UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

AUG 16 2002

MEMORANDUM FOR: The Record

FROM: D. Robert Lohn
Regional Administrator

SUBJECT: Endangered Species Act (ESA) Section 7 and Magnuson-Stevens Act Essential Fish Habitat (EFH) Consultation Biological Opinion On the Effects on Upper Columbia River (UCR) Spring Chinook Salmon and Steelhead by UCR Spring Chinook Salmon Supplementation Programs and Associated Scientific Research and Monitoring Conducted By The Washington Department of Fish and Wildlife (WDFW) and The U.S. Fish and Wildlife Service(USFWS)
Consultation Number F/NWR/1999/00836

FEDERAL AGENCIES: U.S. Fish and Wildlife Service

PROPOSED ACTIONS: Issuance of Permit #1196 to WDFW and Permit #1300 to USFWS for the artificial propagation of listed UCR spring chinook salmon as part of the supplementation programs implemented to recover endangered UCR spring chinook salmon populations in the Wenatchee River and Methow River basins. Permit #1196 allows WDFW to collect ESA-listed adults for broodstock, use artificial propagation in a hatchery environment, rear artificially spawned progeny in the hatcheries and release hatchery juveniles in the respective stream of origin. Permit #1300 allows USFWS to collect ESA-listed adults for broodstock, use artificial propagation in a hatchery environment, rear artificially spawned progeny in the hatcheries and release hatchery juveniles in the respective stream of origin. The USFWS supplementation program at the Winthrop National Fish Hatchery is integrated with the WDFW program at the Methow State Fish Hatchery, both in the Methow River Basin. Endangered adult UCR steelhead maybe handled during broodstock collection activities. The permits will expire December 31, 2007.

CONSULTATIONS CONDUCTED BY: Sustainable Fisheries Division, Northwest Region, NOAA Fisheries

SUMMARY: NOAA Fisheries concludes that operation of the referenced artificial propagation programs is not likely to jeopardize the continued existence of endangered UCR spring chinook salmon or UCR steelhead. NOAA Fisheries determined that EFH for chinook salmon will be adversely affected by the proposed activities allowed under Permit #1196 and Permit #1300, however, NOAA Fisheries concluded that conservation measures described in the Permit Applications and Terms and Conditions included in the Permits are applicable to designated chinook salmon EFH and address the adverse effects.

In arriving at these conclusions, NOAA Fisheries considered the best available scientific and commercial information, as well as comments from the Northwest Fisheries Science Center, NOAA Fisheries, and other Federal and non-Federal technical experts and resource managers in the Northwest Region. The administrative record for the attached consultations is on file with NOAA Fisheries' Sustainable Fisheries Division, Northwest Region in Seattle, Washington.

Attachment

Endangered Species Act – Section 7
Consultation and
Magnuson-Stevens Act
Essential Fish Habitat Consultation

BIOLOGICAL OPINION

Effects on Upper Columbia River Spring Chinook Salmon and Steelhead by Upper Columbia River Spring Chinook Salmon Supplementation Program and Associated Scientific Research and Monitoring Conducted By The Washington Department of Fish and Wildlife and The U.S. Fish and Wildlife Service

Agency: NOAA Fisheries

Consultation Conducted by: NOAA Fisheries
Northwest Region
Tracking #: F/NWR/1999/00836

Date Issued: AUG 16 2002

Consultation Number: F/NWR/1999/00836
Permit #1196 and Permit #1300

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I. CONSULTATION HISTORY

This opinion considers the potential impacts of the National Marine Fisheries Service's (NOAA Fisheries) proposed issuance of permits #1196 and #1300 on anadromous salmonid species listed under the Endangered Species Act (ESA). Permits #1196 and #1300 would be issued under section 10(a)(1)(A) of the ESA for artificial propagation programs operated in the Upper Columbia River (UCR) by the Washington Department of Fish and Wildlife (WDFW) and U.S. Fish and Wildlife Service (USFWS), respectively.

WDFW Artificial Propagation Permit #1196
On December 9, 1998, NOAA Fisheries received an application, dated December 4, 1998, for an ESA section 10(a)(1)(A) permit from WDFW (WDFW 1998a) requesting authorization for an annual take of endangered UCR spring chinook salmon associated with a hatchery supplementation program and a captive broodstock program. At that time the UCR spring chinook salmon evolutionarily significant unit (ESU) was proposed for listing as endangered (63 FR 11482). The application was submitted in anticipation of the final listing of the ESU as endangered under the ESA in the spring of 1999 (64 FR 14308).

Operation of the hatchery program and the release of (previously non-listed) hatchery fish from the WDFW facilities included in the application were covered under ESA section 10(a)(1)(B) Permit #902 which authorized an annual incidental take of ESA-listed Snake River sockeye salmon (endangered), spring/summer chinook salmon (threatened) and fall chinook salmon (threatened). Permit #902 was issued on April 8, 1994 and was due to expire on December 31, 1998. However, Permit #902 was extended to expire on December 31, 1999 when NOAA Fisheries issued an amendment to the permit on December 30, 1998 (NMFS 1998a). Permit #902 was subsequently modified on April 8, 1999 (NMFS 1999). The modified permit authorized incidental takes of upper Columbia River steelhead, Snake River steelhead and lower Columbia River steelhead, in addition to those species covered in the original permit. Furthermore, the hatchery operations and releases for 1999 were authorized prior to the listing of the upper Columbia River spring chinook salmon ESU and were included in the section 7 Biological Opinion on Artificial Propagation in the Columbia River Basin (NMFS 1999).

A captive broodstock program for UCR spring chinook was included in the application but is not covered by Permit #1196. During consultation, WDFW, NOAA Fisheries and the other fisheries co-managers collectively decided to address the proposed captive broodstock program and its transition to an adult-based supplementation program as part of a separate section 7 consultation on Public Utility District No. 2 of Grant County's (Grant PUD) interim protection plan for the Priest Rapids Project (Wanapum and Priest Rapids Dams). Grant PUD, who had funded the program in past, will no longer fund the proposed captive broodstock program ending funding for the program December 31, 2001. WDFW is currently developing a management plan for the continuation of the captive broodstock program but limiting it to the White River population of spring chinook salmon. When that plan is completed it is expected that WDFW will apply for a permit for the program's operation at which time NOAA Fisheries will conduct an ESA evaluation of its effects. Captive broodstock fish already on hand will be utilitized where possible by the adult based supplementation programs under Permit 1196.

USFWS Artificial Propagation Permit #1300

The fisheries co-managers, including USFWS and NOAA Fisheries, during the development of this consultation, agreed to the transition from non-listed Carson-stock spring chinook salmon to the Methow Composite stock spring chinook salmon at the Winthrop National Fish Hatchery (NFH). The USFWS had submitted a Biological Assessment to address the operation of the Winthrop NFH for the rearing and release of non-listed salmonids (USFWS 1999); however, this Biological Assessment did not cover the rearing and release of the listed Methow Composite spring chinook. The USFWS sent NOAA Fisheries a new application for a Section 10(a)(1)(A) permit that includes the new Methow Composite spring chinook program at Winthrop NFH (USFWS 2001).

2001 Broodstock Management Agreement

Management of UCR spring chinook and non-listed Carson stock spring chinook in the Methow River basin has been a contentious issue for a number of years prior to 2001. To address this issue in 2001, NOAA Fisheries, USFWS, WDFW, the Yakama Nation and the Colville Tribes reached an agreement that would address the management of an expected return of 6,700 hatchery and naturally produced spring chinook (1,000 naturally produced) to the Methow River Basin (NMFS 2001a). This was a one year agreement and described broodstock management for 2001 returns to the basin. Future annual agreements will be used in the development of the annual broodstock management protocols (see Special Condition 1 for permits #1196 and #1300 in the proposed actions below). The proposed permits would not authorize the management agreement *per se*, however, certain components of the agreement would or could be implemented through activities included in the permits.

NOAA Fisheries has completed review of the two applications for section 10(a)(1)(A) permits and has determined that the permits were applied for in good faith. Consistent with regulations 50 CFR 222.308, NOAA Fisheries is proposing to issue Permit #1196 to WDFW and Permit #1300 to USFWS pending the determination that the permits will not operate to the disadvantage of the ESA-listed species which are the subject of the permits, and that issuance of the permits will be consistent with the purposes and policies set forth in section 2 of the ESA.

II. PROPOSED ACTION

NOAA Fisheries proposes to issue section 10(a)(1)(A) permits #1196 and #1300. The objective of this biological opinion is to determine the likely effects on endangered UCR spring chinook salmon resulting from NOAA Fisheries' issuance of these permits. This biological opinion will determine if the actions of the applicants are likely to jeopardize the continued existence of endangered UCR spring chinook salmon or result in destruction or adverse modification of its designated critical habitat. Furthermore, this biological opinion will determine if the incidental take resulting from WDFW's and USFWS' proposed hatchery supplementation programs are likely to jeopardize the continued existence of the UCR steelhead (endangered), Snake River steelhead (threatened), lower Columbia River chinook salmon (threatened), upper Willamette River chinook salmon (threatened), middle Columbia River steelhead (threatened), lower Columbia River steelhead (threatened), upper Willamette River steelhead (threatened), Columbia River chum salmon (threatened), Snake River fall chinook salmon (threatened), Snake River spring/summer chinook salmon (threatened), and Snake River sockeye salmon (endangered) ESUs or result in the destruction or adverse modification of the respective ESU's designated critical habitat. The permits would be valid for a five-year period beginning in 2002 and expiring December 31, 2007.

WDFW's proposed program as defined in Permit #1196 includes the collection of broodstock, incremental changes in production levels, predetermined means to manage stray fish, and two approaches for population separation. All aspects will be monitored in a manner that allows comparison of the effectiveness of the alternative strategies. Initial recovery options are based upon continued use, and modification as necessary, of existing hatcheries built in the mid- and upper Columbia River Region for spring chinook salmon production (Figure 1). USFWS' proposed program as defined in Permit #1300 includes the use of artificial propagation in coordination with the WDFW's proposed adult supplementation program for the Methow River Basin (Figure 1).

Described in the following sections are the artificial propagation programs and the special conditions proposed to be included in the permits.

A. WDFW's UCR Spring Chinook Salmon Adult Supplementation Program

Permit #1196

WDFW operates two hatchery complexes within the mid- and upper Columbia River Basin for the propagation of spring chinook: the Methow Fish Hatchery Complex and the Rock Island Fish Hatchery Complex. These complexes are funded by the Public Utility Districts in the upper Columbia River Region for the purpose of conducting supplementation programs for the naturally spawning populations on the Methow and Wenatchee Rivers, respectively (Chapman *et al.* 1995). The Public Utility District No. 1 of Chelan County (Chelan PUD) funds the operation of the Rock Island Fish Hatchery Complex, and the Public Utility District No. 1 of Douglas County (Douglas PUD) funds the operation of the Methow Fish Hatchery Complex. The Methow Complex uses returning spring chinook adults collected at weirs on the Methow River and its tributaries, the Twisp and Chewuch rivers. More recently, upriver-bound spring chinook salmon adults have been collected at Wells Dam and propagated at Methow State Fish Hatchery (SFH). The Rock Island Complex uses spring chinook salmon broodstock collected at weirs on the Chiwawa River and Nason Creek, tributaries to the Wenatchee River, and at Tumwater Dam on the mainstem Wenatchee River. WDFW's Eastbank Hatchery is part of the Rock Island Complex. Satellite programs included within the two complexes managed by WDFW are the

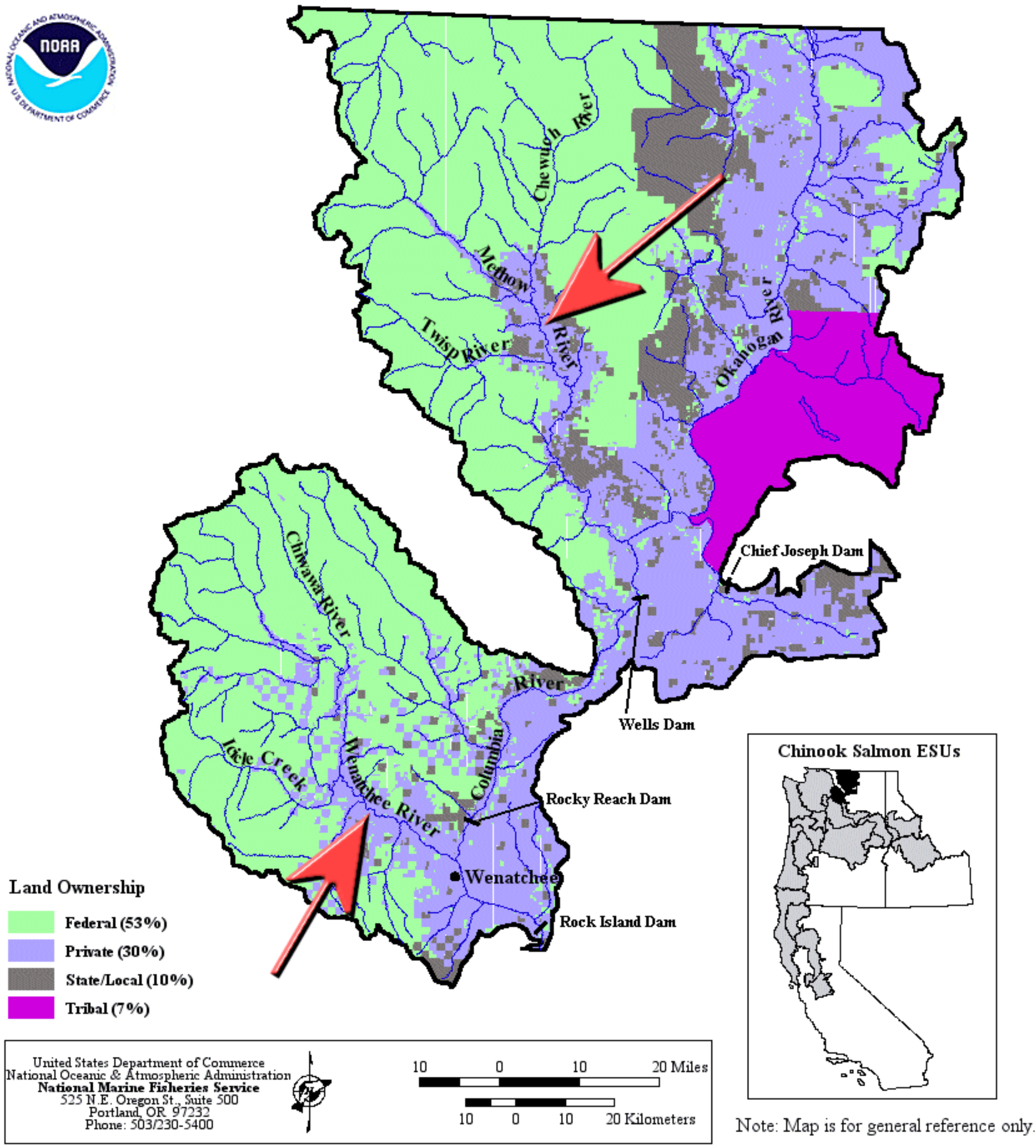

Figure 3. Geographic extent of the Upper Columbia River spring-run chinook salmon Evolutionarily Significant Unit and location of the Wenatchee and Methow rivers.

Twisp Pond, Chiwawa Ponds, Chewuch Pond and the aforementioned adult collection weirs on Nason Creek and the Methow, Chiwawa, Twisp, and Chewuch rivers (WDFW 1998a).

The permit application includes ESA-listed spring chinook salmon artificial propagation activities occurring at the two hatchery complexes, proposed for a five year period commencing in 2002. Through these programs, spring chinook salmon within the UCR spring chinook salmon ESU will be intentionally taken by WDFW for the purpose of enhancing the status of the species through supplementation. Supplementation program activities that will lead to the intentional take of the ESA-listed species will include:

- the collection of broodstock through WDFW trapping operations at Wells Dam for Methow River populations (with potential collection on the Twisp River, Chewuch River, at Foghorn Dam on the Methow River, and at Methow SFH) and on Nason Creek, Chiwawa River or at Tumwater Dam for Wenatchee River Basin-origin spring chinook salmon;
- the holding and artificial spawning of adults at the Methow and Eastbank hatcheries;
- the incubation and propagation from the fertilized egg through the smolt life stage at the Methow and Eastbank hatcheries;
- the transfer of fingerlings and pre-smolts from the two hatcheries for rearing in acclimation ponds on the Chiwawa, Twisp, and Chewuch Rivers; and
- the release of smolts into the Methow, Chewuch, Twisp, and Chiwawa rivers from the WDFW hatcheries and acclimation ponds on those systems.

In addition to requiring that WDFW operate the hatchery programs as described in the permit application, NOAA Fisheries proposes to include special conditions in permit 1196. Described below are the take descriptions and levels and special conditions to be specified in the permit 1196. The permit will also include reporting and notification requirements typical of section 10 enhancement permits that are necessary to monitor compliance and status of the species.

<u>Take Descriptions and/or Levels</u>

<u>Intentional Take – Wenatchee River Basin (Rock Island Complex)</u>

1. Adult and jack, endangered, UCR spring chinook salmon (both natural and hatchery origin) that return to the Chiwawa River and Nason Creek weirs and Tumwater Dam each year may be captured, anesthetized, and handled (enumerated, measured, sampled for tissues and/or scales).

2. Of the combined total number of spring chinook salmon adults and jacks that return to the Chiwawa River and Nason Creek each year, WDFW may retain no more than 400 or one-third, whichever is less, for broodstock to meet the long-term smolt production goals of the program. The ESA-listed adult chinook salmon retained for broodstock may be transferred to transport vehicles and transported to WDFW's spawning facility.

3. The adult and jack endangered UCR spring chinook salmon not retained for broodstock must be released unharmed above the respective trapping facility for natural spawning immediately after being enumerated.

4. The ESA-listed adult fish retained for broodstock may be marked and/or tagged, treated with antibiotics, placed in holding ponds, and spawned. Sperm from ESA-listed adult males may be cryopreserved for potential future use. Carcasses of the ESA-listed fish spawned in captivity may be outplanted in the Chiwawa River watershed for nutrient enrichment.

5. The resulting eggs generated from the supplementation program may be incubated and the ESA-listed juvenile fish progeny may be reared in captivity. ESA-listed juvenile fish produced from WDFW's supplementation program may be tagged/marked with coded wire tags, passive integrated transponders, fin clips, and/or other biological identifiers.

6. Up to 672,000 juvenile, endangered, artificially propagated, UCR spring chinook salmon, progeny generated from the supplementation program, may be transported from the hatchery and released into acclimation ponds on the Chiwawa River for subsequent volitional out-migration and/or released directly into the Chiwawa River when they are ready to out-migrate.

7. ESA-listed juvenile fish within the hatchery environment may be monitored to acquire meristic and morphological information or sacrificed to obtain otoliths for future reference and/or to obtain pertinent pathological or physiological information. Incidental mortalities of adult ESA-listed fish associated with capturing, handling, and transporting activities must not exceed 5 percent of the total adult fish collected.

<u>Intentional Take – Methow River Basin (Methow Hatchery Complex)</u>

8. Adult and jack, endangered, UCR spring chinook salmon (both natural and hatchery origin) that return to Wells Dam, the Twisp River trap, the Chewuch River trap, and Foghorn Dam each year may be captured, anesthetized, and handled (enumerated, measured, sampled for tissues and/or scales).

9. WDFW may retain adult and jack, endangered, UCR spring chinook salmon that return to Wells Dam (and when necessary the Twisp River trap, Chewuch River trap, Foghorn Dam, Winthrop National Fish Hatchery (NFH), and/or the Methow Fish Hatchery (SFH) for use as broodstock. Broodstock collected by WDFW may be used in WDFW's and in U.S. Fish and Wildlife Service's (USFWS) Methow River Basin supplementation programs. Of the adult and jack spring chinook salmon captured and retained for broodstock at Wells Dam, the Twisp

River trap, the Chewuch River trap, and Foghorn Dam, WDFW shall retain a representative sample of both hatchery and naturally produced fish. The annual production goal for WDFW's supplementation program at Methow SFH of 550,000 smolts shall be used until modifications at the fish hatchery is made. Under this production goal scenario, when the total annual adult return to Wells Dam is predicted to be 668 adults or fewer, then all of the adult fish may be retained and placed into WDFW and USFWS' adult-based supplementation programs. When the total annual adult return to Wells Dam is predicted to be 669 to 964, up to 69 percent of the adult run may be placed into WDFW and USFWS' adult-based supplementation programs and a minimum of 296 adults shall be passed upstream of the dam for natural spawning. When the total annual adult return to Wells Dam is predicted to be over 964, the retention of adults shall be at levels that will meet maximum production objectives for WDFW and USFWS' programs.

10. The ESA-listed adult chinook salmon retained for broodstock may be transferred to transport vehicles and transported to WDFW's spawning facility or USFWS' Winthrop NFH. Handling of ESA-listed adult fish by USFWS is authorized under a separate take authorization.

11. The adult and jack, endangered, UCR spring chinook salmon not retained for broodstock must be released unharmed above the respective trapping facility for natural spawning immediately after being enumerated.

12. The ESA-listed adult fish retained for broodstock may be marked and/or tagged, treated with antibiotics, placed in holding ponds, and spawned. Sperm from ESA-listed adult males may be cryopreserved for potential future use. Carcasses of the ESA-listed fish spawned in captivity may be outplanted in the Methow River watershed for nutrient enrichment if disease protocols as determined by fisheries co-managers are met.

13. The resulting eggs generated from the supplementation program may be incubated and the ESA-listed juvenile fish progeny may be reared in captivity. ESA-listed juvenile fish produced from WDFW's supplementation program may be tagged/marked with coded wire tags, passive integrated transponders, fin clips, and/or other biological identifiers.

14. Up to 550,000 juvenile, endangered, artificially propagated, UCR spring chinook salmon, progeny generated from WDFW's supplementation program, may be transported from the hatchery and released into acclimation ponds on the Chewuch and Twisp rivers for subsequent volitional out-migration and/or released directly into the Chewuch River when they are ready to out-migrate.

15. ESA-listed juvenile fish within the hatchery environment may be monitored to acquire meristic and morphological information or sacrificed to obtain otoliths for future reference and/or to obtain pertinent pathological or physiological information. Indirect mortalities of adult ESA-listed fish associated with capturing, handling, and transporting activities must not exceed of the total adult fish collected.

16. The progeny produced from the Methow SFH shall be released on-station or transferred to the Chewuch Pond as subyearlings for acclimation and release. The progeny of known Twisp River spring chinook salmon shall be acclimated and released from the Twisp Pond or on-station. A portion of the eggs/progeny from the Methow SFH may be transferred to the Winthrop NFH for rearing and release.

Incidental Take

17. Incidental take of ESA-listed UCR steelhead during WDFW's broodstock collection activities is authorized. During collection of spring chinook salmon broodstock at Wells Dam, WDFW may handle up to 100 listed steelhead when trapping occurs at both adult fish ladders. Trapping of spring chinook salmon in both ladders is necessary when the annual adult return is such that all adults collected will be retained for broodstock. As the annual return increases, trapping will be limited to the west ladder which reduces the potential to handle listed steelhead to less than 10 adults. Mortalities from the incidental take of listed steelhead is expected to be no more than 9 adults.

18. Incidental takes of the 12 ESA-listed Columbia River Basin salmonid species associated with WDFW's broodstock collection activities, hatchery operations, and juvenile fish releases from the program are authorized. Because of the inherent biological attributes of aquatic species such as salmon and steelhead, the dimensions and variability of the Columbia and Snake River system and tributaries, and the operational complexities of hatchery actions, determining precise incidental take levels of ESA-listed species attributable to WDFW's hatchery activities are not possible at present. In the absence of quantitative estimates of incidental take, WDFW will provide to NOAA Fisheries fish release numbers/locations and other information on WDFW's hatchery operations to assure that incidental take is minimized to the extent necessary to protect ESA-listed species. If NOAA Fisheries determines that incidental takes due to WDFW's hatchery activities have the potential to jeopardize a listed species, WDFW must suspend the activities that result in the incidental takes until a reasonable solution is achieved, this permit is amended, and/or WDFW's program is reevaluated under Section 7 of the ESA.

Special Conditions

1. In cooperation with the Joint Fishery Parties (Federal, state and tribal co-managers) and the Mid-Columbia Coordinating Committee, WDFW shall develop annual broodstock objectives and site-based broodstock collection protocols for the UCR spring chinook salmon supplementation program. The annual broodstock objectives and protocols shall be submitted to the Hatcheries and Inland Fisheries Branch, NOAA Fisheries, by April 15 each year. NOAA Fisheries will provide a letter of approval, if it is determined that the annual broodstock objectives and protocols are consistent with the terms and conditions of this permit.

2. Each year, WDFW shall operate the Nason Creek and Chiwawa River weirs from June 1 to September 10. The annual broodstock collection protocols will determine the daily operations at the Nason Creek and Chiwawa River weirs and the Tumwater Dam trap.

3. WDFW shall remove the captured fish from the traps daily when the traps are operating. Those fish not retained for broodstock shall be passed upstream of the weir for natural spawning after being handled for enumeration and the collection of biological information.

4. WDFW must provide seven-day-a-week on-site monitoring of the adult traps and acclimation sites. The adult trap/holding box must be secured with locking lids or other mechanisms to prevent vandalism and/or unauthorized take.

5. WDFW shall mark all hatchery-produced Nason Creek and Chiwawa River spring chinook salmon to allow the segregation of adults for broodstock and evaluations of escapement and natural production in the Wenatchee River Basin.

6. After the adult fish are spawned, WDFW shall incinerate or bury all UCR spring chinook salmon carcasses if there is not a research, educational, or public outreach purpose identified, or distribute the carcasses in the Wenatchee River or Methow River watersheds for stream fertilization purposes if disease protocols as determined by the fisheries co-managers are met.

7. WDFW shall report to the Hatcheries and Inland Fisheries Branch, NOAA Fisheries, annually on the number of adult, endangered, UCR spring chinook salmon collected and retained for broodstock and the details of the spawning procedures that were implemented. The report shall include a description of the origin (in-basin or out-of-basin; naturally produced or hatchery-produced (when possible)), as well as the proportion of males and females, of all spring chinook salmon used for artificial spawning. WDFW shall also provide detailed

information (number, origin, sex, condition) on the adult fish released for natural spawning.

8. Prior to any hatchery-produced juvenile fish releases and/or transfers, WDFW must receive approval from the Hatcheries and Inland Fisheries Branch, NOAA Fisheries, for the number, stock origin, release dates, and release location(s) of the fish to be released and/or transferred. A plan describing proposed fish releases or transfers, developed annually by the Joint Fishery Parties and the Mid-Columbia Coordinating Committee, must be submitted to NOAA Fisheries two months prior to any such releases or transfers.

9. With the cooperation of the USFWS, WDFW shall develop an identification method for each of the production groups in the Methow River Basin (Twisp River stock, Chewuch River stock, Methow River composite stock Winthrop NFH Carson-stock and others) to allow for the broodstock segregation of returning adults and evaluation of escapement and natural production.

10. WDFW shall determine the origin (in-basin or out-of-basin; naturally produced or hatchery-produced (when possible)) of all spring chinook salmon retained prior to spawning. WDFW shall avoid using marked spring chinook salmon originating outside the Mid-Columbia River region for broodstock. Coded wire tags shall be read and the origin of each adult spawner shall be determined. The progeny of the adults captured at Wells Dam that are from the Entiat River or the Wenatchee River programs shall be transferred to their hatchery of origin if consistent with fish health protocols. Adult hatchery fish that are determined to originate from Winthrop NFH shall be transferred to Winthrop NFH.

11. WDFW shall individually mark/tag or segregate collected adults to identify them by time of arrival. If too many adults are collected because the actual run size differs substantially from the predicted run size, adults may be selected for return to the river for natural spawning. Late arriving adults shall be genotyped through in-situ scale pattern analysis and maturation timing to help ensure that ocean-type chinook salmon are not inadvertently included in the broodstock.

12. WDFW shall spawn both listed hatchery x natural and natural x natural crosses to the extent possible and evaluate the success of the two types of crosses. When possible, naturally produced fish retained for broodstock shall represent the natural-origin population in terms of age composition, sex ratio, and run timing .

13. To the greatest extent possible, WDFW shall maintain known Twisp River spring chinook salmon as a separate broodstock within the hatchery. The progeny of known Twisp River spring chinook salmon shall be distinctly marked for identification purposes.

14. To minimize the lateral transfer of pathogens, a sterilized needle must be used for each individual injection when PIT-tagging ESA-listed fish.

15. All ESA-listed fish handled out-of-water for the purpose of recording biological information must be anesthetized. Anesthetized fish must be allowed to recover (e.g. in a recovery tank) before being released. Fish that are simply counted must remain in water but do not need to be anesthetized.

16. To reduce and control fish disease incidences, WDFW will use the disease control procedures identified in the operations plans and adhere to the Washington Co-Manager, Pacific Northwest Fish Health Protection Committee and IHOT [Integrated Hatcheries Operation Team] fish disease control policies.

B. WDFW's Monitoring and Evaluation Program

WDFW has provided a monitoring and evaluation plan for the spring chinook salmon artificial propagation program to support impact minimization objectives. Complementary components to monitor and evaluate adult-based supplementation fish will be funded and implemented by the parties to the Mid-Columbia Mainstem Conservation Plan (MCMCP). Details associated with the monitoring and evaluation plan for the proposed adult-based supplementation program are provided in the MCMCP's "Biological Assessment and Management Plan – Mid-Columbia River Hatchery Program (BAMP)" (BAMP 1998). The plan for the adult-based supplementation program addresses three critical uncertainties associated with the proposed program: (1) whether the hatchery facilities can safely meet their production objectives, (2) the effect of the programs on the long-term reproductive success of the population in the natural environment, and (3) the identification of ways to operate the facilities to reduce the short-term ecological impacts to the naturally produced fish (WDFW 1998a).

The monitoring and evaluation activities proposed by WDFW in its permit application (WDFW 1998a), include only take of listed species associated with the monitoring and evaluation activities within the hatchery environment. Such activities will include handling fish for tagging, marking, transfers, transportation, and the acquisition of biological information as described in the permit application. Mortalities, including intentional lethal takes associated with pathological and/or physiological analyses, are expected to occur and are addressed in the proposed permit conditions. Annual takes of ESA-listed chinook salmon for scientific research purposes within the hatchery environment may be identified but are not be included in the proposed permit.

Collection of monitoring and evaluation data by WDFW that occurs outside the hatchery environment including the collection of endangered spring chinook salmon carcasses and the acquisition of tissue samples and scales from the carcasses for archiving and/or analysis, and other WDFW scientific research activities that occur outside the hatchery environment are included in WDFW's scientific research Permit #1203 (WDFW 2000a) and are not considered in the current proposed action.

WDFW will monitor and evaluate the UCR spring chinook salmon artificial propagation program activities within the hatchery and report to NOAA Fisheries annually on the monitoring and evaluation efforts. WDFW will also provide an annual report to the Hatcheries and Inland Fisheries Branch, NOAA Fisheries, documenting the monitoring and evaluation activities associated with the endangered UCR spring chinook salmon hatchery supplementation program. Such monitoring and evaluation efforts shall include the relative success of juvenile fish rearing procedures and techniques, a description of any substantial mortality events in the hatcheries, enumeration of CWT recoveries and analysis, an evaluation of the relative success of hatchery x natural and natural x natural crosses, and an evaluation of release strategies. WDFW will also include in the annual report monitoring and evaluation data collected under Permit #1203.

C. USFWS' Spring Chinook Salmon Adult Supplementation Program

Permit #1300

The USFWS operates three federal fish hatcheries within the upper-Columbia River Basin: Leavenworth, Entiat and Winthrop National Fish Hatcheries (NFH) (Complex). The BOR funds the Complex while the USFWS manages and operates the facilities.

Winthrop NFH is located near Winthrop, Washington on the Methow River, 44.7 river miles (RM) (72 km) above the confluence with the Columbia River. Winthrop NFH is located less than one mile downstream of the Methow SFH.

Since 1974, the Winthrop NFH has propagated unlisted spring chinook salmon of varied origin. Original broodstock was obtained from the Cowlitz Salmon Hatchery and has included transfers of Carson-stock spring chinook from Little White Salmon NFH, Klickitat Hatchery and Leavenworth NFH. The current Winthrop NFH production of Carson-stock spring chinook is not considered part of the UCR spring chinook ESU.

The USFWS proposes to reduce annual production from the 800,000 smolts to a level of 600,000 smolts and to phase out the use of Winthrop NFH Carson-stock spring chinook as identified in the BAMP (1998). The Winthrop NFH Carson-stock spring chinook will be replaced by Methow Composite stock in coordination with WDFW. In cooperation with state, tribal and federal co-managers, USFWS would seek to backfill any lost production due to the phase-out of Winthrop NFH Carson-stock spring chinook with other programs that might include coho, captive broodstock spring chinook or some other appropriate stock. The Methow Composite stock spring chinook shall be complete by 2003.

The capture of adults for broodstock (both Carson-stock and Methow Composite) could occur at three different locations. The runsize and annual broodstock collection protocols (see above) will dictate the trapping location(s):

1. Fish that volunteer to the hatchery, via hatchery outfall and the fish ladder (this will be the preferred method).
2. If the run size is low, a proportion of the broodstock will be captured at Wells Dam by WDFW and transferred to Winthrop NFH.
3. Broodstock may also be secured by netting adults at the Methow SFH out-fall and transferred to Winthrop NFH.

Program operation plans include contingencies for use of eggs surplus to production needs. During the transition from Carson-stock spring chinook to Methow Composite stock, USFWS and WDFW might collect more eggs than are needed for meeting full production at both facilities. Prior to the listing of Upper Columbia River spring chinook salmon, Methow Composite stock and Winthrop NFH Carson-stock spring chinook were both marked with CWTs and an adipose fin clips. Adults collected for broodstock would be sorted between the Methow SFH and Winthrop NFH by CWT at the time of spawning. Because Methow Composite stock and Winthrop NFH Carson-stock spring chinook adults cannot be differentiated until they are killed and spawned, all adults would be retained to prevent the culling of listed Methow Composite stock spring chinook. The fact that all adults that volunteer into the Winthrop NFH will be held and spawned may contribute to the collection of more listed Methow Composite stock eggs than are needed to meet production needs for both Methow SFH and Winthrop NFH.

USFWS in cooperation with WDFW proposes to provide eyed eggs that are surplus to the program production goals for use in remote-site incubators, or to out-plant listed fish fry into the Methow River basin.

The USFWS will hold and artificially spawn adults at Winthrop NFH, then incubate and rear spring chinook through the smolt life stage. The release of the spring chinook smolts will be coordinated with WDFW and releases of Methow Composite stock from the Methow SFH. All spring chinook salmon released at the Winthrop NFH will carry an external mark and/or an internal tag. All listed Methow Composite stock will be given a CWT without an adipose clip. The unlisted Winthrop NFH Carson-stock spring chinook, until production ceases in 2003, will have an adipose clip only. Up to 7,500 of the juveniles might be PIT tagged to aid in evaluations.

In addition to requiring that the USFWS operate the hatchery programs as described in the permit application, NOAA Fisheries proposes to include special conditions in permit 1300. Described below are the take descriptions and levels and special conditions to be specified in the permit 1300. The permit will also include reporting and notification requirements typical of section 10 enhancement permits that are necessary to monitor compliance and status of the species.

Take Descriptions and/or Levels

Intentional Take

1. Adult and jack, endangered, UCR spring chinook salmon (both natural and hatchery origin) that return to Winthrop NFH, Foghorn Dam and/or Foghorn Ditch may be captured, anesthetized, and handled (enumerated, measured, sampled for tissues and/or scales).

2. USFWS may retain all adult and jack spring chinook salmon that return to Winthrop NFH, Foghorn Dam and/or Foghorn Ditch for use as broodstock in USFWS' supplementation program in the Methow River Basin.

3. USFWS may accept transfer of listed UCR adult and jack spring chinook collected by WDFW at Wells Dam, the Twisp River trap, the Chewuch River trap, Methow Fish Hatchery and Foghorn Dam for use as broodstock in USFWS' supplementation program in the Methow River Basin. Handling and authorization of any such transfer shall conform to all applicable conditions in this permit.

4. The annual production goal of 600,000 smolts at Winthrop NFH shall be used for the supplementation program until modifications at the fish hatchery are made. Production goals for USFWS' and WDFW's supplementation programs will determine broodstock collection activities by WDFW at Wells Dam and USFWS in the Methow River Basin.

5. The ESA-listed adult chinook salmon retained for broodstock by USFWS shall be retained at Winthrop NFH or transferred to transport vehicles and transported to WDFW's spawning facility.

6. The adult and jack, endangered, UCR spring chinook salmon not retained for broodstock must be released unharmed above the respective trapping facility for natural spawning immediately after being enumerated.

7. The ESA-listed adult fish retained for broodstock may be marked and/or tagged, treated with antibiotics, placed in holding ponds, and spawned. Sperm from ESA-listed adult males may be cryopreserved for potential future use. Carcasses of the ESA-listed fish spawned in captivity may be outplanted in the Methow River watershed for nutrient enrichment if disease protocols as determined by the fisheries co-managers are met.

8. The resulting eggs generated from the supplementation program may be incubated and the ESA-listed juvenile fish progeny may be reared in captivity. ESA-listed juvenile fish produced from USFWS' supplementation program may be

tagged/marked with coded wire tags, passive integrated transponders, fin clips, and/or other biological identifiers.

9. Up to 600,000 juvenile, endangered, artificially propagated, UCR spring chinook salmon, progeny generated from USFWS' supplementation program may be transported from the hatchery and released into acclimation ponds on the Chewuch and Twisp rivers for subsequent volitional out-migration and/or released directly from Winthrop NFH into the Methow River when they are ready to out-migrate.

10. ESA-listed juvenile fish within the hatchery environment may be monitored to acquire meristic and morphological information or sacrificed to obtain otoliths for future reference and/or to obtain pertinent pathological or physiological information. Indirect mortalities of adult ESA-listed fish associated with capturing, handling, and transporting activities must not exceed 5 percent of the total adult fish collected.

11. The progeny produced from the Winthrop NFH shall be released on-station or transferred to the Chewuch Pond as subyearlings for acclimation and release. The progeny of known Twisp River spring chinook salmon shall be acclimated and released from the Twisp Pond or on-station. A proportion (as determined by the fisheries co-managers) of the eggs/progeny from the Winthrop NFH may be transferred to the Methow Fish Hatchery for rearing and release.

12. The progeny produced from the Winthrop NFH may be used in remote site incubators or outplanted into the Methow River Basin as fry.

<u>Incidental Take</u>

13. Incidental take of ESA-listed UCR steelhead during USFWS' broodstock collection activities is authorized. During collection of spring chinook salmon broodstock at Winthrop NFH, USFWS may handle up to 20 listed steelhead. Listed steelhead are to be released into the Methow River unharmed. Lethal take of listed steelhead from these activities shall not exceed one adult annually.

14. Incidental takes of the 12 ESA-listed Columbia River Basin salmonid species associated with USFWS' broodstock collection activities, hatchery operations, and juvenile fish releases from the program are authorized. Because of the inherent biological attributes of aquatic species such as salmon and steelhead, the dimensions and variability of the Columbia and Snake River system and tributaries, and the operational complexities of hatchery actions, determining precise incidental take levels of ESA-listed species attributable to USFWS' hatchery activities are not possible at present. In the absence of quantitative estimates of incidental take, USFWS will provide fish release numbers/locations

and other information on USFWS' hatchery operations to NOAA Fisheries to assure that incidental take is minimized to the extent necessary to protect ESA-listed species. If NOAA Fisheries determines that incidental takes due to USFWS' hatchery activities have the potential to jeopardize a of listed species, USFWS must suspend the activities that result in the incidental takes until a reasonable solution is achieved, this permit is amended, and/or USFWS' program is reevaluated under section 7 of the ESA.

Special Conditions

1. In cooperation with the Joint Fishery Parties and the Mid-Columbia Coordinating Committee, USFWS shall develop annual broodstock objectives and site-based broodstock collection protocols for the UCR spring chinook salmon supplementation program. The annual broodstock objectives and protocols shall be submitted to the Hatcheries and Inland Fisheries Branch, NOAA Fisheries, by April 15 each year. NOAA Fisheries will provide a letter of approval, if it is determined that the annual broodstock objectives and protocols are consistent with the terms and conditions of this permit.

2. USFWS shall not release pure non-listed Carson-stock spring chinook salmon at Winthrop NFH after 2005.

3. USFWS shall collect adults at Foghorn Dam, Foghorn Ditch, and Winthrop NFH ladder to meet the broodstock objectives and site-based broodstock collection protocols.

4. USFWS shall determine the origin (in-basin or out-of-basin; naturally produced or hatchery-produced (when possible)) of all spring chinook salmon retained prior to spawning, including noting numbers of fish of unknown origin. USFWS shall avoid using marked spring chinook salmon originating outside the Mid-Columbia River region for broodstock. Coded wire tags shall be read and the origin of each adult spawner shall be determined. The progeny of the adults captured at Wells Dam that are from the Entiat River or the Wenatchee River programs shall be transferred to their hatchery of origin if consistent with fish health guidelines.

5. After the adult fish are spawned, USFWS shall incinerate or bury all UCR spring chinook salmon carcasses if there is not a research, educational, or public outreach purpose identified, or distribute the carcasses in the Methow River watershed for stream fertilization purposes if disease protocols as determined by the fisheries co-managers are met.

6. USFWS shall report to the Hatcheries and Inland Fisheries Branch, NOAA Fisheries, annually on the number of adult, endangered, UCR spring chinook

salmon collected and retained for broodstock and the details of the spawning procedures that were implemented. The report shall include a description of the origin (in-basin or out-of-basin; naturally produced or hatchery-produced (when possible)), as well as the proportion of males and females, of all spring chinook salmon used for artificial spawning. USFWS shall also provide detailed information (number, origin, sex, condition) on the adult fish released for natural spawning.

7. Prior to any hatchery-produced juvenile fish releases and/or transfers, USFWS must receive approval from the Hatcheries and Inland Fisheries Branch, NOAA Fisheries, for the number, stock origin, release dates, and release location(s) of the fish to be released and/or transferred. A plan describing proposed fish releases or transfers, developed annually by the Joint Fishery Parties and the Mid-Columbia Coordinating Committee, must be submitted to NOAA Fisheries two months prior to any such releases or transfers.

8. With the cooperation of WDFW, USFWS shall develop an identification method for each of the production groups in the Methow River Basin (Twisp River stock, Chewuch River stock, Methow River composite stock, Winthrop NFH Carson-stock and others) to allow for the segregation of returning adults and evaluation of escapement and natural production.

9. USFWS shall remove the captured fish from traps daily when the traps are operating. Those fish not retained for broodstock shall be passed upstream of the traps for natural spawning after enumeration and the collection of biological information.

10. USFWS shall determine the genotype, through in-situ scale pattern analysis and maturation timing, of late arriving adults to help ensure that ocean-type chinook salmon are not inadvertently included in the broodstock.

11. USFWS shall spawn both listed hatchery x natural and natural x natural crosses to the extent possible and evaluate the success of the two types of crosses. When possible, naturally produced fish retained for broodstock shall represent the natural-origin population in terms of age composition, sex ratio, and run timing.

12. To the greatest extent possible, USFWS shall maintain known Twisp River spring chinook salmon as a separate broodstock within the hatchery. The progeny of known Twisp River spring chinook salmon shall be distinctly marked for identification purposes.

13. To minimize the lateral transfer of pathogens, a sterilized needle must be used for each individual injection when PIT-tagging ESA-listed fish.

14. All ESA-listed fish handled out-of-water for the purpose of recording biological information must be anesthetized. Anesthetized fish must be allowed to recover (e.g., in a recovery tank) before being released. Fish that are simply counted must remain in water but do not need to be anesthetized.

15. To reduce and control fish disease incidences USFWS will use the disease control procedures identified in the operations plans and adhere to the Washington Co-Manager, Pacific Northwest Fish Health Protection Committee and IHOT fish disease control policies.

D. Action Area

The action area for the analysis of the effects of the proposed take activities will be the upper Columbia River Basin including the tributaries above Rocky Reach Dam and below Chief Joseph Dam (within the UCR spring chinook salmon ESU; see Figure 1). Impacts to listed spring chinook in the Entiat River are expected to be negligible, though interactions may occur in the mainstem migration corridor and from stray hatchery adults. These potential impacts will be discussed below. Incidental take of endangered UCR steelhead during broodstock collection activities described above will also occur in the action area.

The incidental take of other ESA-listed salmon and steelhead (Table 1) may occur in locations outside the action area where progeny (both juvenile and returning adults) generated from the proposed programs will interact with such species. However, NOAA Fisheries does not believe it is possible to meaningfully measure, detect or evaluate the effects of those interactions.

III. STATUS OF SPECIES/CRITICAL HABITAT

A. Life History and Population Trends

Life history and population trend information for the endangered Upper Columbia River spring chinook salmon and steelhead ESUs that are the primary focus of this opinion is summarized below. The status of listed species (Table 1) that may be taken incidentally as result of the issuance of a section 10 permit for the proposed programs are also detailed in NMFS (2000b). Greater detail of life history traits, particularly as related to the determination of ESUs, can be found for steelhead in Busby *et al.* (1996), and for chinook salmon in Myers *et al.* (1998). The All Species Review (ASR) prepared by the *U.S. v Oregon* Technical Advisory Committee focused on the status of Columbia River Basin salmonids, including steelhead (TAC 1997).

In general, it can be said that, Columbia River Basin-wide, salmon and steelhead population trends are down. The causes for the depressed status of salmonid populations in the Basin are numerous and varied. In the Lower Columbia River region, urbanization and other habitat alterations have severely curtailed populations. In the Mid-Columbia and Snake River drainages, hydropower development and habitat destruction account for many of the detrimental factors affecting salmon and steelhead. In the Upper Columbia River region, hydropower facilities and habitat destruction are the major causes of population declines, although past over-harvest in fisheries and some hatchery practices are other factors. To these factors for decline are added recent poor ocean conditions that have suppressed fish survival, and vastly increased avian predation in the Columbia River estuary. These latter factors affect all of the Basin's salmon and steelhead populations.

Table 1. The 12 listed salmon and steelhead ESUs in the Columbia River Basin.

ESU	Status	Federal Register Notice
Snake River spring/summer chinook	T	57 FR 14653 (April 22, 1992)
Upper Columbia River spring chinook	E	64 FR 14308 (March 24, 1999)
Lower Columbia River chinook	T	64 FR 14308 (March 24, 1999)
Upper Willamette River chinook	T	64 FR 14308 (March 24, 1999)
Snake River fall chinook	T	57 FR 14653 (April 22, 1992)
Snake River steelhead	T	62 FR 43937 (August 18, 1997)
Upper Columbia River steelhead	E	62 FR 43937 (August 18, 1997)
Lower Columbia River steelhead	T	63 FR 13347 (August 19, 1998)
Middle Columbia River steelhead	T	64 FR 14517 (March 25, 1999)
Upper Willamette River steelhead	T	64 FR 14517 (March 25, 1999)
Snake River sockeye	E	56 FR 58619 (November 20, 1991)
Columbia River chum	T	64 FR 14508 (March 25, 1999)

The above factors for decline are described in greater detail in the Environmental Baseline Section below. However, the net result is that, despite recent improvements in the areas mentioned, all the listed salmon and steelhead ESUs continue to face significant obstacles to recovery throughout their life cycle.

In a draft analysis of risks faced by salmonid populations in the Columbia River Basin, NOAA Fisheries estimated annual rates of population change and risks of extinction for the listed salmonid ESUs (McClure *et al.* 2000a; 2000b). NOAA Fisheries determined that annual rates of population change were less than 1.0 for ten of the eleven ESUs evaluated, and less than 0.9 for four of the ESUs (Upper Columbia River spring chinook salmon, Middle Columbia River steelhead, Upper Columbia River steelhead, and Upper Willamette steelhead). The four ESUs with annual rates of population change less than 0.9 are decreasing in abundance at a rate of at least 10% per year. These populations are at dire risk, with only small fractions of their already depressed populations expected to persist through the next 24 years under current conditions.

Using Viable Salmonid Population (VSP) principles (McElhany *et al.* 2000), criteria for viable populations in the listed upper Columbia River region ESUs (including critical and viable population abundance levels) will be developed by the NOAA Fisheries-administered Technical Recovery Team responsible for long term listed salmonid ESU recovery planning in the upper Columbia River Basin. These criteria will not only encompass abundance, but also population trends, spatial distribution, and diversity. When developed, the critical threshold will generally represent a state where a population is at relatively low abundance or productivity. At the viable threshold, a population is functioning properly and at a self-sustaining abundance level. Derivation of these thresholds for abundance will be based upon the specific ESU and historic information on population distribution and abundance. In general, if population abundance is less than 500 to 5,000 per generation, there is an increased risk of extinction. If the salmon population generation length is four years (the approximate generation length for spring chinook salmon), the annual spawner abundance at this critical abundance level would be in the range of 125 to1,250 fish. From NMFS (2000b), average annual abundance levels for the listed spring chinook salmon populations in the action area are below this critical abundance level range. At viable levels, abundance would range from 5,000 to 10,000 fish per generation, or (for fish with a four year generation length) 1,250 to 2,500 spawners per year. None of the listed natural spring chinook salmon or steelhead stocks in the action area exhibited average annual spawner escapements within this approximate viable population range.

Current stock status and extinction risk information will be used for recovery planning purposes, and for evaluation of the effects of proposed actions on the listed Upper Columbia River region spring chinook salmon and steelhead stocks in this Opinion. These status and extinction risk ratings will be used as standards for evaluating hatchery actions until critical and viable population thresholds (as per McElhany *et al.* 2000) for the listed populations are derived. The determination of the final critical and viable thresholds are not expected to change the evaluation of the proposed actions because the populations are currently below critical threshold levels.

1. Upper Columbia River Spring Chinook Salmon

The Upper Columbia River spring chinook salmon ESU, listed as endangered on March 24, 1999 (64 FR 14308), includes all natural-origin stream-type chinook salmon from river reaches above Rock Island Dam and downstream of Chief Joseph Dam, including the Wenatchee, Entiat, and Methow River basins (Myers *et al.* 1998). All chinook in the Okanogan River are apparently ocean-type and are considered part of the Upper Columbia River Summer/Fall run ESU. WDF *et al.* (1993) identified nine stocks within this ESU. All stocks, with the exception of the Methow stock, were considered by WDF *et al.* (1993) to be of native origin, of *wild* production type, and as *depressed* in status. The WDFW considers the Methow spring chinook stock to be a *composite* in production type, but of native origin, and depressed in status.

Based upon the population status of the species and risk factors affecting the likelihood for its continued existence, NOAA Fisheries has proposed that the ESU warrants protection under the ESA as endangered. When listing the UCR spring chinook salmon as endangered NOAA Fisheries included six hatchery populations as part of the ESU: Chewuch River, Methow River, Twisp River, Chiwawa River, White River and Nason Creek. These six hatchery populations were considered to be essential for recovery and were therefore listed as part of the ESU. Hatchery populations at Winthrop NFH, Entiat NFH and Leavenworth NFH were not included as part of the ESU because they were derived from Carson NFH spring chinook salmon.

Upper Columbia River spring chinook have a stream-type life history. Adults return to the Wenatchee River during late March through early May, and to the Entiat and Methow rivers during late March through June. Most adults return after spending 2 years in the ocean, although 20% to 40% return after 3 years at sea. Upper Columbia River spring chinook experience very little ocean harvest. Peak spawning for all three populations occurs from August to September. Smolts typically spend 1 year in freshwater before migrating downstream. There are slight genetic differences between this ESU and others containing stream-type fish, but more importantly, the ESU boundary was defined using ecological differences in spawning and rearing habitat (Myers *et al.* 1998). The Grand Coulee Fish Maintenance Project (1939 through 1943) may have had a major influence on this ESU because fish from multiple populations were mixed into one relatively homogenous group and redistributed into streams throughout the Upper Columbia River region.

NOAA Fisheries recently proposed Interim Recovery Abundance Levels and Cautionary Levels (Ford *et al.* 2001). *Cautionary Levels* were characterized as abundance levels that the population fell below only about 10% of the time during a historical period when it was considered to be relatively healthy. The three independent populations of spring chinook salmon identified for the ESU include those that spawn in the Wenatchee, Entiat, and Methow basins (Ford *et al.* 2001). The number of natural-origin fish returning to each sub-basin is shown in Table 2. Escapements for UCR spring chinook salmon have been substantially below the *Cautionary Levels* in recent years, especially in 1995, indicating increasing risk to and uncertainty about the population's future status. In 2000, estimated natural-origin adult spring chinook escapements to the mainstem rivers were well below recovery abundance levels. Escapement levels to the Wenatchee and Methow rivers were also well below the cautionary abundance levels of 1,200 and 750, respectively. A total of 829 Wenatchee and up to 426 Methow natural-origin adult spring chinook salmon are preliminarily forecast to reach the upper Columbia River region in 2001 (K. Petersen and H. Bartlett, WDFW, pers. comm.). If these forecasts are realized, returns to the Wenatchee and Methow rivers in 2001 will also be below their respective *Cautionary Levels* (Table 2). Recovery levels are not addressed here, because the ESU is not expected to attain these levels during the duration of the permits.

Table 2. Estimates of the Number of Natural-Origin Fish Returning to Sub-basin for Each Independent Population of Upper Columbia River Spring Chinook Salmon and Preliminary Interim Recovery Abundance and Cautionary Levels

Year	Wenatchee River	Entiat River	Methow River
1979	1,154	241	554
1980	1,752	337	443
1981	1,740	302	408
1982	1,984	343	453
1983	3,610	296	747
1984	2,550	205	890
1985	4,939	297	1,035
1986	2,908	256	778
1987	2,003	120	1,497
1988	1,832	156	1,455
1989	1,503	54	1,217
1990	1,043	223	1,194
1991	604	62	586
1992	1,206	88	1,719
1993	1,127	265	1,496
1994	308	74	331
1995	50	6	33
1996	201	28	126
1997	422	69	247
1998	218	52	125
1999 [1]	119	64	73
2000 [1]	489	175	<75
2001 [2]	*829*	*172*	*744*
Recovery Abundance	**3,750**	**500**	**2,000**
Cautionary Abundance	**1,200**	**150**	**750**

1/ Estimates for 1999 and 2000 are preliminary.

2/ Estimates for 2001 (*italics*) are based on preliminary preseason forecasts.

Recent artificial production programs for fishery enhancement and hydrosystem mitigation have been a concern because a non-native Carson-stock spring chinook was used. However, the programs that are the focus of this opinion were initiated to develop locally-adapted brood stocks to supplement natural populations. At facilities where straying and interactions with natural stock are known problems, Carson-stock spring chinook programs are being phased out. Captive broodstock conservation programs were under way in Nason Creek and White River (the Wenatchee basin) and in the Twisp River (Methow basin), with the goal of preventing the extinction of those spawning populations. These programs are being discontinued due to lack of funding. WDFW is developing a program that would captively rear fish from the White River population. All spring chinook salmon passing Wells Dam in 1996 and 1998 were trapped and brought into the hatchery to begin a composite-stock broodstock supplementation program for the Methow.

Recent year (1990-95) mean escapement for all the stocks that are the subject of the proposed WDFW programs was estimated to be 4,880 (Myers *et al.* 1998). Estimates of recent annual trends in abundance were found by NOAA Fisheries to be downward (Table 3), with eight of the nine spring chinook populations exhibiting rates of decline exceeding 20% per year. Record low returns have been experienced in recent years for the populations' proposed herein for supplementation and captive broodstock development.

The number of listed adult spring chinook that may potentially be affected by broodstock collection activities may be indicated through total run size and escapement estimates. Recent five year (1991-95) geometric mean spawning escapement estimates for the natural populations that will be targeted for broodstock collection are presented in Table 3, (taken from Myers *et al.* 1998). Estimates of recent annual trends in the abundance of each population are also included to help indicate their status relative to the proposed taking (Table 3).

The status of naturally produced spring chinook juveniles within the action area (Table 4) is indicated by the following estimates of (1) potential smolt production capacities (2) recent ten year (1989-98) mean (actual) seeding levels and (3) percent of capacity met by actual production (from BAMP 1998). Current naturally produced smolt production is approximately one-third of the production capacity for the major systems that are the focus of the proposed programs.

Table 3. Geometric mean spawning escapement estimates and annual abundance trend estimates (1991-1995) for natural Upper Columbia spring chinook salmon populations (WDFW 1998a).

Population	Mean Escapement (Number of spawners)	Annual Abundance Trend
Chiwawa River	134	-29.3
Nason Creek	85	-26.0
White River	25	-35.9
Methow River	144	-15.3
Twisp River	87	-27.4
Chewuch River	62	-28.1

The status of spring chinook populations within the action area has declined further from the escapement and abundance trend estimated in Table 3. Redd counts in the Wenatchee Basin (Table 5) reached all time lows in 1995 when only 32 redds were counted in the entire basin. Slight improvement was seen in 1996 when 84 redds were counted. 1997 was a strong return year with redd counts increasing to 208 but still less than half the mean for 1989 to 1994 of 430 redds. In 1998, the returns dropped again to only 89 redds for the entire Wenatchee Basin (Table 5).

Table 4. Estimated spring chinook salmon smolt production capacities compared to estimated seeding levels (WDFW 1998a).

Watershed	Smolt production capacity	Recent ten-year seeding levels	Percent of capacity
Wenatchee River	1,200,000	510,863	42.6
Methow River	826,359	155,734	18.8
Totals	2,026,359	666,597	32.9

For the Upper Columbia River spring chinook salmon ESU as a whole, NOAA Fisheries estimates that the average population growth rate (lambda) over the base period ranged from 0.87 to 0.78, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of natural origin (Appendix B in McClure *et al.* 2000) (an annual average growth rate above 1.0 represents a population that is not declining). NOAA Fisheries has also estimated average population growth rates and the risk of absolute extinction within 24 and 100 years for the three spawning populations identified by Ford *et al.* (2001), using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk

Table 5. Wenatchee Basin redd counts for brood years 1991 to 2000, with estimates of proportion hatchery spring chinook based on carcass recoveries (WDFW 1998c; WDFW 2001).

Location	BROODYEAR									
	91	92	93	94	95	96	97	98	99	00
Nason Creek (Index)	36	55	134	18	5	27	32	20	1	50
Nason Creek (other)	31	26	89	6	2	6	33	4	7	50
Nason Creek (total)	67	81	123	27	7	33	55	24	8	100
Proportion hatchery by carcass recovery[a]						.333	.524	.083	.000	.423
Chiwawa River (Index)	38	153	51	43	2	9	19	12	15	36
Chiwawa River (other)	66	149	55	39	11	14	63	29	19	92
Chiwawa River (total)	104	302	106	82	13	23	82	41	34	128
Proportion hatchery by carcass recovery[a]						.546	.546	.320	.067	.402
Little Wenatchee River	18	35	61	7	0	3	8	8	3	9
White River	21	35	60	3	2	12	15	5	1	8
Upper Wenatchee River	41	38	86	6	1	1	15	0	2	37
Total above Icicle Creek	251	491	436	125	23	72	175	78	48	282
Proportion hatchery by carcass recovery[a]						.448	.444	.182	.047	.435
Icicle Creek	40	37	53	15	9	12	33	11	6	68
Proportion hatchery by carcass recovery[a]						.00	.464	.00	1.00	.981
Basin Totals	291	528	489	140	32	84	208	89	54	350
Proportion hatchery by carcass recovery[a]						.433	.451	.164	.151	.539

[a] *Intensified carcass recovery began in 1996. Assumes hatchery origin adults 100% Ad/CWT.*

of absolute extinction within 100 years ranges from 0.73 for the Methow River to 1.00 for the Wenatchee and Entiat rivers (Appendix B in McClure *et al.* 2000). At the high end, assuming that the hatchery fish spawning in the wild have been as productive as natural-origin fish (hatchery effectiveness = 100%), the risk of extinction within 100 years is 1.00 for all three spawning populations (Appendix B in McClure *et al.* 2000).

NOAA Fisheries has also calculated the proportional increase in the average growth rates of each population that would be needed to reduce the risk of absolute extinction within 100 years to only 5% (Appendix B in McClure *et al.* 2000). Assuming that the effectiveness of hatchery fish has been zero, relatively small changes (≤20%) are needed in the growth rates of each of the natural populations. The needed change in growth rate rises as high as 60% for the Entiat River population if hatchery-origin spawners have been 100% as effective as natural fish.

Wenatchee River adult spring chinook returns rebounded in 2000 from low returns observed in 1999. In 2000, an estimated 350 redds were counted in the basin, an almost seven-fold increase from the 54 redds observed in 1999 (Table 5). The greatest increases were seen in Nason Creek, Chiwawa River and the upper Wenatchee River. The 2001 return of naturally produced spring chinook to the Wenatchee River was estimated to be between 640 and 1,052 adults with an additional 438-696 hatchery spring chinook returning to the Chiwawa River. The increased returns in 2000 and 2001 are likely the result of favorable out migration conditions and ocean rearing environment.

Redd counts in the Methow Basin have shown a decline similar to that observed for the Wenatchee Basin (Table 6). The mean total annual redd counts for the Methow Basin from 1989 to 1993 was 559; since then redd counts have declined to 133 in 1994, 15 in 1995 and 145 in 1997 (Table 5). In 1996 and 1998, all spring chinook were intercepted at Wells Dam and used for broodstock at the Methow FH and Winthrop NFH (Table 6 and Table 7).

In 2000, the preseason return estimates predicted a return of between 3,566 and 4,373 adult spring chinook salmon over Wells Dam. Actual escapement over Wells Dam in 2000 was 2,130 adults and 457 jacks (these counts are after fish were removed for broodstock purposes). The program at these levels was to trap 668 adults to meet production goals. During trapping activities at Wells Dam, WDFW collected a total of 431 spring chinook and retained 338 for broodstock. In 2000, broodstock collection also occurred at Methow SFH outfall and at the Winthrop NFH. A total of 162 fish were collected at the Methow SFH outfall with 156 sent to Winthrop NFH. At the Winthrop NFH a total of 936 spring chinook entered the hatchery. In combined hatchery egg takes for the two facilities, a total of 1,397 adults were spawned. Out of this total, 381 were listed hatchery and natural adults, 957 were Winthrop NFH Carson-stock spring chinook, 59 were from the Entiat and Leavenworth NFHs and 4 were from Idaho hatcheries. The progeny from these last two groups were not used in the hatchery programs.

Table 6. Methow Basin spring chinook redd counts for broodyears 1990 to 2000 (WDFW 1998c; WDFW 2001) .

	BROODYEAR										
	90	91	92	93	94	95	96[a]	97	98[a]	99	00
Methow River	194	74	336	290	64	9	0	56	0	17	230
Chewuch River	158	91	185	83	27	2	0	47	0	6	20
Lost River	33	16	73	51	6	0	0	7	0	3	0
Twisp River	113	69	141	192	32	4	0	35	0	10	100
Early Winters Creek	1	0	3	1	4	0	0	0	0	0	1
Totals	499	250	738	617	133	15	0	145	0	36	350

[a] Entire spring chinook run intercepted at Wells Dam in 1996 and 1998. All brood year production at Methow FH and Winthrop NFH for those two years.

Table 7. Estimated hatchery broodstock composition of combined Methow SFH and Winthrop NFH (WDFW 1998c; WDFW 2001).

	BROODYEAR						
	95	96	97	98	99	2000	2001
Number of Hatchery Fish	13	324	508	281	269	1,412	841
Number of Natural Fish	1	126	28[a]	125	78	7	61
Total Broodstock Collected	14	450	554	406	424	1,419	902

[a] Only 1 natural fish of 231 swim-ins at Winthrop NFH and 27 natural of 141 swim-ins at Methow SFH. Rest of brood from trapping adipose clipped fish at Wells Dam.

The return of 457 jack salmon in 2000 is almost double the largest jack count since 1977 and indicates that the 2001 returns should be greater than the 2000. The preseason estimates for 2001 returns ranged from 1,190 to 7,604 above Wells Dam. Because of the expected large returns and some changes in broodstock management, adults were not be trapped at Wells Dam in 2001, but collect at weirs on the Twisp and Chewuch rivers and at the Methow SFH. For the return year 2001, a total of 9,989 adult and 892 jack spring chinook had crossed Wells Dam. The goal was to collect 1,000 adults for broodstock in 2001 with 60% coming from the Fulton Dam trap (Chewuch River). Problems at the Fulton Dam trap led to only 68 being collected at that sight, 48 were collected at the Twisp River trap and 776 adults were collected at the Methow SFH outfall for a total of 902 adults.

2. UCR Steelhead

The Upper Columbia River steelhead ESU, listed as endangered on August 18, 1997 (62 FR 43937), includes all natural-origin populations of steelhead in the Columbia River Basin upstream from the Yakima River, Washington, to the U.S./Canada border. The WDFW Wells Hatchery steelhead stock is considered essential for recovery, and is included in the listing.

Upper Columbia River steelhead inhabit the Columbia River reach and its tributaries upstream of the Yakima River. This region includes several rivers that drain the east slopes of the Cascades Mountains and several that originate in Canada (only U.S. populations are included in the ESU). Dry habitat conditions in this area are less conducive to steelhead survival than in many other parts of the Columbia River Basin (Mullan *et al.* 1992a). Although the life history of this ESU is similar to that of other inland steelhead, smolt ages are some of the oldest on the west coast (up to 7 years old), probably due to the ubiquitous cold water temperatures (Mullan *et al.* 1992b). Adults of this ESU spawn later than most downstream populations. Adults of the Methow River and Wenatchee River populations primarily return after 2 years of ocean residency. Steelhead from this ESU enter the lower Columbia between May and September with fish arriving at Wells Pool in early July. Fish enter the Wenatchee and Methow rivers in mid-July and peak between mid-September and October. During winter, adult steelhead generally return to the warmer Columbia River and re-enter the Methow to begin spawning in mid-March after the ice had thawed. Spawning continues through May and many fish seek out higher reaches in the tributaries. Fry emergence occurs that summer and juveniles rear for two to four years prior to spring downstream migration. Adult steelhead may be handled during broodstock collection activities.

Although runs during the period 1933 through 1959 may have already been affected by fisheries in the lower river, dam counts suggest a pre-fishery run size of more than 5,000 adults above Rock Island Dam. The return of Upper Columbia River natural-origin steelhead to Priest Rapids Dam declined from a 5-year average of 2,700 beginning in 1986 to a 5-year average of 900 beginning in 1994 (Table 8). Recent escapements at Priest Rapids Dam of both hatchery and natural-origin steelhead have shown an increasing trend reaching 11,330 in 2000. Preliminary estimates show an escapement of over 29,900 steelhead past Priest Rapids in 2001. The preliminary estimate for naturally produced steelhead at Rock Island in 2001 was 16,237. This is well above the escapement goal for natural-origin fish of 4,500 at Priest Rapids Dam. Most current natural production occurs in the Wenatchee and Methow river systems, with a smaller run returning to the Entiat River. Very limited spawning also occurs in the Okanogan River basin. A majority of the fish spawning in natural production areas are of hatchery origin. Prior to the 2000 and 2001 return years, the indications were that natural populations in the Wenatchee, Methow, and Entiat rivers were not self-sustaining. Even with the recent returns, the long-term self-sufficiency for these natural populations is not a certainty.

This entire ESU has been subjected to heavy hatchery influence; stocks were mixed as a result of the Grand Coulee Maintenance Project, which began in the 1940s (Fish and Hanavan 1948,

Table 8. Adult Summer Steelhead Counts at Priest Rapids, Rock Island, Rocky Reach, and Wells Dams (FPC 2000)

	Priest Rapids		Rock Island	Rocky Reach	Wells
Year	**Count**	**Natural**	**Count**	**Count**	**Count**
1978	4,545		3,352	2,453	1,621
1979	8,409		7,420	4,896	3,695
1980	8,524		7,016	4,295	3,443
1981	9,004		7,565	5,524	4,096
1982	11,159		10,150	6,241	8,418
1983	31,809		29,666	19,698	19,525
1984	26,076		24,803	17,228	16,627
1985	34,701		31,995	22,690	19,757
1986	22,382	2,342	22,867	15,193	13,234
1987	14,265	4,058	12,706	7,172	5,195
1988	10,208	2,670	9,358	5,678	4,415
1989	10,667	2,685	9,351	6,119	4,608
1990	7,830	1,585	6,936	5,014	3,819
1991	14,027	2,799	11,018	7,741	7,715
1992	14,208	1,618	12,398	7,457	7,120
1993	5,455	890	4,591	2,815	2,400
1994	6,707	855	5,618	2,823	2,138
1995	4,373	993	4,070	1,719	946
1996	8,376	843	7,305	5,774	4,127
1997	8,948	785	7,726	7,726	4,107
1998	5,790	919	4,810	4,265	2,482
1999	8,277	not reported	6,361	4,815	3,557
2000	11,331	not reported	10,515	8,272	6,280
2001	29,937	not reported	28,435	21,954	17,407

Mullan *et al.* 1992a). Recently, as part of the development of the Mid-Columbia Habitat Conservation Plan (BAMP 1998), it was determined that steelhead habitat within the range of the Upper Columbia ESU was over-seeded, primarily due to the presence of Wells Hatchery fish in excess of those collected for broodstock. This would partially explain recent observations of low natural cohort replacement rates (0.3 for populations in the Wenatchee River and no greater than 0.25 for populations in the Entiat River; Bugert 1997). The problem of determining appropriate levels of hatchery output to prevent negative effects on natural production is a subject of analysis and review in the Upper Columbia River Quantitative Analytical Report (Cooney 2000). In the meantime, given these uncertainties, efforts are underway to diversify broodstocks used for supplementation and to minimize the differences between hatchery and natural-origin fish (as well as other concerns associated with supplementation). The best use for the Wells Hatchery program in the recovery process is yet to be defined, and should be integrated with harvest activities and recovery measures to optimize the prospects for recovery of the species.

For the Upper Columbia River steelhead ESU as a whole, NOAA Fisheries estimates that the average annual population growth rate (lambda) over the base period ranges from 0.90 to 0.29, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of natural origin (Appendix B in McClure *et al.* 2000b). The NOAA Fisheries has also estimated the risk of absolute extinction for the aggregate Upper Columbia River steelhead population, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years is 0.95. Assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years is 1.00.

NOAA Fisheries has also calculated the proportional increase in the average growth rate of the aggregate population that would be needed to reduce the risk of absolute extinction within 100 years to 5% (Appendix B in McClure *et al.* 2000b). Assuming that the effectiveness of hatchery fish has been zero, a 7% increase would be needed in the growth rate of the natural population. The needed change in growth rate rises to 225% if hatchery-origin spawners have been 100% as effective as natural fish.

B. Critical Habitat

Critical habitat was designated for the remainder of the listed salmon and steelhead ESUs considered in this Opinion on February 16, 2000 (65 FR 7764). However, on April 30, 2002, the U.S. District Court for the District of Columbia approved a NOAA Fisheries consent decree withdrawing the February 2000 critical habitat designation for this and 18 other ESUs.

IV. ENVIRONMENTAL BASELINE

Environmental baselines for biological opinions include the past and present impacts of all state, Federal or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). The environmental baseline for this opinion is generally included in the extensive discussion of environmental baseline in the Federal Columbia River Power System (FCRPS) biological opinion (NMFS 2000b). What follows below is a summary of that discussion. Generally the activities having the greatest impact on the environmental baseline of the UCR spring chinook salmon and steelhead ESUs fall into four categories: hydropower system impacts on juvenile out-migration and adult return migration; habitat degradation effects on water quality and availability of adequate incubation and rearing locations; harvest impacts on adults; and artificial propagation impacts. Fish are also affected by fluctuations in natural conditions.

A. The Hydropower System

Hydropower development in the Columbia basin has dramatically affected anadromous salmonids in the basin. Storage dams have eliminated spawning and rearing habitat and altered the natural hydrograph of the Snake and Columbia Rivers – decreasing spring and summer flows and increasing fall and winter flows. Power operations cause flow levels and river elevations to fluctuate – slowing fish movement through reservoirs, altering riparian ecology, and stranding fish in shallow areas. Columbia River dams kill smolts and adults and alter their migrations. The dams have also converted the once-swift river into a series of slow-moving reservoirs – slowing the smolts' journey to the ocean and creating habitat for predators. Because the UCR spring chinook salmon and steelhead must navigate between four and nine major hydroelectric projects during their up and downstream migrations (and experience the effects of other dam operations occurring upstream from their ESU boundary), they feel the influence of all the impacts listed above.

However, ongoing consultations between NOAA Fisheries and the Bonneville Power Administration, the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and the Bureau of Reclamation have brought about numerous beneficial changes in the operation and configuration of the Columbia River hydropower system. For example, increased spill at the dams allows smolts to avoid both turbine intakes and bypass systems; increased flow in the mainstem Snake and Columbia Rivers provides better inriver conditions for smolts; and better smolt transportation (through the addition of new barges and by modifying existing barges) helps the young salmonids make their way down to the ocean. However, even though there have been a number of improvements, more are needed because the Federal hydropower system continues to kill a significant number of fish from some ESUs.

Several non-Federal projects licensed by the Federal Energy Regulating Commission (FERC) also affect UCR spring chinook and steelhead. Operations of the Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids Dams are currently governed by existing FERC license requirements and settlement agreements. Each of these license requirements and settlement agreements specify actions intended to reduce the effects of project operations on anadromous salmonids. For example, a spring flow objective of 135 thousand cubic fee per second at Priest Rapids Dam was established for the mid-Columbia River in the 1998 FCRPS Supplemental Biological Opinion (NMFS 1998b). It is hoped that this and other actions will improve salmon survival, but much remains to be done to offset the effects of hydropower development, and for now the net impact of the hydropower system on UCR spring chinook and steelhead survival is still unequivocally negative.

B. Human-Induced Habitat Degradation

The quality and quantity of freshwater habitat in much of the Columbia River Basin have declined dramatically in the last 150 years. Forestry, farming, grazing, road construction, hydrosystem development, mining, and other development have radically changed habitat conditions in the basin. Water quality in streams throughout the Columbia River Basin has been degraded by human activities such as dams and diversion structures, water withdrawals, farming and animal grazing, road construction, timber harvest activities, mining activities, and development. Over 2,500 streams, river segments, and lakes in the Northwest do not meet Federally-approved, state and Tribal water quality standards and are now listed as water quality limited under Section 303(d) of the Clean Water Act. Tributary water quality problems contribute to poor water quality when sediment and contaminants from the tributaries settle in mainstem reaches and the estuary.

Most of the water bodies in Oregon, Washington, and Idaho on the 303(d) list do not meet water quality standards for temperature. High water temperatures adversely affect salmonid metabolism, growth rate, and disease resistance, as well as the timing of adult migrations, fry emergence, and smoltification. Many factors can cause high stream temperatures, but they are primarily related to land-use practices rather than point-source discharges. Some common actions that cause high stream temperatures are the removal of trees or shrubs that directly shade streams, water withdrawals for irrigation or other purposes, and warm irrigation return flows. Loss of wetlands and increases in groundwater withdrawals contribute to lower base-stream flows which, in turn, contribute to temperature increases. Activities that create shallower streams (e.g., channel widening) also cause temperature increases.

Pollutants also degrade water quality. Salmon require clean gravel for successful spawning, egg incubation, and the emergence of fry. Fine sediments clog the spaces between gravel and restrict the flow of oxygen-rich water to the incubating eggs. Excess nutrients, low levels of dissolved oxygen, heavy metals, and changes in pH also directly affect the water quality for salmon and steelhead.

Water quantity problems are also a significant cause of habitat degradation and reduced fish production. Millions of acres of land in the basin are irrigated. Although some of the water withdrawn from streams eventually returns as agricultural runoff or groundwater recharge, crops consume a large proportion of it. Withdrawals affect seasonal flow patterns by removing water from streams in the summer (mostly May through September) and restoring it to surface streams and groundwater in ways that are difficult to measure. Withdrawing water for irrigation, human consumption, and other uses increases temperatures, smolt travel time, and sedimentation. Return water from irrigated fields introduces nutrients and pesticides into streams and rivers. Water withdrawals (primarily for irrigation) have lowered summer flows in nearly every stream in the basin and thereby profoundly decreased the quantity and quality of habitat.

Blockages that stop downstream and upstream fish movement exist at many dams and barriers, whether they are for agricultural, hydropower, municipal/industrial, or flood control purposes. Culverts that are not designed for fish passage also block upstream migration. Migrating fish are often killed when they are diverted into unscreened or inadequately screened water conveyances or turbines. While many fish-passage improvements have been made in recent years, manmade structures continue to block migrations or kill fish throughout the basin.

On the landscape scale, human activities have affected the timing and amount of peak water runoff from rain and snowmelt. Forest and range management practices have changed vegetation types and density which, in turn, affect runoff timing and duration. Many riparian areas, flood plains, and wetlands that once stored water during periods of high runoff have been destroyed by development that paves over or compacts soil – thus increasing runoff and altering its natural pattern.

Land ownership has also played its part in the region's habitat and land-use changes. Federal lands, which compose 50 percent of the basin, are generally forested and influence upstream portions of the watersheds. While there is substantial habitat degradation across all ownerships, in general, habitat in many headwater stream sections is in better condition than in the largely non-Federal lower portions of tributaries (Doppelt *et al.* 1993; Frissell 1993; Henjum *et al.* 1994; Quigley and Arbelbide 1997). In the past, valley bottoms were among the most productive fish habitats in the basin (Stanford and Ward 1992; Spence *et al.* 1996; ISG 1996). Today, agricultural and urban land development and water withdrawals have significantly altered the habitat for fish and wildlife. Streams in these areas typically have high water temperatures, sedimentation problems, low flows, simplified stream channels, and reduced riparian vegetation.

At the same time UCR spring chinook and steelhead habitat was being destroyed by water withdrawals, water impoundments in other areas dramatically reduced UCR spring chinook and steelhead habitat by inundating large amounts of spawning and rearing habitat and reducing migration corridors, for the most part, to a single channel. Floodplains have been reduced in size, off-channel habitat features have been lost or disconnected from the main channel, and the amount of large woody debris (large snags/log structures) in rivers has been reduced. Most of the remaining habitats are affected by flow fluctuations associated with reservoir management.

The Columbia River estuary (through which all the basin's species – including UCR spring chinook and steelhead – must pass) has also been changed by human activities. Historically, the downstream half of the estuary was a dynamic environment with multiple channels, extensive wetlands, sandbars, and shallow areas. The mouth of the Columbia River was about four miles wide. Winter and spring floods, low flows in late summer, large woody debris floating downstream, and a shallow bar at the mouth of the Columbia River kept the environment dynamic. Today, navigation channels have been dredged, deepened, and maintained; jetties and pile-dike fields have been constructed to stabilize and concentrate flow in navigation channels; marsh and riparian habitats have been filled and diked; and causeways have been constructed across waterways. These actions have decreased the width of the mouth of the Columbia River to two miles and increased the depth of the Columbia River channel at the bar from less than 20 to more than 55 feet. Sand deposition at river mouths has extended the Oregon coastline approximately four miles seaward and the Washington coastline approximately two miles seaward (Thomas 1981).

More than 50 percent of the original marshes and spruce swamps in the estuary have been converted to industrial, transportation, recreational, agricultural, or urban uses. More than 3,000 acres of intertidal marsh and spruce swamps have been converted to other uses since 1948 (Lower Columbia River Estuary Program [LCREP] 1999). Many wetlands along the shore in the upper reaches of the estuary have been converted to industrial and agricultural lands after levees and dikes were constructed. Furthermore, water storage and release patterns from reservoirs upstream of the estuary have changed the seasonal pattern and volume of discharge. The peaks of spring/summer floods have been reduced, and the amount of water discharged during winter has increased.

Human-cause habitat alterations have also increased the number of predators feeding on UCR spring chinook salmon and steelhead. For example, researchers estimated that a population of terns on Rice Island (created under the Columbia River Channel Operation and Maintenance Program) consumed six to 25 million out-migrating salmonid smolts during 1997 (Roby *et al.* 1998) and seven to 15 million out-migrating smolts during 1998 (Collis *et al.* 1999). Even after considerable efforts by Federal and state agencies, between 5 and 7 million smolts were consumed in 2001. As another example, populations of Northern pikeminnow (a salmonid predator) in the Columbia River has skyrocketed since the advent of the mainstem dams and their warm, slow-moving reservoirs.

To counteract all the ill effects listed in this section, Federal, state, tribal, and private entities have – singly and in partnership – begun recovery efforts to help slow and, eventually, reverse the decline of salmon and steelhead populations. Nevertheless, while these efforts represent a number of good beginnings, it must be stated that much remains to be done to recover UCR steelhead and other salmonids in the Columbia basin. Full discussions of these efforts can be found in the FCRPS biological opinion.

C. Artificial Propagation

For more than 100 years, hatcheries in the Pacific Northwest have been used to (a) produce fish for harvest and (b) replace natural production lost to dam construction and other development – not to protect and rebuild naturally produced salmonid populations. As a result, most salmonids returning to the region are primarily derived from hatchery fish. In 1987, for example, 95 percent of the coho salmon, 70 percent of the spring chinook salmon, 80 percent of the summer chinook salmon, 50 percent of the fall chinook salmon, and 70 percent of the steelhead returning to the Columbia River Basin originated in hatcheries (CBFWA 1990). Because hatcheries have traditionally focused on providing fish for harvest, it is only recently that the substantial effects of hatcheries on native natural populations been demonstrated. For example, the production of hatchery fish, among other factors, has contributed to the 90 percent reduction in natural coho salmon runs in the lower Columbia River over the past 30 years (Flagg *et al.* 1995).

NOAA Fisheries has identified four primary ways hatcheries harm wild-run salmon and steelhead: (1) ecological effects, (2) genetic effects, (3) overharvest effects, and (4) masking effects. Ecologically, hatchery fish can predate on, displace, and compete with natural fish. These effects are most likely to occur when fish are released in poor condition and do not migrate to marine waters, but rather remain in the streams for extended rearing periods. Hatchery fish also may transmit hatchery-borne diseases, and hatcheries themselves may release disease-carrying effluent into streams. Hatchery fish can affect the genetic variability of native fish by interbreeding with them. Interbreeding can also result from the introduction of stocks from other areas. Interbred fish are less adapted to the local habitats where the original native stock evolved and may therefore be less productive there.

In many areas, hatchery fish provide increased fishing opportunities. However, when natural fish mix with hatchery stock in these areas, naturally produced fish can be overharvested. Moreover, when migrating adult hatchery and natural fish mix on the spawning grounds, the health of the natural runs and the habitat's ability to support them can be overestimated because the hatchery fish mask the surveyors' ability to discern actual natural run status.

Currently, the role hatcheries play in the Columbia Basin is being redefined under the Basinwide Salmon Recovery Strategy (Federal Caucus 2000) from simple production to supporting species recovery. These efforts will focus on maintaining species diversity and supporting weak stocks. The program will also have an associated research element designed to clarify interactions between natural and hatchery fish and quantify the effects supplementation has on natural fish. The final facet of the strategy is to use hatcheries to create fishing opportunities that are benign to listed populations (e.g., terminal area fisheries). For more detail on the use of hatcheries in recovery strategies, please see the Basinwide Salmon Recovery Strategy.

D. Harvest

Salmon and steelhead have been harvested in the Columbia basin as long as there have been people there. For thousands of years, native Americans have fished on salmon and other species in the mainstem and tributaries of the Columbia River for ceremonial and subsistence use and for barter. Salmon were possibly the most important single component of the native American diet, and were eaten fresh, smoked, or dried (Craig and Hacker 1940; Drucker 1965). A wide variety of gears and methods were used, including hoop and dip nets at cascades such as Celilo and Willamette Falls, to spears, weirs, and traps (usually in smaller streams and headwater areas) (NRC 1996; Drucker 1965).

Commercial fishing developed rapidly with the arrival of European settlers and the advent of canning technologies in the late 1800s. The development of non-Indian fisheries began in about 1830; by 1861, commercial fishing was an important economic activity. The early commercial fisheries used gill nets, seines hauled from shore, traps, and fish wheels. Later, purse seines and trolling (using hook and line) fisheries developed. Recreational fishing began in the late 1800s, occurring primarily in tributary locations (ODFW and WDFW 1998). Steelhead have formed a major component of these fisheries for decades.

Initially, the non-Indian fisheries targeted spring and summer chinook salmon, and these runs dominated the commercial harvest during the 1800s. Eventually the combined ocean and freshwater harvest rates for Columbia River spring and summer chinook salmon exceeded 80 percent and sometimes 90 percent of the run – accelerating the species' decline (Ricker 1959). From 1938 to 1955, the average harvest rate dropped to about 60 percent of the total spring chinook salmon run and appeared to have a minimal effect on subsequent returns (NMFS 1991). Until the spring of 2000 – when a relatively large run of hatchery spring chinook salmon returned and provided a small commercial Tribal fishery – no commercial season for spring chinook salmon had taken place since 1977. Present Columbia River harvest rates are very low compared with those from the late 1930s through the 1960s (NMFS 1991). Though steelhead – UCR steelhead included – were never as important a component of the Columbia basin's fisheries as chinook, net-based fisheries generally do not discriminate among species, so it can fairly be said that harvest has also contributed to the UCR steelhead declines.

Salmonids' capacity to produce more adults than are needed for spawning offers the potential for sustainable harvest of naturally produced (versus hatchery-produced) fish. This potential can be realized only if two basic management requirements are met: (1) enough adults return to spawn and perpetuate the run, and (2) the productive capacity of the habitat is maintained. Catches may fluctuate in response to such variables as ocean productivity cycles, periods of drought, and natural disturbance events, but as long as the two management requirements are met, fishing can be sustained indefinitely. Unfortunately, both prerequisites for sustainable harvest have been violated routinely in the past. The lack of coordinated management across jurisdictions, combined with competitive economic pressures to increase catches or to sustain them in periods of lower production, resulted in harvests that were too high and escapements that were too low.

At the same time, habitat has been increasingly degraded, reducing the capacity of the salmon stocks to produce numbers in excess of their spawning escapement requirements.

Fish harvest in the Columbia River basin affects the listed species by incidentally taking them in fisheries that target non-listed species. UCR spring chinook and steelhead are not harvested in ocean fisheries (Chapman *et al.* 1995). The largest potential impacts on UCR spring chinook and steelhead come from treaty Indian and non-tribal fisheries in the Columbia River mainstem (Myers *et al.* 1998). Most take is in the form of catch and retention, mortalities resulting from hooking and release, and mortalities resulting from encounters with fishing gear as a consequence of fishery activities. Two recent opinions describe harvest rate impacts from mainstem Columbia River fisheries accruing to listed UCR salmonids. Both opinions conclude that, due to the constraints set on harvest levels as described in the opinions, the activities associated with the treaty Indian and non-tribal fisheries during the winter/spring/summer and fall seasons were not likely to jeopardize the continued existence of any of the listed species (NMFS 2001b; NMFS 2001c). The development of fishery regimes for the Columbia River mainstem includes evaluation of escapement needs and impacts to Upper Columbia River spring chinook and steelhead.

In the mainstem winter/spring/summer seasons, UCR spring chinook and SR spring/summer chinook are expected to be the primary management constraints, in most years, for the mainstem fisheries in that they will define the upper limit of allowable harvest. Harvest rate limits are described as percentages of the adult return to Bonneville Dam. For 2001, based on preseason run size information, the applicable harvest rate limits for UCR hatchery and natural-origin steelhead in treaty Indian fisheries were 5.6% and 7.6%, respectively. In non-tribal mainstem fisheries, harvest rates for UCR natural-origin steelhead did not exceed 2%. These harvest rate limits will apply in the early part of 2002. In non-tribal and tribal fisheries, harvest rates for UCR natural and hatchery-origin steelhead did not exceed 2% and 15%, respectively.

For years, the response to declining catches was hatchery construction to produce more fish. Because hatcheries require fewer adults to sustain their production, harvest rates in the fisheries were allowed to remain high, or even increase, further exacerbating the effects of overfishing on the naturally produced (non-hatchery) runs mixed in the same fisheries. Harvest managers have instituted reforms including weak stock, abundance-based, harvest rate, and escapement-goal management to limit harvest effects. Recently recreational fisheries were modified to allow for the retention of only externally marked hatchery spring chinook and steelhead and requiring the release of all natural unmarked fish. This modification has reduced harvest impacts on natural populations. As with improvements being made in other phases of the UCR spring chinook salmon and steelhead life histories, it will take some time for these (and future) measures to contribute greatly to the species recovery, but the effort has begun.

E. Natural Conditions

Changes in the freshwater and marine environments cause changes in salmonid abundance. Recent evidence suggests that marine survival among salmonids fluctuates in response to 20- to 30-year cycles of climatic conditions and ocean productivity (Cramer *et al.* 1999). This phenomenon has been referred to as the Pacific Decadal Oscillation; this has also been referred to as the Bidecadal Oscillation (Mantua *et al.* 1997). In addition, large-scale climatic regime shifts, such as El Niño, appear to change ocean productivity. During the first part of the 1990s, much of the Pacific Coast was subject to a series of very dry years. More recently, severe flooding has adversely affected some stocks (e.g., the low returns of Lewis River bright fall chinook salmon in 1999).

A key factor affecting many West Coast stocks – including UCR spring chinook and steelhead – has been a general 30-year decline in ocean productivity. The mechanism whereby stocks are affected is not well understood, partially because the pattern of response to these changing ocean conditions has differed among stocks, presumably due to differences in their ocean entry timing and distribution. It is presumed that survival is driven largely by events occurring between ocean entry and recruitment to a subadult life stage (NMFS 2000b).

Salmon and steelhead are exposed to high rates of natural predation, particularly during freshwater rearing and migration stages. Ocean predation may also contribute to significant natural mortality, although it is not know to what degree. In general, salmonids are prey for pelagic fishes, birds, and marine mammals, including harbor seals, sea lions, and killer whales. There have been recent concerns that the rebound of seal and sea lion populations – following their protection under the Marine Mammal Protection Act of 1972 – has caused a substantial number of salmonid deaths. In recent years, for example, sea lions have learned to target upper Willamette River spring chinook salmon in the fish ladder at Willamette Falls.

V. ANALYSIS OF THE EFFECTS OF THE PROPOSED ACTIONS

A. WDFW's and USFWS' Artificial Propagation Programs

1. Factors to be Considered

The Biological Opinion on Artificial Propagation in the Columbia River (NMFS 1999) and the Biological Opinion for 1995-1998 Hatchery Operations in the Columbia River Basin (NMFS 1995) identify nine general types of potential adverse effects of hatchery operations and production on natural fish populations. These are: (a) operation of hatchery facilities, (b) broodstock collection, (c) genetic introgression, (d) density-dependent effects of hatchery production, (e) disease, (f) competition, (g) predation, (h) residualism, and (i) migration corridor/ocean. The take of UCR spring chinook salmon occurs during broodstock collection of adults, eyed-eggs, and/or emergent fry as well as during hatchery operations. The adverse effects of hatchery operations and production listed above also have the potential to incidentally take ESA-listed salmon and steelhead, and will be evaluated below.

In addition, there are other potential indirect effects, such as pressure to increase harvest rates on returning salmon that are produced from additional hatchery releases. Harvest in the mainstem Columbia River will be managed through the *U.S. v Oregon* process, and covered under separate annual Biological Opinions. The operation of the proposed artificial propagation programs account for the potential for ocean and mainstem harvest (see Environmental Baseline) but are designed for restoration and recovery not harvest augmentation.

2. Analysis of the Effects of the Proposed Actions

The take of endangered UCR spring chinook salmon requested by WDFW and USFWS will result from proposed artificial propagation efforts designed to benefit the species. The primary objectives of these efforts are to preserve extant spring chinook populations in the region, and to boost the abundance of remaining stocks. There are risks of ecological and genetic impacts to the ESA-listed juvenile and adult spring chinook salmon resulting from the proposed programs. However, the risk of extinction to natural populations is high enough that aggressive intervention is proposed. Strategies are proposed by WDFW and USFWS to minimize potential impacts to endangered spring chinook salmon that may be associated with these programs. In response to these potential impacts, WDFW and USFWS propose monitoring and evaluation programs to assess the effects of the proposed programs and to adjust the programs as needed consistent with the adaptive management approach adopted within the MCMCP.

Operation of Hatchery Facilities

Potential adverse impacts identified with the physical operation of hatchery facilities include impacts from water withdrawal, release of hatchery effluent and facilities failure (NMFS 1999). Water withdrawal for hatcheries located within the spawning and/or rearing areas can diminish stream flow from points of intake to outflow and, if great enough, can impede migration and affect spawning behavior. Effluent from the hatchery may change water temperature, pH, suspended solids, ammonia, organic nitrogen, total phosphorus, and chemical oxygen demand in the receiving stream's mixing zone (Kendra 1991). Hatchery effluent may also transport pathogens (disease) out of the hatchery and infect natural-origin fish. Aside from the potential impacts to water flow and quality, operational failures due to power/water loss, flooding, freezing, vandalism, predation and disease may result in catastrophic losses to rearing adults and juveniles.

Hatcheries operating under the proposed programs rely mainly on ground water withdrawal, thus reducing the risk of impacts on surface water critical to listed fish. Further, WDFW and USFWS propose to comply with water right permits established for each hatchery, preventing over-appropriation of surface water needed for natural fish production and migration. Hatcheries participating in the programs will maintain all screens associated with water intakes in surface water areas to NOAA Fisheries screening criteria (NMFS 1996). NOAA Fisheries finds that these measures affecting water withdrawal are expected to be sufficient to protect chinook and steelhead because the withdrawals will be limited since the proposed program relies primarily on ground water withdrawals. Even with the projected tributary and mainstem water withdrawals, the measures in place are expected to provide flows that are adequate to protect passage and other uses by listed chinook salmon and steelhead.

All hatcheries associated with the proposed action operate under National Pollutant Discharge Elimination System (NPDES) permits issued by Washington Department of Ecology. While the overall affect of proposed hatchery operations on existing water quality conditions is unknown, it is reasonable to expect the effect to be very small because discharges are localized at outfall areas and effluent is rapidly diluted in the receiving streams and rivers. Further, WDFW and USFWS can address water quality problems through the adaptive management component of the proposed plan should that become necessary. Reporting of hatchery effluent and water quality monitoring activities are part of the annual report provided to NOAA Fisheries. NOAA Fisheries will be consulted regarding any changes to the operation of the facilities that may affect water quantity and quality.
Flow reductions, flooding and poor fish culture practices may all cause hatchery facility failure or the catastrophic loss of listed fish under propagation. To protect endangered spring chinook, all efforts should be made to ensure that the survival of adult spring chinook held for broodstock at the hatchery facility be maximized. WDFW and USFWS propose a variety of measures to address risks associated with operational failures, including:

- Staffing hatchery facilities and fish weirs full time during their operation, providing for the protection of fish from vandalism and predation, and allowing for rapid response in the event of power and water loss or freezing;
- Equipping hatchery facilities with back-up generators to provide an alternative source of power to supply water to rearing fish during power outages;
- Rearing juveniles at lower pond loading densities to minimize the risk of loss due to disease at all facilities where spring chinook are held; and
- Ensuring staff are adequately trained in proper fish handling, rearing, and biological sampling techniques, and that all activities will be conducted in accordance with the WDFW Fish Health Manual (WDFW 1996) and/or Pacific Northwest Fish Health Protection Committee (PNFHPC 1989) disease prevention and control standards.

NOAA Fisheries believes operational measures proposed by WDFW and USFWS will adequately protect listed chinook salmon and steelhead. The proposed measures are in accordance with standard scientific protocols for operating hatchery facilities (IHOT 1995; 1996). Further, staff implementing these programs will be sufficiently trained and will be qualified to exercise professional judgement should unforeseen circumstances arise.

Adult Broodstock Collection

Potential adverse impacts to migrating adult spring chinook salmon from the collection of broodstock with the use of weirs or at traps in fish ladders include (1) delays in upstream migration, (2) rejection of the weir or fishway structure by adults, inducing spawning downstream of the trap (displaced spawning), (3) adults falling back downstream after passing upstream of the weir, (4) injury or death from attempts by adult salmonids to jump the barrier and (5) induced stress from handling of adults (NMFS 1999). These impacts are due to the physical presence and operation of the weirs and traps, other potential impacts of broodstock collection including the numerical reduction of the donor population (mining), and selection effects.

Adult spring chinook salmon are generally collected at the Chiwawa River and Nason Creek weirs (Wenatchee River) and at the Wells Dam trap. Other potential collection locations include sites on the Twisp and Chewuch rivers, Methow SFH and at Foghorn Dam on the Methow River and Tumwater Dam on the Wenatchee River (WDFW 1998a). Detailed descriptions of the hatchery traps and weirs used to collect broodstock are in IHOT (1996) and in WDFW (1998b). USFWS will collect adults that volunteer to the Winthrop NFH and at Foghorn Dam.

The trapping of adult spring chinook salmon for broodstock generally occurs from June 9 to July 31 at Tumwater Dam and from June 1 to September 10 on the Chiwawa River and Nason Creek weirs in the Wenatchee Basin. The Tumwater Dam trap, when operated, collects only marked Chiwawa hatchery adults to supplement collections at the Chiwawa River weir. In the future, when Chiwawa River and Nason Creek spring chinook adults can be differentiated from White River spring chinook adults, collection of broodstock will occur at Tumwater Dam but still may be supplemented with collection at the weirs. The Wells Dam traps generally collect adult spring chinook salmon from May 1 to June 28 and the Methow SFH and Winthrop NFH will collect volunteers from June to September. Actual operations will depend on broodstock objectives and site-based broodstock collection protocols developed annually by the Joint Fisheries Parties (federal, state and tribal fisheries co-managers) and the Mid-Columbia Coordination Committee which are submitted to NOAA Fisheries. The objectives and protocols can be adjusted in season to meet changes in the abundance and location of adult returns.

Weir installation and operation are very dependent on water conditions in the Chiwawa River and Nason Creek. High flows in the spring can prevent adult spring chinook from passing through Tumwater Canyon, delaying the time when adults reach Tumwater Dam, the Chiwawa River and Nason Creek. Installation of the weirs are dependent on flows and they are inoperable during periods of high flows. When in operation, the weirs are continuously monitored by Chiwawa Ponds personnel to keep the weir clear of debris and to ensure proper and safe functioning of the trap. The weirs have been operated in two modes: operate the trap continuously and collect up to 90% of the run, but passing upstream, to spawn naturally, two of every three fish collected, or operate the weir for four days per week with the weir panels lowered three days per week to provide unimpeded passage. The operational mode is determined during the development of the site-based broodstock collection protocols but can be adjusted based on in season escapement estimates and environmental factors.

WDFW, by operating the weirs as described above, addresses the potential impacts of weir rejection, fall back and injury by lowering the weir three days per week to provide unimpeded passage, and by operating the trap continuously thereby maintaining the weir is operating properly. To further address delay and handling stress all spring chinook encountered during broodstock collection are held for a minimal duration in the traps – generally less than 24 hours – and spring chinook salmon in excess of broodstock goals are released upstream immediately without harm to spawn naturally. Listed steelhead are not encountered at the weirs during spring chinook broodstock collection because these activities end prior to summer steelhead reaching the trapping sites. NOAA Fisheries believes that the proposed operational modes for the weirs and traps used for broodstock collection will adequately protect listed spring chinook salmon and steelhead.

The removal of adults from the naturally spawning population has potential adverse impacts. These include numerical reduction of the natural population (mining) and selection effects. Selection is the intentional and unintentional collection of adults for broodstock based on one or more of the life history characteristics such as run timing, age, morphology and sex ratio, that do not fully represent the natural (or target) population. The effects of selection or selection effects can change the characteristics of the natural population as well as cause the hatchery-produced fish to diverge genetically or demographically from the naturally produced population.

The proposed supplementation program is designed to preserve and rebuild naturally producing spring chinook populations in the upper Columbia River Region. Natural spring chinook salmon populations are not replacing themselves and extinction of one or all of the extant runs appears likely without the proposed program, as assisted by changes in hydroelectric dam operations, harvest activities, and competing land use actions. Risks to the donor natural populations, including numerical reduction and selection effects, are therefore viewed by WDFW and NOAA Fisheries as subordinate to the need to expeditiously implement the supplementation program that will prevent extinction of the ESU (BAMP 1998). To preserve the remaining natural populations and to address the numerical reduction and selection effects, WDFW will implement the following measures:

- Broodstock removals will be limited within the region through designation of *non-intervention* areas where the supplementation program will not be applied. The designation of *non-intervention* areas will prevent numerical reduction impacts for some of the region's populations as a result of program operations;
- An upstream escapement of approximately 80 adults per population will be maintained as a minimum level for natural spawning for those areas where the supplementation program will be applied when escapement to Wells Dam is greater than 668 adults;
- Removal of adult broodstock at traps for the supplementation program shall be representative of the run-at-large with respect to migration timing, age class, morphology, and sex ratio. Selection effects on that portion of each fish population allowed to spawn naturally will be minimized through these measures;

- Allow natural production to continue concurrent with the Methow Basin supplementation program through passage of a interim program minimum of 296 adults upstream when the run size at Wells Dam is expected to be greater than 668. A long term program minimum of 40% of the total arriving run will be passed for future runs between 741 and 1,415 fish; and
- Allow natural production to continue concurrent with the Wenatchee Basin supplementation program by the use of the fish collection weirs on the Chiwawa River and Nason Creek to trap up to 90% of the run but to pass two of every three fish collected to spawn naturally.

USFWS will use broodstock collected by WDFW at Wells Dam, the Twisp trap, the Chewuch trap and/or the Methow SFH and returning hatchery adults that volunteer into the fish ladder at Winthrop NFH. If in-season broodstock collections are below broodstock needs, then USFWS may also collect adults in the outfall from the Methow SFH. During the transition to Methow composite stock, USFWS may retain all adult spring chinook that return to the Winthrop NFH, but may cull any known Carson-stock spring chinook. Currently a large proportion of the returning Carson-stock spring chinook are not differentially marked from the Methow composite stock and must be held and sorted at time of spawning. In the future, returning Carson-stock spring chinook, will be externally marked and can be sorted at time of return. All unmarked spring chinook adults not needed for broodstock will be released unharmed to the mainstem Methow River.

NOAA Fisheries believes that the implementation of these measures will adequately protect endangered UCR spring chinook salmon populations in the action area from the effects of numerical reduction and selection effects.

During the trapping of spring chinook salmon broodstock at Wells Dam, there is the potential for endangered UCR summer steelhead to be present. At Wells Dam, UCR summer steelhead tend to move through the east ladder and not the west ladder. In recent years only 1 steelhead was handled in the west ladder and up to 89 steelhead were handled in the east ladder during spring chinook salmon broodstock collection. Trapping spring chinook salmon in the east ladder only occurs when returns to Wells Dam are expected to be below 668 adults. Thus, when returns are greater than 668, the handling of ESA-listed summer steelhead will be greatly reduced because trapping will only occur in the west ladder fish trap. The total number of steelhead handled may increase as returns of ESA-listed steelhead increase in the future. No ESA-listed steelhead are handled at the other adult collection sites due to the steelhead returning after the broodstock collection period. However, there is the potential for up to 20 listed steelhead that volunteer into the trap at Winthrop NFH to be handled during broodstock collection activities. Steelhead that are handled during broodstock collection will be released unharmed into the Methow River.

The potential handling of up to 100 adult, endangered, UCR summer steelhead during the collection of adult spring chinook salmon at Wells Dam is not expected to result in more than 9 mortalities of listed steelhead because collection occurs early in the run when few fish are present and the water temperatures are colder. Cold water temperatures increases the ability of salmonids to survive handling and release without harm. Fish will be sorted daily to reduce delay and handling will be kept to a minimum. Even with these measures the nine mortalities assumes a 5% mortality rate from handling and includes a buffer if steelhead returns increase to the point where more than 100 are handled at Wells Dam and other locations in the action area. The expected handling of up to 100 endangered summer steelhead is only 2.5 percent of the recent 5-year average passage for UCR steelhead at Wells Dam (Table 8). The potential for USFWS to handle 20 listed steelhead, which is less than 0.5% of the recent 5-year average escapement of steelhead at Wells Dam, is not expected to jeopardize the continued existence of the species.

Genetic Introgression

The genetic risks to naturally produced populations from artificial propagation include reduction in the genetic variability (diversity) among and within populations, genetic drift, selection, and domestication which can contribute to a loss of fitness for the natural populations (Hard *et al.* 1992; Cuenco *et al.* 1993; NRC 1996; and Waples 1996).

The loss of among population genetic diversity is the reduction in the difference in quantity, variety and combinations of alleles among populations (Busack and Currens 1995). The loss of genetic diversity among populations is caused by the introduction of genes from outside the population – for example from hatchery releases – at rates greater than what would occur naturally. This introduction can cause the loss of genetic uniqueness of the natural population with a concurrent reduction in performance (fitness) of the fish. Excessive flow of non-local genes into a population can reduce the fitness of individual populations through outbreeding depression. Salmon populations adapt to the local environment and this adaptation is reflected in the frequency of specific alleles that improve survival in that environment. When gene flow occurs, alleles that may have developed in a different environment are introduced into the population and these new alleles may not benefit survival.

Another source of outbreeding depression is the loss of combinations of alleles called co-adapted complexes. Co-adaptive complexes are alleles that tend to vary together over time and tend to be inherited as a group rather than independently. Gene flow can introduce new alleles that can replace alleles in the co-adaptive complexes leading to a reduction in performance (Busack and Currens 1995). Out breeding depression from gene flow occurs when eggs and fish are transferred between populations or when out of basin hatchery populations are allowed to spawn with the local population.

In the proposed programs, the risk of loss of among-population genetic diversity through out-breeding depression will be addressed through the application of several spawning, fish rearing, and fish-planting measures within selected watersheds in the ESU. It is acknowledged that among-population diversity for a portion of the ESU (Methow River Basin populations) will likely be negatively affected by the proposed WDFW and USFWS programs if escapements remain low. Specifically, this effect may result from the consolidation of Methow Basin populations into a single Methow population through collection and mating of upriver-origin spawners arriving at Wells Dam. However, this strategy will provide unique information on how best to increase the abundance of fish, and the populations' recovery.

To address the loss of genetic diversity among specific populations, WDFW proposes the following measures:

- Manage for the most discrete population units possible for supplementation. Critical criteria for choosing population units targeted for supplementation include the logistical limitations of terminal area collection and release for each population, the maintenance of genetic integrity and local adaptation, and the ability to manage for each discrete population. Discrete populations chosen for the supplementation program (Chiwawa River/Nason Creek, White River, Chewuch and Twisp River) represent major nominal spring chinook salmon populations in the Wenatchee and Methow River systems;
- Provide that a proportion of each population will not be subjected to artificial propagation and the associated potential risk of negative genetic effects, an upstream escapement goal of approximately 80 adults per population will be maintained as a minimum level for natural spawning;
- Limit the loss of diversity among populations within the region through the designation of *non-intervention* areas where the supplementation program will not be applied. These *non-intervention* areas will include the Little Wenatchee River and possibly the Entiat River, depending on the results of genetic sampling effort;
- Volitionally release hatchery spring chinook smolts after acclimation in the desired adult return location to minimize straying to other streams, reducing the risk of interbreeding between unrelated chinook populations and diversity loss among populations; and
- Assess and manage straying, and the potential for genetic diversity effects, through the marking of all hatchery spring chinook with a CWT and visual mark. Mass marking will allow for ready differentiation between hatchery and natural fish on spawning grounds.

USFWS and the fisheries co-managers have implemented the phasing out of the non-endemic Carson-stock spring chinook hatchery program to address the potential for genetic introgression and out-breeding depression. Recent returns to the Methow River have been at low enough levels to cause concern with regards to these Carson-stock hatchery fish spawning in the wild. Efforts are being made to minimize the effects of these fish on the natural spawning population. By phasing out the Carson-stock spring chinook and changing to Methow Composite stock, the potential adverse genetic effects from natural spawning hatchery fish will be greatly reduced.

NOAA Fisheries believes that the above measures proposed by WDFW will minimize the risk of genetic diversity loss among specific populations and outbreeding depression for UCR spring chinook populations in the Wenatchee River through the maintenance of discrete populations, protection of refuge (non-intervention) populations, and control of straying. NOAA Fisheries supports the transition by USFWS to Methow composite stock which will reduce the potential for genetic introgression.

Artificial propagation also has the potential to increase the risk of loss of within population genetic diversity caused by inbreeding depression, genetic drift, or domestication selection. Loss of within population genetic diversity (variability) is the reduction in quantity, variety and combinations of alleles in a population (Busack and Currens 1995). Quantity is defined as the proportion of an allele in the population and variety is the number of different kinds of alleles in the population. There are generally two ways that within population genetic diversity can change, random genetic drift, and inbreeding. Random genetic drift occurs because the progeny of one generation represents a sample of the quantity and variety of alleles in the parent population. Since the next generation is a sample and not a copy of the parent generation, rare alleles could be lost. Loss of rare alleles is unlikely in large populations, but becomes a greater risk in small populations where the rare allele is less likely to be represented in the next generation (Busack and Currens 1995).

The other mechanism of change is inbreeding, which is the breeding of related individuals. Inbreeding may not lead directly to changes in the quantity and variety of alleles in a population but inbreeding increases individual and population homozygosity. The homozygosity contributes to changes in the frequency of phenotypes in the population which are then acted upon by the environment. If the environment is selective towards specific phenotypes then the frequency of alleles in the population can change (Busack and Currens 1995). Waldman and McKinnon (1993) observed that genetic changes in a population from inbreeding depression can result from the expression of homozygous genotypes for rare, harmful alleles that are normally hidden in the population of heterozygotes. These genetic changes can also come from lower performance of the population (fitness) since heterozygotes tend to perform better than homozygotes.

In hatchery programs, the effective population size (N_e) can be used to identify potential sources of random genetic drift. The effective population size tends to be smaller than the actual number of spawners because not all spawners contribute equally to the next generation. To reduce the risk of inbreeding depression and genetic drift an N_e of at least 50 adults is required (Nelson and Soule 1987). Small effective population size in hatchery programs can contribute to genetic drift by the use of small numbers of adults for broodstock, using more females than males (or more males than females), pooling gametes, changing the age structure and allowing progeny of some matings to have greater survival than allowed others (Gharrett and Shirley 1985; Simon *et al.* 1986; and Withler 1988 cited in Busack and Currens 1995). Hatchery stocks have been found to have less genetic diversity than natural populations (Waples *et al.* 1990), indicating the potential for random genetic drift in hatcheries. The loss of genetic diversity within a hatchery population could be due to a genetic bottleneck, which occurs when only a very small number of fish are used for broodstock. Busack and Currens (1995) observed that it would be difficult to totally control random loss of within population genetic diversity in hatchery populations, but by controlling the broodstock number, sex ratios and age structure, loss could be minimized.

The other major hazard of the artificial propagation of salmon is domestication, which is the change in quantity, variety, and combination of alleles within a captive population or between a captive population and its source population in the wild that are the result of selection in an artificial environment (Busack and Currens 1995). Domestication occurs because putting fish into an artificial environment for all or part of their lives imposes different selection pressures on them than does the natural environment. The concern is that domestication effects will decrease the performance of hatchery fish and their descendants in the wild. Busack and Currens (1995) identified three types of domestication selection: (1) intentional or artificial selection; (2) biased sampling during some stage of culture; and (3) unintentional selection.

Artificial selection is the attempt to change the population to meet management needs, such as selecting for time of return or spawning time. The concern is that hatchery fish selected to perform well in a hatchery environment tend to not perform well when released into the wild due to the difference between the hatchery and the wild environments. Potential impacts to the natural population occur when the hatchery fish spawns in the wild and the resulting performance of the natural population is reduced due to outbreeding depression (Busack and Currens 1995). Domestication due to biased sampling generally occurs by error and can occur during any stage of hatchery operations. The selection of broodstock is a common source of biased sampling. In general, broodstock selection should be random but bias occurs when selection is based on particular traits. Genetic changes due to unintentional selection can be caused by the hatchery environment which allows more fish to survive compared to the natural environment.

The elimination of all risks due to genetic diversity loss and domestication is not possible, but NOAA Fisheries believes that these risks can be minimized through the following measures proposed for the adult supplementation program:

- Address genetic concerns regarding selectivity, the collection of adult broodstock at traps for the supplementation program shall be representative of the run-at-large with respect to natural and hatchery parentage, migration timing, age class, morphology, and sex ratio;
- Provide that a proportion of each population that will not be subjected to artificial propagation and the associated potential risk of negative genetic effects, upstream escapement goal of approximately 80 adults per population will be maintained as a minimum level for natural spawning when escapement to Wells Dam is greater than 668 adults;
- An effective population size (N_e) of 500 fish per population per generation should be the *long-term* program production objective to maintain an adequate genetic base, even thought an N_e of at least 50 adults per generation is required to reduce the risk of inbreeding depression and genetic drift in the short term (fewer than 5 salmon generations) (BAMP 1998). If fewer adults are available, production can be scaled to ensure that hatchery-origin progeny do not overwhelm the population as a whole;
- Rear fish at minimum pond loading densities to reduce the risk of domestication effects; and
- Eliminate of Carson-stock spring chinook (a highly domesticated stock) which will further reduce potential genetic effects.

Hatchery Production: Density-Dependent Effects

Hatchery salmon smolt releases may cause displacement of rearing natural salmon and steelhead juveniles from occupied stream areas, leading to abandonment of advantageous feeding areas or premature out-migration (Pearsons *et al.* 1994). The presence of large numbers of hatchery-produced fish may also alter natural fish behavior patterns, which may increase their vulnerability to predation (NMFS 1995). Adverse effects of the release of hatchery pre-smolt salmonids are reviewed by Steward and Bjornn (1990) and are discussed under the competition section below.

The out-planting of only volitionally migrating smolts by the programs will contribute to a decrease in density-dependent effects on natural fish, by limiting interactions between natural and hatchery fish. Releases of hatchery smolts coincident with managed releases of water (flow augmentation) will also help accelerate downstream migration of hatchery salmon and steelhead, further reducing spatial and temporal overlaps with listed fish and potential adverse behavioral effects.

As stated in Section III.A., the carrying capacity of the Columbia River mainstem and estuary ecosystems is very difficult to determine and this uncertainty has fueled debate over the density dependent effects of hatchery fish on natural populations in this area. Within the Wenatchee River Basin, recent ten-year seeding levels were at 42% of capacity and in the Methow River Basin seeding levels were only 18.9% of capacity (Table 4). The short-term goal for the combined supplementation and captive broodstock programs as originally proposed was to release 900,000 smolts (75% of the production capacity) into the Wenatchee River basin (Table 9). The current production goal for the supplementation program is 672,000 smolts (a combination of Chiwawa River and Nason Creeks) and is same as the proposed long-term objective or 56% of the production capacity (Table 4).

The Methow River basin short-term goal as originally proposed was 1.474 million smolts from the supplementation and captive broodstock programs (Table 9). The proposed long-term goal was for 738,000 smolts from the supplementation program at the Methow SFH and an additional 800,000 from the Winthrop NFH. Currently the goal for both facilities is the release up to 1,150,000 spring chinook smolts (550,000 at Methow and 600,000 at Winthrop NFH). The current short-term production goal will provide 139% of the smolt production capacity and the long-term production will provide over 186% of the natural smolt capacity of the Methow River basin (Table 4).

The production goals are high when compared to the basin's carrying capacity. This is due to the current low smolt-to-adult survival observed for the Methow River and Wenatchee River spring chinook salmon. Smolt-to-adult survival rates for the 1992 and 1993 broodyears have ranged from 0.01% to 0.08% (BAMP 1998). The smolt-to-adult survival rates for the most recent broodyears are expected to show improvements. To achieve adult escapement goals, at the present mainstem passage and ocean conditions, smolt releases in excess of the carrying capacity of the basin are necessary. For this analysis, the carrying capacity is the number of smolts that the habitat can produce from the egg life stage to the smolt life stage. Because hatchery spring chinook salmon will be acclimated and volitionally released as smolts and therefore are expected to outmigrate soon after release, hatchery-produced fish are not expected to adversely impact the natural carrying capacity of the basin. Interactions between naturally produced and hatchery-produced spring chinook will only occur in the migration corridor (see discussion below) and when these fish return to spawn as adults.

Table 9. Short-term and long-term hatchery production goals for the supplementation and captive broodstock programs as originally proposed in the application. Note that the captive broodstock programs are not part of this opinion.

Population	Program Type	Short-Term Objective	Long-Term Objective
Chiwawa River	Supplementation	300,000	672,000
White River	Captive Broodstock	240,000	To be determined
Nason Creek	Captive Broodstock	360,000	To be determined
Methow River (WDFW)	Supplementation	550,000	738,000
Methow River (USFWS)	Supplementation	600,000	800,000
Twisp River	Captive Broodstock	324,000	To be determined

The production of Chiwawa River and Nason Creek have been combined into one stock with a combined production goal of 672,000 smolts.

Disease

Interactions between hatchery fish and listed fish in the natural environment may be a source of pathogen transmission. This impact is probably occurring in headwater spawning and/or rearing areas and throughout the entire migration corridor (Sanders *et al.* 1992). Because the pathogens responsible for diseases are present in both hatchery and natural-origin populations, there is some uncertainty associated with determining the extent of disease transmission from hatchery fish (Williams and Amend 1976; Håstein and Lindstad 1991). However, hatchery populations are potential reservoirs of disease pathogens because of the high rearing densities and resultant stress. Under natural conditions, which usually involve rearing at low density, most pathogens are held in check. When epizootics do occur, they are often triggered by increased population density and unusual changes in the environment (Saunders 1991). Consequently, it is likely that release of large numbers of hatchery fish may be responsible for some loss of listed salmon and steelhead from disease.

Although hatchery populations can be reservoirs for disease pathogens because of their elevated exposure to high rearing densities and stress, there is little evidence to suggest that diseases are routinely transmitted from hatchery to natural fish (Steward and Bjornn 1990). Chapman *et al.*

(1994) concluded that disease transmittal from hatchery to natural populations is probably not a major factor negatively affecting natural steelhead in the Columbia Basin.

To address concerns of potential disease transmission from hatchery to natural fish, the Pacific Northwest Fish Health Protection Committee (PNFHPC) has established guidelines to ensure hatchery fish are released in good condition, thus minimizing impacts to natural fish (PNFHPC 1989). Also, the IHOT (1995) developed detailed hatchery practices and operations designed to prevent the introduction and/or spread of any fish diseases with the Columbia River Basin. Hatcheries in the Columbia River Basin generally follow fish health protocols in accordance with PNFHPC and IHOT recommended guidelines.

WDFW has implemented both disease prevention and disease control programs to maximize production of healthy fish. Adult broodstock are injected with Food and Drug Administration (FDA) approved antibiotics under the control of a certified Fish Pathologist, for treatment of BKD prior to transportation and during spawning. Spawned adults are evaluated for the presence of viral and bacterial pathogens following accepted standard procedures set forth by the Pacific Northwest Fish Health Protection Committee (PNFHPC 1989). NOAA Fisheries believes that following these practices in the hatchery environment will adequately protect listed naturally produced UCR spring chinook from impacts from the transmission of disease.

At the Winthrop NFH, adults enter the facility as early as May and are not ready for spawning until mid-August. To curb infestations of parasites, formalin is administered to the adult pond water at concentrations of 167 ppm. Just prior to spawning, all females are injected with erythromycin. This antibiotic is absorbed by the eggs to help fight against the transmission of Bacterial Kidney Disease (BKD) from adult spawners to progeny. To combat disease and viruses which commonly occur at fish production facilities, fish health specialists conduct monthly exams on all “lots” of juvenile fish. Whenever abnormal behavior or mortality is observed, the fish health specialists will examine the affected fish, make a diagnosis and recommend the appropriate remedial or preventative measures. In most cases, this will involve a chemical treatment. All medications used are approved by the FDA for use in fish culture.

Competition

Direct competition for food and space between hatchery and listed fish may occur in spawning and/or rearing areas, the migration corridor, and ocean habitat. These impacts are assumed to be greatest in the spawning and nursery areas and at points of highest fish density (release areas) and to diminish as hatchery smolts disperse (USFWS 1994). Competition continues to occur at some unknown, but probably lower, level as smolts move downstream through the migration corridor. Release of large numbers of pre-smolts in a small area is believed to have greater potential for competitive effects because of the extended period of interaction between hatchery fish and listed species. Release of hatchery smolts that are physiologically ready to migrate is expected to minimize competitive interactions because they are more likely to quickly migrate out of the spawning and nursery areas.

At the short-term target production goals, the programs will produce up to 672,000 (Chiwawa/Nason supplementation programs) hatchery smolts for release into the Wenatchee River Basin and 1,150,000 into the Methow River Basin based on the expected survival of broodstock and progeny. Due to size variance of the population around the target release size of 15 fish/lb (30 grams/fish), only a portion (about 10%) of each year's release are not classified as true "smolts." Based on numerous snorkel observations made by WDFW, during volitional releases of spring chinook salmon into the Tucannon River, the hatchery smolts tended to migrate down river almost immediately. This observation is further supported by recaptures of hatchery-produced smolts at a downstream migrant trap, 33 miles below the release site. Smolt travel times of over 12.4 miles/day have been documented for several hatchery release locations within the Tucannon River drainage. Snorkel observations determined that naturally produced fish do not generally move from their preferred location, and are apparently not disturbed by the release of large numbers of hatchery fish (WDFW 1998b).

Competition for space and cover in the Wenatchee and Methow Rivers probably occurs between hatchery and natural fish shortly after release and during downstream migration, but based on the smolt travel times the duration of interaction is minimal in the river (WDFW 1998a). Rearing and release strategies at all WDFW spring chinook hatcheries are designed to limit adverse ecological interactions through minimizing the duration of interaction between newly liberated hatchery chinook and naturally produced fish. WDFW and USFWS propose to minimize the amount of interactions between hatchery smolts and naturally produced spring chinook salmon through the following actions:

- Rear hatchery spring chinook to sufficient size such that smoltification occurs within nearly the entire population, reducing residence time in the streams after release (Bugert *et al.* 1991) and promoting rapid seaward migration. Physiological measures of the degree of smoltification within the hatchery population, including allowable fork length coefficient of variation maximums (CV less than 10 %) and average condition factor at release targets (0.9 – 1.0), will be used to indicate when fish should be allowed to volitionally migrate;
- Continue to release spring chinook smolts to benefit from water budget releases through upstream dams, to further accelerate seaward migration of released hatchery fish, further reducing the duration of any interactions with natural fish;
- Rear fish on-station using parent river water which will contribute to the smoltification process leading to reduced hatchery fish residence time in the rivers and mainstem migration corridors; and
- Liberate hatchery spring chinook smolts, after acclimation, in the desired adult return location to minimize the risk of straying to other streams, thereby reducing the risk of adverse competitive effects with indigenous natural fish for spawning sites or mates.

<u>Predation</u>

Hatchery fish may prey upon listed fish. Due to their location, size, and time of emergence, newly emerged chinook salmon fry are likely to be most vulnerable to predation by hatchery released fish. Their vulnerability is believed to be greatest as they emerge and decreases somewhat as they move into shallow, shoreline areas (USFWS 1994). Emigration out of hatchery release areas and foraging inefficiency of newly released hatchery smolts may minimize the degree of predation on chinook salmon fry (USFWS 1994).

Predation by hatchery fish on natural-origin smolts is less likely to occur than predation on fry. USFWS (1994) presented information indicating salmonid predators are generally thought to prey on fish approximately 1/3 or less their own length (see also Witty *et al.* (1995) citing Parkinson *et al.* (1989)). Chinook salmon, after entering the marine environment, generally prey upon fish one-half their length or less and consume, on average, fish prey that is less than one-fifth of their length (Brodeur 1991). Consequently, predation by hatchery fish on listed salmon smolts in the migration corridor is believed to be low.

Chinook salmon yearling smolts released from hatcheries may interact with one, two and three year old un-smolted natural steelhead that are rearing in the tributary and mainstem migration corridors. The Species Interaction Work Group (SIWG 1984) reported that there is an unknown risk of predation by hatchery chinook salmon on natural steelhead juveniles where they interact in freshwater migrational areas. Steward and Bjornn (1990) referenced a report from California that estimated, through indirect calculations rather than actual field sampling methods, the potential for significant predation impacts by hatchery yearling chinook salmon on natural chinook and steelhead fry. They also reference a study in British Columbia that reported no evidence of predation by hatchery chinook smolts on emigrating natural chinook fry in the Nicola River. Although rating the risk to natural fish as unknown, the SIWG (1984) noted that predation may be greatest when large numbers of hatchery smolts encounter newly emerged fry or fingerlings, or when hatchery fish are large relative to natural fish.

There is the potential for predation on natural steelhead by hatchery chinook smolts, if the steelhead are of a small enough size. Chapman *et al.* (1994) reported a steelhead smolt size range at out migration of 6.3-6.9 inches (160-175 mm) FL in the Mid-Columbia Region. Naturally produced steelhead smolts sampled at Rock Island Dam averaged between 6.4-7.4 inches (163-188 mm) FL for years 1986 through 1994 (Chapman *et al.* 1994). Assuming that non-smolted age 2 and 3 steelhead are within the range recorded for smolts (6.3-6.9 inches (160-175 mm FL)), predation by hatchery spring chinook smolts, which at release are of a size nearly equal to that of the natural steelhead, would be unlikely. Age 1 steelhead smolts have a mean FL of 6.1 inches (156 mm) at Rock Island Dam (1988-89 date from Peven *et al.* 1994). Age 1^+ non-smolts may be of a size smaller than that recorded for smolts that age. However, it is unlikely that age 1^+ natural steelhead non-smolts are less than 2.4 inches (60 mm) FL, which (assuming the 1/3 length “rule”) would be vulnerable size for predation by hatchery salmon that are larger than 7.1 inches (180 mm) FL. Chapman *et al.* (1994) reported mean FL sizes of natural underyearling Wenatchee River steelhead of 2.8 inches to 3.1 inches (72 mm to 78 mm) in October. These natural fish would be larger as yearlings in April and May when hatchery smolts are released.

Spring chinook transition to a fish diet when they reach 4.7 inches (120 mm) FL or larger (BPA 1997a) and begin their seaward migration as yearling smolts. Muir and Emmett (1988) found chinook smolts actively feeding on invertebrate species such as cladocerans, chironomids and amphipods during their downstream migration. Larger smolts may eat smaller fish, but recent information indicates that fish are an insignificant fraction of the food consumed by migrating chinook salmon in the Snake and Columbia rivers (Muir and Coley 1995).

Large numbers of hatchery fish may attract predators (birds, fish, pinnipeds) and, consequently, contribute indirectly to predation of naturally produced fish. On the other hand, a mass of hatchery fish moving through an area may confuse or distract predators and may provide a beneficial effect to naturally produced fish. Both effects may be occurring to some extent. The presence of large numbers of hatchery fish may also alter the listed species' behavioral patterns, which may influence vulnerability and prey susceptibility (USFWS 1994).

Impacts from predation by hatchery-produced spring chinook salmon released into the upper Columbia River are not likely to jeopardize the continued existence of listed UCR spring chinook salmon and steelhead because of their size at release and because they tend to migrate out of the basin quickly (WDFW 1998a). Impacts on listed fish due to predators attracted by the presence of hatchery chinook salmon smolts in the migration corridor are unquantifiable, but are not expected to adversely affect listed fish.

Residualism

Hatchery salmonids that do not emigrate after release, are said to have residualized. These fish that residualize can adversely effect naturally produced fish through competition and predation. Chinook salmon do not tend to residualize (Groot and Margolis 1991), thus no effects are expected on natural UCR spring chinook salmon or steelhead in the Wenatchee River or Methow River basins.

Migration Corridor/Ocean

The mainstem and estuarine ecology of the Columbia River Basin has profoundly changed from the time when it supported healthy anadromous salmonid populations. Access to major production areas has been eliminated, much of the riverine habitat has been transformed into reservoirs, runoff timing and food resources have been altered, the abundance of predators and potential competitors has increased enormously, and exotic species that prey on or compete with listed salmon and steelhead have flourished. These factors taken together make it very difficult to determine the capacity of the mainstem and estuarine ecosystems to sustain anadromous fish stocks. This has fueled an intense debate over the issues of carrying capacity and density-dependent effects on natural populations of salmon from hatchery releases in the Columbia River Basin.

Considerable speculation, but little scientific information, is available concerning the overall effects to listed salmon and steelhead from the combined number of hatchery fish in the Snake/Columbia River migration corridor. In a review of the literature, Steward and Bjornn

(1990) indicated that some biologists consider density-dependent mortality during freshwater migration to be negligible; however, they also cited a steelhead study that indicated there may have been a density-dependent effect (Royal 1972, cited in Steward and Bjornn 1990). Hatchery and natural populations have similar ecological requirements and can potentially be competitors where critical resources are in short supply (Lower Granite Migration Study Steering Committee [LGMSC] 1993).

Carrying capacity depends on system productivity, which fluctuates. Variation in productivity is probably linked to climatic cycles as well as to human activities that have altered the habitat in the last 100 years. The difficulty of estimating a system's capacity to support salmon is probably further compounded by cycles of oceanic productivity and other ecological and human factors, effects that may be difficult to isolate from each other. Current carrying capacity estimates must be based on present conditions and may be lower than historical levels. However, a reasonable estimate of the current carrying capacity is not available and would be difficult to derive. The limited information available concerning effects from changes in the historic carrying capacity to listed salmon is insufficient to determine definitive impacts.

The effects of hatchery production on listed salmon and steelhead in the ocean would be speculative, since hatchery fish intermingle at the point of ocean entry with natural and hatchery anadromous salmonids from many other regions. Witty *et al.* (1995), assessing the effects of Columbia River hatchery salmonid production on natural fish, stated:

> "We have surmised the ocean fish rearing conditions are dynamic. Years of limited food supply affect size of fish, and reduced size makes juveniles more subject to predation (quoted from Parker 1971). Mass enhancement of fish populations through fish culture could cause density-dependent affects during years of low ocean productivity. However, we know of no studies which demonstrate, or even suggest, the magnitude of changes in numbers of smolts emigrating from the Columbia River Basin which might be associated with some level of change in survival rate of juveniles in the ocean. We can only assume that an increase in smolts might decrease ocean survival rate and a decrease might improve ocean survival rate."

A recent study by Levin *et al.* (2001) demonstrated a negative relationship between the survival of Snake River spring chinook salmon and the number of hatchery chinook released into the Columbia River. The relationship was amplified during periods of poor ocean conditions. The specific interactions – through density-dependent effects, competition and predation – in the mainstem corridor and ocean environments between natural fish and the hatchery spring chinook released from the proposed artificial propagation programs cannot be meaningfully measured. Because these specific effects cannot be measured and are expected to be small or nonexistent, NOAA Fisheries considers those effects to be insignificant effects (as defined in the Interagency Handbook on Section 7 Consultations, NMFS/USFWS 1998) and consequently will not consider these further in this opinion.

B. WDFW's UCR Spring Chinook Salmon Captive Broodstock Program

During the development of this consultation, WDFW, the other fisheries co-managers, and NOAA Fisheries collectively decided to address the ongoing captive broodstock program, and the effects associated with its transition to an adult-based supplementation program, as part of a separate section 7 consultation. However adult captive broodstock spring chinook produced from this program can be incorporated into the adult supplementation programs for the respective basins.

C. Monitoring and Evaluation Programs

WDFW's hatchery supplementation program will be closely monitored and evaluated within the hatchery environment under WDFW's proposed scientific research/enhancement permit (Permit #1196). The hatchery supplementation program will also be closely monitored outside of the hatchery environment in the Wenatchee River Basin under WDFW's scientific research Permit #1203 and Chelan PUD's scientific research Permit #1115 (Modification 3). Monitoring will also occur outside of the hatchery environment in the Methow River Basin through work funded by Douglas PUD under scientific research Permit #1246. The monitoring and evaluation program will help identify problems or deviations from the criteria established to measure the expected performance of the supplementation program. The monitoring and evaluation program will also provide data that can be used to change the program if the program drops below minimum threshold criteria (WDFW 1998a). The monitoring and evaluation programs will also provide invaluable data on the use of supplementation to conserve and recover ESA-listed salmon species. Furthermore, while the monitoring and evaluation program work will be considered separately from the proposed action, the proposed action includes the intent to modify the production protocols based on input from these monitoring and evaluation activities.

The scientific research and sampling of artificially propagated UCR spring chinook salmon proposed by WDFW in its permit application (WDFW 1998a) would address the effects of the adult supplementation program and include takes associated with the monitoring and evaluation activities within the hatchery environment. Such activities will include handling fish for tagging, marking, transfers, transportation, and the acquisition of biological information. Annual takes of ESA-listed chinook salmon for scientific research purposes within the hatchery environment will be identified and enumerated as part of the proposed permit (Permit 1196).

The takes of juvenile, endangered, UCR spring chinook salmon associated with scientific research/monitoring within the hatchery environment will be directed at artificially propagated fish only. Therefore, no impact to the naturally produced component of the species would occur as a result of the within-hatchery research and monitoring activities.

D. UCR Steelhead

The operation of the hatchery facilities are not expected to negatively impact listed UCR steelhead juveniles. Hatchery facility impacts described for spring chinook are expected to be similar for listed steelhead. Juvenile steelhead may encounter hatchery intake screens during migration within the Wenatchee and Methow river systems, but these encounters are expected to result in negligible impacts because hatchery intake screens are maintained to NOAA Fisheries criteria. Effects of hatchery effluent on steelhead juveniles are similar to those for natural spring chinook juveniles. Impacts are expected to be low as long as the hatcheries meet permitted discharge requirements.

WDFW's proposed permit (Permit #1196) and USFWS' proposed permit (Permit #1300) would authorize the incidental capture, handling, and release of up to 120 adult endangered, UCR steelhead annually during WDFW's and USFWS' adult chinook salmon broodstock collection activities (100 by WDFW and 20 by USFWS). The mortality estimate assumes a 5% mortality rate for fish handled during broodstock collection activities. The addition mortality of 4 adults above the 5% loss rate provides for additional incidental impacts if steelhead returns increase relative to spring chinook or if listed steelhead are encountered in greater numbers during broodstock collection activities in the tributaries. The expected mortality of UCR steelhead from these activities is 10 adults. The impact of the loss of 10 adult steelhead is considered small considering that the recent 5-year mean escapement of summer steelhead was 4,155 as measured at Wells Dam. The escapement of summer steelhead over Wells Dam in 2001 was 18,483 adults. The loss of 10 adults steelhead is less than 0.2% of the 5-year average.

Endangered UCR steelhead will be handled during WDFW's broodstock collection activities at Wells Dam fish trap and the level of take depends on the number of adult spring chinook salmon returning to Wells Dam as well as the number of UCR steelhead. If the returns of UCR spring chinook salmon to Wells Dam are expected to be greater than 668, then only the trap in the west ladder is used, which substantially reduces the number of steelhead handled compared to the operation of both the west and east ladder traps. Adult, endangered, UCR steelhead may also be incidentally taken during UCR spring chinook salmon broodstock collection activities at the Chiwawa River and Nason Creek weirs and Tumwater Dam in the Wenatchee River Basin and the Twisp River trap, the Chewuch River trap, Foghorn Dam, and the Methow SFH and Winthrop NFH in the Methow River Basin. WDFW's broodstock collection activities may involve the temporary delay of returning adult steelhead and the potential for handling-related stress. Based on prior experience with the techniques and protocols to be used to collect adult chinook salmon broodstock, WDFW expects that no more than 1 percent of the adult steelhead to be handled will be killed annually, resulting in no more than 1 adult, endangered, UCR steelhead incidental mortality. NOAA Fisheries assumes that handling of listed steelhead during broodstock collection activities at Wells Dam and potentially at other locations (though it is not expected) can result in a 5% mortality rate of those steelhead handled. Furthermore, to allow for increases in steelhead escapement, NOAA Fisheries will authorize the an incidental mortality from WDFW's activities under Permit #1196 of 9 adult steelhead.

The potential loss of up to 9 adult steelhead annually may have a greater impact to the species if the fish are naturally produced . The impact to the species and thus the relative impact to the population of origin would also depend on where the mortality occurred (e.g., Wells Dam/Methow River or Wenatchee River). Based on the recent 5-year average (1995-1999) of adult steelhead returns to Priest Rapids Dam, the probability of one the steelhead mortalities being a naturally produced adult steelhead is approximately 1:7.

Listed UCR steelhead may volunteer into the fish ladder and trap at Winthrop NFH. The occurrence of listed steelhead within the trap during adult spring chinook broodstock collection is very low, with less than 20 steelhead encountered annually. Adult steelhead encountered in the trap are removed and released unharmed back into the Methow River. NOAA Fisheries assumes that the mortality rate for steelhead handled during these activities can be up to 5%, or potentially one adult. However, mortality from the transfer to the Methow River has been very low with no known mortalities. NOAA Fisheries will authorize the USFWS under Permit #1300 an incidental mortality of 1 adult steelhead. The low level of handling and potential for mortality of not more than 1 UCR steelhead is not likely to appreciably reduce the likelihood of the survival and recovery of the UCR steelhead ESU as a whole or substantially reduce the species' size or its ability to recover.

WDFW's and USFWS' proposed UCR spring chinook salmon hatchery supplementation programs have the potential to impact the juvenile life stages of UCR steelhead from the operation of the hatcheries and from juvenile fish releases from the program. The take of ESA-listed juvenile fish will be limited by compliance with the special provisions proposed to be included in the permit for hatchery operations that are designed to eliminate entrainment in intakes, straying into outlets, and other sources of mortality.

The monitoring of incidental takes of juvenile UCR steelhead associated with the release of hatchery-produced smolts from WDFW's and USFWS' UCR spring chinook salmon supplementation programs will be covered in part under WDFW's scientific research Permit #1203, WDFW's scientific research/enhancement Permit #1094 (UCR steelhead hatchery supplementation program), Chelan PUD's scientific research Permit #1115, and Douglas PUD's scientific research Permit #1246.

E. Other Listed Salmonids

Incidental takes of ESA-listed juvenile fish that occur outside the action area, that could potentially result from the WDFW's and USFWS' hatchery operations and hatchery-produced fish releases are currently unquantifiable but expected to be small. Because of the inherent biological attributes of aquatic species such as salmon and steelhead, the dimensions and variability of the Columbia River system and tributaries, and the operational complexities of hatchery actions, determining precise incidental take levels of ESA-listed species attributable to WDFW's and USFWS' hatchery activities are not possible at present. In the absence of quantitative estimates of incidental take, NOAA Fisheries will monitor fish release numbers/locations and WDFW's and USFWS' hatchery operations to assure that incidental takes do not operate to the disadvantage of the ESA-listed species. If NOAA Fisheries determines that incidental takes due to WDFW's hatchery activities have the potential to operate to the disadvantage of ESA-listed species, WDFW must suspend the activities that result in the incidental takes until a reasonable solution is achieved, the permit is amended, and/or the specific program is reevaluated under Section 7 of the ESA.

The proposed action includes the incidental handling of up to 120 adult, endangered, UCR steelhead annually during WDFW's and USFWS' broodstock collection activities. There is the potential for a loss of up to 10 adult, endangered, UCR steelhead, from these activities. The impacts to juvenile listed UCR steelhead and other listed salmon and steelhead in the Columbia River basin from the release of hatchery fish from these programs are not measurable and are expected to be very small.

F. Effects to Critical Habitat

As noted above, critical habitat has been designated for both UCR spring chinook salmon and UCR steelhead. The essential features of the critical habitat are set out in Section III.B. of this opinion.

Critical habitat may be impacted by activities such as weir placement, water withdrawals and from hatchery effluent. Weirs placed in rivers or at water diversions may affect the substrate, riparian vegetation and migration features of the critical habitat. Water withdrawal and hatchery effluent may affect water quality, water quantity, water temperature, water velocity and to a lesser extent cover/shelter, space and food. These impacts are thought to be small because many of these activities occur over short periods of time, are in isolated locations or impact localized areas thus limiting potential impacts to only part of the natural populations in the basins and ESU as a whole.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local or private actions not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to this consultation. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Act.

A full discussion of cumulative effects in this area can be found in the FCRPS opinion (NMFS 2000b), many of which are relevant to this discussion. State, Tribal and local government actions will likely to be in the form of legislation, administrative rules or policy initiatives. Generally, a number of habitat improvements are being undertaken by the State of Washington and tribal governments. Because these are long-term projects, their effects are uncertain. Local governments are also involved in habitat improvement projects, but as with other habitat projects their impacts will be measured on a long-term basis. Government and private actions may encompass changes in land and water uses – including ownership and intensity – any of which could impact listed species or their habitat. Government actions are subject to political, legislative, and fiscal uncertainties. These realities, added to the geographic scope of the action area which encompasses numerous government entities exercising various authorities and the many private landholdings, make any analysis of cumulative effects difficult and frankly speculative.

A. Representative State Actions

Each state in the Columbia River basin administers the allocation of water resources within its borders. Most streams in the basin are over-appropriated even though water resource development has slowed in recent years. Washington closed the mainstem Columbia River to new water withdrawals, and is funding a program to lease or buy water rights. It is hoped that this will improve water quantity over the long term. The state governments are cooperating with each other and other governments to increase environmental protections, including better habitat restoration and hatchery and harvest reforms. NOAA Fisheries also cooperates with the state water resource management agencies in assessing water resource needs in the Columbia River basin and in developing flow requirements that will benefit listed fish. During low-water years, however, there may not be enough flow to meet the fishes' needs. These government efforts could be reduced or even discontinued, so their cumulative effects on listed fish is unpredictable.

If these programs are actually implemented, there may be some improvement in various habitat features considered important for the listed species. The Oregon Plan also identifies several private and public cooperative programs for improving the environment for listed species. The success of such programs will depend on continued interest and cooperation among the parties involved.

The state of Washington has various strategies and programs designed to improve the habitat for listed species and assist in recovery planning. One such is the Salmon Recovery Planning Act – a framework for developing watershed restoration projects. The state is also developing a water quality improvement scheme through the development of Total Maximum Daily Loads (TMDLs). As with the Oregon initiatives, these programs could benefit the listed species if implemented and sustained.

Economic diversification has contributed to population growth and movement in the states – a trend likely to continue for the next few decades. Such population trends will engender greater demands in the action area for electricity, water, and buildable land; they will affect water quality directly and indirectly; and they will increase the need for transportation, communication, and other infrastructure development. The impacts associated with economic and population demands will affect habitat features (such as water quality and quantity) that are important to the survival and recovery of the listed species. The overall effect is likely to be negative unless carefully planned for and mitigated.

Some of the state programs described above are designed to address these impacts. Oregon also has a statewide land use planning program with growth management and natural resource protection goals. Washington enacted a Growth Management Act to help communities plan for growth and address growth impacts on the natural environment. If the programs continue, they may help lessen some of the potential adverse effects identified above.

B. Local Actions

Local governments will be faced with similar but more direct pressures from population growth and movement. There will be demands for intensified development in rural areas as well as increased demands for water, municipal infrastructure, and other resources. The reaction of local governments to such pressures is difficult to assess at this time. In the past, local governments in the action area generally accommodated additional growth in ways that adversely affected listed fish habitat. Also there is little consistency among local governments in dealing with land use and environmental issues, so any positive effects that local government actions have on listed species and their habitat are likely to be scattered throughout the action area.

In Washington, local governments are considering ordinances to address how different land uses affect fish and habitat health. These programs are part of state planning structures. Some local government programs may qualify for a limit under the NOAA Fisheries' ESA section 4(d) rule which is designed to conserve listed species. Local governments also may participate in regional watershed health programs, although political will and funding will determine participation and therefore the effect such actions have on listed species. Overall, without comprehensive and cohesive beneficial programs – and the sustained application of such programs – it is not likely that local actions will have measurable positive effects on listed species and their habitat, and may even contribute to further degradation.

C. Tribal Actions

Tribal governments will continue to participate in cooperative efforts involving watershed and basin planning designed to improve fish habitat. The result that changes in Tribal forest and agriculture practices, water resource allocations, and land uses will have on listed fish and their habitat is difficult to assess for the same reasons discussed above under State and Local Actions. The earlier discussions related to growth impacts also apply to Tribal government actions. Tribal governments will need to put into practice comprehensive and beneficial natural resource programs if they are to have measurable positive effects on listed species and their habitat.

D. Private Actions

The effects of private actions are the most uncertain. Private landowners may change, intensify, or diminish their current land uses. Individual landowners may voluntarily initiate actions to improve environmental conditions, or they may abandon or resist any improvement efforts. Their actions may be compelled by new laws, or may arise out of growth and economic pressures. Changes in ownership patterns will have unknown impacts. There is no way to predict whether any of these private actions will take place, and gauging their possible effects is even more difficult.

Non-Federal actions are likely to continue affecting listed species. The cumulative effects in the action area are difficult to analyze considering the geographic landscape of this opinion, the different resource authorities in the action area, the uncertainties associated with government and private actions, and the changing economies of the region. Whether these effects will increase or decrease is a matter of speculation; however, based on the trends identified in this section, the adverse cumulative effects are likely to increase. Although state, Tribal and local governments have developed plans and initiatives to benefit listed fish, they must be applied and sustained in a comprehensive way before NOAA Fisheries can consider them reasonably certain to occur in its analysis of cumulative effects.

VII. INTEGRATION AND SYNTHESIS

Both proposed artificial propagation programs will remove listed fish from the natural spawning populations in the Wenatchee River and Methow River basins. In the Wenatchee River, up to 400 adults will be collected for broodstock and in the Methow River (either at Wells Dam or at other sites) up to 1,000 adults could be collected. The collection of broodstock in the Wenatchee River basin at the Chiwawa River trap will be limited to 1/3 of the run returning to the trap or 400 adults, which ever is less. Based on redd count data (see Section III) this is equal to about 1/6 or 16.5% of the potential natural spawning fish returning to the Wenatchee River Basin.

In the Methow River Basin, the artificial propagation program will trap and retain for broodstock all the spring chinook reaching Wells Dam if the expected return is less than 668 adults. This would remove all the adults that could potentially spawn naturally in the Methow River Basin. This scenario has occurred twice, once in 1996 and again 1998 when a total of 450 adults and 406 adults were collected, respectively. Furthermore, a proportion of the adults that were collected in 1996 and 1998 were non-listed Carson-stock spring chinook from the Winthrop NFH, illustrating how poor the returns were in those years.

NOAA Fisheries supports these programs because we believe along with the fisheries co-managers that, due to the status of the populations in these basins, these artificial propagation programs are necessary to preserve and eventually recover the listed populations. The status of the natural populations in the Wenatchee River and Methow River basins have shown a declining trend in abundance that has lead to the listing of the ESU as endangered. Analysis has shown that the population growth rate for the ESU as whole for 1980 to 1998 adult returns ranged from 0.78 to 0.87 (see Section III). Basically, the populations in the ESU have not been replacing themselves. A recent population risk assessment for the UCR spring chinook populations estimated that the extinction risk for the Methow River population was 50% and for the Wenatchee River population was 98% (Cooney 2000).

In the summary of the Biological Assessment and Management Plan (BAMP 1998) for spring chinook salmon, NOAA Fisheries concluded:

> "Spring chinook salmon are at high risk of extinction, and the Plan's artificial propagation programs are aimed at reducing this risk and rebuilding natural runs. Although the use of artificial propagation to rebuild natural, self-sustaining populations does not have a good track record and entails substantial risks to the genetic integrity and fitness of the supplemented populations, these risks appear to be lower than the immediate risk of extinction in the wild. The Plan recognizes that the use of artificial propagation to rebuild self-sustaining natural populations is largely unproven, and because of this uncertainty recommends a *spread the risk* strategy that involves different artificial propagation approaches for different populations. Adult based supplementation programs will continue in the Chiwawa River and the Methow Basin, and captive brood programs will be established for the White River, Nason Creek, and Twisp River populations, with the Little Wenatchee and (possibly) the Entiat River serving as non-interference reference populations. It is important to emphasize that the [Mid-Columbia Habitat Conservation Plan] spring chinook salmon program is a *spread the risk* strategy involving several diverse components, and as such would be considerably weakened by the elimination of any major component. Likewise, monitoring and evaluation plays a critical role in the spring chinook salmon program, and in order to be effective should be implemented as fully as possible."

As described above, the risks and benefits of the supplementation program were discussed extensively in the development of the BAMP (BAMP 1998). The federal, state and tribal fisheries co-managers and the Mid-Columbia Coordinating Committee concluded that, due to the status of spring chinook salmon populations in the upper Columbia River region, the supplementation program should be continued. This decision was based on two factors: (1) the low abundance of naturally spawning spring chinook salmon leading to an increased chance of extinction in the near future, and (2) the increase in survival of hatchery returns compared to naturally produced fish. This second factor is based on the data from the 1989 brood of Chiwawa River spring chinook salmon that were part of the supplementation program. The data showed that the supplemented fish provided a 15 – to – 1 short-term adult-to-adult survival benefit over naturally produced Chiwawa River spring chinook salmon (Larry Brown, WDFW, pers. com., April 24, 1999).

The risks of genetic variability (diversity) loss within and between populations from domestication, inbreeding depression, genetic selection, changes in life-history characteristics, and impacts from broodstock collection associated with the adult supplementation program will be minimized through the measures proposed by WDFW and USFWS. These actions do not completely remove the risks of genetic diversity loss, to reduce the risk to zero, the hatchery programs would have to be eliminated. Because of the status of the populations in these basins and the *spread the risk* approach used by the fisheries co-managers, eliminating these artificial propagation programs was not considered an option. Until recently, the natural populations of spring chinook salmon in the Wenatchee and Methow River Basins were not replacing themselves and could eventually become extinct. Fortunately, in 2000 and 2001 returns to the Wenatchee River and the Methow River have shown improvement to the point where some broodyears are in fact replacing themselves.

USFWS will further reduce risks to the listed populations in the Methow River Basin by eliminating the propagation and release of non-endemic hatchery spring chinook. The replacement of Carson-stock spring chinook with Methow Composite will minimize the risks of genetic introgression from stray Carson-stock hatchery fish spawning naturally and still provide all the benefits identified above, while meeting mitigation responsibilities.

Critical habitat features for UCR spring chinook salmon and steelhead may be impacted by the activities analyzed in this opinion. The potential impacts to critical habitat features would result from the placement of weirs in the rivers to collect adults for broodstock, from water withdrawals for hatchery operations and from hatchery effluent. These impacts are expected to be small and isolated to where these activities occur, furthermore many of these activities are short in duration and not continuous. The potential impacts to critical habitat from the proposed artificial propagation activities are small and can be considered inconsequential with regards to effects on the natural populations within the Wenatchee and Methow rivers and the ESU as a whole.

VIII. CONCLUSION

NOAA Fisheries has determined, after reviewing the current status of UCR spring chinook salmon, the environmental baseline for the action area, the effects of the proposed section 10(a)(1)(A) actions, and the cumulative effects, that the issuance of the multi-year section 10(a)(1)(A) permits to WDFW (Permit #1196) and USFWS (Permit #1300) for an annual take of endangered UCR spring chinook salmon for scientific research/enhancement purposes is not likely to jeopardize the continued existence of the species or result in the destruction or adverse modification of its designated critical habitat. Furthermore, the supplementation programs covered by the permits are expected to provide a survival benefit by increasing the production of Wenatchee River and Methow River spring chinook salmon smolts.

NOAA Fisheries has determined, after reviewing the current status of the ESA-listed species (UCR steelhead, Snake River fall chinook salmon, Snake River spring/summer chinook salmon, Snake River sockeye salmon, Snake River steelhead, lower Columbia River chinook salmon, upper Willamette River chinook salmon, middle Columbia River steelhead, lower Columbia River steelhead, upper Willamette River steelhead, and Columbia River chum salmon), the environmental baseline for the action area, the effects of the proposed section 10(a)(1)(A) actions, and the cumulative effects, that the incidental impacts are not likely to jeopardize the continued existence of the other ESA-listed salmon and steelhead species or result in the destruction or adverse modification of their respective designated critical habitats.

IX. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered or threatened species, respectively, without special exemption. *Take* is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. *Harm* is further defined to include significant habitat modification or degradation that results in death or injury to ESA-listed species by significantly impairing essential behavioral patterns such as breeding, feeding, and sheltering. *Harass* is defined as intentional or negligent actions that create the likelihood of injury to ESA-listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. *Incidental take* is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

An Incidental Take Statement specifies the impact of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures. The measures described below are non-discretionary, and must be undertaken by WDFW and USFWS so that they become binding conditions of any grants or permits issued, as appropriate, for the exemption in section 7(o)(2) to apply. NOAA Fisheries has a continuing duty to regulate the activity covered by this Incidental Take Statement. If WDFW or USFWS (1) fail to assume and implement the terms and conditions, or (2) if NOAA Fisheries fails to require WDFW and USFWS to adhere to the terms and conditions of this Incidental Take Statement through enforceable terms that are added to the permits or grant documents, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, WDFW and USFWS must report the progress of their actions and the respective impacts on the species to NOAA Fisheries as specified in this Incidental Take Statement.

A. Amount or Extent of Take Anticipated

WDFW's and USFWS' UCR Spring Chinook Salmon Adult Supplementation Programs

Adult, endangered, UCR steelhead will be handled during WDFW's broodstock collection activities at Wells Dam fish trap and the level of take is dependent on the number of adult spring chinook salmon returning to Wells Dam as well as the number of UCR steelhead. If the returns of UCR spring chinook salmon to Wells Dam are expected to be greater than 668, then only the trap in the west ladder will be used, which significantly reduces the number of steelhead handled compared to the operation of both the west and east ladder traps. Adult, endangered, UCR steelhead may also be incidentally taken during UCR spring chinook salmon broodstock collection activities at the Chiwawa River and Nason Creek weirs and Tumwater Dam in the Wenatchee River Basin and the Twisp River trap, the Chewuch River trap, Foghorn Dam, and the Methow SFH. in the Methow River Basin. The total number of adult steelhead to be handled and released annually by WDFW is expected to be no more than 100 with an associated incidental mortality of no more than 9 adults, endangered, UCR steelhead. The total number of adult steelhead to be handled and released annually by USFWS at the Winthrop NFH is expected to be no more than 20 with an associated incidental mortality of no more than 1 adult, endangered, UCR steelhead.

WDFW's and USFWS' proposed UCR spring chinook salmon hatchery supplementation programs have the potential to impact the adult and juvenile life stages of ESA-listed salmonids including upper Columbia River steelhead, Snake River fall chinook salmon, Snake River spring/summer chinook salmon, Snake River sockeye salmon, Snake River steelhead, lower Columbia River chinook salmon, upper Willamette River chinook salmon, middle Columbia River steelhead, lower Columbia River steelhead, upper Willamette River steelhead, and Columbia River chum. These impacts may occur from density dependent effects, competition and predation within the migration corridor/ocean environments through interactions with progeny of the hatchery programs. These impacts are currently unquantifiable but are expected to be small.

No incidental takes of ESA-listed species are expected to occur as a result of WDFW's and USFWS' within-hatchery monitoring and evaluation program associated with the endangered UCR spring chinook salmon artificial propagation program. Incidental takes of ESA-listed species associated with WDFW's monitoring and evaluation program outside of the hatchery environment will be addressed in separate consultations.

B. Effects of the Take

WDFW's and USFWS' UCR Spring Chinook Salmon Adult Supplementation Programs

In the accompanying biological opinion, NOAA Fisheries determined that this level of anticipated take is not likely to result in jeopardy to the listed species or destruction or adverse modification of critical habitat.

C. Reasonable and Prudent Measures

In order to issue the multi-year section 10(a)(1)(A) permits to WDFW and USFWS for the proposed actions, NOAA Fisheries believes that the following reasonable and prudent measures are necessary and appropriate to minimize the incidental take of ESA-listed species associated with the UCR spring chinook salmon adult-based supplementation program and the monitoring and evaluation efforts:

<u>WDFW's UCR Spring Chinook Salmon Adult Supplementation Program</u>

NOAA Fisheries shall require that WDFW monitor and minimize the incidental take of ESA-listed species associated with the UCR spring chinook salmon artificial propagation program and report to NOAA Fisheries annually on the incidental take.

NOAA Fisheries shall require that WDFW minimize the incidental take of ESA-listed species associated with the UCR spring chinook salmon artificial propagation program by releasing listed steelhead unharmed.

<u>USFWS' UCR Spring Chinook Salmon Adult Supplementation Program</u>

NOAA Fisheries shall require that USFWS monitor and minimize the incidental take of ESA-listed species associated with the UCR spring chinook salmon artificial propagation program and report to NOAA Fisheries annually on the incidental take.

NOAA Fisheries shall require that USFWS minimize the incidental take of ESA-listed species associated with the UCR spring chinook salmon artificial propagation program by releasing listed steelhead unharmed.

D. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, WDFW and USFWS must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are not discretionary and are valid for the duration of the respective permits:

WDFW's UCR Spring Chinook Salmon Adult Supplementation Program

1. WDFW shall monitor the incidental take of ESA-listed species, including endangered UCR steelhead, during the trapping of adult spring chinook salmon for broodstock and during hatchery operations.

2. WDFW shall release unharmed all of the endangered UCR steelhead trapped during the collection of adult spring chinook salmon for broodstock at the Chiwawa River and Nason Creek weirs and Tumwater Dam (Wenatchee River hatchery supplementation program) and Wells Dam, the Twisp River trap, the Chewuch River trap, Methow SFH and Foghorn Dam (Methow River hatchery supplementation program).

3. WDFW shall monitor the incidental take of ESA-listed species, including endangered, naturally produced, UCR spring chinook salmon, as a result of juvenile fish releases from the artificial propagation program. As part of the monitoring effort, WDFW shall attempt to determine the extent to which artificially propagated juvenile chinook salmon released from the program interact adversely with the UCR spring chinook salmon's natural production in the upper Columbia River Basin.

4. WDFW shall provide an annual report to the Hatcheries and Inland Fisheries Branch, NOAA Fisheries, documenting the incidental take of ESA-listed species associated with the endangered UCR spring chinook salmon hatchery supplementation program by January 31 of each year the permit is in effect.

USFWS' UCR Spring Chinook Salmon Adult Supplementation Program

1. USFWS shall monitor the incidental take of ESA-listed species, including endangered UCR steelhead, during the trapping of adult spring chinook salmon for broodstock and during hatchery operations.

2. USFWS shall release unharmed all of the endangered UCR steelhead trapped during the collection of adult spring chinook salmon for broodstock at the Winthrop NFH, Methow SFH outfall and Foghorn Ditch.

3. USFWS shall provide an annual report to the Hatcheries and Inland Fisheries Branch, NOAA Fisheries, documenting the incidental take of ESA-listed species associated with the endangered UCR spring chinook salmon hatchery supplementation program by January 31 of each year the permit is in effect.

X. REINITIATION OF CONSULTATION

This concludes formal consultation of the actions outlined in the applications for section 10(a)(1)(A) permits. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or authorized by law) and if: (1) the amount or extent of annual take, either intentional take or incidental take, is exceeded or is expected to be exceeded; (2) new information reveals effects of the agency action that may affect ESA-listed species or critical habitat in a manner or to an extent not previously considered; (3) the agency action is subsequently modified in a manner that causes an effect to ESA-listed species or critical habitat that was not previously considered; or (4) a new species is listed or critical habitat is designated that may be affected by the agency action. In instances where the amount or extent of incidental take is exceeded, NOAA Fisheries must reinitiate consultation immediately.

XI. MAGNUSON-STEVENS ACT ESSENTIAL FISH HABITAT CONSULTATION

A. Background

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2));
- NOAA Fisheries must provide conservation recommendations for any Federal or State action that would adversely affect EFH (§305(b)(4)(A));
- Federal agencies must provide a detailed response in writing to NOAA Fisheries within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NOAA Fisheries EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.10). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (*e.g*., contamination or physical disruption), indirect (*e.g*., loss of prey or reduction in species fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).

EFH consultation with NOAA Fisheries is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

B. Identification of Essential Fish Habitat

Pursuant to the MSA, the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of federally-managed Pacific salmon: chinook (*O. tshawytscha*); and coho (*O. kisutch*); and Puget Sound pink salmon (*O. gorbuscha*)(PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC 1999), and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the proposed action is based, in part, on this information.

C. Proposed Action and Action Area

For this EFH consultation, the proposed actions and action area are as described in detail in this biological opinion (Section II.). The actions are the issuance of scientific research/enhancement permits pursuant to section 10(a)(1)(A) of the ESA for the operation by the WDFW (Permit #1196) and USFWS (Permit #1300) of artificial propagation facilities rearing listed spring chinook salmon. The proposed action area is the Upper Columbia River basin, including all river reaches accessible to salmon in the Wenatchee and Methow Rivers in Washington and is part of the EFH for chinook and coho salmon. The proposed actions may also affect EFH in the lower Columbia River and near ocean areas; however, NOAA Fisheries does not believe it is possible to meaningfully measure, detect or evaluate the effects of those actions in these areas, and, consequently, NOAA Fisheries will not include EFH subject to these effects in the action area. Assessment of the impacts on these species' EFH from the above proposed action is based on this information.

D. Effects of the Proposed Action

As described in detail in Section V. of this Biological Opinion, the proposed action may result in adverse effects to EFH. These adverse effects are:

- Water quality impacts from water withdrawal and hatchery effluent.
- Adult passage impediments due operation of weirs used for broodstock collection.
- Predation of natural juvenile salmonids by hatchery fish.
- Competition for resources between hatchery and natural salmonids.
- Exchange of disease pathogens between hatchery and natural salmonids.

E. Conclusion

NOAA Fisheries concludes that the proposed action would adversely affect designated EFH for chinook and coho salmon.

F. EFH Conservation Recommendation

Pursuant to Section 305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations to Federal agencies regarding actions which may adversely affect EFH. NOAA Fisheries understands that the conservation measures described in the Permit Applications that will be implemented by WDFW and USFWS and Terms and Conditions (see Section II.) above are applicable to designated salmon EFH and address the adverse effects. Therefore, NOAA Fisheries recommends that those same Conservation Measures and Terms and Conditions be adopted as the EFH Conservation Recommendations for this consultation.

G. Statutory Response Requirement

Pursuant to the MSA (§305(b)(4)(B)) and 50 CFR 600.920(j), Federal agencies are required to provide a detailed written response to NOAA Fisheries' EFH conservation recommendations within 30 days of receipt of these recommendations. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity on EFH. In the case of a response that is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

H. Consultation Renewal

The NOAA Fisheries must reinitiate EFH consultation if the proposed actions are substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR Section 600.920(k)).

XII. References

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