in exchange for Douglas PUD producing spring Chinook at the Methow Fish Hatchery for Chelan PUD.

Complete information is not currently available for the 2014 return (this information will be provided in the 2015 annual report).

Origin of Broodstock

Both 2012 and 2013 broodstock consisted almost entirely of natural-origin (adipose fin present) summer Chinook (Table 9.1). These fish were used for both the Methow and Okanogan supplementation programs. In 2012, to meet production goals, hatchery-origin adults were collected in concert with natural-origin fish. About 4% of the 2013 broodstock were comprised of hatchery-origin fish (hatchery-origin was determined by examination of scales and CWTs).

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 1989-2012. Numbers of broodstock collected from 2013 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***
2012	125	5	0	98	22	3	0	0	1	2	99
2013	98	1	0	97	0	4	0	0	4	0	101
Average[d]	***112***	***3***	***0***	***98***	***11***	***4***	***0***	***0***	***3***	***1***	***100***

[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] This average represents 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] This average represents 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 2012 return consisted primarily of age-4 and 5 natural-origin Chinook (95.1%) and age-5 hatchery-origin Chinook. Age-3 natural-origin fish made up 3.9% of the broodstock (Table 9.2).

Broodstock collected from the 2013 return consisted primarily of age-4 and 5 natural-origin Chinook (84.8%) and age-5 hatchery-origin Chinook (100%). Age-3 natural-origin Chinook made up 15.2% of the broodstock (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, 1991-2013.

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

Return Year	Origin	Total age				
		2	3	4	5	6
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
	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
Average	***Wild***	***0.8***	***11.0***	***49.5***	***37.3***	***1.4***
	Hatchery	***0.2***	***9.0***	***32.6***	***47.0***	***7.3***

Mean lengths of natural-origin summer Chinook of a given age differed little between 2012 and 2013 (Table 9.3). Average fork lengths for age-5 natural-origin adults were 5 cm longer than that of age-5 hatchery fish (Table 9.3). Differences in hatchery-origin and natural-origin fish were hard to discern 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, 1991-2013; 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	-

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	-	-	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	-
	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	-

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	-	-	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	-
Average	***Wild***	***42***	***3***	***4***	***62***	***32***	***6***	***80***	***140***	***7***	***91***	***108***	***6***	***94***	***3***	***7***
	Hatchery	***42***	***1***	***5***	***52***	***19***	***7***	***72***	***52***	***6***	***87***	***64***	***6***	***94***	***13***	***6***

Sex Ratios

Male summer Chinook in the 2012 broodstock made up about 49.0% of the adults collected, resulting in an overall male to female ratio of 0.96:1.00 (Table 9.4.). In 2013, males made up about 51.0% of the adults collected, resulting in an overall male to female ratio of 1.04:1.00 (Table 9.4). The ratios for 2012 and 2013 broodstock were above and below the assumed 1:1 ratio goal in the broodstock protocol, respectively.

Table 9.4. Numbers of male and female wild and hatchery summer Chinook collected for broodstock at Wells Dam for the Methow/Okanogan programs, 1991-2013. 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
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

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	
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
Total[b]	***3645***	***3395***	***1.07:1.00***	***1902***	***1258***	***1.51:1.00***	***1.19:1.00***

[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 2012 and 2013 summer Chinook broodstock averaged 4,470 and 4,717 eggs per female, respectively (Table 9.5). These values are close to the overall average of 4,943 eggs per female. Mean observed fecundities for the 2012 and 2013 returns were slightly below the expected fecundity of 5,000 eggs per female assumed in the broodstock protocol.

Table 9.5. Mean fecundity of wild, hatchery, and all female summer Chinook collected for broodstock at Wells Dam for the Methow/Okanogan programs, 1989-2013; 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

Return year	Mean fecundity		
	Wild	Hatchery	Total
2011	4,594	3,915	4,578
2012	4,470	--	4,470
2013	4,700	5,490	4,717
Average	***4,957***	***4,897***	***4,943***

* Individual fecundities were not assigned to females until 1997 brood.

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 9.6). From 2012 to present, the egg take goal was not reached in any year, but the numbers were close to the goal (Table 9.6).

Table 9.6. Numbers of eggs taken from summer Chinook broodstock collected at Wells Dam for the Methow/Okanogan programs, 1989-2014.

Return year	Number of eggs taken
1989	482,800
1990	464,097
1991	586,594
1992	486,260
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

Return year	Number of eggs taken
2008	441,778
2009	560,602
2010	505,188
2011	488,747
Average (1989-2011)	***473,091***
2012	245,245
2013	231,136
2014	223,839
Average (2012-present)	***233,407***

Number of acclimation days

Rearing of the 2012 brood Methow summer Chinook was similar to previous years with fish being held on well water before being transferred to Carlton Acclimation Pond for final acclimation on Methow River water in March 2014 (Table 9.7). Groups of the 1994 and 1995 broods were reared for longer durations at the Methow Fish Hatchery on Methow River water.

Table 9.7. Number of days Methow summer Chinook were acclimated at Carlton Acclimation Pond, brood years 1989-2012.

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

Brood year	Release year	Transfer date	Release date	Number of days
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

Release Information

Numbers released

The 2012 brood Methow summer Chinook program achieved 99% of the 200,000 target goal with about 197,391 fish being released volitionally from the circular ponds on 7-14 May 2014 (Table 9.8).

Table 9.8. Numbers of Methow summer Chinook smolts released from the hatchery, brood years 1989-2012. Beginning with the 2014 release, the release target for Methow summer Chinook is 200,000 smolts.

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

Brood year	Release year	CWT mark rate	Number of smolts released
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***
2012	2014	0.9987	197,391
Average (2012-present)		***0.9987***	***197,391***

Numbers tagged

The 2012 brood Methow summer Chinook were 99.9% CWT and adipose fin-clipped (Table 9.8).

A total of 10,159 Methow summer Chinook (brood 2013) were PIT tagged at Eastbank Hatchery on 25-28 August 2014. These fish were tagged in raceways #1, #2, #7, and #8. Fish were not fed during tagging or for two days before and after tagging. Fish averaged 72 mm in length and 5.3 g at time of tagging. These fish will be released in spring 2015.

Table 9.9 summarizes the number of hatchery summer Chinook that have been PIT-tagged and released into the Methow River.

Table 9.9. Summary of PIT-tagging activities for Methow hatchery summer Chinook, brood years 2008-2012.

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	0	0
2011	2013	0	0	0	0
2012	2014	10,099	41	7	10,051

Fish size and condition at release

A volitional release of yearling smolts took place between 7 April and 14 May 2014. Size at release from the acclimated population was 96.9% and 91.6% of the respective target fork length and weight goals (Table 9.10). This brood year exceeded the target CV for length by 34.4%.

Table 9.10. 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 1991-2012. 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
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
Average		***158***	***12.1***	***41.6***	***11***
Targets		***163***	***9.0***	***45.4***	***15***

Survival Estimates

Overall survival of the Methow summer Chinook from green (unfertilized) egg-to-release was above the standard set for the program (Table 9.11). High hatchery survival can be attributed to exceeding the survival standards set for the program at almost every life stage.

Table 9.11. Hatchery life-stage survival rates (%) for Methow summer Chinook, brood years 1989-2012. 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
Average	***93.7***	***96.2***	***87.1***	***97.6***	***98.1***	***97.7***	***94.1***	***98.4***	***82.2***
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 adult broodstock bacterial kidney disease (BKD) monitoring indicated that most females had ELISA values less than 0.199. Just less than 94% of females had ELISA values less than 0.120, which means about 6% of the progeny needed to be reared at densities not to exceed 0.06 fish per pound (Table 9.12).

Table 9.12. Proportion of bacterial kidney disease (BKD) titer groups for the Methow/Okanogan summer Chinook broodstock, brood years 1997-2014. 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)	
	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
Average	***0.9297***	***0.0317***	***0.0117***	***0.0270***	***0.9503***	***0.0497***

[a] Individual ELISA samples were not collected before the 1997 brood.

9.4 Natural Juvenile Productivity

During 2014, 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 six mark-recapture release groups in 2014. The flow-efficiency estimate was based on 12 mark-recapture release groups that were conducted over the period 2008-2011.

The Methow Trap operated at night between 21 February and 29 November 2014. During that time period the trap was inoperable for 24 days because of high river flows, fires, landslides, or snow/ice. During the ten-month sampling period, a total of 5,586 wild subyearling Chinook were captured at the Methow Trap. Based on the pooled-efficiency model and the flow efficiency model, the total number of wild subyearling Chinook that emigrated past the Methow Trap in 2014 was 473,625 (±923,267). Because 516 summer Chinook redds were observed downstream from the trap in 2013, the total number of summer Chinook emigrating from the Methow River in 2014 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 709,066 fish. Most of these fish emigrated during late May (Figure 9.1).

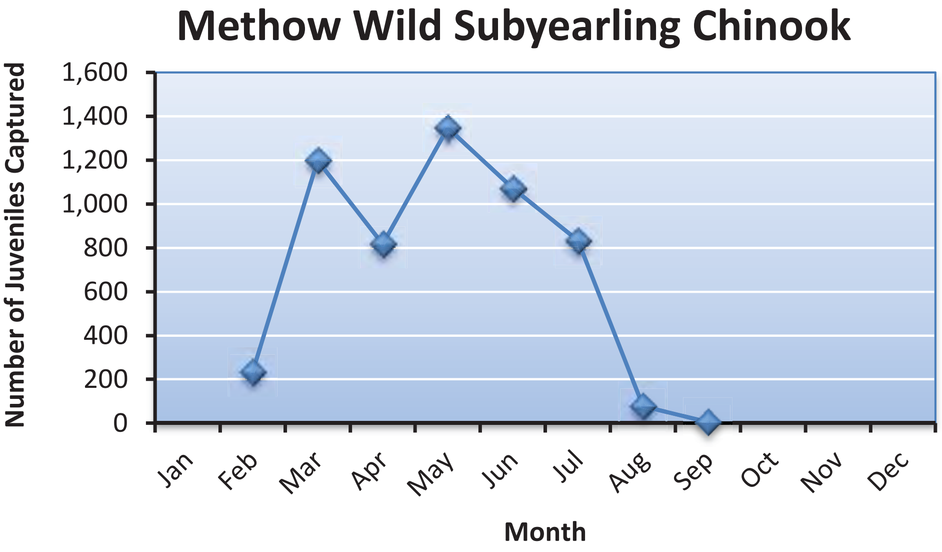

Figure 9.1. Numbers of wild subyearling Chinook captured at the Methow Trap during February through September, 2014.

9.5 Spawning Surveys

Surveys for Methow summer Chinook redds were conducted from late September to mid-November 2014 in the Methow River. Total redd counts (not peak counts) were conducted in the river (see Appendix N for more details).

Redd Counts

A total of 591 summer Chinook redds were counted in the Methow River in 2014 (Table 9.13). This was lower than the overall average of 675 redds.

Table 9.13. Total number of redds counted in the Methow River, 1989-2014.

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
Average	***675***

* 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 (67%) were located between Carlton and Twisp and between MVID and Winthrop (Reaches 3 and 5) (Table 9.14; Figure 9.2). Unlike in past years, few summer Chinook spawned downstream from Carlton (Reaches 1 and 2) because of recruitment of suspended sediments from the Carlton Complex fire. High flows also hampered redd surveys in November.

Table 9.14. Total number of summer Chinook redds counted in different reaches on the Methow River during September through early November, 2014. Reach codes are described in Table 2.11.

Survey reach	Total redd count	Percent
Methow 1 (M1)	9	1.5
Methow 2 (M2)	36	6.1
Methow 3 (M3)	202	34.2
Methow 4 (M4)	77	13.0
Methow 5 (M5)	193	32.7
Methow 6 (M6)	40	6.8
Methow 7 (M7)	34	5.8
Totals	***591***	***100.0***

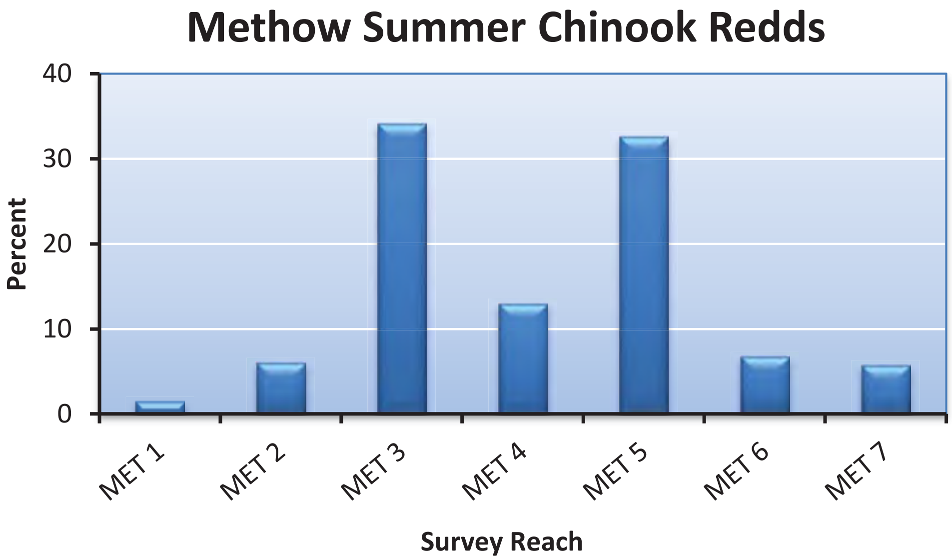

Figure 9.2. Percent of the total number of summer Chinook redds counted in different reaches on the Methow River during September through mid-November, 2014. Reach codes are described in Table 2.11.

Spawn Timing

Spawning in 2014 began the last week of September, peaked the second week of October, and ended after the last week of October (Figure 9.3). Stream temperatures in the Methow River, when spawning began, varied from 9.5-12.0°C. Peak spawning occurred during the first week of October in the upper reaches of the Methow River and one or two weeks later in the lower reaches.

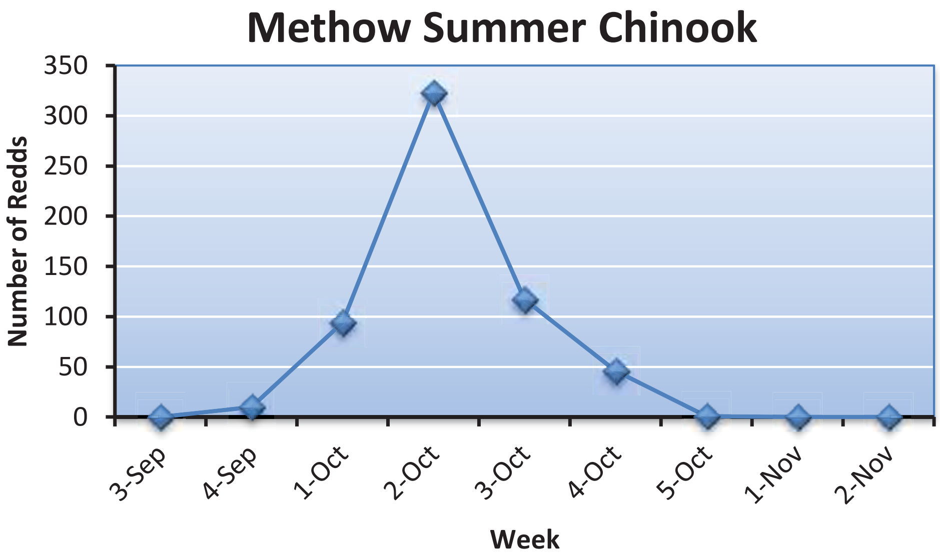

Figure 9.3. Number of new summer Chinook redds counted during different weeks in the Methow River, September through mid-November 2014.

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. The estimated fish per redd ratio for Methow summer Chinook in 2014 was 2.75. Multiplying this ratio by the number of redds counted in the Methow River resulted in a total spawning escapement of 1,625 summer Chinook (Table 9.15).

Table 9.15. Spawning escapements for summer Chinook in the Methow River for return years 1989-2014.

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
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

Return year	Fish/Redd	Redds	Total spawning escapement
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
Average	***2.98***	***675***	***1,822***

* 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 2014 in the Methow River (see Appendix N for more details).

Number sampled

A total of 487 summer Chinook carcasses were sampled during September through mid-November in the Methow River (Table 9.16). This was lower than the overall average of 507 carcasses sampled since 1991.

Table 9.16. Numbers of summer Chinook carcasses sampled within each survey reach on the Methow River, 1991-2014. Reach codes are described in Table 2.11.

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**
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**

Survey year	Number of summer Chinook carcasses							
	M-1	M-2	M-3	M-4	M-5	M-6	M-7	Total
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**
Average	***109***	***127***	***151***	***41***	***70***	***8***	***2***	***507***

[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 2014 (Table 9.15; Figure 9.4). Most of the carcasses were found between Carlton and Twisp and between MVID and Winthrop (Reaches 3 and 5). Unlike in past years, few summer Chinook carcasses were found downstream from Carlton (Reaches 1 and 2) because of high turbidity levels associated with the Carlton Complex fire. High flows also hampered carcass surveys in November.

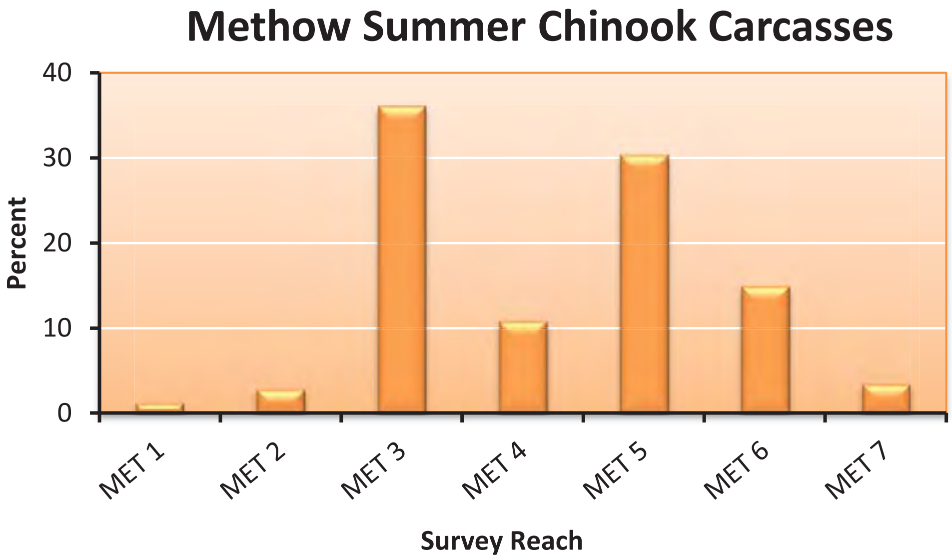

Figure 9.4. Percent of summer Chinook carcasses sampled within different reaches on the Methow River during September through mid-November, 2014. Reach codes are described in Table 2.11.

Numbers of wild and hatchery-origin summer Chinook carcasses sampled in 2014 will be available after analysis of CWTs and scales. Based on the available data (1991-2013), hatchery and wild summer Chinook carcasses were not distributed equally among the reaches in the Methow River (Table 9.17). 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 9.5).

Table 9.17. Numbers of wild and hatchery summer Chinook carcasses sampled within different reaches on the Methow River, 1991-2013.

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**
	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**

Survey year	Origin	Survey reach							Total
		M-1	M-2	M-3	M-4	M-5	M-6	M-7	
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	**355**
	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**
Average	***Wild***	***36***	***69***	***95***	***30***	***55***	***4***	***1***	***290***
	Hatchery	***77***	***63***	***55***	***10***	***12***	***1***	***0***	***218***

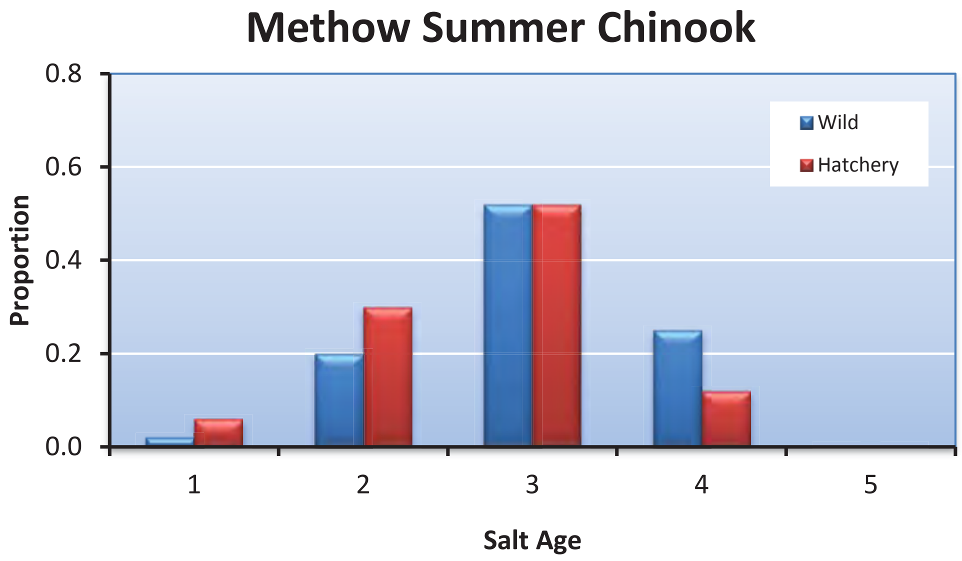

Figure 9.5. Distribution of wild and hatchery produced carcasses in different reaches on the Methow River, 1993-2013. Reach codes are described in Table 2.11.

Sampling Rate

Overall, 30% of the total spawning escapement of summer Chinook in the Methow River basin was sampled in 2014 (Table 9.18). Sampling rates among survey reaches varied from 14 to 66%.

Table 9.18. Number of redds and carcasses, total spawning escapement, and sampling rates for summer Chinook in the Methow River basin, 2014. Reach codes are described in Table 2.11.

Survey reach	Total number of redds	Total number of carcasses	Total spawning escapement	Sampling rate
Methow 1 (M1)	9	6	25	0.24
Methow 2 (M2)	36	14	99	0.14
Methow 3 (M3)	202	176	556	0.32
Methow 4 (M4)	77	53	212	0.25
Methow 5 (M5)	193	148	531	0.28
Methow 6 (M6)	40	73	110	0.66
Methow 7 (M7)	34	17	94	0.18
Total	***591***	***487***	***1,625***	***0.30***

Length Data

Mean lengths (POH, cm) of male and female summer Chinook carcasses sampled during surveys on the Methow River in 2014 are provided in Table 9.19. The average size of males and females sampled in the Methow River were 65 cm and 68 cm, respectively.

Table 9.19. 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, 2014. Reach codes are described in Table 2.11.

Stream/watershed	Mean length (cm)	
	Male	Female
Methow 1 (M1)	52.0 (12.0)	71.0 (0.0)
Methow 2 (M2)	65.3 (10.4)	66.4 (7.5)
Methow 3 (M3)	63.7 (9.5)	68.0 (5.1)
Methow 4 (M4)	65.1 (7.6)	69.5 (5.4)
Methow 5 (M5)	64.8 (7.9)	68.7 (5.6)
Methow 6 (M6)	67.2 (8.4)	69.0 (4.7)
Methow 7 (M7)	66.8 (5.7)	65.6 (4.4)
Total	***64.7 (8.8)***	***68.4 (5.3)***

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) (Table 2.1). Based on broodstock sampling in 2014, hatchery summer Chinook generally arrived at Wells Dam earlier than did wild summer Chinook (Table 9.20). 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 2007-2014 survey period.

Table 9.20. The week that 10%, 50% (median), and 90% of the wild and hatchery summer Chinook salmon passed Wells Dam, 2007-2014. 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
Average	***Wild***	***27***	***30***	***35***	***31***	***3,242***
	Hatchery	***28***	***30***	***35***	***31***	***5,130***

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 1993-2013 in the Methow River were salt age-3 fish (Table 9.21; Figure 9.6). 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 9.21. Proportions of wild and hatchery summer Chinook of different salt (ocean) ages sampled on spawning grounds in the Methow River, 1993-2013.

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
	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

Sample year	Origin	Salt age						Sample size
		1	**2**	**3**	**4**	**5**	**6**	
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
Average	***Wild***	***0.02***	***0.21***	***0.51***	***0.26***	***0.00***	***0.00***	***292***
	Hatchery	***0.05***	***0.32***	***0.57***	***0.06***	***0.00***	***0.00***	***226***

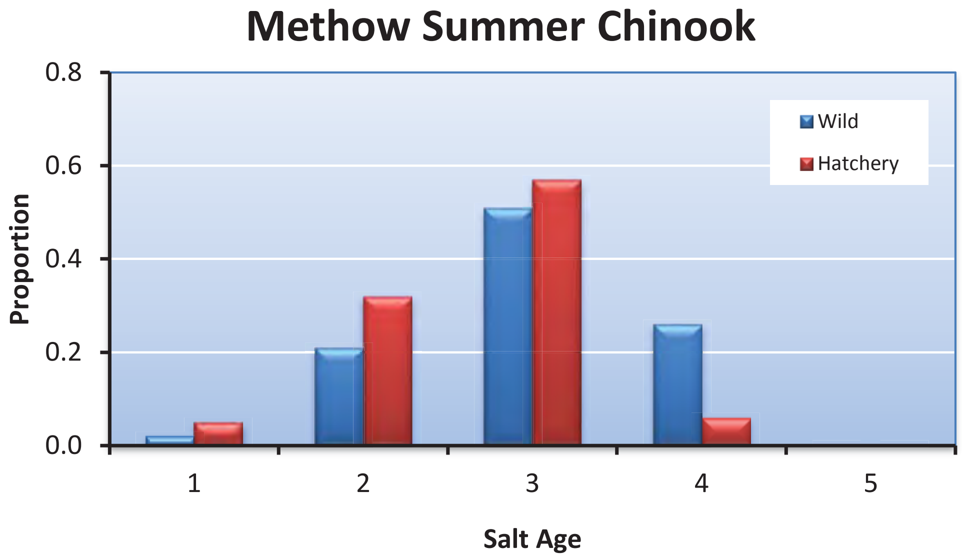

Figure 9.6. Proportions of wild and hatchery summer Chinook of different salt (ocean) ages sampled at broodstock collection sites and on spawning grounds in the Methow River for the combined years 1993-2013.

Size at Maturity

On average, hatchery summer Chinook were about 4 cm smaller than wild summer Chinook sampled in the Methow River basin (Table 9.22). 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 9.22. Mean lengths (POH; cm) and variability statistics for wild and hatchery summer Chinook sampled in the Methow River basin, 1993-2013; 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
	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

Survey year	Origin	Sample size	Summer Chinook length (POH; cm)			
			Mean	SD	Minimum	Maximum
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
Pooled	***Wild***	***6,854***	***70***	***9***	***29***	***99***
	Hatchery	***4,976***	***66***	***10***	***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 9.23). Ocean harvest has made up 13% to 99% of all hatchery-origin Methow summer Chinook harvested. Brood years 1989, 1998, 26, and 2008 provided the largest harvests, while brood years 1996 and 1999 provided the lowest.

Table 9.23. Estimated number and percent (in parentheses) of hatchery-origin Methow summer Chinook captured in different fisheries, brood years 1989-2008.

Brood year	Ocean fisheries	Columbia River Fisheries			Total
		Tribal	Commercial (Zones 1-5)	Recreational (sport)	
1989	1,041 (52)	884 (44)	0 (0)	66 (3)	1,991
1990	53 (56)	41 (44)	0 (0)	0 (0)	94
1991	10 (17)	49 (83)	0 (0)	0 (0)	59
1992	17 (55)	14 (45)	0 (0)	0 (0)	31
1993	14 (58)	8 (33)	2 (8)	0 (0)	24
1994	153 (81)	34 (18)	1 (1)	1 (1)	189
1995	77 (99)	0 (0)	1 (1)	0 (0)	78
1996	12 (92)	1 (8)	0 (0)	0 (0)	13
1997	214 (88)	7 (3)	0 (0)	21 (9)	242
1998	1,755 (83)	101 (5)	14 (1)	234 (11)	2,104
1999	2 (13)	13 (87)	0 (0)	0 (0)	15
2000	357 (71)	88 (17)	27 (5)	33 (7)	505
2001	319 (52)	97 (16)	43 (7)	160 (26)	619
2002	271 (48)	96 (17)	61 (11)	137 (24)	565
2003	58 (58)	17 (17)	7 (7)	18 (18)	100
2004	132 (49)	55 (20)	16 (6)	68 (25)	271
2005	295 (54)	137 (25)	50 (9)	66 (12)	548
2006	1,127 (48)	811 (35)	100 (4)	314 (13)	2,352
2007	205 (60)	69 (20)	16 (5)	54 (16)	344

Brood year	Ocean fisheries	Columbia River Fisheries			Total
		Tribal	Commercial (Zones 1-5)	Recreational (sport)	
2008	1,280 (57)	349 (15)	43 (2)	592 (26)	2,264
Average	***370 (60)***	***144 (28)***	***19 (3)***	***88 (10)***	***620***

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) and brood year should be less than 5%.

Few hatchery-origin Methow summer Chinook have strayed into basins outside the Methow (Table 9.24). Although hatchery-origin Methow summer Chinook have strayed into the Wenatchee River basin, Okanogan River basin, Entiat River basin, Chelan tailrace, and Hanford Reach, they have made up less than 1% of the spawning escapement within those areas.

Table 9.24. Number and percent of spawning escapements within other non-target basins that consisted of hatchery-origin Methow summer Chinook, return years 1994-2011. 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 5%.

Return year	Wenatchee		Okanogan		Chelan		Entiat		Hanford Reach	
	Number	%	Number	%	Number	%	Number	%	Number	%
1994	0	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	6	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
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	1	0.4	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
Average	***0***	***0.0***	***18***	***0.3***	***3***	***0.4***	***0***	***0.0***	***0***	***0.0***

Based on brood year analyses, on average, about 3% of the returns have strayed into non-target spawning areas, falling within the acceptable level of less than 5% (Table 9.25). Depending on brood year, percent strays into non-target spawning areas have ranged from 0-11.9%. Few (<1% on average) have strayed into non-target hatchery programs.

Table 9.25. Number and percent of hatchery-origin Methow summer 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 1989-2008. Percent stays should be less than 5%.

Brood year	Homing				Straying			
	Target stream		Target hatchery*		Non-target streams		Non-target hatcheries	
	Number	%	Number	%	Number	%	Number	%
1989	773	55.7	459	33.0	81	5.8	76	5.5
1990	199	70.6	81	28.7	0	0.0	2	0.7
1991	82	65.6	43	34.4	0	0.0	0	0.0
1992	68	63.0	40	37.0	0	0.0	0	0.0
1993	25	65.8	10	26.3	3	7.9	0	0.0
1994	419	79.7	94	17.9	13	2.5	0	0.0
1995	126	81.8	28	18.2	0	0.0	0	0.0
1996	57	93.4	4	6.6	0	0.0	0	0.0
1997	379	93.8	7	1.7	18	4.5	0	0.0
1998	1,653	94.7	32	1.8	60	3.4	0	0.0
1999	18	100.0	0	0.0	0	0.0	0	0.0
2000	239	93.0	4	1.6	14	5.4	0	0.0
2001	272	88.3	6	1.9	29	9.4	1	0.3
2002	315	95.2	4	1.2	12	3.6	0	0.0
2003	131	99.2	1	0.8	0	0.0	0	0.0
2004	194	85.5	6	2.6	27	11.9	0	0.0
2005	373	90.5	13	3.2	23	5.6	3	0.7
2006	1,317	91.4	15	1.0	109	7.6	0	0.0
2007	134	98.5	2	1.5	0	0.0	0	0.0
2008	1,871	97.9	13	0.7	25	1.3	3	0.2
Average	***434***	***85.2***	***44***	***11.0***	***21***	***3.4***	***4***	***0.4***

* Homing to the target hatchery includes Methow hatchery summer Chinook that are captured and included as broodstock in the Methow Hatchery program. These hatchery fish are typically collected at Wells Dam.

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 M). Samples from the Eastbank Hatchery – Wenatchee stock, Eastbank Hatchery – Methow/Okanogan (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 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.

Proportion of 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). The ratio pNOB/(pHOS+pNOB) is the Proportion of Natural Influence (PNI). The larger the ratio (PNI), 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 important integrated populations should have a PNI of at least 0.67 (HSRG/WDFW/NWIFC 2004).

For brood years 1993-2003, the PNI was generally less than 0.67 (Table 9.26). However, since brood year 2003, the PNI has generally been greater than 0.67; brood years 2011 and 2013 had PNI values of 0.66.

Table 9.26. Proportionate natural influence (PNI) of the Methow summer Chinook supplementation program for brood years 1989-2013. PNI was calculated as the proportion of naturally produced Chinook in the hatchery broodstock (pNOB) divided by the proportion of hatchery Chinook on the spawning grounds (pHOS) plus pNOB. 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
	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	0.63
1994	596	489	0.45	341	244	0.58	0.56
1995	596	618	0.51	173	240	0.42	0.45
1996	435	180	0.29	287	155	0.65	0.69
1997	529	168	0.24	197	265	0.43	0.64
1998	437	238	0.35	153	211	0.42	0.55
1999	573	413	0.42	224	289	0.44	0.51
2000	861	339	0.28	164	337	0.33	0.54
2001	1,122	1,646	0.59	12	345	0.03	0.05
2002	2,572	2,058	0.44	247	241	0.51	0.54
2003	2,307	1,623	0.41	381	101	0.79	0.66
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	2,039	694	0.25	500	10	0.98	0.80
2007	764	600	0.44	456	17	0.96	0.69
2008	1,293	654	0.34	359	86	0.81	0.70
2009	1,093	665	0.38	503	4	0.99	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	0.66
2012	1,593	1,354	0.46	98	1	0.99	0.68
2013	1,807	1,776	0.50	97	4	0.96	0.66
Average	***1,120***	***710***	***0.33***	***403***	***169***	***0.70***	***0.68***

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 9.27).[11] Over the three brood years for which PIT-tagged hatchery fish were released, survival rates from the Methow River to McNary Dam ranged from 0.485 to 0.747; SARs from release to detection at Bonneville Dam ranged from 0.002 to 0.016. Average travel time from the Methow River to McNary Dam ranged from 17 to 39 days.

Table 9.27. 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 2008-2012. 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	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)	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 1989-2007, NRR for summer Chinook in the Methow averaged 1.15 (range, 0.10-4.90) if harvested fish were not include in the estimate and 2.36 (range, 0.18-10.84) if harvested fish were included in the estimate (Table 9.28). 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 5.30 (the calculated target value in Hillman et al. 2013). HRRs exceeded NRRs in 11 out of the 19 years of data, regardless if harvest was or was not included in the estimate (Table 9.28). Hatchery replacement rates for Methow summer Chinook have exceeded the estimated target value of 5.30 in three of the 19 years of data, regardless if harvest was or was not included in the estimate.

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[11] 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 9.28. 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 1989-2007.

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	3,380	1,528	16.73	3.11
1990	202	1,421	282	979	1.40	0.69	376	1,311	1.86	0.92
1991	266	566	125	288	0.47	0.51	184	427	0.69	0.75
1992	214	460	108	614	0.50	1.33	139	792	0.65	1.72
1993	234	508	82	431	0.35	0.85	132	703	0.56	1.38
1994	260	1,085	526	545	2.02	0.50	715	743	2.75	0.68
1995	242	1,214	154	1,201	0.64	0.99	232	1,809	0.96	1.49
1996	220	615	61	445	0.28	0.72	74	541	0.34	0.88
1997	209	697	404	1,494	1.93	2.14	646	2,398	3.09	3.44
1998	235	675	1,745	3,308	7.43	4.90	3,849	7,319	16.38	10.84
1999	222	986	18	2,863	0.08	2.90	33	5,253	0.15	5.33
2000	222	1,200	257	808	1.16	0.67	762	2,405	3.43	2.00
2001	223	2,768	308	2,877	1.38	1.04	927	8,718	4.16	3.15
2002	222	4,630	331	1,072	1.49	0.23	896	2,921	4.04	0.63
2003	224	3,930	132	397	0.59	0.10	232	698	1.04	0.18
2004	223	2,189	227	1,646	1.02	0.75	498	3,618	2.23	1.65
2005	225	2,561	412	1,159	1.83	0.45	960	2,708	4.27	1.06
2006	236	2,733	1,441	1,714	6.11	0.63	3,793	4,522	16.07	1.65
2007	209	1,364	136	1,503	0.65	1.10	480	5,330	2.30	3.91
Average	***226***	***1,584***	***428***	***1,262***	***1.91***	***1.15***	***964***	***2,829***	***4.30***	***2.36***

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 0.01883 for hatchery summer Chinook in the Methow River basin (Table 9.29).

Table 9.29. Smolt-to-adult ratios (SARs) for Methow summer Chinook, brood years 1989-2008.

Brood year	Number of tagged smolts released[a]	Estimated adult captures[b]	SAR
1989	358,237	2,869	0.00801
1990	371,483	359	0.00097
1991	377,097	129	0.00034
1992	392,636	138	0.00035
1993	200,345	62	0.00031
1994	400,488	710	0.00177

Brood year	Number of tagged smolts released[a]	Estimated adult captures[b]	SAR
1995	344,974	229	0.00066
1996	289,880	73	0.00025
1997	380,430	642	0.00169
1998	202,559	3,815	0.01883
1999	422,473	33	0.00008
2000	334,337	761	0.00228
2001	246,159	923	0.00375
2002	310,846	893	0.00287
2003	353,495	232	0.00066
2004	394,490	495	0.00125
2005	262,496	958	0.00365
2006	417,795	3,785	0.00906
2007	426,188	479	0.00112
2008	373,234	3,962	0.01062
Average	***342,982***	***1,077***	***0.00343***

[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 2012 broodstock collection protocol, 108 natural-origin (adipose fin present) adults were targeted for collection between 1 July and 15 September at the West Ladder of Wells Dam. Actual collections occurred between 2 July and 10 September and totaled 128 summer Chinook (including 20 for the Okanogan program that were subsequently released when they were identified as being in excess of program needs). 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 2012, broodstock collection activities were accomplished within the allowable trapping days authorized under ESA Permit 1347.

Collection of Methow and Okanogan 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 and Okanogan 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.

Hatchery Rearing and Release

The 2012 brood Methow/Okanogan summer Chinook reared throughout their juvenile life-stages at Eastbank Fish Hatchery and the Carlton Acclimation Pond without incident (see Section 9.2). The 2012 brood smolt release totaled 197,391 summer Chinook, representing 98.7% of the 200,000 production objective and was compliant with the 10% overage allowable in ESA Section 10 Permit 1347.

Hatchery Effluent Monitoring

Per ESA Permits 1196, 1347, 1395, 18118, 18119, and 18121, permit holders shall monitor and report hatchery effluents in compliance with applicable National Pollution Discharge Elimination Systems (NPDES) (EPA 1999) permit limitations. There was one NPDES violation reported at PUD Hatchery facilities during the period 1 January 2014 through 31 December 2014. NPDES monitoring and reporting for PUD Hatchery Programs during 2014 are provided in Appendix F.

Spawning Surveys

Summer Chinook spawning ground surveys conducted in the Methow River basin during 2014 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 the east ladder trapping facility 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 will be 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 was typically collected at the East and West Ladders of Wells Dam. In 2012, broodstock was also collected at the mouth of the Okanogan River via purse seine. In 2012, a total of 81 summer Chinook (79 wild Chinook and two hatchery Chinook)[12] were spawned for the Okanogan

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[12] 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

program. Refer to Section 9.1 for information on the origin, age and length, sex ratios, and fecundity of summer Chinook broodstock collected at Wells Dam prior to 2013.

10.2 Hatchery Rearing

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
2011	683,419
Average (1989-2011)	***708,173***
2012	201,295

Return year	Number of eggs taken
Average (2012-present)	***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
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

Brood year	Release year	Rearing facility	Transfer date	Release date	Number of days
		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
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)

Brood year	Release year	Rearing facility	CWT mark rate	Number of smolts released
		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***
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***

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
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***
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***
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

Rearing of the 2012 brood Okanogan summer Chinook was similar to previous years with fish being held on well water before being transferred for final acclimation on the Similkameen. The Similkameen group was transferred in late October. Fish acclimating at the Similkameen facility experienced mortality because of cold water disease and external fungus from October through December. No additional disease-related problems were noted before the fish were released.

Results of adult broodstock bacterial kidney disease (BKD) monitoring for Methow/Okanogan summer Chinook are shown in Table 9.12 in Section 9.3.

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 2014, the number of summer Chinook redds in the Okanogan River basin averaged 1,994 and ranged from 110 to 6,025 (Table 10.7).

Table 10.7. Total number of redds counted in the Okanogan River basin, 1989-2014. The Colville Tribes provided data for survey years 2013 to present.

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

Survey year	Number of summer Chinook redds		
	Okanogan River	Similkameen River	Total count
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
Average	***990***	***989***	***1,979***

* 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. During the survey period 1989 through 2014, the summer Chinook spawning escapement within the Okanogan River basin averaged 5,396 and ranged from 473 to 13,857 (Table 10.8).

Table 10.8. Spawning escapements for summer Chinook in the Okanogan and Similkameen rivers for return years 1989-2014. The Colville Tribes provided data for return years 2013 to present.

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

Return year	Fish/Redd	Spawning escapement		
		Okanogan	Similkameen	Total
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	2.14	4,851	2,739	7,591
2014	2.86	6,381	5,783	12,164
Average	***2.97***	***2,641***	***2,721***	***5,363***

* 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 2012, the number of summer Chinook carcasses sampled in the Okanogan River basin averaged 1,205 and ranged from 115 to 2,460 (Table 10.9). In all years, most were sampled in the upper Okanogan River and lower Similkameen River (Table 10.9).

Table 10.9. Numbers of summer Chinook carcasses sampled within each survey reach in the Okanogan River basin, 1993-2012. Reach codes are described in Table 2.11. The Colville Tribes provided data for survey years 2013 to present.

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

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	
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
2013[d]	0	0	39		52	432	387		910
2014	1	1	79	54	275	783	770	489	2,452
Average	***1***	***5***	***35***	***16***	***154***	***286***	***639***	***130***	***1,248***

[a] 25 additional carcasses were sampled on the Similkameen and 46 on the Okanogan without any reach designation.
[b] One additional carcasses 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 Distribution and Origin

Based on the available data (1991-2012), most fish, regardless of origin, were found in Reach 1 on the Similkameen River (Driscoll Channel to Oroville Bridge) (Table 10.10). 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 10.10. Numbers of wild and hatchery summer Chinook carcasses sampled within different reaches in the Okanogan River basin, 1993-2012.

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

Survey year	**Origin**	**Survey reach**								**Total**
		O-1	**O-2**	**O-3**	**O-4**	**O-5**	**O-6**	**S-1**	**S-2**	
2000	Wild	0	0	8	8	24	11	189	4	244
	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
Average	***Wild***	***1***	***2***	***14***	***7***	***88***	***163***	***291***	***53***	***618***
	Hatchery	***1***	***3***	***19***	***8***	***65***	***92***	***341***	***60***	***587***

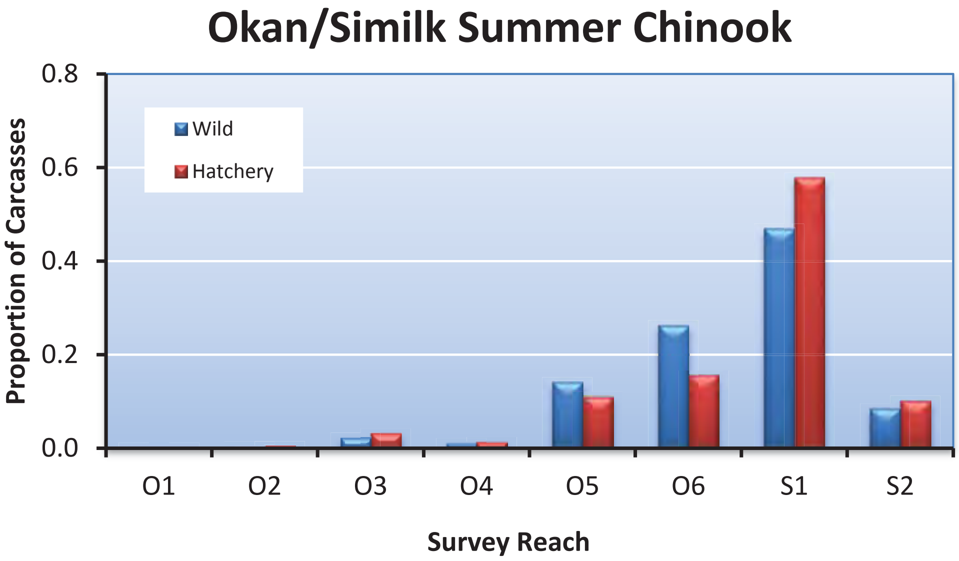

Figure 10.1. Distribution of wild and hatchery produced carcasses in different reaches in the Okanogan River basin, 1993-2012. Reach codes are described in Table 2.11.

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 for Okanogan/Similkameen summer Chinook is described in Section 9.6.

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 1993-2012 in the Okanogan River basin were salt age-3 fish (Table 10.11; 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 10.11. Proportions of wild and hatchery summer Chinook of different salt (ocean) ages sampled on spawning grounds in the Okanogan River basin, 1993-2012.

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
	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

Sample year	Origin	Salt age					Sample size
		1	2	3	4	5	
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
Average	***Wild***	***0.01***	***0.14***	***0.55***	***0.29***	***0.00***	***571***
	Hatchery	***0.05***	***0.31***	***0.57***	***0.07***	***0.00***	***550***

[a] There was one salt age-6 hatchery fish that was not included in this table.

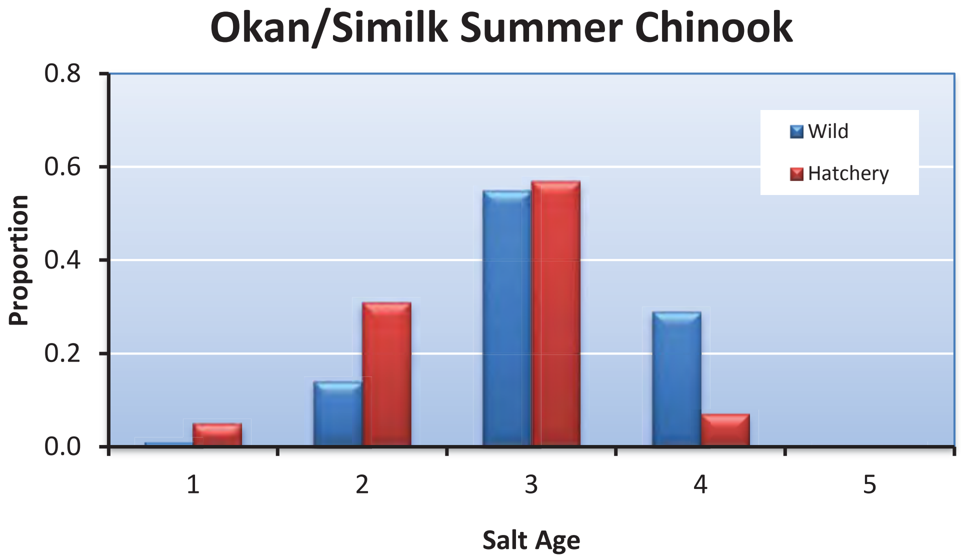

Figure 10.2. Proportions of wild and hatchery summer Chinook of different salt (ocean) ages sampled at broodstock collection sites and on spawning grounds in the Okanogan River basin for the combined years 1993-2012.

Size at Maturity

For the period 1993 through 2012, on average, hatchery summer Chinook were about 2 cm smaller than wild summer Chinook sampled in the Okanogan River basin (Table 10.12). This is likely because a higher percentage of wild fish returned as salt age-4 fish than did hatchery fish.

Table 10.12. Mean lengths (POH; cm) and variability statistics for wild and hatchery summer Chinook sampled in the Okanogan River basin, 1993-2012; 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

Sample year	**Origin**	**Sample size**	**Summer Chinook length (POH; cm)**			
			Mean	**SD**	**Minimum**	**Maximum**
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
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
Pooled	***Wild***	***12,303***	***70***	***8***	***22***	***99***
	Hatchery	***11,567***	***68***	***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 10.13). Ocean harvest has made up 37-100% of all hatchery-origin Okanogan/Similkameen summer Chinook harvested. Brood years 1997, 1998, 2000, 2004, 2006, and 2008 provided the largest harvests, while brood years 1993 and 1996 provided the lowest.

Table 10.13. Estimated number and percent (in parentheses) of hatchery-origin Okanogan/Similkameen summer Chinook captured in different fisheries, brood years 1989-2008.

Brood year	Ocean fisheries	Columbia River Fisheries			Total
		Tribal	Commercial (Zones 1-5)	Recreational (sport)	
1989	2,371 (80)	553 (19)	0 (0)	42 (1)	2,966
1990	355 (89)	34 (8)	0 (0)	12 (3)	401
1991	220 (86)	37 (14)	0 (0)	0 (0)	257
1992	422 (91)	28 (6)	2 (0)	10 (2)	462
1993	24 (80)	6 (20)	0 (0)	0 (0)	30
1994	374 (92)	23 (6)	2 (0)	7 (2)	406
1995	652 (93)	9 (1)	12 (2)	25 (4)	696
1996	6 (100)	0 (0)	0 (0)	0 (0)	6
1997	6,520 (92)	136 (2)	36 (1)	416 (6)	7,108
1998	4,363 (89)	251 (5)	45 (1)	219 (4)	4,898
1999	1,353 (68)	224 (11)	31 (2)	384 (19)	1,992
2000	3,141 (69)	533 (12)	222 (5)	665 (15)	4,561
2001	184 (58)	81 (25)	31 (10)	23 (7)	319
2002	702 (56)	200 (16)	90 (7)	258 (21)	1,250
2003	697 (37)	568 (31)	130 (7)	466 (25)	1,861
2004	3,091 (38)	2,162 (27)	694 (9)	2,165 (27)	8,112
2005	468 (46)	306 (30)	79 (8)	167 (16)	1,020
2006	3,164 (38)	3,352 (40)	469 (6)	1,419 (17)	8,404
2007	1,551 (45)	951 (27)	67 (2)	910 (26)	3,482
2008	4,527 (43)	1,950 (18)	214 (2)	3,948 (37)	10,639
Average	***1,710 (58)***	***570 (19)***	***106 (4)***	***557 (19)***	***2,944***

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) and brood year should be less than 5%.

Few hatchery-origin Okanogan summer Chinook have strayed into basins outside the Okanogan (Table 10.14). Although hatchery-origin Okanogan summer Chinook have strayed into other spawning areas, they usually made up less than 5% of the spawning escapement within those areas. The Chelan tailrace has received the largest number of Okanogan strays.

Table 10.14. Number and percent of spawning escapements within other non-target basins that consisted of hatchery-origin Okanogan summer Chinook, return years 1994-2011. 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 5%.

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
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	1.2	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	1.3	0	0.0
2009	15	0.2	3	0.2	11	1.8	18	7.2	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
Average	**2**	**0.0**	**4**	**0.2**	**18**	**2.9**	**4**	**1.0**	**1**	**0.0**

On average, about 1% of the returns have strayed into non-target spawning areas, falling within the acceptable level of less than 5% (Table 10.15). Depending on brood year, percent strays into non-target spawning areas have ranged from 0-4.4%. Few (<1% on average) have strayed into non-target hatchery programs.

Table 10.15. Number and percent of hatchery-origin Okanogan summer Chinook that homed to target spawning areas and the target hatchery, and number and percent that strayed to non-target spawning areas and non-target hatchery programs, by brood years 1989-2008. Percent stays should be less than 5%.

Brood year	Homing				Straying			
	Target stream		Target hatchery*		Non-target streams		Non-target hatcheries	
	Number	%	Number	%	Number	%	Number	%
1989	3,132	69.7	1328	29.6	2	0.0	31	0.7
1990	729	71.4	291	28.5	0	0.0	1	0.1

Brood year	Homing				Straying			
	Target stream		Target hatchery*		Non-target streams		Non-target hatcheries	
	Number	%	Number	%	Number	%	Number	%
1991	1,125	71.3	453	28.7	0	0.0	0	0.0
1992	1,264	68.5	572	31.0	8	0.4	1	0.1
1993	54	62.1	32	36.8	0	0.0	1	1.1
1994	924	80.8	203	17.7	16	1.4	1	0.1
1995	1,883	85.4	271	12.3	50	2.3	0	0.0
1996	27	100.0	0	0.0	0	0.0	0	0.0
1997	11,659	97.1	309	2.6	34	0.3	3	0.0
1998	2,784	95.4	102	3.5	31	1.1	2	0.1
1999	828	96.7	18	2.1	10	1.2	0	0.0
2000	2,091	93.6	29	1.3	99	4.4	15	0.7
2001	105	98.1	2	1.9	0	0.0	0	0.0
2002	702	96.2	17	2.3	11	1.5	0	0.0
2003	1,580	96.2	47	2.9	16	1.0	0	0.0
2004	4,947	94.4	206	3.9	85	1.6	2	0.0
2005	606	93.2	22	3.4	22	3.4	0	0.0
2006	5,220	97.6	60	1.1	68	1.3	0	0.0
2007	1,396	97.9	20	1.4	10	0.7	0	0.0
2008	3,582	98.3	35	1.0	23	0.6	4	0.1
Average	**2,232**	**88.2**	**201**	**10.6**	**24**	**1.1**	**3**	**0.2**

* Homing to the target hatchery includes Okanogan/Similkameen hatchery summer Chinook that are captured and included as broodstock in the Okanogan/Similkameen Hatchery program. These hatchery fish were typically collected at Wells Dam.

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 M). Samples from the Eastbank Hatchery – Wenatchee stock, Eastbank Hatchery – Methow/Okanogan (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 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.

Proportion of 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). The ratio pNOB/(pHOS+pNOB) is the Proportion of Natural Influence (PNI). The larger the ratio (PNI), 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 important integrated populations should have a PNI of at least 0.67 (HSRG/WDFW/NWIFC 2004).

For brood years 1993-2003, the PNI was less than 0.67 (Table 10.16). However, since brood year 2003, the PNI has generally been greater than 0.67, save 2008 and 2011.

Table 10.16. Proportionate natural influence (PNI) of the Okanogan/Similkameen summer Chinook supplementation program for brood years 1989-2012. PNI was calculated as the proportion of naturally produced Chinook in the hatchery broodstock (pNOB) divided by the proportion of hatchery Chinook on the spawning grounds (pHOS) plus pNOB. 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
	NOS	HOS	pHOS	NOB	HOB	pNOB	
1989	1,719	0	0.00	1,297	312	0.81	1.00
1990	837	0	0.00	828	206	0.80	1.00
1991	574	0	0.00	924	314	0.75	1.00
1992	473	0	0.00	297	406	0.42	1.00
1993	915	570	0.38	681	388	0.64	0.63
1994	1,323	2,710	0.67	341	244	0.58	0.46
1995	979	2,023	0.67	173	240	0.42	0.39
1996	568	1,251	0.69	287	155	0.65	0.49
1997	862	1,327	0.61	197	265	0.43	0.41
1998	600	492	0.45	153	211	0.42	0.48

Brood year	Spawners			Broodstock			PNI
	NOS	HOS	pHOS	NOB	HOB	pNOB	
1999	1,274	2,343	0.65	224	289	0.44	0.40
2000	1,174	2,527	0.68	164	337	0.33	0.33
2001	4,306	6,551	0.60	12	345	0.03	0.05
2002	4,346	9,511	0.69	247	241	0.51	0.43
2003	1,933	1,487	0.43	381	101	0.79	0.65
2004	5,309	1,412	0.21	506	16	0.97	0.82
2005	6,441	2,448	0.28	391	9	0.98	0.78
2006	5,507	3,094	0.36	500	10	0.98	0.73
2007	2,983	1,434	0.32	456	17	0.96	0.75
2008	2,998	3,977	0.57	359	86	0.81	0.59
2009	4,204	3,340	0.44	503	4	0.99	0.69
2010	3,189	2,763	0.46	484	8	0.98	0.68
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***	***0.63***

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 10.17).[13] 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 0.030. 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 10.17).

Table 10.17. 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	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	--	--	--

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[13] 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	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam	SAR to Bonneville Dam
2011	5,036	0.682 (0.064)	41.9 (12.3)	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 1989-2007, NRR for summer Chinook in the Okanogan averaged 1.05 (range, 0.16-3.82) if harvested fish were not include in the estimate and 2.35 (range, 0.32-10.26) if harvested fish were included in the estimate (Table 10.18). 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 5.30 (the calculated target value in Hillman et al. 2013). HRRs exceeded NRRs in 16 of the 19 years of data, regardless if harvest was or was not included in the estimate (Table 10.18). Hatchery replacement rates for Okanogan summer Chinook have exceeded the estimated target value of 5.30 in 8 or 12 of the 18 years of data depending on if harvest was or was not included in the estimate.

Table 10.18. 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 1989-2007.

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	1,550	2,946	5.13	0.73
1995	385	3,002	2,204	959	5.72	0.32	2,902	1,267	7.54	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	19,113	6,959	61.06	3.18
1998	352	1,092	2,919	4,166	8.29	3.82	7,817	11,199	22.21	10.26
1999	333	3,617	856	6,641	2.57	1.84	2,848	22,211	8.55	6.14
2000	334	3,701	2,234	1,716	6.69	0.46	6,795	5,232	20.34	1.41

Brood year	Broodstock Collected	Spawning Escapement	Harvest not included				Harvest included			
			HOR	NOR	HRR	NRR	HOR	NOR	HRR	NRR
2001	335	10,857	107	8,946	0.32	0.82	426	35,784	1.27	3.30
2002	333	13,857	730	6,061	2.19	0.44	1,980	16,470	5.95	1.19
2003	337	3,420	1,643	562	4.88	0.16	3,504	1,201	10.40	0.35
2004	335	6,721	5,240	3,112	15.64	0.46	13,352	7,959	39.86	1.18
2005	338	8,889	650	6,173	1.92	0.69	1,670	15,951	4.94	1.79
2006	355	8,601	5,348	2,422	15.06	0.28	13,752	6,242	38.74	0.73
2007	314	4,417	1,426	6,334	4.54	1.43	4,908	21,841	15.63	4.94
Average	***331***	***4,279***	***2,398***	***3,163***	***7.32***	***1.05***	***4,936***	***8,658***	***14.96***	***2.35***

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 0.00006 to 0.03249 for hatchery summer Chinook in the Okanogan River basin (Table 10.19).

Table 10.19. Smolt-to-adult ratios (SARs) for Okanogan/Similkameen summer Chinook, brood years 1989-2008.

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	1,528	0.00702
1995	574,197	2,851	0.00497
1996	487,776	32	0.00007
1997	572,531	18,599	0.03249
1998	287,948	7,706	0.02676
1999	610,868	2,776	0.00454
2000	528,639	6,767	0.01280
2001	26,315	424	0.01611
2002	245,997	1,975	0.00803
2003	574,908	3,489	0.00607
2004	676,222	12,896	0.01907
2005	273,512	1,660	0.00607
2006	597,276	13,633	0.02283
2007	610,379	4,890	0.00801

Brood year	Number of tagged smolts released[a]	Estimated adult captures[b]	SAR
2008	516,533	14,225	0.02754
Average	***432,348***	***5,105***	***0.01168***

[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

Because summer Chinook adults collected at Wells Dam are used for both the Methow and Okanogan supplementation programs, please refer to Section 9.7 for information on ESA compliance during 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 1196, 1347, 1395, 18118, 18120, and 18121, permit holders shall monitor and report hatchery effluents in compliance with applicable National Pollution Discharge Elimination Systems (NPDES) (EPA 1999) permit limitations. There was one NPDES violation reported at PUD Hatchery facilities during the period 1 January 2014 through 31 December 2014. NPDES monitoring and reporting for PUD Hatchery Programs during 2014 are provided in Appendix F. 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

Although the Chelan Falls summer Chinook program (formerly the Turtle Rock program) is an augmentation program, the production of 200,000 fish is No Net Impact (NNI) compensation for passage mortalities associated with Rocky Reach Dam. In addition, the conversion of the subyearling program to a 400,000 yearling program is 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, 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 Wells Dam and consisted of volunteers to the Wells Fish Hatchery. 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 Wells Fish Hatchery and then transferred to Eastbank Fish Hatchery for spawning, hatching, and rearing. Beginning in 2013, broodstock have been collected from Eastbank Hatchery Outfall.

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 facilities at Chelan Falls Hatchery on Chelan River water. In 2012, the Turtle Rock program officially became the Chelan Falls summer Chinook program.

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 reuse and standard raceways.

11.1 Broodstock Sampling

Before 2013, broodstock for the program were collected as part of the Wells summer Chinook volunteer program. Refer to Snow et al. (2012) for information related to adults collected for these programs. Beginning in 2013, broodstock for the Chelan Falls program are collected from the Eastbank Hatchery Outfall.

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 2012-2014, the egg take goal was reached in 2013.

Disease

Significant health concerns were encountered during rearing of Chelan Falls summer Chinook in 2014 (BY 2012). Specifically, after transfer from Eastbank Fish Hatchery to the Chelan Falls acclimation facility in November, there was an increase in mortality. Diagnosis showed initial transfer trauma, followed by fungus, bacterial cold water disease, and fusobacteria. January to February showed an increase in mortality of emaciated, smaller fish. No treatment was prescribed.

Number of acclimation days

Rearing of the 2012-brood Chelan Falls summer Chinook was similar to previous years with fish being held on well water. This was the third year that the whole program was transferred to the Chelan Falls Acclimation Facility for final overwinter acclimation. Transfer occurred on 4-14 November 2013. Fish were force released on 15 April 2014 after 153-163 days of acclimation on Chelan River water.

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 11.1 and 11.2. Production from the subyearling programs was converted to the yearling program.

The 2012 yearling summer Chinook program achieved 94.4% of the 600,000 target goal with about 566,188 fish being released from the Chelan River Acclimation Ponds (Table 11.3). Releases of 2013 yearling Chinook will be reported in the 2015 report.

Table 11.1. 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
2002	2003	0.3070	656,399

Brood year	Release year	CWT mark rate	Number of subyearlings released
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***

Table 11.2. 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***

Table 11.3. Numbers of Turtle Rock summer Chinook yearling smolts released from the hatchery, brood years 1995-2012. 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.

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

Brood year	Release year	Acclimation facility	CWT mark rate	Number of smolts released
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***
2010	2012	Chelan Falls	0.9702	563,824
2011	2013	Chelan Falls	0.9859	582,460
2012	2014	Chelan Falls	0.9879	566,188
Average (2010-present)		***Chelan Falls***	***0.9813***	***570,824***

[a] No CWT mark rate was provided because of the early release of this group.

Numbers tagged

Brood year 2012 yearling Chinook were 98.0% CWT and adipose fin-clipped.

In 2014, a total of 10,000 summer Chinook from the 2012 brood were PIT tagged at the Chelan River Hatchery during 10-19 March. Fish were tagged in four groups of 2,500 per group. Two groups made up a “small-size fish” group that averaged 123-129 mm and 21-25 g at time of tagging, and the other two made up a “big-size fish” group that averaged 133-138 mm and 25-29 g at time of tagging. The two size groups were developed to identify techniques that maximize performance of hatchery-origin summer yearling Chinook salmon. This is part of the NOAA Fisheries size-target study. Fish were not fed during tagging or for two days before and after tagging. A total of 9,943 PIT-tagged summer Chinook were released into the Chelan River in April 2014. A total of 57 fish died and no fish shed their tags during the period between tagging and release.

Table 11.4 summarizes the number of yearling summer Chinook that have been PIT-tagged and released from the Turtle Rock/Chelan Falls Program.

Table 11.4. Summary of PIT-tagging activities for Turtle Rock/Chelan Falls yearling summer Chinook, brood years 2007-2012.

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	15	0	11,087
		Standard	11,100	18	2	11,080
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	4,190
2011	2013	Chelan Falls	4,101	26	0	4,075
2012	2014	Chelan Falls (Small Fish)	5,000	17	0	4,983
		Chelan Falls (Big Fish)	5,000	40	0	4,960

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 11.5 and 11.6.

Table 11.5. 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

Brood year	Release year	Fork length (mm)		Mean weight	
		Mean	CV	Grams (g)	Fish/pound
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 11.6. 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
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 2012 yearling summer Chinook was 80.1% and 54.0% of the fork length and weight targets, respectively, for the Chelan Falls group. This group exceeded the target CV for length (Table 11.7).

Table 11.7. Mean lengths (FL, mm), weight (g and fish/pound), and coefficient of variation (CV) of Turtle Rock/Chelan summer Chinook yearling releases, brood years 1995-2012. 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

Brood year	Release year	Acclimation facility	Fork length (mm)		Mean weight	
			Mean	CV	Grams (g)	Fish/pound
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
Average			***161***	***17.0***	***51.1***	***9***
Targets[a]			***161***	***9.0***	***45.4***	***10***

[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 11.8). Lower than expected survival at ponding and post-ponding reduced the overall program performance. This program was discontinued in 2010.

Table 11.8. 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

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							
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***
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 11.9). Lower than expected survival in post-ponding reduced the overall program performance. This program was discontinued in 2010.

Table 11.9. 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***
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 yearling Chelan Falls summer Chinook program from green egg to release was above the standard set for the program (Table 11.10). Higher than expected survivals in all life stages contributed to the increased program performance.

Table 11.10. Hatchery life-stage survival rates (%) for Turtle Rock/Chelan Falls yearling summer Chinook, brood years 2004-2012. 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

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							
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
Average (Chelan)	***NA***	***NA***	***90.5***	***98.0***	***97.9***	***98.1***	***93.3***	***95.6***	***82.7***
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 mid-November 2014. Total redd counts were conducted in the river (see Appendix N for more details).

Redd Counts

A total of 400 summer Chinook redds were counted in the Chelan River in 2014 (Table 11.11). This was higher than the overall average of 286 redds.

Table 11.11. Total number of redds counted in the Chelan River, 2000-2014.

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
Average	***286***

Redd Distribution

Summer Chinook redds were not evenly distributed among the four sampling areas within the Chelan River. Most redds (62%) were located in the Chelan Tailrace (Table 11.12). Few summer Chinook spawned in the Habitat Pool.

Table 11.12. Total number of summer Chinook redds counted in different survey areas within the Chelan River during September through early November, 2014.

Survey area	Total redd count	Percent
Chelan Tailrace	246	61.5
Columbia Tailrace	76	19.0
Habitat Channel	62	15.5
Habitat Pool	16	4.0
Totals	***400***	***100.0***

Spawn Timing

Spawning in 2014 began the last week of September, peaked in late October and early November, and ended late November. Peak spawning occurred in the Chelan Tailrace and Columbia River Tailrace during the first week of November and in the Habitat Channel in late October (Figure 11.1).

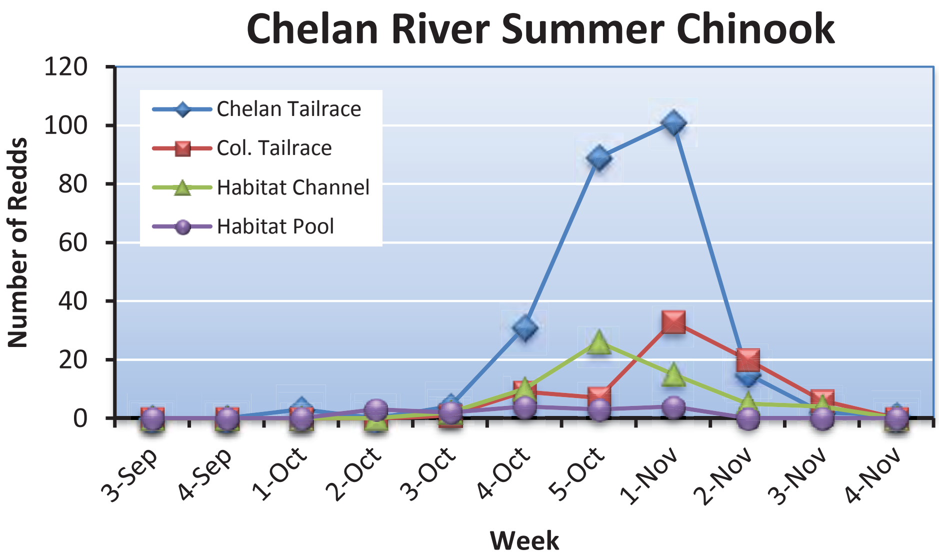

Figure 11.1. Number of new summer Chinook redds counted during different weeks within different sections of the Chelan River, September through November 2014.

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. The estimated fish per redd ratio for Methow summer Chinook in 2014 was 2.75. Multiplying this ratio by the number of redds counted in the Chelan River resulted in a total spawning escapement of 1,100 summer Chinook (Table 11.13).

Table 11.13. Spawning escapements for summer Chinook in the Chelan River for return years 2000-2014.

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
Average	***2.70***	***286***	***775***

11.4 Carcass Surveys

Surveys for summer Chinook carcasses within the Chelan River were conducted during late September to mid-November 2014 (see Appendix N for more details).

Number sampled

A total of 309 summer Chinook carcasses were sampled during September through mid-November in the Chelan River (Table 11.14). This was higher than the overall average of 161 carcasses sampled since 2000.

Table 11.14. Numbers of summer Chinook carcasses sampled within each survey area within the Chelan River, 2000-2014; 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**

Survey year	Number of summer Chinook carcasses				
	Chelan Tailrace	Columbia Tailrace	Habitat Channel	Habitat Pool	Total
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**
Average	***111***	***101***	***104***	***17***	***161***

Carcass Distribution and Origin

Summer Chinook carcasses were not evenly distributed among survey areas within the Chelan River in 2014 (Table 11.14). Most of the carcasses in the Chelan River were found in the Chelan Tailrace.

Numbers of wild and hatchery-origin summer Chinook carcasses sampled in 2014 will be available after analysis of CWTs and scales. Based on the available data, hatchery and wild summer Chinook carcasses were not distributed equally among the survey areas within the Chelan River (Table 11.15; Figure 11.2). A larger percentage of hatchery carcasses occurred in the Habitat Channel and Habitat Pool, while a larger percentage of wild summer Chinook carcasses occurred in the Columbia River Tailrace.

Table 11.15. Numbers of wild and hatchery summer Chinook carcasses sampled within different survey areas on the Chelan River, 2000-2013; 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**

Survey year	Origin	Survey reach				Total
		Chelan Tailrace	Columbia Tailrace	Habitat Channel	Habitat Pool	
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**
Average	***Wild***	***18***	***55***	***51***	***6***	***52***
	Hatchery	***32***	***65***	***106***	***22***	***96***

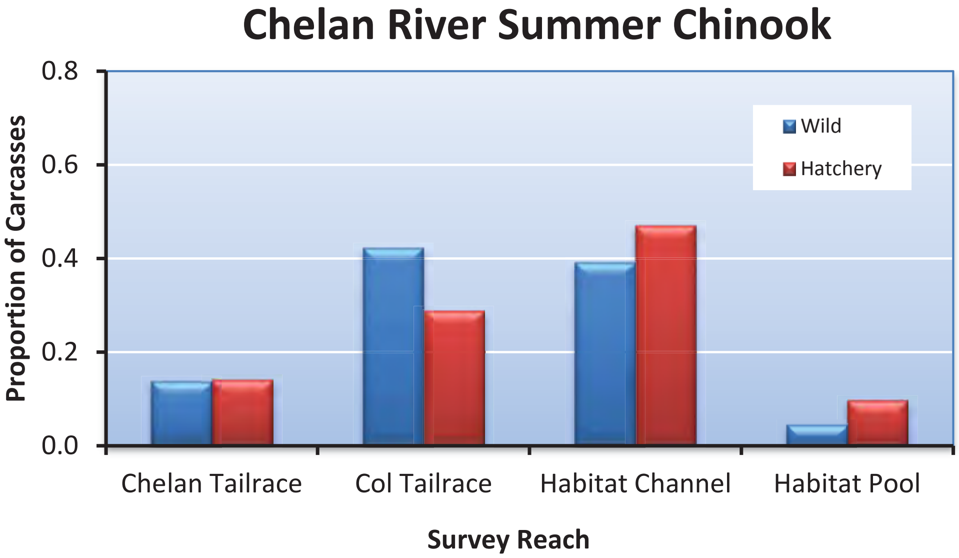

Figure 11.2. Distribution of wild and hatchery produced carcasses in different survey areas within the Chelan River, 2014.

Sampling Rate

Overall, 28% of the total spawning escapement of summer Chinook in the Chelan River was sampled in 2014 (Table 11.16). Sampling rates among survey reaches varied from 12 to 82%.

Table 11.16. Number of redds and carcasses, total spawning escapement, and sampling rates for summer Chinook in the Chelan River, 2014.

Survey reach	Total number of redds	Total number of carcasses	Total spawning escapement	Sampling rate
Chelan Tailrace	246	82	677	12.1
Columbia Tailrace	76	171	209	81.8
Habitat Channel	62	50	171	29.3
Habitat Pool	16	6	44	13.6
Total	***400***	***309***	***1,100***	***28.1***

Length Data

Mean lengths (POH, cm) of male and female summer Chinook carcasses sampled during surveys on the Chelan River in 2014 are provided in Table 11.17. The average size of males and females sampled in the Chelan River were 62 cm and 66 cm, respectively.

Table 11.17. 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, 2014.

Stream/watershed	Mean length (cm)	
	Male	Female
Chelan Tailrace	62.2 (6.4)	65.0 (5.2)
Columbia Tailrace	61.8 (9.0)	66.0 (5.0)
Habitat Channel	63.1 (8.7)	65.8 (5.0)
Habitat Pool	68.0 (0.0)	69.0 (7.3)
Total	***62.2 (8.6)***	***65.7 (5.1)***

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 11.18). 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 in 2010.

Table 11.18. Estimated number and percent (in parentheses) of Turtle Rock summer Chinook (normal subyearling releases) captured in different fisheries, brood years 1995-2008.

Brood year	Ocean fisheries	Columbia River Fisheries			Total
		Tribal	Commercial (Zones 1-5)	Recreational (sport)	
1995	688 (84)	106 (13)	11 (1)	16 (2)	821
1996	72 (80)	0 (0)	5 (6)	13 (14)	90
1997	10 (100)	0 (0)	0 (0)	0 (0)	10
1998	21 (100)	0 (0)	0 (0)	0 (0)	21
1999	184 (64)	26 (9)	4 (1)	75 (26)	289
2000	36 (55)	8 (12)	8 (12)	14 (21)	66
2001	164 (64)	30 (12)	20 (8)	44 (17)	258
2002	23 (20)	33 (29)	3 (3)	56 (49)	115
2003	9 (10)	55 (61)	2 (2)	24 (27)	90
2004	42 (37)	29 (25)	2 (2)	42 (37)	115
2005	100 (38)	95 (36)	24 (9)	44 (17)	263
2006	305 (41)	288 (38)	53 (7)	104 (14)	750
2007	110 (34)	91 (28)	21 (6)	104 (32)	326
2008	42 (33)	32 (25)	4 (3)	48 (38)	126
Average	***129 (54)***	***57 (21)***	***11 (4)***	***42 (21)***	***239***

Accelerated subyearling releases

Most of the harvest on Turtle Rock summer Chinook (accelerated subyearling releases) occurred in ocean fisheries (Table 11.19). Ocean harvest has made up 27% to 100% of all Turtle Rock summer Chinook harvested (no fish from the 2003 brood year were harvested). Brood year 1999 provided the largest total harvest, while brood years 1995, 1997, 2002, and 2003 provided the lowest. This hatchery program was discontinued in 2010.

Table 11.19. 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
		Tribal	Commercial (Zones 1-5)	Recreational (sport)	
1995	3 (100)	0 (0)	0 (0)	0 (0)	3
1996	77 (89)	5 (6)	5 (6)	0 (0)	87
1997	3 (100)	0 (0)	0 (0)	0 (0)	3
1998	97 (95)	2 (2)	3 (3)	0 (0)	102
1999	1,025 (76)	142 (10)	12 (1)	178 (13)	1,357
2000	117 (100)	0 (0)	0 (0)	0 (0)	117
2001	205 (59)	49 (14)	13 (4)	80 (23)	347
2002	9 (100)	0 (0)	0 (0)	0 (0)	9
2003	0 (0)	0 (0)	0 (0)	0 (0)	0

Brood year	Ocean fisheries	Columbia River Fisheries			Total
		Tribal	Commercial (Zones 1-5)	Recreational (sport)	
2004	45 (27)	79 (48)	6 (4)	34 (21)	164
2005	65 (59)	12 (11)	26 (24)	7 (6)	110
2006	130 (43)	113 (37)	16 (5)	43 (14)	302
2007	169 (42)	168 (42)	12 (3)	51 (13)	400
2008	20 (54)	2 (5)	4 (11)	11 (30)	37
Average	***140 (60)***	***41 (13)***	***7 (4)***	***29 (9)***	***217***

Yearling releases

Most of the harvest on Turtle Rock/Chelan Falls summer Chinook (yearling releases) occurred in ocean fisheries (Table 11.20). Ocean harvest has made up 39% to 95% of all Turtle Rock summer Chinook harvested. Brood year 2008 provided the largest harvest, while brood years 1995 and 1996 provided the lowest.

Table 11.20. Estimated number and percent (in parentheses) of Turtle Rock/Chelan Falls summer Chinook (yearling releases) captured in different fisheries, brood years 1995-2008.

Brood year	Ocean fisheries	Columbia River Fisheries			Total
		Tribal	Commercial (Zones 1-5)	Recreational (sport)	
1995	457 (75)	51 (8)	31 (5)	70 (11)	609
1996	766 (95)	14 (2)	2 (0)	21 (3)	803
1997	2,798 (91)	61 (2)	27 (1)	176 (6)	3,062
1998	4,292 (90)	224 (5)	16 (0)	230 (5)	4,762
1999	1,655 (73)	233 (10)	7 (0)	383 (17)	2,278
2000	1,205 (72)	129 (9)	54 (3)	273 (16)	1,679
2001	1,938 (59)	453 (14)	178 (5)	729 (22)	3,298
2002	1,005 (50)	384 (19)	102 (5)	536 (26)	2,027
2003	753 (46)	449 (27)	70 (4)	378 (23)	1,650
2004	838 (39)	560 (26)	127 (6)	605 (28)	2,130
2005	500 (44)	303 (27)	123 (11)	206 (18)	1,132
2006	1,169 (39)	880 (30)	231 (8)	688 (23)	2,968
2007	753 (50)	367 (24)	66 (4)	323 (21)	1,509
2008	3,543 (56)	971 (15)	148 (2)	1,696 (27)	6,358
Average	***1,548 (63)***	***364 (16)***	***84 (4)***	***451 (18)***	***2,448***

Straying

Normal subyearling releases

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 5% of the spawning escapement within those areas (Table 11.21). The Chelan tailrace has received the largest number of Turtle Rock strays. This hatchery program was discontinued in 2010.

Table 11.21. Number (No.) and percent of spawning escapements within other non-target basins that consisted of Turtle Rock summer Chinook (normal subyearling releases), return years 1998-2011. 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 5%.

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	9.5	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
Average	**2**	***0.0***	**5**	***0.2***	**5**	***0.1***	**8**	***1.1***	**2**	***0.5***	***0***	***0.0***

On average, about 31% of the brood year returns have strayed into spawning areas in the upper basin (Table 11.22). Depending on brood year, percent strays into spawning areas have ranged from 0-100%. Few (2.5% on average) have strayed into non-target hatchery programs.

Table 11.22. Number and percent of Turtle Rock summer Chinook (normal subyearling releases) that homed to the target hatchery and strayed to non-target spawning areas and non-target hatchery programs, by brood years 1995-2008.

Brood year	**Homing**				**Straying**			
	Target stream		**Target hatchery***		**Non-target streams**		**Non-target hatcheries**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
1995	-	-	197	74.1	64	24.1	5	1.9
1996	-	-	54	54.5	44	44.4	1	1.0
1997	-	-	2	28.6	5	71.4	0	0.0
1998	-	-	0	0.0	24	100.0	0	0.0
1999	-	-	40	43.5	52	56.5	0	0.0
2000	-	-	5	50.0	5	50.0	0	0.0

Brood year	Homing				Straying			
	Target stream		Target hatchery*		Non-target streams		Non-target hatcheries	
	Number	%	Number	%	Number	%	Number	%
2001	-	-	56	77.8	16	22.2	0	0.0
2002	-	-	10	100.0	0	0.0	0	0.0
2003	-	-	27	100.0	0	0.0	0	0.0
2004	-	-	71	97.3	2	2.7	0	0.0
2005	-	-	80	92.0	7	8.0	0	0.0
2006	-	-	194	72.1	72	26.8	3	1.1
2007	-	-	113	68.5	34	20.6	18	10.9
2008	-	-	16	80.0	0	0.0	4	20.0
Average	**-**	**-**	***62***	***67.0***	***23***	***30.5***	***2***	***2.5***

* Homing to the target hatchery includes Turtle Rock hatchery fish that were captured and included as broodstock in the Turtle Rock Hatchery program. These hatchery fish were typically collected at Wells Dam and Wells Hatchery.

Accelerated subyearling releases

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 5% of the spawning escapement within those areas (Table 11.23). The Chelan tailrace, Entiat Basin, and Methow River basin have received the largest numbers of Turtle Rock strays. This hatchery program was discontinued in 2010.

Table 11.23. Number (No.) and percent of spawning escapements within other non-target basins that consisted of Turtle Rock summer Chinook (accelerated subyearling releases), return years 1998-2011. 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 5%.

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	2	0.3	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	4	0.9	0	0.0

Return year	Wenatchee		Methow		Okanogan		Chelan		Entiat		Hanford Reach	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Average	***3***	***0.0***	***8***	***0.2***	***3***	***0.0***	***6***	***1.3***	***2***	***0.4***	***2***	***0.0***

On average, about 28% of the brood year returns have strayed into spawning areas in the upper basin (Table 11.24). Depending on brood year, percent strays into spawning areas have ranged from 0-83%. Few (1% on average) have strayed into non-target hatchery programs.

Table 11.24. Number and percent of Turtle Rock summer Chinook (accelerated subyearling releases) that homed to the target hatchery and strayed to non-target spawning areas and non-target hatchery programs, by brood years 1995-2008.

Brood year	Homing				Straying			
	Target stream		Target hatchery*		Non-target streams		Non-target hatcheries	
	Number	%	Number	%	Number	%	Number	%
1995	-	-	7	70.0	3	30.0	0	0.0
1996	-	-	33	32.4	69	67.6	0	0.0
1997	-	-	6	100.0	0	0.0	0	0.0
1998	-	-	2	16.7	10	83.3	0	0.0
1999	-	-	138	54.1	117	45.9	0	0.0
2000	-	-	12	40.0	18	60.0	0	0.0
2001	-	-	57	96.6	2	3.4	0	0.0
2002	-	-	0	0.0	0	0.0	0	0.0
2003	-	-	3	100.0	0	0.0	0	0.0
2004	-	-	90	75.6	29	24.4	0	0.0
2005	-	-	64	75.3	19	22.4	2	2.4
2006	-	-	88	88.9	7	7.1	4	4.0
2007	-	-	133	61.9	70	32.6	12	5.6
2008	-	-	21	84.0	2	8.0	2	8.0
Average	-	-	***47***	***64.0***	***25***	***27.5***	***1***	***1.4***

* Homing to the target hatchery includes Turtle Rock hatchery fish that were captured and included as broodstock in the Turtle Rock Hatchery program. These hatchery fish were typically collected at Wells Dam and Wells Hatchery.

Yearling releases

Rates of Turtle Rock/Chelan Falls summer Chinook (yearling releases) straying into spawning areas in the upper basin have varied widely depending on spawning area. Most of these fish strayed to spawning areas within the Chelan tailrace, Entiat Basin, and Methow River basin. On average, Turtle Rock summer Chinook have made up 5-15% of the spawning escapement within those basins (Table 11.25). Relatively few, on average, have strayed to spawning areas in the Okanogan River basin, Wenatchee River basin, and the Hanford Reach (i.e., they made up less than 5% of the spawning escapement in these areas).

Table 11.25. Number (No.) and percent of spawning escapements within other non-target basins that consisted of Turtle Rock/Chelan Falls summer Chinook (yearling releases), return years 1998-2011. 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 5%.

Return year	Wenatchee		Methow		Okanogan		Chelan		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	11.0	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	17.9	0	0.0	0	0.0
2005	5	0.1	73	2.9	78	0.9	88	19.8	46	12.5	0	0.0
2006	0	0.0	100	3.7	25	0.3	64	15.2	9	1.6	0	0.0
2007	0	0.0	65	4.8	31	0.7	40	21.2	20	8.2	19	0.1
2008	18	0.3	72	3.7	60	0.9	110	22.1	46	14.4	0	0.0
2009	8	0.1	95	5.4	32	0.4	5	0.8	18	7.2	0	0.0
2010	12	0.2	105	4.2	111	1.9	0	0.0	30	6.9	0	0.0
2011	8	0.1	88	3.0	35	0.4	15	1.2	2	0.4	0	0.0
Average	***25***	***0.2***	***132***	***4.9***	***86***	***1.2***	***82***	***15.2***	***35***	***7.5***	***3***	***0.0***

On average, about 48% of the brood year returns have strayed into spawning areas in the upper basin (Table 11.26). Depending on brood year, percent strays into spawning areas have ranged from 14-86%. Few (<2% on average) have strayed into non-target hatchery programs.

Table 11.26. Number and percent of Turtle Rock/Chelan Falls summer Chinook (yearling releases) that homed to the target hatchery and strayed to non-target spawning areas and non-target hatchery programs, by brood years 1995-2008.

Brood year	Homing				Straying			
	Target stream		Target hatchery*		Non-target streams		Non-target hatcheries	
	Number	%	Number	%	Number	%	Number	%
1995	-	-	180	39.3	278	60.7	0	0.0
1996	-	-	218	27.2	583	72.8	0	0.0
1997	-	-	254	14.2	1,531	85.6	3	0.2
1998	-	-	166	16.1	864	83.8	1	0.1
1999	-	-	181	42.7	243	57.3	0	0.0
2000	-	-	102	29.1	249	70.9	0	0.0
2001	-	-	389	59.8	261	40.2	0	0.0
2002	-	-	303	57.8	220	42.0	1	0.2
2003	-	-	373	62.9	219	36.9	1	0.2

Brood year	Homing				Straying			
	Target stream		Target hatchery*		Non-target streams		Non-target hatcheries	
	Number	%	Number	%	Number	%	Number	%
2004	-	-	287	56.6	219	43.2	1	0.2
2005	149	29.4	202	39.9	144	28.5	11	2.2
2006	429	40.4	376	35.4	220	20.7	36	3.4
2007	123	28.2	218	50.0	63	14.4	32	7.3
2008	873	47.1	658	35.5	255	13.8	66	3.6
Average	***394***	***36.3***	***279***	***40.5***	***382***	***47.9***	***11***	***1.2***

* Homing to the target hatchery includes Turtle Rock/Chelan Falls hatchery fish that were captured and included as broodstock in the Turtle Rock/Chelan Falls Hatchery program. These hatchery fish are typically collected at Wells Dam, Wells Hatchery, and the Eastbank Hatchery Outfall.

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 10.27).[14] Over the six brood years for which PIT-tagged hatchery fish were released, survival rates from the release sites to McNary Dam ranged from 0.552 to 0.722; SARs from release to detection at Bonneville Dam ranged from 0.009 to 0.028. Average travel times from release sites to McNary Dam ranged from 15 to 28 days.

Much of the variation in survival rates and travel time among brood years resulted from releases of different experimental groups (Table 10.27). 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 appeared to be greater for the Circular Reuse fish than for the Standard Raceway fish. However, the differences between groups were small for brood year 2008. 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.

Another experiment was conducted with brood year 2012 (Table 10.27). That brood year was split into two different treatment groups (small-size fish and large-size fish). The small-size fish appeared to have a higher survival rate to McNary Dam and faster travel time than did the large-size fish. SARs for these fish will be calculated after all fish have returned to the Columbia River.

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[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.

Table 10.27. 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 2007-2012. 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	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	9,546	0.564 (0.037)	28.4 (11.7)	0.009 (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)	NA
2011*	Chelan Falls	4,075	0.552 (0.054)	27.2 (11.5)	NA
2012	Chelan Falls (Small Fish)	4,983	0.590 (0.049)	25.0 (11.2)	NA
	Chelan Falls (Big Fish)	4,960	0.578 (0.043)	24.4 (10.1)	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 0.000034 to 0.001886 (Table 11.28). This hatchery program was discontinued in 2010.

Table 11.28. Subyearling-to-adult ratios (SARs) for Turtle Rock normal subyearling-released summer Chinook, brood years 1995-2008.

Brood year	Number released[a]	Estimated adult captures[b]	SAR
1995	201,230	204	0.001014
1996	371,848	188	0.000506
1997	496,904	17	0.000034
1998	194,723	28	0.000144
1999	197,793	203	0.001026
2000	222,460	28	0.000126
2001	211,306	330	0.001562
2002	200,163	38	0.000190

Brood year	Number released[a]	Estimated adult captures[b]	SAR
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	73	0.000477
Average	***230,762***	***140***	***0.000679***

[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 0.004609 (Table 11.29). This hatchery program was discontinued in 2010.

Table 11.29. 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	69	0.000372
1999	192,665	888	0.004609
2000	194,603	63	0.000324
2001	196,355	167	0.000851
2002	200,165	5	0.000025
2003	185,834	2	0.000011
2004	203,255	156	0.000768
2005	192,045	82	0.000427
2006	186,324	217	0.001165
2007	188,328	299	0.001588
2008	197,136	32	0.000162
Average	***191,689***	***148***	***0.000771***

[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, SARs for yearling-released Chinook have ranged from 0.007212 to 0.028185 (Table 11.30).

Table 11.30. Smolt-to-adult ratios (SARs) for Turtle Rock/Chelan Falls yearling-released summer Chinook, brood years 1995-2008.

Brood year	Number released[a]	Estimated adult captures[b]	SAR
1995	145,318	1,048	0.007212
1996	194,251	1,553	0.007995
1997	198,924	4,776	0.024009
1998	215,646	5,772	0.026766
1999	280,683	2,670	0.009513
2000	278,308	2,029	0.007290
2001	199,694	3,905	0.019555
2002	192,234	2,523	0.013125
2003	199,386	2,092	0.010492
2004	202,682	2,605	0.012853
2005	202,329	1,630	0.008056
2006	142,699	4,022	0.028185
2007	161,071	1,841	0.011430
2008	353,450	8,144	0.023041
Average	***211,905***	***3,186***	***0.014966***

[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.

11.6 ESA/HCP Compliance

Broodstock Collection

The 2012 brood Chelan Falls (formerly Turtle Rock) summer Chinook program is supported through adult collections at the volunteer trap at Wells Fish Hatchery and in conjunction with the Wells summer Chinook collections. During 2012, broodstock collections at the volunteer trap were consistent with the 2012 Upper Columbia River Salmon and Steelhead Broodstock Objectives and site-based broodstock collection protocols as required in ESA permit 1347. The 2012 collection target totaled 1,287 summer Chinook (including 318 for the Chelan Falls program).

Hatchery Rearing and Release

Brood year 2012 releases totaled 566,188 yearling fish. These releases represented 98.3% 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 Permits 1196, 1347, 1395, 18118, 18119, and 18121, permit holders shall monitor and report hatchery effluents in compliance with applicable National Pollution Discharge Elimination

Systems (NPDES) (EPA 1999) permit limitations. There was one NPDES violation reported at PUD Hatchery facilities during the period 1 January through 31 December 2014. NPDES monitoring and reporting for Chelan PUD Hatchery Programs during 2014 are provided in Appendix F.

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SECTION 13: APPENDICES

Appendix A: **Abundance and Total Numbers of Chinook Salmon and Trout in the Chiwawa River Basin, Washington, 2014.**

Appendix B: **Fish Trapping at the Chiwawa and Wenatchee Smolt Traps during 2014.**

Appendix C: **Summary of CSS PIT-Tagging Activities in the Wenatchee River Basin, 2014.**

Appendix D: **Wenatchee Steelhead Spawning Ground Surveys, 2014.**

Appendix E: **Examining the Genetic Structure of Wenatchee River Basin Steelhead and Evaluating the Effects of the Supplementation Program.**

Appendix F: **NPDES Hatchery Effluent Monitoring, 2014.**

Appendix G: **Steelhead Stock Assessment at Priest Rapids Dam, 2014.**

Appendix H: **Wenatchee Sockeye Salmon Spawning Escapement, 2014.**

Appendix I: **Genetic Diversity of Wenatchee Sockeye Salmon.**

Appendix J: **Genetic Diversity of Natural Chiwawa River Spring Chinook Salmon.**

Appendix K: **Fish Trapping at the Nason Creek Smolt Trap during 2014.**

Appendix L: **Fish Trapping at the White River Smolt Trap during 2014.**

Appendix M: **Genetic Diversity of Upper Columbia Summer Chinook Salmon.**

Appendix N: **Summer Chinook Spawning Ground Surveys in the Methow and Chelan Rivers, 2014.**

APPENDIX Q

NEW PREFERRED BROODSTOCK COLLECTION STRATEGY FOR WENATCHEE SPRING CHINOOK HATCHERY SUPPLEMENTATION PROGRAMS UNDER SECTION 10(A)(1)(A) PERMITS 18118 AND 18121 AND ASSOCIATED BIOLOGICAL OPINION

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March 5, 2015

Via Email Only

Rob Jones
NMFS Sustainable Fisheries Division
Anadromous Production and Inland Fisheries
National Marine Fisheries Service
1201 NE Lloyd Blvd., Suite 1100
Portland, OR 97232

Subject: New Preferred Broodstock Collection Strategy for Wenatchee spring Chinook Hatchery Supplementation Programs under Section 10(a)(1)(A) Permits 18118 and 18121 and associated Biological Opinion

Dear Mr. Jones:

The Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) and the Rocky Reach and Rock Island Hatchery Committees (HCP HC; hereafter referred to as the Parties) are submitting to you the attached proposed broodstock collection strategy for consideration and incorporation into the existing Biological Opinion and associated Section 10(a)(1)(A) Permits for the Wenatchee Basin spring Chinook hatchery programs. Inclusion of this strategy in these permits will allow the Parties to implement Chelan PUD's Chiwawa spring Chinook and Grant PUD's Nason Creek spring Chinook hatchery programs. Currently these programs are being implemented consistent with NMFS' Section 10(a)(1)(A) permits 18121 and 18118 using methods with considerable limitations and lack of long term support from the Parties.

The proposed broodstock collection strategy, which was not previously analyzed for effects in the current Biological Opinion, would collect Wenatchee basin spring Chinook salmon broodstock at Tumwater Dam and the Chiwawa weir beginning with brood year 2015. The proposed strategy was developed with considerable input from the upper Columbia River co-managers, the PRCC HSC, and HCP HC members. The Parties support this proposed alternative as the best approach to (1) maintain some level of genetic diversity within the basin for the Chiwawa and White and Little Wenatchee Rivers spring Chinook Major Spawning Aggregates (MSAs) while remaining consistent with NMFS' viability criteria and delineation of the Wenatchee population, (2) allow the programs to continue to contribute to recovery of the natural origin population, and (3) allows Chelan and Grant PUDs to meet their mitigation responsibilities (e.g., production obligations) as currently authorized by NOAA and required under the HCPs and Settlement Agreement.

In the last few years, technically and logistically challenging approaches to spring Chinook salmon broodstock collection have been attempted in the Wenatchee Basin for the purposes of conserving and fostering genetic diversity among major spawning aggregates. These have either proven ineffective or unfeasible. Subpopulation-specific culture of fish from the Chiwawa River, Nason Creek, and White River was planned and implemented. However the plan for a tributary based program utilizing fish of White River origin was discontinued when it was demonstrated that low adult abundance made collection of sufficient broodstock to meet program objective unfeasible, and that in the present political environment, development of appropriate juvenile over winter acclimation facilities was equally unfeasible. Subpopulation-specific culture of Nason has also been shown to be ineffective due to the inability to genetically distinguish Nason natural origin fish from the remaining MSAs with the necessary precision, particularly genetic differences between Chiwawa and Nason spring Chinook salmon. Although the PRCC HSC and HCP HC is committed to conserving and fostering genetic diversity among MSAs where possible, the Parties, in consultation with NMFS, must consider a less ambitious genetic approach for the foreseeable future to reduce handling effects of endangered spring Chinook salmon and incidental impacts to other listed species such as bull trout. The proposed approach still allows for subpopulation-specific culture of spring Chinook from the Chiwawa River, but the Nason Creek program will now be based on collections from the run at large. The approach also includes some provision for exclusion of fish from the White River, Little Wenatchee River, and Upper Wenatchee River.

We understand that you intend to reinitiate consultation based upon the description of the preferred broodstock collection method. Please accept this letter as our understanding and acceptance of the reinitiation action and subsequent implementation of the preferred methodology pending new permits authorizing such methodology.

The HCP HC and PRCC HSC members will be reviewing the new Wenatchee spring Chinook salmon broodstock protocol in February and anticipate approving the new broodstock protocol via our respective committee meetings on March 18 & 19, 2015. We anticipate completion of the new biological opinion and permits as soon as possible, prior to implementation of the 2015 Wenatchee spring Chinook salmon broodstock collection.

Sincerely,

Michael H. Schiewe
Chair, HCP HC
Anchor QEA, LLC

Elizabeth McManus

Elizabeth McManus
Facilitator, PRCC HSC
Ross Strategic

cc: Alene Underwood, Chelan PUD
Greg Mackey, Douglas PUD
Todd Pearsons, Grant PUD
Bill Gale, USFWS
Kirk Truscott, Colville Tribes
Tom Scribner, Yakama Nation
Craig Busack, NMFS
Mike Tonseth, WDFW

APPENDIX R

2015 PLAN SPECIES ACCOUNT ANNUAL FINANCIAL REPORT



PUBLIC UTILITY DISTRICT NO. 1 of CHELAN COUNTY
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MEMORANDUM

DATE: **January 11, 2016**

TO: **Becky Gallaher, Natural Resources Program Analyst**
Keith Truscott, Director - Natural Resources

FROM: **Debbie Litchfield, Treasurer/Director – Treasury** Debbie Litchfield

RE: **Rock Island Hydro Project Habitat Conservation Plan**
2015 Annual Financial Report, Plan Species Account

In accordance with Section 7.4.3 of the Rock Island Habitat Conservation Plan attached is the 2015 year end annual financial report of the Plan Species Account activity completed by Chelan County Public Utility District No. 1.

COMMISSIONERS: *Garry Arseneault, Carnan Bergren, Dennis S. Bolz, Ann Congdon, Randy Smith* GENERAL MANAGER: *Steve Wright*

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: 2015

Beginning Balance:	**1/1/2015**		**$ 4,837,822.51**
Transfers In:			
Rock Island Funding		711,794.00	
Interest Earnings		7,545.68	
Total Transfers In			719,339.68
Transfers Out:			
Payments		(218,281.74)	
Bank Service Fees		(79.20)	
Total Transfers Out			(218,360.94)
Ending Balance:	**12/31/2015**		**$ 5,338,801.25**

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.