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4.8 REPORT ON FISH MANAGEMENT AND HATCHERY OPERATIONS OF THE LEWIS RIVER (AQU 8)

The Aquatic Resources Group (ARG) identified the need for a descriptive report summarizing fish hatchery management and hatchery operations in the Lewis River basin. A study plan designed to address this issue (AQU 8) was developed by ARG members in 1999 and approved by both the ARG and Steering Committee in early 2000.

4.8.1 Study Objectives

According to the approved Study Plan Document (PacifiCorp and Cowlitz PUD 1999, as amended), the objective of the fish hatchery management and operations report is to present a summary of the following:

- Past and current hatchery management practices and policies;
- Current and historical hatchery releases;
- Current hatchery and fish management goals for the Lewis River;
- Potential effects of hatchery operations on native species, and
- Effects of commercial and recreation fisheries on Lewis River stocks.

Trends or effects of fish hatchery management or hatchery operations are not analyzed; however, such information is provided when located in the available literature.

4.8.2 Study Area

The study area for AQU 8 is the Lewis River basin.

4.8.3 Methods

Information on fish management and hatchery operations in the Lewis River basin was compiled primarily from current and historic documents, records of the Washington Department of Fish and Wildlife (WDFW) and its predecessor agencies, and PacifiCorp archives. The Lewis River Hatchery Complex manager, WDFW regional and area fish managers and PacifiCorp fisheries staff were also contacted and provided with a list of questions relating to fish management and hatchery operations, presented in Section 4.8.4 of this report. After receiving the list of questions, WDFW Region 5 staff elected to prepare a joint response, rather than conduct individual interviews. The agency's limited response to these questions is presented in AQU 8 Appendix 1. Existing information was reviewed, summarized and combined with information gathered from WDFW staff and included in the report.

4.8.4 Key Questions

Results of AQU 8 can be used to address some of the following "key" watershed questions identified during the Lewis River Cooperative Watershed Studies meetings.

- What species are currently augmented or supplemented by the Lewis River hatchery program?
- What management policies or guidelines direct current hatchery production and management?
- What kind of monitoring and adaptive management plans are in place for hatchery programs on the Lewis River?
- What are the current escapement and production goals for both wild and hatchery fish on the North Fork Lewis River watershed?
- What stocks would be the most suitable for anadromous fish reintroduction and why?
- What are the effects of hatchery operations and production on wild or native, and listed salmonid stocks in the Lewis River?
- How have Lewis River hatcheries affected commercial and recreation fisheries and harvest of resident and anadromous native stocks?
- How might Lewis River hatchery operations and production be improved to lessen the effect on wild, native and listed stocks?
- What diseases have occurred at existing hatcheries?
- What changes to life history patterns or timing of wild or native stocks have been attributable to hatchery management practices?
- What role do treaty tribal fisheries play in the use of Lewis River salmon production?
- Where are excess fish being released and have environmental effects been considered?
- What is the purpose of the three hatcheries? Are the hatchery objectives being met?

These questions were submitted directly to WDFW personnel. Their responses are included as AQU 8 Appendix 1.

4.8.5 Results

4.8.5.1 History and Background of Hatcheries in the Basin

The first salmon hatchery in the Columbia River basin was built on the Clackamas River in the late 1870s. By 1928, 15 hatcheries were operating in the basin producing over 100 million fry, fingerlings and yearlings annually (NRC 1996). Early artificial production efforts focused almost exclusively on spring and summer-run Chinook salmon (*Oncorhynchus tshawytscha)*; however, when the abundance and harvest of Chinook

began to decline, the fishery and hatchery production switched to other species. Production of coho salmon (*O. kisutch*) and steelhead (*O. mykiss*) began about 1900; chum (*O. keta*) and sockeye (*O. nerka*) salmon programs began about 10 years later (NPPC 2000). The original goal of these early hatchery programs was to "gain control over the production of salmon and maintain a supply of fish for the salmon fishing industry in the face of intensive harvest" (Oregon Board of Fish Commissioners 1888 and Goode 1884, as cited in NPPC 2000). Overall, early fish culture was viewed as an alternative to other forms of management, such as harvest regulation or habitat conservation.

Fish hatchery management in the Lewis River basin dates back to 1909. From 1909 through 1917, a salmon hatchery was operated on Johnson Creek at Lewis River Mile (RM) 15 to "handle" fall Chinook and chum salmon (WDF and USFWS 1951). During this 8 year period, between 26,000 and 1.7 million fall Chinook eggs and between 14,500 and 1.8 million chum eggs were collected annually (PacifiCorp and Cowlitz PUD 2000). Approximately 600,000 coho eggs were also collected in 1909. Between 1918 and 1930, there were no known hatchery operations in the Lewis River basin, although a fish rack was maintained on Cedar Creek "for some years" (WDF and USFWS 1951). It is unclear from existing literature why the Johnson Creek facility was closed in 1917.

In 1929, the Federal Power Commission issued a 50-year license to Inland Power and Light (the predecessor of PacifiCorp) to construct, operate and maintain a hydroelectric development on the North Fork Lewis River. Construction of Ariel Dam at RM 19.4 (now called Merwin Dam) began in 1930 and was completed in 1932. Immediately following the completion of Merwin Dam, upstream resident and anadromous fish passage was blocked at River Mile [RM] 19.4 (the Merwin Dam site) (PacifiCorp and Cowlitz PUD 2001).

Lewis River Hatchery

To help maintain anadromous fish runs in the Lewis River basin and comply with Article 14 of the original project license, Inland Power and Light, the Washington Department of Fisheries (WDF) and the Washington Department of Game (WDG) (now WDFW) built the Lewis River Hatchery and Merwin Dam Anadromous Fish Collection Facility (Inland Power and Light Company 1932, Hamilton et al. 1970). Inland Power and Light funded the construction of both facilities, although they were, and continue to be, operated by WDFW (PacifiCorp and Cowlitz PUD 2000). The original goal of the Lewis River hatchery program, as written in the initial project license, was to "maintain existing conditions of fish migration and fish culture in the Lewis River as the Secretary of Commerce may consider necessary." Fishways were not constructed over Ariel Dam because Inland Power and Light and the WDF and WDG considered them to be "impracticable from the standpoint of properly preserving fish life" (Inland Power and Light Company 1932). The perception was that a conventional fish passage facility could not be designed to accommodate the height of Merwin Dam (PacifiCorp and Cowlitz PUD 2000). During the Merwin Dam and Merwin fish collection facility construction phase, a temporary fish wheel was installed in the river to allow the collection and transport of adult salmon and steelhead upstream of the dam site (PacifiCorp and Cowlitz PUD 2000). At least initially, these were wild Lewis River fish.

The Lewis River Hatchery and the Merwin Dam Anadromous Fish Collection Facility became fully operational in 1932, although juvenile salmon stocking began as early as 1930. During subsequent years, returning adult anadromous fish were collected at the Merwin trap, enumerated, and either used for hatchery broodstock or transported upstream by truck to spawn naturally in the Lewis River watershed above Merwin Dam. The spillways and turbine outlets of Merwin Dam (and eventually Yale Dam) provided the only means of downstream passage for outmigrants (Hamilton et al. 1970).

Unfortunately, detailed information describing the number of salmon and steelhead released into the Lewis River basin during the first 2 decades of hatchery operation is limited to data collected between 1942 and 1950. During this 8-year period, approximately 750,000 fall Chinook, 800,000 spring Chinook, 9.2 million coho, and 260,00 steelhead were released into the basin (Table 4.8-1). Most spring and fall Chinook were released as fingerlings. Most coho were released as fingerlings and yearlings and the majority of the steelhead were released as fry.

Table 4.8-1. The number of fall Chinook, spring Chinook, coho and steelhead released into the Lewis River basin from 1942 to 1950.

Year	Fall Chinook		Spring Chinook		Coho (Silvers)			Steelhead	
	Fingerlings	Yearlings	Fingerlings	Yearlings	Fry	Fingerlings	Yearlings	Fry	Yearlings
1942	85,774	--	205,847	48,137	377,620	69,374	147,452	--	--
1943	--	--	203,575	--	--	--	338,840	--	--
1944	9,547	--	--	6,462	--	479,384	419,449	--	--
1945	--	30,050	59,765	29,280	--	462,440	508,079	--	--
1946	111,290	8,721	40,797	31,186	574,768	948,782	394,543	40,000	21,431
1947	149,708	13,349	21,702	19,953	--	819,819	265,582	--	20,766
1948	19,295	--	88,834	21,311	19,305	734,385	356,685	--	23,030
1949	209,114	12,548	28,127	--	--	331,128	532,855	--	30,308
1950	39,602	64,975	--	--	121,918	735,217	539,287	121,600	6,832

Between 1933 and 1953, Lewis River Hatchery practices were poor and adult spring and fall Chinook returns to the Merwin Dam trap declined dramatically (Table 4.8-2). According to Smith (1937), "poor water supply, disease, faulty technique and inherent weakness of the spawning fish themselves" were responsible for the decline in abundance. Unfortunately, the "inherent weakness" of the stock was not discussed in Smith's report. Smoker et al (1951) also noted that the native Lewis River spring Chinook stock was "undoubtedly injured" by poor hatchery practices and a lack of regular spill at Merwin Dam. In particular, brood years 1931, 1932, 1933 and 1934 were "seriously damaged." Smoker (1951) further states, "Where the original runs were about 3,000 fish per annum, the present run averages only about 100 adults and has been as low as 19 fish in 1949."

Table 4.8-2. The number of adult spring Chinook, fall Chinook, coho and steelhead collected at the Merwin Dam Anadromous Fish Collection Facility (1932 to 1953).

Year	Spring Chinook	Fall Chinook	Coho	Steelhead
1932	NA	NA	5,674	693
1933	2,046	1,031	29,264	350
1934	4,007	1,506	3,153	828
1935	2,710	1,296	1,231	1,366
1936	97	394	24,595	619

Table 4.8-2. The number of adult spring Chinook, fall Chinook, coho and steelhead collected at the Merwin Dam Anadromous Fish Collection Facility (1932 to 1953) (cont.).

Year	Spring Chinook	Fall Chinook	Coho	Steelhead
1937	151	65	3,859	47
1938	26	29	643	133
1939	850	232	19,814	311
1940	7,397	592	3,202	438
1941	259	332	7,032	214
1942	114	164	3,938	186
1943	145	287	7,375	203
1944	259	205	7,919	208
1945	540	427	4,858	347
1946	152	634	4,603	246
1947	132	627	10,664	647
1948	100	685	3,507	489
1949	19	476	5,947	71
1950	199	839	9,550	453
1951	18	1,903	7,917	1,629
1952	53	1,146	4,187	NA
1953	4	383	6,079	NA

NA = Data not available.

Severe mortality also occurred when ripening spring Chinook were held at the Lewis River Hatchery and at the Johnson Creek and Colvin Creek holding ponds. Smith (1937) noted: "The success of the hatchery has been so poor that a program of chemical and biological investigations was begun to isolate and investigate the factors responsible for the poor showing." This mortality was ultimately blamed on unsatisfactory water conditions, mainly related to higher than "normal" water temperatures in the fall (Smith 1937 and Chambers 1957). The Lewis River hatchery water supply was the Lewis River downstream of Merwin Dam, and according to Smith (1937), the river downstream from the dam was made cooler than normal in the summer and warmer than normal during the fall (due to thermal stratification of Lake Merwin). The lower river was also made more acidic and exhibited higher CO_2 concentrations during the fall spawning and incubation period. Unfortunately, information describing the "poor hatchery practices" is not discussed in the literature.

In an attempt to minimize Lewis River Hatchery-related mortality, a hatchery substation was built near the mouth of Cougar Creek, located approximately 18 miles upstream from Merwin Dam. Constructed in the late 1930s, the Cougar Creek facility consisted of a small hatchery building, a residence, 2 holding ponds and 4 rearing ponds, all ponds being formed of earth with gravel bottoms (WDF and USFWS 1951). With improved water quality conditions, spring Chinook survival increased during holding; however, this facility eventually was decommissioned in the late 1950s during the construction of Yale Dam and relocated to Speelyai Creek (Speelyai Hatchery).

Efforts to maintain the native Lewis River spring Chinook stock through hatchery production eventually failed, and by the mid-1950s spring Chinook had completely disappeared from Merwin Dam trap catches. Fall Chinook runs were also severely

impacted by poor hatchery practices and dam operation and "fell to almost complete elimination," but then slowly recovered (Table 4.8-2) (Smoker et al. 1951). Fall Chinook recovery was thought to have occurred largely as a result of tighter fishing regulations on the Columbia River. Prior to 1941, excessive harvest exploitation and widespread habitat degradation acted synergistically to severely reduce abundance of Columbia River salmon stocks (NPPC 2000). This intensive harvest undoubtedly impacted the pre-project abundance of salmon and steelhead in the Lewis River basin.

Coho trap catches also decreased in 1935 and 1938, but then recovered and remained relatively stable through 1953 (Table 4.8-2). The decrease in coho returns during the late 1930s was blamed on "poor intermittent spilling" over Merwin Dam during the outmigration period (Smoker et al. 1951). This lack of regular spill at Merwin Dam resulted in extensive mortality by either preventing downstream migration or forcing migration through the turbines (where juvenile salmonids were subject to turbine related injury or mortality). Steelhead returns remained relatively consistent from 1932 through 1951. Commercial and recreation fishery impacts on Lewis River coho and steelhead during this period are unknown.

Because of declining run sizes and habitat losses associated with the construction of both Merwin and Yale dams (Yale Dam was completed in 1953), the transportation of Chinook into the upper Lewis River watershed was discontinued in 1953; from that point on, all captured Chinook were held to provide eggs for the Lewis River Hatchery.

In 1979 and 1980, the original Lewis River Hatchery was renovated to accommodate sorting, holding and transporting of adult steelhead and cutthroat trout (*O. clarki*). This expansion was associated with the new FERC License for the Merwin Project and the subsequent construction of the Merwin gamefish hatchery (Merwin Hatchery). The Lewis River Hatchery presently has twelve 10 x 100 x 4-foot concrete raceways, 3 half-acre ponds, and one half-acre juvenile rearing/adult holding pond located off-station (NPPC 1990, WDFW 2000a). There is 410,000 cubic feet of rearing space with a total water flow of approximately 29,000 gpm. The facility has an eyeing capacity of 13 million eggs and a hatching capacity of 7.7 million fry. Nine pumps use water from the North Fork Lewis River to supply all the water needs.

PacifiCorp currently provides 100 percent of the funding for the Lewis River Hatchery. PacifiCorp's funding for Lewis River Hatchery from 1994 through 2000 is summarized in Table 4.8-3.

Table 4.8-3. Funding provided for Lewis River Hatchery from 1994 through 2000.

Year	PacifiCorp Funding[1]
1994	$469,000
1995	$529,000
1996	$532,000
1997	$575,000
1998	$619,000
1999	$640,000
2000	$689,000

1. pers. comm., E. Lesko, PacifiCorp, December 2001.

Speelyai Creek Hatchery

During the planning phases for the Swift No. 1 and Swift No. 2 projects in the mid-1950s, an investigation was conducted by the WDF to determine the effects of the new hydroelectric projects on coho salmon in the Lewis River. Although detailed study results are not available, WDF decided to discontinue transporting and releasing coho salmon into the upper watershed for natural spawning. It was further proposed that all the coho salmon be spawned artificially at a new hatchery to be built on Speelyai Creek (Speelyai Hatchery). The transportation of coho into the upper watershed was discontinued in 1957, 2 years prior to the completion of Swift Dam (Hamilton et al. 1970).

Speelyai Hatchery was completed in 1958 at the confluence of Speelyai Creek and Lake Merwin. Initially, the facility consisted of 2 holding ponds (each measuring 60 by 30 feet) and an incubation station.

As part of the Speelyai Hatchery agreement with WDF, PacifiCorp and Cowlitz PUD funded a series of studies to determine if it was feasible to rear coho salmon in Lake Merwin (Hamilton et al. 1970). From 1958 through 1964, coho fry and fingerlings reared at Speelyai Hatchery were released into Lake Merwin and Speelyai Creek. During the period of outmigration, smolt collectors (including a skimmer mounted in the spillway of the dam, floating "Merwin" traps, and a floating skimmer) were installed at the outlet of the lake and in the outlet of Speelyai Creek. Coho capture efficiency of these traps varied from year to year, ranging from 31 to 70 percent of the "available smolts." Even with marked fish capture efficiencies as high as 70 percent, the number of migrant coho collected at the dam each year represented only small portion of the fish released into the lake. Low survival, 0.8 to 2.8 percent in Lake Merwin and 5.7 to 19.2 percent in Speelyai Creek, was found to be the major cause of low migration numbers. Northern pikeminnow and rainbow trout (*O. mykiss*) predation in Lake Merwin was believed to be the major cause of this low survival. In 1960, nearly 15 percent of the northern pikeminnow captured in Lake Merwin with gill nets (n=141) contained coho fry or finerlings from a release of over 6,000,000 coho fry into Speelyai Bay (Hamilton et al. 1970). It should be noted that the northern pikeminnow population in Lake Merwin in 1961 was estimated to be 350,000 individuals (>200 mm in length).

Of the marked juvenile coho collected in Lake Merwin and transported downstream to the Lewis River, 6.4 and 10.4 percent returned to the Merwin Dam Anadromous Fish Collection Facility. However, most of these fish returned as jacks in the year of release. After 6 years of study, it was concluded that Lake Merwin could not be used "under present conditions" as a substitute for the in-river environment for coho salmon (Hamilton et al. 1970). As a result, rearing of coho in Lake Merwin was abandoned in favor of additional hatchery production.

Speelyai Hatchery was upgraded (expanded) in 1970 under conditions set forth in Article 32 of the Swift No. 1 Project and Article 23 of the Swift No. 2 Project licenses. Today, the primary rearing structures include a hatchery building which houses 50 stacks of vertical incubators and 3 deep troughs for bulk eyeing, along with 4 shallow troughs. The eyeing capacity is 6 million eggs. Outside rearing space consists of four 10 x 80 x 4-foot raceways and two 0.25-acre rearing ponds. Approximately 9,200 gpm can be delivered

to the hatchery system by gravity flow from Speelyai Creek. The Speelyai Hatchery water diversion (dam), located at the mouth of Speelyai Creek, is a total barrier to upstream fish migration. As a result, fish are not able to access the creek from Lake Merwin. Although not part of Pacificorp's and Cowlitz PUD's mitigation program, there are also 7 net pens located in the Echo Park Cove at RM 10 on the North Fork Lewis River that provide approximately 50,000 cubic feet of rearing space.

Currently, Speelyai Hatchery is used for adult holding, spawning, incubation, and rearing of spring Chinook, coho and kokanee (Montgomery Watson 1997). The hatchery is owned and jointly funded by PacifiCorp and Cowlitz PUD and operated by WDFW (Hamilton et al. 1970, PacifiCorp and Cowlitz PUD 2000). PacifiCorp provides approximately 80 percent of the funding and Cowlitz PUD provides the remaining 20 percent. PacifiCorp and Cowlitz PUD funding for Speelyai Hatchery from 1994 through 2000 is summarized in Table 4.8-4.

Table 4.8-4. Funding provided for Speelyai Hatchery from 1994 through 2000.

Year	PacifiCorp Funding[1]	Cowlitz PUD Funding[2]	Total
1994	$191,773	$51,227	$243,000
1995	$207,773	$51,227	$259,000
1996	$224,032	$53,968	$278,000
1997	$207,246	$55,754	$263,000
1998	$221,327	$56,673	$278,000
1999	$229,414	$57,586	$287,000
2000	$267,868	$59,132	$327,000

1. pers. comm., E. Lesko, PacifiCorp, December 2001.
2. pers. comm., Diana MacDonald, Cowlitz PUD, November 2001.

Merwin Hatchery

In 1983, FERC issued a new license for the Merwin Hydroelectric Project. Article 50 of the new license required Pacific Power and Light (now PacifiCorp), to fund the construction, operation and maintenance of a new steelhead and sea-run cutthroat trout hatchery on the Lewis River and to make the following provisions for anadromous fish:

1) **Spring Chinook Salmon:** The Licensee shall pay all expenses for the annual hatchery production of approximately 250,000 juvenile spring Chinook (to produce 12,800 adult fish). This production will take place in existing hatcheries.

2) **Coho Salmon:** The Licensee shall pay all expenses for the annual hatchery production of approximately 2,100,000 juveniles (to produce 71,000 adult fish). This production will take place in existing hatcheries.

3) **Steelhead and Sea-Run Cutthroat Trout:** The Licensee shall construct and pay all operating and maintenance expenses of a hatchery to produce annually approximately 250,000 juvenile steelhead (about 41,600 pounds) and approximately 25,000 juvenile sea-run cutthroat trout (up to 6,250 pounds).

Article 51 of the new Merwin Project license required PacifiCorp to pay the costs associated with the operation and maintenance of such facilities that must be provided or modified to provide for the following resident fisheries:

> **Lake Merwin:** Annual release of 100,000 kokanee at 7-8 fish per pound. Kokanee releases can be supplement partially or completely with rainbow trout (same poundage) if insufficient numbers of kokanee are available.
>
> **Yale Lake:** Protection of habitat on that portion of Cougar Creek under control of the licensee, which provides spawning for resident sockeye (kokanee) salmon.
>
> **Swift Reservoir:** Annual release of 800,000 rainbow trout fry at 25-30 fish per pound.

In 1988, WDF and WDW (now WDFW) and Pacific Power and Light entered into an agreement leading to the development and operation of the Merwin Hatchery. As part of this agreement, each of the parties determined it was necessary to ensure that the operation of the new hatchery:

1) Does not impair opportunities to maintain and enhance fall Chinook salmon residing in the Lewis River;

2) Does not create an unacceptable risk of disease for the natural fall Chinook or the salmon reared at the Lewis River Salmon Hatchery; and

3) Provide a successful cutthroat, rainbow and steelhead trout program in the Lewis River.

The parties also agreed to a suite of management conditions, disease control measures and monitoring actions to ensure that each of the above objectives was met. Management modifications included:

1) Closing fishing on the Lewis River between Merwin Dam and the mouth of Colvin Creek from October 1 through December 15 to reduce human interference with fall Chinook spawning.

2) Stocking winter and summer steelhead and sea-run cutthroat trout at locations that would minimize predation and competition with juvenile fall Chinook, reduce residualism, and select the lowest site(s) that allow for broodstock collection and a “reasonable” sport harvest.

Control measures deemed necessary to reduce fish disease outbreaks at the hatchery and to minimize the discharge of pathogens into the Lewis River included:

1) Providing a year-round supply of disinfected water;

2) Treating all effluent water for use during an occurrence of an emergency or certified disease (as defined by WDFW);

3) Providing separate supplies of water to the broodstock holding ponds and to the egg incubation system; and

4) Consultation between WDF, WDW, and PacifiCorp if there is an occurrence of an emergency or certifiable disease within the watershed.

Monitoring measures identified to develop the stocking strategies and ensure that the program is not adversely affecting the fishery resource in the basin included:

1) Differentially marking steelhead based on release location and conducting a creel census to determine their contribution to the sport fishery.

2) Conducting spawning surveys, tagging juvenile fall Chinook, and evaluating predation on juvenile fall Chinook by steelhead, sea-run cutthroat trout, spring Chinook and coho salmon.

3) Initiating a special evaluation if the population of juvenile fall Chinook falls below established target levels for three consecutive years.

The agreement between the parties also called for the modification of the existing Lewis River Hatchery to provide for sorting, holding and transporting of adult steelhead, and cutthroat trout to the new gamefish hatchery.

The Merwin Hatchery became fully operational in 1993. The facility includes 4 adult holding ponds, 10 concrete fingerling raceways, 6 intermediate raceways, 4 rearing ponds, and incubation facilities. Approximate rearing space is 216,470 cubic feet. Water is supplied to the hatchery from Lake Merwin using a 5,000-gallon per minute pump station on the dam face. Two intakes are used at depths of 15 and 110 feet (Montgomery Watson 1997). Ozone water sterilization is used to meet fish health needs. In addition to treating incoming water, all water exiting the adult holding ponds and incubation building is disinfected prior to discharge into the pollution abatement ponds.

The original goal of the Merwin Hatchery program was to provide winter and summer steelhead, sea-run cutthroat trout, and rainbow trout for harvest by sport anglers (Montgomery Watson 1997). Prior to 1993, steelhead released in the North Fork Lewis River were reared at other hatcheries (Hymer et al. 1993). Because of a low return to the creel in 1997 and 1998, and concerns over potential interactions (predation and competition) with wild cutthroat and fall Chinook salmon, the sea-run cutthroat trout program at Merwin Hatchery was discontinued in 1999 (Hillson and Tipping 2000).

Under the terms of the existing project licenses, PacifiCorp provides 100 percent of the funding for the Merwin Hatchery. PacifiCorp funding for the Merwin Hatchery from 1994 through 2000 is summarized in Table 4.8-5.

Table 4.8-5. Funding provided for Merwin Hatchery from 1994 through 2000.

Year	PacifiCorp Funding[1]
1994	$273,000
1995	$267,000
1996	$274,000
1997	$291,000
1998	$308,000
1999	$345,000
2000	$357,000

1. pers. comm., E. Lesko, PacifiCorp, December 2001.

4.8.5.2 Stock Introductions, Stock Composition and Hatchery Fish Releases

As described in the Lewis River Hydroelectric Project Initial Information Package (PacifiCorp and Cowlitz PUD 2000), numerous stock introductions have occurred in the Lewis River basin. In this section of the report, we summarize available information describing known stock introductions and the stock composition for each of the species produced at the Lewis River Hatchery Complex (Lewis River Hatchery, Speelyai Hatchery and Merwin Hatchery). We also present a summary of the number of hatchery fish released into the Lewis River basin (by species and life stage) from 1952 through 1999 (the period of best available data). These releases include fish from both the Lewis River Hatchery Complex and from other WDFW hatcheries in the region.

Spring Chinook

According to PacifiCorp and Cowlitz PUD (2000), spring Chinook from the Cowlitz River, Wind River (Carson Hatchery) and Willamette River were first introduced into the Lewis River basin in the 1950s, although relatively few were planted until 1972. In 1972, Lewis River Complex hatchery managers used Carson (from the Bonneville Dam fishway) and Cowlitz stock spring Chinook to reestablish the spring Chinook run in the Lewis River basin (Table 4.8-6) (Myers et al. 1998). Since then, spring Chinook used for the program have originated from a variety of sources including Cowlitz, Kalama, Carson, and even Klickitat stock (Hymer et al. 1993, Myers et al. 1998). Between 1972 and 1999, over 22.4 million hatchery spring Chinook were planted into the Lewis River basin (PSMFC 2001,[1] WDFW 2001a). Annual releases ranged from about 122,000 in 1972 to over 1.5 million in 1998 (Figure 4.8-1). Most (91 percent) were released as yearlings. The vast majority of these were planted in the mainstem Lewis River (AQU 8 Appendix 2). According to Myers et al. (1998), only 4 percent of these plants were from hatcheries located outside of the Lower Columbia River Evolutionarily Significant Unit (ESU). Contrary to what is presented in Myers et al. (1998), the Lewis River Hatchery Complex manager believes that the majority of spring Chinook returning to the North Fork Lewis River are from Carson stock (pers. comm. R. Nicolay, WDFW, as cited in

1 http://query.streamnet.org/Request?cmd=BuildCriteria&NewQuery=BuildCriteria&Required=Run&columbiaSubbasin=24

Shrier 2000). Carson stock spring Chinook are bound for the upper Columbia River and are not considered part of the Lower Columbia River ESU.

Table 4.8-6. Releases of spring Chinook stocks in the Lewis River basin (from Myers et al. 1998).

Spring Chinook Source	Duration	Total Planted	Number of Years Planted
Carson NFH[1]	1973-81	702,708	4
Cowlitz Hatchery	1972-87	2,476,235	9
Kalama Falls Hatchery	1981-93	2,415,550	5
Klickitat Hatchery[1]	1975,76	203,660	2
Lewis River Hatchery	1977-93	6,999,862	11
Lewis River/Kalama Hatchery	1980	807,408	1
Speelyai Hatchery	1977-82	2,011,325	4
Unknown	1948-51	192,943	4

1. Stocks located outside of the Lower Columbia River ESU.

Fall Chinook

Although native to the Lewis River basin, out-of basin fall Chinook were introduced into the Lewis River immediately following the construction of Merwin Dam. From 1930 to 1939, between 600,000 and 10.5 million fall Chinook eggs were imported annually from the Little White Salmon and Kalama rivers (WDF and USFWS 1951). Smith (1937) also makes reference to "a lot of Cowlitz Chinook eggs" being transported to the Lewis River Hatchery in 1938. From the early 1950s through the early 1980s, releases were also made from the Grays River Hatchery, Kalama Falls Hatchery, and the Spring Creek National Fish Hatchery (located 62 miles east of Vancouver on the Columbia River) (Table 4.8-7). During this period, over 26-million fall Chinook were released into the Lewis River basin. Annual releases ranged from 0 in the late 1960s and early 1970s to over 3 million in 1965 (Figure 4.8-2) (PSMFC 2001). Most (68 percent) were released as fingerlings. Like spring Chinook, the vast majority of these were planted in the mainstem Lewis River (AQU 8 Appendix 2). According to Myers et al. (1998), all fall Chinook plants in the Lewis River basin have been made from stocks located within the Lower Columbia River ESU (Myers et al. 1998).

The Lewis River hatchery fall Chinook program was discontinued in 1986 to eliminate negative interactions with wild fall Chinook. Despite these hatchery fish introductions, the fall Chinook stock in the Lewis River system has "maintained a significant population with negligible hatchery influences" (Hymer et al. 1993).

Table 4.8-7. Releases of fall Chinook stocks in the Lewis River basin (from Myers et al. 1998).

Fall Chinook Source	Duration	Total Planted	Number of Years Planted
Grays River Hatchery	1979	23,567	1
Lewis River Hatchery	1952-93	15,283,070	41
Lower Kalama Hatchery	1954	41,128	1
Lower Kalama Hatchery and Kalama Falls Hatchery	1954, 1974	274,978	2
Speelyai Hatchery	1961-79	1,315,749	18
Spring Creek NFH	1959-81	3,121,717	22

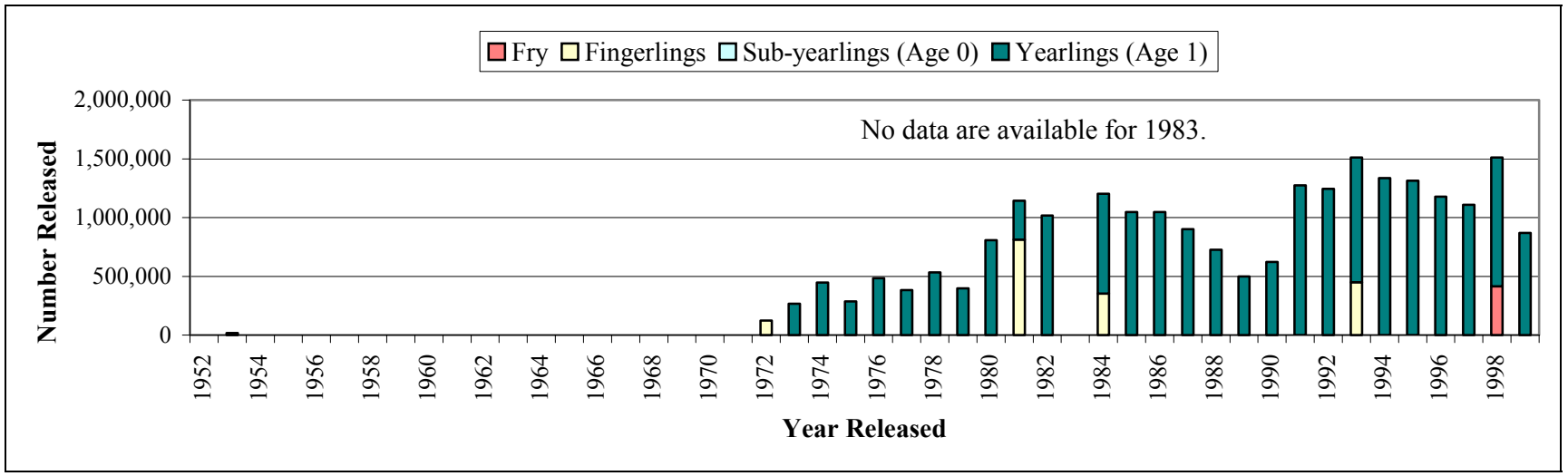

Figure 4.8-1. Hatchery releases of spring Chinook salmon yearlings, sub-yearlings, fingerlings and fry from 1952 through 1999.

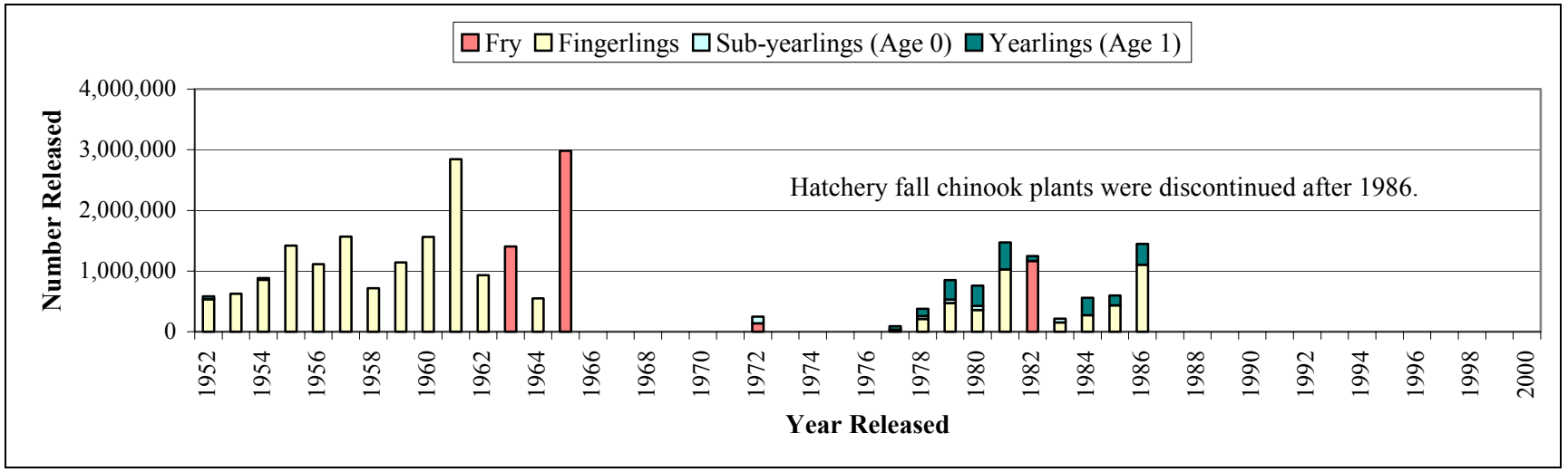

Figure 4.8-2. Hatchery releases of fall Chinook salmon yearlings, sub-yearlings, fingerlings and fry from 1952 through 2000.

Coho

The original Lewis River Hatchery coho stock was taken from native coho trapped at the Merwin Dam Anadromous Fish Collection Facility (WDFW 2000a). Since that time, coho have been supplemented from a variety of sources (Table 4.8-8). Late-run (Type-N) Cowlitz coho were introduced into the Lewis River basin in the early 1970s and over time, WDFW hatchery practices have attempted to stratify coho production into two groups, "early" (Type S) and "late" (Type N), to meet harvest management requirements (Hymer et al. 1993). From 1952 through 1999, over 172 million hatchery coho were planted in the basin (Figure 4.8-3) (PSMFC 2001). Annual releases ranged from 457,000 in 1959 to over 12.2 million in 1989. Most (65 percent) were released as yearlings. The majority of the releases were from Cowlitz River and Toutle River stock. Release locations receiving the largest number of coho include the mainstem Lewis River, East Fork Lewis River, Cedar Creek, Green Fork, Copper Creek, and North Fork Chelatchie Creek (AQU 8 Appendix 2). In 1991, NMFS concluded that, as a result of massive and prolonged effects of artificial propagation, harvest, and habitat degradation, the agency could not identify natural populations of coho salmon in the lower Columbia River that qualified for ESA consideration (Shrier 2000).

Table 4.8-8. Releases of coho salmon stocks in the Lewis River basin from 1963 through 1992 (from Weitkamp et al. 1995).

Coho Stock	Years Planted	Life-stages Planted	Total Planted	Number of Years Planted
Abernathy	1963	Fry	518,056	1
Big Creek (Oregon)	1965	Yearling	163,548	1
Eagle Creek (Oregon)	1963	Fry	2,624,122	1
Kalama Falls	1963, 1966	Fry, Yearlings	167,152	2
Klaskanine (Oregon)	1962, 1965	Fry, Yearlings	272,148	2
Toutle	1958	Yearlings	15,878	1
Type N (Cowlitz)	1975-1992	Fry, Yearlings	65,681,281	18
Type S (Toutle)	1967-1992	Fry, Yearlings	58,287,123	26
Washougal	1963	Fry	96,110	1

Winter and Summer Steelhead

Skamania summer steelhead and Beaver Creek and Skamania winter steelhead were first introduced into the Lewis River basin in 1946. Since their introduction, these stocks have been used extensively at the Lewis River Hatchery Complex and some interbreeding has likely occurred with the native Lewis River stocks (PacifiCorp and Cowlitz PUD 2000). Skamania summer steelhead were developed from Washougal River and Klickitat River summer steelhead in the late 1950s at the Skamania Hatchery, Washington (Crawford 1979). This stock has been widely used in Washington, Idaho, Oregon, and California to provide recreation angling opportunities. In many cases, Skamania stock have been introduced where summer steelhead did not naturally exist. Beaver Creek winter steelhead are from the Elochoman River and Chambers Creek (Puget Sound) origin. In the last 15 years, an average of just under 500,000 winter and summer steelhead have been released into the Lewis River basin annually (Figure 4.8-4) (PSMFC 2001). The vast majority of

the releases have been yearlings from the Merwin Hatchery (post 1993), as well as the Skamania, Vancouver, and Beaver Creek hatcheries. Release locations include the mainstem Lewis River, East Fork Lewis River, Cedar Creek and Rock Creek.

Kokanee

Kokanee are not native to the Lewis River basin. In the late 1950s and early 1960s, Swift Reservoir, Yale Lake and Lake Merwin all were stocked with kokanee from Kootenay Lake and Cultus Lake, British Columbia. Self-sustaining populations currently exist in Yale Lake and Lake Merwin (PacifiCorp 1999). In 1996, WDFW decided to supplement the kokanee population in Lake Merwin using hatchery kokanee spawned and reared at Speelyai Hatchery. In 1999, Yale Lake received its first planting of kokanee since 1957 (PacifiCorp and Cowlitz PUD 2000). Plants in Yale Lake were temporary and discontinued in late 2001. The current kokanee production goal at Speelyai Hatchery is 45,000 fingerlings and 48,000 yearlings. The number of kokanee released into the Lewis River basin and the release locations (from 1995 through 2001) are presented in AQU 8 Appendix 3.

Rainbow Trout

Non-native stocks of rainbow trout have been planted in Swift Reservoir since at least 1978 (PacifiCorp and Cowlitz PUD 2000, PacifiCorp 1996). The primary stock source is from the Goldendale Hatchery in Washington; however, rainbow trout stocks from the Spokane Hatchery (Washington) and Mt. Whitney Hatchery (California) have also been planted. According to Crawford (1979), Goldendale rainbow trout are derived from a combination of "McNott, Meander, and Cape Cod rainbow trout strains." Meander rainbow trout were originally obtained from the meander trout farm in Pocatello, Idaho using eggs from the U.S. Fish Commission's hatchery at Springville, Utah (between 1970 and 1930). Cape Cod rainbow trout, originally produced at the Cape Cod Trout Company of Wareham, Massachusetts, were obtained from the McCloud River near Mt. Shasta (in 1882). Spokane rainbow trout, produced at the Spokane Hatchery since 1942, were also originally obtained from the McCloud River. Mt. Whitney rainbow trout are a mixture of Sacramento River rainbow trout and Klamath River steelhead. This stock was originally obtained by WDFW in 1962 (Crawford 1979). Goldendale rainbow trout spawn from October through February, Spokane rainbow trout spawn from November through December, and Mt. Whitney rainbow trout spawn from February through March (Crawford 1979).

The spring-spawning Mount Whitney rainbow trout have a similar spawning period to native Lewis River cutthroat trout and as a result, there exists a potential for hybridization. The number of rainbow trout released into the Lewis River basin and the release locations (from 1995 through 2001) are presented in AQU 8 Appendix 3.

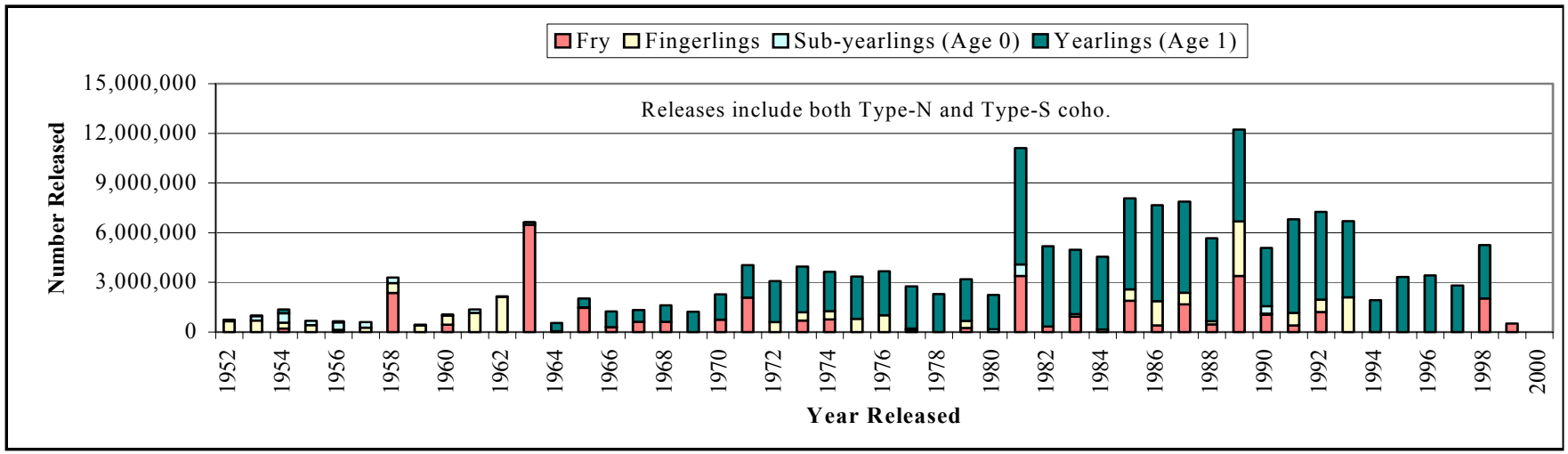

Figure 4.8-3. Hatchery releases of coho salmon yearlings, sub-yearlings, fingerlings and fry from 1952 through 1999.

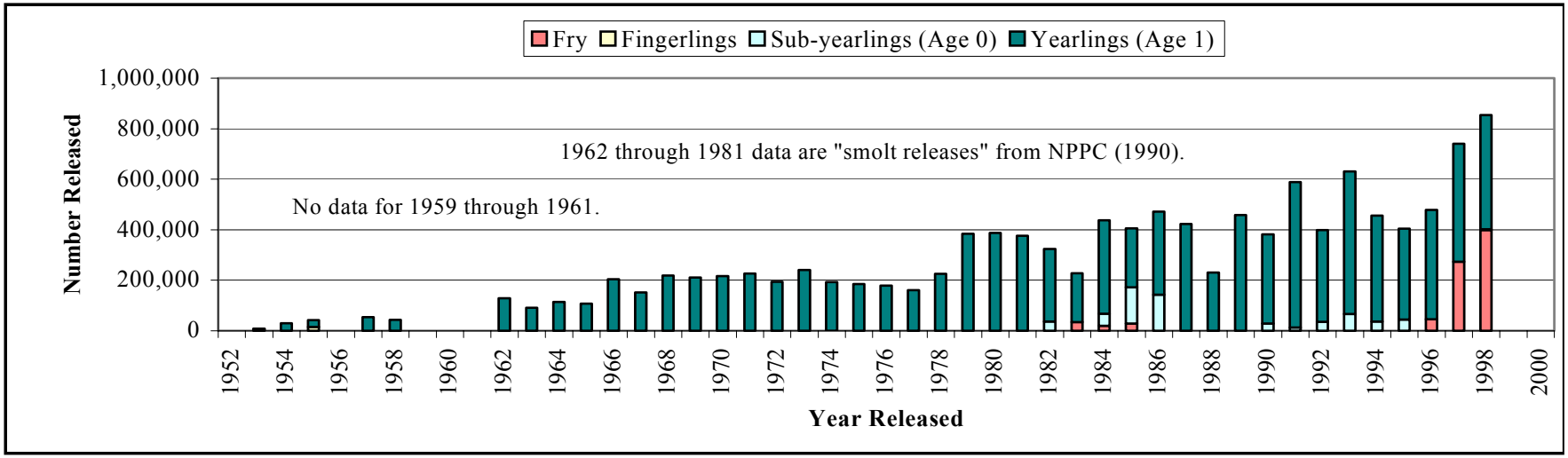

Figure 4.8-4. Hatchery releases of summer and winter steelhead yearlings, sub-yearlings, fingerlings and fry from 1952 through 1998.

Since 1978, approximately 800,000 rainbow trout fry at 25 per pound have been stocked annually (as required by Article 51 of the existing Merwin license). Juvenile rainbow trout are incubated and reared at the Merwin Trout Hatchery.

Tiger Musky

Tiger musky, a non-native sterile hybrid (northern pike and muskellunge cross) known to prey heavily on northern pikeminnow (*Ptychocheilus oregonensis*) and other soft-rayed fishes (Schmetterling 2001), were introduced into Lake Merwin in 1995 and have been planted into Lake Merwin annually. A more detailed discussion of the Lake Merwin tiger musky program is presented in the *Current Hatchery and Fish Management Goals for the Lewis River* section of this report. The number of tiger musky released into the Lewis River basin and the release locations (from 1995 through 2001) are presented in AQU 8 Appendix 3.

WDFW and Western Washington Treaty Tribes Salmon and Steelhead Stock Status

In 1992, the WDF, WDW and Western Washington Treaty Tribes completed a detailed resource status inventory of Washington's wild salmon and steelhead stocks. This inventory, the *1992 Washington State Salmon and Steelhead Stock Inventory* (SASSI), evaluated the stock origin, production type and stock status of salmon and steelhead in the Lewis River basin. The stock origin, production type and status of anadromous salmonids found in the Lewis River basin are presented in Table 4.8-9. It should be noted that the SASSI document was completed prior to steelhead production at Merwin Hatchery. Currently, steelhead produced at Merwin Hatchery are derived primarily from eggs from returning adults. Although eggs are also occasionally imported from other hatcheries (e.g. Skamania Hatchery) if there are insufficient adult returns to meet egg take goals (WDFW 2001b).

Table 4.8-9. Stock origin, production type and status of spring Chinook, fall Chinook, coho and steelhead in the Lewis River basin (from WDF, WDW and WWTIT 1993).

Species/Race	Stock Origin[1]	Production Type[2]	Stock Status[3]
Spring Chinook	Mixed	Composite	Healthy
Fall Chinook	Native	Wild	Healthy
Coho	Mixed	Composite	Depressed
Summer Steelhead	Native	Wild	Depressed
Winter Steelhead	Native	Wild	Depressed

1. Native: An indigenous stock of fish that has not been substantially impacted by genetic interactions with non-native stocks, or by other factors, and is still present in all or part of its original range. In limited cases, a native stock may also exist outside of its original habitat (e.g. captive brood stock programs).

Mixed: A stock whose individuals originated from commingled native and non-native parents, and/or by mating between native and non-native fish (hybridization); or a previously native stock that has undergone substantial genetic alteration.

2. Wild: A stock that is sustained by natural spawning and rearing in the natural habitat, regardless of parentage (includes native).

Composite: A stock sustained by both wild and artificial production.

3. Healthy: A stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock.

Depressed: A stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely.

4.8.5.3 Current Hatchery and Fish Management Goals for the Lewis River

Currently, the Lewis River Hatchery Complex (Lewis River Hatchery, Merwin Hatchery and Speelyai Hatchery) produces spring Chinook, early coho, late coho, summer steelhead, winter steelhead, rainbow trout, and kokanee (up until 2001). Until 2001, tiger muskie were also reared at the Merwin Trout Hatchery. Prior to 1999, the Merwin Trout Hatchery reared and released sea-run cutthroat trout smolts. Current hatchery and fish management goals for each of the species produced at the Lewis River Hatchery Complex are presented in the following paragraphs. A description of current hatchery operations relating to each of these species is also presented in this section.

Spring Chinook

The overall goal of the Lewis River Hatchery Complex spring Chinook program is to mitigate for the loss of spring Chinook salmon stock that would have been produced naturally in the North Fork Lewis River system in the absence of the hydroelectric dams (WDFW 2001a). The current WDFW production goal is 1.05 million smolts at 5 to 7 per pound (Table 4.8-10). According to WDFW (2001a), additional "performance goals" are to:

1) Produce adult fish for harvest;

2) Meet hatchery production goals; muskellunge

3) Manage for adequate escapement;

4) Minimize interactions with listed fish through proper broodstock management;

5) Minimize interactions with other fish populations through proper rearing and release strategies;

6) Maintain stock integrity and genetic diversity;

7) Maximize in-hatchery survival of broodstock and their progeny; and limit the impact of pathogens associated with hatchery stocks, on listed fish; and

8) Ensure that hatchery operations comply with state and federal water quality standards through environmental monitoring.

Table 4.8-10. Current WDFW fish production goals for the Lewis River basin.

Species	Hatchery	Release Site	Production Goal
Spring Chinook	Lewis River/Speelyai	Lewis River	1,050,000 (5-7/lb) (210,000 pounds)
Early Coho (Type-S)	Lewis River/Speelyai	Lewis River	1,880,000[1]
Late Coho (Type-N)	Lewis River	Lewis River	2,100,000[2]
Summer Steelhead	Merwin	Lewis River	175,000 (5/lb) (35,700 pounds)
Winter Steelhead	Merwin	Lewis River	100,000 (5/lb) (20,400 pounds)
Kokanee	Speelyai	Lake Merwin	45,000 fingerlings, 48,000 yearlings
Tiger Musky	Merwin	Lake Merwin	Approx. 3,000 (4-5/lb)
Rainbow Trout	Merwin	Swift Reservoir	800,000 (25/lb) (30,000 pounds)

1. 880,000 smolts at 13 to 15 per pound for the Lewis River Hatchery program and 1 million smolts (and 750,000 eyed eggs) for the Tribal component of the program.
2. 800,000 smolts at 13 to 15 per pound for the Lewis River Hatchery program.

Broodstock for the Lewis River spring Chinook program is collected at the Lewis River Hatchery trap and Merwin Dam trap from April through July. The broodstock collection goal is 800 adults (400 males and 400 females) (Table 4.8-11) (WDFW 2001a). Between 1995 and 1999, these goals were only met once. After being collected, spring Chinook are inoculated and transferred to the Speelyai Hatchery holding pond and allowed to mature. All wild (non-marked) Chinook collected in the traps are returned to the river. Excess hatchery origin fish are also marked a second time and recycled to the lower river to support the recreation fishery. If collected again, they are removed from the system. Spawning occurs at the Speelyai Hatchery at a ratio of one male to one female and all carcasses are taken to the local landfill for disposal (WDFW 2001a).

Table 4.8-11. Current broodstock collection goals for the Lewis River Hatchery Complex.

Species	Broodstock Collection Goal
Spring Chinook	800 adults (400 males and 400 females)
Early Coho (Type-S)	2,600 (1,300 males and 1,300 females)
Late Coho (Type-N)	7,200 (3,600 males and 3,600 females)
Summer Steelhead	430 (215 males and 215 females)
Winter Steelhead	400 fish (200 males and 200 females)

Spring Chinook eggs are incubated and the resulting fry are mass marked (adipose fin clipped) and coded wire tagged at Speelyai Hatchery. In April of each year, approximately 850,000 spring Chinook are transferred from the Speelyai Hatchery to the Lewis River Hatchery. Of these, approximately 180,000 are transferred to net pens located in the Lewis River at RM 10. These net pens are maintained through a cooperative effort between WDFW and Fish First. The remaining 260,000 spring Chinook are reared at Speelyai Hatchery for approximately 375 days before they are transferred to the Lewis River hatchery for release. According to WDFW, rearing densities are consistent with those recommended by Piper (1982). All fish are eventually released on-site into the North Fork Lewis River at RM 10 and RM 13 between February 22nd and March 31st (WDFW 2001a).

Although fish health is continuously monitored in accordance with WDFW Fish Health Policy Standards, disease outbreaks have affected spring Chinook during rearing at the

Lewis River Hatchery. Over the last 6 years, rearing losses have averaged 9.8 percent per year. Most of the mortality has been associated with bacterial kidney disease (BKD) (WDFW 2001a).

Early Coho Salmon (Type–S)

The overall goal of the Lewis River Hatchery Complex early coho (Type-S) program is to mitigate for the loss of early coho salmon stock that would have been produced naturally in the North Fork Lewis River in the absence of the hydroelectric dams (WDFW 2000b). An additional goal has been to assist in supplementing coho runs to the upper Columbia River system for Tribal catch[1]. The current WDFW early coho production goal at the Lewis River Hatchery Complex is to produce 880,000 smolts as mitigation for the hydro-electric projects in the basin (funded by the licensees). One million smolts (and 750,000 eyed eggs) were also produced for the tribal component of the program (previously funded by the Mitchell Act via NMFS) (Table 4.8-10) (WDFW 2000b). With the termination of the Mitchell Act funding, the tribal program has been discontinued.

Other early coho program goals are to:

1) Minimize interactions with other fish populations through proper rearing and release strategies;

2) Maintain stock integrity and genetic diversity;

3) Provide maximum survival and fish health using disease control and disease prevention techniques; and

4) Conduct environment monitoring to ensure that hatchery operations comply with water quality standards (WDFW 2000b).

Broodstock for the Lewis River early coho program are collected at the Lewis River Hatchery trap and Merwin Dam trap throughout the entire run (September through early November) (WDFW 2000b). The current broodstock goal is 2,600 fish and adult returns usually exceed egg take needs. Broodstock are selected randomly and collected without the use of anesthetic. The vast majority of the early coho returning to the facilities are marked (adipose fin clipped) hatchery fish. All unmarked fish are assumed to be from natural spawning. Those fish collected and determined to be from natural spawning (unclipped) are marked and returned to the river. If they return to the hatchery for a second time, they are removed from the system. All fish selected for spawning are transported by truck to Speelyai Hatchery and held at the facility's holding pond until ripe. All spawning is done at Speelyai Hatchery using a ratio of 1:1 males to females. The current egg take goal is 3.2 million for both portions of the program. All spawned

[1] In 1997, the Yakama Nation initiated a reintroduction program for selected tributaries in the Mid-Columbia Region with early stock coho salmon from lower Columbia River hatcheries to restore natural production identified in the Yakima Nation's "Coho Salmon Species Plan (CSSP) for the Mid-Columbia Basin. The goal of this program is to initiate restoration of coho salmon populations in mid-Columbia tributaries to levels of abundance and productivity sufficient to support sustainable annual harvest by tribal and other fishers (NMFS et al. 1998).

carcasses are used for nutrient enhancement, taken to the local landfill for disposal, sold, or donated for educational purposes (WDFW 2000b).

Eggs are eyed at Speelyai Hatchery and then transferred as follows: 600,000 to Hagerman Hatchery in Idaho, 1.1 million to Lewis River Hatchery, 1.1 million to Merwin Hatchery, 150,000 to Washougal Hatchery and 16,000 to educational co-ops (WDFW 2000b). Coho eggs sent to Merwin Hatchery are returned to Speelyai Hatchery as fingerlings, mass marked and transferred as yearlings to mid-Columbia acclimation sites selected by the tribal program. Coho at the Lewis River Hatchery are ponded into raceways and remain there for mass marking in June and July. These fish are then transferred to two large rearing ponds fed by Lewis River water. According to WDFW (2000b), Lewis River Hatchery loading densities are consistent with those recommended by Piper (1982). The mitigation portion of the program calls for a volitional release beginning on April 5th and ending on or prior to May 20th of each year (an average of 415 to 420 days reared) (WDFW 2000b).

According to WDFW, early coho health is continuously monitored in compliance with WDFW Co-manager Fish Health Standards; however, early-coho eggs have not been used for the tribal component of the program for the past 3 years due to a viral haemorrhagic septicaemia (VHS) disease quarantine.

Late Coho Salmon (Type–N)

One goal of the Lewis River Hatchery late coho (Type-N) supplementation program is to mitigate for the loss of late coho salmon stock that would have been produced naturally in the North Fork Lewis River in the absence of the hydroelectric dams (WDFW 2000a). A second goal is to provide enough returning broodstock to supplement the egg take needs of the Klickitat, Washougal, Elochoman and Kalama Falls hatcheries. The current late coho production goal is to produce 1.3 million smolts for returning broodstock to meet egg take needs, and 800,000 smolts as mitigation for the hydroelectric projects in the basin (Table 4.8-10). Other late coho program goals are to:

1) Minimize interactions with other fish populations through proper rearing and release strategies;

2) Maintain stock integrity and genetic diversity;

3) Enable maximum survival and fish health using disease control and disease prevention techniques; and

4) Conduct environment monitoring to ensure that hatchery operations comply with water quality standards (WDFW 2000a).

Like spring Chinook and early coho, broodstock for the late coho program are collected at the Lewis River Hatchery trap and Merwin Dam trap throughout the entire run (November through December). The current annual broodstock goal is 7,200 fish (3,600 males and 3,600 females) (Table 4.8-11) (WDFW 2000a). Returns usually exceed egg take needs. Those fish that are not marked (the progeny of wild spawners) are returned to

the river. According to WDFW (2000a), the goal is to remove as many hatchery stock late coho as possible to minimize the interaction with those fish that result from wild spawners. Broodstock are held to maturity and spawned at the Lewis River Hatchery. All spawned carcasses are used for nutrient enhancement, taken to the local landfill for disposal, donated to local food bank organizations, sold to contract buyers or donated for educational purposes.

All eggs are incubated and eyed and 2.5 million of these are retained for the Lewis River Hatchery program. As described previously, transfers are also made to meet shortfalls at the Klickitat, Washougal, Elochoman and Kalama Falls hatcheries. Some years, up to 10 million eyed eggs are transferred. At the Lewis River Hatchery, eggs are incubated using water from the Lewis River via pumps. All fry are ponded into the raceways and remain there until mass marked and coded wire tagged in June and July. They are then transferred into the facility's two large rearing ponds at near total button up. According to WDFW (2000a), Lewis River Hatchery loading densities are consistent with those recommended by Piper (1982). All coho are released volitionally (on-site) from April 5th through May 20th each year (an average of 415 to 420 days reared) (WDFW 2000a).

A variety of hatchery diseases also affect coho rearing at the Lewis River Hatchery. Type-N rearing losses have averaged 7.8 percent per year for the past six years (WDFW 2000a).

Summer Steelhead

The overall goal of the Lewis River Hatchery Complex summer steelhead program is to mitigate for the loss of summer steelhead due to the development of the hydroelectric dams in the Lewis River basin and to provide harvest opportunities (WDFW 2001b). The current mitigation production goal is 175,000 smolts to be released into the North Fork Lewis River system (Table 4.8-10). In addition to the present hatchery program of 175,000 smolts, 60,000 summer steelhead smolts are released to the lower river from the new Fish First Lake Merwin net pen project. As with spring Chinook, additional goals are to:

1) Produce adult fish for harvest;

2) Meet hatchery production goals;

3) Manage for adequate escapement;

4) Minimize interactions with listed fish through proper broodstock management;

5) Minimize interactions with other fish populations through proper rearing and release strategies;

6) Maintain stock integrity and genetic diversity;

7) Maximize in-hatchery survival of broodstock and their progeny and limit the impact of pathogens associated with hatchery stocks on listed fish; and

8) Ensure hatchery operations comply with state and federal water quality standards through environmental monitoring (WDFW 2001b).

Broodstock for the Lewis River summer steelhead program are collected at the Lewis River Hatchery trap and the Merwin Dam trap over the entire run (July through November) without the use of anesthetic. The current broodstock collection goal is 430 fish (215 males and 215 females) (Table 4.8-11) (WDFW 2001b). The vast majority of the fish collected in the traps are of hatchery stock. All unclipped "wild" summer steelhead are returned to the river in a location that will reduce the chance of recapture. In 1999, only 6 wild summer steelhead were collected at the traps. In 2000, only one wild summer steelhead was captured. After collection, spawners are transferred to 4 large adult holding ponds at Merwin Hatchery. The holding ponds are supplied entirely by water from Lake Merwin.

All spawning and incubation is done at Merwin Hatchery and all spawned carcasses are taken to the local landfill for disposal. Eggs are incubated using water pumped from Lake Merwin. All button up fry are ponded in intermediate raceways. Juveniles are adipose clipped in September and then transferred to large rearing ponds until release in April and May. According to WDFW (2001b), summer steelhead loading densities are consistent with those recommended by Piper (1982). All Merwin Hatchery fish are reared to the yearling stage and then released volitionally into holding ponds, then trucked to the lower river (RM 4) for release.

Fish health at Merwin Hatchery is continuously monitored in compliance with WDFW Co-manager Fish Health Standards (WDFW 2001b).

Winter Steelhead

As is the case for summer steelhead, the goal of the Lewis River Hatchery Complex winter steelhead program is to mitigate for the loss of winter steelhead due to the development of the hydroelectric dams in the Lewis River basin and to provide harvest opportunities (WDFW 2001c). According to WDFW's draft Hatchery and Genetic Management Plan, the current Lewis River Hatchery Complex winter steelhead production goal is 100,000 yearling smolts into the North Fork Lewis River (Table 4.8-10). Additional goals are to:

1) Produce adult fish for harvest;

2) Meet hatchery production goals;

3) Manage for adequate escapement;

4) Minimize interactions with listed fish through proper broodstock management;

5) Minimize interactions with other fish populations through proper rearing and release strategies;

6) Maintain stock integrity and genetic diversity;

7) Maximize in-hatchery survival of broodstock and their progeny and limit the impact of pathogens associated with hatchery stocks on listed fish; and

8) Ensure hatchery operations comply with state and federal water quality standards through environmental monitoring.

Broodstock for the Lewis River winter steelhead program are collected at the Lewis River Hatchery trap and the Merwin Dam trap over the entire run (November through January). The current broodstock collection goal is 400 fish (200 males and 200 females) (Table 4.8-11) (WDFW 2001c). All winter steelhead collected are examined for marks, and unmarked fish (the progeny of wild spawners) are marked and returned to the river. As with other anadromous species, all fish are handled without the use of anesthetic. Since the start of the program in 1993, the vast majority of the winter steelhead collected are of hatchery origin. Spawners are selected throughout the entire run and are taken at both traps and transferred to 4 adult holding ponds at the Merwin Trout Hatchery. Broodstock are held until ripe and spawned at the Merwin Hatchery. The current egg take goal is 2.5 million. Following spawning, all carcasses are taken to the local landfill for disposal. Steelhead carcasses are not used for nutrient enhancement due to disease concerns (WDFW 2001c).

Eggs are incubated at Merwin Hatchery using Mari® stack incubators with ozonated water supplied from Lake Merwin. Fry are ponded at near-total button up and reared at densities recommended by Piper (1982). All summer steelhead are adipose fin clipped and beginning in April and ending on May 10th of each year. All fish are released volitionally into holding ponds (an average of 380 to 390 days reared), then trucked to the lower Lewis River (RM 4) for final release. According to WDFW, the release strategy is designed to minimize interactions with native stocks, particularly fall Chinook.

Fish health and condition are monitored by hatchery staff following Co-manager Fish Health Policy standards (WDFW 2001c).

Sea-run Cutthroat Trout

Prior to 1999, as a condition of the Merwin Project license, Merwin Hatchery annually released about 25,000 sea-run cutthroat smolts (Cowlitz and Skamania stocks) into the North Fork Lewis River. The original goal of the program was to produce sea-run cutthroat trout to mitigate for lost habitat due to construction of the three PacifiCorp dams on the Lewis River (Hillson and Tipping 1999). Because of a low return to the creel in 1997 and 1998 and concerns over potential interactions (predation and competition) with wild cutthroat and fall Chinook salmon, the program was discontinued in 1999. The Merwin Project license is in the process of being amended to reflect this change. The existing Lewis River coastal cutthroat trout population is considered native with wild production (WDFW 2000c).

Kokanee

Kokanee planted in Yale Lake and Lake Merwin are produced at Speelyai Hatchery. Broodstock are collected in the Speelyai Hatchery trap, in Speelyai Creek (electrofishing)

and in Speelyai Bay (gill nets). The current kokanee production goal at Speelyai Hatchery is 45,000 fingerlings and 48,000 yearlings. The fish are planted in Lake Merwin annually (and in Yale Lake in 1999). The WDFW management objective for kokanee is for naturally reproducing populations to sustain the fishery (WDFW 1998a).

Resident Rainbow Trout

Non-native rainbow trout have been planted in Swift Reservoir since 1978 (PacifiCorp and Cowlitz PUD 2000, PacifiCorp 1996). The goal of the existing program is to provide a popular recreation fishery. Since 1978, approximately 800,000 to 1,000,000 rainbow trout fry at 25 per pound have been stocked annually (as required by Article 51 of the Merwin license). Juvenile rainbow trout are incubated and reared at the Merwin Trout Hatchery. The egg source is typically from the Goldendale Hatchery and South Tacoma Hatchery (PacifiCorp and Cowlitz PUD 2000). Rainbow trout fry are planted in May or June. Fry plants often show up in the creel beginning in September following planting, but mainly over-winter in the reservoir before contributing to the fishery the following year (PacifiCorp 1996).

Tiger Musky

Tiger musky, a non-native sterile hybrid (northern pike and muskellunge cross) known to prey heavily on soft-rayed fishes, were introduced into Lake Merwin in 1995. Like the tiger musky program implemented in Mayfield Lake on the Cowlitz River, the goal of the Lake Merwin program is to reduce the abundance of salmonid-eating northern pikeminnow and to provide a sport fishery for anglers. Currently, juvenile tiger musky are reared at the Merwin Trout Hatchery. The current production goal is approximately 3,000 at 7 per pound. Since the inception of the program, annual tiger musky plants into Lake Merwin have ranged from 375 to just over 1,700 (Table 4.8-12). According to Hillson and Tipping (1999), the first couple of tiger musky releases did not survive; however, the survival of subsequent releases "appeared to be good". Little is known about tiger musky habitat use in Lake Merwin and few anglers appear to be fishing for them. It is also unclear whether tiger musky are reducing the northern pikeminnow population in Lake Merwin, although the percent of 20 to 29 cm northern pikeminnow in the lake appears to be in decline (Hillson and Tipping 1999, Hillson and Tipping 2000).

Table 4.8-12. Tiger musky plants into Lake Merwin since 1995 (Hillson and Tipping 1999).

Date	Number Planted	Size (#/lb.)
September 1995	1,208	5.8
May 1996	375	2.0
May 1997	1,331	4.0
May 1998	1,945	3.5
October 1998	1,717	10.0
May 1999	1,273	2.9

Excess Hatchery Fish Plants

In recent years, excess summer and winter steelhead, early and late coho, spring Chinook, rainbow trout and sea-run cutthroat trout have been planted into Lake Merwin. According to WDFW, these excess hatchery fish are part of the rearing process, especially steelhead because of strict release size requirements. Other stocks are held as backup in case of excessive disease mortality. A summary of these annual plants from 1995 through 1999 is presented in Table 4.8-13 (Hillson and Tipping 1999, Hillson and Tipping 2000). No sea-run cutthroat trout have been planted since 1998. To date, the ecological ramifications of these plants has not been evaluated by WDFW.

Table 4.8-13. Hatchery fish plants into Lake Merwin (1995 through 1999).

Year	Spring Chinook	Coho	Summer Steelhead	Winter Steelhead	Kokanee	Sea-run Cutthroat	Rainbow Trout
1995	0	241,300	0	0	0	9,840	0
1996	0	108,500	34,572	10,846	0	0	0
1997	0	0	130,737	13,920	46,360	0	0
1998	415,124	1,533,960	52,701	73,802	0	2,214	131,302
1999	356,140	366,722	6,256	66,157	292,310	0	0

Excess hatchery fish produced at the Lewis River Hatchery Complex (in addition to the rainbow trout program) have also been planted in Swift Reservoir and Swift canal on occasion. In 1999, 154,433 winter steelhead were planted in Swift Reservoir. In 1997, 1998 and 1999, WDFW released an average of just over 1,000 rainbow trout into the Swift canal to supplement the recreation fishery. The number of excess hatchery fish released into the Lewis River basin and the release locations (from 1995 through 2001) are presented in AQU 8 Appendix 3.

4.8.5.4 Potential Effects of Hatchery Operations on Native Salmonids

Since the late 1800s, hatchery production has been the focus of fishery resource management in the Columbia River basin. Today, hatchery fish comprise approximately 80 percent of the fish returning to the Columbia River and 70 to 80 percent of the fish harvested in the Pacific Northwest (Flagg et al. 2000, NPPC 2000). Although production hatcheries play a major role in supplying salmon and trout to the fishery, and in some cases have slowed the decline of natural populations, traditional hatcheries and hatchery management practices can also impose serious, unintended negative effects on native fish. Only recently, have biologists begun to seriously examine these impacts.

According to NRC (1996) and NPPC (2000), large-scale hatchery production can adversely affect native fish populations through 2 primary mechanisms: 1) direct genetic impacts (resulting from hybridization of non-native cultured fish with native wild fish) and 2) indirect genetic impacts (ecological factors directly affecting a native fish population's size, indirectly modifying the genetic structure of the population).

Direct Genetic Impacts

Direct genetic impacts include: (1) the loss of between-population genetic variation, (2) the loss of within-population genetic variation, and (3) domestication (NRC 1996). According to NPPC (2000), the loss of between-population genetic variation is usually associated with the straying of out-of-watershed hatchery fish into wild fish spawning areas, or the transfer of non-local hatchery fish (non-native stock) into a watershed with distinct native populations. In severe cases, interactions between these non-native and native populations can lead to reduction in reproductive fitness and reduced ability of the species or group of populations to respond to environmental change (NPPC 2000).

The loss of within-population genetic diversity (the amount of genetic information in a population) is largely associated with a reduction in population abundance and mating success. Although uncommon in wild salmonid populations (unless their numbers reach very low levels), this loss of genetic diversity can occur in hatchery populations. If hatchery populations are allowed to breed with wild populations, the net effect is usually a reduction in the F_1 hybrids (and subsequent generations) fitness, closing off options for evolution and jeopardizing the long-term persistence of the population (NRC 1996).

Domestication is the intentional or unintentional selection for adaptation to an artificial environment. Domestication can be imposed by non-random hatchery broodstock collection or by adaptation to an artificial environment, such as a hatchery, during one phase of a salmon's life history (NPPC 2000). In general, domestication can increase fitness in the artificial environment but hinder the ability of the fish to survive under wild conditions.

Indirect Genetic Impacts

Any behavioral or environmental factor that causes a reduction in population size can have an indirect effect on the genetic structure and ultimately the survival of wild fish populations (NPPC 2000). Some of the hatchery production and management related factors that can adversely affect wild fish include: competition, disease, harvest, broodstock collection, and hatchery operations (water withdrawals and effluent discharge).

Predation

According to Flagg et al. (2000), the effects of artificial propagation on predator prey-interactions involving salmonid populations can be divided into 3 major categories: 1) salmon released from hatcheries might prey on wild fish, 2) releases of hatchery fish may influence the behavior and dynamics of predator populations, which can indirectly affect wild fish, and 3) hatchery rearing and release protocols can influence the vulnerability of hatchery-reared salmonids (cultured for conservation purposes) to predators after release.

Newly released hatchery smolts are known to prey on wild juvenile salmonids that are encountered in freshwater during downstream migration (Hawkins and Tipping 1999, Flagg et al. 2000). Hatchery-origin smolts, sub-adults, and adults may also prey on wild fish of susceptible sizes and life stages in lacustrine, estuarine, and marine areas where

they commingle (Flagg et al. 2000). A hatchery fish predation study conducted in the lower Lewis River from 1997 to 1998 found that hatchery smolts released from the Lewis River Hatchery Complex consumed a large number wild Chinook fry (Hawkins and Tipping 1999). The findings of this and other Lewis River studies eventually lead to the elimination of the sea-run cutthroat trout program at Merwin Hatchery. Additional studies cited in Flagg et al. (2000) have documented hatchery Chinook, steelhead predation on natural-origin fish populations located throughout the Pacific Northwest.

Large concentrations of migrating hatchery fish may also attract predators such as fish (especially northern pikeminnow), birds (Caspian terns, gulls, American merganser, and cormorants) and seals, and consequently contribute indirectly to predation of wild fish. Large numbers of hatchery fish may also alter wild salmonid behavioral patterns, potentially influencing their vulnerability and susceptibility to predation. Alternatively, a mass of hatchery fish migrating through an area may overwhelm established predator populations, providing a beneficial, protective effect (predation buffer) to co-occurring wild fish (Flagg et al. 2000).

Competition

If resources are limited in a given environment (i.e. freshwater, estuarine, or ocean), competition between hatchery fish and wild fish may result in negative impacts to wild fish populations. This competition can occur when larger or more aggressive hatchery fish fight for preferred habitat types (e.g. cover), feeding territories, or limited food sources. It can also occur when adult hatchery fish compete for available mates or super-impose redds of spawning wild fish. All of these interactions can have an adverse effect on wild fish populations. According to Flagg et al. (2000), releasing hatchery salmonids as true smolts which rapidly migrate downstream to the estuary and marine environment minimizes or eliminates competition with wild fish rearing in streams, rivers, and lakes. Properly imprinting hatchery smolts to the hatchery can also minimized any competition between retuning hatchery fish and wild fish. Releasing hatchery fish so that they remain spatially and temporally separated from wild salmon can also minimize impacts.

Disease

Although pathogens responsible for fish diseases are present in both hatchery and natural populations, most hatchery-origin fish have an increased risk of carrying disease because of stress associated with relatively high rearing densities (Flagg et al. 2000). While the effects of these disease outbreaks on hatchery populations are relatively well understood, little is known about the potential for hatchery fish to transmit disease to wild populations. As a result, it is extremely difficult to determine the incidence of disease transmission from hatchery to wild fish, as well as the impacts such transmission would have on wild stocks. According to NRC (1996), the ability of hatchery fish to transmit disease to wild populations probably depends on the ecological characteristics of the disease, the environmental conditions of the site, and the abundance and distribution of released hatchery fish.

Bacterial, viral, and fungal outbreaks occur occasionally at the Lewis River Hatchery Complex (PacifiCorp and Cowlitz PUD 2000). According to WDFW, common diseases include Furunculosis, Columnaris, Low Temperature Disease, Bacterial Kidney Disease, Costia, Trichodina, Ichthyophthirius, infectious hematopoetic necrosis virus (IHNV), Saprolegnia, Coagulated-Yoke, Stomach Fungus, Gill Fungus, and Sanguinicola (pers. comm. Robin Nicolay, WDFW, May 1, 2001). Fish health and condition are monitored by hatchery staff throughout the entire rearing period in accordance with Co-manager Fish Health Policy standards (WDFW 1996). Fungal and protozoan diseases are treated with either formalin or hydrogen peroxide baths or drips. Bacterial infections are usually treated with antibiotics (PacifiCorp and Cowlitz PUD 2000). Additionally, all water exiting the Merwin Hatchery adult holding ponds and incubation building is disinfected prior to discharge into the pollution abatement ponds.

Recently, the Merwin Trout Hatchery experienced a serious outbreak of IHN virus. In late 1998 and early 1999, the Merwin Hatchery received 350,032 Spokane rainbow trout eggs and 784,176 Goldendale Hatchery rainbow trout eggs for the Swift Reservoir program. Shortly after hatching, fry losses of both stocks increased sharply and it was soon learned that the fry were infected with IHNV. In March, Merwin Hatchery received an additional 150,340 juveniles from Spokane. This group of fish also contracted IHNV and had to be destroyed. Finally, 186,833 Mt. Whitney rainbow trout were transferred from Chelan Hatchery. These fish experienced 44 percent mortality during rearing leaving only about 83,000 for planting into Swift Reservoir (WDFW 2000d).

Broodstock Collection

The collection of broodstock for hatchery production purposes and the removal of hatchery fish from rivers have the potential to adversely affect wild fish populations. During broodstock collection, hatchery personnel may inadvertently remove wild fish from the river if there is no means to distinguish them from hatchery-produced fish (i.e. fin clips). The collection of adult anadromous fish in traps and weirs may also delay the spawning migration, stress, or injure wild fish during handling. Since the advent of mass marking at the Lewis River Hatchery Complex in the late 1990s, the potential for the inadvertent collection and removal of wild fish has been greatly diminished. However, wild fish, including ESA listed species, are still collected in the Merwin Dam and Lewis River Hatchery traps. According to WDFW (2001a, 2001b, and 2001c), between 100 to 300 adult fall Chinook, and up to 80 winter and summer steelhead, enter the Lewis River traps annually. As described previously in this report, all unmarked wild fish collected in the traps are examined and immediately returned to a reach of the river that would enhance their chances for natural spawning and reduce their potential to reenter the traps.

The collection of hatchery broodstock and the removal of returning hatchery fish also reduce the number of salmon carcasses (and marine derived nutrients) in the affected river system. This reduced nutritive capacity may ultimately affect primary production, reducing the amount of food available to rearing wild salmonids, resulting in lower survival rates. Carcasses can be returned to the river after hatchery spawning to maintain or increase nutrient levels.

Harvest

Large-scale harvest of hatchery stocks in mixed stock fisheries can also adversely affect wild fish populations. When abundant hatchery-produced fish are targeted for maximum harvest, there is a potential to over-harvest wild stocks (Flagg et al. 2000). This over-harvest can result in an under escapement of wild fish to the spawning grounds, adversely affecting their survival. In severe cases, it can even lead to extinction. NPPC (2000) describes this effect as follows:

> "*When a mixture of stocks is harvested at a common rate which permits them all to survive indefinitely, the sustainable yield is always lower, sometimes much lower, than the sum of the individual sustainable yields of the stocks, if harvested separately at rates appropriate to their individual productivities. Correspondingly, the actual spawning population level, or escapement goal, which provides the greatest sustainable yield from a mixture of stocks is not the escapement goal which gives the theoretical maximum sustained yield from each stock from the mixture.*"

Unfortunately, without the implementation of informed stock fishing (accounting of all individual stock mortality that is potentially under human control), the fishery managers (and often the hatchery managers) do not have the full knowledge needed to minimize these impacts and implement scientifically sound conservation measures (Flagg et al. 2000).

Commercial and recreation fisheries on native Lewis River stocks are discussed in detail in the *Commercial and Recreation Fisheries on Lewis River Stocks* section of this report.

Hatchery Operations

Hatchery operations also can adversely affect wild fish through water withdrawals and release of hatchery effluents. Hatchery water withdrawals can reduce streamflow between the hatchery intake and the outflow, degrading the quality of the habitat in the bypassed stream reach. Because Merwin Hatchery is fully supplied by withdrawals from Lake Merwin (up to 5,000 gpm (11.1 cfs) from 2 intakes), operation of Merwin Hatchery has no affect on instream flows below Merwin Dam. The Lewis River Hatchery can withdraw up to 29,000 gpm (64.6 cfs) from the Lewis River at 2 separate intakes and Speelyai Hatchery can withdraw up to 9,200 gpm (20.5 cfs) by gravity flow from Speelyai Creek (WDFW 2001a).

Hatchery intakes and diversions also can entrain aquatic organisms and in some cases impede the upstream and downstream migration fish (i.e. Speelyai Hatchery diversion). According to WDFW (2001a), the intake screens at the Lewis River and Merwin hatcheries meet all NMFS intake screen requirements. The Speelyai Hatchery diversion dam, located approximately 200 feet upstream of Lake Merwin, meets NMFS fingerling criteria and acts as a total barrier to upstream and downstream fish migration.

Hatchery effluent also has the potential to impact water temperature and water quality (pH, suspended solids, ammonia, organic nitrogen, total phosphorus, and biological

oxygen demand) in reaches downstream from the hatchery outflows. In Washington, all state hatcheries are operated in compliance with the National Pollution Discharge Elimination System (NPDES) permit requirements and should be protective of fish rearing downstream. At the Lewis River Hatchery Complex, settleable solids and total suspended solids in the hatchery effluents are monitored monthly and documented in the annual hatchery reports. As a result, few water quality impacts are expected downstream. However, during water quality monitoring in the Lewis River Project area in 1999 and 2000, total phosphorus was relatively high in the Lewis River Hatchery Complex effluents. In particular, phosphorus levels in the Speelyai Hatchery effluent was over 10 times higher than in upper Speelyai Creek in October and November 1999 (approximately 0.07 mg/l), and typically was more than 3 times higher than samples collected above the diversion (PacifiCorp and Cowlitz PUD 2001). Ammonia and nitrate plus nitrite concentrations were also comparatively high in the hatchery effluent samples.

WDFW and Tribal Hatchery Reform Efforts

Hatchery reform efforts have been ongoing for several years, and state and tribal co-managers have begun to implement mitigation provisions as part of conservation initiatives. Hatchery activities in the Columbia Basin are currently the subject of ongoing Section 7 consultation designed to address the adverse effects of ongoing hatchery programs. According to WDFW's Draft Fisheries Management and Evaluation Plan (WDFW 2001e), strategies used to limit genetic risks to the native steelhead populations in the Lower Columbia River Management Area include the following:

1) Limiting the number of hatchery spawners by providing intense selective fisheries, and maintaining high trapping efficiency at the hatcheries or adult traps that remove hatchery fish prior to spawning.

2) Advancing the spawning timing of Chambers Creek and Skamania type steelhead stocks, so that these fish spawn 3 months earlier than wild stocks, minimizing interbreeding between these two groups.

3) Keeping hatchery steelhead spawners in the lower river away from prime wild steelhead spawning areas through lower river releases and acclimation.

4) Using hatchery management practices, acclimation, timing, and lower river releases to limit steelhead residualism and the competition and predation that can occur when steelhead smolts residualize.

5) Following the Integrated Hatchery Operations Team guidelines to limit disease risks from hatchery steelhead.

WDFW employs an alternate strategy for most salmon stocks and some steelhead stocks, in which every effort is made to maintain similarities between hatchery and wild fish. Guidelines for this program include the following:

1) Incorporate wild fish annually into the broodstock.

2) Maintain similar genetic and biological characteristics between hatchery and wild populations including, size, age, size at maturity, age at ocean entry, fecundity, sex ratio, run timing, and spawning time.

3) Limit the number of hatchery spawners by providing intense selective fisheries, and maintaining high trapping efficiency at the hatcheries or adult traps that remove hatchery fish prior to spawning.

4) Use hatchery management practices, acclimation, timing, and lower river releases to limit steelhead residualism and the competition and predation that can occur when steelhead smolts residualize.

5) Follow the Integrated Hatchery Operations Team guidelines to limit disease risks from hatchery salmon and steelhead.

4.8.5.5 Commercial and Recreation Fisheries on Lewis River Stocks

Native and introduced salmonid stocks in the Lewis River basin are subject to both commercial and recreation fisheries. Depending on species and stock, ocean commercial fisheries can intercept Lewis River fish off the coasts of Washington, Oregon, California, Canada, and southeast Alaska. Salmon can also be taken incidentally in the Bering Seas/ Aleutian Islands (BSAI) and the Gulf of Alaska (GOA) groundfish fisheries. A restricted commercial fishery targeting lower Columbia River spring Chinook (including Lewis River spring Chinook) also occurs in the mainstem Columbia River below the Willamette River. Recreation fisheries target Lewis River stocks in the lower mainstem Columbia River, mainstem Lewis River and tributaries, and project reservoirs. The current tribal fishery in the Columbia River basin has little or no affect on Lewis River stocks, since this fishery occurs on the Columbia River above the Lower Columbia River Management Area (WDFW 2001e).

Spring Chinook

Ocean fisheries off Alaska, Canada, and the southern U.S impact lower Columbia River spring Chinook. They were also subject, in past years, to significant sport and commercial harvest in the Columbia River. According to NMFS et al. (2000), the ocean fisheries' exploitation rate (ER) of lower Columbia River spring Chinook, including Lewis River spring Chinook, is 15.6 percent (based on 2000 model estimates) (Table 4.8-10). The majority of these fish (12.5 percent) are harvested (troll and sport) off the coasts of Washington, Oregon and California. Very few lower Columbia River spring Chinook (less than 0.7 percent) are incidentally harvested in the BSAI (Bering Sea and Aleutian Islands) and GOA (Gulf of Alaska) groundfish fisheries (NMFS 1999). According to WDFW (2001a), the in-river sport fishery harvest rate has averaged about 60 percent of the total return (1988 to 1999 data). The actual number of spring Chinook harvested in the Lewis River recreation fishery (the Lewis River and tributaries below Merwin Dam) from 1980 to 1998 based on punch card returns has ranged from 394 in 1996 to 10,382 in 1987 (Figure 4.8-5) (PSMFC 2001, WDFW 1997, WDFW 1999a, WDFW 1999b, WDFW 1999c, WDFW 2001d). During this period, 99.9 percent of the total recreation

catch were harvested in the Lewis River and 0.09 percent were harvested in the East Fork Lewis River.

Fall Chinook

Lewis River fall Chinook are one of the few healthy wild stocks in the Lower Columbia River. They are also more heavily impacted by ocean fisheries. According to NMFS et al. (2000), total harvest rates on this stock in the ocean commercial fisheries have averaged 49 percent from 1977 through 1990 and 28 percent between 1991 and 1992 (Table 4.8-14). This is a far-north migrating stock so the ocean harvest occurs primarily in Alaska and Canada. The long-term average harvest rate off the coasts of Washington, Oregon, and California is 5 percent, while the more recent rate (1991 through 1994) is 1 percent. Columbia River catch rates have averaged 22 percent from 1977 through 1990 and 12 percent in more recent years (Table 4.8-14). The catch rate on North Fork Lewis fall Chinook in Puget Sound and other terminal marine area fisheries averaged 1 percent for the 1977 through 1990 brood years and 0 percent for brood years (1991 through 1994).

Table 4.8-14. Summary of total adult equivalent exploitation rates for the North Fork Lewis River fall Chinook (bright stock) (from NMFS et al. 2000).

Brood Year	Lewis River Fall Chinook					
	Total	**SE Alaska**	**Canada**	**PFMC[1]**	**Columbia River**	**Other**
1977	0.51	0.08	0.19	0.06	0.16	0.02
1978	0.56	0.15	0.14	0.09	0.18	0.01
1979	0.50	0.10	0.16	0.07	0.17	0.01
1980	NA	NA	NA	NA	NA	NA
1981	NA	NA	NA	NA	NA	NA
1982	0.59	0.09	0.16	0.02	0.31	0.00
1983	0.67	0.06	0.20	0.05	0.35	0.01
1984	0.45	0.03	0.15	0.03	0.24	0.00
1985	0.44	0.07	0.12	0.07	0.17	0.02
1986	0.41	0.04	0.15	0.05	0.16	0.00
1987	0.38	0.05	0.13	0.05	0.14	0.01
1988	0.47	0.06	0.16	0.04	0.20	0.01
1989	0.42	0.02	0.07	0.05	0.29	0.00
1990	0.45	0.07	0.10	0.01	0.27	0.00
1991	0.31	0.11	0.07	0.02	0.10	0.00
1992	0.26	0.13	0.03	0.01	0.10	0.00
1993	0.41	0.14	0.05	0.00	0.22	0.00
1994	0.14	0.08	0.00	0.00	0.06	0.00
1977-1990	**0.49**	**0.07**	**0.14**	**0.05**	**0.22**	**0.01**
1991-1994	**0.28**	**0.12**	**0.04**	**0.01**	**0.12**	**0.00**

[1] The ocean salmon fisheries in the exclusive economic zone off Washington, Oregon, and California (3 to 200 miles offshore) are managed according the "Pacific Coast Salmon Plan" of the Pacific Fishery Management Council (PFMC).

The Lewis River fall Chinook recreation fishery is managed for an escapement goal of 5,700 adult spawners. In years where tributary run size is expected to exceed the escapement goal, a sport fishery is open. From 1996 through 2000 the recreation fishery was closed for all or part of the season due to low escapement (< 5,700 fish). The number of fall Chinook harvested in the Lewis River recreation fishery from 1980 to 1998 (the latest final data) based on punch card returns has ranged from 8 in 1998 to 3,057 in 1988 (Figure 4.8-6) (PSMFC 2001, WDFW 1997, WDFW 1999a, WDFW 1999b, WDFW 1999c, WDFW 2001d). During this period, 99.3 percent were harvested in the Lewis River (upriver bright Chinook) and 0.70 percent were harvested in the East Fork Lewis River (Tule fall Chinook).

Coho

According to Hymer et al. (1993), the majority of Lewis River early-coho (Type-S) are harvested off the Oregon coast with the Oregon troll fishery accounting for the highest percentage of the catch. Most late-coho (Type N) harvest occurs in the Washington and Oregon fisheries. Marine recoveries of coded wire tagged Lewis River Hatchery coho for brood years 1976, 1984, and 1986 through 1989 are presented in Table 4.8-15 (Weitkamp et al. 1995).

Table 4.8-15. Marine recoveries of coded wire tagged Lewis River Hatchery coho in Alaska (AK), British Columbia (BC), Washington (WA), Oregon (OR), and California (CA).

	Number of Marine Recoveries (% of Total)					
Brood Years	**AK**	**BC**	**WA**	**OR**	**CA**	**Total**
1976, 1984, 1986-1989	1 (0.0)	1,386 (11.8)	4,317 (36.9)	5,546 (47.4)	454 (3.9)	11,703.4

For the 1991 through 1994 broods, contribution rates of Lewis River Type-N coho were approximately 13 percent to Washington coastal fisheries, 8 percent to the Canadian troll, and 6 percent to the Columbia River net fisheries. Escapement accounted for about 66 percent of the total survival (Byrne and Fuss 1999). Contribution rates for Type-S coho were 8 percent to the Washington coastal fishery, and 5 percent to the Oregon sport fishery. Escapement accounted for the majority (85 percent) of the total Type-S coho survival (Byrne et al. 1998).

The number of coho salmon harvested in the Lewis River recreation fishery 1980 to 1998 based on punch card returns has ranged from 739 in 1994 to 8,673 in 1991 (Figure 4.8-7) (PSMFC 2001, WDFW 1997, WDFW 1999a, WDFW 1999b, WDFW 1999c, WDFW 2001d). During this period, 99.4 percent were harvested in the mainstem Lewis River and 0.6 percent were harvested in the East Fork Lewis River.

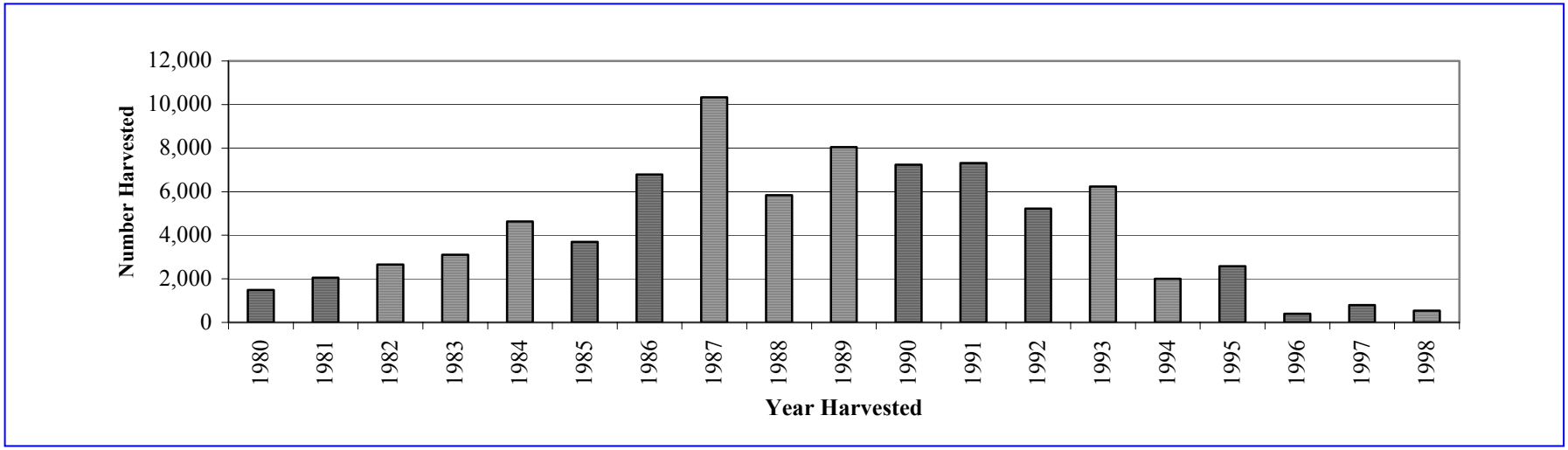

Figure 4.8-5. The number of spring Chinook harvested in the Lewis River basin recreation fishery from 1980 through 1998.

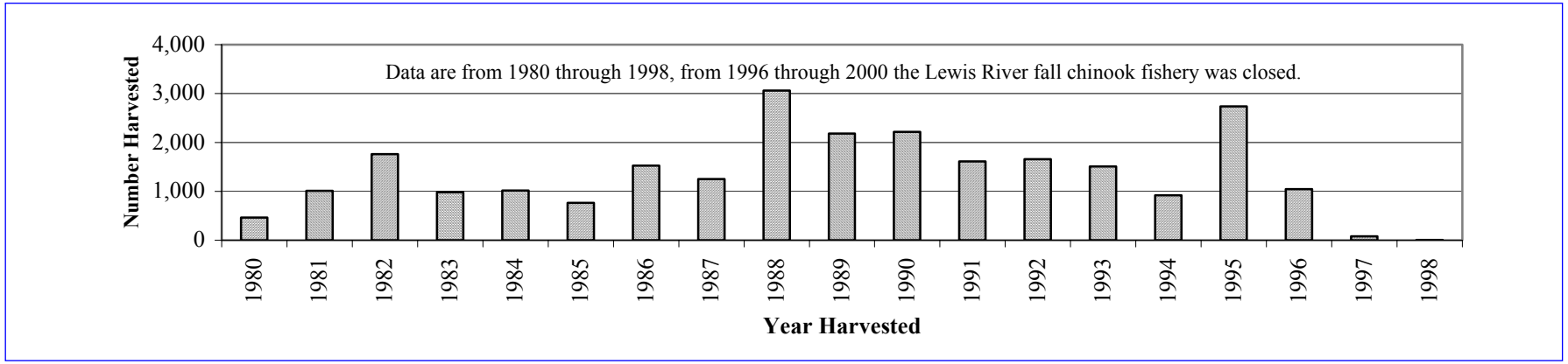

Figure 4.8-6. The number of fall Chinook harvested in the Lewis River basin recreation fishery from 1980 through 1998.

Winter and Summer Steelhead

Steelhead retention is prohibited in commercial ocean fisheries and as a result, they are rarely caught in the marine environment (WDFW 2001e, NMFS et al. 2000). Non-tribal commercial fisheries for steelhead in the lower Columbia River have been prohibited since 1975. The tribal steelhead fishery is limited to the mainstem Columbia River above Bonneville Dam and in the Wind River (WDFW 2001e). Consequently, very few Lewis River summer and winter steelhead are expected to be incidentally caught in this fishery. On the Lewis River, recreation fisheries for winter steelhead are concentrated from December through February and extend through May 31. Summer steelhead enter the system from March through October. Selective harvest regulations allow only the harvest of adipose-fin clipped fish to protect wild fish. According to WDFW (2001e), specific harvest rates for hatchery summer and winter steelhead in the lower Columbia River are unknown; however, punch card estimates are available by month for the Lewis River basin (Figures 4.8-8 and 4.8-9). Annual in-river harvest of winter steelhead between 1962 and 1998 has ranged from 403 in 1997 to 6,869 in 1980. Annual harvest of summer steelhead has ranged from 359 in 1962 to 8,714 in 1986 (PSMFC 2001, WDFW 1997, WDFW 1999a, WDFW 1999b, WDFW 1999c, WDFW 2001d).

4.8.5.6 Reservoir Fisheries

Lake Merwin

From 1983 through 1995, approximately 200,000 hatchery coho juveniles (20 per pound) were planted annually in Lake Merwin to support a resident sport fishery (PacifiCorp and Cowlitz PUD 2001). To assess this fishery, a creel survey was conducted by WDFW from May through August 1995. Results of this survey estimated that 19,350 angler hours were expended to catch 3,068 kokanee, 511 coho, 20 rainbow trout and 20,764 northern pikeminnow (Tipping 1996). The coho harvest represented a return to the creel of only 0.24 percent (PacifiCorp and Cowlitz PUD 2001). Based on this relatively poor coho harvest, the coho program was terminated and replaced with a hatchery kokanee program in 1997. In addition, excess hatchery spring Chinook, coho, steelhead and sea-run cutthroat trout have also been planted into Lake Merwin since 1994 (Table 4.8-13). To help evaluate the contribution of these fish to the sport fishery, WDFW conducted a creel survey in Lake Merwin from November 1999 through October 2000 (PacifiCorp and Cowlitz PUD 2001). During this survey, a total of 757 anglers were contacted. These anglers fished a total of 3,444 hours and harvested 956 fish. The total estimated angler effort was 32,123 hours to harvest 10,428 fish. The estimated catch was comprised of 9,602 kokanee, 448 coho, 161 rainbow tout, 161 Chinook salmon and 56 cutthroat trout. Catch rates averaged 0.29 for boat anglers and 0.07 for bank anglers. About half of the kokanee observed in the creel were unmarked fish, assumed to be from Yale Lake (passed via spill or through the Yale Project turbines) or natural production in Lake Merwin. Although tiger muskies were reported as caught and released, only one was harvested (PacifiCorp and Cowlitz 2001).

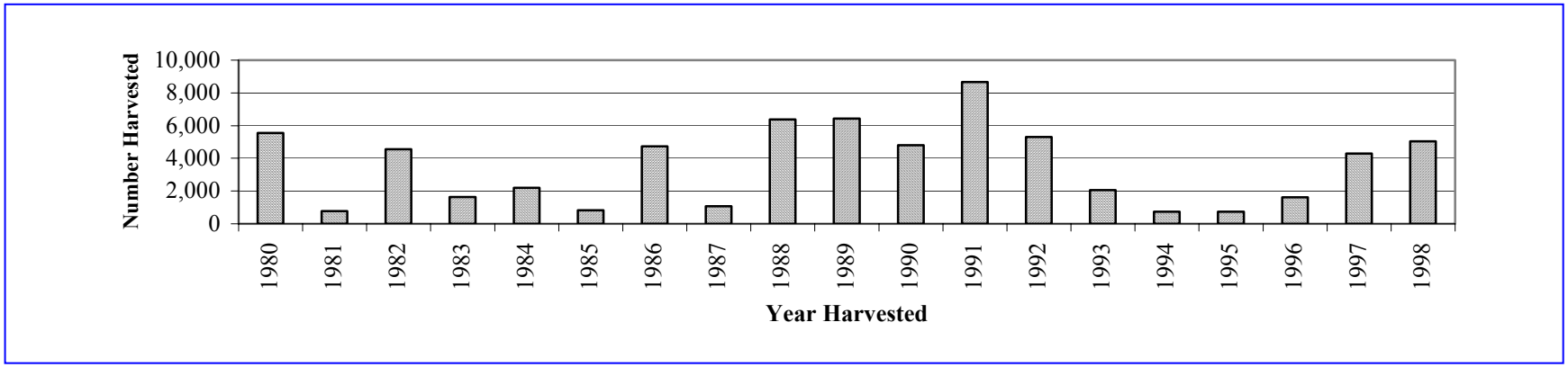

Figure 4.8-7. The number of coho salmon harvested in the Lewis River basin recreation fishery from 1980 through 1998.

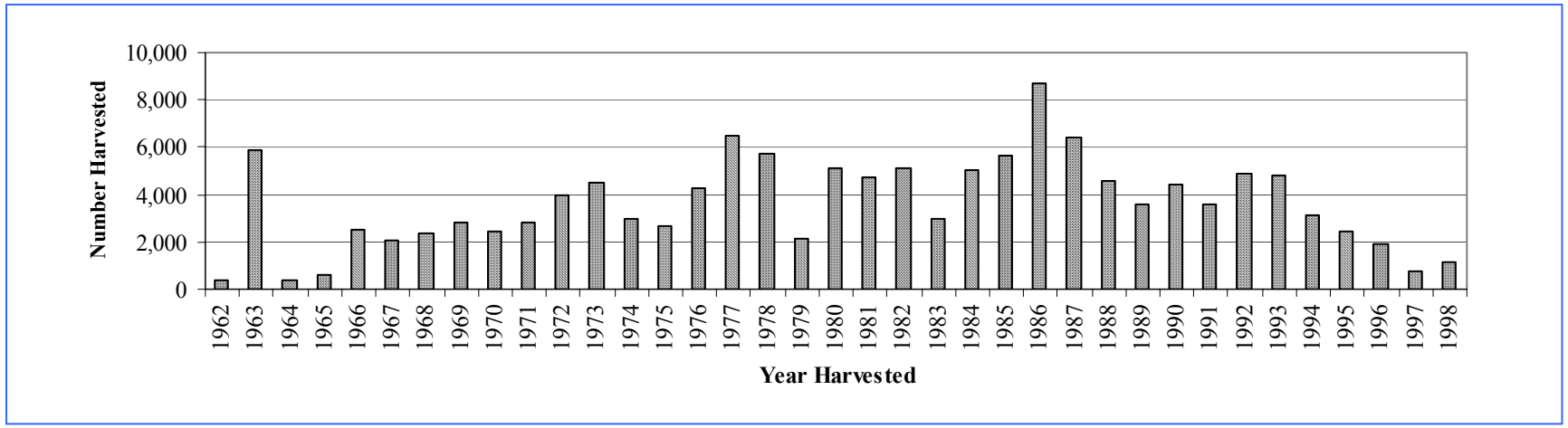

Figure 4.8-8. The number of summer steelhead harvested in the Lewis River basin recreation fishery from 1962 through 1998.

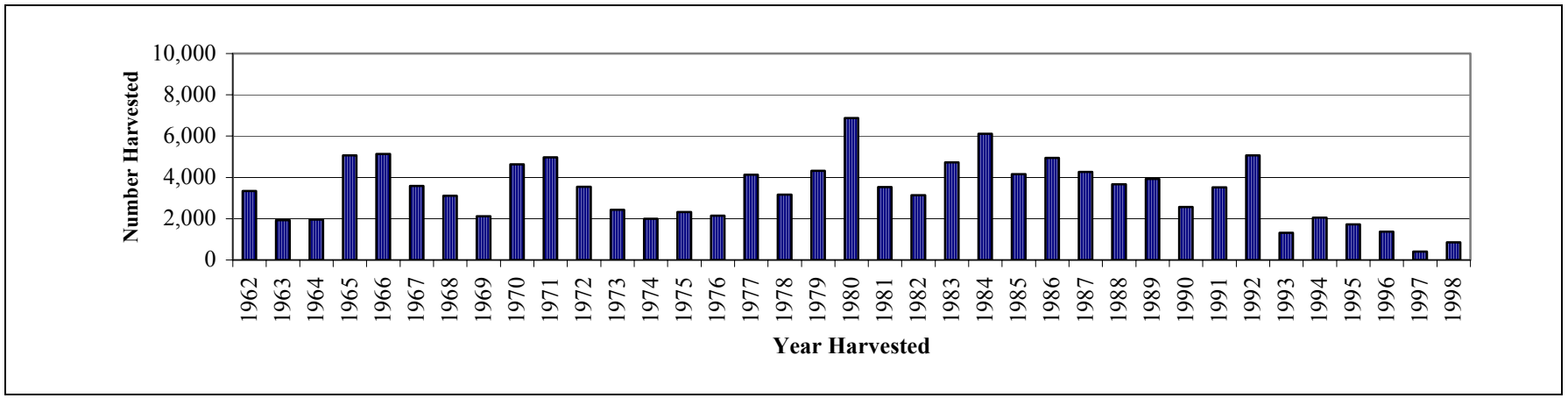

Figure 4.8-9. The number of winter steelhead harvested in the Lewis River basin recreation fishery from 1962 through 1998.

Yale Lake

To describe the existing recreation fishery in Yale Lake and to provide data to assist state fishery management, PacifiCorp conducted a 1-year creel survey in 1996. During this period, a total of 326 bank and 341 boat anglers were contacted on 75 days of sampling. Bank and boat anglers fished for 1,935 hours and caught 604 gamefish (kokanee, cutthroat trout and rainbow trout). Gamefish caught included 441 kokanee (73 percent), 27 cutthroat trout (4 percent) and 136 rainbow trout (23 percent). Anglers also illegally creeled 1 bull trout and released 15 bull trout. The mean catch per unit effort of all gamefish, including fish released by anglers, was 0.30 fish per angler hour (PacifiCorp 1997).

Swift Reservoir

Swift Reservoir is a put-grow-take fishery and as mentioned previously in this report, approximately 800,000 rainbow trout fingerlings are planted annually. As part of Merwin Project studies in 1990, PacifiCorp biologists completed a creel survey on Swift Reservoir (PacifiCorp 1996). From May through October 1990, Swift Reservoir had a catch rate 0.97 fish per hour. Rainbow trout comprised approximately 99 percent of the fish harvested (PacifiCorp 1996). Thus the high catch rate was most likely a result of the rainbow trout plants. From April 24 through October 1999, WDFW conducted an additional creel survey in Swift Reservoir and Swift canal (PacifiCorp and Cowlitz PUD 2001). During this survey, a total of 496 anglers were interviewed. These bank and boat anglers fished a total of 1,800 hours to harvest 1,504 fish. Rainbow trout and cutthroat trout comprised 84.7 percent and 14.7 percent of the fish harvested (PacifiCorp and Cowlitz PUD 2001). Three bull trout were caught and released. A few coho salmon were also observed in the creel. These coho likely were accidentally mixed in with the rainbow trout fingerlings and released in the lake. Harvest rates in Swift Reservoir during the 1999-2000 creel survey averaged 0.15 fish per hour for shore anglers and 0.28 fish per hour for boat anglers. This catch rate was the lowest observed at any time for all 3 Lewis River reservoirs (PacifiCorp and Cowlitz PUD 2001).

Swift Canal

In 1997, 1998 and 1999, WDFW released an average of just over 1,000 rainbow trout into the Swift canal. During the 1999 WDFW creel survey, at total of 292 anglers who were fishing in the canal were interviewed. They fished a total of 691 hours to catch 153 fish, a harvest rate of 0.2 fish/hour (PacifiCorp and Cowlitz PUD 2001). The total estimated effort and harvest was 3,108 hours and 656 fish. The harvest was comprised of 96 percent rainbow trout, 2 percent cutthroat trout, and 1 percent bull trout. Two bull trout were observed in the creel early in the season. Overall, the Swift canal sport fishery was considered poor.

4.8.6 Discussion

The Lewis River Hatchery Complex and other WDFW facilities have been releasing Chinook, coho, and steelhead into the Lewis River basin for over 70 years. Although hatchery production and management strategies have changed over time, the ultimate goal of this program is to maintain anadromous fish runs in the basin to support

recreation and commercial harvest opportunities (in the absence of historical habitat). For the most part, the Lewis River Hatchery Complex has met this goal; however, early hatchery practices, out-of-basin stock releases, mixed-stock fisheries, lost historical habitat due to dam construction, and habitat degradation have adversely affected a number of native Lewis River salmon and steelhead stocks. For example, native Lewis River spring Chinook disappeared from the basin in the early 1950s, and today; the spring Chinook population in the Lewis River is a mixture of Carson (upper Columbia River), Cowlitz, Kalama, and Klickitat stocks. The native Lewis River coho population was also altered by extensive stock introductions and early hatchery practices, and is currently a mixture of Cowlitz, Toutle, and Lewis River stocks. Lewis River steelhead are thought to be native, although interbreeding has undoubtedly occurred with introduced stocks from the Cowlitz, Washougal, Elochoman, and Klickitat rivers. Fortunately, native Lewis River fall Chinook have remained relatively unaffected by hatchery operation and are one of the few healthy fall Chinook stocks in the lower Columbia River. The impacts of hatchery fish on other species such as native bull trout and cutthroat trout are largely unknown.

While impacts to some native Lewis River stocks have been substantial, more recent hatchery management goals and practices have focused on reducing hatchery impacts on native and wild (naturally spawning) stocks. These goals and management directions, as outlined in the Merwin Hatchery agreement, WDFW's recent HGMPs for Chinook and steelhead, and in policy documents such as WDFW's Wild Salmonid Policy, should reduce or eliminate the negative effects of hatchery production and operation, and contribute to the conservation and potential recovery of ESA-listed salmon and steelhead.

Over the next few years, relicensing will present an opportunity for the licensees, the resource agencies, the Tribes, and the public to become more involved in the long-term management of the Lewis River Hatchery Complex and in the reintroduction of anadromous fish upstream of the Lewis River dams. For years, hatchery production has mitigated for lost habitat due to dam construction, and it is likely that the complex will continue to produce salmon and steelhead. The complex will also likely play a major role in the reintroduction effort. However, if reintroduction succeeds, the existing reliance on hatchery production should diminish as populations of naturally produced salmon and steelhead become established. Defining reintroduction success, implementing measures designed to increase the potential for success, and outlining the steps leading to a potential reduction in future hatchery production are the next logical steps in the process.

4.8.7 Schedule

This study is complete.

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4.8.9 Comments and Responses on Draft Report

This section presents stakeholder comments provided on the draft report, followed by the Licensees' responses. The final column presents any follow-up comment offered by the stakeholder and in some cases, in italics, a response from the Licensees.

Commenter	Volume	Page/ Paragraph	Statement	Comment	Response	Response to Responses
WDFW – KAREN KLOEMPKEN	1	AQU 08	Background- lack of harvest regulation & habitat conservation. 1909-1917 hatchery operational. 1918-1930 hatchery not operational other than the fish rack. 1929-1932 Dam construction and completion.	I would tend to think the construction of a dam on a river would have a lot more impact on fish runs.	Impacts resulting from timber harvest activities, urban and rural development, agriculture, commercial and recreational harvest, and hatchery production have all had a major effect on salmon and steelhead runs.	
WDFW – KAREN KLOEMPKEN	1	AQU 08-3 – 6	Section 4.8.5.1. Continual mention and reference to "poor hatchery practices" as being a major cause of declining spring and fall Chinook runs.	Very little mention of "poor intermittent spilling, unsatisfactory water conditions, or tighter fishing regulations on the Columbia River" as being major contributors to the declining fish runs.	Spill records for Merwin Dam are provided in the IIP. To the extent the records are available, the final report will include a description of hatchery water quality and lower Columbia fishing regulations.	

Commenter	Volume	Page/ Paragraph	Statement	Comment	Response	Response to Responses
WDFW – KAREN KLOEMPKEN	1	AQU 08-3 para 1	4.8.5.1 under Lewis River heading. 1930 – fish production began. 1933-1953 – "poor hatchery practices" were reported to have taken place. Poor water conditions caused high mortality.	When were Lewis and Merwin hatchery fish collection facilities built? What were the "poor hatchery practices" that took place?	As stated on page AQU 8-4, full paragraph 2, the Lewis River Hatchery and Merwin Dam Anadromous Fish Collection Facility became fully operational in 1932, although juvenile salmon stocking began as early as 1930. The discussion of "poor hatchery practices" will be expanded, although data describing these early hatchery practices are very limited.	
USDA Forest Service: John Kinney	1	AQU 08-15 RBT p. 39 Swift Reservoir	…Mt. Whitney RBT spawn from February through March (Crawford 1979). …1999 angler survey…rbt and ct comprised 84.7% and 14.7% of the fish harvested.	These RBT have the potential to hybridize with native coastal cutthroat trout. Will this interaction be discussed? Species composition would indicate potential interaction.	Agreed, this potential interaction will be discussed briefly in the final report, and in more detail in the Species Interactions Study (AQU 16) and Lewis River Fish Planning Document (AQU 18).	Thank you!
TWHB	1	AQU 08-15, 23-25	Hatchery program – Winter-Summer Steelhead	Smoker (1951) estimated that >1K adults returned to the river. Most destined for the N.F. upper Lewis. Combined goal of 800 fish is below what the target mitigation value should be. ESA native steelhead resides in the	Agreed; the goal of the Lewis River Fish Planning Document and ongoing interagency ESA consultation is to address several of these concerns.	

Commenter	Volume	Page/ Paragraph	Statement	Comment	Response	Response to Responses
				Lewis river below Merwin Dam. The hatchery fish have been brought in from a variety of diverse sources. Thus, there are genetic and demographic concerns. The hatchery practices needs to be reconciled with ESA population needs. The hatchery program could be transformed to a combination supplementation (upper basin) and safety-net facility (lower river stocks) while ensuring harvest opportunities. This requires an updated Fish Management Plan, to include a supplementation plan for re-introduction that is consistent with state, ESA and tribal goals.		
TWHB	1	AQU 08-15-17;	Direct planting of Non-native species	Planting of non-native species while well meaning for recreational fisheries may be having negative genetic and demographic impacts to native endangered species. Hybridization of rainbow and native rainbow/steelhead is a concern. The tiger musky program is uncertain because predatory-prey studies are lacking. Will the kokanee program be converted to a sockeye program with fish passage? What will be the broodstock source? Could this be an opportunity to provide an 'experimental' population of redfish lake sockeye?	Agreed, the planting of non-native fish stocks has the potential to adversely affect native Lewis River stocks. In the READ document, the Licensees have proposed several "actions" addressing this issue, including modifications to the Swift Reservoir rainbow trout stocking program and Lake Merwin kokanee stocking program. Modifications to the Lake Merwin tiger musky program are also being discussed. Because fishery management in the Lewis River basin is largely the responsibility of the WDFW,	

Commenter	Volume	Page/ Paragraph	Statement	Comment	Response	Response to Responses
					future reductions or increases in the planting of non-native stocks will need to be coordinated with, and approved by WDFW.	
WDFW – KAREN KLOEMPKEN	1	AQU 08-18 para 1, last sentence	Missing word.	Need to insert the word "of" after the word "description."	Comment noted.	
TWHB	1	AQU 08-19	Hatchery program – Spring Chinook	The goal of mitigation for lost production above the three dams is not being met. In fact not even the hatchery broodstock goals are being met. While over fishing was common in the Lower Columbia prior to the building of Merwin Dam an estimated 3,000 adult spring Chinook were reported to return. The hatchery goal of 800 fish is significantly lower than full mitigation. Between 1995 and 1999 these goals were met only once. Clearly, full mitigation is and has not occurred. In those years when returning adults do exceed hatchery goals the fish are recycled through a sport fishery once then removed from the system. Thus, the hatchery program is under-scaled to meet project effects on native runs.	The adequacy of the existing mitigation goals and the potential to increase basin production as a result of anadromous fish reintroduction are currently being evaluated as a component of the Lewis River Fish Planning Document. Because of variations in harvest (regulated by entities other than the Licensees), hatchery conditions, ocean and estuary survival, and other factors affecting the size of adult returns, adult returns to a facility should not be the only factor used to assess the success of a mitigation program. While the mitigation goals included in the current license are not being met for all species in all years,	

Commenter	Volume	Page/ Paragraph	Statement	Comment	Response	Response to Responses
					greater reliance on natural production (i.e. reintroduction) should increase the abundance of salmon and steelhead returning to the basin. The juvenile to adult survival of naturally produced salmonids has been shown to be significantly higher than that of hatchery produced fish.	
WDFW – KAREN KLOEMPKEN	1	AQU 08-19 para 1, second to the last sentence	Removal of spring Chinook from the system.	This sentence states that the spring Chinook "are removed from the system" but doesn't say where they "are removed" to. Could you give a little more info on where the fish go?	It is our understanding that these fish are either sold or transported to a local landfill for disposal.	
WDFW – KAREN KLOEMPKEN	1	AQU 08-20 para 2, sentence # 7	Removal of coho from the system.	This sentence also states that the coho "are removed from the system." Where are they removed to?	It is our understanding that these fish are either sold or transported to a local landfill for disposal.	
WDFW – KAREN KLOEMPKEN	1	AQU 08-21 para 2	Acronym VHS.	Might consider spelling out "VHS" before using the acronym.	VHS will be spelled out in the final report.	
WDFW – KAREN KLOEMPKEN	1	AQU 08-29 para 1	List of diseases.	Should spell out IHN before using acronym and the correct use is IHNV epizootic, not IHN.	Comment noted. It will be addressed in the final report. If IHN is present as a chronic condition, as is the case with fall Chinook spawning in the Rogue River, it may not become an epizootic.	
WDFW – KAREN KLOEMPKEN	1	AQU 08-31 para 1, second to the last sentence	Extra word in sentence.	Should remove "as" from between "3 times" and "higher than" for the sentence to make sense. Also, were the phosphorus levels at	Comment noted. It will be corrected in the final report.	

Commenter	Volume	Page/ Paragraph	Statement	Comment	Response	Response to Responses
				Speelyai Hatchery within NPDES standards?	A more detailed description of the phosphorous levels observed at Speelyai Hatchery is included in WAQ-1.	
WDFW – KAREN KLOEMPKEN	1	AQU 08-32 Strategy #2	Strategy.	This strategy conflicts with the WDFW's Draft Fisheries Management and Evaluation Plan's strategy #2. Is this correct? This also doesn't fit with the other strategies.	Correct. For steelhead, the goal is to provide fish for recreational harvest while minimizing impacts (interbreeding and competition) to native stocks.	
WDFW – KAREN KLOEMPKEN	1	AQU 08-36 Sentence #8	Information source.	This sentence doesn't specify to whom the information is "according to." Are the "()" only supposed to be around the year notation?	Comment noted, it will be corrected in the final report	
WDFW – CURT LEIGH	1	AQU 08-40		This is an example of an unnecessary opinion in a technical report.	The discussion section of this report was designed to summarize what the author has gleaned from his review of available information and to some extent, it does represent professional opinion.	
WDFW – KAREN KLOEMPKEN	1	AQU 08-40 para 1	Adverse affects on native salmon and steelhead stocks.	Building the three dams has also had an adverse affect on the number of native Lewis River salmon and steelhead stocks. Actually, they are the stimulus for many of the hatchery practices.	Comment noted. Text referencing the construction of the dams will be added to the discussion section of the report.	
WDFW – JIM BYRNE	1	AQU 08-40 para 2	Hatchery Operations.	It will be the intention of the licensees to push for a drop in hatchery production if reintroduction succeeds.	Comment noted.	

AQU 8 Appendix 1

WDFW Joint Response to "Key" Questions

AQU 8 Appendix 1: WDFW Joint Response

After receiving the list of questions presented in Section 4.8.4, WDFW Region 5 staff elected to prepare a joint response, rather than conduct individual interviews. This written response was faxed to PacifiCorp on June 20, 2001. WDFW staff answered only 5 of the 13 questions.

Jeff Koenings
Director

Washington Department of FISH and WILDLIFE

Washington Department of Fish and Wildlife • Region 5
2108 Grand Boulevard, Vancouver, Washington 98661

Telecopier Transmittal Cover Sheet

FAX Phone (360) 906-6776 or 6777
Phone number (360) 696-6211 (Dial 0 to reach receptionist)

Date: June 20, 2001

Pages to follow:

Addressee: Eric Lesko

Sender: Craig Burley

Subject:

Comments:

DRAFT

WASHINGTON STATE DEPARTMENT OF FISH AND WILDLIFE
LEWIS COMPLEX
111 MERWIN HATCHERY CT.
ARIEL, WASHINGTON 98603
PHONE (360) 225-2120
FAX (360) 225-6330

May 1, 2001

TO: Craig Burley

FROM: Robin Nicolay

SUBJECT: Questionnaire

I have no idea where the information that I sent you ended up but here goes again. Most of the questions that are put forth will have to be addressed by your staff but I will add what I can.

1. What species are currently augmented or supplemented by hatchery programs?

Spring Chinook, Summer and Winter Steelhead, Early (type S) and Late Coho (type N), Kokanee and Rainbow.

4. What are the current escapement and production goals for both wild and hatchery fish on the North Fork Lewis River Watershed?

Production goals for hatchery stocks are as follows; Spring Chinook - 1.05 million smolts, 210k pounds. Summer Steelhead - 175k smolts, 35,700 pounds. Winter Steelhead- 100k smolts, 20,400 pounds. Early Coho - 880k, 58,700 pounds. Late Coho - 815k smolts, 54,300 pounds. Kokanee - 45k fingerlings, 3,750 pounds, 48k yearlings, 8,750 pounds. Rainbow -800k, 30k pounds.

5. What diseases have occurred at existing hatcheries?

Furunclosis, Columnaris, Low Temperature Disease, Bacterial Kidney Disease, Costia, Trichodina, Ichthyophthirius, IHN, VHS, Saprolegnia, Coagulated-Yoke, Stomach Fungus, Gill Fungus, Sanguinicola.

DRAFT

12. Where are excess fish being released and have environmental effects been considered?

In recent years, fish excess to our program (summer & winter steelhead, early & late coho) have been planted as excess into Merwin Reservoir. Records of numbers planted are available at Merwin Hatchery. Excesses of hatchery stocks are part of the rearing process especially in the rearing of steelhead because of strict release size requirements. Excesses are held to provide for backup in case of an excessive mortality due to disease during the early rearing phase of each stock and in the case of Steelhead, excesses are reared to insure that the programed release numbers can all meet the minimum length criteria.

13. What is the purpose of the three hatcheries? Are the hatchery objectives being met?

The chief purpose of the three facilities is to provide the capability of rearing all mitigated stocks for release into local waters. Actually the present facilities are less than adequate to rear all of the mitigated stocks in a presently accepted rearing environment. Although hatchery objectives are met in almost every instance, fish health is being compromised in many instances due to less than adequate available water flows, water temperatures either higher or lower than is acceptable and the overall lack of rearing space.

AQU 8 Appendix 2

Hatchery Fish Release Locations (1952 through 1998)

Appendix 2: Hatchery Fish Release Locations (1952 through 1998)

Species	Release Location	Total Planted	Number of Years Planted
Spring Chinook	E. F. Lewis River, trib to Lewis River	461,950	4
	Green Fork, trib to East Fork Lewis River	32,000	1
	Lewis River	21,895,922	27
	Speelyai Creek, trib to Lewis River	22,926	4
Fall Chinook	Cedar Creek, trib to Lewis River	158,040	2
	E. F. Lewis River, trib to Lewis River	405,452	2
	Johnson Creek, trib to Lewis River	2,095,275	5
	Lewis River	22,031,139	25
	N. F. Chelatchie Creek, trib to Chelatchie Creek	285	1
	Rock Creek, trib to East Fork Lewis River	975,881	4
	Speelyai Creek, trib to Lewis River	18,292	1
Coho	Big Creek, trib to Lewis River	249,000	1
	Big Tree Creek, trib to East Fork Lewis River	596,901	6
	Canyon Creek, trib to Lewis River	420,534	2
	Cedar Creek, trib to Lewis River	3,860,199	19
	Copper Creek, trib to East Fork Lewis River	1,306,684	8
	E. F. Lewis River, trib to Lewis River	5,557,772	22
	Fly Creek, trib to Canyon Creek	350,000	1
	Green Fork, trib to East Fork Lewis River	1,738,907	10
	John Creek, trib to Cedar Creek	358,200	5
	Johnson Creek, trib to Lewis River	266,500	5
	Lewis R & Tribs	2,942,787	10
	Lewis River	137,956,068	47
	Little Creek, trib to East Fork Lewis River	38,100	2
	Lockwood Creek, trib to East Fork Lewis River	771,559	10
	Mason Creek, trib to East Fork Lewis River	893,850	8
	N. F. Chelatchie Creek, trib to Chelatchie Creek	1,311,874	10
	Pass Creek, trib to Lewis River	55,200	1
	Riley Creek, trib to Lockwood Creek	299,060	6
	Rock Creek, trib to East Fork Lewis River	2,966,024	14
	Speelyai Creek, trib to Lewis River	7,477,812	20
Steelhead	Cedar Creek, trib to Lewis River	88,913	5
	E. F. Lewis River, trib to Lewis River	3,029,656	17
	Lewis R & Tribs	499,179	3
	Lewis River	4,464,034	20
	Rock Creek, trib to East Fork Lewis River	5,032	1

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Comments and Responses on Draft Report

This section presents stakeholder comments provided on the draft report, followed by the Licensees' responses. The final column presents any follow-up comment offered by the stakeholder and in some cases, in italics, a response from the Licensees.

Commenter	Volume	Page/ Paragraph	Statement	Comment	Response	Response to Responses
WDFW – KAREN KLOEMPKEN	1	AQU 08 App 2	Table.	How about including years released in the table? It would be useful information.	This information was not readily available.	

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AQU 8 Appendix 3

Hatchery Fish Releases Above Merwin Dam (1995-2000)

Hatchery fish releases into Lake Merwin (1995 through 2001).

Year	Species	Size (#/lb)	Number Released	Source
1995	Coho	14	241,300	Hillson and Tipping (1999)
	Sea-run Cutthroat	24	9,840	
	Tiger Musky	5.8	1,208	
1996	Coho	6.7	108,500	Hillson and Tipping (1999)
	Winter Steelhead	34	10,846	
	Summer Steelhead	33.5	34,572	
	Tiger Musky	2	375	
1997	Kokanee	6	41,560	Hillson and Tipping (1999)
	Kokanee	2,600	4,800	
	Winter Steelhead	22	13,920	
	Winter Steelhead	1,575	50,261	
	Summer Steelhead	767	80,476	
	Tiger Musky	4	1,331	
1998	Rainbow Trout	3.6	52,562	Hillson and Tipping (1999)
	Rainbow Trout	116	78,740	
	Spring Chinook	1,400	415,124	
	Winter Steelhead	50	53,787	
	Winter Steelhead	24	20,015	
	Summer Steelhead	11	4,160	
	Summer Steelhead	30.8	48,541	
	Sea-run Cutthroat	24	2,214	
	Coho	1,300	1,417,005	
	Coho	150	116,955	
	Tiger Musky	3.5	1,945	
	Tiger Musky	10	1,717	
1999	Kokanee	14	20,234	Hillson and Tipping (2000)
	Kokanee	5	49,925	
	Kokanee	461	55,208	
	Kokanee	461	166,943	
	Spring Chinook	259	66,175	
	Spring Chinook	166	10,126	
	Spring Chinook	54	83,405	
	Spring Chinook	1,200	30,741	
	Spring Chinook	1,110	165,693	
	Coho	651	177,072	
	Coho	126	61,992	
	Coho	153	155,040	
	Coho	159	112,168	
	Coho	1,160	1,359,588	
	Summer Steelhead	23	6,256	
	Winter Steelhead	68	9,724	
	Winter Steelhead	40	56,433	
	Tiger Musky	2.9	1,273	

Hatchery fish releases into Lake Merwin (1995 through 2001) (Continued).

Year	Species	Size (#/lb)	Number Released	Source
2000	Kokanee	11	4,348	2000 Hatchery Report
	Kokanee	4.8	39,772	
	Winter Steelhead	55	42,395	
	Winter Steelhead	22.5	36,530	
	Tiger Musky	2.8	968	
	Tiger Musky	3.1	1,128	
	Goldendale Rainbow Trout	0.5	962	
	Coho	574	78,638	
	Coho	557	80,208	
	Coho	71	277,568	
2001	Kokanee	330	37,356	2001 Hatchery Report
	Kokanee	42	45,742	
	Kokanee	16	45,014	
	Coho	30	10,380	
	Coho	88	4,397	

Hatchery fish releases into Yale Lake (1995 through 2001).

Year	Species	Size (#/lb)	Number Released	Source
1995	None	NA	NA	1995 Hatchery Report
1996	None	NA	NA	1996 Hatchery Report
1997	None	NA	NA	1997 Hatchery Report
1998	None	NA	NA	1998 Hatchery Report
1999	Kokanee	461	222,151	1999 Hatchery Report
2000	Kokanee	230	32,085	2001 Hatchery Report
2001	Summer Steelhead	67	125,677	2001 Hatchery Report

Hatchery fish releases into Swift Reservoir (1995 through 2001).

Year	Species	Size (#/lb)	Number Released	Source
1995	South Tacoma Rainbow Trout	43	453,328	1995 Hatchery Report
	Goldendale Rainbow Trout	27.6	422,061	
	Goldendale Rainbow Trout	28	82,804	
1996	Goldendale Rainbow Trout	26	419,683	1996 Hatchery Report
	Goldendale Rainbow Trout	25	306,973	
	Goldendale Rainbow Trout	25	69,020*	
1997	Goldendale Rainbow Trout	27.5	243,569	1997 Hatchery Report
	Goldendale Rainbow Trout	26	50,315	
	Goldendale Rainbow Trout	30	355,696	
	Goldendale Rainbow Trout	13	30,000	
1998	Goldendale Rainbow Trout	31	436,900	Hillson and Tipping (1999)
	Goldendale Rainbow Trout	29	65,304	1998 Hatchery Report
	Goldendale Rainbow Trout	27	224,613	
	Goldendale Rainbow Trout	22	203,544	
1999	Mt. Whitney Rainbow Trout	25	83,289	1999 Hatchery Report
	Winter Steelhead	34	99,972	
	Winter Steelhead	34	44,737	
2000	Spokane Rainbow Trout	36	85,485	2000 Hatchery Report
	Spokane Rainbow Trout	42	126,798	
	Spokane Rainbow Trout	39	102,375	
	Goldendale Rainbow Trout	39	116,103	
	Goldendale Rainbow Trout	40	116,600	

Hatchery fish releases into Swift Reservoir (1995 through 2001).

Year	Species	Size (#/lb)	Number Released	Source
2001	Spokane Rainbow Trout	37.5	116,266	2001 Hatchery Report
	Goldendale Rainbow Trout	34	147,678	
	Goldendale Rainbow Trout	38	112,551	
	Spokane Rainbow Trout	37	154,569	
	Mt. Whitney Rainbow Trout	37.5	152,400	
	Mt. Whitney Rainbow Trout	34.8	150,548	
	Mt. Whitney Rainbow Trout	34.8	84,175	

Hatchery fish releases into Swift canal (1995 through 2001).

Year	Species	Size (#/lb)	Number Released	Source
1995	None	NA	NA	1995 Hatchery Report
1996	None	NA	NA	1996 Hatchery Report
1997	None	NA	NA	1997 Hatchery Report
1998	None	NA	NA	1998 Hatchery Report
1999	None	NA	NA	1999 Hatchery Report
2000	Sea-run Cutthroat	2	2,212	2000 Hatchery Report
	Goldendale Rainbow Trout	3.7	23,754	
	Goldendale Rainbow Trout	3.8	4,408	
2001	Sea-run Cutthroat	1	552	2001 Hatchery Report

Hatchery fish releases into Swift Reservoir tributaries (1995 through 2001).

Year	Species	Stream Name	Size (#/lb)	Number Released	Source
1995	None	NA	NA	NA	1995 Hatchery Report
1996	None	NA	NA	NA	1996 Hatchery Report
1997	None	NA	NA	NA	1997 Hatchery Report
1998	None	NA	NA	NA	1998 Hatchery Report
1999	None	NA	NA	NA	1999 Hatchery Report
2000	Coho	NA	Adult	120	2001 Technical Report
2001	Coho	Muddy River	102	100,266	2001 Hatchery Report
	Coho	Smith Creek	236	100,399	Pers comm. J. Byrne, WDFW
	Spring Chinook	Upper Lewis River	100	150,100	
	Spring Chinook	Upper Lewis River	100	140,000	
	Coho	Upper Lewis River	Adult	7,011	
	Spring Chinook	Upper Lewis River	Adult	82	

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