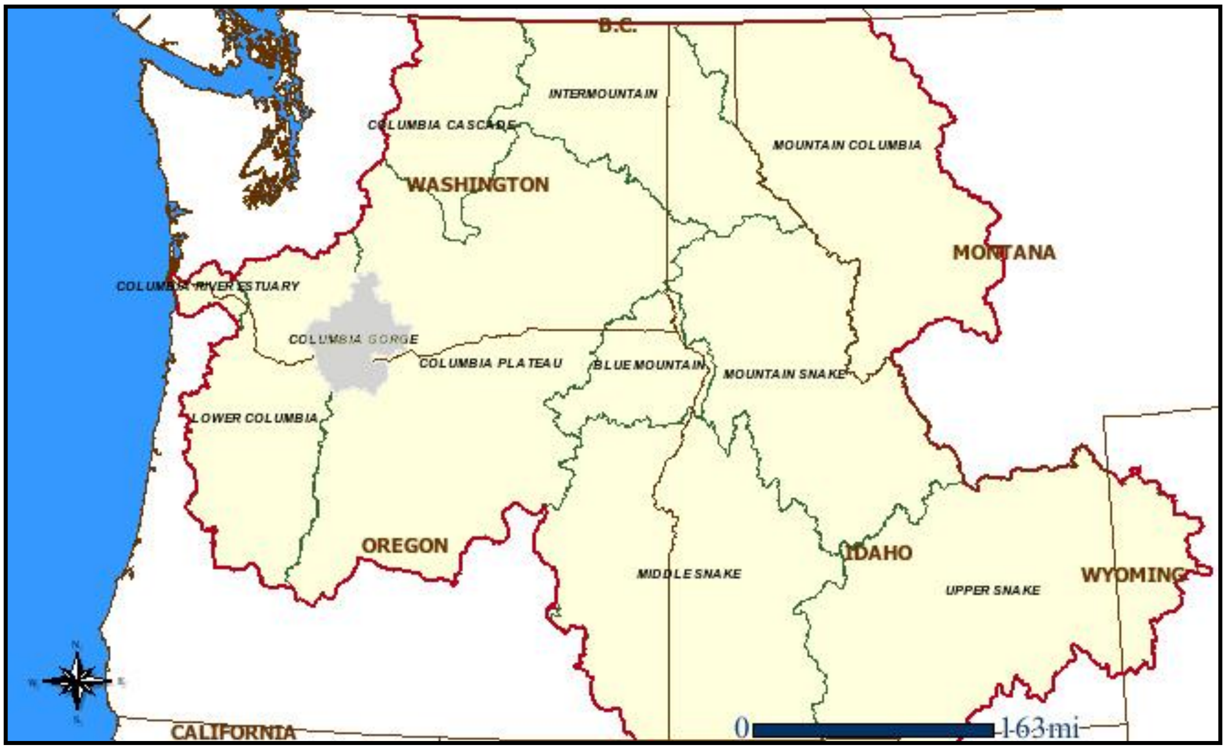
U.S. Fish and Wildlife Service Pacific Region

Columbia River Basin Hatchery Review Team

Columbia River Basin, Columbia Gorge Province

Little White Salmon, Big White Salmon, and Wind River Watersheds



Carson, Spring Creek, Little White Salmon, and Willard National Fish Hatcheries

Assessments and Recommendations

Final Report, Appendix B:

Briefing Document; Summary of Background Information

December 2007

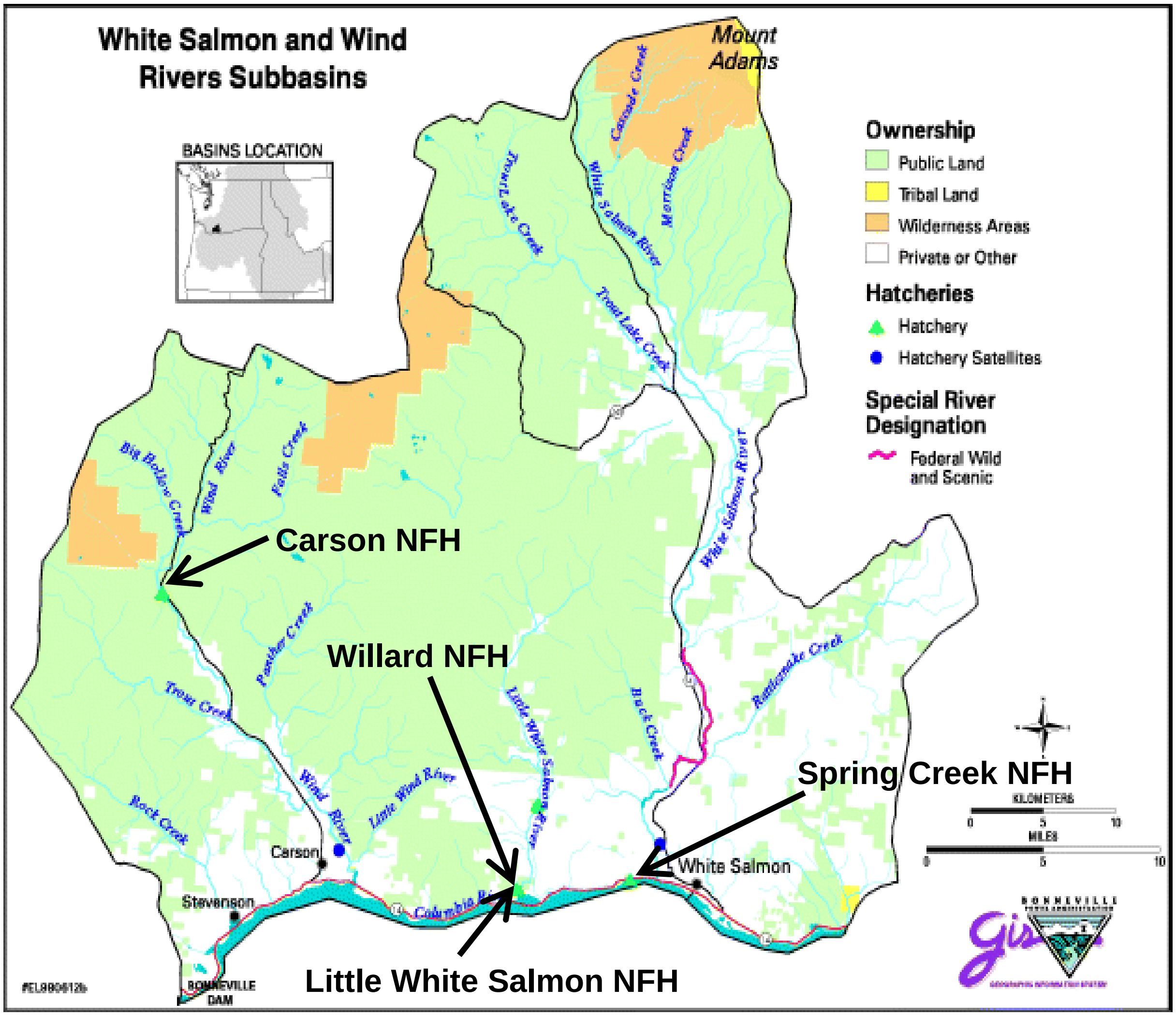


Figure 1. National Fish Hatcheries in the Columbia River Gorge[1]

[1] *Modified figure from Rawding 2000b.*

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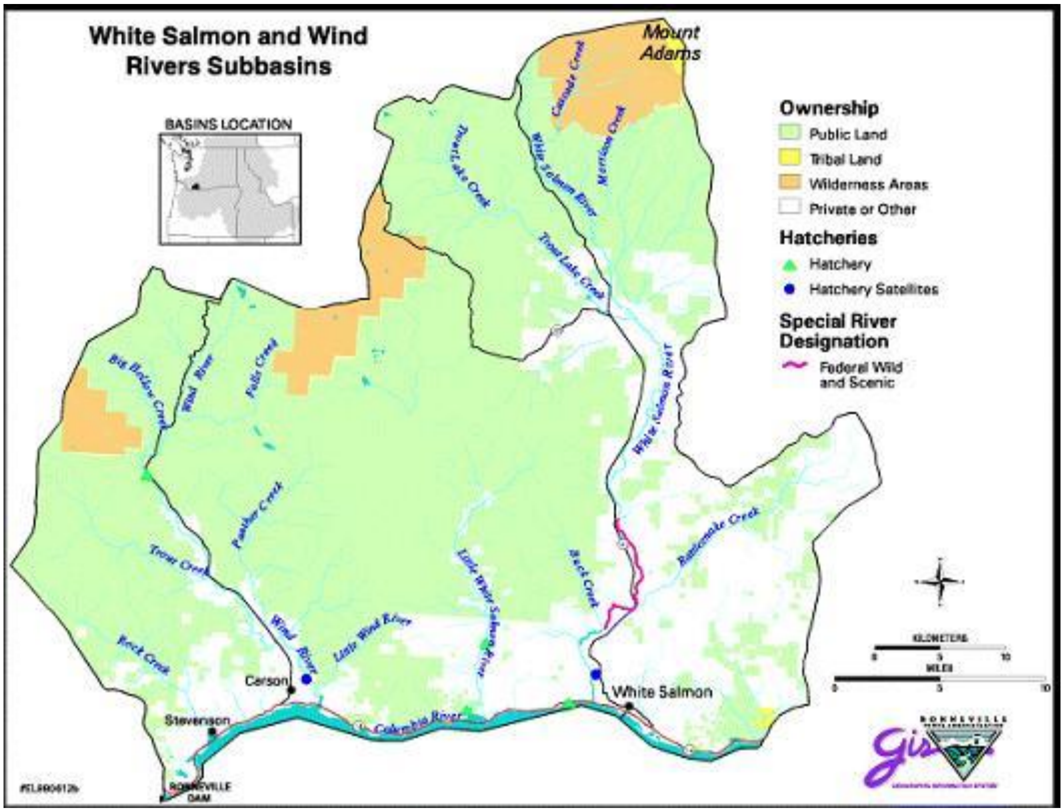
I. Columbia Gorge Region

A. Watersheds and geographic description

- The **White Salmon River** originates in the Gifford Pinchot National Forest in south central Washington along the south slope of Mount Adams in Skamania and Yakima counties. It flows south for 45 miles before entering the Bonneville Reservoir in Underwood, Washington at River Mile (RM) 167



Location of the Wind in the Columbia River Subbasin Gorge Province Drainage Area

The White Salmon River drains approximately 386 mi² (250,459 acres) of Skamania, Yakima, and Klickitat counties over a distance of 45 miles. Principal tributaries include Trout Lake, Buck, Mill, Dry, Gilmer, and Rattlesnake Creeks.

- **Little White Salmon/Willard -** The Little White Salmon River drains approximately 135 square miles of Skamania and Klickitat counties, Washington, over a distance of approximately 19 miles. Principle tributaries to the Little White Salmon River include Lost (north and south), Beetle, Lusk, Homes, Berry, Cabbage, Moss, and Rock creeks. The geology of the Little White Salmon watershed is dominated by past volcanic activity, with soils being the result of volcanism and glaciation. The basin is oriented northwest to southeast. Elevations range from 80 feet to 5,300 feet, with topography varying from gentle slopes formed by lava flows and volcanic cones to steep rugged landforms. Based on geomorphology the watershed can be split into one area containing tertiary deposits of tuff and pyroclastic flow (Monte Cristo Range) and another containing younger quaternary basalt/andesite flows originating from the Indian Heaven Area. The Big Lava Bed flow covers 16,000 aces of the watershed. The mainstem of the Little White Salmon River drops 3,520 feet in 19 miles for an average gradient of 3.5 percent. Anadromous fish passage is blocked by a series of waterfalls located 2 miles upstream from the rivers confluence with the Bonneville Reservoir. (Information courtesy of Columbia Basin Fish and Wildlife Authority Website, 2004)

- **Spring Creek** – The Big White Salmon River originates in the Gifford Pinchot National Forest in south central Washington along the southwest slope of Mt. Adams. The river flows south and enters the Columbia River at Underwood, Washington at RM 168.3. Major land uses in the subbasin include timber production, forest, range, and agriculture. Principal tributaries are Trout Lake and Buck and Rattlesnake creeks.

  The Columbia River is the fourth largest river in North America and drains parts of Washington, Oregon, Idaho, western Montana, northern Nevada and southern British Columbia (Bonneville Power Administration 1994). Spring Creek NFH is located on the banks of the Columbia River within the Columbia River Gorge National Scenic Area upstream from Bonneville Dam hydropower facility and downstream of The Dalles hydropower facility. Located in the lower Columbia basin, the Columbia River Gorge National Scenic Area is managed by the U.S. Department of Agriculture – Forest Service and was established by Congress in 1986 (Perry and Perry 1997). Being designated as a National Scenic Area allows for existing rural and scenic characteristics to be retained within the Columbia Gorge, while encouraging compatible growth and development within urban areas. The Columbia River Gorge itself is a deep canyon between Washington and Oregon and is the only near sea-level passage through the Cascade Mountains. The western Columbia River gorge consists of forested hillsides of Douglas fir, Western cedar, and many fern and moss species. The eastern gorge consists of grassland interspersed with Ponderosa Pine and oaks. Within the Columbia Gorge there are massive canyon walls, large rock formations, waterfalls and numerous small tributary streams and springs (Perry and Perry 1997). (Spring Creek NFH CHMP 2004)

- **The Wind River Subbasin**, located in southwestern Washington, originates in McClellan Meadows in the western Cascades on the Gifford Pinchot National Forest (Wind River Ranger District) and enters the Columbia River's Bonneville Reservoir at River Mile (RM) 155 near Carson, Washington (Map-Attachment 4). Wind River, a fifth order stream, drains approximately 225 mi2 of Skamania County over a distance of approximately 31 miles. Principle tributaries to Wind River include Little Wind River, Bear, Panther, Trout, Trapper, Dry, Nineteenmile, Falls and Paradise creeks. The largest tributary, Panther Creek, enters at RM 4.3 and drains 18% of the Wind River subbasin (26,466 acres). Trout Creek, which drains 15% of the subbasin (21,732 acres), enters at RM 10.8. (Carson NFH CHMP 2002)

B. Historical distribution of salmon and steelhead throughout region

Little White Salmon/Willard[2]

Fish assemblages in the Little White Salmon River are divided into the area above and below the RM 2 falls. Species found downstream from the falls include spring and fall chinook, coho salmon, winter and summer steelhead, largescale and bridgelip suckers, pacific and brook lamprey, threespine stickleback, sculpins, white sturgeon, redside shiners, peamouth, and northern pikeminnow. Historically, pink and chum salmon likely used this area but are believed to be extirpated. Species found upstream of the falls included rainbow trout, sculpin, brook trout (non-endemic) and coho salmon (nonendemic). No anadromous fish except hatchery coho smolts, which are released from Willard National Fish Hatchery, are found above the falls at RM 2.

A fluvial population of bull trout use Drano Lake.[3] For example, a bull trout tagged in Hood River was recovered by WDFW personnel in Drano Lake and was observed to be preying on salmon smolts. Tribal pikeminnow gillnetters also observed a bull trout in Drano Lake. Bull trout are not found in the Little White Salmon River upstream of the natural barrier falls upstream from the hatchery.[4]

Steelhead (Threatened, Lower Columbia Ecologically Significant Unit (ESU), 3/98) - Natural spawning of summer and winter steelhead in the Little White Salmon River below the hatchery diversion is limited. Size of historical spawning populations is not well documented, but is believed to be low since distribution was limited to only two miles of habitat. Since 1998, Skamania stock summer steelhead have been released in the Little White Salmon River watershed. Due to the reduced ecological and genetic risks in the Little White Salmon River, Wind River releases were transferred to this site to provide local recreational and tribal fishing opportunities. All hatchery steelhead are adipose fin clipped and the river has been managed under catch-and-release sport fishing regulations for wild steelhead since 1986. The Drano Lake area of the Little White Salmon River supports a tremendous steelhead fishery. As upriver summer steelhead migrate up the Columbia River, they seek refuge in the cooler waters of Drano Lake. These fish will hold in the cooler water for days or weeks before continuing their upstream migration. This area provides a thermal refuge for summer steelhead stocks migrating up the Columbia River.

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[2] *Section text adapted from Rawding et al. 200b (Little White Salmon River Subbasin Summary).*

[3] *Columbia Gorge mainstem subbasin plan, prepared for the NW Power and Conservation Council by the lead planning entity: Oregon Department of Fish and Wildlife, May 28, 2004*

[4] *Little White Salmon River watershed analysis by the Mt. Adams Ranger District of Gifford Pinchot National Forest, September 1995*

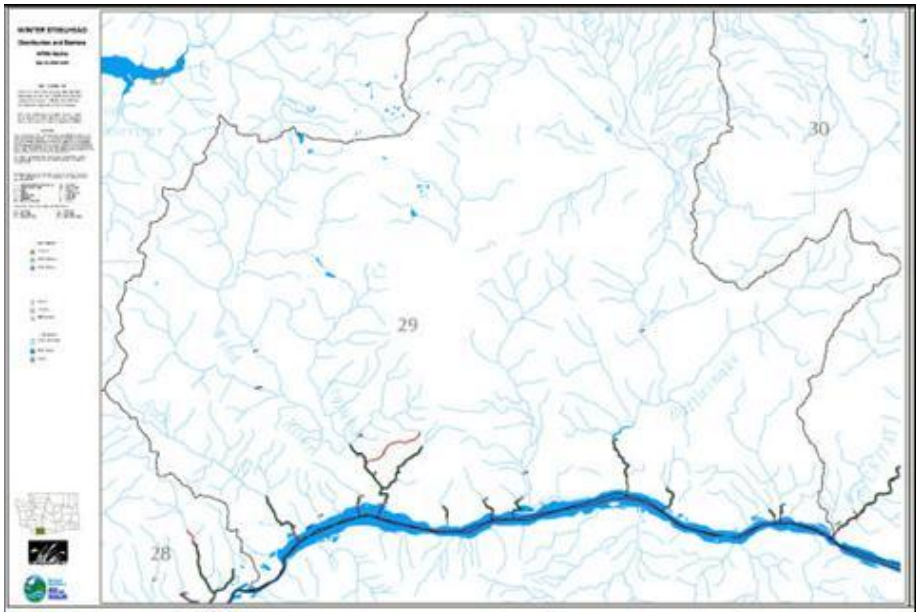

Figure: Distribution of winter steelhead in the Wind River Subbasin

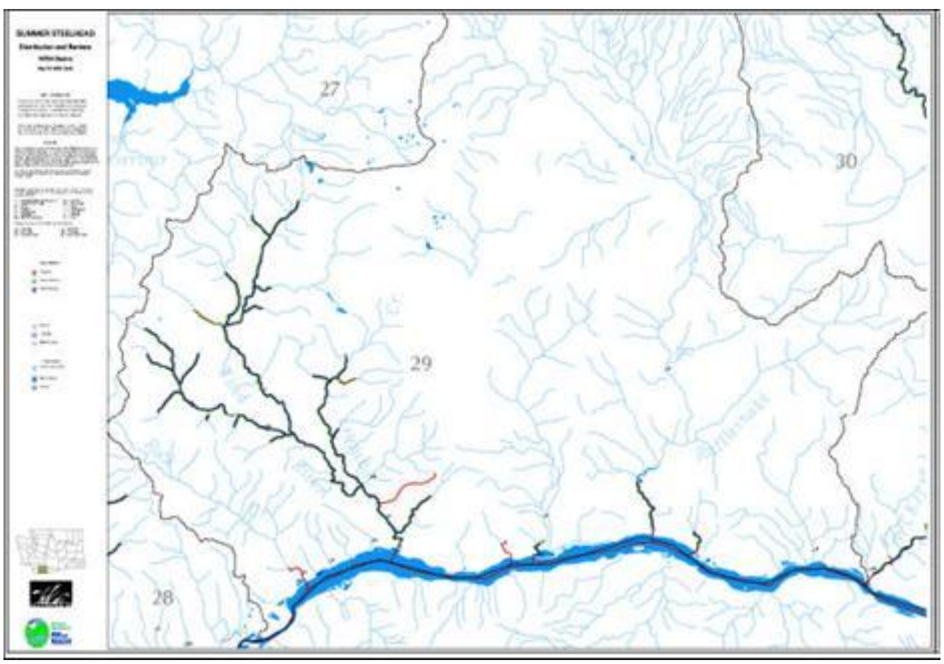

Figure: Distribution of summer steelhead in the Little White Salmon River Subbasin

Chinook Salmon (Threatened, Lower Columbia ESU, 3/99) - Natural spawning of spring chinook in the Little White Salmon River did not occur until a hatchery was built on the Little White Salmon River. The WDFW believes the majority of naturally spawning fish are hatchery strays, and that this population is not self-sustaining. Currently, spring chinook salmon in the Little White Salmon River are managed for hatchery production.

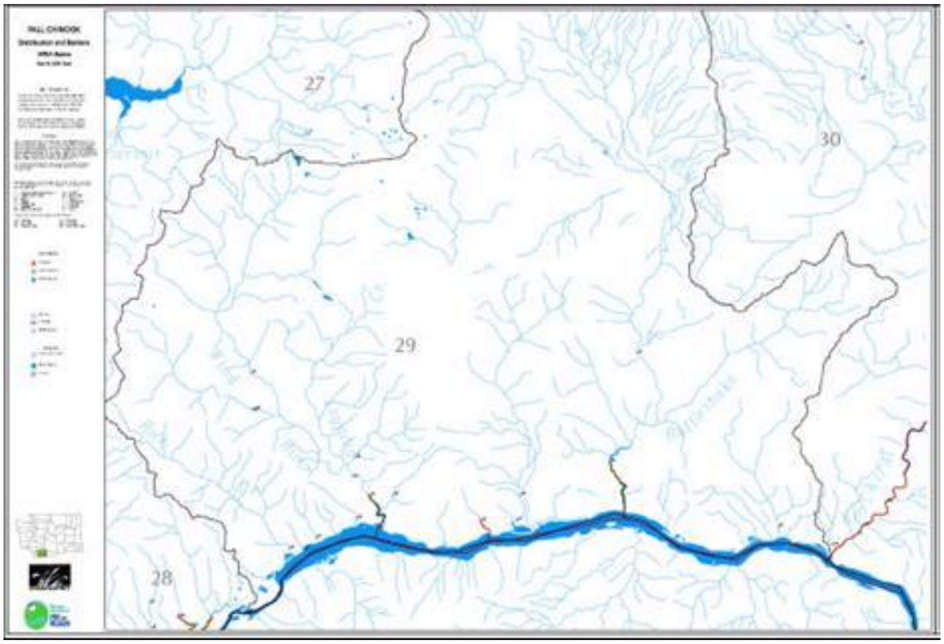

Figure: Distribution of fall chinook in the Wind River Subbasin

Natural spawning of tule fall chinook in the Little White Salmon River occurs below the barrier. Completion of Bonneville Dam inundated the primary habitat in the lower Little White Salmon River and created Drano Lake. Natural production is likely composed of hatchery strays. The abundance of the fall chinook salmon has been enumerated since 1997.

Bright fall chinook salmon originated from the Columbia River above McNary Dam. These fish have been reared at Bonneville and Little White Salmon hatcheries to mitigate for chinook salmon lost due to the construction and operation of mainstem Columbia River dams. Stray brights from these facilities have been observed in the Little White Salmon River and natural production of bright fall chinook occurs in the Little White Salmon River. Bright fall chinook salmon tend to spawn later than tule fall chinook (Figure 2) and the abundance of bright fall chinook salmon has been enumerated since 1997 in the Little White Salmon River.

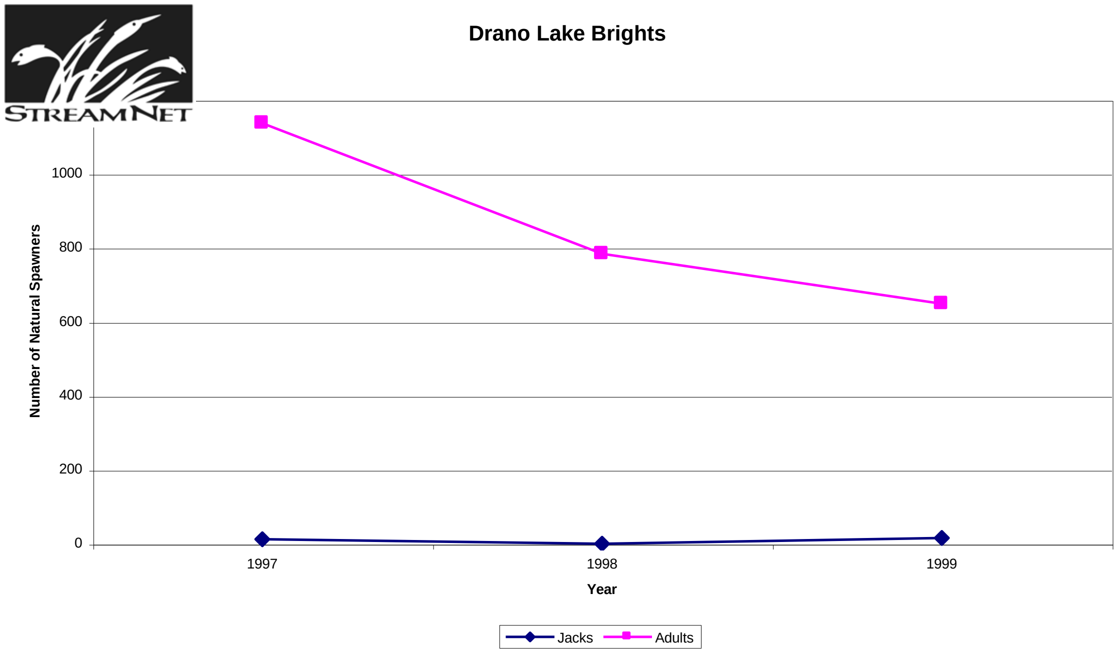

Figure 1. Bright Fall Chinook abundance estimates in the Little White Salmon River

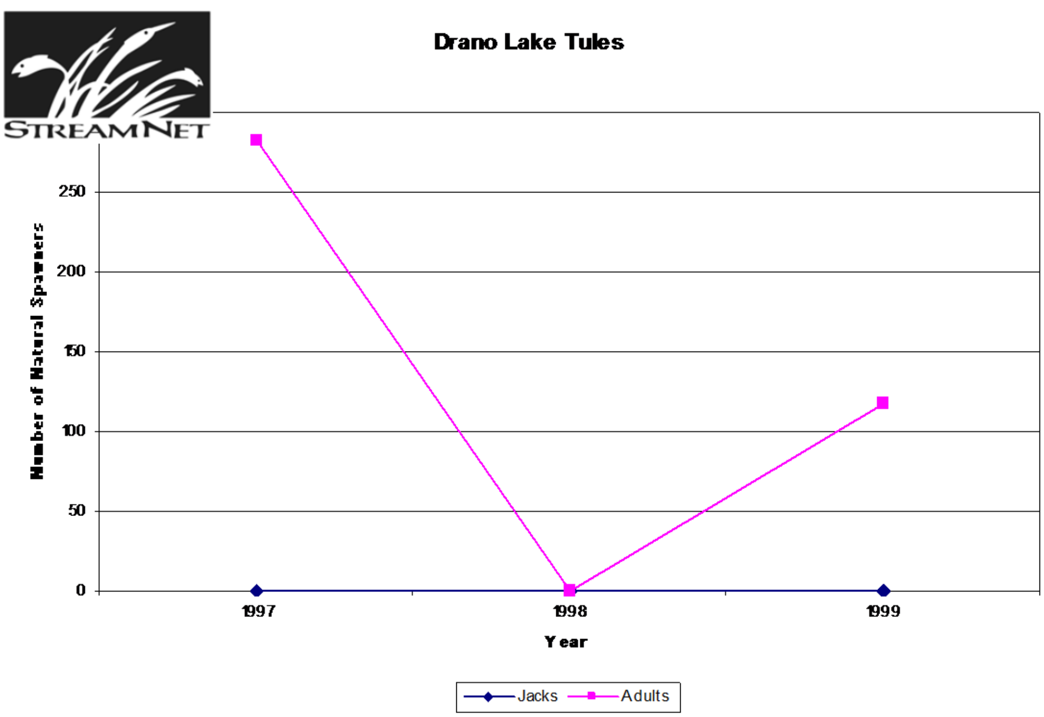

Figure 2. Tule Fall Chinook abundance in the Little White Salmon River, 1997-99

Bull Trout (Threatened, 1998) - Bull trout have been observed in Drano Lake and managers believe these fish are part of an adfluvial population, which uses the Bonneville Pool. No bull trout were found in the Little White Salmon River (including a snorkel survey conducted during September 1995) aside from one caught in Drano Lake during 1988. Most recently, fisheries biologist Jim Byrne, WDFW, conducted a snorkel survey in the lower reach during spring 2004 and confirmed no evidence of bull trout found in the Little White Salmon River during surveys completed in the last 3 years. The WDFW believes that there are no resident bull trout in Drano Lake.

Coastal Cutthroat Trout - Because of the limited information and the lack of sampling that specifically targeted cutthroat trout, the status of coastal cutthroat trout in the watershed is unknown.

Coho (Threatened, Lower Columbia ESU, 6/05) - A small spawning population of coho persists in the Little White Salmon River. Hatchery coho are released in the Basin and hatchery strays are a likely source of any natural production.

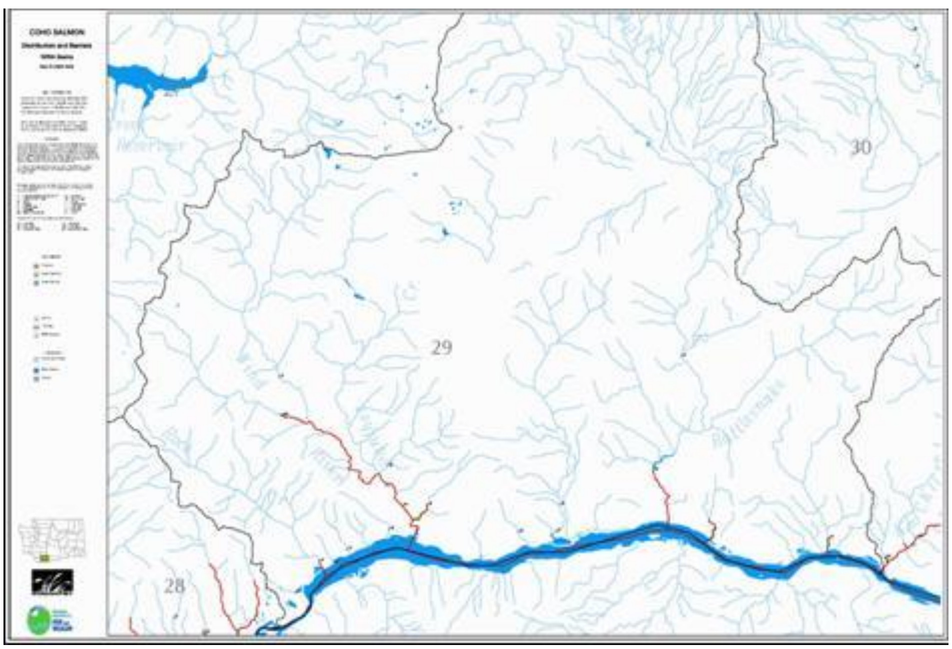

Figure: Coho distribution throughout the Wind River Subbasin

Resident Rainbow - Resident rainbow trout are native to the Little White Salmon River drainage. Hatchery rainbow trout have also been stocked into this watershed. Hatchery trout were stocked throughout the Basin but most of the current stocking is confined to areas adjacent to camping sites in the middle section of the river. The purpose of this program is to provide recreational opportunities for local anglers. Stocking occurs annually at the end of May just prior to the start of the statewide stream fishing season on June 1. The status of the rainbow trout population is unknown.

Brook Trout - Brook trout are not indigenous to the Little White Salmon River watershed. Hatchery releases have been discontinued, but naturally reproducing populations have been established within this watershed from previous stockings. The status of brook trout populations is unknown at this time.

Pacific Lamprey (YN Species of Concern) - Pacific lamprey were historically and are currently important to the Yakama Nation (YN). The status of this species is unknown.

Spring Creek

See above for description of White Salmon Drainage salmonid distributions.

Carson[5]

Fish assemblages in the Wind River are divided into the area above and below Shipherd Falls. Species found downstream from the falls include spring and fall chinook, coho salmon, winter and summer steelhead, coastal cutthroat trout, largescale and bridgelip suckers, pacific and brook lamprey, threespine stickleback, sculpins, white sturgeon, redside shiners, peamouth, and northern pikeminnow. Historically, pink and chum salmon likely used this area but are believed to be extirpated. Species found upstream of the falls included steelhead trout, shorthead sculpin, mountain whitefish, brook trout (non-endemic) and spring chinook salmon (non-endemic). No anadromous fish except unmarked steelhead are allowed above Hemlock Dam on Trout Creek (Figure 1). Shorthead sculpin is found in most areas except upstream of the canyon area of Trout Creek (Figure 1), which has numerous small falls that are potential barriers to this sculpin's upstream distribution. Mountain whitefish, brook trout, and spring chinook occur in limited areas of the watershed, and wider occurrence is limited by habitat requirements and preferences. Fish surveys and smolt trap catches indicate limited natural reproduction of spring chinook. Sockeye salmon, coho salmon, lamprey (one or more species), and brown trout have recently been observed above Shipherd Falls.

Steelhead (Threatened, Lower Columbia ESU, 3/98) - Natural spawning of summer and winter steelhead in the Wind River occurs in upper mainstem reaches, Trout Creek, Panther Creek, and lower reaches of nearly every major tributary (Figures 2 and 3). Until recently, Trout Creek accounted for a large amount of total spawning, but the annual adult return to Trout Creek has declined from over 100 in the 1980s to less than 30 in the 1990s. Prior to construction of a ladder over Shipherd Falls, steelhead were the only anadromous salmonid known to pass the falls successfully.

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[5] *Section text adapted from Rawding et al. 2000c (Wind River Subbasin Summary).*

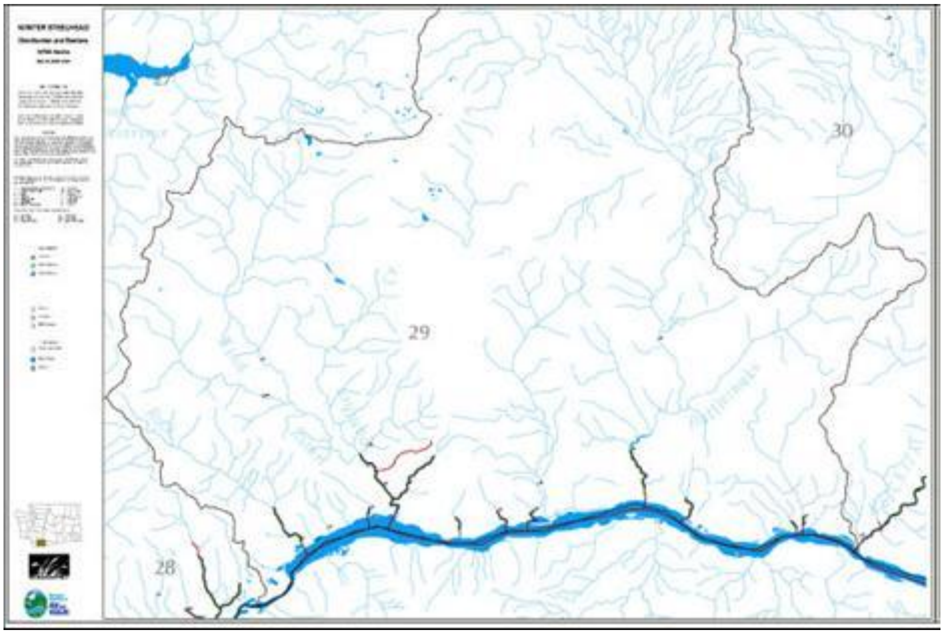


Figure 2. Distribution of winter steelhead in the Wind River Subbasin.

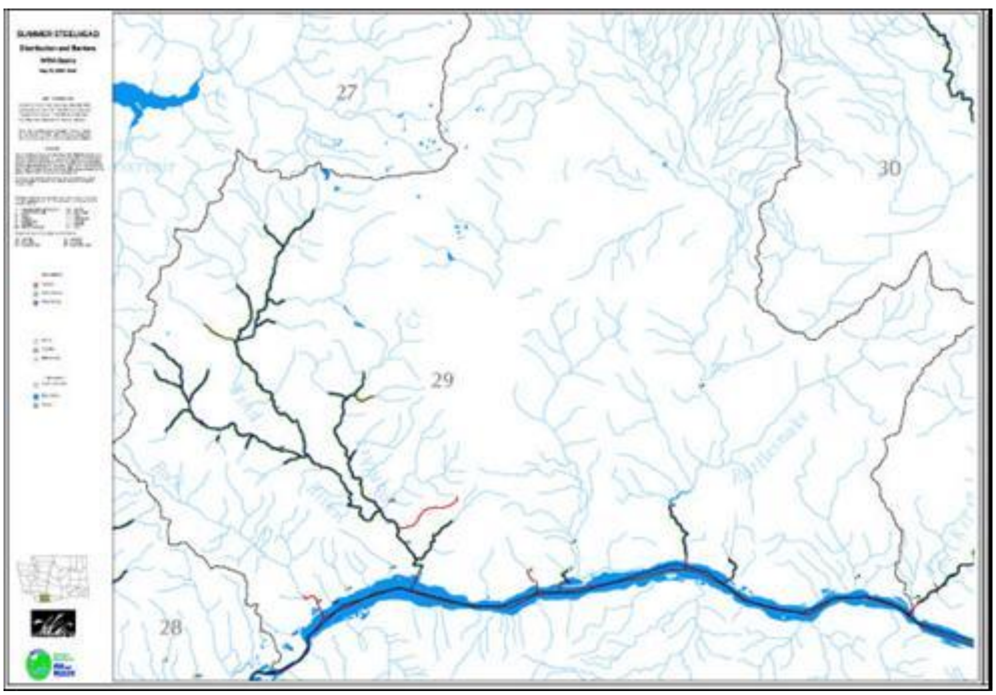


Figure 3. Distribution of summer steelhead in the Wind River Subbasin

Size of historical spawning populations is not well documented, but historic run size has been estimated at 2,500 fish (Bryant 1951). The current escapement goal for wild summer steelhead is 1,000 adults, most recently met in the mid-1980's. In 1999, WDFW initiated a mark-recapture study for wild summer and winter steelhead. Preliminary estimates indicated that less than 200 wild summer steelhead returned in 1999. Based on redd and snorkel surveys, the abundance of wild summer steelhead has declined since the late 1980s (Figure 4).

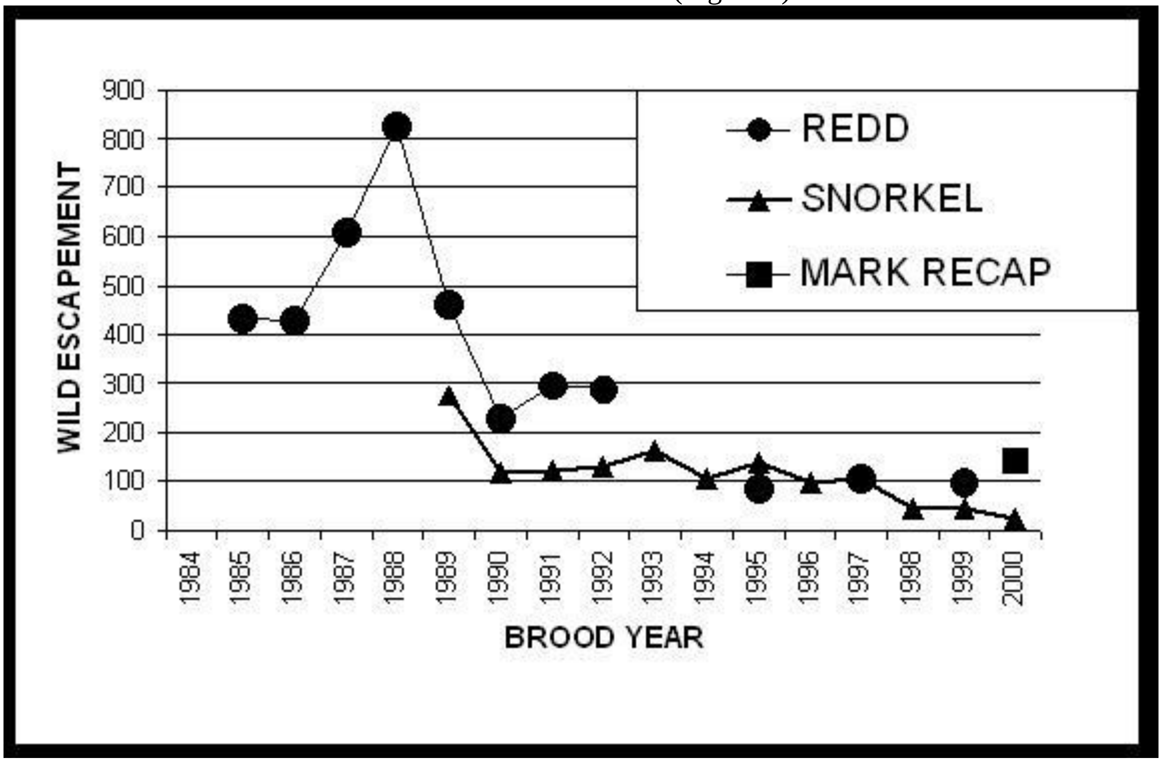


Figure 4. Wild summer steelhead abundance trends for the Wind River in the Columbia Gorge Province

Data from these surveys serve as an index of population strength and change, rather than estimates, of population numbers because redd surveys cover a small portion of the basin and snorkel surveys occurred before the entire run entered the basin. Currently, a population estimate is unavailable for adult wild winter steelhead. Wild steelhead smolt production has been monitored for the entire subbasin and in key tributaries since 1995. Steelhead smolt yields for the basin during this period of time have been increasing (Figure 5).

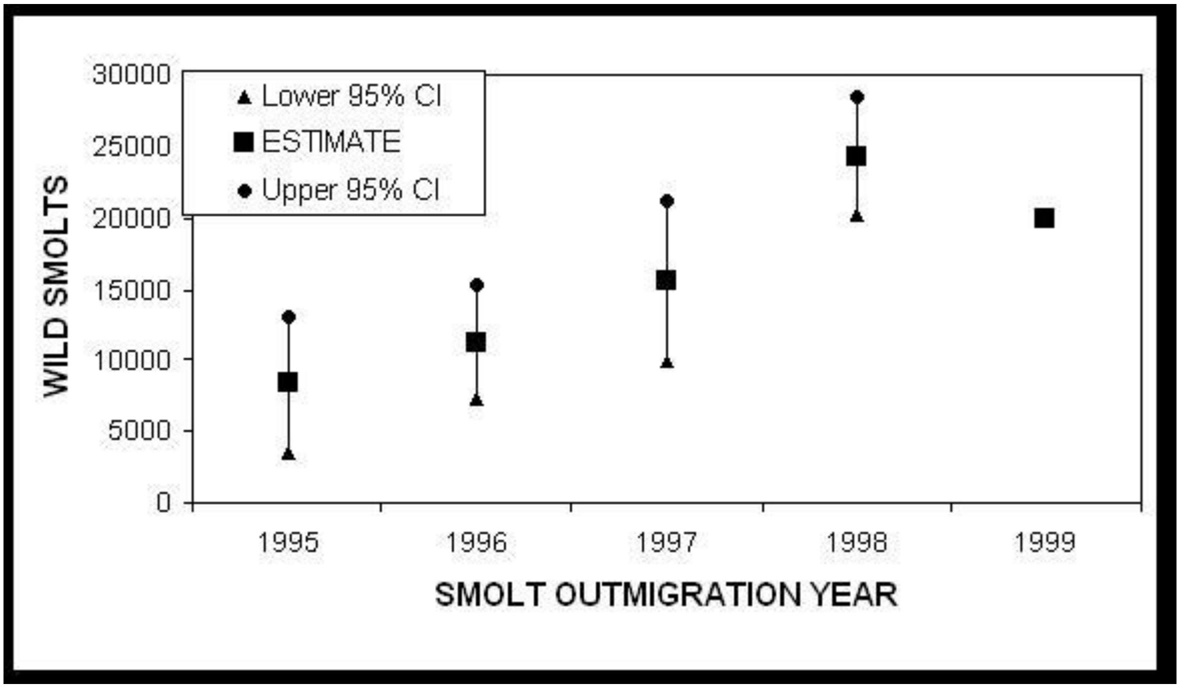


Figure 5. Wild steelhead smolt yield in the Wind River, Columbia Gorge Province from 1995-99

Surveys in the mid-1980s and late 1990s found juvenile steelhead in all major tributaries accessible to returning adult steelhead, including Paradise, Dry, Trapper, Trout, and Panther creeks. Surveys in the late 1990s indicated juvenile steelhead were present in streams surveyed in the mid-1980s (Figure 6). However, densities and biomass of juvenile steelhead in the late 1990s were less than or similar, but never those from the mid-1980s. As described in Connolly (1997), juvenile steelhead in some areas of the watershed have high infestation of the ciliated protozoan *Hydropolaria lwoffi* (formerly *Epistylis lwoffi*). Connolly's data suggests that growth and survival of steelhead are negatively effected by this organism. However, additional evaluations are required.

Skamania Stock summer steelhead have been released in the Wind River watershed above Shipherd Falls most years since 1960. Releases of smolts were suspended in the early 1980s when WDG began managing the Wind River intensively for wild summer steelhead. Releases of adipose-clipped smolts were reinstated in the mid-1980s, and the river has been managed under catch-and-release regulations for wild steelhead since that time. Angling closures and size-restrictions have been established to decrease angler take of juvenile steelhead and smolts. Due to concerns about negative ecological and genetic interactions with wild steelhead, hatchery releases of catchable rainbow trout were discontinued in 1994 and releases of hatchery steelhead were discontinued in 1997. An adult trap has been operated at RM 2 on Trout Creek since 1993, and hatchery fish have been excluded from this tributary to preserve and maintain genetic diversity of the wild stock. Recent genetic analyses by WDFW indicated genetic differences between hatchery and wild steelhead have been maintained. Due to the lack of reproductive success of the Skamania hatchery strain in the wild, the exclusion of hatchery fish in Trout Creek, and the results of genetic analyses, WDFW believes that natural production in the watershed is primarily sustained by wild fish.

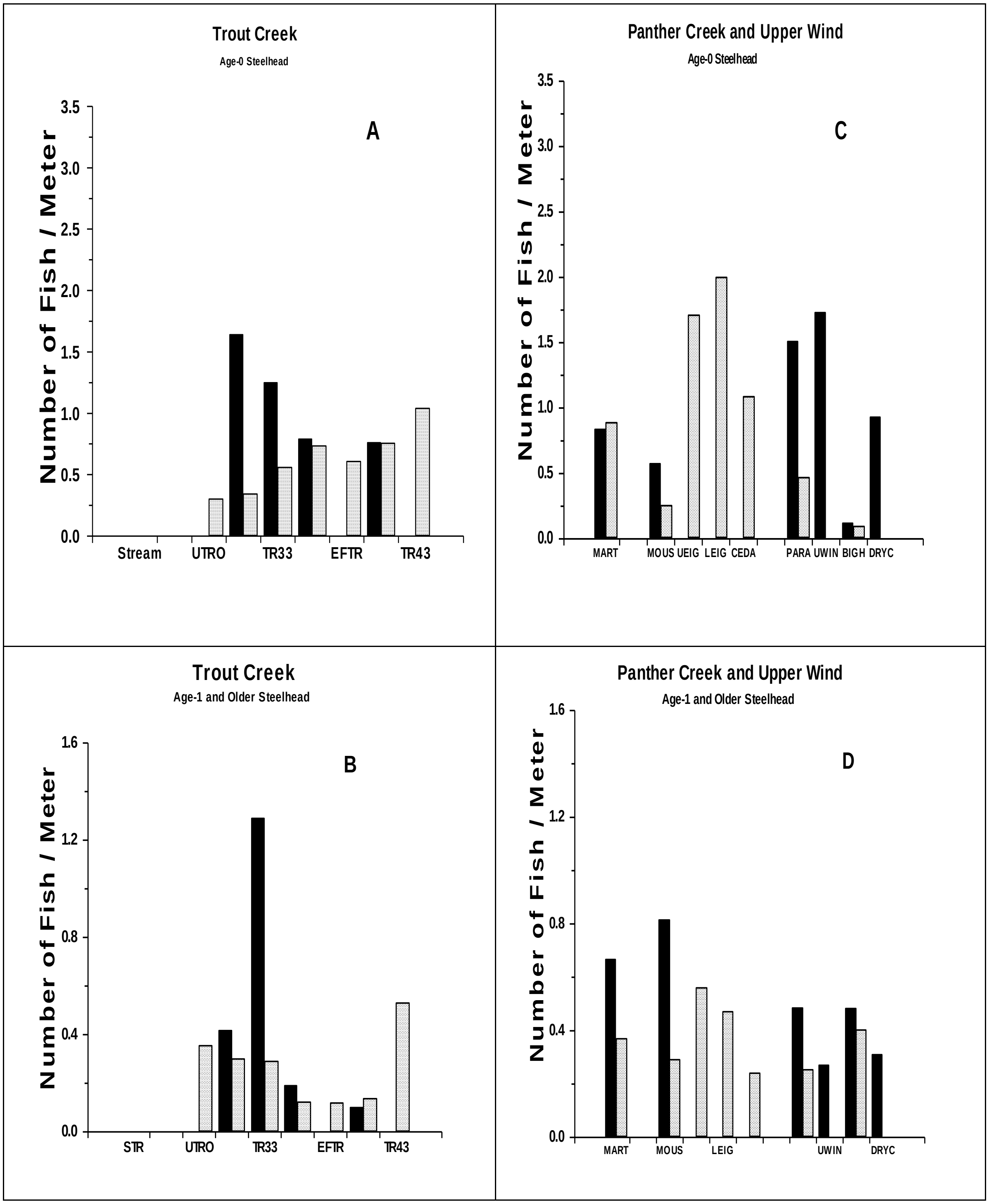


Figure 6. Comparison of abundance estimates of juvenile steelhead in tributaries of Trout Creek (A, C), Panther Creek (B, D), and upper Wind River (B, D) watersheds for surveys conducted during 1984-88 (dark bars) by USFS (unpublished data) and WDFW (Crawford et al. 1986) to surveys in 1996-99 (light bars conducted by USGS-CRRL (Connolly, unpublished data). Absence of bars indicates no data were available.

Chinook salmon (Threatened, Lower Columbia ESU, 3/99) - Natural spawning of spring chinook in the upper Wind River did not occur until passage facilities were built at Shipherd Falls. After passage was provided, a spring chinook run was established at the Carson National Fish Hatchery (CNFH), and natural spawning began in habitats above and below the hatchery. Most juvenile chinook have been found in the mainstem Wind River above the hatchery but occasionally higher densities were recorded in tributaries including Compass, Crater, Planting, Trout, and Trapper creeks after hatchery outplanting (Figure 7).

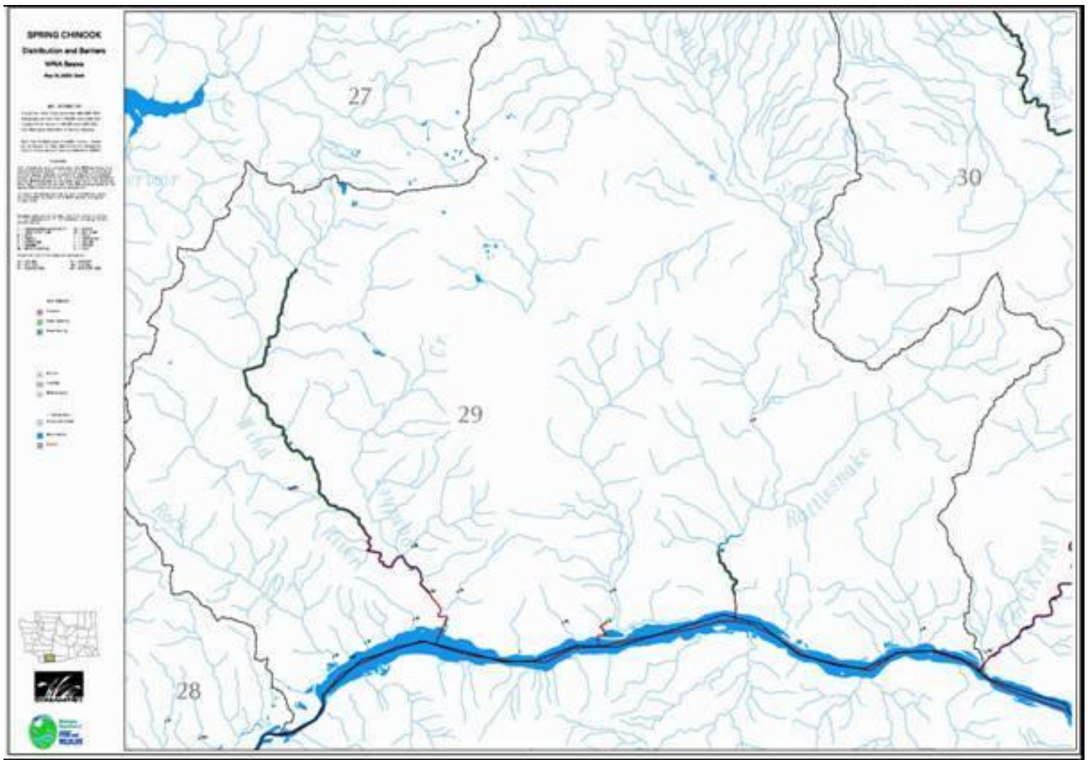


Figure 7. Distribution of spring chinook in the Wind River Subbasin

In two years of smolt trapping below one of the primary spawning areas (above the CNFH) only four unclipped chinook smolts were observed, which equates to 16 naturally produced smolts. The WDFW believes the majority of naturally spawning fish are hatchery strays, and that this population is not self-sustaining. Currently, spring chinook salmon in the Wind River are managed for hatchery production. Natural spawning of tule fall chinook in the Wind River occurs in the mainstem below Shipherd Falls (Figure 8).

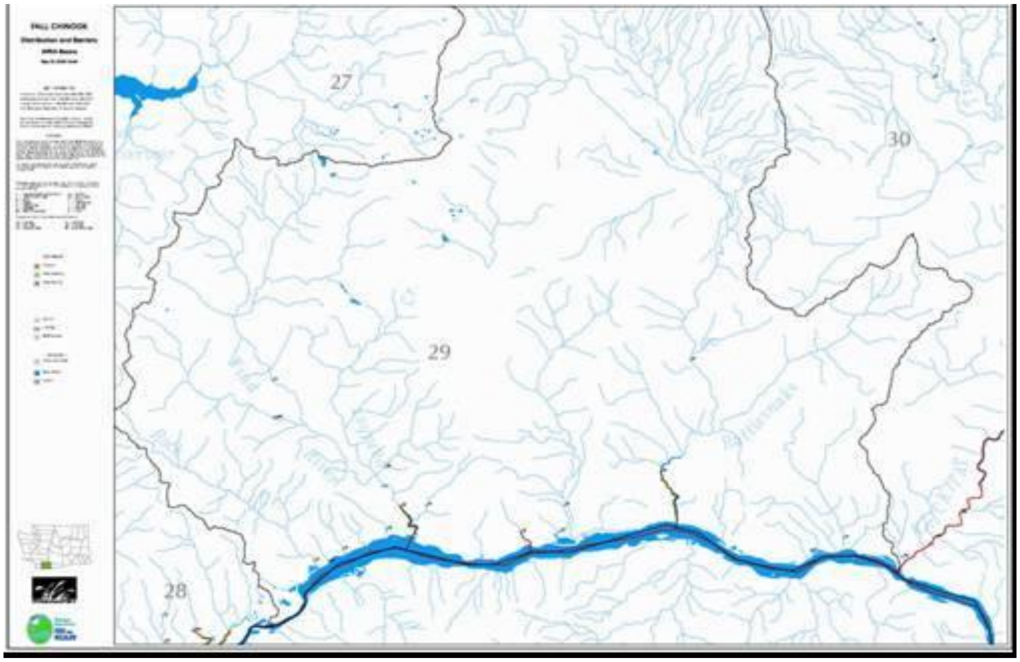


Figure 8. Distribution of fall chinook in the Wind River Subbasin

Spawning also may occur in the Little Wind River, but surveys have not been completed for this tributary. Completion of Bonneville Dam inundated the primary habitat in the lower Wind River. Natural production is likely composed of naturally produced adults and hatchery strays. Tule fall chinook escapement is shown in Figure 9.

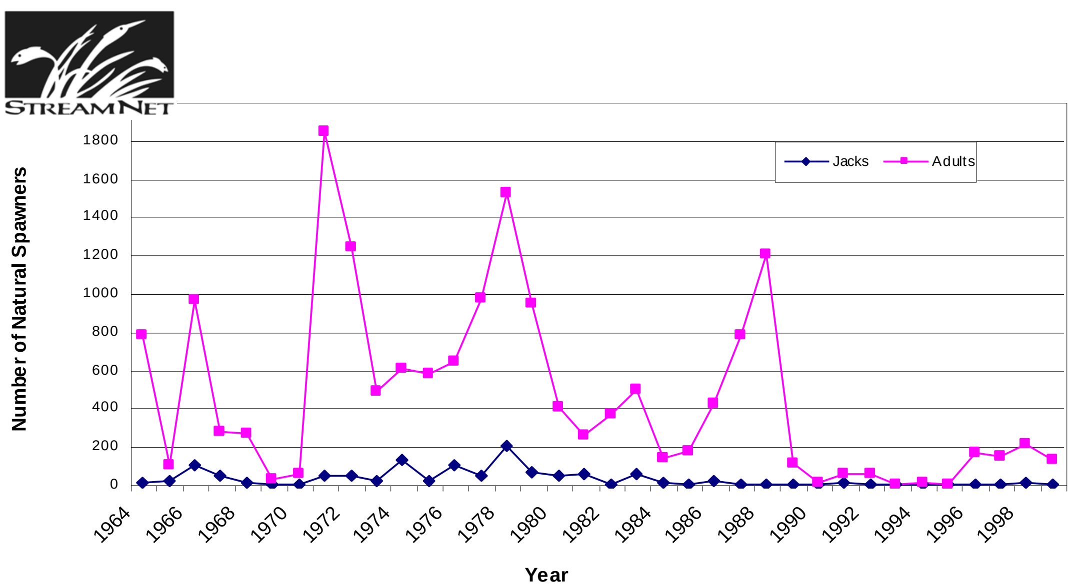


Figure 9. Wind River tule fall chinook abundance estimates, 1964-2000

Naturally produced fry are observed each year in the lower Wind River smolt trap indicating that fall chinook are successfully spawning. Tule fall chinook in the Columbia Basin have primarily been managed for hatchery production. Bright fall chinook salmon originated from the Columbia River above McNary Dam. These fish have been reared at Bonneville and Little White Salmon hatcheries to mitigate for chinook salmon lost due to the construction and operation of mainstem Columbia River dams. Stray brights from these facilities have been observed in the Wind River and natural production of bright fall chinook occurs in the Wind River. Bright fall chinook salmon tend to spawn later than tule fall chinook and the abundance of bright fall chinook salmon has been enumerated since 1988 in the lower Wind River (Figure 10).

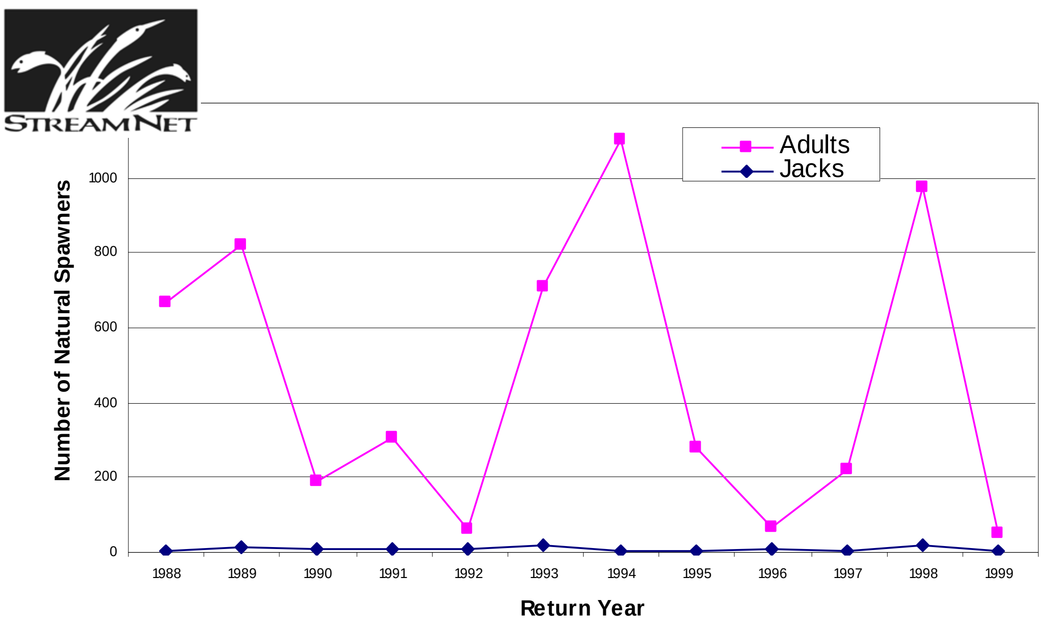


Figure 10. Wind River bright fall chinook abundance, 1988-1999

Bull Trout (Threatened, 1998) - The status of bull trout in the Wind River is unknown. Bull trout have been observed in the lower river below Shipherd Falls (Figure 11) and managers believe these fish are part of an adfluvial population, which uses the Bonneville Pool. The WDFW has initiated a bull trout sampling project in the Columbia Gorge Province to determine the distribution of bull trout in the Wind River and other Washington tributaries. Until this project is completed, there is insufficient information to determine distribution, assess population status, or develop a recovery plan for these fish.

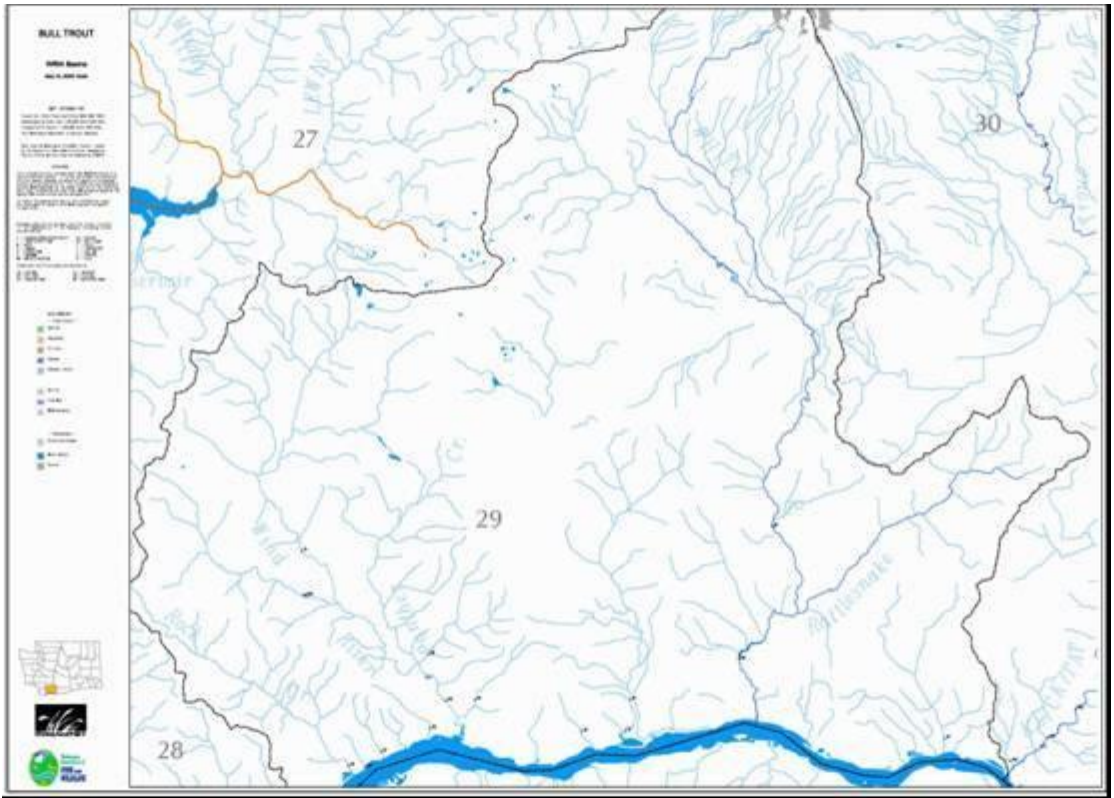


Figure 11. Distribution of bull trout in the Wind River Subbasin

Coastal cutthroat trout (not listed) - Coastal cutthroat trout occur in the watershed, but the historic and recent distribution and status of this species are unknown. Historical distribution may have been limited to below Shipherd Falls, with the Little Wind River likely providing suitable habitat. Reports of cutthroat trout occurring above Shipherd Falls do exist, but they appear to be after hatchery cutthroat had been released into the watershed above Shipherd Falls. Hatchery cutthroat releases occurred as early as the 1930s, but were discontinued 30 years ago. Personnel from USGS-CRRL have not observed cutthroat trout during recent (1996-99) surveys in first and second order tributaries accessible to anadromous fish throughout the watershed above Shipherd Falls. Personnel from WDFW have observed one coastal cutthroat in five years of smolt outmigration monitoring at the lower Wind River trap located below Shipherd Falls. Because of limited information and lack of sampling that specifically targeted cutthroat trout, the status of coastal cutthroat trout in the watershed is unknown. However, if coastal cutthroat trout are present, the population number appears to be very low, the distribution appears to be very limited, and the sea-run form may be extirpated.

Coho (Threatened, Lower Columbia ESU, 6/05) - A small spawning population of coho persists in the Wind River. The WDFW believes that upstream adult coho distribution was limited to the area below Shipherd Falls (Figure 12). Although hatchery coho are not released in the basin, a few were observed at the Shipherd Falls adult trap in the fall of 1999 during the first year of adult trapping. Smolt trapping in the lower Wind River during the last five years has produced few wild coho smolts. This indicates that current natural production for coho is low and hatchery strays are likely the source of any natural production.

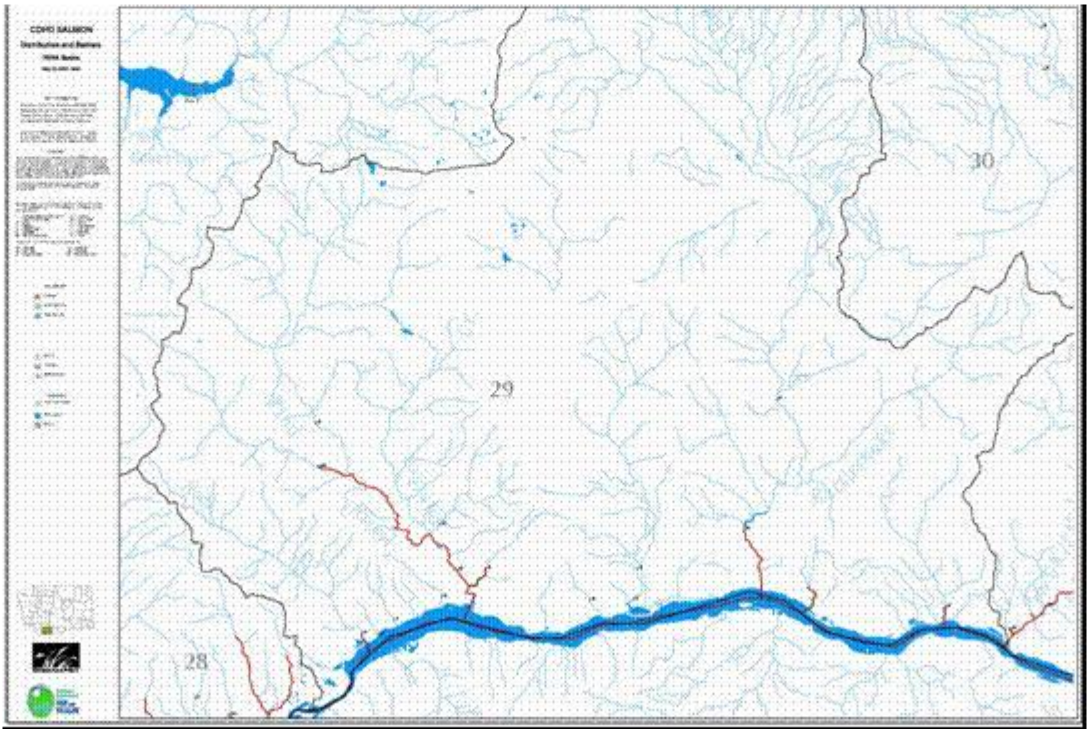


Figure 12. Coho distribution throughout the Wind River Subbasin

Resident Rainbow - Resident rainbow trout are native to the Wind River drainage and occur sympatrically with steelhead within and above the anadromous zone. Initially, hatchery trout were stocked throughout the basin with most confined to Hemlock Lake in Trout Creek to provide local anglers recreational opportunity. Due to concerns about declining steelhead in Trout Creek, the Hemlock Lake program was terminated in the early 1990's. When juvenile steelhead/rainbow trout were collected for genetic analysis in the 1990's, there was no evidence of hatchery rainbow trout introgression in these collections. The status of rainbow trout is unknown at this time.

Brook Trout - Brook trout are non-indigenous to the Wind River watershed. Hatchery releases have been discontinued but naturally reproducing populations have been established within the Wind River. Brook trout densities are highest in upper Trout Creek and Tyee Springs (Connolly et al. 1999). In these areas they are likely to compete with native rainbow/steelhead populations. The status of brook trout populations is unknown at this time.

Pacific Lamprey – YIN Species of Concern - Pacific lamprey have been observed in the Wind River Subbasin above and below Shepherd Falls. Pacific lamprey were historically and are currently important to the Yakama Indian Nation. The current status of the species is unknown.

C. Historical anthropogenic impacts to salmonid populations in the region

1. *Early 1800's to 1930* (e.g., logging, agricultural development, commercial fishing, canneries)[6]

Prior to active state and federal regulation of forest practices, fishery habitat was damaged. Indiscriminate logging around and through streams, use of splash dams to transport logs, and poor road construction with associated siltation reduced or eliminated anadromous fish from many streams. Other problems include destruction of riparian vegetation, land reclamation and non-point source pollution from agricultural development. Urbanization, port development, and flood control efforts further impacted stream habitat. (WDW 1990)

The Little White Salmon River drainage was traditionally managed for timber production; however, under the Northwest Forest Plan, much of the drainage has been designated as riparian reserves, or reserved through other means. In addition to the GPNF and DNR, there is a limited amount of commercial timberland ownership in the lower valley. The land holdings within the CRGNSA are regulated by the CRGNSA's land use regulations as administered by Skamania County in addition to the Washington Forest Practices Act. Those outside the CRGNSA are regulated by the Washington State Forest Practices Regulations. Urban development has been concentrated in Willard, Washington, which is located five miles from the mouth of the river. Large-scale industrial activities are limited by lack of available land outside the National Forest and Scenic Area. The river's proximity to the Portland/Vancouver area make it a popular recreation destination for cross country skiing, tubing, sledding, fishing, mineral prospecting, swimming, golfing, camping, hiking, picnicking, waterfall viewing, hunting, and berry picking.

Fishing has a long history in the Columbia River Basin. To the Indians living along the Columbia River, salmon were their lifeblood, essential to their subsistence, their culture, and their religion. A focal point of this great salmon fishery for many centuries was Wy-am, one of the longest continuously occupied sites on the North American continent. Located near Celilo Falls on the Columbia River, the Wy-am area, before the Dalles Dam in 1957, was a commercial center during the fishing season. In autumn, as many as 5,000 people would gather to trade, feast, and participate in games and religious ceremonies.

Salmon played a key role in developing the West by European settlers. As early as 1828, various trading companies were purchasing and exporting salmon caught by the Indians on the Columbia River. The first commercial use of fishery products in Oregon was the packing of salmon. Development of the canning process in the mid 1800's created a huge demand for salmon. The total harvested pounds of salmon and steelhead in the early 1890's ranged from 21 million pounds to 40 millions pounds. During the late 1880's and early 1920's, the salmon gillnet fishery in the Columbia River pumped a substantial amount of income into communities on the lower Columbia River, such as Astoria.

The history of Columbia River salmon harvest exhibits a transition from hand-held spears and dip nets, to riverboats with purse seines and gillnets, to ocean-going vessels with diesel

[6] *Unless cited otherwise, section text from IEAB 2005.*

engines and trolling poles. Originally, harvesters waited until salmon returned to the Columbia River. When salmon became scarcer and gas powered engines allowed fishermen to venture out farther into the ocean, trolling for salmon became an attractive alternative. As ocean fisheries developed, a growing share of the fish produced in the Basin was harvested in the ocean. Today, salmon produced in the Columbia River system are harvested from California to Alaska by trolling gear and by nets set to harvest other species of salmon. The effect of economic development in the Columbia Basin, hatchery production, and mixed stock, open access fisheries has been to reduce the total harvest and change the species and stock composition of salmon returning to the Columbia River. The change in the nature of the harvest patterns and the decline in total Columbia Basin production has resulted in fewer fish available for harvest in the Columbia River. Commercial landings of salmon and steelhead harvested in the Columbia River declined from around 20 million pounds in the late 1940's to a very low level in 1993, when a total of just over one million pounds of salmon was harvested.

Another trend is that, in the last two decades, farmed salmon has grown to provide more than half of the world salmon market. This infusion of new supply has resulted in significant reductions in salmon prices that, combined with reduced catch, has put substantial economic pressure on commercial salmon fisheries. As returning fish numbers have declined, so have the revenues received by fishermen and the resulting household income generated for inland communities. Some of these trends may be changing. Adult salmon and steelhead numbers have always been volatile, depending on ocean and other conditions. Since 2000, numbers of adult salmon and steelhead available for harvest have increased dramatically. Increased prices for certain salmon products during the 2004 season may indicate increased demand for specialty products, such as "wild caught" salmon. Another recent trend is the rapid decline in the U.S. dollar. This has also increased prices for most salmon products.

2. Hydropower development: 1930-1975

The Little White Salmon only supported about 2 miles of anadromous spawning and rearing habitat. Almost all of the anadromous habitat has been eliminated by the construction of **Bonneville Dam** and the inundation of this habitat. A barrier at the Little White Salmon Hatchery limits fish passage for the short distance between the hatchery barrier and the natural barrier. There is limited potential anadromous habitat above the natural barrier due to the steep gradient and other barrier falls locate between the Little White Salmon Hatchery and the Willard Hatchery at RM 6 (Rawding 2000a).

The **Condit Hydroelectric Project** is a 14-megawatt project is located on the White Salmon River in southwestern Washington. Owned by PacifiCorp, the dam is 471 feet long, 125 feet high, with a 125-foot spillway. The project was built in 1913 and is located three miles upstream from the confluence of the White Salmon and Columbia Rivers about 60 miles east of Portland, Ore. It is the only man-made impoundment along the river's 45 miles, from its source on Mt. Adams to the Columbia River (FOE 2007).

The dam is a complete barrier to all ocean-migrating fish. Two early attempts to construct fish passage for migrating salmon shortly after the dam was built construction washed away within a few years and were never rebuilt (FOE 2007).

As a result of gravel loss and low flows caused by the dam, very little natural salmon production occurs downstream of Condit Dam. Discharge from the powerhouse attracts and injures what few salmon and steelhead remain in the lower river. And flow fluctuations resulting from power peaking operations at the dam cause stranding of juvenile fish and disturb adult spawning (FOE 2007).

The White Salmon River's once abundant fish runs are in deep trouble. The American Fisheries Society found that the river's wild salmon and steelhead runs are at high risk of extinction, due in large part to Condit Dam. The dam also segregates the river's scenic areas from one another, and prevents the integration of the river's fish, wildlife, recreational, and aesthetic resources (FOE 2007).

Condit Dam was construction prior to enactment of the Federal Power Act (which requires licenses for hydroelectric dams), so it wasn't until 1968 that the federal government issued a 25 year license for the project as an already-operating facility. In 1989 PacifiCorp began the process seeking a new operating license for Condit in anticipation of the original license expiring. That licensing process is intended to determine whether to relicense the dam, and if so, what terms and conditions for operating the dam would be required (FOE 2007).

CONDIT HYDROELECTRIC PROJECT CHRONOLOGY

1911-1913	Condit Dam was built
December 20, 1968	New license issued by the FERC for 25 year term
December 1991	PacifiCorp filed an application for a new Federal Energy Regulatory Commission (FERC) license
October 1996	FERC issued their final Environmental Impact Statement (EIS) with mandatory conditions
January 1997	PacifiCorp initiated settlement discussions with the interveners
September 1999	Settlement Agreement signed by Federal and State agencies, environmental groups and the Yakama Indian Nation
February 2000	FERC issued notice of Settlement Agreement filing and allowed new interventions
July 2000	FERC began National Environmental Protection Act (NEPA) process
June 2001	Filed application of Clean Water Act Section 401 Water Quality Certification for the proposed Project removal (*subsequently withdrew and resubmitted in May 2002, May 2003, May 2004, and May 2005*)
December 2001	FERC issued a Declaratory Order regarding PacifiCorp's requests that the Commission find it has jurisdiction to entertain the amendment/settlement application, to approve the Settlement, and to issue the amendment as submitted
March 2002	FERC issued an Order on Motion for Clarification regarding the Declaratory Order (*issued December 2001*)

May 2002 FERC	issued their final supplemental final EIS (FSFEIS) endorsing dam removal
July 2002	PacifiCorp filed the request for FERC abeyance of proceedings to get all permits and a firm cost estimate
September 2002	U.S. Fish & Wildlife Service issued Biological Opinion
July 2004	Filed application for Clean Water Act Section 404 and Rivers and Harbors Act Section 10 permits with the U.S. Army Corps of Engineers (Corps)
December 2004	FERC requested re- initiation of U.S. Fish & Wildlife Service Endangered Species Act (ESA) consultation
December 2004	FERC deadline for NOAA's National Marine Fisheries Service (NOAA Fisheries Service) Biological Opinion (*signed and filed with FERC October12, 2006*)
February 2005	Settlement Agreement amendment signed and filed with FERC
May 2005	PacifiCorp filed response to U.S. Army Corps of Engineers additional information requests regarding Sections 404 and 10 permit applications
September 2005	Washington State Department of Ecology released the State Environmental Policy Act (SEPA) Draft Supplemental Environmental Impact Statement (DSEIS)
October 2005	PacifiCorp filed Klickitat County draft conditional use permit application documents and draft substantial shoreline development permit application documents
October 2005	PacifiCorp filed Skamania County draft shoreline substantial development permit application documents
October 2005	PacifiCorp filed petition for declaratory order on preemption with FERC
November 2005	PacifiCorp filed Klickitat County draft floodplain development permit application documents
November 2005	PacifiCorp filed comments on Washington State Department of Ecology's SEPA DSEIS
November 2005	U.S. Fish & Wildlife re- initiation of consultation and
January 2006	supplement of 2002 Biological Opinion submitted to the FERC
December 2005	PacifiCorp filed Issues of Material Fact and proposed an alternative with the Department of Interior and U.S. Fish & Wildlife Service challenging Federal Power Act Section 18 Prescriptions
December 2005	American Rivers, Columbia Riverkeeper, American Whitewater, Friends of the Columbia Gorge, Klickitat and Skamania Counties, Yakama Nation and Columbia River Inter-tribal Fish Commission file to intervene in issues of material fact and proposed alternative process with DOI and USFWS

January 2006	PacifiCorp, Ecology and URS completed final SEPA scope and budget
January 2006	Quarterly meeting with settlement parties
March 2006	DOI sent notice of schedule for hearing requested. Hearing deferred unless and until FERC issues an order or notice reinitiating evaluation of the 1991 license application
April 2006	Quarterly meeting with settlement parties
May 2006	FERC sent order on petition for declaratory order.
July 2006	Quarterly meeting with settlement parties
August 2006	Sampling and Analysis Plan sent to U.S. Army Corps of Engineers for approval
August 2006	Bathymetric Survey Report sent to Ecology for SEPA process
September 2006	Addendum to Sampling and Analysis Plan sent to U.S. Army Corps of Engineers
October 2006	NOAA Fisheries releases Biological Opinion
October 2006	Quarterly meeting with settlement parties

(Pacificorp 2007)

3. Recent developments: 1975-present[7]

Since 1982, the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program has called for PacifiCorp to provide fish passage at Condit dam to help restore the anadromous fish runs.

The Federal Energy Regulatory Commission (FERC) is the agency responsible for making the licensing decision. In October 1996, FERC issued a final Environmental Impact Statement for the project that called for PacifiCorp to install fish ladders and other measures to allow fish to migrate past the dam. These and other license conditions would have cost $30 million or more of license conditions. The company argued that these conditions would make the project uneconomic to operate over the life of a new license, primarily because of the required fish passage facilities.

Dam Removal

In 1992, Friends of the Earth and a broad coalition of environmental, fishing and recreation groups intervened in the FERC licensing process for Condit Dam. In conjunction with the Yakama Indian Nation and the Columbia River Inter-Tribal Fish Commission, we called for removal of Condit Dam and restoration of the White Salmon River as a fully-integrated ecosystem.

Time is running out for the river and the fish. Wild spring chinook in the White Salmon River are now extinct, and the river's three other wild anadromous fish runs (fall chinook, summer

[7] *Section text from FOE 2007.*

and winter steelhead) are on the brink of extinction. Fisheries biologists at the National Marine Fisheries Service have stated that dam removal is "the most fail-safe method to safely pass fish through the project area." Dam removal is the "optimum means for anadromous fish to access their historical range," as mandated by the Northwest Power Planning Council's Fish & Wildlife Program.

In addition, aquatic species other than salmon and steelhead (trout, sturgeon, eel) will benefit from unimpeded passage and water quality and flow improvements that come with dam removal. Dam removal will also permanently eliminate water quality problems related to dam operations. And spawned-out salmon will become an additional, nutrient-rich food source for wildlife frequenting upper reaches of the sub-basin, including bears, ospreys (a state-monitored species), and bald eagles (a federally-listed species).

Dam removal and bringing back White Salmon anadromous fish stocks will help to restore continually eroding Native American treaty rights. The Yakama Nation lost several significant treaty-protected fishing sites -- including the site at Husum Falls - when salmon migration was blocked over 80 years ago. Restoration and enhancement of upstream wildlife habitat will also help to restore the Yakama Nation's treaty-protected hunting and gathering rights in the White Salmon watershed.

Condit Dam removal will add over 5 contiguous miles of whitewater runs for commercial and non-commercial whitewater boating, benefiting local guides and outfitters. Restoration of the salmon fishery will benefit businesses dependent upon commercial and sports fishing. And while the negative impacts of Condit Dam are huge, the amount of electricity generated at the dam is quite small. PacifiCorp can easily replace the output from Condit dam with cost-effective, less damaging sources of power.

Once the dam is removed the White Salmon watershed can be restored and managed as a fully-integrated and federally-protected river from headwaters to mouth. In addition, dam removal will improve public safety downstream of the dam as sudden and large flow fluctuations resulting from project operations will no longer be a danger. Beneficiaries include Native Americans who use the in-lieu tribal fishing site at Underwood and instream recreationists who frequent the riparian corridor downstream of the project.

Settlement Agreement

Following FERC's determination in 1996 that PacifiCorp must install ladders and other fish passage measures if Condit Dam was to be relicensed, the environmental coalition, Native American tribes, federal and state fisheries agencies and the company began exploring settlement possibilities to resolve the deep conflicts surrounding the Condit Dam licensing process.

In January 1997, all parties petitioned FERC to halt the licensing proceedings for Condit and we entered in to settlement discussions over possible dam removal options. The feasibility of dam removal was the central issue of the talks, particularly whether it could be accomplished at a substantially lower cost than a new license. Settlement discussions also focused on potential methods and costs of removing the dam, as well as addressing short-term impacts associated with removal. Friends of the Earth staff were key participants in those negotiations, providing important technical expertise on several issues, including dam removal and sediment management.

In September 1999, all parties reached a final settlement agreement. The agreement calls for the company to stop generating electricity at the project after seven years - October 2006 - and for the dam and the water conveyance system to be removed.

During the seven-year period, funds generated by the project operations will go toward dam removal, engineering, permitting, a fisheries enhancement fund and a fund to enhance a traditional Indian fishing site at the mouth of the White Salmon River. The overall costs will not exceed $17.15 million. Of this:

- $13.65 million will go for project removal costs;
- $2.0 million will go for permitting and mitigation costs;
- $1 million will go for a Tribal Restoration Fund which will be administered by the Yakama Nation for enhancement and restoration of fishery resources in the White Salmon River; and
- $500,000 will go for an enhancement fund for the traditional Indian fishing site which will assist in dredging near the mouth of the White Salmon River.

The settlement agreement was submitted to FERC for approval. It is anticipated that FERC will amend PacifiCorp's current license that will allow it to continue operating until the dam is removed in 2006. If FERC rejects the settlement agreement or modifies it, all parties will ask FERC to stay the proceedings to allow time for the parties to negotiate changes to the settlement. If the amended license is ultimately rejected, the relicensing proceeding will be restored to the status quo prior to reaching the settlement, meaning FERC would issue a license with conditions for the project.

An engineering plan, agreed to by all parties, has been developed that identifies how removal will be accomplished. During the fall of 2006, a large hole will be drilled in the base of the dam, and through it the reservoir will be drained fairly rapidly. Most of the sediment will be flushed when the dam is breached. The canyon where the reservoir is located will consist of bare rock and soils although vegetation is expected to rejuvenate rapidly.

The dam will be taken down in pieces, and the water flowline, surge tank and penstocks will be removed. The historic powerhouse will remain.

4. History of hatcheries in the region

- The **Carson National Fish Hatchery**, built by the Civilian Conservation Corps, began rearing salmon and trout in 1937. During the 1980s, the hatchery began rearing spring Chinook salmon exclusively. Because of the loss and degradation of spawning habitat and the impact of dams on migration, the spring Chinook was in rapid decline. Since 1960, hatchery production has helped spring Chinook populations recover in the lower Columbia River.

- Established in 1901, **Spring Creek National Fish Hatchery** was one of several egg collection stations for the Bureau of Commercial Fisheries Clackamas Hatchery, near Portland. As the human population of the Columbia Gorge increased, heavy fishing pressure and destruction of habitat resulted in the U.S. government establishing a fish hatchery at this site.

The original hatchery was flooded when the Bonneville Dam was completed in 1938. After several modifications, the hatchery was redesigned and rebuilt by the U.S. Army Corps of Engineers in 1972. Expansion was undertaken to partially compensate for the loss of Fall Chinook spawning grounds due to dam construction along the Columbia River. The hatchery is funded by the U.S. Army Corps of Engineers and the Mitchell Act, which is administered by the National Marine Fisheries Service (NMFS).

Today the hatchery raises more than 15 million Tule Fall Chinook salmon annually. The hatchery uses water from several springs located at the base of the adjacent basalt cliffs, recycling the water through a unique, oyster shell filtration system to conserve water and reduce pollution. Ninety percent of the water used in the hatchery's rearing ponds is recycled.

- The **Little White Salmon National Fish Hatchery** was a pioneer in the fledgling science of salmon propagation when it began rearing salmon in 1896. During the past 100 years, the facilities and the propagation methods have changed dramatically and research is on-going. Today, more than 9.4 million young salmon are released into the river or transferred to other sites for release each year. The Little White Salmon River provides the cold, clean source of river water in which salmon are incubated and raised for 6 to 18 months.

- The **Willard National Fish Hatchery** is part of the Little White Salmon/Willard National Fish Hatchery complex with administrative offices located at the Little White Salmon hatchery. It was built in 1952 and has been used primarily for raising coho salmon since the mid-1960s. Coho salmon are adapted to the cold water of the Little White Salmon River. Willard NFH is currently an integral component of the Yakama Nation Mid-Columbia coho salmon reintroduction effort aimed at reestablishing self sustaining populations of coho salmon in the Wenatchee River Basin of north central Washington.

- **Skamania Hatchery -** The first fish captured at the Skamania Hatchery for broodstock occurred in 1956. The first returns of wild fish reared at the hatchery returned in 1959. Lavier (1973) described the Washougal River as originally being a summer steelhead stream. Cowlitz and Skamania Hatchery stocks were introduced into the system in the late 1950s and are assumed to have interbred with the wild stock (WDFW Skamania steelhead HGMP 2004)

- **Klickitat Hatchery** – Originally constructed between 1950 and 1954, the Klickitat Hatchery was funded under the federal Mitchell Act of 1938 as mitigation for effects of hydropower development and operation. It is the centerpiece of artificial propagation activities in the Klickitat subbasin, and is used at least in part to rear and release spring and fall Chinook and coho salmon. In addition, steelhead smolts are released annually directly into the lower Klickitat at several locations downstream of the Klickitat Hatchery. On June 2, 2003, a Memorandum of Understanding (MOU) was completed that describes the proposed transfer of ownership and operational responsibility of the Klickitat Hatchery and the Lyle Falls and Castile Falls fishways from the WDFW to the Confederated Tribes and Bands of the Yakama Nation (YN). In May of 2006, the Yakama Nation officially assumed responsibility for the operation of the Klickitat Hatchery (Yakama Nation Fisheries Program Website, 2007).

D. ESUs identified by NMFS and current ESA status[8]

- *Lower Columbia River Chinook Salmon:* The lower Columbia River Chinook salmon ESU was listed as threatened on March 24, 1999.
- *Lower Columbia River Steelhead:* The lower Columbia River Steelhead ESU was listed as Threatened in March, 1998
- *Mid-Columbia Steelhead:* (*Oncorhynchus mykiss*) were originally listed as threatened as part of the Middle Columba River steelhead ESU on March 25, 1999
- *Lower Columbia River coho:* The lower Columbia River coho salmon ESU was listed as threatened on June 28, 2005.
- *Columbia River chum:* The Columbia River chum ESU was listed as threatened in 1999.

E. Salmonid stocks in the region

1. Stocks identified by state and tribal comanagers

Wind Spring Chinook	WRIA29	Columbia River Lower	Depressed	Healthy
Wind Tule Fall Chinook	WRIA 29	Columbia River Lower	Depressed	Critical
Wind Bright Fall Chinook	WRIA 29	Columbia River Lower	Healthy	Healthy
White Salmon River Tule Fall Chinook	WRIA 29	Columbia River Lower	Depressed	Depressed
White Salmon River Bright Fall Chinook	WRIA 29	Columbia River Lower	Healthy	Healthy
Wind River Summer Steelhead	WRIA 29	Columbia River Lower	Depressed	Depressed
Wind River Winter Steelhead	WRIA 29	Columbia River Lower	Unknown	Unknown
White Salmon River Summer Steelhead	WRIA 29	Columbia River Middle	Depressed	Unknown
White Salmon River Winter Steelhead	WRIA 29	Columbia River Middle	Depressed	Unknown
Klickitat Spring Chinook	WRIA 30	Columbia River Middle	Depressed	Depressed
Klickitat Tule Fall Chinook	WRIA 30	Columbia River Middle	Healthy	Healthy
Klickitat Bright Fall Chinook	WRIA 30	Columbia River Middle	Healthy	Healthy
Klickitat Coho	WRIA 30	Columbia River Middle	Depressed	Unknown
Klickitat Summer Steelhead	WRIA 30	Columbia River Middle	Unknown	Unknown
Klickitat Winter Steelhead	WRIA 30	Columbia River Middle	Unknown	Unknown

(Figure from SaSSI 2004)

[8] *Section text from www.nwr.noaa.gov/salmon-recovery-planning.*

2. *“Independent populations” and “major population groups identified by NMFS*[9]

White Salmon Steelhead

This section describes the White Salmon steelhead population.

Current Status within the DPS - White Salmon steelhead (*Oncorhynchus mykiss*) were originally listed as threatened as part of the Middle Columba River steelhead ESU on March 25, 1999. After NMFS revised its species determinations for West Coast steelhead, White Salmon steelhead were included in the Mid-Columbia River steelhead Distinct Population Segment (DPS), which NMFS listed as threatened on January 5, 2006 (71 FR 834). The Mid-Columbia River steelhead DPS includes steelhead populations in Oregon and Washington drainages upstream of the Hood and Wind river systems, up to and including the Yakima River. The Snake River is not included in this DPS (Good et al. 2005). Stream systems in the DPS include Rock Creek and the White Salmon, Klickitat, and Yakima rivers on the northern side of the Columbia, and Fifteenmile Creek and the Deschutes, John Day, Umatilla and Walla Walla rivers on the southern side (Figure 3-2).

The White Salmon steelhead population is one of twenty (seventeen extant and three extirpated) historical independent populations in the Mid-Columbia River steelhead DPS (McClure et al. 2005). Within the DPS, White Salmon River steelhead are part of the Cascade Eastern Slope Tributaries MPG, one of four major population groups in the Mid- Columbia River DPS. This MPG contains seven populations: five extant populations (Klickitat River, Fifteenmile Creek, Rock Creek, Deschutes River Eastside tributaries, and Deschutes River Westside tributaries) and two extirpated populations (White Salmon and Deschutes Crooked River) (Figure 2-2) (McClure et al. 2005). The MPG supports both winter and summer steelhead.

The ICTRT considers the historical White Salmon River steelhead run an extirpated population within the Mid-Columbia River Steelhead DPS because of Condit Dam, which has stopped all anadromous fish migration since 1913 (McClure et al. 2003). The ICTRT regards the population as "functionally extinct", which is a term reserved for populations that have some combination of very low returns, artificial propagation, and lack of suitable habitat that would maintain 500 spawners. By contrast, a fully extirpated population is one in which all areas have been made inaccessible to the anadromous lifecycle (pers. comm. Don Matheson 2007).

[9] *Section text from the Draft White Salmon Recovery Plan, 2006.*

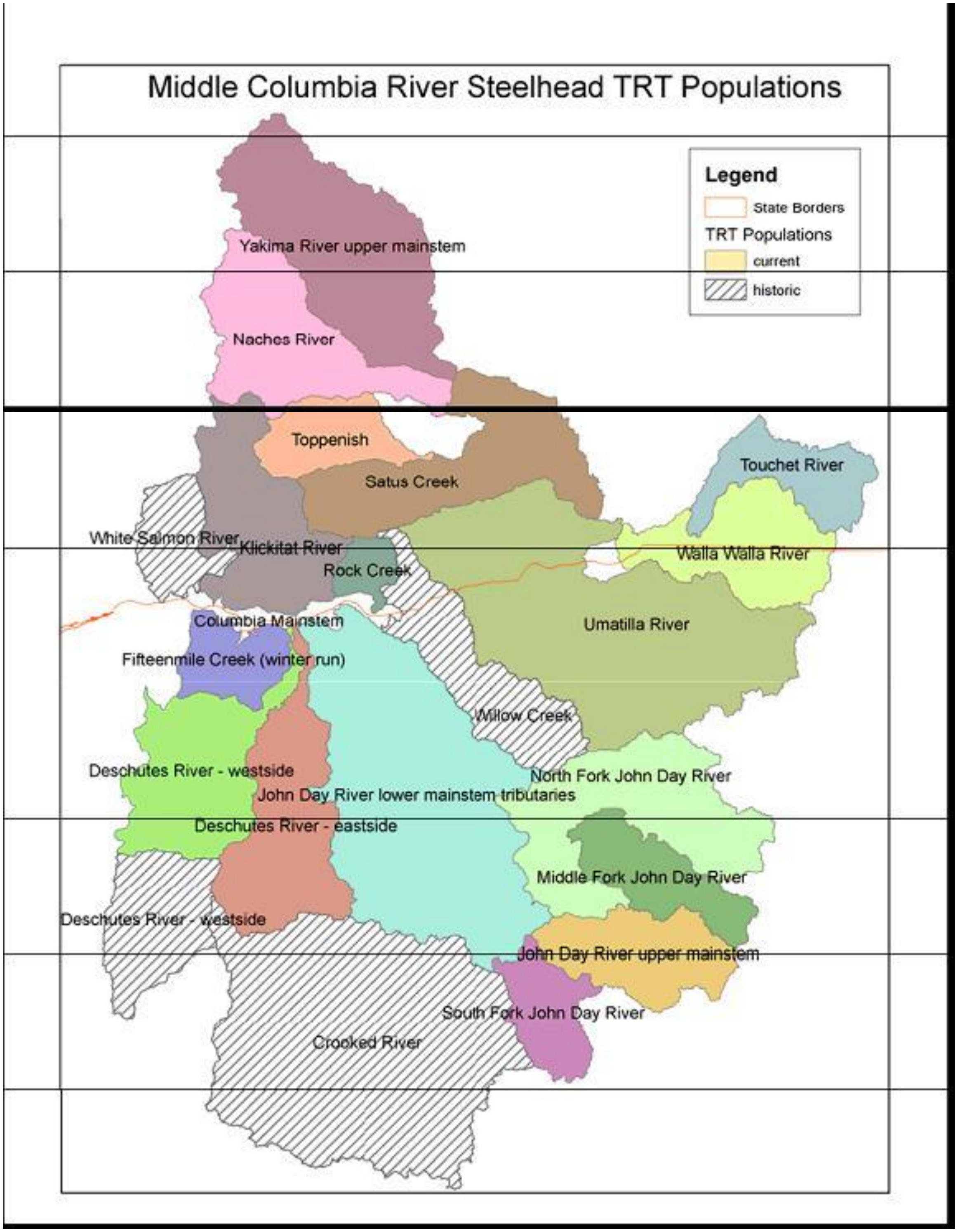


Figure 3-2 The White Salmon population is one of twenty historical independent steelhead populations in the Mid-Columbia River steelhead ESU (McClure et al. 2003).

Abundance and Productivity - Summer and winter steelhead are native to the White Salmon River (WDF et al. 1993). Abundance of these populations before 1913, when Condit Dam blocked passage to upriver spawning and rearing grounds, is unknown. However, the ICTRT projects that historical steelhead spawning habitat in the subbasin could have potentially supported approximately 1,000 steelhead (Cooney et al. 2005).

Today, some natural steelhead production occurs in the reach below Condit Dam. This natural production has not been extensively monitored, but is believed to be very low. EDT models indicate that the reach is capable of supporting a steelhead run-size under average ocean conditions of 20 to 50 adults (NPCC 2004, pg. 105).

Table 3-1 shows steelhead performance in the subbasin based on recent EDT modeling results. These results indicate that steelhead productivity in the subbasin dropped from 20.4 under historical conditions to 4.1 with current conditions. EDT results for the White Salmon population reflect steelhead performance in a nearby river system, the Wind River and its major tributary Trout Creek. Planners used information from the Wind River, where good information is available, to supplement limited data supplies for White Salmon steelhead. They felt the EDT-based projections of White Salmon steelhead performance were reasonable, as the rationale developed for using derived information and expanding empirical data for the Wind River was incorporated into the development of White Salmon River EDT dataset (NPCC 2004, pg 102).

Spatial Structure and Diversity - Biologists generally believe that White Salmon steelhead historically ranged from the mouth to RM 16.3 in the mainstem and into Buck, Spring, Indian and Rattlesnake Creeks (Figure 3-3) (NPCC 2004). Some anecdotal historical records (WDF 1951), suggest that anadromous fish may have once ascended the White Salmon River as far as Trout Lake (RM 28.2). Most biologists, however, consider a series of falls on the White Salmon leading up to the largest at RM 16.3, being 29 feet high, the upper limit of historical steelhead migration (NPCC 2004). This historical range provided approximately 36 to 40 miles of steelhead spawning and rearing habitat (NPCC 2004; Bambrick et al. 2004). Steelhead continue to spawn in the 3.1-mile reach from below Condit Dam to the Bonneville Pool (Bambrick et al. 2004). Historically, this reach supported only 10 percent of steelhead spawning in the White Salmon subbasin, while areas above Condit Dam provided 90 percent of steelhead habitat (NPCC 2004, pg. 108). The subbasin also supports rainbow trout, which are not included in the Mid-Columbia River steelhead DPS. Genetic analysis shows that White Salmon steelhead and rainbow trout are an inland race of *O. mykiss* (Phelps et al. 1990 and Phelps et al. 1994).

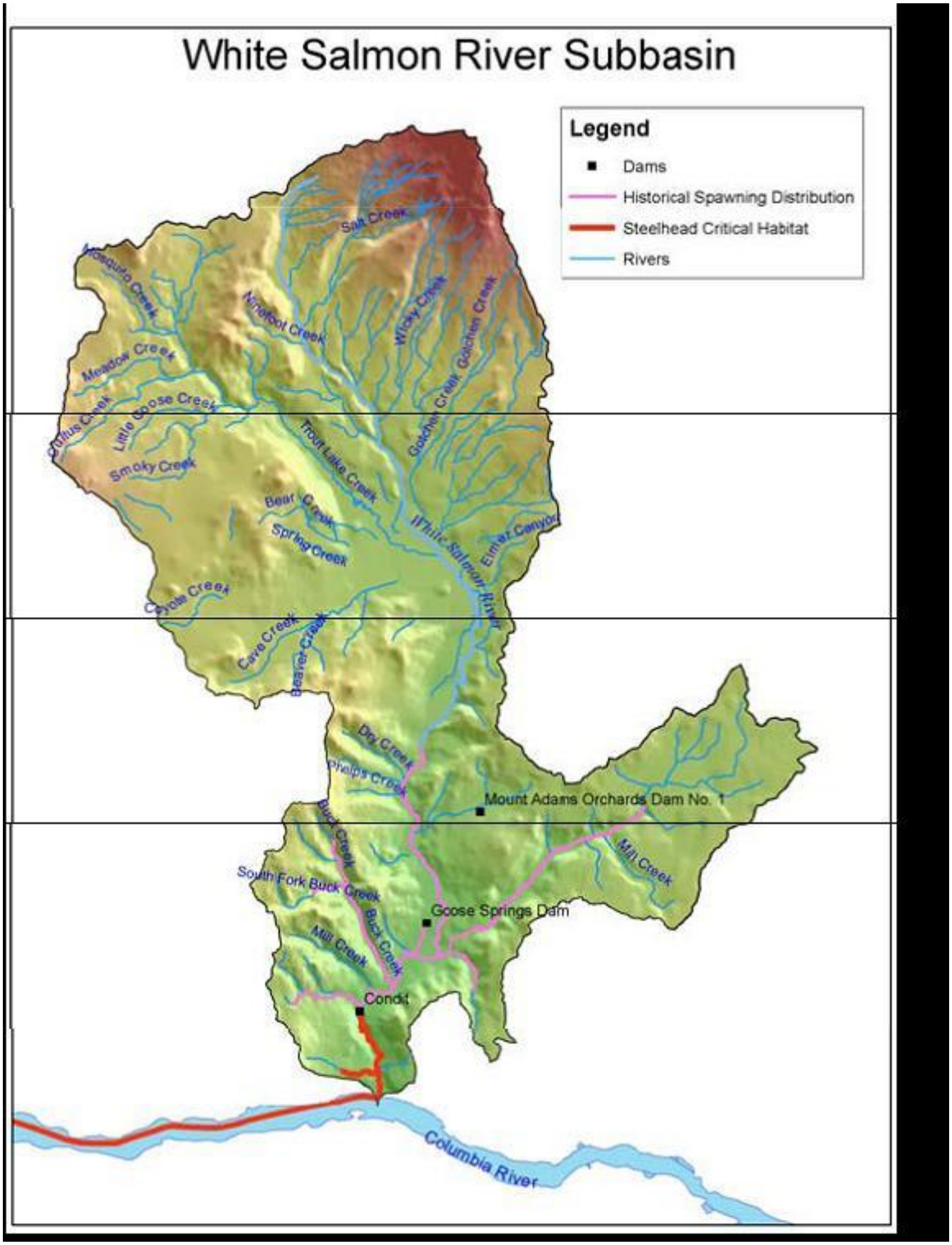


Figure 3-3 Historical spawning distribution of steelhead in the White Salmon River. Current spawning distribution is limited to the area below Condit Dam (Cooney et al. 2005b).

Subpopulation structure of the population is unknown (NPCC 2004). Some biologists believe that residual steelhead populations in the form of resident trout may contribute to anadromy in the subbasin. Phelps et al. (1990) found that introgression from hatchery rainbow plants was not evident in wild rainbow trout samples and high levels of genetic diversity still exist in this population. Sieler and Neuhuaser (1985) caught more steelhead smolts than were predicted by the modeling. One hypothesis is that the steelhead smolts were produced from resident rainbow trout above Condit Dam, and the genetic diversity and fitness of anadromous *O. mykiss* has been maintained (NPCC 2004, p.105).

Major and Minor Spawning Areas - The ICTRT has identified the watershed below Big Brother Falls at RM 16.3 as a major spawning area (MaSA) for Mid-Columbia River steelhead in the White Salmon subbasin. They define a MaSA as a system of one or more branches that contains sufficient habitat to support 500 spawners. The ICTRT identified the area using model results that estimated the historical amount of potentially accessible spawning and rearing habitat available to a specific population based on stream width, gradient, and valley width from GIS-based analysis of tributary habitat associated with each population (Cooney et al. 2005a). They did not identify any minor spawning areas, contiguous production areas capable of supporting between 50 and 500 spawners, in the subbasin. Figure 3-4 shows potential intrinsic spawning aggregates for steelhead in the White Salmon subbasin.

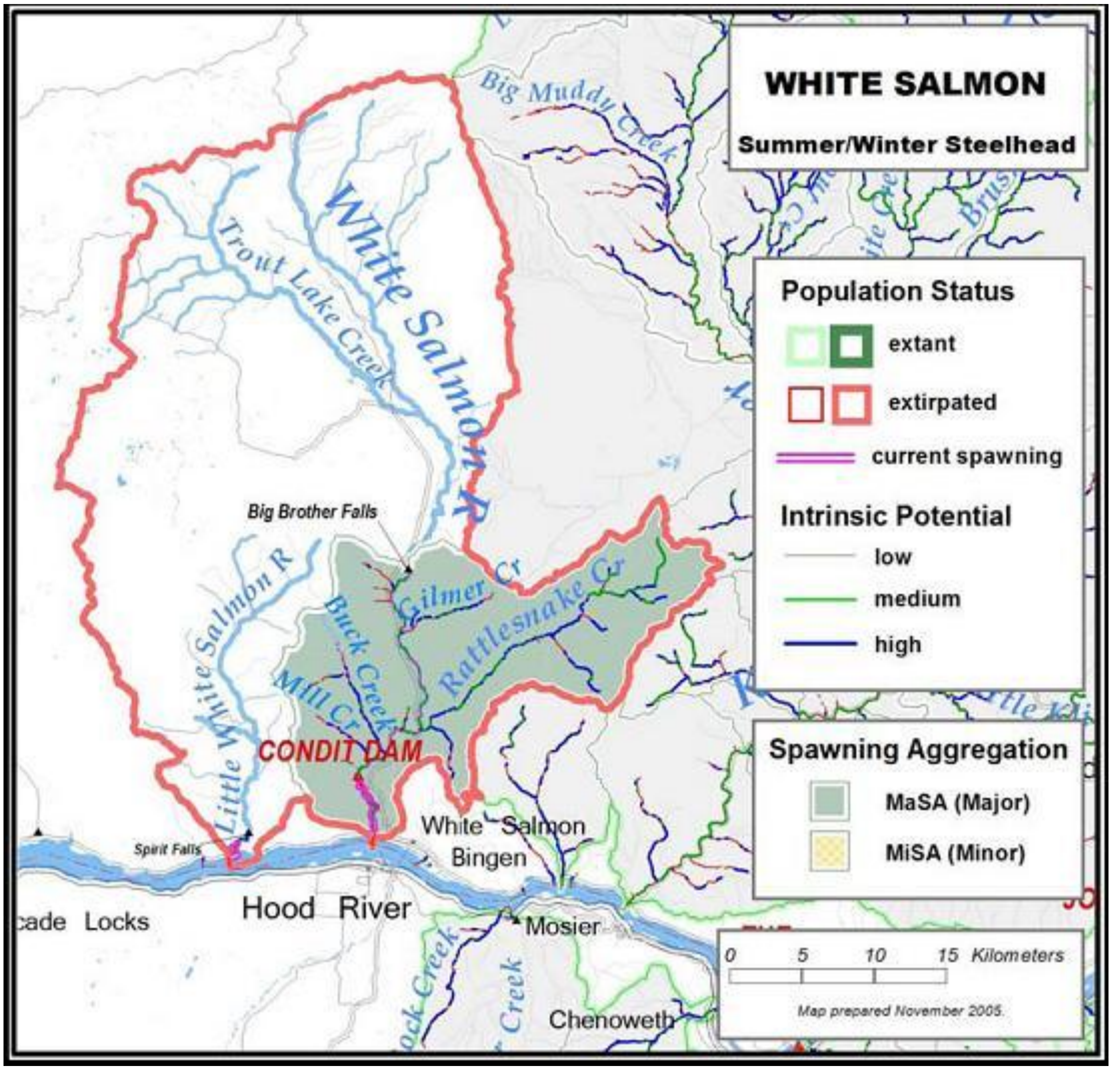


Figure 3-4 Potential spawning aggregations/'habitat' area (MaSA) for Mid-Columbia steelhead in the White Salmon subbasin (Cooney et al. 2005b).

Hatchery Production and Releases - No hatchery programs in the White Salmon River subbasin are considered part of the Mid-Columbia River steelhead DPS. Hatchery winter steelhead from the Skamania Hatchery on the Washougal River are released into the subbasin to support recreational and tribal fisheries. A description of this program follows.

Non-DPS Skamania Summer and Winter Steelhead Programs (White Salmon River):

Smolts from these programs are from broodstock collected at the Skamania Hatchery on the West Fork of the Washougal River. The summer steelhead broodstock was derived from summer steelhead from the Washougal and Klickitat Rivers. The winter steelhead broodstock was derived from returns to the Washougal River. These are isolated programs, and the hatchery steelhead are segregated from the natural-origin summer and winter steelhead.

The program goal is to provide fisheries for summer and winter steelhead in the White Salmon River as mitigation for hydro-system development and habitat loss, and to meet obligations under *U.S. v. Oregon*. The program production goal is an annual release of a 24,000 summer and 20,000 winter steelhead smolts, actual releases vary from year to year. Production is adipose fin-clipped to allow for selective fisheries and to facilitate assessment of the ratio of hatchery adults to wild adults. The smolts are trucked from Skamania Hatchery and direct stream released into the White Salmon River at RM 1.5. A more suitable broodstock would have to be developed or identified if hatchery fish are used to expedite the re-colonization of habitats upstream of Condit Dam.

Stray rates for these programs have not been estimated. Natural production in the White Salmon River is limited to the river below Condit Dam. This natural production has not been estimated.

Harvest - This section briefly describes fisheries and harvest levels influencing steelhead in the White Salmon subbasin. A more detailed discussion is included in Appendix A. Harvest of steelhead, while locally important, was likely less important historically than salmon harvest due to lower abundances and spawning times that coincided with higher flows (NPCC 2004, p. 105). In the White Salmon subbasin, the Yakama Nation reports having fished for steelhead historically as high as Husum Falls and Rattlesnake Falls (YN Cultural Resources Dept., personal communication). On the Columbia River, Chapman (1986) estimated that historical harvest rates of Columbia River steelhead exceeded 80 percent in the late 1800s during the development of the Columbia River fishery.

Commercial harvests of steelhead were prohibited in Washington in 1913 and in Oregon in 1974. Since 1986, sport fisheries in the Columbia River and Washington tributaries have been regulated under wild steelhead release. All fisheries have been substantially reduced since the listing of steelhead for protection under the ESA in 1998. Today, wild steelhead are intercepted primarily in mainstem Columbia River tribal, commercial, and sport fisheries along with tributary sport fisheries.

Since steelhead and salmon in the White Salmon River basin are listed for protection under the ESA, tributary fisheries must be approved by NMFS. WDFW developed a Fisheries Monitoring and Evaluation Plan (FMEP) for steelhead and salmon fisheries in the Mid-Columbia River ESU/DPS in 2001 and is in final consolation with NMFS for a section 4(d) permit for these activities. Wild summer steelhead impacts were substantially reduced in 1986 after wild steelhead release regulation were enacted. Current impacts from tributary sport fisheries are estimated to be 4 percent for summer steelhead and 4 percent for winter steelhead (NPCC 2004).

Mainstem Columbia River sport and commercial impacts are not estimated directly for White Salmon River steelhead, but are estimated for the Mid-Columbia River steelhead DPS. Mid-Columbia River impacts are less than 2 percent and these impacts occur mainly in the spring chinook tangle net fishery and the summer steelhead sport fishery (NPCC 2004). WDFW receives authorization for these fisheries through a section 7/10 consultation and biological opinion from NMFS.

Tribal fisheries affect both summer and winter steelhead. These fisheries are authorized through a section 7/10 consultation and biological opinion from NMFS. Tribal fisheries target salmon stocks; steelhead may be incidentally taken when salmon fishing. Summer steelhead are caught primarily in the fall fishery, with fewer fish caught in other fisheries. They are also intercepted in ceremonial and subsistence fisheries. In 2003, the projected impacts to wild Mid-Columbia River steelhead from tribal fisheries was 4 percent and the maximum impact was 9 percent. The annual cumulative impact from all fisheries is likely to range from 11 percent to a maximum of 16 percent of run-size (NPCC 2004).

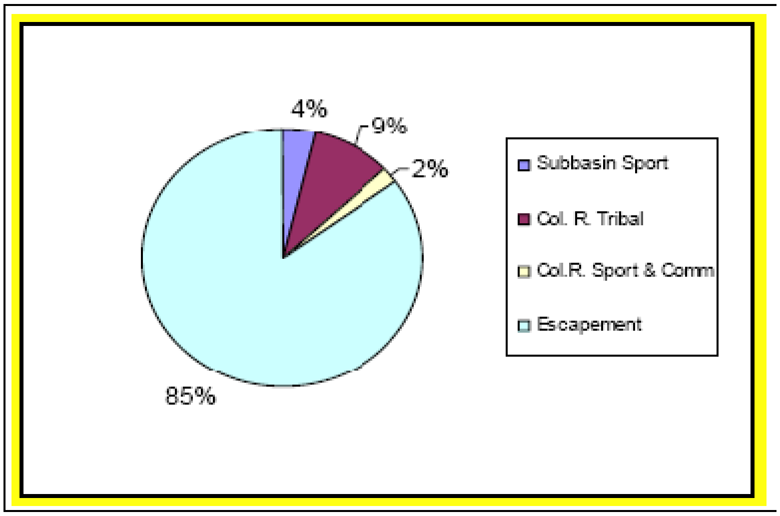


Figure 3-5 Estimated harvest rate by fisheries for White Salmon subbasin wild steelhead (NPCC 2004).

<u>White Salmon Chinook Salmon</u>

This section describes fall and spring chinook populations in the White Salmon subbasin.

Current Status within the ESU - White Salmon chinook salmon *(Oncorhynchus tshawytscha*) are part of the lower Columbia River chinook salmon ESU, which includes all naturally spawned populations of chinook salmon in the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point east of Hood River in Oregon and the White Salmon River in Washington. The historical site of Celilo Falls on the Columbia River is considered the transitional point for this ESU, since it may have been a migration barrier to chinook at certain times of year (Meyer et al. 1998). Figures 3-6 and 3-7 show the historical independent populations within this ESU as identified by the W/LC TRT (Myers et al. 2005). The ESU exhibits three major life history types: fall-run (tules), late fall-run (brights), and spring-run. The White Salmon River supports two of these life history strategies: fall-run and spring-run. Chinook in the White Salmon are included in two of six strata within the lower Columbia River chinook salmon ESU. The Gorge fall-run stratum contains the White Salmon River fall-run, as well as the lower and upper Gorge fall-run populations. The Gorge spring-run stratum contains the White Salmon River spring-run and the Hood River spring-run. The lower Columbia River chinook salmon ESU was listed as threatened on March 24, 1999. The W/LC TRT considers the White Salmon River fall-run chinook population to be at very high risk of extinction and the White Salmon River spring-run chinook population to be extirpated because of Condit Dam (McElhany et al. 2004).

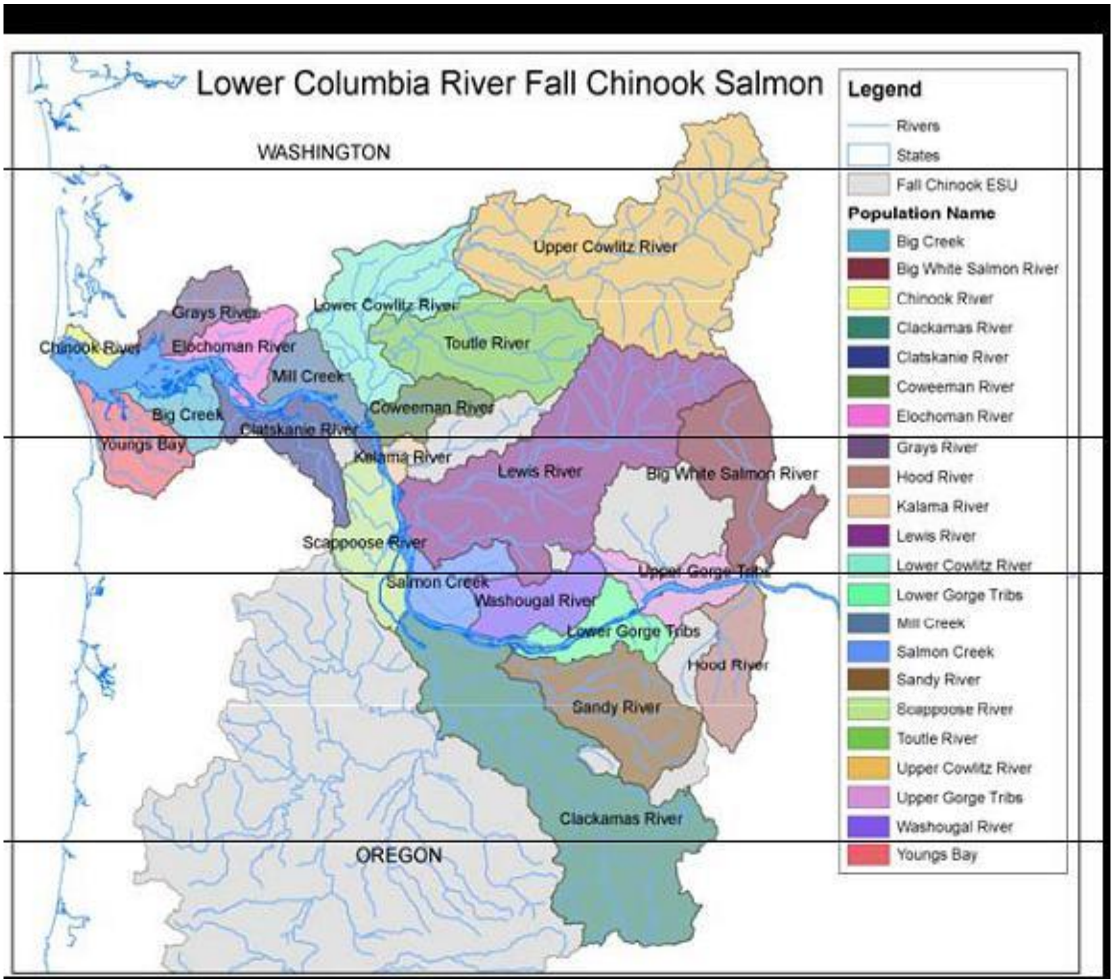


Figure 3-6 White Salmon fall chinook are one of the historical independent lower Columbia River ESU early and late-fall-run chinook salmon populations (Myers et al. 2002).

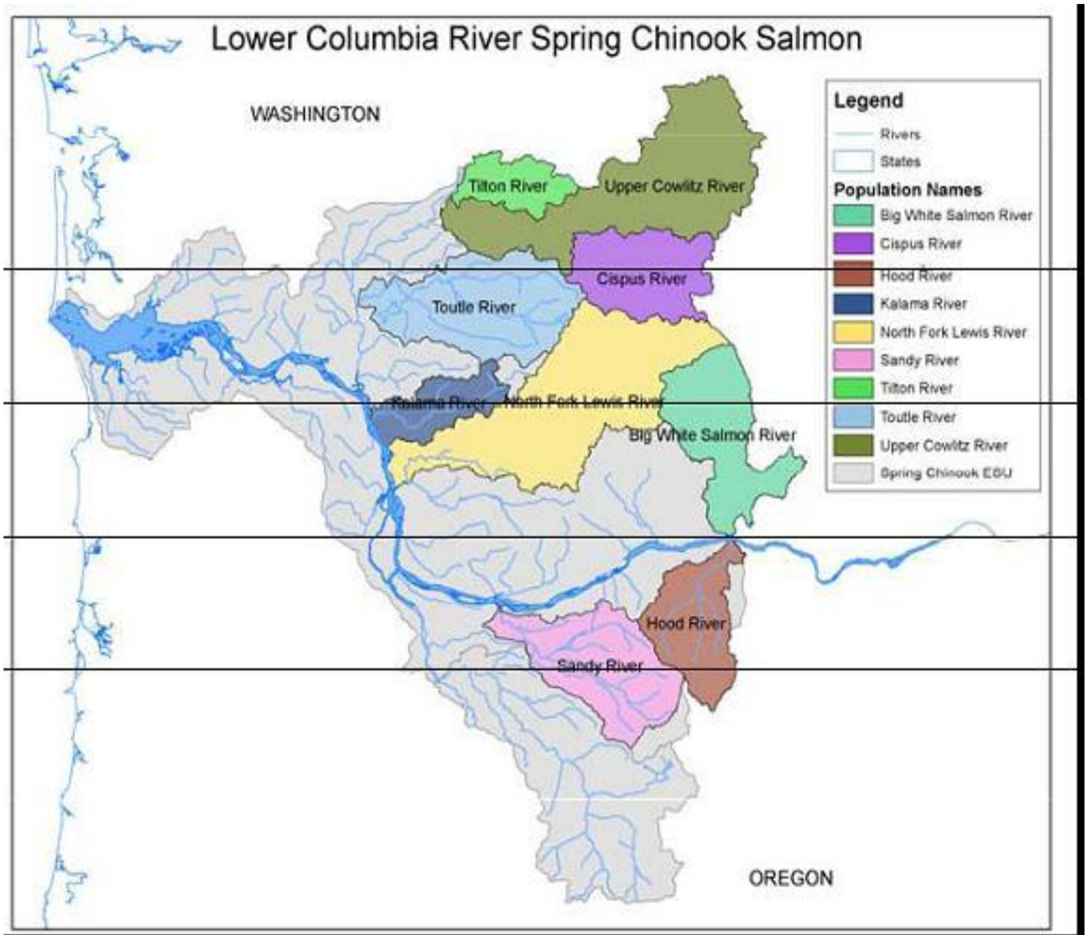
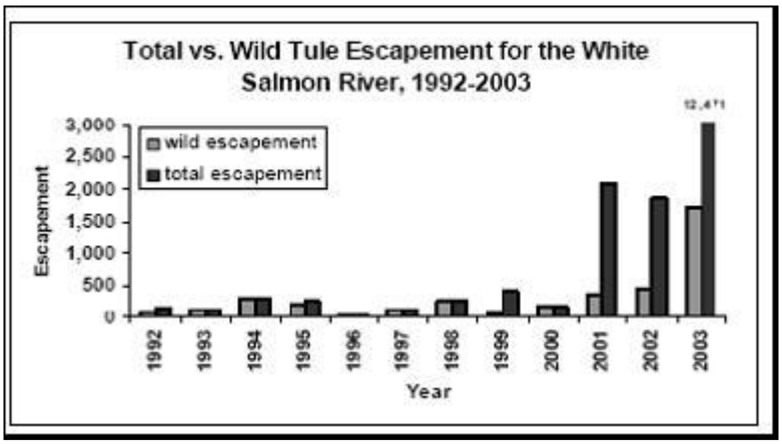


Figure 3-7. White Salmon spring chinook are a historical lower Columbia ESU spring-run chinook salmon population (Myers et al. 2002)

Abundance and Productivity - The W/LC TRT recognizes two historical independent chinook salmon populations in the subbasin: White Salmon fall-run chinook salmon and White Salmon spring-run chinook salmon (Meyers et al. 2003). These populations are described below.

White Salmon fall chinook: Tule fall chinook are considered native to the system, although the historical size of the fall-run to the White Salmon River is unknown. Past hatchery records indicate that fall run chinook salmon in the Little White Salmon and White Salmon rivers began spawning in early September, with peak egg takes in the later part of the month (21 September 1901); 12,840,700 eggs were collected in 1901 (Meyers et al. 2003; Bowers, 1902). The current stock origin for the natural spawning tule fall chinook is considered mixed (Klickitat Lead Entity 2005). Hatchery tule fall chinook were last released in the White Salmon River in the 1980s, but strays are commonly recovered in the river (WDFW 2003). The Spring Creek National Fish Hatchery is located on the Columbia River approximately three miles west of the mouth of the White Salmon River.

The level of wild tule production in the White Salmon River remains unknown, however, surveys conducted by the Pacific States Marine Fisheries Commission (PSMFC) provide some indication of White Salmon fall chinook run-size. PSMFC's estimates wild fall-run chinook escapement by subtracting the hatchery component ─ calculated by expanding the number of coded wire tags recovered during carcass surveys by the Spring Creek Hatchery brood year tag rate ─ from the total tule escapement. PSMFC's estimates of wild spawner escapement from 1992 to 2003 averaged 319 spawners and ranged from 32 to 1,696 (NPCC 2004, pg.75). Figure 3-8 shows estimated level of wild fall-run chinook escapement in the White Salmon River from 1992 to 2003.



White Salmon spring chinook: Biologists generally believe the White Salmon spring chinook population was historically significant, but declined to low numbers after construction of Condit Dam (LCFRB 2004). The W/LC TRT considers the population to be extirpated, or nearly so (McElhany et al. 2004). Recent hatchery releases return to spawn below Condit Dam, however, their reproductive success is unknown (NPCC 2004).

Spatial Structure and Diversity - Historically, chinook salmon ranged up the White Salmon River to above Husum Falls (RM 12) and possibly to Big Brothers Falls at RM 16.3. They also migrated into Rattlesnake Creek (NPCC 2004). It is unknown whether chinook salmon observed at Husum Falls were spring or fall chinook salmon because the White Salmon River gorge is inundated by Condit Dam, and it is not known if barrier waterfalls existed to maintain a separation between spring and fall chinook salmon. Important habitat for fall chinook exists below Condit Dam and important habitat for spring chinook above the dam, with a probably a transition zone between the areas where the habitat is important for both races (NPCC 2004, pg. 71).

Since 1913, Condit Dam has limited distribution for both chinook races to the 3.4-mile area below the dam. This development affected the fall-run less than the spring-run since most historical fall chinook habitat remained accessible. The dam significantly affected spring chinook production in the subbasin as the run's historical spawning habitat exists above the dam and became inaccessible (NPCC 2004).

Today, chinook salmon spawn and rear in the lower White Salmon River below Condit Dam. Most of these fish are fall chinook, however the run is heavily influenced by hatchery strays. Some W/LC TRT members consider the Spring Creek NFH broodstock as a potential source for reestablishing a native run, as it may have been established using White Salmon River fall-run fish before construction of Condit Dam (McElhany et al. 2004, pg 70). W/LC TRT members generally believe that the construction of Condit Dam extirpated spring chinook in the White Salmon River and eliminated the genetic resources of the population (McElhany et al. 2004, pg 71).

Key Habitat during Different Life Stages - White Salmon River fall-run chinook are considered an ocean type because they migrate to the ocean as subyearlings. Tule chinook begin entering the Columbia River in early August, with the greatest abundance in the estuary between late August and early September. Tule counts at Bonneville Dam generally peak between September 4 and September 9. Most tules mature at age three, with very few five year olds. Fall chinook spawning in the White Salmon River peaks in late September through early October. The adults tend to spawn in mainstem rivers and large tributaries.

Since native spring-run chinook are extirpated in the White Salmon, little is known about them and their life history information is assumed consistent with lower Columbia River ESU spring chinook. These spring chinook are considered a spring type because they primarily smolt as yearlings. Fecundity varies within and among chinook salmon populations. Spring chinook spawning occurs slightly earlier than fall chinook, primarily in September (NPCC 2004).

Both fall and spring chinook salmon generally spawn in streams reaches at least 10 feet wide. They construct redds in gravel and small cobble substrate in pool tailouts, riffles, and glides. Eggs remain in the gravel until emergence, which occurs from February to April depending on water temperatures. Emerging fry seek out shallow, low velocity areas in the stream channel; preferring backwater and dammed pools, along with glides. Shortly after fry colonization, however, tule fall chinook juveniles begin their outmigration, while the spring chinook juvenile can continue rearing until October. During the inactive or overwintering life stage, spring chinook juvenile prefer nonturbulent deeper water habitat types (primary pools) in the main channel, but also use slower portions of large cobble riffles. Yearling spring chinook outmigrate during the following spring. Table 3-3 shows key habitat for fall and spring chinook during different life stages.

Hatchery Production and Releases - ***<u>Fall-run chinook salmon</u>****:* No hatchery fall chinook are released directly in the White Salmon subbasin, however, hatchery tule fall chinook from Spring Creek NFH do stray into the subbasin, supporting natural production. Spring Creek NFH tule fall chinook salmon are considered part of the lower Columbia River chinook salmon ESU. Upriver bright (URB) fall chinook salmon released from the Little White Salmon NFH have been straying into the White Salmon River. This URB fall chinook salmon program is not part of the lower Columbia River chinook salmon ESU. These programs are described below:

Spring Creek National Fish Hatchery (NFH) tule fall chinook salmon: Fall chinook salmon from the White Salmon River were used to establish the Spring Creek NFH fall chinook salmon program and are part of the lower Columbia River chinook salmon ESU. The program uses only returns to the hatchery for broodstock, but has incorporated other tule stocks in the past. Non- Spring Creek NFH tule fall chinook salmon were last released from the hatchery in 1991 (Bonneville tule fall chinook salmon). The Spring Creek NFH tule fall chinook salmon is the most representative of the native chinook salmon population that was historically present in the White Salmon River.

The program mitigates for lost and degraded habitat due to the construction and operation of the Columbia River hydrosystem by producing locally adapted broodstock for sport, commercial, tribal, and international harvest. This isolated program uses returning hatchery-origin adults for broodstock. The production goal for the current program is for a total release of 15,100,000 subyearlings annually. This production requires a minimum of 7,000 adults (4,000 females). This large broodstock will maintain the diversity of the population, and the program practices BMPs. When Condit Dam is removed, fall chinook salmon from the program will be used to re-introduce fall chinook salmon into the basin. Genetic analysis of naturally spawning fall chinook salmon in the White Salmon and other Bonneville Pool tributaries is being conducted to determine if Spring Creek NFH fall chinook salmon are representative of the naturally spawning populations of fall chinook salmon.

The stray rate into local tributaries of Spring Creek NFH tule fall chinook salmon is unknown, but program fish are supporting naturally spawning tule fall chinook salmon in upper gorge tributaries ─ including the White Salmon River. The exact proportion of program fish on the spawning grounds in unknown because only a small number of program fish are marked. Habitat is very limited within the reference populations, and with the large returns of program fall chinook salmon, a majority of the spawners are probably program fish. These program fish also contribute to natural spawning populations in the White Salmon River and the Hood River. The number of tule fall chinook salmon spawners has increased in recent years with 561 being observed in the Wind River, 8645 in the White River, and 262 in the Klickitat River (preliminary estimates for 2003, WDFW 11/15/2005 email). Smolt-to-adult survival rates averaged 0.136 percent for the 1991-95 brood years (Spring Creek NFH HGMP 2002). The total exploitation rate for the hatchery program was as high as 75.3 percent for the 1982-89 brood years. A more recent estimate has the total exploitation rate at 67 percent, with nearly half of the impacts occurring in-river, primarily in the Zone 6 area above Bonneville Dam (Spring Creek NFH HMGP 2002). The Spring Creek NFH is funded through the Mitchell Act and by the Army Corps of Engineers. Future funding of this program is uncertain. The program is currently under-funded, and it has a large backlog of maintenance and monitoring needs.

Non-ESU Little White Salmon NFH upriver bright fall chinook salmon: The original source of this stock of upriver bright fall chinook salmon was collected at the Bonneville State Fish Hatchery. The current source of URB fall chinook salmon is returns to the Little White Salmon NFH. The URB fall chinook salmon stock is not native to the Little White Salmon and is not considered part of the lower Columbia River chinook salmon ESU.

The purpose of the program is to successfully rear and release URB fall chinook salmon into the Little White Salmon River to provide mitigation for lost and degraded habitat due to the construction and operation of the Columbia River hydrosystem, to meet *U.S. v. Oregon* court agreements, and to provide 1.7 million fry for release in the Yakima River basin. The program production goal is to release 2.0 million subyearlings at the hatchery. The program is managed as an isolated program.

The program has been successful in meeting the broodstock needs for 1,860 adults, except in 1998 when URB stock from other programs was used to fill production shortfalls due to equipment failure. Stray rates to other tributaries in the upper gorge area have not been determined, but naturally spawning URB fish have been observed in Bonneville Pool tributaries (e.g., White Salmon River) and below Bonneville Dam. These strays adversely affect tule fall chinook salmon populations as a result of redd super-imposition and competition for resources, although additional monitoring is needed to evaluate the extent of these impacts. Harvest rate estimates for the 1990, 1991, and 1992 brood years were 46.7 percent, 52.2 percent, and 37.3 percent, respectively (LWS NFH URB HGMP 2002). The 1990-94 average brood year juvenile-to-adult survival was 0.32 percent. The on-station release portion of this program is funded through the Mitchell Act and the Corps of Engineers (COE). Future funding of the program is uncertain. Yakima basin releases are partially funded by BPA and the COE.

Spring-run chinook salmon: Presently there are no hatchery programs associated with this population. Spring chinook salmon are not observed spawning in the White Salmon River, which lacks adult holding and rearing habitat.

Harvest - This section briefly describes fisheries and harvest levels influencing chinook salmon populations in the White Salmon subbasin. A more detailed discussion is included in Appendix A.

While heavy harvest of Columbia River chinook salmon occurred in the late 1800s and early 1900s, all fisheries have been substantially reduced since the listing of chinook salmon for protection under the ESA in 1998. Today, wild chinook salmon are intercepted primarily in ocean, mainstem Columbia River, commercial, tribal, and sport fisheries along with tributary sport fisheries.

The tule fall-run lower Columbia chinook are heavily impacted by ocean fisheries. The exploitation rate on lower Columbia River tule fall chinook is expected to be 35 percent during the 2002 ocean fisheries (NPCC 2004; NMFS 2000). Mainstem Columbia River non-tribal recreational and commercial fisheries in 2002 account for an exploitation rate of 10 percent of tule fall chinook (NPCC 2004; NMFS 2002). Tribal fisheries are not expected to have a significant impact on the entire tule fall chinook run, but have a higher impact on the BON pool tule populations including the White Salmon River (NPCC 2004; NMFS 2000). Tule fall chinook are minimally impacted by tributary fisheries. Exploitation of lower Columbia River tule fall chinook during ocean and Columbia River mainstem fisheries averaged 69.2 percent from 1980 through 1994 and 35.3 percent since 1995 (NPCC 2004; NMFS 2002). These fisheries are estimated to exploit 45 percent of the 2002 lower Columbia River tule fall chinook run (NPCC 2004; NMFS 2002). The White Salmon River tributary fishery accounts for less than 1 percent of the total run-size of lower Columbia River fall chinook, and less than 4 percent of the White Salmon River tule fall chinook. The NMFS has developed criteria for establishing harvest rates that are consistent with salmon recovery termed Rebuilding Exploitation Rates (RER) (NMFS 2000). The RER for naturally produced lower Columbia River tule fall chinook is 49 percent (NMFS 2000). This includes the impact from all fisheries: ocean, Columbia River, tribal, and recreational tributary (NPCC 2004).

Estimates of the total recreational chinook catch in the White Salmon River are based on catch record cards. Data recording errors and fish misidentification may be represented in these data, along with dip-in fish destined for upriver systems. The exploitation rate of White Salmon River tule fall chinook during WDFW-regulated fisheries in the White Salmon River is less than 5 percent of the terminal run. The terminal run-size is estimated based on the annual catch rate and spawning escapement estimate data collected since 1995 (NPCC 2004, p. 83). The annual catch of wild tule fall chinook is approximately 30 fish and the annual escapement estimate is 461, therefore the annual terminal run of White Salmon River tule fall chinook is approximately 491 fish. Total run-size of the White Salmon River tule fall chinook and total fisheries impact can be extrapolated from these data. Using the estimated annual terminal run-size and estimated annual exploitation from ocean and Columbia River mainstem fisheries, the estimated average total run-size of White Salmon River tule fall chinook is 784 fish (K. Harlan, PSMFC, pers. comm.; NMFS 2002b). Figure 3-9 shows the distribution of the estimated annual White Salmon tule fall chinook run (n = 784) based on data collected since 1995. The WDFW fisheries in the White Salmon River will harvest approximately 4 percent of the total run of the White Salmon River tule fall chinook (30/784 = 0.04) (NPCC 2004).

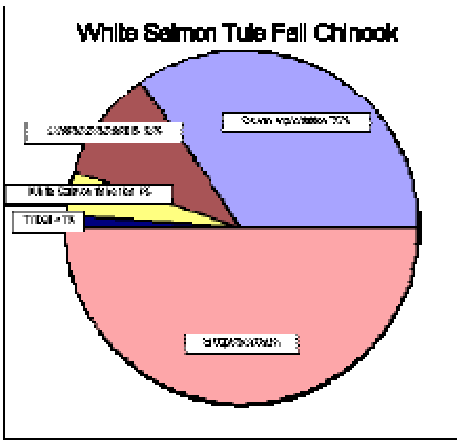


Figure 3-9. Distribution of the estimated annual White Salmon tule fall chinook run (n = 784) based on data collected since 1995 (K. Harlan, WDFW; NMFS 2002).

<u>White Salmon Coho</u>

This section describes the White Salmon coho population.

Current Status within the ESU - The W/LC TRT identified coho salmon (*Oncorhynchus kisutch)* in the White Salmon River as an independent population in the lower Columbia coho salmon ESU (McElhany et al. 2003). The ESU includes all naturally spawned coho populations in the Columbia River and its tributaries from the mouth of the Columbia River to a transitional point east of the Hood River in Oregon and the White Salmon River in Washington (Figure 3-10). The population is part of the Gorge stratum, one of three major population groupings in the lower Columbia River coho ESU.

The lower Columbia River coho salmon ESU was listed as threatened on June 28, 2005. The W/LC TRT considers the White Salmon coho population to be at very high risk of extinction (McElhany et al. 2004).

Hatchery Production and Releases - There are no hatchery programs that directly release hatchery coho salmon into the White Salmon River. The coho salmon program at the Little White Salmon NFH released coho salmon that contributed to strays into the White Salmon River, but stray rates have not been estimated. This program was discontinued after releases in 2004 due to funding shortfalls. The program was funded through the Mitchell Act.

Harvest - This section briefly describes fisheries and harvest levels impacting coho salmon in the White Salmon subbasin. A more detailed discussion is included in Appendix A. Harvest rates for coho salmon were high in the late 1800s and early 1900s, declined after this period, and increased again when Mitchell Act hatchery production became available. From 1970 to 1983, harvest rates for Columbia River coho salmon ranged from 70 percent to 90 percent (NPCC 2004, p. 123). Recently, commercial and recreational harvests of coho salmon have been reduced to protect wild coho salmon from the Sandy and Clackamas rivers and the Oregon Coast. Harvest rates of ESA listed coho salmon were less than 15 percent between 1999 and 2002 (NPCC 2004). Current coho salmon harvest in the ocean, Columbia River, and tributaries is managed to meet hatchery escapement objectives and meet rebuilding objectives for the Clackamas River population. Harvest rates of White Salmon River coho salmon are unknown (NPCC 2004).

White Salmon Chum

This section describes the White Salmon chum population.

Current Status within the ESU - White Salmon chum (*Oncorhynchus keta*) are considered part of the Columbia River chum salmon ESU (Myers et al. 2003). NMFS defined the Columbia River chum salmon ESU as including all naturally spawning populations in the Columbia River and its tributaries in Washington and Oregon (Fed. Reg., V64, N57, March 25, 1999, p. 14508)

The Columbia River chum ESU was listed as threatened in 1999. At that time, NMFS Biological Review Team (BRT) was concerned about the dramatic declines in abundance and contraction in distribution from historical levels (Good et al. 2205). More recently, the WLC-TRT has estimated that close to 90 percent of this ESU's historical populations are extinct or nearly so, resulting in loss of much diversity and connectivity between populations. Only two of sixteen populations are presently considered extant. These remaining populations are small, and overall abundance for the ESU is low. This ESU has shown low productivity for many decades, even though the remaining populations are at low abundance and density-dependent compensation might be expected (Good et al. 2005).

The Columbia River chum ESU includes three strata: Coastal, Cascade and Columbia Gorge. White Salmon chum are considered part of the upper Gorge tributaries historical population. The population is included in the Gorge stratum, one of three major population groupings in the ESU.

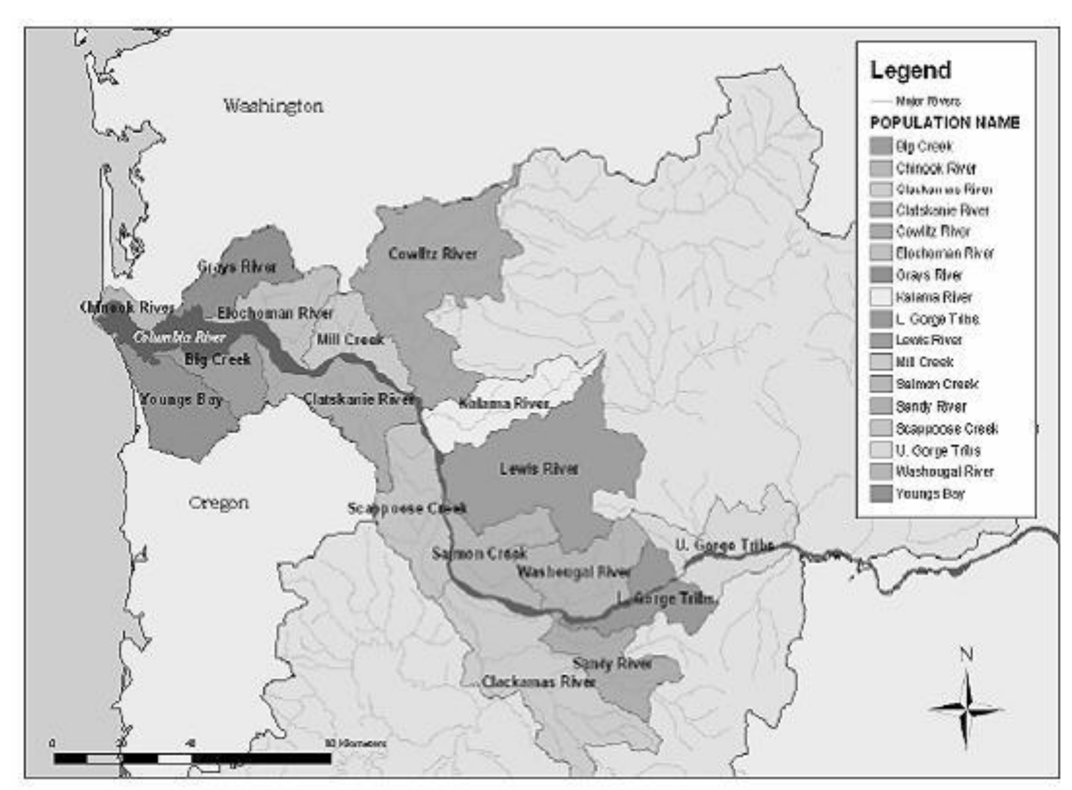


Figure 3-12 Historical demographically independent chum salmon populations in the lower Columbia River ESU (Myers et al. 2002)

Abundance and Productivity - The historical chum run-size in the Columbia River has been estimated at nearly 1.4 million fish per year. Annual escapements to Washington waters of the lower Columbia mainstem and tributaries declined to an average of 3,000 after 1955 (WDFW 2001). The chum returns remained relatively stable at low levels from 1956-2000, but there were significant increases in returns to Washington waters during 2001-2002 as indicated in index area peak counts in Grays River, Hardy Creek, and Hamilton Creek area. Very few chum salmon return to areas above Bonneville Dam. In 1998 and 1999, about 195 and 135 chum salmon, respectively, were observed ascending the fish ladder at the dam (Keller 2001, NMFS 2000). Recent chum surveys by WDFW have identified less than 5 chum morts annually; no morts were observed in 2005 (Jenkins, personal communication 2006).

Today, chum salmon are limited almost exclusively to habitats downstream of Bonneville Dam, with the majority of spawning occurring on the Washington side of the Columbia River. Little is known about the chum salmon production potential of subbasins in the lower Columbia River. Chum salmon fecundity data are variable. In North America, literature reported individual fecundity ranged from 2,018 to 3,977 eggs per female. No fecundity data are available for wild chum salmon in the lower Columbia River, or specifically for the White Salmon River. In the upper Gorge population, dam-related reduction in abundance was assumed to be 96 percent. The impacts were assumed to be 20 percent passage mortality for juveniles and an additional 50 percent for adults (LCFRB 2004, Appendix A).

Spatial Structure and Diversity - While many streams in the lower Columbia River support small populations of chum salmon, large enough numbers to conduct a meaningful allozyme analysis have only been found in two regions, Grays River and just downstream of Bonneville Dam (Hamilton and Hardy creeks). No information regarding diversity for the chum in White Salmon is available. Chum are presumed to access the same area available to them historically. However, the pool behind Bonneville Dam has inundated approximately 80 percent of the historical habitat (NPPC 2004).

Key Habitat during Different Life Stages - Chum seldom show persistence in surmounting river blockages and falls. They usually spawn in lower river reaches. They dig their redds in the mainstem, tributaries or in side channels of rivers from just above tidal influence to nearly 60 miles (100 km) from the sea. They spawn in shallower, slower-running streams and side channels more frequently than do other salmonids. Water velocity in spawning areas varies widely for chum salmon. In Washington, Johnson et al. (1971) measured water velocities near 1,000 chum salmon redds and found that velocities where fish spawned varied from 0.0 to 5.5 ft/sec (0.0 to 167.6 cm/sec), and that over 80 percent of the fish spawned in velocities between 0.7 and 2.7 ft/sec (21.3 and 83.8 cm/sec). This range is similar to that found in other species of salmon.

One of the earliest detectable differences between chum salmon populations in different areas is the time it takes for eggs to incubate, hatch, and emerge as alevins from the gravel. Differences between populations are caused by physical factors such as stream flow, water temperature, dissolved oxygen, and gravel composition, and by such biotic factors as genetics, spawning time, and spawning density, all of which can affect survival (reviewed in Bakkala 1970, Salo 1991).

Water temperature is believed to have the most influence on the rate of embryonic development in chum salmon (reviewed in Bakkala 1970, Koski 1975, Salo 1991). The amount of heat, measured in TUs, required by fertilized chum salmon eggs to develop and hatch is about 400-600 TUs, and the heat required to complete yolk absorption is about 700-1,000 TUs. Lower water temperatures can prolong the time required from fertilization to hatching by 1.5–4.5 months.

Chum salmon do not typically have substantial freshwater rearing time. Most chum juveniles begin seaward migration with minimal time spent in natal streams. Consequently, the period of estuarine residence appears to be the most critical phase in the life history of chum salmon and may play a major role in determining the size of the subsequent adult run back to fresh water. Chum salmon juveniles, like other anadromous salmonids, use estuaries to feed before beginning long-distance oceanic migrations. However, chum and ocean-type chinook salmon usually have longer residence times in estuaries than do other anadromous salmonids (Dorcey et al. 1978, Healey 1982).

Little is known about the seaward migration of juvenile chum salmon from the Columbia River. Generally, however, migration of chum salmon juveniles out of estuaries appears to be closely correlated with prey availability (LCFRB 2004, Appendix A).

Hatchery Production and Releases - Historical and current hatchery influences on chum are minimal. Hatchery chum salmon have been released into only 4 of 10 Washington populations. Hatchery fish do not comprise a substantial fraction of any naturally spawning chum population and all originate from local wild populations (category 1 brood types).

Current chum hatchery programs are focused on reintroduction (Chinook River) and conservation (Duncan Creek) (LCFRB 2004, Appendix A).

Harvest - Chum salmon once were very abundant in the Columbia River basin with commercial landings ranging from 1 to 8 million pounds (80,000 to 650,000 fish) in most years before the early 1940s. Chum salmon were harvested in significant numbers in mainstem Columbia River commercial fisheries until their decline in the early 1950s. Chum were harvested in late fall with most caught in November. Corresponding with the decline in salmon returns, late fall commercial fisheries were reduced. December has been closed to commercial salmon fishing since 1949 and November commercial fisheries have been closed or minimized since 1959. Commercial chum landings gradually diminished during the 1940s and 1950s to less than 50,000 pounds annually by 1959 (LCFRB 2004, Appendix A). Harvest in the lower Columbia River mainstem has been below 100 chum per year since 1992 (LCFRB 2004). Retention of chum in tributary recreational fisheries is prohibited. Recreational harvest impacts on chum salmon in the lower Columbia River are minimal.

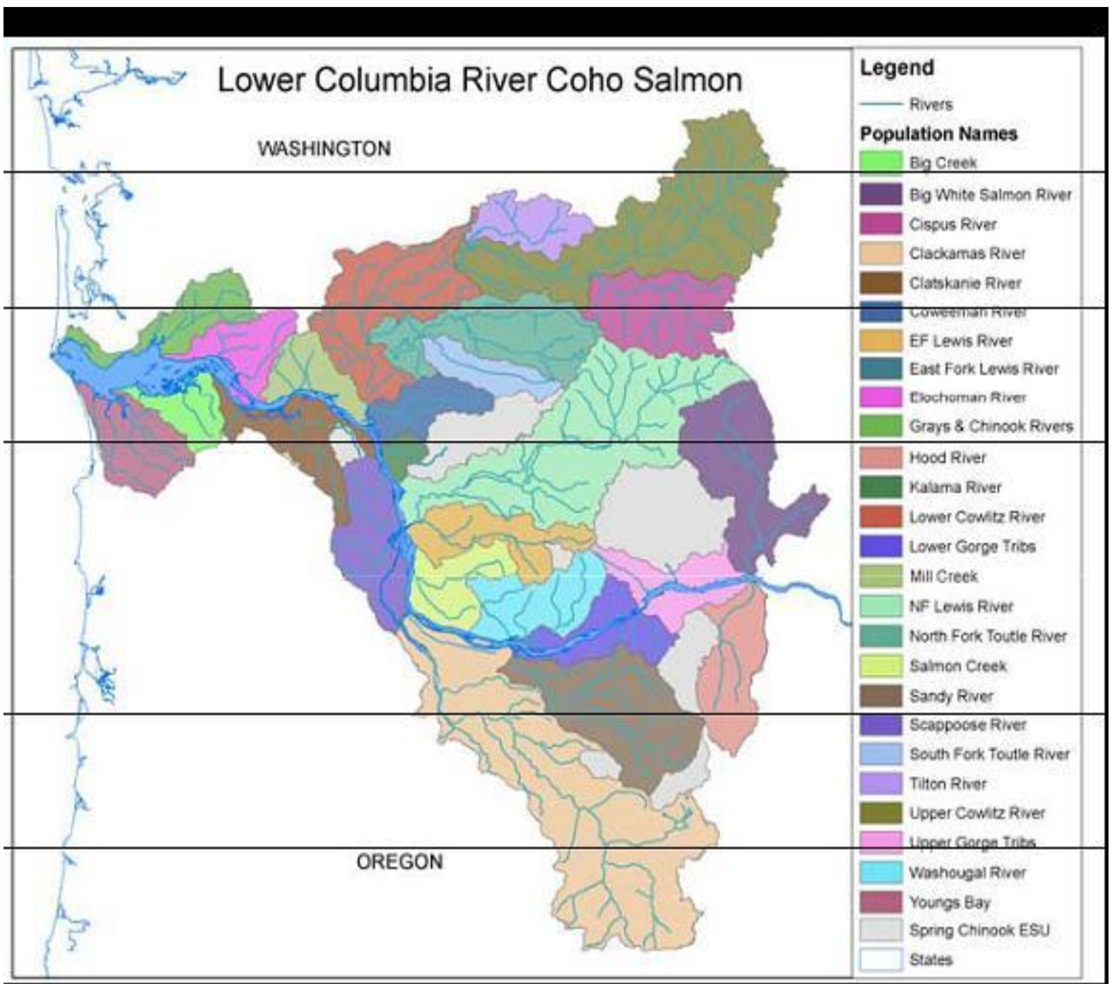


Figure 3-10. Tentative historical populations of the lower Columbia River coho salmon ESU (Myers et al. 2002).

Abundance and Productivity - Coho salmon are native to the White Salmon River (WDF et al. 1993). Currently, the size of this population is unknown. In a 2004 population status evaluation, W/LC TRT members found that there was not enough data to determine the productivity and abundance of the White Salmon River coho population (McElhany et al. 2004, pg. 86). Some members noted that the population was probably extirpated following construction of Condit Dam, as most historical spawning habitat for the population lies above the dam.

Spatial Structure and Diversity - Historical coho distribution extended from the mouth up to RM 14 in the mainstem and into Buck, Spring, Indian, and Rattlesnake creeks (Figure 3-11) (NPCC 2004). This range provided approximately 21 miles of spawning and rearing habitat for coho salmon, with most spawning habitat above Condit Dam. The current distribution is limited to the area below Condit Dam (NPCC 2004, pg. 118).

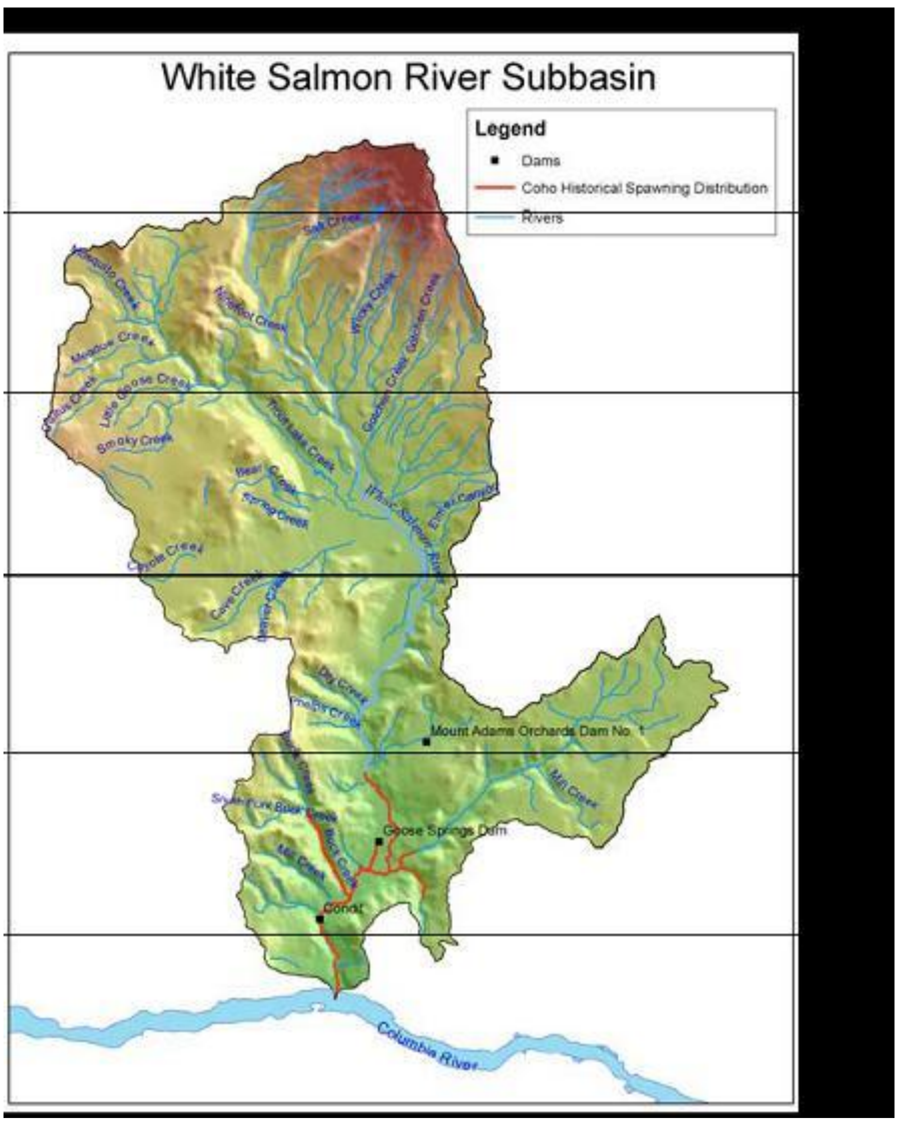


Figure 3-11. Historical spawning distribution of coho salmon in the White Salmon River (McElhany et al. 2004).

Key Habitat during Different Life Stages - Coho adults return to the White Salmon from September through November, and typically spawn from October through January, with peak activity in November. Redds are constructed in gravel and small cobble substrate in pool tailouts, riffles, and glides, with sufficient flow depth for spawning activity. The eggs incubate in the gravel from October to May and generally emerge from February to April, depending on water temperatures. Emerging fry migrate to shallow, low velocity areas associated with stream margins and back eddies. After fry colonization, juvenile coho seek out slow water habitat types near velocity shears, which are often associated with relatively low gradient stream reaches where they continue rearing until October. Preferred areas are primary, backwater, and dammed pools. As winter approaches, juveniles become inactive and prefer off channel pool habitat over primary pool habitat for overwintering. Coho yearling migration occurs the following spring, peaking in May.

F. Current regional management objectives for salmonid resources

1. Little White Salmon watershed

The Little White Salmon River and Drano Lake is managed for hatchery production for fisheries harvest. The historic natural production area for tule fall Chinook and chum salmon is inundated by Bonneville Dam pool.

2. (Big) White Salmon watershed

The natural production area for fall chinook salmon has been impacted by Bonneville Dam pool. Condit Dam has impacted bull trout, steelhead, coho, and extirpated spring Chinook salmon in the Big White Salmon River. With the anticipated removal of Condit Dam, restoration of the watershed is possible. Management planning for this scenario is currently underway and needs further development.

3. Wind River watershed

The Wind River is managed for natural production of indigenous steelhead and hatchery production for harvest of introduced spring Chinook salmon. Bonneville Dam impacted tule fall Chinook and chum salmon in the lower Wind River.

G. Current state, federal, and tribal hatchery programs/facilities in the region

1. *Federal*

a) Carson NFH

The Carson National Fish Hatchery lies in a heavily forested valley within the Gifford Pinchot National Forest at the confluence of Tyee Creek and Wind River. The hatchery, built by the Civilian Conservation Corps, began rearing salmon and trout in 1937. During the 1980s, the hatchery began rearing spring Chinook salmon exclusively. Because of the loss and degradation of spawning habitat and the impact of dams on migration, the spring Chinook was in rapid decline. Since 1960, hatchery production has helped spring Chinook populations recover in the lower Columbia River. Today Carson releases more than 2 million smolts (young salmon) annually. Funding for the Carson National Fish Hatchery is through Mitchell Act funds, which are administered by the National Marine Fisheries Service (NMFS).

b) Spring Creek NFH

Spring Creek National Fish Hatchery was established in 1901, Spring Creek hatchery was one of several egg collection stations for the Bureau of Commercial Fisheries Clackamas hatchery. As the human population of the Columbia Gorge increased, heavy fishing pressure and destruction of habitat resulted in the U.S. government establishing a fish hatchery at this site. The original hatchery was flooded when the Bonneville Dam was completed in 1938. After several modifications, the hatchery was redesigned and rebuilt by the U.S. Army Corps of Engineers in 1972. Expansion was undertaken to partially compensate for the loss of fall chinook spawning grounds due to dam construction along the Columbia River. The hatchery is funded by the U.S. Army Corps of Engineers and the Mitchell Act, which is administered by the National Marine Fisheries Service (NMFS). Today the hatchery raises more than 15 million tule fall chinook salmon annually.

c) Little White Salmon NFH

The Little White Salmon National Fish Hatchery was a pioneer in the fledgling science of salmon propagation when it began rearing salmon in 1896. During the past 100 years, the facilities and the propagation methods have changed dramatically and research is on-going. Today, more than 9.4 million young salmon are released into the river or transferred to other sites for release each year. The Little White Salmon River provides the cold, clean source of river water in which salmon are incubated and raised for 6 to 18 months. The Little White Salmon/Willard National Fish Hatchery Complex is funded almost entirely by the National Marine Fisheries Service through authority of the Mitchell Act. Additional funds are received from the U.S. Fish & Wildlife Service (operations and cyclical maintenance), the U.S. Army Corps of Engineers (off-site feed for fish reared for John Day Mitigation Program), and from the Bonneville Power Administration (operational costs for rearing fish as part of the Umatilla Basin Fisheries Program.) Spring chinook salmon return up the Little White Salmon River in May through August with spawning taking place in mid-July through mid-August.

d) Willard NFH

The Willard National Fish Hatchery is part of the Little White Salmon/Willard National Fish Hatchery complex. The hatchery is located on the Little White Salmon River approximately 4 miles upstream from the Little White Salmon NFH. It was built in 1952 and has been used primarily for raising coho salmon since the mid-1960s. Coho salmon are adapted to the cold water of the Little White Salmon River. Willard NFH is the only Federal hatchery above Bonneville Dam that produces coho salmon. The goal of the hatchery is to provide fish to the commercial, sport, and tribal fisheries.

Coho eggs, taken in October and November from adult salmon returning to the Little White Salmon hatchery downriver, are transported to Willard at the eyed-up stage. They continue their incubation, are moved into indoor tanks and then to outdoor raceways. The young fish are released into the Little White Salmon River in the spring.

The Little White Salmon/Willard National Fish Hatchery Complex is funded almost entirely by the National Marine Fisheries Service through the authority of the Mitchell Act. Additional funds are received from the U.S. Fish & Wildlife Service (operations and cyclical maintenance), the U.S. Army Corps of Engineers (off-site feed for fish reared for the John Day Mitigation Program), and from the Bonneville Power Administration (operational costs for rearing fish as part of the Umatilla Basin Fisheries Program).

2. *State*

a) The Skamania Hatchery

The Skamania Hatchery operated by Washington Department of Fish and Wildlife is located the North Fork Washougal River about 0.5 mile above the Washougal River. The Washougal River is a north bank tributary of the lower Columbia River, just downstream of Washougal, Washington. Skamania Hatchery was authorized under the Mitchell Act and began operating in 1956 as part of the Columbia River Fisheries Development Program. The goal of the hatchery is to produce winter steelhead, summer steelhead, and sea-run cutthroat for harvest by sport anglers.

3. *Tribal*

a) Klickitat Hatchery

Klickitat Hatchery was authorized and constructed under the Mitchell Act and began operation as part of the Columbia River Fisheries Development Program and is operated by Washington Department of Fish and Wildlife. The purpose of the hatchery is to produce adult fall chinook, Type-N coho, and spring chinook that will contribute to NE Pacific and Columbia River Basin commercial and sport fisheries

H. Special considerations in region (e.g., ESA listings, Habitat Conservation Plans, Fishery Management Plans, FERC relicensing, etc.)

- ESA listings – see Section B.
- FERC – See Condit Dam description in Section C 2,3

II. Carson National Fish Hatchery

A. Description of hatchery

Carson NFH was authorized by Special Act 50 Stat. 220, May 28, 1937, and placed into operation in December 1937 to mitigate for the effects of federal water projects, primarily Bonneville Dam. The hatchery was reauthorized by the Mitchell Act (16 USC 755-757; 52 Stat. 345) May 11, 1938 and amended on August 8, 1946, (60 Stat. 932) for conservation of fishery resources in the Columbia River Basin. The hatchery was remodeled in 1956 to establish a hatchery spring Chinook run in the Wind River, and is currently used for adult collection, egg incubation and rearing of spring Chinook. It also provides eggs for re-establishing spring Chinook runs in other Columbia River tributaries, as needed. (CRNFH CHMP, p. 7)

Carson National Fish Hatchery (NFH) is located at river kilometer (rkm) on the Wind River, Skamania County, Washington within the Columbia River basin. The actual position of the hatchery is 45°52’05” Latitude and 121°58’23” Longitude. The hatchery has five buildings involved in fish production, five residences, and a large pond cover. Currently, there are no plans for new buildings; however, the hatchery would like to construct an outreach/visitor center near the main entrance. A description of hatchery buildings, their primary use, and improvements are listed in Attachment 5. (CRNFH CHMP, p. 7)

Attachment 5.C Hatchery Buildings, Primary Use, and Improvements.

Building	Construction type
Nursery Building 4141 sq. ft.	Wood frame, constructed 1937. Used to incubate eggs and fry.
Shop 2118 sq.ft	Wood frame, constructed 1937. Expanded 1994.
Residences Residence-1, 192 ft^2 Residence-2 1,500 ft^2 Residence-3 1,500 ft^2 Duplex-37 2,600 ft^2 Duplex-39 2,600 ft^2	Residences at Carson NFH consist of three wood frame houses constructed circa 1937 and two concrete block three bedroom duplex units constructed in 1955. A third duplex unit was declared excess to hatchery needs and razed in FY 1996.
Service/Administration 3,537 ft^2	Brick/ceramic block, constructed 1955. Includes office space for Project Leader, Assistant Manager and Administrative Assistant plus storage for three vehicles, fish food storage freezer, feed prep room and production crew office.
Oil and Paint Storage	Brick, constructed 1955. Used to store gas powered

Building	Construction type
339 ft^2	equipment, oil, and paint.
Pond Cover 17,170 ft^2	Galvanized steel cover constructed over the middle bank of raceways in 2000 to replace a cover which had collapsed during heavy snow. This structure is made of very heavy steel posts and trusses designed to carry up to 1,000,000 pounds of snow.
Hazardous Material Storage 69 ft^2	Prefabricated 9' x 12' metal hazardous material storage building purchased in 2001 to store formalin.

Attachment 6.C Carson NFH Physical Description of Holding, Incubation, and Rearing Units.

Unit type	Length (ft)	Width (ft)	Depth (ft)	Volume (ft^3)	No.	Material	Age	Condition
Brood pond	146	40	4	23,360	2	concrete	42	fair
Lower earth pond	270	78	3	63,180	1	dirt	42	good
Upper earth pond	170.0	45.0	2.3	17,212	1	dirt	42	good
Raceways	80	8	2	1,280	46	concrete	42	fair[1]
Incubator troughs	20.0	1.5	1.5	45	8	fiberglass	20	good
Vertical stack incubators				7	21	fiberglass	5	good
Starter tanks	15.0	3.5	2.0	105	24	fiberglass	20	good

Currently Carson NFH operates with a staff of seven. This includes the Hatchery Manager, Assistant Hatchery Manager, one Animal Caretaker, two Motor Vehicle Operators, one Maintenance Mechanic, and one Program Assistant. The hatchery also provides partial support to the Columbia River Basin Outreach Office, located at Spring Creek NFH. Volunteers are utilized to assist with outreach activities and station operations when available. (CRNFH CHMP, p. 7)

Proposed annual fish release levels (maximum number) by life stage and location. (HGMP section 1.11.2)

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry		
Fingerling		
Yearling	Wind River, 3rd week of April	1.42 million (Spring Chinook)

Budget Overview

Carson National Fish Hatchery receives 100% of it's operations budget from reimbursable Mitchell Act funds, which are administered by the NOAA Fisheries. Operation budget needs are identified each year and negotiated with NOAA Fisheries to determine the final fiscal year allocation (see following section on Mitchell Act). However, Deferred Maintenance and most construction funding is through the Service. Some funding for special studies can also be derived from reimbursable sources other than Mitchell Act. Current budget and number of full-time personnel for the Carson NFH are provided in Attachment 18. Additional Mitchell Act funding is provided to the CRFPO, LCRFHC, and Abernathy Fish Technology Center for support services to the hatchery. In past years approximately 5% of operational funds did come from the Service. However, those funds are now directed to stations where the Service has the primary funding responsibility. (CRNFH CHMP, p. 55)

B. Hatchery water sources

CNFH holds the certificates of water rights to: 1.) Tyee Creek (1953) at 53 ft3/s for fish propagation year-round (main source for hatchery). 2.) Tyee Springs (1953) at 2 ft3/s for fish propagation and domestic supply (incubation and domestic water supply). 3. Wind River (1950) at 40 ft3/s for fish propagation year-round (secondary supply). (CRNFH CHMP)

In May 1937, the Forest Service granted a long-term special use permit reserving the use of 10 acres for Carson NFH within the Gifford Pinchot National Forest. By 1953, protection was provided to the hatchery water supplies when ~220 acres were withdrawn from all forms of appropriation under the public land laws and reserved for use by the USFWS. This included the hatchery site occupying around 20 acres and the rights-of –way for a 3385 ft and a 2700 ft. pipeline. The balance of the area lies between the pipelines and around the development". Primary jurisdiction of the withdrawn land, with the exception of the 20 acre developed hatchery site, remained with the Forest Service.

The primary water source for the Carson NFH is Tyee Creek located approximately 3/8 mile from the hatchery site and is not accessible to anadromous fish. Tyee Springs is an exceptional water source producing 44 second-feet of 44EF, high quality water. A feral brook trout, *Salvelinus fontinalus*, population is established in Tyee Creek, which supplies the spring-water to the hatchery. During limited periods of the year, water may be drawn from the Wind River to adjust water temperatures for rearing and to supplement Tyee Creek withdrawals. Intake screening for the Wind River withdrawal pipe does not meet current NOAA Fisheries ESA screening standards. However, with the reduced production program at Carson NFH, water withdrawal from the Wind River for hatchery operations are significantly reduced and short-lived when it does occur, which is primarily late in the summer. A temporary screen is utilized when withdrawal from the Wind River is necessary. (CRNFH CHMP, p. 16)

Wind River water flows to the hatchery through a 36" pipeline and then to the adult ponds, the raceways or the upper earthen pond. The route of the water is determined by manipulating valves or dam boards. (CRNFH CHMP, p. 32)

The configuration of the water conveyance is such that it is possible to send second use water to the middle bank and to the adult ponds which is rarely, if ever, done. Water is routinely reused from the upper earthen to the lower earthen pond. Studies are underway to determine if there are any deleterious effect on fish receiving second use water. (CRNFH CHMP, p. 32)

Water withdrawals for hatchery operations are not expected to have a significant negative impact on natural spawning populations. Entry of listed species into the hatchery through the river intake structure has not been observed.

Water Use and Management. Carson NFH holds the following certificates of water right: (CRNFH CHMP, p. 30)

Source	Certificate No.	Date	Flow (ft^3/s)	Use
Tyee Creek	5856	Jan. 12, 1953	53	Fish propagation year-round
Tyee Springs	5854	Jan. 12, 1953	2	Fish propagation and domestic supply
Wind River	7378	Sept. 28, 1950	40	Fish propagation year-round

Incubation and domestic water is provided by Tyee Springs. All water is supplied by gravity flow and all rearing units receive single-pass water with the exception of the lower earthen dirt pond which receives second use water from the upper earthen pond. (CRNFH CHMP, p. 31)

C. Adult broodstock collection facilities

Returning spring Chinook are collected for brood stock at the hatchery rack. Hatchery fish volitionally return to the hatchery using the hatchery's fish ladder, homing into Tyee Creek. There is no barrier dam in the Wind River at the hatchery. This is significant because the Wind River watershed upstream of the hatchery is an important spawning and rearing area for native summer steelhead trout (listed). (CRNFH CHMP, p. 16)

D. Broodstock holding and spawning facilities

There are two adult holding ponds that are 140 feet long, 40 feet wide, and 4 feet deep (CRNFH CHMP, p. 7)

The adult brood stock remain in the west holding pond until removed for spawning. The first spawn date is usually scheduled for mid-August and all spawning is usually completed by the end of the month. The holding ponds are supplied with Tyee Creek water so the temperature remains at 44E to 46E F. The volume of the pond is such that density is not a concern. However, pond loading is managed to meet or exceed one gallon of inflow per fish on the keep side and one-half gallon of inflow per fish on the surplus side. (CRNFH CHMP, p. 33)

The adults are crowded to the lift system on the morning of the spawn day and hoisted in small numbers to the anesthetic vat. Once the fish are anaesthetized, they are sorted for ripeness. Unripe fish are returned to the holding pond and held there until the following week. Ripe fish are killed with a guillotine and bled prior to spawning. (CRNFH CHMP, p. 34)

In most years more fish return to the hatchery than are needed for brood stock. Most of these surplus fish are still in very good condition and are distributed to the Yakama Nation for ceremonial and subsistence use. Fish beyond Yakama tribal needs can be distributed to other tribes, as requested. Fish beyond tribal needs are distributed to federal prison programs. Fish not suitable for food are typically buried. Plans are underway to determine the number, if any, suitable for stream enrichment, both dead and alive. (CRNFH CHMP, p. 53)

E. Incubation facilities

The eggs from each female are individually incubated, utilizing 8 fiberglass troughs, until the eyed stage at which time dead eggs are removed. Viable eggs are counted and moved into vertical stack incubators for hatching and larval development. All incubation takes place in 44^0 F Tyee Springs water. Eggs from females with high levels of Bacterial Kidney Disease are discarded unless needed to meet production goals. The first take of eggs hatches in mid-October. (CRNFH CHMP, p. 35)

Eggs are loaded into vertical tray incubators at a rate of 6,000 eggs per tray. Egg size varies from 1,050 to 1,350 eggs per pound. Formalin treatments (250mg/L for 15 minutes) are performed three times per week. Flow in the incubators is 3 gpm for eyed eggs and 5 gpm for fry. (CRNFH Chinook HGMP, sec. 5.3)

F. Indoor rearing facilities

There are 8 fiberglass troughs – 45 cu ft of rearing space/ea. These tanks are not used for starting newly hatched fry. Instead fry are moved directly to outdoor rearing units. They are used for early incubation to separate mated pairs until levels of Bacterial Kidney Disease is determined.

G. Outdoor rearing facilities

Rearing facilities consist of 46, 8' wide by 180' long outside raceways, 2 earthen ponds, and 1 adult pond.

Fry are moved outside to the covered middle bank of 18 raceways for first feeding in early January. The remaining 28 raceways contain yearling fish at this time. In May, the fry, fingerlings by now, are spread across all 46 raceways. This occurs after the April smolt release and raceways are cleaned. (CRNFH CHMP, p. 35)

The large earthen ponds and the adult holding pond are generally filled in late fall after fall rains have recharged Tyee Springs providing sufficient flow to support these rearing units. Use of the adult pond for rearing juveniles must be delayed until after spawning season. (CRNFH CHMP, p. 36)

H. Release locations and facilities

All fish are reared and released on-station. Smolts are mass released directly into the Wind River at 18 fish/pound or larger to minimize interaction with other fish populations (CRNFH CHMP, p. 38). Carson NFH has also contributed fish to re-introduce spring Chinook salmon into the Umatilla River, and now Walla Walla River, as part of tribal restoration programs.

I. Outmigrant monitoring facilities

Smolts are released around the third week of April to coincide with normal spring migration and spill at Bonneville Dam. It is likely that the fish are functional or near functional smolts at this time as evidenced by their rapid migration to the mouth of the Wind River (smolt trap data) and detection at Bonneville Dam. Detecting PIT tagged fish at Bonneville Dam bypass facilities provide an indication of travel time for releases from Carson NFH. (CRNFH CHMP, p. 38)

Since releases from the hatchery are targeted during Bonneville Dam spill schedules, most PIT tagged fish released from Carson NFH go undetected at Bonneville Dam's fish bypass facilities with most fish utilizing the spillway. (CRNFH CHMP, p. 38)

J. Additional or special facilities

Effluent Treatment and Monitoring.[10] Raceway cleaning effluent is sent to a pollution abatement pond where solids are removed prior to discharge to the Wind River. Cleaning effluent and total discharge (normal operation) effluent are monitored weekly for suspended and settleable solids. Environmental Protection Agency standards have never been exceeded for either cleaning effluent discharge or total discharge since monitoring began in the early 1980s.

The east adult holding pond is used to overwinter spring Chinook smolts. This pond is too large to clean using standard draw down and brushing techniques, nor can effluent from this pond be directed to the pollution abatement pond. So, starting in 2000, a trash pump has been used to periodically vacuum fish waste that typically collect in slack water along the pond sides. A 2-inch

[10] *Section text from CRNFH CHMP, p. 32.*

fire hose is used to direct the pumped fish waste to the drains in the spawning building and then to the pollution abatement pond.

The earthen ponds present another challenge because they cannot be brushed or vacuumed. While a large percentage of fish waste is self digested, there always remains some which escapes when fish are released. Beginning in 2002, a solution of beneficial bacteria has been added to the culture water in hopes of increasing the digestion rate. Preliminary observations suggest that the pond is cleaner after treatment. The hatchery will continue to monitor the effects of beneficial bacteria on accumulated fish waste.

K. Outreach and public education facilities/programs[11]

The Columbia River Gorge Information and Education (I&E) Office services the Carson and Spring Creek National Fish Hatcheries and the Lower Columbia River Fish Health Center. The Office shares/distributes its time and staffing between these stations. The I&E program is mainly funded by the Spring Creek NFH with assistance from the Carson NFH and the Lower Columbia River Fish Health Center.

The goal of the Columbia River Gorge I&E Office outreach program is to increase the visibility of the Fish and Wildlife Service facilities in the Columbia River Gorge and to provide information about Service programs to internal and external audiences. Staff and volunteers show how Service programs benefit the public and the environment in keeping with the Service's mission to conserve, protect, and enhance the Nation's fish and wildlife and their habitats for the continuing benefit of people.

On Station - On station activities include tours of the facility to predominantly local schools. Some special interest groups schedule special tours to better understand hatchery operations. On site educational efforts include an Outdoor Learning Day each May introducing Camas, WA 5th graders to various elements of the hatchery and general stewardship of the outdoors. Columbia River Day Camp is held each August as a joint effort with various agencies introducing Vancouver children to the hatchery and outdoors. Students from both Carson Elementary and Stevenson High School raise spring Chinook salmon in their classrooms and visit the hatchery annually to release their fish and tour the facility. Annual festivals include an Open House each June and an annual Disabled Fishing Day and Kid's Fishing Day each September. Additional information and education assistance is provided at the hatchery on weekends during peak adult fish returns (May - June) to give tours, answer questions, and disseminate general information.

Off station - Outreach efforts include an array of activities that occur throughout the Pacific Region. Examples include various festivals, classroom participation at local schools, stream adoption, participation in other National Fish Hatchery events, and county fairs (Hood River and Skamania counties and the Trout Lake Community Fair).

The hatchery maintains a 5-hole miniature golf course, Migration Golf, which depicts the life cycle of salmon. This very popular activity is requested throughout the year. The Service chooses events which will reach a broad audience. The Service rotates events we attend each year. The Service does not have adequate funding or staffing to attend all events for which the golf course is

[11] *Section text from CRNFH CHMP, p.48-49.*

requested. The golf course is an excellent tool to tell the hatchery and wild salmon story and is a great asset to the Carson NFH.

L. Special issues or problems (e.g. water and property rights issues, law suits, etc.)

Summer Steelhead Propagation - Biologists with WDFW have made inquiries on rearing captive brood summer steelhead should the native population reach dangerously low levels. To address this issue a feasibility report was prepared for the Wind River Restoration Team (Smith 1995). No further actions have transpired (CRNFH CHMP, p. 35)

Brook Trout/Screening Issues - A feral brook trout, Salvelinus fontinalus, population is established in Tyee Creek, which supplies the spring-water to the hatchery. Bacterial kidney disease is present in the brook trout population at very low levels. Attempts to eradicate the trout have been unsuccessful. Periodic monitoring is conducted to determine the level of infection. The presence of the trout, in the water source, has had no noticeable effect on the hatchery fish in recent years. (CRNFH Chinook HGMP, sec. 4.1) Inadequate screening at the hatchery permits brook trout to enter to the facility which has prevented fish transfers into watersheds that currently do not contain brook trout populations. Example is the Wenatchee spring Chinook program that the Little White Salmon Complex supports instead of Carson NFH. In summer of 2007, new water intake screens (profile bars) were installed at the hatchery. A Biological Assessment was completed and it was determined that with new screens and regular monitoring, Carson NFH can transfer juvenile spring Chinook salmon to the tribal salmon restoration program in the Walla Walla River.

Water Use (Drought) - In summer of 2001, a drought year, we anticipated having extremely low and insufficient water supply for raising 1.42 million juveniles to full-term smolts. An interim plan by Service, NOAA Fisheries, WDFW, and YN was to have an emergency release from 10 ponds, distributing 250,000 juveniles in the lower Wind River, if the hatchery water supply dropped to critically low levels during summer. Although this plan was agreed to by the fisheries managers, some conservation groups were highly concerned about this potential action and its impact to listed steelhead and resident cutthroat trout. Fortunately water supply was adequate and an emergency early release was not necessary. (CRNFH CHMP, p.53)

Insufficient operations and maintenance funding through the Mitchell Act - Mitchell Act Funding has been flat for over ten years, and may result in reductions in hatchery production programs, and preclude the Service's mitigation and tribal trust responsibilities. (CRNFH CHMP, p. xvi)

IIA. Carson NFH Spring Chinook

A. General information

The Carson National Fish Hatchery (NFH) was placed in operation in December 1937 with the intent to mitigate for the loss of fall Chinook and coho salmon spawning grounds lost in the lower Wind River from the backwaters of the Bonneville Dam pool. Over the years the Carson NFH production program has included a variety of fish species: rainbow trout, yellowstone cutthroat, brook trout, coho salmon, sockeye salmon and kokanee, spring and fall Chinook. Since 1981 Carson NFH has focused almost exclusively on spring Chinook. Though not native to the Wind River system, spring Chinook adapted well to the Carson NFH environment, and the resulting program has emerged from that success. (CRNFH CHMP, p. 0)

B. Stock/Habitat/Harvest Program Goals and Purpose

1. *Purpose and justification of program*

Carson NFH was authorized by Special Act 50 Stat. 220, May 28, 1937, and placed into operation in December 1937 to mitigate for the effects of federal water projects, primarily Bonneville Dam. The hatchery was reauthorized by the Mitchell Act (16 USC 755-757; 52 Stat. 345) May 11, 1938 and amended on August 8, 1946, (60 Stat. 932) for conservation of fishery resources in the Columbia River Basin. The hatchery was remodeled in 1956 to establish a hatchery spring Chinook run in the Wind River, and is currently used for adult collection, egg incubation and rearing of spring Chinook. It also provides eggs for re-establishing spring Chinook runs in other Columbia River tributaries, as needed. CRNFH CHMP, p.7)

In addition to the initial authorizations listed above, hatchery operations are authorized, sanctioned and influenced by the following treaties, judicial decisions and specific legislation:

- Treaty with the Walla Walla, Cayuse, Umatilla Tribes, 06/09/1855;
- Treaty with the Yakama, 06/09/1855;
- Treaty with the Nez Perce, 06/11/1855;
- Treaty with the Tribes of Middle Oregon, 06/25/1855;
- Mitchell Act, 52 STAT. 345, 05/11/1938;
- Mitchell Act (Amended), 60 STAT. 932, 08/08/1946;
- U.S. v. Oregon (Sohappy v. Smith, Belloni decision:, Case 899), 07/08/1969;
- Endangered Species Act of 1973, 87 STAT. 884, 12/28/1973;

- Salmon and Steelhead Conservation and Enhancement Act, 94 STAT. 3299, 12/22/1980; and Pacific Salmon Treaty Act of 1985 (U.S./Canada Pacific Salmon Treaty), Public law 99-5, 16 U.S.C. 363, 03/15/1985. (CRNFH CHMP, p.12)

2. Goals of program

Carson NFH's spring Chinook salmon program was initiated in 1955. Carson NFH operates as part of the Columbia River Fisheries Development Program under U.S. v. Oregon and is funded through the Mitchell Act- a program to provide for the conservation of Columbia River fishery resources. The purpose of the hatchery is to successfully rear and release 1,420,000 spring Chinook salmon smolts for release on-station. Those releases are to help mitigate for fish losses in the Columbia River Basin caused by main stem hydropower project construction and operation and other basin development. Fish releases contribute to important terminal area tribal ceremonial and subsistence fisheries and non-tribal sport fisheries while providing for adequate escapement for hatchery production. Hatchery operations strive to meet mitigation requirements of the Mitchell Act and the Columbia River Fish Management Plan (U.S. v. Oregon). (CRNFH Chinook HGMP, sec. 1.7)

The following Hatchery Management Goals were adapted from the Mitchell Act, Endangered Species Act (ESA) Biological Opinions, U.S. v. Oregon agreements, and the Integrated Hatchery Operations Team - Operation Plans for Anadromous Fish Production Facilities in the Columbia River Basin Volume III - Washington, Annual Report for 1995 (IHOT 1996): (CRNFH CHMP, p. 25 – 30)

Goal 1: Conserve Columbia River spring Chinook salmon in the area upstream of Bonneville Dam (as defined in the Mitchell Act of 1937).

Objective 1: Successfully maintain a brood stock of spring Chinook salmon at Carson NFH without the need for out-of-basin egg or fish transfers to the hatchery (achieve a minimum 0.1% smolt to adult return back to the hatchery)

Objective 2: Conduct monitoring and evaluation to ensure goal #1 is achieved.

Goal 2: Assure that hatchery operations support Columbia River Fish Management Plan (U.S. v Oregon) production and harvest objectives.

Objective 1: Collect sufficient brood stock to produce 1.42 million smolts for on-station release into the Wind River.

Objective 2: Contribute to a meaningful harvest for sport, tribal and commercial fisheries from March through July of each year in the Columbia and Wind Rivers (achieve a 10-year average of 0.5% smolt to adult survival, harvest plus escapement).

Objective 3: Meet tribal trust responsibilities.

Objective 4: Communicate and coordinate effectively with co-managers in the Columbia River Basin.

Objective 5: Conduct monitoring and evaluation to ensure goal #2 is achieved.

Goal 3: Minimize impacts to listed (ESA) and other native species, their habitat, and the environment.

Objective 1: Minimize interactions with other fish populations by implementing state-of-the-art fish culture technology.

Objective 2: Conduct monitoring and evaluation to ensure goal #3 is achieved.

Goal 4: Develop outreach to enhance public understanding, participation and support of Service and Carson NFH programs.

Objective 1: Increase visibility of Carson NFH.

Objective 2: Provide information and education about the Service programs and Carson NFH to internal and external audiences, news releases and articles regarding agency issues and station activities.

Objective 3: Develop forums for public participation (or input) into Carson NFH issues.

Objective 4: Conduct monitoring and evaluation to ensure goal #4 is achieved.

3. *Objectives of program*

The following performance measures have been established at the hatchery: (CRNFH CHMP, p. 32)

Performance Measure	Hatchery Goal	5-Year Average	Range
Spawning Population[1]	1,000	980	894 - 1,131
Fish release (millions)[2]	1.42	1.32	0.91 - 2.2
Egg transfers (thousands)[2]	0	3	0 - 9
Fish transfers (thousands)[2]	0	183	0 - 419
Adults passed upstream[3]	--		
Percent survival juvenile to adult [4]	0.20	0.34	0.05 - 0.97
Smolt size at release (fish/lb)[2]	18	17.90	13 - 24

4. *Type of program (Integrated or Segregated)*

Segregated, Isolated Harvest; Mitigation (CRNFH Chinook HGMP, sec. 1.6)

5. *Alignment of program with ESU-wide plans*[12]

- Species and population (or stock) under propagation at Carson NFH, and ESA status: Spring Chinook Salmon (Oncorhynchus tshawytscha). This population (Carson stock) is not listed under the Endangered Species Act.

- The hatchery has authorization under the NMFS Biological Opinion on Artificial Propagation in the Columbia River Basin 1999. On-going Section 7 consultation is on-going with the development of draft Hatchery and Genetic Management Plans. USFWS (U.S. Fish and Wildlife Service). 2004. Hatchery and Genetic Management Plan, spring Chinook salmon, Carson NFH, May 2004. Columbia River Fisheries Program Office, Vancouver, Washington.

- Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grand, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-35, 443 p.

- NWPCC (Northwest Power and Conservation Council). 2004. Wind River subbasin plan, Portland, OR.

6. *Habitat description and status where fish are released.*

Stream surveys, sub-basin assessments, and watershed analyses were used to evaluate factors limiting fish production in the Wind River. All watershed assessments indicate that fish production in the Wind River is primarily limited by habitat and water quality. Past riparian timber harvest, stream clean-outs, road building, and regeneration harvest within the rain on snow zone all have contributed to a decline in fish production. Alluvial reaches within the mainstem Wind River and tributaries, which contain the majority of steelhead spawning habitat, have been significantly impacted. Many of these reaches were initially disturbed over eighty years ago, yet habitat and water quality have not recovered and in some cases are getting worse. Habitat problems noted in the subbasin plan are mainly related to timber harvesting practices. Throughout the subbasin there continues to be a need to restore riparian vegetation to reduce water temperatures and peak flows, reduce sediment delivery to streams, and ensure continuous recruitment of large woody debris into the system. (CRNFH CHMP, p. 11)

Watershed/Ecosystem Setting[13]

General Description. The Wind River Subbasin, located in southwestern Washington, originates in McClellan Meadows in the western Cascades on the Gifford Pinchot National Forest (Wind River Ranger District) and enters the Columbia River's Bonneville Reservoir at River Mile (RM) 155 near Carson, Washington (Map-Attachment 4). Wind River, a fifth order stream, drains approximately 225 mi^2 of Skamania County over a distance of approximately 31 miles. Principle tributaries to Wind River include Little Wind River, Bear, Panther, Trout,

[12] *Refer to "I. Columbia River Gorge" section "D. ESUs identified by NMFS and Current ESA status" for list of ESUs.*

[13] *Adapted from the Draft Wind River Subbasin Summary, November 15, 2000, prepared for the Northwest Power Planning Council (WDFW 2000).*

Trapper, Dry, Nineteenmile, Falls and Paradise creeks. The largest tributary, Panther Creek, enters at RM 4.3 and drains 18% of the Wind River subbasin (26,466 acres). Trout Creek, which drains 15% of the subbasin (21,732 acres), enters at RM 10.8.

Topography varies within the watershed; it is steep in the northwest and lower southeast, gentle in the northeast-McClellan Meadows area, and it is benchy in Trout Creek Flats and middle portions of the Wind River Valley. The mainstem of the Wind River drops 3,820 ft in 30.5 miles for an average gradient of 2.3%. Shipherd Falls, located at RM 2, is a series of four falls ranging from 8 to 12 ft that were a barrier to all anadromous salmonids except steelhead until the construction of a fish ladder in 1956. (CRNFH CHMP, p. 8)

7. Size of program and production goals (No. of spawners and smolt release goals)

- Carson NFH sets a goal of 1,000 adults to be spawned so 1,400 adults are retained (CRNFH Chinook HGMP, sec. 1.11.1)

  (CRNFH Chinook HGMP, sec. 1.11.2)

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry		
Fingerling		
Yearling	Wind River, 3rd week of April	1.42 million

C. Description of program and operations

1. Broodstock goal and source

The fish ladder around Shipherd Falls is located approximately two miles from the mouth of the Wind River and was completed in 1955 as part of the Columbia River Fishery Development Program (Mitchell Act). Coincident to the construction of the fish ladder, was an extensive expansion of the hatchery. The goal of the expansion was to produce spring Chinook, fall Chinook, coho, blue-back (sockeye) salmon, and steelhead to artificially enhance natural production of the Wind River Basin. No more than half the fish of any run were to be artificially spawned with the exception of the blue-back (Lower Columbia Fisheries Development Program, Wind River Area, 1951). Although the expansion was completed, no serious attempts to raise any fish other than spring Chinook materialized. A long-range cooperative federal/state program was implemented to trap upriver spring Chinook adults at Bonneville Dam and transport them to Carson NFH for stock development. (CRNFH Chinook HGMP, sec. 6.2)

From 1955 through 1964 approximately 500 spring Chinook salmon were trapped annually at Bonneville Dam on the Washington side of Columbia River and transported to the holding ponds at Carson National Fish Hatchery. Genetic data indicate that the Carson stock was derived from a mixture of upper Columbia and Snake River populations passing Bonneville Dam (Campton 2000 Draft). The adult fish were held and spawned, with their progeny reared and released at Carson. Although small numbers of spring Chinook were counted past the newly constructed Shipherd Falls fishway on Wind River in 1956,1957, and 1958, the first returns to Carson NFH did not occur until 1959 when 107 fish entered the hatchery (99 jacks, 2 adult females and 6 adult males). This run of spring Chinook has been maintained since then and continues to flourish. Annual returns to Carson NFH have averaged 3,797 since 1980 with over 10,000 returning in 1990, 2000 and 2001. (CRNFH Chinook HGMP, sec. 6.2)

Other Acceptable Stocks. If brood stock numbers are insufficient to meet hatchery production objectives, the hatchery will rear fewer fish. Carson stock from Little White NFH or Leavenworth NFH Complex would be acceptable for use at this facility. (CRNFH Chinook HGMP, sec. 1.16.1)

Stock Transfers to Other Watersheds. Carson origin spring Chinook eggs, fry, and fingerlings have been transferred to a wide range of localities including Alaska (over 2 million eggs in the early 1970's), Oregon (22.9 million eggs from 1957 to 1993), Idaho (15.9 million eggs from 1960 to 1980), and several hatcheries in Washington (29.7 million eggs from 1957 to1991). The strain has prospered at many locations, for example Leavenworth and Little White Salmon NFHs, Washington and Umatilla River, Oregon (CRNFH Chinook HGMP). Future plans for using Carson stock in another watershed are the responsibility of the agency proposing the transfer. For example, the Service has been requested to provide 250,000 spring Chinook salmon smolts to the Walla Walla River as part of Confederated Tribes of the Umatilla Indian Reservation program.

Past performance and Survival of spring Chinook salmon hatchery releases into the Umatilla River, Oregon. a/

Hatchery	Brood year	Code-wire tag # released	Hatchery/ Trap Recovery		Harvest Recovery	Spawning Ground b/	Total Estimated CWT Recovery	% Survival
Carson NFH	1996	18721	17		10	24	51	0.27
Carson NFH	1997	19593	21		33	22	76	0.39
Little White Salmon NFH	1997	35700	13	c/	59	7	79	0.22
Carson NFH	1998	19444	17		79	33	129	0.66
Carson NFH	1999	18398	2		26	8	36	0.20
Willard NFH	2000	39968	12		20	4	36	0.09
Distribution			82		227	98	407	

Percent Distribution	20%	56%	24%

a/ data from Regional Mark Information System 04/16/2007, Steve Pastor and Doug Olson USFWS
b/ Umatilla River was the only reported spawning ground recovery location
c/ One trap recovery reported by IDFG as "Powell Rack"

2. *Adult collection procedures and holding*

- Adult spawners returning to Carson NFH volitionally enter the holding ponds and are held until ripe.
- Adult spring Chinook enter the hatchery holding pond from May to August. Spawning occurs in August and early September. Fish are collected from throughout the spectrum of the run.
- Voluntary hatchery returns are used in the spawning process. If any "natural" spring Chinook voluntarily enter the hatchery, they are incorporated into the brood stock. However, because spring Chinook are not native to the Wind River, these fish also would be of Carson stock origin.

3. *Adult spawning*

a) Spawning protocols

Current program needs for Carson NFH is 500 females and 500 males at time of spawning. The 1,400 adult escapement goal is to allow for the expected male to female ratio of 45% to 55%, respectively, to maintain the 1:1 spawning criteria, and to allow for the culling of eggs from high titer BKD infected fish. The escapement goal includes any pre-spawning mortalities that may occur during the extended holding period of adults at the hatchery. (CRNFH Chinook HGMP, sec. 7.4)

b) No. of males and females spawned each year over past 10 years

Table 7.4.2. Numbers of fish spawned at Carson NFH, 1980-2001 (Carson CHMP, CRiS database).

Year	Female	Male	Jacks	Total
1980	1,920	1,448	32	3,400
1981	1,425	1,123	3	2,551
1982	1,027	629	20	1,676
1983	1,515	959	4	2,478
1984	1,068	719	45	1,832
1985	2,324	1,433	62	3,819
1986	1,687	1,056	67	2,810
1987	1,714	1,247	4	2,965
1988	1,161	727	56	1,944
1989	1,098	861	162	2,121
1990	1,059	794	34	1,887
1991	1,661	1,144	40	2,845
1992	1,362	1,043	17	2,422
1993	1,657	1,125	2	2,784
1994	474	365	0	839
1995	233	225	81	539
1996	933	691	22	1,646
1997	630	501	3	1,134
1998	503	391	12	906
1999	511	426	85	1,022
2000	525	505	162	1,192
2001	525	381	205	1,111
Mean	1,137	809	51	1,997

Fish are sorted and ripe females spawned until 100% of the fish have been checked. Green females are passed back to the holding ponds with an adequate number of males to assure a 1:1 mating ratio. The eggs collected during a given sort are considered an egg “take”. Male spawners are randomly selected during the sort. Jack males are used in proportions representative of their return rate. In years of high jack returns, a larger proportion of jacks are used as spawners, up to a five percent maximum. The number of jacks to be spawned on a given day is subjectively defined by hatchery staff and is determined by jack availability and ripeness. After all of the adult fish being held have been sorted and ripe females spawned, a maximum one-week period is allowed to pass before the fish are re-sorted and newly ripened females spawned. The objective is to achieve maximum fertilization by spawning fish soon after ovulation and yet avoid the needless handling of green females. The re-sorting process continues until all fish are spawned. (CRNFH Chinook HGMP, sec. 8.1)

If the hatchery escapement goal is met, then a 1:1 spawning ratio will be achieved. This is one of the highest brood stock program goals at the hatchery. During low escapement years, males are re-used on an as-needed basis to achieve production goals. This practice was thoroughly discussed with the U.S. Fish & Wildlife Service hatchery geneticist to assure that the uncommon practice of reusing male fish did not compromise the genetic diversity of the hatchery stocks. It was determined that, in all instances, a minimum escapement need had been met to maintain genetic diversity, although some male fish had to be reused to achieve production goals. (CRNFH Chinook HGMP, sec. 8.2)

4. *Fertilization*

a) Protocols

Adults are crowded from holding ponds and anesthetized using Electro-anesthesia. Anesthetized adults are then sexed and checked for ripeness. Ripe adults are killed with a guillotine. Females are allow to bleed for approximately 3-5 minutes. Eggs are then removed using a Wyoming knife and collected in iodophor-disinfected stainless steel colanders to drain ovarian fluid. The eggs are then transferred to iodophor-disinfected plastic buckets and sperm is added directly to the eggs. A 1:1 random spawning ratio is maintained and male jacks are used proportionally to their percentage of the run. The fertilized eggs are stirred and allowed to rest for a minimum of thirty seconds, then washed and water hardened for one half hour in a 75 mg/L iodophor solution. The eggs are then transferred to plastic colanders placed in a trough filled with water, inside the hatchery. The eggs are incubated using single pass spring water, until the eggs eye-up. Once the eggs are eyed-up they are transferred to and held in individual Heath incubator trays until hatching occurs. Aseptic procedures are followed to assure equipment is disinfected throughout the egg handling process.

All spawned adult spring Chinook are assigned an individual identification number to assist in sampling and identification of egg lots. Enzyme linked immunosorbent assay (ELISA) sampling is performed on all spawned adults to assist with the culling or segregation of progeny having a high likelihood of contracting bacterial kidney disease. All eggs from females with medium high or high titer of *Renibacterium salmoninarum* (causative agent of bacterial kidney disease) are culled. Additional fish health samples are collected to determine the incidence of other pathogens. (CRNFH Chinook HGMP, sec. 8.3)

b) Number of eggs collected and fertilized each year over past 10 years

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding. (CRNFH Chinook HGMP)

Brood Year	Eggs Taken	Eye-up (% survival egg to eye-up)	Ponded (% survival egg to ponding)	*Release (% survival pond to release)
1990	4,184,600	87%	82%	89%
1991	7,279,350	91%	84%	83%
1992	5,758,800	97%	94%	77%
1993	7,637,990	94%	89%	80%
1994**	2,021,225	92%	92%	93%
1995	1,074,835	96%	96%	88%
1996	3,998,050	96%	92%	79%
1997	2,924,828	95%	89%	100%
1998	2,302,287	93%	92%	75%
1999	2,194,698	91%	89%	94%
2000	2,216,032	87%	86%	96%
2001	2,224,100	90%	87%	
Mean	3,651,400	92%	89%	87%

* Number is an actual count, other numbers are estimated.
** Includes 320,000 fingerlings released from 1993 brood year.

Data for table 9.1.1 provided by CRiS database.

5. *Incubation*

- Eggs are loaded into vertical tray incubators at a rate of 6,000 eggs per tray. Egg size varies from 1,050 to 1,350 eggs per pound. Flow in the incubators is 3 gpm for eyed eggs and 5 gpm for fry. (CRNFH Chinook HGMP, sec. 9.13)

- During incubation, the water is 45-47 °F and is saturated with oxygen. Formalin treatments (250mg/L for 15 minutes) are performed three times per week. (CRNFH Chinook HGMP, sec. 9.14)

6. *Ponding*

a) Protocols

- Fry are ponded into 18, 8' wide by 180' long outside raceways before button-up or approximately 1650 temperature units (TUs). (CRNFH Chinook HGMP, sec. 9.1.5)

b) Number of fry ponded each year, including % hatch each year

- See section 4 Fertilization Table 9.1.1

7. *Rearing/feeding protocols*

- A maximum density index is 0.25. Fish growth is sampled monthly and extrapolated to the following month to ensure this level is not exceeded. (CRNFH Chinook HGMP, sec. 9.2.2)

- Fry are placed in raceways divided in half until the density index gets close to 0.25 when the center screens are removed to lower densities. Feeding frequency ranges from 1 to 8 per day and percent body weight fed ranges from 0.6-2-%depending upon fish size and time of year. Flow is 380 gpm and oxygen levels are at saturation level during inflow and outflow is never lower than 6 ppm. The lower earthen pond is the only rearing unit that gets second pass water from the upper earthen pond. When both ponds are in use, minimum flow is 4,000 gpm but typically 4,500-5,000 gpm is maintained. (CRNFH Chinook HGMP, sec. 9.2.3)

8. *Fish growth profiles*

Table 9.2.4. Fish growth data from Carson NFH.

Date (month-year)	Length (inches)	Number per Pound	Condition Factor (C)	Monthly Conversion	Density Index	Flow Index
January-00	1.475	1038	0.0003	0.70	0.08	0.29
February-00	1.867	512	0.0003	0.86	0.13	0.46
March-00	2.343	259	0.0003	0.64	0.20	0.48
April-00	2.834	146	0.0003	0.58	0.15	0.60
May-00	3.190	103	0.0003	1.20	0.06	0.29
June-00	3.528	76	0.0003	1.39	0.07	0.35
July-00	3.877	57	0.0003	0.86	0.09	0.42
August-00	4.483	37	0.0003	0.68	0.12	0.65
September-00	4.717	32	0.0003	1.45	0.13	0.69
October-00	4.862	29	0.0003	1.66	0.14	0.74
November-00	4.951	27	0.0003	1.56	0.08	0.50
December-00	5.042	26	0.0003	1.47	0.08	0.54
January-01	5.227	23	0.0003	1.30	0.09	0.58
February-01	5.471	20	0.0003	0.93	0.09	0.64
March-01	5.766	17	0.0003	0.97	0.11	0.71
April-01	5.976	16	0.0003	0.78	0.11	0.76

9. *Fish health protocols and issues*

- The Lower Columbia River Fish Health Center (FHC) in Underwood, WA provides fish health care for Carson NFH under the auspices of the published policy 713 FW in the Fish and Wildlife Service Manual (FWM). In addition to this policy, the 1994 annual report

"Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries", by the Integrated Hatchery Operations Team (IHOT 1995) provide further fish health guidelines as approved by northwestern state, federal, and tribal entities. The directives of these two documents meet the requirements of Washington's state and tribal fish health entities and are consistent with the directives in the Co-Managers' Salmonid Disease Control Policy of 1998.

- Monthly examination: A pathologist from the FHC visits once per month to examine fish at the hatchery. From each stock and broodyear of juveniles, fish are randomly sampled to ascertain general health. Based on pathological signs, age of fish, concerns of hatchery personnel, and the history of the facility, the examining pathologist determines the appropriate tests. This usually includes a necropsy with an external and internal exam of skin, gills, and internal organs. Kidneys (and other tissues, if necessary) will be checked for the common bacterial pathogens by culture and by a specific test for bacterial kidney disease (BKD). Blood is checked for signs of anemia or other infections, including viral anemia. Additional tests for virus or parasites are done if warranted. The pathologist will also examine fish that are moribund or freshly dead to ascertain potential disease problems in the stocks.

- Diagnostic Examination: This is done on an as-needed basis as determined by the pathologist or requested by hatchery personnel. Moribund, freshly dead, or fish with unusual signs or behavior are examined for disease using necropsy and appropriate diagnostic tests. A pathologist will normally check symptomatic fish during a monthly examination.

- Ponding Examination: The first health exam of newly hatched fish occurs when approximately 50% of the animals are beyond the yolk sac stage and begin feeding. Sixty fish will be sampled and tested for virus.

- Pre-release Examination: At two to four weeks prior to a release or transfer from the hatchery, 60 fish from the stock of concern are necropsied and tissues taken for testing of listed pathogens. The listed pathogens, defined in Service policy 713 FW (Fish and Wildlife Service Manual) include infectious hematopoietic necrosis virus (IHNV), infectious pancreatic necrosis virus (IPNV), viral hemorrhagic septicemia virus (VHSV), *Renibacterium salmoninarum, Aeromonas salmonicida, Yersinia ruckeri*, and *Myxobolus cerebralis*.

- Adult Certification Examination: At spawning, tissues from adult fish are collected to ascertain viral, bacterial, and parasite infections and to provide a brood health profile for the progeny. The FHC tests for all of the listed pathogens, except *Myxobolus cerebralis*, and including *Ceratomyxa shasta*. The minimum number of samples collected is defined by 713 FW. At Carson NFH, all brood females are tested for *R. salmoninarum* (causative agent of BKD), with an identifying fish health number corresponding to each female's eggs so that selective culling and/or segregation is possible. This is done to reduce/control BKD, a vertically transmitted disease. Progeny from females with high levels of BKD are culled (if not needed to make production goals) or segregated from progeny at lower risk. The FHC provides results from testing within four weeks to allow management decisions.

- Escapement and natural spawning of Carson NFH spring Chinook raises concerns regarding disease transmission to hatchery and wild fish. Through 1996, when the Wind River supply was regularly used to supplement Tyee Springs water, disease outbreaks (BKD, IHN and furunculosis) occurred in the hatchery juveniles in varying magnitudes. By combining a reduction in fish production to 1.42 million along with no or limited use of this water supply, disease problems in the juvenile were essentially eliminated (Lower Columbia River Fish Health Center records). So far, no disease issues have been detected in the wild steelhead and naturalized Chinook salmon juveniles residing in the Wind River as based on sampling from 1997 to 2007 (National Wild Fish Health Survey database). However, Carson NFH spring Chinook adults have an IHNV incidence of up to 88% and steelhead fry are very susceptible to this virus. Although no virus has been detected, sampling has been minimal during the most susceptible life stage. Timely seining and removal of the adult salmon from the Wind River would eliminate potential disease risks to the wild fish and to the hatchery juveniles should this water source be needed for rearing.

10. Chemotherapeutant use

- Erythromycin injections for brood stock are critical to the control of bacterial kidney disease that is caused by a vertically transmitted bacterium (*Renibacterium salmoninarum*) that can reside in the ovarian and seminal fluids. In addition, erythromycin injections control the mortality and reduce horizontal transmission of BKD between adults in the brood pond. The injection schedule is set to maximize the number of adults injected, with a goal of two injections for the early arriving adults and one injection for the later arrivals. To reduce bacterial numbers in the reproductive fluids and to deposit the drug inside the ova, erythromycin must be injected at a dosage of 20 mg drug/kg of fish at 30 days prior to spawning. At Carson NFH, the first injection is scheduled on about June 12th and the second injection on about July 12th. Except for fish arriving too close to the time of spawning for safe handling and injection, all spring Chinook salmon adults kept for broodstock are injected. The injected drug is Erythro-200 or Erythro-100 (200 mg/ml or 100 mg/ml, respectively, of active erythromycin base in PEG, ethly acetate and ethyl alcohol), to be injected in the dorsal sinus at 20 mg drug/kg of body weight.

- Since 1998 (brood year 97 juveniles), prophylactic medicated feedings to control BKD in juveniles has been deemed unnecessary. The reduced levels of BKD in the juveniles is attributed to lowered densities ($\leq$ 0.25 density index and < 1.0 flow index) during rearing, regular cleaning and maintenance of individual equipment (nets, etc.) for each pond, erythromycin injection of the adults, culling/segregation of progeny from highly infected females, and the use of Tyee Springs water for rearing. Should prophylactic feeding be necessary, as determined by the FHC, juveniles are to be fed at a daily dosage of 100 mg/kg of fish for a minimum of 21 days unless contraindicated by drug toxicity or needed feeding rate adjustments. The time and number of treatments will be dictated by circumstances. As of 2001, there is a temporary INAD 4333 that allows feeding of Aquamycin 100 (erythromycin thiocyanate in a wheat flour base) and prescription by a veterinarian is not required.

- Formalin treatment of adults held for brood stock is used to control external pathogens three times per week prior to spawning.

- Salmonid egg hardening and disinfection treatment with a polyvinylpyrrolidone iodine compound (approximately 1% iodine) is required by 713 FW policy to minimize/prevent transmittance of viral and bacterial pathogens. The eggs shall be disinfected in 50 ppm iodine in water buffered by sodium bicarbonate (at 0.01%) for 30 minutes during the water-hardening process. Eggs received at the hatchery must be disinfected before they are allowed to come in contact with the station's water, rearing units or equipment.

11. Tagging and marking of juveniles

- All fish are adipose clipped prior to release to identify them as hatchery fish upon return. Annually, 75,000 fish are coded-wire tagged as an index group, and is part of the ongoing stock assessment evaluation of Carson NFH. A portion of the release is PIT tagged as part of a comparative survival study to address main stem Columbia River passage issues. (CRNFH Chinook HGMP, sec. 10.7)

12. Fish Release

a) Protocols

Smolts are mass released directly into the Wind River at 18 fish/pound or larger to minimize interaction with other fish populations. Releasing fish at 18 fish/pound or larger helps ensure that the released fish are functional smolts which actively migrate through the Wind River corridor, reducing competition with listed steelhead. Rearing the smolts almost exclusively on Tyee Springs water minimizes straying of adults, further reducing competition with native steelhead.

Smolts are released around the third week of April to coincide with normal spring migration and spill at Bonneville Dam. It is likely that the fish are functional or near functional smolts at this time as evidenced by their rapid migration to the mouth of the Wind River (smolt trap data) and detection at Bonneville Dam. Detecting PIT tagged fish at Bonneville Dam bypass facilities provide an indication of travel time for releases from Carson NFH. For example, in 1999 the average travel time to Bonneville Dam for a release date of April 29, 1999 from Carson NFH was 10.2 days (n=1,800 detected). The quickest time was less than 24 hours (0.8 days) and the slowest was 94.3 days (Columbia River Fisheries Program Office, Vancouver, WA unpublished data). Since releases from the hatchery are targeted during Bonneville Dam spill schedules, most PIT tagged fish released from Carson NFH go undetected at Bonneville Dam=s fish bypass facilities with most fish utilizing the spillway. (CRNFH CHMP 2002)

b) Number of fish released each year (subyearlings?; yearlings?; other?)

Release dates, stage, number of fish, and number per pound of Carson National Fish Hatchery spring Chinook salmon, 1990-2007 (USFWS CRiS Database).

Carson NFH Spring Chinook releases
in Wind River, 1990 - 2007.

Release Date	Brood Year	Number	Size #/lb.	Stage
04/12/1990	88	1,052,641	19.00	yearling
04/13/1990	88	1,052,640	19.00	yearling
04/15/1991	89	2,336,788	18.00	yearling
04/15/1992	90	2,315,382	18.00	yearling
04/14/1993	91	2,321,285	20.00	yearling
04/14/1994	92	2,040,568	19.00	yearling
06/08/1994	93	320,000	98.00	fingerling
04/10/1995	93	127,113	19.00	yearling
04/13/1995	93	666,073	18.00	yearling
04/14/1995	93	1,402,006	18.00	yearling
02/08/1996	94	600,000	24.00	yearling
04/08/1996	94	44,034	18.00	yearling
04/18/1996	94	1,046,363	18.00	yearling
04/19/1996	94	32,224	18.00	yearling
04/17/1997	95	907,708	16.00	yearling
04/20/1998	96	1,734,188	17.00	yearling
04/20/1999	97	1,415,744	13.00	yearling
04/20/2000	98	1,430,022	16.00	yearling
04/19/2001	99	1,608,684	15.00	yearling
04/17/2002	00	1,449,361	16.00	yearling
04/16/2003	01	1,673,255	17.00	yearling
04/16/2004	02	1,417,986	17.00	yearling
04/15/2005	03	1,470,134	14.00	yearling
04/10/2006	04	1,209,384	17.00	yearling
04/12/2007	05	1,158,425	17.00	yearling

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Smolts are released around the third week of April to coincide with normal spring migration and spill at Bonneville Dam. It is likely that the fish are functional or near functional smolts at this time as evidenced by their rapid migration to the mouth of the Wind River (smolt trap data) and detection at Bonneville Dam. Detecting PIT tagged fish at Bonneville Dam bypass facilities provide an indication of travel time for releases from Carson NFH. For example, in 1999 the average travel time to Bonneville Dam for a release date of April 29, 1999 from Carson NFH was 10.2 days (n=1,800 detected). The quickest time was less than 24 hours (0.8 days) and the slowest was 94.3 days (Columbia River Fisheries Program Office, Vancouver, WA unpublished data). Since releases from the hatchery are targeted during Bonneville Dam spill schedules, most PIT tagged fish released from Carson NFH go undetected at Bonneville Dam's fish bypass facilities with most fish utilizing the spillway. (CRNFH CHMP, p.38)

D. Program benefits and performance

1.10) List of program "Performance Indicators", designated by "benefits" and "risks." (CRNFH Chinook HGMP, sec. 1.10)

	Benefits	
Performance Standard	**Performance Indicator**	**Monitoring and Evaluation**
Program contributes to mitigation for construction of dams as defined in the Mitchell Act of 1937.	Spawn 1,000 spring Chinook salmon to produce 1.42 million smolts for release. Produce a run returning to the hatchery and for harvest.	Monitor adult return and contribution to fisheries and perform best rearing strategies to meet spawning and production goals.
Successfully maintain a broodstock of spring Chinook salmon at Carson NFH without the need for out of basin egg or fish transfers to the hatchery.	Achieve a minimum 0.1% smolt-to-adult return back to the hatchery.	Smolt-to-adult survival rates are monitored for each brood-year release.
Assure that hatchery operations support Columbia River Fish Management Plan (U.S. v Oregon) production and harvest objectives.	Collect between 1,000 to 1,400 broodstock to produce 1.42 million smolts for on-station release into the Wind River. Contribute to a meaningful harvest for sport, tribal, and commercial fisheries from March through July of each year in the Columbia and Wind rivers. Achieve a 10-year average of 0.5% smolt-to-adult survival that includes harvest plus escapement.	Survival and contribution to fisheries will be estimated for each brood year released. Work with co-managers to manage adult fish returning in excess of broodstock need. Work with states and tribes to establish meaningful fisheries (through US v Oregon forums).

Develop outreach to enhance public understanding, participation, and support of the U.S. Fish and Wildlife Service and Carson NFH programs.	Increase the visibility of the U. S. Fish and Wildlife Service facilities in the Columbia River Gorge and to provide information about Service programs to internal and external audiences. For example, local schools and special interest groups tour the facility to better understand hatchery operations. Off station efforts include festivals, classroom participation, stream adoptions, and county fairs.	Evaluate use and/or exposure of program materials and exhibits as they help support goals of the information and education program.
Implement measures for broodstock management to maintain integrity and genetic diversity of Carson hatchery stock.	A minimum of 1,000 adults are collected throughout the spawning run in proportion to age and sex composition at return.	Annual run timing, age and sex composition, and return data is collected and compared to historical data.
Program contributes to fulfilling tribal trust responsibility mandates and treaty rights.	Follow pertinent laws, agreements, policies, and executive orders on consultation and coordination with Native American tribal governments. Columbia River tribes support the service program at Carson NFH. An annual report on stock assessment and contribution to fisheries will be developed.	Hold an annual coordination meeting between the service and Yakama Nation to identify and report on issues of interest, coordinate management, and review programs.
Communicate and coordinate effectively with co-managers in the Columbia River basin.	Participate in US v Oregon production advisory committee (PAC) and technical advisory committee (TAC) meetings. Discuss management issues for Carson NFH at an annual coordination meeting each February between the Service, WDFW, NOAA Fisheries, and Yakama Nation.	Develop technical reports for PAC and TAC. Hold hatchery evaluation team meetings each spring and fall to review progress.
Design and implement projects to improve the quality of fish production at Carson NFH.	Projects are identified, reviewed, and implemented that will increase survival of program fish while minimizing impacts on wild populations.	Monitoring programs will be incorporated into project designs. Examples of projects include: diet studies, rearing and release studies, and rearing environment projects.
Release groups are sufficiently marked in a manner consistent with information needs and protocols to determine impacts to natural and hatchery origin fish in fisheries.	All fish are adipose fin clipped and 75,000 are implanted with coded wire tags to monitor and evaluate fish cultural techniques, survival, and fishery contribution.	All returning fish are checked for coded-wire tags by passing them through a tag detection unit.

	Risks	
Performance Standard	**Performance Indicator**	**Monitoring and Evaluation**
Minimize impacts to ESA listed and other native species, their habitat, and the environment.	Adult ESA listed steelhead are allowed to pass the hatchery volitionally. Hatchery juveniles are raised to smolt-size (18 fish/lb) and released from the hatchery to expedite migration through the Wind and Columbia rivers. Mass mark all production fish to distinguish them from naturally produced fish.	The hatchery ladder is monitored to document if steelhead are entering. Juvenile passage is monitored in the Wind River by WDFW to determine the length of time fish spend in the river after release. Hatchery juveniles are also PIT-tagged and passage is monitored at Bonneville Dam. USGS Columbia River Research Laboratory conducts instream evaluations. Additional Service projects pending (straying, risk assessment, instream evaluations, fish health).
Artificial production facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols such as those described by IHOT, PNFHPC, the Co-Managers of Washington Fish Health Policy, INAD, and the Service.	Prevent the introduction, amplification, or spread of certain fish pathogens that might negatively affect the health of both hatchery and naturally reproducing stocks and to produce healthy smolts that will contribute to the goals of Carson NFH.	A pathologist from the Lower Columbia River Fish Health Center will examine the fish at least once per month to ascertain general health. Tests include the following examinations: regular, diagnostic, ponding, pre-release, and adult certification.
Effluent from artificial production facility will not detrimentally affect natural populations	Raceway cleaning effluent is sent to a pollution abatement pond where solids are removed prior to discharge.	Cleaning and total discharge (normal operation) effluents are monitored weekly for suspended and settleable solids.
Water withdrawals and instream water diversion structures for artificial production facility operation will not prevent access to natural spawning areas, affect spawning behavior of natural populations, or impact juvenile rearing environment.	Adult steelhead volitionally pass the hatchery ladder to the upper Wind River. The primary water source, Tyee Creek, is not accessible to anadromous fish and the Wind River is used only as a secondary source. Hatchery intake meets screening criteria.	Number of steelhead entering the hatchery and water use is regularly monitored.
Hatchery operations comply with ESA responsibilities.	Hatchery conducts section 7 consultations and completes an HGMP. Section 10 permits are issued when applicable.	Identified in HGMP and Biological Opinion for hatchery operations.
Harvest of hatchery-produced fish minimizes impact to wild populations.	Harvest is regulated to meet appropriate biological assessment criteria. Mass mark juvenile hatchery fish prior to release to enable state agencies to implement selective fisheries.	Harvest is monitored by state and tribal agencies to meet biological opinion on fisheries.

1. Adult returns

a) Numbers of adult returns (need data for the past 10-20 years)

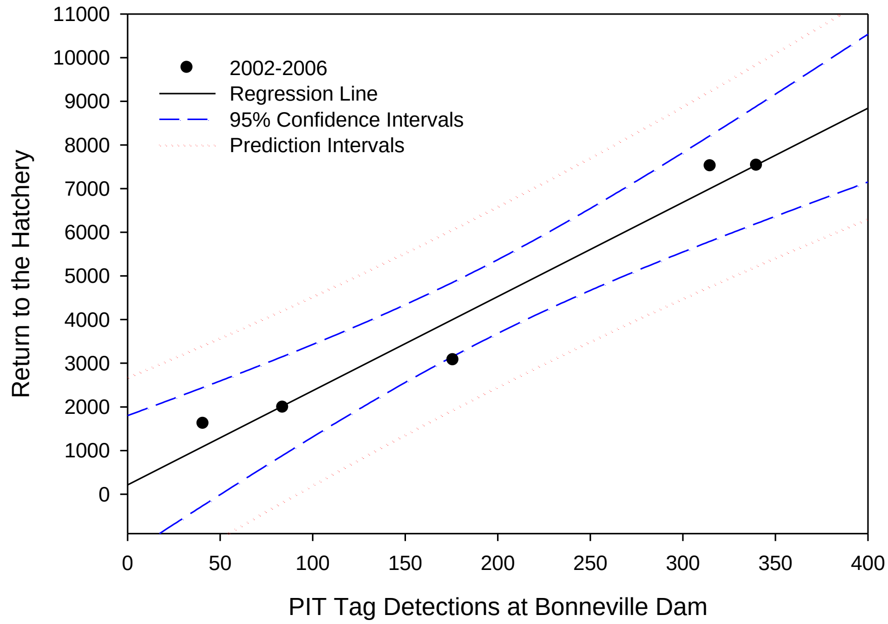
- Contribution and recovery of coded-wire tagged spring Chinook salmon from Carson National Fish Hatchery (data presented in table were reproduced from Stock Assessment Reference Summary, U.S. Fish and Wildlife Service, Columbia River information System, Pastor 2007).

Brood Year[1]	Number Released	Hatchery	Columbia River Harvest	Ocean Harvest	Spawning Ground	Total Expanded Recoveries	Smolt to Adult Survival (%)
1990	2,315,382	1,610	190	0	1	1,801	0.08
1991	2,321,285	450	92	0	12	554	0.02
1992	2,040,568	8,137	3,899	82	421	12,539	0.61
1993	2,195,192	4,720	4,720	42	113	9,595	0.44
1994	1,722,621	1,082	894	0	165	2,141	0.12
1995	907,708	2,425	997	0	0	3,422	0.38
1996	1,734,188	10,047	8,951	0	146	19,144	1.10
1997	1,415,744	8,086	9,885	14	173	18,158	1.28
1998	1,430,022	6,876	12,299	0	323	19,498	1.36
1999	1,608,684	7,218	12,802	0	592	20,612	1.28
10 year avg.	1,769,139	5,065	5,473	14	195	10,747	0.67
Percent		47%	51%	0.1%	2%		

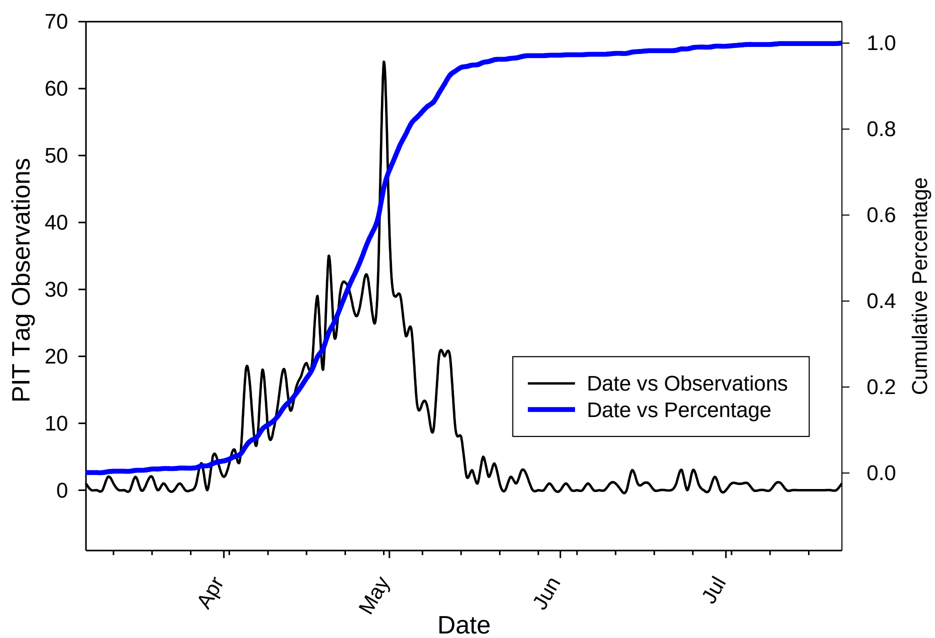
1 Brood year 1990-1999 fish were spawned in that year and returned three, four and five years later as adults. For example, a five year old fish from brood year 1999 returned in calendar year 2004.

- PIT tag detections from 2002-2006 used to predict adult returns to Carson NFH

Adult Spring Chinook Salmon Returns
To Carson National Fish Hatchery Based
on PIT Tag Detections at Bonneville Dam
2002-2006



PIT Tag Observations and Cumulative Percentage
of Carson NFHSpring Chinook Salmon at Bonneville Dam
2002-2006



Carson NFH Spring Chinook Returns

Year	Males	Females	Jacks	Unknown	Total	Males Spawned	Females Spawned
80	1,405	1,931	32	0	3,368	1,448	1,920
81	1,120	1,425	3	0	2,548	1,123	1,425
82	609	1,027	20	0	1,656	629	1,027
83	955	1,515	4	20	2,494	959	1,515
84	945	1,163	45	0	2,153	719	1,068
85	2,026	2,646	62	0	4,734	1,433	2,324
86	1,303	1,811	67	2,475	5,656	1,056	1,687
87	1,577	2,797	4	0	4,378	1,247	1,714
88	774	1,280	56	0	2,110	727	1,161
89	925	1,209	162	0	2,296	861	1,098
90	1,019	1,693	34	7,910	10,656	794	1,059
91	1,322	1,942	40	1,029	4,333	1,144	1,661
92	1,206	1,643	17	1,322	4,188	1,043	1,362
93	1,220	1,855	2	1,362	4,439	1,125	1,657
94	397	525	0	0	922	365	474
95	245	239	81	0	565	225	233
96	793	1,600	22	1,902	4,317	691	933
97	511	648	3	2,242	3,404	501	630
98	409	517	12	0	938	391	503
99	458	912	85	2,273	3,728	426	511
00	606	1,060	162	9,030	10,858	505	525
01	449	929	205	10,491	12,074	381	525
02	605	1,155	115	5,647	7,522	381	600
03	526	560	90	6,578	7,754	514	556
04	515	1,117	45	1,493	3,170	452	550
05	537	1,018	55	0	1,610	389	550
06	625	868	14	475	1,982	420	552

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b) Return timing and age-class structure of adults

Age cf returns, Carson National Fish Hatchery spring Chinook salmon, 1980-2007 (USFWS CRiS Databasє).

Careon NFH Spring Chinook Age of Returns

Year	Age-2	Age-3	Age-4	Age-5	Age-6	Total
80		32	606	2,730		3,368
81		3	901	1,609		2,548
82		22	1,085	549		1,656
83		9	1,072	1,413		2,494
84		79	1,274	789	11	2,153
85		53	3,591	1,090		4,734
86		48	3,557	2,051		5,656
87		7	2,464	1,907		4,378
88		72	252	1,786		2,110
89		118	1,883	287	8	2,296
90		26	9,324	1,306		10,656
91		37	1,178	3,105	13	4,333
92		7	3,094	1,080	7	4,188
93		12	1,455	2,972		4,439
94		7	542	371	2	922
95		104	361	100		565
96		14	4,230	73		4,317
97		5	2,911	488		3,404
98		14	406	518		938
99		95	3,524	109		3,728
00		316	9,875	667		10,858
01		92	11,010	972		12,074
02		96	7,017	409		7,522
03		79	5,471	2,204		7,754
04		56	2,894	220		3,170
05		50	1,489	71		1,610
06		23	1,862	97		1,982
07		80	1,269	298		1,647

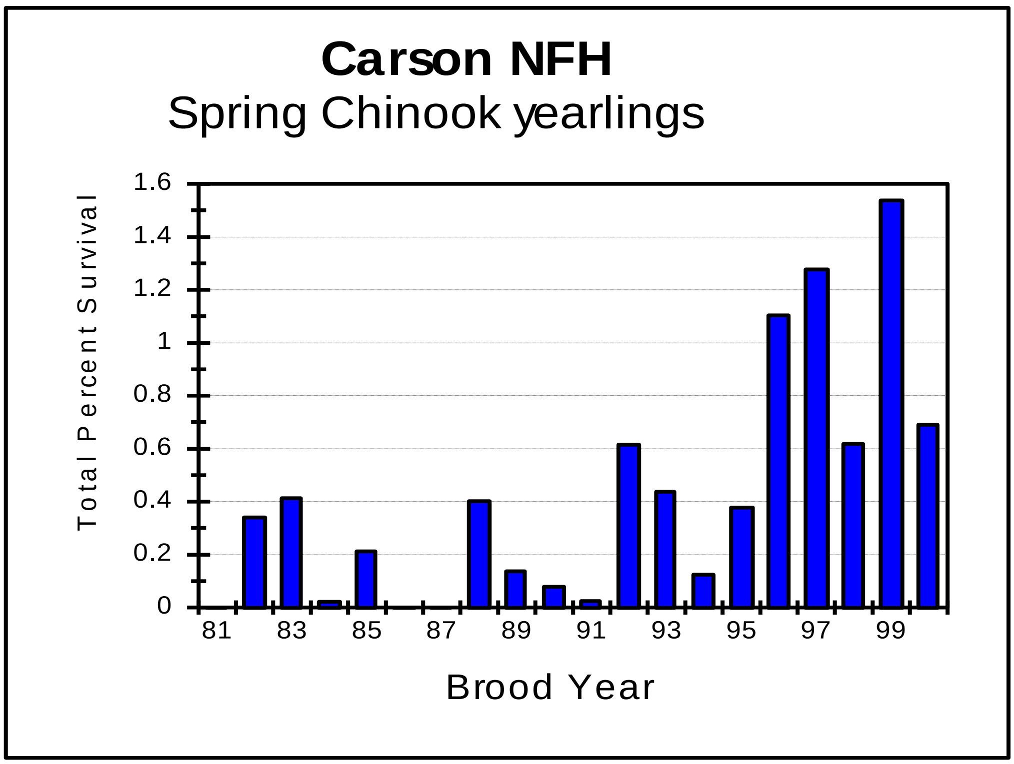
CRiS\AgePr

Returns to Carson NFH from Spring Chinook released in Wind River as yearlings — CRiS\SMP\Coh 11/08/2007

BY	Number Released	Returns to the Hatchery: Age 2	Age 3	Age 4	Age 5	Age 6	Total	% Return
79	2,598,912		22	1,073	789		1,884	0.072
80	2,578,650		9	1,274	1,090		2,373	0.092
81	1,722,080		79	3,591	2,051		5,721	0.332
82	2,886,560		53	3,557	1,907		5,517	0.191
83	2,390,971		48	2,464	1,786	8	4,306	0.180
84	2,392,468		7	252	287		546	0.023
85	2,524,164		72	1,883	1,306	13	3,274	0.130
86	1,956,220		118	9,324	3,105	7	12,554	0.642
87	1,983,639		26	1,178	1,080		2,284	0.115
88	2,105,281		37	3,094	2,972	2	6,105	0.290
89	2,336,788		7	1,455	371		1,833	0.078
90	2,315,382		12	542	100		654	0.028
91	2,321,285		7	362	73		442	0.019
92	2,040,568		103	4,230	488		4,821	0.236
93	2,195,192		14	2,911	518		3,443	0.157
94	1,722,621		5	406	109		520	0.030
95	907,708		14	3,524	376		3,914	0.431
96	1,734,188		95	10,341	972		11,408	0.658
97	1,415,744		141	10,897	409		11,447	0.809
98	1,430,022		205	7,017	2,204		9,426	0.659
99	1,608,684		96	5,471	220		5,787	0.360
00	1,449,361		79	2,894	71		3,044	0.210
01	1,673,255		56	1,489	97		1,642	0.098
02	1,417,986		50	1,862	298		2,210	0.156
03	1,470,134		23	1,269			1,292	0.088
04	1,209,384		80				80	0.007
(age 5 > 0) Number			56	3,379	945	1		
Average %			1%	74%	24%	0%		0.250

c) Smolt-to-adult return rates

As assessed by CRFPO, the average survival for 12 brood years with complete coded-wire tag recovery information (1982-95) is estimated to be 0.23% with a standard deviation of 0.18%. The minimum survival was 0.022% for brood year 1991 and maximum was 0.59% for brood year 1992 (Attachment 16). A more optimistic outlook is appearing for returns in 2000, 2001and 2002 (brood years 1996, 1997 and 1998) with over 1% survival expected for brood year 1997. As previously mentioned, the marking program has also made it possible for CRFPO to determine contribution rates to various fisheries (Attachment 17). Since brood year 1980, an average 74% of adults returned to the hatchery with remaining recoveries of Carson spring Chinook salmon occurring almost exclusively in the Columbia River Basin. The majority of fish were harvested in the freshwater sport fishery, followed by tribal treaty and subsistence fishery, and the Columbia River gill net fishery. A very small percentage may also be picked up in the Alaska, Washington, Oregon, California and British Columbia commercial fisheries. (CRNFH CHMP, p.44)



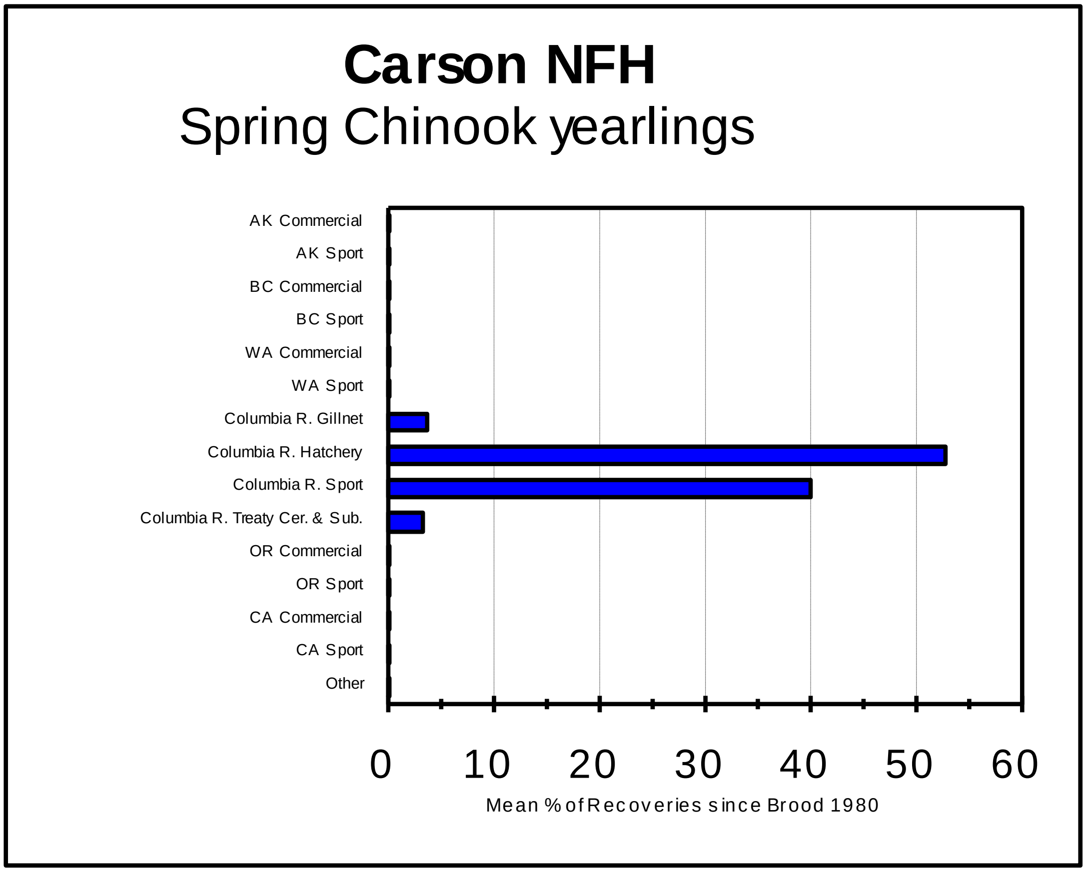
d) Stock productivity (e.g. recruits per spawner)

A 10-year average of 8 to 9 recruits per spawner (R/S) for brood years 1990-99. For those brood years, 1.77 million smolts were released to produce 10,747 total adult recoveries. This assumes that between 1,200 and 1,300 adult spawners produced 1.77 million smolts.

2. Contributions to harvest and utilization (e.g. food banks)

Spring Chinook salmon from Carson NFH have, over the years, supported successful sport and tribal fisheries in the Columbia and Wind rivers. Fisheries occur almost exclusively in the Columbia and Wind rivers with the majority of fish harvested in the freshwater sport fishery, followed by tribal treaty and Columbia River gill net fisheries (Refer to Chapter 3 for more discussion on harvest). For example in 2001, the sport catch in the Wind River was 11,956 fish, with tribal catch at 1,840, and escapement to the hatchery at 12,075 fish (CRNFH CHMP, p. 23)

Carson spring Chinook are not part of either the lower Columbia River Chinook ESU or the mid-Columbia River spring Chinook ESU, however, they do provide important fishery benefits to Columbia River fisheries. Upriver spring Chinook comprise a very minor component of the ocean fisheries with very few CWTs recovered in ocean fisheries. Columbia River main stem fisheries have been highly restricted in recent years (5 to 7 percent harvest rate) to address conservation needs and NMFS biological opinion jeopardy standards for listed Snake River spring/summer Chinook. Therefore, Carson spring Chinook contribute primarily to terminal area sport and tribal fisheries at the mouth of the Wind River. Providing terminal area fisheries is one of the management strategies to allow harvest opportunities while minimizing impacts on listed species and other stocks of concern. The average terminal area harvest rate for the period 1989-1998 was 0.439 for years when fisheries occurred (from Pettit 1999b). Average sport and tribal catches for this period for years when fisheries occurred were 2,615 and 868, respectively. Average tribal distribution of surplus fish from the hatchery for this period for years when tribal distribution occurred was 2,575 (from Pettit 1999b). Recoveries of CWTs from other stocks of concern (e.g., upper Columbia and Snake River spring Chinook) are extremely rare. The Wind River mouth fisheries provide quality terminal area fishery opportunity for sport and tribal fishers with minimal impacts to other stocks of concern. Also, all of the Carson NFH spring Chinook releases are mass marked for terminal area fisheries management. Main stem Columbia River fisheries are managed to achieve the NMFS biological opinion jeopardy standards for Snake River spring/summer Chinook of 5 to 7 percent harvest rate. So, production levels at Carson NFH are not expected to add adverse effects to listed species or other stocks of concern beyond those currently allowable under non-jeopardy biological opinions for harvest. (CRNFH Chinook HGMP, sec. 3.3)



More fish enter the hatchery than are needed for brood stock. Brood stock excess to hatchery needs are transferred to the Bureau of Indian Affairs for distribution to the Yakama Nation for Ceremonial and Subsistence (C&S) use, other tribes for C&S use, or the Bureau of Federal Prisons for inmate rations Surplus fish or spawned carcasses may also be available for stream enrichment. Adult spring Chinook held for brood stock must be treated (injected) with erythromycin to control bacterial kidney disease infection. Erythromycin has not been cleared for use on food fish by the Federal Drug Administration, therefore, carcasses previously injected with erythromycin cannot be used for human consumption and must be buried on site. Pre-spawn mortalities are unfit for human consumption and, in accordance with the Pacific Northwest Fish Health Protection Committee's draft Salmon and Steelhead Carcass Distribution Protocols, cannot be used for stream enrichment outplants and must be buried on site as well. (CRNFH CHMP, p. 34)

There is a MOU with GH/PC Food Bank Distribution Center effective August 2006 that establishes the transfer of excess salmon and steelhead carcasses to the food banks in place of the Bureau of Federal Prisons.

3. Contributions to conservation

The hatchery program may be filling an ecological niche in the freshwater and marine ecosystem. A large number of species are known to utilize juvenile and adult salmon as a nutrient and food base (Groot and Margolis 1991; and McNeil and Himsworth 1980). Pacific salmon carcasses are also important for nutrient input back to freshwater streams (Cederholm et al. 1999). Reductions and extinctions of wild populations of salmon could reduce overall ecosystem productivity. Because of this, hatchery production has the potential for playing an important role in population dynamics of predator-prey relationships and community ecology. The Service speculates that these relationships may be particularly important (as either ecological risks or benefits) in years of low productivity and shifting climactic cycles. (CRNFH CHMP, p. 21)

4. Other benefits

Economic Benefit. An economic benefit analysis of returning Carson NFH spring Chinook salmon was drafted by the Service′s Division of Economics. The results of the analysis show that the economic benefit produced by Carson NFH ranged from a low of $13,519 to a high of $1,916,000 at a 1.0 % escapement. The low, of course, was for a poor return year with no fishery. Recent returns have approached or exceeded the 1% mark. For each $1.00 spent at the hatchery, $3.88 of economic activity was generated. (CRNFH CHMP, p. xvi)

In 2001, Washington Department of Fish and Wildlife estimated that 32,442 angler-days (one person fishing for at least part of one day) occurred on the Wind River as a direct result of a record return of Carson NFH adult spring chinook salmon (CRNFH CHMP, p. 23).

Cultural Values. The Yakama Nation share the in-river harvest of spring Chinook salmon returning to Carson NFH and is the primary beneficiary of surplus spring Chinook salmon which have entered the hatchery holding ponds. The cultural significance of these fish to the tribes is best characterized by the following quotations: (CRNFH CHMP, p. 23)

E. Research, monitoring, and evaluation programs

- Along with normal monitoring and evaluation of the stock using coded wire tags, the hatchery continues to develop and evaluate fish culture protocols (such as electro-anesthesiology, feeding practices) and cooperates with researchers on disease research. Research projects in the coming years may include evaluation of NATURES rearing raceways. This study should have no adverse effect on listed species.

- **Ecological interaction studies between spring Chinook and ESA-listed steelhead in the Wind River.** In cooperation with the USGS Columbia River Research Lab , a multi-year study on steelhead and Chinook salmon juvenile interactions shows that highly variable numbers (0 to 99 fish/100 meters) of spring Chinook fry are produced each year by hatchery-origin spring Chinook spawning in the upper Wind River and its tributaries between river kilometer 29.7 to 42.5. (All figures below courtesy of Ian Jezorek and Pat Connolly, USGS).

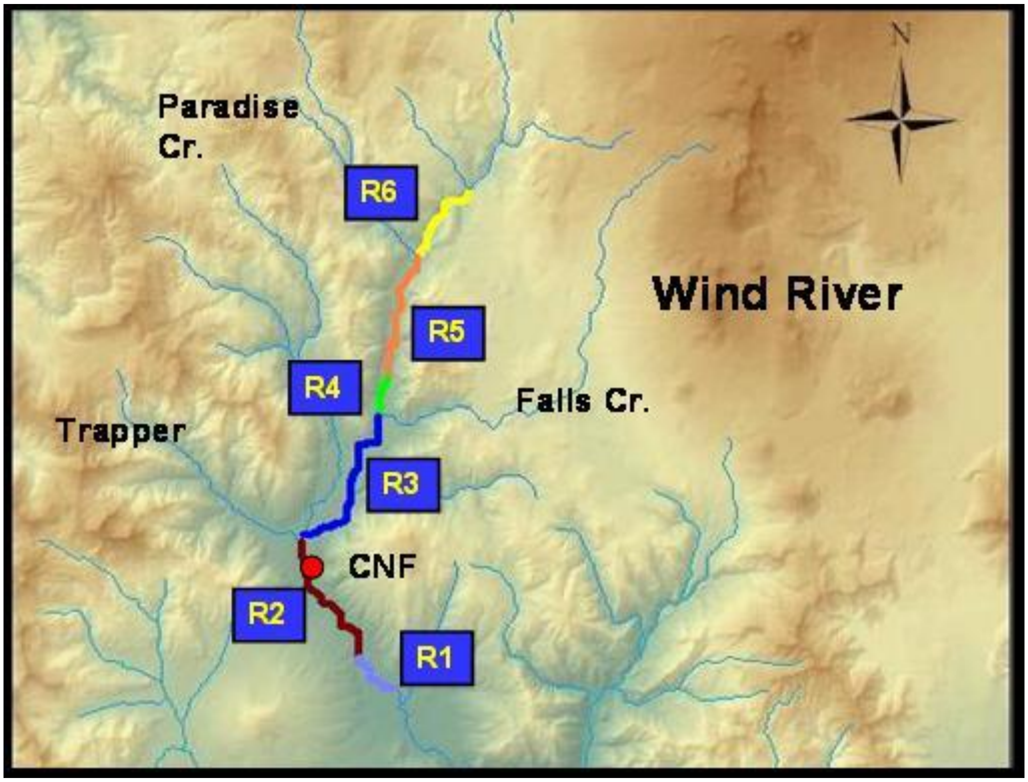


Figure XX. Study reaches of the Wind River for ecological interaction studies between steelhead and spring Chinook. "CNF" is the Carson National Fish Hatchery. Principal spawning areas for steelhead occur in Reaches 5 and 6. Principal spawning areas for hatchery-origin spring Chinook are in Reach 2.

- Juvenile Chinook salmon populations were highly variable between reaches and years and juvenile Chinook salmon were not present in all reaches during all years.

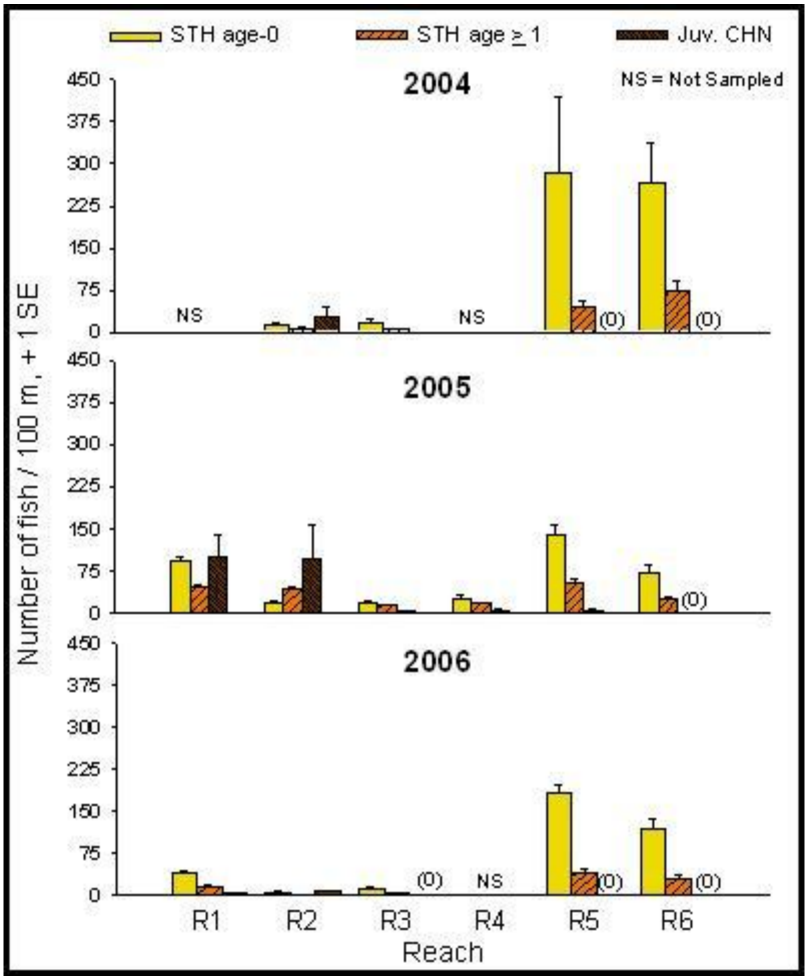


Figure XX. Relative abundance of age 0+ steelhead, age 1+ steelhead, and juvenile Chinook salmon within each of six reaches of the Wind River, 2004-2006. The greatest potential for inter-species competition occurred in 2006 in reaches 1 and 2, immediately downstream and adjacent to the Carson NFH. However, the vast majority of steelhead spawning occurs in reaches 5 and 6, approximately 8-12 km upstream of the hatchery.

- When present, juvenile Chinook salmon populations varied from 0.5 fish/100 m (R5, 2002) to 98.9 fish/100 m (R1, 2005). In R2, juvenile Chinook salmon were present each year sampled (*n* = 3), with mean population of 41.6 fish/100m. Juvenile Chinook salmon populations were low in R3 and R4 (< 3.5 fish/100 m), when present. Juvenile Chinook salmon were present in R5 during five of the seven years we surveyed it, with mean population of 3.7 fish/100 m, including the two years when we found none. The highest populations of juvenile Chinook salmon were found in reach 1 and reach 2, which were just downstream of and adjacent to CNFH, respectively."

- In reach 5, which has the highest concentration of steelhead juveniles, juvenile Chinook are largely absent, and there is little opportunity for direct competition or predation between species.

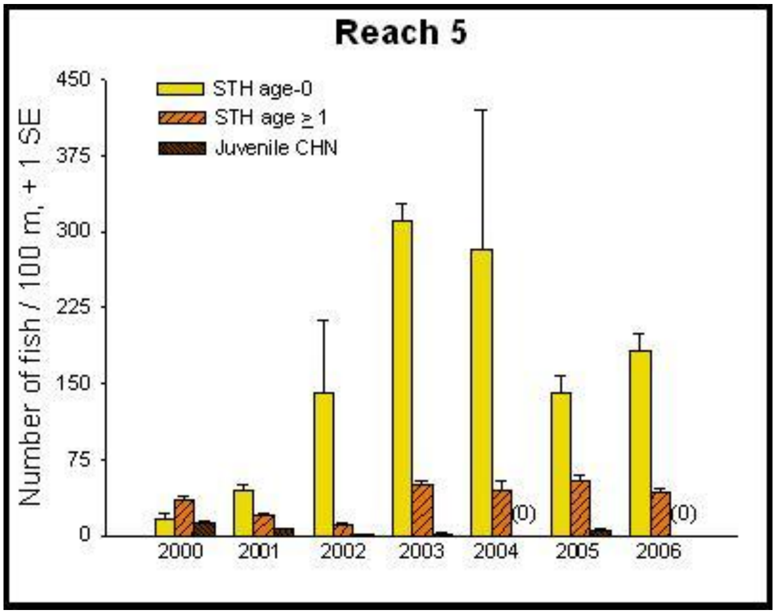


Figure XX. Relative abundance of age 0+ steelhead, age 1+ steelhead, and juvenile Chinook in Reach 5 of the Wind River during August, 2000-2006.

- Condition factors for age 0+ steelhead are not significantly different when juvenile Chinook are present or absent.

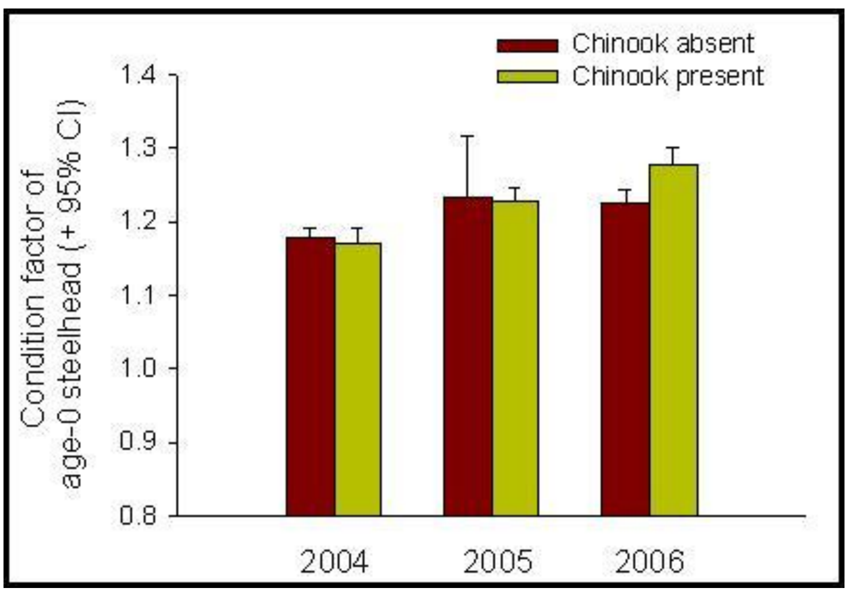


Figure XX. Mean conditions factors of age 0+ steelhead in the Wind River, 2004-2006, in areas where juvenile spring Chinook are present versus areas where spring Chinook are absent.

- When juvenile steelhead and Chinook salmon occur sympatrically, direct competition between species is most likely in the late summer when the size distribution of age 0+ steelhead overlaps with the larger juvenile Chinook. In the spring, prior to the emergence of age 0+, there is little overlap in the size distributions of age 0+ Chinook and age 1+ steelhead.

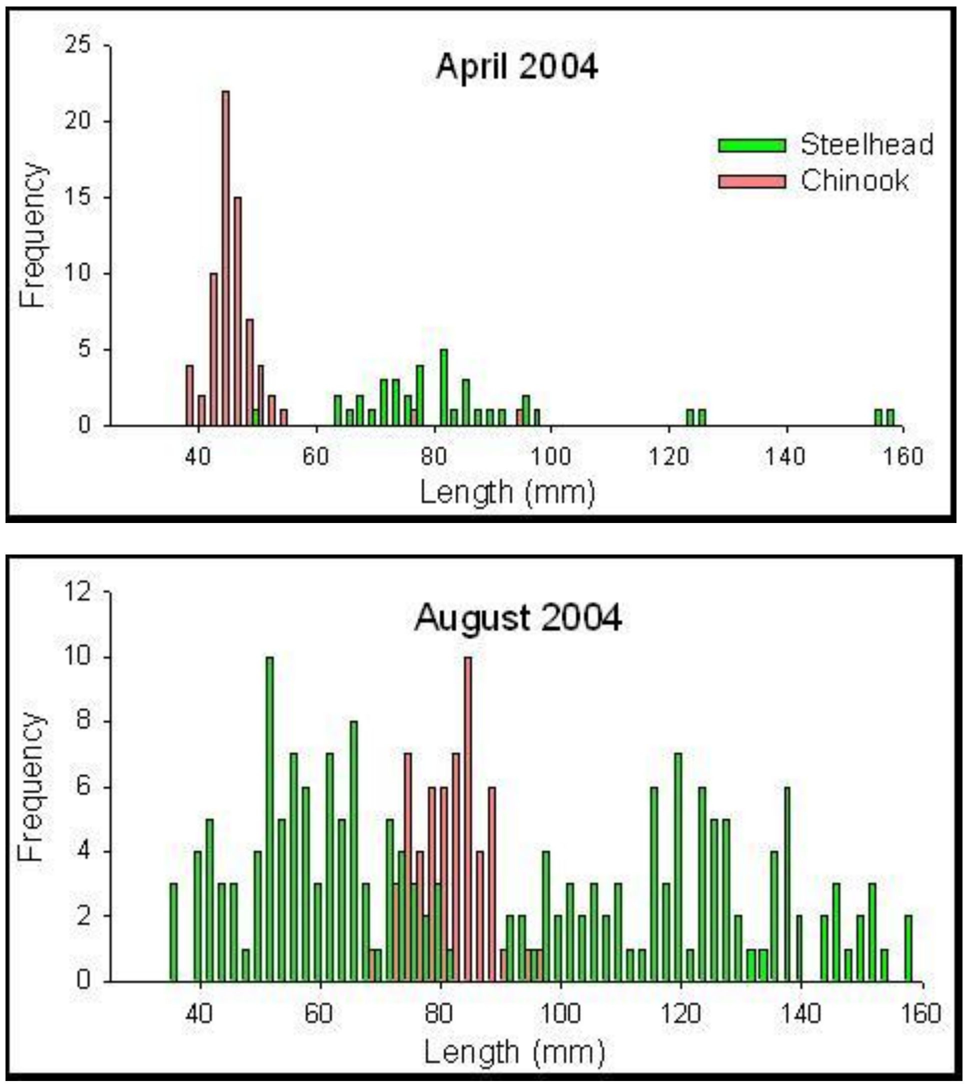


Figure XX. Size overlap distributions of juvenile steelhead and juvenile spring Chinook in the Wind River, 2004.

- The abundance and distribution of natural-origin spring Chinook juveniles in the Wind River seem to depend on river flows which variably affect either the adult and/or the juvenile life stages, depending on the river reach. Low base flow probably restricts access to the upper reaches of the Wind River during the late-summer period when adult Chinook salmon spawn. Some Chinook salmon redds may have been dewatered after the spawning period, thus influencing juvenile population abundance. In the river reach adjacent to the hatchery, the redds and/or fry appear to be susceptible to high winter flows.

- A few natural-origin spring Chinook smolts with PIT tags have been detected at Bonneville Dam (seven PIT tag detections out of 538 tagged fish, between 2004-2006). However, the low percentage of smolt outmigrants and the lack of returning adults indicate that a self-sustaining, naturalized population of spring Chinook has not been established in the Wind River despite nearly 50 years of hatchery propagation.

- Adult returns of steelhead to the upper Wind River upstream of Shipherd Falls ranged from approximately 200 to 1100 adults, 2000-2006, and were positively correlated with the abundance of age 0+ steelhead the following summer.

- **Conclusion:** Although the potential exists for negative ecological interactions between juvenile spring Chinook and steelhead, the data collected to date (Jezoreck et al. 2007) suggest that such interactions are minimal due to (a) highly variable inter-annual spawning success of hatchery-origin spring Chinook and (b) substantial spatial segregation of principal spawning areas for the two species (R1 and R2 for Chinook; R5 and R6 for steelhead.

- Carson NFH has been evaluating a number of different starter feeds since Bio-diet was no longer available. (Personal communication from Project leader)

- The use of electroanesthesiology for temporal and terminal anesthetization of spawning adult salmon was conducted to ascertain benefits and risks by Zydlewski et al.

- Past studies include National Marine Fisheries Service's (NOAA Fisheries) coded-wire tagging of Willard stock coho and Carson stock spring Chinook salmon reared at Carson NFH in the late 1970's and early 80's. This study evaluated imprinting and homing mechanisms of fish released at various locations in the Columbia River basin (Slatick 1988). Abernathy Fish Technology Center has also conducted hatchery evaluation studies at the hatchery. For example, brood years 1982 to 1985 spring Chinook from Carson were marked and coded-wire tagged for a rearing density study (Banks 1994). As a result of this study, rearing densities in hatchery raceways were reduced. The guidelines being implemented as a result of the density study are to keep the rearing density index at 0.25 or lower with a flow index greater than 1.0. The present production goal at Carson NFH is 1.42 million smolts. (CRNFH CHMP, p. 43)

- A study to evaluate survival of spring Chinook from the effects of fin clipping and coded-wire tagging was completed as part of a three brood year (1989-91), three hatchery investigation (Carson NFH, Oregon's South Santiam, and Washington's Cowlitz hatcheries). The results and conclusions of this study are forthcoming. (CRNFH CHMP, p. 44)

- Carson NFH also participated in a study on the genetic effects of ELISA-based segregation for control of BKD, addressing concerns that disease resistance might be changed by the selective culling of eggs from females with high levels of BKD. Importantly, the researchers found that no adverse genotypic or phenotypic correlation in disease resistance occurred, verifying use of this practice for reducing BKD in the spring Chinook hatcheries of the Pacific Northwest (Hard et. al, 2006) and alleviating a potential risk factor identified in the Artificial Production Review and Evaluation Reports for Carson NFH and other hatcheries.

- The Columbia River Fisheries Program Office (CRFPO) provides monitoring, evaluation, and coordination services concerning Carson NFH production. The CRFPO staff monitors hatchery returns, biological characteristics of the hatchery stock, fish marking, tag recovery, and other aspects of the hatchery program. They maintain the database that stores this information and serve as a link to databases maintained by other entities. The CRFPO also cooperates with the hatchery, fish health center, Abernathy Fish Technology Center, and co-managers to evaluate fish culture practices, assess impacts to native species, and coordinate hatchery programs both locally and regionally. (CRNFH CHMP, p. 42)

- Information from and about Carson NFH is connected to the broader fisheries community of the West Coast of the North American Continent through the U.S. Fish & Wildlife Service Columbia River (information) System (CRiS). The following information is recorded in files that are components of the CRiS database: adult, jack and mini-jack returns to the hatchery; age, sex, length, mark and coded-wire tag information for returning fish that are sampled; egg development and disposition; the origin of fish raised at the hatchery; and fish transfers and releases. Carson NFH maintains files containing information generated at the hatchery (brood stock management, incubation, rearing, and release). Staff from CRFPO maintain files containing information on marked juvenile fish and on sampled adult fish (adult bio-samples). (CRNFH CHMP, p. 42)

- **Marking/Tagging Program**.– Juvenile fish are fin clipped, coded-wire tagged and/or PIT tagged at Carson NFH by CRFPO to monitor and evaluate fish cultural techniques, survival and fishery contribution. Presently all spring Chinook salmon are fin clipped at Carson NFH to identify hatchery fish in selective fisheries and to measure the impact on wild anadromous and resident stocks of fish in Wind River. This action is in compliance with recommendations of the Biological Opinions of NMFS′s 1999 Artificial Propagation in the Columbia River Basin and the 2000 Reinitiating of Consultation on Operation of the Federal Columbia River Power System, under the Endangered Species Act-Section 7 Consultation.

- **Bio-sampling and Reporting**.- State and tribal coast-wide sampling of sport, tribal, and commercial fisheries and hatchery rack return sampling, by CRFPO and the hatchery staff, provides total recovery and survival estimates for each brood year released.

- Coded-wire tag recovery information is used to evaluate the relative success of individual brood stocks and compare performance between years and hatcheries. This information is used by salmon harvest managers to develop plans to allow the harvest of excess hatchery fish while protecting threatened, endangered, or other stocks of concern.

F. Program conflicts

In the December 1999 Draft HGMP, the Service assessed the potential impacts from hatchery operations including: water withdrawal and effluent discharge, brood stock collection, genetic introgression, juvenile fish releases, disease, competition, predation, residualism, and migration corridor and ocean impacts. Our assessment to date, with NOAA Fisheries concurrence, concludes that operation of Carson NFH will not jeopardize listed fish populations. However, we also recognize that more research is needed to more fully understand the impacts of hatchery operations, releases, and impact of natural spawning spring Chinook on steelhead in the Wind River (refer to Chapter 3 Monitoring and Evaluation discussion). In addition to completing documentation to comply with our ESA responsibilities, we must also meet our mitigation responsibilities under the Mitchell Act as well as meet our Tribal Trust and U.S. v Oregon obligations. In order to balance these sometimes conflicting mandates, we regularly meet with our co-managers to discuss operation and management of the hatchery. (CRNFH CHMP, p. 15)

1. *Biological conflicts (e.g. propagated stock maladapted to hatchery water source)*

Carson spring Chinook releases are not known to residualize in the Wind River. Available out-migrant trap and PIT tag monitoring information indicate a rapid exit of Carson spring Chinook from the Wind River (CRNFH CHMP, p. 21)

2. *Harvest conflicts (e.g. mixed stock fishery on hatchery and wild fish limits harvest opportunities on hatchery fish)*

- Non-Indian and treaty Indian winter and spring season fisheries will be managed in accordance with Table A1 of the "2005-2007 Interim Management Agreement for Upriver Chinook, Sockeye, Steelhead, Coho and White Sturgeon". Based on 2007 preseason forecasts, the spring Chinook harvest allocation table allows for non-Indian impacts up to 1.5% of the upriver spring Chinook run and treaty Indian impacts up to 7.0%. (ODFW and WDFW 2006)

- For a complete description of upriver spring Chinook salmon harvest management, see the related section for Little White Salmon River spring Chinook salmon as described later on in this document.

3. *Conservation conflicts and risks*

a) Genetic conflicts associated with straying and natural spawning of hatchery fish (Stray rates, proportion of hatchery-origin fish on natural spawning grounds, etc. Provide tables or figures where appropriate)

Coded-wire tag recoveries show that Carson NFH spring Chinook stray into the Little White Salmon NFH and are caught in the Drano Lake sport and tribal fisheries. However, the Carson spring Chinook stock is also released from Little White Salmon NFH. Straying of Carson spring Chinook is not considered a major problem for other streams where spring Chinook are listed based on a general lack of Carson recoveries in other areas. Therefore, genetic introgression of spring Chinook released from Carson NFH with other listed spring Chinook stocks is not considered a significant problem. The Service is currently analyzing data to quantify the degree of straying of fish from our National Fish Hatcheries. (CRNFH CHMP, p. 17)

b) Ecological conflicts (e.g. competition between hatchery fish and wild fish, predation,)

Carson NFH spring Chinook releases are moderate in magnitude relative to other Columbia River spring Chinook production programs. Carson NFH releases have been reduced from a previous program level of over 2 million smolts to the current 1.42 million smolt level. Reduced production decreases density dependent effects and other potential ecological effects on other natural stocks. Juvenile out-migration trapping and PIT tag monitoring at Bonneville Dam (see Chapter 3 Monitoring and Evaluation discussion on PIT tagging) indicate that Carson spring Chinook exit the Wind River quickly after release, further reducing potential density dependent effects. The Service will continue to evaluate our release strategies and production numbers to minimize any negative effect upon the aquatic community, especially on listed species. (CRNFH CHMP, p. 17)

Carson spring Chinook are released into the Wind River at the hatchery site and migrate quickly into the mainstem Columbia River migration corridor en route to the ocean based on juvenile out-migrant trapping and PIT tag monitoring at Bonneville Dam (see Chapter 3), reducing potential competitive interactions within the Wind River basin. Because Carson spring Chinook releases occur low in the Columbia Basin system relative to many other upriver programs, there is reduced opportunity for competitive interactions. (CRNFH CHMP, p. 19)

There is little potential for Carson spring Chinook to prey on natural steelhead fry or parr in the Wind River. Based on time of spawning, steelhead fry would be emerging from the gravel after Carson Chinook had exited the river. In addition, much of the spawning and early rearing stage (egg to parr) production areas for natural populations of Wind River steelhead are in the tributaries and upper basin areas above Carson NFH. However, the life history rearing stage for steelhead, age-1 parr to age-2 smolt, does occur below the hatchery with the parr moving into the area as smolts vacate the area during their annual migration which peaks from May 10-15 (Dan Rawding, WDFW, personal communication). Mr. Rawding indicated that age-1 parr typically range in size from 80-100mm and age-2 smolts from 140-200mm so neither life history stage would be at a size susceptible to Carson spring Chinook predation. Out-migrant sampling conducted by WDFW indicates that steelhead smolts/pre-smolts are not drawn out of the Wind River system early by release of Carson spring Chinook. Available data indicate that Carson spring Chinook smolts exit the Wind River very quickly and that potential negative impacts on listed steelhead within the basin are likely to be negligible.

Carson spring Chinook releases may contribute to indirect predation effects on listed stocks by attracting predators (birds, fish, pinnipeds) and/or by providing a large forage base to sustain predator populations. Releasing large numbers of hatchery fish may lead to a shift in the density or behavior of non-salmonid predators, thus increasing predation on naturally reproducing populations. Conversely, large numbers of hatchery fish may mask or buffer the presence of naturally produced fish, thus providing sufficient distraction to allow natural juveniles to escape (Park 1993). Prey densities at which consumption rates are highest, such as northern pikeminnow in the tailraces of mainstem dams (Beamesderfer et al. 1996; Isaak and Bjornn 1996), have the greatest potential for adversely affecting the viability of naturally reproducing populations, similar to the effects of mixed fisheries on hatchery and wild fish. However, hatchery fish may be substantially more susceptible to predation than naturally produced fish, particularly at the juvenile and smolt stages (Piggins and Mills 1985; Olla et al. 1993).

Predation by birds and marine mammals (e.g. seals and sea lions) may also be significant source of mortality to juvenile salmonid fishes, but functional relationships between the abundance of smolts and rates of predation have not been demonstrated. Nevertheless, shorebirds, marine fish, and marine mammals (NMFS 1997) can be significant predators of hatchery fish immediately below dams and in estuaries (Bayer 1986; Ruggerone 1986; Beamish et al. 1992; Park 1993; Collis et al. 2001). Unfortunately, the degree to which adding large numbers of hatchery smolts affects predation on naturally produced fish in the Columbia River estuary and marine environments is unknown, although many of the caveats associated with predation by northern pikeminnow in freshwater are true also for marine predators in saltwater. (CRNFH CHMP, p. 20)

Cutthroat Trout. Since there is likely a small breeding population of coastal cutthroat trout in the lower Wind River, program fish from Carson NFH could potentially encounter out-migrants of sea-run cutthroat in the Wind or Columbia rivers. Time of out-migration of the sea-run cutthroat in the Columbia River may begin as early as March and peaks in mid-May (Trotter 1997) similar in time to the release of hatchery smolts. The size of the sea-run cutthroat trout smolts observed in other lower Columbia River tributaries, 100mm-260mm (USFWS Columbia River Fisheries Program Office, Vancouver, WA unpublished data), is very similar to the size of the yearling hatchery smolts released from Carson NFH. Instances of predation by hatchery smolts are thought to be low.

Bull Trout. As previously mentioned, until WDFW completes surveys, the information base is insufficient to determine status and distribution of bull trout in the Wind River and potential impact from our hatchery program. However, hatchery juveniles may be providing a forage base benefit to adfluvial bull trout. (CRNFH CHMP, p. 22)

4. Other conflicts between the hatchery program, or fish produced by the program, and other non-hatchery issues

Escapement and spawning of adult spring Chinook salmon in the Wind River pose potential disease risks both to wild steelhead and hatchery juveniles. So far there is no evidence of disease transmission to the wild steelhead after 10 years of limited sampling for pathogens. However, through 1996, the use of the Wind River water supply for higher density juvenile rearing resulted in significant disease problems with minor to major outbreaks of one or more diseases (BKD, IHN, and furunculosis). A reduction in fish production, along with limited or no use of this water (i.e., reduced horizontal transmission of pathogens from the in-river salmon) consequently eliminated pathogens of concern in the hatchery juveniles. (Lower Columbia River Fish Health Center records). In the years 2000 and 2001, in deference to political pressure and despite fish health objections, a decision was made to close the hatchery ladder on August 1st so that more adults were left in the river (Hatchery Evaluation Team meeting notes, 2000 & 2001). Subsequent studies by the USGS and USFWS indicate that spring Chinook salmon do not successfully establish naturalized populations and other than providing a possible source of nutrient enhancement, the risks of keeping spring Chinook adults in the river outweigh the benefits.

III. Spring Creek National Fish Hatchery

A. Description of hatchery

Spring Creek National Fish Hatchery (NFH) was authorized by Special Act 24 Stat. 523, March 03, 1887 and Special Act 30 Stat. 612, July 01, 1898 and placed into operation in September 1901 to support the commercial fishing industry. The hatchery was reauthorized by the Mitchell Act (16 USC 755-757; 52 Stat. 345) May 11, 1938 and amended on August 8, 1946, (60 Stat. 932) for conservation of fishery resources in the Columbia River Basin. The hatchery was remodeled in 1948 to prevent inundation by Bonneville Dam. The hatchery was again remodeled in 1970 to expand operations to meet commitments under the John Day Mitigation Act. The hatchery is currently producing tule fall Chinook salmon and is used for adult collection, egg incubation and rearing. The tule fall Chinook stock is indigenous to the White Salmon River and the hatchery has reared this stock since 1901. (SCNFH CHMP, p. xiii)

Spring Creek NFH is located 20 miles upstream from Bonneville Dam on the Columbia River, at river mile 167, on 60.21 acres. The hatchery is on the north side of the Columbia River near Hwy 14 in Skamania County, Washington (Figure 1). The hatchery is bounded by the Columbia River on the south and by 500ft high basalt cliffs to the north. (SCNFH CHMP, p. 11)

Spring Creek NFH also operates a sub-station on the White Salmon River. Known as the Big White Salmon Ponds, this facility is located on 42 acres about one and a quarter miles from the mouth of the White Salmon River. The two ponds have been used to rear spring Chinook but the facility has not been used recently and will not be used until ESA screening concerns are met and the removal of Condit Dam is decided. (SCNFH CHMP, p. 11)

The Big White Ponds were originally design to capture adult tule fall Chinook as an egg source for the Spring Creek Hatchery. Once sufficient number of adults returned directly to hatchery, the ponds were used for tule fall Chinook production and a number of other species over the years. (Hatchery Manager)

Currently Spring Creek NFH operates with a staff of ten personnel. This includes the Hatchery Manager, Assistant Hatchery Manager, a Lead Fish Culturist, three additional Fish Culturists, two Maintenance Mechanics, a Program Assistant and an Information and Education Assistant. Additionally, volunteers are utilized to assist with outreach activities and station operations when available. (SCNFH CHMP, p. 11)

7,000 to 10,000 tule fall Chinook adult brood stock are collected, spawned, eggs incubated and reared at the hatchery to produce 15.1 million sub-yearling smolts for release into the Columbia River. (SCNFH CHMP, p. 15)

The hatchery has eight buildings involved in fish production and four residences (Table 1). Currently, there are no plans for new buildings; Except for the residences, majority of all structures are the property of the Corps of Engineers. The hatchery facilities and rearing units are described in Table 2. (SCNFH CHMP, p. 13 and 14)

Table 1. Hatchery buildings, primary use of buildings, size (sq. feet) and construction type. Further information can be found within the Spring Creek NFH station guide.

Building	Square Footage (ft^2)	Construction type
Incubation Bldg	9,994	Concrete & Brick , constructed 1953, remodeled 1972. Used to incubate eggs and fry.
Shop/Garage	4,196	Brick wall, constructed 1950. Expanded 1972.
Spawning/ Office/Visitor Center	5,329	Cement/Brick, constructed 1972.
Mechanical building	10,000	Cement/Brick, constructed 1972. Water recirculating plant and biological filtration are housed within this building.
Fish Food Storage/Crew Break Room	3,577	Cement/Brick and Aluminum constructed in 1972.
Storage Building	1,500	Brick, constructed 1990. Covers variable speed pump.
Well House	120	Cement/Brick, constructed in1972.
Chlorination Bldg.	168	Cement/Brick, constructed in1972.
Quarters #1	1,087	Wood frame, constructed 1947.
Quarters #2	1,176	Brick, constructed 1952.
Quarters #3	1,228	Wood frame, constructed 1950.
Quarters #4	3,000	Wood frame, constructed 1950. Converted to Lower Columbia River Fish Health Laboratory and then converted to administrative offices in 2005
Quarters #5	1,176	Brick, constructed 1952.

Table 2. Spring Creek NFH physical description of incubation, biological filters and rearing units.

Unit type	Length (ft)	Width (ft)	Depth (ft)	Volume (ft^3)	No.	Material	Age	Condition
Burrows pond	75	17	4	5,100	44	concrete	30	Good
Circular	30 (diam.)		3	283	1	concrete	56	Good
White Salmon Raceways	232	12	4	11,136	2	concrete	50	Poor
Biological Filters	75	23	8	12,600	18	concrete	30	Good
Incubator troughs	20	1.5	1.5	45	30	fiberglass	20	Good
Vertical stack incubators				7	288	fiberglass	32	Fair
Settling lagoons				470,000	2	earthen	30	Good

Spring Creek National Fish Hatchery receives 100% of its operations budget from reimbursable funds, Corps of Engineers (COE) under the John Day Mitigation Act and NOAA Fisheries under the Mitchell Act. The original agreement was for a 50/50 split between the COE and NOAA-Fisheries, but over the years funding has been skewed toward the COE. Presently, the COE provides approximately 70% of operating costs for Spring Creek NFH. Operational budget needs are identified each year and negotiated with the COE and NOAA-Fisheries to determine the final fiscal year allocation (see following section on Mitchell Act). Deferred maintenance and most construction are usually funded by the COE, but projects are also entered into the Service's Maintenance Management System (MMS) for possible funding. Some funding for special studies can also be derived from reimbursable sources. The current budget and the number of full-time personnel at Spring Creek NFH are provided in Table 6. Additional COE and Mitchell Act funding is provided to the CRFPO, LCRFHC, Little White Salmon NFH and Abernathy Fish Technology Center for support services to the hatchery. In past years, Spring Creek NFH received Service operational funds but this was discontinued in the early 1990's. (SCNFH CHMP, p. 63)

B. Hatchery water sources[14]

The main water source for the hatchery is spring water upwelling from basalt cliffs and which is collected at several locations. Spring water is collected via a series of small dams and connecting pipes. The water is piped under State Highway 14 into a distribution box where it can be diverted into the incubation building, down the fish ladder or sent to the mechanical buildings to be pumped into the system.

Spring water is piped into the Mechanical Building where it is pumped into the recirculating system. Water flow has fluctuated from a low of 1,800 gpm to over 4,000 gpm, but supply 3,000 gpm on average. The recirculating system consists of 18 biological filter beds and 44 Burrows ponds and designed as a 90% reuse system, circulating 30,000 gpm at maximum loading. During power outages and possible failure of the standby generator to operate, water can be supplied by gravity flow to the incubation building keeping eggs and fish alive.

In 1990, the hatchery drilled an additional well that supplies warm water (66^0F) which is mixed with the spring water to increase incubation temperature from 47^0F to 52^0F. The well can supply up to 800 gpm and is used to increase the production water temperature if the hatchery is experiencing extremely cold weather The hatchery also has rights to 11.2 cfs Columbia River water. This water was used on an emergency basis for fish culture before the hatchery was remodeled in 1970 and then used as heat source water for the heat exchangers before the well was established in 1990.

Table 3. Certificates of water right held by Spring Creek NFH.

Source	Certificate No.	Date	Flow (cfs)	Use
Unnamed Creek	8398	Feb. 9, 1955	0.01	Domestic Supply
Hatchery Springs	6716	Nov. 4 1953	12.0	Fish Propagation Domestic Supply
Unnamed Creek	10424	Feb. 4, 1957	1.5	Fish Propagation
White Salmon River	9029	May 11, 1956	30.0	Fish Propagation
Well	Pending	Sept. 1991	2.22	Fish Propagation
Columbia River	12045	Nov. 20, 1959	11.2	Fish Propagation

As of December 2006 the domestic water supply has been transferred to a well source and all spring water is now used for fish culture.

[14] *SCNFH CHMP, p. 39*

C. Adult broodstock collection facilities

Adult fish come into the hatchery by swimming up a fish ladder, which drains directly into the Columbia River. From the top of the ladder, adults are directed into the rearing ponds that serve to hold broodstock during the spawning season. Holding ponds are provided with 750 gpm of hatchery spring / reuse water. To prevent fish from jumping between and out of ponds, 2' high jump boards are installed along the edge of each pond. (SCNFH Chinook HGMP, sec. 5.3)

Fish enter the hatchery daily, are visually counted and sexed, and guided to one of 17 Burrows ponds. One Burrows pond is filled at a time before another pond is opened, with each pond receiving between 400 and 1,000 fish, depending on the size of the run. (SCNFH CHMP, p. 41)

D. Broodstock holding and spawning facilities

At the start of the spawning process, adults are crowded out of the ponds and into a central channel leading to the spawning building. Fish are then crowded down the channel to the building where a portion is lifted with elevators into a bath of anesthesia. Once the fish are anesthetized they are sorted for ripeness. "Green" or unripe fish are returned to the holding pond and held for two days before being crowded and checked again for ripeness. Ripe fish are euthanized and bled prior to spawning to maximize the fertilization process. (SCNFH CHMP, p. 41)

E. Incubation facilities

The hatchery rears eggs and yolk sac fry in vertical (Heath type) incubators supplied with 3-7 gpm of de-aerated spring / well water. On-site 288 vertical units (16 trays ea, total of 4,432 trays) are housed in a 9,994 ft2 incubation building. Also housed in the incubation building are 30 fiberglass troughs (16' x 14" x 14") for washing, shocking, and inventorying of eggs. (SCNFH Chinook HGMP, sec. 5.4)

All eggs are treated with iodophor three times a week at a rate of 10 to 15 ppm. These treatments are used to reduce any bacteria related soft shell problems. Incubation takes place in a mix of spring and well water to control temperature between 48°F and 53°F. Swim-up fry are placed directly into the raceways. (SCNFH CHMP, p. 43)

F. Indoor rearing facilities

The 30 fiberglass troughs in the incubation building are used for washing, shocking, and inventorying of eggs and holding coded wire tagged fish for tag retention studies. There is no early life stage indoor rearing at Spring Creek NFH (Hatchery Manager)

G. Outdoor rearing facilities

Fry are moved outside to 44 Burrows ponds starting the first week of December. At full production, 350,000 swim up fry are placed in each of the ponds. Pond flow rates at the time of ponding are 400 gpm. After three weeks, flow is increased to 550 gpm, and again at seven weeks to a maximum 700 gpm. (SCNFH CHMP, p. 43)

Water chemistries are conducted weekly, or more frequently, to evaluate the status of the biological filters and water quality. Ammonia output by fish can be controlled by adjusting the feeding level and/or adding commercial bacteria (*Nitrosomonas* and *Nitrobacter* species) to the biofilter system. (SCNFH CHMP, p. 43)

Pond cleaning is generally not needed until the last week of February when hatchery density and loading levels are reaching their maximum level. During the past several years, the hatchery has been using a commercial, organic-reducing bacteria with some success. This action has resulted in reduced pond cleaning and back-washing of the biological filter beds. From about the first of March, pond cleaning and back-washing must be done every other week. (SCNFH CHMP, p. 43)

The use of aquamats in the ponds over the last few years has greatly reduced to need to brush the ponds to remove organic material and has improved overall water quality in the biological water reuse system. (Hatchery Manager)

In the early 1990's a study was conducted and concluded that present rearing densities produced the highest adult recoveries (Banks and LaMotte 2002). Banks and LaMotte (2002) provided data that adult contributions might increase by increasing rearing densities, but the potential for catastrophic losses in a recirculation system was a concern. The Density Index standard established at Spring Creek NFH is not to exceed 0.30. (SCNFH CHMP, p. 44)

H. Release locations and facilities[15]

Fish are released directly into the Columbia River from the hatchery.

Releases are dictated by loading factors and half of the production fish are released in March to reduce densities and organic loads on the biological filtration system. Therefore, at full production of 15.1 million smolts, 7.6 million is the release goal for mid-March at a target size ≤ 125 fish per pound.

Fish remaining after the first release are split into the empty ponds to lessen crowding and allow for more growth. In mid-April, the release goal is 4.2 million smolts at a target size of ≤ 90 fish per pound. The April release group generally migrates quickly past Bonneville Dam to the Columbia River estuary. The final hatchery release occurs during the first week in May, with a release goal of 3.3 million at a target size of ≤ 60 fish per pound. Behavior, coloration, and saltwater challenges indicate that the May release group exhibit smolt characteristics.

I. Outmigrant monitoring facilities

Release groups generally migrates quickly past Bonneville Dam to the Columbia River estuary based on weekly and monthly juvenile fish passage information provided by the Fish Passage Center located at Bonneville, Dam. (SCNFH CHMP, p. 44)

[15] *SCNFH CHMP, p. 44.*

J. Additional or special facilities

The wastewater treatment lagoon consists of a series of two rock lined settling ponds, 470,000 cu ft each, that eventually drain into the Columbia River. Hatchery effluent from the settling ponds meet established water quality standards and are diluted by the flow in the Columbia River (SCNFH CHMP, p.24).

Ponds may be cleaned or flushed weekly and the filter bed back-washed every other week. Organic loads are kept low by controlling feeding level and use of organic consuming bacteria.

K. Outreach and public education facilities/programs[16]

The Columbia River Gorge Information and Education (I&E) Office services the Spring Creek and Carson National Fish Hatcheries and the Lower Columbia River Fish Health Center. The Office shares/distributes its time and staffing between these stations. The I&E program is mainly funded by the Spring Creek NFH with assistance from the Carson NFH and the Lower Columbia Fish Health Center.

The goal of the Columbia River Gorge I&E Office outreach program is to increase the visibility of the Fish and Wildlife Service (FWS) facilities in the Columbia River Gorge and to provide information about FWS programs to internal and external audiences. FWS staff and volunteers show how FWS programs benefit the public and the environment in keeping with the FWS mission: Working with others, to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.

Program efforts l include providing information to staff, partners, and volunteers and, through them, to members of the community and other publics. Outreach is used as a management tool, providing support to the Service, the public, and our hatchery programs.

On Station. On station activities include tours of the facility to schools and special interest groups. On site educational efforts include touring some 800-1000 students through the hatchery during spawning, to gain a better understanding of hatchery operations and salmon life cycle. Information and education staff provide educational materials to schools and set up fish tanks for learning situations. Students from area schools raise tule fall Chinook salmon in their classrooms and annually release their fish into the nearby White Salmon River. Annual festivals include a Visitor's Weekend each September to highlight spawning and hatchery operations for the visiting and local public.

Off Station. Outreach efforts include an array of activities that occur throughout the Pacific Region. Examples include various festivals, classroom participation at local schools, stream adoption, participation in other National Fish Hatchery events, Jewett Creek restoration project and county fairs (Hood River and Skamania counties, and the Trout Lake Community Fair).

[16] *SCNFH CHMP, p. 56.*

L. Special issues or problems (e.g. water and property rights issues, law suits, etc.)

Spring Creek Reprogramming. In early 2003, the U.S. v Oregon parties suggested the following production change for tule and upriver bright fall Chinook salmon: Reduce tule fall Chinook salmon hatchery production at Spring Creek NFH from 15.1 million to 10.5 million smolts, make-up this reduced tule production at a lower river hatchery below Bonneville Dam, and increase upriver bright fall Chinook production upstream of Bonneville Dam. The impacts and feasibility of changing tule and upriver bright fall Chinook production are still being discussed. The discussed issues involve Bonneville Dam spill in March to benefit Spring Creek NFH, the impact on ESA listed fish, the impact of changes in rearing and release locations for Columbia River tule production on U.S. – Canada (Pacific Salmon Treaty) negotiations, and the cost for increased hatchery infrastructure for both tule and upriver bright program changes. (SCNFH CHMP, p. xvi)

Condit Dam Removal -Removal of Condit Dam on the Big White Salmon River is under negotiation. Use of Spring Creek NFH production for tule fall Chinook salmon supplementation efforts after dam removal is likely since the Big White Salmon River was the original seed stock for the hatchery. Further planning is needed.

The use of the Big White Ponds on the White Salmon River could also play a role in reestablishing salmon runs through supplementation and acclimation programs. This facility has the capacity for 100,000 smolts. However, this facility cannot currently be used for fish production or adult trapping until the water intake structure is modified to meet proper screening requirements. The facility also requires raceway rehabilitation and installation of flood protection measures. (SCNFH Chinook HGMP, sec. 1.16.2)

Hatchery Fish Ladder Management. The ladder typically remains open until all fish have entered the hatchery. Fish other than tule fall Chinook that enter the ladder during hatchery brood stock collection and surplus activities are returned to the river to continue their migration. These fish may include ESA listed species. In 2003 with the permission of NOAA-Fisheries, COE, WDFW and Yakama Nation, an alternative to the current ladder operation was tested on two separate occasions, one during which ladder operation would be open and closed periodically, or pulsed, for brood stock collection. During a pulsed ladder operation, fish in surplus of brood stock collection will be left in the river for nutrient enhancement, natural spawning, and additional fishing opportunities. Ladder operations will be evaluated again in 2004 with future operational plans negotiated through HET meetings and communications with NOAA-Fisheries, COE, WDFW and Yakama Nation. Ecological risks and benefits to native and ESA listed salmon will be evaluated. (SCNFH CHMP, p. 60)

Water Use (Drought). During drought years spring water flow may drop low enough to negatively impact water quality within the hatchery. Earlier than planned releases may be necessary during those years to reduce fish densities. All proper approvals will be obtained prior to a drought related release. (SCNFH CHMP, p. 59)

Insufficient Operations and Maintenance Funding Through the Mitchell Act. Increased demands on hatchery programs, as required by ESA Biological Opinions, have strained hatchery budgets. Without increases in Mitchell Act funding, reductions in production programs will be made. While reducing hatchery production may allow the hatchery, and the Service, to meet some ESA requirements, it may not uphold mitigation and tribal trust responsibility. The Service is working with NOAA-Fisheries and other co-mangers (SCNFH CHMP, p. 62)

Marking. Mass marking (100% adipose fin clipped) of the entire hatchery production (15.1 million smolts) of fall Chinook salmon began in 2005. Mass marking at Spring Creek NFH is logistically difficult due to the large number of fish produced. (SCNFH CHMP, p. 58)

IIIA. Spring Creek NFH Tule Fall Chinook[17]

A. General information

- Tule fall Chinook (*Oncorhynchus tshawytscha*) are the propagation species. The Lower Columbia Fall Chinook have a Threatened Status under the ESA. The hatchery component of Columbia Fall Chinook is considered part of the ESU but is not essential for recovery.

- Spring Creek National Fish Hatchery was founded and began rearing tule fall Chinook in 1901. The brood stock originated from the White Salmon River, a mile from the location of the hatchery, and is the stock of choice for reintroduction in the White Salmon River pending Condit Dam removal scheduled in 2006.

- Spring Creek NFH tule fall Chinook salmon are a major component in ocean fisheries. This stock influences ocean fishery management decisions.

- The hatchery escapement goal is 7000 adults of which 4,000 need to be females to produce 15.1 million sub-yearling smolts for release into the Columbia River.

- Fish exceeding the escapement goal are distributed meeting tribal requests as a first priority. When return numbers are in excess of escapement goals, surplus fish are randomly selected throughout the spectrum of the run.

- In early 2003, the U.S. v Oregon parties suggested the following production change for tule and upriver bright fall Chinook salmon: Reduce tule fall Chinook salmon hatchery production at Spring Creek NFH from 15.1 million to 10.5 million smolts, make-up this reduced tule production at a lower river hatchery below Bonneville Dam, and increase upriver bright fall Chinook production upstream of Bonneville Dam. The impacts and feasibility of changing tule and upriver bright fall Chinook production are still being discussed. The discussed issues involve Bonneville Dam spill in March to benefit Spring Creek NFH, the impact on ESA listed fish, the impact of changes in rearing and release locations for Columbia River tule production on U.S. – Canada (Pacific Salmon Treaty) negotiations, and the cost for increased hatchery infrastructure for both tule and upriver bright program changes.

- Fish are normally released as fingerlings in three groups (7.6 million in March, 4.2 million in April, and 3.3 million in May) with total juvenile fish production at 15.1 million smolts. Actual release numbers are dependent upon loading densities, river conditions, growth, health and development of the fish.

- All fish reared in this program are released and expected to return to the Bonneville pool of the Columbia River.

- Compared to other hatchery populations of tule fall Chinook, the Spring Creek stock has likely retained many of the genetic and life-history characteristics of the original lower Columbia River tule Chinook population. This is because of Spring Creek's large annual

[17] *Unless noted otherwise, all information from the SCNFH Chinook HGMP, 2003 & SCNFH CHMP, 2004.*

spawning population and relative lack of historical brood stock transfers from outside sources into Spring Creek NFH compared to other lower river tule fall Chinook facilities.

- Spring Creek National Fish Hatchery is located in Skamania County, near the communities of Underwood and White Salmon, WA. The hatchery is bordered by the Columbia River (WRIA 29) at river kilometer 269.

B. Stock/Habitat/Harvest Program Goals and Purpose

1. Purpose and justification of program

The purpose of the tule fall Chinook program at Spring Creek National Fish Hatchery (SCNFH) is to mitigate for lost and degraded habitat and fish populations caused by the construction and operation of the Columbia River hydrosystem by producing locally adapted broodstock for sport, commercial, tribal, and international harvest.

2. Goals of program

- Goal 1: Conserve Columbia River tule fall Chinook salmon in the area upstream of Bonneville Dam (as defined in the Mitchell Act of 1937).

- Goal 2: Assure that hatchery operations support Columbia River Fish Management Plan (United States v. Oregon) production and harvest objectives.

- Goal 3: Minimize impacts to ESA listed and other native fish and wildlife species, their habitat, and the environment.

- Goal 4: Develop outreach to enhance public understanding, participation and support of Service and Spring Creek NFH programs.

3. Objectives of program

- Successfully maintain a brood stock of tule fall Chinook salmon at Spring Creek National Fish Hatchery without the need for out-of-basin egg or fish transfers to the hatchery (achieve a minimum 0.05% smolt to adult return back to the hatchery).

- Collect sufficient brood stock to produce 15.1 million smolts for on-station release into the Columbia River.

- Contribute to a meaningful harvest for sport, tribal and commercial fisheries both in the ocean and in-river (achieve a 10-year average of ≥ 0.5% smolt to adult survival, harvest plus escapement).

- Conduct monitoring and evaluation to ensure that goals are achieved.

- Meet tribal trust responsibilities.

- Communicate and coordinate effectively with co-managers in the Columbia River Basin.

- Minimize harmful interactions with other fish and wildlife populations.

- Increase public awareness, providing information and education about Service programs and Spring Creek NFH to internal and external audiences; and develop forums for public participation into Spring Creek NFH issues.

4. *Type of program*

Isolated (Segregated) Harvest Program: Mitigation

5. *Alignment of program with ESU-wide plans*

- The Spring Creek tule fall Chinook brood stock originated from the White Salmon River, a mile from the location of the hatchery, and is the stock of choice for reintroduction in the White Salmon River pending Condit Dam removal scheduled in 2006 (SCNFH Chinook HGMP, sec. 1.7). Removal of dam now scheduled for October 2008 (from public meeting with Pacificorp, January 2007)

- For Spring Creek NFH, two distinct factors contribute towards minimizing adverse effects on listed fish species: the present fishery harvest design and the release of hatchery smolts that are physiologically ready to migrate. The lower Columbia River Chinook ESU escapes significant mainstem harvest rate impacts in the lower river due to the current design of the fishery. A small population of the naturally spawning lower Columbia River Chinook ESU occurs above Bonneville Dam. This population presumably experiences a higher harvest rate in tribal fisheries (Zone 6 fishery unit) than the populations below Bonneville Dam. The potential for higher harvest rates on a couple of the small tributary populations above Bonneville Dam, is believed to be largely supported by locally spawning Spring Creek NFH tule fall Chinook, and is not expected to have a significant impact on the overall ESU. Because harvest rate jeopardy standards for Snake River fall Chinook dictate the management of both ocean and in-river fisheries under a weak-stock management approach, harvest of Spring Creek fall Chinook program fish is not expected to have a significant impact on listed species. The 1999 fall-season harvest biological opinion determined that fisheries did not jeopardize any listed species (NMFS 1999c) (SCNFH Chinook HGMP, 2003).

- Spring Creek fish are released directly into the mainstem Columbia River migration corridor rather than into tributary spawning or rearing areas. Based on Bonneville Dam sampling of juveniles, Spring Creek fish appear to emigrate rapidly, reducing the potential for competitive interaction with listed fish. Because Spring Creek NFH releases occur "low" in the system relative to many other upriver programs, and the emigration through the migration corridor appears to be rapid, there is reduced opportunity for competitive interactions. In addition, the three-release strategy also should reduce potential competitive interactions (SCNFH Chinook, 2003).

6. Habitat description and status

- One of the main purposes of this program is to mitigate for spawning habitat lost by the creation of dams in the main stem of the Columbia River. Given that much of this habitat is irretrievably lost (unless several major dams are removed) this production program is expected to continue for the foreseeable future.

- Tule fall Chinook spawned in the lower reaches of the Wind, Little White Salmon, White Salmon, and Klickitat rivers. After the construction of Bonneville Dam in 1938, spawning grounds were inundated and little of the historical spawning grounds of tule fall Chinook remained. Restoring the tule fall Chinook run into the White Salmon River, where the Spring Creek NFH stock originated, may be a reality if Condit Dam is removed. With the removal of Condit Dam, 18 miles of river will be available for all anadromous fish, including tule fall Chinook salmon.

7. Size of program and production goals (No. of spawners and smolt release goals)

Spring Creek NFH's production goal is 15.1 Million subyearling smolts. The escapement goal is 10,000 adults of which 4,000 needs to be spawning females. To achieve a 1 to 1 spawning ratio, a minimum of 4,000 males, of which 2 to 3% could be jacks, is needed.

C. Description of program and operations

1. Broodstock goal and source

- The brood stock originated from the White Salmon River, a mile from the location of the hatchery. Compared to other hatchery populations, the Spring Creek stock has likely retained many of the genetic and life-history characteristics of the original lower Columbia River tule Chinook population. This is because of Spring Creek's large annual spawning population and relative lack of historical brood stock transfers from outside sources into Spring Creek NFH compared to other lower river tule fall Chinook facilities.

- To achieve production goals, 7,000 tule fall Chinook brood stock are needed based on the following assumptions:
    a. 15.1 million smolt release goal
    b. 4,000 of the 7,000 are females
    c. Fecundity of 5,000 eggs per female
    d. Less than 5% pre-spawning mortality
    e. ≥ 95% survival egg to eye-up
    f. ≥ 90% survival egg to fry
    g. ≥ 97% survival fry to smolt

- A widely held assumption regarding Spring Creek broodstock collection is that the escapement needs to be 7,000 adults (4,000 females). However, this is the minimum. With normal mortality during broodstock holding, ripeness/green issues, variable sex ratios, and including jack returns, a more realistic escapement goal for the hatchery is 10,000 adults. To safely reach the spawning target, escapement needs to be roughly 10,000 total (including jacks). (Ahren Sept. 2006)

- If brood stock numbers are insufficient to meet hatchery production objectives, the hatchery will rear fewer fish. At present there is no other hatchery rearing the Spring Creek stock and therefore, no other acceptable tule fall Chinook hatchery stock. Historically, tule fall Chinook returning to the White Salmon River were used for brood stock in years of insufficient return.

- HGMP: Adult tule fall Chinook collected from the White Salmon and Little White Salmon rivers provided the original source of eggs for the hatchery. Eggs were collected from the White Salmon starting in 1901 and continued uninterrupted until 1964. Eggs were also collected from the White Salmon in 1986 and 1987.

- In 1972, 12 million eggs from the Toutle River State Hatchery (Washington Department of Fish and Wildlife) were brought into Spring Creek. The Toutle River stock originated from Spring Creek. Toutle River State Hatchery eggs were fertilized with Spring Creek NFH males and egg loss exceeded 50%. Less than 5 million smolts were released from this group.

- In 1986, 1.1 million eggs were transferred from Little White Salmon National Fish Hatchery. These adults were strays from Spring Creek that entered the Little White Salmon River.

- In 1987 and 1988 adult females were transferred from Bonneville State Hatchery (Oregon Department of Fish and Wildlife). These eggs were fertilized with Spring Creek NFH males. In 1987 and 1988, 6.1 and 13.1 million eggs were collected, reared and released at Spring Creek NFH. To minimize the effect on future brood year genetics, a spawning protocol was devised to minimize any genetic impairment (see section 8.3) and followed as closely as possible by Spring Creek NFH personnel.

2. *Adult collection procedures and holding*

- Adult tule fall Chinook return to the hatchery from late August through September with 70% of the return entering the hatchery between September 4th and September 20th. Traditionally, the spawning process starts on the 15th of September and is generally finished by the 5th of October. Spawning takes place daily with an average daily egg take of 1.75 million (up to 5 million).

- Fish enter the hatchery daily, are visually counted and sexed, and guided to one of 17 Burrows ponds. One Burrows pond is filled at a time before another pond is opened, with each pond receiving between 400 and 1,000 fish, depending on the size of the run. Adult holding ponds are provided with 750 gpm of hatchery spring / reuse water. Ponds are checked daily for any moribund or dying fish.

- Surplusing of excess adults occurs daily (?). Fish beyond hatchery needs are distributed to the Yakama Nation for Ceremonial and Subsistence (C&S) and other tribes as requested. Additional fish are transferred to the Bureau of Federal Prisons for inmate rations. Any fish anesthetized using Tricaine Methanesulfonate (MS-222) is considered unfit for human consumption by the Food and Drug Administration. Surplus or spawned carcasses are available for stream enrichment directly or can be processed into bio-cubes for future enrichment programs. All other surplus fish will be rendered through a Service-approved rendering company.

- Tule fall Chinook are easily distinguished from other fall Chinook stocks and salmonid species based on coloration. All tules returning to the hatchery are assumed to be of hatchery origin --- all other fish are returned directly to the Columbia River.

3. *Adult spawning*

a) Spawning protocols

- Brood stock collection at the hatchery is managed to maintain the genetic integrity of the stock and is randomly collected across the spawning run in proportion to the rate at which they return. All fish returning are allowed to enter the hatchery.

- At the start of the spawning process, adults are crowded out of the ponds and into a central channel leading to the spawning building. Fish are then crowded down the channel to the building where a portion is lifted with elevators into a bath of anesthesia. Once the fish are anesthetized they are sorted for ripeness. “Green” or unripe fish are returned to the holding pond and held for two days before being crowded and checked again for ripeness. Ripe fish are euthanized and bled prior to spawning to maximize the fertilization process.

- When possible, a strict 1:1 spawning ratio is used, however the sex ratio of returning adults is typically skewed toward females (1.0 male to1.4 females). Jacks are randomly included and comprise 2% of the male spawning population. The hatchery goal is to maintain an effective population size of greater than 5,000.

b) No. of males and females spawned each year over past 10 years

Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

Year	Adults Females	Males	Jacks	Eggs (millions)
1987[a]	2476	495	0	20.5
1988[a]	4076	696	125	39.7
1989[a]	2433	993	68	24.4
1990	3880	1166	0	20.7
1991	6435	3764	373	33.3
1992	4701	2705	0	24.1
1993	4257	2827	72	20.5
1994	5435	3886	134	26.2
1995	4924	2482	74	23.3
1996	3647	2266	91	16.2
1997	5267	2803	79	24.3
1998	2807	1700	106	11.9
1999	6095	3050	55	27.3
2000	2401	1551	75	11.8
2001	6265	4005	140	30.9
Mean	4340	2293	93	23.7

[a]Adult fish include fish captured in adult traps below and above Bonneville Dam and returning to Spring Creek NFH
Data source: CRiS (Stephen M. Pastor August 2002) database

- Recent returns to hatchery: **2001**—48,702; **2002** – 70,959 (SCNFH HET, July 2003)

4. Fertilization

a) Protocols

On a given spawning day, fish are transferred to the spawning building, one pond at a time. Fish are crowded out of the pond and into the channel with manual crowders. Mechanical crowders are used to move the fish from the channel into a mechanical lift. While in the lift, fish are anaesthetized with MS-222, and then transferred onto the sorting table. While on the sorting table, ripe fish are segregated, and unripe fish returned to the holding ponds. All fish judged to be ripe are sent down the table where they are killed, and separated by sex. The females are bled by severing the caudal vein. Eggs are then removed by cutting the abdomen open with a Wyoming knife. Ovarian fluid is removed by draining the eggs in a colander. Eggs from a single female are placed in a bowl and fertilized with a single male (1:1 spawning ratio). Immediately after milt is added, saline solution is added and eggs mixed gently, this is to increase the distribution of sperm around the eggs and increase fertilization. Fertilized eggs are transferred to the incubation building where the milt is washed from the eggs, and water-hardening occurs. Fertilized eggs are placed into vertical incubators (Heath type) at a density of 7500 eggs / tray. All equipment used is routinely disinfected with an iodine solution. Any vessels used to hold eggs or sperm are disinfected between individual fish.

b) Number of eggs collected and fertilized each year over past 10 years[18]

Brood Year	Eggs Taken (millions) Hatchery goal > 17.8 million	Survival Egg to Eye-up (%) Hatchery goal >95%	Survival Egg to Pond (%) Hatchery goal >90%	Survival Pond to Release (%) Hatchery goal >97%
1988 [a]	21.72 [b]	80.2	77.9	90.5
1989 [a]	12.2 [b]	93.0	86.5	96.9
1990	20.72	91.7	85.8	97.7
1991	33.3	95.5	90.1	95.5
1992	24.14	96.3	93.3	96.3
1993	20.45	96.1	87.0	97.2
1994	26.2	95.4	91.1	98.8
1995	23.31	93.1		97.5
1996	16.22	93.2	90.5	98.0
1997	24.25	96.6	94.3	98.1
1998	11.89	95.7	92.6	96.3
1999	27.25	97.4	94.8	97.2
2000	11.76	94.4	92.4	97.3
2001	30.98	91.9	87.5	97.9
Mean ± SD	21.7 ± 6.8	93.6 ± 4.3	89.5 ± 4.6	96.8 ± 2.0

[a]Survival rates for this year are for eggs taken from Spring Creek NFH and from trap sites located above and below Bonneville Dam.
[b]Eggs taken from fish returning to hatchery only. For complete number of eggs taken during this year from trap sites and hatchery see Table 7.4.2 in Spring Creek HGMP.

[18] *SCNFH Chinook HGMP, sec. 9.1.*

- For 2006, full egg enumeration was completed on Nov. 3, 2006. The final estimated total of eggs taken during spawning this year was 20.16 million. The final fecundity calculation has been slightly corrected to be 4,748 eggs per female (from 4,725 at midpoint of enumeration). This is far closer to the 4,700 eggs/female prediction than the fecundity estimates were last year using average the female length regression formula. Final eye-up was 93.1%. (Ahren Nov. 2006)

- Hatching began Nov. 5, and as of the end of the month all fry are hatched. Ponding is expected to begin Dec. 11. The target for ponding is 15.80 million.

- Water source to the egg-incubation building is 50% well water and 50% spring water, averaging 52°F.

- Nov. 2006 Egg/Fry Summary (takes 10 thru 12 left to pick mortality)

Females Spawned	Eggs/Female	Green Eggs	Eyed Eggs
4,748	4,748	20,160,523	18,765,833

Sac-Fry on hand so far after mortality pick from trays thru take 9 and including unpicked takes 10-12 (no discards): = 16,469,367
Discards to date eyed-eggs and fry: eyed-eggs 1,050,000
fry = 616,617

- Hatchery goals (from Performance Standards) are: ≥ 95% egg to eye up; ≥ 90% egg to fry (ponding); ≥ 97% fry to smolt (ponding to release).

5. *Incubation*

- Eggs in excess of program goals are routinely taken in years of high adult returns. This is to ensure that fish from the entire spectrum of the migration period are used in the spawning population. If these excess eggs are not required by other production facilities / programs they are discarded (by burying on-site). A representative portion from each of the egg takes (spawning days) is maintained and additional eggs culled from the population. The decision about which egg baskets (within an egg take) to discard is largely determined on the base of egg quality and eye-up rate. All excess eggs discarded are at the eyed stage.

- Fertilized eggs are put down at a density of 1.5 females / tray (average 7500 eggs /tray) in Health type incubators. Prior to eye-up eggs are provided with 3 gpm of de-aerated spring/ well water. At eye-up eggs are shocked, salted, enumerated, and returned to the trays at a density of 4000 eggs / tray. Following eye-up, flows are increased to 5-6 gpm.

- To manipulate growth and development of the eggs, well water (66 °F) is added to the spring water (47 °F) to maintain a temperature of 50 °F. This mixing occurs prior to entering the de-aeration tower where culture water passes through a packed column of coke rings. Dissolved oxygen has never been an issue and is not routinely monitored.

6. *Ponding*

a) Protocols

- Fry are ponded at 1500 – 1550 cumulative temperature units, which correspond to about 85% button-up. Swim-up and ponding are forced during mid to late December. The average size at ponding for the latest brood year was 1209 ± 6.7 fish / lb (± SE).

b) Number of fry ponded each year, including % hatch each year

- See table under *Fertilization.*

- Fry began going out to ponds on Dec. 11, 2006. Ponding went very well and ended on Dec. 20 when the last of 15,810,622 fry were put out. Survival from spawning to feeding was 87.3%. Survival to eye-up was normal with slight drop this year to 93.1% from 93.2% last year and 93.4% in 2004. Average fry size at ponding was 1,100 fish/lb. (Ahren Dec. 2006)

7. *Rearing/feeding protocols*

- Current hatchery rearing practices stipulate a density-index goal of no higher then 0.28, and a flow-index goal of no higher then 1.50 (see section 1.10 for computation of density and flow indices). Values for these two metrics rarely exceed the targeted goals, however density-index is generally higher than the target for the week or two prior to the March release. Fish left after the March release, are split into the empty ponds and the density index remains below target for the rest of the rearing season. Initial ponding is at a density of about 350,000 fish / pond (113 fish / ft^3), this density is maintained until the fish are split after the March release, when fish density decreases to around 210,000 / pond (68 fish / ft^3).

- Water quality (O_2, NH_3, NO_2, NO_3, pH; before and after the filter beds) is measured weekly. Water temperature is monitored daily. Pond screens (drains) are cleaned as needed, at least weekly. Pond bottoms are cleaned with a brush as needed (weekly to monthly). The filter beds are backwashed on a biweekly basis at the beginning of the rearing period, and then on a weekly basis as the level of feed applied increases. For the first month to month and a half after ponding, well water (66 ºF) is mixed with spring water (47 ºF). This allows the hatchery to maintain a water temperature of 48-50 ºF, depending on weather conditions. The well is generally turned off by the first of February and water temperature is dependent on ambient conditions (47-49 ºF range).

- For the first three weeks of culture, ponded fry are fed at a targeted rate of 0.016 inches / day. This rate is increased to 0.016 – 0.018 inches / day, and kept there until the March release. If water temperature drops (due to unusually cold weather) the targeted growth rate is reduced to 0.014 - 0.015 inches / day. After the March release growth rate is increased to 0.02 inches / day. A feed conversion factor of 0.85 – 0.9 (lb feed / lb growth) is maintained throughout the rearing period. During the two weeks prior to release, the feeding rate is increased by 10 %. After the initial month of culture, fish growth is assessed bi-weekly and condition factor determined monthly.

8. Fish growth profiles

Overall fish size and culture conditions at the end of each month for all release groups from brood year 2001.

Month	Fork Length (in)	Weight (#/lb)	Condition Factor ($C*10^{-7}$)	Density Index (lbs fish / ft^3)	Flow Index[2]	Feed Conversion to date
Dec. 2001	1.7	729	2790	0.09	0.40	0.94
Jan. 2002	2.2	324	2900	0.16	0.75	0.75
Feb. 2002	2.8	154	2960	0.26	1.23	0.69
March 2002	3.4	85	2990	0.15	0.73	0.74
April 2002	4.1	48	3020	0.22	1.05	0.74

[2]- Flow index is calculated as lbs fish / (length of fish in inches)(gallons per minute inflow).

Please note that this data is provided to demonstrate general fish growth and culture characteristics of tule fall Chinook Salmon reared at Spring Creek NFH. This data combines values from three distinct release groups (March, April, and May) that are managed for different target release sizes and may be grown at considerably different overall rates (see SCNFH Chinook HGMP, sec. 9.2.6 for details).

9. Fish health

- The Spring Creek tule fall Chinook salmon are remarkably healthy, making this a suitable stock for this facility dependent upon 90% reuse water.

- The Spring Creek tule fall Chinook adults have a very low incidence of vertically transmitted pathogens so their offspring begin life without the burden of inherited infections (i.e., BKD, IHNV) that could develop into disease.

- The young tule fall Chinook are generally only at risk from environmentally-induced pathogens that are natural inhabitants in the water source or carried by aquatic animals/birds. The spring water source is relatively clean, notwithstanding its aquatic residents (frogs, salamanders, other animals) which may contribute pathogens like *Yersinia ruckeri* (enteric redmouth disease), *Aeromonas hydrophila* and *Saprolegnia*. Enteric red mouth (ERM) disease annually causes low level mortalities, as does "flag tail" a fungus infection of the caudal peduncle.

- The young hatchery juveniles are at risk when water temperatures enhance the life cycles of pathogens ubiquitous in the springs or the Columbia River. The recirculation of ninety percent of the water also means the recirculation of any pathogens that benefit from environmental conditions conducive to their growth. *Ich* periodically causes concern and has initiated a partial release a few days prior to one of the scheduled releases.

- Bacterial gill disease can cause rapid annihilation of fish within days, and was responsible for a catastrophic loss in 1985 when the system was overloaded. The last outbreak of BGD occurred two weeks (April 27) before the last release in May 2005, prompting an early release before epizootic conditions ensued. This was the first year for mass marking which had been completed the first week of April. Released all but three ponds (340,000 fish) which were treated with Diquat as an experiment in efficacy and its effect on the biofilter.

- The LCRFHC provides a special exam of the external/internal physical features (Goede's exam, Goede and Barton, 1990) of 10 randomly selected fish/raceway a few days prior to each release. This information is used by hatchery personnel to ascertain general health of the population in relation to their survival and return as adults.

10. Chemotherapeutant use

- Generally, fish health remains generally excellent because the adults have a very low incidence of pathogens. This is important because they inhabit the ponds eventually used by their juveniles, and despite extensive cleaning and back-flushing of the oyster beds in the recirculation system, it would be impossible to thoroughly disinfect the system.

- Abatement of pathogen transmission through the use of chemotherapeutants requires a fine balancing of fish numbers, density, water temperature (limited) and levels of the chemotherapeutant to obtain an effective treatment, while preventing dysfunction of the bio-filter. In reality, even simple formalin treatments for parasites are often ineffective, the levels necessary for killing also being the levels that kill the bio-filter and creating the potential for rapid onset of bacterial gill disease.

- The hatchery has used formalin at low concentrations to control some external parasites on juveniles with limited/minimal success. The adult brood stock is in the hatchery for only two to three weeks so formalin treatments for fungus and parasites are not used.

- As of 2005, the technical difficulties of water-hardening of eggs with a polyvinyl-pyrrolidone iodine compound (approximately 1% iodine) at this large facility were worked out, and this protocol has been used since. All eggs are water-hardened in the incubator trays at 50 ppm iodophor for 20 minutes (HET meeting notes, 2006)

- Eggs are treated three times per week regularly with a low level of Iodophor (10 - 15 ppm), primarily to prevent losses from soft-shell disease. In the past, mortalities from this disease were severe enough to initiate various experimental treatments to control mortalities (Lower Columbia River FHC files) but a series of improvements over the years, including gentler handling of adults and the use of well water with a high sulfur content, have controlled this problem (personal communication, Ed LaMotte, 2002). Fungus on eggs has not been a problem so treatments for its control are not routinely used. Losses incurred during and after hatching are typically less than 3% and are removed manually by hatchery staff.

- In 2005, the April/May release groups were vaccinated against ERM as a precautionary measure to reduce disease potential and to limit carrier status that might be induced by the first mass marking event. (LCRFHC Report, 1/4/05)

- In May 2005, Diquat, an herbicide effective against waterborne fish pathogens, was tested for its efficacy in controlling bacterial gill disease in three ponds of fish affected by the disease. It was deemed neither effective nor harmful.

- In 2006, a closely monitored medicated feed trial was performed April 18-27 with ponds 1, 16, and 24 to determine efficacy of controlling ERM. . The fish received oxytetracycline medicated feed at 1.0% BWD for ten days. Ponds 5 and 23 were monitored as controls. The LCRFCH observed nothing conclusive: neither pathology exam nor daily mortality rates showed changes/improvement during and after treatment. (Ahrens May 2006)

- The inability to use chemotherapeutants to control pathogens makes it important to prevent disease occurrence and to ensure that regular sanitation of the reuse system is maintained. It has been necessary to protect fish health through approved early releases to reduce fish numbers when environmental conditions dictate. All early releases are done in accordance with the fish health policies of the USFWS and the Washington and Oregon co-managers which prohibit the spread of exotic or listed pathogens.

- The limitations imposed by the biological filter minimize chemical and drug use which reduces impacts on the local environment, eases compliance with many safety regulations, and reduces risks to employees.

11. *Tagging and marking of juveniles*

- Spring Creek is an index stock for the US/Canada Pacific Salmon Treaty. Juvenile fish are fin clipped and coded-wire tagged by CRFPO to monitor and evaluate fish cultural techniques, survival and fishery contribution.

- Since 2005, 100% of the salmon are mass marked (adipose clipped) for the purpose of selective fisheries management. This 15 million subyearling smolt program is the largest marking operation ever attempted. Of the 15 million fish mass mark, 450,000 receive a cwt and another 450,000 receive a cwt, but are not adipose clipped, to assess selective fisheries. (LCRFHC report, 1/4/05)

- This operation requires daily handling of about 264,000 fish in 16 hour days from January 18 to April 8, 2005, a total of 57 days of near-constant human presence. In the past, only 450,000 fish (66,000 to 88,000 per day) were marked and tagged with coded-wire, requiring fewer than 14 eight hour days.

- Marking begins in January, necessitating manual tagging because of the small fish size. Later, automated marking trailers are operating. (LCRFHC Report, 1/4/05)

- It is expected that the extra crowding and handling of the fish necessary for mass marking operations can increase the stress levels of the fish, a factor that is more significant at Spring Creek NFH which rears fish in water that is 90% reused. It is for this reason that the parameters in Tables 1 and 2, Monitoring Criteria and Disease Monitoring, respectively, will be used to prevent the spread of disease as per USFWS Fish Health Policy. If signs of concern reach the notification level in Table 2, personnel from the Lower Columbia River Fish Health Center and hatchery will contact the marking crew chief, the Vancouver Fisheries Resource office, and the Regional Office to assess a possible need for cessation of marking activities. (LCRFHC Report, 1/4/05)

Table 1: Monitoring Criteria

Component	**Desired Range**	**Comments**
Water Chemistry		
Temperature	46˚F - 50˚F	Over 51˚F expedites disease problems (49˚F if ERM present)
Dissolved Oxygen	> 7.5 ppm	Not an expected concern
pH	7.1 – 7.6	pH of 8.0 indicates significant problem in water reuse system
Ammonia (NH4)	< 0.30 ppm	At or near this level, BGD bacteria multiply rapidly (*see disease monitoring)
Nitrate (NO3)	0.0 – 3.0 ppm	Indicator of nitrification function and ammonia levels
Nitrite (NO2)	0.001 – 0.030 ppm	Indicator of nitrification function and ammonia levels
Environmental Parameters		
Density Index (D.I.)	< 0.28	0.29 is near limit for effective cleaning of water by reuse system
Flow Index (F.I.)	< 1.40	1.50 is near limit for effective cleaning of water by reuse system
Fish Health		
Daily Mortality	< 0.01%	0.1% daily mortality for 4 consecutive days indicates serious problem

Table 2: Disease Monitoring

Disease/stress	Signs of Concern -- Notification Level	Cessation of Marking
Bacterial Gill Disease (BGD); causes up to 90% mortality within 2-5 days. Onset is rapid with few warning signs. Causative agent is always present in water supply.	*Increase in ammonia levels, clubbing, fusing of gills; fish go off-feed	Any detection of bacteria on gills. Onset and rapid mortality can occur within 24 hours after seeing bacteria. Release of fish may be necessary.
Virus Uncontrollable by chemotherapeutants	Any detection of virus	Virus detected in moribund/dead fish. Full or partial release may be required to prevent spread of disease.
Enteric Redmouth Disease (ERM); stress causes disease and increases undetectable disease carriers.	0.05% daily mortality continuing 4-5 days (ERM detected in 25% of moribund fish with no tail rot)	0.1% daily mortality continuing 4-5 days (ERM detected in 25% of moribund fish with no tail rot).
***Ichthyophthirius mutifiliis* (Ich)**	Appearance of theronts (sub-adult stage) on gills and skin	5+ theronts/gill arch on 60% of the fish.
Other	Increased cannibalism or aggression, anorexia (off-feed), fungus, tail rot, unknown	$\geq$0.1% daily mortality for 7 consecutive days.

12. Fish Release

a) Protocols

- The Spring Creek facility is operated under a strategy that releases smolts (fingerlings) during three time periods: March, April, and May. This release strategy maximizes production from available rearing space. The three-release strategy also likely reduces potential density dependent effects, as well as other potential ecological effects, at least in the mainstem corridor and estuary, relative to a single large release.

- Approximately one-half of the total production is typically released in March, with the remaining production split approximately equally between April and May releases. The March release occurs before the general out-migration of most other natural and hatchery stocks begins, reducing potential density dependent effects as well as other potential ecological effects such as competition, predation, and disease transmission. The date of the March release is largely dictated by loading densities at the hatchery and coincide with an approved spill request to the Corps of Engineers, a total dissolved gas waiver from Oregon Department of Environmental Quality (ODEQ), and an adjusted dissolved gas standard from Washington Department of Ecology (WDEQ) for increased spill at Bonneville Dam for a ten day period Splitting the April and May releases reduces the potential for significant interactions on a particular component of the natural out-migration that may be emigrating from the Columbia River system at the same time as Spring Creek releases.

- April and May release dates are more flexible and can be changed on the basis of river conditions, growth, health and development of the fish. Fish are forcibly released on a per pond basis. Although the hatchery would prefer to adopt a volitional release strategy, available facilities prevent this strategy from being used.

b) Number of fish released each year (subyearlings?; yearlings?; other?)

Release dates, stage, number of fish, and number per pound of Spring Creek National Fish Hatchery tule fall Chinook salmon, 1990-2007 (USFWS CRiS Database).

Spring Creek NFH Tule Fall Chinook releases
in Columbia River, 1990 - 2002.

Release Date	Brood Year	Number	Size #/lb.	Stage
03/15/1990	89	2,700,974	109.00	fingerling
04/12/1990	89	3,518,071	63.00	fingerling
04/19/1990	89	597,183	65.00	fingerling
05/17/1990	89	3,417,259	37.00	fingerling
03/21/1991	90	6,864,063	123.00	fingerling
04/18/1991	90	4,094,005	68.00	fingerling
05/16/1991	90	3,390,536	42.00	fingerling
12/20/1991	91	3,292,304	1,100.00	fry
02/19/1992	91	3,184,971	131.00	fingerling
02/20/1992	91	2,186,030	132.00	fingerling
03/05/1992	91	7,210,680	115.00	fingerling
04/16/1992	91	3,547,434	53.00	fingerling
05/21/1992	91	2,943,240	36.00	fingerling
12/24/1992	92	7,663,086	1,193.00	fry
03/18/1993	92	6,856,282	138.00	fingerling
04/15/1993	92	3,978,719	89.00	fingerling
05/20/1993	92	3,475,019	46.00	fingerling
03/17/1994	93	7,837,490	120.00	fingerling
04/14/1994	93	4,141,822	82.00	fingerling
05/19/1994	93	3,628,544	42.00	fingerling
03/16/1995	94	7,941,332	112.00	fingerling
04/13/1995	94	4,257,254	78.00	fingerling
05/18/1995	94	3,791,428	45.00	fingerling
03/14/1996	95	8,018,699	124.00	fingerling
04/18/1996	95	4,478,112	76.00	fingerling
05/16/1996	95	3,468,857	45.00	fingerling
05/17/1996	95	474,823	51.00	fingerling
03/13/1997	96	7,172,638	120.00	fingerling
04/18/1997	96	3,918,021	67.00	fingerling
05/15/1997	96	3,456,666	41.00	fingerling
12/24/1997	97	6,928,619	1,150.00	fry
03/13/1998	97	7,727,127	111.00	fingerling
04/20/1998	97	4,217,700	62.00	fingerling
05/15/1998	97	3,674,602	39.00	fingerling
03/18/1999	98	4,065,232	116.00	fingerling
04/22/1999	98	3,527,184	75.00	fingerling
05/13/1999	98	2,999,659	60.00	fingerling
12/16/1999	99	3,116,006	1,194.00	fry
03/09/2000	99	8,177,725	122.00	fingerling
04/20/2000	99	4,309,676	68.00	fingerling
05/18/2000	99	3,578,544	39.00	fingerling
03/08/2001	00	5,314,481	118.00	fingerling
04/16/2001	00	5,255,329	60.00	fingerling
12/11/2001	01	1,523,330	1,218.00	fry
12/12/2001	01	1,518,072	1,276.00	fry
02/11/2002	01	848,986	350.00	fingerling
03/11/2002	01	7,791,715	116.00	fingerling
03/29/2002	01	3,995,694	100.00	fingerling
04/30/2002	01	3,481,511	49.00	fingerling
12/09/2002	02	3,007,990	1,173.00	fry

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Spring Creek NFH Tule Fall Chinook releases
in Columbia River, 2003 - 2007.

Release Date	Brood Year	Number	Size #/lb.	Stage
03/08/2003	02	7,638,672	133.00	fingerling
04/14/2003	02	4,070,365	71.00	fingerling
05/08/2003	02	3,370,867	48.00	fingerling
03/01/2004	03	3,677,307	170.00	fingerling
03/10/2004	03	3,654,168	144.00	fingerling
04/14/2004	03	3,940,257	72.00	fingerling
05/06/2004	03	3,381,797	52.00	fingerling
03/02/2005	04	7,348,976	183.00	fingerling
04/15/2005	04	3,915,785	122.00	fingerling
04/27/2005	04	923,029	108.00	fingerling
04/28/2005	04	2,005,782	110.00	fingerling
05/04/2005	04	339,916	59.00	fingerling
03/02/2006	05	7,591,028	171.00	fingerling
04/17/2006	05	4,227,018	128.00	fingerling
05/05/2006	05	3,421,008	134.00	fingerling
03/05/2007	06	6,598,443	149.00	fingerling
03/09/2007	06	1,168,810	128.00	fingerling
04/12/2007	06	4,210,573	89.00	fingerling
05/01/2007	06	3,494,735	74.00	fingerling

CRIS\DistBA07

D. Program benefits and performance

1. Adult returns

a) Numbers of adult returns (need data for the past 10-20 years)

Hatchery escapement, Columbia River harvest, ocean harvest and total adult production for Spring Creek NFH tule fall Chinook salmon brood year 1990-99. The total adult production number given includes all estimated sport, tribal, commercial, and international harvest of Spring Creek NFH fish.

Contribution and recovery of coded-wire tagged tule fall Chinook salmon from Spring Creek National Fish Hatchery (data presented in table were reproduced from Stock Assessment Reference Summary, U.S. Fish and Wildlife Service, Columbia River information System, Pastor 2007).

Brood Year[1]	Millions Released	Hatchery	Columbia River Harvest	Ocean Harvest	Spawning Ground	Total Expanded Recoveries	Smolt to Adult Survival (%)
1990	14.35	5,608	4,409	8,566	0	18,583	0.13
1991	19.07	9,387	7,874	8,938	9	26,208	0.14
1992	14.31	8,784	10,635	3,309	459	23,187	0.16
1993	15.61	10,534	18,319	5,279	155	34,287	0.22
1994	15.99	7,337	4,759	4,430	70	16,596	0.10
1995	16.44	3,421	2,396	1,821	444	8,082	0.05
1996	14.55	21,185	23,107	16,388	1,148	61,828	0.42
1997	15.62	5,943	6,308	5,635	0	17,886	0.11
1998	10.59	51,766	41,320	43,276	1,370	137,732	1.30
1999	16.07	68,989	70,815	83,341	7,904	231,049	1.44
10 year avg.	15.26	19,295	18,994	18,098	1,156	57,543	0.41
Percent		34%	33%	31%	2%		

[1] Brood year 1990-1999 fish were spawned in that year and returned two, three, four and five years later as adults. For example, a five year old fish from brood year 1999 returned in calendar year 2004.

Spring Creek NFH tule fall Chinook returns, 1939-2007 (USFWS CRiS Database).

Spring Creek NFH Tule Fall Chinook Returns

Year	Males	Females	Jacks	Unknown	Total	Males Spawned	Females Spawned
39	0	0	0		7,000	0	3,143
39	989	1,066	929		2,984	0	0
40	2,133	1,578	1,889		5,600	0	0
44	647	1,244	157		2,048	0	0
44	1,402	1,381	306		3,089	0	0
45	1,787	2,189	1,787		4,272	0	0
45	1,625	1,424	761		3,820	0	0
46	2,950	2,264	492		6,706	0	0
46	4,476	2,704	595		7,775	0	0
47	0	0			8,128	0	0
47	4,592	4,012	1,494		10,098	0	0
48	2,348	1,681	714		4,743	0	0
48	5,118	3,723	4,026		12,867	0	0
49	516	645	38		1,199	0	0
49	5,288	5,795	584		11,667	0	0
50	826	1,068	189		2,083	0	0
50	5,140	7,239	677	0	13,056	0	0
51	717	1,134	60		1,911	717	1,134
51	3,541	5,665	2,750	0	11,956	3,541	5,865
52	6,303	4,697	2,740	0	13,740	6,303	4,697
53	309	230	97		636	0	0
53	4,217	4,928	2,289	0	11,434	4,217	4,928
54	0			1,103	1,103	0	0
54			0	16,894	16,894	0	0
55	55	86	91		232	0	0
55	6,836	5,763	1,294	175	14,068	0	0
56	381	238	29		648	0	0
56	6,498	6,133	2,915	0	15,546	0	0
57	547	924	94		1,565	0	0
57	11,367	5,278	8,402	116	25,163	0	0
58	814	1,992	180		2,986	0	0
58	21,706	18,360	3,148	0	43,214	0	0
59	1,331	1,826	68		3,225	0	0
59	14,990	18,062	1,456	0	34,508	0	0
60	182	356	47		585	0	0
60	9,177	6,995	2,199	0	18,371	0	0
61	191	199	49		439	0	0
61	4,886	6,132	874		11,892	0	0
62	197	406	3		603	0	0
62	6,894	6,523	604		14,021	0	0
63	49	54	9		112	0	0
63	5,490	7,655	645		13,790	0	0
64	49	54	9		112	0	0
64	5,490	7,655	645		13,790	0	0
65	1,581	3,266	1,074		5,921	1,099	3,077
66	6,290	7,085	996		14,371	2,538	6,692
67	1,668	3,633	853		6,154	1,101	3,522
70	1,776	2,565	227		4,568	405	2,480
71	3,040	4,720	190		7,950	1,017	4,651
72	2,989	2,842	218		6,049	669	2,583
73	4,996	6,022	335		11,353	797	4,871
77	5,821	7,952	927		14,700	840	6,658
80	9,494	15,116	2,822	0	27,432	1,342	8,804
81	10,175	13,898	6,451	0	30,524	2,709	8,739

Spring Creek NFH Tule Fall Chinook Returns

Year	Males	Females	Jacks	Unknown	Total	Males Spawned	Females Spawned
82	9,498	17,210	739	0	27,447	2,201	9,039
83	3,514	5,889	1,005	0	10,408	1,415	4,714
84	3,435	5,273	799	0	9,507	1,028	4,846
85	2,139	3,258	84	0	5,481	573	2,918
86	88	88	88		258	0	0
86	572	1,502	33	0	2,107	0	0
86	82	88	88	0	258	0	0
86	421	757	104	0	1,282	515	2,110
86	1,075	2,347	225	0	3,647	515	2,110
87	0	1,473	0	0	1,473	0	1,338
87	766	721	0	0	1,487	341	466
87	105	49	32	0	186	49	92
87	202	297	96	0	595	105	277
87	1,073	2,540	128	0	3,741	495	2,476
88	0	2,981	0	0	2,981	335	2,456
88	1,381	1,278	225	0	2,884	322	1,112
88	415	564	604	0	1,583	164	508
88	1,796	4,823	829	0	7,448	696	4,076
89	647	870	39	0	1,556	333	833
89	1,145	1,681	511	0	3,337	728	1,600
89	1,792	2,551	550	0	4,893	993	2,433
90	3,499	4,622	3,313	0	11,434	1,166	3,880
91	5,506	7,216	1,233	0	13,955	4,137	6,435
92	3,573	4,981	615	0	9,169	2,705	4,701
93	3,292	4,544	662	0	8,498	2,899	4,257
94	4,187	5,796	1,006	0	10,989	3,886	5,435
95	3,196	5,492	1,566	0	10,254	2,482	4,924
96	2,987	4,009	938	0	7,934	2,266	3,647
97	2,941	5,622	229	0	8,792	2,803	5,267
98	623	556	51		1,230	0	0
98	45	65			110	0	0
98	1,176	2,375	5,288		8,839	0	0
98	1,844	2,996	5,339	0	10,179	1,700	2,807
99	4,640	9,739	261	0	14,640	3,050	6,095
00	2,738	2,781	5,828	0	11,347	1,551	2,401
01	16,737	22,447	9,518	0	48,702	4,005	6,265
02	33,322	33,629	4,008	0	70,959	3,167	4,960
03	24,682	33,540	6,319	0	64,541	3,394	4,434
04	32,039	39,068	3,405	0	74,512	2,961	3,741
05	12,478	20,545	1,268	0	34,291	2,382	3,744
06	4,051	5,825	869	0	10,745	2,812	4,246
07	2,674	3,738	7,790	0	14,202	2,098	3,301

CRiS\ReturnPr

b) Return timing and age-class structure of adults

Age of Return, Spring Creek National Fish Hatchery tule fall Chinook salmon, 1980-2007 (USFWS CRiS Database).

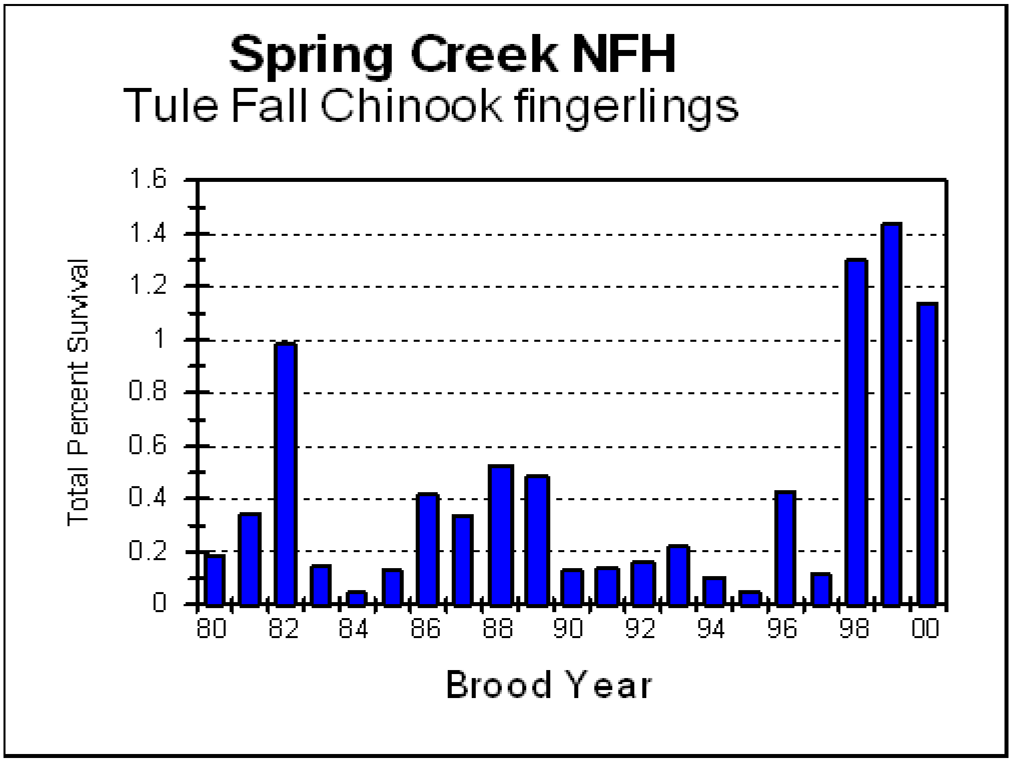
Spring Creek NFH Tule Fall Chinook Age of Returns

Year	Age-2	Age-3	Age-4	Age-5	Age-6	Total	ID
80						27,432	
81	6,606	20,713	3,135	70		30,524	
82	291	20,659	6,465	32		27,447	
83	1,102	3,933	5,319	54		10,408	
84	596	7,116	1,784	11		9,507	
85	53	4,192	1,208	28		5,481	
86	33	968	1,071	35		2,107	BT
86	88	136	33	1		258	BW
86	104	300	861	17		1,282	SC
86	225	1,404	1,965	53		3,647	*
87		1,404	63	6		1,473	Bo
87		923	538	26		1,487	BT
87	17	70	91	4		186	BW
87	95	383	108	9		595	SC
87	112	2,780	800	45		3,741	*
88		147	2,834			2,981	Bo
88	244	1,166	1,433	42		2,884	BT
88	563	857	163			1,583	SC
88	807	2,170	4,430	42		7,448	*
89	37	944	553	23		1,556	BT
89	561	2,278	484	14		3,337	SC
89	598	3,222	1,037	37		4,893	*
90	3,226	4,922	3,207	79		11,434	
91	1,474	10,689	1,773	19		13,955	
92	537	6,088	2,486	58		9,169	
93	776	4,390	3,314	18		8,498	
94	883	7,853	2,238	15		10,989	
95	1,385	7,081	1,603	185		10,254	
96	591	6,923	420			7,934	
97	103	5,087	3,579	23		8,792	
98						1,230	BT
98						110	LW
98						8,839	SC
98	5,517	3,465	1,148	49		10,179	*
99	142	12,582	1,855	61		14,640	
00	5,060	4,929	1,322	36		11,347	
01	12,037	34,107	2,558			48,702	
02	4,464	60,634	5,861			70,959	
03	7,605	28,088	28,719	129		64,541	
04	5,580	54,282	14,129	521		74,512	
05	2,314	16,421	15,129	427		34,291	
06	757	6,950	2,892	146		10,745	
07						14,202	

CRiS\AgePr

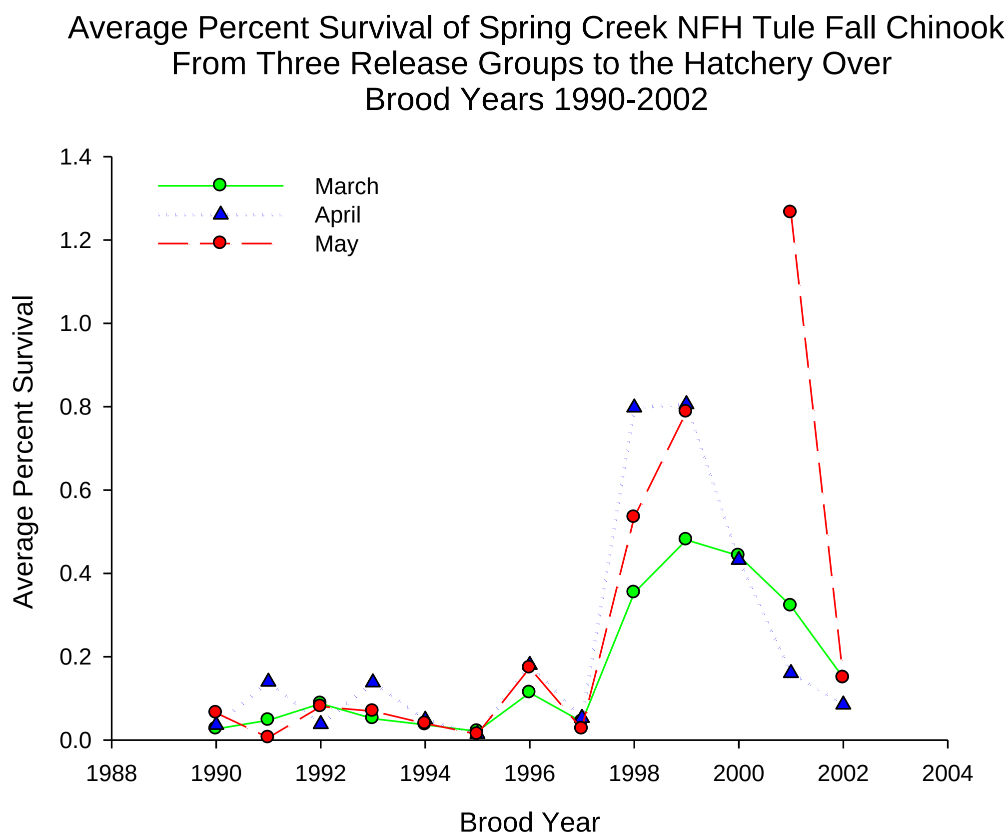
ID = BT = Bonneville Dam Trap, BW = Big White Salmon River,
SC = Spring Creek NFH, Bo = Bonneville hatchery, LW = Little White Salmon NFH,
* = total for that year with multiple trapping sites

c) Smolt-to-adult return rates

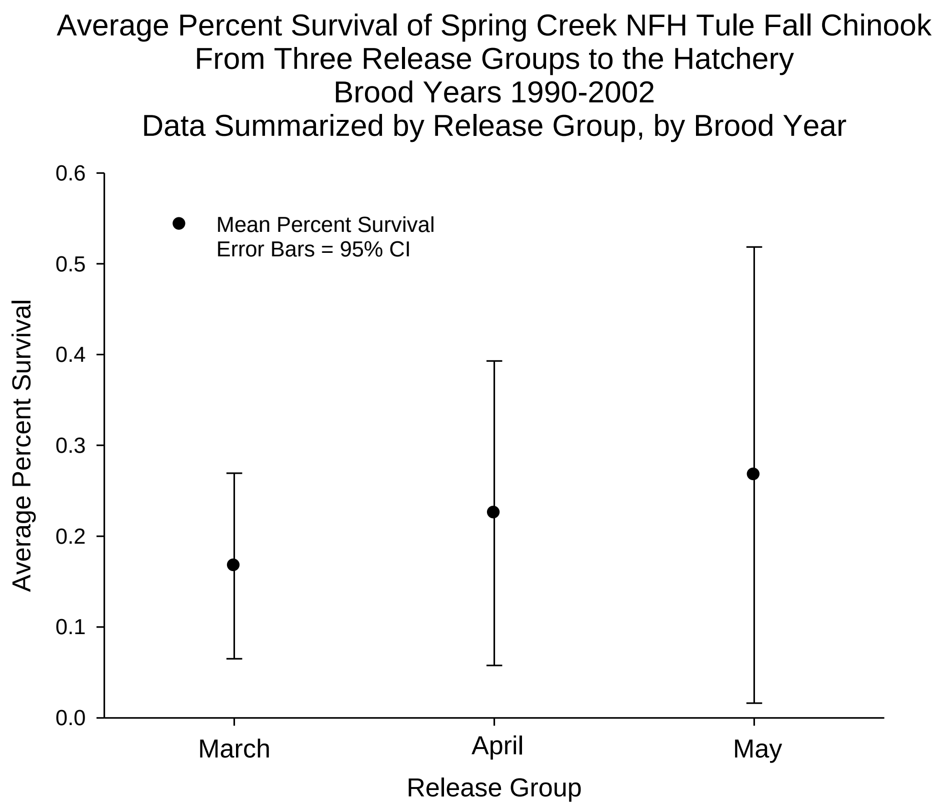


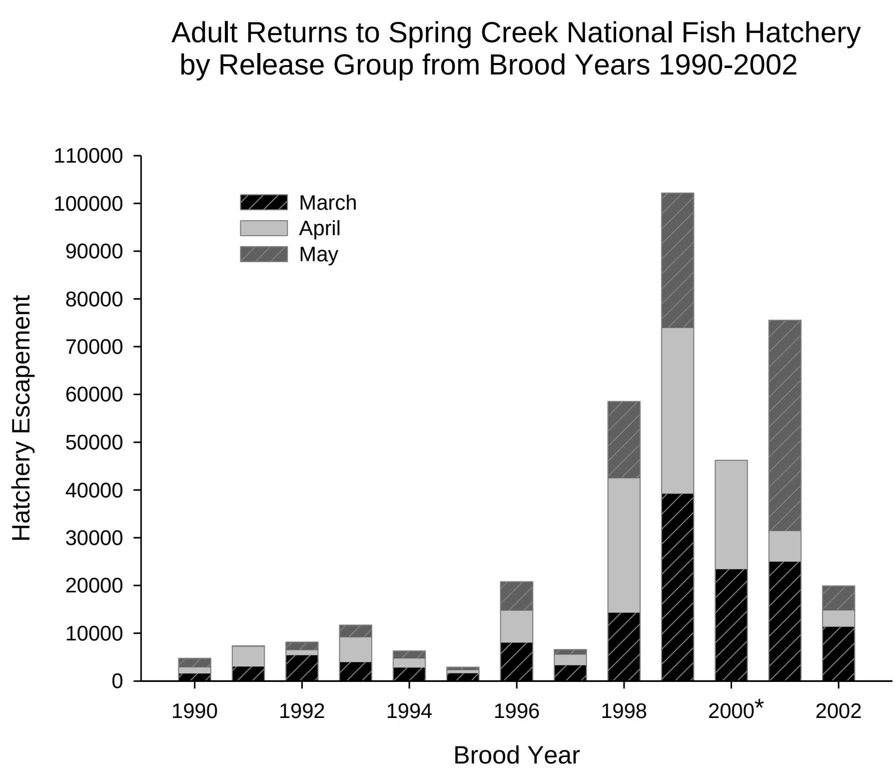
- The following bullets are based on an analysis performed by the USFWS Columbia River Fisheries Program Office December, 2007. See the tables below for further detail.
  - On average, May release groups have had the highest smolt to adult survival, followed by April then March, brood years 1990-2002 (return years 1992-2006).
  - However, when brood year 2001 is not included in the analysis, April has the highest smolt to adult survival, followed by May and then March (the May 2001 brood year had the highest survival rate of any release during brood years 1990-2002).
  - May release groups had the highest variability in returns and March the lowest variability. This is most likely linked to fish health and pathology, where in some years May release groups can experience more fish health problems prior to release.
  - Because of this variability, the differences in smolt to adult survival are not significantly different between the three release groups.
  - Because of variable survival and the large release in March (7.6 million fish), in some years March release groups have the highest adult yield.

- Historically, brood stock needs are met most years to meet a 15.1 million release.
- Under a "re-programming" scenario with a 10.5 million release and no March release, brood stock needs are also met most years.
- This analysis does not include several coded wire tag groups that occurred in the early 1990's that were distributed across all three releases (March, April and May). Therefore, it does not completely represent the complete survival of Spring Creek NFH tule fall Chinook salmon production during these brood years.



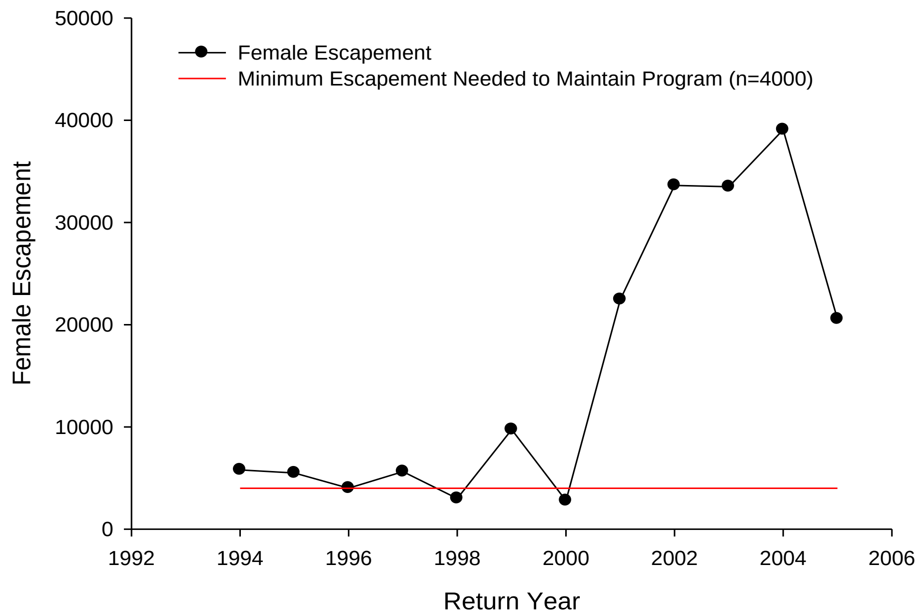
*BY 2000 only had March and April release groups (no May release).



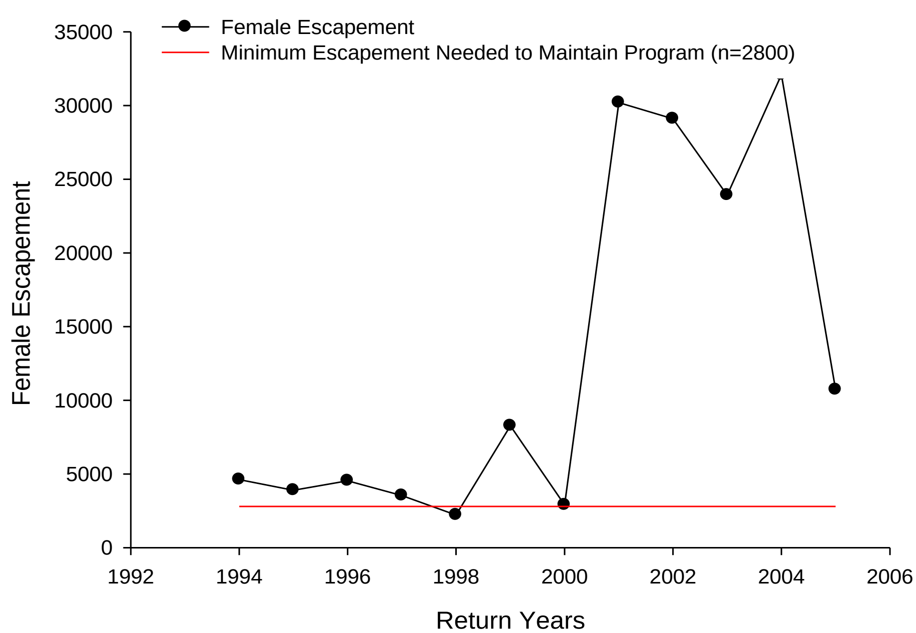


*Only March and April release this year

Female Escapement to Spring Creek NFH During
Brood Years 1990-2002
Return Years 1994-2005



Female Escapement to Spring Creek NFH
During Hypothetical "Reprogramming" Situation
Brood Years 1990-2002
Return Years 1994-2005



d) Stock productivity (e.g. recruits per spawner)

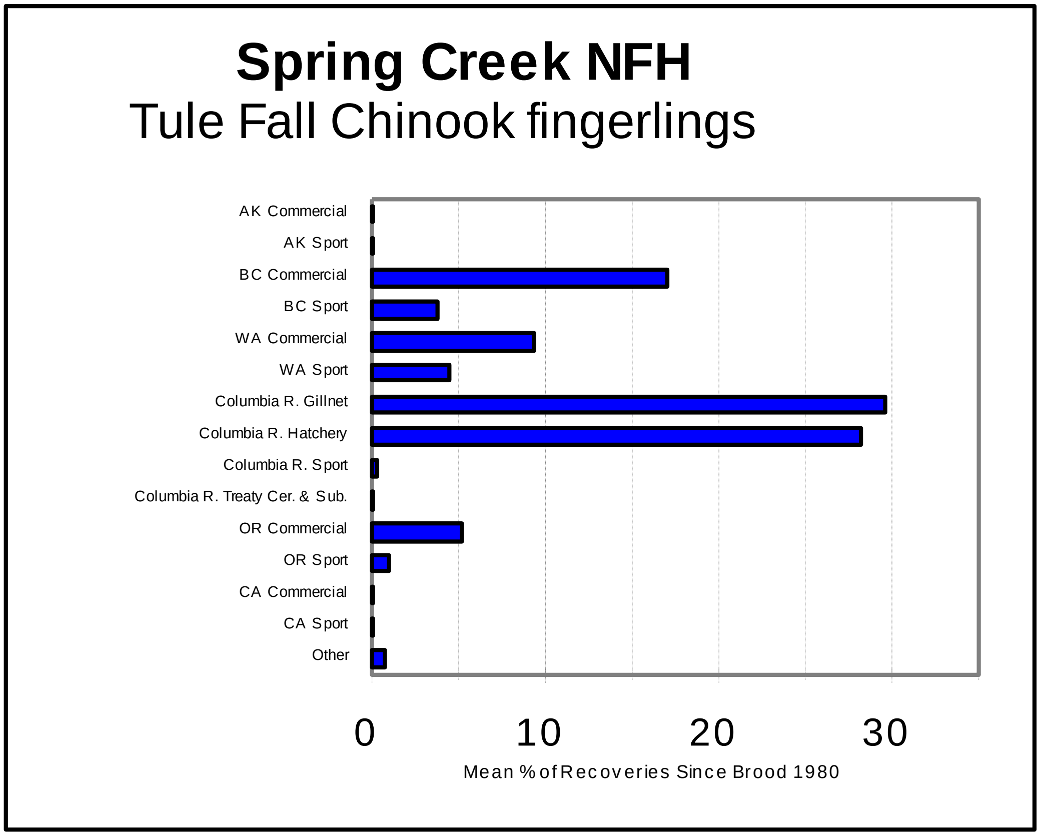
A 10-year average of 7 to 8 recruits per spawner (R/S) for brood years 1990-99. For those broodyears, 15.3 million smolts were released to produce 57,543 total adult recoveries. This assumes that between 7,000 and 8,000 adult spawners produced 15.3 million smolts.

2. Contributions to harvest and utilization (e.g. food banks)

- The tule fall Chinook salmon from Spring Creek NFH have been a very successful stock in supporting the commercial, sport and tribal fisheries along the coast of Washington as far north as the west coast on Vancouver Island, BC (Pastor 2000).

  - Historically, Spring Creek NFH fish contributed to 9% of the catch in the fishery off the west coast of Vancouver Island and 27% of the catch off of the Washington and northern Oregon coasts. Spring Creek NFH has contributed as many as 65,600 fish to treaty Indian fisheries and 41,500 fish to non-treaty commercial fisheries in the Columbia River in the past (PFMC, 1995). In the 2001 fall season treaty Indian fisheries above Bonneville Dam, catch of Spring Creek NFH origin fall chinook was over 52,000 (preliminary numbers). In 2002, one half of the commercial and sport Chinook catch off the coast of Washington was Spring Creek tules and over 140,000 Spring Creek adults entered the Columbia River.

  - If the run size prediction shows a harvestable surplus (>7,000 tule fall Chinook, 2003 Management Agreement for Upper Columbia River fall Chinook, Steelhead, and Coho, US v Oregon), commercial seasons for non-tribal and/or tribal fisheries are set up in the main stem Columbia River. Sport regulations are set by each state individually. Ocean and in-river fisheries are managed to help achieve this escapement in accordance with the fishing regimes described within the document.



- Spring Creek NFH is a major contributor to the sports fishery at the mouth of the Columbia River as well as the commercial gill net fishery below Bonneville Dam. The Spring Creek stock is also a major contributor in the tribal zone 6 fishery above Bonneville Dam.

- In most years, more fish enter the hatchery than are needed for brood stock. Fish beyond hatchery needs are distributed to the Yakama Nation for Ceremonial and Subsistence (C&S) and other tribes as requested.

- Additional fish are transferred to the Bureau of Federal Prisons for inmate rations. Any fish anesthetized using Tricaine Methanesulfonate (MS-222) is considered unfit for human consumption by the Food and Drug Administration.

- Surplus or spawned carcasses are available for stream enrichment directly or can be processed into bio-cubes for future enrichment programs.

- All other surplus fish will be rendered through a Service-approved rendering company.

3. *Contributions to conservation*

- Spring Creek NFH stock provides protection to the listed Snake River populations and other stocks of chinook salmon because the Canadian ocean fisheries are managed under harvest quota, time, and area regulations. Both Spring Creek NFH and endangered Snake

River stocks of salmon occur off the west coast of Vancouver Island. Greater numbers of Spring Creek NFH fish in the total number of fish in the United States/Canada treaty fishery area result in fewer Snake River fish being caught. Other Chinook salmon stocks, including listed Snake River fish will be exposed to higher harvest rates in Canadian fisheries if the productivity of Spring Creek NFH stock is reduced.

- Because of Mitchell Act funding deficits, Spring Creek NFH remains the only facility producing tule fall chinook above Bonneville Dam. The reductions and closures at other hatcheries make production at Spring Creek NFH even more important for maintaining and improving fisheries in the Pacific Ocean and Columbia River.

- Restoring the tule fall Chinook run into the White Salmon River, where the Spring Creek NFH stock originated, will be a reality if Condit Dam is removed. With the removal of Condit Dam (scheduled for Oct. 2008), 18 miles of river will be available for all anadromous fish, including tule fall Chinook salmon.

- Production at Spring Creek NFH mitigates for lost habitat as a result of John Day and Bonneville Dams.

- Surplus or spawned carcasses are available for stream enrichment directly or can be processed into bio-cubes for future enrichment programs.

- To help protect wild and naturally produced fish, the states of Washington, Oregon and Idaho are implementing selective sport and commercial fisheries (non-tribal) on marked hatchery fish. As of 2005, all Spring Creek tule fall Chinook are being mass-marked.

4. *Other benefits*

- Economic benefit: The role of a federal mitigation hatchery is to compensate for natural habitat lost to federal hydro-projects and other impacts caused by Basin development. Mitigation hatcheries serve a significant role in supporting economically important fisheries. Spring Creek NFH is an economically efficient producer of smolts in addition to being one of the major contributors to the commercial, sports and tribal fishery both in the ocean and in river

- Outreach: An Information and Education Office, mainly funded by Spring Creek NFH, increases the visibility of the Fish and Wildlife Service (FWS) facilities in the Columbia River Gorge and provides information about FWS programs and their benefit to the public and environment. In 2007, this office will play an extended role in promoting Mitchell Act funding for NW hatcheries.

- Educational efforts include touring some 800-1000 students through the hatchery during spawning, to gain a better understanding of hatchery operations and salmon life cycle. Information and education staff provide educational materials to schools and set up fish tanks for learning situations. Students from area schools raise tule fall Chinook salmon in their classrooms and annually release their fish into the nearby White Salmon River. Annual festivals include a Visitor's Weekend each September to highlight spawning and hatchery operations for the visiting and local public. Other events in the NW include: various festivals, classroom participation at local schools, stream adoption, participation in other National Fish Hatchery events, Jewett Creek restoration project and county fairs (Hood River and Skamania counties, and the Trout Lake Community Fair).

E. Research, monitoring, and evaluation programs

- Unfed fry release study
- White Salmon River and Condit Dam -- Fish passage studies prior to removal of Condit Dam.
- Ladder Operations study
- ERM epizootiology and transmission study
- Genetic sampling
- Determine ecological interactions between wild and hatchery fish in the Columbia River Gorge (ladder pulsing study).
- Conduct spawning ground surveys
- Assess physiological status of juveniles prior to release and determine downstream migration rates.
- Assess straying rates and recovery location of fish from Spring Creek NFH

F. Program conflicts[19]

1. *Biological conflicts (e.g. propagated stock maladapted to hatchery water source)*

The native White Salmon River tule fall Chinook population was the founding source for Spring Creek tule fall Chinook. The Spring Creek stock is the stock of choice for reintroduction into the White Salmon River if and when Condit Dam is removed. Condit Dam removal is expected in 2008. Although Spring Creek hatchery fish may be largely supporting the Wind and White Salmon tule fall Chinook naturally spawning populations, genetic introgression of Spring Creek fish for the ESU as a whole is not considered a significant problem because the vast majority of the natural production for this ESU occurs below Bonneville Dam where there is not a documented history of significant straying of Spring Creek fish into natural production areas (Spring Creek CWT recoveries are rare). Furthermore, Spring Creek tule fall Chinook may be the stock of choice for future supplementation programs for individual tule populations within the ESU if this action is deemed necessary/appropriate. Compared to other hatchery populations of tule fall Chinook, the Spring Creek stock has likely retained many of the genetic and life-history characteristics of the original lower Columbia River tule Chinook population. This is because of Spring Creek's

[19] *Section text from SCNFH tule fall Chinook HGMP.*

large annual spawning population and relative lack of historical brood stock transfers from outside sources into Spring Creek NFH compared to other lower river tule fall Chinook facilities.

2. Harvest conflicts (e.g. mixed stock fishery on hatchery and wild fish limits harvest opportunities on hatchery fish)

Spring Creek NFH stock provides protection to the listed Snake River populations and other stocks of Chinook salmon because the Canadian ocean fisheries are managed under harvest quota, time, and area regulations. Both Spring Creek NFH and endangered Snake River stocks of salmon occur off the west coast of Vancouver Island. Greater numbers of Spring Creek NFH fish in the total number of fish in the United States/Canada treaty fishery area result in fewer Snake River fish being caught. Other Chinook salmon stocks, including listed Snake River fish will be exposed to higher harvest rates in Canadian fisheries if the productivity of Spring Creek NFH stock is reduced.

3. Conservation conflicts

a) Genetic conflicts associated with straying and natural spawning of hatchery fish (Stray rates, proportion of hatchery-origin fish on natural spawning grounds, etc.)

See 1. above. Spring Creek tule fall Chinook are indigenous to local watersheds. In most years, spawning ground surveys have shown that the number of natural spawning fall Chinook in local tributaries is relatively small (Eric Olsen ODFW, personal communication). Today, there are on average less than 100 spawning tule fall Chinook salmon in the Wind River below Shipherd Falls, and about 200 in the White Salmon River (WDFW and ODFW 2002).

b) Ecological conflicts (e.g. competition between hatchery fish and wild fish)

Spring Creek NFH has a large production program (15.3 million smolt release) relative to other Columbia River production programs. The Spring Creek facility is operated under a strategy that releases smolts during three time periods: March, April, and May. This release strategy maximizes production from available rearing space. The three-release strategy also likely reduces potential density dependent effects, as well as other potential ecological effects, at least in the mainstem corridor and estuary, relative to a single large release. Approximately one-half of the total production is typically released in March, with the remaining production split approximately equally between April and May releases. The March release occurs before the general out-migration of most other natural and hatchery stocks begins, reducing potential density dependent effects as well as other potential ecological effects such as competition, predation, and disease transmission. Splitting the April and May releases reduces the potential for significant interactions on a particular component of the natural out-migration that may be emigrating from the Columbia River system at the same time as Spring Creek releases.

Spring Creek releases are not known to residualize in the mainstem Columbia River corridor where they are released. Juvenile sampling at Bonneville Dam indicates that Spring Creek fish rapidly emigrate from the release site.

The Spring Creek tule fall Chinook salmon are healthy with low to no incidence of the regulated and reportable pathogens that plague other hatcheries (Fish Health Inspection Reports, 1982 to present, Lower Columbia River Fish Health Center). Adults return with a minor incidence of virus and bacteria so there is little or no vertical transmission of these pathogens to their offspring. Juvenile fish can be affected by pathogens carried by animals coming into the hatchery from the Columbia River or in the spring water source so their infections generally evolve from environmental pathogens external to the hatchery. Because Spring Creek juveniles are released directly into the mainstem Columbia River and pass only one dam (Bonneville Dam) en route to the ocean, there is reduced potential for transmission of pathogens to other populations. In comparison, other upriver programs are subjected to the high density impacts and stresses of collection for transport and/or diversion through multiple bypass systems which can trigger disease transmission. As a consequence, direct infection of natural fish by Spring Creek fish appears to be minimal.

Spring Creek fish are released directly into the mainstem Columbia River migration corridor rather than into tributary spawning or rearing areas. Based on Bonneville Dam sampling of juveniles, Spring Creek fish appear to emigrate rapidly, reducing the potential for competitive interactions with listed fish. Because Spring Creek releases occur “low” in the system relative to many other upriver programs, and emigration through the migration corridor appears to be rapid, there is reduced opportunity for competitive interactions. In addition, the three-release strategy also should reduce potential competitive interactions. (See hatchery production discussion above.)

The USFWS (1994) presented information that salmonid predators are generally thought to prey on fish approximately one-third or less their size. Spring Creek releases are of sub-yearling fish and are generally smaller than other yearling sized releases in the Columbia River. Therefore, it is likely that Spring Creek fish have reduced predatory impacts on natural stocks relative to other yearling releases. Because Spring Creek releases occur “low” in the system relative to many other upriver programs there is reduced opportunity for predatory interactions. In addition, the March release, (typically one-half of the total production) occurs before the start of the normal out-migration season for most other stocks, further reducing potential impacts on listed stocks.

Spring Creek tule fall Chinook released in March may have the potential to prey on listed chum salmon that would be emerging from the gravel in natural production areas below Bonneville Dam during that time frame. Peak emergence of chum at Ives Island was estimated to occur during the latter half of March in 1999 (2/19/99 fax to Donna Allard USFWS from Wayne Vander Naald, ODFW). It is believed that chum fry exit the nursery area shortly after emergence. Length samples for chum fry collected in the Ives and Pierce Island juvenile sampling area with stick seines in 1999 ranged from 32 to 42mm (4/1/99 fax from Fish Passage Center to Salmon Managers). Significant impacts on the listed chum population in the natural production area immediately below Bonneville Dam are not expected because juvenile sampling at Bonneville Dam and in the natural production area below Bonneville Dam indicates that Spring Creek smolts released in March move rapidly through the area. In addition, the emerging chum fry are generally larger than would be preyed upon by Spring Creek smolts released in March, which are generally about two times the length of the chum fry rather than three times their length. It is expected that most of the chum fry would have emigrated from the natural production area before the April release of larger Spring Creek tule fall Chinook occurs, further reducing the potential for impacts. Out-migrant sampling conducted by the USFWS in 1998 and 1999 in Hardy Creek, which is adjacent to the mainstem Pierce/Ives Island natural production area, indicated that peak emigration of chum fry occurred during the first two weeks of March (unpublished data). Interactions of program fish and chum in the estuary and ocean are unknown

4. *Other conflicts between the hatchery program, or fish produced by the program, and other non-hatchery issues*

Spring Creek releases may contribute to indirect predation effects on listed stocks by attracting predators (birds, fish, pinnipeds) and/or by providing a large forage base to sustain predator populations. On the other hand, a large mass of hatchery fish moving through an area may confuse or distract predators or have a “swamping” effect towards predators providing them prey that are more readily accessible than wild stocks, thereby providing a beneficial effect to listed species. Releasing large numbers of hatchery fish may lead to a shift in the density or behavior of non-salmonid predators, thus increasing predation on naturally reproducing populations. Conversely, large numbers of hatchery fish may mask or buffer the presence of naturally produced fish, thus providing sufficient distraction to allow natural juveniles to escape (Park 1993). Prey densities at which consumption rates are highest, such as northern pikeminnow in the tailraces of mainstem dams (Beamesderfer et al. 1996; Isaak and Bjornn 1996), have the greatest potential for adversely affecting the viability of naturally reproducing populations, similar to the effects of mixed fisheries on hatchery and wild fish. However, hatchery fish may be substantially more susceptible to predation than naturally produced fish, particularly at the juvenile and smolt stages (Piggins and Mills 1985; Olla et al. 1993).

Predation by birds and marine mammals (e.g. seals and sea lions) may also be significant source of mortality to juvenile salmonid fishes, but functional relationships between the abundance of smolts and rates of predation have not been demonstrated. Nevertheless, shorebirds, marine fish, and marine mammals can be significant predators of hatchery fish immediately below dams and in estuaries (Bayer 1986; Ruggerone 1986; Beamish et al. 1992; Park 1993). Unfortunately, the degree to which adding large numbers of hatchery smolts affects predation on naturally produced fish in the Columbia River estuary and marine environments is unknown, although many of the caveats associated with predation by the northern pikeminnow in freshwater are true also for marine predators in saltwater.

Urban water traffic can decimate Spring Creek tule fall Chinook salmon during their migration to the ocean. In ~2000, water levels were low and speed limits for boats not enforced, causing the enbeachment of thousands of Spring Creek fish on an island near Portland.

IV. Little White Salmon National Fish Hatchery

A. Description of hatchery

The Little White Salmon NFH was placed in operation following official Congressional authorization in 1898 with the intent to supplement the commercial fishing industry. The hatchery's role expanded during the 1930's under the Mitchell Act to one of mitigation for the loss of habitat due to the completion of Bonneville Dam in 1938. (LWNFH CHMP, p. 18)

In 1975, the Little White Salmon NFH and Willard NFH were administratively combined to form the Little White Salmon/Willard NFH Complex (Complex). Administration of the Complex occurs at the Little White Salmon facility. Complex facilities are managed, staffed, and budgeted as a single entity. The Complex has 12 full-time employees. The staff includes the Complex Manager, Deputy Complex Manager, Hatchery Manager – Willard NFH, two Fishery Biologists, a Maintenance Worker, and five Animal Caretakers. (LWNFH CHMP, p. 27)

The Little White Salmon/Willard NFH Complex program includes the production of three species of salmon for release and off-site transfer to provide mitigation for the construction and operation of dams on the Columbia River and to assist with tribal restoration efforts. (LWNFH CHMP, p. 18)

Little White Salmon NFH is located in south-central Washington one mile upstream of the mouth of the Little White Salmon River. The Little White Salmon River joins the Columbia River at river mile 162. Drano Lake, a natural impoundment at the mouth of the river, is a popular sport and tribal fishing area. The hatchery encompasses 433 acres of land including easements. (LWNFH CHMP, p. 28-30)

2,000 upriver bright fall Chinook and 1,500 spring Chinook adult brood stock from the Little White Salmon River are collected, spawned, eggs incubated and reared at the hatchery to produce 3.7 million sub-yearling upriver bright fall Chinook smolts and 1.0 million spring Chinook yearling smolts for release into the Columbia River or transfer for acclimation and release at other facilities. (LWNFH CHMP, p. 32)

Major facilities are located in two areas. The lower hatchery area includes the following major facilities:

- office building
- four stall garage
- feed storage building
- freezer/cold storage building
- hatchery building
- WDFW law enforcement office building
- 9 – 8' X 79' raceways with building enclosure
- spring collection box
- biofilter reuse system

Major facilities located at the upper hatchery area include:

- fish ladder
- barrier dam
- pollution abatement facility
- adult holding/spawning building
- road bridge over the Little White Salmon River
- 22 – 10' X 110' raceways
- 2 – 10' X 235' raceways

In addition, five government residences are located approximately ½ mile from the lower hatchery area. Table 1 contains descriptions of primary buildings located at Little White Salmon NFH.

Table 1. Hatchery buildings, primary use of buildings, size and construction type. Further information can be found within the Little White Salmon NFH Real Property Inventory and the Complex station development plan (USFWS 1987) (LWNFH CHMP, p.29)

Building	Area (ft^2)	Construction Material	Year Constructed and Remodeled	Purpose
Hatchery Building	4,228	Concrete & Wood	1939 and 1998	Used to incubate eggs and fry
Office/Visitor Center	3,180	Wood	1952 and 2000	Administration and public information
Cold Storage Building	3,684	Cement/Brick	1949, 1954 and 1999	Used to store fish feed
4-Stall Garage	1,456	Cement Block	1955	Used for vehicle storage and welding area
Adult Holding Spawning Bldg.	10,800	Cement/Metal	1983 and 1991	Used to hold and spawn adult fish
Spring House	495	Cement/Wood	1998	Contains microscreen drum filter and provides river, spring, and well water for incubation.
Heavy Equipment Garage	2,160	Metal	1981	Used for vehicle and equipment storage
WDFW Law Enforcement Building	500	Metal	1988	Office and equipment storage for WDFW Law Enforcement
Quarters #3A	1,100	Brick	1952	Hatchery staff residence
Quarters #4A	1,100	Brick	1952	Hatchery staff residence
Quarters #5A	1,100	Brick	1952	Hatchery staff residence
Quarters #6A	1,100	Brick	1952	Hatchery staff residence
Quarters #7A	1,100	Brick	1952	Hatchery staff residence

Facilities used for the incubation and rearing of both spring Chinook and upriver bright fall Chinook salmon are described in Table 2.

Table 2. Incubation and rearing facilities located at Little White Salmon NFH. (LWNFH CHMP, p.30)

Unit type	Length (ft)	Width (ft)	Depth (ft)	Volume (ft^3)	#	Material	Age	Condition
Lower Raceways 25-33	79	8	1.8	1,159	9	concrete	50	Good
Upper Raceways 1-22	110	10	3.5	3,850	22	concrete	3	Good
Upper Raceways 23-24	214	10	3.5	7,490	2	concrete	3	Good
Adult Holding Ponds	90	30	6	16,200	2	concrete	12	Good
Vertical Stack, 16 Tray Incubators					132	fiberglass	20	Good
Pollution Abatement Clarifier, Circular				19,625	1	concrete	28	Fair
Nursery Tanks 1-10	16	3	2	96	10	fiberglass	30	Good

- Carson Depot Springs is a separate substation of the Little White Salmon/Willard NFH Complex. Located approximately 15 miles west of Little White Salmon NFH, this facility has a water supply and space for egg incubation. The Service has an indefinite lease with Burlington Northern Railroad for use of this 55' X 100' land parcel. This area includes a spring water supply and a small building equipped with 50 -16 tray incubators for egg incubation. Carson Depot Springs is primarily used for incubation of coho salmon eggs prior to shipment to Willard NFH and for various research activities requiring egg isolation (quarantine to prevent the spread of fish disease for eggs from outside the Little White Salmon River watershed). (CHMP pg- 28)

<u>Little White Salmon NFH</u>

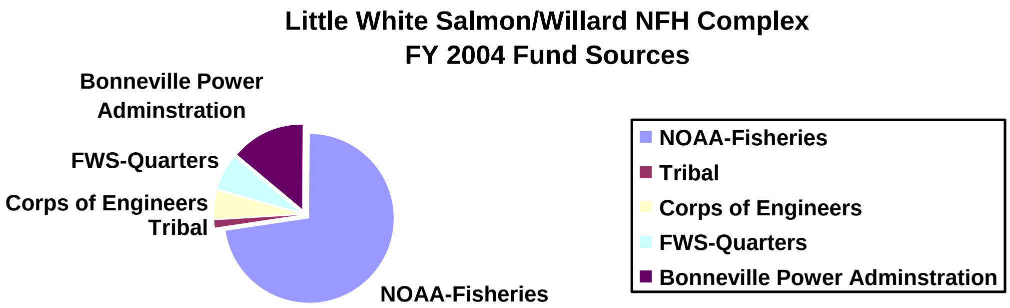
- 1,000,000 yearling spring Chinook salmon released on site.

- 210,000 yearling spring Chinook salmon released on the Umatilla Indian Reservation using native, locally adapted fish stocks.
- 2,000,000 subyearling upriver bright fall Chinook released on site.
- 1,700,000 subyearling upriver bright fall Chinook released off site on the Yakama Indian Reservation as part of mitigation for John Day Dam and to restore this stock to historic levels. (CHMP pg 12)

Budget Overview

The Fiscal Year 2004 budget for the Little White Salmon/Willard NFH Complex totaled $1,054,961 from all fund sources. Reimbursable funds from other agencies accounted for 100% of the budget with a majority of operational funds (77%) coming from the NOAA-Fisheries Mitchell Act appropriation. These funds reimburse the operating agencies (in this case the Service) for fish production to mitigate for fish losses associated with the operation of hydroelectric dams on the Columbia River. Remaining reimbursable funds are for fish reared for specific programs such as the BPA reimbursed Umatilla River and Mid-Columbia coho reintroduction (Wenatchee Basin) programs and the COE John Day mitigation effort. In addition, operation of Willard NFH involves a cost share program between the Service and YN. In this cost-share effort the YN covers 60% of the operational costs of Willard NFH while the Service funds the remaining 40% required for operation. The Complex received no operational funds from the Service during Fiscal Year 2004.

In addition to a complicated hatchery production program, administration of the Complex also includes the management of 14 government residences, the largest government housing program in the National Fish Hatchery System. Rent paid for occupying a government residence is deposited into a dedicated account (subactivity 8610) for use in maintaining residential facilities. Although these funds are shown as a Complex fund source, monies generated from rental receipts are not used to support fish production efforts. A total of $69,218 was spent operating and maintaining government quarters at the Complex during Fiscal Year 2004. (LWNFH CHMP, p. 91)



B. Hatchery water sources[20]

The water source for the Little White Salmon NFH is withdrawal from the Little White Salmon River, a series of springs and a well.

3.2.1 Water Use and Management

Table 5. Certificates of water right held by Little White Salmon NFH.

Source	Permit No.	Date	Flow (ft^3/s)	Use
Little White Salmon River	235	12/12/1921	4.456	Fish propagation
Little White Salmon River	2914	06/12/1939	15.6	Fish propagation
Little White Salmon River	6042	03/08/1949	34.4	Fish propagation
Little White Salmon River	10423	07/20/1956	18.0	Fish propagation
2 unnamed springs (Bailey)	11795	01/07/1958	3.0	Fish propagation
Unnamed spring (Hillside)	Vested	Pre-1914	0.978	Fish propagation
Unnamed spring	7069	09/19/1950	0.11	Domestic
Well	29251	07/19/1995	0.668	Fish propagation

The warmer spring water is a critical component for the incubation and early rearing stages of spring and upriver bright fall Chinook salmon, and is used as the sole water source initially and latter mixed with river water. Unfortunately the hatchery program cannot maintain the desired warm water temperatures for an extended period of time due to a lack of available spring water. To help extend the period of warm water incubation and rearing, a well was drilled (depth 300-feet) and a submersible pump installed to provide the warm well water to the system. Studies have shown well water temperatures are similar to the spring sources (approximately 48° F) compared to the much colder river source (mean 44° F).

Little White Salmon River water enters the hatchery through a trash rack to screen larger debris. The rack is constructed from steel angle with 1-3/4-inch spaced vertical openings. The water then passes through two rotating drum screens that measure 8-feet long and 6-feet in diameter. Each drum is screened with stainless steel woven mesh with ¼-inch openings. Both drum screens are operated independently of each other by adjustable timers allowing adjustment according to river

[20] *Section text from LWNFH CHMP, p.62-64.*

conditions. All screened debris is floated off on the down flow side of the drum screen and channeled back to the river.

All of the hatchery spring water first passes through stainless steel screen and/or grating at the point of collection. Spring water used for incubation and early rearing of spring Chinook is diverted through the hatchery spring box building where it passes over an 8 foot square incline bar screen with 1/32-inch horizontal openings. Finer screening occurs using a micro-screen drum filter. The 4-foot diameter drum filter is 6-foot in length and screened with 60-micron filter panels. Filter operation can be set to full time rotation or on an as needed basis using an automated float switch. During operation, the filter is back washed using high pressure domestic water filtered through a charcoal filter to neutralize residual chlorine.

River water is collected at the main intake, passed through the hatchery settling basin, and piped to adult holding ponds, raceways and spring box building. Spring water is collected as close as possible to the originating source and piped primarily to the spring box building. From this location, spring water can be directed into the nursery building or lower raceways. Water from the two Bailey springs can also be piped directly to the upper hatchery raceways for initial rearing. Well water can be diverted to the abandoned nursery building re-use system and is also separately piped into the spring box building. The river, well and Bailey spring water supplies can also be directed to the hatchery truck fill station. Average water use for fish propagation during 2003 ranged from 5,286 gpm in April to 19,294 gpm in May. All water, with the exception of the pumped well, is gravity fed.

C. Adult broodstock collection facilities

Fish enter the spawning facility volitionally via a fish ladder that opens immediately below the hatchery barrier dam. (LWNFH URB Chinook HGMP, sec. 5.1)

Adults are collected by pulsing the ladder openings through the spectrum of the run until escapement is met. Fish that enter the hatchery are visually counted and guided to one of two holding ponds. (LWNFH CHMP, p. 66.)

D. Broodstock holding and spawning facilities

Brood holding facilities include two 30' X 90' X 6' holding ponds. Spawning facilities include a transfer tower to move fish from the holding ponds into the anesthetic tank where fish are sorted. Fish not ready to spawn (green fish) are returned to the holding ponds via return tubes. Ripe fish are handled on a stainless steel spawning table. URB (LWNFH URB Chinook HGMP, sec. 5.3)

At the start of the spawning process, adults are crowded out of the ponds and into a transfer channel leading to the spawning building. Fish are then crowded into the anesthetic tower

where they are lifted into a bath of anesthesia (MS 222 or tricaine methanesulfanate) that includes polyvinylpyrollidine at 0.1% to alleviate stress and replace “slime”. The fish never leave water except for a very brief period of de-watering. Once the fish are anesthetized they are sorted for ripeness. “Green” or unripe fish are returned to the holding pond and held until the following week before being crowded and checked again for ripeness. Ripe fish are euthanized and females bled by tail cutting prior to spawning to maximize the fertilization process.

E. Incubation facilities

Fertilized eggs are washed and then water hardened for one half hour in a 75 ppm active iodine solution in individual incubator trays. The eggs are incubated using single pass spring or well water. Aseptic procedures are followed to assure the disinfection of equipment throughout the egg handling process.

At the eyed stage, eggs are shocked and picked to remove the dead eggs, then placed back into the incubators, at approximately 5,000 eggs per tray. There are 132 stacks of incubation trays that have the capacity to incubate up to a total of 9.9 million eggs. Nonviable embryos are removed from each incubator tray at least two times during incubation with a cumulative record maintained for each take of eggs. All eggs are treated with formalin three to five times a week at a rate of approximately 1,667 ppm. Formalin treatments are used to reduce fungus related mortality and are terminated once hatching has begun. Incubation takes place in a mix of spring, river and well water to control temperature. Temperatures normally are between 42°F and 48°F. Swim-up fry are placed directly into the raceways or into the nursery tanks, depending on program goals. . (LWNFH CHMP, p. 75)

F. Indoor rearing facilities

Indoor rearing facilities include 10 fiberglass tanks that provide 96 cu ft of rearing space each. The tanks are utilized by some production programs for only one to two weeks before fish are moved to outdoor rearing units. Other programs bypass the indoor rearing facilities and go directly to outside rearing units.

G. Outdoor rearing facilities

There are 22 - 10 x110 foot raceways and 2 - 10 x 214 ft raceways at the upper hatchery. The lower hatchery contains 9 - 8 x 79’ raceways All raceways are considered in good condition

H. Release locations and facilities

Spring Chinook (1.0 million) are released into the Little White Salmon River as yearlings in mid-April and upriver bright fall Chinook (2.0 million) as sub-yearlings in late June. Releases are made directly into the Little White Salmon River less than a half mile from the Columbia River and coincide with a number of other hatchery releases within the basin. Both spring and fall Chinook destined for off-site release are loaded onto distribution trucks using a hydraulic fish pump and dewatering tower. (LWNFH CHMP, p. 72)

Raceway tail screens are removed a day prior to release allowing a limited volitional release. The day of release, fish are liberated one raceway at a time by slowly flushing fish out of the raceway to minimize injury as fish move through the effluent channel to the river. After final release, numbers, size, tagging data and other pertinent information are recorded. (LWNFH CHMP, p. 24)

I. Outmigrant monitoring facilities

It is assumed that juvenile fish migrate quickly into the mainstem Columbia River migration corridor en route to the ocean, as do fish released from Spring Creek NFH. PIT tagging juvenile fish at Little White NFH would provide additional, valuable information on the timing of emigration, but would require additional funding. (LWNFH URB Chinook HGMP, p. 12)

Releases from Little White Salmon must pass the Fish Passage Center located at Bonneville Dam.

J. Additional or special facilities

At Little White Salmon NFH, effluent from raceway cleaning, spawning and settleable solids collected in the adult holding ponds is piped directly to the hatchery pollution abatement pond (clarifier) where solids are allowed to settle and are removed weekly. Solids removed from the pollution abatement pond are placed in a holding area located on the hatchery grounds and allowed to naturally compost. Effluent water during cleaning and during normal operations is monitored weekly and reported quarterly for suspended and settleable solids under the guidelines of the hatchery NPDES Permit (#000021-3) issued by the Environmental Protection Agency (EPA). (LWNFH CHMP, p. 65)

K. Outreach and public education facilities/programs[21]

The goal of the outreach program is to increase public understanding of the role hatcheries play in supplementing and restoring fisheries within the Columbia River Basin. The diverse, multi-species production program and close proximity of the hatchery to the Portland/Vancouver metro area places both hatcheries in an ideal situation to describe the positive contributions of the hatchery program. Hatchery staff meet with visitors to share information and answer questions. Visitor center displays and an underwater adult fish viewing area are major attractions used to promote the visibility of the hatchery complex in the Columbia River Gorge and to provide information about Service programs to internal and external audiences.

Recognizing the importance of all Service staff to be involved in gaining or retaining public support for our programs, the hatchery outreach program will strive to insure that staff are well-informed about policies, procedures, and issues; and that staff are willing and able to interact with the public. Program efforts will include providing information to staff, partners, and volunteers and, through them, to members of the community and other publics. Outreach will be used as a management tool to maintain the health and survival of our hatcheries, and the Service as a natural resource agency.

Information about Little White Salmon NFH can be found online at http://gorgefish.fws.gov/littlewhite, and for Willard NFH at http://gorgefish.fws.gov/willard. In

[21] *Section text from LWNFH CHMP, p. 85.*

addition, the underwater viewing webcam in the Little White Salmon River can be viewed over the internet at http://pacific.fws.gov/webcam.

On Station On station activities include tours of the facility to schools and special interest groups. Late summer and fall spawning seasons are the most popular tour times. Hatchery staff take advantage of these opportunities to give the visiting public a better understanding of hatchery operations and salmon life cycle. The hatchery, visitor center and underwater viewing area are open to the public seven days per week.

Off Station Off station outreach efforts focus primarily on formal presentations to special interest groups. A majority of these presentations describe Basin-wide fishery restoration and enhancement efforts where the use of hatcheries is integrated with the more global issues of Columbia River water management, habitat restoration, harvest management and operation of the hydropower system. Other off station outreach efforts support tribal celebrations like the CTUIR Salmon Walk, or to increase the visibility of the hatchery in the local area by participating in annual July 4th parade

L. Special issues or problems (e.g. water and property rights issues, law suits, etc.)

Reprogramming The on-station release of coho salmon into the Little White Salmon River was terminated during 2004 due to shortfalls in Mitchell Act operational funding. Also during 2004, the fishery co-managers have reached agreement in the U.S. *v* Oregon forum to discuss a major program change involving the reprogramming of 4.2 million ODFW Bonneville Hatchery upriver bright fall Chinook to the Little White Salmon/Willard NFH Complex. The reprogramming proposal also includes the transfer of rearing responsibility of up to 5.0 million Spring Creek NFH tule fall Chinook to Bonneville Hatchery. Reprogramming is being explored to eliminate the early spring (March) release of Spring Creek NFH tule fall Chinook and subsequent spill requests from the Service to the BPA to spill water at Bonneville Dam to enhance the survival of this release group, more than one month premature to mandated Biological Opinion spill. In addition, reprogramming would result in a reduction in the number of returning adult tule fall Chinook to the Columbia River Zone 6 tribal fishery and an increase in the more economically valuable upriver bright fall Chinook to the Zone 6 tribal fishery. (LWNFH CHMP, p. 87)

Water Use (Drought) During recent drought years, river water flow has not dropped low enough to negatively impact water quality within the hatchery. The decommissioning of the Broughton Lumber Flume in 1985 and subsequent addition of the Flume diversion water right to the Little White Salmon River has made drought restrictions non-existent. Although unlikely, if a premature release is required due to drought, all proper approvals will be obtained prior to a drought related release. (LWNFH CHMP, p. 88)

Hatchery Fish Ladder Management The hatchery fish ladder is operated for both spring Chinook, upriver bright fall Chinook and coho salmon to assure adult fish for brood stock are collected from a spectrum of the run. This assures a genetically diverse brood stock by eliminating any potential bias toward run timing. Ladder management is slightly more complicated during the collection of upriver bright fall Chinook due to the simultaneous collection of adult coho salmon. The excess of one species must be returned to the river to assure collection of adequate numbers of the other species. This often results in the collection and handling of an excess adult fish (normally coho salmon) more than one time. The ladder is closed once the hatchery escapement goal is met and excess fish beyond the needs of the YN are left in the river to spawning naturally, provide nutrients to the watershed, and to feed local populations of wildlife. Ladder operations and migration behavior of fall Chinook salmon will be evaluated further starting in 2004. (LWNFH CHMP, p. 88)

Insufficient Operations and Maintenance Funding Through the Mitchell Act Increased demands on hatchery programs, as required by ESA Biological Opinions, have strained hatchery budgets. Without increases in Mitchell Act funding, reductions in production programs will continue to be made. While reducing hatchery production may allow the hatchery and the Service to meet some ESA requirements, it may not uphold mitigation and tribal trust obligations. The Service is working with NOAA-Fisheries and other co-managers to address current budget shortfalls. (LWNFH CHMP, p. 89)

IVA. Little White Salmon NFH Upriver Bright Fall Chinook

A. General information

- Species and population (or stock) under propagation, and ESA status: Up-River Bright (URB) Fall Chinook Salmon (*Oncorhynchus tshawytscha*). This population is not listed under the Endangered Species Act. (LWNFH URB Chinook HGMP, p. 2)

- The program began in 1983 with the release of 1982 brood year fish from the Spring Creek NFH (HGMP p. 9). The original source of this stock is from up-river bright (URB) fall Chinook trapped in 1977 at the Bonneville Dam & State Fish Hatchery. The current source is from adult URB fall Chinook returning to the Little White Salmon River (LWNFH URB Chinook HGMP, p. 24-25).

- Hatchery adult URB capture goal is 1,860 fish. The average number spawned for the years 1997 to 2001 was 2,404 fish with a range of 1,756 to 3,546 fish (LWNFH URB Chinook HGMP, p. 8)

- Hatchery juvenile production objective is 2.0 million on-station release and 1.7 million transfer to the Yakama Nation. Release size target is 100 fish/lb. (LWNFH URB Chinook HGMP, p. 9)

- The upriver fall Chinook program fish have contributed to commercial and sport fisheries along the west coast of the U.S. and Canada from Alaska to California. Of the fall Chinook from Little White Salmon NFH that reach catchable size, commercial fisheries in Alaska, British Columbia and gillnet fisheries in the Columbia River each harvest greater than 10%. Sport fisheries in B.C. and the Pacific coast states account for a much smaller percentage of adult fish caught (LWNFH URB Chinook HGMP, p. 16).

B. Stock/Habitat/Harvest Program Goals and Purpose

1. Purpose and justification of program[22]

Purpose (Goal) of program. The purpose of the program is to successfully rear and release upriver bright fall Chinook salmon into the Little White Salmon River to provide mitigation (production for fisheries) for federal hydro-power construction, and other development, to meet obligations under the U.S. *v* Oregon court agreement and to produce 1.7 million fry for transfer to the Yakima River basin. A total of 2 million sub-yearling upriver bright fall Chinook salmon are reared and released from Little White Salmon National Fish Hatchery as part of the U.S. Army Corps of Engineers (USACE) John Day Dam mitigation program (see Yakima Program in Section 1.8 of the HGMP). It also provides fish to reaffirm tribal treaty granted fishing rights as mandated by U.S. *v* Oregon.

[22] *Section text from LWNFH URB Chinook HGMP, p. 3.*

Justification for the program. Little White Salmon River Program: The Little White Salmon/Willard NFH Complex (Complex) currently operates as part of the Columbia River Fisheries Development Program, a part of the Mitchell Act, a program to provide for the conservation of Columbia River fishery resources. This program is a part of the mitigation for habitat loss resulting from flooding, siltation, and fluctuating water levels caused by the construction and operation of the John Day Dam. The Columbia River Fish Management Plan is currently under renegotiation, however, current production goals are generally consistent with the production goals in the expired plan.

Yakima Program: The Yakima program is covered under a separate HGMP for the BPA funded program. A total of 1.7 million upriver bright fall Chinook are reared at the Little White Salmon/Willard National Fish Hatchery Complex and transferred by Service personnel to acclimation ponds on the Yakima River, WA. This project is a critical component of the Service's obligation under the U.S. *v* Oregon agreement to assist with the development of naturally spawning fish stocks on tribal lands in the mid-Columbia River basin. Funding received from the USACE is used to provide feed to the tribal fisheries program to assist with the off-site rearing of these fish following transfer and during the acclimation period. USACE funds are also used to feed an additional 1.7 million upriver bright fall Chinook salmon located at the Priest Rapids Hatchery under co-manager agreement and to meet U.S. *v* Oregon agreement obligations. Adult fish returning to the Yakima River are designated for the development of locally adapted, naturally spawning populations within the Yakima River Basin.

2. Goals of program

Hatchery Goals [23]

- Goal 1: Return upriver bright fall (and spring Chinook) salmon upstream of Bonneville Dam as defined in the Mitchell Act of 1937 to mitigate for fisheries lost due to the construction and operation of Columbia River hydroelectric projects.

- Goal 2: Transfer upriver bright fall (and spring Chinook and coho) salmon for off-site acclimation and release in areas upstream of Bonneville Dam in support of tribal restoration programs and to support the development of locally adapted stocks.

- Goal 3: Assure that all the requirements of legal orders and federally mandated legislation are met.

- Goal 4: Develop public use opportunities related to recreational fishing on Drano Lake and provide information and educational opportunities to enhance public understanding of Little White Salmon NFH and Service programs.

3. Objectives of program[24]

[23] *Tasks and current practices to achieve objectives are described in Chapter 3 of LWNFH CHMP.*

- Release 2.0 million upriver bright fall Chinook and 1.0 million spring Chinook into the Little White Salmon River annually.
- Produce the healthiest, highest quality fish possible at every stage of production.
- Conduct monitoring activities that will provide information on the progress of the hatchery in meeting its return goal for spring and upriver bright fall Chinook salmon.
- Cooperate and coordinate with the WDFW and the YN to develop opportunities for sport and tribal harvest in Drano Lake and upriver locations.
- Transfer 1.7 million upriver bright fall Chinook to the YN Prosser Hatchery annually to assist with the John Day Dam mitigation effort.
- Develop external partnerships with new and existing private, non-profit and special interest groups and local, regional and national organizations, institutions tribes and agencies, to promote public awareness and stewardship of fishery resources in the Columbia River Basin.
- Conduct hatchery operations consistently with requirements and obligations called for under the ESA.
- Operate the hatchery so that all requirements and obligations called for under the Clean Water Act are satisfied.
- Assure that hatchery operations support Columbia River Fish Management Plan (U.S. *v* Oregon) production and harvest objectives.
- Increase public awareness of Little White Salmon NFH.
- Develop new and maintain existing levels of public contact and education programs both on- and off-site.

4. Type of program

Isolated harvest (and restoration in Yakima River)

5. Alignment of program with ESU-wide plans

- Species and population (or stock) under propagation, and ESA status:
- Up-River Bright (URB) Fall Chinook Salmon (*Oncorhynchus tshawytscha*). This population is not listed under the Endangered Species Act. (LWNFH URB Chinook HGMP, p. 2)

[24] *Section text from LWNFH CHMP, p. 58.*

- The hatchery has authorization under the NMFS Biological Opinion on Artificial Propagation in the Columbia River Basin 1999. Section 7 permits were obtained for construction projects from NMFS (WSB-00-360 dated 06/28/2000 good through 09/30/2001) and from an Internal Section 7 Consultation (permit number 1-3-00-FW-1914, 1915) from the USFWS Western Washington Office in Lacey, Washington. (LWNFH URB Chinook HGMP, p. 13)

- There are no known listed natural origin salmonids on natural spawning grounds in the Little White Salmon River. (LWNFH URB Chinook HGMP, p. 11)

- There is potential to take listed species through observation, migrational delay, capture and handling during ladder operation at the Little White Salmon NFH between mid-September and early November. Trapping and handling devices and methods may lead to injury to listed fish through descaling, delayed migration and spawning, or delayed mortality as a result of injury or increased susceptibility to predation. No listed species, however, has been recorded entering the facility during fall Chinook operations. (LWNFH URB Chinook HGMP, p. 11)

- If any listed species are identified entering the hatchery, they will be returned to the river via a return tube that empties below the fish ladder entrance. (LWNFH URB Chinook HGMP, p. 12)

- Straying of URB hatchery fall Chinook in the lower Columbia River Chinook salmon ESU is of concern (NOAA Fisheries 2006, NMFS 1999a, NWPPC 2004b, USFWS 2004).

- The Little White Salmon NFH upriver bright fall Chinook, spring Chinook, and coho salmon programs may adversely affect listed populations, but impacts are substantially below the jeopardy threshold (NMFS 1999a). The 1999 Biological Assessment for the Operation of Hatcheries Funded by the NOAA-Fisheries under the Columbia River Fisheries Development Program (NMFS 1999a) and the 1999 Biological Opinion on Artificial Propagation in the Columbia River Basin (NMFS 1999b) present a discussion of the potential effects of hatchery programs on listed salmon and steelhead populations. (LWNFH CHMP, p. 46)

<u>Pertinent References:</u>

- IHOT (Integrated Hatchery Operations Team). 1995. Policy and procedures for Columbia Basin anadromous salmonid hatcheries. Annual report 1994 to the Bonneville Power Administration, Portland Oregon. Project # 92-043. Chapters xx and 5.

- IHOT (Integrated Hatchery Operations Team). 1996. Operation plans for anadromous fish production facilities in the Columbia River Basin, Volume III-Washington. Annual report 1995 to the Bonneville Power Administration, Portland, Oregon. Project 92-043.

- Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grand, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-35, 443 p.

- NOAA Fisheries. 2006. Draft White Salmon Subbasin Recovery Plan for the Middle Columbia River Steelhead, Lower Columbia River Chinook, and Lower Columbia River Coho ESU's.

- NMFS (National Marine Fisheries Service). 1999a. Biological Assessment for Mitchell Act Hatchery Operations. Hatcheries and Inland Fisheries Branch, Portland, Oregon.

- NMFS (National Marine Fisheries Service). 1999b. Biological Opinion on Artificial Propagation in the Columbia River Basin, Endangered Species Act - Section 7 Consultation.

- NMFS (National Marine Fisheries Service). 1999c. Biological Opinion on Harvest in the Columbia River Basin, Endangered Species Act - Section 7 Consultation.

- NWPCC (Northwest Power and Conservation Council). 2004a. Little White Salmon subbasin plan, Volume II, Chapter 17. Portland, OR.

- NWPCC (Northwest Power and Conservation Council). 2004b. White Salmon subbasin plan, Portland, OR.

- USFS (U.S. Forest Service). 1995. Little White Salmon River Watershed Analysis. Gifford Pinchot National Forest, Mt. Adams Ranger District, Trout Lake, WA.

- USFWS (U.S. Fish and Wildlife Service). 2004. Hatchery and Genetic Management Plan, upriver bright fall Chinook salmon, Little White Salmon/Willard NFH Complex, May 2004. Columbia River Fisheries Program Office, Vancouver, Washington.

6. *Habitat description and status*

- The Little White Salmon River originates in the Gifford Pinchot National Forest west of Monte Cristo Peak in south-central Washington and enters Drano Lake near Cook, Washington. Drano Lake, a backwater created by impoundment of the Columbia River, enters Bonneville Reservoir at River Mile (RM) 162. (Rawding et al. 2000a.)

- Little White Salmon NFH is located one mile upstream from the confluence of the Little White Salmon and the Columbia River within the Columbia River Gorge National Scenic Area upstream from the Bonneville Dam hydropower facility and downstream of The Dalles hydropower facility. Located in the lower Columbia Basin, the Columbia River Gorge National Scenic Area is managed by the U.S. Department of Agriculture – Forest Service and was established by Congress in 1986.

- Fish assemblages in the Little White Salmon River are divided into the area above and below the RM 2 Falls. Species found downstream from the falls include spring and fall Chinook, coho salmon, winter and summer steelhead, largescale and bridgelip suckers, pacific and brook lamprey, threespine stickleback, sculpins, white sturgeon, redside shiners, peamouth, and northern pikeminnow. Historically, pink and chum salmon likely used this area but are believed to be extirpated. Species found upstream of the falls included rainbow trout, sculpin, brook trout (non-endemic) and coho salmon (non-endemic). No anadromous fish except hatchery coho smolts, which were released from

Willard NFH, are found above the falls at RM 2. (Little White Basin Subbasin Plan (Rawding et al. 2000a.)

- The Little White Salmon NFH was established in 1898, although production began in 1896 on an experimental basis. The hatchery was built to address the decline of tule fall Chinook, the native salmon stock that returned to the Little White Salmon River. This site was selected since it was considered one of the principal spawning areas of the Quinnat, or Chinook salmon. Assistant U.S. Fish Commissioner William Ravenel, describing the significance of the hatchery site noted in 1898 that "During the season, the salmon appeared in such large numbers below the rack that the Indians often speared two and three at one cast of the spear." (LWNFH CHMP, p. 33)

- Profound changes occurred in hatchery operations during the next 50 years. While the hatchery continued to produce the native tule fall Chinook salmon, production was expanded to included chum, coho, sockeye and spring Chinook salmon. The completion of Bonneville Dam was probably the most significant event of the time. Not only was the hatchery flooded by the rising Bonneville pool, but the average annual egg take of tule fall Chinook declined by 44%. The natural spawning grounds of this fish were lost as habitat at the mouth of the river was inundated by the Bonneville pool. (LWNFH CHMP, p. 33)

7. *Size of program and production goals (No. of spawners and smolt release goals)*

Little White Salmon/Willard NFH Complex brood stock and hatchery escapement goals (LWNFH CHMP)

	Spring Chinook	Fall Chinook	Coho[2]
Release to LWS R.	1,000,000	2,000,000	0
Transfers	210,000 to Umatilla R.[1]	1,700,000 to Yakama R.	650,000
# Females Spawned	290	872	685
Fecundity	4,000	4,800	2,600
Prespawn Mortality	2%	2%	2%
Percent Survival			
Egg to Eye	>92%	>95%	>90%
Egg to Fry	98.5%	99%	98.5%
Fry to Smolt	95%	99%	95%

[1]Eggs for this program are brought in from other facilities.

[2]Historic data. Spawning of this stock at Little White Salmon NFH was discontinued in 2004.

List of program "Performance Indicators", designated by "benefits" and "risks." (LWNFH URB Chinook HGMP, p.4-8)

BENEFITS *Performance standards*	*Performance Indicators*	*Monitoring and Evaluation*
1. Provide predictable, stable, and increased opportunity for harvest.	Adult survival and annual contribution to recreational, commercial and tribal fisheries.	Continued analysis of CWT returns through CRiS and PSMFC database (see Table A).
2. Achieve genetic and life history conservation.	1860 adults are spawned (1:1 male:female sex ratio) annually. Fecundity is approximately 5000 eggs per female. Average adult body size is 96 cm F.L. Isolation of species from others returning at the same time. *NA for mitigation hatcheries (APR 1999).*	Separation by species (see section 7.6). Annual evaluation of life history characteristics: juvenile preparedness for seawater entry, fecundity, body size, sex ratio, distribution and straying (through CRiS)See section 3.5.4.3 on genetic effects on other species.
3. Enhance tribal, local, state, regional and national economies.	Contribution to all fisheries established.	Draft economic analysis was conducted in 1997 (Montgomery Watson 1997).
4. Fulfill legal/policy obligations.	Legal and policy goals established by US v Oregon and John Day Dam Mitigation policies are met (note: there are currently no policy goals for numbers to the fishery, only for production goals).	Annual evaluation of fish counted in the fishery by state, tribes, and USFWS. Production goals are monitored and met annually.
5. Contribution of fish carcasses to ecosystem function by subbasin and by hatchery.	Hatchery Research Monitoring and Evaluation (RM & E) plans in IHOT.	Carcasses are not outplanted due to disease concerns (See sections 3.5.4 and 7.8).
6. Provide fish to satisfy legally mandated harvest.	See sections 2.2.1 and 2.2.2.	There are no other affected stocks in the watershed.
7. Will achieve within-hatchery performance standards.	IHOT standards	IHOT standards are monitored See sections 1.8, 1.9, 1.12, 3.2, 4.1, 5.8, 7.7, 7.9, 8.3, 10.11.
8. Restore and create viable naturally spawning populations.	No spawning habitat available.	NA
9. Plan and provide fish with coordinated mainstem passage and habitat research.	Developed release protocols. *NA for mitigation hatcheries (APR 1999).*	Releases annually determined to coincide with expected maximum river flows (see section 10.4).
10. Conduct within- hatchery	Research on performance	Onsite evaluation of

BENEFITS *Performance standards*	*Performance Indicators*	*Monitoring and Evaluation*
research, improve performance or cost effectiveness of artificial production hatcheries to address the other four purposes (augmentation, mitigation, restoration and conservation).	indicators *NA for mitigation hatcheries (APR 1999).*	physiological condition of released fish to reduce ecological interactions (more in section 9.2.8) Also see sections 9.2.9 and 12.
11. Minimize management, administrative, and overhead costs.	IHOT and USFWS audits. *NA for mitigation hatcheries (APR 1999).*	Audits conducted periodically and results integrated (see sections 1.8, 1.9, 3.2, 3.5, 4.1, 5.8, 7.7, 7.9, 8.3, 10.11).
12. Improve performance indicators to better measure performance standards.	Adaptive management. *NA for mitigation hatcheries (APR 1999).*	Continuous adaptive management: e.g. implementation of naturally colored raceways (section 9.2.9) and annual monitoring of seawater tolerance (see section 9.2.8).

RISKS *Performance standards*	*Performance Indicators*	*Monitoring and Evaluation*
1. Develop harvest management plan to protect weak populations where mixed population fisheries exist.	Annual harvest of Fall fisheries are within the Harvest Biological Opinions.	Performance of URB are monitored for distribution and straying (via CWT collections). Joint staff report developed annual for Fall fishery. Genetic introgression with other stocks is unlikely (see section 3.5).
2. Do not exceed the carrying capacity of fluvial, lacustrine, estuarine, and ocean habitats.	RM & E plans established.	Monitoring has not been conducted on this topic previously or currently.
3. Assess detrimental genetic impacts among hatchery vs. wild where interactions exist.	Evaluation of stray rates.	Stock assessment report produced annually by USFWS and posted at http://columbiariver.fws.gov
4. Unpredictable egg supply leading to poor programming of hatchery production.	Achieve percent egg take goal in 4 out of 5 years (See sections 6.2.1 and 7.4.2). IHOT disease protocols	Annual evaluation of adult returns (See sections 6.2.1, 7.4.2, 7.7, and 7.9).

RISKS *Performance standards*	*Performance Indicators*	*Monitoring and Evaluation*
	implemented (See sections 7.7 and 7.9).	
5. Production cost of program outweighs the benefit.	Evaluate trends in juvenile production cost.	Montgomery Watson 1997 Hatchery Evaluation report (part of IHOT evaluation).
6. Cost effectiveness of hatchery ranked lower than other actions in subregion or subbasin.	Social/economic effectiveness.	Economic analysis needs to be conducted.
7. Will not achieve within-hatchery performance standards.	Comparative evaluation of within-hatchery standards	IHOT standards are met annually.
8. Evaluate habitat use and potential detrimental ecological interactions.	No habitat available within the watershed adjacent to the hatchery. For impacts in other watersheds see section 3.5.	NA
9. Avoid disease transfer from hatchery to wild fish and visa versa.	Comply with IHOT standards and USFWS policy.	See sections 3.5, 4.1, 5.4, 5.8, 7.8, 7.9, 9.2.7, 10.11
10. Evaluate impacts on life history traits of wild and hatchery fish from harvest and spawning escapement.	Track trends of life history characteristics of hatchery fish (no wild fish in this system).	Annual evaluation of: Adult age distribution, fecundity, body size, sex ratio, juvenile size (e.g. data in section 9.2), distribution and straying (annual compilation of CWT data from the CRB).
11. Assess survival of captive broodstock progeny vs. wild cohorts.	*NA for mitigation hatcheries (APR 1999).*	
12. Depleting existing population spawning in the wild through broodstock collection.	*NA for mitigation hatcheries (APR 1999).*	

C. Description of program and operations

1. Broodstock goal and source[25]

- Source - The original source of this stock is from up-river bright (URB) fall Chinook trapped at the Bonneville State Fish Hatchery. The current source is from adult URB fall Chinook returning to the Little White Salmon River.

- Supporting information -

  History. The "mid-Columbia Bright" brood stock was developed in 1977 when upriver bright fall Chinook were trapped from the Bonneville Dam fish ladder and spawned at Bonneville Hatchery (CRFMP All-Species Review 1997). Following an unsuccessful attempt to rear upriver bright fall Chinook that started in 1982, along with tule fall Chinook at Spring Creek NFH, the John Day Dam upriver bright mitigation program was moved to the Little White Salmon/Willard NFH Complex in 1988.

  The following lists all the fall Chinook stocks that have been transferred to the Little White Salmon/Willard NFH Complex during the last 5 brood years. All stocks were received during 1998 to meet production shortfalls due to the above mentioned mechanical-caused loss of progeny from fish that had returned to the Complex:

  - 1,213,000 upriver bright fall Chinook (URB) from Klickitat SFH, WA
  - 13,168 URB from Lyons Ferry SFH, WA
  - 2,054,000 URB from Bonneville SFH, OR
  - 600,000 URB from Priest Rapids SFH, WA
  - 200,000 URB from Umatilla SFH, OR

- Annual size - Adult upriver bright fall Chinook enter the hatchery holding ponds from mid-October through mid-November. Spawning occurs from late October to mid November. Total adult returns ranged from 3,498 to 7,860 averaging 5,442 for the period 1997 to 2001. The annual escapement goal is 1,860 adults returning to the hatchery (see HGMP Section 1.11.1 and Section 7.4.2 for number of adults spawned).

2. Adult collection procedures and holding

Ladder Operations Assessments (Hatchery Update 2006) In 2004 and 2005, a ladder operation study was conducted at the hatchery utilizing disc and radio tags (Engle et al. 2005 and 2006). As a result of the study and further consultation with NOAA Fisheries, the fish ladder will be operated intermittently until the third week of October. After that period, the ladder will be open to bring in all hatchery fish. This operation will reduce handling of fish at

[25] *Section text from LWNFH URB Chinook HGMP sec. 6.1-6.2.*

the hatchery, keep fish in Drano Lake during the sport and tribal fisheries, and reduce straying and spawning of hatchery fish outside of the Little White Salmon River.

3. Adult spawning

a) Spawning protocols

Selection method: Broodstock are collected to represent the full spectrum of the run. Fish are sorted over a one to two day period with ripe females being spawned and green females sent back to the ponds until 100% of the fish have been checked. Enough male fish are sent back to the pond with the green females to ensure a 1:1 spawning ratio. The eggs collected during this sorting process are considered a "take". Male spawners are randomly selected during the take with up to five percent of males used being jacks. The number of jacks spawned on a given day is subjectively defined by hatchery staff up to the five percent maximum and is dependent on availability and ripeness. After all fish have been sorted once and ripe females spawned, a maximum one week period is allowed to pass before the fish are re-sorted and newly ripened females spawned. The objective is to achieve maximum fertilization by spawning fish soon after ovulation and yet avoid the needless handling of green females. The re-sorting process continues until all fish are spawned. Since there are no naturally spawning upriver bright fall Chinook in the watershed, differentiating spawners based on natural stock origin from within the watershed is not a criteria. (LWNFH URB Chinook HGMP, sec. 8.1)

b) No. of males and females spawned each year over past 10 years

If the hatchery escapement goal is met, then a 1:1 spawning ratio will be achieved. Achieving this spawning ratio is one of the highest brood stock program goals at the Hatchery. During low escapement years, males have been re-used on an as-needed basis to maximize the total number of females available to spawn. In low escapement years it is better to spawn the available females (and not lose that genetic material), than discard them. Under these conditions, reusing male fish does not compromise the genetic diversity of the hatchery stocks. It was determined that, in all instances, a minimum escapement need had been met to maintain genetic diversity, although some male fish had to be reused to achieve production goals. (LWNFH URB Chinook HGMP, sec. 8.2)

Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available (LWNFH URB Chinook HGMP, sec. 7.4.2)

Year	**Adults**		
	Females	Males	Jacks
1990	990	670	0
1991	1,090	781	5
1992	1,149	747	150
1993	1,398	1,354	36
1994	1,335	1,281	26
1995	1,350	1,312	31
1996	1,149	1,117	26
1997	960	957	6
1998	1,811	1,660	75
1999	1,081	1,008	17
2000	1,252	1,163	89
2001	878	872	6

4. *Fertilization*

a) Protocols[26]

- It is important to note that at no time in the recent past has the Hatchery pooled the eggs of females prior to fertilization. Again, as mentioned in section 7.2 above, an intense effort is made to achieve a 1:1 spawning ratio. The following is a detailed description of the spawning protocol.

- Adults are crowded from holding ponds and anesthetized using carbon dioxide. Anesthetized adults are then sexed and checked for ripeness. Ripe adults are selected and euthanized. Tails of all ripe females spawned are cut to allow bleeding for approximately 3-5 minutes.

- Eggs are then removed using a Wyoming knife and collected in iodophor-disinfected colanders to drain ovarian fluid. The eggs are then transferred to iodophor-disinfected stainless steel buckets and sperm is added directly to the eggs.

- A 1:1 random spawning ratio is maintained and male jacks are used proportionally to their percentage of the run. The buckets containing eggs and sperm of individual (paired) fish are then transferred to the Little White Salmon hatchery nursery building

[26] *Section text from LWNFH URB Chinook HGMP, sec. 8.3.*

(0.5 kilometers away) where water is added to activate the sperm. This process takes from 5-10 minutes.

- The fertilized eggs are stirred and allowed to rest for a minimum of thirty seconds, then washed and water hardened for one half hour in a 75 ppm active iodine solution in individual Heath incubator trays. The eggs are incubated using single pass spring or well water.

- Aseptic procedures are followed to assure the disinfection of equipment throughout the egg handling process. Tissue samples are collected by fish health specialists to determine the incidence of *Ceratomyxa shasta*, and all of the listed pathogens except *Myxobolus cerebralis,* according to procedures and guidelines in 713 FW and IHOT. Refer to sections 9.1.6 and 9.2.7 for more fish health details.

b) Number of eggs collected and fertilized each year over past 10 years[27]

BROOD YEAR	EGGS TAKEN	% SURVIVAL TO EYE	% SURVIVAL GREEN TO POND	% SURVIVAL POND TO RELEASE
1990	5,295,939	90.6	88.7	93.5
1991	5,332,182	93.0	91.8	80.8
1992	5,640,292	93.0	83.0	97.9
1993	6,675,395	93.0	87.9	99.2
1994	6,390,236	89.2	85.9	97.3
1995	6,331,790	92.3	90.2	84.0
1996	5,352,726	88.7	85.3	97.3
1997	4,584,966	86.2	13.2-	96.2
1998	4,461,450*	88.5	87.9	99.1
1999	4,931,822	89.3	89.0	98.7
2000	5,962,075	89.2	88.7	99.1
2001	4,192,595	90.9	90.6	99.0
Average	5,429,289	90.33	81.85	95.18

* Data compiled from LWS NFH lot histories and egg summaries.

*Excludes 4,084,800 green eggs shipped to other facilities.

_ Refer to Section 5.7 of this document.

- Extra eggs may be taken to safeguard against potential incubation losses. Excess eggs are buried on-station.

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[27] *From LWNFH URB Chinook HGMP, sec. 9.1.*

5. *Incubation*

- Fertilized eggs are washed and then water hardened for one half hour in a 75 ppm active iodine solution in individual incubator trays. The eggs are incubated using single pass spring or well water. Aseptic procedures are followed to assure the disinfection of equipment throughout the egg handling process. (LWNFH CHMP, sec.3.4)

- At the eyed stage, eggs are shocked and picked to remove the dead eggs, then placed back into the incubators, at approximately 5,000 eggs per tray. There are 132 stacks of incubation trays that have the capacity to incubate up to a total of 9.9 million eggs. Nonviable embryos are removed from each incubator tray at least two times during incubation with a cumulative record maintained for each take of eggs. All eggs are treated with formalin three to five times a week at a rate of approximately 1,667 ppm. Formalin treatments are used to reduce fungus related mortality and are terminated once hatching has begun. (LWNFH CHMP, sec. 3.4)

- Initial water flows are set at 3 gpm and increased to 5 gpm at hatch. (LWNFH URB Chinook HGMP, sec. 9.1.3 - 9.1.4)

- Water temperature is monitored using temperature loggers taking readings every 30 minutes. Incubation takes place in a mix of spring, river and well water to control temperature. Temperatures normally are between 42°F and 48°F. (LWNFH URB Chinook HGMP, sec. 9.1.3 - 9.1.4)

- Dissolved oxygen levels are not regularly monitored, but have been tested and found to be at, or near saturation. All water for incubation is passed through a 70 micron drumscreen to filter out solids. (LWNFH URB Chinook HGMP, sec. 9.1.3 - 9.1.4)

6. *Ponding*

a) Protocols

Fish are transferred to the raceways from egg trays when most individuals have absorbed their yolk sac (at around 1750 Temperature Units, TUs). At this time eggs destined for an individual raceway are emptied into a transport tank, moved to the appropriate raceway and released directly into the raceway (i.e. swim up and ponding are forced) in late February to mid-March. Average length at ponding is 43 mm. (LWNFH URB Chinook HGMP, sec. 9.1.5)

b) Number of fry ponded each year, including % hatch each year

With an 89% hatch rate approximately 3,810,000 fry are ponded each year to meet the release goal of 2.0m on site and 1.7m transfer to the Yakama Nation.

7. *Rearing/feeding protocols*

- Fish are transferred to the raceways from egg trays when most individuals have absorbed their yolk sac (at around 1750 Temperature Units, TUs). At this time eggs destined for an individual raceway are emptied into a transport tank, moved to the appropriate raceway and released directly into the raceway (i.e. swim up and ponding are forced) in late February to mid-March. Average length at ponding is 43 mm.

- Temperature readings are taken using data loggers taking readings every 30 minutes. Temperatures in the raceways range from 43°F to 48°F for the period that the fall Chinook are being raised. Mortalities are removed daily. Raceways are cleaned with a broom while effluent water is drained to a pollution control structure. Cleaning is performed as needed but no less than once a week. Fish are reared on river water for the final three weeks.

- Current production goals are to have a final density index of below 0.25 and a flow index of no higher than 1.5 (Piper et al., 1982). Maximum density and loading criteria are for maximum loadings of 4.5 lbs/gpm or 0.87 lbs/ft^3.

- The fish are fed BioMoist starter, grower and feed following manufacturer recommendations (generally between 3.5% and 1.0% of body weight per day). They are fed between two and nine times daily depending on fish size. Overall conversions are around 1.0.

8. *Fish growth profiles*

Table B: End of Month Growth Parameters for LWS NFH Fall Chinook Brood Year 2001. (LWNFH URB Chinook HGMP, sec. 9.2.4)

Month	Length (inches)	#/lb	Condition Factor C	Conversion For Month	Density Index	Flow Index
March	2.035	491.0	-	0.87	0.23	2.57
April	2.450	229.9	-	0.90	0.23	1.55
May	3.082	115.6	-	0.67	0.22	1.55
June*	3.280	82.2	0.000346	0.85	0.29	2.05

Fish released June 20, 2002. Data from Lot History, Production for Brood Year 2001 fall Chinook

Little White Salmon/Willard NFH Complex Upriver Bright Fall Chinook - Brood Year 2005													
MONTH	NUMBER OF FISH	WEIGHT (LBS.)	LENGTH (IN.)	DENSITY INDEX	FLOW INDEX	MORTALITY	NUMBER SHIPPED	WEIGHT (LBS.)	NUMBER ADDED	WEIGHT (LBS.)	WEIGHT GAIN MONTH	WEIGHT GAIN TO DATE	FPP
Feb-06	1738145	1886	1.466	0.10	0.54	1943					48	48	921.4
Mar-06	2013051	5300	1.969	0.17	1.48	4197	1482500	3362	1761603	2005	4771	4819	379.8
Apr-06	1808779	7490	2.289	0.21	1.22	4608	199664	703			2893	7712	
May-06	1804014	15742	2.936	0.28	1.61	1099	3666	14			8266	15978	
Jun-06				0.25	1.43	1840	1802174	21950			6208	22186	
Final Release - 22 June, 2006													

9. *Fish health*

- The first health exam of newly hatched fish occurs when approximately 50% are beyond the yolk sac stage and begin feeding. Sixty fish are sampled and tested for virus. Regular fish health checks are done on a monthly basis by the fish health specialist from the Lower Columbia River Fish Health Center as per the fish health policy in 713 FW. (LWNFH URB Chinook HGMP, sec. 9.1.6)

- Monthly examination: A pathologist from the LCRFHC visits at least monthly after fry are placed in ponds. Based on pathological signs, age of fish, concerns of hatchery personnel, and the history of the facility, the examining pathologist determines the appropriate tests. This usually includes a necropsy with an external and internal exam of skin, gills, and internal organs and can include other tests for bacteria, virus and parasites. Kidneys, gills and other tissues are checked for common bacterial pathogens by culture. Blood is checked for signs of anemia or other infections, including viral anemia. Additional tests for virus or parasites are done if warranted. The pathologist examines the healthy and moribund/freshly dead fish to ascertain potential disease problems in the stock. (LWNFH CHMP, sec. 3.7.2)

- Diagnostic Examination: This is done on an as-needed basis as determined by the pathologist or requested by hatchery personnel. Moribund, freshly dead fish or fish with unusual signs or behavior are examined for disease using necropsy and appropriate diagnostic tests. A pathologist will normally check symptomatic fish during a monthly examination. (LWNFH CHMP, sec. 3.7.2)

- Ponding Examination: The first health exam of newly hatched fish occurs when approximately 50% of the animals are beyond the yolk sac stage and begin feeding. Sixty fish will be sampled and tested for virus. (LWNFH CHMP, sec. 3.7.2)

- Pre-release Examination: At two to four weeks prior to a release or transfer from the hatchery, 60 fish from the stock are necropsies and tissues are taken for testing of listed pathogens. The listed pathogens, defined in USFWS policy 713 FW (Aquatic Animal Health Policy, Service Manual) include infectious hematopoietic necrosis virus (IHNV), infectious pancreatic necrosis virus (IPNV), viral hemorrhagic septicemia virus (VHSV), *Renibacterium salmoninarum, Aeromonas salmonicida,* and *Yersinia ruckeri*. The LCRFHC tests for *Myxobolus cerebralis,* another listed pathogen upon request. (LWNFH CHMP, sec. 3.7.2)

- Adult Certification Examination: At spawning, tissues from adult fish are collected to assay viral, bacterial and parasite infections and to provide a health profile. The LCRFHC tests for all of the listed pathogens, except *Myxobolus cerebralis* (unless requested), and *Ceratomyxa shasta*. The minimum number of samples collected is defined by 713 FW. *Renibacterium salmoninarum* (causative agent of bacterial kidney disease, BKD): Upriver bright fall Chinook salmon have a low incidence of BKD. (LWNFH CHMP, sec. 3.7.2)

- Other Stocks: The Little White Salmon/Willard NFH Complex coordinates with tribes and states to help achieve supplementation and restoration goals, as appropriate to U.S. *v* Oregon contractual agreements. In so doing, stocks external to the Little White Salmon watershed are often received on station. Prior to import to the station, fish health policy must be met as described in Section 3.7.1. While on station, each stock undergoes fish health sampling as detailed above. Furthermore, any eggs received at the hatchery must be disinfected as described in 713 FW Policy before they are allowed to come in contact with the station's water, rearing units or equipment. (LWNFH CHMP, sec. 3.7.2)

10. Chemotherapeutant use

- The upriver bright fall Chinook salmon stock is generally healthy and hasn't required chemotherapeutant use. The adult brood stock does not require formalin treatments for fungus and other external pathogens. The level of vertically transmitted pathogens, primarily infectious hematopoietic necrosis virus and *Renibacterium salmoninarum,* is relatively low in the upriver bright fall Chinook adults which reduces the risk of these diseases in the fry. Transmission of virus and other pathogens found in the ovarian fluid are prevented by water-hardening of eggs with a polyvinyl-pyrrolidone iodine compound (approximately 1% iodine), required by 713 FW policy to minimize/prevent transmittance of viral and bacterial pathogens. The eggs are disinfected in 75 ppm iodine in water buffered by sodium bicarbonate (at 0.01%) for 30 minutes during the water-hardening process. BKD becomes a major concern when fish are kept beyond their normal release time in the spring; however, the Little White Salmon NFH has never required a late release and no chemotherapeutants have been mandated for their stock. (LWNFH CHMP, sec. 3.7.3)

- Formalin is used on the eggs of all species to prevent losses due to fungus growth. The formalin is metered into stacks of eggs for fifteen minutes in a diluted solution (ten parts filtered water to one part formalin) to achieve a treatment concentration of 1,667 ppm formalin. This is accomplished using a formalin treatment system (installed in 2000) that automatically times the treatment and a subsequent 30 minute flush to assure that all stacks being treated receive a full fifteen minute treatment and to clear the distribution system of formalin. Treatments are performed three to five times a week and are discontinued once hatching begins. Formalin is not used at Willard NFH. (LWNFH CHMP, sec. 3.7.3)

Other Fish Health Precautions (LWNFH CHMP, sec. 3.7.24)

- Although fish health policy applies to all fish coming into Little White Salmon/Willard NFH Complex, this does not necessarily prevent disease outbreaks that occur on station due to a particular stock's disease ancestry or poor husbandry prior to arrival. Therefore, it is to the best advantage of the hatchery to reject stocks whose condition may compromise the overall health of on-station stocks, even though they may meet the fish health policy.

- The ladder barrier at Little White Salmon NFH prevents passage of anadromous salmon and steelhead into the water supply, which would otherwise be a source of disease for juveniles. Adult salmon carcasses leftover from spawning are removed and rendered to prevent possible contamination of the water supply. However, many adult salmon die in Drano Lake, a popular fishing site, either from natural causes or from fishing mortality. It is quite possible that the common practice of fishermen's gutting fish and discarding of entrails into the lake may be a source of virus and other pathogens, whether through the water or scavenger animals which access the lake.

- It is necessary to continue a vigilance of the upriver Little White Salmon River to prevent/reduce the horizontal dissemination of pathogens through the water or through predators like great blue herons, eagles and otters. Located five river miles above Little White Salmon NFH, the Willard NFH and the Columbia River Fisheries Research Center of the U.S. Geological Service (CRRL) raise fish and use water from the Little White Salmon River. As for Little White Salmon NFH, the fish of the Willard NFH are cared for by the LCRFHC under the auspices of the same fish health policies. In addition, the LCRFHC maintains good communication with the CRRL to assess health of incoming fish and to periodically examine fish as needed to prevent or treat any disease which might infect salmon at Little White Salmon/Willard NFH complex. The CRRL also uses ozone and chlorine to disinfect all effluent water which is channeled down to an abatement pond. Under less control of the Service are the fisheries activities of the WDFW which periodically plants rainbow trout above Willard NFH, a possible source of disease.

- Decontamination of all holding and rearing units is necessary after release, transfer or spawning of the occupying fish. Disinfection of the brood pond after completion of spring Chinook salmon spawning is especially important to prevent carryover of pathogens to the upriver bright fall Chinook salmon adults. Units should be dewatered, pressure washed (where feasible), and dried to reduce problems caused by fungus, bacteria and parasites. If necessary, a formalin treatment may be applied to the surface.

- Tank trucks or tagging trailers are disinfected before being brought onto the station.

- Abernathy Fish Technology Center (AFTC) provides quarterly feed quality analyses to meet nutritional requirements and prevent nutritional diseases.

11. *Tagging and marking of juveniles*[28]

- Juvenile fish are fin clipped and coded-wire tagged by CRFPO to monitor and evaluate fish cultural techniques, survival and fishery contribution.

- The station release of 2.0 million upriver bright fall Chinook receive 200,000 CWT's as with the 1.7 million upriver bright fall Chinook that are transferred to the Yakima River, Prosser Hatchery. The coho transferred to the YN are marked with CWT's as well.

- Starting with brood year 2004, fall Chinook released on station were mass marked with an adipose fin clip, adipose fin clip plus CWT, or CWT only.

[28] *Section text fro LWNFH CHMP, sec. 3.8.2.*

12. Fish Release

a) Protocols[29]

- Upriver bright fall Chinook (2.0 million) are released from the hatchery as sub-yearlings in late June. Releases are made directly into the Little White Salmon River less than a half mile from the Columbia River and coincide with a number of other hatchery releases within the basin.

- Fall Chinook destined for off-site release are loaded onto distribution trucks using a hydraulic fish pump and dewatering tower.

- At time of release, all rearing units are sampled and length frequency data collected. Salt water challenges are performed on individual lots of fish for a period of 24 hrs at a salinity of 3%. This test is used to determine the degree of smoltification and readiness to out-migrate following release.

- Raceway tail screens are removed a day prior to release allowing a limited volitional release. The day of release, fish are liberated one raceway at a time by slowly flushing fish out of the raceway to minimize injury as fish move through the effluent channel to the river.

- After final release, numbers, size, tagging data and other pertinent information are recorded.

[29] *Section text fro LWNFH CHMP, sec. 3.6.*

b) Number of fish released each year (subyearlings?; yearlings?; other?)

Release dates, stage, number of fish, and number per pound of Little White Salmon National Fish Hatchery upriver bright fall Chinook salmon, 1990-2007 (USFWS CRiS Database).

L White Salmon NFH Upriver Bright FCS releases in L White Salmon River, 1990 - 2007.

Release Date	Brood Year	Number	Size #/lb.	Stage
06/25/1990	89	1,438,372	111.00	fingerling
06/24/1991	90	4,029,158	102.00	fingerling
06/19/1992	91	2,862,783	95.00	fingerling
06/23/1993	92	1,866,901	101.00	fingerling
06/23/1994	93	1,797,922	88.00	fingerling
06/29/1995	94	1,967,894	91.00	fingerling
06/27/1996	95	1,788,446	96.00	fingerling
07/03/1996	95	308,760	115.00	fingerling
06/19/1997	96	2,153,118	89.00	fingerling
06/25/1998	97	1,999,435	71.00	fingerling
06/24/1999	98	2,149,397	56.00	fingerling
06/22/2000	99	1,970,592	66.00	fingerling
06/21/2001	00	1,937,764	109.00	fingerling
06/20/2002	01	2,074,295	82.00	fingerling
06/26/2003	02	2,084,184	92.00	fingerling
06/17/2004	03	2,031,737	87.00	fingerling
06/23/2005	04	1,459,873	79.00	fingerling
06/22/2006	05	1,802,174	82.00	fingerling
06/28/2007	06	2,061,924	77.00	fingerling

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D. Program benefits and performance

1. Adult returns

a) Numbers of adult returns (need data for the past 10-20 years)

Contribution and recovery of coded-wire tagged upriver bright fall Chinook salmon from Little White Salmon National Fish Hatchery (data presented in table were reproduced from Steve Pastor's Stock Assessment Reference Summary, U.S. Fish and Wildlife Service, Columbia River information System, 2005 and 2006 reports).

Brood Year[1]	Millions Released	Hatchery	Columbia River Harvest [2]	Ocean Harvest	Spawning Ground	Total Expanded Recoveries	Smolt to Adult Survival (%)
1990	4.03	7,142	1,041	4,005	1,047	13,235	0.33
1991	2.86	2,461	1,148	1,426	802	5,837	0.20
1992	1.87	3,892	1,455	905	511	6,763	0.36
1993	1.80	6,678	1,581	3,306	1,975	13,540	0.75
1994	1.97	708	309	309	299	1,625	0.08
1995	2.10	2,634	493	1,213	739	5,079	0.24
1996	2.15	1,329	568	808	283	2,988	0.14
1997	2.00	1,918	1,966	1,334	3,057	8,275	0.41
1998	2.15	2,394	1,245	1,525	2,610	7,774	0.36
1999	1.97	2,158	2,464	4,902	6,949	16,473	0.84
10year avg.	2.29	3,131	1,227	1,973	1,827	8,158	0.37
Percent		38%	15%	24%	22%		

1 Brood year 1990-1999 fish were spawned in that year and returned two, three, four, five and six years later as adults. For example, a six year old fish from brood year 1999 returned in calendar year 2005.

2 It was undetermined how consistently the sport and tribal fisheries in Drano Lake have been sampled to recover coded-wire tags, so Columbia River harvest should be considered a minimum estimate.

Contribution and recovery of coded-wire tagged upriver bright fall Chinook salmon from Little White Salmon National Fish Hatchery and transferred to the lower Yakima River near Prosser Dam for the Yakama Nation (data presented in table were reproduced from Stock Assessment Reference Summary, U.S. Fish and Wildlife Service, Columbia River information System, Pastor 2007).

Brood Year[1]	Millions Released [2]	Hatchery [3]	Columbia River Harvest	Ocean Harvest	Spawning Ground	Total Expanded Recoveries	Smolt to Adult Survival (%)
1990		3	52	163	65	283	
1991							
1992							
1993							
1994		27	503	682	1,030	2,242	
1995		18	2,238	3,078	2,817	8,151	
1996		6	348	245	514	1,113	
1997		0	0	187	0	187	
1998		0	4,775	3,360	1,815	9,950	
1999		0	3,320	4,026	6,006	13,352	
7 year avg.		8	1,605	1,677	1,750	5,040	
Percent		0.1%	32%	33%	35%		

1 Brood year 1990-1999 fish were spawned in that year and returned two, three, four, five and six years later as adults. For example, a six year old fish from brood year 1999 returned in calendar year 2005.

2 Release records are incomplete.

3 Hatchery recoveries have strayed from the Yakima River release location.

L White Salmon NFH Upriver Bright FCS Returns

Year	Males	Females	Jacks	Unknown	Total	Males Spawned	Females Spawned
84	28	40	164	0	232	0	0
85	269	143	441	0	853	84	122
86	673	868	286	0	1,827	365	720
87	1,188	1,538	367	0	3,093	1,068	1,421
88	675	1,262	155	0	2,092	590	1,142
89	759	888	171	0	1,818	539	840
90	692	1,038	400	0	2,130	670	990
91	893	1,148	340	0	2,381	786	1,090
92	797	1,183	306	0	2,286	897	1,149
93	1,454	1,416	186	0	3,056	1,390	1,398
94	2,410	2,751	395	0	5,556	1,281	1,335
95	3,683	4,155	933	1	8,772	1,312	1,350
96	3,548	3,940	105	5	7,598	1,117	1,149
97	3,216	4,483	161	0	7,860	957	960
98	1,928	2,040	106	0	4,074	1,660	1,811
99	1,469	1,508	114	0	3,091	1,063	1,136
00	1,458	1,360	680	0	3,498	1,163	1,252
01	2,720	905	562	0	4,187	872	878
02	2,615	1,152	122	140	4,029	877	900
03	2,944	1,480	108	0	4,532	928	903
04	1,266	1,258	129	0	2,653	851	851
05	1,252	1,036	23	5,453	7,764	864	870
06	853	1,033	298	0	2,184	803	897

CRiS\ReturnPr

b) Return timing and age-class structure of adults[30]

Age of return, Little White Salmon National Fish Hatchery upriver bright fall Chinook salmon, 1984-2006 (USFWS CRiS Database).

L White Salmon NFH Upriver Bright FCS Age of Returns

Year	Age-2	Age-3	Age-4	Age-5	Age-6	Total
84						232
85	562	196	62	33		853
86	30	339	1,402	56		1,827
87	8	596	1,268	1,221		3,093
88	83	132	1,471	398	8	2,092
89	76	228	457	1,041	16	1,818
90	371	246	657	781	75	2,130
91	436	440	833	630	42	2,381
92	251	235	1,044	713	43	2,286
93	174	782	1,358	716	26	3,056
94	233	410	3,316	1,567	30	5,556
95	776	2,078	3,300	2,564	54	8,772
96	44	1,864	4,175	1,478	37	7,598
97	109	587	5,973	1,191		7,860
98	105	1,124	1,651	1,194		4,074
99	91	446	2,267	287		3,091
00	699	627	1,181	991		3,498
01	642	2,062	1,324	159		4,187
02	14	923	2,895	197		4,029
03	102	250	2,972	1,208		4,532
04	13	374	686	1,580		2,653
05	39	218	7,065	387	49	7,764
06	283	373	618	869	41	2,184

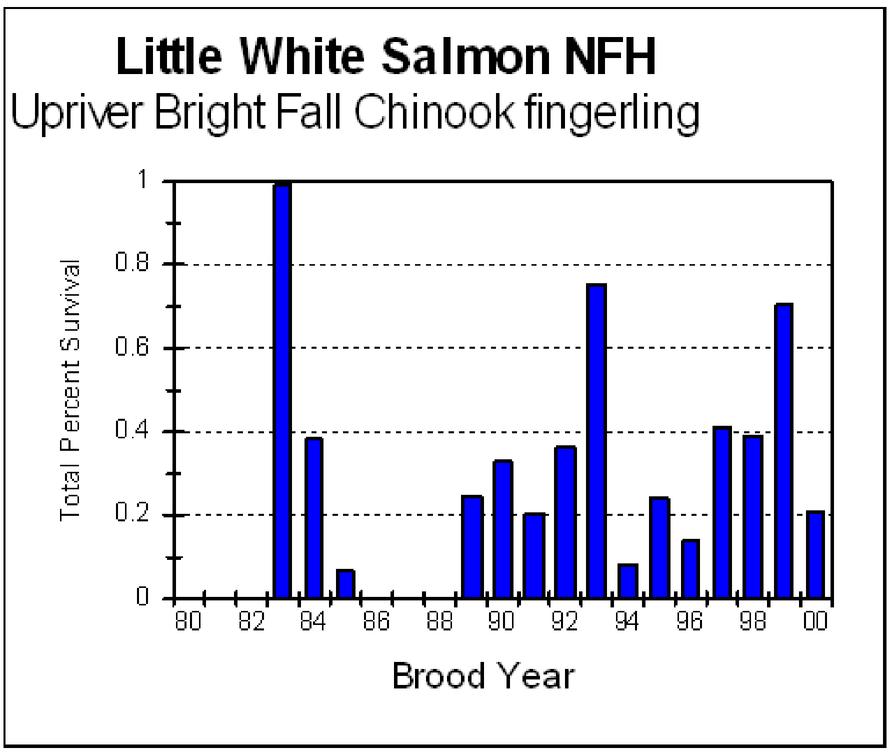
CRiS\AgePr

[30] *From LWNFH URB Chinook HGMP, sec. 6.2.2.*

- Adult upriver bright fall Chinook enter the hatchery holding ponds from mid-October through mid-November. Spawning occurs from late October to mid November.
- Total adult returns ranged from 3,498 to 7,860 averaging 5,442 for the period 1997 to 2001.
- The annual escapement goal is 1,860 adults returning to the hatchery (see Section 1.11.1 and Section 7.4.2 for number of adults spawned).
- From 2000 to the present, intermittent ladder operations have occurred to limit handling of brood stock. During intermittent ladder operation, fish remain in the river, and are not taken into the hatchery.

c) Smolt-to-adult return rates

Smolt to adult survival rates based on sampling and recovery of coded-wire tags (total estimated recovery). (Pastor 2007 – CWT Assessment Report)



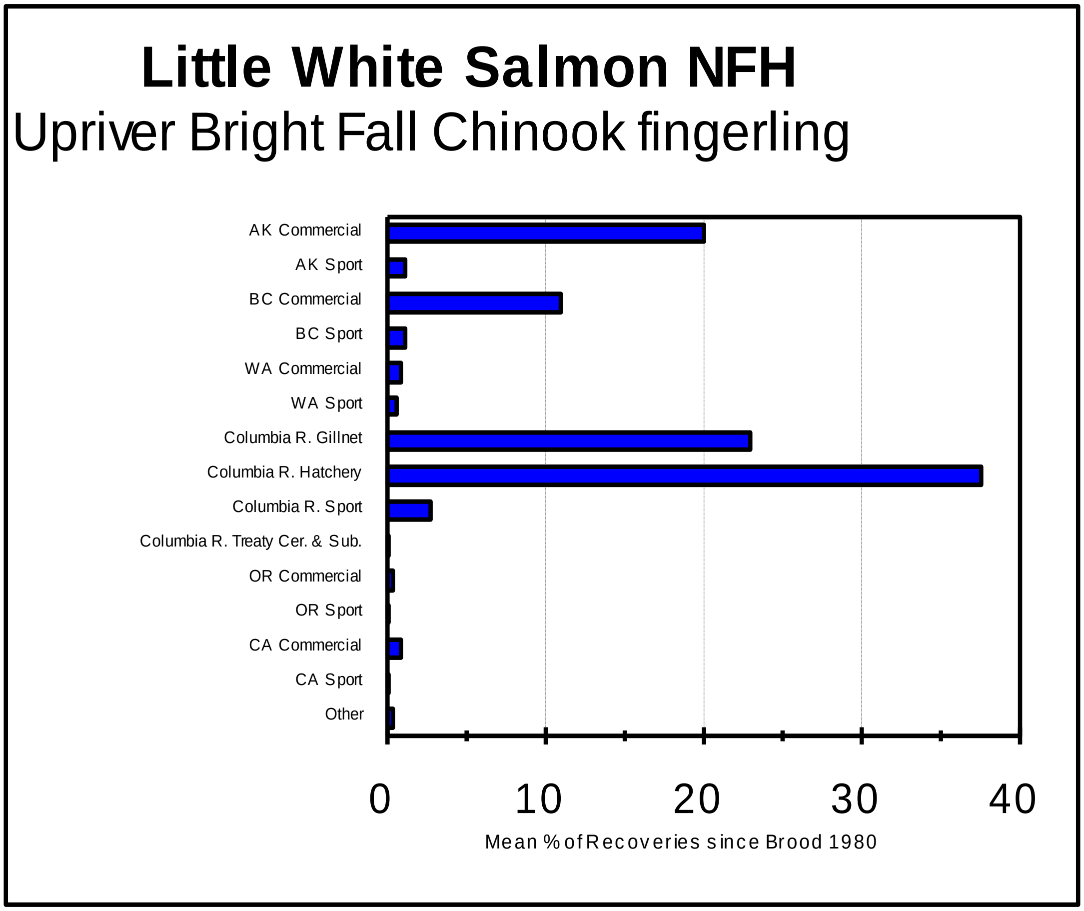
d) Stock productivity (e.g. recruits per spawner)

A 10-year average of 7 to 8 recruits per spawner (R/S) for brood years 1990-99. For those broodyears , 2.3 million smolts were released to produce 8,158 total adult recoveries. This assumes that 1,100 adult spawners produced 2.3 million smolts.

2. Contributions to harvest and utilization (e.g. food banks)

- Upriver bright fall Chinook salmon contribute to commercial and sport fisheries along the west coast of the U.S. and Canada from Alaska to California. Commercial fisheries in Alaska & British Columbia and gillnet fisheries in the Columbia River harvest the majority of the fish. (LWS Hatchery Update 2006)

CWT Assessment Report (Pastor 2007)



- Drano Lake is also an important terminal fisheries area for sport and tribal fisheries. In 2006, an estimated 600 fish were harvested in sport fisheries, and between 2004 and 2005 an estimated 7,000 fish were harvested in the Drano Lake tribal fishery (Engle et al. 2006).

  Number of Chinook salmon and coho salmon captured during October 2004 in the Drano Lake tribal gillnet fishery. Numbers reported by Roger Dick Jr., Yakama Nation during November 2004 (table 4 in Engle et al. 2006).

Date of Fishery	Chinook Salmon	Chinook Salmon Jacks	Coho Salmon
October 5	1,918	49	270
October 12	1,141	5	516
October 19	437	21	571
Total	3,496	75	1,357

  Number of Chinook salmon and coho salmon captured during October 2005 in the Drano Lake tribal gillnet fishery. Numbers reported by Roger Dick Jr., Yakama Nation, during November 2005 (table 8 in Engle et al. 2006).

Date of Fishery	Chinook Salmon	Coho Salmon
October 5	1,626	51
October 12	1,286	130
October 19	974	243
Total	3,866	424

- Surplus Adult Salmon Distribution **-** In most years, more fish return to the hatchery than are needed for brood stock. Most of these surplus fish are in good condition upon entry into the hatchery and are distributed to the YN as needed for ceremonial and subsistence use and for use in the tribal nutrition program. Fish anesthetized with MS-222 are typically rendered or buried on site. (LWNFH CHMP, sec.3.10.6)

3. *Contributions to conservation*

- Whenever possible, excess hatchery fish will be left in the Little White Salmon River to allow for natural spawning, consumption by wildlife, and stream nutrient enhancement from carcass decomposition. The waterfall creating a historic barrier to anadromous fish passage in the upper watershed limits the options available for natural spawning activity. While agency managers agree that spawning habitat on the Little White Salmon River is marginal at best, small pockets of spawning gravel exist below the barrier. (LWNFH CHMP, sec.3.10.6)

- In addition, the hatchery (433 acres) is the site of an active bald eagle roost and is intensively used by wintering bald eagles. Allowing carcasses to remain in the River and Drano Lake is extremely beneficial to local wildlife and the Columbia River ecosystem. As a result, the hatchery has become a popular watchable wildlife viewing area. (LWNFH CHMP, sec.3.10.6)

- The hatchery complies with Endangered Species Act Biological Opinions issued by NOAA Fisheries and the USFWS.

4. Other benefits

The Columbia River Treaty Tribes (Yakama Nation, Nez Perce, Confederated Tribes of the Warm Springs Reservation of Oregon, and Confederated Tribes of the Umatilla Indian Reservation) share the in-river harvest of salmon. Surplus fish returning to the hatchery are also provided to the Yakama Nation and other tribes. (LWS Hatchery Update 2006)

E. Research, monitoring, and evaluation programs

- Bio-sampling and Reporting Sampling of hatchery returns provides data that is combined with other information collected by agencies and tribes to evaluate the relative success of individual broods and compare performance between years and hatcheries. This information is used by salmon harvest managers to develop plans allowing harvest of hatchery fish while protecting threatened, endangered, or other stocks of concern. (LWNFH CHMP, sec. 3.8.3)

- All fish are checked for CWTs. All coded-wire tagged fish are sampled, their heads are removed, and CWTs are read for year of hatchery release. A percentage of untagged fish are also sampled. For all sampled fish, length and sex are recorded and scales are collected to determine average size, sex ratios, and age composition of returning fish. At least 600 adults are sampled throughout the spawning year and additional sampling occurs when adults are excessed. LWNFH CHMP, sec. 3.8.3)

- Stock Assessment and Contribution to Fisheries : Currently, a release group of 200,000 are adipose fin clipped and coded-wire tagged to access survival and fisheries contribution. An additional 1.8 million were previously released unmarked, however, beginning in 2005 all upriver bright fall Chinook released into the Little White Salmon River received an adipose fin clip. In cooperation with the YN, 200,000 upriver bright fall Chinook salmon are being adipose fin clipped, coded-wire tagged and 1.5 million unmarked fish are transferred to tribal facilities. (LWNFH CHMP, sec. 3.8.5)

- Juvenile Monitoring Juvenile fish at the Little White Salmon/Willard NFH Complex are monitored on a routine basis by the hatchery staff to determine the condition factor of fry, fingerlings and smolts. Samples are taken by the LCRFHC to determine the health condition of fry, fingerling and smolts. Sampling of fingerlings for tag retention and fin mark quality, prior to release, is conducted by CRFPO. Salt water challenges are conducted before each release to assess smolting. The results from the 24-hour saltwater test are entered into the hatchery's database and noted in the Columbia River Information System. (LWNFH CHMP, sec. 3.8.6)

- Brood year 1983 through 1985 upriver brights were marked for both a normal age-0 release and an extended rearing release. Average percent survival for the fingerling release from these three brood years was 1.1%, compared to the survival of 0.3882% for the extended rearing fish. The extended rearing program strategy is no longer being used. (Pastor 2007)

- Intermittent ladder operations occurred at Little White Salmon NFH during 2000-2005. Only those fish needed for brood stock and tribal subsistence were taken into the hatchery. The remainder of the time, the hatchery ladder was closed (Engle et al. 2006).

- Brood year 1997 is in the upper third of the survivals at 0.4139%. Nearly 1,100 fish were harvested in Alaskan waters. The 5,000 plus fish recovered in the Columbia River are particularly noteworthy. Over 3,000 of those resulted from WDFW conducted spawning ground surveys. This high number of estimated spawning ground recoveries is undoubtedly due to the hatchery restricting the number of fish entering the adult holding pond during spawning season. This practice was begun in 2000. This brood year contributed 1,500 fish to the Columbia River gill net fishery. (Pastor 2007)

- Overall survival for brood year 1998 is now 0.3617%, a bit lower than the previous brood year. Over 2,600 fish from brood year 1998 are estimated to have been recovered on spawning grounds. 1,200 fish were harvested in Columbia River gill nets. Over 2,600 fish from brood year 1998 are estimated to have been recovered on spawning grounds. Spawning ground recoveries were no doubt higher than usual due to the fact that all returning fish were not allowed to enter the Little White Salmon adult holding building. (Pastor 2007)

- Spawning ground recoveries expand to nearly 7,000 fish for brood year 1999. This is a result of restriction adult returns to the hatchery. The estimated total survival is 16,473 fish or 0.8359%, the second highest survival to date. Close to 4,000 fish were taken in Alaska non-treaty troll fisheries, and about 2,500 in Columbia River gill nets. (Pastor 2007)

- Ladder Operations Assessments - In 2004 and 2005, a ladder operation study was conducted at the hatchery utilizing disc and radio tags (Engle et al. 2005 and 2006). As a result of the study and further consultation with NOAA Fisheries, the fish ladder will be operated intermittently until the third week of October. After that period, the ladder will be open to bring in all hatchery fish. This operation will reduce handling of fish at the hatchery, keep fish in Drano Lake during the sport and tribal fisheries, and reduce straying and spawning of hatchery fish outside of the Little White Salmon River. (LWS Hatchery Update 2006)

F. Program conflicts

1. Biological conflicts (e.g. propagated stock maladapted to hatchery water source)[31]

- The propagated stock survives well at the hatchery and post-release, contributing to fisheries in the Columbia River and Pacific Ocean.

- Upriver bright fall chinook salmon from the hatchery stray and spawn with ESA listed lower Columbia River fall chinook salmon

[31] *Section text from LWNFH URB Chinook HGMP, sec. 3.5.*

- Co-occurring natural salmon and steelhead populations in local tributary areas and the Columbia River mainstem corridor areas could be negatively impacted by program fish. Of primary concern are the ESA listed endangered and threatened salmonids: Snake River fall-run Chinook salmon ESU (threatened); Snake River spring/summer-run Chinook salmon ESU (threatened); Lower Columbia River Chinook salmon ESU (threatened); Lower Columbia River Coho salmon ESU (threatened);Upper Willamette River Chinook salmon ESU (threatened); Upper Columbia River spring-run Chinook salmon ESU (endangered); Columbia River chum salmon ESU (threatened); Snake River sockeye salmon ESU (endangered); Upper Columbia River steelhead ESU (endangered); Snake River Basin steelhead ESU (threatened); Lower Columbia River steelhead ESU (threatened); Upper Willamette River steelhead ESU (threatened); Middle Columbia River steelhead ESU (threatened); and the Columbia River distinct population segment of bull trout (threatened). An additional concern is the Southwestern Washington/Columbia River coastal cutthroat trout ESU.

2. *Harvest conflicts (e.g. mixed stock fishery on hatchery and wild fish limits harvest opportunities on hatchery fish)*[32]

2006 Columbia River Salmon Management Guidelines

The CRFMP expired on July 31, 1999. The parties to *U.S. v Oregon* have re-negotiated a new plan covering fisheries from January 2005 through December 2007. This interim agreement titled "2005-2007 Interim Management Agreement for Upriver Chinook, Sockeye, Steelhead, Coho and White Sturgeon" provides specific fishery management constraints for fall Chinook, steelhead and coho. Guidelines from the Interim Management Agreement, and other agreements, are highlighted below.

- ✓ Allowable Snake River Wild (SRW) fall Chinook impacts in combined non-Indian and treaty Indian mainstem fisheries below the confluence of the Snake River is a 30% reduction from base period harvest rates. The corresponding impact rate is 31.29% of the aggregate Upriver Bright (URB) run.

- ✓ The freshwater URB impact rate of 31.29% will be allocated 23.04% for treaty Indian fisheries and 8.25% for non-Indian fisheries.

- ✓ Upriver fall Chinook escapement goals include 7,000 adult fall Chinook (4,000 females) to Spring Creek Hatchery and 43,500 adult fall Chinook (natural and hatchery included) for spawning escapement above McNary Dam.

- ✓ Treaty Indian fall fisheries will be managed to limit impacts on wild Group B index steelhead to no greater than 15%. All non-Indian fisheries outside the Snake River Basin will be managed for an upriver wild steelhead impact rate not to exceed 2% on wild Group B index steelhead.

[32] *Section text from ODFW and WDFW 2006.*

- ✓ Ocean and lower river fisheries will be managed to provide for Bonneville Dam escapement of at least 50% of the upriver coho salmon return.

- ✓ Ocean and lower river fisheries will be managed for an exploitation rate of no more than 15% combined for lower Columbia River coho. Expected Columbia River exploitation rate is 5%.

- ✓ Non-Indian fisheries will be managed for an impact rate of less than 5% for Columbia River chum salmon.

- ✓ Management and allocation guidelines for non-Indian fisheries are included in the "2006 Non-Indian Columbia River Fall Fishery Chinook Allocation Agreement", which was developed during the North of Falcon process. URB fall Chinook impacts in fisheries downstream of the Snake River are allocated preseason 50% to the sport fishery and 50% to the commercial fishery. The Columbia River Compact/Joint States will use this URB impact allocation as guidance for making in-season management decisions concerning the Columbia River sport and commercial fisheries.

3. *Conservation conflicts*

a) Genetic conflicts associated with straying and natural spawning of hatchery fish (Stray rates, proportion of hatchery-origin fish on natural spawning grounds, etc.)

- Genetic introgression- Upriver bright fall Chinook are known to contribute to natural spawning populations in the local tributaries of the Wind and Big White Salmon rivers. Coded Wire Tag recoveries from Little White Salmon NFH upriver bright fall Chinook have been recovered in annual spawning ground surveys and upriver bright fall Chinook have been colonizing these local tributaries since the mid 1980s (Harlan 1999). There is essentially very little, if any, productive spawning habitat below Little White Salmon NFH at the mouth of the Little White Salmon River (Drano Lake). Historical tule fall Chinook habitat was inundated by Bonneville Pool when Bonneville Dam was constructed in 1938. (LWNFH URB Chinook HGMP, sec. 3.5)

- Although upriver bright fall Chinook are colonizing the nearby Wind and Big White Salmon tributaries, the potential for genetic introgression with the local tule populations is diminished by the temporal separation in spawn timing of the two stocks, with tules spawning in September and early October and upriver brights spawning in late October and November. (However, there is concern of redd superimposition, with upriver brights spawning on top of tule fall Chinook redds). It is believed that the tule populations in the Wind and Big White Salmon rivers may be largely supported by Spring Creek NFH strays (NMFS 1999a). Thus, it appears that both the tule and upriver bright naturally spawning populations of fall Chinook in the Wind and Big White Salmon rivers may be heavily influenced by hatchery strays. However, the fall Chinook natural production areas in these tributaries is very limited. The potential negative effect on the ESU as a whole may be relatively minor. It would be advantageous to collect & analyze genetic samples from the naturally spawning populations of tules and upriver brights in the two tributaries for comparison with samples from Spring Creek tules and hatchery upriver brights as well as for comparison with samples from other natural populations in the lower Columbia River to determine and monitor the genetic stock structure of the various populations. (LWNFH URB Chinook HGMP, sec. 3.5)

- Coded-wire tag recovery data can be used to document straying rates of program fish. Data extracted from the Columbia River Information System (CriS) and Pacific States Marine Fish Commission (PSMFC) databases can be indicative of straying and homing of program fish. Pastor (2004), examining coded-wire tag recoveries from brood years 1983-85 and 1989-98, found that 10 percent of the total estimated recoveries of upriver bright fall Chinook salmon were further up the Columbia River than the hatchery location. Nearly 80% of those that passed the hatchery, were recovered in the "Big" White Salmon River, which is 6.3 miles upstream from the Little White Salmon River. Other off-route recoveries were recovered between The Dalles and John Day dams, the Hanford Reach, the Snake River, and the Wind River. (Pastor 2004)

b) Ecological conflicts (e.g. competition between hatchery fish and wild fish)[33]

- Hatchery production (density dependent effects)- upriver bright fall Chinook releases from the facility are moderate in magnitude (typically about 2.0 million fall Chinook smolts) relative to other Columbia River fall Chinook production programs (e.g. Spring Creek NFH releases over 7 million smolts in March). This level of release is not expected to cause serious density dependent effects in the mainstem Columbia River. Fall Chinook are assumed to migrate rapidly after release. PIT tagging would help to test this assumption, but would require additional funding.

- Disease-Under the guidance of the USFWS Lower Columbia River Fish Health Center (LCRFHC), the hatchery follows the US Fish and Wildlife Service's fish health policy (713 FW in the Fish and Wildlife Service Manual) and Integrated Hatchery Operations Team (IHOT 1995) protocols to produce healthy fish and prevent disease transmission (see sections 9.1.6 and 9.2.7). Most pathogens enter hatcheries through returning adult fish, surface water supplies, and other mechanisms involving direct contact with naturally spawning fish. Procedures used at the hatchery and the LCRFHC reduce pathogen transmission from these sources. The fish health goal for hatchery upriver bright fall Chinook is to release healthy fish that are physiologically ready to migrate. The upriver bright fall Chinook are relatively disease-free and have a reduced potential for transmission of disease to other populations relative to other upriver programs which are subjected to the high density impacts and stresses of collection for transport and/or diversion through multiple bypass systems. The hatchery takes appropriate measures to control disease and the release of diseased fish. As a consequence, infection of natural fish by hatchery fish would not appear to be a problem.

- Competition- The impacts from competition are assumed to be greatest in the spawning and nursery areas at points of highest density (release areas) and diminish as

[33] *LWNFH URB Chinook HGMP, sec. 3.5.*

hatchery smolts disperse (USFWS 1994). Salmon and steelhead smolts actively feed during their downstream migration (Becker 1973; Muir and Emmett 1988; Sager and Glova 1988). Competition in reservoirs could occur where food supplies are inadequate for migrating salmon and steelhead. However, the degree to which smolt performance and survival are affected by insufficient food supplies is unknown (Muir and Coley 1994). On the other hand, the available data are more consistent with the alternative hypothesis that hatchery-produced smolts are at a competitive disadvantage relative to naturally produced fish in tributaries and free-flowing mainstem sections (Steward and Bjornn 1990). Although limited information exists, available data reveal no significant relationship between level of crowding and condition of fish at mainstem dams. Consequently, survival of natural smolts during passage at mainstem dams does not appear to be affected directly by the number - or density - of hatchery smolts passing through the system at present population levels. While smolts may be delayed at mainstem dams, the general consensus is that smolts do not normally compete for space when swimming through the bypass facilities (Enhancement Planning Team 1986). The main factor causing mortality during bypass appears to be confinement and handling in the bypass facilities, not the number of fish being bypassed.

- Juvenile salmon and steelhead, of both natural and hatchery origin, rear for varying lengths of time in the Columbia River estuary and pre-estuary before moving out to sea. The intensity and magnitude of competition in the area depends on location and duration of estuarine residence for the various species of fish. Research suggests, for some species, a negative correlation between size of fish and residence time in the estuary (Simenstad et al. 1982).

- While competition may occur between natural and hatchery juvenile salmonids in or immediately above the Columbia River estuary, few studies have been conducted to evaluate the extent of this potential problem (Dawley et al. 1986). The general conclusion is that competition may occur between natural and hatchery salmonid juveniles in the Columbia River estuary, particularly in years when ocean productivity is low. Competition may affect survival and growth of juveniles and thus affect subsequent abundance of returning adults. However, these are postulated effects that have not been quantified or well documented.

4. *Other conflicts between the hatchery program, or fish produced by the program, and other non-hatchery issues*[34]

- Tule and upriver bright fall chinook reprogramming at Spring Creek NFH, Bonneville state hatchery, and Little White Salmon NFH.

- Reprogramming proposal increases upriver bright production at Little White Salmon NFH by 4.5 million juveniles (at the same time, Bonneville state fish hatchery would reduce upriver bright production by 4.5 million and pick up 4.5 million tule stock from Spring Creek NFH. Spring Creek NFH would decrease tule production by 4.5 million).

[34] *U.S. v Oregon parties, May 2005 proposal.*

- Reliance on reimbursable funding: Mitchell Act (NOAA Fisheries) and John Day Dam mitigation (U.S. Army Corps of Engineers) and tribal restoration programs (Bonneville Power Administration).

IVB. Little White Salmon NFH Spring Chinook

A. General information

- Species and population (or stock) under propagation, and ESA status:
- Carson stock Spring Chinook Salmon (*Oncorhynchus tshawytscha*). This population is not listed under the Endangered Species Act. (LWNFH Sp. Chinook HGMP, p. 2)
- The on-station program began in 1967. (LWNFH Sp. Chinook HGMP, p. 10).
- A total of 900 adult fish are required for normal full production (LWNFH Sp. Chinook HGMP, sec. 1.11).
- Hatchery Production (LWNFH Sp. Chinook HGMP, sec. 1.9)
- Produce 1.0 million spring Chinook smolts for on-station release.
- Produce 350,000 (or more) spring Chinook smolts for transfer.
- Little White Salmon NFH Program: The purpose is to successfully rear and release 1,000,000 locally adapted yearling spring Chinook salmon smolts for release on-station to help mitigate (production for fisheries) for fish losses in the Columbia River Basin caused by mainstem hydro-power project construction and other developments (LWNFH Sp. Chinook HGMP, sec. 1.7).
- Umatilla River, Oregon : A total of 350,000 juveniles are transported from Umatilla River (locally adapted Carson stock) to rear at the Little White Salmon/Willard National Fish Hatchery Complex for one and one-half years and transferred to acclimation ponds on the Umatilla River operated by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). (LWNFH Sp. Chinook HGMP, sec. 1.7).
- Walla Walla River, Oregon: Starting in 2005, Little White Salmon hatchery has provided 250,000 spring Chinook salmon for the Walla Walla River, CTUIR tribal program. This was formerly completed by Carson NFH, but moved to Little White Salmon NFH because of brook trout concerns in the Carson NFH water supply and bull trout in the Walla Walla River (USFWS memo.).

B. Stock/Habitat/Harvest Program Goals and Purpose

1. Purpose and justification of program[35]

Purpose (Goal) of program. Little White Salmon NFH Program

[35] *Section text from LWNFH Sp. Chinook HGMP, p. 3.*

The purpose is to successfully rear and release 1,000,000 locally adapted yearling spring Chinook salmon smolts for release on-station to help mitigate (production for fisheries) for fish losses in the Columbia River Basin caused by mainstem hydro-power project construction and other developments. Fish releases contribute to important terminal area tribal ceremonial and subsistence fisheries, and non-tribal sport fisheries, while providing adequate escapement for hatchery production. Mainstem commercial fisheries have been precluded in recent years because of the very low abundance of naturally spawning populations of spring Chinook (principally from the Snake River and upper Columbia River basins) that are now listed under the ESA. Hatchery operations strive to meet mitigation requirements of the Mitchell Act and the Columbia River Fish Management Plan goals (U.S. *v* Oregon). The Columbia River Fish Management Plan is currently under renegotiation, however, current production goals are generally consistent with the production goals in the expired plan.

Umatilla Program: The purpose is to rear and transfer locally adapted spring Chinook salmon to the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). From at least 1998 through 2007, 210K to 350K smolts were reared and transferred from LWS to the Umatilla's for acclimation and release in the Umatilla Basin. In the early years, the eggs were from LWS stock or Ringold stock. By about 2000 or 2001, all eggs came from adults returning to the Umatilla Basin and LWS reared these. Program discontinued due to BPA funding cuts. (From Umatilla Annual Operation Plans).

Juveniles are released into the Umatilla River, Oregon in cooperation with the State of Oregon and the Umatilla Tribe to support development of self sustaining, naturally spawning fish. Adults returning to the Umatilla River are collected at Threemile Dam. A small percentage of fish are collected and spawned. The remaining fish are then trucked and released upstream and allowed to spawn naturally to continue development of locally adapted, self-sustaining and naturally spawning populations. A total of 350,000 juveniles are transported to and reared at the Little White Salmon/Willard National Fish Hatchery Complex for one and one-half years and transferred to acclimation ponds on the Umatilla River operated by the CTUIR. This project is funded by the Bonneville Power Administration (BPA) and is a cooperative effort between the CTUIR, the Oregon Department of Fish and Wildlife (ODFW), and the Service. The ODFW and CTUIR are responsible for the monitoring and evaluation program necessary to determine the success of this restoration effort. The Umatilla program is not evaluated in this HGMP. It will be covered under a separate HGMP for the BPA funded Umatilla tribal program.

Ringold Program: Originally, Ringold Springs Rearing Facility (RSRF) reared 1.1 M SCS for harvest augmentation until funding from Mitchell Act was cut in 1999. The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) provided funding to support BY03, BY04 of a 500K smolt program at LWS and RSRF to re-establish a source of SCS adults for harvest and tribal reintroduction program. If successful, this program will provide adult SCS that will be trapped RSRF for reintroduction efforts in the South Fork Walla Walla R. beginning in 2007 and continuing through 2009. These fish were mass-marked to permit selective harvest in all fisheries, including the Ringold bank sport fishery which is scheduled to resume targeting marked hatchery SCS in 2007. WDFW is funding FWS to produce 230 K BY06 Carson stock SCS fry for transfer to RSRF in March 2007. As per the Office Funding Target, LWS NFH will be rearing and releasing these fish (BY06). (From Interlocal Agreement for SCS Production at LWS and Carson NFHs).

Justification for the program

Little White Salmon River Program: The Little White Salmon/Willard NFH Complex (Complex) currently operates as part of the Columbia River Fisheries Development Program and is funded through the Mitchell Act - a program to provide for the conservation of Columbia River fishery resources. This program is a part of the mitigation for habitat loss resulting from flooding, siltation, and fluctuating water levels caused by Bonneville Dam. The Columbia River Fish Management Plan is currently under renegotiation, however, current production goals are generally consistent with the production goals in the expired plan.

2. *Goals of program*[36]

Hatchery Goals [37]

- Return spring Chinook salmon upstream of Bonneville Dam as defined in the Mitchell Act of 1937 to mitigate for fisheries lost due to the construction and operation of Columbia River hydroelectric projects.
- Transfer fish for off-site acclimation and release in areas upstream of Bonneville Dam in support of tribal restoration programs and to support the development of locally adapted stocks.
- Assure that all the requirements of legal orders and federally mandated legislation are met.
- Develop public use opportunities related to recreational fishing on Drano Lake and provide information and educational opportunities to enhance public understanding of Little White Salmon NFH and Service programs.

3. *Objectives of program*[38]

- Release 1.0 million spring Chinook into the Little White Salmon River annually.
- Transfer up to 350,000 locally adapted spring Chinook salmon to Umatilla River acclimation sites to support CTUIR restoration efforts.
- Transfer up to 250,000 spring Chinook salmon to the Walla Walla River acclimation sites to support CTUIR restoration efforts.
- Cooperate and coordinate with the CTUIR, ODFW, and BPA to enhance the survival and return of spring Chinook salmon to the Umatilla and Walla Walla Rivers.
- Produce the healthiest, highest quality fish possible at every stage of production.

[36] *Section text from LWNFH CHMP, sec. 3.1.*
[37] *Tasks and current practices to achieve objectives are described in Chapter 3 of LWNFH CHMP.*
[38] *Section text from LWNFH CHMP, sec. 3.1.*

- Conduct monitoring activities that will provide information on the progress of the hatchery in meeting its return goal for spring Chinook salmon.

- Cooperate and coordinate with the WDFW and the YN to develop opportunities for sport and tribal harvest in Drano Lake.

- Develop external partnerships with new and existing private, non-profit and special interest groups and local, regional and national organizations, institutions tribes and agencies, to promote public awareness and stewardship of fishery resources in the Columbia River Basin.

- Conduct hatchery operations consistently with requirements and obligations called for under the ESA.

- Operate the hatchery so that all requirements and obligations called for under the Clean Water Act are satisfied.

- Assure that hatchery operations support Columbia River Fish Management Plan (U.S. *v* Oregon) production and harvest objectives.

- Increase public awareness of Little White Salmon NFH.

- Develop new and maintain existing levels of public contact and education programs both on- and off-site.

4. Type of program

Isolated harvest (and reintroduction / restoration in Umatilla and Walla Walla Rivers)

5. Alignment of program with ESU-wide plans

- Species and population (or stock) under propagation, and ESA status: Spring Chinook Salmon (Oncorhynchus tshawytscha). This population (Carson stock) is not listed under the Endangered Species Act. (LWNFH Sp. Chinook HGMP, p. 2)

- The hatchery has authorization under the NMFS Biological Opinion on Artificial Propagation in the Columbia River Basin 1999. Section 7 permits were obtained for construction projects from NMFS (WSB-00-360 dated 06/28/2000 good through 09/30/2001) and from an Internal Section 7 Consultation (permit number 1-3-00-FW-1914, 1915) from the USFWS Western Washington Office in Lacey, Washington. (LWNFH Sp. Chinook HGMP, p. 13)

- There are no known listed natural origin salmonids on natural spawning grounds in the Little White Salmon River.

- There is potential to take listed species through observation, migrational delay, capture and handling during ladder operation at the Little White Salmon NFH between mid-September and early November. Trapping and handling devices and methods may lead to injury to listed fish through descaling, delayed migration and spawning, or delayed mortality as a result of injury or increased susceptibility to predation.

- If any listed species are identified entering the hatchery, they will be returned to the river via a return tube that empties below the fish ladder entrance.

- During the later part of the spring Chinook return some steelhead may enter the adult holding ponds. Procedures at the Hatchery require unmarked steelhead (presumably wild) to be returned to the river immediately if they have not been exposed to the anesthetic tricaine methane sulfonate (MS-222). The steelhead are returned to the river via a return tube that empties below the entrance to the fish ladder. Generally, the steelhead are removed from the adult holding ponds as the Chinook are sorted for spawning. Unmarked steelhead exposed to MS-222 will be returned to the river only if the full 21 days of required holding for chemical withdrawal is possible. The steelhead are to be placed into a holding raceway for 21 days and then transported to an area below the hatchery barrier dam and released. All marked steelhead (adipose fin clipped hatchery strays) will be retained. Coded-wire tags will be collected from all adipose/left ventral clipped steelhead to determine the origin (see section 10.4.5). The expected number of steelhead entering the adult holding ponds each year is low. The numbers of steelhead entering the holding ponds from 1991 through 1999 has ranged from 0 to 14 (1995). The average is less than 4 per year. Records have been kept of marked versus unmarked steelhead entering the hatchery since 1998. In 1998 three steelhead entered the hatchery, one of which was unmarked. No steelhead entered the hatchery in 1999.

- The Little White Salmon NFH upriver bright fall Chinook, spring Chinook, and coho salmon programs may adversely affect listed populations, but impacts are substantially below the jeopardy threshold (NMFS 1999a). The 1999 Biological Assessment for the Operation of Hatcheries Funded by the NOAA-Fisheries under the Columbia River Fisheries Development Program (NMFS 1999a) and the 1999 Biological Opinion on Artificial Propagation in the Columbia River Basin (NMFS 1999b) present a discussion of the potential effects of hatchery programs on listed salmon and steelhead populations.

<u>Pertinent References:</u>

- IHOT (Integrated Hatchery Operations Team). 1995. Policy and procedures for Columbia Basin anadromous salmonid hatcheries. Annual report 1994 to the Bonneville Power Administration, Portland Oregon. Project # 92-043. Chapters xx and 5.

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- Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grand, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-35, 443 p.

- NOAA Fisheries. 2006. Draft White Salmon Subbasin Recovery Plan for the Middle Columbia River Steelhead, Lower Columbia River Chinook, and Lower Columbia River Coho ESU’s.

- NMFS (National Marine Fisheries Service). 1999a. Biological Assessment for Mitchell Act Hatchery Operations. Hatcheries and Inland Fisheries Branch, Portland, Oregon.

- NMFS (National Marine Fisheries Service). 1999b. Biological Opinion on Artificial Propagation in the Columbia River Basin, Endangered Species Act - Section 7 Consultation.

- NMFS (National Marine Fisheries Service). 1999c. Biological Opinion on Harvest in the Columbia River Basin, Endangered Species Act - Section 7 Consultation.

- NWPCC (Northwest Power and Conservation Council). 2004a. Little White Salmon subbasin plan, Volume II, Chapter 17. Portland, OR.

- NWPCC (Northwest Power and Conservation Council). 2004b. White Salmon subbasin plan, Portland, OR.

- USFS (U.S. Forest Service). 1995. Little White Salmon River Watershed Analysis. Gifford Pinchot National Forest, Mt. Adams Ranger District, Trout Lake, WA.

- USFWS (U.S. Fish and Wildlife Service). 2004. Hatchery and Genetic Management Plan, spring Chinook salmon, Little White Salmon/Willard NFH Complex, May 2004. Columbia River Fisheries Program Office, Vancouver, Washington.

6. *Habitat description and status*

- The Little White Salmon River originates in the Gifford Pinchot National Forest west of Monte Cristo Peak in south-central Washington and enters Drano Lake near Cook, Washington. Drano Lake, a backwater created by impoundment of the Columbia River, enters Bonneville Reservoir at River Mile (RM) 162. (Rawding et al. 2000a.)

- Little White Salmon NFH is located one mile upstream from the confluence of the Little White Salmon and the Columbia River within the Columbia River Gorge National Scenic Area upstream from the Bonneville Dam hydropower facility and downstream of The Dalles hydropower facility. Located in the lower Columbia Basin, the Columbia River Gorge National Scenic Area is managed by the U.S. Department of Agriculture – Forest Service and was established by Congress in 1986. (Rawding et al. 2000a.)

- Fish assemblages in the Little White Salmon River are divided into the area above and below the RM 2 Falls. Species found downstream from the falls include spring and fall Chinook, coho salmon, winter and summer steelhead, largescale and bridgelip suckers, pacific and brook lamprey, threespine stickleback, sculpins, white sturgeon, redside shiners, peamouth, and northern pikeminnow. Historically, pink and chum salmon likely used this area but are believed to be extirpated. Species found upstream of the falls included rainbow trout, sculpin, brook trout (non-endemic) and coho salmon (non-endemic). No anadromous fish except hatchery coho smolts, which were released from Willard NFH, are found above the falls at RM 2. (Rawding et al. 2000a.)

- The Little White Salmon NFH was established in 1898, although production began in 1896 on an experimental basis. The hatchery was built to address the decline of tule fall

Chinook, the native salmon stock that returned to the Little White Salmon River. This site was selected since it was considered one of the principal spawning areas of the Quinnat or Chinook salmon. Assistant U.S. Fish Commissioner William Ravenel, describing the significance of the hatchery site noted in 1898 that *"During the season, the salmon appeared in such large numbers below the rack that the Indians often speared two and three at one cast of the spear*." (LWNFH CHMP, p. 33)

- Profound changes occurred in hatchery operations during the next 50 years. While the hatchery continued to produce the native tule fall Chinook salmon, production was expanded to included chum, coho, sockeye and spring Chinook salmon. The completion of Bonneville Dam was probably the most significant event of the time. Not only was the hatchery flooded by the rising Bonneville pool, but the average annual egg take of tule fall Chinook declined by 44%. The natural spawning grounds of this fish were lost as habitat at the mouth of the river was inundated by the Bonneville pool. (LWNFH CHMP, p. 33)

7. Size of program and production goals (No. of spawners and smolt release goals)

Little White Salmon/Willard NFH Complex brood stock and hatchery escapement goals.

	Spring Chinook	Fall Chinook	Coho[2]
Release to LWS R.	1,000,000	2,000,000	0
Transfers	250,000 to Umatilla R.[1]	1,700,000 to Yakama R.	650,000
Transfers	250,000 Walla Walla R		
# Females Spawned	290	872	685
Fecundity	4,000	4,800	2,600
Prespawn Mortality	2%	2%	2%
Percent Survival			
Egg to Eye	>92%	>95%	>90%
Egg to Fry	98.5%	99%	98.5%
Fry to Smolt	95%	99%	95%

[1]Eggs for this program are brought in from other facilities.

Walla Walla program was at Carson NFH, shifted to Little White in 2005

[2]Historic data. Spawning of this stock at Little White Salmon NFH was discontinued in 2004.

List of program "Performance Indicators", designated by "benefits" and "risks." (LWNFH Sp. Chinook HGMP, sec. 1.10)

BENEFITS *Performance standards*	*Performance Indicators*	*Monitoring and Evaluation*
1. Provide predictable, stable, and increased opportunity for harvest.	Adult survival and annual contribution to recreational, commercial and tribal fisheries.	Continued analysis of CWT returns through CRiS and PSMFC database (see Table A).
2. Achieve genetic and life history conservation.	Isolation of species from others returning at the same time. Annual evaluation of life history characteristics See section 3.5 on genetic effects on other species. *NA for mitigation hatcheries (APR 1999).*	Separation by species (see section 7.6). Annual monitoring of: juvenile preparedness for seawater entry, fecundity, body size, sex ratio, distribution and straying (through CRiS)
3. Enhance local, tribal, state, regional and national economies.	Contribution to all fisheries established.	No economic evaluation is conducted on a local level.
4. Fulfill legal/policy obligations.	Legal and policy goals established by US v Oregon and John Day Dam Mitigation policies are met (note: there are no policy goals for numbers to the fishery, only for production goals).	Annual evaluation of fish counted in the fishery. Production goals are met annually.
5. Contribution of fish carcasses to ecosystem function by subbasin and by hatchery.	Hatchery Research Monitoring and Evaluation (RM & E) plans in IHOT.	Carcasses are not outplanted due to disease concerns (See sections 3.5.4 and 7.8).
6. Provide fish to satisfy legally mandated harvest.	See sections 2.2.1 and 2.2.2.	There are no other affected stocks in the watershed.
7. Will achieve within-hatchery performance standards.	IHOT standards	IHOT standards are met See sections 1.8, 1.9, 1.12, 3.2, 4.1, 5.8, 7.7, 7.9, 8.3, 10.11.
8. Restore and create viable naturally spawning populations.	No spawning habitat available.	NA

BENEFITS *Performance standards*	*Performance Indicators*	*Monitoring and Evaluation*
9. Plan and provide fish with coordinated mainstem passage and habitat research.	Developed release protocols. *NA for mitigation hatcheries (APR 1999).*	Releases annually determined to coincide with expected maximum river flows (see section 10.4)**.**
10. Conduct within-hatchery research, improve performance or cost effectiveness of artificial production hatcheries to address the other four purposes (augmentation, mitigation, restoration and conservation).	Research on performance indicators *NA for mitigation hatcheries (APR 1999).*	Onsite evaluation of physiological condition of released fish to reduce ecological interactions (more in section 9.2.8) Also see sections 9.2.9 and 12.
11. Minimize management, administrative, and overhead costs.	IHOT audits conducted on a regular schedule. *NA for mitigation hatcheries (APR 1999).*	IHOT audits as scheduled and results integrated (see sections 1.8, 1.9, 3.2, 3.5, 4.1, 5.8, 7.7, 7.9, 8.3, 10.11).
12. Improve performance indicators to better measure performance standards.	Adaptive management. *NA for mitigation hatcheries (APR 1999).*	Continuous adaptive management: e.g. implementation of naturally colored raceways (section 9.2.9) and annual monitoring of seawater tolerance (see section 9.2.8).

RISKS *Performance standards*	*Performance Indicators*	*Monitoring and Evaluation*
1. Develop harvest management plan to protect weak populations where mixed population fisheries exist.	This is an isolated harvest program. Little if any interaction with other populations are expected. Harvest is consistent with NMFS Biological Opinions.	Performance of spring Chinook are monitored for distribution and straying (via CWT collections). Genetic introgression with other stocks is unlikely (see section 3.5). Co-managers develop Biological Assessments for fisheries.

RISKS *Performance standards*	*Performance Indicators*	*Monitoring and Evaluation*
2. Do not exceed the carrying capacity of fluvial, lacustrine, estuarine, and ocean habitats.	RM & E plans established.	No research has been conducted on this topic previously or currently.
3. Assess detrimental genetic impacts among hatchery vs. wild where interactions exist.	Evaluation of stray rates.	Continuous evaluation with CWT collections of the subsample of juveniles released with CWTs.
4. Unpredictable egg supply leading to poor programming of hatchery production.	Implement annual evaluation of adult returns.	Achieve percent egg take goal in 4 out of 5 years (See sections 6.2.1 and 7.4.2). IHOT disease protocols implemented (See sections 7.7 and 7.9).
5. Production cost of program outweighs the benefit.	Evaluate trends in juvenile production cost.	Montgomery Watson 1997 Hatchery Evaluation report (part of IHOT evaluation).
6. Cost effectiveness of hatchery ranked lower than other actions in subregion or subbasin.	Social/economic effectiveness.	This has not been and is not being evaluated.
7. Will not achieve within-hatchery performance standards.	Comparative evaluation of within-hatchery standards	IHOT standards are met annually.
8. Evaluate habitat use and potential detrimental ecological interactions.	No habitat available within the watershed adjacent to the hatchery. For impacts in other watersheds see section 3.5.	NA
9. Avoid disease transfer from hatchery to wild fish and visa versa.	Comply with IHOT standards and USFWS policy.	See sections 3.5, 4.1, 5.4, 5.8, 7.8, 7.9, 9.2.7, 10.11
10. Evaluate impacts on life history traits of wild and hatchery fish from harvest and spawning escapement.	Track trends of life history characteristics of hatchery fish (no wild fish in this system).	Annual evaluation of: Adult age distribution, fecundity, body size, sex ratio, juvenile size (e.g. data in section 9.2), distribution and straying (annual compilation of CWT data from the CRB).

RISKS *Performance standards*	*Performance Indicators*	*Monitoring and Evaluation*
11. Assess survival of captive broodstock progeny vs. wild cohorts.	*NA for mitigation hatcheries (APR 1999).*	
12. Depleting existing population spawning in the wild through broodstock collection.	*NA for mitigation hatcheries (APR 1999).*	

C. Description of program and operations

1. Broodstock goal and source[39]

Source

- *On-station releases into the Little White Salmon River (and Walla Walla River release)*: Adult spring Chinook returning to the Little White Salmon River.

- *Umatilla program*: Adult spring Chinook salmon collected at Three Mile Dam on the Umatilla River by CTUIR.

Supporting information.

- *History*: The spawning of spring Chinook salmon at the Hatchery first occurred in 1967 when fish of unknown origin returned to the Little White Salmon River (Nelson and Bodle 1990). These fish could have been strays or descendants from previous attempts to rear spring Chinook from the McKenzie River (1916 brood), Salmon River (1925 brood), or Carson stock reared at Willard during the 1964 brood year. Since that time, fish were released into the Little White Salmon River from Willamette stock (Eagle Creek NFH), South Santiam State Fish Hatchery, Klickitat River stock, Ringold Springs stock, and Carson stock. The present stock is considered a derivative of the Carson stock. Part of the 1995 brood included adult fish trapped on the White Salmon River (progeny of Carson stock reared and released at Big White Salmon Ponds). Fish originating from White Salmon River adults (released in 1997) were the only fish released since 1985 that did not originate from adults returning to the Hatchery.

Annual size

- Spring Chinook enter the hatchery holding ponds from mid-April to mid-August. Spawning occurs from early August to early September. A summary of numbers spawned from 1991 through 2002 is found in Section 7.4.2 of HGMP. Total adult returns ranged

[39] *Section text from LWNFH Sp. Chinook HGMP, sec.6.1-6.2.*

from 615 to 8,243, averaging 2,982 per year for this period. The annual escapement goal is 900 adults returning to the hatchery (see Section 1.11.1 and Section 7.4.2 of HGMP).

2. Adult collection procedures and holding

- All fish production for the Hatchery is initiated by adult collection at Little White Salmon NFH. An impassable natural waterfall, located approximately 0.8 kilometers upstream of the Little White Salmon facility prevents adult passage to Willard NFH. (LWNFH Sp. Chinook HGMP, sec. 7.2)

- Returning adult fish migrate through Drano Lake (backwater of the Bonneville Pool at the mouth of the Little White Salmon River) and up the Little White Salmon River, before entering the hatchery ladder. To facilitate and maximize adult collection, further migration is prevented by a concrete barrier dam. Constructed in 1974, the fish ladder and barrier dam were built in anticipation of new peaking levels at Bonneville Dam (USFWS 1987). River water is supplied to two 30' wide X 90' long X 6' deep adult holding ponds. Water exiting the ponds, in addition to a separate attraction water intake, supplies water to the fish ladder. Adult fish migrating up the ladder enter the ponds through a finger weir. (LWNFH Sp. Chinook HGMP, sec. 7.2)

- The hatchery ladder is opened during the 3rd week of April to begin the collection of adult spring Chinook. Historical records show that a majority of the fish enter the hatchery during the month of May, however, the ladder is operated throughout the spawning period to ensure collection of fish from the entire spectrum of the run. Spawning historically occurs between August 1 and September 7. The hatchery ladder is closed at the end of spawning to prevent the possible collection of stray tule fall Chinook from Spring Creek NFH. (LWNFH Sp. Chinook HGMP, sec. 7.2)

- Fish enter the spawning facility volitionally via a fish ladder that opens immediately below the hatchery barrier dam. Once inside the trap, the fish are held in a 30' X 90' X6’ holding pond. (LWNFH Sp. Chinook HGMP, sec. 5.1-.3)

- Adult fish are moved from pond to pond and into the anesthetic tank using hydraulically operated mechanical crowders. (LWNFH Sp. Chinook HGMP, sec. 5.1-3)

- Brood holding facilities include two 30' X 90' X 6' holding ponds. (LWNFH Sp. Chinook HGMP, sec. 5.1-3)

3. Adult spawning

a) Spawning protocols

- Spawning facilities include a transfer tower to move fish from the holding ponds into the anesthetic tank where fish are sorted. Fish not ready to spawn (green fish) are returned to the holding ponds via return tubes. Ripe fish are handled on a stainless steel spawning table. (LWNFH Sp. Chinook HGMP, sec. 5.3)

- Selection method: Broodstock are collected to represent the full spectrum of the run. Fish are sorted over a one to two day period with ripe females being spawned and green females sent back to the ponds until 100% of the fish have been checked. Enough male fish are sent back to the pond with the green females to ensure a 1:1 spawning ratio. The eggs collected during this sorting process are considered a "take". Male spawners are randomly selected during the take with up to five percent of males used being jacks. The number of jacks spawned on a given day is subjectively defined by hatchery staff up to the five percent maximum and is dependent on availability and ripeness. After all fish have been sorted once and ripe females spawned, a maximum one week period is allowed to pass before the fish are re-sorted and newly ripened females spawned. The objective is to achieve maximum fertilization by spawning fish soon after ovulation and yet avoid the needless handling of green females. The re-sorting process continues until all fish are spawned. Since there are no naturally spawning spring Chinook in the watershed, differentiating spawners based on natural stock origin from within the watershed is not a criteria. (LWNFH Sp. Chinook HGMP, sec. 8.1)

b) No. of males and females spawned each year over past 10 years

If the hatchery escapement goal is met, then a 1:1 spawning ratio will be achieved. Achieving this spawning ratio is one of the highest brood stock program goals at the Hatchery. During low escapement years, males have been re-used on an as-needed basis to maximize the total number of females available to spawn. In low escapement years it is better to spawn the available females (and not lose that genetic material), than discard them. Under these conditions, reusing male fish does not compromise the genetic diversity of the hatchery stocks. It was determined that, in all instances, a minimum escapement need had been met to maintain genetic diversity, although some male fish had to be reused to achieve production goals. (LWNFH Sp. Chinook HGMP, sec. 8.2)

Broodstock Collection Levels (LWNFH Sp. Chinook HGMP, sec. 7.4.2)

Year	**Adults**			**Eggs**	**Juveniles**
	Females	Males	Jacks		
1991	731	446	0		
1992	747	432	0		
1993	799	736	0		
1994	302	228	3		
1995	202	182	21		
1996	539	508	12		
1997	401	396	3		
1998	653	367	14		
1999	424	368	12		
2000	419	383	28		

Year	**Adults**			**Eggs**	**Juveniles**
	Females	Males	Jacks		
2001	405	379	12		
2002	438	424	3		
Average	505	404	8		

4. *Fertilization*

a) Protocols[40]

- It is important to note that at no time in the recent past has the Hatchery pooled the eggs of females prior to fertilization. Again, as mentioned in section 7.2 above, an intense effort is made to achieve a 1:1 spawning ratio. The following is a detailed description of the spawning protocol.

- Adults are crowded from holding ponds and anesthetized using MS-222. Anesthetized adults are then sexed and checked for ripeness. Ripe adults are selected and euthanized. Tails of all ripe females spawned are cut to allow bleeding for approximately 3-5 minutes. Each female is tagged with a numbered tag that is recorded and remains with the eggs from that fish until the eggs are eyed up to facilitate tracking of the eggs (see Section 9.1.3). Prior to removing the eggs, Fish Health Center employees collect samples of ovarian fluid from 150 fish to test for the presence of viruses.

- Eggs are removed using a Wyoming knife and collected in iodophor-disinfected colanders to drain ovarian fluid. The eggs are then transferred to iodophor-disinfected stainless steel buckets and sperm is added directly to the eggs.

- A 1:1 random spawning ratio is maintained and male jacks are used proportionally to their percentage of the run to a maximum of 5%. The numbered buckets containing eggs and sperm of individual (paired) fish are then transferred to the Little White Salmon hatchery nursery building (0.5 kilometers away) where water is added to activate the sperm.

- The above described process takes from 5-10 minutes. The fertilized eggs are gently stirred and allowed to rest for a minimum of thirty seconds, then washed and water hardened for one half hour in a 75 ppm active iodine solution in individual Heath incubator trays. The eggs are incubated using single pass spring and/or well water.

- Aseptic procedures are followed to assure the disinfection of equipment throughout the egg handling process. Tissue samples are collected by fish health specialists to determine the incidence of Ceratomyxa shasta, and all of the listed pathogens except

[40] *Section text from LWNFH Sp. Chinook HGMP, sec. 8.3.*

Myxobolus cerebralis, according to procedures and guidelines in 713 FW and IHOT. Refer to sections 9.1.6 and 9.2.7 for more fish health details.

b) Number of eggs collected and fertilized each year over past 10 years [41]

BROOD YEAR	EGGS TAKEN	% SURVIVAL TO EYE	% SURVIVAL GREEN TO POND	% SURVIVAL POND TO RELEASE
1989	4,134,045	90.5	89.9	84.4
1990	3,493,268	81.7	79.6	78.3
1991	3,207,155	78.3	73.1	65.1
1992	2,981,646	96.3	93.1	82.7
1993	3,718,222	91.3	82.8	89.5
1994	1,307,102	92.2	89.9	92.1
1995	900,581	95.9	94.8	95.5
1996	2,190,460	94.1	93.6	96.0
1997	1,961,472	93.9	89.7	97.1
1998	2,419,139	94.2	93.6	97.8
1999	1,716,264	94.5	92.0	90.0
2000	1,732,592	95.1	93.9	95.9
Average	2,480,162	91.50	88.83	88.70

- Extra eggs may be taken to safeguard against potential incubation losses and to allow culling based on levels of *R. salmoninarum*. Excess eggs are buried on-station.

5. *Incubation*

- Fertilized eggs are washed and then water hardened for one half hour in a 75 ppm active iodine solution in individual incubator trays. The eggs are incubated using single pass spring or well water. Aseptic procedures are followed to assure the disinfection of equipment throughout the egg handling process. (LWNFH CHMP, sec. 3.4)

- At the eyed stage, eggs are shocked and picked to remove the dead eggs, then placed back into the incubators, at approximately 5,000 eggs per tray. There are 132 stacks of incubation trays that have the capacity to incubate up to a total of 9.9 million eggs. Nonviable embryos are removed from each incubator tray at least two times during

[41] *From LWNFH Sp. Chinook HGMP, sec. 9.1.*

incubation with a cumulative record maintained for each take of eggs. All eggs are treated with formalin three to five times a week at a rate of approximately 1,667 ppm. Formalin treatments are used to reduce fungus related mortality and are terminated once hatching has begun. (LWNFH CHMP, sec. 3.4)

- Eggs are placed into incubation trays at a rate of one female (approximately 4000 eggs) per incubation tray. Each tray is tagged with a number corresponding to the female spawned. When Fish Health personnel have completed the tests for BKD, eggs from females with a bacterial antigen level (corresponding to the infection level) above a set limit are disposed of or segregated from the rest of the population. At eye-up, the eggs are shocked, dead eggs are removed, the remaining eggs are enumerated and then placed back into incubation trays at a rate of 5000 eggs per tray. Initial water flows are set at 3 gpm and increased to 5 gpm at hatch. (LWNFH Sp. Chinook HGMP, sec. 9.1.3-4)

- Water temperature is monitored using temperature loggers taking readings every 30 minutes. Temperatures during incubation range from 43°F to 50°F with typical temperatures around 47°F. Dissolved oxygen levels are not regularly monitored, but have been tested and found to be at, or near saturation. All water for incubation is passed through a 70 micron drumscreen to filter out solids. (LWNFH Sp. Chinook HGMP, sec. 9.1.3-4)

6. *Ponding*

a) Protocols

Fish are transferred to the nursery tanks from egg trays when most individuals have absorbed their yolk sac (at around 1,700 Temperature Units, TUs). At this time, eggs destined for an individual tank are emptied into a transport vessel, moved to the appropriate tank and released directly into the tank (i.e. swim up and ponding are forced) in December and early January. The fish are held in the tanks and fed using automatic feeders until they are large enough to be moved into the raceways and/or the next take of fry needs the tank space. At this time the fish are loaded by net into a 400 gallon transport tank and moved to the 8' X 80' raceways. Average length at initial ponding is 33mm. (LWNFH Sp. Chinook HGMP, sec. 9.1.5)

b) Number of fry ponded each year, including % hatch each year

With an average hatch rate of 88.8%, approximately 1,050,000 fry are ponded each year to meet the onsite release goal of 1m smolts. Additional eggs maybe taken to meet other requests such as the Umatilla River program, 350,000 smolts and the Walla Walla program 250,000 smolts.

7. *Rearing/feeding protocols*

Fingerling spring Chinook are held in the 8' X 80' raceways until mid-May when they are moved to the new colored raceways. Temperature readings are monitored using data loggers taking readings every 30 minutes. Temperatures in the raceways range from 38°F to 49°F during the year. Mortalities are removed daily and raceways are cleaned with a broom while effluent water is drained to a pollution control structure. Cleaning is performed as needed but no less than once a week. Dissolved oxygen, carbon dioxide and total gas pressure have never been problems and are not recorded on a regular basis. Fish are reared on river water for most of their rearing cycle. The fish are fed BioMoist starter, grower and feed following manufacturer recommendations (generally between 3.5% and 0.5% of body weight per day). They are fed between two and nine times daily depending on fish size. Overall conversions are around 1.1.

8. Fish growth profiles

Table B: End of Month Growth Parameters for LWS NFH Spring Chinook Brood Year 2000. (LWNFH Sp. Chinook HGMP, sec. 9.2.4)

Month	Length	#/lb	Condition Factor C	Conversion For Month	Density Index	Flow Index
December,2000	1.417	976		1.53	0.09	0.63
January, 2001	1.724	542		1.18	0.10	0.59
February	1.977	359		1.65	0.13	0.89
March	2.414	197		0.97	0.20	0.90
April	2.827	123		1.01	0.28	0.93
May	3.308	76.7		0.83	0.30	0.98
June	3.547	62.2		1.39	0.34	1.13
July	3.949	45.1		1.27	0.17	0.53
August	4.309	34.7		1.22	0.20	0.64
September	4.746	26.0		1.16	0.24	0.77
October	4.822	24.8		3.86	0.25	0.80
November	4.866	24.1		3.26	0.20	0.95
December	4.953	22.9		1.52	0.22	1.13
January, 2002	5.043	21.7		1.71	0.23	1.17
February	5.154	20.3		1.55	0.24	1.22
March	5.416	17.5		1.03	0.26	1.35
April*	5.771	15.8	0.000330	0.97	0.27	1.40

Data from Lot History, Production for Brood Year 2000 spring Chinook.

* Fish released April 18, 2002.

Little White Salmon/Willard NFH ComplexSpring Chinook - Brood Year 2004											
MONTH	NUMBER OF FISH	WEIGHT (LBS.)	LENGTH (IN.)	DENSITY INDEX	FLOW INDEX	MORTALITY	NUMBER SHIPPED	WEIGHT (LBS.)	WEIGHT GAIN MONTH	WEIGHT GAIN TO DATE	FPP
Dec-04	1555253	1.671	1.440	0.11	0.77	18053			537	930	930
Jan-05	1549712	2.913	1.735	0.12	0.87	5.541			1242	1779	532
Feb-05	1034483	3.153	2.038	0.14	1.11	1402	513827	917	1157	2936	328.1
Mar-05	1028857	5534	2.463	0.21	1.60	1832			3.298	6.234	185.9
Apr-05	1027751	9.759	2.976	0.3	1.41	1106			4225	10459	105.3
May-05	1026400	14367	3.387	0.08	0.57	1349			4608	15067	71.4
Jun-05	1024437	14367	3.688	0.09	0.67	1963			4144	19211	55.3
Jul-05	1023690	18511	4.070	0.11	0.81	747			6349	25560	41.2
Aug-05	1023500	24860	4.437	0.14	0.97	190			7337	32897	31.8
Sep-05	1023417	32197	4.684	0.15	1.08	83			5664	38561	24.9
Oct-05	1023377	37861	4.815	0.16	1.14	40			3285	41846	23.4
Nov-05	1023374	41146	4.915	0.17	1.19	43			2598	44444	23.4
Dec-05	1023287	43556	4.908	0.17	1.18	47			(-188)	44256	23.5
Jan-06	1023200	47326	5.046	0.18	1.25	87			3770	48026	21.6

9. *Fish health*

- The current treatment to control fungus on the eggs is a 1,667 ppm drip of formalin for 15 minutes three to five times a week. The first health exam of newly hatched fish occurs when approximately 50% are beyond the yolk sac stage and begin feeding. Sixty fish are sampled and tested for virus. Regular fish health checks are done on a monthly basis by the fish health specialist from the Lower Columbia River Fish Health Center as per the fish health policy in 713 FW. (LWNFH Sp. Chinook HGMP, sec. 9.1.6*)*

- Monthly examination: A pathologist from the LCRFHC visits at least monthly after fry are placed in ponds. Based on pathological signs, age of fish, concerns of hatchery personnel, and the history of the facility, the examining pathologist determines the appropriate tests. This usually includes a necropsy with an external and internal exam of skin, gills, and internal organs and can include other tests for bacteria, virus and parasites. Kidneys, gills and other tissues are checked for common bacterial pathogens by culture. Blood is checked for signs of anemia or other infections, including viral anemia. Additional tests for virus or parasites are done if warranted. The pathologist examines the healthy and moribund/freshly dead fish to ascertain potential disease problems in the stock. (LWNFH CHMP, sec. 3.7.2)

- Diagnostic Examination: This is done on an as-needed basis as determined by the pathologist or requested by hatchery personnel. Moribund, freshly dead fish or fish with unusual signs or behavior are examined for disease using necropsy and appropriate diagnostic tests. A pathologist will normally check symptomatic fish during a monthly examination. (LWNFH CHMP, sec. 3.7.2)

- Ponding Examination: The first health exam of newly hatched fish occurs when approximately 50% of the animals are beyond the yolk sac stage and begin feeding. Sixty fish will be sampled and tested for virus. (LWNFH CHMP, sec. 3.7.2)

- Pre-release Examination: At two to four weeks prior to a release or transfer from the hatchery, 60 fish from the stock are necropsies and tissues are taken for testing of listed pathogens. The listed pathogens, defined in USFWS policy 713 FW (Aquatic Animal Health Policy, Service Manual) include infectious hematopoietic necrosis virus (IHNV), infectious pancreatic necrosis virus (IPNV), viral hemorrhagic septicemia virus (VHSV), *Renibacterium salmoninarum, Aeromonas salmonicida,* and *Yersinia ruckeri*. The LCRFHC tests for *Myxobolus cerebralis,* another listed pathogen upon request. (LWNFH CHMP, sec. 3.7.2)

- Adult Certification Examination: At spawning, tissues from adult fish are collected to assay viral, bacterial and parasite infections and to provide a health profile. The LCRFHC tests for all of the listed pathogens, except *Myxobolus cerebralis* (unless requested), and *Ceratomyxa shasta*. The minimum number of samples collected is defined by 713 FW. At Little White Salmon NFH, all brood spring Chinook adult females are tested for *Renibacterium salmoninarum* (causative agent of bacterial kidney disease, BKD), and their eggs identified by a fish health number corresponding to each female. This allows tracking of the eggs so that selective culling and/or segregation is possible. If not needed to make production goals, progeny from females with high levels of BKD are culled. Otherwise, these are segregated from progeny at lower risk of disease. This level of sampling is not required for the upriver bright fall Chinook salmon which have a low incidence of BKD. (LWNFH CHMP, sec. 3.7.2)

- Other Stocks: The Little White Salmon/Willard NFH Complex coordinates with tribes and states to help achieve supplementation and restoration goals, as appropriate to U.S. *v* Oregon contractual agreements. In so doing, stocks external to the Little White Salmon watershed are often received on station. Prior to import to the station, fish health policy must be met as described in Section 3.7.1. While on station, each stock undergoes fish health sampling as detailed above. Furthermore, any eggs received at the hatchery must be disinfected as described in 713 FW Policy before they are allowed to come in contact with the station's water, rearing units or equipment. (LWNFH CHMP, sec. 3.7.2)

10. Chemotherapeutant use[42]

- The spring Chinook salmon adults are taken into the hatchery beginning mid-May and due to the lengthy holding time of three months, require formalin treatment three to five times weekly at a rate of 167 ppm to control external fungus. In early July, about 30 days prior to spawning, adults are injected with erythromycin at 15 mg/kg body weight to control the vertical and horizontal transmission of BKD. Except for fish arriving too close to the time of spawning for safe handling and injection, all spring Chinook salmon adults are injected. Injections have been done under the INAD 6430 (Investigational New Animal Drug regulation) and thus did not require a prescription from a veterinarian. The injected drug is Erythro-200 or Erythro-100 (200 mg/ml or 100 mg/ml, respectively, of active erythromycin base in polyethylene glycol, ethyl acetate and ethyl alcohol), to be injected in the dorsal sinus at 15-20 mg drug/kg of body weight. In 2004, the manufacturer suspended production of erythromycin so modifications of drug, acquisition, and application may apply in future dates.

[42] *Section text from LWNFH CHMP, sec. 3.7.3-4.*

- As for the upriver bright fall Chinook salmon, the spring Chinook eggs are water-hardened in a solution of polyvinylpyrrolidone iodine compound at 75 ppm iodine in water buffered by sodium bicarbonate (at 0.01%) for 30 minutes during the water-hardening process. To prevent/reduce BKD, the spring Chinook juveniles are fed erythromycin in June at a daily dosage of 100 mg/kg of fish for a minimum of 21 days. Unless deemed otherwise by fish pathologists, the feeding of erythromycin to the Little White Salmon stock is limited to early summer because drug toxicity, as noted by tetani and mortality, becomes more enhanced in the fall. The CTUIR fish do receive a second feeding in the fall as requested in the Umatilla Hatchery and Basin Operation Plan. As of 2001, there is a temporary INAD 4333 that allows feeding of Aquamycin 100 (erythromycin thiocyanate in a wheat flour base) and prescription by a veterinarian is not required.

- Formalin is used on the eggs of all species to prevent losses due to fungus growth. The formalin is metered into stacks of eggs for fifteen minutes in a diluted solution (ten parts filtered water to one part formalin) to achieve a treatment concentration of 1,667 ppm formalin. This is accomplished using a formalin treatment system (installed in 2000) that automatically times the treatment and a subsequent 30 minute flush to assure that all stacks being treated receive a full fifteen minute treatment and to clear the distribution system of formalin. Treatments are performed three to five times a week and are discontinued once hatching begins. Formalin is not used at Willard NFH.

Other Fish Health Precautions

- Unless knowledge regarding vertical transmittance of BKD proves otherwise, eggs from female brood stock with high levels of BKD will not be used in production unless egg production is low. The enzyme-linked immunosorbent assay or ELISA is used to measure BKD levels in 100% of the spring Chinook adult females. Returning adult numbers permitting, eggs from females measuring greater than 0.199 optical density (O.D.) in this test will be culled to reduce/control BKD. If the number of brood females is low, progeny from highly infected females shall be segregated into rearing units apart from the rest of the production and absolute fastidiousness maintained as to using equipment that is disinfected and/or dedicated to these rearing units.

- The Little White Salmon/Willard NFH Complex coordinates with tribes and states to help achieve supplementation and restoration goals, as appropriate to U.S. *v* Oregon contractual agreements. In so doing, stocks external to the Little White Salmon watershed are often received on station and can be a health risk. Prior to import to the station, fish health policy must be met as described in Section 3.7.1. Any eggs received at the hatchery must be disinfected as described in 713 FW Policy before they are allowed to come in contact with the station’s water, rearing units or equipment. While on station, each stock undergoes fish health sampling as detailed above.

- Little White Salmon NFH rears spring Chinook salmon for the CTUIR. In coordination with the ODFW and the CTUIR, the brood adults returning to the Umatilla Hatchery are screened for BKD and other pathogens in accordance to the Umatilla Basin Annual Operations Plan (reference in bibliography) which follows the dictates of 713 FW Policy and IHOT. Eggs intended for rearing at Little White Salmon NFH must be from females individually screened for BKD with the caveat to prevent receipt of eggs from females with medium to high BKD (greater than 0.499 O.D.), as measured by the ELISA.

- Although fish health policy applies to all fish coming into Little White Salmon/Willard NFH Complex, this does not necessarily prevent disease outbreaks that occur on station due to a particular stock's disease ancestry or poor husbandry prior to arrival. Therefore, it is to the best advantage of the hatchery to reject stocks whose condition may compromise the overall health of on-station stocks, even though they may meet the fish health policy.

- The ladder barrier at Little White Salmon NFH prevents passage of anadromous salmon and steelhead into the water supply, which would otherwise be a source of disease for juveniles. Adult salmon carcasses leftover from spawning are removed and rendered to prevent possible contamination of the water supply. However, many adult salmon die in Drano Lake, a popular fishing site, either from natural causes or from fishing mortality. It is quite possible that the common practice of fishermen's gutting fish and discarding of entrails into the lake may be a source of virus and other pathogens, whether through the water or scavenger animals which access the lake.

- It is necessary to continue a vigilance of the upriver Little White Salmon River to prevent/reduce the horizontal dissemination of pathogens through the water or through predators like great blue herons, eagles and otters. Located five river miles above Little White Salmon NFH, the Willard NFH and the Columbia River Fisheries Research Center of the U.S. Geological Service (CRRL) raise fish and use water from the Little White Salmon River. As for Little White Salmon NFH, the fish of the Willard NFH are cared for by the LCRFHC under the auspices of the same fish health policies. In addition, the LCRFHC maintains good communication with the CRRL to assess health of incoming fish and to periodically examine fish as needed to prevent or treat any disease which might infect salmon at Little White Salmon/Willard NFH complex. The CRRL also uses ozone and chlorine to disinfect all effluent water which is channeled down to an abatement pond. Under less control of the Service are the fisheries activities of the WDFW which periodically plants rainbow trout above Willard NFH, a possible source of disease.

- Decontamination of all holding and rearing units is necessary after release, transfer or spawning of the occupying fish. Disinfection of the brood pond after completion of spring Chinook salmon spawning is especially important to prevent carryover of pathogens to the upriver bright fall Chinook salmon adults. Units should be dewatered, pressure washed (where feasible), and dried to reduce problems caused by fungus, bacteria and parasites. If necessary, a formalin treatment may be applied to the surface.

- Tank trucks or tagging trailers are disinfected before being brought onto the station.

- Abernathy Fish Technology Center (AFTC) provides quarterly feed quality analyses to meet nutritional requirements and prevent nutritional diseases.

11. Tagging and marking of juveniles[43]

[43] *Section text from LWNFH CHMP, sec. 3.8.2.*

- Juvenile fish are fin clipped and coded-wire tagged by CRFPO to monitor and evaluate fish cultural techniques, survival and fishery contribution. To assess survival and evaluate harvest potential under normal production, the current marking strategy is that all of the Little Salmon NFH 1.0 million spring Chinook salmon are adipose fin clipped with 75,000 receiving CWTs. Umatilla program spring Chinook also receive an adipose clip except for 40,000 that receive CWTs and a left/right ventral fin clip.

- This is in compliance with recommendations of the Biological Opinions of NOAA-Fisheries 1999 Artificial Propagation in the Columbia River Basin (NMFS 1999) and the 2000 Reinitiating of Consultation on Operation of the Federal Columbia River Power System, under the ESA-Section 7 Consultation.

12. Fish Release

a) Protocols

Spring Chinook (1.0 million) are released into the Little White Salmon River as yearlings in mid-April. Releases are made directly into the Little White Salmon River less than a half mile from the Columbia River and coincide with a number of other hatchery releases within the basin. Both spring and fall Chinook destined for off-site release are loaded onto distribution trucks using a hydraulic fish pump and dewatering tower. At time of release, all rearing units are sampled and length frequency data collected. Salt water challenges are performed on individual lots of fish for a period of 24 hrs at a salinity of 3%. This test is used to determine the degree of smoltification and readiness to out-migrate following release. Raceway tail screens are removed a day prior to release allowing a limited volitional release. The day of release, fish are liberated one raceway at a time by slowly flushing fish out of the raceway to minimize injury as fish move through the effluent channel to the river. After final release, numbers, size, tagging data and other pertinent information are recorded. (LWNFH CHMP, sec. 3.6)

b) Number of fish released each year (subyearlings?; yearlings?; other?)

Release dates, stage, number of fish, and number per pound of Little White Salmon National Fish Hatchery spring Chinook salmon, 1990-2007 (USFWS CRiS Database).

L White Salmon NFH Spring Chinook releases
in L White Salmon River, 1990 - 2007.

Release Date	Brood Year	Number	Size #/lb.	Stage
01/12/1990	89	384,706	1,460.00	fry
04/18/1990	88	461,446	15.00	yearling
06/25/1990	89	1,050,126	36.00	fingerling
04/15/1991	89	1,016,706	17.00	yearling
03/05/1992	90	138,960	19.00	yearling
04/14/1992	90	668,782	17.00	yearling
06/14/1992	91	324,288	39.00	fingerling
06/24/1992	91	324,287	39.00	fingerling
04/15/1993	91	809,079	18.00	yearling
06/23/1993	92	503,458	52.00	fingerling
04/14/1994	92	994,588	16.00	yearling
06/23/1994	93	571,101	38.00	fingerling
04/13/1995	93	1,057,864	15.00	yearling
04/18/1996	94	961,515	15.00	yearling
04/15/1997	95	540,210	16.00	yearling
04/22/1997	95	142,413	16.00	yearling
04/20/1998	96	1,066,702	16.00	yearling
04/20/1999	97	1,074,173	14.00	yearling
04/20/2000	98	1,115,384	15.00	yearling
04/19/2001	99	1,016,574	16.00	yearling
04/18/2002	00	1,037,382	16.00	yearling
04/17/2003	01	1,012,339	15.00	yearling
04/15/2004	02	1,036,733	15.00	yearling
04/19/2005	03	779,716	14.00	yearling
04/13/2006	04	769,508	15.00	yearling
04/20/2006	04	244,766	16.00	yearling
04/12/2007	05	1,006,105	14.00	yearling

CRiS\DistBA07

D. Program benefits and performance

1. Adult returns

a) Numbers of adult returns (need data for the past 10-20 years)

Contribution and recovery of coded-wire tagged spring Chinook salmon from Little White Salmon National Fish Hatchery (data presented in table were reproduced from Stock Assessment Reference Summary, U.S. Fish and Wildlife Service, Columbia River information System, Pastor 2007).

Brood Year[1]	Number Released	Hatchery	Columbia River Harvest [2]	Ocean Harvest	Spawning Ground	Total Expanded Recoveries	Smolt to Adult Survival (%)
1990	1,677,694	260	0	0	0	260	0.02
1991	809,079	232	0	0	0	232	0.03
1992	994,588	2,895	1,924	0	607[a]	5,426	0.55
1993	1,057,864	1,246	1,055	0	0	2,301	0.22
1994	961,515	322	18	0	0	340	0.04
1995	682,623	2,381	334	0	61	2,776	0.41
1996	1,066,702	3,459	1,402	0	44	4,905	0.46
1997	1,074,173	576	3,358	0	24	3,958	0.37
1998	1,115,384	3,221	3,813	0	0	7,034	0.63
1999	1,016,574	480	990	0	0	1,470	0.14
10 year avg.	1,045,620	1,507	1,289	0	74	2,870	0.29
Percent		53%	45%	0%	2%		

[1] Brood year 1990-1999 fish were spawned in that year and returned three, four and five years later as adults. For example, a five year old fish from brood year 1999 returned in calendar year 2004.

[2] It was undetermined how consistently the sport and tribal fisheries in Drano Lake have been sampled to recover coded-wire tags, so Columbia River harvest should be considered a minimum estimate.

a/ Estimated number of hatchery fish that navigated the damaged barrier dam, during unusually high water and escaped above the hatchery and were observed below the falls, near the hatchery water intake supply.

L White Salmon NFH Spring Chinook Returns

Year	Males	Females	Jacks	Unknown	Total	Males Spawned	Females Spawned
80	383	591	115	0	1,089	0	403
81	895	1,699	1	0	2,595	0	1,587
82	917	1,594	33	0	2,544	0	328
83	849	1,573	8	178	2,608	0	1,408
84	226	326	25	0	577	98	304
85	470	887	0	0	1,357	202	473
86	326	690	128	0	1,144	271	588
87	1,313	3,242	11	0	4,566	484	1,260
88	1,554	2,392	74	0	4,020	416	1,048
89	537	1,295	55	0	1,887	331	998
90	697	1,649	16	0	2,362	423	893
91	618	1,116	43	14	1,791	446	731
92	723	1,467	48	0	2,238	432	747
93	1,174	1,789	0	0	2,963	736	799
94	268	343	4	0	615	228	302
95	292	330	157	299	1,078	203	202
96	847	2,048	17	25	2,937	520	539
97	670	1,362	7	0	2,039	396	401
98	259	509	24	0	792	249	468
98	151	248	0	0	399	118	185
99	1,440	2,723	101	0	4,264	368	424
00	699	2,011	123	5,410	8,243	383	419
01	530	1,429	38	0	1,997	379	405
02	1,423	2,487	7	2,812	6,729	424	438
03	755	1,231	101	410	2,497	577	561
04	667	1,405	17	179	2,268	532	520
05	526	1,295	100	0	1,921	413	450
06	667	1,488	5	1,459	3,619	481	480

CRiS\ReturnPr

b) Return timing and age-class structure of adults

Age of Return, Little White Salmon National Fish Hatchery spring Chinook salmon, 1980-2007 (USFWS CRiS Database).

L White Salmon NFH Spring Chinook Age of Returns

Year	Age-2	Age-3	Age-4	Age-5	Age-6	Total
80						1,089
81						2,595
82		33	727	1,784		2,544
83		14	939	1,655		2,608
84		53	249	275		577
85		43	1,202	112		1,357
86		220	699	225		1,144
87		331	3,903	332		4,566
88		109	1,460	2,438	13	4,020
89		75	1,698	114		1,887
90		30	2,006	326		2,362
91		66	675	1,050		1,791
92		27	1,977	234		2,238
93		15	1,016	1,921	11	2,963
94		4	354	254	3	615
95		279	618	178	3	1,078
96		44	2,801	92		2,937
97		14	1,253	772		2,039
98		16	418	358		792
98		11	356	32		399
99		140	3,977	147		4,264
00		83	7,448	712		8,243
01		28	979	990		1,997
02		31	5,871	827		6,729
03		47	1,129	1,321		2,497
04		12	2,032	224		2,268
05	2	83	1,661	175		1,921
06		9	3,500	110		3,619
07	96	207	1,724	710	2	2,739

CRiS\AgePr

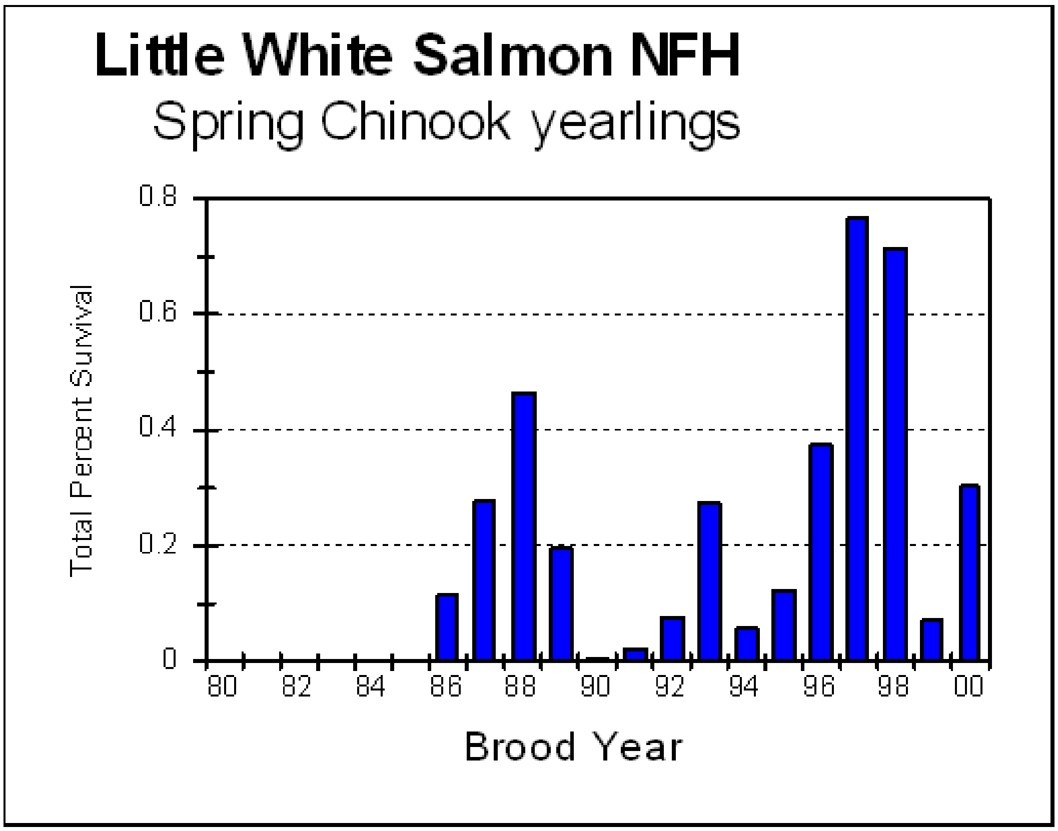
- Age 2 fish are also recovered at the hatchery in some years, and can be high in some years. Reporting for this age class of "mini jacks" or "residuals" is not consistent.

- Spring Chinook enter the hatchery holding ponds from mid-April to mid-August. Spawning occurs from early August to early September.

- A summary of numbers spawned from 1991 through 2002 is found in Section 7.4.2 HGMP. Total adult returns ranged from 615 to 8,243, averaging 2,982 per year for this period. The annual escapement goal is 900 adults returning to the hatchery (LWNFH Sp. Chinook HGMP, sec. 1.11.1 and 7.4.2).

c) Smolt-to-adult return rates

Smolt to adult survival rates based on sampling and recovery of coded-wire tags (total estimated recovery). (Pastor 2007 – CWT Assessment Report)



Survival of spring Chinook salmon hatchery releases into the Umatilla River, Oregon a/.

Hatchery	Broodyear	Code-wire tag # released	Hatchery/Trap Recovery	Harvest Recovery	Spawning Ground b/	Total Estimated CWT Recovery	% Survival
Carson NFH	1996	18,721	17	10	24	51	0.27
Carson NFH	1997	19,593	21	33	22	76	0.39
Little White Salmon NFH	1997	35,700	13 c/	59	7	79	0.22
Carson NFH	1998	19,444	17	79	33	129	0.66
Carson NFH	1999	18,398	2	26	8	36	0.20
Willard NFH	2000	39,968	12	20	4	36	0.09
Distribution			82	227	98	407	
Percent Distribution			20%	56%	24%		

a/ Data from Regional Mark Information System 04/16/2007, Steve Pastor and Doug Olson USFWS
b/ all spawning ground recoveries were reported as “Umatilla River”
c/ one trap recovery reported ny IDFG as “Powell rack”

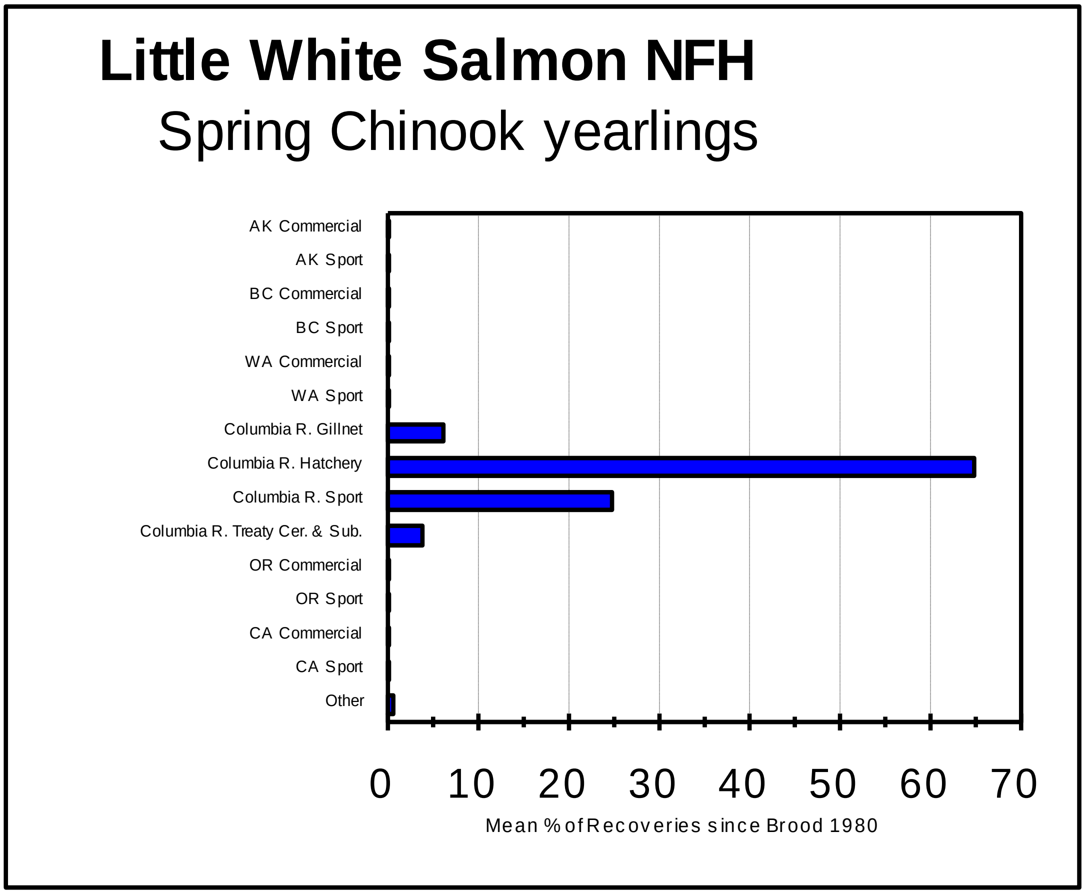
d) Stock productivity (e.g. recruits per spawner)

A 10-year average of 3 recruits per spawner (R/S) for brood years 1990-99. For those broodyears , 1.05 million smolts were released to produce 2,870 total adult recoveries. This assumes that between 800 and 1,000 adult spawners produced 1.05 million smolts.

2. Contributions to harvest and utilization (e.g. food banks)

- Almost all spring Chinook salmon are harvested in freshwater within the Columbia River basin. The majority are harvested in Drano Lake. WDFW estimated that 1,787 were harvested by sport fisherman in Drano Lake in 2006. (LWNFH Hatchery Update 2006)
- During 2006, the Treaty Indian spring Chinook harvest in the mainstem Columbia River was 8,401 (this includes all upriver spring Chinook salmon). (ODFW and WDFW 2006)
- Sport catch in mainstem Columbia River in 2006 was 6,628 (this includes all upriver spring Chinook salmon). (ODFW and WDFW 2006)

Figure from CWT Assessment Report (Pastor 2007)



- Surplus Adult Salmon Distribution: In most years, more fish return to the hatchery than are needed for brood stock. Most of these surplus fish are in good condition upon entry into the hatchery and are distributed to the YN as needed for ceremonial and subsistence use and for use in the tribal nutrition program. Fish anesthetized with MS-222 or injected with erythromycin (spring Chinook adults) are typically rendered or buried on site. Whenever possible, excess hatchery fish will be left in the Little White Salmon River to allow for natural spawning, consumption by wildlife, and stream nutrient enhancement from carcass decomposition. The waterfall creating a historic barrier to anadromous fish passage in the upper watershed limits the options available for natural spawning activity. While agency managers agree that spawning habitat on the Little White Salmon River is marginal at best, small pockets of spawning gravel exist below the barrier. In addition, the hatchery (433 acres) is the site of an active bald eagle roost and is intensively used by wintering bald eagles. Allowing carcasses to remain in the River and Drano Lake is extremely beneficial to local wildlife and the Columbia River ecosystem. As a result, the hatchery has become a popular watchable wildlife viewing area. (LWNFH CHMP, sec. 3.10.6)

3. Contributions to conservation

- Whenever possible, excess hatchery fish will be left in the Little White Salmon River to allow for natural spawning, consumption by wildlife, and stream nutrient enhancement from carcass decomposition. The waterfall creating a historic barrier to anadromous fish passage in the upper watershed limits the options available for natural spawning activity. While agency managers agree that spawning habitat on the Little White Salmon River is marginal at best, small pockets of spawning gravel exist below the barrier. (LWNFH CHMP, sec. 3.10.6)

- In addition, the hatchery (433 acres) is the site of an active bald eagle roost and is intensively used by wintering bald eagles. Allowing carcasses to remain in the River and Drano Lake is extremely beneficial to local wildlife and the Columbia River ecosystem. As a result, the hatchery has become a popular watchable wildlife viewing area. (LWNFH CHMP, sec. 3.10.6)

- The hatchery complies with Endangered Species Act Biological Opinions issued by NOAA Fisheries and the USFWS. (LWNFH Sp. Chinook HGMP)

4. Other benefits

Cultural Values: The Columbia River Treaty Tribes (Yakama Nation, Nez Perce, Confederated Tribes of the Warm Springs Reservation of Oregon, and Confederated Tribes of the Umatilla Indian Reservation) share the in-river harvest of salmon. Surplus fish returning to the hatchery are also provided to the Yakama Nation and other tribes. (LWNFH Hatchery Update 2006)

E. Research, monitoring, and evaluation programs

- Juvenile Monitoring: Juvenile fish at the Little White Salmon/Willard NFH Complex are monitored on a routine basis by the hatchery staff to determine the condition factor of fry, fingerlings and smolts. Samples are taken by the LCRFHC to determine the health condition of fry, fingerling and smolts. Sampling of fingerlings for tag retention and fin mark quality, prior to release, is conducted by CRFPO. Salt water challenges are conducted before each release to assess smolting. The results from the 24-hour saltwater test are entered into the hatchery’s database and noted in the Columbia River Information System. (LWNFH CHMP, sec. 3.8.6)

- Bio-sampling and Reporting: Sampling of hatchery returns provides data that is combined with other information collected by agencies and tribes to evaluate the relative success of individual broods and compare performance between years and hatcheries. This information is used by salmon harvest managers to develop plans allowing harvest of hatchery fish while protecting threatened, endangered, or other stocks of concern. (LWNFH CHMP, sec. 3.8.3)

- All fish are checked for CWTs. All coded-wire tagged fish are sampled, their heads are removed, and CWTs are read for year of hatchery release. A percentage of untagged fish are also sampled. For all sampled fish, length and sex are recorded and scales are collected to determine average size, sex ratios, and age composition of returning fish. At least 600 adults are sampled throughout the spawning year and additional sampling occurs when adults are excessed. (LWNFH CHMP, sec. 3.8.3)

- Stock Assessment and Contribution to Fisheries : Coded-wire tagging of spring Chinook salmon production at Little White Salmon NFH began in 1982-84, then started up again in 1986 through the present. Currently, a release group of 75,000 are adipose fin clipped and coded-wire tagged to assess survival and fisheries contribution. The remaining 925,000 fish are adipose fin clipped to comply with selective fisheries management practices now instituted for hatchery production of spring Chinook salmon released from Columbia River hatcheries. (LWNFH CHMP, sec. 3.8.5)

- For three brood years (2002-04) an additional 75,000 spring Chinook salmon are being adipose fin clipped and coded-wire tagged to assess the use of raceway-baffles during the rearing of these fish. The first group of age four returns will be in 2006 from this study. (LWNFH CHMP, sec. 3.8.5)

- For the Umatilla Basin program, 40,000 spring Chinook salmon are adipose fin clipped, ventral fin clipped and coded-wire tagged, and 170,000 are adipose fin clipped. These two groups are transferred to the tribal Imeques acclimation facility located on the Umatilla River. (LWNFH CHMP, sec. 3.8.5)

- The 2004 Annual Stock Assessment Report (Pastor 2004), includes CWT recovery information for on-station releases for brood years 1988 through 1998. Average percent survival for these brood years is estimated to be 0.3520 (+/- 0.3048 standard deviation). The minimum percent survival was 0.0155 for brood year 1990, and the maximum was 1.0458 for brood year 1988. (LWNFH CHMP, sec. 3.8.5)

- Both age-0 and yearling spring Chinook have been released from the hatchery. Brood years 1982 through 1984 were coded-wire tagged to evaluate age-0 and yearling releases. Average survival for age-0 fish was 0.11%, compared with an average survival of 0.39% for yearling releases. Columbia River gill nets took a greater proportion of age-0 fish than yearlings (9.7% vs. 3.2%) for these three broods. Release of coded-wire tagged age-0 fish was resumed with brood year 1991.(Pastor 2007)

F. Program conflicts

1. *Biological conflicts (e.g. propagated stock maladapted to hatchery water source)*[44]

- The propagated stock survives well at the hatchery and post-release, contributing to sport, tribal and commercial fisheries in the Columbia River.

- Co-occurring natural salmon and steelhead populations in local tributary areas and the Columbia River mainstem corridor areas could be negatively impacted by program fish. Of primary concern are the ESA listed endangered and threatened salmonids: Snake River

[44] *Section text from LWNFH Sp. Chinook HGMP, sec. 3.5.*

fall-run Chinook salmon ESU (threatened); Snake River spring/summer-run Chinook salmon ESU (threatened); Lower Columbia River Chinook salmon ESU (threatened); Lower Columbia River Coho salmon ESU (threatened);Upper Willamette River Chinook salmon ESU (threatened); Upper Columbia River spring-run Chinook salmon ESU (endangered); Columbia River chum salmon ESU (threatened); Snake River sockeye salmon ESU (endangered); Upper Columbia River steelhead ESU (endangered); Snake River Basin steelhead ESU (threatened); Lower Columbia River steelhead ESU (threatened); Upper Willamette River steelhead ESU (threatened); Middle Columbia River steelhead ESU (threatened); and the Columbia River distinct population segment of bull trout (threatened). An additional concern is the Southwestern Washington/Columbia River coastal cutthroat trout ESU.

2. *Harvest conflicts (e.g. mixed stock fishery on hatchery and wild fish limits harvest opportunities on hatchery fish)*[45]

Upriver Spring Chinook

- Non-Indian and treaty Indian winter and spring season fisheries will be managed in accordance with Table A1 of the *"2005-2007 Interim Management Agreement for Upriver Chinook, Sockeye, Steelhead, Coho and White Sturgeon"*. Based on 2007 preseason forecasts, the spring Chinook harvest allocation table allows for non-Indian impacts up to 1.5% of the upriver spring Chinook run and treaty Indian impacts up to 7.0%.

Table A1. Spring Management Period Chinook Harvest Rate Schedule.

Total Upriver Spring and Snake River Summer Chinook Run Size	Snake River Natural Spring/Summer Chinook Run Size [1]	Treaty Zone 6 Total Harvest Rate [2,5]	Non-Treaty Natural Harvest Rate [3]	Total Natural Harvest Rate [4]	Non-Treaty Natural Limited Harvest Rate [4]
<27,000	<2,700	5.0%	<0.5%	<5.5%	0.5%
27,000	2,700	5.0%	0.5%	5.5%	0.5%
33,000	3,300	5.0%	1.0%	6.0%	0.5%
44,000	4,400	6.0%	1.0%	7.0%	0.5%
55,000	**5,500**	**7.0%**	**1.5%**	**8.5%**	**1.0%**
82,000	8,200	7.0%	2.0%	9.0%	1.5%
109,000	10,900	8.0%	2.0%	10.0%	
141,000	14,100	9.0%	2.0%	11.0%	
217,000	21,700	10.0%	2.0%	12.0%	
271,000	27,100	11.0%	2.0%	13.0%	
326,000	32,600	12.0%	2.0%	14.0%	
380,000	38,000	13.0%	2.0%	15.0%	
434,000	43,400	14.0%	2.0%	16.0%	
488,000	48,800	15.0%	2.0%	17.0%	

[1.] *If the Snake River natural spring/summer forecast is less than 10% of the total upriver run size, the allowable mortality rate will be based on the Snake River natural spring/summer Chinook run size. In the event the total forecast is less than 27,000 or the Snake River natural spring/summer forecast is less than 2,700, Oregon and Washington would keep their mortality rate below 0.5% and attempt to keep actual mortalities as close to zero as possible while maintaining minimal fisheries targeting other harvestable runs.*

[45] *Section text from ODFW and WDFW 2006.*

[2] *Treaty Fisheries include: Zone 6 Ceremonial, subsistence, and commercial fisheries from January 1-June 15. Harvest impacts in the Bonneville Pool tributary fisheries may be included if TAC analysis shows the impacts have increased from the background levels.*

[3] *Non-Treaty Fisheries include: Commercial and recreational fisheries in Zones 1-5 and mainstem recreational fisheries from Bonneville Dam upstream to the Hwy 395 Bridge in the Tri-Cities and commercial and recreation SAFE (Selective Areas Fisheries Evaluation) fisheries from January 1-June 15; Wampum tribal fisheries, and Snake River mainstem recreational fisheries upstream to the Washington-Idaho border from April through June. Harvest impacts in the Bonneville Pool tributary fisheries may be included if TAC analysis shows the impacts have increased from the background levels.*

[4] *If the Upper Columbia River natural spring Chinook forecast is less than 1,000, then the total allowable mortality for treaty and non-treaty fisheries combined would be restricted to 9% or less. Whenever Upper Columbia River natural fish restrict the total allowable mortality rate to 9% or less, then non-treaty fisheries would transfer 0.5% harvest rate to treaty fisheries. In no event would non-treaty fisheries go below 0.5% harvest rate.*

The Treaty Tribes and the States of Oregon and Washington may agree to a fishery for the Treaty Tribes below Bonneville Dam not to exceed the harvest rates provided for in this Agreement.

- The Interim Management Agreement provides for a minimum mainstem treaty Indian C&S entitlement to the Columbia River treaty tribes of 10,000 spring and summer Chinook. It is anticipated that the majority of this entitlement will be taken from the January 1 through June 15 management period. Tributary harvest of spring and summer Chinook is not included in this entitlement. It is understood that if the total mainstem Columbia River treaty Indian harvest of spring and summer Chinook is greater than or equal to 10,000 spring and summer Chinook, then this entitlement has been met. If the total mainstem Columbia River treaty Indian harvest of spring and summer Chinook is less than 10,000, then the difference will be distributed to the tribes from spring Chinook hatcheries below Bonneville Dam as first priority. If spring Chinook are not available from hatcheries below Bonneville Dam, or by agreement of the parties, the entitlement may be filled from other hatchery sources of equivalent quantity and quality.

Mainstem Columbia River Spring Chinook Allocation for Non-Indian Fisheries, 2006-2007.
Guiding Principles
• Meet conservation requirements for wild spring Chinook, including populations listed under the federal Endangered Species Act. • Manage non-Indian harvest of spring Chinook within the provisions of the *U.S. v Oregon* Management Agreement for upriver spring/summer Chinook. • Manage harvest to meet hatchery escapement goals. • Focus recreational and commercial fisheries allocation on harvest of hatchery fish by implementing live capture and release of unmarked spring Chinook.
Fisheries Management Objectives
• Specific structure of recreational and commercial fisheries will be set by the Columbia River Compact on an annual basis to meet adopted allocation policies and fisheries objectives after annual run size forecasts are available. • Provide for in season management flexibility to utilize the non-Indian upriver spring Chinook impact allocation to meet the objectives of both fisheries, i.e., upriver impact sharing adjustments in response to in season information pertaining to catch and run size. • Adjustments to the recreational fishery may occur in-season if it is estimated the fishery will not continue through April. In season adjustments may include such options as day and area closures. • Recognize economic benefits of recreational and commercial fisheries in the Columbia River. • Provide for recreational fisheries throughout the Columbia River downstream of McNary Dam, sport/tribal fisheries in the Snake River and Upper Columbia River, commercial fisheries in the lower Columbia River, and commercial and recreational fisheries in Select Areas.

Table 7. Estimated numbers of Adult Upriver Spring Chinook Entering the Columbia River, Mainstem Harvest and Escapement, 1980-2006.

		Non-Indian Catch [3]				Bonn.	Non-Indian	Treaty Indian Zone 6[2]						
	Upriver	Zones 1-5				Dam	Zone 6	Winter	Comm.	Ceremonial		Zones1-6	Escapement	
Year	Run[1]	Comm.	Sport[4]	Misc.[5]	Total	Count[6]	Sport	Gillnet	Gillnet	& platform	Total	% of run	No.[7]	% of Run
80-84 Ave.	*63,153*	*951*	*320*	*182*	*1,452*	*61,700*	*0*	*1,008*	*0*	*2,306*	*3,313*	*7.5%*	58,387	92.5%
85-89 Ave.	*104,837*	*2,308*	*806*	*222*	*3,335*	*101,501*	*0*	*208*	*0*	*5,991*	*6,199*	*0%*	*95,303*	*90.9%*
1990	105,213	2,082	3,115	150	5,347	99,866	0	4	0	6,924	6,928	11.2%	92,938	88.3%
1991	64,233	897	1,537	120	2,254	61,679	0	5	0	3,871	3,876	9.5%	57,803	90.0%
1992	95,323	235	1,187	162	1,584	93,739	0	48	0	5,711	5,759	7.7%	87,980	92.3%
1993	119,203	238	413	373	1,024	118,179	0	0	0	7,296	7,296	7.0%	110,883	93.0%
1994	23,809	441	409	86	936	22,873	0	10	0	1,151	1,161	8.8%	21,712	91.2%
1995	12,634	0	5	2	7	12,627	0	13	0	620	633	5.1%	11,994	94.9%
1996	55,299	5	17	41	63	55,236	0	0	0	2,911	2,911	5.4%	52,325	94.6%
1997	123,824	9	13	44	66	123,758	0	14	0	8,309	8,323	6.8%	115,435	93.2%
1998	43,512	0	14	27	41	43,471	0	1	0	2,224	2,225	5.2%	41,246	94.8%
1999	42,582	2	21	26	49	42,533	0	1	0	1,983	1,984	4.8%	40,549	95.2%
2000	186,141	88	102	177	367	185,774	0	6	1,348	9,973	11,327	6.3%	174,447	93.7%
2001	437,910	1,579	22,714	964	25,257	412,653	93	85	43,630	10,985	54,700	18.3%	357,860	81.7%
2002	331,303	9,483	16,213	667	26,363	304,940	875	45	24,209	9,208	33,462	18.3%	270,603	81.7%
2003	242,638	2,759	9,615	765	13,139	229,499	1,302	857	8,348	9,090	18,295	13.5%	209,902	86.5%
2004	221,600	5,989	17,041	245	23,275	198,325	1,349	2	8,368	9,114	17,484	19.0%	179,492	81.0%
2005	106,935	2,246	7,235	57	9,538	97,397	449	1	0	6,163	6,164	15.1%	90,784	84.9%
2006	132,138	1,689	4,161	130	5,980	126,158	648	0	0	8,401	8,401	11.4%	117,109	88.6%

1. *Tribal commercial catches include any spring Chinook sold in the winter season gillnet fishery. Ceremonial and subsistence include catch by gillnet, dipnet, and hook and line since 1982.*
2. *Through 1979 all fish caught in April and May were considered upriver stocks. From 1980 to 1987 the February-March incidental catch in Zone 1-5 and lower Columbia River recreational catch was based on CWT recoveries. Since 1988, incidental commercial catch was based on GSI analysis and incidental recreational catch was based on VSI analysis. Commercial fishery became selective beginning 2002.*
3. *Includes mainstem fisheries up to McNary Dam. Recreational fishery became selective beginning in 2001.*
4. *Miscellaneous fisheries include Select Area, test fisheries, mortalities from area 2S shad fisheries and selective tangle net experimental fishery in 2001.*
5. *Chinook passing from January 1 through June 15 are considered spring Chinook. Dam counts in 1980, and 1981 were not adjusted for fallback; runsize and escapements are maximum in those years.*
6. *Bonneville count minus Zone 6 harvest.*

Federally-listed Species Found in Columbia River Fishery Management Areas. [1]			
Species - *ESU*	Designation	Listing Date	Effective Date
Chinook			
Snake River Fall	Threatened	April 22, 1992	May 22, 1992
Snake River Spring/Summer	Threatened	April 22, 1992	May 22, 1992
Upper Columbia Spring	Endangered	March 24, 1999	May 24, 1999
Upper Columbia Summer/Fall	Not warranted	--	--
Middle Columbia Spring	Not warranted	--	--
Lower Columbia River Spring/Fall	Threatened	March 24, 1999	May 24, 1999
Upper Willamette Spring	Threatened	March 24, 1999	May 24, 1999
Deschutes River Fall	Not warranted	--	--
Steelhead			
Snake River	Threatened	August 18, 1997	October 17, 1997
Upper Columbia River [2]	Endangered	August 18, 1997	October 17, 1997
Lower Columbia River	Threatened	March 19, 1998	May 18, 1998
Middle Columbia River	Threatened	March 25, 1999	May 24, 1999
Southwest Washington	Not warranted	--	--
Upper Willamette	Threatened	March 25, 1999	May 24, 1999
Sockeye – Snake River	Endangered	November 20, 1991	December 20, 1991
Chum – Columbia River	Threatened	March 25, 1999	May 24, 1999
Coho – Columbia River [3]	Threatened	June 28, 2005	August 26, 2005
Green Sturgeon- Southern DPS	Threatened	April 7, 2006	July 7, 2006

1. *The ESUs in bold are present in the Columbia River basin during the time when fisheries described in this report occur and therefore may be impacted by these fisheries.*
2. *Includes hatchery fish.*
This ESU includes all naturally spawning population of coho salmon in the Columbia River and its tributaries from the mouth of the Columbia up to and including the White Salmon and Hood rivers. Lower Columbia River coho destined for Oregon tributaries were listed as an endangered species

3. *Conservation conflicts*

a) Genetic conflicts associated with straying and natural spawning of hatchery fish (Stray rates, proportion of hatchery-origin fish on natural spawning grounds, etc.)

- Little White Salmon spring Chinook are Carson stock and are not part of either the lower Columbia River Chinook ESU, which is listed as threatened, or the mid-Columbia River spring Chinook ESU which is not listed. Returning spring Chinook are collected for brood stock at the Little White Salmon NFH rack near the mouth of the Little White Salmon River. (LWNFH Sp. Chinook HGMP, sec. 3.5)

- Stray hatchery spring Chinook from other locations (primarily from Carson NFH and occasionally from upper Columbia and Snake River facilities) do occur at Little White Salmon NFH. Incidental collection of listed upper Columbia and Snake River spring Chinook are believed to be very low based on CWT recoveries and should not have a significant impact on the listed stocks or the genetic integrity of the brood stock at the Hatchery. (LWNFH Sp. Chinook HGMP, sec. 3.5)

- Little White spring Chinook are not known to contribute to a significant straying problem outside of the local area. There is essentially very little, if any, productive spawning habitat below Little White Salmon NFH at the mouth of the Little White Salmon River (Drano Lake). (LWNFH Sp. Chinook HGMP, sec. 3.5)

- Historical spring Chinook habitat was inundated by Bonneville Pool when Bonneville Dam was constructed in 1938. (LWNFH Sp. Chinook HGMP, sec. 3.5)

- There is no indication that the Carson stock of spring Chinook reared and released at Little White Salmon NFH is negatively impacting other listed stocks through straying and genetic introgression. The very low numbers of non-Carson stock strays that occur on occasion in the Little White Salmon brood stock collection are at a level that should not significantly alter the genetic structure of the Carson stock used in Little White's spring Chinook production program. (LWNFH Sp. Chinook HGMP, sec. 3.5)

- Coded-wire tag recovery data can be used to document straying rates of program fish. Data extracted from the Columbia River Information System (CriS) and Pacific States Marine Fish Commission (PSMFC) databases can be indicative of straying and homing of program fish. Pastor (2004), examining coded-wire tag recoveries from brood years 1988-89 and 1991-97, found that 98.9% of the estimated recoveries of Little White Salmon NFH spring Chinook salmon released at the hatchery as yearlings were recovered at the hatchery or on the route to it. A total of 0.62% of recoveries were in the Wind River, and 0.35% of the recoveries were in the Big White Salmon River. (Pastor 2004)

b) Ecological conflicts (e.g. competition between hatchery fish and wild fish)[46]

- Spring Chinook releases from the facility are moderate in magnitude (typically about 1.0 million spring Chinook smolts) relative to other Columbia River spring Chinook production programs. This level of release is not expected to cause serious density dependent effects in the mainstem Columbia River. Spring Chinook are assumed to migrate quickly after release like their Carson NFH counterparts, however, these fish are not currently PIT tagged to verify out-migration timing.

- Disease- Under the guidance of the USFWS Lower Columbia River Fish Health Center (LCRFHC), Little White Salmon NFH follows the US Fish and Wildlife Service's fish health policy (713 FW in the Fish and Wildlife Service Manual) and Integrated Hatchery Operations Team (IHOT 1995) protocols to produce healthy fish and prevent disease transmission (see sections 9.1.6 and 9.2.7). Most pathogens enter

[46] *Section text from LWNFH Sp. Chinook, sec. 3.5.*

hatcheries through returning adult fish, surface water supplies, and other mechanisms involving direct contact with naturally spawning fish. Procedures used at the hatchery and the LCRFHC reduce pathogen transmission from these sources. The fish health goal for Little White Salmon NFH spring Chinook is to release healthy fish that are physiologically ready to migrate.

- Hatchery managers largely understand the strain, abundance, and virulence (epidemiology) of pathogens and parasites in hatchery fish. Recent studies suggest that the incidence of some pathogens in naturally spawning populations may be higher than in hatchery populations (Elliot and Pascho 1994). Indeed, the incidence of high ELISA titers for *Renibacterium salmoninarum*, the causative agent of Bacterial Kidney Disease (BKD), appears, in general, to be significantly more prevalent among wild smolts of spring/summer Chinook salmon than hatchery smolts (Congleton et al. 1995; Elliot et al. 1997). For example, 95% versus 68% of wild and hatchery smolts, respectively, at Lower Granite Dam in 1995 had detectable levels of *R. salmoninarum* (Congleton et al. 1995). Although pathogens may cause significant post-release mortality among hatchery fish, there is little evidence that hatchery origin fish routinely infect naturally produced salmon and steelhead in the Pacific Northwest (Enhancement Planning Team 1986; Steward and Bjornn 1990). Many biologists believe disease-related losses often go undetected and that the impact of disease on naturally spawning populations may be underestimated (Goede 1986; Steward and Bjornn 1990). Nevertheless, we are unaware of any studies or documentation in the scientific literature where hatchery fish have infected a naturally spawning population of salmon or steelhead in the Pacific Northwest (see also Campton 1995).

- The hatchery takes appropriate measures to control disease and the release of diseased fish, including chemotherapeutant administration to adults and juveniles (see sections 7.7 and 9.2.7). In addition, Little White Salmon NFH spring Chinook are released directly into the Little White Salmon River at the hatchery site near the river mouth and pass only one mainstem Columbia River dam (Bonneville Dam) en route to the ocean. Therefore, these spring Chinook have a much reduced potential for transmission of disease to other populations relative to other upriver programs which are subjected to the high density impacts and stresses of collection for transport and/or diversion through multiple bypass systems. Little White Salmon NFH takes extensive measures to control disease and the release of diseased fish. As a consequence, infection of natural fish by hatchery fish would not appear to be a problem.

- Competition- The impacts from competition are assumed to be greatest in the spawning and nursery areas at points of highest density (release areas) and diminish as hatchery smolts disperse (USFWS 1994). Salmon and steelhead smolts actively feed during their downstream migration (Becker 1973; Muir and Emmett 1988; Sager and Glova 1988). Competition in reservoirs could occur where food supplies are inadequate for migrating salmon and steelhead. However, the degree to which smolt performance and survival are affected by insufficient food supplies is unknown (Muir and Coley 1994). On the other hand, the available data are more consistent with the alternative hypothesis that hatchery-produced smolts are at a competitive disadvantage relative to naturally produced fish in tributaries and free-flowing mainstem sections (Steward and Bjornn 1990). Although limited information exists, available data reveal no significant relationship between level of crowding and condition of fish at mainstem dams. Consequently, survival of natural smolts during passage at mainstem dams does not appear to be affected directly by the number - or density - of hatchery smolts passing through the system at present population levels. While smolts may be delayed at mainstem dams, the general consensus is that smolts do not normally compete for space when swimming through the bypass facilities (Enhancement Planning Team 1986). The main factor causing mortality during bypass appears to be confinement and handling in the bypass facilities, not the number of fish being bypassed.

- Juvenile salmon and steelhead, of both natural and hatchery origin, rear for varying lengths of time in the Columbia River estuary and pre-estuary before moving out to sea. The intensity and magnitude of competition in the area depends on location and duration of estuarine residence for the various species of fish. Research suggests, for some species, a negative correlation between size of fish and residence time in the estuary (Simenstad et al. 1982).

- While competition may occur between natural and hatchery juvenile salmonids in - or immediately above - the Columbia River estuary, few studies have been conducted to evaluate the extent of this potential problem (Dawley et al. 1986). The general conclusion is that competition may occur between natural and hatchery salmonid juveniles in the Columbia River estuary, particularly in years when ocean productivity is low. Competition may affect survival and growth of juveniles and thus affect subsequent abundance of returning adults. However, these are postulated effects that have not been quantified or well documented.

- The release of hatchery smolts that are physiologically ready to migrate is expected to minimize competitive interactions as they should quickly migrate from the release site. The Hatchery's spring Chinook are released into the Little White Salmon River at the Little White Salmon NFH site. It is assumed that they migrate quickly into the mainstem Columbia River migration corridor en route to the ocean, as does the same stock released from Carson NFH, thereby reducing the potential for competitive interactions with listed stocks. There have been no mortalities recorded during saltwater challenges conducted during the last three brood years at the Hatchery. Released fish have been fully smolted and begin their downstream migration immediately following release. In addition, blood plasma collected from brood year 1995 spring Chinook was analyzed for sodium and potassium concentrations. Those results also indicated that the spring Chinook are functional smolts at time of release. PIT tagging would provide additional, valuable information on the timing of emigration, but would require additional funding. Because Hatchery spring Chinook releases occur "low" in the Columbia Basin system relative to many other upriver programs, there is reduced opportunity for competitive interactions.

- Other observations leading to conclusions regarding the behavior of released smolts included physiological and survival data collected during recent NATURES rearing studies conducted for spring Chinook at Little White Salmon NFH. For several brood years, researchers from the (now) Biological Resources Division of the U.S. Geological Survey collected data to evaluate the use of cover (simulating natural riparian cover) during hatchery rearing to improve the post-release survival of hatchery-reared salmon and to alter their behavior to more closely match wild (naturally produced) fish. In addition to this study, hatchery-reared fish were exposed to predators six months prior to release in an attempt to "teach" them to avoid predators following release. As many as six northern pikeminnow were placed in each of three raceways as part of this predator avoidance study. Preliminary physiological and survival data collected to date for both studies indicate that, although there were no differences detected among treatment groups when compared to control groups, the behavior of hatchery-produced fish from the Hatchery appears to be normal when compared to naturally produced fish.

- There are no natural fish populations that spawn in the target area. Fish headed further up the Columbia River may dip into Drano Lake and hold in the favorable water conditions. Characteristic of steelhead, this species holds in Drano Lake during periods of low Columbia River flow and high water temperature, preferring the cooler Little White Salmon River water during the period of July through August. Since the majority of spring Chinook have entered the hatchery, and this period is sooner than migration of hatchery fall Chinook and coho, it is doubtful that there is any interaction between program fish and any natural fish.

- The natural spawning spring Chinook salmon in the Wind River is not a targeted population of the Hatchery's program. That hatchery-induced population in the Wind River is considered a depressed, non-native, composite production (wild and hatchery fish) population by WDFW (WDF et al. 1993). The NMFS (Myers et al. 1998) considers this population as not an ESA issue, as these fish were not historically present in the watershed. The five-year geometric mean natural spawning population size is 162 fish. The short-term abundance trend (the most recent 7-10 years, based on total escapement) is positive, + 0.1 % per year. The long-term abundance trend (1970-1996) is negative, - 2.9 % per year (Myers et al. 1998). The run of spring Chinook into the White Salmon River is considered extinct (Nehlsen 1991), primarily attributable to dam construction and habitat degradation (Myers et al. 1998).

- Predation- The releases of spring Chinook occur at the Little White Salmon hatchery site near the mouth of the river. Predation effects would therefore be limited to the migration corridor where effects are likely to be reduced relative to spawning and nursery areas. It is likely that Hatchery spring Chinook have much reduced predatory impacts on natural stocks relative to other yearling releases in natural production spawning and rearing areas. Depending on species and population, hatchery smolts are often released at a size that is greater than their naturally-produced counterparts. In addition, for species that typically smolt at one year of age or older (e.g. steelhead, spring Chinook salmon), hatchery-origin smolts may displace younger year classes of naturally-produced fish from their territorial feeding areas. Both factors could lead to predation by hatchery fish on naturally produced fish, but these effects have not been extensively documented, nor are the effects consistent (Steward and Bjornn 1990). The USFWS (1994) presented information that salmonid predators are generally thought to prey on fish approximately one-third or less their size.

- In general, the extent to which salmon and steelhead smolts of hatchery origin prey on fry from naturally reproducing populations is not known, particularly in the Columbia River basin. The available information - while limited - is consistent with the hypothesis that predation by hatchery-origin fish is, most likely, not a major source of mortality to naturally reproducing populations, at least in freshwater environments of the Columbia River basin (Enhancement Planning Team 1986). For example, peak emergence of listed chum salmon at Ives Island, a natural production area below

Bonneville Dam, was estimated to occur during the latter half of March in 1999 (2/19/99 fax to Donna Allard from Wayne Vander Naald, ODFW). Out-migrant sampling conducted by the USFWS in 1998 and 1999 in Hardy Creek, which is adjacent to the mainstem Pierce/Ives Island natural production area, indicated that peak emigration of chum fry from this tributary occurred during the first two weeks of March (unpublished data). Based on life history traits, it is expected that most of the chum fry would have emigrated from the natural production area before the mid-April release of larger hatchery Chinook occurs at the Hatchery. The potential for the Hatchery smolts to prey on emerging chum fry would not be significant. However, virtually no information exists regarding the potential for such interactions in the marine environment.

- 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). Releasing large numbers of hatchery fish may also lead to a shift in the density or behavior of non-salmonid predators, thus increasing predation on naturally reproducing populations. Conversely, large numbers of hatchery fish may mask or buffer the presence of naturally produced fish, thus providing sufficient distraction to allow natural juveniles to escape (Park 1993). Prey densities at which consumption rates are highest, such as northern pikeminnow in the tailraces of mainstem dams (Beamesderfer et al. 1996; Isaak and Bjornn 1996), have the greatest potential for adversely affecting the viability of naturally reproducing populations, similar to the effects of mixed fisheries on hatchery and wild fish. However, hatchery fish may be substantially more susceptible to predation than naturally produced fish, particularly at the juvenile and smolt stages (Piggins and Mills 1985; Olla et al. 1993).

- Predation by birds and marine mammals (e.g. seals and sea lions) may also be significant source of mortality to juvenile salmonid fishes, but functional relationships between the abundance of smolts and rates of predation have not been demonstrated. Nevertheless, shorebirds, marine fish, and marine mammals can be significant predators of hatchery fish immediately below dams and in estuaries (Bayer 1986; Ruggerone 1986; Beamish et al. 1992; Park 1993). Unfortunately, the degree to which adding large numbers of hatchery smolts affects predation on naturally produced fish in the Columbia River estuary and marine environments is unknown, although many of the caveats associated with predation by squawfish in freshwater are true also for marine predators in saltwater.

- Residualism- PIT tagging would help to provide information relative to hatchery out-migration questions.

4. *Other conflicts between the hatchery program, or fish produced by the program, and other non-hatchery issues*

- U.S. v Oregon mandates

- Reliance on reimbursable funding: Mitchell Act (NOAA Fisheries) and tribal restoration programs (Bonneville Power Administration).

IVC. Little White Salmon NFH White River (Wenatchee) Spring Chinook[47]

A. General information

- Species and population (or stock) under propagation, and ESA status. White River (Wenatchee River Basin, Washington) spring Chinook salmon *Oncorhynchus tshawytscha*, endangered. (White Chinook HGMP, p. 2)

- The recovery program incorporates captive brood technology to rear progeny of native spring Chinook spawners from the White River. (LWNFH white Chinook HGMP, p. 2)

- The White River spring Chinook captive broodstock are currently held at Aquaseed Inc., a private fish hatchery located in Rochester, WA. PUD No. 2 of Grant County covers all costs associated with that program that include operational costs at Aquaseed Inc. ($1,070,000 during 2004), monitoring and evaluation by the Washington Department of Fish & Wildlife ($456,000 proposed for 2004), and program development and administration by PUD No. 2 of Grant County ($85,000 in 2004). (Klickitat Lead Entity 2003, p. 1)

- Production goals identified in the Grant County PUD Biological Opinion exceed available rearing space at Aquaseed. The Priest Rapids Coordinating Committee– Hatchery Subcommittee, composed of representatives from the Yakama Nation, Colville Tribe, U.S. Fish and Wildlife Service, WDFW, and NOAA-Fisheries, searched for available rearing space at other facilities to meet White River spring Chinook juvenile production for the next several years as identified in the biological opinion. The PRCC–Hatchery Subcommittee asked about using available rearing space at Little White Salmon NFH, Willard NFH, and at the off-site incubation facility at Carson Depot Springs to rear progeny from captive brood for reintroduction back into the White River system. While the agencies and Grant County PUD are strongly in favor of this proposal, representatives of Aquaseed may perceive the NFH system's involvement as usurping private enterprise. (Klickitat Lead Entity 2003, p. 1)

- Little White Salmon NFH involvement is to rear juveniles from eggs of captive broodstock maintained by AquaSeed Inc, Rochester, WA. (White Chinook HGMP, p. 2)

- In May 2006, grant County PUD entered into a MOA with USFWS to rear up to 65,000 brood year 2005 juvenile White River spring Chinook from captive broodstock parents at LWS NFH. There are approximately 57,000 fish currently being raised at LWS under this MOA. In October 2006, the agreement was extended to provide capacity for brood years 2006-2008. (Diggs-USFWS memo, Jan 15, 2007, p. 1)

[47] *See the subappendix 1 titled "White River (Wenatchee) Spring Chinook Captive Broodstock Program Evaluation of Columbia River National Fish Hatcheries" for the Review Team's evaluation of the USFWS's ability to conduct some or all of the White River (Wenatchee) Spring Chinook captive broodstock program.*

B. Stock/Habitat/Harvest Program Goals and Purpose

1. Purpose and justification of program

- The White River spring Chinook spawning aggregation is severely depressed and persistently experiences escapement levels below critical population thresholds. The White River spawning aggregation is within the Upper Columbia River Spring-run Chinook Salmon ESU which is listed as Endangered (FR Vol. 64, No. 56, March 24, 1999). This ESU includes all naturally spawned populations of Chinook salmon in all river reaches accessible to Chinook salmon in Columbia River tributaries upstream of Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River. The White R. aggregation is the most genetically unique among those spawning in tributaries within the ESU (Utter et al. 1995). Hatchery propagation of the White River, Nason Creek, Chiwawa River, Twisp River, Methow River, and Chewuch River stocks is included in the ESU. (White Chinook HGMP, p. 4)

- Mitigation: The conservation/preservation program has been incorporated into the mitigation responsibilities of Public Utility District No. 2 of Grant County through their Biological Opinion (dated May 3, 2004). Following the successful restoration to self-sustaining natural production of White River stock (eight to twelve years estimated), Grant Co. will continue mitigation production of this stock at a level consistent with continuing impacts associated with operation of their Priest Rapids hydro complex. (White Chinook HGMP, p. 4)

2. Goals of program

- The goal of this program is to prevent the extinction of, conserve, and ultimately restore the naturally spawning White River spring Chinook salmon spawning aggregation (Wenatchee R, system). (White Chinook HGMP, p. 4)

- Produce a maximum adult contribution up to approximately 450 adult spring Chinook based on a release of 150,000 smolts and smolt-to-adult survival rate of 0.3%. (White Chinook HGMP, p. 6)

- Achieve life stage survival rates as follows: captive fry-to-adult = 30%; F2 egg-to-smolt = 65%; F2 smolt-to-adult = 0.3%. (White Chinook HGMP, p. 9)

- Staff of Little White Salmon National Fish Hatchery have been asked to consider the following preliminary production goals if a decision was made to rear White River spring Chinook at Little White Salmon National Fish Hatchery: Number: up to 200,000; Duration: full-term, smolt size, transfer as pre-smolts; Density: maximum density index of 0.06; Size: 10-15 fish per pound (White Chinook HGMP, p. 9)

- The goal of this program is to prevent the extinction of, conserve, and ultimately restore the naturally spawning White River spring Chinook salmon spawning aggregation (Wenatchee River watershed). This recovery program has been incorporated into the mitigation responsibilities of Public Utility District No. 2 of Grant County through their Biological Opinion (dated May 3, 2004). (Klickitat Lead Entity 2003, p. 1)

3. *Objectives of program*

- Right now, LWS is responsible for 150,000 and AquaSeed has capacity to rear approximately 60,000. A 150,000 smolt release is the current requirement but any additional production may help jump start the recovery effort.

- The plan is for 375,000 fish at 75,000 per raceway until marking is completed during March. Once marking is completed all fish above Little White Salmon's 150,000 smolt commitment would be transferred to the White River.

- Captive broodstock approximately two life cycles to reduce potential consequences of raising fish in an intense culture environment. (White Chinook HGMP, p. 14)

- Eyed egg collections are planned through 2009; smolt releases through 2016. (White Chinook HGMP, p. 20)

4. *Type of program*

Integrated Recovery Program (White Chinook HGMP, p. 4)

5. *Alignment of program with ESU-wide plans*

Action is ESA recovery program for stock

6. *Habitat description and status*

- The proposed program will focus on the White R. subpopulation within the Wenatchee R. basin. The White R. subpopulation has evolved in a unique environment and is genetically distinct from other Wenatchee Basin subpopulations (Marshall and Young 1994). Juveniles must pass through Lake Wenatchee on their way to the Columbia River, and returning adults pass through a second time to reach the spawning grounds. Spawning takes place between RM 8 and RM 13 from the second week in August through the fourth week in September (Murdoch and Hopley 20juvenile life history of the White R. subpopulation. (White Chinook HGMP, p. 23)

- The White River spring Chinook spawning aggregation is severely depressed and persistently experiences escapement levels below critical population thresholds. The White River spawning aggregation is within the Upper Columbia River Spring-run Chinook Salmon ESU which is listed as Endangered (FR Vol. 64, No. 56, March 24, 1999). This ESU contains all naturally spawned populations of Chinook in Columbia River tributaries upstream of Rock Island Dam and downstream of Chief Joseph Dam excluding the Okanogan River. The ESU also includes hatchery propagation of the White River, Nason Creek, Chiwawa River, Twisp River, Methow River, and Chewuch River stocks. Klickitat Lead Entity 2003, p. 1)

7. *Size of program and production goals (No. of spawners and smolt release goals)*

The plan is for 375,000 fish at 75,000 per raceway until marking is completed during March. Once marking is completed all fish above Little White Salmon's 150,000 smolt commitment would be transferred to the White River.

C. Description of program and operations

1. Broodstock goal and source

The proposed recovery program will incorporate captive brood technology to rear progeny of native spring Chinook spawners from the White River. (White Chinook HGMP, p. 15)

2. Adult collection procedures and holding

- N/A – captive broodstock program. During Captive Brood Phase: No adults will be collected. Up to 1,700 eggs/fry will be collected from the White River spawning aggregation for captive brood rearing (updated from 1000 as described in BAMP 1998).

- Eggs or fry from naturally spawning spring Chinook will be collected from redds and reared in captivity. The subsequent adults will be spawned and the resulting progeny will be released from acclimation ponds into the native stream at the smolt stage after approximately 18 months of rearing. (White Chinook HGMP, p. 5)

- When eggs are collected from captive brood adults, the F2 progeny are expected to enjoy additional survival advantage during the juvenile life history phase (about 65%) before being released as smolts for natural migration to the ocean and return. (White Chinook HGMP, p. 5)

- The number of eggs/fry collected for the White R. rebuilding program might be reduced depending on the overall distribution of artificial propagation among Wenatchee River tributaries as agreed by the Joint Fishery Parties (JFP) in May, 2005. (White Chinook HGMP, p. 19)

3. Adult spawning

a) Spawning protocols

<u>At AquaSeed</u>

- captive brood - 1. A representative sample of up to 100 eggs/fry will be collected from between 25 and 50 redds resulting in a total egg/fry collection of approximately 1700. 2. Family size will be equalized as much as possible to maintain the highest Ne possible. 3. Mating protocols will avoid full-sib or closely related matings and between-year-class matings will be prioritized over within-year-classes. 4. Factorial matings of 2X2 or greater will capture a high percentage of available genetic variation. (White Chinook HGMP, p. 13)

- Mature captive broodstock are the surviving representatives of families collected as eyed eggs or fry from redd pumping three to five years previously (see Sections 2.2, 5.1, and 7.2). It is intended that all maturing captive broodstock will be used for spawning. Mature fish are spawned systematically as they become ripe, usually during one spawning session per week. Each individual fish is identified by a PIT tag and coded- wire tag denoting the specific family (redd) from which that fish was originally extracted. Each fish is spawned after ascertaining family and brood year by interrogation of the family-specific tag. The highest priority is to mate males and females from different brood years and, secondarily, from different families within brood years to assure the highest effective population size possible. When surplus males are generated, such as early maturation of two-yr-old precocial males, milt will be save through cryopreservation. Infrequently, an adult female may mature and ripen when a mate is not available. Use of non-sibling cryopreserved males would be used to fertilize the eggs. (White Chinook HGMP, p. 52)

b) No. of males and females spawned each year over past 10 years

N/A – newly developed captive broodstock program

4. Fertilization

a) Protocols

<u>At AquaSeed</u>

- Spawning protocols call for a factorial spawning matrix, preferably with a 1:1 ratio of males and females and with a priority for matings between or among age classes or among families within age classes. The project strives for a minimum 2x2 factorial design to capture a large proportion of the genetic variance present in the population. At times more complex or unbalanced matrices such as 3x3 or 2x3 or greater may be incorporated if necessary to make sure that all available spawners are included. (White Chinook HGMP, p. 53)

- The fertilized eggs from each individual cell within a factorial mating are held separately within incubators. Two elements are of importance. First, discrete matings (cells of a factorial design) can be monitored and evaluated to attribute sources (male or female) of high or low mortality rates through analysis of variance. Secondly, individual groups can be separated based on fish health status, especially bacterial kidney disease or viral status, following fish health screening. (White Chinook HGMP, p. 53)

b) Number of eggs collected and fertilized each year over past 10 years

N/A – newly developed captive broodstock program

5. Incubation

At AquaSeed

- Each tray of a vertical incubator is populated with eggs from one female. Density per tray has ranged from 183 eggs to 1,529 eggs collected from one of more natural redds. Average density for F2 progeny of captive broodstock has ranged from 985 to 1,548 over three years. The vertical style incubators are arranged in half stacks (eight trays) and receive 5 gpm of water flow each. The same protocols are expected during adult-based supplementation which is anticipated to result in approximately 4,400 eggs per tray of a vertical incubator assuming expected average fecundity of naturally spawning females within the ESU. (White Chinook HGMP, p. 57)

- Water flow system is monitored by alarm. Temperature is constant at 50F. Dissolved oxygen is tested periodically, usually when water flow has been adjusted. Dissolved oxygen is at saturation when water enters the incubators. Dissolved oxygen levels have decreased no more than 0.5 ppm at any check. Eggs were placed on chilled water starting with the 2005 brood year. (White Chinook HGMP, p. 57)

At transfer to LWS

- 48 – 15 tray Heath incubators are available at the off-site Carson Depot Springs incubation facility. These incubators, supplied by spring water, can be used to hold freshly fertilized, green eggs from captive broodstock pending ELISA test results. Egg lots can then be segregated based on their incidence of bacterial kidney disease, held to eye-up, and then transferred to Little White Salmon National Fish Hatchery incubators for hatching and rearing to presmolts. The Carson Depot Springs facility was completely remodeled in 2005 and 2006 following installation of new plumbing, insulation, wall and ceiling panels, and water and intrusion alarms. (USFWS 2007a, p. 6)

6. *Ponding*

a) Protocols

- Currently, 5 raceways are available at LWS that could be potentially used for this program, each raceway containing 3,850 ft3 of rearing space. As a result, a total of 19,250 ft3 of raceway space is available for the final rearing of White River spring Chinook. (USFWS 2007a, p. 5)

- *Typical Rearing Strategies at LWS* --Spring Chinook fry are initially transferred from incubation trays to nursery tanks to establish initial feeding with water flows set at 30 gpm. Due to consecutive weekly takes at spawning, tank rearing occurs for only one to two weeks. From tanks, fish are transferred to nine 8 foot x 80 foot lower raceways with water flows ranging from 233 to 466 gpm (flow rates are increased as fish size increases). Fish remain in these raceways until release of the previous brood year from seventeen upper hatchery raceways. Once these raceways are emptied and disinfected, final transfer is made to fifteen 10-foot x 110-foot raceways and two 10-foot x 214-foot upper raceways at water flow rates of 670gpm and 900 gpm respectively. Fish are held in baffled raceways until release during mid-April of the following year. (USFWS 2007a, p. 6-7)

b) Number of fry ponded each year, including % hatch each year

N/A – newly developed captive broodstock program

7. Rearing/feeding protocols

Typical Rearing Strategies at LWS-- Fish are fed Bio-Oregon TM (Warrenton, OR) Starter #2, #3, Bio-Moist Grower 1.0mm, 1.3mm, 1.5mm and Bio-Moist Feed 2.5mm and 3.0mm feeds. Fish, initially fed by hand, are fed once an hour, eight times per day and those fed by automatic tank feeders receive feed every half hour. As fish grow and feed size increased, feeding frequency is reduced. At the time of release fish are fed 2 to 3 times a day. Daily feed rations are determined by water temperature and fish size, and are adjusted when feed waste is observed. (USFWS 2007a, p. 8)

8. Fish growth profiles

- *Typical Rearing Strategies at LWS*-- Fish are sampled approximately every two weeks to determine growth and feed rates during early rearing and then once a month after reaching approximately 100 fish per pound. Condition factors (K) are taken once a month and again prior to release. (USFWS 2007a, p. 9)

- Two limitations currently exist based on the preliminary production goals established for the White River spring Chinook program at Little White Salmon National Fish Hatchery. First, the characteristic cold water temperature of the Little White Salmon River, the principal rearing water supply, restricts growth. In the best (warmest) years, full-term yearling spring Chinook smolts have achieved a maximum of 13 fish per pound during the 3rd week of April, although 15 fish per pound is goal (and normally attainable). Traditional transfer size of presmolt spring Chinook to the Umatilla River during mid-March is approximately 18 fish per pound (for the most recent transfer, brood year 2003, 17.9 fish per pound on March 15, 2005). (USFWS 2007a, p. 9)

- Secondly, the upper rearing density limit of a 0.06 density index restricts the number of fish that can be reared in a raceway. At this density index, the full-term rearing of 200,000 spring Chinook in 5 raceways cannot be achieved. (USFWS 2007a, p. 9)

9. Fish health

- All fish will be handled, transported and propagated in accordance with WDFW Fish Health Manual (1996), Co-Managers Salmonid Fish Disease Control Policy (1997), and Pacific Northwest Fish Health Protection Committee (PHFHPC 1989) model program. (White Chinook HGMP, p. 43)

- Groups of fish are being reared from high BKD ELISA parents (WRSC BKD ELISA spreadsheet, p. 1-2)

- Fish health concerns have been raised given high ELISA results for the captive brood program at Aquaseed and their possible impacts to fish health on existing programs at the Little White Salmon/Willard NFH Complex. However, it is believed that through a combination of hatchery management practices that the Service can successfully produce these fish and minimize the potential for adverse impacts to existing programs at the Complex. These practices include rearing fish at ultra low densities, maintaining best management practices (e.g., minimizing cross contamination between raceways), and ensuring fish segregation structures (e.g., double raceway screens, predator exclusion fencing, etc.) are operational and in good working order. Additional discussions are ongoing regarding the appropriateness and desirability of culling eggs from high titer females to reduce the probability of BKD outbreaks. (Klickitat Lead Entity 2003, p. 2)

10. Chemotherapeutant use

Typical Rearing Strategies at LWS-- Once final loadings are achieved, all spring Chinook undergo a prophylactic medicated feed treatment with erythromycin thiocyanate for a minimum of 21 days. The treatment is designed as a preventive measure to reduce the incidence of BKD and is applied at a dosage rate of 100 mg/kg body weight. A second medicated feed treatment is completed during the fall for fish destined for future transfer to the Umatilla River, Oregon as specified in the Umatilla Hatchery and Basin Operation Plan. If deemed necessary by fish pathologists, a second treatment may also be given to the other spring Chinook. The treatments are covered under provisions of section 512 of Federal Food, Drug and Cosmetic Act, INAD 4333. (USFWS 2007a, p. 9)

11. Tagging and marking of juveniles

All juveniles will carry a mark that can be interrogated at the adult stage without sacrificing the animal. (White Chinook HGMP, p. 14)

12. Fish Release

a) Protocols

- Release point: White River

  Major watershed: Wenatchee

  Basin or Region: Upper Columbia River (White Chinook HGMP, p. 64)

- Juvenile smolts will be imprinted on surface water from the natal stream to reduce or eliminate straying to other tributaries. (White Chinook HGMP, p. 14)

b) Number of fish released each year (subyearlings?; yearlings?; other?)

N/A – newly developed captive broodstock program

D. Program benefits and performance

1. Adult returns

a) Numbers of adult returns (need data for the past 10-20 years)

A small number of second generation (F2) smolts were released in 2004 and 2005 from 2002 and 2003 captive broodstock spawning activities. Adults have not returned from these releases but the expected smolt-to-adult survival rate is 0.3%. (White Chinook HGMP, p. 20)

b) Return timing and age-class structure of adults

N/A - Adults have not returned from these releases but the expected smolt-to-adult survival rate is 0.3%. (White Chinook HGMP, p. 20)

c) Smolt-to-adult return rates

N/A - Adults have not returned from these releases but the expected smolt-to-adult survival rate is 0.3%. (White Chinook HGMP, p. 20)

d) Stock productivity (e.g. recruits per spawner)

N/A - Adults have not returned from these releases but the expected smolt-to-adult survival rate is 0.3%. (White Chinook HGMP, p. 20)

2. Contributions to harvest and utilization (e.g. food banks)

- Adults have not returned from these releases but the expected smolt-to-adult survival rate is 0.3%. (White Chinook HGMP, p. 20)

- No directed harvest of these populations is intended during the rebuilding phase. (White Chinook HGMP, p. 33)

3. Contributions to conservation

- Broodstock was selected to prevent extinction of the White River spawning aggregation. (White Chinook HGMP, p. 45)

- The proposed activity is expected to reduce risk of extinction, increase survival, maintain genetic distinction, and improve the overall numerical abundance of the White River spawning aggregation. (White Chinook HGMP, p. 5)

- The amplification gained through survival efficiencies while in the hatchery environment will result in a greater quantity of spring Chinook salmon returning to the White River for natural spawning. (White Chinook HGMP, p. 5)

- The survival efficiency gained between the egg/fry life history stage and the adult stage while reared in captivity is expected to increase the quantity of spawners produced when compared to that realized in natural production (i.e. about 30% vs about 0.3%, respectively). (White Chinook HGMP, p. 5)

4. *Other benefits*

None listed.

E. Research, monitoring, and evaluation programs

- Little is known about the specific juvenile life history of the White R. subpopulation. Juvenile monitoring will be initiated during 2005 to characterize juvenile migration patterns, life history strategies, and productivity. (White Chinook HGMP, p. 23)
- The project is not a research project. The Monitoring and Evaluation Plan referenced above will produce significant data and information on the success and effects of captive brood and supplementation programs applied to the conservation and recovery of listed species. (White Chinook HGMP, p. 69)

F. Program conflicts

1. *Biological conflicts (e.g. propagated stock maladapted to hatchery water source)*

N/A – releases are for recovery of ESA-listed stock.

2. *Harvest conflicts (e.g. mixed stock fishery on hatchery and wild fish limits harvest opportunities on hatchery fish)*

No directed harvest of these populations is intended during the rebuilding phase. (White Chinook HGMP, p. 33)

3. *Conservation conflicts*

a) Genetic conflicts associated with straying and natural spawning of hatchery fish (Stray rates, proportion of hatchery-origin fish on natural spawning grounds, etc.)

N/A – releases are for recovery of ESA-listed stock.

b) Ecological conflicts (e.g. competition between hatchery fish and wild fish)

N/A – releases are for recovery of ESA-listed stock.

4. *Other conflicts between the hatchery program, or fish produced by the program, and other non-hatchery issues*

During the captive rearing phase, program fish would not be affected by or affect other species. Progeny of captive brood, and fish from adult-based supplementation will however, be released as yearling smolts at which time they may interact with White River natural rearing spring Chinook or other species. Program fish could be negatively impacted by competition for food or space with naturally rearing spring Chinook or with other species such as coho, bulltrout or rainbow trout competing for the same resources. Program fish could suffer predation if predators of sufficient size were present. Program fish could also negatively affect naturally rearing spring chinook and other species through increased competition for food or space. Naturally rearing spring Chinook or other species could experience increased indirect predation if the presence of large numbers of program smolts were to entice a large number of predators into the area. Program fish might also negatively impact the same or other species through increased transfer of disease from hatchery effluent or from commingling in the natural habitat. Positive impacts to program fish might include shielding from predation by large numbers of non-program fish such as coho salmon released concurrent with program releases. Alternatively, program fish might positively affect non-program fish by "swamping" predators when large numbers of program fish are present, thereby reducing the predation rate on non-program fish. Program fish might also benefit from nutrient enrichment resulting from the naturally spawned carcasses of spring chinook or coho salmon. Carcasses originating from the program will provide nutrients brought from the ocean for ecosystem enhancement of naturally rearing spring chinook and other non- target species. (White Chinook HGMP, p. 34)

V. Willard National Fish Hatchery

A. Description of hatchery

The Willard facility was authorized by an amendment to the Mitchell Act to mitigate for fisheries lost due to the construction and operation of hydroelectric dams on the Columbia River. The earliest reports available regarding the Willard hatchery indicate that it was planned and constructed as a fall Chinook salmon production facility. The extremely cold water temperatures characteristic of the Willard NFH rearing water supply proved to be too excessive for the rearing of fall Chinook but were adequate for the rearing of coho and spring Chinook salmon. Located above an impassable natural waterfall, migrating adult salmon were unable to reach the Willard facility. (LWNFH CHMP, sec. 2.1)

Adult fish were collected and spawned at Little White Salmon and eggs shipped to Willard to initiate fish production. Originally, Willard was co-located with the former Western Fish Nutrition Laboratory which was responsible for making significant early advances in fish nutrition. The laboratory building is now occupied by the U.S. Geological Survey (USGS) Columbia River Research Laboratory, a substation of the Western Fisheries Research Center, Seattle, WA. (LWNFH CHMP, sec. 2.1)

Willard NFH is located on the Little White Salmon River approximately 5 miles upstream from the Little White Salmon facility. The hatchery includes 83.80 acres of land including an easement deed of 1.76 acres for water supply lines. (LWNFH CHMP, sec. 2.2)

Willard NFH

- 1,000,000 yearling coho salmon released on site. This program was discontinued in 2004.
- 650,000 yearling coho salmon released off site in the Wenatchee River, Washington for the Yakama Nation using locally adapted fish stocks. This Mitchell Act funded restoration effort has been implemented to restore an extinct stock of coho salmon to the Wenatchee River Basin.
- 500,000 coho salmon released off site on the Yakima Indian Reservation as part of a Yakima River restoration effort to help restore this stock to historic levels. This program was moved to Eagle Creek NFH, OR in 2004.

(LWNFH CHMP, p. 12)

During 2004 both the on site release of coho into the Little White Salmon River and transfer to the Yakima and Naches River were terminated due to Mitchell Act funding shortfalls. Subsequent negotiations between the Service and Yakama Nation (YN) resulted in a cost share arrangement where the YN would fund 60% of the Willard NFH operational costs to support the rearing of locally adapted coho for the tribe's Mid-Columbia River coho reintroduction program. The Service agreed to contribute funds to cover the remaining 40% operational costs. (LWNFH CHMP, p. 12)

Major facilities located at Willard NFH include:

- hatchery building
- hazardous materials storage building
- metal-sided storage building
- pump house
- laboratory building and garage
- 50 – 8' X 80' raceways
- screen chamber and settling Basin
- concrete dam
- pollution abatement facility
- 9 government residences

(LWNFH CHMP, sec. 2.2)

Table 3. Hatchery buildings, primary use of buildings, size and construction type. Further information can be found within the Willard NFH Real Property Inventory and the Complex station development plan (USFWS 1987). (LWNFH CHMP, sec. 2.2)

Building	**Area (ft^2)**	**Construction Material**	**Year Constructed and Remodeled**	**Purpose**
Hatchery Building	21,840	Brick	1952 and 2001	Office space and used to incubate eggs and fry
Garage	1,740	Brick	1952	Contains shop areas
Storage Building	2,304	Metal	1955	Equipment storage
Laboratory Building	7,792	Brick	1952	Currently occupied by USGS
Laboratory Garage	2,070	Brick	1952	Used for USGS fish rearing experiments
Quarters 1-9	1,100 each	Brick	1952	Occupied by employees from the Complex, USGS, Spring Creek NFH, and LCRFHC

Table 4. Incubation and rearing facilities located at Willard NFH. (LWNFH CHMP, sec. 2.2)

Unit type	Length (ft)	Width (ft)	Depth (ft)	Volume (ft^3)	#	Material	Age	Condition
Raceways 1-50	80	8	2.2	1,408	50	concrete	52	Good
Vertical Stack, 16 Tray Incubators					30	fiberglass	20	Good
Nursery Tanks 1-52	16	3	1.9	91	52	concrete	30	Good
Carson Depot Springs					48	fiberglass	20	Good

B. Hatchery water sources

Table 6. Certificates of water right held by Willard NFH. (LWNFH CHMP, p. 62)

Source	Permit No.	Date	Flow (ft^3/s)	Use
Little White Salmon River	5013	07/30/49	50.0	Fish propagation
unnamed springs	5010	02/24/51	0.2	Domestic
Well #1	3024A	05/22/65	1.11	Fish propagation
Well #2	3027A	03/06/1957	1.11	Laboratory
Well #3	4855A	01/17/1961	2.22	Fish propagation
Carson Depot Springs	S2-01077C	07/07/1958	0.34	Fish propagation

The water source for the Willard NFH is withdrawal from the Little White Salmon River. (LWNFH CHMP, p. 46)

River water at Willard NFH enters the hatchery through a trash rack and 36-inch diameter pipe. This water is filtered at the large screen chamber where heavier debris is separated by ¼-inch stainless steel woven screen. This chamber has an overflow back to the river and can be diverted into the sand/grit settling basin to remove accumulated river debris once annually. Similarly, river water is screened at the smaller screen chamber for use in nursery tanks located within the hatchery building. This hatchery building supply line also has a connection to two well water chambers that divert well water following degassing through two 24-inch packed columns. In addition, excess drinking water (ultraviolet light-treated spring water) that overflows at the domestic water storage tank is available for use during early rearing at Willard NFH. A 2003 construction project tied the 30-inch excess spring water pipeline into the 24-inch hatchery building supply line for use in nursery tanks. This water supply is not currently screened. (LWNFH CHMP, p. 64)

The unnamed spring at Willard NFH (Permit No. 5010) is used solely for drinking and irrigation water. The springs, reservoir and initial 8-inch ductile iron pipeline are located on land obtained by easement from Broughton Lumber Company, approximately one-half mile northwest of the hatchery. Water for domestic use is diverted into the disinfection building, disinfected with ultraviolet light and stored in a 50,000 gallon concrete reservoir. The water is then piped to hatchery buildings, hatchery residences and USGS laboratory for domestic use. Domestic water is tested monthly for fecal coliform contamination in addition to annual testing for nitrate, volatile organic compounds, and inorganic compounds to assure adherence with State of Washington Department of Health drinking water standards. The Willard NFH drinking water system is classified as a Group A Community system and is subject to a high degree of monitoring due to the number of residents it serves. (LWNFH CHMP, p. 64)

River rearing water at Willard NFH enters the hatchery through a 36-inch steel pipeline that eventually branches into smaller lines supplying 50 outdoor raceways. These raceways are composed of 3 decks, the upper two decks consist of 20 raceways each and the lower deck contains the remaining 10 raceways. The upper two decks have the capability for serial reuse, occasionally used during drought situations or during extremely turbid river conditions. Serial reuse conserves water during drought situations and reduces the draw at the intake during times of high turbidity ultimately reducing the amount of silt deposition in hatchery facilities. This reuse capability is used sparingly due to concerns for disease transmission and poorer water quality in the lowermost deck. Well #1 and #3 are piped to the hatchery building containing concrete nursery tanks (52 total) and incubators. River water and the newly accessible spring water (treated drinking water overflow) supply are accessible in this area as well. Average water use for fish propagation during 2003 ranged from 7,800 gpm in April to 21,000 gpm in June. All water, with the exception of the pumped well, is gravity fed. (LWNFH CHMP, p. 65)

C. Adult broodstock collection facilities

There are no adult broodstock facilities at Willard NFH

D. Broodstock holding and spawning facilities

There are no broodstock holding or spawning facilities at Willard NFH. Spawning of adults take places at Little White Salmon NFH or eggs are shipped in from other facilities.

E. Incubation facilities

Production at Willard NFH is initiated with the receipt of eyed eggs from incubation facilities located within the Wenatchee River basin, WA. After these coho salmon egg shipments begin arriving during the months of December and January, they are disinfected in a 100 ppm active iodophor solution for 10 minutes, then loaded into Heath incubation trays at approximately 5,000 eggs per tray. Under each water inlet are a maximum of 15 trays; the nursery water source consists of a 500 gallon per minute (gpm) well and a 1,000 gpm well each powered by a turbine pump and supplying a constant 41.7^{o} F temperature flow. The water is supplied at 3 gpm until hatching (at 842 temperature units), at which time flow is increased to 4 gpm for final incubation at the completion of yolk sac absorption. The eggs are picked regularly and as a result, formalin treatments are not required at Willard NFH. Incubation occurs until swim-up when fry are placed into one of 52 concrete nursery tanks. (LWNFH CHMP, p. 70)

F. Indoor rearing facilities

There are 52 concrete nursery tanks. The nursery is evenly divided into 26 tanks on the northerly half of the nursery, and another 26 on the southerly side. Each tank is coated with a dark grey colored polyurethane rubberized coating. Cleaning and removal of mortalities are performed by working one side of the nursery one day and the next side the following day. Nursery tanks inflows are initially set at 20 gpm and increased to 45 gpm as fish grow and increase feeding rate. Each nursery tank contains approximately 15,000 to 20,000 fish depending on the size of the egg take. Density indices are usually in the area of 0.25 at the time the fish are transferred to the outdoor raceways in early May at a rate of 2 tanks per raceway (40 tanks into 20 raceways). (LWNFH CHMP, p. 71)

G. Outdoor rearing facilities

There are 20 - 8-foot x 80-foot (1,525 cubic feet of rearing space) concrete raceways Water flows are adjusted to 600 gpm per raceway supplied from the Little White Salmon River. River water temperatures for the period 1958 – 2002 ranged from an average monthly high temperature of 45.2^{o} F in July to an average monthly low of 39.9^{o} F in January. Raceways are cleaned once a week, and cleaning effluent is discharged to a pollution abatement pond. Mortalities are removed daily from all 20 raceways. Barrels containing a chlorine solution are used to disinfect pond brooms and mortality nets between raceways. In early 2004, new steel-framed shade structures constructed of 3-inch diameter steel tube were erected and covered with shade cloth. Willard NFH coho have a history of increased sensitivity to sunburn, a malady that causes sloughing of skin and subsequent infection along the dorsal surface of the fish. The new shade structures have prevented any deterioration in fish health resulting from sunburn. (LWNFH CHMP, p. 72)

H. Release locations and facilities

Coho salmon at Willard NFH reach a target transfer size of 20-22 fish per pound during late March and early April. Raceway density indices approach 0.17 at the time of transfer. Fish are not fed for two full days prior to the morning of actual loading, and then pumped from the raceways via a fish pump and loaded onto distribution trucks for transport to a variety of acclimation and release sites. (LWNFH CHMP, p. 73)

I. Outmigrant monitoring facilities

Coho Salmon produced by Willard NFH are transferred to Mid-Columbia River sites located in the Wenatchee and Methow River Basins as part of the Yakama Nation Coho reintroduction effort. Some of these fish may be Pit tagged and monitored through detection devises located at McNary, John Day and Bonneville Dams (Mid-Columbia Coho Restoration Master Plan 2005, p. 157)

J. Additional or special facilities

On November 16, 1998, the EPA determined that Willard NFH was exempt from the NPDES permit requirement. Formerly operating under permit number WA-000019-1, the hatchery's current permit was deactivated since it was determined that the hatchery effluent did not enter the waters of the Little White Salmon River. While investigating a complaint of illegal chemical dumping at the USGS Laboratory, EPA Special Agent Sandy Smith and Service Special Agent Ed Wickersham discovered that overflow from the hatchery pollution abatement pond drained underground into the porous basalt outcropping located downstream of the pond rather than into the Little White Salmon River. As a non-point discharge the hatchery is exempt from NPDES regulation. (LWNFH CHMP, p. 65)

K. Outreach and public education facilities/programs

Same as Little White Salmon NFH

L. Special issues or problems (e.g. water and property rights issues, law suits, etc.)

Program Changes - Mitchell Act funding shortfalls resulted in recent coho program changes. As a result, coho salmon are no longer collected and spawned at Little White Salmon NFH for eventual transfer of eggs to Willard NFH. (LWNFH CHMP, p. 47)

Insufficient Operations and Maintenance Funding Through the Mitchell Act Increased demands on hatchery programs, as required by ESA Biological Opinions, have strained hatchery budgets. Without increases in Mitchell Act funding, reductions in production programs will continue to be made. While reducing hatchery production may allow the hatchery and the Service to meet some ESA requirements, it may not uphold mitigation and tribal trust obligations. The Service is working with NOAA-Fisheries and other co-managers to address current budget shortfalls. (LWNFH CHMP, p. 89)

VA. Willard NFH Coho

A. General information

- Species and population (or stock) under propagation, and ESA status. Coho salmon (Oncorhynchus kisutch), non-listed hatchery stock (Doulos and Magneson 2006, p. 1)

- The Little White Salmon/Willard National Fish Hatchery Complex has assisted the Yakama Nation in an effort to reestablish Coho salmon in the Upper Columbia River system using both locally adapted and lower river stocks of fish.

- The highest priority rearing program involves the use of gametes collected from fish returning to the Wenatchee River system in an attempt to develop a locally adapted stock of fish. (Doulos and Magneson 2006, p. 1)

- The long-term goal of this project is to reestablish Coho salmon with enough numbers to be near carrying capacity and provide harvest opportunities for tribal and non-tribal fishers. (Doulos and Magneson 2006, p. 1)

- A major change occurred in the Willard NFH coho program when shortfalls in Mitchell Act funding nearly resulted in the closure of the facility. A total of 2.5 million Brood Year 2003 coho eggs and fry were destroyed and another 974,000 coho pre-smolts were released 3 months prematurely as cost saving measures. As a result, 2005 will be the last year that Willard NFH adult coho return to the Little White Salmon River. Willard NFH continues to operate in support of the YN Wenatchee River and mid-Columbia coho reintroduction program using Wenatchee River returning fish to initiate production. (LWNFH CHMP, p. 45)

B. Stock/Habitat/Harvest Program Goals and Purpose

1. Purpose and justification of program

- As part of the U.S. Fish and Wildlife Service (USFWS) Little White Salmon/Willard National Fish Hatchery Complex, Willard National Fish Hatchery (NFH) has produced fish for reintroduction into the Wenatchee River Basin, WA since 2001. (Doulos and Magneson 2006, p. 1)

- The purpose of this cooperative program (Yakama Nation biologists funded by Mitchell Act and BPA funds) is to assist with the development of locally adapted, naturally spawning populations of fish in the Wenatchee River system. A total of 200,000 coho salmon derived from a locally adapted stock returning to and spawned on the Wenatchee River, WA along with 300,000 Little White Salmon stock (500,000 total) are reared at the Willard NFH. As juveniles, these fish are then transferred to the Wenatchee River watershed for release. (LWNFH coho HGMP, p. 4)

- The YIN Mid-Columbia Coho Restoration program Master Plan builds on the success of the feasibility phase and is designed to achieve coho restoration goals as identified in the Tribal Restoration Plan (*Wy-Kan-Ush-Mi Wa-Kish-Wit*) and in the Wenatchee and Methow subbasin plans. The program is a phased approach to restoration which incorporates development of a mid-Columbia hatchery broodstock, local adaptation to tributaries in the Wenatchee and Methow basins, and habitat restoration that will benefit coho as well as ESA-listed spring chinook, steelhead, and bull trout. (Mid-Columbia Coho Restoration Master Plan 2005, p. vii-viii)

2. Goals of program

Coho salmon produced by Willard NFH including egg incubation, nursery rearing and raceway rearing are transferred to Mid-Columbia River sites located in the Wenatchee and Methow River Basins as part of the Yakama Nation Coho reintroduction effort. (Doulos and Magneson 2006, p. 1)

3. Objectives of program

- The USFWS provides labor and facilities to produce 650,000 Coho salmon pre-smolts during an 18-month period for transfer, acclimation, and release from sites designated by the Yakama Nation. (Doulos and Magneson 2006, p. 1)

- Production is initiated using eggs derived from adult fish returning to the Wenatchee River, and previously from adult Coho returning to other lower Columbia River facilities following a shortfall in the number adults returning to the Wenatchee River. (Doulos and Magneson 2006, p. 1)

4. Type of program

Integrated Recovery (tribal restoration programs). (Doulos and Magneson 2006, p. 1)

5. Alignment of program with ESU-wide plans

Project provides for reestablishment of coho populations in the ESU

6. Habitat description and status

- Mid-Columbia coho salmon populations were decimated in the early 1900s by impassable dams, harmful forestry practices, and unscreened irrigation diversions in the tributaries, along with an extremely high harvest rate in the lower Columbia River. The loss of natural stream flow degraded habitat quality and further reduced coho productivity. Over the years, irrigation, livestock grazing, mining, timber harvest, road and railroad construction, development, and fire management also contributed to destruction of salmon habitat. (Mid-Columbia Coho Restoration Master Plan 2005, p. 2)

- Coho salmon were once widely distributed within the Columbia River Basin (Fulton 1970: Chapman 1986). In the early 1900's coho were extirpated from the middle reach of the Columbia River including the Wenatchee and Methow River Basins (Mullan 1983). Mullan (1984) estimated historical populations of 23,000 to 31,000 annually in the Methow River drainage and 6,000 to 7,000 annually in the Wenatchee River drainage. (Cooper 2006)

- By the end of the 20th century, indigenous natural coho salmon no longer occupied the mid- Columbia river basins. (Mid-Columbia Coho Restoration Master Plan 2005, p. 2)

7. *Size of program and production goals (No. of spawners and smolt release goals)*

- Final rearing of Brood Year 2003 Coho salmon occurred on March 25, 2005 when a total of 647,455 pre-smolts were transferred to a variety of sites within the Methow and Wenatchee River Basins. (Doulos and Magneson 2006, p. 1)

- For Brood Year 2004, eyed egg shipments from Peshastin totaled 420,000 and while those from Entiat NFH totaled 245,000. The combined total was 665,000. (Doulos and Magneson 2006, p. 2)

C. Description of program and operations

1. *Broodstock goal and source*

- Adult Coho salmon returning to the Wenatchee River Basin are trapped at Dryden Dam, spawned, and the fertilized eggs are then incubated within facilities located at Peshastin and Entiat NFH. (Doulos and Magneson 2006, p. 2)

- The highest priority rearing program involves the use of gametes collected from fish returning to the Wenatchee River system in an attempt to develop a locally adapted stock of fish. (Doulos and Magneson 2006, p. 1)

- After initially releasing "domesticated" hatchery fish for reintroduction, the program seeks to increase the fitness of reintroduced coho salmon by reducing domestication selection and emphasizing local adaptation. The program would use strict broodstock protocols that maximize natural-origin adults in the hatchery program and would place a limit on the proportion of hatchery origin returns on the spawning grounds. The AHA model was used as a guide to address the fitness loss that commonly occurs with hatchery programs and that presumably occurred in the lower Columbia River hatchery source stock. (Mid-Columbia Coho Restoration Master Plan 2005, p. 8)

- The Complex coho program is now reliant on shipment of eggs originating from fish collected and spawned from outside the Little White Salmon River watershed. (LWNFH CHMP, p. 67)

2. Adult collection procedures and holding

- Adult Coho salmon returning to the Wenatchee River Basin are trapped at Dryden Dam, spawned, and the fertilized eggs are then incubated within facilities located at Peshastin and Entiat NFH. (Doulos and Magneson 2006, p. 2)

- The highest priority rearing program involves the use of gametes collected from fish returning to the Wenatchee River system in an attempt to develop a locally adapted stock of fish. (Doulos and Magneson 2006, p. 1)

3. Adult spawning

a) Spawning protocols

Adult Coho salmon returning to the Wenatchee River Basin are trapped at Dryden Dam, spawned, and the fertilized eggs are then incubated within facilities located at Peshastin and Entiat NFH. (Doulos and Magneson 2006, p. 2)

b) No. of males and females spawned each year over past 10 years

N/A, program in early stages of development.

4. Fertilization

a) Protocols

Adult Coho salmon returning to the Wenatchee River Basin are trapped at Dryden Dam, spawned, and the fertilized eggs are then incubated within facilities located at Peshastin and Entiat NFH. (Doulos and Magneson 2006, p. 2)

b) Number of eggs collected and fertilized each year over past 10 years

For Brood Year 2004, mortality in the incubation trays varied from a low of 1.25% for eggs originating from Peshastin to a high of 2.41% for the eggs originating from Entiat NFH. This translates into the hand-picking of 11,183 unfertile eggs from the remaining 653,817 eggs. (Doulos and Magneson 2006, p. 3)

5. Incubation

- Incubation is accomplished using Heat incubators located in the Willard hatchery building. (Doulos and Magneson 2006, p. 1)

- Upon receipt of eyed eggs from Peshastin and Entiat NFH in December 2004, egg numbers were confirmed with the eggs being measured and transferred into Heath incubation trays at a target level of approximately 5,000 eggs per tray. (Doulos and Magneson 2006, p. 3)

- Dates of hatching and completion of yolk sac absorption (i.e. ready to leave trays and be transferred to nursery tanks to begin feeding) were projected based on total temperature units starting from the time of fertilization through time of receipt and subsequent incubation in the constant 41.7o F temperature of the Willard NFH well water incubation supply. (Doulos and Magneson 2006, p. 3)

- The eyed eggs were incubated under a constant flow of 3 gallons per minute (GPM), increased to 4 GPM at hatching. (Doulos and Magneson 2006, p. 3)

- Eggs were hand-picked to remove unfertile embryos and prevent fungus from adhering to adjacent fertile eggs. (Doulos and Magneson 2006, p. 3)

- For Brood Year 2004, mortality in the incubation trays varied from a low of 1.25% for eggs originating from Peshastin to a high of 2.41% for the eggs originating from Entiat NFH. This translates into the hand-picking of 11,183 unfertile eggs from the remaining 653,817 eggs. (Doulos and Magneson 2006, p. 3)

- Production at Willard NFH is initiated with the receipt of eyed eggs from incubation facilities located within the Wenatchee River basin, WA. (LWNFH CHMP, p. 70)

- After these coho salmon egg shipments begin arriving during the months of December and January, they are disinfected in a 100 ppm active iodophor solution for 10 minutes, then loaded into Heath incubation trays at approximately 5,000 eggs per tray. Under each water inlet are a maximum of 15 trays; the nursery water source consists of a 500 gallon per minute (gpm) well and a 1,000 gpm well each powered by a turbine pump and supplying a constant 41.7o F temperature flow. The water is supplied at 3 gpm until hatching (at 842 temperature units), at which time flow is increased to 4 gpm for final incubation at the completion of yolk sac absorption. The eggs are picked regularly and as a result, formalin treatments are not required at Willard NFH. Incubation occurs until swim-up when fry are placed into one of 52 concrete nursery tanks. (LWNFH CHMP, p. 70)

6. Ponding

a) Protocols

Nursery rearing is accomplished using concrete nursery tanks located in the Willard hatchery building. (Doulos and Magneson 2006, p. 1)

b) Number of fry ponded each year, including % hatch each year

Initial feeding occurred during February 2005 when a total of 653,817 swim-up fry were placed into nursery tanks. (Doulos and Magneson 2006, p. 3)

7. Rearing/feeding protocols

- Final rearing and subsequent transfer occur in outdoor 8’ x 80’ concrete raceways. (Doulos and Magneson 2006, p. 1)

- As of March 31, 2005 there were 646,763 Coho fry on-hand (411,150 from Peshastin and 235,613 originating from Entiat NFH). (Doulos and Magneson 2006, p. 3)

- Survival from initial feeding through March 31 was 99.13% and 98.55% respectively. (Doulos and Magneson 2006, p. 3)

- Additional nursery tank space was used to rear these fish at low densities (reducing normal rearing density indices by half at time of release), ultimately improving fish health and quality. (Doulos and Magneson 2006, p. 3)

- Coho salmon in raceways are hand fed 4 times per day from initial ponding through May 31, 3 times per day June 1 – 30, and then 2 times per day from July 1 through the remainder of raceway rearing. (Doulos and Magneson 2006, p. 5)

- From October 16 until February 14, fish in raceways 5 -8 were fed at a reduced rate (approximately 50% of prescribed level) in hopes of better mimicking the winter growth patterns observed in wild fish. (Doulos and Magneson 2006, p. 5)

- Nursery tank feeding is done using automatic feeders, set to feed every half hour over the course of a 12 hour day. Feeds used in the nursery are all manufactured by Bio-Oregon, and feeding is done using Bio-Oregon's established guidelines based on the rate for a given percentage of their body weight and water temperature. Feeds used during nursery rearing include BioDiet Starter #2 and #3 followed by BioMoist Grower 1.0 and 1.3mm. Feed size changes are made using the recommendations provided by Bio-Oregon and feeding at least to, and usually somewhat beyond, the largest size of the suggested range. (LWNFH CHMP, p. 71)

- The feeding level is adjusted upwards every 3 days, and sample counts in the nursery are taken 3 times per month from representative tanks for each egg source and take. Since all fish reared at Willard NFH receive a CWT, feeding is performed to ensure a uniform size at the time of tagging. Uniformity of size during the time of tagging is necessary to assure that fish will fit the headmolds used in the tagging process. Properly sized headmolds on tagging machines is necessary for proper tag placement and to achieve optimum tag retention. (LWNFH CHMP, p. 71)

- In early 2004, new steel-framed shade structures constructed of 3-inch diameter steel tube were erected and covered with shade cloth, this covers all 8x80 raceways. LWNFH CHMP, p. 72)

8. Fish growth profiles

- Raceways are cleaned once per week, and sample counts to monitor fish growth are performed at the end of each month and occasionally at mid-month to validate growth and feeding rates. (Doulos and Magneson 2006, p. 5)

- As of December 31 the Coho numbered 591,022 and had attained an average size of 26.00 fish/lb. (Doulos and Magneson 2006, p. 5)

9. Fish health

- Fish health was excellent at the time of transfer and this distribution of fish occurred without incident. (Doulos and Magneson 2006, p. 1)

- Fish health has been exceptionally good to date, with no outward appearance of potential fish health problems. Mortalities have been quite low. (Doulos and Magneson 2006, p. 5)

- In early 2004, new steel-framed shade structures constructed of 3-inch diameter steel tube were erected and covered with shade cloth. Willard NFH coho have a history of increased sensitivity to sunburn, a malady that causes sloughing of skin and subsequent infection along the dorsal surface of the fish. The new shade structures have prevented any deterioration in fish health resulting from sunburn. (LWNFH CHMP, p. 72)

- The Lower Columbia River Fish Health Center in Underwood, WA provides fish health care for Little White Salmon NFH. (LWNFH CHMP, p. 73)

- Monthly examination: A pathologist from the LCRFHC visits at least monthly after fry are placed in ponds. Based on pathological signs, age of fish, concerns of hatchery personnel, and the history of the facility, the examining pathologist determines the appropriate tests. This usually includes a necropsy with an external and internal exam of skin, gills, and internal organs and can include other tests for bacteria, virus and parasites. Kidneys, gills and other tissues are checked for common bacterial pathogens by culture. Blood is checked for signs of anemia or other infections, including viral anemia. Additional tests for virus or parasites are done if warranted. The pathologist examines the healthy and moribund/freshly dead fish to ascertain potential disease problems in the stock. (LWNFH CHMP, p. 74)

10. Chemotherapeutant use

Chemotherapeutants are used as deemed necessary to control bacterial or parasitic problems. However, they have not been needed for several years.

11. Tagging and marking of juveniles

- Fish marking occurred during June 7 – 28, 2005 and was accomplished with a single automated marking trailer. The automated marking trailers feature the latest in fish marking technology and this was the first use of such a trailer at Willard NFH. (Doulos and Magneson 2006, p. 4)

- Automated trailer mark quality appeared excellent. The actual marks employed consisted of coded-wire tags only with no fin clips involved.

- For raceways 1 - 10, 5 tag codes were used or 1 tag code for each pair of raceways. For raceways 11 - 20, fish in each raceway were assigned a single unique code. Doulos and Magneson 2006, p. 4)

- Additionally, raceways 14 -16 were “body- tagged” by a regular marking trailer and contracted employees. This type of tagging consisted of injecting a second, blank wire tag just beneath and off to the side of the adipose fin. (Doulos and Magneson 2006, p. 5)

- Information collected from these body tags will be used at a later date to identify fish that originate from releases above Tumwater Dam. (Doulos and Magneson 2006, p. 5)

- During the week of December 12, 2005 Yakama Nation fisheries staff PIT-tagged a total of 20,246 Coho at Willard NFH. (Doulos and Magneson 2006, p. 5)

12. Fish Release

a) Protocols

- Coho salmon at Willard NFH reach a target transfer size of 20-22 fish per pound during late March and early April. Raceway density indices approach 0.17 at the time of transfer. Fish are not fed for two full days prior to the morning of actual loading, and then pumped from the raceways via a fish pump and loaded onto distribution trucks for transport to a variety of acclimation and release sites. (LWNFH CHMP, p. 73)

- Final rearing of Brood Year 2003 Coho salmon occurred on March 25, 2005 when a total of 647,455 pre-smolts were transferred to a variety of sites within the Methow and Wenatchee River Basins. (Doulos and Magneson 2006, p. 1)

b) Number of fish released each year (subyearlings?; yearlings?; other?)

- Final rearing of Brood Year 2003 Coho salmon occurred on March 25, 2005 when a total of 647,455 pre-smolts were transferred to a variety of sites within the Methow and Wenatchee River Basins. Fish health was excellent at the time of transfer and this distribution of fish occurred without incident. (Doulos and Magneson 2006, p. 1)

- For Brood Year 2004, eyed egg shipments from Peshastin totaled 420,000 and while those from Entiat NFH totaled 245,000. The combined total was 665,000. (Doulos and Magneson 2006, p. 2)

- Four raceways of Brood Year 2004 Coho salmon located at Willard NFH were transferred to the Wenatchee River Basin during January 2006. This early transfer group marked with 4 unique tag codes will be allowed to acclimate over-winter prior to a Spring 2006 release. (Doulos and Magneson 2006, p. 5)

- See LW-10, Tables P. 2 & 6 for specific fish transfer/release information to Wenatchee and Methow basin locations.

D. Program benefits and performance

1. Adult returns

a) Numbers of adult returns (need data for the past 10-20 years)

N/A, program in early stages of development.

b) Return timing and age-class structure of adults

N/A, program in early stages of development.

c) Smolt-to-adult return rates

N/A, program in early stages of development.

d) Stock productivity (e.g. recruits per spawner)

N/A, program in early stages of development.

2. Contributions to harvest and utilization (e.g. food banks)

The long-term goal of this project is to reestablish Coho salmon with enough numbers to be near carrying capacity and provide harvest opportunities for tribal and non-tribal fishers. (Doulos and Magneson 2006, p. 1)

3. Contributions to conservation

- The project provides for reestablishment of coho populations in the ESU.
- The highest priority rearing program involves the use of gametes collected from fish returning to the Wenatchee River system in an attempt to develop a locally adapted stock of fish. (Doulos and Magneson 2006, p. 1)

4. Other benefits

The feasibility phase demonstrated that a local broodstock can be developed from lower river stocks. (Mid-Columbia Coho Restoration Master Plan 2005, p. 70)

E. Research, monitoring, and evaluation programs

The Yakama Nation fisheries staff conducts the primary evaluation of the Leavenworth Complex coho programs. (Cooper 2006)

F. Program conflicts

1. Biological conflicts (e.g. propagated stock maladapted to hatchery water source)

The project provides for reestablishment of coho populations in the ESU using both locally adapted and lower river stocks of fish.

2. Harvest conflicts (e.g. mixed stock fishery on hatchery and wild fish limits harvest opportunities on hatchery fish)

N/A, program in early stages of development.

3. Conservation conflicts

a) Genetic conflicts associated with straying and natural spawning of hatchery fish (Stray rates, proportion of hatchery-origin fish on natural spawning grounds, etc.)

N/A, program in early stages of development.

b) Ecological conflicts (e.g. competition between hatchery fish and wild fish)

N/A, program in early stages of development.

4. Other conflicts between the hatchery program, or fish produced by the program, and other non-hatchery issues

N/A, program in early stages of development.

VI. References

Reference/supporting documents can be found at the Columbia River Basin Hatchery Review website <http://www.fws.gov/pacific/Fisheries/Hatcheryreview/index.html> under "Reports & Publications".

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Subappendix 1: White River Spring Chinook Captive Broodstock Program Evaluation of Columbia River National Fish Hatcheries

U.S. Fish and Wildlife Service Pacific Region
Columbia Basin Hatchery Review Team

White River Spring Chinook Captive Broodstock Program Evaluation of Columbia River National Fish Hatcheries

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March 26, 2007

Executive Summary

The U.S. Fish and Wildlife Service (Service) has been contacted by Grant County Public Utilities District (PUD) about the Service's capability and interest in assuming responsibility for the captive propagation portion of the White River Spring Chinook program. White River spring Chinook are considered a distinctive population of Chinook salmon and are currently listed as endangered under the U.S. Endangered Species Act. The Hatchery Review Team of the Pacific Region has been requested by Service regional office staff to determine whether Service facilities have the capability to conduct the major elements of this propagation program and to identify principal facility modifications and operational considerations associated with implementation. The Team has collected information over the course of its hatchery reviews concerning four facilities (Eagle Creek, Little White Salmon, Willard and Entiat National Fish Hatcheries (NFH)) that may have uncommitted rearing capability. Of these facilities, Eagle Creek NFH was judged to be an inappropriate site for the program due to constraints associated with its water source. Accordingly, the Team looked closely at the Little White Salmon and Willard NFH (LWS/Willard) complex and Entiat NFH to assess their capability to implement the White River captive broodstock program.

The following report brings together available biological and facility information including the results of detailed discussions with each of the facility project leaders. The Team assessment also has given special consideration to fish disease risk and prevention issues raised by this captive broodstock program and the possible consequences of transferring the program to existing Service facilities.

The Review Team concluded that the LWS/Willard NFH complex and Entiat NFH have the potential combined capability to assume responsibility for the White River spring Chinook program. The Team envisions the following possible scenario. Eggs pumped from salmon redds in the White River would be transferred to the Willard NFH for hatch and initial growth in indoor nursery tanks. After PIT tagging, those fish (F1 generation) would be transferred to large, outdoor raceways at the Little White Salmon NFH for captive rearing to sexual maturity. Three brood years (BY) of F1 spring Chinook would be reared captively to sexual maturity: BY2007, BY2008, and BY2009. "F2" generation offspring would be reared at the Entiat NFH from eyed eggs to yearling smolts (or pre-smolts) prior to transfer and release into the White River. F2 eyed eggs would initially be obtained from the captive broodstock currently held at a private aquaculture company (Aquaseed Corporation) and subsequently from the captive broodstock at the Little White Salmon NFH.

The captive broodstock program poses significant disease and fish culture risks to White River spring Chinook and other fish stocks in Service facilities and potentially in the White River (e.g., from the release of disease-infected subyearlings). Consequently, those risks should be carefully considered before the Service accepts or declines the spring Chinook captive broodstock program. The Team concluded that significant infrastructure improvements would be required to minimize fish health risks. These improvements include installation of facilities to treat (e.g., via ozone, chlorine, or ultra-violet light) effluent water from fish rearing vessels prior to discharge into settling ponds or any open waters. In general, pathogen loads in effluent water are a very high concern at all facilities. Additional security fences and covers enclosing outdoor raceways at Little White Salmon and Entiat NFHs would be required also. If the Service accepts responsibility for the White River spring Chinook captive broodstock program, then an *Implementation Team* should be assembled as soon as possible. The Service may also wish to consider formation of a *Risk Assessment Team*, potentially including representatives of the Priest Rapids Hatchery Subcommittee, to assess risks and establish requisite fish health protocols before a final decision is made to accept or reject the captive broodstock program.

Background

The White River is a major tributary to Lake Wenatchee in the Wenatchee River watershed and Columbia River of eastern Washington State. Spring Chinook salmon inhabiting the White River are considered a distinctive population genetically and are listed as endangered under the U.S. Endangered Species Act (ESA). This population is one of only a few Chinook salmon populations range-wide that spawn in a glacial-fed tributary to a lake.

Grant County Public Utilities District (PUD) is currently funding a captive breeding program to assist with recovery of White River spring Chinook. Eyed eggs are pumped from salmon redds in the White River each fall (November) and transferred to a private aquaculture company, Aquaseed Corporation, in Rochester, Washington, for hatch and captive rearing to sexual maturity (F1 generation). Captively-reared adults are spawned at Aquaseed, and the resulting "F2" progeny are reared to the yearling (smolt or pre-smolt) stage and then transferred to the White River for acclimation and release. The goal of the program is to recover White River spring Chinook via the natural spawning of F2 fish following their outmigration as smolts and return from the ocean as adults. In May 2006, Little White Salmon NFH received F2 brood year (BY) 2005 subyearling fry that were excess to Aquaseed's rearing capacity. For producing the F2 BY2006 fish, Aquaseed transported unfertilized eggs and sperm to Little White Salmon NFH in August and September (2006) for fertilization and incubation. As of February 22, 2007, the LWS/Willard complex had 53,000 BY2005 and 316,400 BY2006 F2 juveniles on station.

The U.S. Fish and Wildlife Service (Service) has recently received a request from Grant County PUD to assume responsibility for the captive propagation portion (F1 generation) of the White River spring Chinook program. Much uncertainty exists regarding the capabilities of existing NFHs in the Columbia River Basin to assume responsibility for both the F1 captive broodstock *and* the F2 juvenile rearing portions of the captive breeding program. Consequently, the Service's Portland (Oregon) Regional Office requested that the Pacific Region's Hatchery Review Team (Team) determine the capability of the Service to potentially assume responsibility of both the F1 and F2 portions of the captive breeding program.

Tasks

The Regional Office provided the Review Team with the following the tasks:

> ***Task 1:*** Determine the appropriateness of the Service assuming responsibility for the captive broodstock portion of the White River spring Chinook program.
>
> ***Task 2:*** Determine the best Service facilities in the Columbia River Basin for maintaining the White River spring Chinook broodstock program. Does the Service currently have the facilities and capability to accept this responsibility? Is new construction needed to meet this objective? The Team was told that Grant County PUD will provide funds for new construction, if necessary.
>
> **Deadline:** The Service must respond to Grant County PUD by March 26, 2007.

Review Team Approach

Task 1: The Team quickly concluded that the captive broodstock program for White River spring Chinook fits within the mission of the Service's Fisheries Program. The Service's mission statement reads as follows:

> *The U.S. Fish and Wildlife Service's mission is, working with others, to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.*

Task 2: As of March 1, 2007, the Team has reviewed hatchery programs at the Warm Springs, Leavenworth, Entiat, Winthrop, and Eagle Creek NFHs in the Columbia River Basin. The Team has also initiated reviews, including site visits, of Carson, Spring Creek, Little White, and Willard NFHs in the Columbia River Gorge region. The Team has not visited or reviewed Dworshak, Kooskia, or Hagerman NFHs in the Snake River or NFHs outside the Columbia River Basin. Due to time constraints, the Team decided to restrict it's evaluation to those hatcheries that it had reviewed and/or formally visited as part of the Service's formal hatchery review process. Of the hatcheries reviewed or visited, the team concluded that only Little White Salmon, Willard, and Entiat NFHs are currently capable of potentially providing facilities for the White River spring Chinook program. All other NFHs in the Columbia River basin are either 100% committed to existing Service programs (e.g. Winthrop NFH) and/or are undesirable for rearing spring Chinook salmon (e.g., Eagle Creek NFH) because of fish health or other issues. The Team also concluded that there was insufficient time to evaluate the potential for the Service to accept the current inventory of White River spring Chinook at Aquaseed.

The Review Team asked team member Larry Marchant, Project Leader and Manager of Spring Creek NFH, to work with the manager of LWS/Willard NFH complex (Speros Doulos) and the manager of Entiat NFH (Craig Eaton) to determine the current capabilities and infrastructure needed for the three hatcheries to successfully take on the F1 captive broodstock component and continue the F2 production component of the White River Spring Chinook program. The Team envisioned that, of the three hatcheries, one hatchery might best be suited for supporting the F1 component while another hatchery might be best suited for supporting the F2 component. Little White Salmon and Willard NFHs are only a few miles apart and are managed as a complex; hence, Little White Salmon and Willard NFHs might provide some added flexibility regarding specific facilities needed at multiple life-history stages.

The Review Team's evaluation and recommendations are based on a number of assumptions, outlined below.

Assumptions and Rearing Requirements

The following assumptions are based on propagation parameters identified in the White River Spring Chinook Hatchery and Genetic Management Plan (HGMP)[48] and monthly progress reports prepared by the Washington Department of Fish and Wildlife (WDFW), Science Division Supplementation Research Team.

Captive Broodstock (F1 generation)

[48] *Available at: www.fws.gov/pacific/Fisheries/hatcheryreview/documents/LE001.pdf/.*

- Maximum number of family groups, or redds pumped, per year: 50. The goal is to pump a minimum of 25 redds per year, but all redds would be pumped if less than 25 redds were available.

- Maximum number of eyed eggs collected per redd: 100. Maximum number of eyed eggs collected per year: 1700.

- Number of eyed eggs (fish) per family group (redd) could range from 34–100 individuals per family based on the stated maxima of 50 redds and 1,700 eyed eggs total. .

- Newly-hatched families would need to be reared separately until fish were large enough to receive a PIT tag and their disease status certified by Fish Health prior to combining families in rearing vessels.
    - Fish Health recommends that individual family groups are reared to 50 fish per pound (mean length = 4 in. or 101 mm) for a minimum space of 142 ft^3 per family in up to 50 separate rearing units.
    - The suggested minimum length for PIT tagging juvenile Chinook salmon is 3 inches or 76 mm.

- From a maximum of 1,700 eyed eggs per brood year, the expected maximum number of captively-reared adults that would need to be maintained to sexual maturity is estimated to be 510 adults per brood year, based on a 30% survival rate as listed in the HGMP.

- Rearing space required for each brood year lot at sexual maturity is a minimum of 2,550 ft^3 based on a maximum rearing density of 0.5 lb./ft^3 and assuming a mean adult size of 0.1 fish per pound (mean size = 10 pounds per fish).

- Maximum rearing densities (loading index) is 1.8 lbs. of fish / gpm of water flow / inch of length (from the HGMP).

- Three brood years of captively-reared fish would need to be reared to sexual maturity: BY2007, BY2008, and BY2009. Redd pumping is scheduled to be discontinued after 2009.

- Estimated mean fecundity of captively-reared females (from WDFW October monthly report) is 1,830 eggs per female.

- Number of F2 yearling smolts required annually for release into the White River = 150,000 smolts. Number of green eggs necessary to yield 150,000 smolts = 238,000 eggs. Number of female parents necessary to yield 238,000 green eggs = 130 females @ 1,830 eggs/female.

- A 90,000 fingerling subyearling release is scheduled for 2007, 2008, and 2009 (up to 150,000 fingerling subyearlings are available for release in 2007).

- Assumed survival rates:
    - F1 captive fry to sexually mature adult: 30%.
    - F2 green egg to smolt: 65%.
    - F2 smolt to returning adult following release in the White River: 0.3%.

Offspring Production (F2 generation)

- Release goal into White River: 150,000 yearling White River spring Chinook per year at 15 fish per pound.
- Total release poundage: 10,000 pounds per year.
- Maximum rearing densities to control bacterial kidney disease:
  - If adult BKD-ELISA optical density is < 0.12, then maximum rearing density for juveniles = 0.125 lbs./ft.^{3} / inch length = Density Index (D.I.) = 0.125.
  - If adult BKD-ELISA optical density is > 0.12, then maximum rearing density for juveniles = 0.06 lbs./ft.^{3} / inch length or a D.I of 0.06.
  - Fish health recommends (1) density indexes no greater than 0.06 for progeny of female parents with BKD-ELISA optical density levels between 0.12 and 0.4, and (2) discard families from female parents with optical densities > 0.4.
- Total required rearing space:
  - 27,548 ft^3 at a maximum density index of 0.06.
  - 13,774 ft^3 at a maximum density index of 0.125.
- Proposed release of 90,000 subyearlings for years 2007 – 2009. There was no target release size identified in the HGMP (page 19).
- Recommended flow index of 1.0 or less with a minimum water turnover rate of 30 minutes, as recommended by Fish Health. However, the Team recognizes that current facilities may not be able to achieve the recommended water turnover rates at every life stage. Turnover rates for the Little White Salmon broodstock ponds (raceways) and Entiat NFH raceways would be 41 minutes and 45 minutes, respectively, at maximum biomass load.

Evaluation of Captive Broodstock (F1) Capabilities

I. Egg Isolation Facilities

A. Little White Salmon/Willard NFHs: Carson Depot Springs

Advantages

- Water source is pathogen-free, gravity-feed spring water at a constant 48°F.
- Facility is currently setup for incubation with sufficient space to keep individual family groups separate.
- Has an alarm system.
- Located off station and, thus, reduces disease transmission risks to primary culture areas because of physical location.

Disadvantages

- Effluent is not treated currently.
- Security could be a problem due to isolated location.
- Located off station, thus resulting in potential travel or transport issues for LWS/Willard NFH hatchery staff for dealing with emergencies or security.

Infrastructure needs and improvements

- Effluent treatment necessary (e.g., U.V. or chlorine).
- Security fencing around incubation building necessary.
- Night watchman may need to be hired.
- Alternatively, the main hatchery building at Willard NFH may be available if no other new programs are established there. Under these circumstances, the hatchery building at Willard NFH could be managed as an "egg isolation building". (See "Willard incubation building" below under "Early Life Stage Rearing".)

B. Entiat NFH (no isolation facilities currently available)

Advantages

- Located in the mid-Columbia region, one watershed north of the Wenatchee River watershed.
- A new isolation facility could be designed specific to the needs of the White River spring Chinook program.
- New isolation facility at Entiat NFH could be used for future programs.
- Sufficient space exists at Entiat NFH to construct an isolation facility.

Disadvantages

- Time commitment for design and construction. Would need to be available by November 2007 to receive pumped eggs from the White River.
- Cost of construction.

Infrastructure needs and improvements

- Construct new isolation facility with appropriate water effluent treatment.

II. Early Life Stage Rearing

A. Little White Salmon/Willard NFHs: Willard incubation building

Advantages

- 52 nursery tanks (92.8 ft^3) capable of rearing individual family groups to 18 fpp if necessary.
- 1500 gpm of pathogen free well water (42° F).
- River water supply available (38 - 46°F) for temperature manipulation.
- Nursery tanks are located in secure building with existing alarm system and generator for backup power.

Disadvantages

- Willard NFH located upstream of Little White Salmon NFH. Pathogens in effluent water from Willard NFH can be entrained with intake water to Little White Salmon NFH. Treatment or disinfection of effluent water from Willard NFH would be mandatory.
- Relatively cold water increases disease risks and may require heating to reduce those risks.
- Well water must be pumped, although backup generator power is available.

Infrastructure needs and improvements

- Hatchery building effluent disinfection system (UV, ozone, chlorination).
- Covers over nursery tanks to prevent fish jumping between tanks for maintaining family group separation prior to PIT tagging.
- Electrical power and a traveling screen to utilize spring water for a warmer pathogen free water source. This water source is UV treated.

B. Entiat NFH: incubation building

Advantages

- 16 nursery tanks (94.6 ft^3) and 18 circular tanks (10 ft^3).
- Well water supply, 1500 gpm, pathogen free at 47 - 51°F.
- Tanks are located inside secure building.
- Standby power is available.
- Gravity flow spring water at 200 – 700 gpm is available if needed.

Disadvantages

- Additional rearing space (nursery tanks) may be needed if the maximum number of family groups (50) is attained and family identifications are to be maintained prior to PIT tagging.
- Effluent water is not treated.
- Water source is pumped well water, standby power is available.

Infrastructure needs and improvements

- Additional nursery rearing tanks.
- Effluent disinfection (UV, ozone, chlorination).
- Covers for tanks.
- River water supply line with appropriate disinfection would need to be installed, or heating /cooling equipment installed to adjust water temperatures.

III. Adult Holding Facilities

A. Little White Salmon/Willard NFHs

Facilities: five outdoor raceways in upper bank at Little White Salmon available and 2 additional indoor raceways if needed.

Advantages

- New oversize outside raceways (3850 ft^3 each). Total available space: 19,250 ft^3 (outside raceways) and 3,100 ft^3 (inside raceways).
- Headbox separated in compartments to isolate units receiving spring, well and river water.
- Ability to manipulate water temperature using different water sources.
- Raceways are enclosed by predator exclusion fencing, 12-foot high chain link fence and overhead cables are spaced 6 inches apart.
- Existing headbox equipped with low water alarm, pager and phone dialer notification.
- Raceways can be compartmentalized with screens to separate groups of adults.
- Proven water system for holding, final maturation, and spawning of spring Chinook.
- Raceways for maintaining captive broodstock of spring Chinook could be an advantage for controlling BKD with a flow through system compared to circular rearing vessels. However, the ability to captively rear spring Chinook successfully in raceways is an uncertainty.

Disadvantages

- No cover or shade available.
- Gates would require locks for security (currently not locked).

- Other Chinook stocks would be reared in the same bank of raceways, but separated by empty ponds and isolated head boxes.
- Effluent water is not treated.
- Rearing of F2 fish would not be able to continue if F1 captive broodstock program is implemented at Little White Salmon NFH.

Infrastructure needs and improvements

- Cover over raceways to provide shade and additional security with lockable fencing (e.g., similar to covered raceways at Leavenworth NFH).
- Fish handling equipment for spawning.
- Effluent disinfection is recommended.
- Formalin delivery system desired.

B. Entiat NFH

Facilities: 30 raceways available.

Advantages

- All 30 raceways could be used if necessary for a total of 38,400 ft^3 of rearing space.
- Pathogen free well water supply.
- Would be consistent with the Review Team's recommendation to terminate the existing spring Chinook program at the Entiat NFH and use the Entiat NFH for propagation of upper Columbia River species of high conservation concern.

Disadvantages

- Raceways are serial reuse. Would be unable to operate both captive brood and production phases of this program.
- Well water is a constant 48°F. Would need to manipulate water temperature for proper sexual maturation and gamete production.
- Unable to use river water due to detrimental parasites (*Myxobolus* sp.).
- Effluent is not disinfected.
- Raceways are not secured.
- No cover or shade currently exists over raceways.
- No low water alarms.
- Would have to discontinue coho program because effluent water from raceways drains into adult holding pond where coho broodstock are held until they are spawned. Captively-reared spring Chinook would pose a significant disease risk to the coho.

Infrastructure needs and improvements

- Security fencing around the raceways with cover or shade structures.

- River water treatment facility to kill the myxosporidian parasites so that water temperatures on station can be manipulated to induce sexual maturation of captively-reared broodstock.
- Change water delivery system to isolate banks of raceways so all raceways are single pass water.
- Low water alarms would need to be installed.
- Effluent disinfection is recommended.

Evaluation of Juvenile Production (F2) Capabilities

I. Little White Salmon/Willard NFHs

Advantages

- Currently is successfully rearing both BY2005 and BY2006 year classes of F2 White River spring Chinook.
- Current rearing of F2 fish has not interfered with existing programs for spring Chinook (Carson NFH strain) and upriver-bright fall Chinook.

Disadvantages

- Cooler water temperatures limit ability to achieve target release size of 15 fpp.

Infrastructure needs and improvements

- Treatment of effluent water recommended to prevent potential disease transmission to fish in the Little White Salmon River and Drano Lake.

II. Entiat NFH

Advantages

- Would be consistent with the Review Team's recommendation to terminate the existing spring Chinook program at the Entiat NFH and use the Entiat NFH for propagation of upper Columbia River species of high conservation concern.
- Facility located much closer to the White River than LWS/Willard NFH complex, reducing transportation time and cost for releasing F2 fish into the White River.
- Well water provides excellent quality and temperature (48˚ F) for achieving targeted release size, and the facility has demonstrated the ability to successfully rear spring Chinook to the target release size.

Disadvantages

- No security fencing currently exists around the raceways.
- No shade covers exist over raceways.

- White River spring Chinook could cause a conflict with the coho reintroduction program. Water is currently discharged from raceways into adult holding pond where adult coho are held prior to spawning. The risk of disease could be minimized if only F2 fish with low BKD risk are reared to the smolt stage at Entiat NFH. This latter approach is consistent with current protocols for current spring Chinook program at Entiat NFH.
- No low water alarms.
- Entiat NFH would not have sufficient space to rear 90,000 subyearlings (BY 2007-2009) plus the 150,000 yearlings at the 0.06 DI level. The best they could achieve would be 0.08 using 20 nursery tanks and two outside raceways.

Infrastructure needs and improvements

- Security fencing with cover or shade structures for raceways.
- Low water alarms would need to be installed on each raceway.
- Water passages may have to be restructured to avoid disease risks to adult coho that are held on station (October and November) prior to spawning.
- Treatment of effluent water recommended to prevent potential disease transmission to fish in the Entiat River.
- Additional indoor nursery tanks and plumbing to maintain juvenile densities below recommended levels.

Recommendations

The Review Team based the following recommendations on the goals and objectives of the White River spring Chinook program as they are specified in the HGMP. The Review Team assumes that goals or objectives not explicitly described in the HGMP are the responsibility of Grant County PUD and would not be the responsibility of the Service if the captive broodstock program is transferred to a Service facility.

Programmatic Recommendations

1) Implement the F1 captive broodstock program at LWS/Willard NFH complex with the BY2007 through BY2009 eyed eggs pumped from the White River. Pumped eggs would be transferred to the Willard NFH for hatch and initial rearing in the nursery tanks. PIT-tagged fish resulting from those eggs would be captively reared to sexual maturity at Little White Salmon NFH with the identified infrastructure modifications. This recommendation is based on the early life stage rearing capability of maintaining up to 50 family groups separated for extended periods of time at the Willard incubation building and the presence of large outside ponds (raceways) for rearing and holding adult spring Chinook at Little White Salmon NFH, including the ability to compartmentalize each holding pond for broodstock management flexibility.

2) The Little White Salmon/Willard NFH complex does not have the infrastructure to handle both the F1 captive broodstock and F2 production phases of the White River spring Chinook

program; therefore, F2 production should be transferred to Entiat NFH beginning with BY2007 eyed eggs from Aquaseed. If adult coho are to be maintained in the adult holding pond at the Entiat NFH, it will be necessary to either disinfect the water coming in from the White River stock raceways or pipe water in from the river to the adult holding pond. The risk of horizontal transmission of BKD from F2 White River spring Chinook juveniles (via the raceway effluent) to adult coho, followed by potential vertical transmission to the progeny of those coho, is significantly greater than the risk of *Myxobolus sp*. infection from the river water to the adult coho.

3) Disease risk should dictate number released for both yearling and subyearling release groups. For the F2 program at Entiat NFH, the Team recommends that fish at risk from BKD (progeny from female parents with ELISA optical densities >0.4) be culled prior to transfer to Entiat NFH to reduce horizontal transmission, lessen need for antibiotic treatments, and increase survival of F2 fish after transfer and release into the White River. Culling of high BKD risk progeny will significantly improve mean overall survival without genetically decreasing disease resistance. Culling for BKD does not negatively affect the genetic diversity of the population unless all the F2 descendants from a single F1 pumped redd are culled. Some combination of culling to control BKD and pedigree representation of all pumped redds would be desired.

4) To avoid density dependent impacts, release goals for both the yearling and subyearling program stated in the HGMP (a maximum of 150,000 yearling release and a maximum of 90,000 subyearling release (BY 2007-2009), subject to disease impacts) should be followed. Therefore, egg acquisition (number of redds pumped, number of eggs taken from each redd) should adhere strictly to the program objectives as stated in the HGMP.

5) Little White Salmon NFH has 316,400 F2 BY2006 fish currently on station. For the F1 female parents producing those F2 BY2006 progeny, 68 female parents had ELISA O.D. < 0.45 and 147 female parents had an O.D.> 0.45. The resulting progeny from those 147 high risk females are known to have a high probability of amplifying BKD. Rearing these high risk fish is not recommended. Releasing those high risk fish and subjecting the existing wild population to this same risk is also not recommended. At best, the Service should propose that only the progeny from 68 BY females be reared for this program and the remainder destroyed to avoid amplification of disease and exposing the wild population in the White River. The original redd sources for the 147 high risk females should be identified to determine whether the recommended culling would eliminate all the F2 descendants from a single redd. In this latter situation, the disease and genetic risks should be compared regarding partial culling of the progeny to ensure that all pumped redds are represented among the retained F2 fish. Pumped eggs received from the White River for development of the F1 BY2007 broodstock will be held at Willard NFH until transfer and release of the F2 BY2006 smolts into the White River, eliminating any conflict for rearing space at Little White Salmon NFH.

6) Maintain the BY2005 F2 fish at Little White Salmon NFH until release in the spring of 2007 (currently 53,000 yearlings).

7) Entiat NFH would assume responsibility for the future rearing of all F2 fish that the Service receives from Aquaseed (starting with BY2007) and eventually from Little White NFH (BY2007, BY2008, BY2009 F1 captively-reared parents) until termination of the White River spring Chinook program in 2016. This recommendation is based on the quality of the water supply and temperature at Entiat NFH to meet production targets and the availability of

sufficient juvenile rearing space to meet the rearing density requirement of a maximum 0.06 DI level. Relatively close proximity of the Entiat NFH to the White River is an added advantage of this facility for transporting F2 yearlings. All these programmatic recommendations are contingent upon implementation of the facility recommendations, as identified previously and described below.

Facility Recommendations

The Review Team identified the following facility needs and infrastructure improvements necessary at Little White Salmon, Willard, and Entiat NFHs for the Service to assume responsibility for the White River spring Chinook captive broodstock program. Major construction or facility improvements are indicated by a double asterisk (**).

Little White Salmon/Willard NFH Complex: Captive Broodstock Program

1) Use the Incubation building at Willard NFH as an isolation facility to accept eyed eggs from White River pumped redds for incubation and early life stage rearing by family group. Using the Carson Depot Springs facility as an isolation unit for incubation would not provide sufficient holding time to determine disease status prior to moving those family groups to Willard NFH. Transporting pumped eyed eggs directly to the Willard NFH incubation building would provide improved security over the Carson Depot Springs site and eliminate the need to move the family groups between the two sites. The Willard NFH incubation building would also be used to incubate F2 eggs produced by the captive broodstock prior to transfer to Entiat NFH.

2) **Disinfection treatment of the effluent water from the incubation building at Willard NFH is absolutely necessary since that discharge is located upstream of the water intake for the Little White Salmon NFH. Total flow through the incubation building is 1500 gpm; however, the water flow needs of F1 and F2 eyed eggs and F1 juveniles for the captive broodstock program would be considerable less (500 – 1,000 gpm). Nevertheless, the treatment unit should be sized for the full discharge capacity of the building for added flexibility and as a fish health precaution. The most effective and efficient type of effluent treatment would need to be determined (e.g., ozone, UV or chlorine).

3) Covers for the nursery tanks are needed to isolate individual family groups to complete their disease screening period and until they can be PIT tagged (requires rearing to a minimum size of 50 fpp).

4) **Install electrical power and a traveling screen at the spring water intake to allow collection of warmer (46˚ F) pathogen free spring water and reduce BKD disease risks. This warmer water supply would be used to adjust the water temperature of the available well water supply (41˚ F) to provide warmer incubation and fry rearing water temperatures in the Willard NFH incubation building.

5) Additional isolation equipment will be necessary such as foot baths, disinfection containers for fish culture equipment, and isolation panels between incubation stacks.

6) **Adult grow-out and holding for sexual maturation would take place in five “oversized” raceways located in the upper deck at Little White Salmon NFH. These 10 ft. x 110 ft. x 3.5 ft.

deep raceways would require construction of an overhead metal roof, pole barn type structure of sufficient strength to meet wind and snow load requirements. Structure would need to be enclosed with chain link fence with lockable gates for security and protection from avian and other predators (e.g., mink).

7) **Effluent treatment of the discharge water from the raceways is highly recommended because the full disease status of these fish may not be known until they become sexually mature. Expected flow rates would be 600 to 700 gpm per raceway (five raceways total) with a total effluent discharge of 3500 gpm. The most effective and efficient type of effluent treatment would need to be determined (e.g., ozone, UV or chlorine).

8) Raceway dividing screens will be necessary to compartmentalize each raceway for broodstock management.

9) Shade covers, fixed or floating located at or near the water operating level, will be necessary to provide proper rearing environment for adult spring Chinook.

10) Additional fish handling equipment for inoculation and spawning of broodstock fish will be required.

Entiat NFH: F2 Production Program

11) **The Review Team recommends that the F2 portion of the program take place at the Entiat NFH. Eyed eggs from Aquaseed and, eventually, LWS/Willard NFH Complex would be incubated inside the Entiat NFH incubation building. Nursery tanks inside the hatchery building would be used also for newly hatched fry until the preceding brood year of F2 fish had been transferred from the outside raceways to the White River for release. Consequently, there will be two year-classes on site during a portion of each year, as occurs currently for the existing spring Chinook programs. For Entiat NFH to achieve a maximum density index of 0.06 in all rearing vessels, the younger year-class will need to either be reared in a combination of nursery tanks (20) and raceways (2) until the older year-class has been transported for release into the White River which is expected to occur by April of each year or an add-on to the existing nursery building may be required. Under the former situation, two raceways of yearling fish would be moved to the broodstock ponds after coho spawning is completed, to provide rearing space for the younger year-class of fish. Although effluent water from the incubation building could be discharged directly into the Entiat River or to settling basins, the Review Team recommends disinfection treatment of the incubation building effluent water to control or prevent discharge of out of basin fish pathogens transported to the Entiat NFH with the F2 eyed eggs. The most effective and efficient type of effluent treatment would need to be determined (ozone, UV or chlorine).

12) Additional nursery tanks (4) will be necessary at the Entiat NFH to properly manage family groups by ELISA optical density (OD), for monitoring BKD levels among family groups. Family groups with similar OD levels will be combined, while groups with different OD levels would be reared separately. Covers for all 20 nursery tanks will be needed to keep groups separated during early life stage rearing phase.

13) **Install a backup chiller to provide chilled water to incubation stacks if the existing chiller fails. Incubation water is currently chilled as part of the current spring Chinook program at

Entiat NFH to prolong the incubation period and delay ponding to reduce overall production loading levels until release of the yearling smolts on station provides additional rearing space for subyearlings.

14) **Six or eight foot high security fencing around the 30 raceways is required to control access and provide security. Security fencing needs to include locking main gates and oversized vehicle access gates to accommodate fish transport-size vehicles.

15) Pond shading will be necessary. Floating or fixed covers at the water level height that shades a large portion of the raceway will improve rearing environment and may provide some protection from predators.

16) **Low water alarms would need to be installed. A minimum of three alarms, one per each head box or (preferably) one in each of the 30 raceways, which would alert station personnel of water flow problems.

17) **Disinfection treatment of effluent water from the production raceways is highly recommended. Discharge from the raceways is typically directed to the adult holding ponds that are used in September, October, and November for holding adult coho for the coho reintroduction program. Rearing White River spring Chinook with potentially moderately high levels of BKD could impact the coho program. Effluent treatment could significantly reduce those disease risks. Effluent water from the raceways can also be discharged directly to the Entiat River, but that would require using 100% river water for holding adult coho and, thus, creating another disease risk associated with the presence of detrimental parasites (Myxobolus sp.) The most effective and efficient type of effluent treatment would need to be determined (ozone, UV or chlorine). Rearing only low risk BKD-ELISA F2 families at Entiat NFH would also reduce disease risks to coho.

General Recommendations

1) Appoint an *Implementation Team* to further develop and implement the potential actions presented herein. If the Service accepts the request from Grant PUD, then the Regional Office needs to assemble a White River spring Chinook implementation team as soon as possible. The implementation team would develop a detailed operations and management (O&M) plan and budget, including estimating costs for all infrastructure needs and modifications. The implementation team would also need to develop *Standard Operating Procedures* (SOPs) for each phase of the program.

2) Appropriate water effluent treatment will need to be determined for each site based on volume and point of discharge. The size of the treatment facility at some locations could be significant. Safety concerns with chlorine treatment might exist also given the amount of water that would need to be treated. Engineering assistance would be required.

3) The Service may wish to consider the formation of a *Risk Assessment Team*, potentially including representatives of the Priest Rapids Hatchery Subcommittee, to assess risks and establish requisite fish health protocols at Willard/LWS NFH complex and Entiat NFH before a final decision is made to accept or reject the captive

broodstock program. These assessments should include risks to other species/stocks associated with releasing potentially-infected subyearling spring Chinook into the White River.

Future Infrastructure Needs (not required to initiate White River program)

Additional future infrastructure needs have also been identified which are not strictly required to initiate the White River program but which would support its future implementation at Entiat NFH as well as potentially support other future conservation programs. These include construction of a large isolation and captive broodstock structure at Entiat NFH with a combination well and river water source and with full treatment of both supply and discharge water. The suggested facility should be designed to potentially accept captive broodstock from Aquaseed and/or to provide backup facilities for captive broodstocks developed at LWS/Willard NFH Complex. The facility could be constructed to accommodate future restoration and recovery programs consistent with the Review Team's recommendation for the future use of the Entiat NFH: "Discontinue existing segregated spring Chinook program and use the Entiat NFH for propagation of upper Columbia River basin species of high conservation or harvest concern, including - but not limited to – reintroduction of spring Chinook to the upper Columbia and Okanogan rivers consistent with the Colville Tribe's Restoration plan."

Uncertainties and Concerns

1) Disease risks, particularly BKD, are a major concern. Any measure that reduces these risks will increase the likelihood of success and the ability of the captive broodstock program for White River spring Chinook to meet its goals. Within a new or modified HGMP and/or ESA Section 10 permit, the Service needs to identify appropriate - and comanager-approved - methods for dealing with eggs or fish that are excess to program objectives, particularly if retaining those fish or eggs increases disease risks and, thus, jeopardizes the success of the program. Carrying more fish in our facilities than specified in our objectives could compromise our ability to successfully conduct the White River spring Chinook program. Facility managers need the flexibility to properly manage overall numbers and fish health issues by using prior approved methods for handling excess eggs, fingerlings, smolts and adults.

2) For Entiat NFH to achieve a maximum density index of 0.06 in all rearing vessels, the subyearling year-class will need to be ponded into 20 nursery tanks and two outdoor raceways when the yearling year class is still on station prior to transport and release into the White River. However, water discharge from those two raceways would flow to the second deck and, thus, would be used to help rear the older yearling fish. It will be imperative that the subyearling fish held in the two raceways are from low BKD risk groups. This concern is consistent with the Team's recommendation that high risk BKD groups not be transferred to Entiat NFH for grow-out to the yearling pre-smolt (or smolt) stage. Alternative dispositions of high BKD risk fish should be established.

3) A major uncertainty exists regarding the ability of rectangular raceways to rear spring Chinook salmon to sexual maturity in freshwater. Virtually all captive broodstock programs for Chinook salmon currently use large circular tanks (e.g., 20 ft. fiberglass circular tanks). However, the Dungeness River (Olympic Peninsula) and Methow River (upper Columbia River) spring Chinook captive broodstock programs used rectangular raceways with some success.

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