

January 1999
**1999 LOWER GRANITE DAM
SMOLT MONITORING PROGRAM**

Annual Report



DOE/BP-02117-2



This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views of this report are the author's and do not necessarily represent the views of BPA.

This document should be cited as follows:

Verhey, Peter, Charles Morril, Fred Mensik, Doug Ross - Washington State Department of Fish and Wildlife, 1999 Lower Granite Dam Smolt Monitoring Program, Annual Report, Report to Bonneville Power Administration, Contract No. 88-FC38906, Project No. 87-127-00, 87 electronic pages (BPA Report DOE/BP-02117-2)

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1999 LOWER GRANITE DAM
SMOLT MONITORING PROGRAM

ANNUAL REPORT

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Project Number 87-127
Contract Number 88-FC38906

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Summary

The 1999 fish collection season at Lower Granite was characterized by high spring flows and spill, low levels of debris, cool water temperatures, increased hatchery chinook numbers, and an overall decrease in numbers of smolts collected and transported. A total of 5,882,872 juvenile salmonids were collected at Lower Granite. Of these, 5,466,057 were transported to release sites below Bonneville Dam, 5,232,105 by barge and 233,952 by truck. An additional 339,398 fish were bypassed back to the river. A total of 117,609 salmonids were examined in daily samples. Nine research projects conducted by four agencies impacted a total of 440,810 smolts (7.5% of the total collected) of which 247,268 were PIT tagged and 572 were recorded as incidental mortalities.

Introduction

The Fish Passage Center's Smolt Monitoring Program (SMP) is designed to provide a consistent, real-time database on fish passage and document the migrational characteristics of the many stocks of salmon and steelhead in the Columbia Basin. Each of the SMP sites collects and provides fish passage as well as pertinent flow, spill and/or other site specific data required for the SMP on a daily basis throughout the season to the FPC. FPC staff oversees and guides the SMP sampling programs at each of the sites. The Fish Passage Center, as a representative of the fishery agencies and tribes, uses this data to work with the fishery managers to seek appropriate flow and spill measures to enhance smolt passage and survival as identified in the hydrosystems operations requirements set forth in NMFS Biological Opinion and in the Northwest Power Planning Council's Fish and Wildlife Program.

Lower Granite Dam is located on the Snake River, approximately 107.5 miles upstream from the confluence with the Columbia River. Lower Granite is the first of eight dams that migratory juvenile salmonids in the Snake River and its tributaries encounter on their way to the ocean. It has one of four juvenile fish collection and transportation facilities operated by the Corps of Engineers on the Snake and Columbia Rivers. Fish that are collected are transported in barges and trucks to the release locations below Bonneville Dam on the Columbia River or bypassed back to the river. From there, they complete the remaining 140-mile journey to the ocean on their own.

At Lower Granite Dam, SMP staff collect and record data by inspecting a sample of each day's total smolt collection. The SMP has been active at Lower Granite since 1984 and has been operated by the Washington State Department of Fish and Wildlife (WDFW) since 1988. Staff technicians and biologists identify and record the following information for each fish sampled: species, rearing type (hatchery or wild), freeze brands and other external marks or tags including elastomer tags, fin clips, injuries and external signs of disease and/or stress. Lengths and weights are taken on a subsample of up to one hundred fish of each species every other day. The staff also collects daily river flow and/or spill and temperature data, monitors and assists on-site research activities of other agencies as needed, maintains accurate records of sample and collection data, transmits daily reports to the FPC and prepares an annual report.

River Conditions

Flow

Flows in the Snake River were generally good for migrating fish during most of 1999. River flows during April were moderate with flows increasing in May and June to near the average of the previous four years (Table 1). River flows for the last few days of March ranged between 98 and 128 kcfs (Appendix 1, Table 1). April flows, which averaged 93.8 kcfs, were the third highest in the last five years, and ranged between 73 and 126 kcfs. River flows first exceeded 100 kcfs on April 20, declined slightly, and then rose rapidly to peak for the year at 192.6 kcfs on May 27. Flows exceeded 150 kcfs for twelve days, from May 26 to June 6. Flows then declined steadily from June 6 through June 13. On June 14, flows began to rise, reaching 166.1 kcfs on June 20. Flow remained above 100 kcfs daily through June 28. River flows during July averaged 55.5 kcfs and dropped below 50 kcfs for the first time on July 25. Flows during August averaged 38.2 kcfs, dropping below 30 kcfs by the end of the month. Flows during most of September and October were in the mid-to-high 20 kcfs range. The flow on November 10, the last day of the season, was 23.0 kcfs. In all, daily average flows exceeded 150 kcfs for 17 days and 100 kcfs for 56 days. Flows did not reach the 200 kcfs level during 1999.

In early April, the Snake River projects were drafted to minimum operation pool (MOP) or MOP plus one foot. Lower Granite pool was drafted to 733-734 and Little Goose pool to 633-634. Little Goose pool was refilled between September 7 and 14 to 637 in order to improve adult fish passage facility operations at Lower Granite Dam. Lower Granite reservoir was refilled in November.

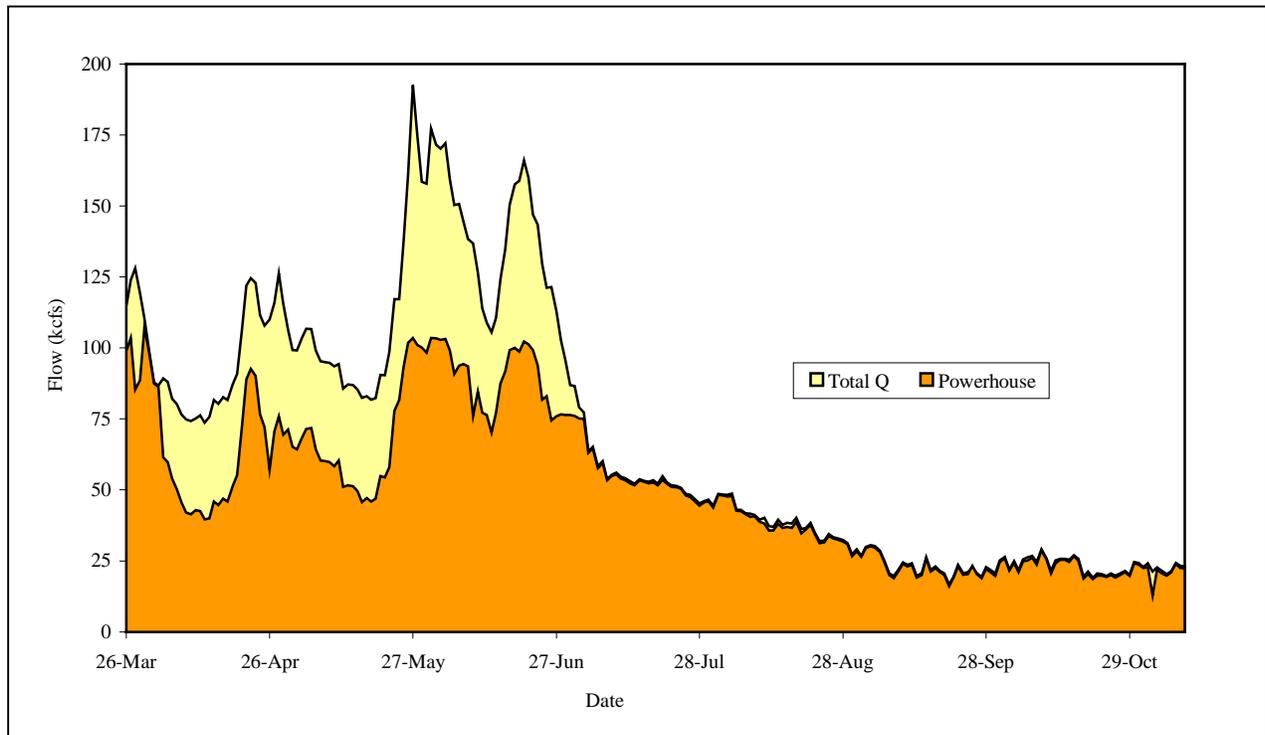
Spill

Spill took place for a few days at the end of March and then daily from April 3 through July 1. Spill for surface bypass collector research occurred between April 3 and June 2 and then intermittently during limited testing in July and August. Surface collector discharge through spillbay 1, along with accompanying discharge from spillbay 2, occurred nearly continuously during the spring test. Discharge through the collector averaged 4 kcfs and was shut off only for maintenance activities. Discharge through spillbay 2 averaged 2 kcfs. In all, spill occurred at the project a total of 93 days and ranged between 88 kcfs and 10 kcfs. The peak spill level occurred on the peak flow date of May 27. Spill in excess of turbine capacity occurred on 22 days during 1999.

Table 1. Comparison of average monthly river flow and spill at Lower Granite Dam, 1995-1999.

Month	1995	1996	1997	1998	1999	1995-1998 Average
Flow (kcfs)						
Apr	60.1	112.6	120.9	64.8	93.8	90.0
May	107.9	126.2	168.5	139.3	110.8	135.2
Jun	115.6	146.2	162.8	115.4	135.8	135.1
Jul	62.0	55.4	69.8	62.4	55.5	62.4
Aug	37.4	37.6	46.9	33.7	38.2	38.9
Sep	27.4	25.0	29.6	26.4	23.0	28.5
Oct	28.0	22.2	40.5	24.3	23.4	27.6
Spill (kcfs)						
Apr	0.0	47.0	27.2	12.7	32.6	21.7
May	18.4	47.0	58.5	45.1	41.9	42.2
Jun	9.3	52.6	62.1	29.0	46.4	38.2
Jul	0.0	3.4	3.3	3.3	0.5	2.5
Aug	0.0	0.1	0.6	0.0	0.3	0.1
Sep	0.0	0.0	1.5	0.0	0.0	0.4
Oct	0.0	0.0	0.2	0.0	0.0	0.0

Figure 1. Daily average powerhouse discharge and spill at Lower Granite Dam, 1999.

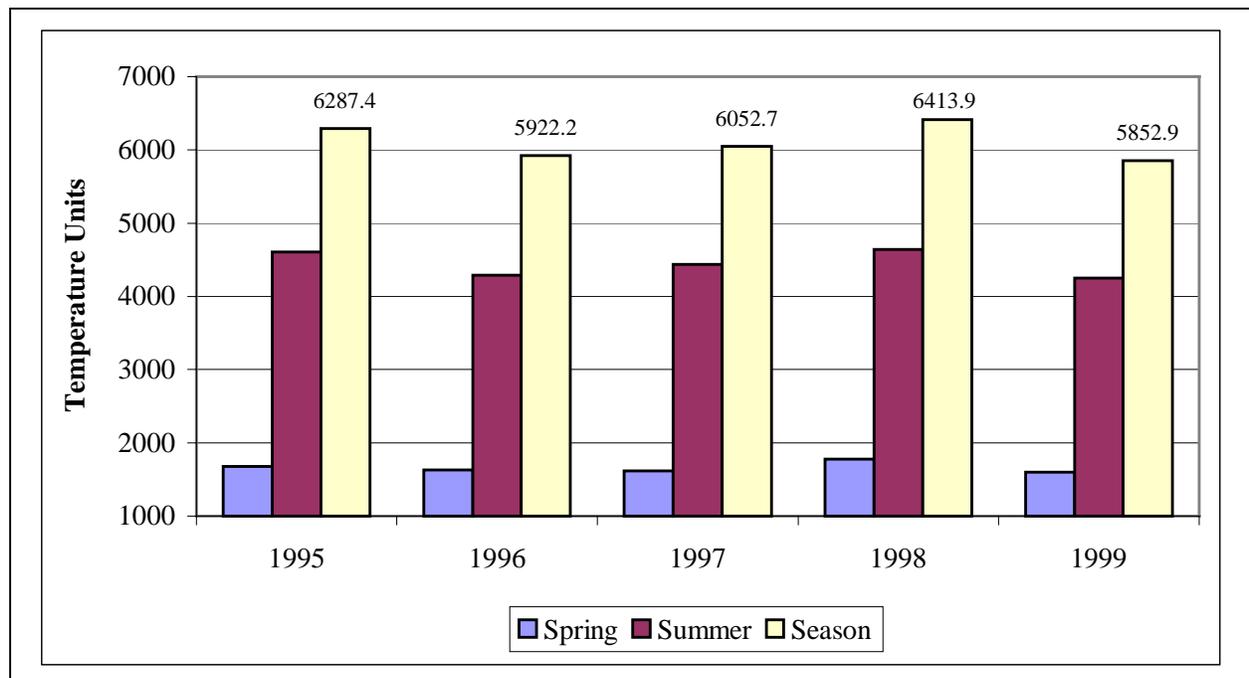


Temperature

Water temperatures were generally favorable for fish migration during 1999. Facility water temperatures were in the mid-forty degree range at the beginning of the season in late March and did not exceed 60° F until June 30 (Appendix 1, Table 1). The water temperature remained below 65° F until July 12 and did not reach 70° F during 1999 at Lower Granite. The peak temperature of 68.9° F occurred on three dates: August 25, August 28 and August 29. Water temperatures declined steadily during September and October and dropped below 60° F on October 14. The water temperature on November 10, the last day of the season, was 51.3° F.

From April 1 through October 31, 1999, temperature units (tu's), the number of Fahrenheit degrees above 32° F, totaled 5,853, the lowest in the last five years. The number of temperature units for the same period in 1998 and 1997 were 6,414 and 6,053, respectively. Temperature unit totals in 1999 decreased 5.1% over the average for the last four years. Water temperatures in 1999 during the spring migration period, April 1 to June 20, were 9.9% and 0.7% cooler based on tu totals for the same periods in 1998 and 1997 (1,776 in 1998 and 1,613 in 1997). Temperature unit totals during the spring/summer migration period, June 21 through October 31, in 1999 were 8.3% cooler than in 1998 (4,638 in 1998) and 4.3% cooler than in 1997 (4,440 in 1997). The average water temperature was 3.7° F cooler in 1999 between August and September than in 1998.

Figure 2. Sum of temperature units for Spring (April 1 – June 20), Summer (June 21 – Oct. 31) and fish collection season (April – Oct. 31) at Lower Granite, 1995 through 1999.



Debris

We began in 1998 to measure the volume of small woody debris collected in the sample tank on a daily basis during the season. Additionally, we made weekly estimates of floating debris in the forebay and recorded forebay debris removal events, trash rack raking events and dewatering screen cleaning events.

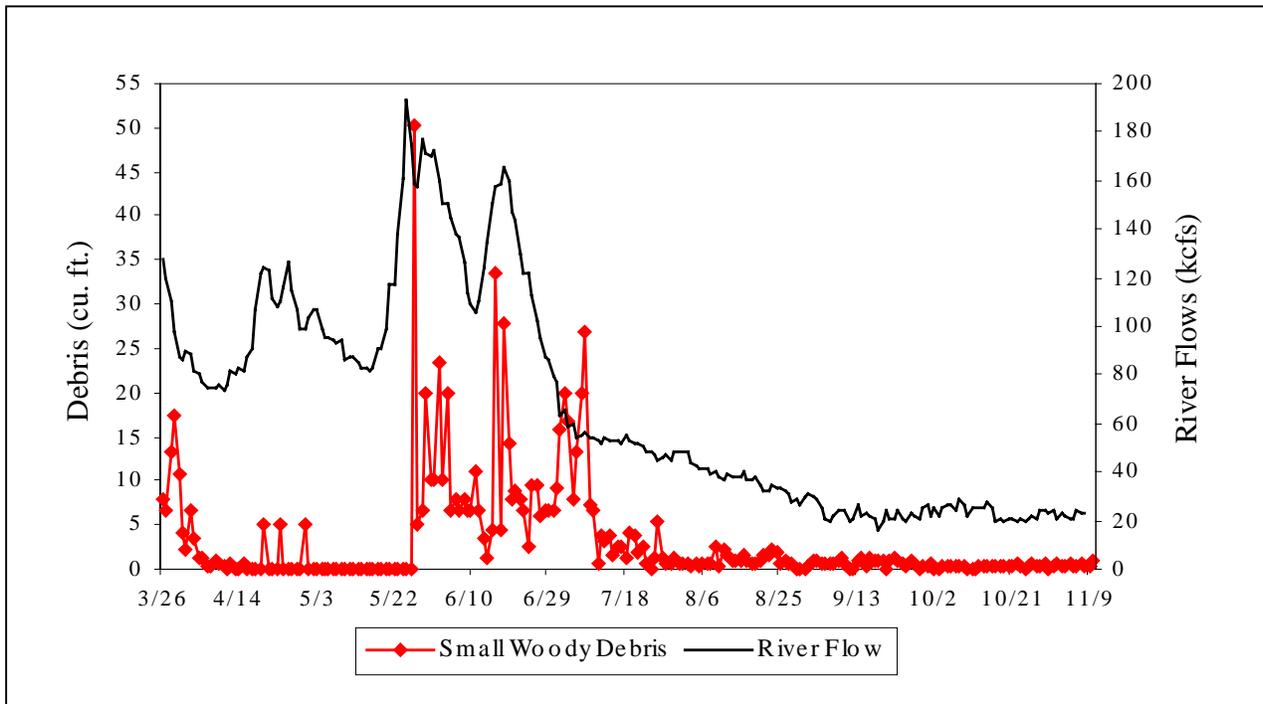
An estimated total of nearly 730 cubic feet of small woody debris passed through the fish facility in 1999. Daily debris accumulation averaged approximately 3.2 cubic feet per day. This is a decrease of approximately 19% from debris volumes measured in 1998 when an estimated total of 939 cubic feet of material, or 4.3 cubic feet per day passed through the collection facility. Peak facility debris periods in 1999 occurred at startup of fish collection, March 26 and following the seasons' peak flow date on May 29, between May 30 and June 16. Daily facility debris estimates during these periods ranged between five and 55 cubic feet of material. Daily facility debris loads were estimated based on daily sample tank accumulations and sample rates. Volumes of woody debris too large to pass through the separator bars were not estimated.

Floating woody debris in the forebay was estimated during 1999. From the beginning of the fish collection season on March 26 to about May 24, floating debris covered approximately 1,500 square feet in the forebay. Between May 25 and May 27, peak flows brought more debris downriver and floating woody debris in the forebay increased to approximately 20,000 square feet. The following week (May 28 through June 3) floating debris in the forebay increased 120% to approximately 45,000 square feet, or about one acre. By June 10, the raft had grown to about 3.7 acres. Between June 17 and early July, the raft increased in size to about 4.0 acres. During the first two weeks of July, wind and wave action gradually reduced the size of the debris raft to about 2.5 acres. Forebay debris removal was conducted on July 12. At this time, the debris raft was surrounded by a log booms and was towed away from the powerhouse to the north side of the river. Between July 16 and August 23, floating woody debris in the forebay was negligible. However, on August 24, floating woody debris in front of turbine units 1-4 increased from approximately 5,000 square feet to 25,000 square feet following the removal of the behavioral guidance structure (BGS).

Trashracks on unit 1 first were cleaned of debris on February 1 and then in conjunction with unit 2 on February 16. Other trashrack cleaning dates and the areas cleaned were: June 24-25 (unit 5), and July 7 (units 5 & 6).

The inclined screen of the primary dewatering screen located between the upwell and the separator was cleaned of fine organic debris during the season. Heavy movement of small debris caused an increased number of screen cleanings during the spring and early summer of 1999. There were a total of 36 separate cleaning events, each of which took approximately 20 minutes. This is a considerable increase from 1998 when 14 cleanings were required. Debris was removed in each instance by closing the dewatering valve below the screen and opening the 72-inch bypass valve. This took the pressure off the top of the inclined screen and allowed the debris to wash off or be easily brushed off.

Figure 2. Estimated total daily small woody debris accumulation in the juvenile fish bypass system and flows at Lower Granite Dam in 1999.



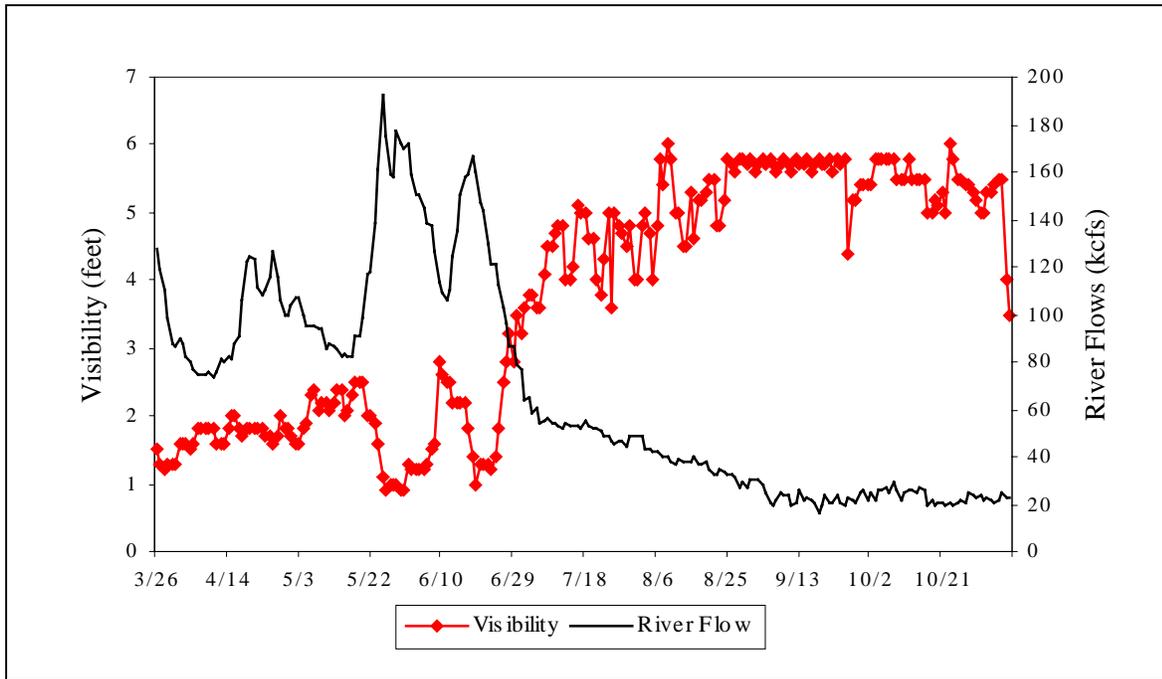
Turbidity

We used a secchi disc to measure turbidity during the season in the adult fish ladder at Lower Granite. Visibility readings gave us a relative measure of turbidity. When loads of suspended solid particle materials in the river increased, visibility through the water decreased. Measurements were taken from the surface of the fish ladder adjacent to the adult fish viewing windows. We used a six-inch black and white disk attached to the end of a two-meter rod with graduations in tenths of feet. Most measurements were taken at about the same time of day every day between 10 A.M. and noon. Surface water conditions at the measurement location were generally flowing and rippled and together with varying lighting conditions may have decreased the accuracy of individual measurements somewhat. Shallower readings were easier to take accurately than deep ones.

We observed two relatively sharp decreases in visibility in the river this season. The largest decrease in visibility occurred during peak flows of the main spring runoff period between May 25 and June 13 with peak runoff of 192 on May 27 (Figure 4). The long cool spring resulted in a protracted runoff period and a second surge of water peaking at 166 kcfs on June 20. Visibility during these periods averaged under 1.8 feet while visibility during peak flows in 1998 was generally less than one foot. Low visibility in the river during this period did not corresponded with peak season collection counts as it did in 1998 (see migration timing). Subsequent decreases in visibility corresponded with storm events in the region during the

summer. Two windstorms resulted in nearly two-foot decreases in visibility. The first wind storm occurred on June 15, and reduced visibility from 2.8 feet on June 15 to about 1.0 feet on June 21. Again, on September 25 a windstorm swept upriver reducing visibility from 5.8 to 4.4 feet on September 28. Visibility in late July and for the rest of the season ranged between four and five feet and did not appear to appreciably effect daily fish counts.

Figure 3. Fish ladder visibility and river flows at LGR, 1999.



Sample Program and Summary

Overview

Daily samples of fish from the general collection were counted by hand and examined throughout the season. Sample data including counts by species, weight and descaling data were recorded and summarized daily to provide real time information for the Smolt Monitoring Program and for the Corps of Engineers transportation program. Daily samples were collected over a 24-hour period between 7 a.m. and 7 a.m. and processed between 7:30 and 10 a.m. each day. In the latter part of the season when the mini-tanker was used to transport fish daily samples were processed every-other-day on transport days. Throughout most of the season, researchers taking advantage of the availability of anesthetized fish in the sample took fish for marking and study purposes. We sampled a total of 117,609 smolts, 2.0% of the total collection this season. Daily sample sizes averaged 511 fish for the season and ranged between 86 and 2,355 fish.

Daily sample procedure

Fish diverted to the sample tank were held for up to 24 hours prior to examination. The 24-hour sample period started at 7 a.m. At the end of each 24-hour sampling period, the entire sample was processed. Small groups of fish were separated into batches as follows: screens in the sample holding tank were moved forward to crowd fish to the front of the tank. Once there, small groups of fish were drawn/guided into the pre-anesthetic chambers by opening and closing the knife gates. Batch sizes typically ranged between 30 and 60 fish per chamber and the number of fish was adjusted based on the amount of time the gate was opened and the position of the crowder screen. The fish tranquilizer, ethyl m-aminobenzoate methansulfonate (MS-222®), was added to the chamber to obtain a concentration of about 62 mg/l. At this concentration, about 95 percent of the fish were adequately sedated within three minutes. Once anesthetized, these fish are flushed through the exit valve on down to the sorting tank.

The sorting tank is part of a re-circulating anesthetic system with water temperature control and aeration. The anesthetic levels in the system are set to keep fish sedated and easy to handle during the sample. Typically the MS-222 levels averaged between 55-60 mg/L. Sample fish remained in the sorting tank for as little as five seconds and up to five minutes. We strive to process fish within three minutes of entering the tank to minimize the effects of sedation and handling as much as possible. Between the pre-anesthetic chambers and the sorting tank, sample fish were sedated an average of five minutes.

All fish handled in the sorting tank were enumerated by species and examined for unique marks and descaling. Additionally, a detailed sub-sample of up to 100 fish of each species was conducted during each daily sample. The detailed sub-sample recorded species, length, weight, unique marks, descaling, injuries and external symptoms of disease. In this process, fish were individually weighed and measured in a water-filled tray on an electronic balance. This detailed sub-sample provides the Corps with fish per pound and species composition data essential for calculations of raceway, barge and truck loading densities needed to stay within the maximum

loading densities (0.5 pounds of fish per gallon of water). Immediately after handling, fish were routed in fresh water to the recovery tank on non-transport days or routed directly onto a waiting truck or barge on transport days. The maximum time that any fish was held at the fish facility was 48 hours.

Sample rates

The sample system at Lower Granite consists of two slide gates located in the bottom of the flumes a few feet downstream of the separator, a large slide gate which separates PIT tagged fish from sample fish, a sample tank with four 4-inch counter tunnel exits, an enclosed pipe that carries fish from the sample tank to the holding tank, and a holding tank divided into two equal halves, each with two pre-anesthetizing chambers. The two primary slide gates, which are controlled by a timer calibrated in tenths of a minute, also act as PIT tag diversion gates. The system has the capability to send PIT tagged fish that exit the separator during a sample either to the sample or to the river. Most of the time, the system is set so the sample overrides the PIT tag diversion system, sending PIT tagged fish to the sample instead of being diverted back to the river. During 1999, this occurred from March 25 through July 13. From July 14 until September 1, when the PIT tag diversion system was shut down for renovation, the system was set to divert PIT tagged fish back to the river during the sample.

Samples were taken six times per hour during the course of the season, except later in the summer when the system was switched to 100% sample for the duration of the season. Samples ranged from 0.67% to 33.12% outside of the 100% sample period, which began at 0700 hours on September 2 and continued through the rest of the season. There were minor problems with the sample system: plastic air lines rupturing and causing breakdowns. With the exception of the air lines, the sample system worked properly for the most part, needing only minor adjustments in air pressure and gate timing by PSMFC personnel from time to time.

Sample rates were adjusted throughout the season to achieve daily sample sizes of between 500 and 1,000 smolts whenever practical. Sample rate adjustments were based on the SMP Sample Rates Guideline Table (Table 2), on daily trends in total collection estimates, and to meet researcher needs.

Daily sampling began at Lower Granite at 0700 on March 26 and continued daily through September 29, when every-other-day sampling commenced. A total of 230 daily samples were processed during the sampling season. The sample rate was set at 10% for the first six days of the season between 26 March and March 31. The sample rate was then dropped to 6% on April 1 and subsequently increased to 14% for April 7 only. The sample rate dropped back to 5% on April 15 and remained at that rate through April 19. Sample rates on April 20 and April 21 were set at 2% and 1%, respectively. The sample rate was reduced to its minimum setting of 0.67% on April 22 and varied between 1% and 0.67% for 29 days between April 22 and May 28, when collection counts were highest. Rates were then gradually increased to 10% on June 24. The sample rate was increased to 25% on July 8 and fluctuated between 25% and 10% for 51 days until September 2, when it was increased to 100%. The sample rate remained at 100% through the end of the collection season on November 10, a period of 70 days.

Sample sizes exceeded 1,000 fish on three days between March 25 and April 22 as daily

collection counts increased and the sample rate was gradually reduced to the minimum rate of 0.67%. While the sample rate was set on the minimum, samples sizes exceeded 1,000 smolts for thirteen days. Sample sizes exceeded 1,000 smolts on six days when the NMFS was marking fish from the sample lab between June 5 and 23. After June 24, samples exceeded 1,000 smolts three times, twice in mid-July and once on October 15.

Table 2. Lower Granite Dam Juvenile Fish Facility sample rate guidelines.

Daily Collection	Sample rate	Gate activations and Durations per hour**	Number of fish In sample
>80,000	0.67%	4 @ 6 seconds	533 plus
60,000 - 80,000	1.00%	6 @ 6 seconds	600 - 800
40,000 - 59,999	1.33%	4 @ 12 seconds	533 - 800
25,000 - 39,999	2.00%	6 @ 12 seconds	500 - 800
15,000 - 24,999	3.00%	6 @ 18 seconds	450 - 750
10,000 - 14,999	5.00%	6 @ 30 seconds	500 - 750
7,500 - 9,999	7.00%	6 @ 42 seconds	525 - 700
5,000 - 7,499	10.00%	6 @ 60 seconds	500 - 750
2,500 - 4,999	16.67%	10 @ 1 minute	417 - 833
500 - 2,499	25.00%	10 @ 1.5 minutes	125 - 625
<500	100%	Gate open	ALL

**This column refers to the number of times the sample slidegate opens in an hour. For instance the first set of numbers means the slidegate will open 3 times for 8 seconds each time during each hour of a 24-hour sampling period.

Season sample summary

A total of 117,609 fish, 2.0% of the total collection, were sampled in 1999 (Table 3 and 4). The total number of fish sampled by species included: 16,208 hatchery yearling chinook, 8,365 wild yearling chinook, 50,965 subyearling chinook, 35,060 hatchery steelhead, 4,481 wild steelhead, 420 hatchery sockeye/kokanee, 489 wild sockeye/kokanee and 1,621 hatchery coho (Table 4). Due to lower collection numbers, approximately 7,132 fewer smolts were sampled in 1999 than in 1998 when 124,741 fish, 1.8% of the collection, were sampled.

Subyearling fall chinook were sampled at a higher rate than other species because their migration timing through the summer exposes them to higher sample rates. In 1999 we sampled 19.8% of the subyearling fall chinook (Table 3). Higher daily collection counts of subyearling fall chinook in 1999 resulted in sample rates approximately 14% less than the previous four years (33.9%). In 1998, nearly 30% of the subyearling fall chinook smolts collected at the facility were sampled. Weekly sample totals and sample rates are provided in Table 4.

Table 3. Annual percentage of total juvenile salmonids collected that were sampled at Lower Granite Dam, 1995-1999.

Year	Yearling Chinook		Subyearling ¹ Chinook		Steelhead		Sockeye/Kokanee ²		Coho ³	Total
	Hatchery	Wild	Hatchery	Wild ⁴	Hatchery	Wild	Hatchery	Wild	Hatchery	
1995	1.0	2.4	---	28.7	1.0	1.3	10.0	9.8	---	1.2
1996	1.5	2.5	---	38.5	1.7	2.6	7.4	9.7	8.4	1.9
1997	1.3	1.7	26.9	38.3	1.5	1.6	7.1	36.3	6.9	2.0
1998	1.4	2.5	14.0	30.0	1.3	1.6	2.0	2.5	2.7	1.8
1999	0.9	2.0		19.8	1.2	1.4	4.2	6.1	2.1	2.0

¹Hatchery subyearling chinook were not present until 1997.

²Hatchery sockeye/kokanee were not present until 1995.

³Hatchery coho were not present until 1996.

⁴Includes unmarked hatchery subyearling chinook in 1999.

Table 4. Weekly sample rates in percent and sample totals at Lower Granite Dam, 1999.

Week Ending	Weekly Rate (%) ¹	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Totals
		Hatchery	Wild	Hatchery	Unmrk	Hatchery	Wild	Hatchery	Wild	Hatchery	
Apr 1	8.89	534	1,188	0	6	579	504	0	93	17	2,921
Apr 8	8.05	259	926	0	4	1,155	277	0	22	1	2,644
Apr 15	6.68	396	837	0	0	2,422	220	0	13	2	3,890
Apr 22	1.70	2,460	927	0	3	2,209	308	0	9	1	5,917
Apr 29	0.67	2,037	658	0	3	2,862	444	0	9	3	6,016
May 6	0.67	2,714	484	0	4	5,801	297	0	7	10	9,317
May 13	0.70	2,616	240	0	0	2,362	176	0	4	12	5,410
May 20	0.91	2,395	189	0	0	1,837	157	4	8	44	4,634
May 27	0.72	1,573	309	0	0	5,233	636	7	4	266	8,028
Jun 3	1.45	205	336	0	7	2,251	437	107	10	252	3,605
Jun 10	5.43	450	963	0	2,009	2,821	540	38	18	441	7,280
Jun 17	6.56	194	500	0	1,055	1,448	191	15	6	127	3,536
Jun 24	4.56	130	391	0	1,665	1,699	139	8	4	75	4,111
Jul 1	12.36	51	145	0	1,503	481	31	5	4	95	2,315
Jul 8	20.53	56	141	0	1,930	485	40	11	12	81	2,756
Jul 15	24.77	73	82	0	2,784	451	24	5	12	64	3,495
Jul 22	25.00	30	33	0	5,585	401	23	2	7	27	6,108
Jul 29	10.31	10	7	0	3,429	147	4	0	2	8	3,607
Aug 5	10.00	0	0	0	3,023	97	2	0	2	2	3,126
Aug 12	19.00	3	0	0	3,074	101	2	0	4	5	3,189
Aug 19	25.00	0	0	0	1,849	82	7	2	0	3	1,943
Aug 26	25.00	2	0	0	922	35	1	0	3	4	967
Sep 2	33.12	0	0	0	1,126	24	4	0	5	0	1,159
Sep 9	100.00	3	1	0	1,545	13	1	0	8	1	1,572
Sep 16	100.00	0	2	0	1,942	14	3	0	9	3	1,973
Sep 23	100.00	2	1	0	2,493	8	2	0	10	20	2,536
Sep 30	100.00	0	1	0	1,516	7	1	0	11	24	1,940
Oct 7	100.00	0	3	0	1,791	3	1	0	39	1	1,838
Oct 14	100.00	5	1	0	3,318	6	3	0	24	9	3,366
Oct 21	100.00	5	0	0	3,200	4	2	0	30	9	3,250
Oct 28	100.00	2	0	0	1,012	4	0	0	11	5	1,034
Nov 4	100.00	2	0	0	2,035	6	3	48	40	2	2,136
Nov 10	100.00	1	0	0	2,132	12	1	168	49	7	2,370
Season Total		16,208	8,365	0	50,965	35,060	4,481	420	489	1,621	117,609
Of Sample		13.8%	7.1%	0.0%	43.3%	29.8%	3.8%	0.4%	0.4%	1.4%	100.0%
Of Collection		0.9%	2.0%	0.0%	19.8%	1.2%	1.4%	4.2%	6.1%	2.1%	2.0%

¹ Fish sampled/fish collected X 100%.

A total of 1,914 sample fish were bypassed during the season in addition to fish bypassed for research. On May 28, a total of 471 smolts were bypassed because the barge trip was cancelled due to high spill, which prevented docking at the fish facility. Bypass species composition for that day was: 37 hatchery yearling chinook, 47 wild yearling chinook, 269 hatchery steelhead, 55 wild steelhead, 8 hatchery sockeye/kokanee, 2 wild sockeye/kokanee and 53 hatchery coho. On May 31, the sample recovery tank with 670 smolts was bypassed to the river accidentally. Bypass from the sample, due to lack of mini-tanker space, occurred on October 12 and 14 when 102 and 671 smolts, respectively, were returned to the river. Over 95% of the fish bypassed in October were subyearling chinook.

Four different agencies conducted five studies using fish from daily samples in 1999. During the sample season, researchers handled 18,582 smolts from the daily samples (Table 5), more than double the 7,340 smolts in 1998. Of the 17,831 sample fish tagged by researchers, 11,523 fish (64.6%) were subsequently bypassed, including: 2,958 hatchery yearling chinook, 2,230 wild yearling chinook, 97 subyearling fall chinook, 5,395 hatchery steelhead, 842 wild steelhead and one coho. NMFS fish marking activities for the transportation study occurred in the sample lab from April 2 to April 18 and again from June 5 to June 24. During this time, a total of 16,364 smolts were tagged including, 2,570 hatchery yearling chinook, 3,710 wild yearling chinook, 8,612 hatchery steelhead, 1,471 wild steelhead and one coho. For the cooperative NMFS/USGS-BRD sham radio tag study, a total of 1,350 hatchery yearling chinook were taken from the sample lab between April 17 and 28. Researchers with USGS BRD Radio-tagged 20 subyearling chinook and 20 hatchery steelhead and handled six hatchery yearling chinook and five hatchery steelhead on April 9 for the Surface Bypass Collector study. BRD researchers also tagged 97 subyearling fall chinook with temperature and depth radio tags from July 6 to September 7. During this temperature telemetry study they handled an additional 72 subyearling fall chinook and recorded two mortalities. Researchers with the University of Idaho sacrificed 124 smolts for a smolt condition study of in-river migrating fish. For this objective, they sacrificed: 54 hatchery yearling chinook, 34 wild yearling chinook, 18 hatchery steelhead and 18 wild steelhead. An additional 18 hatchery and 13 wild yearling chinook, and 27 hatchery and 13 wild steelhead were handled during this research. Additional details of these and other research activities conducted at LGR in 1999 are provided in the research section of this report.

Table 5. Total number of fish taken from daily samples for research needs at LGR, 1999.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Hatchery	Wild	Hatchery	Unmark	Hatchery	Wild	Hatchery	Wild	Hatchery	
Tagged	3,940	3,710	0	97	8,612	1,471	0	0	1	17,831
Examined	0	0	0	0	0	0	0	0	0	0
Sacrificed	54	34	0	0	18	18	0	0	0	124
Handled	235	58	0	73	206	14	0	15	0	601
Mortality	5	14	0	2	4	1	0	0	0	26
Total	4,234	3,816	0	172	8,840	1,504	0	15	1	18,582

Mark Recapture

We recorded hatchery marks and tags from marked smolts sampled for the Smolt Monitoring Program (SMP) and Gas Bubble Trauma sampling program (GBT). These marks include freeze brands, fin clips, elastomer tags (VIE) and coded wire tags (CWT). Information recorded for each mark type included location, orientation, color, clip codes, lengths on branded fish and tally totals. This information was reported daily to the Fish Passage Center throughout the season. We also recorded passive integrated transponder (PIT) tag codes from tagged fish collected in GBT samples, from daily facility mortalities and from all fish collected after September 1, when the PIT interrogation system was shut down. PIT tag records were flagged with conditional codes “RE” for recaptured fish and “M” for mortalities where appropriate and were submitted to the Columbia River Basin PIT Tag Information System (PTAGIS).

Hatchery subyearling fall chinook were released above Lower Granite at Big Canyon and Captain Johns Landing between June 3 and 5. However, because these fish were not fin clipped and only a portion of one group were coded wire tagged, we were unable to distinguish them from wild migrants. Because of this, beginning June 7, we recorded subsequent subyearling chinook as neither hatchery nor wild but of unknown rearing type. In all, approximately 670,000 Lyons Ferry hatchery subyearling fall chinook, of which 200,000 were coded wire tagged, were released above Lower Granite.

Dworshak hatchery releases included 2,100,000 hatchery steelhead divided into four treatment groups of which 10,000 smolts in each group were marked with freeze brands (Table 6). Releases were made from Dworshak Hatchery between March 25 and April 30 (Table 7). The freeze brand codes were RAR3, LAK1, RDK1, and LDK3. Only one fish from one group, RAR3, was observed in daily samples. This fish was recaptured at LGR on May 3 and represented 150 in the collection, or 1.5% of the total number released.

A total of 250,000 Lyons Ferry hatchery steelhead marked with the freeze brand code, RAIT3, were released from the Cottonwood Acclimation Ponds between March 25, and April 30, 1999. Of these, an estimated 20.6% (51,458) were collected at Lower Granite. The peak collection day for this group was April 29 when 9,900 branded smolts were collected

A total of 528,646 Lyons Ferry hatchery yearling fall chinook marked with colored elastomer (VIE) tags were released above Lower Granite from acclimation ponds at Big Canyon, Pittsburgh Landing and Captain Johns Landing (Table 6). Colored elastomer mark codes for fish released at these sites were left green (EL-LGR), right green (EL-RGR) and right blue (EL-RBL), respectively. Two releases were made at the Big Canyon site, on the Clearwater River approximately 108 river kilometers above Lower Granite, between April 12 and 28 with a total of 228,451 smolts. These smolts were observed in daily samples between April 16 and July 13 (Table 7). An estimated 51,490 (22.5%) smolts from the Big Canyon releases were collected at Lower Granite. From the Pittsburgh Landing acclimation ponds, 173 river kilometers above Lower Granite, a total of 142,885 yearling fall chinook elastomer coded EL-RGR were released between April 12 and 15. Nearly 30% (42,835) were collected at the bypass facility between April 16 and May 25. Smolts from Captain Johns Landing, 90 river kilometers above Lower Granite, were marked with the elastomer code EL-RBL. A total of 157,310 marked yearling fall

chinook were released from this site between March 25 and April 15. An estimated 29.5% (46,447) were collected at Lower Granite between April 17 and May 20. The peak collection day for each of these release groups was on April 22 (Figures 4, 5 and 6).

Supplementation releases of hatchery yearling spring/summer chinook marked only with coded wire tags (no fin clips) were made above Lower Granite between July 7, 1998 and April 16, 1999 for the 1999 migration season. Approximately 829,580 supplementation smolts were released in a cooperative effort by IDFG and the Nez Perce tribe in twelve releases from nine sites in the Snake River watershed. In the sample lab, we scanned unclipped yearling chinook for tags with coded wire tag detectors to distinguish hatchery smolts from wild. An estimated 70,238 coded wire tagged yearling chinook, or 8.5% of the total released, were collected at Lower Granite between March 27 and September 26 (Table 7). The peak daily collection for these smolts occurred on May 3 when an estimated 4,650 fish were collected (Figure 7).

Table 6. Number of hatchery steelhead and chinook marked and released above LGR and the estimated total numbers and percent of each marked group collected at LGR fish facility, 1999.

Mark Code ¹	Rearing type & Species	Race	Hatchery	Release Site	RKm To LGR	Total Released	Total Recaptured	Percent Recovered
FB-RA-R-3	H. Steelhead	SU	Dworshak	N.F. Clearwater R.	116	10,000	150	1.5%
FB-LA-K-1	H. Steelhead	SU	Dworshak	N.F. Clearwater R.	116	10,000	0	0.0%
FB-RD-K-1	H. Steelhead	SU	Dworshak	N.F. Clearwater R.	116	10,000	0	0.0%
FB-LD-K-1	H. Steelhead	SU	Dworshak	N.F. Clearwater R.	116	10,000	0	0.0%
FB-RA-T-3	H. Steelhead	SU	Lyons Ferry	N.F. Clearwater R.	116	250,000	51,458	20.6%
CWT only No Clip	H. Chinook	SP/ SU	Multi-Sites	Snake Basin	---	829,580	70,238	8.5%
EL-LGR	H. Chinook	FA	Lyons Ferry	Big Canyon Clearwater R.	108	228,451	51,490	22.5%
EL-RGR	H. Chinook	FA	Lyons Ferry	Pittsburgh L. Snake R.	173	142,885	42,835	30.0%
EL-LBL	H. Chinook	FA	Lyons Ferry	Cpt. John A.P. Snake R	90	157,310	46,447	29.5%

¹Mark Codes: FB = freeze brands (location, brand, orientation); EL = elastomer tags (side, color).
Table does not include GBT marked fish

Table 7. Passage dates of marked hatchery steelhead and chinook collected at Lower Granite Dam in 1999.

Mark Code	Species, run & rear type	Total Obs.	Release Date	First Observed	25%	50%	75%	Last Observed
FB-RA-R3	H.ST, SU	1	Mar 25-Apr 30	May 3	May 3	May 3	May 3	May 3
FB-LA-K1	H.ST, SU	0	Mar 25-Apr 30	---	---	---	---	---
FB-RD-K1	H.ST, SU	0	Mar 25-Apr 30	---	---	---	---	---
FB-LD-K3	H.ST, SU	0	Mar 25-Apr 30	---	---	---	---	---
FB-RA-T3	H.ST, SU	182	Mar 25-Apr 30	Apr 19	Apr 24	Apr 28	May 1	Jun 16
CWT, nc	H.CH1	719	Jul '98-Apr '99	Mar 27	Apr 28	May 3	May 13	Sept 26
EL-LGR	H.CH1, FA	513	Apr 12-28	Apr 16	Apr 21	Apr 25	May 1	Jul 13
EL-RGR	H.CH1, FA	483	Apr 12-15	Apr 16	Apr 21	Apr 22	Apr 27	May 25
EL-LBL	H.CH1, FA	441	Mar 25-Apr 4	Apr 17	Apr 21	Apr 22	Apr 27	May 20

¹Mark Codes: FB = freeze brands (location, brand, orientation); EL = elastomer tags (side, color). No fin clip, nc. Table does not include GBT marked fish

Figure 4. Daily collection of Lyons Ferry hatchery yearling fall chinook (EL-LGR, Big Canyon) at Lower Granite Dam, 1999.

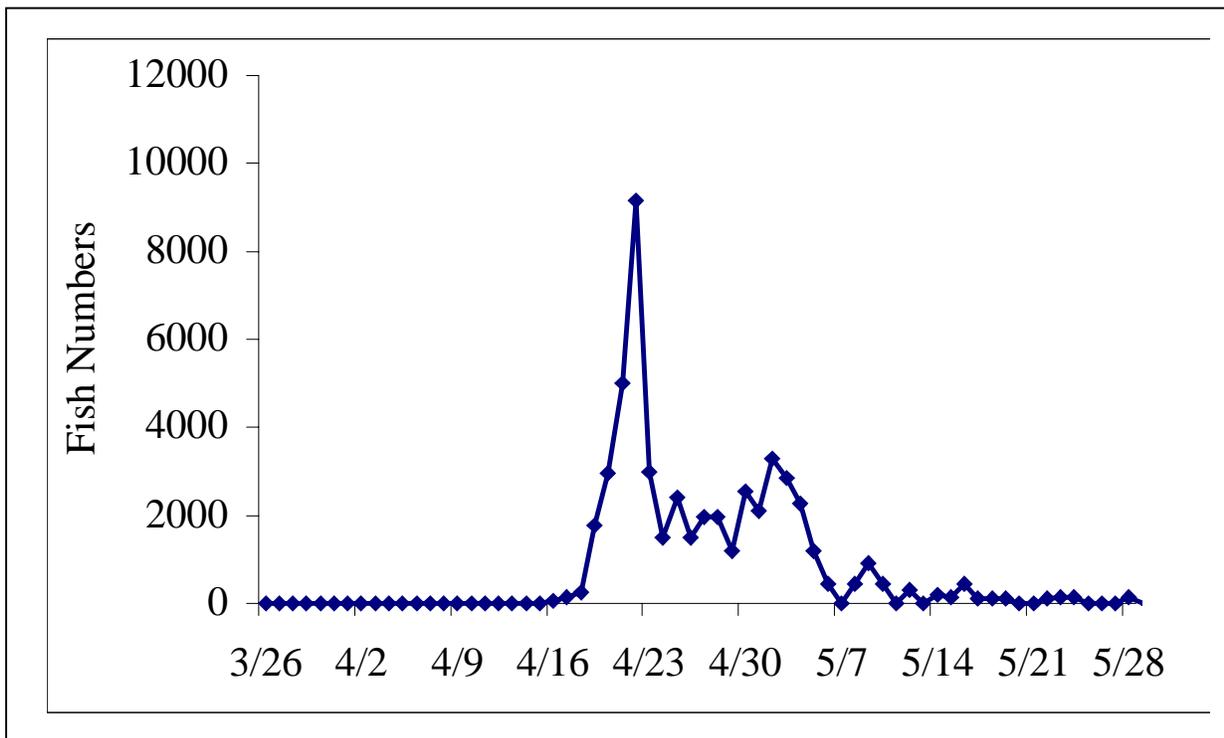


Figure 5. Daily collection of Lyons Ferry hatchery yearling fall chinook (EL-RGR, Pittsburg Landing) at Lower Granite Dam, 1999.

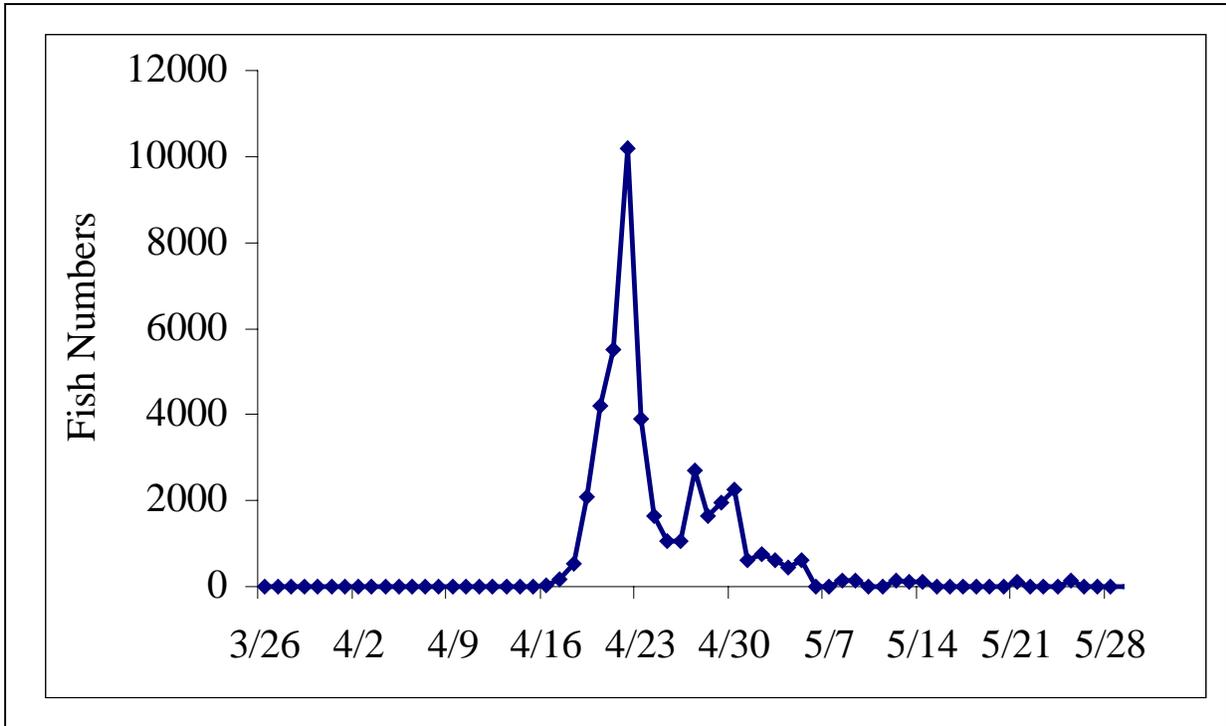


Figure 6. Daily collection of hatchery yearling fall chinook (EL-LBL, Captain Johns Landing) at Lower Granite Dam, 1999.

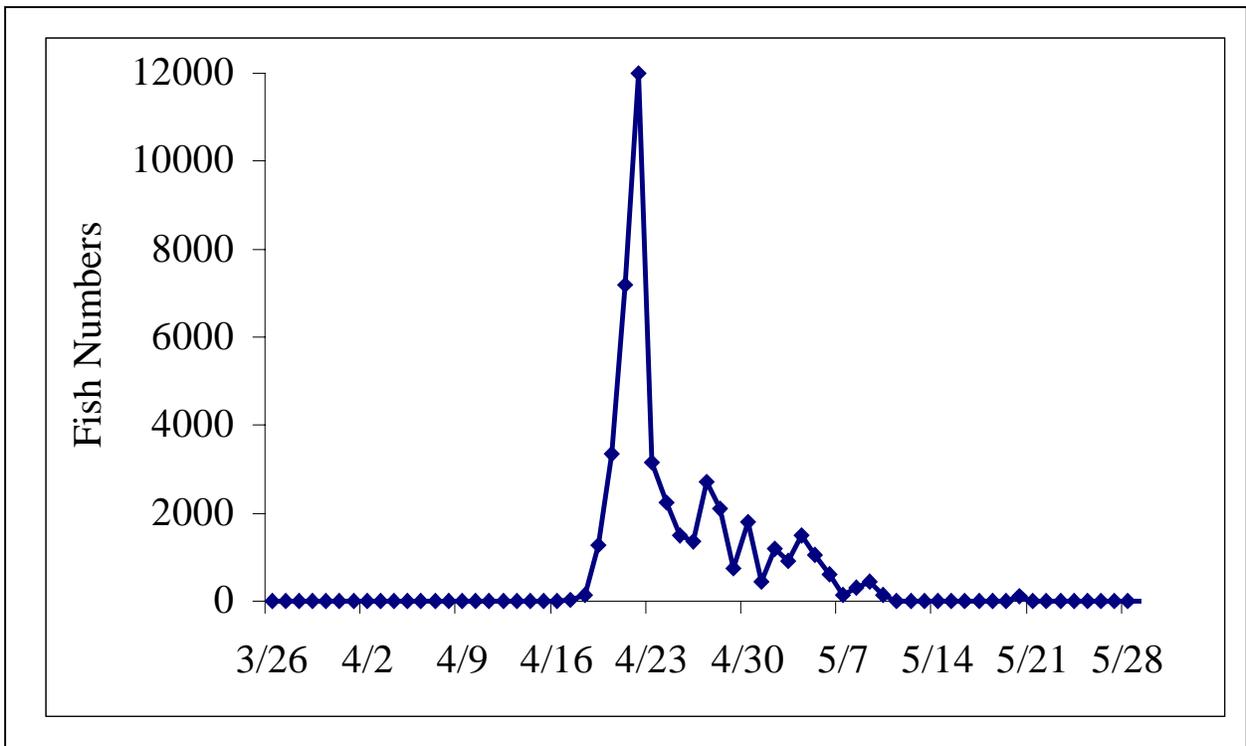
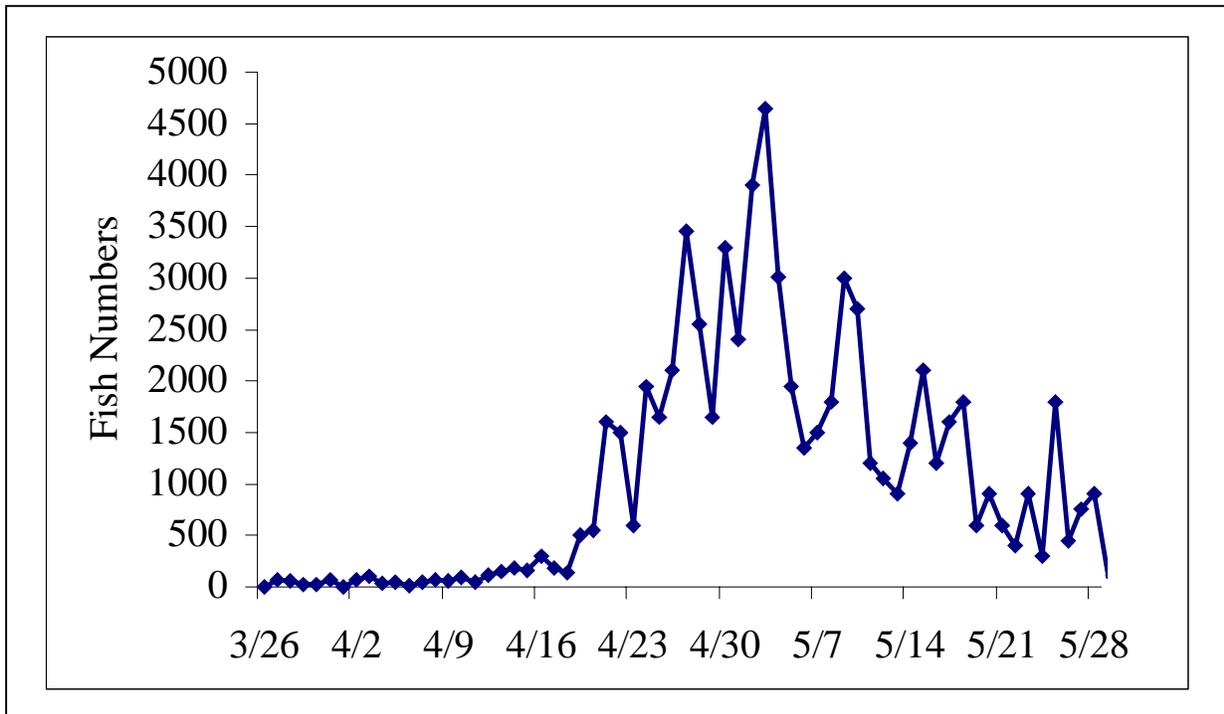


Figure 7. Daily collection of supplementation SP/SU hatchery yearling chinook (CWT only, no clip) at Lower Granite Dam, 1999.



Mark records for fish captured off the separator for GBT examinations were reported to FPC. GBT sample fish removed from the separator between April 12 and June 14 were not returned to the separator but their counts were added to the total daily collection. A total of 41 colored elastomer (VIE) tagged hatchery yearling chinook were examined for symptom of GBT, including: 19 left green, 15 right green and seven left-blue. Additionally, two freeze-branded steelhead (one RAIT3 and one RAR3) were recorded in GBT samples.

All fish removed from the separator during the GBT monitoring program were scanned for PIT tags. PIT-tagged fish were not examined but placed in fresh water and allowed to recover from the anesthetic before being returned to the separator. All PIT tag codes were stored in a scanner and recorded on a form with species, rearing type and hatchery mark information. Daily pit tag records were combined into one tagging file and sent to PTAGIS database (GBT Sample Summary). A total of 29 PIT-tagged fish were netted from the separator incidental to GBT sampling. These include one wild steelhead, four hatchery steelhead, six wild yearling chinook and 18 hatchery yearling chinook

We collected PIT tag data from smolts collected after September 1 when the PIT tag interrogation system was shut down (Table 8). The system was deactivated to facilitate the installation of hardware for new 134.2 kHz PIT tag system. On the morning of September 1, the sample rate was increased to 100% and all fish entering the collection facility were diverted to the sample tank. Between September 2 and November 11, a total of 1,685 PIT tagged fish were

detected in daily samples. Tag recapture information was submitted to PTAGIS.

During the collection season, we scanned for PIT tags all smolt mortalities removed from daily samples and from raceways. A total of 173 tagged mortalities were recovered and recorded in files submitted to PTAGIS. Tag records were flagged with the conditional comment codes of “RE” for recapture and “M” for mortality. Tagged mortalities included 115 hatchery spring chinook, three wild spring chinook, 15 hatchery summer chinook, two wild summer chinook, 28 hatchery fall chinook, four hatchery unknown chinook, two wild unknown chinook, two orphan chinook and two hatchery summer steelhead.

Adult fallbacks that entered the sample were returned to the river throughout the season. Of these, 48 chinook jacks with colored elastomer (VIE) tags were recorded, including 10 left blue, six left green, 21 left orange, five left red and six right green elastomer marks. Marked fallback sample data including sample date, fish length, eye tag, fin clip, opercula punch marks and fish condition were reported to the NMFS Adult Monitoring Project at Lower Granite.

Table 8. Records of PIT tagged fish detected in daily samples at Lower Granite Dam between September 2 and Nov. 11, 1999 (when PIT interrogation system was off line).

Organization	Tag Site	Release Site	Species and Race	Rearing Type	Release Date	Average Trav. time	Number of fish
NPT	CLWH	ELDORC	CH, FA	H	6/3-6/5/98	449.4	2
IDFG	AMERR	AMERR	CH, FA	H	6/29/99	159.6	1
WDFW	LYFE	LYFE	CH, FA	H	6/15-7/6/99	133.3	4
NPT	LYFE	BCCAP	CH, UNK	W	6/1-6/17/99	130.7	3
NPT	BCCAP	BCCAP	CH, UNK	W	5/26-6/2/99	124.0	2
NPT	BCCAP	BCCAP	CH, FA	H	6/1-7/6/99	120.7	40
NMFS	LYFE	CLWR	CH, UNK	W	5/18-6/30/99	116.1	10
NPT	LYFE	BCCAP	CH, FA	H	6/1-7/7/99	111.4	74
NPT	CJRAP	CJRAP	CH, FA	H	6/1-7/6/99	111.2	27
NPT	LAKEC	LAKEC	CH, FA	H	6/29-7/6/99	110.2	2
NMFS	LYFE	CLWR	CH, FA	H	6/1-7/6/99	105.7	375
NPT	LYFE	CLWR	CH, UNK	W	5/26-7/8/99	105.4	30
NPT	LYFE	CLWR	CH, UNK	U	6/23-7/5/99	101.8	5
NPT	LYFE	CLWR	CH, FA	H	6/1-7/6/99	101.4	893
NMFS	LYFE	CLWR	CH, UNK	U	6/28/99	98.7	1
NPT	CLWR	CLWR	CH, FA	H	6/1-7/6/99	95.5	8
NPT	LYFE	CLWR	ST, SU	H	5/28/99	93.8	1
NMFS	LYFE	SNAKER	CH, UNK	W	6/23/99	85.7	1
NMFS	LYFE	SNAKER	CH, FA	H	6/1-7/6/99	76.5	204
NPT	LYFE	CLWR	CO, SU	H	6/23/99	76.0	1
NMFS	LYFE	SNAKER	CH, SU	W	7/3/99	66.9	1
Total							1,685

Abbreviations: NPT = Nez Perce Tribe, IDFG = Idaho Dept. of Fish and Game, WDFW = Washington Dept. of Fish and Wildlife, NMFS – National Marine Fisheries Service, CLWH = Clearwater Hatchery, AMERR = American River, LYFE = Lyons Ferry, BCCAP = Big Canyon Creek Acclimation Pond, CJRAP = Captain John Rapids Acclimation Pond, LAKEC = Lake Creek, SNAKER = Snake River, ELDORC = Eldorado Creek.

GBT Sample Program and Summary

GBT Sampling Procedures

Sampling methods to identify levels of dissolved gas in juvenile salmonids have undergone continuous review since the program started in 1994. Current sampling methods and protocol are based on research conducted by fish physiologists and health specialists/pathologists with the United States Geological Survey, Biological Research Division (USGS-BRD) at the Columbia River lab at Cook, WA. Fish Passage Center staff have actively guided and participated in this process. BRD staff has conducted training sessions at the beginning of each season for the past four years. Staff from Lower Granite Dam attended this season's GBT training seminar at the Cook lab on March 30 and 31 where fish handling methods, examination techniques, and data handling protocols were reviewed and demonstrated. Site specific sample protocols at Lower Granite called for us to examine 100 yearling chinook and 100 steelhead, hatchery or wild, every Monday, between April and June.

Smolts collected for GBT samples were netted from the open flume in front of the separator bars. We netted fish individually, either steelhead or chinook, and placed them in a dark five-gallon bucket with 10 liters of water with MS-222® at 30mg/l. When we had collected seven fish, they were carried downstairs to the GBT lab located next to the separator. The time required to net seven fish varied due to fish availability but generally took about five minutes. In the GBT lab, one fish at a time would be removed from the capture bucket and scanned for the presence of a PIT tag. If a tag was detected, the code was recorded and the fish was allowed to recover and released back into the separator. Later all PIT tag codes were entered into a PTAGIS recapture file. If no PIT tag was detected the fish was placed in a bucket with water and MS-222® at 80mg/l to fully sedate the fish for the detailed examination. Once fully sedated this fish was placed in an examination tray equipped with hoses that provide flowing water with 30mg/l of MS-222® directly to the mouth and over the gills throughout the examination. Another fish was then scanned for a PIT tag and if not tagged, placed in the bucket of water with 80mg/l MS-222®. Staff then carefully examined the left lateral line, unpaired fins and both sides of the head on the fish in the examination tray for bubbles associated with GBT using a stereo microscope. The examiner recorded species, origin, fork length, presence or absence of bubbles, and the time at the start of the exam. The sample fish was then placed in a bucket of freshwater with aeration and allowed to recover before it was released into a raceway. This prevented them from being diverted to the sample tank and being sampled again. It took about 1.5 minutes to complete each examination. At the end of the day, sample data were transcribed to a database on a spreadsheet and transmitted to FPC. GBT fish were treated and recorded as a separate sample with a sample rate of 100% and their numbers added to the following day's collection totals.

GBT Sample Summary

Smolts were netted from the separator every Monday between April 5 and June 14 this season. We examined a total of 1,997 smolts for symptoms of GBT including, 574 hatchery yearling chinook, 323 wild yearling chinook, 970 hatchery steelhead and 130 wild steelhead. These fish were anesthetized, examined, allowed to recover from anesthesia and then placed in raceways for transportation. The tallies for examined fish were added to daily collection totals

on the day after they were examined. Symptoms of GBT were observed on 23 fish including 14 with bubbles in the lateral line, four with bubbles in the anal fin, two with bubbles in the caudal fin, two with bubbles in the dorsal fin and one with bubbles in the eye tissues. We were able to net 100 fish per day of both chinook and steelhead from April 5 through May 24 after which time chinook collection was too low to provide an adequate sample.

Incidental to fish netted from the separator and examined for GBT, we netted and released 157 fish back into the separator because they were not the correct species, or were PIT-tagged. A total of 29 PIT-tagged fish were netted from the separator during this project: one wild steelhead, four hatchery steelhead, six wild yearling chinook and 18 hatchery yearling chinook. After each GBT day, the codes stored in the scanner were downloaded to a temporary computer file, and later assembled in a PTAGIS tagging file. The remaining 128 fish not examined included, five hatchery yearling chinook, three wild yearling chinook, 31 hatchery steelhead, 37 wild steelhead, 15 hatchery sockeye, four wild sockeye, and 33 coho.

Sample Anesthesia

The use of the fish tranquilizer, MS-222®, to safely sedate juvenile salmonids is an important component of the smolt monitoring programs. Reviews of methods employed at different sites by FPC, USGS-BRD and SMP program staff in 1992 provided more specific guidelines for standard stock solutions, minimal induction times and total exposure times for SMP sampling programs. At LGR concentrations of approximately 60 mg/L of MS-222® from stock solutions of 100 g/L enable us to follow the general guidelines and handle the juvenile salmonids safely and efficiently. Over the course of each season we make some adjustments to account for changes in water temperature and the number of fish in the sample. Induction and recovery times for a given concentration tend to decrease as water temperatures increase.

Anesthesia Procedures

Anesthetic solutions are used in the pre-anesthetic chambers and the re-circulating sample system. The pre-anesthetic chambers are drained to about 95 liters before we add between 70 and 90 ml of MS-222® to achieve an initial concentration of about 63 mg/L. This typically sedates nearly all the fish within three minutes. However the pre-anesthetic chambers are not watertight. Fresh water seepage reduces the effective concentration. Depending upon the amount of fresh water seepage, fish response, water temperature, the size and number of smolts in the chamber, we may add more MS-222®. Once sedated, these fish are flushed down to the sorting trough.

The re-circulation system holds 670 liters of water and includes the sorting trough, sump, chilling reservoir, a rotary chiller, a filter and two pumps. We add anesthetic to the sump and chilling reservoir to achieve an initial concentration of about 50 mg/L. This level maintains sedation in most fish, allows some fish to gradually recover. The effective concentration of anesthetic in this system diminishes over time as more fish are sampled and absorb the anesthetic. Some leakage and infusion of fresh water also occurs throughout the sample. The longer we use the re-circulation system the more likely we are to add additional MS-222® in 50 to 100 ml increments to maintain effective concentrations. As a result, careful monitoring of fish response is a constant component of our sample procedures. To monitor anesthetic effectiveness and ensure the safety of the fish in the sample, we continuously watch and observe fish behavior and gilling rates.

Anesthetic induction

Safe and effective induction times should be greater than one minute but not longer than three minutes. For each batch of fish sedated in the pre-anesthetic chambers, we recorded induction times as well as the estimated number and relative size of smolts, water temperature and concentration of MS-222® (Table 9). The induction time was that point when approximately 95% of the fish were belly-up or on their side and gilling evenly

We observed a decrease in anesthetic induction time for all species as water temperature increased (Figure 8). When water temperatures were below 12 C (53.6 F), average induction

times ranged between 2.3 minutes and 2.6 minutes. Above this temperature, average induction times were about 10% faster and ranged between 2 and 2.4 minutes.

Longer anesthetic induction times earlier in the season when water temperatures were lowest may have also been influenced by the size of fish anesthetized. We observed that as the proportion of smaller fish, typically chinook, in sample batches increased, induction times decreased (Figure 9). Because steelhead were present in samples mainly during the spring, they likely contributed to increased induction times recorded for sample batches anesthetized during this time.

Table 9. Average induction times of sample fish exposed to MS-222®, by week at LGR, 1999.

Week Ending Date	Average Temp. (C.)	Number of Batches	Average No. Fish per Batch	Average Proportion Small Fish/Batch	Average Concentration (mg/L) MS-222®	Average Induction Time (seconds)
4/1	7.8	89	25	0.48	67	178
4/8	8.0	82	30	0.50	63	164
4/15	8.9	92	36	0.44	67	178
4/22	9.9	106	51	0.53	68	148
4/29	10.5	86	53	0.64	72	140
5/6	10.1	118	60	0.62	72	140
5/13	10.6	82	54	0.65	73	145
5/20	11.2	71	56	0.71	84	133
5/27	12.4	135	53	0.49	84	128
6/3	12.0	71	46	0.39	83	130
6/10	11.9	115	52	0.56	84	140
6/17	14.1	79	42	0.62	83	133
6/24	14.8	87	47	0.70	81	139
7/1	14.6	63	45	0.78	84	135
7/8	16.4	67	46	0.80	84	138
7/15	18.0	72	47	0.83	85	140
7/22	20.0	91	59	0.85	84	136
7/29	19.6	70	59	0.93	84	137
8/5	20.0	56	55	0.95	84	122
8/12	19.4	50	61	0.97	84	131
8/19	18.7	46	59	0.97	84	136
8/26	19.3	32	47	0.94	84	132
9/2	20.1	28	43	0.93	83	130
9/9	19.4	42	52	0.94	74	132
9/16	18.6	41	50	0.92	74	134
9/23	18.7	46	46	0.96	74	134
9/30	18.4	49	38	0.97	74	136
10/7	17.0	43	46	0.96	90	140
10/14	15.9	59	48	0.98	95	130
10/21	15.1	90	44	1.00	95	132
10/28	13.5	37	31	0.94	95	137
11/4	12.3	48	36	0.94	95	145
11/11	12.3	7	36	0.94	95	145

Figure 8. Average weekly induction times for fish exposed to MS-222® (~60 mg/L) compared to average weekly temperature at LGR in 1999.

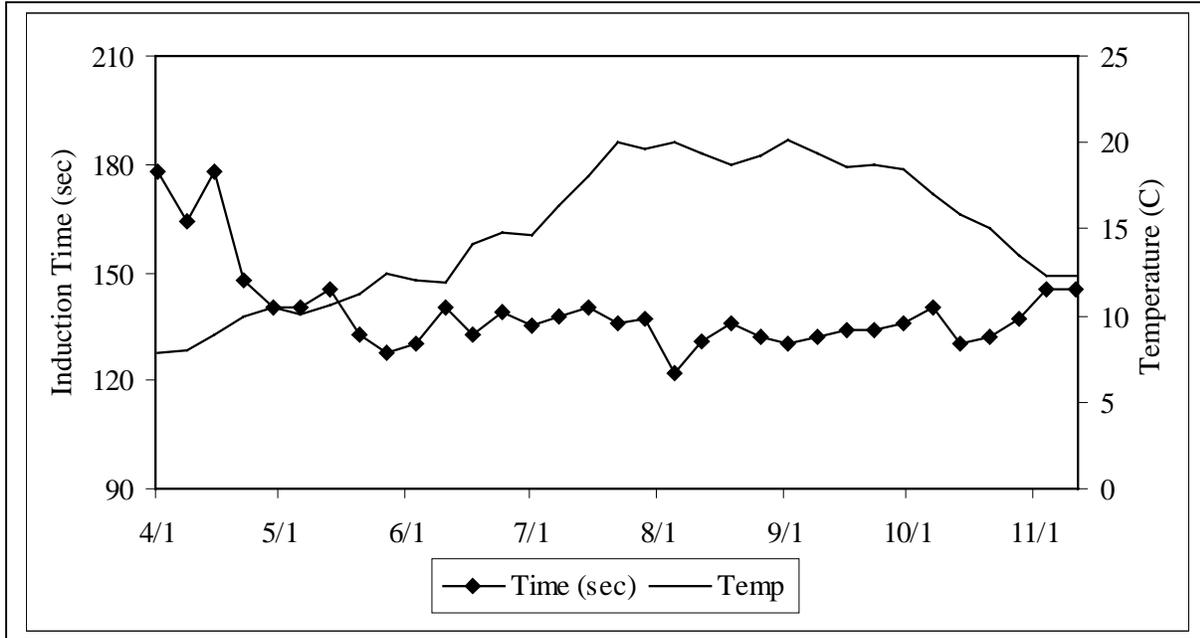
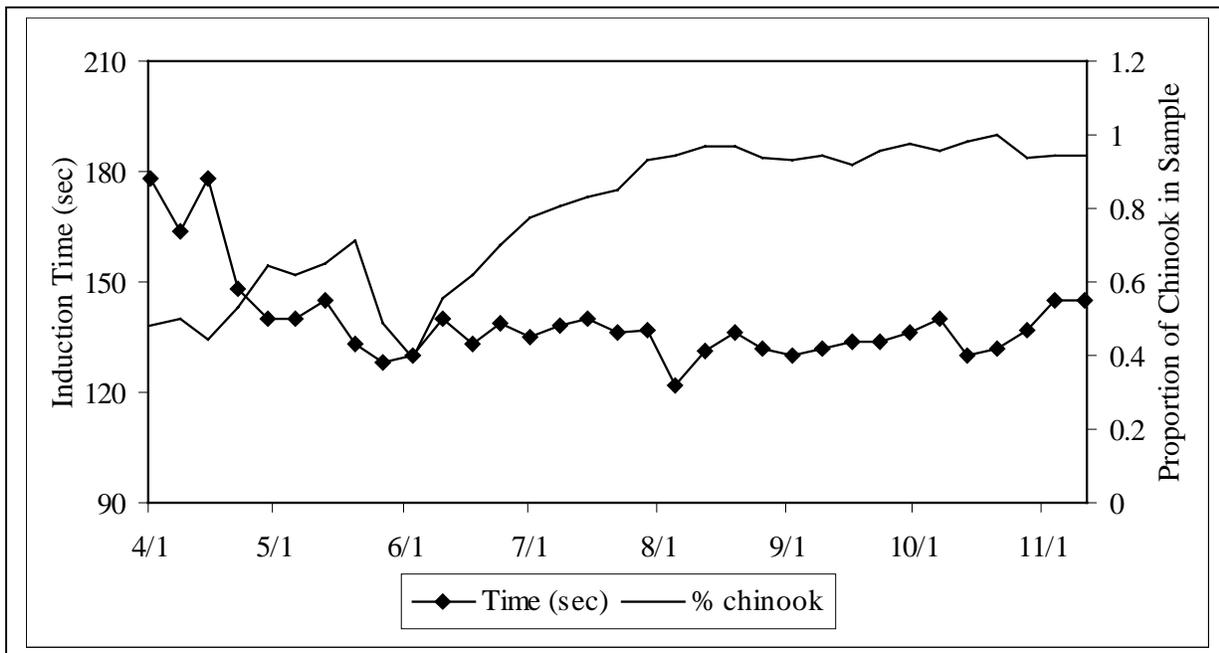


Figure 9. Weekly average induction time and average number of small fish (chinook) per sample batch at LGR, 1999.



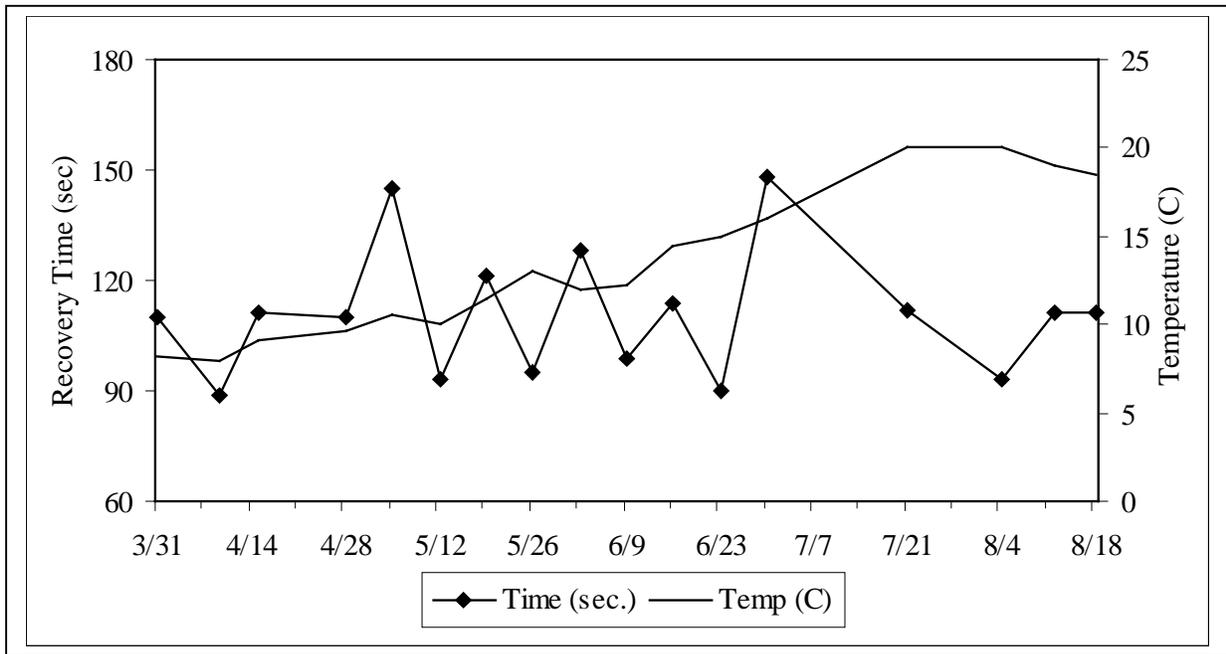
Anesthetic recovery

Each year we monitored the time required for fish to recover equilibrium following exposure to MS-222® during sampling procedures. This season we conducted recovery tests on up to 10 subyearling chinook once per week between March 31 and August 8 (Table 10). Fish used for these tests were taken from the sample trough immediately after they entered it from the preanesthetic chambers and placed in fresh water with an airstone. In the preanesthetic chambers, the fish were held for an average of 2.4 minutes in a solution of MS-222® at approximately 76 mg/L. Test fish were allowed to recover in the fresh water and timed until they regained an upright and stable orientation. Average recovery times ranged between 1.5 minutes and 2.5 minutes. Average recovery times for subyearling chinook tested in 1999 and water temperatures at the time of the tests are presented in Figure 10.

Table 10. Average recovery time of subyearling chinook exposed to MS-222® during samples at LGR, 1999.

Sample Day	Temp (C)	Number of Fish timed	MS-222® @start (mg/L)	Induction Time (sec.)	Recovery Time (sec.)
3/31	8.2	10	65	170	110
4/9	7.9	10	60	163	89
4/15	9.1	10	65	159	111
4/28	9.6	10	70	142	110
5/5	10.5	10	66	134	145
5/12	10	10	80	164	93
5/19	11.5	9	80	133	121
5/26	13	10	80	125	95
6/2	12	7	80	118	128
6/9	12.3	10	80	151	99
6/16	14.5	10	80	129	114
6/23	15	8	80	157	90
6/30	16	9	80	140	148
7/21	20	10	80	138	112
8/4	20	6	80	133	93
8/12	19	7	80	137	111
8/18	18.5	5	80	132	111
Average	13	9	76	143	111

Figure 10. Average recovery times of subyearling chinook exposed to MS-222® (60-80 mg/L) at LGR compared to temperature in 1999.



Audit of data entry

During the course of the season, a total of 230 daily sample batches were generated and sent to FPC. A total of 32 batches, 15%, were resent because they were revised after their original posting. In 1998, a total of 141 batches or 64% of the daily samples were revised and resubmitted. Most of the revisions occurred in the first 70 days of sampling when marked fish collection, research activities and GBT sampling was most prevalent. We categorized the errors that led to the revisions into six categories; setup errors, recording errors, omitted data, fish identification errors, facility errors and miscellaneous changes (Table 11).

Table 11. Number and percentages of sample batches revised and resent to FPC, 1999.

Error Type	Number of re-posted batches	Percent of total re-posted batches	Percent of total number of batches
Setup	7	22%	3%
Recording	13	40%	6%
Omitted data	8	25%	3%
Fish I.D.	1	3%	<1%
Facility	1	3%	<1%
Miscellaneous	2	6%	<1%
Total	32		14%

Setup errors resulted from problems with templates or formulas within spreadsheets used to summarize daily data. A total of seven batch revisions were attributed to these types of error in 1999. Three batches were revised because of daily flow averages that were originally calculated in a spreadsheet by using 25 hours instead of 24. Two batches were revised to modify reported sample dates. The FPC32 data entry program occasionally did not advance the dates in the new file. Typically this discrepancy was detected during handlog and printout comparison, but these two batches were not. One of these date-revised batches was re-posted a second time because the revised batch was lost in transmission to FPC. Day light savings time (DST) change in the spring resulted in a revised batch because we originally reported sample hours at 24 instead of 25 and averaged 24 hours of flow data instead of 25.

Recording errors resulted from "typos" and inaccurate transcription of handlog data into the FPC32 data entry program. A total of 13 batches were revised and resent because of recording errors. These errors included incorrect entries of facility mortalities (2), incorrect entry of descaling in the sub-sample (1), incorrect clip code entry (1), lack of brand code entry (1), incorrect entry of river and/or powerhouse flows (3), incorrect entry of incidental codes (3), incorrect entry of elastomer color code (1) and incorrect entry of sample rate (1). Most of the recording errors should have been detected prior to file transmission by comparing the handlogs to the FPC32 printouts.

Missing or omitted data resulted in revisions of eight batches this season, one of which was revised a second time. In these revised batches, data was originally left out, including: a

facility mortality number (1 batch), a raceway mortality number (2 batches), a race code (1 batch), a freeze brand (1 batch) and a clip code (3 batches).

Misidentification of fish resulted in one batch requiring revision this season. This occurred on the second day of sampling, when some small wild yearling chinook were originally identified as sub-yearling chinook. The original sampler thought the fish, which ranged in size near 70 mm, were too small to be yearling chinook. However, after referring to previous length data, consultation with other experienced samplers and the prevalence of fish this size in the subsequent sample, it was decided that these small fish were likely yearling chinook.

Facility errors resulted from events or changes in the data because of unusual operations, mistakes in fish facility data reporting, or technical problems related to the fish facility. This season, one batch was revised to correct a facility related error. A sample gate malfunction caused by a broken air hose was not reported until after that day's sample was processed and the batch submitted. When the error came to our attention, we revised the sample quality code to reflect an incomplete and biased sample.

Miscellaneous errors resulted in revisions of two batches. In this case, we were directed to begin labeling subyearling chinook as rearing type unknown (u.ch0) two days after we first detected them in the sample. We had initially identified these smolts as wild.

Fish Collection

Migration and Collection

The juvenile fish bypass gallery was watered up at 0700 hours on March 16. Fish were bypassed through the 42-inch pipe (primary bypass) until 0700 on March 25, when the separator was watered up and collection of fish for transportation began. Collection ended at 0700 hours on November 10. Total collection estimates were derived from expanded hand counts of smolts in the daily sample and includes smolts removed from the separator for research (Table 12). An estimated 5,882,872 juvenile salmonids were collected at Lower Granite Dam during the 1999 operating season. The species composition included: 1,762,655 hatchery yearling chinook, 410,842 wild yearling chinook, 257,507 subyearling chinook, 3,032,104 hatchery steelhead, 323,083 wild steelhead, 10,085 hatchery sockeye/kokanee, 7,975 wild sockeye/kokanee and 78,621 hatchery coho (Table 8). Daily collection and river condition are provided in Appendix 1, Table 1.

An estimated 20,384,585 hatchery fish (10,887,374 yearling chinook and 9,685,840 steelhead) were released above Lower Granite Dam between July 7, 1998 and May 1, 1999 for the 1999 outmigration. These fish were raised at fourteen hatcheries, operated by the following agencies; Idaho Department of Fish and Game, The Nez Perce Tribe, the United States Fish and Wild Service, the Oregon Department of Fish and Wildlife and the Washington Department of Fish and Wildlife.

Subyearling chinook smolts in 1999 were composed of unknown proportions of both hatchery origin and natural production (wild) fish. In early June, two releases of externally unmarked subyearling chinook from Lyons Ferry Hatchery were released at sites above Lower Granite. A total of 670,032 hatchery subyearling chinook with no fin clips were released at Big Canyon Acclimation Pond (June 3) and Captain John's Landing Acclimation Pond (June 5). According to hatchery officials, approximately 347,104 smolts were released at Big Canyon, of which, approximately 197,211 or 56.8% were coded wire tagged only. Because these fish were not externally marked, wild subyearling chinook could not be distinguished from hatchery fish in 1999 and numbers and percentages reported for wild subyearling chinook are a combination of both hatchery and wild smolts. Although small numbers of fin clipped smolts were identified as hatchery subyearling chinook, and are represented in tables and the appendix of this report, their counts and percentages are not representative of the actual hatchery subyearling chinook data for 1999.

In addition, a total of 528,646 hatchery yearling fall chinook from Lyons Ferry Hatchery, marked with colored eye tags (left-blue, left-green and right-green elastomer tags), were released above LGR in 1999. Of these, approximately 26.6% (140,772) were collected and transported. These hatchery fall chinook, because they were released as yearlings, were included in the hatchery yearling data collected in 1999.

Total fish collection and transportation numbers during 1999 were below the 1995-1998 average. Hatchery and wild yearling chinook, subyearling chinook, wild sockeye and coho were all above the previous four-year average. Hatchery and wild steelhead and hatchery sockeye

exhibited declines. Hatchery steelhead were about 66% as abundant as the previous four-year average and hatchery sockeye were about 71% as abundant. Some of the decline in wild and hatchery steelhead collected may have been due to spill, and operation of the experimental surface bypass collector in conjunction with the behavioral guidance screen.

Table 12. Annual collection, bypass, and transport at Lower Granite Dam, 1995-1999.

Year	Yearling Chinook		Subyearling ¹ Chinook		Steelhead		Sockeye/Kokanee ²		Coho ³	Total
	Hatchery	Wild	Hatchery	Wild ⁴	Hatchery	Wild	Hatchery	Wild	Hatchery	
Collection										
1995	2,991,449	789,070	---	31,019	5,501,552	414,082	2,552	3,773	---	9,733,497
1996	462,995	126,895	---	17,346	4,264,688	321,821	5,137	9,762	---	5,227,672
1997	224,847	56,978	73,437	17,473	4,022,510	300,215	411	2,937	1,517	4,700,325
1998	1,317,503	287,186	520	81,286	4,527,534	557,991	48,623	1,025	155,546	6,977,214
1999	1,762,655	410,842	257,507		3,032,104	323,083	10,085	7,975	78,621	5,882,872
Bypass										
1995	222,928	53,260	---	1,590	368,705	22,014	1	104	---	668,602
1996	49,978	19,332	---	358	30,883	977	107	30	---	102,430
1997	407	787	1,031	617	110,753	2,941	---	---	29	116,565
1998	88,312	20,074	---	1,033	107,561	17,990	---	---	1,474	236,414
1999	88,628	27,289	861		235,513	30,851	1,338	309	14,609	399,398
Truck										
1995	37,526	89,658	---	28,068	71,430	13,389	2,310	784	---	243,165
1996	2,207	4,004	---	15,857	82,108	12,802	889	6,054	---	126,887
1997	2,659	3,100	70,793	15,221	134,154	20,533	399	799	420	248,078
1998	21,764	20,344	18	70,260	49,629	18,215	613	32	6,430	187,305
1999	9,235	23,261	162,646		26,133	9,158	315	1,640	1,564	233,952
Barge										
1995	2,722,029	644,226	---	787	5,059,422	378,619	229	2,822	---	8,808,134
1996	407,960	102,368	---	885	4,149,222	307,805	4,120	3,184	---	4,990,798
1997	219,740	52,680	---	998	3,774,372	276,520	---	2,022	1,066	4,327,398
1998	1,203,805	245,809	489	8,043	4,366,903	521,297	47,921	990	147,145	6,542,402
1999	1,653,625	357,962	91,851		2,769,501	282,912	8,348	5,652	62,254	5,232,105
Total Transported										
1995	2,759,555	733,884	---	28,855	5,130,852	392,008	2,539	3,606	---	9,051,299
1996	410,167	106,372	---	16,742	4,231,330	320,607	5,009	9,238	---	5,117,685
1997	222,342	55,779	70,793	16,219	3,908,523	297,053	399	2,821	1,486	4,575,415
1998	1,225,569	226,153	507	78,303	4,416,532	539,512	48,534	1,022	153,575	6,729,707
1999	1,662,860	381,223	254,497		2,795,634	292,070	8,663	7,292	63,818	5,466,057

¹Hatchery subyearling chinook were not present until 1997.

²Hatchery sockeye were not present until 1995.

³Hatchery coho were not present until 1996.

⁴Includes unmarked hatchery subyearling chinook in 1999.

Migration timing

In general, peak collection days in 1999 followed the pattern of the previous four years (Table 13). The peak daily collection total on May 5 also was the peak collection day for hatchery steelhead. Wild steelhead peaked on May 26, the latest and fewest numbers (19,050) in five years. The subyearling chinook collection peak, heavily influenced by releases of unmarked hatchery fish in early June, was nearly one month earlier than any of the previous four years at 12,700 smolts on June 9. There were 23 days in which the total collection exceeded 100,000 fish, five days in which the collection exceeded 200,000 fish, and one day in which the collection exceeded 300,000 fish. Peak collection days and other aspects of the 1999 outmigration at Lower Granite Dam are illustrated in Appendix 2.

Table 13. Annual peak collection days at Lower Granite Dam, 1995-1999.

Year	Yearling Chinook		Subyearling ¹ Chinook		Steelhead		Sockeye/Kokanee		Coho ²	Total
	Hatchery	Wild	Hatchery	Wild ⁴	Hatchery	Wild	Hatchery	Wild	Hatchery	
1995	May 2 (288,000)	May 3 (30,600)	---	July 28 (960)	May 3 (654,000)	May 10 (34,050)	July 6 (400)	May 1,10 (300)	---	May 3 (910,051)
1996	May 14 (31,350)	April 21 (9,000)	---	July 13 (1,004)	April 27 (366,900)	April 27 (22,350)	May 17 (750)	April 2 (910)	---	April 27 (407,550)
1997	April 22 (13,070)	April 22 (5,730)	July 18 (2,876)	July 2 (480)	May 2 (250,146)	April 22 (27,821)	July 25 (28)	April 22 (400)	May 27 (150)	May 2 (261,350)
1998	May 4 (70,950)	May 3 (19,050)	June 1-2 (60)	July 9 (6,210)	May 4 (375,900)	April 28 (40,220)	May 15 (5,550)	May 15 (450)	May 15 (15,000)	May 4 (489,450)
1999	May 10 (82,650)	April 27 (20,877)		June 9 ³ (12,700)	May 5 (291,750)	May 26 (19,050)	May 29 (1,800)	May 2 (300)	May 26 (8,400)	May 5 (353,250)

¹Hatchery subyearling chinook were not present until 1997.

²Hatchery coho were not present until 1996.

³Hatchery and wild subyearling chinook were indistinguishable in 1999.

⁴Includes unmarked hatchery subyearling chinook in 1999.

The distribution of daily collection counts for a particular species provides a measure of migration timing for smolts passing Lower Granite Dam (Table 14). Collection efficiency, spill and spill volume influence daily and seasonal collection at the facility. Thus the 10 and 90% dates are approximations of the middle 80% passage timing for smolts passing LGR. These dates of 10% and 90% passage are based on the cumulative daily collection.

Hatchery yearling chinook, hatchery and wild steelhead, and coho in 1999 followed the general trend of the previous four years for their respective 10% and 90% passage dates. Subyearling chinook in 1999, a mix of unmarked hatchery origin and naturally produced fish, had the earliest passage dates of the last five years. Subyearling chinook passage dates were influenced by the early June release of approximately 670,000 unclipped hatchery subyearling chinook in early June. Hatchery and wild sockeye/kokanee migration timing dates over the last five years show a wide variation, ranging between May 26 and Sept. 25. The length of time for the middle 80% passage for all species in 1999 was five to ten days longer than in the previous four years.

Table 14. Estimation of the middle 80% passage dates based on 10% and 90% cumulative numbers of fish at LGR, 1995 through 1999.

	Yearling Chinook		Subyearling ^{1,2} Chinook		Steelhead		Sockeye/Kokanee		Coho ³	Total
	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	
10%										
1995	4/22	4/15	7/23	7/7	4/28	4/24	6/17	5/1	---	4/25
1996	4/24	4/17	---	6/27	4/24	4/17	5/17	3/30	5/18	4/23
1997	4/22	4/13	6/30	6/22	4/23	4/17	7/18	4/23	5/22	4/22
1998	4/20	4/12	6/1	6/24	4/27	4/25	5/8	5/11	5/6	4/24
1999	4/23	4/17	6/10		4/24	4/22	5/24	4/1	5/20	4/23
90%										
1995	5/15	6/3	9/22	9/21	5/21	5/23	7/13	7/21	---	5/21
1996	5/19	5/19	---	8/29	5/18	5/20	6/15	5/16	6/17	5/19
1997	5/20	5/16	8/19	9/20	5/23	5/19	9/25	7/5	6/27	5/25
1998	5/10	5/17	6/17	8/30	5/20	5/23	5/26	5/26	5/29	5/20
1999	5/22	6/2	8/22		5/27	5/30	6/7	6/7	6/9	5/30

¹Hatchery subyearling chinook were not present until 1997.

²Hatchery and wild subyearling chinook were indistinguishable in 1999.

³Hatchery coho were not present until 1996.

Transportation

An estimated 5,466,057 juvenile salmonids (92.9% of all fish collected) were transported from Lower Granite Dam in 1999 (Table 12 and Appendix 1, Table 2). The numbers of fish transported and the percentages of the total collected of each species group were: 1,662,860 hatchery yearling chinook (94.3%), 381,223 wild yearling chinook (92.8%), 254,497 subyearling chinook (98.9%), 2,795,634 hatchery steelhead (92.2%), 292,070 wild steelhead (90.4%), 8,663 hatchery sockeye/kokanee (85.9%), 7,292 wild sockeye/kokanee (91.4%), and 63,818 hatchery coho (81.2%).

The transport season began with trucks, switched to barges as fish numbers increased and then back to trucks when fish numbers declined. The first truck left Lower Granite on March 27. Subsequent trucks left every-other-day through April 6. The first barge departed Lower Granite on April 8 and barging continued everyday through April 20. Barges left every-other-day from April 22 through May 26 with the exception of May 25 when no tugboat was available. Due to excessively high spill, fish were not barged from Lower Granite on May 28. Final every-other-day barging ran from May 30 through June 27. To comply with NMFS biological opinion, barging was extended through most of the month of June during 1999. Trucking operations resumed on June 29 and continued every-other-day until November 10. Due to comparatively large numbers of subyearling chinook in the collection, the transport season was extended an additional nine days.

The 3,500-gallon trailers were used during the early and late season trucking phase up to September 29, when the 300-gallon pickup-mounted mini-tanker was brought into use for the duration of the season. The majority of the fish transported in 1999 were transported in barges. However, subyearling chinook, which arrive in greatest numbers after the conclusion of barging, were transported primarily by truck. On several days because of the larger daily collections during September and October, the Corps used a second truck to transport the additional fish. Daily truck and barge numbers, by species and total fish, can be found in Appendix 1, Table 3.

A special barge deployment took place in 1999 in cooperation with the City of Tacoma, WA. The barge which left Lower Granite on April 18 released fish below Bonneville as normal and then continued downstream to pick up 23,000 cutthroat trout from the Cowlitz Hatchery. The trout were loaded onto the transport barge at the Port of Longview's Berth #7. The fish were then transported downstream to Bouy 18, near the mouth of the Columbia, where they were released.

Approximately 233,952 juvenile salmonids, 4.3% of the fish transported in 1999, were transported by truck (Table 12). The numbers of fish trucked and the percentages of the total transported for each species group were: 9,235 hatchery yearling chinook (0.6%), 23,261 wild yearling chinook (6.1%), 162,646 subyearling chinook (63.9%), 26,133 hatchery steelhead (0.9%), 9,158 wild steelhead (3.1%), 315 hatchery sockeye/kokanee (3.6%), 1,640 wild sockeye/kokanee (22.5%), and 1,564 hatchery coho (2.5%).

An estimated 5,232,105 juvenile salmonids, 95.7% of transported fish, were barged from

Lower Granite Dam in 1999 (Table 12). The number of fish barged and the percentages of the total transported by species group were: 1,653,625 hatchery yearling chinook (99.4%), 357,962 wild yearling chinook (93.9%), 91,851 subyearling chinook (36.1%), 2,769,501 hatchery steelhead (99.1%), 282,912 wild steelhead (96.9%), 8,348 hatchery sockeye/kokanee (96.4%), 5,652 wild sockeye/kokanee (77.5%), and 62,254 hatchery coho (97.5%).

Fish collected at Little Goose Dam, Lower Monumental Dam and McNary Dam were loaded onto barges that originated from Lower Granite Dam during the season. The total number of fish barged from these other sites included: Little Goose Dam (6,659,980), Lower Monumental Dam (3,549,890), McNary Dam (2,601,252).

Bypass

An estimated 399,398 juvenile salmonids, 6.8% of the collection, were bypassed from Lower Granite for various reasons in 1999 (Table 12 and Appendix 1, Table 2). This is an increase of 68.9% compared to 1998 when 236,414 juveniles were bypassed. The numbers of fish bypassed during 1999 and the percentages of the total collected by species group were: 88,628 hatchery yearling chinook (5.0%), 27,289 wild yearling chinook (6.6%), 861 subyearling chinook (0.3%), 235,513 hatchery steelhead (7.8%), 30,851 wild steelhead (9.5%), 1,338 hatchery sockeye/kokanee (13.3%), 309 wild sockeye/kokanee (3.9%) and 14,609 coho (18.6%).

Primary bypass at Lower Granite (fish diverted directly back to the river) was initiated the morning of March 16 and continued until 0700 hours on March 25 when collection began. At 0700 hours on November 10, the system returned to primary bypass when collection for the transportation program ended. The facilities remained in primary bypass until December 16 when the entire bypass system was dewatered for the season. When the facility was in primary bypass mode, no estimates of the number of fish bypassed are made because fish do not pass through a counting system.

Fish were also bypassed through the primary bypass system a number of times during the regular collection season. On a number of occasions, the inclined screen in the separator plugged with debris, requiring the system to be put into the bypass mode to take pressure off the inclined screen so that it could be cleaned. Most of these events occurred during periods of high debris flow in late spring and early summer. Each event was of approximately one-half hour in duration.

Due to unusual circumstances this season, fish were released back to the river on several occasions directly from the recovery tank, separator or after they had been loaded into raceways. The first release occurred when a tugboat was not available for barge transport on May 25. These fish were held for transport on the barge scheduled to depart Lower Granite on May 26. However, between 1700 hours on May 25 and 0900 hours on May 26 collection numbers exceeded the capacity of the available raceway holding space and an estimated 179,137 fish, about 13% chinook and 83% steelhead, were bypassed to the river. On May 28, spill levels were too high to allow the barge to ferry across the river to dock at the fish facility and load fish and the barge trip was canceled. This resulted in bypassing an estimated 70,409 smolts held in raceways and 471 smolts from the sample on May 28. On May 31, the sample recovery tank

with 670 smolts was accidentally released to the river. Approximately 250,687 juvenile salmonids, 4.3% of the collection, were released back to the river from Lower Granite due collection numbers in excess of transport and holding capacity or barge trip cancellation (WDFW Daily Calculation Forms.)

There were four research projects at Lower Granite in 1999 that bypassed fish back to the river. The NMFS Transportation Evaluation Study PIT-tagged and bypassed 62,172 hatchery chinook, 12,683 wild yearling chinook, 60,152 hatchery steelhead and 8,407 wild steelhead. The NMFS Reach Survival Study (sham-radio tag versus PIT tag evaluation) tagged and bypassed 4,379 hatchery chinook. The United States Geological Survey Biological Research Division (USGS BRD) radio-tagged 97 wild subyearling chinook for their summer temperature/depth telemetry study and released them into the Lower Granite tailrace. The USGS BRD also radio-tagged 20 hatchery yearling chinook and 20 hatchery steelhead release into the prototype surface bypass collector (SBC).

A summary of daily and total bypass is included in Appendix 1, Table 1. These numbers include fish bypassed from the raceways, sample fish bypassed, and fish bypassed for research projects. They do not include fish bypassed during periods of primary bypass or through the PIT tag diversion system.

PIT tag Diversion

The PIT tag diversion system was operated in the standard diversion mode from March 26 to July 14. During this time, the sample diversion gate overrode the PIT tag diversion gate and any fish present during a sample diversion gate operation went to the sample holding tank. After July 14, the PIT-tag diversion system was set to divert all PIT tagged fish and override the sample diversion gate. During the season, most of the PIT-tagged fish detected exiting the separator were bypassed. Some PIT tagged fish were sent to the raceways and transported for research purposes. Others were missed by the diversion system and were sent to either the raceways or the sample tank. On Sept. 1 the PIT tag diversion system was shutdown. After that, all PIT tagged fish in the juvenile bypass system were transported.

According to the PTAGIS database, 79,257 PIT tagged fish were detected at Lower Granite in 1999. Of these, 46,277 (58.4%) were bypassed through the PIT tag diversion system, 29,069 (36.7%) diverted to the raceways and transported, 2,976 (3.7%) were diverted to the sample tank, sampled and then transported, and 935 (1.2%) were not detected at any of the exit monitors, bypass, raceway or sample (fish disposition unknown). The PIT tagged fish bypassed included: 24,589 hatchery chinook, 8,414 wild chinook, 38 unknown rearing type chinook, 9,315 hatchery steelhead, 3,255 wild steelhead, two unknown rearing type steelhead, 392 hatchery sockeye/kokanee, 44 wild sockeye/kokanee and 228 hatchery coho. PIT-tagged fish that were diverted to raceways included 26,854 hatchery yearling chinook. An unknown number of non-tagged fish were also bypassed by the PIT-tag diversion system along with the tagged fish. Fish bypassed through the PIT-tag diversion system are not included in the facility bypass numbers.

Table 2. Final disposition of PIT tagged juvenile salmonids detected at LGR, 1999.

Disposition	Chinook			Steelhead			Sockeye/Kokanee		Coho	Total
	h.ch	w.ch	u.ch	h.st	w.st	u.st	h.so	w.so	u.co	
Raceway, T	26,854	1,145	7	750	219	0	55	6	33	29,069
Bypass, D	24,589	8,414	38	9,315	3,255	2	392	44	228	46,277
Sample, T	802	258	2	159	43	0	13	2	12	1,291
Unk. Exit, ?	713	159	0	37	18	0	2	0	6	935
Recapture, T	1,677	0	6	2	0	0	0	0	0	1,685
Total	54,635	9,976	53	10,263	3,535	2	462	52	279	79,257

Key: T=transported, D=diversion (to river), ?=either transported or diverted, u=unknown rearing type, Recapture=tagged fish sampled and transport after Sept. 1 (date the 400 KHz interrogation system was decommissioned)

Fish Condition

Descaling

The combined descaling rate for all juvenile fish sampled in 1999 was 3.6%, and was the lowest in the last five years (Table 15). Annual descaling rates by species group were: hatchery yearling chinook (3.1%), wild yearling chinook (1.1%), subyearling chinook (1.7%), hatchery steelhead (7.2%), wild steelhead (1.7%), hatchery sockeye/kokanee (3.4%), wild sockeye/kokanee (10.0%), and hatchery coho (4.2%). Annual descaling rates for wild yearling chinook, subyearling chinook, wild steelhead, hatchery sockeye and coho all decreased in 1999 compared to 1998. Daily descaling rates by species group are provided in Appendix 1, Table 3.

Weekly average descaling rates for all species combined were highest during the spring migration, in late-May and early-June (Table 16). Weekly average descaling rates for hatchery yearling chinook, when sample numbers exceeded 100 fish per week, never exceeded 8.7%. Subyearling chinook descaling rates peaked at 3.8% on October 28. Hatchery steelhead rates peaked at 16.6% for the week ending June 10. Wild steelhead peaked at 2.8% in the week ending May 13. Hatchery sockeye/kokanee weekly sample numbers exceeded 100 fish only once, during the week ending June 3, and wild sockeye/kokanee sample numbers never exceeded 100 fish per week. We observed that descaling rates tended to increase with large increases in debris and/or large numbers of fish in the facility.

Table 15. Annual descaling rates in percent for fish sampled at Lower Granite Dam, 1995-1999.

Year	Yearling Chinook		Subyearling ¹ Chinook		Steelhead		Sockeye/Kokanee ²		Coho ³	Total
	Hatchery	Wild	Hatchery	Wild ⁴	Hatchery	Wild	Hatchery	Wild	Hatchery	
1995	2.7	0.9	---	5.4	7.7	1.0	3.2	30.1	---	5.0
1996	3.0	1.5	---	9.3	6.3	1.1	3.8	18.4	2.4	5.8
1997	5.6	2.8	6.5	7.4	6.2	2.7	9.9	24.5	0.9	6.2
1998	3.1	2.3	9.9	4.7	5.3	2.2	4.7	3.0	4.3	4.4
1999	3.1	1.1		1.7	7.2	1.7	3.4	10.0	4.2	3.6

¹Hatchery subyearling chinook were not present until 1997.

²Hatchery sockeye/kokanee were not present until 1995.

³Hatchery coho were not present until 1995.

⁴Includes unmarked hatchery subyearling chinook in 1999.

Table 16. Weekly descaling rates in percent for fish sampled at Lower Granite Dam, 1999.

Week Ending	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Hatchery	Wild	Hatchery	Unmark ¹	Hatchery	Wild	Hatchery	Wild	Hatchery	
Apr 1	8.7	0.8	---	*0.0	1.0	2.3	---	*11.4	*0.0	2.8
Apr 8	5.1	0.8	---	*0.0	0.7	1.8	---	*0.0	*0.0	1.3
Apr 15	2.6	0.1	---	---	1.3	0.9	---	*16.7	*0.0	1.2
Apr 22	1.3	0.4	---	*0.0	3.0	1.3	---	*11.1	*0.0	1.8
Apr 29	3.3	0.8	---	*0.0	2.9	0.9	---	*14.3	*0.0	2.7
May 6	2.8	0.8	---	*0.0	2.5	1.4	---	*16.7	*0.0	2.4
May 13	3.2	2.6	---	---	3.4	2.8	---	*0.0	*0.0	3.2
May 20	2.8	1.1	---	---	5.5	1.3	*0.0	*12.5	*0.0	3.7
May 27	4.6	3.3	---	---	13.9	2.0	*14.3	*0.0	3.8	10.4
Jun 3	5.4	1.8	---	*0.0	13.8	2.3	1.0	*22.2	5.2	9.8
Jun 10	2.2	1.6	---	0.3	16.6	1.1	*2.7	*0.0	3.9	7.2
Jun 17	3.1	0.8	---	0.3	11.7	1.6	*13.3	*0.0	3.3	5.4
Jun 24	3.2	1.6	---	0.4	9.9	1.4	*28.6	*50.0	*9.3	4.9
Jul 1	*2.0	3.4	---	0.6	6.0	*6.5	*0.0	*0.0	*7.4	2.3
Jul 8	*0.0	2.9	---	0.5	7.5	*0.0	*9.1	*41.7	*2.5	2.1
Jul 15	*5.7	*6.2	---	1.6	8.1	*0.0	*20.0	*18.2	*1.6	2.7
Jul 22	*0.0	*3.0	---	2.4	8.2	*13.0	*0.0	*0.0	*3.7	2.8
Jul 29	*11.1	*0.0	---	2.7	6.8	*0.0	---	*50.0	*0.0	2.9
Aug 5	---	---	---	0.4	*7.2	*0.0	---	*50.0	*0.0	0.6
Aug 12	*0.0	---	---	1.0	10.0	*0.0	---	*0.0	*0.0	1.3
Aug 19	---	---	---	1.0	*3.7	*0.0	*0.0	---	*0.0	1.1
Aug 26	*0.0	---	---	1.6	*11.4	*0.0	---	*0.0	*0.0	2.0
Sep 2	---	---	---	2.2	*4.2	*0.0	---	*0.0	---	2.2
Sep 9	*0.0	*0.0	---	2.6	*15.4	*0.0	---	*14.3	*0.0	2.8
Sep 16	---	*0.0	---	2.4	*7.1	*0.0	---	*11.1	*33.3	2.5
Sep 23	*0.0	*0.0	---	2.5	*0.0	*0.0	---	*0.0	*10.0	2.5
Sep 30	---	*0.0	---	1.7	*0.0	*0.0	---	*0.0	*0.0	1.7
Oct 7	---	*0.0	---	2.8	*0.0	*0.0	---	*16.2	*0.0	3.1
Oct 14	*0.0	*0.0	---	2.1	*16.7	*0.0	---	*9.1	*0.0	2.1
Oct 21	*0.0	---	---	1.9	*0.0	*0.0	---	*10.3	*11.1	2.0
Oct 28	*0.0	---	---	3.8	*0.0	---	---	*0.0	*0.0	3.7
Nov 4	*0.0	---	---	1.4	*0.0	*0.0	*0.0	*8.1	*0.0	1.5
Nov 10	*0.0	---	---	1.2	*0.0	*0.0	*3.0	*2.1	*14.3	1.4
#Descaled	496	94	0	848	2,528	76	14	44	67	4,167
#Examined	15,946	8,241	0	50,241	34,949	4,458	413	442	1,612	116,360
%Descale	3.1%	1.1%	0.0%	1.7%	7.2%	1.7%	3.4%	10.0%	4.2%	3.6%

*Less than 100 fish sampled during the week.

---No fish sampled during the week.

¹Includes unmarked hatchery subyearling chinook.

Injury and disease

In addition to standard length, weight and descaling data recorded for individual smolts in the daily sub-sample, smolts were also examined for visible injuries and symptoms of disease. A total of 29,304 smolts were examined in the detailed sub-sample during the 1999 season compared to over 40,000 in 1998. Of the fish examined in 1999, a total of 6,853 (21%) were recorded as having some level of descaling, head, body or predator-caused injury or symptom of disease. In contrast, rates of visible injury and disease in 1996, 1997 and 1998 were 20.2%, 16.8% and 22.2% respectively.

We began looking at gradations of scale loss in smolts last year to augment the standard descaling data taken from sample fish. Standard descaling criteria identifies a fish with 20% or greater scale loss on one side of its body as descaled. If scale loss is less, the fish is not considered descaled at all. We observed that some fish have levels of scale loss that don't fit the standard descaling criteria. Rather than lose this information we began noting, in addition to standard descaling, if a smolt was more than 5% but less than 20% descaled, and if a smolt was descaled 50% or more. Furthermore, each gradation of scale loss was characterized as patchy or scattered. In 1999, patchy low level scale loss, scale loss greater than 5 but less than 20%, was observed on 3.5% of all fish examined. In 1998 it was 3.3%. Subyearling chinook in 1999 suffered more low level scale loss (5.6%), when sample counts exceeded 500 smolts, than other species. The next highest was hatchery yearling chinook with 3.4%. Similarly, the less than 20% scattered descaling was higher in 1999 (2.1%) than in 1998 (1.1%) and hatchery steelhead (2.1%) and wild subyearling chinook (7.9%) had the highest rates. The greater than 50% descaling rate for all species combined in 1999 was 0.14% and highest in subyearling chinook (0.2%).

Head injuries that were noted during the season included abrasions and injury to the eye, opercle, jaw and snout. Head injuries were recorded on 3.0% of smolts examined in 1999, up from 2.6% in 1998, and 0.9 % observed in 1997. Head injuries were recorded in 1.7% of hatchery yearling chinook examined and were primarily of the eye and opercula. Subyearling chinook and hatchery steelhead exhibited 5.2% and 3.8% head injuries, respectively, more than half of which were jaw injuries.

Body injuries that were noted this season included bloat, scale regeneration, emaciation, fin damage, lacerations, lesion and deformity. About 7.0% of smolts examined this year exhibited some visible body injury compared to 2.4% recorded in 1998. Fin injuries, split rays and fraying, were common in all species and represented 89.7% of all body injuries. The overall percentage of smolts recorded as emaciated decreased from 0.41% in 1998 to less than 0.12% this year.

Diseases with common external symptoms noted during the season include fungus, cysts, columnaris, digenia, gill hyperplasia, hemorrhaged fin, bacterial kidney disease, parasites and scoliosis. Fin hemorrhaging, characterized by redness in the fin tissues, was observed in 1.6% of fish examined and was most prevalent in subyearling chinook (4.6%) and hatchery steelhead

(0.6%). In 1998, fin hemorrhaging was recorded in 9.2% of fish examined and 28.6% of wild subyearling chinook.

The percentage of smolts observed with symptoms consistent with columnaris such as yellowish blemishes, lesions, and loss of skin from the snout, increased this year. This disease, caused by the bacterium *Flavobacterium columnare*, infects mainly summer and early fall migrants because it becomes more virulent when water temperatures exceed 60°F. Columnaris rates in subyearling chinook increased to 10.9% in 1999, up from 0.34% in 1996, 0.57% in 1997 and 4.6% in 1998 partially because diagnosis was better defined for the 1999 season. Warren Groberg, Fish Pathologist for Oregon Department of Fish and Wildlife visited the fish facility on September 30, 1998 and provided additional information on external symptoms characteristic of columnaris. Groberg explained that the snout injuries (loss of protective skin tissue) and yellowish blemishes without broken skin were also symptoms of *F. columnare* infection. Based on this information, subyearling chinook with these symptoms observed after September 30 were identified as infected with columnaris. We could not accurately update our observation data for columnaris prior to September 30 and thus the estimate for the 1998 season of only 4.6% underestimates the actual presence of columnaris symptoms in subyearling chinook in 1998.

This season subyearling chinook with snout injuries characteristic of columnaris were observed in the detailed sub-sample starting July 23, shortly after water temperatures reached 20°C (68°F). Between 30% and 67% of the sub-yearling chinook exhibited this symptom through October 7 when water temperatures dropped to 16°C (60.8°F). Columnaris symptoms peaked at 68% on September 26. Although the recorded incidence of columnaris symptoms appeared to be higher than in 1998, mortality rates in subyearling chinook during the peak times for this disease were less than 3% compared to nearly 30% in 1998.

Gill hyperplasia in hatchery steelhead, characterized by swollen or "club-shaped" gill filaments increased from 1.3% in 1998 to 2.0% in 1999. In 1996, approximately 13.5% of hatchery steelhead examined were infected. In 1997, 5.9% of hatchery steelhead were infected. This condition is primarily associated with hatchery steelhead and occurs throughout the main portion of the migration in April and May.

Injuries associated with predator marks included wounds inflicted by anglers, birds, and lampreys. This year, as in 1996, 1997 and 1998, birds were the primary predator causing most of the injuries. Bird predation marks, characterized by V-shaped scratches on both sides of a fish, were most prevalent on hatchery steelhead (1.9%) and wild steelhead (1.5%). In 1996, 2.5% of hatchery steelhead and 0.8% of wild steelhead sub-sampled had bird predator marks. In 1997, 2.0% of hatchery and 1.4% of wild steelhead had bird predator marks. In 1998, 1.8% of hatchery steelhead and 1.7% of the wild steelhead sub-sampled had bird predator marks. Wounds inflicted by anglers, characterized by torn or punctured tissues in the jaw area, although very low, were highest on hatchery steelhead, (0.02%). Few lamprey marks (two), characterized by the presence of small disc-shaped patches of scale loss sometimes with central petechial hemorrhaging, were noted this season.

Fish Mortality

Mortality

The overall facility mortality rate for juvenile salmonids collected at Lower Granite Dam in 1999 was an estimated 0.28% (rounded to 0.3%, Table 17). In all, 16,714 facility mortalities were recorded out of a total collection of 5,882,872 (Appendix 1, Table 2). The numbers of facility mortalities and the percentages of the total collected by species group were: 10,595 hatchery yearling chinook (0.6%), 2,260 wild yearling chinook (0.6%), one hatchery subyearling chinook (0.9%), 2,146 unmarked subyearling chinook (0.8%), 921 hatchery steelhead (0.03%), wild steelhead (0.04%), 84 hatchery sockeye (0.8%), 374 wild sockeye (4.7%), and 194 hatchery coho (0.3%).

Facility mortality included fish removed from the raceways, barges or trucks before departure, sample mortalities, and NMFS marking mortalities. The combined facility mortality rate of 0.28% was almost double the average of the previous four years. This increase was influenced by a decrease in hatchery steelhead collection, which usually makes up the bulk of fish in the annual collection, and an increase in collection numbers of yearling chinook, which typically have higher mortality rates than steelhead. Hatchery and wild yearling chinook mortality rates, both at 0.6% in 1999, were above the 1995-1998 averages. Weekly subyearling chinook mortality rates were highest during the weeks ending September 2 and September 9 when mortality rates exceeded 2% (Table 19). Cooler water temperatures appeared to lessen the impact of fish disease (primarily *Columnaris*) and contributed to the lower rates of mortality late in the season compared to 1998 when mortality rates exceeded 10% in the weeks ending September 17, October 1 and October 8. Hatchery and wild sockeye/kokanee mortality rates in 1999 increased from preceding years to 0.8% and 4.7%, respectively. Daily mortality by species is provided in Appendix 1, Table 3 and weekly mortality rates are listed in Table 19.

Facility mortality counts include fish that perished during on-site marking operations conducted by the NMFS. A total of 396 mortalities were recorded for the Transportation Evaluation Study including: 254 hatchery yearling chinook, 57 wild yearling chinook, 74 hatchery steelhead, 7 wild steelhead, and 4 wild sockeye/kokanee. These fish represent approximately 2.4% of the total facility mortality observed in 1999.

The total 1999 sample mortality rate of 1.1% was the third highest rate in the last five years (Table 18). However, sample mortality rates were still lower than in 1998 for every species group. Subyearling chinook sample mortality rates decreased from 4.7% in 1998 to 1.3% in 1999 and were second lowest of the last five years. Hatchery steelhead sample mortality was less than half of the previous year and among the lowest in the previous five years. Hatchery coho also had a significant decrease in their sample mortality rate, from 2.37% in 1998 to 0.56% in 1999.

Barge mortalities included fish removed from barge holds after the barges departed the loading dock at Lower Granite. Mortalities include fish loaded at Lower Granite, Little Goose and Lower Monumental and McNary Dams. The total barge mortality rate for all facilities in

1999 was 0.03% (a total of 6,179 mortalities out of 18,043,227 barged fish), including 3,808 hatchery yearling chinook, 889 wild yearling chinook, 148 subyearling chinook, 773 hatchery steelhead, 146 wild steelhead, 118 hatchery sockeye/kokanee, 61 wild sockeye/kokanee and 236 coho.

Two incidents resulting in mortalities that were not included in the barge mortality totals occurred on April 25 and May 19. On the April 25 incident, following barge release below Bonneville Dam, a portion of the fish released from a 2000 series barge were drawn into the aeration system of the accompanying 8000 series barge. A total of 1,285 mortalities were recovered including: 735 hatchery yearling chinook, 445 wild yearling chinook, 60 hatchery steelhead, 44 wild steelhead and one hatchery coho. On the May 19 incident, two loaded fish barges (an 8000 and 4000 in tandem) were approaching Bonneville Dam. As the compressor began to build up air pressure in the 4000 barge, in preparation for fish release, the barge began to list to one side. It was found that the release valves on the port side had partially opened. An unknown number of fish were consequently released from the port side holds above Bonneville Dam. There were about 25,000 fish in the front hold and 24,000 in the rear hold, all from Little Goose. The barge rider found 86 mortalities in the partially emptied barge holds and 246 in the aerator baskets. There were likely additional mortalities that could not be retrieved. After stabilizing the barge, the remaining fish were released below Bonneville.

The overall mortality rate for fish trucked from Lower Granite Dam in 1999 was 0.2% (a total of 578 mortalities out of 239,557 trucked fish), compared to 0.5% for 1998 (942 mortalities out of 187,305 trucked fish). This includes fish trucked prior to barging and fish trucked during the late season ending on November 10. Total 1999 trucking mortality numbers by species were as follows: 36 hatchery yearling chinook, 42 wild yearling chinook, 362 subyearling chinook, 121 hatchery steelhead, 8 wild steelhead, 5 wild sockeye/kokanee and 4 hatchery coho.

Table 17. Annual facility mortality in percent at Lower Granite Dam, 1995-1999.

Year	Yearling Chinook		Subyearling ¹ Chinook		Steelhead		Sockeye/Kokanee ²		Coho ³	Total
	Hatchery	Wild	Hatchery	Wild ⁴	Hatchery	Wild	Hatchery	Wild	Hatchery	
1995	0.27	0.21	---	0.12	0.02	0.01	0.20	1.38	---	0.11
1996	0.58	0.88	---	0.37	0.04	0.05	0.35	3.78	0.06	0.12
1997	0.86	0.67	1.15	1.38	0.07	0.04	0.49	2.50	0.00	0.14
1998	0.25	0.32	2.50	2.42	0.07	0.08	0.18	0.29	0.32	0.15
1999	0.60	0.55		0.83	0.03	0.04	0.83	4.69	0.25	0.28

¹Hatchery subyearling chinook were not present until 1997.

²Hatchery sockeye/kokanee were not present until 1995.

³Hatchery coho were not present until 1995.

⁴Includes unmarked hatchery subyearling chinook in 1999.

Table 18. Annual sample mortality in percent at Lower Granite Dam, 1995-1999.

Year	Yearling Chinook		Subyearling ¹ Chinook		Steelhead		Sockeye/Kokanee ²		Coho ³	Total
	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	
1995	1.03	0.95	---	1.13	0.30	0.13	1.97	3.49	---	0.64
1996	1.86	2.36	---	2.71	0.35	0.19	0.79	13.24	0.75	0.78
1997	2.48	3.15	3.89	5.66	0.41	0.45	6.71	20.59	1.87	1.65
1998	1.80	2.23	2.74	4.67	0.82	0.67	2.65	11.54	2.37	1.85
1999	1.62	1.48		1.31	0.32	0.51	1.67	9.61	0.56	1.06

¹Hatchery subyearling chinook were not present until 1997.

²Hatchery sockeye/kokanee were not present until 1995

³Hatchery coho were not present until 1995.

Table 19. Weekly facility mortality in percent at Lower Granite Dam, 1999.

Week Ending	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Hatchery	Wild	Hatchery	Unmark	Hatchery	Wild	Hatchery	Wild	Hatchery	
Apr 1	2.5	0.9	---	0.0	0.4	1.1	---	8.1	1.8	1.4
Apr 8	0.9	0.6	---	0.0	0.1	0.2	---	3.7	0.0	0.4
Apr 15	0.3	0.5	---	---	0.0	0.0	---	5.8	0.0	0.2
Apr 22	0.5	0.6	---	0.0	0.0	0.0	---	2.6	0.0	0.3
Apr 29	0.5	0.6	---	0.0	0.0	0.0	---	2.7	0.9	0.3
May 6	0.5	0.4	---	0.0	0.0	0.0	---	2.3	0.2	0.2
May 13	0.6	0.6	---	---	0.0	0.0	---	4.0	0.1	0.3
May 20	0.8	0.6	---	---	0.0	0.0	0.6	0.8	0.1	0.5
May 27	0.6	0.5	---	---	0.0	0.0	1.5	9.6	0.1	0.2
Jun 3	0.5	0.4	---	0.0	0.0	0.0	0.7	7.4	0.5	0.2
Jun 10	0.5	0.4	---	0.6	0.1	0.0	1.4	5.9	0.2	0.3
Jun 17	0.4	0.4	---	1.0	0.1	0.1	0.0	0.0	1.0	0.5
Jun 24	0.5	0.8	---	1.3	0.1	0.1	1.2	3.6	0.2	0.7
Jul 1	0.3	0.1	---	1.2	0.1	0.9	0.0	37.1	0.1	0.9
Jul 8	3.0	1.2	---	1.2	0.4	0.5	3.9	8.3	0.3	1.1
Jul 15	2.0	0.3	---	1.1	1.7	1.0	0.0	2.1	1.2	1.2
Jul 22	5.8	2.3	---	1.3	4.4	0.0	0.0	3.6	0.0	1.5
Jul 29	3.2	0.0	---	0.4	1.6	5.0	---	0.0	0.0	0.4
Aug 5	---	---	---	0.4	1.9	10.0	---	10.0	0.0	0.5
Aug 12	10.5	---	---	0.5	0.5	0.0	---	5.0	0.0	0.6
Aug 19	---	---	---	0.6	0.6	0.0	0.0	---	0.0	0.6
Aug 26	25.0	---	---	1.0	0.7	0.0	---	0.0	0.0	1.0
Sep 2	---	---	---	2.1	0.0	6.3	---	17.6	---	2.1
Sep 9	0.0	0.0	---	2.2	7.7	0.0	---	12.5	0.0	2.3
Sep 16	---	0.0	---	1.6	0.0	0.0	---	0.0	0.0	1.6
Sep 23	0.0	0.0	---	1.0	0.0	0.0	---	10.0	0.0	1.1
Sep 30	---	0.0	---	0.9	0.0	0.0	---	27.3	0.0	1.0
Oct 7	---	0.0	---	0.9	0.0	0.0	---	5.1	0.0	1.0
Oct 14	0.0	0.0	---	0.4	0.0	0.0	---	8.3	0.0	0.5
Oct 21	0.0	---	---	0.4	0.0	0.0	---	3.3	0.0	0.5
Oct 28	0.0	---	---	0.5	0.0	---	---	18.2	0.0	0.7
Nov 4	0.0	---	---	0.3	0.0	0.0	0.0	7.5	0.0	0.4
Nov 10	0.0	---	---	0.1	0.0	0.0	0.6	4.1	0.0	0.2

---No fish collected during the week.

Incidental Fishes

Incidental species

A total of 55,333 incidental fish entered the fish facility at Lower Granite Dam in 1999 (Table 20). This represents a decrease of 19.4% in total incidentals over last season's total of 68,620. Approximately 92% of this season's incidental fish were sampled prior to September 2 when the facility went to a 100% sample rate. In contrast, 82% of last year's incidentals were counted prior to August 21 when the facility went to a 100% sample rate. Juvenile Pacific lamprey, including ammocetes, numbered 13,920 and made up 25.2% of the total incidental fishes tallied this year. This is approximately 44% less than in 1998, when an estimated total of 24,935 juvenile and ammocoete Pacific lamprey were collected. The second most abundant incidental species in 1999 were peamouths, with 11,283 collected. Other incidentals collected in significant numbers were: channel catfish, chiselmouth, crappie, suckers and whitefish. Sampled incidental fish counts were expanded (based on daily sample rates) and added to separator fallback fish to estimate the total collection.

Table 20. Estimated collection of incidental fish species at Lower Granite Dam, 1999.

Common Name	Scientific Name	Expanded Sample	Separator	Collection ¹
Pacific lamprey (Adult)	<i>Entosphenus tridentatus</i>	7	0	7
Pacific lamprey (Juvenile)	<i>E. tridentatus</i>	5,617	0	5,617
Pacific lamprey (Ammocete)	<i>E. tridentatus</i>	8,303	0	8,303
American shad (Adult)	<i>Alosa sapidissima</i>	24	0	24
American shad (Juvenile)	<i>A. sapidissima</i>	13	0	13
Smallmouth bass	<i>Micropterus dolomieu</i>	441	1	442
Bluegill	<i>Lepomis macrochirus</i>	136	0	136
Bullhead (misc.)	<i>Ictalurus sp.</i>	202	0	202
Common carp	<i>Cyprinus carpio</i>	13	703	716
Channel catfish	<i>Ictalurus punctatus</i>	2,605	57	2,662
Chiselmouth	<i>Acrocheilus alutaceus</i>	5,349	1	5,350
Crappie	<i>Pomoxis sp.</i>	3,306	0	3,306
Crayfish	<i>Cambarus sp.</i>	155	0	155
Kokanee ²	<i>Oncorhynchus nerka</i>	77	0	77
Longnose dace	<i>Rhinichthys cataractae</i>	3	0	3
Peamouth	<i>Mylocheilus caurinus</i>	11,277	6	11,283
Rainbow Trout ³	<i>Oncorhynchus mykiss</i>	190	0	190
Redside shiner	<i>Richardsonius balteatus</i>	4	0	4
Sculpin	<i>Cottus sp.</i>	105	0	105
Squawfish	<i>Ptychocheilus oregonensis</i>	252	4	256
Sucker (misc.)	<i>Catostomus sp.</i>	8,659	1,022	9,681
Sunfish (misc.)	<i>Lepomis sp.</i>	103	0	103
Whitefish	<i>Prosopium sp.</i>	6,461	0	6,461
White Sturgeon	<i>Acipenser transmontanus</i>	0	15	15
Yellow perch	<i>Perca flavescens</i>	221	0	221
Total		53,524	1,809	55,333

¹Incidental species collection estimated based on numbers sampled, sample rates, and separator counts.

²Kokanee in the sample are classified as any sockeye juvenile over 200 mm in length.

³Rainbow trout are classified by morphological characteristics.

Adult Fallbacks

A total of 6,324 adult salmonids were removed from the Lower Granite separator in 1999 (Table 22). This included: 187 adult chinook, 95 jack chinook, 4,091 hatchery steelhead, and 1,951 wild steelhead. Hatchery steelhead were the most abundant adult salmonid removed from the separator and made up nearly 65% of the total salmonid fallbacks during 1999. Wild steelhead were second in abundance and made up about 31% of the fallbacks. As is typical at Lower Granite Dam, April and May were the months of highest fallback for hatchery and wild steelhead while adult and jack chinook fallback counts were highest in October (Table 23).

Table 22. Annual totals of adult salmonids released from the juvenile fish separator at Lower Granite Dam, 1995-1999.

Year	Adult Chinook	Jack Chinook	Hatchery Steelhead	Wild Steelhead	Total
1995	60	49	3,660	2,127	5,896
1996	150	70	5,385	1,167	6,772
1997	470	19	6,609	1,944	9,042
1998	226	163	4,340	2,043	6,772
1999	187	95	4,091	1,951	6,324

The number of adult chinook removed from the separator in 1999 was 17% lower than in 1998 and also below the previous four-year average (Table 22). Jack chinook fallback numbers were 42% below 1998 totals but still remained 26% higher than the previous four-year average. Numbers of adult hatchery steelhead were about 18% below the four-year average while wild steelhead were 7% above the previous four-year average. Fallback salmonids were superficially examined for condition while being released off the separator. Over 96% of all adult salmonids were reported in good or fair condition (Table 24).

Table 23. Monthly totals of adult salmonids released from the juvenile fish separator at Lower Granite Dam, 1999.

Month	Adult Chinook	Jack Chinook	Hatchery Steelhead	Wild Steelhead	Total
April ¹	1	0	1,238	457	1,696
May	7	1	913	705	1,626
June	39	25	123	392	579
July	21	20	100	66	207
August	15	3	288	87	393
September	41	10	467	97	615
October ²	63	36	962	147	1,208
Total	187	95	4,091	1,951	6,324

¹ Includes March 26-31.

² Includes November 1-10.

Table 24. Condition of adult salmonids released from the juvenile fish separator at Lower Granite Dam, 1999.

Condition	Adult Chinook	Jack Chinook	Hatchery Steelhead	Wild Steelhead	Total
Good	153	89	3,148	1,631	5,021
Fair	20	6	767	271	1,064
Poor	8	0	154	42	204
Dead	6	0	22	7	35
Total	187	95	4,091	1,951	6,324

Adult fallbacks that passed through the separator bars were not counted on daily separator fallback forms. Some of these passed into raceways and were transported but not counted while others entered the sample tank and were counted as incidental fish. A total of 119 adult salmonids recorded in the daily samples this season, including: 59 hatchery jack chinook, 14 hatchery mini-jack chinook, 11 wild jack chinook, 22 hatchery steelhead, 5 wild steelhead and 8 wild sockeye/kokanee. Adult chinook between 12 to 22 inches in fork length were recorded as jacks. Mini-jacks were between 6 to 12 inches in fork length. Nearly 67% of the hatchery jack chinook were marked with color coded elastomer tags. These 49 elastomer marked jacks included 22 left-orange, ten left-blue, six right-green, six left-green, and five left-red. There were six adult fish in the sample recorded as mortalities during the season, one wild chinook and four hatchery chinook and one hatchery steelhead. Two hatchery chinook jacks in the sample were marked with double operculum punch holes. These fish were marked by NMFS staff at the adult fish trap, when the fish were handled while ascending the ladder at LGR.

Research

During 1999 four agencies conducted nine research projects which impacted a total of 440,810 smolts. This represents 7.5% of the total fish collection at Lower Granite. Of this total, researchers PIT tagged 247,268 smolts, radio tagged 137, examined 1,997, sacrificed 527, and reported 572 incidental mortalities. In addition, 190,309 smolts (43%) were anesthetized and handled but not tagged, examined, or sacrificed for research.

NMFS Study to Compare the Adult Returns of Inriver Migrating versus Barged Juvenile Anadromous Salmonids

The National Marine Fisheries Service (NMFS) tagged a total of 242,889 smolts with PIT tags for the transportation evaluation study during the spring migration from April 21 to June 24. A total of 99,473 smolts were tagged and barged to release points below Bonneville Dam, including: 43,446 hatchery yearling chinook, 8,812 wild yearling chinook, 41,146 hatchery steelhead and 6,069 wild steelhead. NMFS staff tagged and bypassed, after a 24-hour recovery period, a total of 143,416 smolts, including: 62,172 hatchery yearling chinook, 12,683 wild yearling chinook, 60,152 hatchery steelhead, 8,407 wild steelhead and two coho. These fish were bypassed to the river via the PIT tag bypass outfall pipe to continue their in-river migration. A total of 185,971 smolts were handled but not tagged, including: 34,609 hatchery yearling chinook, 5,633 wild yearling chinook, 13,440 hatchery fall yearling chinook, 77 subyearling fall chinook, 116,342 hatchery steelhead, 10,921 wild steelhead, 1,001 hatchery coho, 81 hatchery sockeye/kokanee and 512 wild sockeye/kokanee. Mortalities removed from raceways in which smolts were collected for this research for tagging and raceways holding tagged fish for transportation and holding tanks for tagged fish to be bypassed were attributed to facility raceway mortalities and not research mortalities. However, NMFS staff recorded mortality counts, mainly bypass group holding tank mortalities, on daily tally forms. A total of 396 smolt mortalities were recorded, including: 254 hatchery yearling chinook, 57 wild yearling chinook, 74 hatchery steelhead, seven wild steelhead and four wild sockeye/kokanee. Most of the smolts handled and tagged for this study were collected into raceways and tagged in the NMFS marking trailer, but when collection numbers were relatively low, NMFS staff marked fish from the sample lab (March 30 and April 16 and between June 5 and 23).

USGS-BRD Summer SBC Evaluation

The United States Geological Survey Biological Research Division (USGS-BRD) researchers surgically implanted radio tags in 20 hatchery yearling chinook and 20 hatchery steelhead on April 8 for release into the Surface and Bypass Collector (SBC). This brief evaluation was implemented to determine how rapidly fish in the SBC move through it. The fish were tagged, held for 24 hours to allow them to recover and then released, one at a time, directly into the SBC. A total of six hatchery yearling chinook and five hatchery steelhead were handled but not tagged during this study.

USGS-BRD Fall Chinook Temperature Telemetry

Researchers from the USGS-BRD implanted temperature and depth data transmitting radio tags in 97 subyearling chinook. These fish were tagged, held for 24 hours to recover and then released through the PIT tag bypass line back to the river between July 6 and September 7. Boat crews tracked these fish as they traveled through the Little Goose pool. Seventy-two smolts were handled but not radio tagged. Two subyearling chinook mortalities were recorded during this research.

WDFW Gas Bubble Trauma Monitoring

The Washington Department of Fish and Wildlife (WDFW) conducted Gas Bubble Trauma (GBT) examinations on fish collected from the wet separator on Mondays from April 5 through June 15. The examinations required stereo microscopic inspections of the unpaired fins, the left lateral line and both eyes of sample fish for the presence of gas bubbles. Up to 100 chinook (hatchery and wild) and up to 100 steelhead (hatchery and wild), depending upon the numbers of fish available, were examined each day for GBT symptoms. A total of 1,997 salmonids were examined, including: 574 hatchery yearling chinook, 323 wild yearling chinook, 970 hatchery steelhead and 130 wild steelhead. Fish handled during sampling for GBT but not examined include 128 fish that were netted and immediately released and 29 PIT tagged smolts that were anesthetized. The PIT tagged smolts were allowed to recover and released back into the separator. Smolts examined for symptoms of GBT were released into a raceway to prevent them from getting diverted to the sample tank and anesthetized again later. These fish were added to daily collection counts because they were not available to the sample system. There were 11 yearling chinook and 10 steelhead observed with symptoms of GBT.

NMFS/USGS Comparative Performance of Sham Radio-tagged and PIT-tagged Juvenile Salmonids

The National Marine Fisheries Service (NMFS) marked hatchery yearling chinook with sham radio tags containing PIT tags and PIT tags to compare survival rates of the two different methods through reservoir reaches below Lower Granite Dam. The sham (fake) radio tags were implanted using one of two methods: surgical or gastric. Between April 17 and 29, a total of 4,379 hatchery yearling chinook were tagged. Most of the fish were collected in conjunction with the NMFS Transportation Study but a total of 1,350 fish were provided from daily SMP samples. Tagged fish were held for 24 hours after tagging and then released back to the river. A total of 580 smolts were handled but not tagged, including: 577 hatchery yearling chinook, one hatchery steelhead and two coho. Researchers reported 149 hatchery yearling chinook handling and post-tagging mortalities during this study.

U of I: Evaluation of the Effects of Multiple Dam Passage on the Physiological Condition of Migrating Juvenile Salmon. Objective 1B: Determine cumulative physiological response to passage through multiple dams: verify results with Snake River spring chinook salmon stocks. (in-river migrants)

University of Idaho Fishery co-op researchers used the PIT tag diversion by code system (GRX) to collect and sample migrating hatchery yearling chinook (provided by the ongoing Hatchery Relative Survival Study) to evaluate the physiological response of these fish to cumulative dam passage. Between April 27 and May 16, research staff sampled (sacrificed), to measure physiological indices, a total of 168 hatchery yearling chinook smolts collected at the GRX holding tanks. A relatively large number (2,544) of other fish, both untagged and PIT tagged, were inadvertently diverted to the GRX tanks during this study, including: 1,129 hatchery yearling chinook, 266 wild yearling chinook, 1,092 hatchery steelhead, 56 wild steelhead and 1 coho. These fish were handled and released through the PIT tag outfall bypass pipe after they were scanned for PIT tags. Tagged fish recapture events were reported to PTAGIS. A total of 20 hatchery yearling chinook mortalities were recorded during this objective.

U of I: Objective 1B: (run-at-large migrants)

University of Idaho researchers obtained a total of 195 smolts from the daily sample at Lower Granite Dam on May 5 and May 7 for comparison with in-river migrating fish. These fish, which were not fed, were held in tanks supplied with filtered river water and sacrificed at intervals of 0, 6, 12, and 18 days. These samples will provide baseline data for fasted fish against which to compare changes in energy stores, condition factor, gall bladder fullness, and plasma alkaline phosphatase concentrations (all indicators of nutritional status) observed in in-river migrating fish. A total of 124 smolts were sacrificed for this objective, including: 54 hatchery yearling chinook, 34 wild yearling chinook, 18 hatchery steelhead and 18 wild steelhead. An additional 18 hatchery yearling chinook, 13 wild yearling chinook, 27 hatchery steelhead and 13 wild steelhead were handled during this research.

U of I: Objective 1B: (in-river migrants, salt water challenge)

Researchers from the University of Idaho collected fish from three selected hatcheries to assess their readiness for seawater entry. Fish from each hatchery were collected at the GRX holding tanks and exposed to temperature controlled, artificial seawater. Blood samples were taken for measurement of plasma Na^+ and CL^- concentrations (and other physiological indices) after 24 hours. Between April 25 and May 13, a total of 122 hatchery yearling chinook smolts were sampled (sacrificed) for this objective. Research staff reported that one hatchery steelhead was handled and released to the river during this study and four hatchery yearling chinook were recorded as mortalities.

U of I: Objective 3B: Compare the effects of handling on the physiology and performance of chinook salmon juveniles of wild and hatchery origin: Verify results with Snake River spring chinook salmon stocks. (hatchery and wild barged smolts)

ICFWRU researchers sampled hatchery and wild chinook salmon smolts from barges on four dates to compare changes in physiological indices for barged chinook with indices for in-river migrating hatchery chinook. In addition, hatchery and wild steelhead were sampled from barges on four dates for comparison of physiological indices and energy stores in hatchery and wild fish across several study years. Research staff collected and sampled (sacrificed) a total of 113 smolts from barges, including: 55 hatchery yearling chinook, 35 wild yearling chinook, 18 hatchery steelhead and 5 wild steelhead. A total of 903 smolts were handled and released back into barges, including: 479 hatchery yearling chinook, 81 wild yearling chinook, 297 hatchery steelhead, 42 wild steelhead and four hatchery coho.

Recommendations

Employ 400-gallon tanks for mini-tanker transportation.

Replace the PIT tag headbox with a flume, eliminating delay in passage of tagged fish and need to manually drain the headbox.

Replace sample tank cover net.

Replace the sample to barge load line hose with lighter weight flexible hose to reduce physical strain and possible work hazard.

Modify through-the-wall sample direct-load line to provide slope and prevent fish stranding.

Install two indoor recovery tanks in the sample lab to receive non-transport day sample fish and fish-to-bypass fish.

Install storage cabinets (or cupboard shelves) in the chiller room.

Cover decking area on eastside of sample holding tank with plywood (or something to keep things from falling through the deck).

Record in logbook the volume estimates of debris removed from trash racks following raking events.

Record on a daily form the orifice blockages for each gallery inspection/back-flushing event.

Appendix 1. Collection Tables

Table 1. Daily Smolt Collection Counts, River Flows and Temperature at Lower Granite Dam, 1999

Date	Daily Number of Fish Collected											River Conditions		
	Yearling Chinook		Sub-yr Chinook		Steelhead	Sockeye/Kokanee		Coho		Daily	Cumulative	River	Spill	Temp.
	Hatchery	Wild	Hatchery	Unk.	Hatchery	Wild	Hatch	Wild	Unk	Total	Total	(kcfs)	(kcfs)	(F)
26-Mar	350	200	0	0	30	210	0	70	10	870	870	114.7	15.4	46.4
27-Mar	570	330	0	0	130	180	0	30	10	1,250	2,120	124.0	19.8	46.4
28-Mar	340	750	0	0	510	530	0	140	0	2,270	4,390	128.0	42.4	46.4
29-Mar	810	1,730	0	10	720	910	0	150	80	4,410	8,800	119.4	30.2	46.4
30-Mar	1,020	3,030	0	0	1,390	1,290	0	230	60	7,020	15,820	110.3	2.3	45.5
31-Mar	1,450	3,190	0	0	1,930	1,150	0	170	10	7,900	23,720	98.0	0.0	45.5
1-Apr	1,333	4,417	0	83	1,800	1,283	0	233	0	9,149	32,869	87.8	0.0	45.5
2-Apr	867	2,400	0	0	2,033	817	0	67	17	6,201	39,070	86.8	0.0	45.5
3-Apr	850	2,617	0	0	2,750	1,267	0	150	0	7,634	46,704	89.3	27.5	45.5
4-Apr	600	1,267	0	0	1,417	550	0	33	0	3,867	50,571	88.0	27.7	46.4
5-Apr	317	1,450	0	33	867	317	0	0	0	2,984	53,555	82.1	27.7	46.4
6-Apr	113	1,052	0	0	1,351	231	0	38	0	2,785	56,340	80.2	29.7	46.9
7-Apr	396	1,644	0	0	3,173	443	0	7	0	5,663	62,003	76.5	29.9	46.4
8-Apr	360	1,440	0	20	1,670	180	0	30	0	3,700	65,703	74.9	32.5	47.3
9-Apr	450	1,500	0	0	2,430	290	0	40	10	4,720	70,423	74.3	32.4	46.4
10-Apr	580	1,510	0	0	6,000	690	0	10	10	8,800	79,223	75.1	32.0	47.3
11-Apr	200	1,283	0	0	2,833	317	0	33	0	4,666	83,889	76.2	33.4	48.2
12-Apr	583	1,633	0	0	4,133	283	0	17	0	6,649	90,538	73.7	33.7	48.2
13-Apr	756	1,394	0	0	3,909	341	0	0	0	6,400	96,938	75.8	35.1	48.2
14-Apr	1,617	2,167	0	0	9,000	717	0	50	0	13,551	110,489	81.6	35.1	48.2
15-Apr	2,120	3,020	0	0	7,840	460	0	40	0	13,480	123,969	80.3	35.2	48.2
16-Apr	3,080	2,340	0	0	8,780	440	0	40	0	14,680	138,649	82.6	35.2	49.1
17-Apr	2,460	1,880	0	0	5,560	340	0	40	0	10,280	148,929	81.6	35.3	49.1
18-Apr	2,620	1,780	0	0	4,120	420	0	20	0	8,960	157,889	87.1	35.3	50.0
19-Apr	11,800	4,280	0	20	7,820	840	0	20	0	24,780	182,669	90.9	35.2	50.0
20-Apr	27,467	11,083	0	100	12,293	3,057	0	0	0	54,000	236,669	106.3	33.4	51.4
21-Apr	48,200	11,900	0	0	32,700	8,400	0	200	0	101,400	338,069	122.0	32.6	50.9
22-Apr	64,800	10,950	0	0	48,600	9,150	0	150	150	133,800	471,869	124.7	31.5	50.0
23-Apr	47,400	17,100	0	0	75,000	18,150	0	150	0	157,800	629,669	122.9	32.4	49.1
24-Apr	39,300	13,950	0	150	86,850	18,150	0	150	0	158,550	788,219	111.6	34.3	50.0
25-Apr	36,300	11,400	0	0	40,800	7,050	0	150	0	95,700	883,919	107.9	35.3	50.9
26-Apr	29,250	9,750	0	300	33,000	6,750	0	150	0	79,200	963,119	110.0	51.7	50.9
27-Apr	59,323	20,877	0	0	63,246	5,404	0	300	0	149,150	1,112,269	115.9	44.8	51.8
28-Apr	46,050	12,450	0	0	57,300	4,350	0	300	0	120,450	1,232,719	126.2	49.7	51.8
29-Apr	48,000	13,200	0	0	73,200	6,750	0	150	450	141,750	1,374,469	115.5	45.5	51.8
30-Apr	57,450	13,950	0	150	88,650	6,450	0	300	0	166,950	1,541,419	106.4	34.6	50.0
1-May	46,050	7,050	0	300	89,250	6,750	0	150	300	149,850	1,691,269	99.3	33.5	50.0
2-May	69,450	13,350	0	150	134,400	10,500	0	300	300	228,450	1,919,719	99.2	34.5	50.0
3-May	75,900	13,050	0	0	105,750	6,300	0	0	150	201,150	2,120,869	103.4	34.6	50.0
4-May	69,679	12,021	0	0	96,841	4,359	0	150	300	183,350	2,304,219	106.7	34.3	50.0
5-May	46,800	6,900	0	0	291,750	7,350	0	150	300	353,250	2,657,469	106.6	34.1	50.9
6-May	41,850	6,300	0	0	63,600	2,850	0	0	150	114,750	2,772,219	99.1	34.4	50.9
7-May	32,850	3,450	0	0	53,550	2,400	0	150	0	92,400	2,864,619	95.3	34.6	50.9
8-May	67,800	5,850	0	0	64,500	4,200	0	0	300	142,650	3,007,269	95.1	34.6	51.8
9-May	82,500	8,100	0	0	78,000	4,650	0	150	450	173,850	3,181,119	94.8	34.5	51.8
10-May	82,650	7,050	0	0	43,500	3,450	0	0	0	136,650	3,317,769	93.6	34.7	51.8
11-May	42,543	3,157	0	0	32,038	3,012	0	0	150	80,900	3,398,669	94.3	33.5	50.9
12-May	31,350	2,250	0	0	28,650	3,000	0	150	300	65,700	3,464,369	85.8	34.2	50.0
13-May	35,200	4,100	0	0	36,100	3,800	0	100	400	79,700	3,544,069	87.2	35.2	50.9

Table 1. Daily Smolt Collection Counts, River Flows and Temperature at Lower Granite Dam, 1999

Page 2

Date	Daily Number of Fish Collected										River Conditions			
	Yearling Chinook		Sub-yr Chinook		Steelhead	Sockeye/Kokanee		Coho		Daily Total	Cumulative Total	River (kcfs)	Spill (kcfs)	Temp. (F)
	Hatchery	Wild	Hatchery	Unk.	Hatchery	Wild	Hatch	Wild	Unk					
14-May	43,500	4,000	0	0	47,300	3,400	0	200	300	98,700	3,642,769	87.0	35.3	51.8
15-May	35,400	3,000	0	0	30,150	1,950	150	0	150	70,800	3,713,569	85.4	35.3	51.8
16-May	36,150	2,400	0	0	26,250	2,100	150	0	450	67,500	3,781,069	82.4	36.1	51.8
17-May	42,600	3,300	0	0	28,400	2,800	0	100	500	77,700	3,858,769	83.0	35.2	51.8
18-May	40,484	2,916	0	0	21,895	1,705	0	300	600	67,900	3,926,669	81.8	35.4	51.8
19-May	33,800	2,700	0	0	27,900	2,200	200	0	300	67,100	3,993,769	82.3	34.9	52.7
20-May	31,500	2,400	0	0	20,700	2,900	0	200	2,300	60,000	4,053,769	90.5	35.3	53.6
21-May	29,700	3,300	0	0	38,200	3,600	0	100	2,200	77,100	4,130,869	90.4	35.4	53.6
22-May	33,200	2,900	0	0	57,500	10,500	0	200	3,400	107,700	4,238,569	98.6	39.9	53.6
23-May	46,050	7,650	0	0	85,200	12,750	300	0	4,800	156,750	4,395,319	117.1	38.8	53.6
24-May	34,050	6,000	0	0	119,700	11,850	300	0	3,750	175,650	4,570,969	117.2	35.2	55.4
25-May	27,827	5,123	0	0	144,380	16,220	150	150	6,150	200,000	4,770,969	137.9	43.7	55.4
26-May	24,450	9,900	0	0	193,950	19,050	150	0	8,400	255,900	5,026,869	161.2	58.9	55.4
27-May	9,300	8,400	0	0	98,250	14,400	150	0	8,400	138,900	5,165,769	192.6	88.7	53.6
28-May	5,700	7,050	0	0	40,500	8,250	1,200	300	7,950	70,950	5,236,719	174.9	73.3	53.6
29-May	2,500	3,400	0	0	25,800	5,600	1,800	200	2,600	41,900	5,278,619	158.6	57.7	53.6
30-May	2,000	3,250	0	0	21,900	4,450	1,100	50	1,700	34,450	5,313,069	157.9	59.1	53.6
31-May	1,650	2,650	0	0	22,250	3,300	1,050	150	2,650	33,700	5,346,769	177.3	73.1	53.6
1-Jun	975	1,576	0	50	9,129	2,321	650	100	1,850	16,651	5,363,420	171.6	67.7	53.6
2-Jun	1,350	2,750	0	0	19,150	3,450	800	0	1,400	28,900	5,392,320	170.1	66.7	53.6
3-Jun	1,150	2,550	0	300	13,800	2,800	450	0	1,050	22,100	5,414,420	172.2	68.3	53.6
4-Jun	1,150	1,650	0	0	8,700	1,400	100	0	1,400	14,400	5,428,820	159.4	59.7	53.6
5-Jun	1,267	1,883	0	17	13,417	3,283	100	33	1,167	21,167	5,449,987	150.4	59.2	53.2
6-Jun	1,300	1,960	0	80	10,760	1,720	60	40	1,320	17,240	5,467,227	150.6	56.6	52.7
7-Jun	1,433	3,817	0	250	8,383	1,433	183	100	1,400	16,999	5,484,226	144.5	49.9	53.2
8-Jun	2,276	5,504	0	8,683	7,769	1,397	67	33	1,617	27,346	5,511,572	138.4	44.3	53.6
9-Jun	717	1,567	0	12,700	3,283	633	117	50	1,083	20,150	5,531,722	136.8	60.2	53.6
10-Jun	350	1,133	0	11,767	2,383	367	83	50	517	16,650	5,548,372	126.7	41.6	53.6
11-Jun	533	1,217	0	7,950	2,967	483	67	0	433	13,650	5,562,022	113.9	36.4	55.4
12-Jun	175	550	0	2,075	1,525	225	50	0	200	4,800	5,566,822	108.9	31.9	55.4
13-Jun	300	367	0	1,550	1,083	317	0	33	183	3,833	5,570,655	105.5	34.9	56.3
14-Jun	133	400	0	1,350	1,200	133	17	0	200	3,433	5,574,088	110.5	32.7	58.1
15-Jun	304	854	0	1,517	2,151	366	33	17	217	5,459	5,579,547	124.3	36.3	59.0
16-Jun	720	2,130	0	1,620	4,440	680	20	20	450	10,080	5,589,627	134.9	42.7	58.1
17-Jun	650	1,583	0	1,133	8,400	617	67	17	200	12,667	5,602,294	150.6	50.9	59.0
18-Jun	917	2,400	0	2,717	12,917	1,150	0	33	317	20,451	5,622,745	157.6	57.0	59.0
19-Jun	522	1,412	0	2,609	10,284	522	31	0	153	15,533	5,638,278	158.9	59.6	58.1
20-Jun	1,033	2,767	0	7,067	7,400	467	33	0	400	19,167	5,657,445	166.1	63.3	58.6
21-Jun	233	1,133	0	8,733	3,967	300	33	33	300	14,732	5,672,177	160.0	58.0	58.1
22-Jun	167	517	0	7,917	1,483	300	33	0	183	10,600	5,682,777	146.9	47.2	59.0
23-Jun	67	567	0	3,250	1,500	117	33	17	267	5,818	5,688,595	143.4	49.0	59.0
24-Jun	60	190	0	2,730	690	50	10	0	30	3,760	5,692,355	129.6	47.2	59.0
25-Jun	20	110	0	1,950	550	30	20	10	130	2,820	5,695,175	121.3	37.9	59.0
26-Jun	50	200	0	1,740	540	10	10	0	180	2,730	5,697,905	121.5	46.7	59.0
27-Jun	40	470	0	1,790	510	10	0	10	80	2,910	5,700,815	112.9	36.7	59.9
28-Jun	90	140	0	2,040	890	90	10	10	130	3,400	5,704,215	102.6	25.6	59.9
29-Jun	60	120	0	1,590	600	10	0	0	80	2,460	5,706,675	95.8	18.9	59.9
30-Jun	60	50	0	1,585	450	35	5	0	80	2,265	5,708,940	87.0	10.2	60.8
1-Jul	65	155	0	1,375	410	45	0	5	95	2,150	5,711,090	86.7	10.0	60.8

Table 1. Daily Smolt Collection Counts, River Flows and Temperature at Lower Granite Dam, 1999

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Date	Daily Number of Fish Collected										River Conditions			
	Yearling Chinook		Sub-yr Chinook		Steelhead	Sockeye/Kokanee		Coho		Daily Total	Cumulative Total	River (kcfs)	Spill (kcfs)	Temp. (F)
	Hatchery	Wild	Hatchery	Unk.	Hatchery	Wild	Hatch	Wild	Unk					
2-Jul	40	50	0	1,835	445	35	5	10	80	2,500	5,713,590	79.0	3.5	61.3
3-Jul	45	95	0	1,785	485	30	0	15	65	2,520	5,716,110	77.3	1.9	61.7
4-Jul	20	285	0	1,820	460	50	0	25	85	2,745	5,718,855	63.5	0.0	61.7
5-Jul	40	135	0	920	215	30	5	5	45	1,395	5,720,250	65.3	0.0	61.7
6-Jul	25	50	0	1,305	300	20	10	5	25	1,740	5,721,990	58.4	0.0	61.7
7-Jul	35	40	0	715	220	10	15	0	70	1,105	5,723,095	60.1	0.0	61.7
8-Jul	60	40	0	1,016	240	20	16	0	28	1,420	5,724,515	53.8	0.0	61.7
9-Jul	64	36	0	1,652	260	20	4	16	84	2,136	5,726,651	55.4	0.0	62.6
10-Jul	72	64	0	1,820	428	24	4	8	44	2,464	5,729,115	56.2	0.0	64.4
11-Jul	20	35	0	415	165	5	0	0	20	660	5,729,775	54.6	0.0	64.4
12-Jul	28	96	0	1,536	312	16	4	8	48	2,048	5,731,823	54.1	0.0	65.3
13-Jul	48	52	0	1,756	252	16	4	8	20	2,156	5,733,979	53.0	0.0	66.2
14-Jul	40	40	0	2,032	240	12	0	8	16	2,388	5,736,367	52.1	0.0	66.7
15-Jul	24	12	0	2,008	180	4	4	0	28	2,260	5,738,627	53.7	0.0	67.6
16-Jul	40	24	0	3,168	300	16	8	16	32	3,604	5,742,231	53.2	0.0	68.0
17-Jul	12	20	0	2,760	284	16	0	0	24	3,116	5,745,347	52.9	0.0	68.0
18-Jul	8	20	0	2,240	200	12	0	0	8	2,488	5,747,835	53.3	0.0	68.0
19-Jul	12	4	0	3,204	208	24	0	8	8	3,468	5,751,303	52.2	0.0	68.0
20-Jul	12	8	0	2,712	188	4	0	4	20	2,948	5,754,251	54.9	0.7	68.0
21-Jul	0	20	0	3,792	248	12	0	0	8	4,080	5,758,331	52.7	0.0	68.0
22-Jul	36	36	0	4,464	176	8	0	0	8	4,728	5,763,059	51.5	0.0	68.0
23-Jul	25	8	0	5,449	202	0	0	0	17	5,701	5,768,760	51.4	0.0	67.1
24-Jul	40	0	0	4,360	200	10	0	0	10	4,620	5,773,380	50.7	0.0	67.1
25-Jul	10	30	0	5,800	210	0	0	0	20	6,070	5,779,450	48.6	0.0	67.1
26-Jul	10	0	0	5,550	360	0	0	0	0	5,920	5,785,370	48.2	0.0	67.1
27-Jul	0	10	0	3,460	170	10	0	10	0	3,660	5,789,030	46.7	0.2	68.0
28-Jul	10	10	0	5,010	130	10	0	10	20	5,200	5,794,230	45.1	0.0	67.1
29-Jul	0	10	0	3,630	160	10	0	0	10	3,820	5,798,050	46.0	0.0	67.1
30-Jul	0	0	0	4,490	120	0	0	10	10	4,630	5,802,680	46.6	0.0	67.6
31-Jul	0	0	0	4,240	200	10	0	0	0	4,450	5,807,130	44.5	0.0	68.0
1-Aug	0	0	0	5,790	180	10	0	10	0	5,990	5,813,120	48.6	0.0	68.9
2-Aug	0	0	0	4,430	180	0	0	0	0	4,610	5,817,730	48.4	0.0	68.9
3-Aug	0	0	0	4,000	100	0	0	0	0	4,100	5,821,830	48.2	0.0	68.0
4-Aug	0	0	0	3,750	170	0	0	0	0	3,920	5,825,750	48.7	0.4	68.0
5-Aug	0	0	0	3,530	20	0	0	0	10	3,560	5,829,310	43.1	0.0	68.0
6-Aug	10	0	0	2,640	140	0	0	0	10	2,800	5,832,110	43.0	0.1	67.1
7-Aug	0	0	0	2,155	65	0	0	0	0	2,220	5,834,330	41.8	0.0	67.1
8-Aug	5	0	0	3,275	80	5	0	10	0	3,375	5,837,705	41.7	0.5	67.1
9-Aug	0	0	0	2,585	85	0	0	0	15	2,685	5,840,390	41.3	0.0	67.1
10-Aug	0	0	0	1,715	40	0	0	5	5	1,765	5,842,155	39.5	0.1	67.1
11-Aug	0	0	0	1,620	85	5	0	5	0	1,715	5,843,870	40.1	1.3	66.2
12-Aug	4	0	0	2,160	64	0	0	0	0	2,228	5,846,098	37.4	1.4	66.2
13-Aug	0	0	0	1,604	60	8	0	0	0	1,672	5,847,770	36.9	0.7	66.2
14-Aug	0	0	0	980	56	4	4	0	0	1,044	5,848,814	39.5	0.9	66.2
15-Aug	0	0	0	1,540	56	8	0	0	4	1,608	5,850,422	37.8	0.6	65.3
16-Aug	0	0	0	1,048	72	0	0	0	0	1,120	5,851,542	38.3	0.9	65.3
17-Aug	0	0	0	664	44	4	0	0	0	712	5,852,254	38.1	0.6	65.3
18-Aug	0	0	0	732	28	0	4	0	0	764	5,853,018	40.2	0.5	65.3
19-Aug	0	0	0	828	12	4	0	0	8	852	5,853,870	36.3	1.2	65.3

Table 1. Daily Smolt Collection Counts, River Flows and Temperature at Lower Granite Dam, 1999

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Date	Daily Number of Fish Collected										River Conditions			
	Yearling Chinook		Sub-yr Chinook		Steelhead	Sockeye/Kokanee		Coho		Daily Total	Cumulative Total	River (kcfs)	Spill (kcfs)	Temp. (F)
	Hatchery	Wild	Hatchery	Unk.	Hatchery	Wild	Hatch	Wild	Unk					
20-Aug	0	0	0	740	20	4	0	0	8	772	5,854,642	36.6	0.0	65.3
21-Aug	0	0	0	492	20	0	0	0	4	516	5,855,158	38.4	0.0	66.2
22-Aug	0	0	0	536	24	0	0	4	0	564	5,855,722	34.8	0.0	66.2
23-Aug	0	0	0	556	8	0	0	4	0	568	5,856,290	31.9	0.0	67.1
24-Aug	4	0	0	476	20	0	0	0	0	500	5,856,790	32.2	0.0	68.0
25-Aug	0	0	0	316	28	0	0	0	0	344	5,857,134	34.5	0.0	68.9
26-Aug	4	0	0	572	20	0	0	4	4	604	5,857,738	33.5	0.0	68.0
27-Aug	0	0	0	692	16	0	0	4	0	712	5,858,450	32.9	0.0	68.0
28-Aug	0	0	0	488	12	4	0	4	0	508	5,858,958	32.4	0.0	68.9
29-Aug	0	0	0	416	16	4	0	0	0	436	5,859,394	31.3	0.0	68.9
30-Aug	0	0	0	456	8	0	0	0	0	464	5,859,858	27.4	0.0	68.0
31-Aug	0	0	0	380	4	0	0	0	0	384	5,860,242	29.0	0.0	68.0
1-Sep	0	0	0	592	8	8	0	8	0	616	5,860,858	26.9	0.0	68.0
2-Sep	0	0	0	370	8	0	0	1	0	379	5,861,237	29.8	0.0	68.0
3-Sep	0	0	0	270	2	1	0	0	0	273	5,861,510	30.6	0.0	67.1
4-Sep	1	1	0	164	4	0	0	0	0	170	5,861,680	30.3	0.0	67.1
5-Sep	1	0	0	275	2	0	0	0	0	278	5,861,958	28.6	0.0	67.1
6-Sep	1	0	0	207	2	0	0	2	0	212	5,862,170	25.1	0.0	67.1
7-Sep	0	0	0	175	1	0	0	1	1	178	5,862,348	20.5	0.0	66.2
8-Sep	0	0	0	212	1	0	0	2	0	215	5,862,563	19.6	0.0	66.2
9-Sep	0	0	0	242	1	0	0	3	0	246	5,862,809	21.8	0.0	67.1
10-Sep	0	0	0	289	2	0	0	1	0	292	5,863,101	24.4	0.0	67.1
11-Sep	0	0	0	167	2	0	0	0	0	169	5,863,270	23.6	0.0	65.3
12-Sep	0	0	0	164	3	1	0	0	1	169	5,863,439	24.2	0.0	65.3
13-Sep	0	0	0	162	0	0	0	0	0	162	5,863,601	19.7	0.0	64.4
14-Sep	0	0	0	313	0	1	0	0	0	314	5,863,915	20.6	0.0	65.3
15-Sep	0	0	0	415	3	0	0	3	0	421	5,864,336	26.3	0.0	66.2
16-Sep	0	2	0	432	4	1	0	5	2	446	5,864,782	21.7	0.0	65.6
17-Sep	0	0	0	347	3	2	0	1	3	356	5,865,138	23.0	0.0	65.6
18-Sep	2	1	0	243	1	0	0	0	2	249	5,865,387	21.4	0.0	65.3
19-Sep	0	0	0	350	2	0	0	3	1	356	5,865,743	20.5	0.0	65.3
20-Sep	0	0	0	381	1	0	0	1	3	386	5,866,129	16.6	0.0	65.3
21-Sep	0	0	0	429	0	0	0	1	4	434	5,866,563	19.6	0.0	66.2
22-Sep	0	0	0	367	1	0	0	3	4	375	5,866,938	23.6	0.0	66.2
23-Sep	0	0	0	376	0	0	0	1	3	380	5,867,318	20.7	0.0	66.2
24-Sep	0	0	0	374	2	0	0	0	10	386	5,867,704	21.0	0.0	66.2
25-Sep	0	0	0	203	1	0	0	1	9	214	5,867,918	22.6	0.0	65.7
26-Sep	0	0	0	133	1	0	0	2	0	136	5,868,054	20.6	0.0	65.1
27-Sep	0	0	0	152	0	0	0	1	2	155	5,868,209	19.4	0.0	64.4
28-Sep	0	0	0	175	0	1	0	2	2	180	5,868,389	22.9	0.0	64.4
29-Sep	0	0	0	217	1	0	0	3	0	221	5,868,610	21.8	0.0	64.0
30-Sep	0	1	0	262	2	0	0	2	1	268	5,868,878	20.5	0.0	63.7
1-Oct	0	0	0	244	1	0	0	5	0	250	5,869,128	25.1	0.0	63.4
2-Oct	0	1	0	215	0	0	0	3	0	219	5,869,347	26.5	0.0	63.4
3-Oct	0	2	0	195	1	0	0	7	0	205	5,869,552	22.0	0.0	63.0
4-Oct	0	0	0	224	1	0	0	9	0	234	5,869,786	24.9	0.0	61.5
5-Oct	0	0	0	247	0	0	0	9	1	257	5,870,043	21.8	0.0	61.6
6-Oct	0	0	0	325	0	1	0	2	0	328	5,870,371	25.6	0.0	61.6
7-Oct	0	0	0	341	0	0	0	4	0	345	5,870,716	26.2	0.0	60.8

Table 1. Daily Smolt Collection Counts, River Flows and Temperature at Lower Granite Dam, 1999

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Date	Daily Number of Fish Collected										River Conditions			
	Yearling Chinook		Sub-yr Chinook			Steelhead	Sockeye/Kokanee		Coho		Daily Total	Cumulative Total	River (kcfs)	Spill (kcfs)
	Hatchery	Wild	Hatchery	Unk.	Hatchery	Wild	Hatch	Wild	Unk					
8-Oct	1	1	0	297	0	0	0	3	1	303	5,871,019	26.9	0.0	60.8
9-Oct	0	0	0	325	0	0	0	3	1	329	5,871,348	24.6	0.0	60.7
10-Oct	1	0	0	251	2	1	0	1	1	257	5,871,605	29.1	0.0	60.4
11-Oct	0	0	0	246	2	1	0	2	3	254	5,871,859	26.0	0.0	60.4
12-Oct	1	0	0	309	0	0	0	5	0	315	5,872,174	21.4	0.0	60.4
13-Oct	2	0	0	872	1	1	0	5	2	883	5,873,057	25.2	0.0	60.6
14-Oct	0	0	0	1,018	1	0	0	5	1	1,025	5,874,082	25.8	0.0	59.9
15-Oct	1	0	0	780	2	2	0	4	1	790	5,874,872	25.7	0.0	60.3
16-Oct	2	0	0	485	2	0	0	4	2	495	5,875,367	25.3	0.0	59.5
17-Oct	2	0	0	500	0	0	0	9	2	513	5,875,880	27.0	0.0	59.4
18-Oct	0	0	0	572	0	0	0	4	1	577	5,876,457	25.7	0.0	58.5
19-Oct	0	0	0	466	0	0	0	3	2	471	5,876,928	19.5	0.0	58.5
20-Oct	0	0	0	233	0	0	0	6	1	240	5,877,168	21.2	0.0	58.1
21-Oct	0	0	0	164	0	0	0	0	0	164	5,877,332	19.1	0.0	57.2
22-Oct	0	0	0	187	1	0	0	2	0	190	5,877,522	20.5	0.0	57.2
23-Oct	0	0	0	93	0	0	0	0	0	93	5,877,615	20.3	0.0	56.5
24-Oct	1	0	0	107	0	0	0	0	0	108	5,877,723	19.7	0.0	56.5
25-Oct	1	0	0	122	0	0	0	3	2	128	5,877,851	20.6	0.0	56.5
26-Oct	0	0	0	163	1	0	0	1	1	166	5,878,017	19.8	0.0	55.4
27-Oct	0	0	0	143	0	0	0	0	0	143	5,878,160	20.6	0.0	55.4
28-Oct	0	0	0	197	2	0	0	5	2	206	5,878,366	21.5	0.0	56.3
29-Oct	0	0	0	192	0	0	0	3	0	195	5,878,561	20.1	0.0	54.5
30-Oct	2	0	0	262	0	2	0	2	0	268	5,878,829	24.7	0.0	54.5
31-Oct	0	0	0	230	3	0	0	5	1	239	5,879,068	24.2	0.0	54.0
1-Nov	0	0	0	236	0	0	3	2	0	241	5,879,309	22.9	0.0	54.0
2-Nov	0	0	0	286	1	0	20	11	1	319	5,879,628	24.1	0.0	53.6
3-Nov	0	0	0	385	1	1	11	4	0	402	5,880,030	21.2	4.6	53.1
4-Nov	0	0	0	444	1	0	14	13	0	472	5,880,502	22.6	0.0	52.7
5-Nov	0	0	0	342	3	0	15	6	0	366	5,880,868	21.6	0.0	52.7
6-Nov	0	0	0	371	4	0	22	14	0	411	5,881,279	20.3	0.0	52.2
7-Nov	0	0	0	346	1	0	50	5	1	403	5,881,682	21.3	0.0	51.8
8-Nov	0	0	0	250	0	0	30	7	0	287	5,881,969	24.3	0.0	51.8
9-Nov	0	0	0	247	0	0	17	11	2	277	5,882,246	23.2	0.0	51.4
10-Nov	1	0	0	576	4	1	34	6	4	626	5,882,872	23.0	0.0	51.3
	1,762,655	410,842	0	257,507	3,032,104	323,083	10,085	7,975	78,621	5,882,872				

Table 2. Daily Bypass and Transportation at Lower Granite Dam, 1999

Daily Number of Fish Bypassed											Daily Transportation Numbers										
Date	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily	Yearling Chin.	Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily		
	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total		Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total
26-Mar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
27-Mar	0	0	0	0	0	0	0	0	0	0	831	495	0	0	148	344	0	72	19	1,909	
28-Mar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
29-Mar	0	0	0	0	0	0	0	0	0	0	1,118	2,451	0	10	1,226	1,431	0	273	79	6,588	
30-Mar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
31-Mar	54	178	0	0	79	65	0	0	0	376	2,397	5,997	0	0	3,231	2,372	0	369	69	14,435	
1-Apr	90	165	0	0	74	47	0	0	0	376	0	0	0	0	0	0	0	0	0	0	
2-Apr	44	129	0	0	38	27	0	0	1	239	2,046	6,477	0	83	3,714	2,022	0	288	16	14,646	
3-Apr	31	73	0	0	47	22	0	0	0	173	0	0	0	0	0	0	0	0	0	0	
4-Apr	38	78	0	0	62	33	0	0	0	211	1,367	3,713	0	0	4,055	1,758	0	179	0	11,072	
5-Apr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6-Apr	20	47	0	0	22	9	0	0	0	98	407	2,437	0	33	2,190	539	0	38	0	5,644	
7-Apr	5	38	0	0	45	16	0	0	0	104	0	0	0	0	0	0	0	0	0	0	
8-Apr	46	120	0	0	225	35	0	0	0	426	704	2,916	0	20	4,569	572	0	34	0	8,815	
9-Apr	58	78	0	0	92	13	0	0	0	241	0	0	0	0	0	0	0	0	0	0	
10-Apr	41	66	0	0	113	17	0	0	0	237	927	2,844	0	0	8,217	949	0	50	20	13,007	
11-Apr	48	68	0	0	260	42	0	0	0	418	0	0	0	0	0	0	0	0	0	0	
12-Apr	0	0	0	0	0	0	0	0	0	0	731	2,834	0	0	6,700	558	0	49	0	10,872	
13-Apr	24	51	0	0	123	10	0	0	0	208	0	0	0	0	0	0	0	0	0	0	
14-Apr	24	45	0	0	97	9	0	0	0	175	2,318	3,448	0	0	12,687	1,039	0	44	0	19,536	
15-Apr	61	60	0	0	307	26	0	0	0	454	0	0	0	0	0	0	0	0	0	0	
16-Apr	69	68	0	0	230	15	0	0	0	382	5,060	5,205	0	0	16,075	858	0	76	0	27,274	
17-Apr	295	137	0	0	831	38	0	0	0	1,301	0	0	0	0	0	0	0	0	0	0	
18-Apr	345	111	0	0	588	44	0	0	0	1,088	4,404	3,398	0	0	8,257	678	0	60	0	16,797	
19-Apr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
20-Apr	654	231	0	0	655	67	0	0	0	1,607	38,471	15,051	0	120	19,450	3,830	0	19	0	76,941	
21-Apr	1,546	773	0	0	373	86	0	0	0	2,778	0	0	0	0	0	0	0	0	0	0	
22-Apr	2,099	693	0	0	656	275	0	0	0	3,723	108,738	21,197	0	0	80,256	17,185	0	339	150	227,865	
23-Apr	2,933	629	0	0	996	472	0	0	0	5,030	44,211	16,370	0	0	73,987	17,677	0	142	0	152,387	
24-Apr	2,707	613	0	0	1,200	604	0	0	0	5,124	36,449	13,292	0	150	85,645	17,544	0	143	0	153,223	
25-Apr	2,782	374	0	0	1,289	637	0	0	0	5,082	33,362	10,960	0	0	39,502	6,410	0	146	0	90,380	
26-Apr	2,220	478	0	0	802	312	0	0	0	3,812	26,895	9,228	0	300	32,191	6,438	0	149	0	75,201	
27-Apr	3,389	533	0	0	1,400	324	0	0	0	5,646	55,474	20,207	0	0	61,807	5,075	0	297	0	142,860	
28-Apr	5,157	952	0	0	1,874	341	0	0	0	8,324	40,485	11,414	0	0	55,407	4,007	0	293	0	111,606	
29-Apr	3,877	798	0	0	1,683	293	0	0	2	6,653	43,749	12,302	0	0	71,508	6,456	0	143	444	134,602	
30-Apr	2,348	480	0	0	1,368	199	0	0	0	4,395	54,771	13,404	0	150	87,263	6,251	0	298	0	162,137	
1-May	3,208	470	0	0	1,842	263	0	0	0	5,783	42,644	6,549	0	300	87,405	6,486	0	145	300	143,829	
2-May	1,842	310	0	0	1,496	188	0	0	0	3,836	67,339	12,999	0	150	132,896	10,311	0	295	298	224,288	
3-May	3,289	480	0	0	1,179	145	0	0	0	5,093	72,200	12,501	0	0	104,562	6,155	0	0	149	195,567	
4-May	3,176	432	0	0	1,615	97	0	0	0	5,320	66,279	11,559	0	0	95,223	4,262	0	147	300	177,770	
5-May	5,142	663	0	0	1,928	158	0	0	0	7,891	41,304	6,183	0	0	289,808	7,191	0	141	300	344,927	
6-May	2,517	216	0	0	3,713	244	0	0	0	6,690	39,162	6,065	0	0	59,870	2,605	0	0	150	107,852	
7-May	1,198	112	0	0	1,754	133	0	0	0	3,197	31,427	3,310	0	0	51,791	2,267	0	132	0	88,927	
8-May	2,386	225	0	0	2,307	158	0	0	5	5,081	64,979	5,582	0	0	62,186	4,042	0	0	294	137,083	
9-May	2,669	208	0	0	1,354	98	0	0	0	4,329	79,418	7,844	0	0	76,642	4,552	0	148	450	169,054	
10-May	0	0	0	0	0	0	0	0	0	0	82,062	7,010	0	0	43,493	3,450	0	0	0	136,015	
11-May	1,499	128	0	0	2,382	123	0	0	0	4,132	40,537	3,001	0	0	29,656	2,888	0	0	150	76,232	
12-May	676	99	0	0	1,539	126	0	0	0	2,440	30,499	2,136	0	0	27,106	2,874	0	148	300	63,063	

Table 2. Daily Bypass and Transportation at Lower Granite Dam, 1999

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Daily Number of Fish Bypassed											Daily Transportation Numbers										
Date	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily	Date	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily
	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total		Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total
13-May	892	42	0	0	1,488	109	0	0	0	2,531	34,046	4,046	0	0	34,590	3,673	0	100	400	76,855	
14-May	1,307	91	0	0	1,927	185	0	0	0	3,510	41,954	3,883	0	0	45,365	3,215	0	198	300	94,915	
15-May	839	30	0	0	2,391	187	0	0	0	3,447	34,245	2,949	0	0	27,747	1,763	150	0	150	67,004	
16-May	0	0	0	0	0	0	0	0	0	0	35,686	2,372	0	0	26,236	2,100	148	0	450	66,992	
17-May	0	0	0	0	0	0	0	0	0	0	42,315	3,285	0	0	28,392	2,799	0	99	499	77,389	
18-May	1,433	67	0	0	2,674	192	0	0	0	4,366	38,803	2,825	0	0	19,219	1,513	0	299	600	63,259	
19-May	740	42	0	0	1,527	144	0	0	0	2,453	32,713	2,636	0	0	26,350	2,055	199	0	299	64,252	
20-May	618	53	0	0	1,714	158	0	0	0	2,543	30,593	2,324	0	0	18,981	2,742	0	197	2,299	57,136	
21-May	357	20	0	0	1,746	157	0	0	0	2,280	29,187	3,268	0	0	36,443	3,441	0	73	2,197	74,609	
22-May	365	29	0	0	2,130	199	0	0	0	2,723	32,682	2,846	0	0	55,353	10,298	0	191	3,398	104,768	
23-May	0	0	0	0	0	0	0	0	0	0	45,458	7,571	0	0	85,154	12,743	289	0	4,799	156,014	
24-May	0	0	0	0	0	0	0	0	0	0	33,861	5,951	0	0	119,657	11,845	299	0	3,750	175,363	
25-May	281	50	0	0	1,425	288	0	0	0	2,044	0	0	0	0	0	0	0	0	0	0	
26-May	14,965	5,948	0	0	116,984	11,604	89	0	4,991	154,581	36,856	8,979	0	0	219,818	23,367	205	143	9,535	298,903	
27-May	2,057	1,704	0	0	21,767	3,127	29	0	1,638	30,322	7,196	6,675	0	0	76,459	11,269	120	0	6,743	108,462	
28-May	5,683	7,035	0	0	40,495	8,250	1,199	299	7,919	70,880	0	0	0	0	0	0	0	0	0	0	
29-May	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
30-May	0	0	0	0	0	0	0	0	0	0	4,470	6,627	0	0	47,679	10,050	2,890	237	4,271	76,224	
31-May	33	51	0	0	444	66	21	3	52	670	0	0	0	0	0	0	0	0	0	0	
1-Jun	0	0	0	0	0	0	0	0	0	0	2,571	4,141	0	50	30,922	5,554	1,660	202	4,432	49,532	
2-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3-Jun	0	0	0	0	0	0	0	0	0	0	2,488	5,281	0	300	32,948	6,250	1,233	0	2,439	50,939	
4-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5-Jun	5	20	0	0	68	18	0	0	0	111	2,404	3,500	0	17	22,043	4,664	200	24	2,564	35,416	
6-Jun	38	67	0	0	347	97	0	0	0	549	0	0	0	0	0	0	0	0	0	0	
7-Jun	0	0	0	0	0	0	0	0	0	0	2,680	5,687	0	330	18,775	3,054	240	136	2,711	33,613	
8-Jun	48	129	0	0	205	45	0	0	0	427	0	0	0	0	0	0	0	0	0	0	
9-Jun	99	178	0	0	220	37	0	0	0	534	2,833	6,735	0	21,341	10,620	1,948	181	80	2,697	46,435	
10-Jun	33	36	0	0	101	19	0	0	0	189	0	0	0	0	0	0	0	0	0	0	
11-Jun	15	24	0	0	71	14	0	0	0	124	828	2,283	0	19,492	5,171	815	146	48	946	29,729	
12-Jun	22	32	0	0	86	16	0	0	0	156	0	0	0	0	0	0	0	0	0	0	
13-Jun	0	0	0	0	0	0	0	0	0	0	453	885	0	3,583	2,517	526	50	33	374	8,421	
14-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
15-Jun	8	9	0	0	33	5	0	0	0	55	427	1,243	0	2,838	3,315	494	50	17	412	8,796	
16-Jun	18	19	0	0	61	11	0	0	0	109	0	0	0	0	0	0	0	0	0	0	
17-Jun	57	87	0	0	235	35	0	0	0	414	1,291	3,587	0	2,725	12,531	1,249	87	37	648	22,155	
18-Jun	36	38	0	0	232	22	0	0	0	328	0	0	0	0	0	0	0	0	0	0	
19-Jun	44	50	0	0	359	38	0	0	0	491	1,351	3,691	0	5,277	22,576	1,610	31	32	470	35,038	
20-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
21-Jun	0	0	0	0	0	0	0	0	0	0	1,260	3,871	0	15,675	11,359	767	65	32	698	33,727	
22-Jun	12	7	0	0	50	5	0	0	0	74	0	0	0	0	0	0	0	0	0	0	
23-Jun	10	12	0	0	44	8	0	0	0	74	212	1,052	0	10,920	2,883	404	66	16	448	16,001	
24-Jun	6	10	0	0	50	4	0	0	0	70	0	0	0	0	0	0	0	0	0	0	
25-Jun	0	0	0	0	0	0	0	0	0	0	73	290	0	4,617	1,189	75	29	10	160	6,443	
26-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
27-Jun	0	0	0	0	0	0	0	0	0	0	90	670	0	3,496	1,050	19	10	10	260	5,605	
28-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
29-Jun	0	0	0	0	0	0	0	0	0	0	149	259	0	3,577	1,488	100	10	2	210	5,795	

Table 2. Daily Bypass and Transportation at Lower Granite Dam, 1999

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Date	Daily Number of Fish Bypassed										Daily Transportation Numbers									
	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily
	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total
30-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-Jul	0	0	0	0	0	0	0	0	0	0	125	205	0	2,926	857	80	5	0	174	4,372
2-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-Jul	0	0	0	0	0	0	0	0	0	0	83	145	0	3,586	929	65	3	22	145	4,978
4-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-Jul	0	0	0	0	0	0	0	0	0	0	57	412	0	2,714	672	79	5	28	130	4,097
6-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7-Jul	0	0	0	6	0	0	0	0	0	6	60	90	0	1,995	519	30	25	5	94	2,818
8-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9-Jul	0	0	0	0	0	0	0	0	0	0	120	76	0	2,603	488	39	20	15	112	3,473
10-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Jul	0	0	0	6	0	0	0	0	0	6	90	99	0	2,201	586	29	4	8	61	3,078
12-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Jul	0	0	0	6	0	0	0	0	0	6	74	148	0	3,254	556	32	8	16	68	4,156
14-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Jul	0	0	0	0	0	0	0	0	0	0	63	51	0	4,005	412	16	4	8	44	4,603
16-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Jul	0	0	0	0	0	0	0	0	0	0	47	44	0	5,828	574	32	8	16	56	6,605
18-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Jul	0	0	0	0	0	0	0	0	0	0	19	21	0	5,354	372	36	0	7	16	5,825
20-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Jul	0	0	0	5	0	0	0	0	0	5	12	28	4	6,428	414	16	0	4	28	6,934
22-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Jul	0	0	0	4	0	0	0	0	0	4	60	44	0	9,861	366	8	0	0	25	10,364
24-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Jul	0	0	0	6	0	0	0	0	0	6	47	30	0	10,122	406	10	0	0	30	10,645
26-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jul	0	0	0	4	0	0	0	0	0	4	10	10	0	8,967	524	9	0	10	0	9,530
28-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Jul	0	0	0	0	0	0	0	0	0	0	10	20	0	8,611	286	19	0	10	30	8,986
30-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	8,691	314	8	0	10	10	9,033
1-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	10,179	355	10	0	8	0	10,552
3-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	7,709	266	0	0	0	0	7,975
5-Aug	0	0	0	6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
6-Aug	0	0	0	0	0	0	0	0	0	0	9	0	0	6,137	155	0	0	0	20	6,321
7-Aug	0	0	0	6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
8-Aug	0	0	0	0	0	0	0	0	0	0	5	0	0	5,401	144	5	0	9	0	5,564
9-Aug	0	0	0	6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
10-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	4,271	125	0	0	5	20	4,421
11-Aug	0	0	0	4	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
12-Aug	0	0	0	0	0	0	0	0	0	0	3	0	0	3,748	149	5	0	5	0	3,910
13-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	2,569	115	12	4	0	0	2,700
15-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	2,573	128	8	0	0	4	2,713

Table 2. Daily Bypass and Transportation at Lower Granite Dam, 1999

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Date	Daily Number of Fish Bypassed										Daily Transportation Numbers										
	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily	
	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total	
17-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Aug	0	0	0	4	0	0	0	0	0	0	4	0	0	0	1,382	71	4	4	0	0	1,461
19-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Aug	0	0	0	6	0	0	0	0	0	0	6	0	0	0	1,550	32	8	0	0	16	1,606
21-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Aug	0	0	0	2	0	0	0	0	0	0	2	0	0	0	1,018	44	0	0	4	4	1,070
23-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Aug	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1,028	27	0	0	4	0	1,062
25-Aug	0	0	0	6	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
26-Aug	0	0	0	0	0	0	0	0	0	0	0	3	0	0	868	48	0	0	4	4	927
27-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,156	28	3	0	6	0	1,193
29-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	863	24	4	0	0	0	891
31-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	938	12	8	0	7	0	965
2-Sep	0	0	0	6	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
3-Sep	0	0	0	6	0	0	0	0	0	0	6	0	0	0	618	10	1	0	1	0	630
4-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-Sep	0	0	0	6	0	0	0	0	0	0	6	2	1	0	427	5	0	0	0	0	435
6-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7-Sep	0	0	0	2	0	0	0	0	0	0	2	1	0	0	371	3	0	0	2	1	378
8-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	441	2	0	0	5	0	448
10-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	450	4	0	0	1	0	455
12-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	314	3	1	0	0	1	319
14-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	720	3	1	0	3	0	727
16-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Sep	0	0	0	0	0	0	0	0	0	0	0	0	2	0	769	7	3	0	6	5	792
18-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Sep	0	0	0	0	0	0	0	0	0	0	0	2	1	0	585	3	0	0	3	3	597
20-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	804	1	0	0	1	7	813
22-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	735	1	0	0	4	7	747
24-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	575	3	0	0	1	19	598
26-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	284	1	0	0	1	2	288
28-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	391	1	1	0	4	2	399
30-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-Oct	0	0	0	0	0	0	0	0	0	0	0	0	1	0	493	3	0	0	7	1	505
2-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-Oct	0	0	0	0	0	0	0	0	0	0	0	0	3	0	407	1	0	0	9	0	420

Table 2. Daily Bypass and Transportation at Lower Granite Dam, 1999

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Date	Daily Number of Fish Bypassed										Daily Transportation Numbers										
	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily	
	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total	
4-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	466	1	0	0	17	1	1	485
6-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	661	0	1	0	6	0	6	668
8-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9-Oct	0	0	0	0	0	0	0	0	0	0	0	1	1	0	619	0	0	0	6	2	629
10-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Oct	0	0	0	0	0	0	0	0	0	0	1	0	0	493	4	2	0	3	4	4	507
12-Oct	0	0	0	98	0	0	0	4	0	102	0	0	0	0	0	0	0	0	0	0	0
13-Oct	0	0	0	0	0	0	0	0	0	0	3	0	0	1,080	1	1	0	4	2	1,091	0
14-Oct	0	0	0	666	1	0	0	3	1	671	0	0	0	0	0	0	0	0	0	0	0
15-Oct	0	0	0	0	0	0	0	0	0	0	1	0	0	1,126	2	2	0	6	1	1,138	0
16-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Oct	0	0	0	0	0	0	0	0	0	0	4	0	0	980	2	0	0	12	4	1,002	0
18-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,036	0	0	0	7	3	1,046	0
20-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	392	0	0	0	6	1	399	0
22-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	280	1	0	0	2	0	283	0
24-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Oct	0	0	0	0	0	0	0	0	0	0	2	0	0	226	0	0	0	3	2	233	0
26-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	306	1	0	0	1	1	309	0
28-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	386	2	0	0	6	2	396	0
30-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31-Oct	0	0	0	0	0	0	0	0	0	0	2	0	0	492	3	2	0	7	1	507	0
1-Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	520	1	0	23	11	1	556	0
3-Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4-Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	826	2	1	25	16	0	870	0
5-Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6-Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	713	7	0	37	19	0	776	0
7-Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8-Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	596	1	0	80	11	1	689	0
9-Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-Nov	0	0	0	0	0	0	0	0	0	0	1	0	0	821	4	1	50	17	6	900	0
	88,628	27,289	0	861	235,513	30,851	1,338	309	14,609	399,398	1,662,860	381,223	106	254,497	2,795,634	292,070	8,663	7,292	63,818	5,466,057	

Table 3. Daily Facility Mortality and Percent Descaling at Lower Granite Dam, 1999.

Daily Facility (raceway and sample) Mortality												Daily Percent Descaling									
Date	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily Total	% Mort	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily Total
	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk			Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	
26-Mar	50	16	0	0	8	37	0	9	0	120	13.79	7.1	6.3	---	---	0.0	0.0	---	0.0	0.0	4.5
27-Mar	39	19	0	0	4	9	0	19	1	91	7.28	10.9	0.0	---	---	0.0	6.3	---	0.0	0.0	5.8
28-Mar	20	6	0	0	2	4	0	2	0	34	1.50	21.9	2.7	---	---	0.0	0.0	---	23.1	---	5.5
29-Mar	12	23	0	0	2	5	0	15	1	58	1.32	16.3	0.0	---	0.0	1.4	3.4	---	20.0	0.0	4.6
30-Mar	12	24	0	0	5	1	0	17	1	60	0.85	5.0	0.3	---	---	0.7	2.3	---	5.0	0.0	1.6
31-Mar	7	21	0	0	5	2	0	14	0	49	0.62	6.3	1.0	---	---	1.6	0.9	---	7.1	0.0	2.2
1-Apr	6	19	0	0	3	1	0	7	0	36	0.39	3.8	0.8	---	0.0	0.9	3.9	---	10.0	---	1.9
2-Apr	14	27	0	0	4	3	0	5	0	53	0.85	3.9	0.0	---	---	0.0	4.1	---	0.0	0.0	1.1
3-Apr	11	14	0	0	2	3	0	4	0	34	0.45	10.2	1.9	---	---	0.6	2.6	---	0.0	---	2.4
4-Apr	3	6	0	0	1	1	0	0	0	11	0.28	2.8	1.3	---	---	0.0	0.0	---	0.0	---	0.9
5-Apr	1	12	0	0	1	0	0	0	0	14	0.47	0.0	0.0	---	0.0	3.8	5.3	---	---	---	1.7
6-Apr	2	6	0	0	5	0	0	0	0	13	0.47	0.0	0.0	---	---	2.0	0.0	---	0.0	---	1.0
7-Apr	0	4	0	0	1	0	0	1	0	6	0.11	8.6	0.4	---	---	0.4	0.0	---	0.0	---	1.0
8-Apr	1	6	0	0	3	0	0	2	0	12	0.32	0.0	1.4	---	0.0	0.6	0.0	---	0.0	---	0.8
9-Apr	0	8	0	0	3	0	0	0	0	11	0.23	4.4	0.0	---	---	0.8	0.0	---	0.0	0.0	0.8
10-Apr	4	14	0	0	5	1	0	0	0	24	0.27	1.8	0.7	---	---	0.3	1.4	---	0.0	0.0	0.6
11-Apr	3	8	0	0	0	0	0	0	0	11	0.24	8.3	0.0	---	---	0.0	0.0	---	0.0	---	0.4
12-Apr	1	6	0	0	6	0	0	1	0	14	0.21	2.9	0.0	---	---	2.4	0.0	---	0.0	---	1.8
13-Apr	3	1	0	0	0	0	0	0	0	4	0.06	2.3	0.0	---	---	0.9	0.0	---	---	---	0.8
14-Apr	4	16	0	0	2	0	0	6	0	28	0.21	3.1	0.0	---	---	1.3	0.0	---	33.3	---	1.4
15-Apr	7	19	0	0	3	0	0	4	0	33	0.24	1.0	0.0	---	---	3.3	4.3	---	100.0	---	2.4
16-Apr	3	8	0	0	5	1	0	0	0	17	0.12	2.0	0.9	---	---	1.8	0.0	---	50.0	---	1.8
17-Apr	8	3	0	0	4	0	0	0	0	15	0.15	0.8	2.2	---	---	2.5	0.0	---	0.0	---	2.0
18-Apr	18	11	0	0	0	0	0	0	0	29	0.32	1.5	0.0	---	---	3.9	4.8	---	0.0	---	2.5
19-Apr	36	22	0	0	3	0	0	1	0	62	0.25	1.2	0.0	---	0.0	3.6	2.4	---	0.0	---	1.8
20-Apr	106	59	0	0	5	0	0	0	0	170	0.31	1.1	0.5	---	0.0	3.3	1.6	---	---	---	1.5
21-Apr	251	86	0	0	2	1	0	5	0	345	0.34	2.1	0.0	---	---	3.1	1.2	---	0.0	---	2.1
22-Apr	331	101	0	0	13	3	0	6	0	454	0.34	0.7	0.0	---	---	3.7	0.0	---	0.0	0.0	1.7
23-Apr	224	89	0	0	17	1	0	8	0	339	0.21	1.9	0.0	---	---	2.6	0.0	---	0.0	---	1.8
24-Apr	122	45	0	0	5	2	0	7	0	181	0.11	5.0	1.1	---	0.0	4.0	1.7	---	---	---	3.7
25-Apr	142	66	0	0	9	3	0	4	0	224	0.23	4.1	1.3	---	---	4.4	0.0	---	100.0	---	3.8
26-Apr	109	44	0	0	7	0	0	1	0	161	0.20	2.1	0.0	---	0.0	1.4	0.0	---	0.0	---	1.3
27-Apr	391	137	0	0	21	0	0	3	0	552	0.37	3.1	0.7	---	---	1.9	2.8	---	0.0	---	2.2
28-Apr	392	84	0	0	19	2	0	7	0	504	0.42	3.6	0.0	---	---	3.9	3.4	---	0.0	---	3.4
29-Apr	374	100	0	0	9	1	0	7	4	495	0.35	3.5	2.4	---	---	1.8	0.0	---	0.0	0.0	2.4
30-Apr	331	66	0	0	19	0	0	2	0	418	0.25	3.2	1.1	---	0.0	2.9	2.3	---	0.0	---	2.8
1-May	162	31	0	0	3	1	0	5	0	202	0.13	2.0	0.0	---	0.0	2.7	2.2	---	0.0	0.0	2.3
2-May	224	30	0	0	8	1	0	5	2	270	0.12	4.4	1.1	---	0.0	1.8	1.4	---	0.0	0.0	2.5
3-May	411	69	0	0	9	0	0	0	1	490	0.24	3.0	0.0	---	---	1.8	2.4	---	---	0.0	2.2
4-May	224	30	0	0	3	0	0	3	0	260	0.14	2.0	1.3	---	---	2.9	0.0	---	100.0	0.0	2.5
5-May	354	54	0	0	14	1	0	9	0	432	0.12	1.6	0.0	---	---	2.5	0.0	---	---	0.0	2.3
6-May	171	19	0	0	17	1	0	0	0	208	0.18	2.9	2.4	---	---	3.1	0.0	---	---	0.0	2.9
7-May	225	28	0	0	5	0	0	18	0	276	0.30	2.3	0.0	---	---	2.8	6.3	---	0.0	---	2.6
8-May	350	20	0	0	7	0	0	0	1	378	0.26	2.5	2.6	---	---	2.8	7.1	---	---	0.0	2.8
9-May	413	48	0	0	4	0	0	2	0	467	0.27	3.2	0.0	---	---	3.7	3.2	---	0.0	0.0	3.2
10-May	552	40	0	0	7	0	0	0	0	599	0.44	3.9	2.3	---	---	2.4	4.3	---	---	---	3.4
11-May	507	28	0	0	0	1	0	0	0	536	0.66	3.9	0.0	---	---	4.7	0.0	---	---	0.0	3.9
12-May	137	15	0	0	5	0	0	2	0	159	0.24	3.9	0.0	---	---	3.7	0.0	---	---	0.0	3.5

Table 3. Daily Facility Mortality and Percent Descaling at Lower Granite Dam, 1999.

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Date	Daily Facility (raceway and sample) Mortality											Daily Percent Descaling										
	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily	%	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily	
	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total	Mort	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total	
13-May	226	12	0	0	4	0	0	0	0	242	0.30	2.3	10.3	---	---	3.9	0.0	---	0.0	0.0	0.0	3.3
14-May	221	14	0	0	8	0	0	2	0	245	0.25	3.9	2.6	---	---	4.2	2.9	---	0.0	0.0	0.0	4.0
15-May	316	21	0	0	12	0	0	0	0	349	0.49	2.2	0.0	---	---	5.5	0.0	0.0	---	0.0	0.0	3.4
16-May	428	28	0	0	14	0	2	0	0	472	0.70	2.1	0.0	---	---	4.0	0.0	---	---	0.0	0.0	2.7
17-May	285	15	0	0	8	1	0	1	1	311	0.40	3.8	0.0	---	---	6.7	3.6	---	100.0	0.0	0.0	4.8
18-May	230	12	0	0	2	0	0	1	0	245	0.36	2.0	0.0	---	---	3.7	0.0	---	0.0	0.0	0.0	2.4
19-May	347	22	0	0	23	1	1	0	1	395	0.59	2.7	3.8	---	---	4.3	0.0	0.0	---	0.0	0.0	3.3
20-May	289	23	0	0	5	0	0	3	1	321	0.54	1.6	0.0	---	---	11.7	0.0	---	0.0	0.0	0.0	4.9
21-May	156	12	0	0	11	2	0	27	3	211	0.27	3.0	0.0	---	---	7.9	5.6	---	0.0	0.0	0.0	5.3
22-May	153	25	0	0	17	3	0	9	2	209	0.19	2.8	0.0	---	---	12.2	0.0	---	0.0	0.0	0.0	7.4
23-May	592	79	0	0	46	7	11	0	1	736	0.47	5.7	4.2	---	---	10.4	2.4	0.0	---	9.4	8.1	8.1
24-May	189	49	0	0	43	5	1	0	0	287	0.16	5.0	7.5	---	---	13.6	2.5	50.0	---	0.0	0.0	10.7
25-May	119	33	0	0	61	10	2	7	11	243	0.12	7.7	0.0	---	---	12.4	1.9	0.0	0.0	2.4	10.3	10.3
26-May	56	13	0	0	42	1	4	0	13	129	0.05	5.5	7.7	---	---	18.0	3.1	0.0	---	5.4	14.9	14.9
27-May	47	21	0	0	24	4	1	0	19	116	0.08	3.3	0.0	---	---	16.3	1.1	0.0	---	5.4	12.3	12.3
28-May	17	15	0	0	5	0	1	1	31	70	0.10	2.7	2.1	---	---	14.9	3.6	0.0	0.0	9.4	10.4	10.4
29-May	15	9	0	0	7	0	6	10	15	62	0.15	4.0	0.0	---	---	11.3	0.0	0.0	0.0	7.7	7.7	7.7
30-May	15	14	0	0	14	0	4	3	14	64	0.19	10.3	3.1	---	---	11.2	3.4	0.0	100.0	8.8	9.0	9.0
31-May	5	9	0	0	4	0	3	3	9	33	0.10	9.1	5.9	---	---	15.8	3.0	0.0	33.3	3.8	12.1	12.1
1-Jun	16	25	0	0	9	1	16	42	7	116	0.70	0.0	0.0	---	0.0	13.3	0.0	8.3	0.0	0.0	7.6	7.6
2-Jun	4	10	0	0	1	0	13	0	6	34	0.12	7.4	0.0	---	---	13.4	1.4	0.0	---	3.6	9.6	9.6
3-Jun	8	9	0	0	1	0	4	0	5	27	0.12	0.0	0.0	---	0.0	16.7	3.6	0.0	---	0.0	10.9	10.9
4-Jun	2	2	0	0	2	1	0	0	3	10	0.07	0.0	6.1	---	---	11.5	7.1	0.0	---	3.6	8.7	8.7
5-Jun	6	11	0	0	4	0	0	9	0	30	0.14	0.0	0.0	---	0.0	18.8	0.5	0.0	0.0	4.3	12.3	12.3
6-Jun	11	20	0	0	12	0	1	2	5	51	0.30	3.1	2.1	---	0.0	21.2	1.2	0.0	0.0	3.0	14.1	14.1
7-Jun	4	3	0	0	9	2	2	2	4	26	0.15	5.8	2.2	---	0.0	19.0	1.2	9.1	0.0	1.2	10.6	10.6
8-Jun	8	19	0	7	4	0	1	1	2	42	0.15	1.5	0.9	---	0.2	12.9	1.2	0.0	0.0	2.1	4.2	4.2
9-Jun	5	10	0	35	3	0	2	2	1	58	0.29	2.3	2.2	---	0.4	6.6	0.0	0.0	0.0	4.6	1.8	1.8
10-Jun	3	3	0	158	3	1	4	2	2	176	1.06	0.0	1.5	---	0.3	10.6	0.0	0.0	0.0	16.1	2.3	2.3
11-Jun	4	4	0	67	4	1	0	0	2	82	0.60	10.0	0.0	---	0.4	12.4	0.0	50.0	---	3.8	3.7	3.7
12-Jun	0	0	0	21	3	0	0	0	3	27	0.56	0.0	0.0	---	1.2	10.3	0.0	0.0	---	0.0	3.7	3.7
13-Jun	0	0	0	21	2	0	0	0	6	29	0.76	16.7	4.5	---	0.0	9.2	5.3	---	0.0	0.0	4.8	4.8
14-Jun	0	1	0	15	1	0	0	0	4	21	0.61	0.0	0.0	---	0.0	5.6	0.0	0.0	---	0.0	2.0	2.0
15-Jun	2	1	0	14	2	0	0	0	1	20	0.37	0.0	2.0	---	0.0	12.1	0.0	0.0	0.0	0.0	5.0	5.0
16-Jun	1	0	0	21	2	1	0	0	1	26	0.26	0.0	0.9	---	0.0	8.8	1.5	0.0	0.0	6.8	4.5	4.5
17-Jun	3	20	0	7	11	1	0	0	1	43	0.34	0.0	0.0	---	0.0	15.1	2.7	0.0	0.0	0.0	10.2	10.2
18-Jun	4	16	0	26	15	1	0	1	0	63	0.31	3.8	0.7	---	0.7	8.4	1.5	---	0.0	0.0	5.8	5.8
19-Jun	4	17	0	23	19	1	0	0	0	64	0.41	6.3	4.4	---	1.3	9.9	0.0	0.0	---	40.0	7.8	7.8
20-Jun	6	25	0	40	3	0	0	0	1	75	0.39	0.0	1.2	---	0.0	12.2	0.0	0.0	---	8.3	5.1	5.1
21-Jun	0	4	0	85	5	0	1	1	1	97	0.66	0.0	0.0	---	0.0	10.1	0.0	---	100.0	0.0	3.0	3.0
22-Jun	0	4	0	153	3	0	0	0	0	160	1.51	0.0	0.0	---	0.0	8.0	5.6	50.0	---	18.2	1.9	1.9
23-Jun	0	9	0	94	3	0	0	1	2	109	1.87	25.0	3.0	---	0.5	13.3	0.0	0.0	---	12.5	5.0	5.0
24-Jun	1	0	0	42	1	0	1	0	0	45	1.20	0.0	5.3	---	1.5	17.4	0.0	100.0	---	0.0	4.9	4.9
25-Jun	0	0	0	21	0	1	0	0	0	22	0.78	50.0	18.2	---	2.1	9.1	33.3	0.0	0.0	15.4	5.4	5.4
26-Jun	0	0	0	17	0	0	0	0	0	17	0.62	0.0	0.0	---	0.0	7.4	0.0	0.0	---	16.7	2.6	2.6
27-Jun	0	0	0	17	0	1	0	0	0	18	0.62	0.0	2.1	---	1.1	5.9	0.0	---	0.0	12.5	2.4	2.4
28-Jun	0	0	0	29	2	0	0	8	0	39	1.15	0.0	0.0	---	0.5	6.7	0.0	0.0	0.0	0.0	2.1	2.1
29-Jun	1	1	0	24	0	0	0	0	0	26	1.06	0.0	16.7	---	0.6	5.0	0.0	---	---	0.0	2.5	2.5

Table 3. Daily Facility Mortality and Percent Descaling at Lower Granite Dam, 1999.

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Date	Daily Facility (raceway and sample) Mortality											Daily Percent Descaling									
	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily	%	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily
	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total	Mort	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total
30-Jun	0	0	0	24	0	0	0	0	24	1.06	0.0	0.0	---	0.3	4.4	14.3	0.0	---	---	0.0	1.4
1-Jul	0	0	0	10	3	0	0	5	19	0.88	0.0	0.0	---	0.0	4.9	0.0	---	---	---	5.3	1.2
2-Jul	0	0	0	12	0	0	2	2	16	0.64	0.0	0.0	---	0.6	9.0	0.0	0.0	50.0	0.0	0.0	2.2
3-Jul	2	0	0	22	1	0	0	1	26	1.03	0.0	0.0	---	0.3	4.2	0.0	---	33.3	0.0	0.0	1.2
4-Jul	1	5	0	14	3	1	0	0	24	0.87	0.0	0.0	---	0.3	8.9	0.0	---	40.0	0.0	0.0	2.0
5-Jul	2	3	0	12	0	0	0	2	19	1.36	0.0	8.3	---	0.0	11.6	0.0	0.0	100.0	0.0	0.0	3.0
6-Jul	0	0	0	4	0	0	0	0	4	0.23	0.0	10.0	---	0.4	3.3	0.0	0.0	0.0	20.0	0.0	1.4
7-Jul	0	0	0	15	1	0	0	0	17	1.54	0.0	12.5	---	0.7	6.8	0.0	0.0	---	---	0.0	2.3
8-Jul	3	0	0	38	4	0	0	0	45	3.17	0.0	0.0	---	1.6	10.5	0.0	25.0	---	14.3	0.0	3.5
9-Jul	1	0	0	27	8	1	0	1	38	1.78	6.7	11.1	---	2.0	7.8	0.0	0.0	33.3	4.8	0.0	3.3
10-Jul	1	0	0	7	4	0	0	0	14	0.57	5.6	12.5	---	1.6	7.5	0.0	0.0	50.0	0.0	0.0	3.1
11-Jul	1	0	0	21	3	0	0	0	26	3.94	25.0	0.0	---	1.2	9.1	0.0	---	---	0.0	0.0	3.8
12-Jul	1	0	0	18	0	0	0	0	19	0.93	0.0	4.2	---	1.1	3.8	0.0	100.0	0.0	0.0	0.0	1.8
13-Jul	1	0	0	12	8	0	0	0	21	0.97	0.0	7.7	---	0.7	7.9	0.0	0.0	0.0	0.0	0.0	1.7
14-Jul	1	1	0	3	0	0	0	0	5	0.21	11.1	0.0	---	0.8	11.7	0.0	---	0.0	0.0	0.0	2.0
15-Jul	0	0	0	32	8	0	0	0	40	1.77	0.0	0.0	---	3.3	11.6	0.0	0.0	---	---	0.0	3.9
16-Jul	3	0	0	27	3	0	0	0	33	0.92	0.0	0.0	---	2.9	5.5	25.0	0.0	0.0	0.0	0.0	3.1
17-Jul	2	0	0	73	7	0	0	0	82	2.63	0.0	0.0	---	4.2	5.6	25.0	---	---	---	0.0	4.4
18-Jul	1	3	0	14	5	0	0	0	23	0.92	0.0	0.0	---	2.2	6.1	0.0	---	---	---	0.0	2.5
19-Jul	0	0	0	76	31	0	0	1	108	3.11	0.0	0.0	---	0.5	12.8	16.7	---	0.0	0.0	0.0	1.3
20-Jul	0	0	0	22	4	0	0	0	26	0.88	0.0	0.0	---	2.1	10.6	0.0	---	0.0	0.0	0.0	2.6
21-Jul	0	0	0	45	18	0	0	0	63	1.54	---	0.0	---	1.1	8.3	0.0	---	---	50.0	0.0	1.6
22-Jul	1	0	0	23	3	0	0	0	27	0.57	0.0	11.1	---	3.6	11.4	0.0	---	---	0.0	0.0	3.9
23-Jul	0	0	0	25	9	0	0	0	34	0.60	0.0	0.0	---	3.6	4.2	---	---	---	0.0	0.0	3.6
24-Jul	1	0	0	12	0	0	0	0	13	0.28	0.0	---	---	5.1	5.0	0.0	---	---	---	0.0	5.0
25-Jul	2	0	0	20	4	0	0	0	26	0.43	0.0	0.0	---	4.3	19.0	---	---	---	0.0	0.0	4.8
26-Jul	0	0	0	14	1	0	0	0	15	0.25	0.0	---	---	1.6	8.3	---	---	---	---	---	2.0
27-Jul	0	0	0	25	5	1	0	0	31	0.85	---	0.0	---	2.7	0.0	0.0	---	0.0	---	---	2.5
28-Jul	0	0	0	14	1	0	0	0	15	0.29	100.0	0.0	---	0.4	0.0	0.0	---	100.0	0.0	0.0	0.8
29-Jul	0	0	0	15	3	1	0	0	19	0.50	---	0.0	---	0.8	6.3	0.0	---	---	0.0	0.0	1.1
30-Jul	0	0	0	15	3	0	0	0	18	0.39	---	---	---	1.6	8.3	---	---	100.0	0.0	0.0	2.0
31-Jul	0	0	0	24	3	2	0	0	29	0.65	---	---	---	0.0	10.0	---	---	---	---	---	0.5
1-Aug	0	0	0	15	2	0	0	2	19	0.32	---	---	---	0.0	5.6	0.0	---	0.0	---	---	0.2
2-Aug	0	0	0	26	3	0	0	0	29	0.63	---	---	---	0.2	0.0	---	---	---	---	---	0.2
3-Aug	0	0	0	11	1	0	0	0	12	0.29	---	---	---	0.0	10.0	---	---	---	---	---	0.2
4-Aug	0	0	0	30	3	0	0	0	33	0.84	---	---	---	0.3	5.9	---	---	---	---	---	0.5
5-Aug	0	0	0	12	3	0	0	0	15	0.42	---	---	---	0.9	50.0	---	---	---	---	0.0	1.1
6-Aug	1	0	0	15	2	0	0	0	18	0.64	0.0	---	---	0.4	14.3	---	---	---	---	0.0	1.1
7-Aug	0	0	0	8	1	0	0	0	9	0.41	---	---	---	1.2	8.3	---	---	---	---	---	1.4
8-Aug	0	0	0	15	0	0	0	1	16	0.47	0.0	---	---	1.2	12.5	0.0	---	0.0	---	---	1.5
9-Aug	0	0	0	6	0	0	0	0	6	0.22	---	---	---	1.8	11.8	---	---	---	---	0.0	2.1
10-Aug	0	0	0	17	0	0	0	0	17	0.96	---	---	---	0.0	0.0	---	---	0.0	0.0	0.0	0.0
11-Aug	0	0	0	7	0	0	0	0	7	0.41	---	---	---	0.3	5.9	0.0	---	0.0	---	---	0.6
12-Aug	1	0	0	21	0	0	0	0	22	0.99	0.0	---	---	1.1	12.5	---	---	---	---	---	1.4
13-Aug	0	0	0	5	1	0	0	0	6	0.36	---	---	---	0.3	0.0	0.0	---	---	---	---	0.2
14-Aug	0	0	0	10	0	0	0	0	10	0.96	---	---	---	1.7	7.1	0.0	0.0	---	---	---	1.9
15-Aug	0	0	0	4	0	0	0	0	4	0.25	---	---	---	0.8	0.0	0.0	---	---	---	0.0	0.8
16-Aug	0	0	0	11	0	0	0	0	11	0.98	---	---	---	1.2	5.6	---	---	---	---	---	1.4

Table 3. Daily Facility Mortality and Percent Descaling at Lower Granite Dam, 1999.

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Date	Daily Facility (raceway and sample) Mortality											Daily Percent Descaling									
	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily	%	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily
	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total	Mort	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	Total
17-Aug	0	0	0	4	0	0	0	0	0	4	0.56	---	---	---	1.2	9.1	0.0	---	---	---	1.7
18-Aug	0	0	0	6	1	0	0	0	0	7	0.92	---	---	---	1.1	0.0	---	0.0	---	---	1.1
19-Aug	0	0	0	1	0	0	0	0	0	1	0.12	---	---	---	1.5	0.0	0.0	---	---	0.0	1.4
20-Aug	0	0	0	11	0	0	0	0	0	11	1.42	---	---	---	1.6	40.0	0.0	---	---	0.0	2.6
21-Aug	0	0	0	2	0	0	0	0	0	2	0.39	---	---	---	3.3	0.0	---	---	---	0.0	3.1
22-Aug	0	0	0	6	0	0	0	0	0	6	1.06	---	---	---	0.8	0.0	---	---	0.0	---	0.7
23-Aug	0	0	0	2	1	0	0	0	0	3	0.53	---	---	---	0.7	0.0	---	---	0.0	---	0.7
24-Aug	1	0	0	2	0	0	0	0	0	3	0.60	---	---	---	0.8	0.0	---	---	---	---	0.8
25-Aug	0	0	0	6	0	0	0	0	0	6	1.74	---	---	---	2.6	14.3	---	---	---	---	3.6
26-Aug	1	0	0	8	0	0	0	0	0	9	1.49	0.0	---	---	2.1	20.0	---	---	0.0	0.0	2.7
27-Aug	0	0	0	3	0	0	0	1	0	4	0.56	---	---	---	0.0	0.0	---	---	---	---	0.0
28-Aug	0	0	0	21	0	1	0	1	0	23	4.53	---	---	---	3.4	33.3	---	---	---	---	4.1
29-Aug	0	0	0	1	0	0	0	0	0	1	0.23	---	---	---	2.0	0.0	0.0	---	---	---	1.9
30-Aug	0	0	0	8	0	0	0	0	0	8	1.72	---	---	---	0.0	0.0	---	---	---	---	0.0
31-Aug	0	0	0	5	0	0	0	0	0	5	1.30	---	---	---	2.2	0.0	---	---	---	---	2.2
1-Sep	0	0	0	29	0	0	0	1	0	30	4.87	---	---	---	0.0	0.0	0.0	---	0.0	---	0.0
2-Sep	0	0	0	4	0	0	0	0	0	4	1.06	---	---	---	4.4	0.0	---	---	0.0	---	4.3
3-Sep	0	0	0	6	0	0	0	0	0	6	2.20	---	---	---	3.4	50.0	0.0	---	---	---	3.7
4-Sep	0	0	0	0	0	0	0	0	0	0	0.00	0.0	0.0	---	2.4	25.0	---	---	---	---	2.9
5-Sep	0	0	0	6	1	0	0	0	0	7	2.52	0.0	---	---	2.6	0.0	---	---	---	---	2.6
6-Sep	0	0	0	5	0	0	0	1	0	6	2.83	0.0	---	---	1.0	0.0	---	---	100.0	---	1.5
7-Sep	0	0	0	4	0	0	0	0	0	4	2.25	---	---	---	0.6	0.0	---	---	0.0	0.0	0.6
8-Sep	0	0	0	6	0	0	0	0	0	6	2.79	---	---	---	4.4	0.0	---	---	0.0	---	4.3
9-Sep	0	0	0	7	0	0	0	0	0	7	2.85	---	---	---	3.4	0.0	---	---	0.0	---	3.3
10-Sep	0	0	0	3	0	0	0	0	0	3	1.03	---	---	---	3.5	0.0	---	---	0.0	---	3.5
11-Sep	0	0	0	3	0	0	0	0	0	3	1.78	---	---	---	3.0	0.0	---	---	---	---	3.0
12-Sep	0	0	0	9	0	0	0	0	0	9	5.33	---	---	---	0.6	33.3	0.0	---	---	0.0	1.3
13-Sep	0	0	0	3	0	0	0	0	0	3	1.85	---	---	---	3.1	---	---	---	---	---	3.1
14-Sep	0	0	0	3	0	0	0	0	0	3	0.96	---	---	---	2.6	---	0.0	---	---	---	2.6
15-Sep	0	0	0	5	0	0	0	0	0	5	1.19	---	---	---	2.2	0.0	---	---	0.0	---	2.1
16-Sep	0	0	0	6	0	0	0	0	0	6	1.35	---	0.0	---	1.9	0.0	0.0	---	20.0	50.0	2.3
17-Sep	0	0	0	4	0	0	0	0	0	4	1.12	---	---	---	3.2	0.0	0.0	---	0.0	0.0	3.1
18-Sep	0	0	0	4	0	0	0	0	0	4	1.61	0.0	0.0	---	2.1	0.0	---	---	---	0.0	2.0
19-Sep	0	0	0	4	0	0	0	0	0	4	1.12	---	---	---	1.4	0.0	---	---	0.0	0.0	1.4
20-Sep	0	0	0	1	0	0	0	0	0	1	0.26	---	---	---	2.1	0.0	---	---	0.0	0.0	2.1
21-Sep	0	0	0	5	0	0	0	1	0	6	1.38	---	---	---	2.4	---	---	---	0.0	0.0	2.3
22-Sep	0	0	0	3	0	0	0	0	0	3	0.80	---	---	---	4.4	0.0	---	---	0.0	25.0	4.6
23-Sep	0	0	0	5	0	0	0	0	0	5	1.32	---	---	---	1.9	---	---	---	0.0	33.3	2.1
24-Sep	0	0	0	2	0	0	0	0	0	2	0.52	---	---	---	2.2	0.0	---	---	---	0.0	2.1
25-Sep	0	0	0	0	0	0	0	0	0	0	0.00	---	---	---	2.0	0.0	---	---	0.0	0.0	1.9
26-Sep	0	0	0	1	0	0	0	2	0	3	2.21	---	---	---	2.3	0.0	---	---	0.0	---	2.2
27-Sep	0	0	0	0	0	0	0	0	0	0	0.00	---	---	---	0.7	---	---	---	0.0	0.0	0.6
28-Sep	0	0	0	1	0	0	0	0	0	1	0.56	---	---	---	1.7	---	0.0	---	0.0	0.0	1.7
29-Sep	0	0	0	0	0	0	0	1	0	1	0.45	---	---	---	1.8	0.0	---	---	0.0	---	1.8
30-Sep	0	0	0	9	0	0	0	0	0	9	3.36	---	0.0	---	1.2	0.0	---	---	0.0	0.0	1.2
1-Oct	0	0	0	4	0	0	0	0	0	4	1.60	---	---	---	3.3	0.0	---	---	60.0	---	4.5
2-Oct	0	0	0	1	0	0	0	0	0	1	0.46	---	0.0	---	5.1	---	---	---	0.0	---	5.0
3-Oct	0	0	0	2	0	0	0	1	0	3	1.46	---	0.0	---	3.6	0.0	---	---	0.0	---	3.5

Table 3. Daily Facility Mortality and Percent Descaling at Lower Granite Dam, 1999.

Daily Facility (raceway and sample) Mortality												Daily Percent Descaling									
Date	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily Total	% Mort	Yearling Chin.		Sub-yr Chin.		Steelhead		Sockeye/Kok		Coho	Daily Total
	Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk			Hatch	Wild	Hatch	Unk.	Hatch	Wild	Hatch	Wild	Unk	
4-Oct	0	0	0	3	0	0	0	1	0	4	1.71	---	---	---	2.7	0.0	---	---	0.0	---	2.6
5-Oct	0	0	0	2	0	0	0	0	0	2	0.78	---	---	---	2.4	---	---	---	11.1	---	2.7
6-Oct	0	0	0	2	0	0	0	0	0	2	0.61	---	---	---	0.9	---	0.0	---	50.0	---	1.2
7-Oct	0	0	0	3	0	0	0	0	0	3	0.87	---	---	---	2.7	---	---	---	25.0	---	2.9
8-Oct	0	0	0	1	0	0	0	0	0	1	0.33	0.0	0.0	---	1.0	---	---	---	0.0	0.0	1.0
9-Oct	0	0	0	2	0	0	0	0	0	2	0.61	---	---	---	1.5	---	---	---	0.0	0.0	1.5
10-Oct	0	0	0	1	0	0	0	0	0	1	0.39	0.0	---	---	1.6	0.0	0.0	---	0.0	0.0	2.0
11-Oct	0	0	0	3	0	0	0	0	0	3	1.18	---	---	---	3.3	50.0	0.0	---	50.0	0.0	4.0
12-Oct	0	0	0	0	0	0	0	1	0	1	0.32	0.0	---	---	2.3	---	---	---	0.0	---	2.2
13-Oct	0	0	0	3	0	0	0	1	0	4	0.45	0.0	---	---	2.6	0.0	0.0	---	0.0	0.0	2.6
14-Oct	0	0	0	4	0	0	0	0	0	4	0.39	---	---	---	1.8	0.0	---	---	20.0	0.0	1.9
15-Oct	0	0	0	2	0	0	0	0	0	2	0.25	0.0	---	---	2.8	0.0	0.0	---	25.0	0.0	2.9
16-Oct	0	0	0	4	0	0	0	0	0	4	0.81	0.0	---	---	1.0	0.0	---	---	25.0	50.0	1.4
17-Oct	0	0	0	1	0	0	0	1	0	2	0.39	0.0	---	---	3.8	---	---	---	0.0	0.0	3.7
18-Oct	0	0	0	1	0	0	0	0	0	1	0.17	---	---	---	1.8	---	---	---	25.0	0.0	1.9
19-Oct	0	0	0	1	0	0	0	0	0	1	0.21	---	---	---	0.9	---	---	---	0.0	0.0	0.9
20-Oct	0	0	0	3	0	0	0	0	0	3	1.25	---	---	---	0.9	---	---	---	0.0	0.0	0.8
21-Oct	0	0	0	2	0	0	0	0	0	2	1.22	---	---	---	0.0	---	---	---	---	---	0.0
22-Oct	0	0	0	0	0	0	0	0	0	0	0.00	---	---	---	2.7	0.0	---	---	0.0	---	2.6
23-Oct	0	0	0	0	0	0	0	0	0	0	0.00	---	---	---	7.5	---	---	---	---	---	7.5
24-Oct	0	0	0	0	0	0	0	0	0	0	0.00	0.0	---	---	6.5	---	---	---	---	---	6.5
25-Oct	0	0	0	3	0	0	0	0	0	3	2.34	0.0	---	---	3.4	---	---	---	0.0	0.0	3.2
26-Oct	0	0	0	0	0	0	0	0	0	0	0.00	---	---	---	2.5	0.0	---	---	0.0	0.0	2.4
27-Oct	0	0	0	0	0	0	0	0	0	0	0.00	---	---	---	4.9	---	---	---	---	---	4.9
28-Oct	0	0	0	2	0	0	0	2	0	4	1.94	---	---	---	2.1	0.0	---	---	0.0	0.0	2.0
29-Oct	0	0	0	1	0	0	0	0	0	1	0.51	---	---	---	2.7	---	---	---	0.0	---	2.6
30-Oct	0	0	0	0	0	0	0	0	0	0	0.00	0.0	---	---	1.2	---	0.0	---	0.0	---	1.5
31-Oct	0	0	0	0	0	0	0	0	0	0	0.00	---	---	---	1.7	0.0	---	---	20.0	0.0	2.1
1-Nov	0	0	0	0	0	0	0	0	0	0	0.00	---	---	---	0.0	---	---	0.0	0.0	---	0.0
2-Nov	0	0	0	2	0	0	0	2	0	4	1.25	---	---	---	4.2	0.0	---	0.0	0.0	0.0	3.8
3-Nov	0	0	0	2	0	0	0	0	0	2	0.50	---	---	---	0.8	0.0	0.0	0.0	0.0	---	0.8
4-Nov	0	0	0	1	0	0	0	1	0	2	0.42	---	---	---	0.2	0.0	---	0.0	16.7	---	0.6
5-Nov	0	0	0	0	0	0	0	0	0	0	0.00	---	---	---	0.3	0.0	---	0.0	0.0	---	0.3
6-Nov	0	0	0	0	0	0	0	1	0	1	0.24	---	---	---	1.6	0.0	---	0.0	0.0	---	1.5
7-Nov	0	0	0	0	0	0	0	0	0	0	0.00	---	---	---	2.3	0.0	---	8.0	0.0	0.0	3.0
8-Nov	0	0	0	0	0	0	0	1	0	1	0.35	---	---	---	1.6	---	---	0.0	0.0	---	1.4
9-Nov	0	0	0	0	0	0	0	0	0	0	0.00	---	---	---	1.2	---	---	0.0	9.1	0.0	1.4
10-Nov	0	0	0	2	0	0	1	0	0	3	0.48	0.0	---	---	0.7	0.0	0.0	3.0	0.0	25.0	1.0
Total	10595	2260	0	2147	921	139	84	374	194	16714											
Percent	0.60	0.55	0.93	0.83	0.03	0.04	0.83	4.69	0.25	0.28											

Table 4: Final Disposition of Smolts Collected at Lower Granite Dam, 1999.

TOTAL	Yearling Chinook		Sub-yr Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Hatchery	Wild	Hatchery	Unk.	Hatchery	Wild	Hatchery	Wild	Unk.	
Collected	1,762,655	410,842	0	257,507	3,032,104	323,083	10,085	7,975	78,621	5,882,872
Total Transported	1,662,860	381,223	0	254,497	2,795,634	292,070	8,663	7,292	63,818	5,466,057
Barged	1,653,625	357,962	0	91,851	2,769,501	282,912	8,348	5,652	62,254	5,232,105
Trucked	9,235	23,261	0	162,646	26,133	9,158	315	1,640	1,564	233,952
Bypassed	88,628	27,289	0	861	235,513	30,851	1,338	309	14,609	399,398
Sampled	16,208	8,365	0	50,965	35,060	4,481	420	489	1,621	117,609
Total Mortality	10,595	2,260	0	2,147	921	139	84	374	194	16,714
Facility Mortality	10,333	2,136	0	1,481	810	116	77	327	185	15,465
Sample Mortality	262	124	0	666	111	23	7	47	9	1,249
Research Mortality	572	70	0	2	36	23	0	0	0	703

Appendix 2. Passage Plots

Figure 1. Daily juvenile salmonid collection and river flow at Lower Granite Dam from March 26 through June 30, 1999.

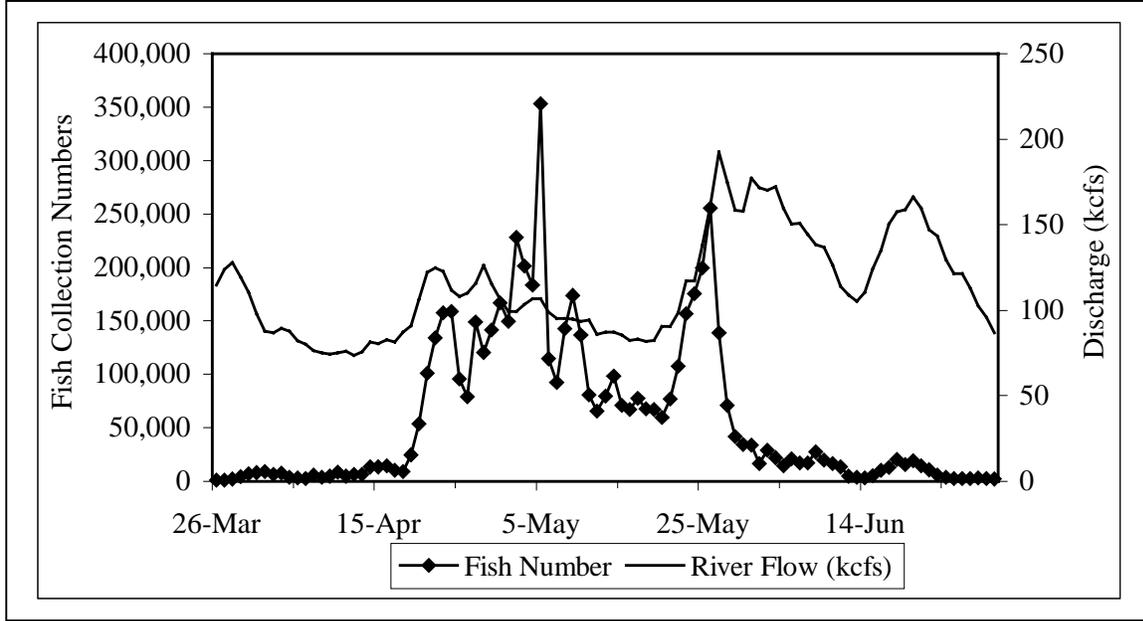


Figure 2. Daily juvenile salmonid collection and river flow at Lower Granite Dam from July 1 through Nov. 10, 1999.

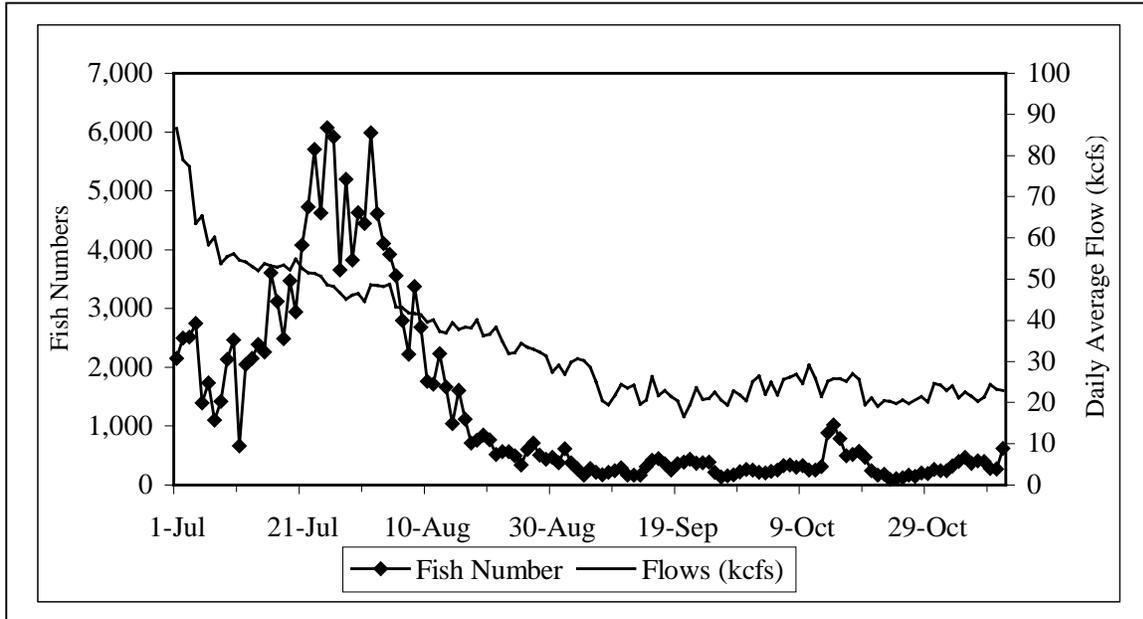


Figure 3. Daily hatchery yearling chinook collection and river flow at Lower Granite Dam from March 26 through June 30, 1999.

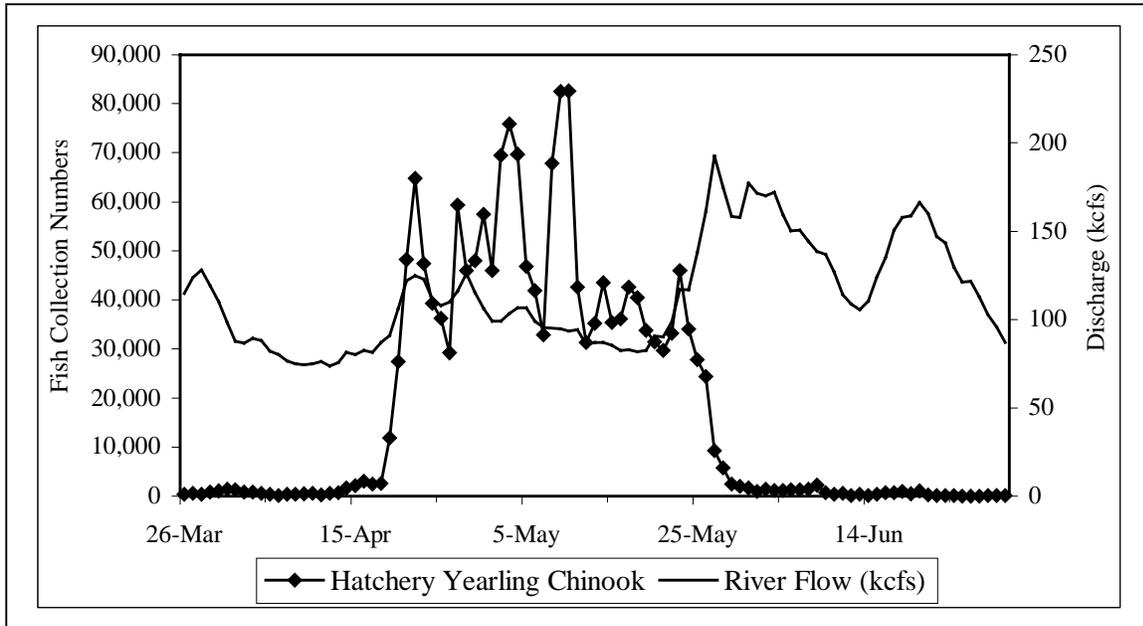


Figure 4. Daily hatchery yearling chinook collection and river flow at Lower Granite Dam from July 1 through November 10, 1999

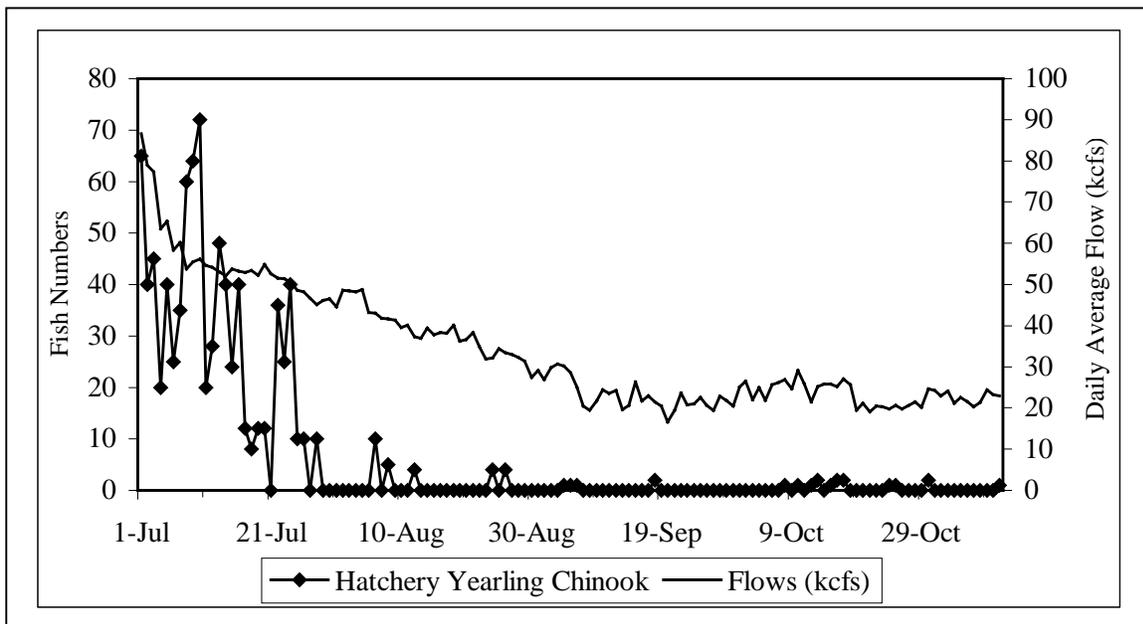


Figure 5. Daily wild yearling chinook collection and river flow at Lower Granite Dam from March 26 through June 30, 1999.

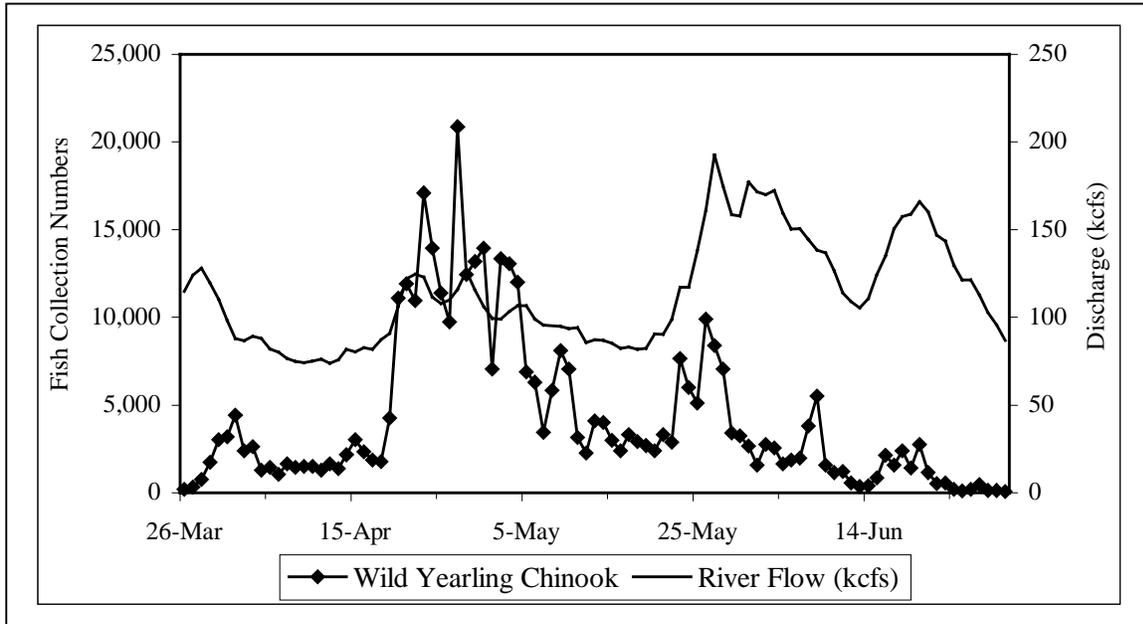


Figure 6. Daily wild yearling chinook collection and river flow at Lower Granite Dam from July 1 through November 10, 1999.

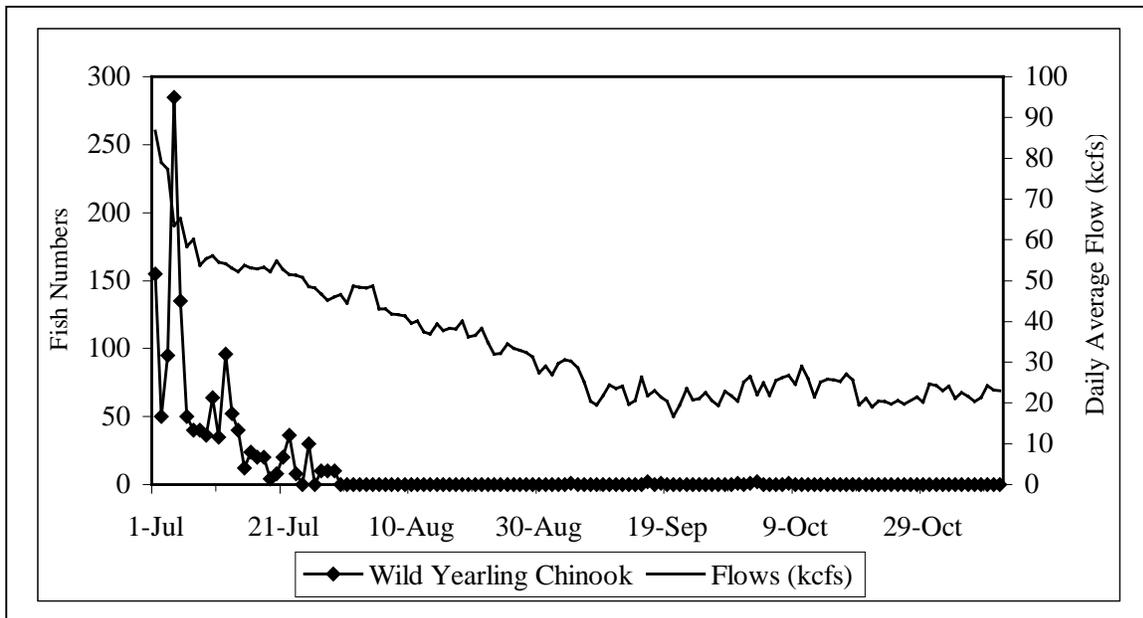


Figure 7. Daily unknown rearing type subyearling chinook collection and river flow at Lower Granite Dam from March 26 through June 30, 1999.

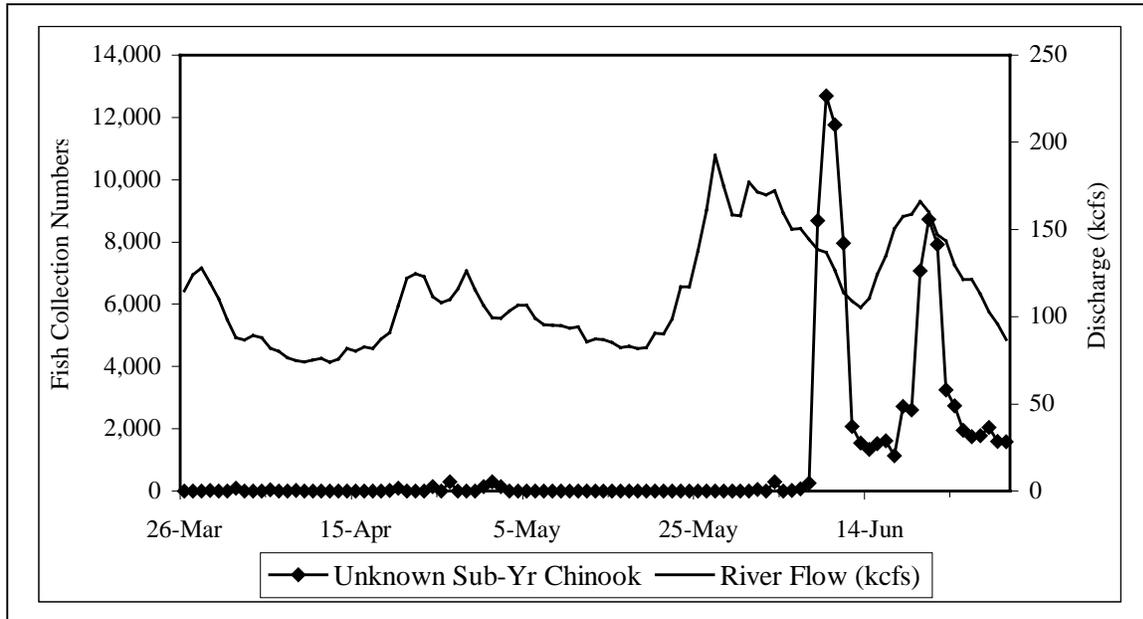


Figure 8. Daily unknown rearing type subyearling chinook collection and river flow at Lower Granite Dam from July 1 through November 10, 1999.

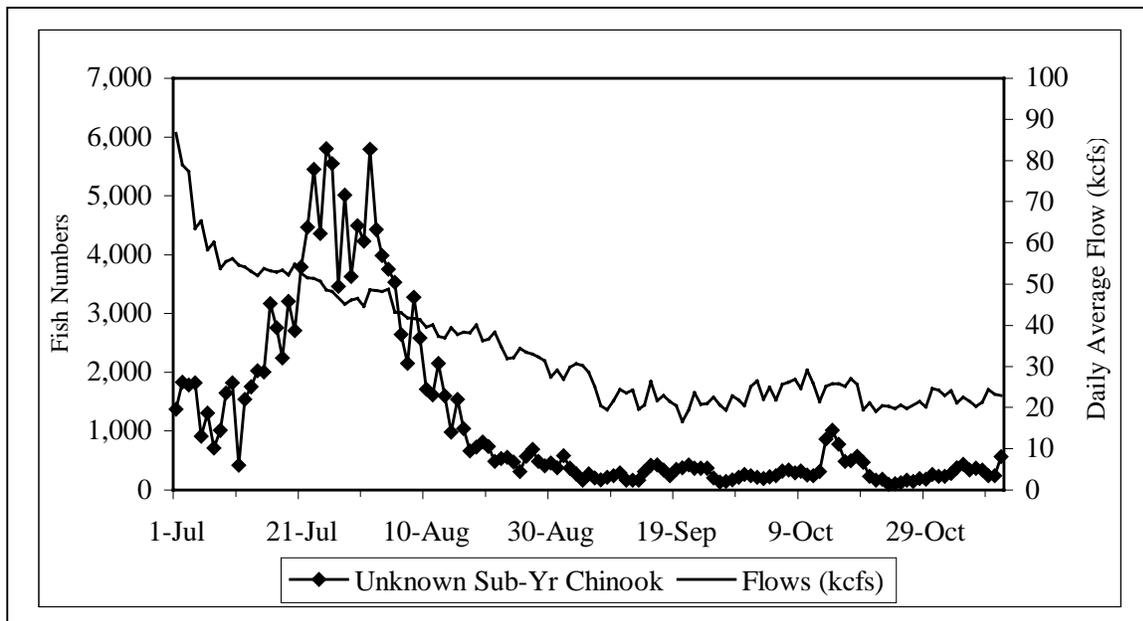


Figure 9. Daily hatchery steelhead collection and river flow at Lower Granite Dam from March 26 through June 30, 1999.

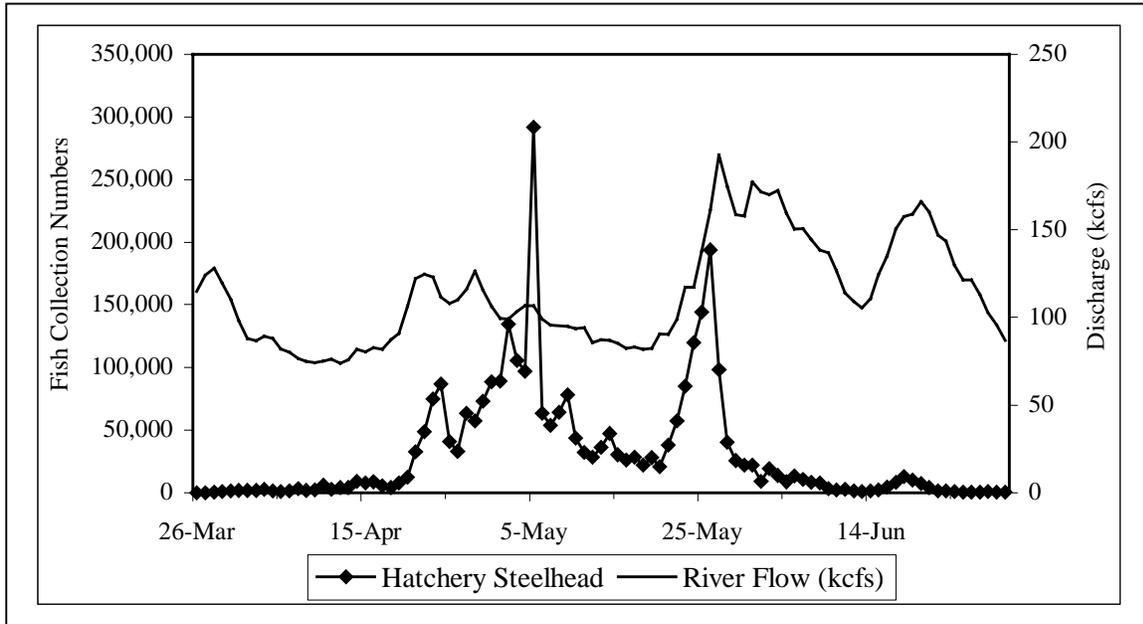


Figure 10. Daily hatchery steelhead collection and river flow at Lower Granite Dam from July 1 through November 10, 1999.

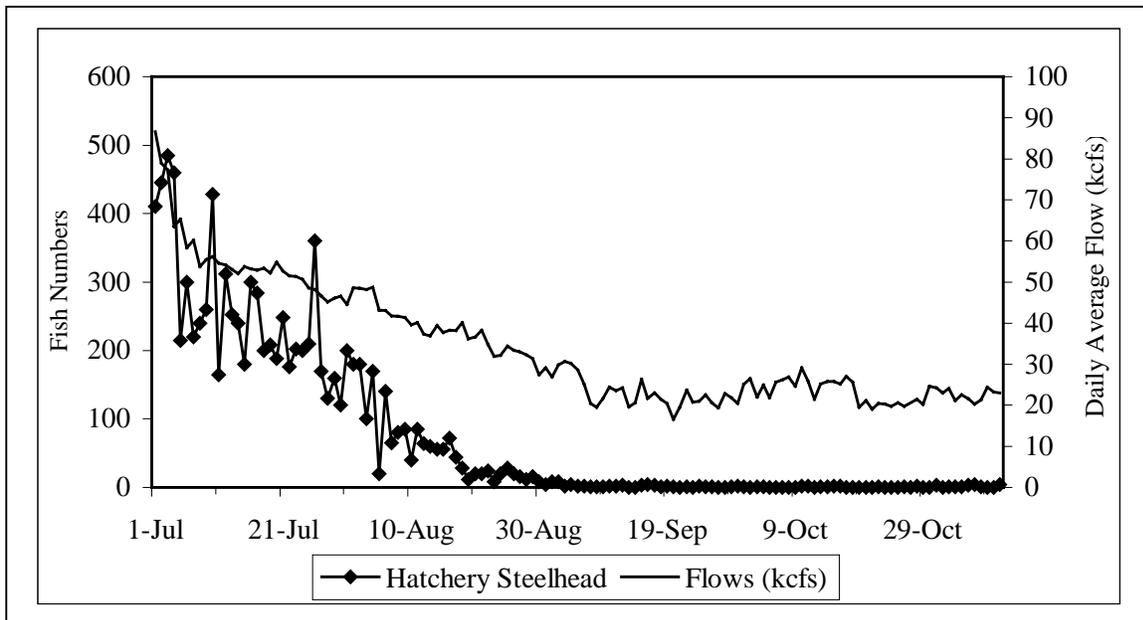


Figure 11. Daily wild steelhead collection and river flow at Lower Granite Dam from March 26 through June 30, 1999.

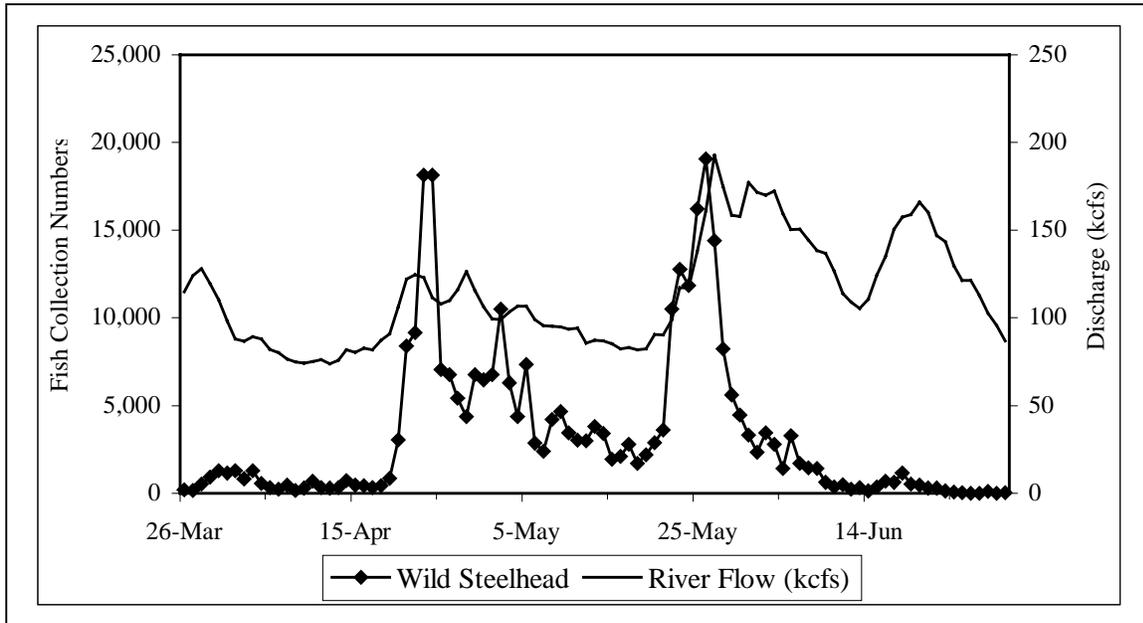


Figure 12. Daily wild steelhead collection and river flow at Lower Granite Dam from July 1 through November 10, 1999.

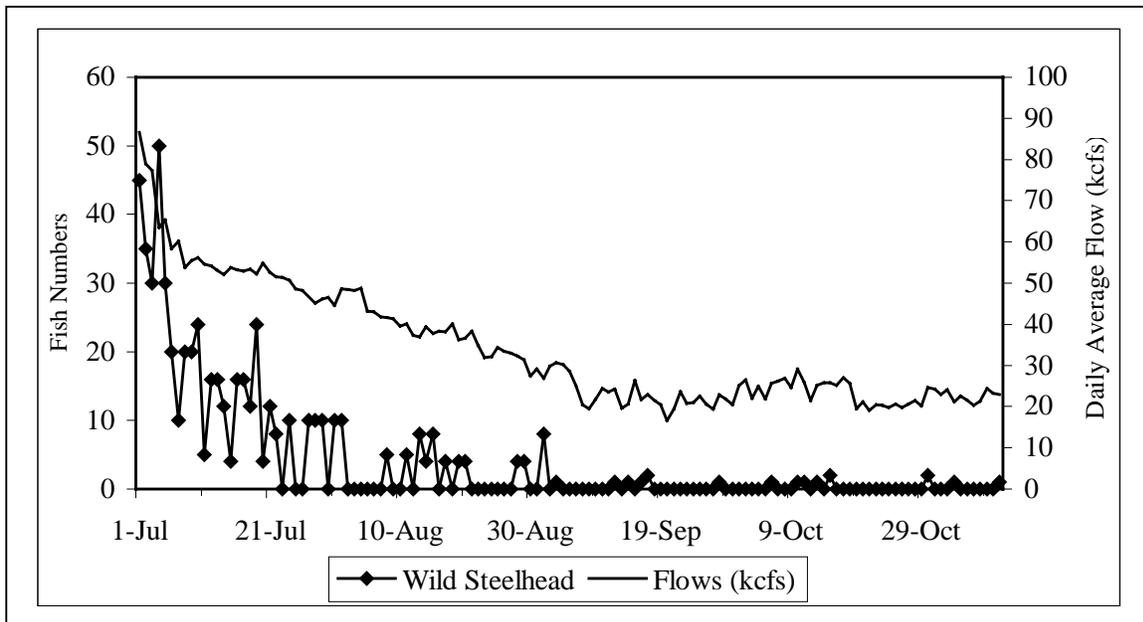


Figure 13. Daily unknown rearing type coho collection and river flow at Lower Granite Dam from March 26 through June 30, 1999.

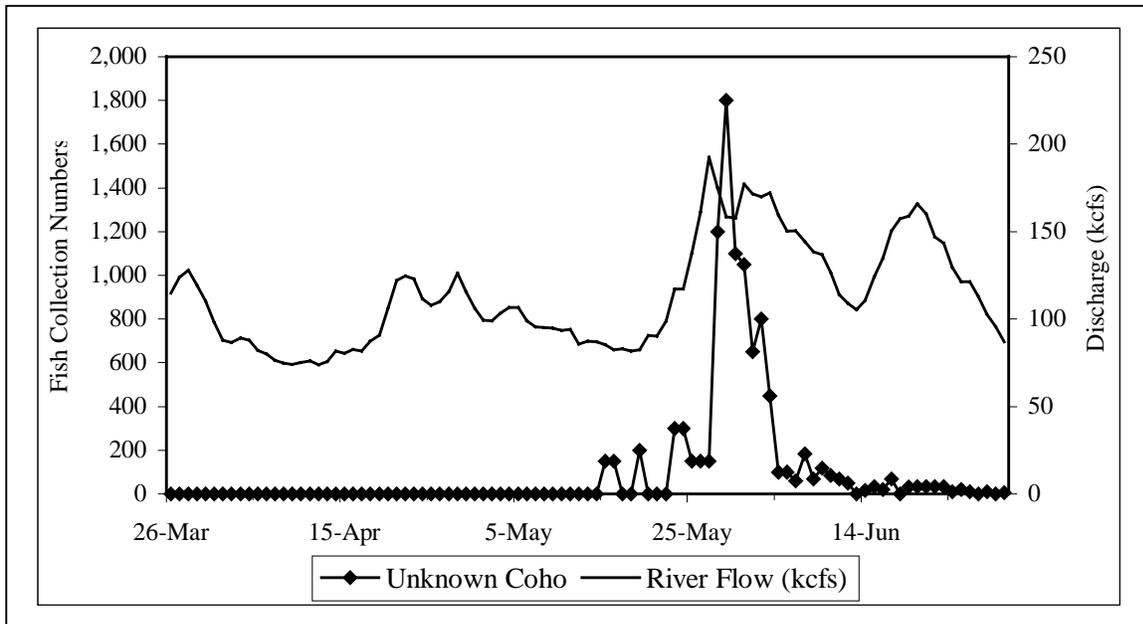


Figure 14. Daily unknown rearing type coho collection and river flow at Lower Granite Dam from July 1 through November 10, 1999.

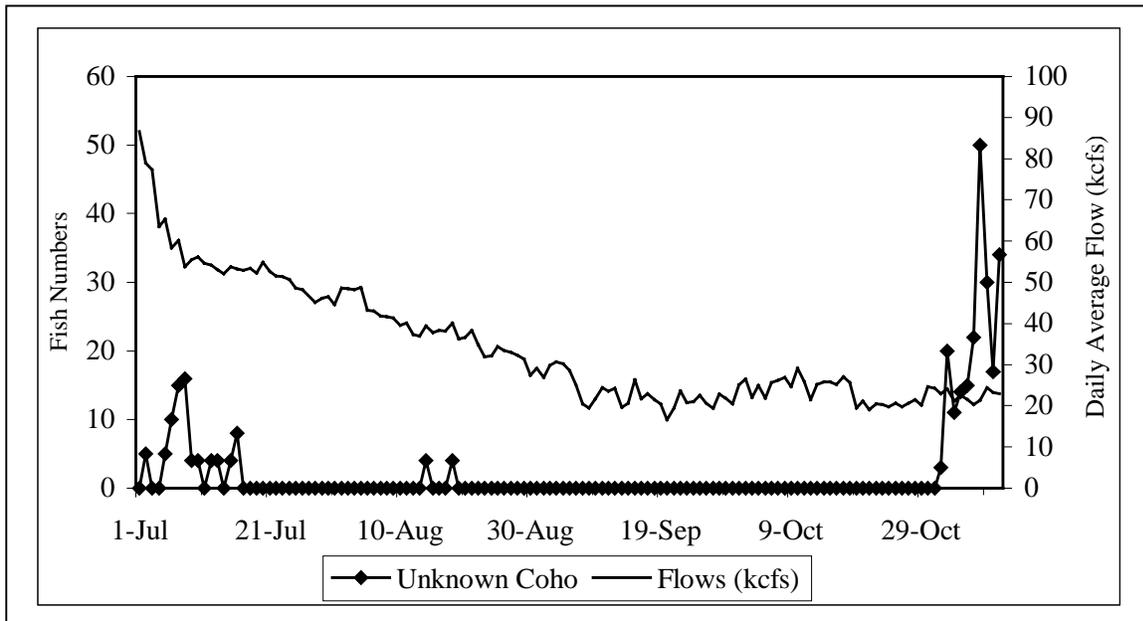


Figure 15. Daily hatchery sockeye/kokane collection and river flow at Lower Granite Dam from March 26 through June 30, 1999.

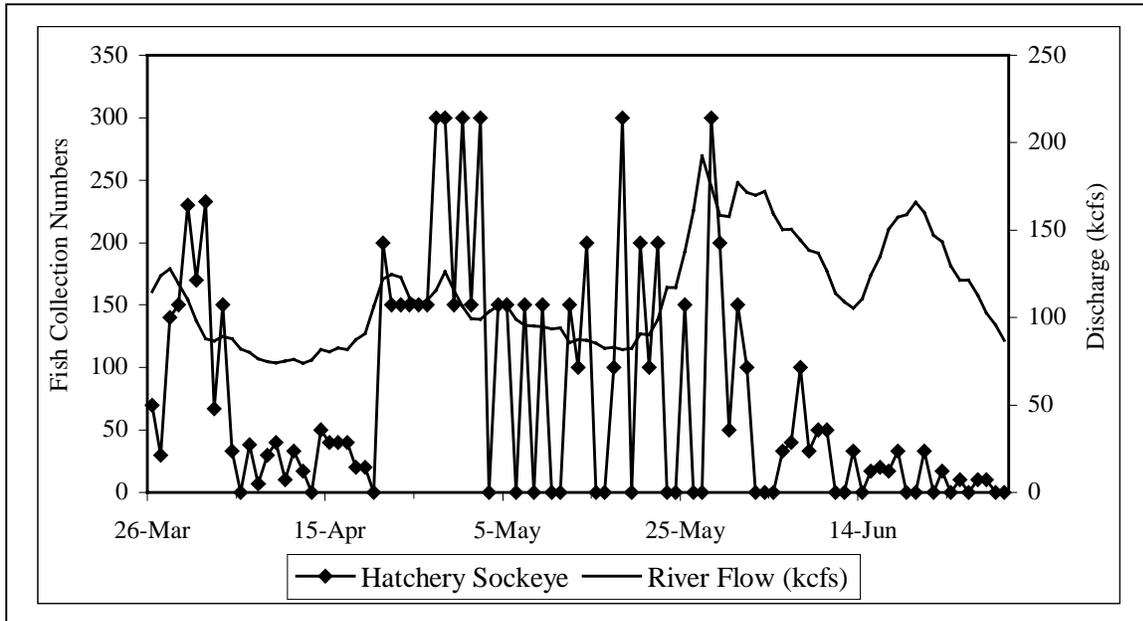


Figure 16. Daily hatchery sockeye/kokane collection and river flow at Lower Granite Dam from July 1 through November 10, 1999.

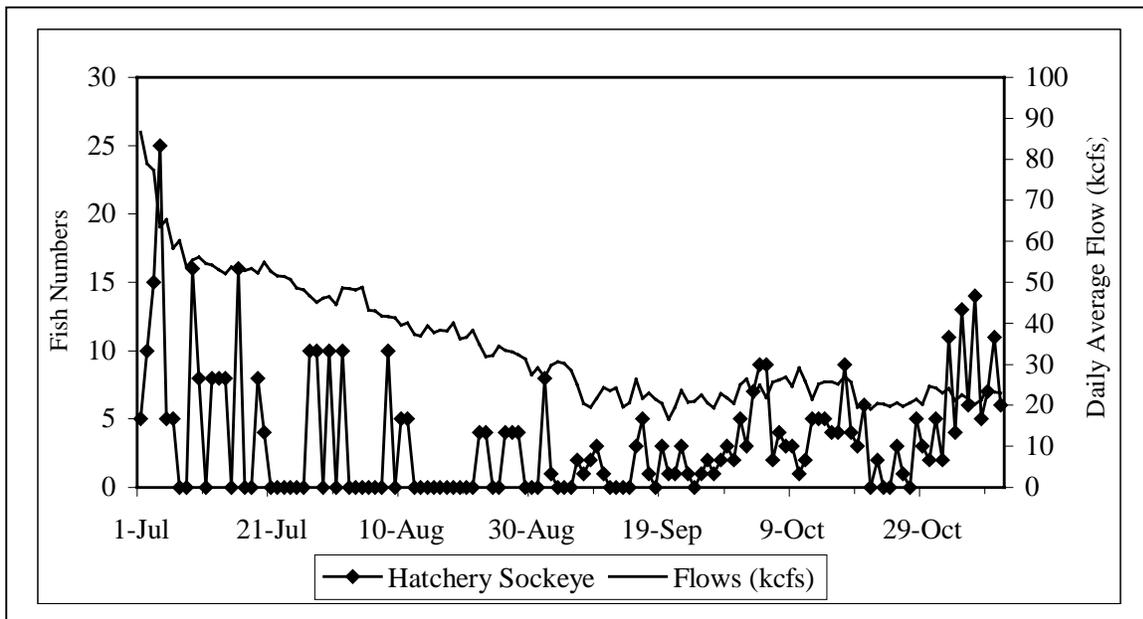


Figure 17. Daily wild sockeye/kokanee collection and river flow at Lower Granite Dam from March 26 through June 30, 1999.

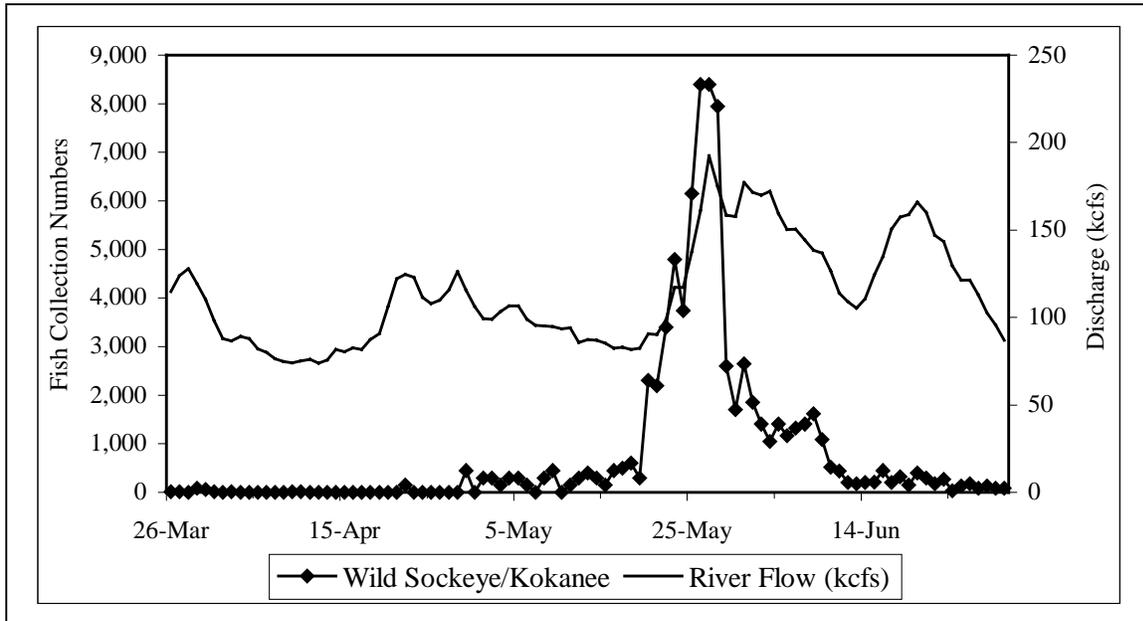


Figure 18. Daily wild sockeye/kokanee collection and river flow at Lower Granite Dam from July 1 through November 10, 1999.

