Monitoring of Downstream Salmon and Steelhead at Federal Hydroelectric Facilities

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MONITORING OF DOWNSTREAM SALMON AND STEELHEAD AT FEDERAL HYDROELECTRIC FACILITIES - 2002
Annual Report

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Abstract.— The 2002 river flows returned to more normal levels this year and provided improved migration conditions for juvenile salmonids. During each of the four peak passage months (April – July), average monthly river flow was nearly double last year's flow for the same month but similar to the 1986 – 2002 average.

The number of fish handled at John Day increased from 98,895 last year to 257,741 this year due to increased research fish collection. Descaling increased for all species compared to the last two years, and steelhead had the highest rates recorded at the new facility. However, descaling for all species was below the average for the airlift sampling years. Mortality increased this year for unclipped steelhead and sockeye but decreased for the other species. With the exception of sockeye, mortality rates at the new facility are well below the average for the years of sampling with the airlift system. With the exception of steelhead, fish passed earlier in the season and the middle 80% took fewer days to pass the project than last year. For steelhead, passage duration was longer than last year and the historical average.

This was the third year of index level sampling at the Hamilton Island Juvenile Monitoring Facility (JMF) at Bonneville. Winter repairs to the primary dewatering structure completely eliminated the erratic operation of this system (flooding or drying up) and improved fish passage conditions. The number of fish handled declined from 100,547 last year to 85,552 this year. Descaling for all species was similar to the previous two years (within 2%) but in all cases lower than the historical average when samples were processed in the second powerhouse lab. Mortality was higher than last year for subyearling chinook and sockeye, but lower for all other species, and below 1% for all species except sockeye (2.5%). The increase in flows did not alter passage timing as much as might be expected for yearling chinook and steelhead, whose passage timing and duration were within a few days of last year's and the historical average. For subyearling chinook, coho, and sockeye, timing and duration were considerably different when compared to last year. Sockeye passed about 3 weeks earlier, coho about a week earlier, and subyearling chinook started later and ended earlier creating a 30 day middle 80% duration compared to 70 days last year.

A total of 8,094 fish were handled in the first powerhouse (PH1) for condition monitoring and gas bubble exams. In general, fish condition was good, except during a couple of unexplained incidents when descaling and mortality were elevated. Descaling was higher than last year for all species and higher than any year for sockeye and clipped steelhead. Mortality rates were higher than any previous year for all species and reached an alarming 7.2% for sockeye, most of which was from the incidents mentioned above.

Powerhouse 2 (PH2) operational priority reduced operation of PH1 again this year especially in midsummer as river flow declined. This prompted a 23 July end to a season that was scheduled to go through August. After 23 July exams for gas bubble trauma symptoms were conducted in the JMF. A total of 3,028 fish were examined but no bubbles were found. This year the lateral line was not examined for bubbles. The lateral line accounted for 92% in 2000 and 100% in 2001, of all bubbles found. PIT tag detections were up from 883 last year to 8,361 this year at PH1.

PREFACE

Project 84-014 has been part of the annual integrated and coordinated Columbia River Basin Smolt Monitoring Program since 1984, and currently addresses measure 5.9A.1 of the 1994 Northwest Power Planning Council's (NPPC) Fish and Wildlife Program. The program is coordinated by the Fish Passage Center (FPC) and funded by the Bonneville Power Administration (BPA). The National Marine Fisheries Service (NMFS) established the project to: 1) collect and report daily fish capture, fish condition, dam operations, and river flow data to water managers to improve the scientific information on which to base in-season operations of the hydro system, and 2) analyze the collected data and characterize juvenile fish passage at main stem federal dams and transfer this information, learning, and understanding to the fisheries community through technical reports and publications. In the 1980s, NMFS conducted the smolt monitoring at Lower Granite, Lower Monumental, McNary, John Day, and Bonneville dams. Since the early 1990s, the smolt monitoring at the Snake River dams and McNary Dam was assumed by the states of Washington and Oregon, and this project (84-014) retained responsibility for monitoring at John Day, The Dalles (1989 - 1991), and Bonneville dams.

In 1999 the contract for project 84-014, which was the remaining federal portion of the Smolt Monitoring Program (SMP), was not renewed. The work done under this contract was combined with the non-federal portion of the SMP, project 87-127. The remaining NMFS employees converted to PSMFC employees and the NMFS withdrawal from the SMP was complete. This consolidation was done to facilitate review and reduce administrative costs.

The following report presents the results of the SMP activities at John Day and Bonneville dams this year as well as summaries of data for all years of the project at John Day and Bonneville dams.

INTRODUCTION

The seaward migration of juvenile salmonids was monitored by the Pacific States Marine Fisheries Commission (PSMFC) at John Day Dam, located at river mile 216, and at Bonneville Dam, located at river mile 145 on the Columbia River (Figure 1). The PSMFC Smolt Monitoring Project is part of a larger Smolt Monitoring Program (SMP) coordinated by the Fish Passage Center (FPC) for the Columbia Basin Fish and Wildlife Authority. This program is carried out under the auspices of the Northwest Power Planning Council's Fish and Wildlife Program and is funded by the Bonneville Power Administration.

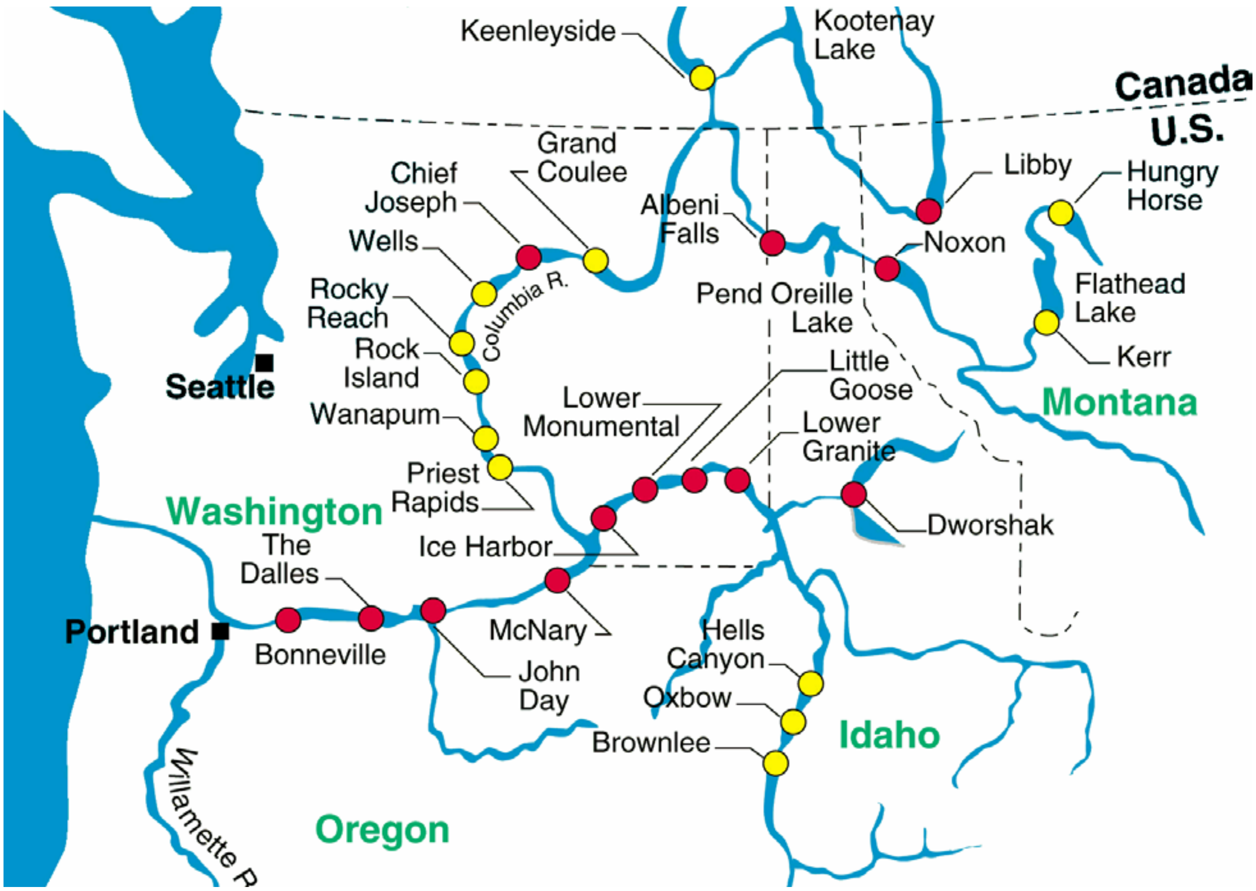

Figure 1. Hydroelectric projects on the Snake and Columbia Rivers. This figure is reprinted courtesy of the U.S. Army Corps of Engineers, Portland District.

The purpose of the SMP is to monitor the timing and magnitude of the juvenile salmonid out-migration in the Columbia Basin and make flow and spill recommendations designed to facilitate fish passage. Data are also used for travel time and survival estimates and to build a time series data set for future reference. The purpose of the PSMFC portion of the program is to provide the FPC with species and project specific real time data from John Day and Bonneville dams.

METHODS AND MATERIALS

JOHN DAY DAM

Sampling

John Day Dam is equipped with a juvenile bypass system (Figure C-10) consisting of Submersible Traveling Screens (STS's), gatewells, 14" orifices, and a tainter gate. As fish exit the bypass channel under the tainter gate, they are directed either back to the river or down the elevated chute toward the sampling facility, depending on the position of the crest gate. At the end of the elevated chute is the Primary Dewatering Structure (PDS). The PDS removes all but 30 cubic feet per second (cfs) of the roughly 450 cfs entering it. This remaining 30 cfs and all the fish travel down a corrugated flume equipped with a switch gate, which directs the flow to either the bypass (back to river) or sample (to sampling facility) flumes. In sample mode, the fish pass over the Secondary Dewatering Structure (SDS) where an additional 29 cfs are removed. The remaining water and fish exit the SDS and enter the large fish and debris separator (FDS), a series of parallel aluminum bars that allow the juveniles to pass through the bars while the adults and debris slide off the end and return to the river. Under the separator bars is a collection area known as the hopper, a sloped floor basket that directs the juveniles into the distribution flume leading to the PIT tag coils and rotating gates.

The 3-way rotating gate is used to obtain the general sample and research fish. When rotated to the west, all fish are diverted into the sample tank, when rotated to the east, all fish are routed to the research flume, and in the center or default position all fish go directly to the river. The research flume contains a 2-way rotating gate capable of selecting specific PIT tagged fish for diversion to a different tank, making it possible to collect fish for two different studies concurrently and hold them in separate tanks. This feature, together with the initial diversion at the 3-way gate, is referred to as the Separation by Code (SBC) system (Figure A-10).

The sample day began at 0700 hours and went to 0700 hours the next day. This is consistent with other smolt monitoring and transportation sites. Depending on the sample rate, 2 - 6 timed subsamples were collected each hour using the 3-way rotational gate. The sample rate range for smolt monitoring is 0.5% to 25%. When the sample rate is 20% or above, the system is put into Divert During Sample (DDS) mode. In this mode, if a PIT tagged fish passes through the system during sample collection, the 3-way gate rotates back to the center or bypass position, diverting the fish away from the sample. This feature is not used below 20% because it may remove too many fish from the sample and bias the data for that day. For a complete summary of sample rates, openings per hour, and other details, see Table 1. Sample rates above 25% are possible if needed for research fish collection.

During the spring migration, when species diversity is greatest, the target sample size range was 500 - 750 fish per day. During the summer migration, with mainly subyearling chinook present, the target sample size range was 150 - 250 fish per day. Sample rates were adjusted as needed to achieve these target sample sizes.

Fish were processed between 1300 and 1400 hours and at 0700 hours daily and the results combined for a sample day total. Fish collected at different sample rates were separated and expanded by their respective sample rates and referred to as a subbatch. For a list of data collected, see Data Collected in the John Day and Bonneville section.

Fish were collected in a 6,796 liter (1,795 gal) holding tank located inside of the sampling lab. At the end of a sample period, the crowder was moved forward and the next sample was collected behind it. When circumstances required holding more than two subbatches at a time, a removable panel was inserted to keep subbatch groups separate. Approximately 145 smolt were then crowded into a 20 by 24 " pre-anesthetic (PA) chamber using a panel net. The water level in the PA chamber was lowered to about 8 "es (48 liters) and fish were anesthetized with MS-222 at a concentration of about 63 mg/l. Average induction time was approximately 2 minutes in 2002. Once anesthetized, fish were routed via a 6 " PVC pipe over a final dewatering screen and into the examination trough. MS-222 was added to the examination trough as needed to keep smolt anesthetized and minimize stress during examination.

When large numbers of fish are being processed, a recirculating system was used to reduce MS-222 usage and a chiller is used to keep examination trough water within 1.5 ^{0}F of river temperature. An inline water filtration system was added to the recirculation system in 2000 to minimize the possibility of inadvertently culturing and spreading pathogens such as bacteria and fungus in the recirculating examination water. The system consists of three Rainbow Plastics UV Sterilizer filters (40 watt), a Venturi Protein skimmer, and two sets of particulate bag filters (100 and 20 micron). The bag filters were switched and cleaned daily or as needed (Figure A-8).

Electronic sample tally counters were used in conjunction with grease boards to record data. Following examination, all sampled fish were routed via a 4 inch PVC pipe to one of two 2,726 liter (720 gal) recovery tanks and held for a timed recovery period of at least 25 minutes before being routed to the outfall of the bypass system. This process was repeated until the entire sample had been examined. All holding and recovery tanks had a constant exchange of river water. Upon release, fish pass through one more set of PIT tag coils before returning to the bypass flume. Drawings of the lab and the footprint of the facility are presented in Figures A-11 and A-12, respectively.

BONNEVILLE DAM

Sampling - Second Powerhouse

The second powerhouse (PH2) at Bonneville is equipped with a juvenile bypass system (Figure C-10) consisting of STS's, gatewells, 12" orifices, and vertical wall screens that remove all but 30 cfs of the roughly 340 cfs in the bypass channel. At the end of the screened section is the entrance to the 1.7-mile conveyance pipe that leads to the Hamilton Island Juvenile Monitoring Facility (JMF). A switchgate at the exit of the pipe directs the flow to either the sampling facility or directly back to the river. In the sample position, the 30 cfs in the flume flows into the PDS where it is reduced to about 0.5 - 1 cfs that empties onto the FDS (see description in John Day section above). As fish exit the hopper area under the separator bars, they travel down a flume toward the first set of PIT tag coils. These coils can be used to activate the 3-way rotational gate to divert fish with specific PIT tag codes into one of two holding tanks in the basement of the facility. This is the Separation by Code (SBC) system (Figure B-9). Just downstream of the 3-way rotational gate on the default center flume is the 2-way rotational gate. The 2-way gate is used exclusively to collect timed subsamples for smolt monitoring. Collected fish are routed to an 18,930 liter (5,000 gallon) holding tank in the basement. This system differs from John Day where the 3-way gate is used for initial SBC and SMP sample collection and the 2-way gate, which is on the SBC flume, is used for subdivision of SBC fish.

The sample day began at 0700 hours and went to 0700 hours on the next day. Depending on the sample rate, 2 - 6 timed subsamples were collected each hour using the 2-way rotational gate. The sample rate range for smolt monitoring is 0.5% to 25%. When the sample rate is 20% or above, the system is put into DDS mode (see explanation in John Day section). For a complete summary of sample rates, openings per hour, and other details, see Table 1. Sample rates above 25% are possible if needed for research fish collection.

During the spring migration, when species diversity is greatest, the target sample size was 500 - 750 fish per day. During the summer migration, with mainly subyearling chinook present, the target sample size was 150 - 250 fish per day. Sample rates were adjusted as needed to achieve these target sample sizes.

All of the holding tanks are equipped with crowders used to crowd fish to the fish lift end of the holding tank and separate fish collected on different sample days, or fish collected at different sample rates within the same sample day. Fish collected at different sample rates are processed separately. Because the JMF is 1.7 miles from the powerhouse, head loss made it necessary to put the holding tanks in the basement of the JMF. The processing area is on the main floor so fish lifts, or fish elevators, are used to transport the fish upstairs. The fish lifts, which measure 24 by 27 inches, also function as PA chambers. Approximately 125 smolt were crowded into the PA chamber, water was lowered to about 10 inches (104 liters), and fish were anesthetized with MS-222 at a concentration of about 39 mg/l. When the fish were partially anesthetized, the fish lift was hoisted to the main floor. From there, fish traveled through a 20 foot piece of 6 " PVC pipe to a final dewatering device and then into the examination trough. MS-222 was added to the examination trough as needed to keep fish anesthetized and minimize stress during examination. Following examination, fish were routed via a 4 " PVC pipe to a recovery tank and held for a minimum of 30 minutes before being released. Upon release, fish pass through one more set of PIT tag coils before returning to the bypass flume. Downstream of where they enter the bypass flume is another switch gate that directs the flow to either the high water or low water outfall. The system automatically switches from one outfall to the other depending on tailwater elevation.

PH2 diagrams showing the footprint of the facility and the schematic of the lab are presented in Figures B-8 and B-9, respectively. Please see Krcma et al. (1984) for a description of the system used prior to 1997. For a description of the system used in 1997 and 1998 see Martinson, et al. (1998) and for diagrams of the system see Figure B-10 and B-11. Figure B-7 shows the fish processing area of PH2 used through 1998.

First Powerhouse

The first powerhouse (PH1) has a bypass system (Figure C-10) consisting of STS's, gatewells, orifices, bypass channel, and outfall. At the end of the bypass channel, there is an inclined floor screen that removes most of the water in the channel. At the end of the floor screen section, the fish and remaining water plunge into an area called the downwell, which leads to the tailrace. The 2,415 liter (638 gal) trap used to collect samples is positioned in the downwell and the water and fish are directed into it with a small movable screen section. For further explanation see Gessel et al. (1986) and for a cross sectional diagram see Figure C-8.

Sampling occurred between 1600 and 2400 hours on Monday and Thursday for condition monitoring and Gas Bubble Trauma (GBT) exams. On Saturdays, only condition monitoring was conducted. Research fish collection occurred on various days. The sampling effort was adjusted from 30 seconds to 15 minutes per set depending upon current passage numbers. Typically, 15 to 25 fish per set were optimal for condition and GBT monitoring, while 50 to 100 fish per set were targeted for research fish collection. Collected fish were routed from the trap to a holding tank via a rectangular chute. From there, 30 to 60 fish were crowded into a PA chamber and anesthetized using a stock solution of MS-222 with a concentration of 50 g/l. Once anesthetized, fish were net transferred from the holding tank to the examination trough. MS-222 is added to the examination trough as needed to minimize stress during examination. After processing, sampled fish were scanned for PIT tags before going to a recovery tank and any tags found are reported to PTAGIS in a recapture file. Fish were allowed to recover for at least 30 minutes before being released into the downwell via a 6 inch PVC pipe.

Flat Plate Operation

Full bypass system PIT tag detections in PH1 began in 1996 when a prototype detection system called a flat plate system was installed onto the top of the sample collection trap. The impetus for the system was a survival study being conducted by the NMFS. The antennae are in a housing and PIT tags are detected as fish pass over the top of the housing. The flat plate has pneumatic cylinders that raise the housing, exposing the top of the trap and allowing fish to be collected in the trap. To end fish collection and resume interrogation for PIT tags, the flat plate housing is lowered back onto the trap and fish are directed onto it rather than into the trap. Flat plate efficiency is affected by water depth and fish orientation.

Gas Bubble Trauma Subsampling

GBT samples were collected twice weekly, usually on Mondays and Thursdays. The number of fish examined each session was 100, and could be a combination of chinook and steelhead. This year, examination of the lateral line was discontinued. Exams focused on unpaired fins and eyes using a variable power, dissecting microscope (6X to 40X). Bubbles were quantified as the "percent of area covered" and assigned a severity ranking as follows: less than 5% = 1, 6% - 25% = 2, 26% - 50% = 3, greater than 50% = 4 (Fish Passage Manager, 1999, p33). Results were summarized, recorded, and transmitted to the FPC.

JOHN DAY AND BONNEVILLE

Subsampled Fish Condition

Detailed fish condition monitoring targeted a sample size of at least 100 individuals per species in the spring, three or four days per week. The sampling crew attempted to choose fish at random and to select fish throughout the sample day. Steelhead and sockeye were examined one day while yearling chinook and coho were examined every alternate day. Target sample sizes of 200 (John Day) or 100 (Bonneville) subyearling chinook were examined every day of the week from June to September (JDA) or October (PH2). In addition to fin clips, tags, and brands, smolts were examined for descaling, injuries to the head and body, parasites, disease, predation, and fork lengths.

Performance Monitoring

Tests and digital imaging were used to evaluate species identification, brand recognition, descaling assessment, and data recording accuracy of SMP personnel during 2002. During tests, a subsample of ten fish were randomly selected, anesthetized, and placed into a compartmentalized divider located in the sorting trough. Fish were processed independently and specific details were recorded for each fish including: 1) species, 2) fin clip, 3) level of descaling, and 4) presence of external marks or tags. Coworkers then compared and discussed results. The benefits of this method include: 1) increased frequency of tests, 2) several people are able to test concurrently, 3) promotes teamwork and builds consistency between coworkers, and most importantly, 4) the ability to discuss discrepancies with fish in hand. Photographs were valuable for documenting unknowns, discrepancies, and oddities, which could be examined later with no risk to the fish.

Data Collected

The following is a list of data collected daily and either manually sent to the FPC or automatically uploaded to the Columbia Basin PIT Tag Information System.

1) Species specific subbatch and daily sample totals.
2) Brands, tags, fin clips, and PIT tag detections.
3) Descaling and mortality data.
4) Species specific length and condition data (subsampling only).
5) River, powerhouse, and spill flow data.

DEFINITION OF TERMS

Three types of numbers are discussed in the report, defined as follows:

1) Total Sample: actual fish counts, number of fish handled.

2) Estimated Collection: total sample number divided by sample rate, resulting in an estimated number of fish passing through the juvenile bypass system.

3) Fish Passage Indices: estimated collection counts divided by the proportion of flow passing through the powerhouse where those fish were collected resulting in a relative indicator of fish abundance with no adjustment for Fish Guidance Efficiency, horizontal, vertical or temporal fish distribution. Essentially, indices attempt to account for fish lost from sampling to spill. Without spill, the collection and index numbers would be the same. Indices are also helpful in setting daily sample rates.

As stated in the FPC annual reports, Fish Passage Indices (FPI) are used as relative indicators of population abundance, and assume that fish pass through spill and powerhouse units in numbers proportional to the flow through those passage routes. Indices are not estimates of total daily passage, but rather a relative measure of how the migration is progressing over the season for a given species.

The following table is used to approximate the correct sample rate for a given level of fish passage.

Table 1. Sample rate reference table for John Day and Bonneville dams.

Estimated Daily Collection	Sample Rate (%)	Equivalent Multiplier 1/sample rate	Sample Sec/ hour	Subsamples per hour	Subsample Duration in seconds	Estimated number of fish in Sample
Emergency	0.50%	200	18	2	9	
> 75,000	0.70%	143	25.2	2	12.6	> 525
50,000 - 75,000	1.00%	100	36	2	18	500 - 750
35,000 - 50,000	1.50%	66.6	54	4	13.5	525 - 750
25,000 - 35,000	2.00%	50	72	6	12	500 - 750
16,500 - 25,000	3.00%	33.3	108	6	18	495 - 750
12,500 - 16,500	4.00%	25	144	6	24	500 - 660
10,000 - 12,500	5.00%	20	180	6	30	500 -625
7,500 - 10,000	7.00%	14.3	252	6	42	525 - 700
5,000 - 7,500	10.00%	10	360	6	60	500 - 750
4,000 - 5,000	12.50%	8	450	6	75	500 - 625
3,000 - 4,000	15.00%	6.66	540	6	90	450 - 600
2,500 - 3,000	20.00%	5	720	6	120	500 - 600
1,500 - 2,500	25.00%	4	900	6	150	375 - 625
500 - 1,500	50.00%	2	1800	6	300	250 - 750
< 500	100.00%	1	3600	1	3600	< 500

RESULTS AND DISCUSSIONS

JOHN DAY DAM

In 2002, the fifth year of sampling in the Smolt Monitoring Facility (SMF) at John Day, sampling commenced on 18 March and ended on 16 September. See Table A-1 for a summary of all years of sampling, including sample dates, sampling effort, and sample, collection, and index numbers. To see a diagram of the airlift system, used from 1985 - 1997, see Figure A-12. For a description of the airlift system, see Martinson, et al. (1997).

The Numbers

Sample Numbers

The total number of fish handled at John Day in 2002 was 257,741 (Table 2), about 260% of the 2001 total of 98,895. Research fish collection is responsible for the increase. The average sample rate in 2001 was 2.4% but in 2002, it was about 9%. Species specific sample numbers expressed as a percent of 2001 sample numbers are as follows: sockeye, 957%; clipped steelhead, 319%; subyearling chinook, 318%; coho, 304%; yearling chinook, 170%; and unclipped steelhead, 130%. See Table A-1 for a comparison to previous years.

The species composition, expressed as a percent of all the fish sampled, was lower this year than last year for yearling chinook, 27.5% versus 42.1% and unclipped steelhead, 3.8% versus 7.7%. It was higher for subyearling chinook, 49.7% versus 40.7%; coho, 3.6% versus 3.1%; clipped steelhead, 4.2% versus 3.4%; unclipped sockeye, 11.0% versus 2.9%; and clipped sockeye at 0.2% versus 0.1%.

Collection Estimates

The total collection estimate of 5,067,733 is about 122% of the 2001 collection estimate of 4,152,457, however, not all species showed an increase in their collection estimates. Collection estimates expressed as a percent of last year's estimates are as follows: subyearling chinook, 83%; sockeye, 679%; yearling chinook, 155%; unclipped steelhead, 138%; coho, 258%; and clipped steelhead, 328%. These large increases may be attributed to the low flows, reduced spill, and other factors in 2001 that greatly reduced collection numbers.

Fish Passage Indices

The 2002 FPI for all species combined was 7,365,812, about 174% of the 2001 FPI of 4,232,594. A breakdown by species for sample, collection, and index numbers can be found in Table 2 and a comparison of 2002 numbers to all previous years can be found in Table A-1. For more information on index estimates see the FPC annual report.

Fry Incidence

The number of chinook fry ($\leq$ 60mm) sampled this season was 315, which generated a collection estimate of 4,979. This is 368% of the fry collection estimate of 2001 (1,352) which was the lowest year recorded since we began sampling in the SMF. Most of the fry were sampled in April (69%) and May (21%), with the other 10% caught in March (2%) and June (8%). See Table A-1 for a summary of chinook fry collection estimates since 1987.

Table 2. Summary of 2002 smolt monitoring at John Day and Bonneville dams.

Species	Site	Sample Number	Sample Percent Comp.	Collection[1] Number	Collection[1] Percent Comp.	FPI[2]	Descaling[3] #	Descaling[3] %	Mortality[4] #	Mortality[4] %
Yearling Chinook	John Day	70,901	27.5	1,470,332	29.0	2,104,942	2,210	3.1	259	0.37
	Bonneville PH #1	1,974	24.4				153	7.9	44	2.23
	Bonneville PH #2	16,723	19.5	1,367,791	22.2	3,328,200	397	2.4	119	0.71
Subyearling Chinook	John Day	127,980	49.7	2,357,720	46.5	3,465,719	1,243	1.0	285	0.22
	Bonneville PH #1	4,567	56.4				170	3.8	91	1.99
	Bonneville PH #2	47,695	55.7	2,951,612	48.0	6,999,286	201	0.4	293	0.61
Unclipped Steelhead	John Day	9,837	3.8	170,478	3.4	245,070	274	2.8	22	0.22
	Bonneville PH #1	219	2.7				17	7.8	0	0
	Bonneville PH #2	2,856	3.3	222,554	3.6	572,070	91	3.2	4	0.14
Clipped Steelhead	John Day	10,842	4.2	210,649	4.2	300,695	775	7.2	44	0.41
	Bonneville PH #1	248	3.1				31	12.9	8	3.23
	Bonneville PH #2	4,334	5.1	340,024	5.5	882,934	279	6.5	15	0.35
Coho	John Day	9,248	3.6	205,548	4.1	315,279	282	3.1	21	0.23
	Bonneville PH #1	555	6.9				12	2.2	9	1.62
	Bonneville PH #2	10,572	12.4	935,337	15.2	2,331,599	114	1.1	38	0.36
Unclipped Sockeye	John Day	28,359	11.0	642,393	12.7	918,937	2,328	8.4	508	1.79
	Bonneville PH #1	518	6.4				170	35.4	38	7.34
	Bonneville PH #2	3,262	3.8	327,492	5.3	826,200	187	5.9	84	2.58
Clipped Sockeye	John Day	574	0.2	10,613	0.2	15,170	26	4.5	1	0.17
	Bonneville PH #1	13	0.2				4	0.0	0	0
	Bonneville PH #2	110	0.1	8,507	0.1	22,000	5	4.6	2	1.82
SEASON TOTALS	John Day	257,741		5,067,733		7,365,812	7,138	2.8	1,140	0.44
	Bonneville PH #1	8,094					557	7.0	190	2.35
	Bonneville PH #2	85,552		6,153,317		14,962,288	1,274	1.5	555	0.65

[1] Collection numbers are sample numbers divided by sample rate.
[2] FPI (Fish Passage Index) is collection divided by the proportion of daily average river flow through the powerhouse.
[3] Descaling numbers are based on sample numbers minus mortality numbers.
[4] Mortality numbers are based on sample numbers.

River Conditions

River Flow

This year, river flow resembled historical averages. The 2002 spring (19 March through May) river flow averaged 206.8 kilo cubic feet per second (kcfs), 168% of the 123 kcfs for the same period last year. The spring peak flow of 351.5 kcfs occurred on 17 April, about two weeks earlier and 186 kcfs larger than last year's 30 May peak of 165.6 kcfs. For the summer migration period, June and July, the average river flow of 278.3 kcfs was about 171 kcfs more than the average for the same period last year. Late summer flows were also higher than for the same period last year, averaging 131.4 kcfs from 1 August through the end of the season (16 September) compared to an average of 89.5 kcfs last year (Figure 2).

Spill and Dissolved Gas

The Fish Passage Plan (FPP) calls for spill to be 60% of river flow from 10 April to 31 August when total river flow is less than 300 kcfs, excluding special conditions for research. This year, spill during that period averaged just 30% of total river flow, much better than the 1.9% average last year, but still far below recommended levels.

For April and May, total dissolved gas supersaturation in the John Day tailrace averaged 115.8% and peaked at

120% on 28 May, compared to an average of 104.6% last year. The 2002 seasonal average was 102.7%. For more detail on dissolved gas levels and monitoring results, see the FPC annual report.

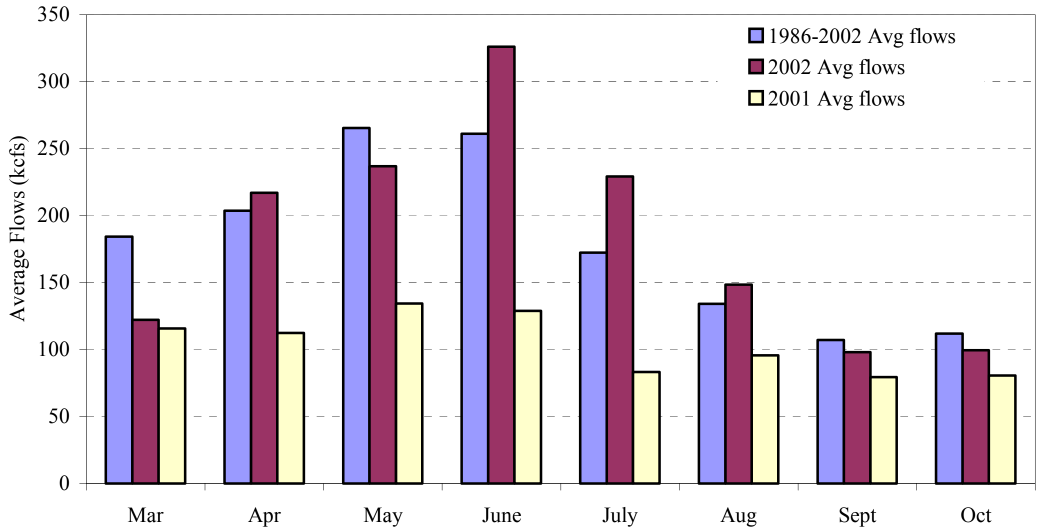

Figure 2. Average monthly flows for 2002, 2001, and the historical average at John Day dam.

Temperature

Spring water temperature in the SMF ranged from 41.6^{0}F to 57.7^{0}F and averaged 49.6^{0}F, which was 3.0^{0}F cooler than last year's average of 52.6^{0}F for the same period. During June and July the range was 57.6^{0}F to 70^{0}F with an average of 63.3^{0}F, which was 2.2^{0}F cooler than the same period last year. In August and September, the range was 67.9^{0}F to 70.6^{0}F, with an average of 69.3^{0}F, which was 1.5^{0}F cooler than the same period last year. The highest daily average temperature of the year (70.6^{0}F) was recorded on 30 August, while the highest instantaneous temperature was recorded on 16 August at 71.2^{0}F.

Passage Patterns

This year river flows were substantially higher than last year and smolt out-migration timing was affected. Based on FPI's, all species reached their respective 10% passage dates earlier than last year and some species were earlier than their historical median 10% date (Figure 3).

Yearling chinook passage reached the 10% date five days earlier than last year and reached the 90% date about ten days earlier than last year. The 90% date this year was just four days later than the 50% date last year. The middle 80% duration was 14 days shorter than last year and three days shorter than the historical median (Figure 3 and Figure A-2).

Yearling chinook passage occurred primarily in May this year. Daily percent of total passage had three peaks in May; the largest (16 May) was nearly 6% of the total and did not coincide with peak flows (Figure 4). Yearling chinook passage timing was very similar to the historical pattern (Figure A-1 and A-2).

Subyearling chinook passage reached the 10% passage date about halfway between last year's 10% date and the historical 10% median date (Figure 3). It is the third shortest migration duration, taking just 31 days for the middle 80% to pass the project and 26 days shorter than last year's middle 80% duration. Additionally, it was the earliest 90% date on record (Figure A-2, Table A-2). The short migration period is the result of two large passage peaks; the first was on 28 June and was almost 10% of the season total and the second was on 13 July and was almost 6% of the season total (Figure 4). Daily fluctuation in passage is common for subyearling chinook and the first peak occurred at a time when fluctuation is common, the second at a time when passage is traditionally low (Figure A-1).

Unclipped steelhead took longer than last year (by 18 days) to pass John Day, contrary to the other species. The duration of the middle 80% (51 days) was also longer than the historical duration which was nearly identical to last year's middle 80% duration; surprising because of the low flows last year (Figure 2). The 51 day middle 80% duration is the longest ever recorded for this species and is the result of an early passage peak on 18 April of 3% and several late season passage peaks between 27 May and 9 June (Figure A-1). Having passage peaks at the beginning and end of the migration will establish an earlier 10% date and a later 90% date, creating a longer middle 80% duration. Unclipped steelhead passage correlates to the increase in river flow on 16 April. As flows declined toward the end of April, so did unclipped steelhead passage, and it stayed lower (relative to the peaks at the beginning and end of the migration) until flows increased around the end of May, when the largest passage peaks for unclipped steelhead were observed (Figure 4).

Clipped steelhead passage was nearly identical to unclipped steelhead passage this year. The 10% passage date was earlier than both last year's and the historical 10% date. Similar to unclipped steelhead, the duration of the middle 80% of the out-migration was longer (44 days) than for any previous year (Figure A-2, Table A-2). The daily passage pattern was characterized by passage peaks at the beginning and end of the migration (Figure A-1) and it was closely correlated to river flow and spill (Figure 4).

Coho reached the 10% passage date earlier than last year or the historical median date. The 90% date came 53 days earlier than last year's anomalous date and 11 days later than the historical median date for a middle 80% duration of 37 days, which is similar to previous years (Figure 2, Figure A-2, Table A-2). Daily coho passage varies greatly within and between years and this year was no exception. Coho passage was dominated by a peak of about 9% of the season total on 5 June, a time when coho passage has been consistently low (Figure A-1). Concurrent increasing river flow likely contributed to the increase in passage (Figure 4). The other passage peak occurred at a time when coho passage usually peaks, 9 May, and was about 6% of the season total (Figure A-1) but did not correspond to an increase in river flow (Figure 4).

Sockeye passage in 2002 resembled previous year's 10%, 50%, and 90% passage dates and the historical median dates. The duration of the middle 80% of the migration (25 days) was also very similar to the historical duration of 26 days. Most of the sockeye passage occurred in mid May when river flow was actually lower than the flows observed before and after that time (Figure 4). Sockeye passage was dominated by two passage peaks; the first was on 16 May at 6% of the season total and the second was on 23 May at 8% of the season total (Figure A-1).

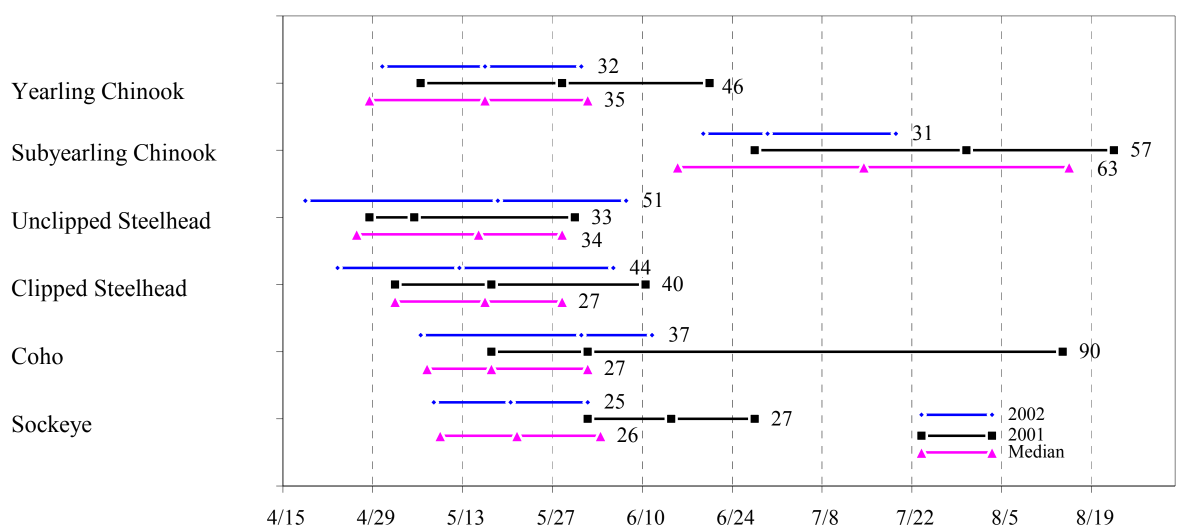

Figure 3. 10%, 50%, and 90% passage dates at John Day for 2002, 2001, and the historical median. The duration (in days) between the 10% and 90% passage dates is indicated for each line.

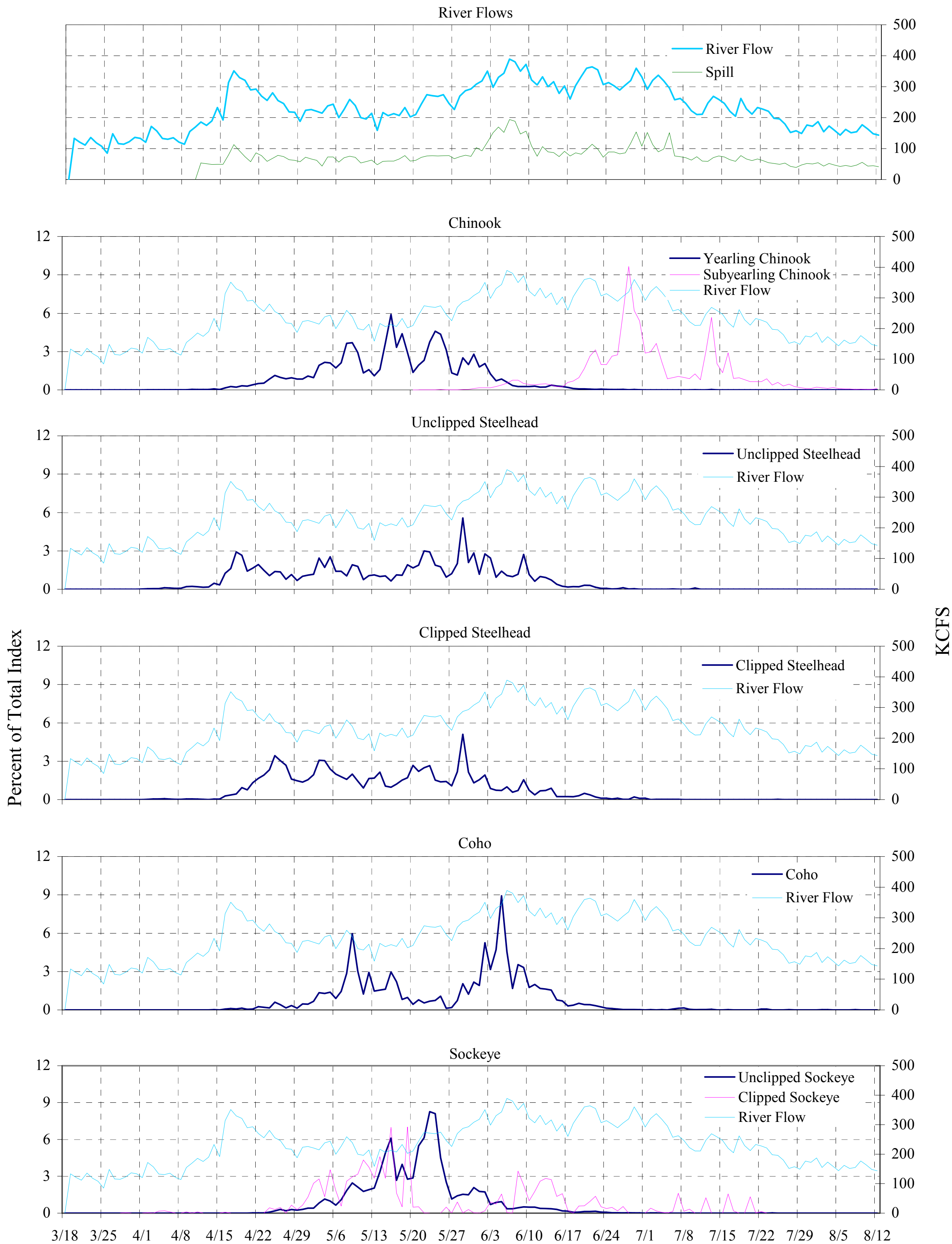

Figure 4. Seasonal passage patterns and daily average river flows for John Day, 2002.

Diel

With the relocation of sampling to the SMF in 1998, the collection of the hourly passage detail was discontinued. However, the diel data collected between 1985 and 1997 is presented several ways in Appendix A. Table A-13 presents the total percent of night passage by species for each year. Figure A-9 is a graphical presentation of the diel pattern for all years, averaged and presented with standard deviation for each hour. Figure A-10 shows the percent of night passage as a bar graph for each year and species, with the average for each species shown as a line. Table A-12 shows the detail for each hour, for all years of sampling, by species.

Fish Condition

Overall, descaling at John Day in 2002 was low for all species, although slight increases were noted when compared to 2001 data (Figure 5). Flows were up from last year but the debris load remained moderate and did not create any serious passage obstructions.

Yearling chinook descaling was 3.1%, nearly twice last year's record setting low rate but below the post-airlift average of 3.9% (Table A-3). Descaling was highest at the beginning and end of the yearling chinook migration, going over 6% on two days in early April. After a seasonal low rate in early May, descaling increased throughout the rest of the month, peaking at 9% on 5 June (Figure A-3). Mortality for yearling chinook was 0.4%, lower than last year and the post-airlift average of 0.5%.

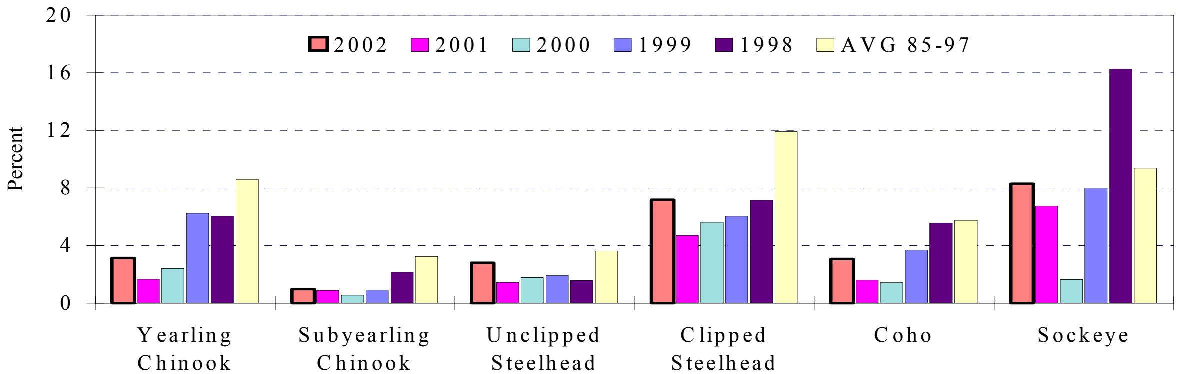

Figure 5. Total descaling for 2002, compared to 2001, 2000, 1999, 1998 and the 85-97 average (single gatewell airlift sampling, Figure A-12) at John Day.

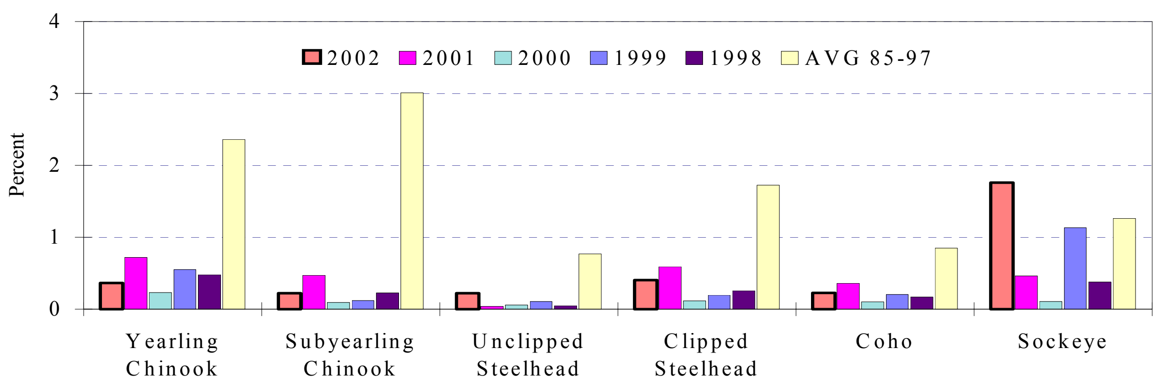

Figure 6. Total mortality for 2002, compared to 2001, 2000, 1999, 1998 and the 85-97 average (single gatewell airlift sampling, Figure A-12) at John Day.

Subyearling chinook descaling at 1.0% was about the same as last year (0.9%) and the post-airlift average of 1.1% (Figure 3, Table A-3). Daily descaling was highest during the first part of the migration in early June. Toward the end of the migration, descaling exceeded 2% on a few days but generally stayed below 2% (Figure A-3). Mortality for subyearling chinook (0.2%) was down from 0.5% last year. The daily fluctuation was similar to the pattern seen in descaling, slightly higher at the beginning and end of the season (Figure A-3).

Unclipped steelhead descaling (2.8%) was double last year's rate and the highest rate observed since sampling relocated to the SMF in 1998 (Figure 5). However, descaling is still lower than the average from the airlift sampling years and within the expected range for this species due to their consistently higher rate of bird predation marks (10.6%) (Figure 5, Table A-3, Figure A-4). The highest rates for unclipped steelhead were seen in late May and early June when descaling exceeded 15% three times (Figure A-3). Mortality was also higher this year compared to the last several years but still very low at 0.2% (Figure 5, Table A-3, Figure A-5). Most of the mortality occurred near the end of the migration and coincided with higher descaling (Figure A-3).

Clipped steelhead descaling reversed the downward trend observed over the last four years and returned to the 7.2% rate recorded in 1998 (Figure 5, Table A-3). Again, as with the other species, descaling has declined since abandoning the airlift system, going from an average of 11.8% prior to 1998, to 6.1% since (Figure A-5, Table A-3). Clipped steelhead descaling was mostly below 6% until 12 May, after that, it was above 6% and as high as 20%. Mortality was down from last year at 0.4% (Figure 5, Figure A-5, Table A-3).

Coho descaling was 3.1% for the season, nearly double last year's rate but equivalent to the post-airlift average (Figure 5, Figure A-4, Table A-3). In general, daily coho descaling increased as the migration progressed but large fluctuations were common (Figure A-3). Mortality for coho has not exceeded 0.4% since sampling relocated to the SMF and this year was no exception at 0.2% (Figure 6, Figure A-5, and Table A-3).

Sockeye descaling increased from 6.7% last year to 8.3% this year (Figure 4). That is about the same as the post-airlift average of 8.2% and 2.2% below the 1985-1997 average (Figure A-4, Table A-3). Daily descaling fluctuated around 5% until 25 May when it increased to over 20% and fluctuated around 15% for the rest of the migration (Figure A-3). Mortality increased to 1.8% this year, more than twice as high as the post-airlift average of 0.8% (Figure 6, Figure A-5, Table A-3).

Subsampled Fish Condition

In 2002, 28,504 smolts were examined for detailed condition information. Condition data were collected on yearling chinook from 21 March to 21 June, steelhead from 21 March to 22 June, coho from 17 April to 21 June, sockeye from 20 April to 22 June, and subyearling chinook from 6 June to 16 September. Partial descaling (3-19% on one side) decreased for subyearling chinook, from 8.1% last year to 4.7% this year. Decreases were also noted for yearling chinook, 6.6% to 6.1%; clipped steelhead, 13% to 11.1%; and sockeye 15.7% to 12%. Increases in partial descaling were observed on unclipped steelhead, 5.1% to 6.4%, and coho, 3.9% to 6.7%. Sockeye had the highest incidence of opercular damage at 2.6%, which is 2% higher than last year and 1.3% higher than the historical airlift sampling percent of 1.3%. Again, as in past years, the incidence of attempted bird predation was much higher on clipped steelhead (10.6%) than any other species (0.1% - 5.1%). Increases in fungus were observed on all species (0.8% to 2.2%), except subyearling chinook which remained at 0%. The frequency of head injuries was 0.4% to 0.9% higher for all species, except subyearling chinook, which stayed the same at 0.1%. Clipped steelhead had the highest incidence at 1.3%. The incidence of parasites on unclipped steelhead decreased from 8.2% to 5.3%, and increased on clipped steelhead from 2.8% to 5.5% in 2002. Columnaris infection in coho decreased slightly from 0.3% last year to 0% this year. See Methods section for a complete list of possible conditions and techniques. For a historical summary of condition subsampling results, see Table A-4.

Length Averages

Since high percentages of out-migrating smolts are of hatchery origin, length data are primarily a function of smolt size at the time of release. However, graphing the data does show some relative size differences and trends throughout the season. Clipped steelhead were consistently the largest fish sampled until 22 June, when subsampling for clipped steelhead stopped. Subyearling chinook and sockeye increased in size as the season progressed and all other species varied (Figure 7).

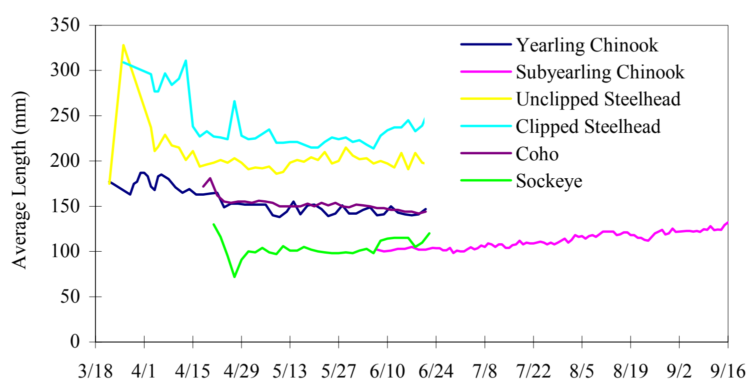

Figure 7. Average lengths at John Day in 2002.

Gas Bubble Trauma (GBT) Monitoring
Sampling of juvenile salmonids for GBT was discontinued at John Day in 1999. For results in 1998 and previous years, see the reports for those years or the FPC website (www.fpc.org).

Passive Integrated Transponder (PIT) Tags and External Marks

PIT Tags
Total PIT tag detections increased from 80,282 in 2001 to 137,423 in 2002, a 171% increase. This increase in detections is similar to the increase in the index estimate (4,232,594 in 2001 to 7,365,812 in 2002) and consequently the proportion of PIT tagged fish the same, 1.9%. Chinook (93.8%) and steelhead (3.9%) accounted for 97.7% of all detections while coho, sockeye, and unknown fish made up the remaining 2.3%. About 0.5% of the detections were from "holdovers", or fish that were scheduled to migrate in 2000 and 2001. A summary for this year by species, run, rearing type, and scheduled migration year can be found in Table A-5. Refer to Table A-6 for a historical comparison of PIT tag detections at John Day.

Elastomer Tags
Elastomer tags are made of colored plastic that is injected into tissue posterior of the eye. A total of 6,623 elastomer tags were recorded this year, which is about 345% of the number observed in 2001 (Table A-8). The increase in observations is primarily due to the larger sample sizes resulting from an increase in research fish collection. The proportion of sampled fish with elastomer tags also increased this year to 2.6% compared to 1.9% in 2001. Most of these tags (52%) were in yearling chinook (unknown race) released in the Yakima River, Snake River, or Middle Fork of the Clearwater River. Table A-7 contains more detail for these marks.

Freeze Brands
A total of 25 freeze brands were observed in 2002, up from three recorded last year. All brands were on hatchery summer steelhead and originated from the Grande Ronde River, Touchet River, or the Snake River (Table A-7). For a summary of brands per year by species see Table A-8.

Performance Monitoring

Personnel
The quality control program at John Day utilized peer consensus and digital cameras to photograph fish. Pictures could be discussed later and decisions reviewed. When all crewmembers were working, questionable fishes, marks, or conditions were discussed with fish in hand. Otherwise, pictures provided the ability to review and discuss specimens without delaying processing or prolonging exposure to the fish anesthetic. The system was useful in checking species identification, fin clips, descaling, fish condition, and brand or tag recognition. This archive also allows off-site personnel and training groups to review species characteristics, which helps increase the accuracy and consistency of the data.

Equipment
No lost or biased sample time occurred at John Day during the 2002 out-migration. CoE fisheries staff chose not to attempt a mid-season dewatering, citing water temperature concerns. On 16 September, the attempt to dewater the PDS for the season had to be postponed due to damage incurred to the crest gate while attempting to raise it before the lower dogging pins were retracted. Assessment of the damage indicated that the repairs were going to take considerable time so the elevated chute and PDS were re-watered and run in bypass mode. Three weeks later the repairs were completed and the facility was dewatered for the season on 7 October. During this period, PDS screen cleaners were cycled manually once per day.

The screen cleaning system at the PDS was out of service (defined as down for at least a portion of the sample day) for approximately 52 days or 29% of the sampling season in 2002. This is an improvement from 2001 when the screen cleaner was inoperable for 56% of the season, and 2000 when they were out of service for 80% of the season. During normal operating situations, the screen cleaners are cycled every two hours. When the screen cleaners could not be operated in the manual mode, accessible portions of the screen were cleaned by hand with a long handled brush. Problems with the system varied but electrical, mechanical, and programming difficulties were encountered throughout the season (March - September). Fortunately, the debris load in the river was moderate, which helped avoid the serious damage to equipment and salmonids that can occur when debris is allowed to accumulate.

Adult Fallback Summary

The SMF is equipped with an adult sampling system, which was used for the second consecutive season by the CoE Fisheries Field Unit in 2002. In addition to this effort and to gauge the quantity of fish exiting the PDS, a hinged gate, installed in 1998 just downstream of the FDS bars, tallied adults as they passed the gate. New in 2002, an electronic laser counter was retro-fitted to this gate which was intended to count fish more accurately than the mechanical counter. The adult fallback passage number was recorded by CoE biological technicians every other hour throughout the season. Approximately 25,195 fish were recorded from 14 April through 16 September. As in previous years, not every fish that passed through the gate tripped the tally mechanism. However, it was possible for the gate to get stuck open, which would then simulate a passing fish every 3 seconds, inflating the count. It was not possible to collect species detail so non-salmonids are included in the season total. See Table A-3 for a summary of fallbacks since 1998.

Table A-3. Unknown fallbacks tallied at John Day FDS, 1998-2002.

	1998	1999	2000	2001	2002
Unknown Fallbacks	642	9,725	5,105	4,685	25,195

Initially, the concern over adults holding in the PDS came from the number of adult fish found during mid-season dewaterings (Table A-10). Eventually, this concern and the fact that such a small portion of the juvenile out-migration passes the project from mid-September through October (2-3%) led to the decision to shut down sampling in mid-September, which we did again this year.

Incidental Catch

American shad (*Alosa sapidissima*) were by far the most common incidental species captured at John Day in 2002. The first juvenile shad was sampled on 21 July and peaked with an estimated 938,500 fish passing through the bypass system on 17 August. Four smaller collection peaks were also observed on 20 August (281,225), 2 September (291,760), 5 September (239,430), and 11 September (220,667). From 21 July to 16 September, shad passage averaged 93,998 per day (Figure A-6). The total estimated collection number for 2002 is 5,451,889, about 8.4 times the 2001 total of 648,522, and approximately 66% of the 8,274,057 collected in 2000 (Figure A-7, Table A-9). The low flows in 2001 likely contributed to the decline in shad numbers.

Another incidental species present in our samples in large numbers is the juvenile (or out-migrating) Pacific lamprey (*Lampetra tridentata).* Although out-migrating lamprey were found in our samples throughout the season, they did appear to have two distinct passage peaks in 2002. The most noteworthy passage peak was 36,540 collected on 18 April and the second peak was 13,098 on 12 June (Figure A-6). The total estimated lamprey collection for 2002 is 279,302. Approximately 97.1% of the out-migrating lamprey were smolted (macropthalmia), while the remaining 2.9% were ammocoetes in various stages of metamorphosis. This year's collection estimate is about 326% of last year's estimate of 85,716, and is dramatically higher than all years prior to 1998 due to the switch from single gatewell to full bypass sampling (Figure A-7, Table A-9).

Research

During the season, John Day smolt monitoring personnel provided support to five research projects, listed below by agency. Support included activities such as: estimated the appropriate sample rate, fish collection and enumeration, equipment set up, and handling. Fish were collected from the general sample which was elevated on 73 of the 183 (40%) sample days to account for the needs of researchers.

U.S. Geological Survey-Biological Resources Division

1. *Tailrace Egress Following Juvenile Bypass System Passage at John Day Dam, 2002.* Principal Investigator: Theresa Liedtke. Radio telemetry was used to evaluate the tailrace egress of juvenile salmon following juvenile bypass system (JBS) passage at John Day Dam. Fish were released into the JBS during two spill conditions (30% and 60%), and their movements through the tailrace were intensively monitored with a combination of fixed-site receiving stations and boat tracking. The emphasis of this study was on gathering information about fish movements within the boat-restricted zone. A total of 145 yearling chinook, and 106 juvenile steelhead were collected for tagging in the spring, and 111 subyearling chinook were collected in the summer at the John Day SMF for this research.

2. *Estimate Fish Passage Efficiency (FPE) and Juvenile Salmon Survival at John Day Dam, 2002.* Principal Investigators: John Beeman and Timothy Counihan. The goal of this research was to use radio telemetry to

generate FPE and juvenile salmonid survival estimates at John Day Dam, including total project survival and route specific survival. A total of 3,377 yearling chinook, 3,888 steelhead, and 9,562 subyearling chinook were collected at the John Day SMF for this research.

3. *Juvenile Salmon Survival Studies at The Dalles Dam, 2002.* Principle Investigator: Tim Counihan. The goal of this research was to use radio telemetry to generate juvenile salmonid survival estimates at The Dalles Dam, including total project survival and route specific survival. A total of 2,034 yearling chinook, and 1,986 subyearling chinook were collected at the John Day SMF for this research.

4. *Investigations into the Parasitic Life History Phase of the Pacific Lamprey (Lampetra tridentata).* Principle investigator: Rebecca Reiche. The goal of this research activity is to determine the salt water requirements for the parasitic phase of the Pacific lamprey. Insight gained will prove helpful to any future projects that study this life history phase. A total of 92 juvenile Pacific lamprey were held for this research.

Pacific Northwest National Laboratory (PNNL) -Battelle

5. *Effects of the Modified ESBS on Migrating Juvenile Pacific Lamprey (Lampetra tridentata) at John Day Dam.* Principal Investigators: Matthew Bleich, Russel Moursund. In 2002, PNNL evaluated the effects of modified Extended Length Bar Screens (ESBS) and other project operations on juvenile Pacific lamprey survival. One task was to determine the fate of PIT tagged lamprey released immediately upstream and within the dam. Also, to observe interactions between fish and ESBS's, video cameras were mounted on brush heads to record behavior during May and June at John Day Dam. Approximately 1172 outmigrating Pacific lamprey were collected in April and May for this research.

BONNEVILLE DAM

For the third consecutive year, index level sampling was conducted in the Hamilton Island Juvenile Monitoring Facility (JMF) using fish from PH2 and sampling in PH1 consisted of condition monitoring (three/week) and GBT exams (twice/week). At the JMF, sampling began at 0700 hours on 13 March and concluded at 0700 on 31 October. Sampling in PH1 began on 9 April and for the second year in a row ended in July instead of going through August as scheduled (23 July, 2002, 31 July, 2001). PH1 sampling ended early because there were no fish passing through the bypass system. The FPP stipulates that during the fish passage season (March – September), PH2 turbines should be operated before PH1 turbines. Further, from 10 April through August, some water is to be spilled for juvenile fish passage before the turbines are operated. In a low to average flow year, little water is left to operate PH1 turbines, as was the case in 2001 and 2002. Without turbine operation, there is insufficient flow to attract fish to the DSM in PH1.

Table B-1 (PH2) and Table C-1 (PH1) are summaries of all years of sampling including sample dates, sampling effort, and sample, collection, and index numbers.

The Numbers - Second Powerhouse

Sample Numbers

The total number of fish sampled at the JMF was 85,552, about 85% of last year's total of 100,620. The species composition was as follows: subyearling chinook, 55.7%; yearling chinook, 19.5%; coho, 12.4%; clipped steelhead, 5.1%; sockeye, 3.9%, and unclipped steelhead, 3.3%. The decrease is due mostly to higher spill levels passing more fish through that route. The average sample rate was 10%, up just one percent from last year's average.

Collection Estimates

The collection estimate for PH2 was 6,153,317, about 110% of last year's collection estimate of 5,606,915. The species composition for the collection estimate can be different from the composition of the sample numbers due to the use of multiple sample rates and changing species composition throughout the day and season. For the composition of the fish using the bypass system, the percentages are as follows: subyearling chinook, 48%; yearling chinook, 22%; coho, 15.2%; clipped steelhead, 5.5%; sockeye, 5.4%; and unclipped steelhead, 3.6%.

Fish Passage Indices

The 2002 index total for all species combined was 14,962,288, which is about 202% of last year's 7,388,877. Sample, collection, and index numbers by species can be found in Table 2. See the FPC annual report for more information.

There are numerous factors that affect FPI's, but the primary factor is flow distribution. In 2001, flows were very low and most of the river flow was going through PH2, producing a smaller expansion of the collection estimate. This year, flows were higher and spill resumed which made PH2 flows a smaller proportion of river flow than in 2001 so the expansion of the collection estimates for the FPI's was greater.

Fry Incidence
At PH2 the number of chinook fry ($\leq$ 60mm) sampled this season was 2,106, which expanded to a collection estimate of 57,987. This is about 360% of last year's collection estimate. Chinook fry passage occurred slightly earlier this year with 20.8% in March, 63.6% in April, and 8.3% in May compared to 42% in April and 43% in May last year.

Coho fry passage was nearly identical to last year with 35 sampled and a collection estimate of 544. In 2001, the sample number was 27 and the collection estimate was 530. The majority (79%) of the coho fry were sampled in April, while 21% were sampled in March.

See Figure 10 for a graphic summary of chinook fry passage and Table B-1 for a historical fry summary.

The Numbers-First Powerhouse
Starting in 2000, sampling in PH1 was reduced to three times per week for condition and GBT monitoring only. The total sample in 2002 was 8,094. This is 136% of last year's sample size. Species specific sample numbers for this year can be found in Table 2. Table C-1 presents sample numbers and other data for all years of sampling in PH1. Species composition was as follows: subyearling chinook, 56.4%; yearling chinook, 24.4%; coho, 6.9%; unclipped sockeye, 6.4%; clipped steelhead, 3.1%; and unclipped steelhead, 2.7% (Table 2). Collection and FPI numbers are not calculated from PH1 samples.

Fry Incidence
At PH1, seven chinook and one coho fry ($\leq$ 60mm) were sampled. These numbers are consistent with the low numbers seen last year when sampling effort at PH1 was reduced. Prior to 2000, both species of fry were sampled in quantities similar to what we have sampled in PH2 since 2000 (Table B-1, Table C-1).

River Conditions
River Flow
This year river flow was much closer to the historical average. The large discrepancy between 2001 and 2002 is evident in Figure 8, especially for the months of April through July, when most of the smolt pass the project.

Spring river flow, March through May, averaged 209.6 kcfs, or 160% of the 130.9 kcfs in 2001. The peak flow for this period was 353.4 kcfs on 17 May. This is a 200% increase from last year's high flow for this same period of 176.4 kcfs on 17 April. For June and July, river flow averaged 279.3 kcfs, about 244% of last year's high for the same period of 114.4 kcfs. Flows for August through October were higher than for the same period in 2001, averaging 123.2 kcfs versus 93.7 kcfs last year. For the period of March through October, PH1 discharge averaged 23.3 kcfs compared to an average of 6.3 kcfs last year.

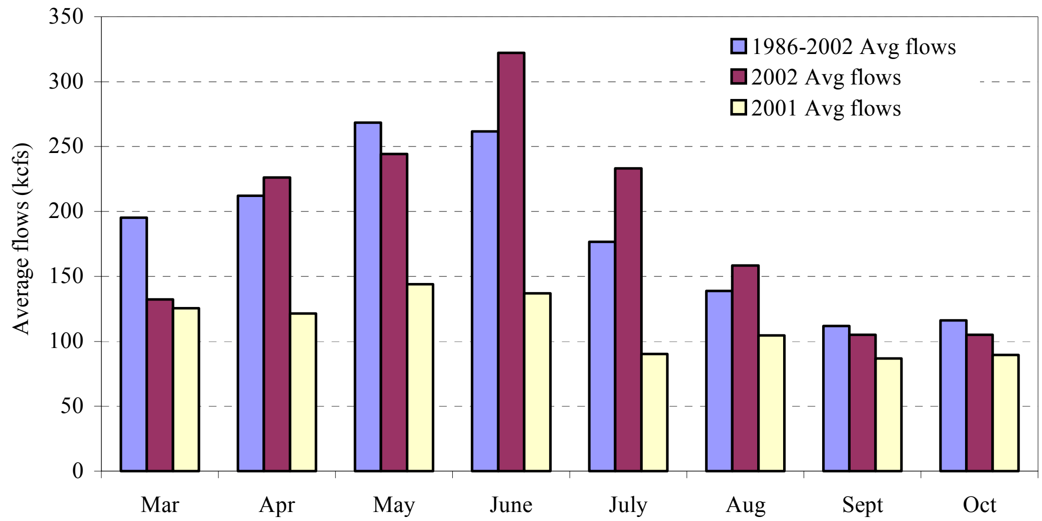

Figure 8. Average monthly flows for 2002, 2001, and the historical average at Bonneville dam.

Spill and Dissolved Gas

The FPP calls for spill of 75 kcfs from 10 April through 31 August during the day and more at night, up to the 120% total dissolved gas cap. This year spill occurred from 10 April to 31 August and averaged 115.7 kcfs, or about 49.7% of river flow. For the same period last year, spill averaged 18.9 kcfs or 15% of river flow.

Shifting of flow to spill following a Spring Creek National Fish Hatchery (SCNFH) release increases the number of those fish passing the project via the spillway and is intended to improve survival. There were three Spring Creek releases of tule fall chinook this year; the first was on 11 March and consisted of 7.7 million fish. For this release, three days of spill were provided, averaging 71.3 kcfs or 41.7% of total river flow. The second was on 29 March and consisted of about 4 million fish which were infected with *Ichthyophythirius multifiliis*. Passage of these fish coincided with a need to dewater the facility to replace the PDS wedgewire, so the JMF was dewatered at 0700 on 1 April to allow the bulk of the infected fish to bypass the facility and to replace the wedgewire. The facility was washed down with a dilute bleach solution and returned to service at 0700 on 4 April. No spill was provided for the second release. The final release included about 3.5 million fish. An average of 51.7 kcfs of spill occurred over the subsequent 10 day period (Table 3).

Table 3. 2002 Spring Creek National Fish Hatchery releases.

Release Date	Number (millions)	Peak PH2 Passage	Average Spill (kcfs)	Spill as % of River
March 11	7.7	14 March	71.3	41.7
March 29	4.0	1 April	0.0	0.0
April 30	3.5	3 May	51.7	50.7

Dissolved gas levels, as measured at the Warrendale site downstream of Bonneville, averaged 115.6% for the juvenile spill program period, 10 April to 31 August. This is below the Oregon and Washington Departments of Environmental Quality imposed gas cap of 120%. For the same period last year, gas supersaturation levels averaged 106.6%.

Passage Patterns

Passage timing and migration duration summaries use FPI numbers, which for the last three years were calculated using PH2 samples. This year's pattern will be compared to the last two years but historical comparisons will use data from PH1 (1987-1999).

Fish passage at Bonneville followed a pattern similar to that seen at John Day; all species reached their respective 10% passage dates earlier than last year with one exception, subyearling chinook (Figure 9).

Yearling chinook passage reached the 10% date one day earlier than last year, and two days later than in 2000. The duration of the middle 80% (38 days) was four days shorter than last year, but one day longer than the historical median (Figure 9). Based on the historical data from PH1, the days required for the middle 80% of the run to pass Bonneville has been quite consistent, ranging from 31 to 41 days (Figure C-2, Table C-2). Consequently, the first three years of passage timing data from PH2 are consistent with the pattern established with PH1 data.

Passage began to increase about 20 April and stayed above 1% of the season total through mid-June. This year's peak passage occurred on 28 May and was about 5% of the season total. During that period last year, passage was at it's lowest point in the migration, but resembles the 2000 passage pattern (Figure B-1).

Subyearling chinook passage is a combination of SCNFH releases of tule stock, all occurring prior to June, upriver bright stock, passing the project after 1 June, and fry (Figure 10). The tule hatchery releases are obvious passage peaks occurring a day or two after the release dates listed in Table 3 above. Since this hatchery is only 21 miles upstream from Bonneville and the releases are large (Table 3), they pass in large groups (Figure 10, Figure B-1) often requiring that we minimize the sample rate or sometimes stop sampling altogether.

The passage timing and duration of the middle 80% listed in tables and shown in figures is for the upriver bright stock, passing Bonneville after 1 June. The upriver bright migration reached the 10% passage date two weeks later than last year and the 90% passage date 26 days earlier than last year, resulting in a middle 80% duration of 30 days, less than half of last years 70 days (Figure 9). This is a new minimum number of days for the middle 80% to pass Bonneville (Table B-2, Figure B-2). The daily passage of the upriver brights occurring after 1 June had two main passage peaks; the first and largest on 30 June was almost 6% of the season total, the second was on 15 July and was about 3% of the season total. Chinook fry passage peaked on 18 April at about 7% of the season total, but fry were present in the samples through early July (Figure 10).

Unclipped steelhead passage reached the 10% passage date one day earlier and the 90% passage date on the same day, resulting in a middle 80% duration one day longer at 40 days (Figure 9). In 2000, the duration was the same (40 days) but the run began and ended a week earlier than this year. When compared to the historical median from PH1, the 10%, 50%, and 90% dates are all later and the duration is 6 days longer (Figure 9).

Unclipped steelhead were present in our samples from 10 April through early July with a single large passage peak of 9.9% on 28 May (Figure 10).

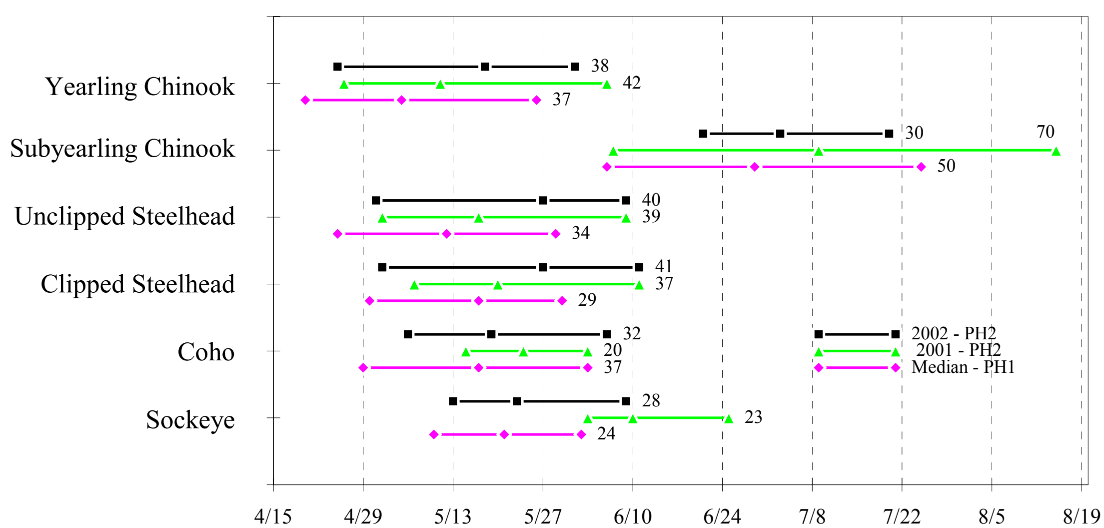

Figure 9. 10%, 50%, and 90% passage dates for 2002 and 2001 from PH2, and the historical median at PH1, 1988-1999. The duration in days between the 10% and 90% passage dates is indicated.

Clipped steelhead and unclipped steelhead passage, for the last three years at the JMF has been very similar (Figure B-2). In 2000, the run was about a week earlier than the last two years and of similar duration (Figure B-2). This year, the 10% date was four days earlier but the 90% passage date was the same as last year, so the middle 80% was four days longer (Figure 9). When this year is compared to the historical median from PH1, the 10%, 50% and 90% dates are later and the duration is 12 days longer. Daily passage as a percent of total passage increased throughout

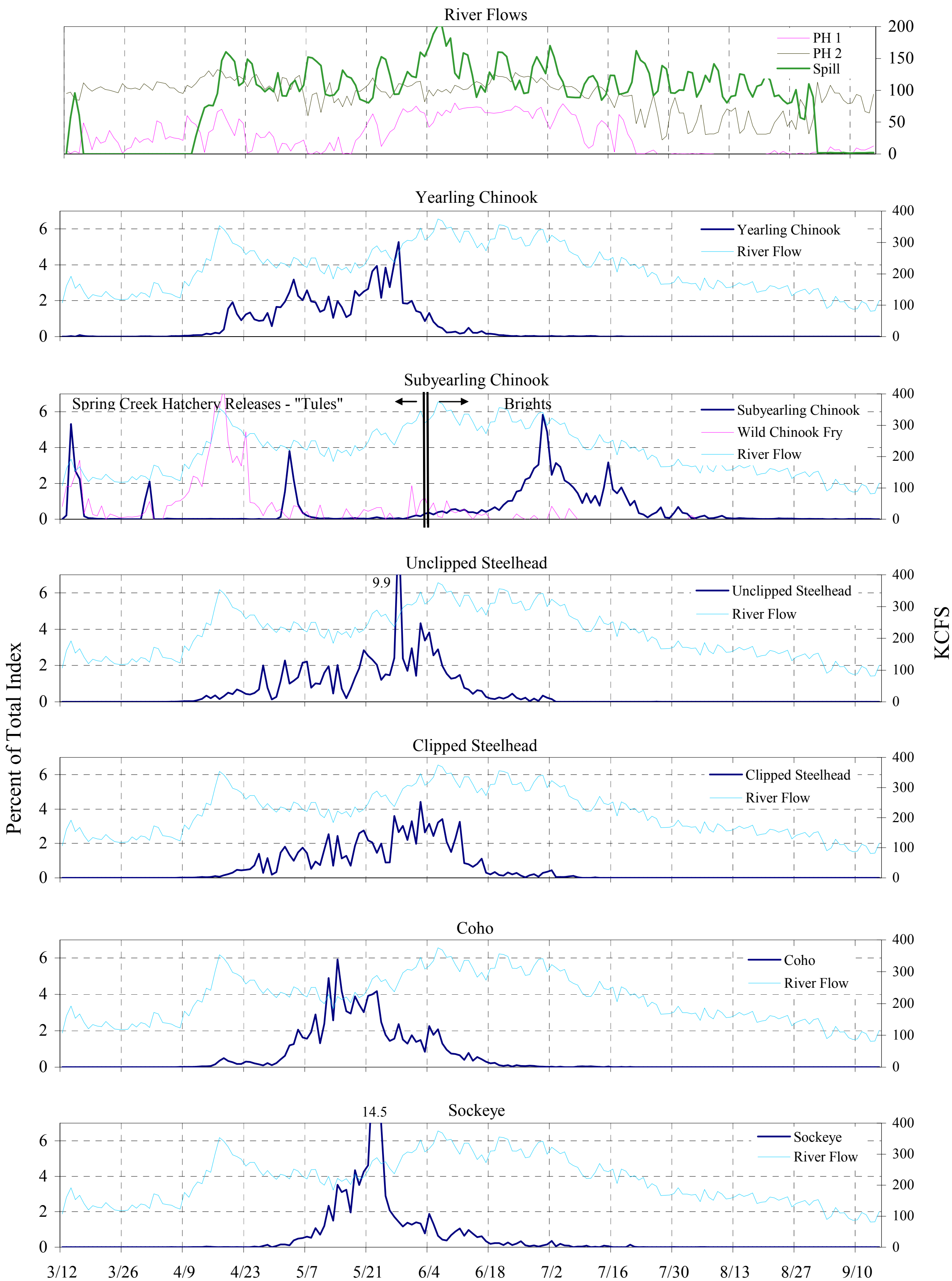

Figure 10. Seasonal passage patterns and daily average river flows at Bonneville PH2, 2002.

the migration, peaking on 2 June at 5% and tapering off after that. The 2 June peak is about two weeks later than the 2001 peak and one week later than the 2000 peak passage point. (Figure B-1).

Coho passage reached the 10% passage date nine days earlier than last year but the 90% date three days later than last year. The net effect is a relatively long middle 80% duration of 32 days, 12 days longer than last year's 20 days and three days longer than in 2000. These duration patterns are all shorter than the pattern generated from 13 years of sampling in PH1, where the median middle 80% duration is 37 days (Figure 9, Table C-2).

Coho passage has varied throughout the years with the greatest variation occurring at the beginning of the run (Figure C-2). This year the migration peaks occurred earlier than the last two years and peaked at a lower percent of total, about 6% on 14 May, compared to 7% in 2001 and 9% in 2000.

Sockeye passed Bonneville earlier this year than last year with the 90% passage date occurring one day before last year's 50% date (Figure B-2). Low flows were the most likely cause of the late and protracted passage pattern observed last year. Compared to the historical median passage pattern from PH1, this year's run reached the 10%, 50%, and 90% dates later and the middle 80% duration was four days longer (Figure 9).

The peak of the sockeye migration occurred on 23 May with 14.5% of the season total passing the project (Figure 10). This is two weeks earlier than the 2001 peak of 15.9% (6 June) and 2 days earlier than the 7.2% peak in 2000 (Figure B-1).

Diel
Diel passage summaries are based on four years (1992-1995) of diel sampling from PH1 which showed that passage of all species increased starting at 2000 hours and peaked at 2200 hours. The average percent of total passage occurring at night (1800 - 0600 hours) ranges from 54.7% for yearling chinook to 70.8% for coho. For more detail on diel passage see Figure C-6, Figure C-7, Table C-8, and Table C-10.

Fish Condition

Powerhouse 2 - Descaling

Descaling at Bonneville was higher for all species except subyearling chinook and sockeye. One of the main contributors to descaling is debris which is difficult to quantify but is usually greater in higher flow years. Please note that the historical average is from the old sampling system in the north end of PH2, referred to as the Fingerling Experimental Research Lab (FERL). In 2000, use of the new dewatering system in the powerhouse, and use of the new juvenile monitoring facility began. The descaling and condition data recorded since that transition, being consistently lower, suggests that the new system causes less descaling and mortality (Figure 11).

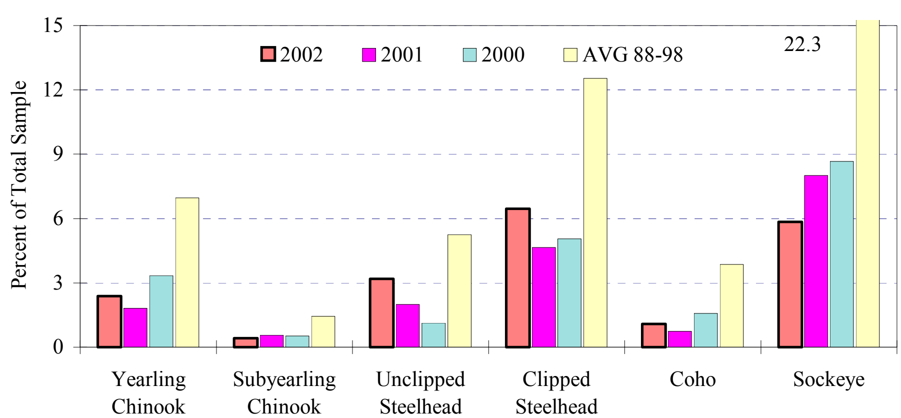

Figure 11. Total descaling for 2002 at PH2, compared to 2001, 2000, and the 88-98 average at Bonneville, PH2.

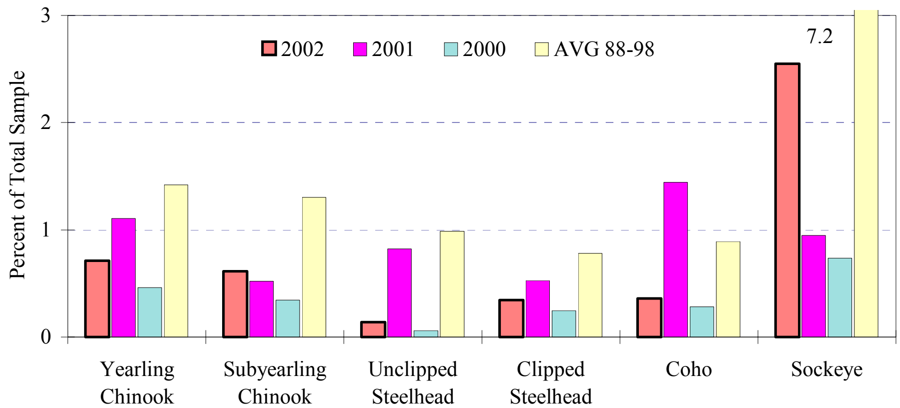

Figure 12. Total mortality for 2002 at PH2, compared to 2001, 2000, and the 88-98 average at Bonneville, PH2.

Yearling chinook descaling was up from 1.8% last year to 2.4% this year (Figure 11, Table B-3, Figure B-4). Descaling averaged 2.5% for the three years at the JMF, which is significantly lower than the 6.8% rate recorded between 1988 and 1998 when sampling was conducted in the juvenile sampling area in PH2. Daily rates were highest toward the end of the migration. Mortality fell to 0.7% this year from 1.1% last year (Figure 12, Table B-3, Figure B-5).

Subyearling chinook traditionally have very low descaling, and this year was no exception at 0.4%, about the same as the 0.6% seen last year (Figure 11, Figure B-4, Table B-3). The average at the JMF (0.5%) is about a third of the average for the previous 11 years (1.5%) (Table B-3). Daily descaling stayed below 2% through mid August, then peaked at almost 8% on 17 August (Figure B-3). Mortality was also low at 0.6% for the season, up slightly from last year's 0.5% and equal to the three year JMF average, but about half the 1.3% average generated over the 11 years of sampling in PH1 (Figure 12, Figure B-5, Table B-3).

Unclipped steelhead descaling was up from 2% last year to 3.2% this year (Figure 11, Figure B-4, Table B-2). The average for the last three years was 1.9%, considerably lower than the 5.3% average for the 1988 to 1998 period. Daily rates varied throughout the migration period with several peaks, the highest in early June at about 9%. The highest descaling coincided with the highest flows (Figure B-3). Mortality for the season was very low at 0.1% with a peak of about 3% on 13 June (Table B-3, Figure B-3).

Clipped steelhead descaling at 6.5% was up from last year's rate of 4.7% and higher than the three year average for the new system (5.5%) but lower than the average for the old system of 8.6% (Figure 11, Table B-3). As with the other species, the average descaling rate for the new system is lower than the average for the old system. Daily descaling was highest towards the end of the migration and peaked at about 16% on 10 June (Figure B-3). Mortality was very low at 0.3%, slightly lower than the three year JMF average of 0.4%, and half the PH1 (1988-1998) average of 0.8% (Figure 12).

Coho descaling increased from last year's record low of 0.7% to 1.1% (Figure 11, Table B-3). Coho descaling has always been low, averaging 3.9% for the 1988 to 1998 period, but the average for the last three years is even lower at 1%. Coho descaling was fairly consistent throughout the migration, ranging between 1% and 4% with only a couple of exceptions, the highest of 7% occurring near the end of the run in late June (Figure B-3). Mortality for coho is also traditionally low and this year's rate of 0.4%, down from 1.4% last year, is no exception. Coho is the only species for which the overall mortality rate from PH1 is the same as the overall rate for the new system at 0.9% (Table B-3, Figure B-5).

Sockeye usually have the highest descaling rate but this year, clipped steelhead, at 6.5%, were higher than sockeye at 5.8% (Figure 11, Table B-3, Figure B-5). While this is higher than most of the other species, it is the lowest descaling rate ever recorded for sockeye. For the last three years, sockeye descaling averaged 6.6%, considerably lower than the historical 22.3% rate from PH1. Sockeye descaling was highest in late May, peaking at about 17% (Figure B-3). Sockeye mortality was 2.6% for the year, up from 0.9% last year (Figure 12, Figure B-5, Table B-3). Again, the average for the last three years, 2.0%, is significantly lower than the average (7.2%) for the samples from the old system (Figure B-7).

Powerhouse 1 – Descaling
Descaling in 2002 was higher than last year and the historical average for all species except coho (Figure 13, Table C-3, and Figure C-3). The number of fish sampled in PH1 was up slightly (8,094) from last year's record low of 5,931. Heightened descaling was observed beginning 21 May through 14 June with the highest rate of 25.4% occurring on 4 June. The control room was contacted and several additional samples were collected, subsequent to the highest incidents, but fish condition showed significant improvement in those samples so the problems seemed to have been corrected. On at least one occasion (4 June), additional orifice flushing was conducted which may have cleared an orifice plug. While debris on the trash racks, vertical barrier screens, or in an orifice are the likely causes for the increases in descaling, debris accumulations in any of those specific areas could not be confirmed.

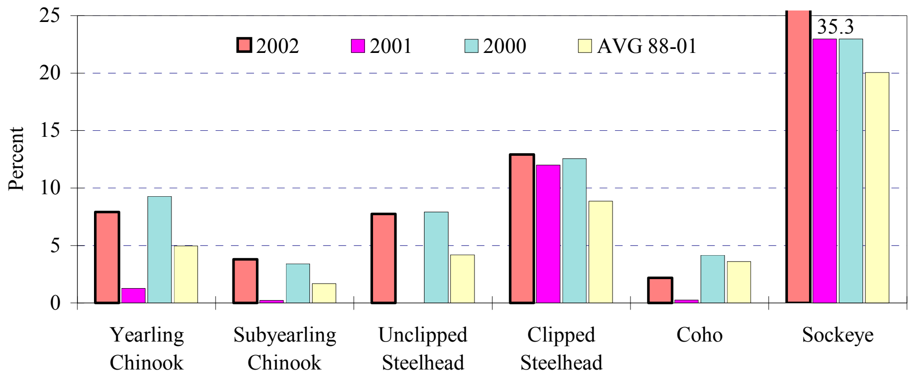

Figure 13. Total descaling for 2002 at PH1, compared to 2001, 2000, and the 88-01 average at Bonneville Dam, PH1.

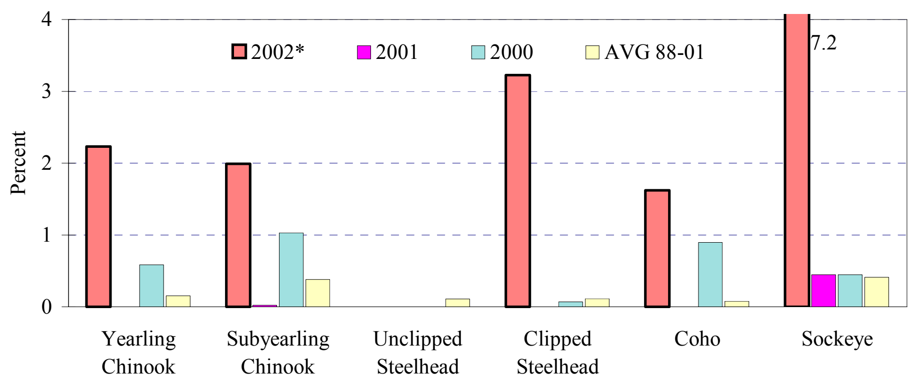

Figure 14. Total mortality for 2002 at PH1, compared to 2001, 2000, and the 88-01 average at Bonneville Dam, PH1.

Mortality
All species except unclipped steelhead showed significant increases in mortality this year (Figure 14). Much of the increase was due to a single night (4 June) when 39% of the season's total mortality and 36% of the sockeye mortality, was collected. Most of the mortalities appeared to have been dead for more than a day, indicating that debris or some other obstacle may have been removed, and these fish were released with it. Debris loads in the river were high at the time. See Figure C-4 for a graphic comparison of the mortality for all years and Table C-3 for a listing of the actual numbers and percentages for each species.

<u>Subsampled Fish Condition</u>
Powerhouse 2
Condition data was collected on yearling chinook, steelhead, coho, and sockeye from 9 April to 29 June and subyearling chinook were examined from 22 June through 31 October. This year a total of 18,684 smolts were examined for detailed condition information. Partial descaling (3-19%) ranged from 33% for clipped steelhead to 5.6% for subyearling chinook. In 2000 and 2001, partial descaling in PH2 averaged 6.4 and 10.2 percentage points higher than in PH1, respectively, all species combined. In 2002, that was reversed, and PH2 partial descaling was equal to or greater than partial descaling in PH1 for all species except sockeye. On average, partial descaling

increased 11.4% in PH2 this year, for all species excluding sockeye (Table B-4, Table C-4). The incidence of attempted bird predation was higher in clipped steelhead (10.8%) than any other species (0.3% to 5.2%). Incidence of external parasites on unclipped steelhead decreased from 11.8% last year to 5.4%, while occurrence in other species was 2.2% or less. Fungus was uniformly low (≤1.3%). The frequency of body injuries ranged from 0.4% to 1.2% for all species, similar to last year. Operculum damage rates were highest on clipped steelhead (3.5%), other species ranged from 0.2% to 2.0%. Additional condition subsampling percentages are presented in Table B-4.

Powerhouse 1

PH1 detailed condition data was collected on yearling chinook, steelhead, coho, and sockeye from 9 April to 30 June and subyearling chinook were examined from 9 June to 23 July. A total of 4,737 smolts were examined for detailed condition subsampling. Partial descaling (3-19%) was the most prevalent condition and ranged from 33.8% for sockeye to 7.1% for subyearling chinook. Partial descaling for clipped and unclipped steelhead increased significantly (13% to 32.4% and 3.3% to 26%, respectively). The incidence of attempted bird predation remained highest for clipped steelhead at 9.2%, up from 8.7%. External parasites on unclipped steelhead declined from 16.4% last year to 6.4% this year. Body injury rates were highest in clipped steelhead at 8.4%, followed by sockeye at 5.4%. For more details on this data and a historical summary of condition subsampling, see Table C-4.
b

Length Averages

Individual fish lengths were obtained in conjunction with the fish condition subsampling. Since a substantial number of the fish are of hatchery origin, this data is largely a function of size at time of release (Figure 15). Clipped steelhead, as in past years, remained the largest juvenile salmonid sampled throughout the season. On average, clipped and unclipped steelhead increased in length as the season progressed, except for the last week that they were present in our samples, when average length declined sharply. Yearling chinook and coho lengths remained relatively consistent throughout the season. Sockeye average lengths varied at the beginning and end of their migration but were fairly consistent in between.

In PH1, length data was collected in conjunction with the twice weekly GBT exams and one additional sampling session. The same size relationships recorded at the JMF were present at PH1. For example, clipped steelhead were the largest followed by unclipped steelhead. Yearling chinook and coho were very similar in size and sockeye on average were shorter. Subyearling chinook were the shortest at around 100 mm for the duration of their migration.

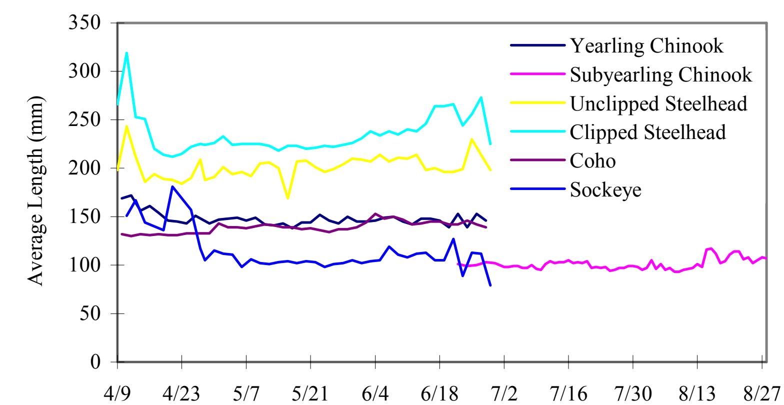

Figure 15. Average lengths for Bonneville PH2 JMF, 2002.

Gas Bubble Trauma (GBT) Monitoring

GBT examinations began on 8 April and concluded on 29 August, 2002. Fish were obtained from PH1 sampling until 23 July when operational priority of the second powerhouse resulted in little flow through PH1 and consequently few fish using the bypass system. To continue exams, the operation was relocated to the JMF for the remainder of the GBT exam season. No bubbles were found in any of the 3,028 fish examined this year (Table C-7). In 2000 and 2001, bubbles in the lateral line accounted for 92% and 100% of all bubbles recorded, respectively. This year the lateral line was not examined and it is likely that the lack of observed bubbles is due to this change in protocol. For more details on the gas bubble monitoring results, see the FPC annual report.

Passive Integrated Transponder (PIT) tags and External Marks

PIT Tags

A total of 100,826 PIT tags were detected at Bonneville this year, which is 212% of the 47,505 detected in 2001 and the second highest number ever recorded at Bonneville, (Table B-6). Ninety one percent of the detections were from the JMF (B2J) and the remaining 9% were from the PH1 flat plate (BVX) (Table B-5). Flat plate operation was halted about six weeks early this year, on 23 July, due to PH2 operation priority, and summer spill. River flow was low enough that these two passage routes accounted for most of the available water leaving little flow for PH1. Discharge for the March through October period averaged 23.3 kcfs at PH1 compared to 91.2 kcfs at PH2. Also, some interrogation time was lost this year due to mechanical problems (Table 6). About 96% of all detections came from chinook (87.8%) and steelhead (8.7%) this year.

Elastomer Tags
A total of 817 elastomer tags were recorded at the JMF this year, which is 247% of the 331 observed in 2001 (Figure B-7). The majority (53%) were observed on summer steelhead released in the Wenatchee, Tucannon or Touchet Rivers. The rest of the elastomer tags were found in chinook. The proportion of elastomer tagged chinook in our samples increased from 1.2% last year to 2.3% this year. For steelhead, the incidence increased from 1.2% to 6% (Table B-7). In PH1, 63 elastomer tags were recorded this year, compared to only four tags last year. Fifty six percent were observed on summer steelhead released from The Chiwawa Hatchery on the Wenatchee River (Table C-5).

Freeze Brands
Six freeze brands were recorded in PH2 this year, up from zero in 2001. All of the brands were observed on summer steelhead from release sites on the Grande Ronde, Touchet, or Snake rivers (Table B-7). No freeze brands have been recorded PH1 since 1999 (Table B-8).

Adult Catch
At the JMF, the separator bars on the PDS juvenile hopper exclude most adult fish from the general sample. However, smaller adults can pass through the bars. In 2002, six chinook jacks were collected in PH2 samples, compared to only one in 2001.

At PH1, the trap has separator bars that prevent most adults from being collected and this combined with the reduced sampling effort resulted in no adult salmonids being caught in either of the last two years.

Incidental Catch
Powerhouse 2
In PH2, American shad juveniles were the most prevalent incidental species sampled. Juvenile shad were present in significant numbers in the samples from the middle of August through the end of October and peaked with an estimated 268,412 fish passing through the bypass system on 11 October. Three slightly smaller collection peaks were also observed on 12 October (214,219), 25 October (250,650), and 31 October (223,980). The total collection estimate for 2002 was 6,444,156, over four times the 2001 total of 1,376,845 (Figure B-6, Table B-9).

Pacific lamprey juveniles were found in samples from March through October. Although juvenile lamprey were found in samples throughout the season, peak passage occurred on 22 and 23 April with collection estimates of 3,150 and 3,400, respectively (Figure B-6). Almost 60% of juvenile lamprey passage occurred in April (13,356). The total collection estimate for the season was 22,443 (Table B-9), of which over 98.2% were smolted. This season's collection estimate is about 233% of last year's total of 9,635.

Increases were observed in the collection estimates of stickleback (71,718 to 95,689), and adult shad (1,385 to 11,192), while peamouth (8,971 to 3,250) and sculpin (99,853 to 3,077) declined sharply from 2001 to 2002.

Powerhouse 1
A total of 529 incidentals were recorded at PH1 this year, up from 58 in 2001. Of those, 94% were stickleback. See Table C-6 for a summary of others species sampled and a summary for all years of sampling.

Performance Monitoring
Personnel
Our data collection quality control program consists of two people examining the same 10 fish and comparing the results. Any discrepancies are discussed while the fish is still in the trough. For a full explanation of the test protocol, see the Methods section. The "Descaled" category generated the lowest efficiency rating at 95.2%. Overall, coworkers were in agreement 98.4% of the time (Table 4).

Table 4. Results of quality control tests.

Categories	ID	Clip	Descaled	Mark	Total
Possible Correct	1000	1000	1000	44	3044
Differences/Errors	0	0	48	0	48
% Correct	100%	100%	95.2%	100%	**98.4%**

Equipment

At the PH2 JMF, 112.25 hours of sampling were missed, about 2% of the season (Table 5). At PH1, 48 hours of sampling were missed due to equipment breakdowns. This was about 13% of the time we were sampling and does not include the time lost due to the early termination of the season (Table 6).

Table 5. PH2 sampling interruptions, 2002.

End Date	Batch Number	Reason for Interruption	Hours Missed
3/22	02081	PDS wedgewire screen installation	17
3/23	02082	PDS wedgewire screen installation	15.5
4/2	02092	PDS repairs and Spring Creek NFH bypass	24
4/3	02093	PDS repairs and Spring Creek NFH bypass	24
4/4	02144	PDS repairs and Spring Creek NFH bypass	24
4/30	02120	PDS separator bar reconfiguration	7.25
7/17	02198	3-way rotating gate repairs	0.5
		Total hours missed	**112.25**

Table 6. PH1 sampling interruptions, 2002.

Date	Batch Number	Reason for Interruption	Hours Missed
4/16	02106	Small dewatering screen trash sweep repairs	8
4/19	02109	Flat Plate and small dewatering screen repairs	8
4/21	02111	Flat Plate and small dewatering screen repairs	8
4/23	02113	Flat Plate and small dewatering screen repairs	8
7/5	02186	Add-in valve airburst mechanism repairs	8
7/7	02188	Add-in valve airburst mechanism repairs	8
		Total hours missed	**48**

* PIT tag interrogation and sampling at PH1 concluded for the season on 23 July.

Primary Dewatering Structure at Juvenile Monitoring Facility

Last year the PDS was plagued with nearly constant fluctuations in the amount of water coming off the end of the system. A restriction in the system drain was the suspected cause of the problem and after several other attempted repairs, it was decided to shunt some of the drainage to the adjacent wetland drain. It was thought that this action would relieve the back-pressure that was causing the erratic dewatering at the PDS. This work was done over the winter and the results were excellent. This year, the system ran consistently all year and no “dry screen” or “flood” situations were recorded. Another very beneficial addition to the system this year was the installation of a camera over the separator bars. This enabled staff to view the separator bars on video monitors from the office or at the sorting trough.

Concern over stranded steelhead kelts last year prompted us to adopt a much more intensive monitoring program at the PDS this year. Monitoring staff were instructed to log their time on the PDS and their observations. Also, they were instructed to spend as much time as possible monitoring the separator bars so response time to stranded fish and debris removal could be minimized. Stranded kelts were recorded from 8 April through 8 July but fish passing over the separator bars were observed throughout the season. We observed 57 kelts (1% of total adults counted at the separator) stranded on or between the separator bars this year, compared to 199 last year. Last year, 61 of the 199, or 31% were recorded as dead upon release. This year, 20 of 57, or 35% were recorded as dead on arrival or dead on release (Table 7). So even though we had staff on the separator more of the time this year, which should have reduced the “time stranded” and the resulting mortality, the mortality rate was actually higher this year. This suggests that most of those fish arrive dead and prompt removal is not critical to survival. An additional 3,908 adult fish were recorded as they passed over the separator bars. We will gather similar data next year and reevaluate.

Table 7. Adult fish fallback data for the Primary Dewatering Structure, 2002.

	Stranded Kelts					Pass By Adults			
	Total	Alive	% Alive	Dead	% Dead	Steelhead	Salmon	Unk. Sal.	Monthly Total
March						31	19	6	56
April	32	21	66%	11	34%	756	221	160	1,169
May	16	10	63%	6	37%	1,451	391	94	1,952
June	7	5	71%	2	29%	493	88	29	617
July	2	1	50%	1	50%	70	30	2	104
Aug						5	2	1	8
Sept.						4	33	2	39
Oct.						10	8	2	20
Total	57	37	65%	20	35%	2,820	792	296	3,965

While we strove for the highest possible rate of coverage at the separator bars, it was not practical to have 100% coverage. Numerous activities such as facility inspections, coffee, lunch, and bathroom breaks, among others, necessitate the staff leave the PDS area for part of their shift. Our data logging system enabled us to evaluate our coverage by shift, and several patterns emerged. First, the highest rates of coverage were observed in May, the month with the highest fallback rate and highest downstream migrant numbers. Coverage ranged from 71% for day shift to 86% for swing shift (Figure 16). For the season, day shift had the lowest percent coverage (49%) and swing shift had the highest (60%). Coverage by shift was fairly equal through June, but from July through the end of the season, day shift coverage was considerably less than the other shifts. This is due mostly to the day shift person assisting with the processing of thousands of juvenile American shad (Figure B-6). Generally speaking, as smolt numbers and debris load started tapering off in July, percent coverage declined.

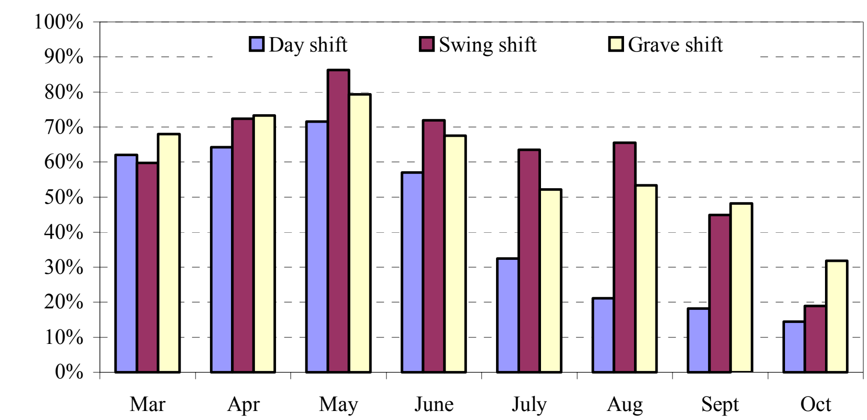

Figure 16. PDS coverage by shift, Bonneville Dam, 2002.

Research

During the season, Bonneville smolt monitoring personnel provided support to four research projects listed below. Support included activities such as: fish collection and enumeration, equipment set up, and handling. Fish were collected from the general sample or by the SBC system.

U.S. Geological Survey-Biological Resources Division

Estimate the Survival of Migrant Juvenile Salmonids in the Columbia River from John Day Dam through Bonneville Dam using Radio-Telemetry, 2002. Principal Investigator: Timothy D. Counihan. Fish were radio tagged to evaluate survival through the project, the DSM at powerhouse 1, and through a Minimum Gap Runner turbine unit at PH1. A total of 2,330 yearling chinook, were held at the JMF for this study in 2002.

Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University

Evaluation of Migration and Survival of Juvenile Salmonids Following Transportation and Evaluation Of Delayed Mortality Of Juvenile Steelhead In The Near Ocean Environment Following Passage Through The Columbia River Hydropower System. Principal Investigator: Carl Schreck. The objectives of this study were aimed at understanding whether barging is affecting, through physiological condition, smolt migration behavior in relation to saltwater entry, vulnerability to avian predators, and survival of barged versus run-of-the-river fish in the Columbia River estuary. A total of 778 clipped steelhead and 332 subyearling fall chinook were collected for this research.

National Marine Fisheries Service, Fish Ecology Division.

A Study to Compare Long-term Survival and Disease Susceptibility of Yearling Hatchery Chinook Salmon Smolts with Different Juvenile Migration Histories. Principal Investigator: Lyle Gilbreath. This research is designed to potentially determine the mechanism(s) that cause differential adult return rates of Snake River chinook salmon depending on their downstream passage history (bypass, multiple bypass, and transportation) at Snake River dams. Goals in 2002 were: 1) estimate variance in delayed mortality of juvenile chinook salmon held long-term (up to eight months) in this system, 2) compare delayed mortality and physiology among run-of-river versus barged yearling chinook salmon, and 3) test effects of bypass system passage on immune competency of chinook salmon through disease challenge tests using the marine pathogen *Vibrio anguillarum*.
Juvenile yearling chinook salmon (*Oncorhynchus tshawytscha*) used in the study were obtained at the JMF and from transport barges passing Bonneville. Delayed mortality comparisons were made for PIT tagged chinook salmon from transport barges and from the run-at-large passing PH2.

Idaho Cooperative Fishery Research Unit, University of Idaho
Evaluation of Physiological Changes in Migrating Chinook Salmon and Effects on Performance and Survival. Principal Investigator: James Congleton. Fish were collected using the Separation by Code (SBC) capabilities of the system. The objectives of this research were: 1) Evaluate comparative survival of in-river passage to multiple bypassed salmon. 2) Compare physiological differences in fish passing through multiple bypass systems rom a first time bypass. 3) Evaluate comparative delayed mortality of juvenile salmon utilizing different routes of passage at the dams on the lower Columbia and Snake River system. The SBC system diverted a total of 626 target hatchery spring chinook for this study.

ACKNOWLEDGMENTS

The success of the John Day and Bonneville portions of the Smolt Monitoring Program continues to involve cooperative interaction with the Fish Passage Center staff, the Corps of Engineers project and fisheries personnel at The Dalles/John Day and Jennifer Sturgill and Tammy Mackey at Bonneville Dam and the Gladstone staff of the Pacific States Marine Fisheries Commission.

We acknowledge the very capable efforts of our Biological technicians and aides, including at Bonneville: John Barton, Martha Jenkins, Jayme Martin, Nickie McConnell, Robert B. Mills, Kathleen Richards, Jerry Rogers, Thomas Ryan, Angela Stephani, Steven Watt and John Windsor; and at John Day: Jonathan Rerecich.

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Table A-1. John Day smolt monitoring program historical summary, 1985-present.

	Year	Dates[1]	Sampling Effort	Sub-Sampling	Sample Rate	Yearling Chinook Sample #	Yearling Chinook Collection	Yearling Chinook Index	Subyearling Chinook Sample #[2]	Subyearling Chinook Fry	Subyearling Chinook Collection[2]	Subyearling Chinook Fry	Subyearling Chinook Index	Coho Sample #	Coho Collection	Coho Index
Single Gatewell Airlift	1985[3]	4/27-10/29	24/day	NO	1	63,578	63,578	-	226,577		226,577		-	600	600	-
	1986	3/28-10/30	24/day	NO	1	92,591	92,951	-	182,117		182,117		-	1,994	1,994	-
	1987	4/1-11/30	24/day	NO	1	84,455	84,455	1,020,768	95,505	780	95,505	780	760,605	13,200	13,200	170,353
	1988	3/30-10/31	24/day	NO	1	34,045	34,045	408,675	109,448	3,800	109,448	3,800	363,101	8,650	8,650	109,325
	1989	3/28-10/31	24/day	NO	1	34,930	34,930	502,642	129,870	3,922	129,870	3,922	1,017,342	6,930	6,930	99,811
	1990(5b)	3/27-10/31	24/day	NO	1	26,992	26,992	361,968	39,602	30	39,602	30	513,669	6,261	6,261	84,342
	1991	4/7-10/31	24/day	NO	1	26,878	26,878	374,387	46,785	513	46,785	513	568,206	5,106	5,106	72,725
	1992(3c)[4]	3/25-10/13	24/day	NO	1	23,052	23,052	NA	27,407	141	27,407	141	NA	5,887	5,887	NA
	1992(3b)	3/25-10/13	24/day	NO	1	19,179	19,179	237,172	32,376		32,376		294,861	3,917	3,917	48,898
	1993(3c)	4/6-10/29	24/day	NO	1	11,054	11,054	NA	50,243	1,317	50,243	1,317	NA	3,437	3,437	NA
	1993(3b)	4/6-10/29	24/day	NO	1	41,767	41,767	720,361	66,561		66,561		717,434	9,727	9,727	173,193
	1994	4/5-9/30	24/day	NO	1	34,071	34,199	446,854	75,164	47	121,272	47	1,207,368	11,385	11,413	151,135
	1995	4/6-9/29	24/day	YES	.25-1	34,308	90,348	1,329,229	48,896	507	90,350	1,350	1,240,260	5,908	22,135	335,902
	1996	4/8-9/9	24/day	YES	.25-1	14,560	38,975	738,311	31,157	105	46,232	217	737,841	8,551	27,043	504,863
	1997	4/8-9/8	24/day	YES	.25-1	4,586	7,646	154,026	20,487	1,305	24,333	2,342	448,328	3,409	6,615	147,267
Full Bypass	1998	4/9-10/31	24/day	YES	.0067-.25	27,732	758,689	1,147,861	31,178	159	1,584,083	4,229	2,155,479	5,330	370,277	572,762
	1999	4/1-10/31	24/day	YES	.0067-.5	160,378	1,597,819	2,193,904	232,131	675	3,090,201	7,012	3,962,632	37,941	388,932	543,318
	2000	4/2-9/18	24/day	YES	.0067-1	124,788	579,810	827,047	197,340	1,021	1,132,204	6,555	1,681,685	57,716	172,742	263,724
	2001	3/30-9/17	24/day	YES	.0067-.25	41,659	948,154	1,006,079	40,215	54	2,840,619	1,352	2,848,404	3,037	79,576	81,644
	2002	3/18-9/16	24/day	YES	.007-.5	70,901	1,470,332	2,104,942	127,980	315	2,357,720	4,979	3,465,719	9,248	205,548	315,279

	Year	Dates	Sampling Effort	Sub-Sampling	Sample Rate	Unclipped Steelhead Sample #	Unclipped Steelhead Collection	Unclipped Steelhead Index	Clipped Steelhead[5] Sample #	Clipped Steelhead[5] Collection	Clipped Steelhead[5] Index	Sockeye Sample #	Sockeye Collection	Sockeye Index	Total Sample #	Total Collection	Total Index
Single Gatewell Airlift	1985[3]	4/27-10/29	24/day	NO	1	36,616	36,616	-		-		17,235	17,235	-	344,606	344,606	-
	1986	3/28-10/30	24/day	NO	1	37,822	37,822	-		-		17,505	17,505	-	332,029	332,389	-
	1987	4/1-11/30	24/day	NO	1	23,988	23,988	300,410		-		11,911	11,911	145,232	229,059	229,059	2,397,368
	1988	3/30-10/31	24/day	NO	1	14,985	14,985	179,089		-		6,333	6,333	80,406	173,461	173,461	1,140,596
	1989	3/28-10/31	24/day	NO	1	19,818	19,818	281,685		-		5,496	5,496	78,190	197,044	197,044	1,979,670
	1990	3/27-10/31	24/day	NO	1	5,028	5,028	68,428	4,921	4,921	6,349	1,755	1,755	23,592	84,559	84,559	1,058,348
	1991	4/7-10/31	24/day	NO	1	5,456	5,456	75,687	11,166	11,166	158,305	3,450	3,450	52,203	98,841	98,841	1,301,513
	1992(3c)[4]	3/25-10/13	24/day	NO	1	2,770	2,770	NA	6,917	6,917	NA	1,647	1,647	NA	67,680	67,680	NA
	1992(3b)	3/25-10/13	24/day	NO	1	2,371	2,371	28,712	5,053	5,053	63,494	961	961	12,051	63,857	63,857	685,188
	1993(3c)	4/6-10/29	24/day	NO	1	4,668	4,668	NA	7,416	7,416	NA	813	813	NA	77,631	77,631	NA
	1993(3b)	4/6-10/29	24/day	NO	1	11,374	11,374	189,400	45,520	45,520	882,474	14,072	14,072	272,869	189,021	189,021	2,955,731
	1994	4/5-9/30	24/day	NO	1	7,604	7,604	96,800	14,454	14,457	189,420	7,260	7,270	96,621	149,938	196,215	2,188,198
	1995	4/6-9/29	24/day	YES	.25-1	4,043	11,584	170,993	18,915	61,385	919,021	5,625	19,526	293,065	117,695	295,328	4,288,470
	1996	4/8-9/9	24/day	YES	.25-1	3,973	11,903	228,911	11,171	36,174	701,899	1,147	3,373	64,584	70,559	163,700	2,976,409
	1997	4/8-9/8	24/day	YES	.25-1	4,011	7,337	151,061	13,645	28,547	614,087	738	1,184	26,519	46,876	75,662	1,541,288
Full Bypass	1998	4/9-10/31	24/day	YES	.0067-.25	8,378	296,969	455,339	6,214	408,195	634,446	4,479	338,099	523,866	83,311	3,756,312	5,489,754
	1999	4/1-10/31	24/day	YES	.0067-.5	33,545	299,072	418,515	42,003	586,952	820,431	54,710	407,398	574,062	560,708	6,370,374	8,512,862
	2000	4/2-9/18	24/day	YES	.0067-1	44,416	188,601	271,975	38,475	182,036	250,020	17,012	41,126	59,951	479,747	2,296,519	3,354,403
	2001	3/30-9/17	24/day	YES	.0067-.25	7,567	123,614	124,829	3,394	64,287	66,302	3,023	96,207	103,973	98,895	4,152,457	4,232,594
	2002	3/18-9/16	24/day	YES	.007-.5	9,837	170,478	245,070	10,842	210,649	300,695	28,933	653,006	934,107	257,741	5,067,733	7,365,812

[1] Sampling conducted 24/7 for all years.
[2] Includes fry numbers.
[3] Unit 3B was out of service from April 2-26 for STS installations and testing.
[4] 3C airlift inoperational 5/13-6/18.
[5] Unclipped and clipped steelhead were not differentiated prior to 1990.

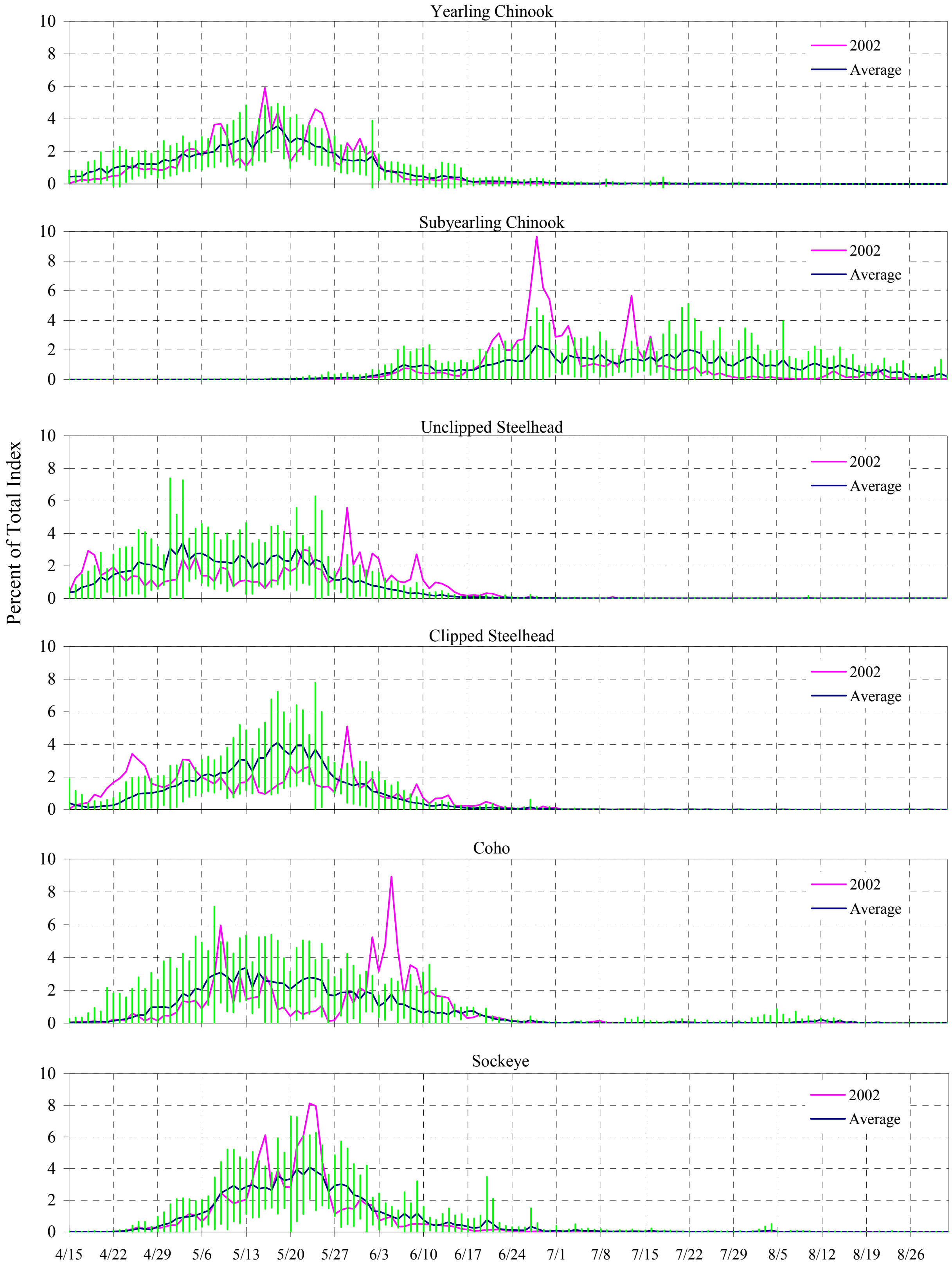


Figure A-1. John Day average daily passage, 2002, with the 1985-present average and standard deviation.

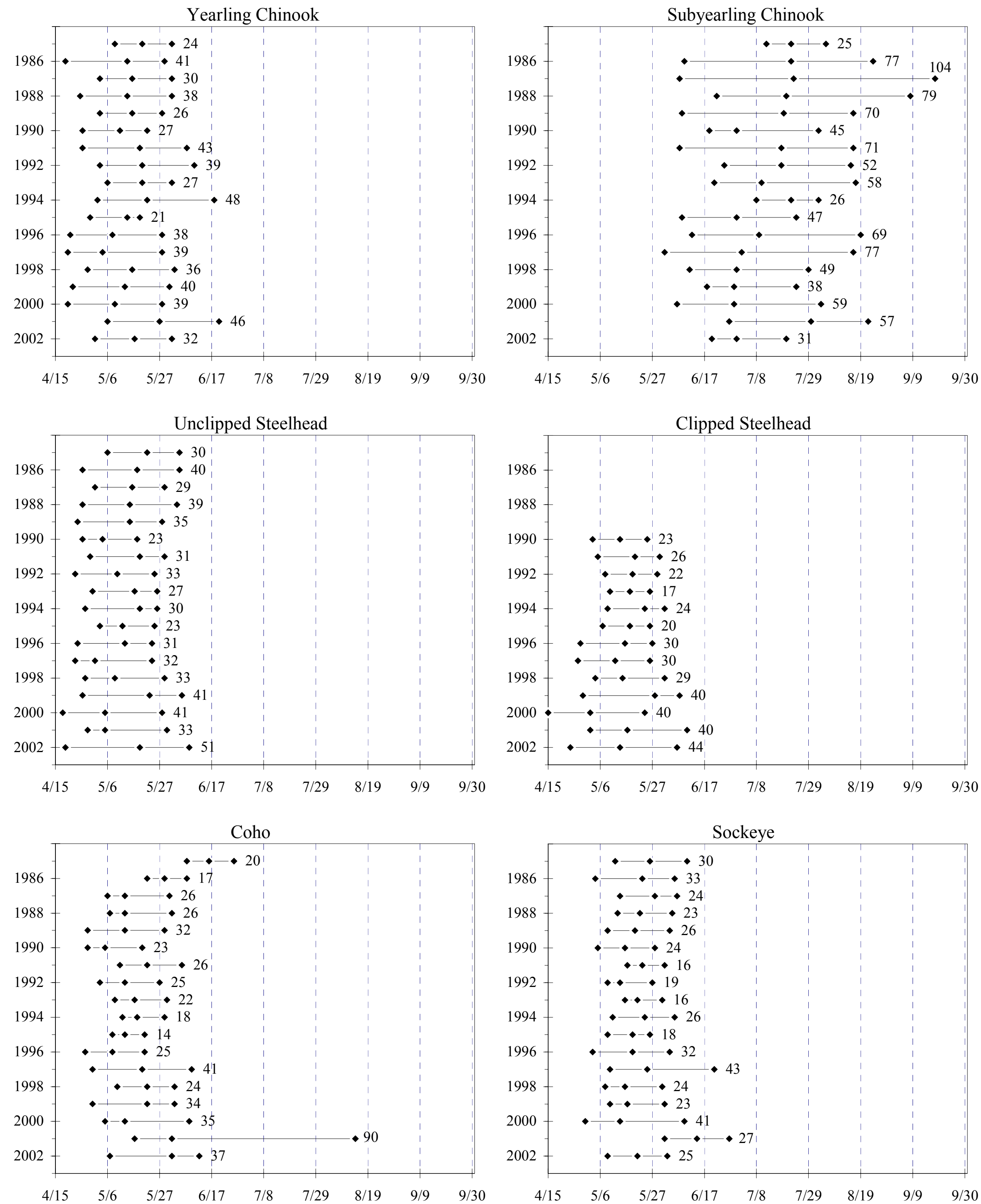


Figure A-2. John Day 10%, 50%, and 90% passage dates by species, 1985-present. The number of days between 10-90% dates is indicated for each year. Clipped and unclipped steelhead were not differentiated before 1990.

Table A-2. John Day 10%, 50%, and 90% passage dates, 1985 to 2002, with duration of middle 80% in days.

	Yearling Chinook				
		10 %	50%	90 %	# of Days
Single Gatewell Airlift	1985[1]	9-May	20-May	1-Jun	24
	1986	19-Apr	14-May	29-May	41
	1987	3-May	16-May	1-Jun	30
	1988	25-Apr	14-May	1-Jun	38
	1989	3-May	16-May	28-May	26
	1990	26-Apr	11-May	22-May	27
	1991[1]	26-Apr	19-May	7-Jun	43
	1992	3-May	20-May	10-Jun	39
	1993	6-May	20-May	1-Jun	27
	1994	2-May	22-May	18-Jun	48
	1995	29-Apr	14-May	19-May	21
	1996	21-Apr	8-May	28-May	38
	1997	20-Apr	4-May	28-May	39
Full Bypass	1998	28-Apr	16-May	2-Jun	36
	1999	22-Apr	13-May	31-May	40
	2000	20-Apr	9-May	28-May	39
	2001	6-May	27-May	20-Jun	46
	2002	1-May	17-May	1-Jun	32
	MEDIAN	28-Apr	16-May	1-Jun	35
	MIN	19-Apr	4-May	19-May	21
	MAX	9-May	27-May	20-Jun	48

	Subyearling Chinook				
		10 %	50%	90 %	# of Days
Single Gatewell Airlift	1985[1]	12-Jul	22-Jul	5-Aug	25
	1986	9-Jun	22-Jul	24-Aug	77
	1987	7-Jun	23-Jul	18-Sep	104
	1988	22-Jun	20-Jul	8-Sep	79
	1989	8-Jun	19-Jul	16-Aug	70
	1990	19-Jun	30-Jun	2-Aug	45
	1991[1]	7-Jun	18-Jul	16-Aug	71
	1992	25-Jun	18-Jul	15-Aug	52
	1993	21-Jun	10-Jul	17-Aug	58
	1994	8-Jul	22-Jul	2-Aug	26
	1995	8-Jun	30-Jun	24-Jul	47
	1996	12-Jun	9-Jul	19-Aug	69
	1997	1-Jun	2-Jul	16-Aug	77
Full Bypass	1998	11-Jun	30-Jun	29-Jul	49
	1999	18-Jun	29-Jun	25-Jul	38
	2000	6-Jun	29-Jun	3-Aug	59
	2001	27-Jun	30-Jul	22-Aug	57
	2002	20-Jun	30-Jun	20-Jul	31
	MEDIAN	15-Jun	14-Jul	15-Aug	63
	MIN	1-Jun	29-Jun	20-Jul	25
	MAX	12-Jul	30-Jul	18-Sep	104

	Unclipped Steelhead				
		10 %	50%	90 %	# of Days
Single Gatewell Airlift	1985[1]	6-May	22-May	4-Jun	30
	1986	26-Apr	18-May	4-Jun	40
	1987	1-May	16-May	29-May	29
	1988	26-Apr	15-May	3-Jun	39
	1989	24-Apr	15-May	28-May	35
	1990[1, 2]	26-Apr	4-May	18-May	23
	1991	29-Apr	19-May	29-May	31
	1992	23-Apr	10-May	25-May	33
	1993	30-Apr	17-May	26-May	27
	1994	27-Apr	19-May	26-May	30
	1995	3-May	12-May	25-May	23
	1996	24-Apr	13-May	24-May	31
	1997	23-Apr	1-May	24-May	32
Full Bypass	1998	27-Apr	9-May	29-May	33
	1999	26-Apr	23-May	5-Jun	41
	2000	18-Apr	5-May	28-May	41
	2001	28-Apr	5-May	30-May	33
	2002	19-Apr	19-May	8-Jun	51
	MEDIAN	26-Apr	15-May	28-May	34
	MIN	18-Apr	1-May	18-May	23
	MAX	6-May	23-May	8-Jun	51

	Clipped Steelhead				
		10 %	50%	90 %	# of Days
Single Gatewell Airlift	1985[1]	ALL STEELHEAD IN UNCLIPPED			
	1986				
	1987				
	1988				
	1989				
	1990[1,2]	3-May	14-May	25-May	23
	1991	5-May	20-May	30-May	26
	1992	8-May	19-May	29-May	22
	1993	10-May	18-May	26-May	17
	1994	9-May	24-May	1-Jun	24
	1995	7-May	18-May	26-May	20
	1996	28-Apr	16-May	27-May	30
	1997	27-Apr	12-May	26-May	30
Full Bypass	1998	4-May	15-May	1-Jun	29
	1999	29-Apr	28-May	7-Jun	40
	2000	15-Apr	2-May	24-May	40
	2001	2-May	17-May	10-Jun	40
	2002	24-Apr	14-May	6-Jun	44
	MEDIAN	3-May	17-May	29-May	27
	MIN	15-Apr	2-May	24-May	17
	MAX	10-May	28-May	10-Jun	44

	Coho				
		10 %	50%	90 %	# of Days
Single Gatewell Airlift	1985[1]	7-Jun	16-Jun	26-Jun	20
	1986	22-May	29-May	7-Jun	17
	1987	6-May	13-May	31-May	26
	1988	7-May	13-May	1-Jun	26
	1989	28-Apr	13-May	29-May	32
	1990[1]	28-Apr	5-May	20-May	23
	1991	11-May	22-May	5-Jun	26
	1992	3-May	13-May	27-May	25
	1993	9-May	17-May	30-May	22
	1994	12-May	18-May	29-May	18
	1995	8-May	13-May	21-May	14
	1996	27-Apr	8-May	21-May	25
	1997	30-Apr	20-May	9-Jun	41
Full Bypass	1998	10-May	22-May	2-Jun	24
	1999	30-Apr	22-May	2-Jun	34
	2000	5-May	13-May	8-Jun	35
	2001	17-May	1-Jun	14-Aug	90
	2002	7-May	1-Jun	12-Jun	37
	MEDIAN	7-May	17-May	1-Jun	27
	MIN	27-Apr	5-May	20-May	14
	MAX	7-Jun	16-Jun	14-Aug	90

	Sockeye (Wild + Hatchery)				
		10 %	50%	90 %	# of Days
Single Gatewell Airlift	1985[1]	12-May	26-May	10-Jun	30
	1986	4-May	23-May	5-Jun	33
	1987	14-May	28-May	6-Jun	24
	1988	13-May	22-May	4-Jun	23
	1989	9-May	20-May	3-Jun	26
	1990[1]	5-May	16-May	28-May	24
	1991	17-May	23-May	1-Jun	16
	1992	9-May	14-May	27-May	19
	1993	16-May	21-May	31-May	16
	1994	11-May	24-May	5-Jun	26
	1995	9-May	19-May	26-May	18
	1996	3-May	19-May	3-Jun	32
	1997	10-May	25-May	21-Jun	43
Full Bypass	1998	8-May	16-May	31-May	24
	1999	10-May	17-May	1-Jun	23
	2000	30-Apr	14-May	9-Jun	41
	2001	1-Jun	14-Jun	27-Jun	27
	2002	9-May	21-May	2-Jun	25
	MEDIAN	9-May	21-May	3-Jun	26
	MIN	30-Apr	14-May	26-May	16
	MAX	1-Jun	14-Jun	27-Jun	43

[1] Years in which the sample unit was out of service (1985: April 2 to April 26; 1990: May 30 to June 9).
[2] Unclipped and clipped steelhead were not differentiated before 1990.

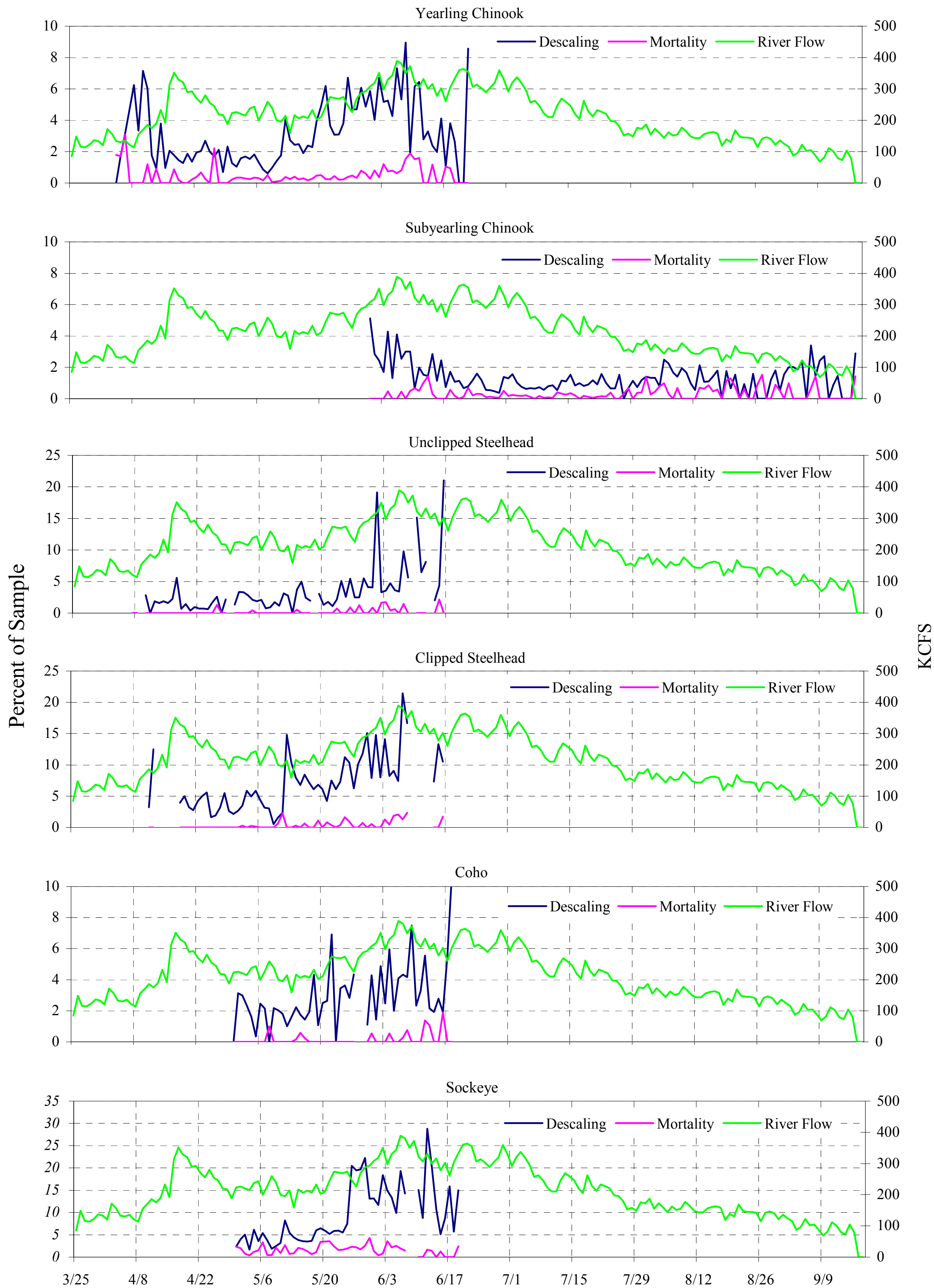


Figure A-3. John Day daily descaling, mortality, and river flow, 2002. Days with sample size of less than 30 have been excluded. **Note percent of sample scale differences**.

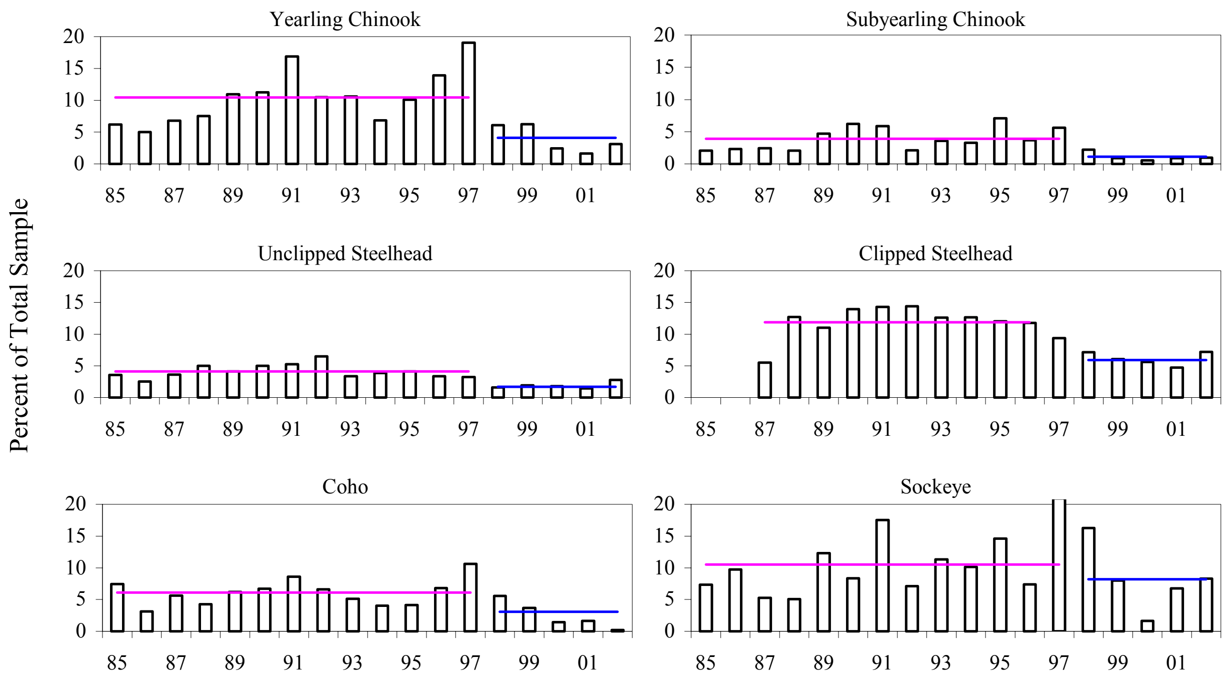


Figure A-4. John Day annual descaling rates, 1985-present. Sampling switched from airlift pump system to new smolt monitoring facility in 1998. Clipped and unclipped steelhead were not differentiated before 1987.

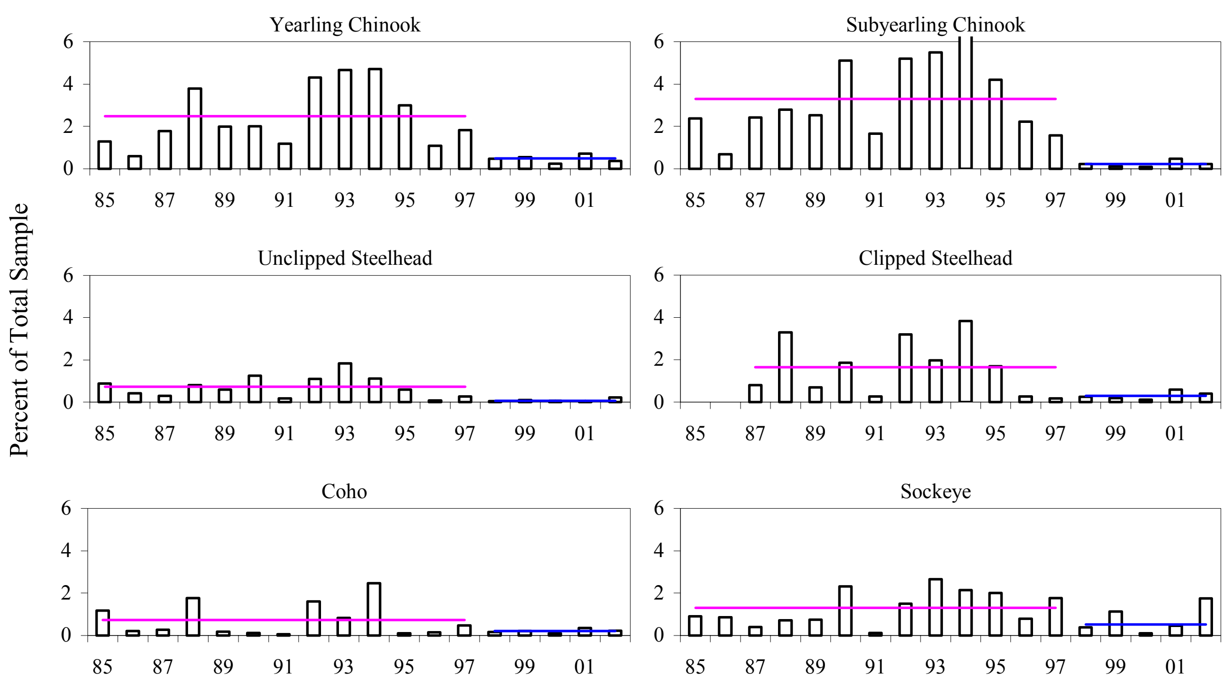


Figure A-5. John Day annual mortality rates, 1985-present. Sampling switched from airlift pump system to new smolt monitoring facility in 1998. Clipped and unclipped steelhead were not differentiated before 1987.

Table A-3. John Day annual descaling and mortality rates, 1985-present.

		YEARLING CHINOOK							SUBYEARLING CHINOOK						
	YEAR	SAMPLE	DESC	%DESC	AVG	MORT	%MORT	AVG	SAMPLE	DESC	%DESC	AVG	MORT	%MORT	AVG
Single Gatewell Airlift	1985	62,790	3,846	6.2		809	1.3		228,211	4,567	2.0		5,425	2.4	
	1986	92,856	4,630	5.0		547	0.6		181,857	4,135	2.3		1,231	0.7	
	1987	84,312	5,617	6.8		1,505	1.8		95,693	2,290	2.5		2,313	2.4	
	1988	34,071	2,470	7.5		1,292	3.8		109,435	2,186	2.1		3,050	2.8	
	1989	34,935	3,749	10.9		694	2.0		129,957	5,922	4.7		3,273	2.5	
	1990	26,907	2,968	11.3		541	2.0		39,280	2,316	6.2		2,009	5.1	
	1991	26,879	4,487	16.9		320	1.2		46,785	2,696	5.9		775	1.7	
	1992	42,231	4,256	10.5		1,823	4.3		59,783	1,216	2.1		3,096	5.2	
	1993	52,821	5,342	10.6		2,464	4.7		116,804	3,954	3.6		6,413	5.5	
	1994	34,071	2,219	6.8		1,606	4.7		75,164	2,309	3.3		5,004	6.7	
	1995	34,308	3,361	10.1		1,032	3.0		48,896	3,325	7.1		2,029	4.2	
	1996	14,560	2,001	13.9		158	1.1		31,157	1,119	3.7		692	2.2	
	1997	4,586	859	19.1	10.4	84	1.8	2.5	20,487	1,133	5.6	3.9	322	1.6	3.3
Full Bypass	1998	27,732	1,675	6.1		133	0.5		31,178	678	2.2		70	0.2	
	1999[1]	160,378	9,952	6.2		882	0.5		232,131	2,094	0.9		282	0.1	
	2000[1]	124,788	3,001	2.4		289	0.2		197,340	1,102	0.6		186	0.1	
	2001	41,659	685	1.7		300	0.7		40,215	355	0.9		189	0.5	
	2002	70,901	2,210	3.1	3.9	259	0.4	0.5	127,980	1,243	1.0	1.1	285	0.2	0.2
	TOTAL	899,884	61,118	6.9		14,479	1.6		1,684,373	41,397	2.5		36,359	2.2	

		UNCLIPPED STEELHEAD							CLIPPED STEELHEAD						
	YEAR	SAMPLE	DESC	%DESC	AVG	MORT	%MORT	AVG	SAMPLE	DESC	%DESC	AVG	MORT	%MORT	AVG
Single Gatewell Airlift	1985	36,355	1,292	3.6		320	0.9		All Steelhead in Unclipped						
	1986	37,858	962	2.6		156	0.4								
	1987[2]	12,374	447	3.6		41	0.3		11,622	634	5.5		94	0.8	
	1988	6,810	335	5.0		56	0.8		8,227	1,012	12.7		268	3.3	
	1989	8,585	348	4.1		53	0.6		11,229	1,225	11.0		84	0.7	
	1990	6,104	303	5.0		76	1.2		4,867	665	13.9		90	1.8	
	1991	5,455	287	5.3		10	0.2		11,171	1,593	14.3		30	0.3	
	1992	5,141	332	6.5		54	1.1		11,970	1,663	14.4		389	3.2	
	1993	16,042	530	3.4		294	1.8		52,936	6,562	12.6		1,049	2.0	
	1994	7,604	290	3.9		85	1.1		14,454	1,761	12.7		554	3.8	
	1995	4,043	166	4.1		26	0.6		18,915	2,236	12.0		325	1.7	
	1996	3,973	134	3.4		3	0.1		11,171	1,310	11.8		30	0.3	
	1997	4,011	130	3.3	4.1	11	0.3	0.7	13,645	1,279	9.4	11.8	24	0.2	1.6
Full Bypass	1998	8,378	132	1.6		4	0.0		6,214	444	7.2		16	0.3	
	1999[1]	33,545	649	1.9		36	0.1		42,003	2,537	6.1		83	0.2	
	2000[1]	44,416	789	1.8		26	0.1		38,475	2,159	5.6		44	0.1	
	2001	7,567	109	1.4		3	0.0		3,394	159	4.7		20	0.6	
	2002	9,837	274	2.8	1.9	22	0.2	0.1	10,842	775	7.2	6.1	44	0.4	0.3
	TOTAL	248,261	7,235	2.9		1,254	0.5		260,293	25,239	9.8		3,100	1.2	

		COHO							SOCKEYE						
	YEAR	SAMPLE	DESC	%DESC	AVG	MORT	%MORT	AVG	SAMPLE	DESC	%DESC	AVG	MORT	%MORT	AVG
Single Gatewell Airlift	1985	598	44	7.4		7	1.2		17,246	1,258	7.4		157	0.9	
	1986	1,990	62	3.1		4	0.2		17,539	1,688	9.7		151	0.9	
	1987	13,213	741	5.6		36	0.3		11,923	624	5.3		48	0.4	
	1988	8,680	363	4.3		153	1.8		6,336	320	5.1		45	0.7	
	1989	6,934	431	6.2		12	0.2		5,497	672	12.3		41	0.7	
	1990	6,261	418	6.7		7	0.1		1,769	144	8.3		41	2.3	
	1991	5,104	437	8.6		3	0.1		3,447	604	17.5		4	0.1	
	1992	9,804	636	6.6		158	1.6		2,608	183	7.1		39	1.5	
	1993	13,164	669	5.1		110	0.8		14,885	1,630	11.3		397	2.7	
	1994	11,385	446	4.0		281	2.5		7,270	719	10.1		155	2.1	
	1995	5,908	244	4.1		8	0.1		5,625	807	14.6		112	2.0	
	1996	8,551	579	6.8		13	0.2		1,147	84	7.4		9	0.8	
	1997	3,409	361	10.6	6.1	16	0.5	0.7	738	152	21.0	10.5	13	1.8	1.3
Full Bypass	1998	5,330	297	5.6		9	0.2		4,479	726	16.3		17	0.4	
	1999[1]	37,941	1,397	3.7		78	0.2		54,710	4,331	8.0		619	1.1	
	2000[1]	57,716	819	1.4		59	0.1		17,012	280	1.6		18	0.1	
	2001	3,037	49	1.6		11	0.4		3,023	203	6.7		14	0.5	
	2002	9,248	18	0.2	2.5	21	0.2	0.2	28,933	2,354	8.3	8.2	509	1.8	0.8
	TOTAL	199,025	7,993	4.0		965	0.5		175,254	14,425	8.3		1,880	1.1	

[1] Sample size during these years was higher than normal to accommodate The Dalles Spillway Survival Study collection needs.
[2] Unclipped and clipped steelhead were not differentiated before 1987.

Table A-4. John Day condition subsampling data, 1985-1997, shown as the average, minimum, and maximums observed using the airlift sampling system, and 1998-present using the full bypass, as a percent of sample.

Yearling Chinook

YEAR	NO. SMPLD	3-19% DESC	INJURY HD	INJURY OP	INJURY PE	INJURY BD	INJURY HM	DISEASE PAR	DISEASE COL	DISEASE FUN	DISEASE BKD	PREDATION BIRD	PREDATION OT
Airlift Sampling Summary													
Avg	2,010	16.9	0.9	0.6	0.2	2.5	1.6	0.4	0.4	0.6	0.7	1.1	1.2
Min	950	10.2	0.3	0.1	0.2	0.3	0.9	0.0	0.0	0.0	0.0	0.0	0.8
Max	3,995	29.7	2.2	1.6	0.2	6.2	2.7	1.5	0.7	1.7	2.6	2.4	1.5
Full Bypass													
1998	2,606	11.2	0.3	0.6	0.5	1.1	1.9	0.1	0.1	0.7	0.9	1.1	0.3
1999	2,753	15.7	0.3	0.7	0.4	1.6	2.1	0.4	0.0	0.8	0.7	1.2	0.8
2000	2,541	8.9	0.2	0.2	0.2	1.8	0.1	0.0	0.0	1.2	0.7	1.4	0.2
2001	3,955	6.6	0.1	0.1	0.1	0.9	0.3	0.4	0.1	0.3	1.0	1.9	0.2
2002	3,917	2.1	6.1	2.9	0.7	0.7	0.2	1.0	0.6	1.7	0.0	1.6	0.7

Unclipped Steelhead

YEAR	NO. SMPLD	3-19% DESC	INJURY HD	INJURY OP	INJURY PE	INJURY BD	INJURY HM	DISEASE PAR	DISEASE COL	DISEASE FUN	DISEASE BKD	PREDATION BIRD	PREDATION OT
Airlift Sampling Summary													
Avg	1,216	12.2	1.1	1.4	0.3	2.0	0.9	2.2	0.1	1.4	0.0	0.6	0.9
Min	476	6.6	0.1	0.6	0.2	0.0	0.4	0.0	0.0	0.0	0.0	2.4	0.3
Max	2,265	21.3	2.5	2.9	0.4	7.5	1.5	15.2	0.3	3.5	0.2	3.4	1.5
Full Bypass													
1998	1,707	3.6	0.2	0.1	0.1	0.4	0.3	2.4	0.1	0.2	0.0	1.8	0.2
1999	2,334	9.3	0.3	0.7	0.1	2.6	1.7	5.0	0.0	1.0	0.1	4.9	0.6
2000	2,304	10.1	0.0	0.0	0.1	1.6	0.0	2.5	0.0	0.4	0.1	2.7	0.0
2001	1,715	5.1	0.2	0.1	0.0	1.2	0.1	8.2	0.0	0.5	0.0	2.0	0.1
2002	2,921	5.1	6.4	3.1	0.8	1.0	0.0	1.2	0.4	5.3	0.0	1.3	0.0

Coho

YEAR	NO. SMPLD	3-19% DESC	INJURY HD	INJURY OP	INJURY PE	INJURY BD	INJURY HM	DISEASE PAR	DISEASE COL	DISEASE FUN	DISEASE BKD	PREDATION BIRD	PREDATION OT
Airlift Sampling Summary													
Avg	1,022	11.5	0.4	0.8	0.1	0.2	0.2	0.4	0.0	0.9	0.0	0.7	0.6
Min	96	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0
Max	2,166	21.5	2.1	2.7	0.2	0.7	0.3	1.2	0.1	2.7	0.2	3.8	1.2
Full Bypass													
1998	1,374	5.9	0.1	0.5	0.4	1.5	0.7	0.0	0.1	0.3	0.1	1.8	0.8
1999	2,767	11.7	0.2	0.5	0.1	1.3	1.0	0.4	0.0	0.4	0.2	1.5	1.2
2000	2,399	5.0	0.2	0.2	0.0	1.2	0.1	0.4	0.0	0.3	0.0	1.1	0.1
2001	591	3.9	0.2	0.2	0.0	0.8	0.0	0.2	0.3	0.0	0.2	1.0	0.5
2002	2,191	2.3	6.7	2.7	0.6	0.4	0.0	0.7	0.1	0.6	0.0	0.8	0.2

Subyearling Chinook

YEAR	NO. SMPLD	3-19% DESC	INJURY HD	INJURY OP	INJURY PE	INJURY BD	INJURY HM	DISEASE PAR	DISEASE COL	DISEASE FUN	DISEASE BKD	PREDATION BIRD	PREDATION OT
Airlift Sampling Summary													
Avg	3,874	9.3	0.5	1.5	0.1	0.4	0.9	3.2	1.4	0.1	0.1	0.1	0.7
Min	2,340	4.1	0.0	0.1	0.1	0.0	0.4	0.0	0.9	0.0	0.1	0.3	0.3
Max	5,869	15.0	1.8	3.8	0.1	1.6	1.1	12.8	3.8	0.4	0.9	0.4	1.5
Full Bypass													
1998	5,169	7.7	0.2	0.3	0.0	1.5	4.0	0.2	0.1	0.2	0.1	0.2	0.5
1999	8,767	4.8	0.1	0.4	0.0	1.4	0.8	0.1	0.1	0.1	0.0	0.3	0.8
2000	9,823	2.8	0.1	0.1	0.0	1.1	0.3	0.1	0.0	0.1	0.0	0.1	0.5
2001	9,588	8.1	0.1	0.2	0.0	1.1	2.0	0.0	0.0	0.0	0.2	0.1	0.6
2002	14,382	4.7	0.1	1.1	1.5	0.1	0.0	0.0	0.1	0.2	1.3	0.0	0.0

Clipped Steelhead

YEAR	NO. SMPLD	3-19% DESC	INJURY HD	INJURY OP	INJURY PE	INJURY BD	INJURY HM	DISEASE PAR	DISEASE COL	DISEASE FUN	DISEASE BKD	PREDATION BIRD	PREDATION OT
Airlift Sampling Summary													
Avg	1,646	29.0	1.8	4.4	0.4	2.2	1.2	2.6	0.1	5.2	0.0	5.3	2.2
Min	507	14.6	0.3	1.2	0.1	0.1	0.6	0.5	0.0	0.7	0.0	7.2	0.8
Max	2,371	41.1	4.5	9.9	0.7	6.6	1.6	7.1	0.1	15.1	0.1	15.1	3.9
Full Bypass													
1998	1,510	12.8	0.7	2.3	0.5	3.7	1.1	0.4	0.1	1.2	0.1	7.6	0.3
1999	2,716	19.3	0.6	2.4	0.2	4.3	1.8	0.1	0.0	1.3	0.0	8.4	1.3
2000	1,990	18.3	0.4	0.7	0.1	3.1	0.1	0.7	0.1	0.9	0.0	6.9	0.2
2001	1,043	13.0	0.6	0.4	0.0	2.2	0.2	2.8	0.0	2.4	0.0	7.3	0.3
2002	2,765	10.6	11.1	6.3	1.3	1.6	0.1	2.4	0.3	5.5	0.0	4.6	0.0

Sockeye

YEAR	NO. SMPLD	3-19% DESC	INJURY HD	INJURY OP	INJURY PE	INJURY BD	INJURY HM	DISEASE PAR	DISEASE COL	DISEASE FUN	DISEASE BKD	PREDATION BIRD	PREDATION OT
Airlift Sampling Summary													
Avg	788	13.6	0.6	1.3	0.2	0.3	0.6	0.2	0.1	0.2	0.0	0.1	0.6
Min	219	6.1	0.0	0.3	0.1	0.0	0.3	0.0	0.0	0.0	0.0	0.5	0.0
Max	1,766	20.3	1.5	3.2	0.9	1.9	0.9	0.8	0.2	0.5	0.3	1.0	0.9
Full Bypass													
1998	1,268	15.5	0.1	1.4	0.2	0.5	0.9	0.0	0.0	0.2	0.1	0.1	0.2
1999	1,864	19.0	0.2	1.9	0.2	1.6	1.2	0.0	0.0	0.8	0.1	0.8	0.2
2000	1,463	6.9	0.8	0.8	0.1	0.9	0.0	0.1	0.0	0.2	0.1	0.1	0.1
2001	828	15.7	0.0	0.6	0.1	1.3	0.8	0.0	0.1	0.4	0.1	0.5	0.1
2002	2,328	0.1	12.0	10.1	0.9	2.6	0.1	1.0	0.9	0.0	0.0	1.8	0.1

NO. SMPLD: The number of fish examined for condition subsampling
3-19% DESC: The number of fish with 3-19% descaling
Injury includes: HD- Head Injury; OP - Opercula Injury; PE - Pop Eye; BD - Body Injury; and HM - Hemorrhage
Disease includes: PAR - Parasites (mostly trematodes and copepods); COL - Columnaris; FUN - Fungus; and BKD - Bacterial Kidney Disease symptoms
Predation includes: BIRD - Marks from bird strikes; OT - Marks from other predators, including lamprey and other fish

Table A-5. John Day PIT tag summary, 2002.

Migration Year	Species	Run	Rear	Observations	Species Totals	Migration Year Totals
2000	Chinook	Spring	Wild	1	1 Chinook	
	Coho	Fall	Hatchery	1	1 Coho	
	Steelhead	Summer	Wild	13	13 Steelhead	**15**
2001	Chinook	Spring	Hatchery	6		
	Chinook	Spring	Wild	11		
	Chinook	Summer	Hatchery	17		
	Chinook	Summer	Wild	6		
	Chinook	Fall	Hatchery	334		
	Chinook	Fall	Unknown	2		
	Chinook	Fall	Wild	7		
	Chinook	Unknown	Hatchery	20		
	Chinook	Unknown	Unknown	11		
	Chinook	Unknown	Wild	7	421 Chinook	
	Coho	Fall	Hatchery	13	13 Coho	
	Steelhead	Summer	Hatchery	41		
	Steelhead	Summer	Wild	131	172 Steelhead	
	Sockeye	Summer	Hatchery	1		
	Sockeye	Unknown	Hatchery	4	5 Sockeye	**611**
2002	Chinook	Spring	Hatchery	72,231		
	Chinook	Spring	Unknown	1,677		
	Chinook	Spring	Wild	3,731		
	Chinook	Summer	Hatchery	14,140		
	Chinook	Summer	Unknown	48		
	Chinook	Summer	Wild	1,222		
	Chinook	Fall	Hatchery	14,177		
	Chinook	Fall	Unknown	11,656		
	Chinook	Fall	Wild	83		
	Chinook	Unknown	Hatchery	5,071		
	Chinook	Unknown	Unknown	408		
	Chinook	Unknown	Wild	4,053	128,497 Chinook	
	Coho	Fall	Hatchery	2,198		
	Coho	Fall	Unknown	59		
	Coho	Unknown	Hatchery	67		
	Coho	Unknown	Unknown	130	2,454 Coho	
	Steelhead	Summer	Hatchery	2,621		
	Steelhead	Summer	Unknown	51		
	Steelhead	Summer	Wild	2,508	5,180 Steelhead	
	Sockeye	Summer	Hatchery	55		
	Sockeye	Summer	Wild	31		
	Sockeye	Unknown	Hatchery	21		
	Sockeye	Unknown	Wild	183	290 Sockeye	
	Unknown	Unknown	Unknown	8		
	Unknown	Unknown	Wild	357	365 Unknown	**136,786**
2003	Chinook	Spring	Wild	10	10 Chinook	
	Steelhead	Summer	Wild	1	1 Steelhead	**11**
			Total Observations at John Day:			**137,423**

Species Summary	Chinook	Coho	Steelhead	Sockeye	Unknown
Number	128,929	2,468	5,366	295	365
Percentage	93.8	1.8	3.9	0.2	0.3

Table A-6. John Day historical PIT tag detections, 1993-present.

Species	Run	Rearing Type	1993 (3B, 3C)	1994 (3B)	1995 (3B)	1996 (3B, 3C)	1997 (3B)	1998	1999	2000	2001	2002
								Full Bypass				
Chinook	Spring	Hatchery	199	205	267	677	66	8,528	21,928	4,420	11,267	72,237
		Wild	23	10	101	37	8	1,242	3,804	2,438	3,308	3,753
		Unknown								28		1,677
	Summer	Hatchery	24	16	52	145	57	3,656	2,502	5,782	38,291	14,157
		Wild	4		20	40	4	832	3,024	1,023	1,391	1,228
		Unknown				1		1				48
	Fall	Hatchery	4	3	52	187	38	12,174	7,046	4,375	9,346	14,511
		Wild	9	4	13	10	2	282	552	541	942	90
		Unknown						3	7,205	3,762	9,385	11,658
	Unknown	Hatchery	44	19	915	795	9	5,964	17,649	1,472	3,147	5,091
		Wild	17	4	253	182	1	1,190	3,948	3,331	256	4,060
		Unknown	15	14	28	215	5	3,340	5,748	254	450	419
Chinook Total			339	275	1,701	2,289	190	37,212	73,406	27,426	77,783	128,929
Steelhead	Spring	Hatchery				5						
		Wild							327			
	Summer	Hatchery	195	210	1,068	1,321	663	8,109	55,135	8,070	1,147	2,662
		Wild	62	26	115	141	61	2,510	4,106	5,390	572	2,653
		Unknown				1		10	18	1		51
	Unknown	Hatchery						63				
Steelhead Total			257	236	1,183	1,468	724	10,692	59,586	13,461	1,719	5,366
Coho	Fall	Hatchery				5	9	652	4,433	780	493	2,212
		Wild								12	6	
		Unknown						484	562	1	71	59
	Spring	Hatchery					3		1	22		
		Unknown								2		
	Unknown	Unknown										130
		Hatchery							1			67
Coho Total						5	12	1,136	4,997	817	570	2,468
Sockeye	Spring	Hatchery	17		3							
	Summer	Hatchery				8		186	207	26	13	56
		Wild		5	1			16	30	7		31
	Unknown	Hatchery				12	1	13	37		5	25
		Wild	19		9	2	1	355	442	43	187	183
		Unknown						4		47		
Sockeye Total			36	5	13	22	2	574	716	123	205	295
Unknown	Unknown	Wild						1				357
		Unknown								21	5	8
Unknown Total								1		21	5	365
TOTALS (all species combined) =			**632**	**516**	**2,897**	**3,784**	**928**	**49,615**	**138,705**	**41,848**	**80,282**	**137,423**

Table A-7. John Day mark recapture data, 2002.

	Species	Location	Color	Release Site	Release No.	No. Recaptured	Collection Est.
Elastomer Tags	Yearling Fall Chinook	Left	Blue	Snake River	150,000	98	2,437
	Yearling Spring Chinook	Left	Orange	Yakima River	136,700	332	9,952
		Right	Orange	Yakima River	128,900	283	7,241
		Right	Red	Yak., Tucannon, Wallowa Rvrs.	276,764	814	22,441
	Yearling Summer Chinook	Left	Yellow	South Fork Salmon River	57,000	8	65
	Yearling Unknown Chinook	Left	Green	Yakima R., Clearwater Rvr M.F.	295,500	542	14,494
		Left	Red	Yakima River, Snake River	596,000	2,430	62,112
		Right	Green	Yakima River, Snake River	292,500	476	11,358
	Summer Steelhead	Left	Green	Wenatchee River	93,000	312	7,478
		Left	Red	Wenatchee River, Touchet River	165,500	312	7,003
		Left	Yellow	Methow River	88,000	630	17,020
		Right	Green	Wenatchee River	75,000	211	4,466
		Right	Orange	Wenatchee River	54,000	90	3,233
		Right	Red	Tucannon River	57,955	85	2,787
				Total elastomer tags =	**2,466,819**	**6,623**	**172,613**

	Species	Location*	Code	Orient.	Release Site	Release No.	No. Recaptured	Collection Est.
Freeze Brands	Summer Steelhead	LA	IT	1	Grande Ronde River	41,454	3	207
		LA	IT	3	Touchet River	20,583	14	158
		RA	IT	3	Unknown		1	14
		LA	IV	1	Unknown		2	41
		LA	IV	3	Unknown		1	2
		RA	IV	3	Snake River	20,259	4	64
					Total Freeze Brands =	**82,296**	**25**	**486**

* RA = right anterior, LA = left anterior

Table A-8. John Day external mark recaptures, 1985-present.

	Year	Yearling Chinook	Subyearling Chinook	Unclipped Steelhead[1]	Clipped Steelhead	Coho	Sockeye	Total
Elastomer Tags	1996	628						628
	1997	201			135			336
	1998	432			417			849
	1999[2]	5,280			777			6,057
	2000[2]	7,292			176			7,468
	2001[2]	1,889		30				1,919
	2002[2]	4,983		1,619	21			6,623
Freeze Brands	1985	1,960	80		2,113	3	334	4,490
	1986	6,084	1,927		4,324	2	304	12,641
	1987	1,890	1,024		1,608	4	107	4,633
	1988	2,262	1,797		895	3	80	5,037
	1989	2,207	1,585		2,150	1	36	5,979
	1990	732	337		599	1	9	1,678
	1991	576	773		1,134		85	2,568
	1992[3]	1,420	945	66	546			2,977
	1993[3]	1,069	1,920	24	1,463		39	4,515
	1994	265	830		416			1,511
	1995	560	317		183			1,060
	1996	255	130		75	2		462
	1997				16			16
	1998				84			84
	1999				55			55
	2000				284			284
	2001				3			3
	2002				25			25

[1] Unclipped and clipped steelhead were not differentiated before 1992.
[2] Large increase due to research collection needs.
[3] Samples from gatewells 3B and 3C combined.

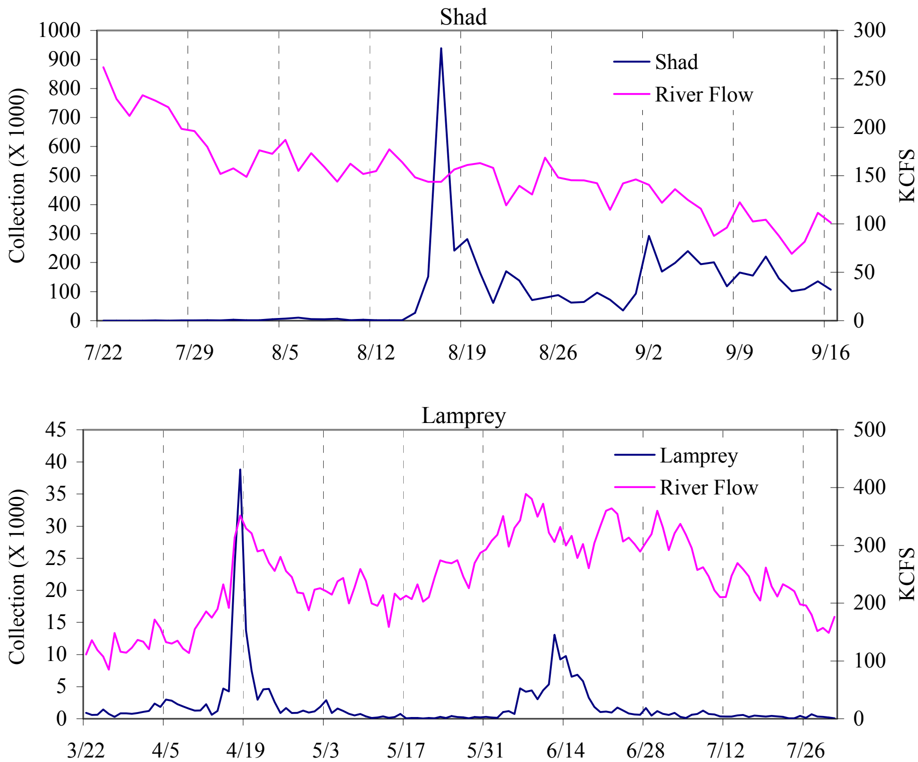


Figure A-6. John Day daily shad and lamprey passage, 2002.

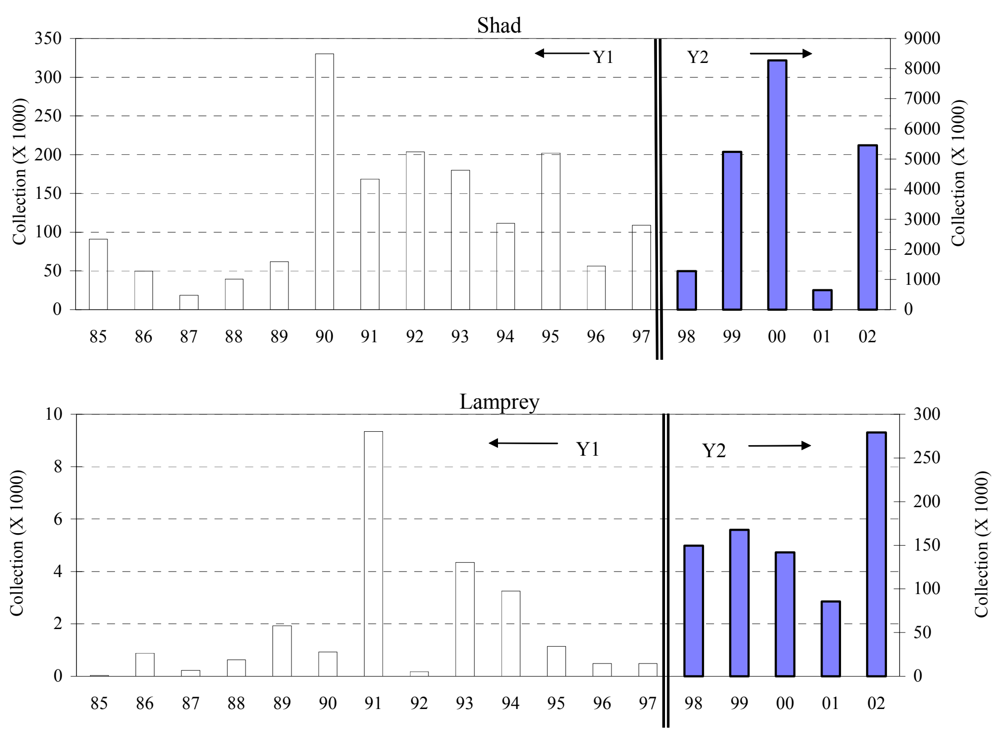


Figure A-7. John Day annual shad and lamprey collection totals, 1985-present. Sampling was conducted with the airlift system prior to 1998.

Table A-9. John Day collection numbers for incidental species, 1998-present.

Species	1998	1999	2000	2001	2002
American shad (Adult)	276	939	174	628	657
American Shad (Juvenile)	1,281,697	5,235,479	8,274,057	648,522	5,451,889
Bluegill/ Pumpkinseed	4,359	2,320	320	525	590
Bull trout					14
Bullhead	975	213	231	260	429
Carp	1,743	319	40	8	139
Channel catfish	2,045	3,550	349	261	166
Chinook Jack (12" to 22")					10
Chinook Minijack		149	7		10
Chiselmouth	196	2,050	1,452		60
Crappie	1,802	281	266	59	438
Dace	60	62	65	253	11
Kokanee	166	517	19		
Largemouth bass	168	297	66	450	28
Northern pikeminnow	187	236	5		121
Pacific lamprey (Adult)	1,012	493	467	586	928
Pacific lamprey (Brown)	30,256	33,500	3,363	435	8,164
Pacific lamprey (Silver)	119,227	134,356	138,298	85,281	271,138
Peamouth	310	117	5	12	83
Rainbow trout	326	32			
Redside shiner		7		4	
Sand roller	298	138	263	149	8
Sculpin	2,682	1,050	6,710	200,362	7,003
Smallmouth bass	7,554	1,586	1,821	3,422	4,441
Sucker	34,583	6,761	1,122	2,744	5,964
Threespine stickleback	4	30	3	4	150
Walleye	628	1,347	2,412	4,197	1,406
White sturgeon	209				
Whitefish	17,808	8,294	4,820	14,541	8,367
Yellow perch	201	799	362	978	3,763

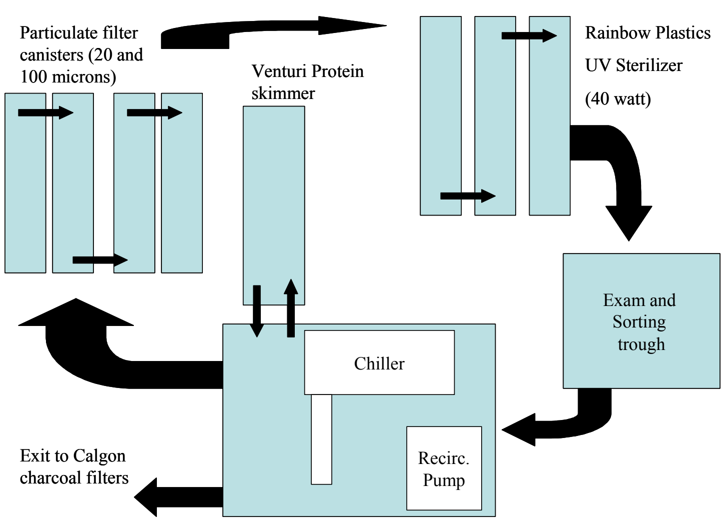


Figure A-8. John Day recirculation system (with filters).

Table A-10. John Day PDS dewatering summaries, 1998-present.

Date	Purpose/details	Adult Salmonids	P. Lamprey	Juvenile salmonids	Shad, cat-fish, other	Total
1998						
27-Jul-98	Scheduled inspection, Crest gate evaluation	69	100	30-50	138-258	337-477
23-Sep-98	PDS Adult holding investigation	130-140	50-100	200	22	402
29-Oct-98	End of season dewatering	164				164
1999						
2-Apr-99	PDS screen cleaner failure, switch gate repairs	2	20-30	50-60		72-92
9-Jun-99	Scheduled inspection, Crest gate malfunction	30-50				30-50
21-Sep-99	PDS Adult holding investigation	150-250	50-60		112	312-424
27-Oct-99	End of season dewatering	182	41		28	251
2000						
18-Sep-00	End of season dewatering	250	12	2	55	319
2001						
11-Jun-01	Scheduled inspection	45			255	300
23-Jul-01	Scheduled inspection	25			200	225
17-Sep-01	End of season dewatering	404			12	416
2002						
5-Oct-02	End of season dewatering	300	20		56	376

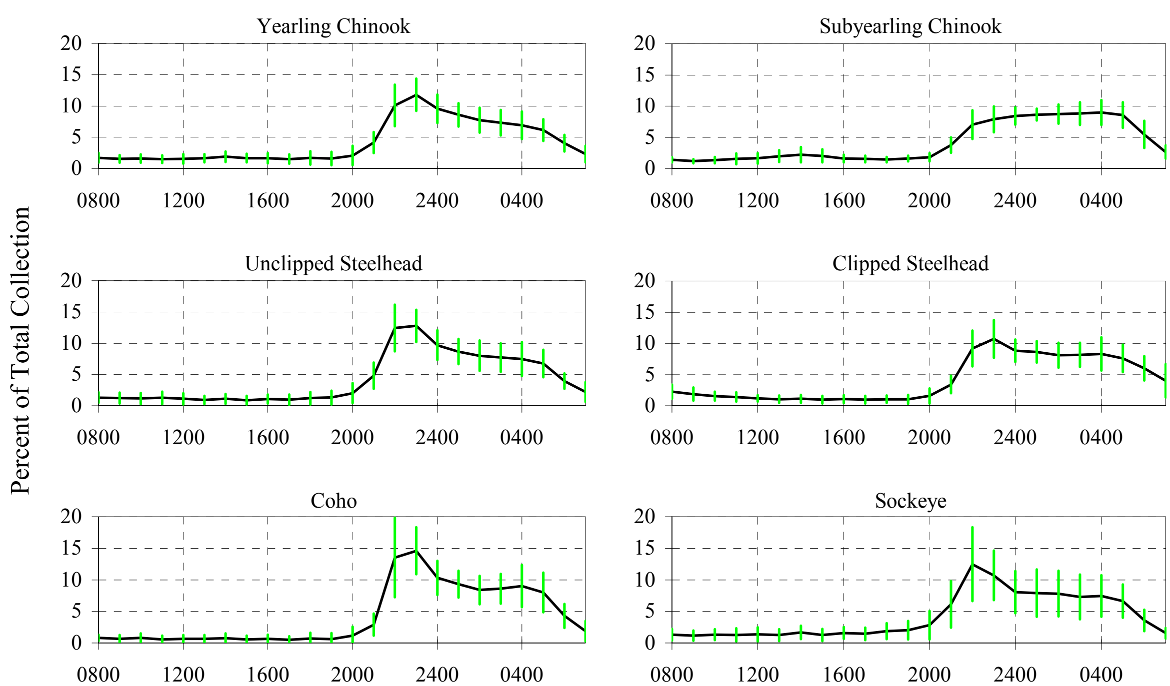


Figure A-9. John Day average diel passage with standard deviation, 1985-1997. Collection of hourly detail ceased in 1998 when sampling relocated to smolt monitoring facility.

Table A-11. John Day percent of total passage per hour, 1985-1997. Collection of hourly detail ceased in 1998 when sampling relocated to the smolt monitoring facility.

Yearling Chinook

	0800	0900	1000	1100	Noon	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	MID	0100	0200	0300	0400	0500	0600	0700
AVG	1.6	1.5	1.5	1.4	1.3	1.6	1.8	1.7	1.6	1.5	1.7	1.6	2.1	4.4	10.5	11.9	9.6	8.7	7.7	7.2	6.8	6.1	4.0	2.4
MIN	0.6	0.5	0.8	0.7	0.8	0.7	0.8	0.7	0.8	0.6	0.7	0.6	0.7	2.4	5.5	8.5	5.2	4.7	4.2	4.0	3.2	3.2	2.5	0.7
MAX	3.2	2.8	2.9	2.5	3.2	2.6	3.3	2.9	3.6	3.3	4.0	3.8	5.5	8.4	15.3	17.4	13.9	10.8	10.4	9.5	9.5	8.3	7.2	4.2

Subyearling Chinook

	0800	0900	1000	1100	Noon	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	MID	0100	0200	0300	0400	0500	0600	0700
AVG	1.4	1.2	1.3	1.7	1.6	1.8	1.9	1.7	1.4	1.4	1.3	1.5	1.7	3.9	7.4	7.5	8.1	8.6	8.9	8.8	9.3	8.9	5.9	2.7
MIN	0.8	0.7	0.8	0.7	0.7	0.6	0.7	0.7	0.8	0.7	0.8	1.0	0.9	2.3	3.3	4.4	6.6	7.1	6.1	6.3	6.0	6.0	3.1	1.1
MAX	2.0	1.9	2.4	3.3	3.7	3.6	4.7	4.0	2.7	2.7	2.1	2.2	3.2	5.7	12.1	12.1	11.4	10.1	11.6	12.4	12.9	12.8	9.4	4.1

Unclipped Steelhead

	0800	0900	1000	1100	Noon	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	MID	0100	0200	0300	0400	0500	0600	0700
AVG	1.4	1.3	1.2	1.3	1.1	0.9	1.1	0.9	1.1	1.0	1.3	1.4	2.2	4.7	12.8	12.8	9.4	8.6	7.7	7.4	7.2	6.5	4.2	2.5
MIN	0.3	0.3	0.3	0.2	0.2	0.2	0.3	0.2	0.3	0.2	0.2	0.1	0.3	2.1	8.1	8.7	5.4	5.3	4.3	4.4	3.9	3.6	2.1	0.4
MAX	2.9	3.0	2.9	3.1	2.9	2.2	2.6	2.3	2.6	2.6	3.5	3.2	5.2	7.3	18.0	16.1	13.7	12.4	12.6	11.1	12.0	10.7	6.1	5.5

Clipped Steelhead

	0800	0900	1000	1100	Noon	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	MID	0100	0200	0300	0400	0500	0600	0700
AVG	2.5	2.3	1.5	1.4	1.1	1.0	1.1	1.0	1.0	1.0	1.0	1.1	1.8	3.4	9.6	10.8	8.8	8.4	7.8	7.7	7.5	7.1	6.2	4.8
MIN	0.5	0.2	0.6	0.1	0.4	0.2	0.5	0.1	0.4	0.1	0.6	0.2	0.3	1.1	6.0	6.6	6.5	6.5	5.1	5.2	4.4	4.5	3.1	0.7
MAX	3.8	4.2	3.1	2.3	2.1	2.1	2.6	2.0	2.2	2.2	2.5	2.7	4.1	6.4	13.8	16.2	12.0	12.7	12.0	11.5	11.4	11.6	9.8	9.7

Coho

	0800	0900	1000	1100	Noon	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	MID	0100	0200	0300	0400	0500	0600	0700
AVG	0.9	0.8	0.8	0.7	0.7	0.7	0.8	0.7	0.6	0.5	0.8	0.7	1.3	2.7	14.7	14.7	9.4	8.8	7.5	7.9	8.4	8.0	5.0	2.9
MIN	0.2	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.2	0.5	5.0	10.4	5.7	5.0	5.4	5.4	4.9	4.7	1.5	0.3
MAX	1.7	2.1	2.3	2.1	2.3	2.1	2.5	2.0	2.1	1.9	3.5	3.4	5.2	6.2	25.0	22.2	16.7	13.4	13.4	12.0	15.3	13.6	7.9	5.6

Sockeye

	0800	0900	1000	1100	Noon	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	MID	0100	0200	0300	0400	0500	0600	0700
AVG	1.0	1.1	1.1	1.1	1.1	1.2	1.4	1.2	1.4	1.4	1.9	2.1	2.7	6.1	14.4	12.4	8.1	7.8	7.4	6.9	7.0	6.2	3.5	1.5
MIN	0.3	0.2	0.2	0.3	0.3	0.2	0.4	0.3	0.4	0.3	0.3	0.2	0.4	1.1	4.9	7.3	3.8	3.7	2.4	2.4	3.0	2.7	2.1	0.6
MAX	3.0	3.0	3.3	4.3	4.4	3.8	3.7	3.5	3.5	3.4	4.2	4.2	7.3	13.5	24.3	22.6	14.0	14.5	13.6	13.0	12.1	10.3	8.0	3.2

All Species Combined

	0800	0900	1000	1100	Noon	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	MID	0100	0200	0300	0400	0500	0600	0700
AVG	1.8	1.6	1.5	1.7	1.5	1.8	1.8	1.6	1.5	1.4	1.5	1.6	2.1	4.5	10.3	10.8	9.5	9.4	9.1	8.9	9.0	8.5	5.8	3.1
MIN	0.8	0.6	0.8	0.7	0.8	0.7	0.8	0.8	0.8	0.8	0.9	0.9	1.0	2.5	5.8	6.7	6.8	6.6	5.8	5.7	4.7	4.6	3.2	0.8
MAX	2.3	2.1	2.2	2.6	2.7	2.9	2.8	2.5	2.3	2.2	2.5	2.6	3.7	5.7	12.0	13.3	10.8	9.8	10.5	11.1	11.3	10.8	8.0	4.9

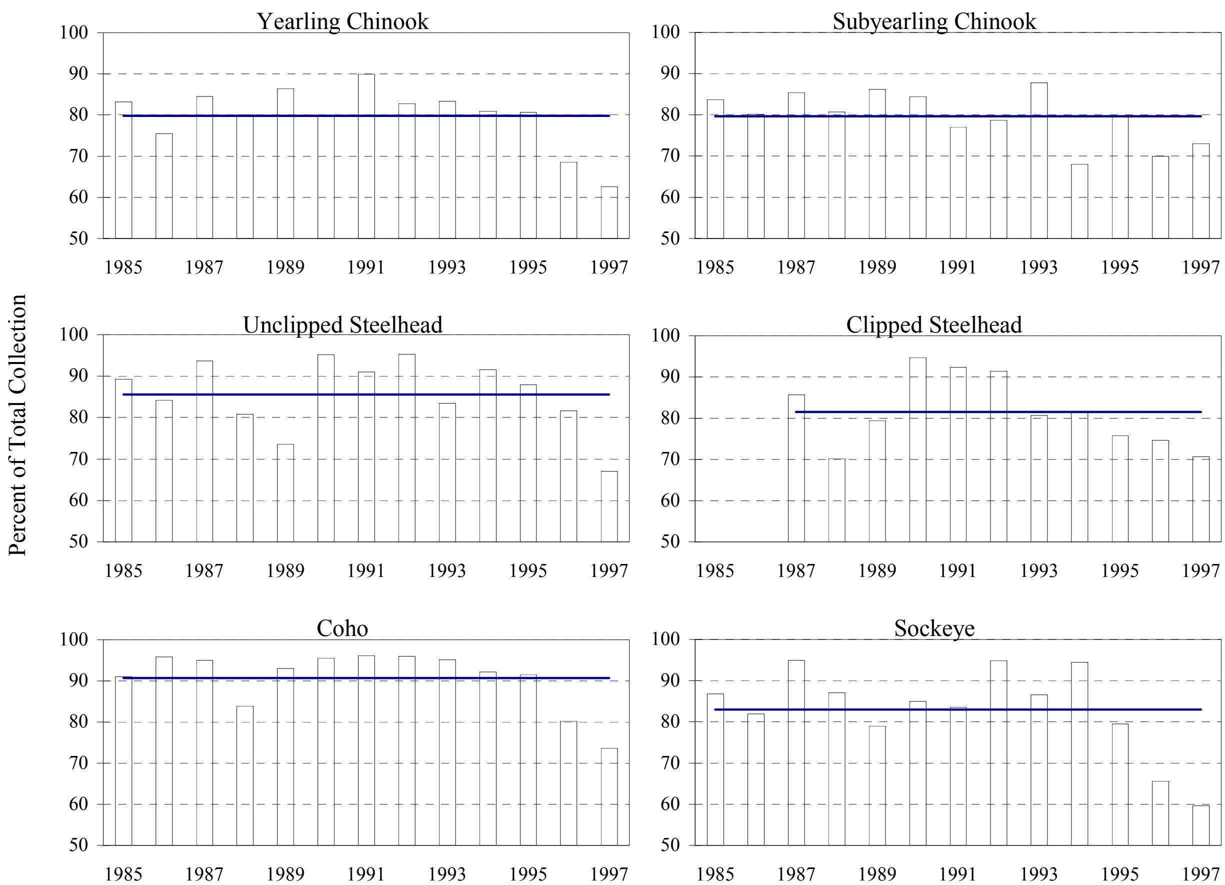


Figure A-10. John Day percent night passage (1800-0600 hours), 1985-1997, by species. Horizontal line is average for all years. Collection of hourly detail ceased in 1998 when sampling relocated to the smolt monitoring facility. Steelhead were not differentiated prior to 1987.

Table A-12. John Day percent night passage (1800-0600), 1985-1997. Collection of hourly detail ceased in 1998 when sampling relocated to smolt monitoring facility.

YEAR	Yearling Chinook	Subyearling Chinook	Unclipped Steelhead	Clipped Steelhead	Coho	Sockeye	All Species Combined
1985	83.2	83.7	89.3	N/A	91.0	86.8	68.1
1986	75.5	80.1	84.2	N/A	95.9	81.9	73.4
1987	84.5	85.4	93.6	85.6	95.0	94.9	82.2
1988	80.0	80.7	80.8	70.3	83.9	87.1	83.3
1989	86.4	86.2	73.6	79.4	93.0	79.0	86.0
1990	79.7	84.4	95.2	94.8	95.6	85.0	88.9
1991	89.9	77.0	91.0	92.3	96.2	83.6	87.7
1992	82.8	78.7	95.3	91.5	96.0	94.9	88.5
1993	83.3	87.8	83.4	80.7	95.1	86.5	83.3
1994	80.9	68.1	91.6	81.4	92.2	94.5	80.4
1995	80.7	79.7	87.9	75.8	91.5	79.5	89.4
1996	68.6	70.0	81.6	74.7	80.2	65.6	82.9
1997	62.6	73.1	67.0	70.6	73.7	59.6	86.4
AVERAGE	79.8	79.6	85.6	81.5	90.7	83.0	**83.1**
MIN	62.6	68.1	67.0	70.3	73.7	59.6	68.1
MAX	89.9	87.8	95.3	94.8	96.2	94.9	89.4

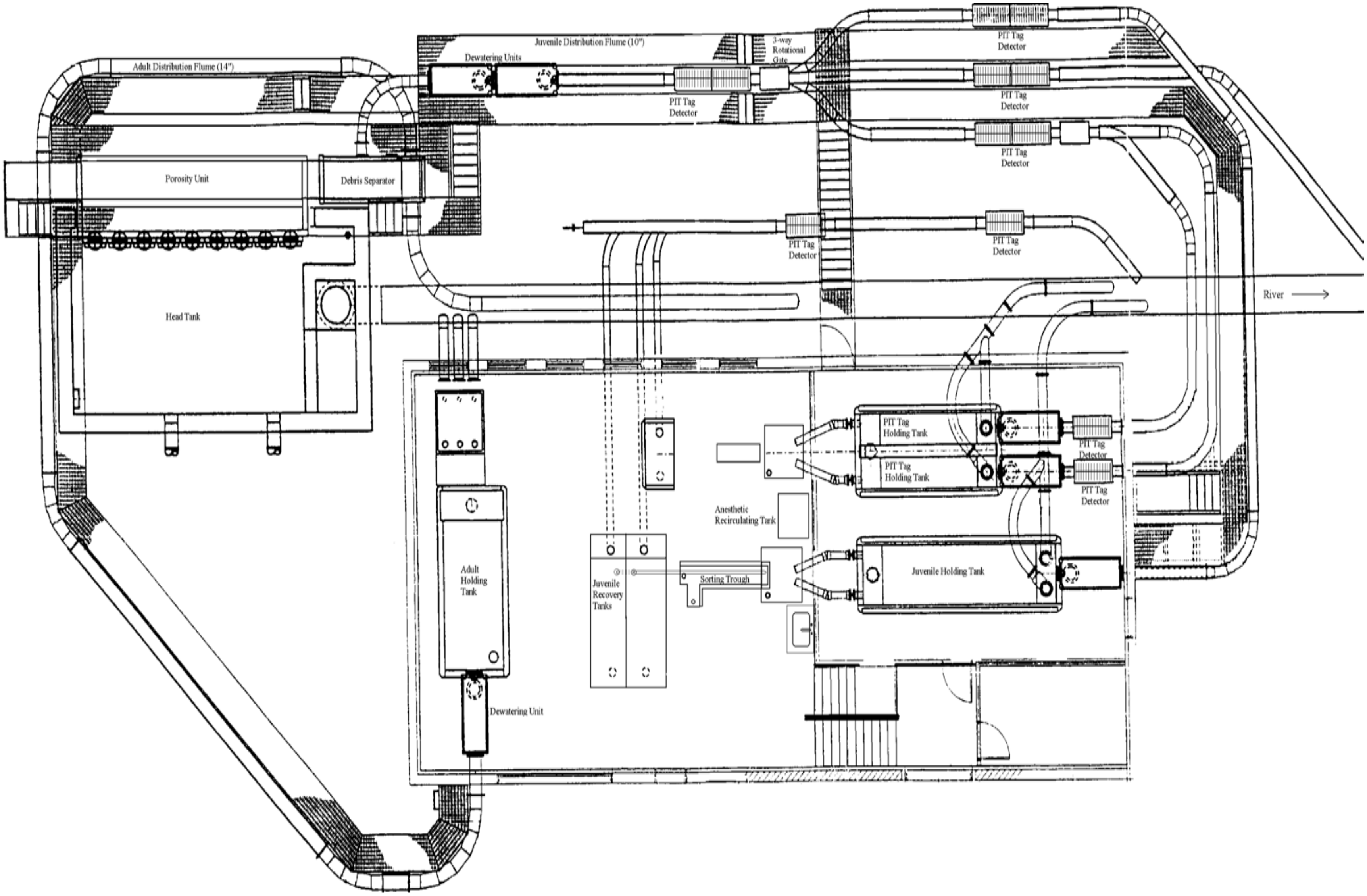


Figure A-11. John Day smolt monitoring facility laboratory layout, 1998-present.

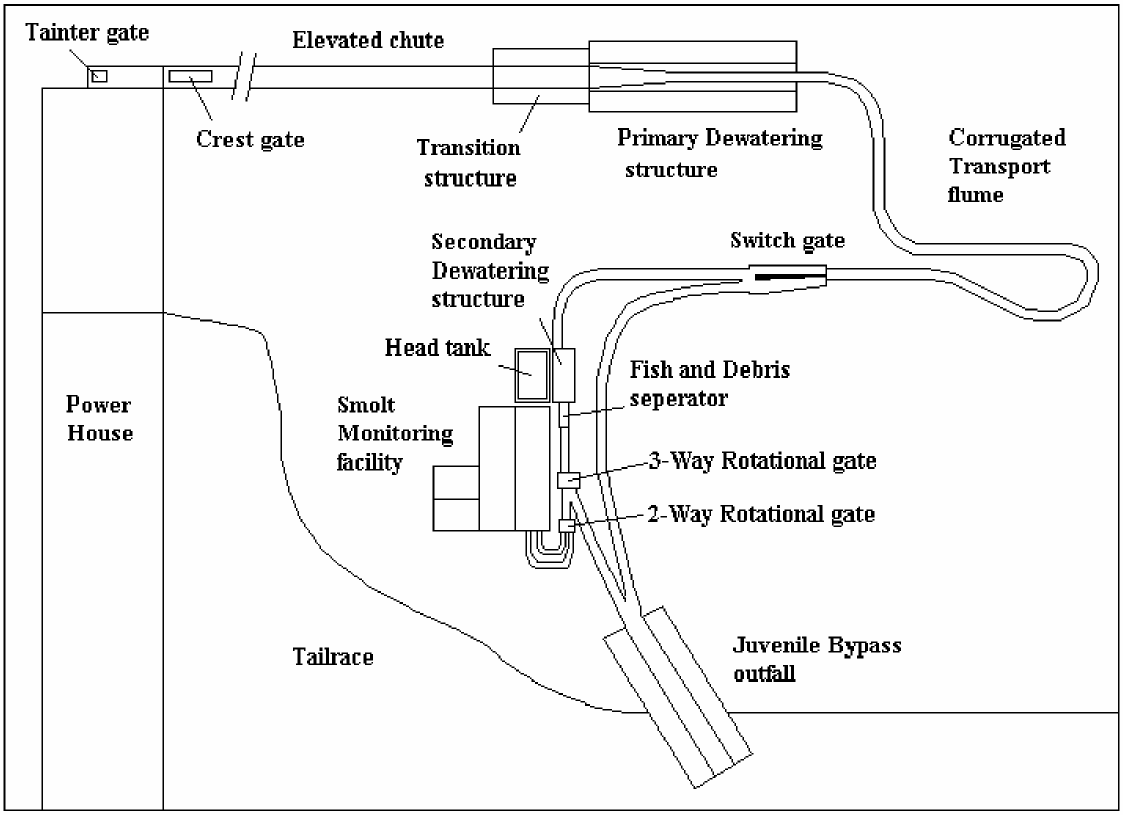


Figure A-12. John Day smolt monitoring facility "footprint", 1998-present.

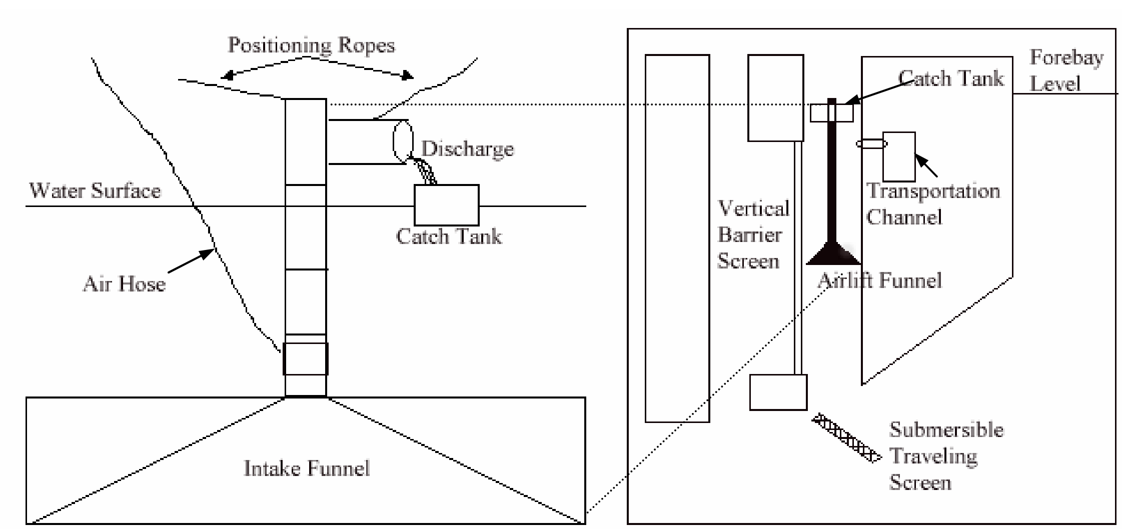


Figure A-13. John Day airlift sampling system, 1985-1997. Air was injected into the collar at the top of the funnel. This created a pressure differential and caused the water and fish inside the pipe to move up the pipe and dump into the suspended catch tank.

Table B-1. PH2 smolt monitoring program summary, 1986-present.

		Sampling	Sub-	Sample	Yearling Chinook			Subyearling Chinook					Coho				
Year	Dates	Effort	Sampling	Rate (%)	Sample #	Collection	Index	Sample #[1]	Fry	Collection	Fry	Index	Sample #	Fry	Collection	Fry	Index
1986	3/4-11/25	24 / 7	NO	10	10,917			16,844					6,112				
1987	3/10-11/20	24 / 4	NO	10	6,461			5,438					3,940				
1988	3/17-11/30	24 / 7	NO	10	7,068			9,744					5,555				
1989	3/17-11/30	24 / 7	NO	10	15,579			12,197					9,192				
1990	3/12-11/30	24 / 7	NO	10	5,463			20,469					6,300				
1991	3/15-11/30	24 / 7	NO	10	18,372			19,050					8,070				
1992	3/13-11/20	≤ 7 / MWF	NO	10	358			1,461					119				
1993	3/17-11/24	≤ 24 / MWF	NO	10	5,468			5,545					3,621				
1994	3/10-10/31	≤ 24 / MWF	NO	10	4,172			5,703					2,678				
1995	3/11-10/31	≤ 24 / MWF	NO	10	2,709			4,696					1,075				
1996	3/13-9/13	≤ 24 / MWF	NO	10	3,059			8,662					4,296				
1997	4/27-9/5	≤ 24 / MWF	NO	100	1,311			7,415	648		N/A		2,169	0		N/A	
1998	4/1-10/2	≤ 24 / MWF	NO	100	3,355			5,519	316		N/A		1,303	18		N/A	
1999[2]	NA																
2000[3]	3/8-10/31	24 / 7	YES	.67-25	17,337	809,700	2,539,355	19,683	1,118	1,130,109	18,790	3,814,964	11,596	6	619,676	40	1,977,601
2001	3/13-10/31	24 / 7	YES	.67-25	21,304	1,320,763	1,687,846	57,366	530	2,348,968	16,099	2,940,643	24,093	27	1,496,057	530	2,164,025
2002	3/11-10/31	24 / 7	YES	.5-25	16,723	1,367,791	3,328,200	47,695	2,106	2,951,612	57,987	6,999,286	10,572	35	935,337	544	2,331,599

		Sampling	Sub-	Sample	Unclipped Steelhead			Clipped Steelhead[4]			Sockeye			Total		
Year	Dates	Effort	Sampling	Rate	Sample #	Collection	Index	Sample #	Collection	Index	Sample #	Collection	Index	Sample #	Collection	Index
1986	3/4-11/25	24 / 7	NO	10	1,494						2,599			37,966		
1987	3/10-11/20	24 / 4	NO	10	823						642			17,304		
1988	3/17-11/30	24 / 7	NO	10	762						238			23,367		
1989	3/17-11/30	24 / 7	NO	10	2,049						2,247			41,264		
1990	3/12-11/30	24 / 7	NO	10	238			205			164			32,839		
1991	3/15-11/30	24 / 7	NO	10	952			1,630			2,592			50,666		
1992	3/13-11/20	≤ 7 / MWF	NO	10	3			4			1			1,946		
1993	3/17-11/24	≤ 24 / MWF	NO	10	255			462			624			15,975		
1994	3/10-10/31	≤ 24 / MWF	NO	10	218			279			400			13,450		
1995	3/11-10/31	≤ 24 / MWF	NO	10	65			183			355			9,083		
1996	3/13-9/13	≤ 24 / MWF	NO	10	182			531			196			16,926		
1997	4/27-9/5	≤ 24 / MWF	NO	100	461			1,596			520			13,472		
1998	4/1-10/2	≤ 24 / MWF	NO	100	696			720			711			12,304		
1999[2]	NA															
2000[3]	3/8-10/31	24 / 7	YES	.67-25	2,208	89,961	277,538	2,839	121,745	380,008	407	19,717	65,491	54,070	2,790,908	9,054,957
2001	3/13-10/31	24 / 7	YES	.67-25	2672	167,593	223,406	3,024	198,581	265,991	1,161	74,953	106,967	109,620	5,606,915	7,388,877
2002	3/11-10/31	24 / 7	YES	.5-25	2856	222,554	572,070	4,334	340,024	882,934	3,372	335,999	848,201	85,552	6,153,317	14,962,288

[1] Includes fry numbers.
[2] No sampling due to construction of new juvenile monitoring facility.
[3] First year of sampling in the juvenile monitoring facility.
[4] Unclipped and clipped steelhead were not differentiated prior to 1990.

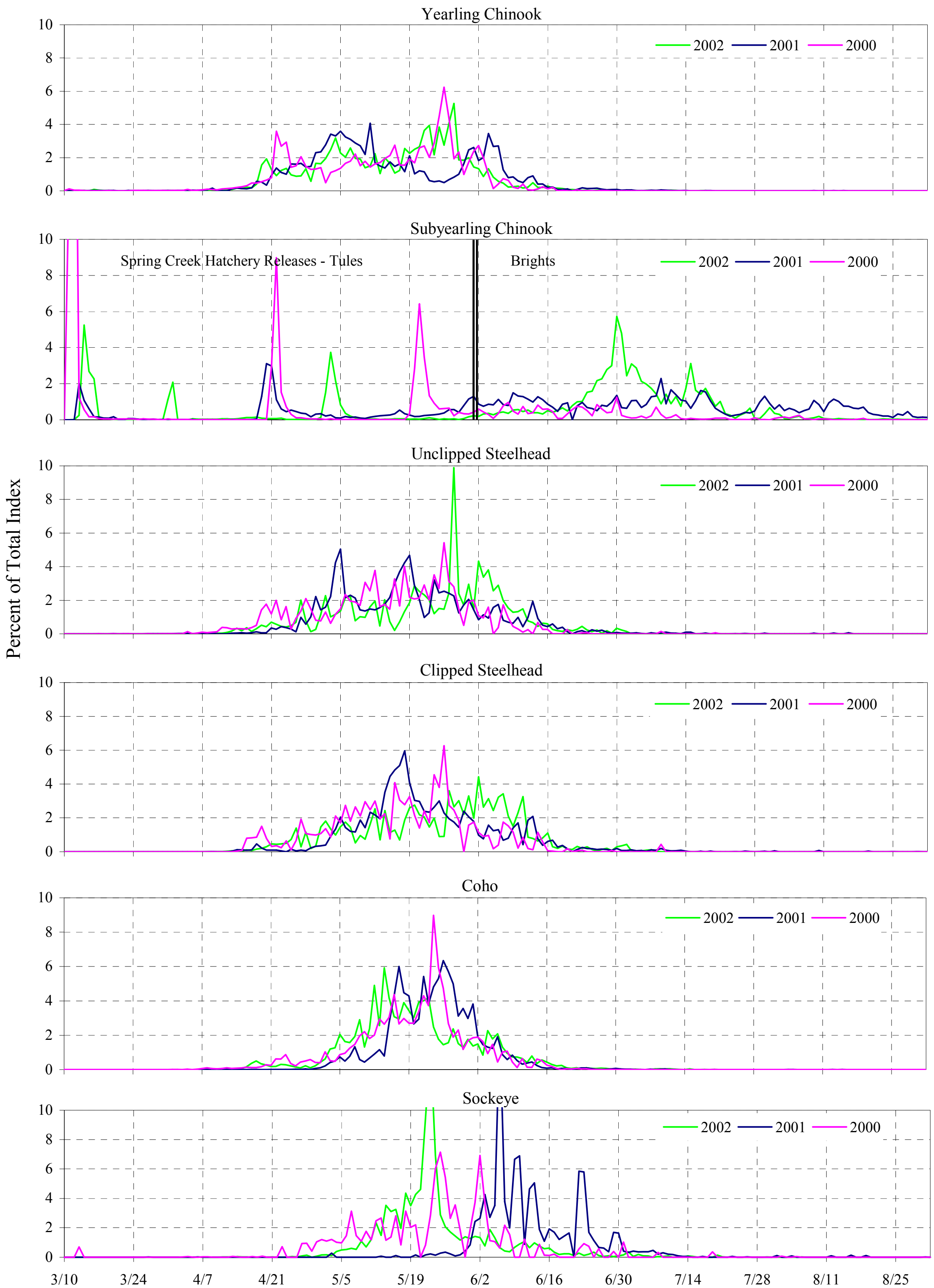


Figure B-1. PH2 daily passage for 2002, 2001 and 2000, as a percent of total index.

A
P
P
E
N
D
I
X

B

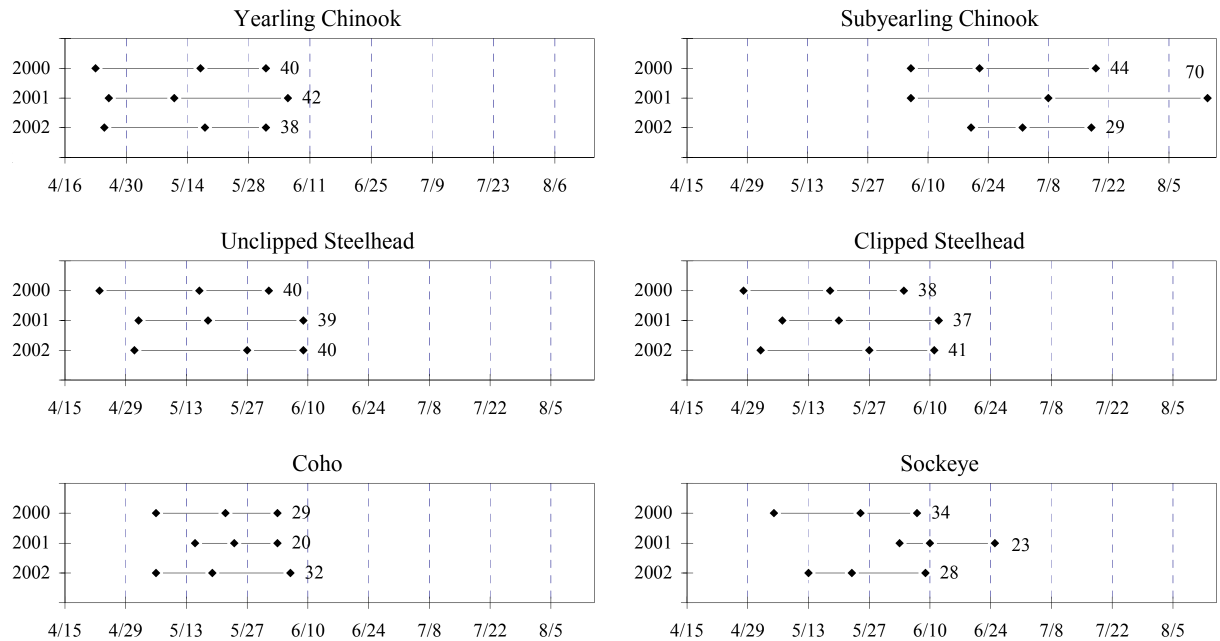


Figure B-2. PH2 10%, 50%, and 90% passage dates by species, 2000-present. The duration between 10-90% dates (in days) is indicated for each year.

Table B-2. PH2 10%, 50%, and 90% passage dates for 2000-present.

Yearling Chinook	10 %	50%	90 %	# of Days
2000	23-Apr	17-May	1-Jun	40
2001	26-Apr	11-May	6-Jun	42
2002	25-Apr	18-May	1-Jun	38

Subyearling Chinook[1]	10 %	50%	90 %	# of Days
2000	6-Jun	22-Jun	19-Jul	44
2001	7-Jun	9-Jul	15-Aug	70
2002	21-Jun	3-Jul	20-Jul	30

Unclipped Steelhead	10 %	50%	90 %	# of Days
2000	23-Apr	16-May	1-Jun	40
2001	2-May	18-May	9-Jun	39
2002	1-May	27-May	9-Jun	40

Clipped Steelhead	10 %	50%	90 %	# of Days
2000	28-Apr	18-May	4-Jun	38
2001	7-May	20-May	12-Jun	37
2002	2-May	27-May	11-Jun	41

Coho	10 %	50%	90 %	# of Days
2000	6-May	22-May	3-Jun	29
2001	15-May	24-May	3-Jun	20
2002	6-May	19-May	6-Jun	32

Sockeye	10 %	50%	90 %	# of Days
2000	5-May	25-May	7-Jun	34
2001	3-Jun	10-Jun	25-Jun	23
2002	13-May	23-May	9-Jun	28

[1] Only includes upriver brights to exclude the influence of Spring Creek NFH tules.

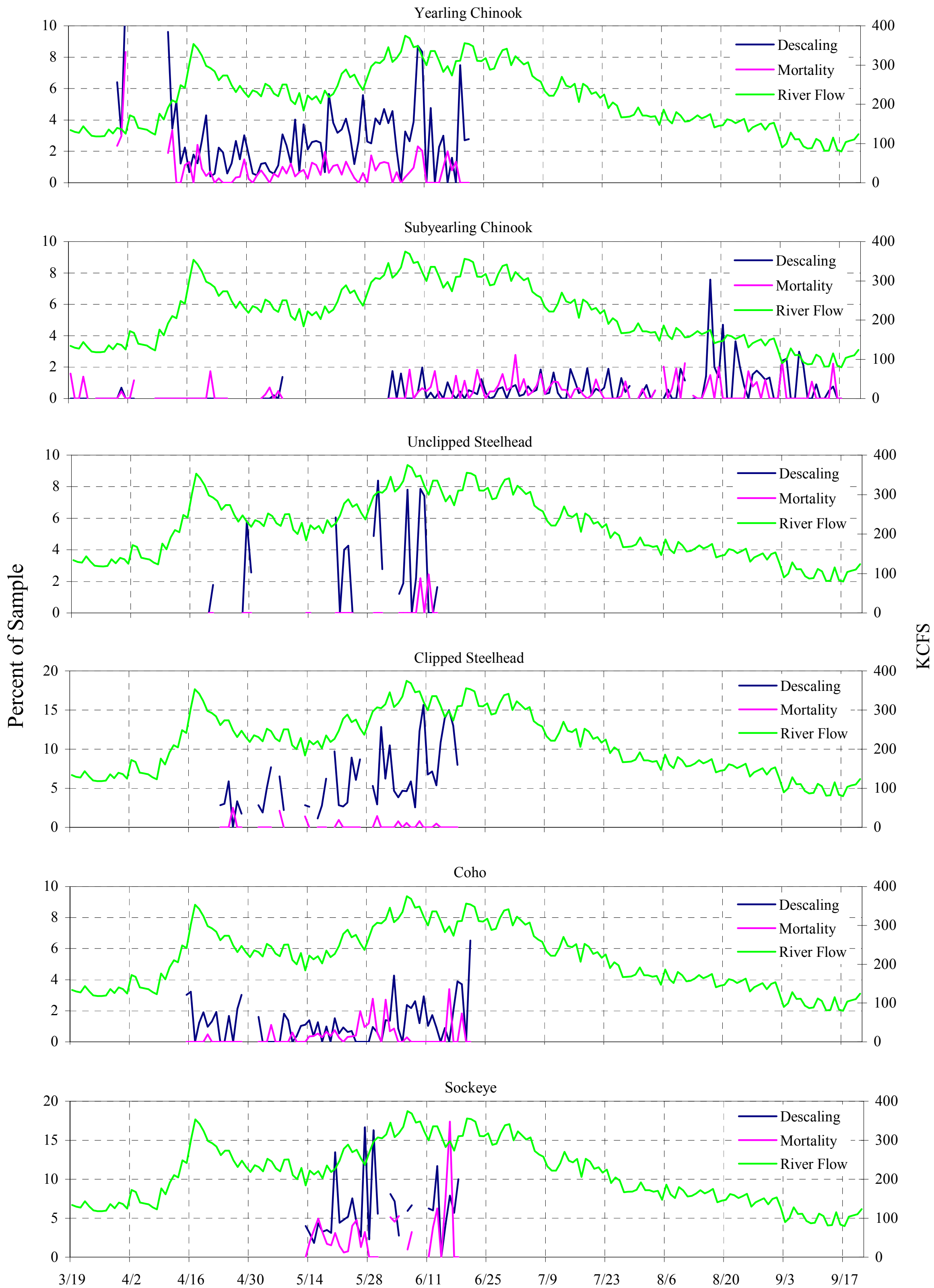


Figure B-3. PH2 daily percent descaling, mortality, and river flow for 2002. Days with sample size less than 30 were excluded. **Note percent of sample scale differences**.

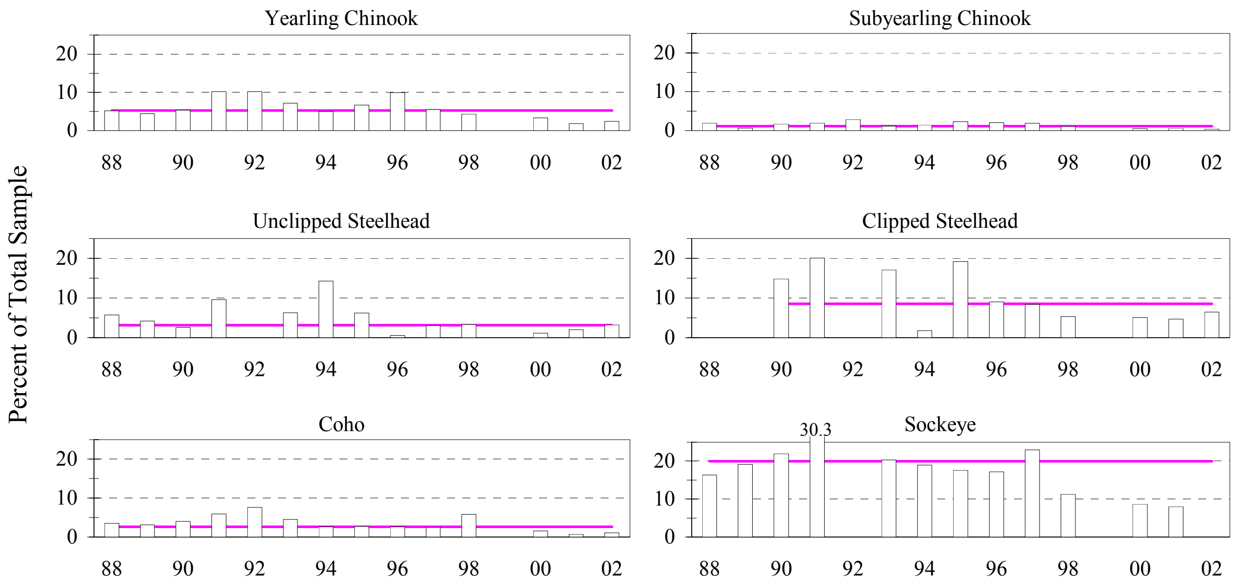


Figure B-4. PH2 annual descaling rate, 1988-present, horizontal line is the average. Clipped and unclipped steelhead were not differentiated before 1990. No sampling conducted in 1999 due to construction.

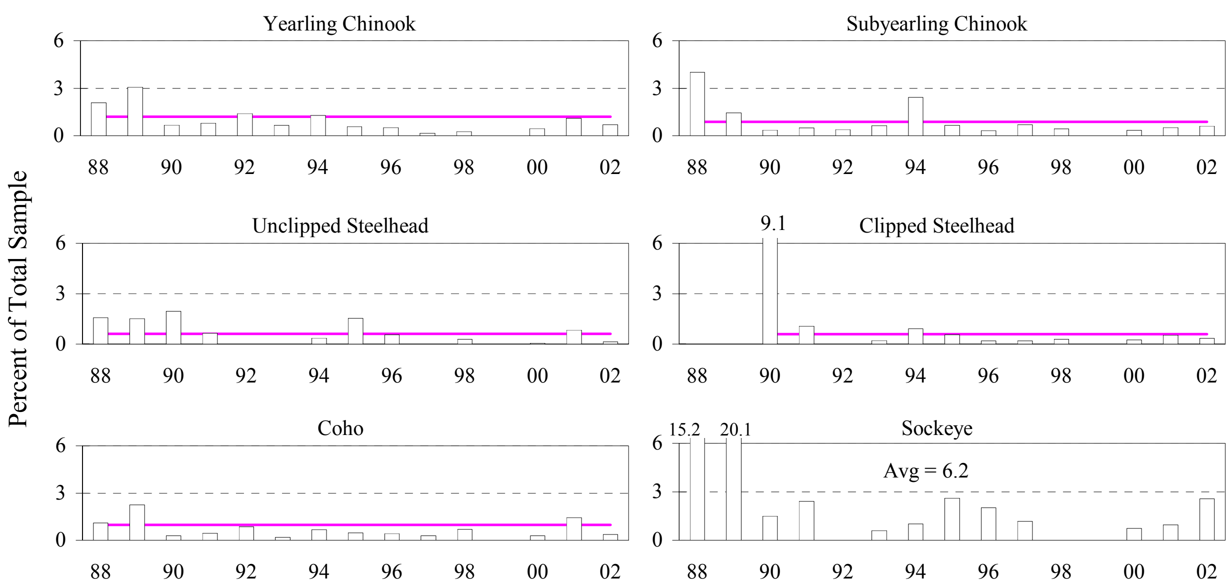


Figure B-5. PH2 annual mortality rate, 1988-present, horizontal line is the average. Clipped and unclipped steelhead were not differentiated before 1990. No sampling conducted in 1999 due to construction.

Table B-3. PH2 annual descaling and mortality data, 1988-present.

	YEARLING CHINOOK							SUBYEARLING CHINOOK						
YEAR	SAMPLE	DESC	%DESC	AVG	MORT	%MORT	AVG	SAMPLE	DESC	%DESC	AVG	MORT	%MORT	AVG
1988	7,076	361	5.2		147	2.1		9,711	185	2.0		390	4.0	
1989	15,579	671	4.4		478	3.1		12,144	74	0.6		176	1.5	
1990	5,267	278	5.3		36	0.7		2,669	8	0.3		10	0.4	
1991	17,943	1,780	10.0		143	0.8		7,846	140	1.8		39	0.5	
1992	358	36	10.2		5	1.4		1,452	42	2.9		6	0.4	
1993	5,468	393	7.2		36	0.7		5,545	65	1.2		36	0.7	
1994	4,172	208	5.1		54	1.3		5,703	80	1.4		138	2.4	
1995	2,709	180	6.7		16	0.6		4,696	108	2.3		31	0.7	
1996	3,059	304	10.0		16	0.5		8,662	176	2.0		29	0.3	
1997	1,311	72	5.5		2	0.2		7,415	138	1.9		52	0.7	
1998	3,355	146	4.4	6.8	9	0.3	1.4	5,519	57	1.0	1.5	24	0.4	1.3
1999[1]														
2000[2]	17,337	576	3.3		80	0.5		19,683	101	0.5		68	0.3	
2001[2]	21,304	384	1.8		236	1.1		57,366	325	0.6		300	0.5	
2002	16,723	397	2.4	2.5	119	0.7	0.8	47,695	201	0.4	0.5	293	0.6	0.5
TOTAL	104,938	5,389	5.2		1258	1.2		148,411	1,499	1.0		1299	0.9	

	UNCLIPPED STEELHEAD							CLIPPED STEELHEAD						
YEAR	SAMPLE	DESC	%DESC	AVG	MORT	%MORT	AVG	SAMPLE	DESC	%DESC	AVG	MORT	%MORT	AVG
1988[3]	762	43	5.7		12	1.6								
1989[3]	2,049	84	4.2		31	1.5								
1990	206	5	2.5		4	1.9		176	25	15.6		16	9.1	
1991	921	88	9.6		6	0.7		1,614	321	20.1		17	1.1	
1992	3	0	0.0		0	0.0		4	0	0.0		0	0.0	
1993	255	16	6.3		0	0.0		462	79	17.1		1	0.2	
1994	279	31	11.2		1	0.4		218	5	2.3		2	0.9	
1995	65	4	6.3		1	1.5		184	35	19.1		1	0.5	
1996	182	1	0.6		1	0.5		531	48	9.1		1	0.2	
1997	461	14	3.0		0	0.0		1,596	134	8.4		3	0.2	
1998	695	23	3.3	5.3	2	0.3	1.0	720	38	5.3	12.5	2	0.3	0.8
1999[1]														
2000[2]	5,047	57	1.1		3	0.1		2,839	143	5.0		7	0.2	
2001[2]	2,672	53	2.0		22	0.8		3,024	140	4.7		16	0.5	
2002	2,856	91	3.2	1.9	4	0.1	0.3	4,334	279	6.5	5.5	15	0.3	0.4
TOTAL	13,597	419	3.1		83	0.6		11,368	968	8.6		66	0.6	

	COHO							SOCKEYE						
YEAR	SAMPLE	DESC	%DESC	AVG	MORT	%MORT	AVG	SAMPLE	DESC	%DESC	AVG	MORT	%MORT	AVG
1988	5,556	195	3.6		61	1.1		237	33	16.4		36	15.2	
1989	9,192	282	3.1		207	2.3		2,247	343	19.1		451	20.1	
1990	5,498	204	3.7		16	0.3		137	25	18.5		2	1.5	
1991	7,284	448	6.2		33	0.5		2,575	761	30.3		61	2.4	
1992	119	9	7.6		1	0.8		1	1	100.0		0	0.0	
1993	3,621	162	4.5		7	0.2		623	126	20.4		4	0.6	
1994	2,678	69	2.6		18	0.7		400	75	18.9		4	1.0	
1995	1,075	29	2.7		5	0.5		348	61	18.0		9	2.6	
1996	4,296	113	2.6		18	0.4		196	33	17.2		4	2.0	
1997	2,169	54	2.5		6	0.3		520	118	23.0		6	1.2	
1998	1,303	75	5.8	3.9	9	0.7	0.9	711	80	11.3	22.3	0	0.0	7.2
1999[1]														
2000[2]	11,596	182	1.6		33	0.3		407	35	8.7		3	0.7	
2001[2]	24,093	176	0.7		348	1.4		1,161	92	8.0		11	0.9	
2002	10,572	114	1.1	1.0	38	0.4	0.9	3,372	192	5.8	6.6	86	2.6	2.0
TOTAL	78,480	1,998	2.6		762	1.0		9,563	1,783	19.9		591	6.2	

[1] No sampling was conducted in the second powerhouse in 1999 due to construction of the new bypass facility.
[2] 2000 was the first season when samples were collected at the juvenile bypass facility.
[3] Unclipped and clipped steelhead were not differentiated before 1990.

Table B-4. PH2 condition subsampling data, 2000-present, as a percent of total sample.

YEAR	NUMBER	DESCALING		INJURY					DISEASE				PREDATION	
	SAMPLED	3-19%	20%	HD	OP	PE	BODY	HEM	PAR	COL	FUNG	BKD	BIRD	OTHR
Yearling Chinook														
2000	3375	18.28	3.5	0.1	0.5	0.1	0.8	0.0	0.3	0.0	0.7	0.2	1.5	0.0
2001	4368	14.54	2.3	0.3	0.6	0.0	0.7	0.2	0.3	0.0	4.1	0.8	1.8	0.0
2002	3196	15.74	2.4	0.2	0.7	0.1	0.5	0.0	0.3	0.0	0.5	0.1	1.7	0.0
Subyearling Chinook														
2000	3310	10.76	1.0	0.1	0.3	0.1	0.5	0.2	0.3	0.0	0.3	0.1	0.4	0.1
2001	11579	8.62	1.0	0.1	0.4	0.0	0.6	0.1	0.2	0.0	0.1	0.0	0.3	0.2
2002	8124	5.64	0.9	0.1	0.5	0.0	0.6	0.1	0.4	0.0	0.1	0.0	0.3	0.1
Wild Steelhead														
2000	868	19.35	3.3	0.5	0.2	0.0	0.5	0.0	5.9	0.0	0.3	0.1	2.9	0.0
2001	1051	15.13	2.5	0.0	1.0	0.1	0.7	0.1	11.8	0.0	0.4	0.0	3.3	0.2
2002	1300	19.08	3.3	0.5	1.7	0.0	0.9	0.0	5.4	0.0	1.0	0.0	5.2	0.1
Hatchery Steelhead														
2000	1152	33.51	5.9	0.3	4.3	0.0	1.0	0.0	0.1	0.0	1.1	0.0	10.9	0.1
2001	1189	33.05	5.6	0.4	2.8	0.1	1.0	0.1	0.3	0.0	0.5	0.0	8.2	0.1
2002	1975	32.96	6.6	0.4	3.5	0.1	1.2	0.0	2.2	0.0	1.3	0.0	10.8	0.1
Coho														
2000	2788	10.72	1.7	0.1	0.2	0.0	0.4	0.0	0.1	0.0	0.9	0.0	0.9	0.1
2001	2136	11.00	0.6	0.2	0.5	0.0	0.6	0.1	0.1	0.0	0.9	0.0	0.9	0.0
2002	2731	11.39	1.1	0.3	0.2	0.0	0.4	0.0	0.1	0.0	1.0	0.0	1.0	0.1
Sockeye														
2000	192	34.38	8.9	0.0	1.6	0.5	0.5	1.0	0.0	0.0	0.0	0.0	0.5	0.0
2001	422	36.02	9.5	0.5	2.1	0.0	0.5	0.2	0.2	0.0	0.2	0.0	0.5	0.2
2002	1358	30.04	6.3	0.3	2.0	0.0	0.7	0.0	0.0	0.0	0.9	0.0	0.4	0.2

Table B-5. Bonneville PIT tag summary, 2002.

		Chinook												Unknown
Migration		Hatchery				Unknown				Wild				Unknown
Year	Site	FA	SP	SU	UN	FA	SP	SU	UN	FA	SP	SU	UN	Unknown
2000	B2J													
	BVX			1										
2000 Total				**1**										
2001	B2J	156	10	4	4	1			8	4	5	2	7	
	BVX	5	2	1							1			
2001 Total		**161**	**12**	**5**	**4**	**1**			**8**	**4**	**6**	**2**	**7**	
2002	B2J	11,063	44,801	8,388	4,349	3,397	3,210	11	136	53	1,860	845	2,516	91
	BVX	421	4,772	1,175	395	275	33		6	4	157	87	297	1
2002 Total		**11,484**	**49,573**	**9,563**	**4,744**	**3,672**	**3,243**	**11**	**142**	**57**	**2,017**	**932**	**2,813**	**92**
2003	B2J										15			
2003 Total											**15**			
Season Total	B2J	11,219	44,811	8,392	4,353	3,398	3,210	11	144	57	1,880	847	2,523	91
	BVX	426	4,774	1,177	395	275	33	0	6	4	158	87	297	1
	Totals	**11645**	**49,585**	**9,569**	**4,748**	**3,673**	**3,243**	**11**	**150**	**61**	**2,038**	**934**	**2,820**	**92**

		Coho				Sockeye				Steelhead					Totals
Migration		Hatchery		Unknown		Hatchery		Wild		Hatchery	Unknown		Wild		
Year	Site	FA	UN	FA	UN	SU	UN	SU	UN	SU	FA	SU	SU	UN	
2000	B2J												34		34
	BVX												1		2
2000 Total													**35**		**36**
2001	B2J	33				3	1	1	3	35			217		494
	BVX									3	1		5		18
2001 Total		**33**				**3**	**1**	**1**	**3**	**38**	**1**		**222**		**512**
2002	B2J	2,600	203	60	155	73	6	36	105	3,844		60	4,059	1	91,922
	BVX	186	10	2	3	8	2	3	9	280		3	212		8,341
2002 Total		**2,786**	**213**	**62**	**158**	**81**	**8**	**39**	**114**	**4,124**		**63**	**4,271**	**1**	**100,263**
2003	B2J														15
2003 Total															**15**
Season Total	B2J	2,633	203	60	155	76	7	37	108	3,879		60	4,310	1	92,465
	BVX	186	10	2	3	8	2	3	9	283	1	3	218		8,361
	Totals	**2,819**	**213**	**62**	**158**	**84**	**9**	**40**	**117**	**4,162**	**1**	**63**	**4,528**	**1**	**100,826**

B2J = PH2 JMF coils, BVX = Flat plate in PH1

Table B-6. Bonneville annual PIT tag detection totals, 1992-present.

Species	Run	Rearing Type	1992	1993	1994	1995	1996[1]	1997[2]	1998	1999	2000	2001	2002
Chinook	Spring	Hatchery	1	70	48	38	831	2,323	7,563	25,971	12,827	12,724	49,585
		Wild	1	13	5	13	60	127	832	12,860	2,495	1,803	2,038
		Unknown	4								18,041	1,847	3,243
	Summer	Hatchery		6	6	9	273	1,199	2,364	3,205	5,426	18,309	9,569
		Wild		1	2	5	43	75	604	2,114	1,553	1,363	934
		Unknown							1				11
	Fall	Hatchery		1		20	140	1,608	5,024	3,934	2,064	2,443	11,645
		Wild		2	3	2	2	117	79	230	58	142	61
		Unknown	2					7,127	3,891	24,167	6,693	3,421	3,673
	Unknown	Hatchery	4	15	7	131	1,057	161	5,018	14,124	4,277	2,292	4,748
		Wild		6	2	60	180	2	1,033	2,846	5,445	247	2,820
		Unknown	5	9	4	2	223	78	1,883	3,102	192	105	150
Chinook Total			17	123	77	280	2,809	12,817	28,292	92,553	59,071	44,696	88,477
Steelhead	Spring	Hatchery					18			1			
		Wild								188			
	Summer	Hatchery		16	19	46	1,454	7,242	4,747	28,118	9,312	1,509	4,162
		Wild		5	4	3	200	423	1,482	3,136	7,934	653	4,528
		Unknown		1			2	8	5	1			63
	Fall	Unknown											1
	Unknown	Hatchery							9				
		Wild											1
Steelhead Total			0	22	23	49	1,674	7,673	6,243	31,444	17,246	2,162	8,755
Coho	Spring	Hatchery						102		1	9		
		Unknown								5,040	9,010		
	Summer	Unknown							1				
	Fall	Hatchery					13	76	269	1,333	698	390	2,819
		Wild									12	4	
		Unknown							68	246	1	109	62
	Unknown	Hatchery							117	2			213
		Unknown						4,789	7,796				158
Coho Total							13	4,967	8,251	6,622	9,730	503	3,252
Sockeye	Spring	Hatchery		6									
	Summer	Hatchery					11	5	161	101	81	12	84
		Wild					2	1	12	10	7	2	40
		Unknown									635		
	Unknown	Hatchery	2		1		23	11	12	20	2	5	9
		Wild		4	4	1	16	33	158	248	20	125	117
		Unknown							2		21		
Sockeye Total			2	10	5	1	52	50	345	379	766	144	
Unknown	Unknown	Unknown									29		92
Unknown Total											29		92
TOTALS (all detections combined) =			**25**	**155**	**105**	**330**	**4,548**	**25,507**	**43,131**	**130,998**	**86,842**	**47,505**	**100,826**

[1] Beginning in 1996, all PH1 flat plate detections added.
[2] Beginning in 1997, all PH2 full bypass detections added.

Table B-7. PH2 mark recapture data, 2002.

	Species	Location	Color	Release Site	Release No.	No. Recaptured	Collection Est.
Elastomer Tags	Yearling Fall Chinook	Left	Blue	Snake River	150,000	5	593
	Yearling Spring Chinook	Left	Orange	Yakima River	136,700	21	2,309
		Right	Orange	Yakima River	128,900	10	993
		Right	Red	Yak., Tucannon, Wallowa Rvrs.	276,764	55	6,211
	Yearling Summer Chinook	Left	Yellow	South Fork Salmon River	57,000	3	300
	Yearling Unknown Chinook	Left	Green	Yakima R., Clearwater Rvr. M.F.	295,500	37	3,873
		Left	Red	Yakima River, Snake River	596,000	216	19,403
		Right	Green	Yakima River, Snake River	292,500	41	4,279
	Summer Steelhead	Left	Green	Wenatchee River	93,000	205	17,179
		Left	Red	Wenatchee River, Touchet River	165,500	110	9,619
		Right	Green	Wenatchee River	88,000	52	4,631
		Right	Orange	Wenatchee River	54,000	38	2,781
		Right	Red	Tucannon River	57,955	24	2,171
				Total Elastomer Tags =	2,466,819	**817**	**74,342**

	Species	Location*	Code	Orientation	Release Site	Release Number	Number Recaptured	Collection Estimate
Freeze Brands	Summer Steelhead	LA	IT	1	Grande Ronde R.	41,454	1	100
		LA	IT	3	Touchet River	20,583	3	300
		LA	IV	1	Unknown		1	100
		RA	IV	3	Snake River	20,259	1	100
					Total Freeze Brands =	82,296	**6**	**600**

Table B-8. Annual mark recapture data, 1988-present.

		Yearling Chinook		Subyearling Chinook		Unclipped Steelhead[1]		Clipped Steelhead		Coho		Sockeye		Total		Grand
	Year	PH1	PH2	PH1	PH2	PH1	PH2	PH1	PH2	PH1	PH2	PH1	PH2	PH1	PH2	Total
Elastomer Tags	1997	183	47					169	12					352	59	411
	1998	58	38					161	4					219	42	261
	1999	156						29						185	0	185
	2000	71	278					14	29					85	307	392
	2001	4	263						68					4	331	335
	2002	28	388			35	429							63	817	880
Freeze Brands	1988	425	56	165	2			157	8	2	1	55	4	804	71	875
	1989	521	247	364	24			443	51			16	4	1344	326	1670
	1990	286	23	189	27			218	9			6		699	59	758
	1991	258	71	235	5			204	32	2		48	11	747	119	866
	1992	220		212		18		40						490	0	490
	1993	349	42	360	10	6		57	4			19	3	791	59	850
	1994	55	7	187	20			27						269	27	296
	1995	181		147				77						405	0	405
	1996	55	36	44	12			59	4	1				159	52	211
	1997							30	2					30	2	32
	1998							7	1					7	1	8
	1999							1						1	0	1
	2000								11					0	11	11
	2001													0	0	0
	2002								6						6	6

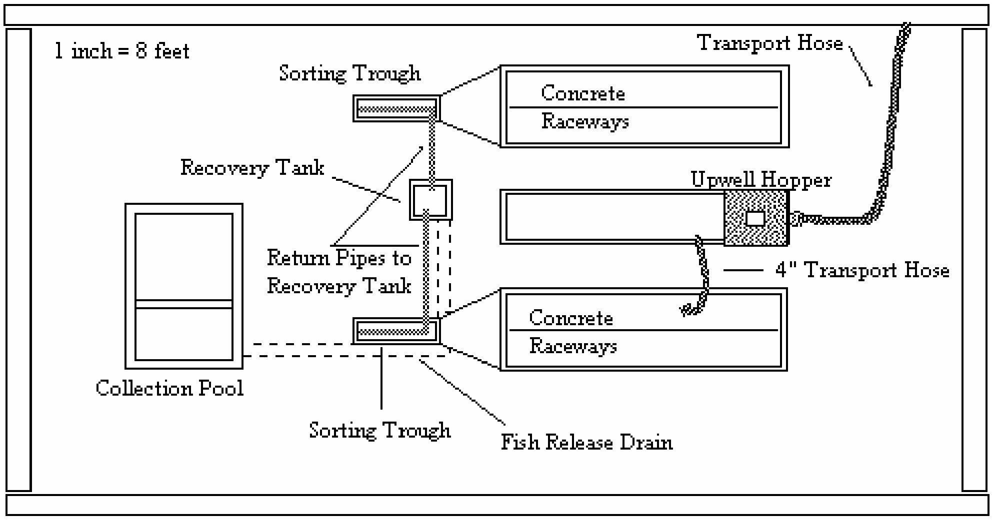
[1] Unclipped and clipped steelhead were not differentiated before 1992.

Figure B-6. PH2 daily juvenile shad and lamprey passage, 2002.

Table B-9. PH2 incidental collection summary, 2000-present.

Species	2000	2001	2002
American shad (Adult)	930	1,385	11,192
American shad (Juvenile)	4,359,372	1,376,845	6,444,156
Bluegill/ Pumpkinseed	306	168	174
Bullhead	29	17	8
Carp	472	98	27
Channel catfish	5		
Chinook Jack - Hatchery			100
Chinook Jack (12" to 22")	75		19
Chinook Minijack	10		
Chiselmouth			8
Crappie	10	4	24
Cutthroat trout	69		
Kokanee	134	12	68
Largemouth bass	255	28	52
Northern pikeminnow	356	1,282	983
Pacific lamprey (Adult)	39	100	192
Pacific lamprey (Brown)	138	245	283
Pacific lamprey (Silver)	7,361	9,390	22,160
Peamouth	3,416	8,972	3,250
Rainbow trout	277	58	14
Redside shiner	10	106	4
Sand roller		4	
Sculpin	454	99,853	3,077
Smallmouth bass	109	180	166
Sucker	56	91	126
Tench	20	40	
Threespine stickleback	319	71,718	95,689
Walleye		16	
White sturgeon	68		
Whitefish	29	276	142
Yellow perch			20

Figure B-7. PH2 laboratory area layout, 1986-1998.



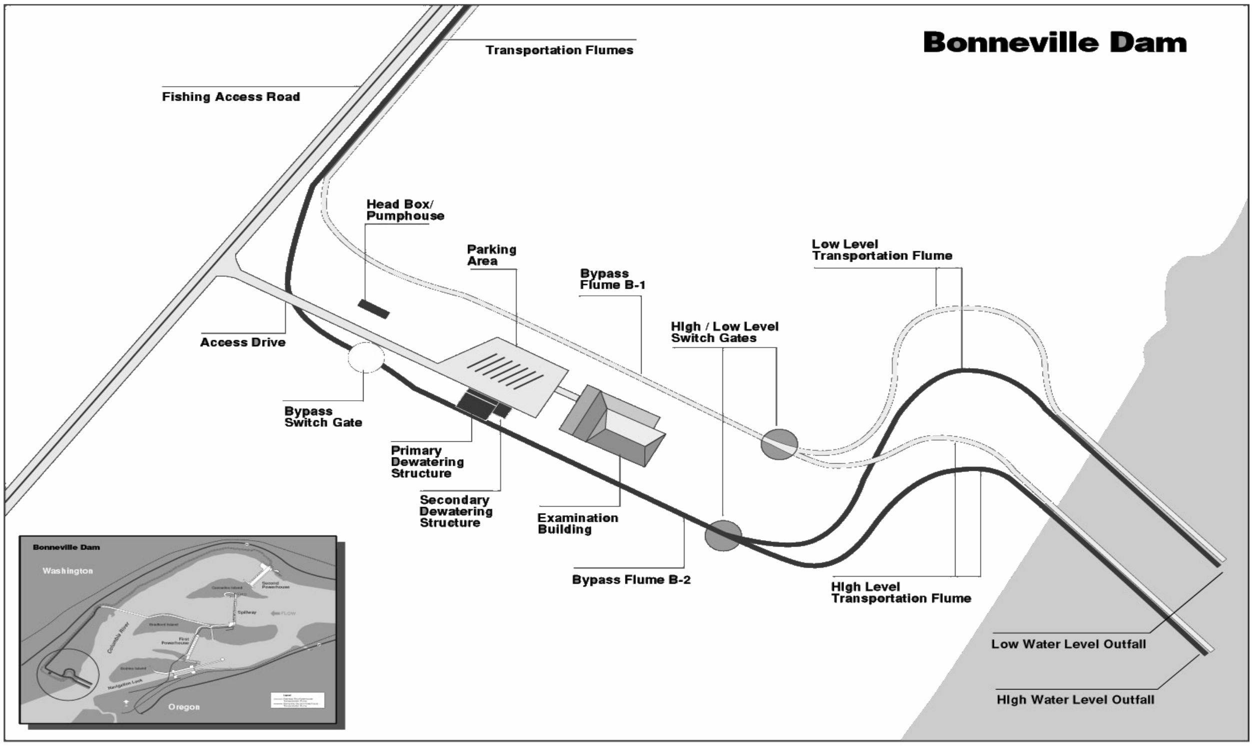


Figure B-8. Hamilton Island juvenile monitoring facility, 2000-present.

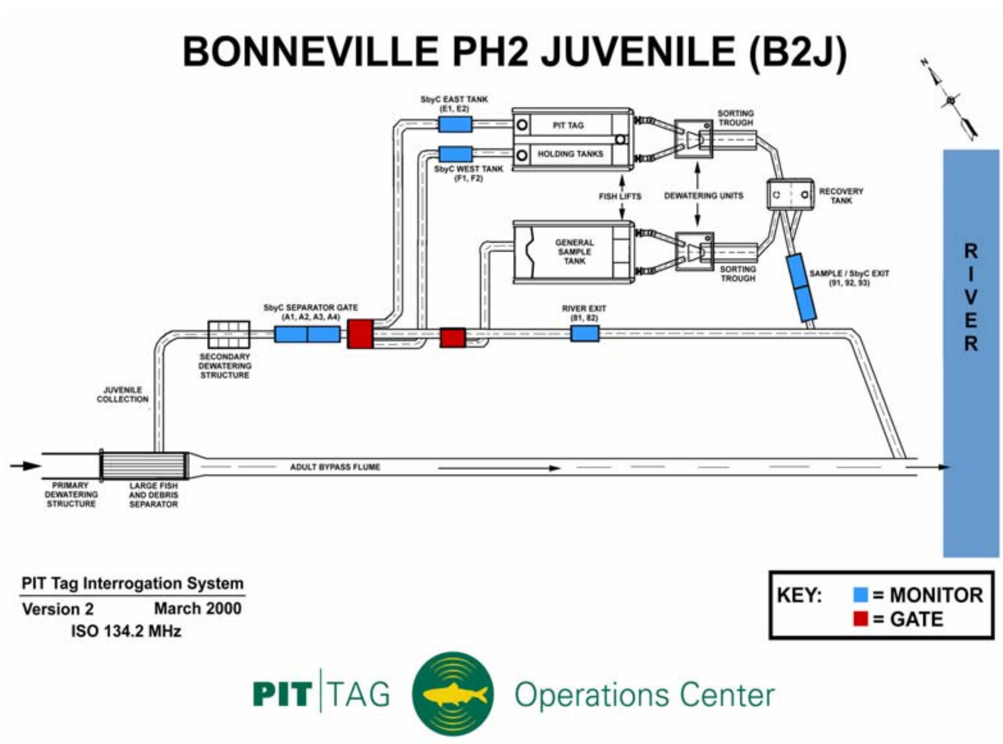


Figure B-9. Hamilton Island juvenile monitoring facility schematic, 2000-present.

APPENDIX B

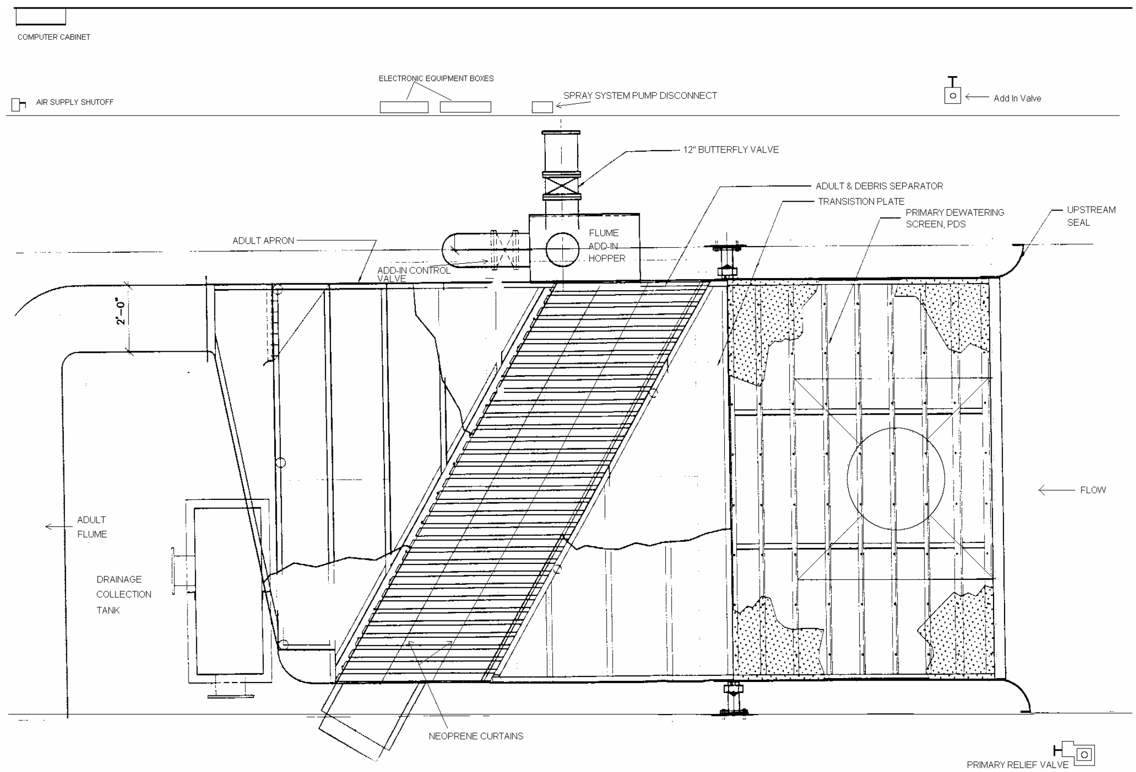


Figure B-10. PH2 PIT tag and sample collection system, top view, 1997-1998. This system was dismantled in 1999 to allow construction of new bypass at PH2.

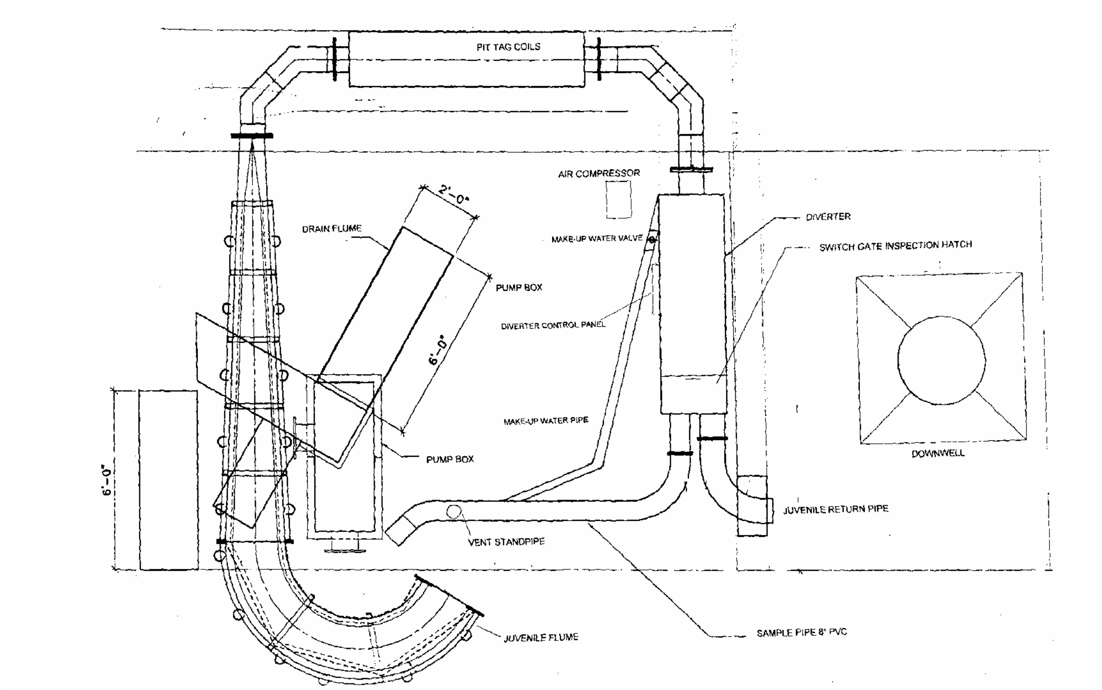


Figure B-11. PH2 PIT tag and collection system, lower level, 1997-1998. This system was dismantled in 1999 to allow construction of new bypass at PH2.

Table C-1. PH1 smolt monitoring program summary, 1986-present.

		Sampling	Sub-	Sample	**Yearling Chinook**			**Subyearling Chinook**					**Coho**				
Year	Dates	Effort	Sampling	Rate	Sample #	Collection	Index	Sample #[1]	Fry	Collection[1]	Fry	Index	Sample #	Fry	Collection	Fry	Index
1986	5/12-11/26	8hr, 5 d/wk	YES	-	9,495	48,282	NA	23,252		86,220		NA	11,538		54,181		NA
1987	3/13-11/20	8hr, 5 d/wk	YES	-	28,828	120,108	NA	61,925		371,000		NA	23,188		102,228		NA
1988	3/15-11/30	8hr/day	YES	-	26,955	301,479	365,812	96,413		580,644		724,102	40,750		419,286		599,194
1989	3/15-11/30	8hr/day	YES	.1-.25	27,935	223,134	435,455	98,521		1,332,736		1,756,794	29,746		257,244		491,618
1990	3/12-11/30	8hr/day	YES	.0167-.2	23,843	196,216	332,792	80,422		658,702		1,219,778	43,030		365,826		677,413
1991	3/15-11/30	8hr/day	YES	.0167-.2	29,374	242,016	609,411	83,189		604,368		1,257,388	23,842		216,330		575,098
1992	3/13-11/20	24hr/day	YES	.0167-.2	42,523	284,983	723,655	112,037	2,742	882,211	15,165	2,320,423	23,971		140,403		388,809
1993	3/17-11/24	24hr/day	YES	.0167-.2	52,623	715,905	2,168,019	130,615	5,659	1,181,615	61,457	4,339,394	28,243		392,627		1,250,698
1994	3/10-10/31	24hr/day	YES	.0167-.2	34,362	248,741	779,713	125,967	1,538	1,360,832	14,731	3,607,383	22,378	72	201,310	459	626,443
1995	3/11-10/31	24hr/day	YES	.0167-.2	19,557	500,804	1,776,344	60,356	1,917	994,015	30,440	3,406,412	11,868	156	301,950	1,389	1,104,471
1996	3/11-10/31	8hr/day	YES	.0167-.2	7,825	77,780	360,961	29,556	79	432,364	647	1,593,073	13,076	9	156,957	97	675,605
1997	3/17-10/30	8hr/day	YES	.0167-.2	5,938	56,891	286,666	44,024	459	342,192	3,761	1,501,962	12,346	13	128,031	105	706,780
1998	3/9-10/31	8hr/day	YES	.00833-.25	6,850	97,581	346,281	30,835	510	450,650	8,116	1,591,883	6,272	28	121,695	452	513,643
1999	3/13-10/31	8hr/day	YES	.00833-.25	15,279	165,918	638,606	35,637	154	474,874	1,451	1,692,665	8,411	10	98,370	64	375,644
2000[2]	4/3-8/31	6-8hr/day	NO	-	5,104	-	-	7,477	18	-	-	-	2,452	5	-	-	-
2001[2]	4/3-7/31	6-8hr/day	NO	-	1,164	-	-	4,245	6	-	-	-	397	1	-	-	-
2002[2]	4/8-7/23	1-8hr/day	NO	-	1,974	-	-	4,567	7	-	-	-	555	1	-	-	-

		Sampling	Sub-	Sample	**Unclipped Steelhead[3]**			**Clipped Steelhead**			**Sockeye**			**Total**		
Year	Dates	Effort	Sampling	Rate	Sample #	Collection	Index	Sample #	Collection	Index	Sample #	Collection	Index	Sample #	Collection	Index
1986	5/12-11/26	8hr, 5d/wk	YES	-	3,753	19,181	NA				2,883	14,350	NA	50,921	222,214	NA
1987	3/13-11/20	8hr, 5d/wk	YES	-	8,760	38,306	NA				4,079	18,733	NA	126,780	650,375	NA
1988	3/15-11/30	8hr/day	YES	-	7,473	75,662	103,701				4,587	52,023	77,921	176,178	1,429,094	1,870,730
1989	3/15-11/30	8hr/day	YES	.1-.25	12,240	106,787	206,226				7,723	72,962	138,310	176,165	1,992,863	3,028,403
1990	3/12-11/30	8hr/day	YES	.0167-.2	3,894	36,812	62,826	5,525	64,400	65,056	4,537	42,633	81,403	161,251	1,364,589	2,439,268
1991	3/15-11/30	8hr/day	YES	.0167-.2	2,775	26,295	74,438	5,504	54,528	155,754	4,462	47,722	147,174	149,146	1,191,259	2,819,263
1992	3/13-11/20	24hr/day	YES	.0167-.2	2,837	16,503	46,098	3,767	21,915	62,486	638	3,872	10,835	185,773	1,349,887	3,552,306
1993	3/17-11/24	24hr/day	YES	.0167-.2	4,025	74,138	226,120	7,456	185,240	563,884	4,939	178,245	538,837	227,901	2,727,770	9,086,952
1994	3/10-10/31	24hr/day	YES	.0167-.2	3,730	29,796	93,520	3,981	33,827	105,693	2,965	27,945	87,146	193,383	1,902,451	5,299,898
1995	3/11-10/31	24hr/day	YES	.0167-.2	1,240	29,963	106,889	3,737	103,508	376,571	2,184	71,990	263,680	98,942	2,002,230	7,034,367
1996	3/11-10/31	8hr/day	YES	.0167-.2	1,885	22,787	101,655	5,083	58,825	254,448	703	7,239	28,513	58,128	755,952	3,014,255
1997	3/17-10/30	8hr/day	YES	.0167-.2	3,615	38,829	205,873	9,285	105,516	575,077	589	5,765	31,099	75,797	677,224	3,307,458
1998	3/9-10/31	8hr/day	YES	.00833-.25	2,587	40,862	159,916	3,294	57,078	237,299	1,737	26,963	114,564	51,575	794,829	2,963,585
1999	3/13-10/31	8hr/day	YES	.00833-.25	2,549	94,322	108,164	5,647	65,488	65,488	2,118	33,100	118,203	69,641	866,584	3,176,429
2000[2]	4/3-8/31	6-8hr, 3d/wk	NO	-	1,314	-	-	1,378	-	-	223	-	-	17,948	-	-
2001[2]	4/3-7/31	6-8hr, 3d/wk	NO	-	91	-	-	25	-	-	9	-	-	5,931	-	-
2002[2]	4/8-7/23	1-8hr, 3d/wk	NO	-	219	-	-	248	-	-	531	-	-	8,094	-	-

[1] Includes fry numbers.
[2] Sampling reduced to condition monitoring only, collection and index estimates not available.
[3] Unclipped and clipped steelhead were not differentiated prior to 1990.

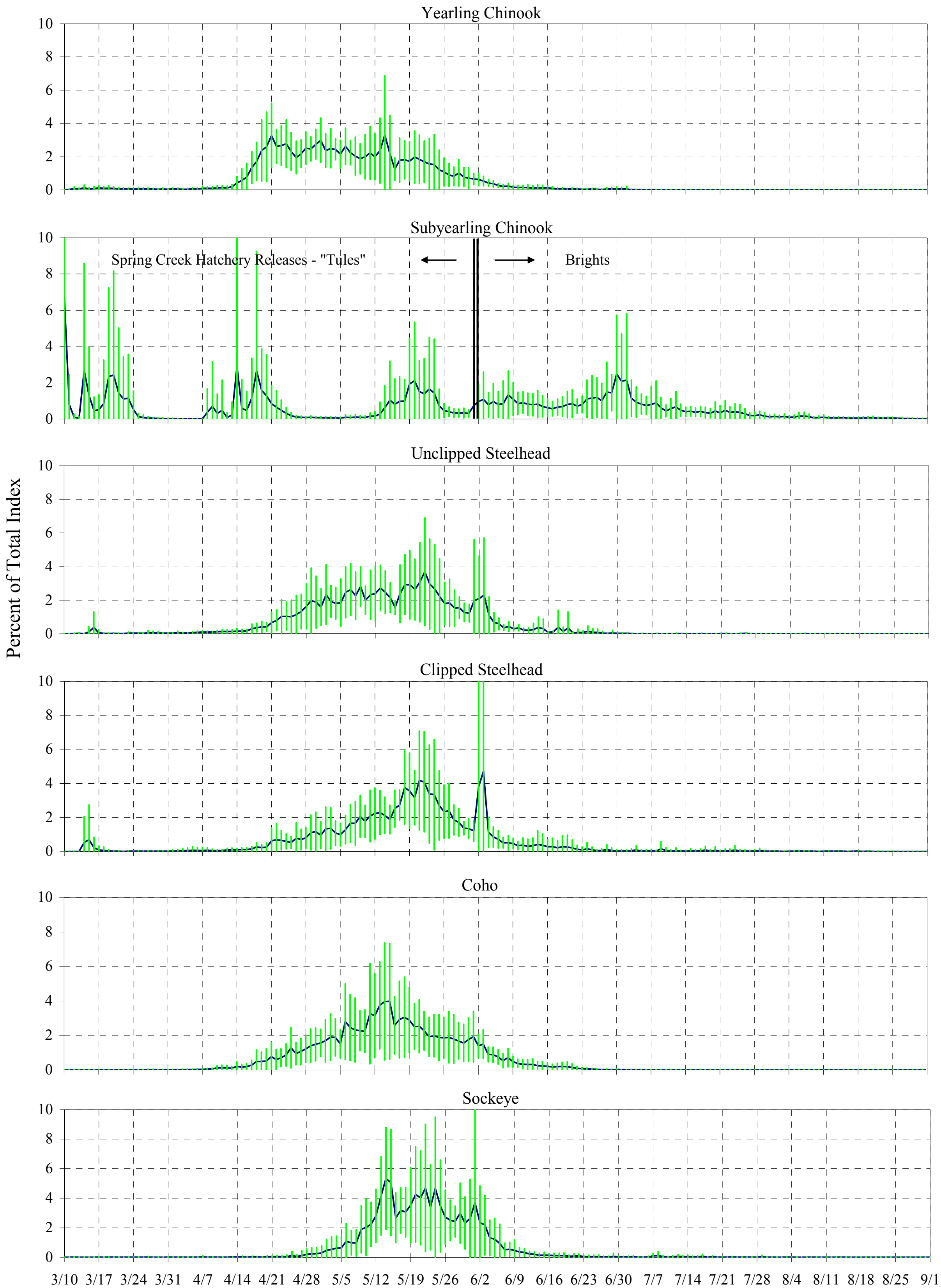


Figure C-1. PH1 average daily passage, 1987-1999, as a percent of total index with the standard deviation.

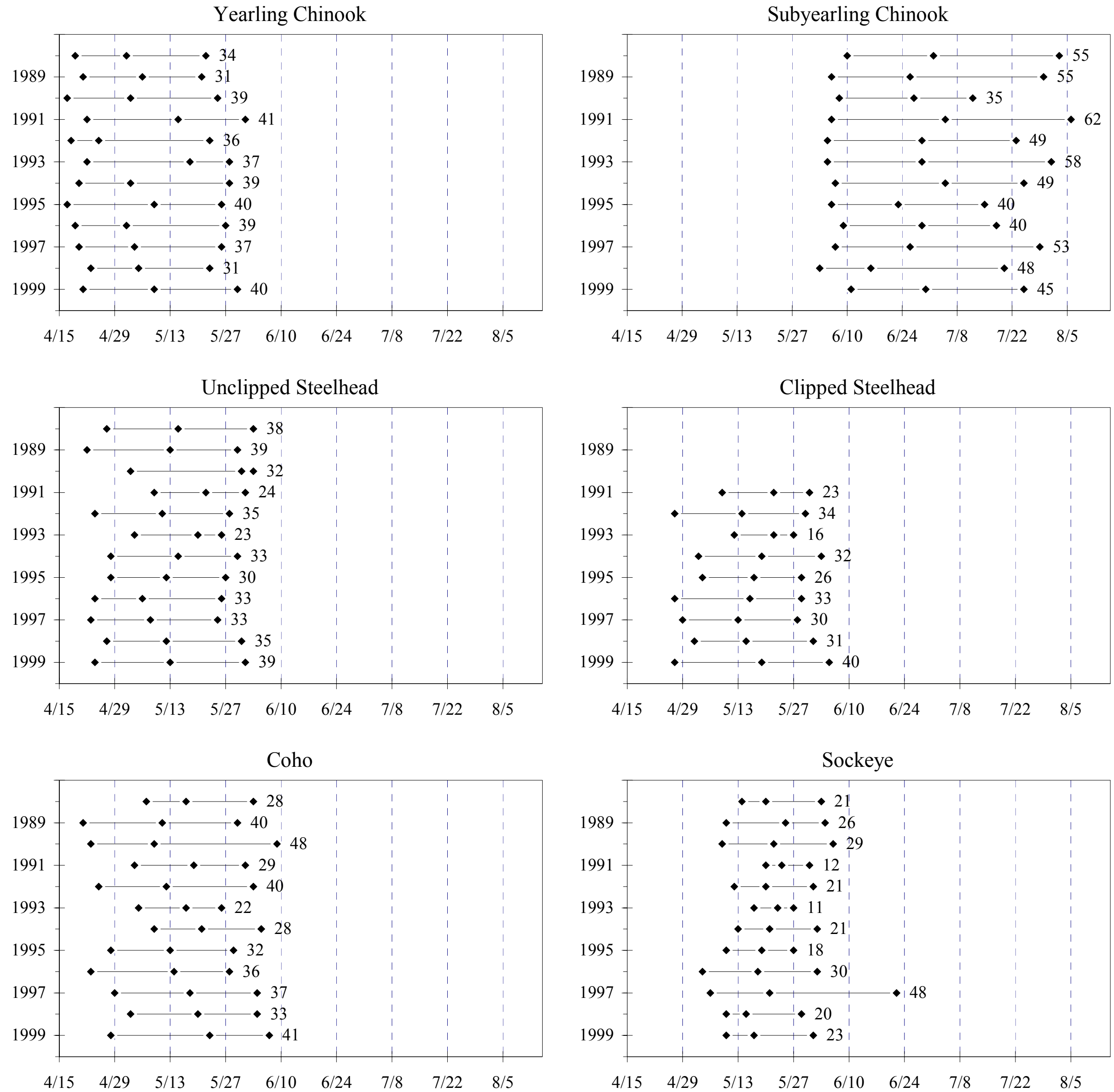


Figure C-2. PH1 10%, 50%, and 90% passage dates by species, 1988-1999. The duration between 10-90% dates (in days) is indicated for each year. Clipped and unclipped steelhead were not differentiated before 1991. Timing and duration calculations made only with PH2 data after 1999.

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Table C-2. PH1 10%, 50%, and 90% passage dates for 1988-1999. This data collected at PH2 after 1999.

Yearling Chinook	10 %	50%	90 %	# of Days
1988	19-Apr	02-May	22-May	34
1989	21-Apr	06-May	21-May	31
1990	17-Apr	03-May	25-May	39
1991	22-Apr	15-May	01-Jun	41
1992	18-Apr	25-Apr	23-May	36
1993	22-Apr	18-May	28-May	37
1994	20-Apr	03-May	28-May	39
1995	17-Apr	09-May	26-May	40
1996	19-Apr	02-May	27-May	39
1997	20-Apr	4-May	26-May	37
1998	23-Apr	5-May	23-May	31
1999	21-Apr	9-May	30-May	40
MEDIAN	20-Apr	04-May	26-May	37
MIN	17-Apr	25-Apr	21-May	31
MAX	23-Apr	18-May	01-Jun	41

Subyearling Chinook - "Brights" Only	10 %	50%	90 %	# of Days
1988	10-Jun	02-Jul	03-Aug	55
1989	06-Jun	26-Jun	30-Jul	55
1990	08-Jun	27-Jun	12-Jul	35
1991	06-Jun	05-Jul	06-Aug	62
1992	05-Jun	29-Jun	23-Jul	49
1993	05-Jun	29-Jun	01-Aug	58
1994	07-Jun	05-Jul	25-Jul	49
1995	6-Jun	23-Jun	15-Jul	40
1996	9-Jun	29-Jun	18-Jul	40
1997	7-Jun	26-Jun	29-Jul	53
1998	3-Jun	16-Jun	20-Jul	48
1999	11-Jun	30-Jun	25-Jul	45
MEDIAN	06-Jun	29-Jun	25-Jul	50
MIN	03-Jun	16-Jun	12-Jul	35
MAX	11-Jun	05-Jul	06-Aug	62

Unclipped Steelhead[1]	10 %	50%	90 %	# of Days
1988	27-Apr	15-May	03-Jun	38
1989	22-Apr	13-May	30-May	39
1990	03-May	31-May	03-Jun	32
1991	09-May	22-May	01-Jun	24
1992	24-Apr	11-May	28-May	35
1993	04-May	20-May	26-May	23
1994	28-Apr	15-May	30-May	33
1995	28-Apr	12-May	27-May	30
1996	24-Apr	6-May	26-May	33
1997	23-Apr	8-May	25-May	33
1998	27-Apr	12-May	31-May	35
1999	24-Apr	13-May	1-Jun	39
MEDIAN	27-Apr	13-May	30-May	34
MIN	22-Apr	06-May	25-May	23
MAX	09-May	31-May	03-Jun	39

Clipped Steelhead[1]	10 %	50%	90 %	# of Days
1988				
1989				
1990				
1991	09-May	22-May	31-May	23
1992	27-Apr	14-May	30-May	34
1993	12-May	22-May	27-May	16
1994	03-May	19-May	03-Jun	32
1995	04-May	17-May	29-May	26
1996	27-Apr	16-May	29-May	33
1997	29-Apr	13-May	28-May	30
1998	2-May	15-May	1-Jun	31
1999	27-Apr	19-May	5-Jun	40
MEDIAN	02-May	17-May	30-May	29
MIN	27-Apr	13-May	27-May	16
MAX	12-May	22-May	05-Jun	40

Coho	10 %	50%	90 %	# of Days
1988	07-May	17-May	03-Jun	28
1989	21-Apr	11-May	30-May	40
1990	23-Apr	09-May	09-Jun	48
1991	04-May	19-May	01-Jun	29
1992	25-Apr	12-May	03-Jun	40
1993	05-May	17-May	26-May	22
1994	09-May	21-May	05-Jun	28
1995	28-Apr	13-May	29-May	32
1996	23-Apr	14-May	28-May	36
1997	29-Apr	18-May	4-Jun	37
1998	3-May	20-May	4-Jun	33
1999	28-Apr	23-May	7-Jun	41
MEDIAN	28-Apr	17-May	03-Jun	37
MIN	21-Apr	09-May	26-May	22
MAX	09-May	23-May	09-Jun	48

Sockeye (Wild + Hatchery)	10 %	50%	90 %	# of Days
1988	14-May	20-May	3-Jun	21
1989	10-May	25-May	4-Jun	26
1990	9-May	22-May	6-Jun	29
1991	20-May	24-May	31-May	12
1992	12-May	20-May	1-Jun	21
1993	17-May	23-May	27-May	11
1994	13-May	21-May	2-Jun	21
1995	10-May	19-May	27-May	18
1996	4-May	18-May	2-Jun	30
1997	6-May	21-May	22-Jun	48
1998	10-May	15-May	29-May	20
1999	10-May	17-May	1-Jun	23
MEDIAN	10-May	20-May	01-Jun	24
MIN	04-May	15-May	27-May	11
MAX	20-May	25-May	22-Jun	48

[1] Unclipped and clipped steelhead were not differentiated before 1991 for index purposes.

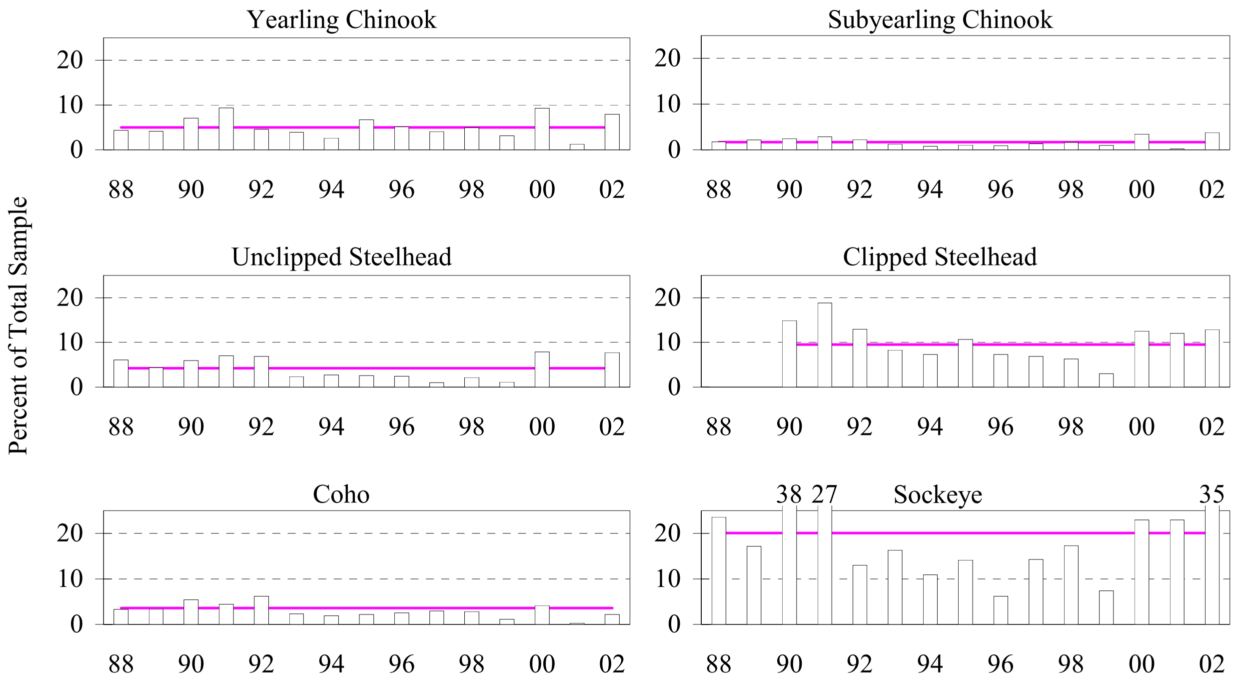


Figure C-3. PH1 annual descaling rate, 1988-present, horizontal line is the average. Clipped and unclipped steelhead were not differentiated before 1990.

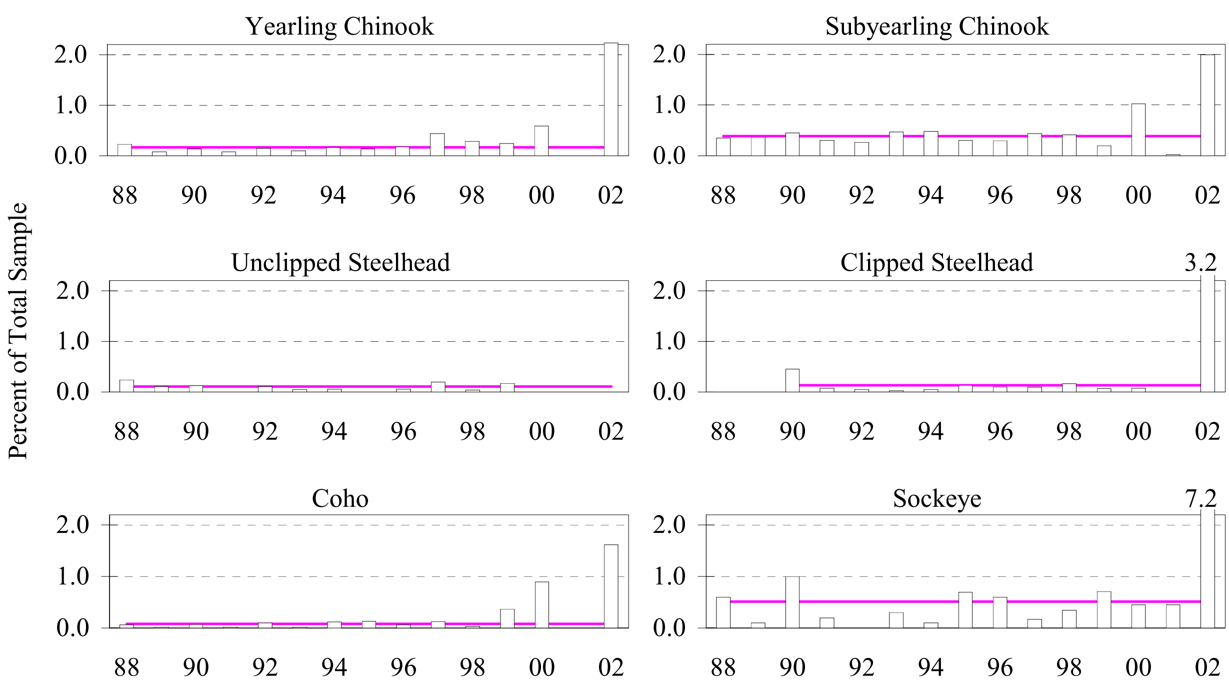


Figure C-4. PH1 annual mortality rate, 1988-present, horizontal line is the average. Clipped and unclipped steelhead were not differentiated before 1990.

Table C-3. PH1 annual descaling and mortality data, 1988-present.

	YEARLING CHINOOK					SUBYEARLING CHINOOK				
YEAR	SAMPLE	DESC	%DESC	MORT	%MORT	SAMPLE	DESC	%DESC	MORT	%MORT
1988	28,958	1,265	4.4	67	0.2	96,416	1,659	1.7	337	0.4
1989	27,934	1,164	4.2	22	0.1	98,571	2,119	2.2	361	0.4
1990	23,821	1,675	7.0	34	0.1	80,446	1,956	2.4	358	0.5
1991	29,409	2,741	9.3	24	0.1	83,240	2,383	2.9	257	0.3
1992[1]	42,523	1,952	4.6	62	0.2	112,037	2,517	2.3	301	0.3
1993[1]	52,623	2,050	3.9	51	0.1	130,616	1,657	1.3	611	0.5
1994[1]	34,361	896	2.6	58	0.2	125,967	999	0.8	600	0.5
1995[1]	19,557	1,310	6.7	27	0.1	60,356	651	1.1	189	0.3
1996	7,246	370	5.1	13	0.2	27,113	254	0.9	82	0.3
1997	5,938	239	4.0	26	0.4	44,024	595	1.4	192	0.4
1998	6,850	337	4.9	20	0.3	30,835	485	1.6	127	0.4
1999	16,279	482	3.2	37	0.2	35,637	339	1.0	71	0.2
2000[2]	5,104	471	9.3	30	0.6	7,477	253	3.4	77	1.0
2001[2]	1,164	15	1.3	0	0.0	4,245	10	0.2	1	0.0
2002[2]	1,974	153	7.9	44	2.2	4,567	170	3.8	91	2.0
TOTAL	303,741	15,120	5.0	515	0.2	941,547	16,047	1.7	3,655	0.4

	UNCLIPPED STEELHEAD[3]					CLIPPED STEELHEAD				
YEAR	SAMPLE	DESC	%DESC	MORT	%MORT	SAMPLE	DESC	%DESC	MORT	%MORT
1988	7,478	452	6.1	18	0.2					
1989	12,240	536	4.4	13	0.1					
1990	3,894	232	6.0	5	0.1	5,521	818	14.9	25	0.5
1991	2,772	194	7.0	0	0.0	5,502	1,036	18.8	4	0.1
1992[1]	2,837	194	6.8	3	0.1	3,767	487	12.9	2	0.1
1993[1]	4,025	96	2.4	2	0.0	7,456	622	8.3	2	0.0
1994[1]	3,730	102	2.7	2	0.1	3,981	290	7.3	2	0.1
1995[1]	1,240	32	2.6	0	0.0	3,737	397	10.6	5	0.1
1996	1,821	44	2.4	1	0.1	5,075	369	7.3	5	0.1
1997	3,616	35	1.0	7	0.2	9,285	635	6.8	9	0.1
1998	2,587	56	2.2	1	0.0	3,294	208	6.3	5	0.2
1999	2,549	29	1.1	4	0.2	5,647	170	3.0	4	0.1
2000[2]	1,314	104	7.9	0	0.0	1,378	173	12.6	1	0.1
2001[2]	91	0	0.0	0	0.0	25	3	12.0	0	0.0
2002[2]	219	17	7.8	0	0.0	248	31	12.9	8	3.2
TOTAL	50,413	2,123	4.2	56	0.1	54,916	5,239	9.6	72	0.1

	COHO					SOCKEYE				
DATE	SAMPLE	DESC	%DESC	MORT	%MORT	SAMPLE	DESC	%DESC	MORT	%MORT
1988	40,776	1,340	3.3	24	0.1	4,588	1,077	23.6	28	0.6
1989	29,747	998	3.4	5	0.0	7,723	1,319	17.1	11	0.1
1990	43,032	2,325	5.4	30	0.1	4,537	1,710	38.1	45	1.0
1991	23,842	1,059	4.4	5	0.0	4,462	1,205	27.1	9	0.2
1992[1]	23,971	1,485	6.2	24	0.1	638	83	13.0	0	0.0
1993[1]	28,243	649	2.3	6	0.0	4,939	803	16.3	16	0.3
1994[1]	22,378	430	1.9	27	0.1	2,965	322	10.9	2	0.1
1995[1]	11,868	258	2.2	16	0.1	2,184	305	14.1	16	0.7
1996	12,689	320	2.5	8	0.1	694	43	6.2	4	0.6
1997	12,346	363	2.9	16	0.1	589	84	14.3	1	0.2
1998	6,272	176	2.8	2	0.0	1,737	299	17.3	6	0.3
1999	8,411	94	1.1	31	0.4	2,118	165	7.4	16	0.7
2000[2]	2,452	101	4.2	22	0.9	223	51	23.0	1	0.4
2001[2]	397	1	0.3	0	0.0	223	51	23.0	1	0.4
2002[2]	555	12	2.2	9	1.6	531	174	35.3	38	7.2
TOTAL	266,979	9,611	3.6	225	0.1	38,151	7,691	20.3	194	0.5

[1] Sampling in 1992-1995 was conducted 24 hours per day.
[2] Sampling was conducted 3 times weekly for GBT exams and condition monitoring purposes.
[3] Unclipped and clipped steelhead were not differentiated prior to 1990.

Table C-4. PH1 annual condition subsampling data, 1988-present, as a percent of total.

YEAR	No.	3-19%	INJURY					DISEASE				PREDATION	
	Sampled	Descaled	HD	OP	PE	BODY	HEM	PAR	COL	FUNG	BKD	BIRD	Other
Yearling Chinook													
1988	1856	4.20	0.27	0.05	NA	0.59	NA	0.05	NA	0.11	0	0.16	NA
1989	2327	8.04	0.39	0.39	NA	1.12	NA	0.21	NA	0.34	0.17	0.43	NA
1990	3111	9.64	0.10	0.13	NA	0.84	NA	0.13	NA	0.51	0.23	0.58	NA
1991	2158	5.38	0.42	0.32	NA	0.65	NA	0	NA	0.23	0.23	0.42	NA
1992	2190	6.39	0.41	0.23	NA	0.73	NA	0.27	NA	0.37	0.87	0.50	NA
1993	2934	14.25	NA	0.65	NA	3.03	NA	0.55	NA	0.85	0	0.55	NA
1994	4018	9.98	NA	0.37	NA	1.84	NA	0.20	NA	0.77	0	1.14	NA
1995	2648	14.31	1.21	1.36	0.23	4.80	0.83	0.98	0.04	0.87	1.13	0.98	0
1996	2305	12.8	0.52	0.56	0.04	1.52	0.04	0.22	0	0.48	0.43	1	0.13
1997	1591	9.99	0.19	0.44	0.06	1.19	0.06	0.06	0	0.31	0.13	0.94	0.06
1998	1687	13.04	0.41	0.24	0.06	0.65	0.06	0.18	0	1.01	0.24	0.95	0.06
1999	3429	14.09	0.55	0.82	0.12	0.73	0.03	0.17	0	0.93	0.90	1.84	0
2000	2601	13.99	0.77	0.69	0.38	0.54	0.46	0.12	0	1.96	0.85	1.35	0.27
2001	1055	5.97	0.76	0.95	0.38	0.95	0.28	0.76	0	3.60	1.42	1.14	0.38
2002	1684	15.97	1.54	1.13	0.06	2.73	0.77	0.24	0	2.02	0.48	2.32	0.48
Subyearling Chinook													
1988	3451	2.98	0.09	0.03	NA	0.67	NA	0.03	NA	0.09	0	0.12	NA
1989	8481	4.55	0.15	0.09	NA	1.29	NA	0.15	NA	0.05	0.12	0.04	NA
1990	6929	1.93	0.10	0.14	NA	0.64	NA	0.16	NA	0.07	0.32	0.27	NA
1991	4404	2.45	0.23	0.11	NA	0.43	NA	0.30	NA	0.05	0.52	0.09	NA
1992	4422	3.55	0.09	0.25	NA	0.34	NA	0.41	NA	0.05	0.79	0.47	NA
1993	8343	7.76	NA	0.36	NA	3.12	NA	0.31	NA	0.08	0	0.11	NA
1994	7149	4.00	NA	0.29	NA	0.92	NA	0.10	NA	0.10	0	0.08	NA
1995	5230	5.35	0.27	0.44	0.06	1.97	0.11	0.23	0.04	0.13	0.17	0.13	0.21
1996	4080	4.56	0.32	0.47	0	0.69	0	0.12	0	0.17	0.05	0.22	0.05
1997	4893	5.89	0.25	0.49	0.04	0.76	0.14	0.25	0.02	0.16	0.14	0.16	0.04
1998	3324	8.33	0.33	0.48	0.09	1.08	0.09	0.30	0	0.39	0.15	0.21	0.15
1999	4513	6.16	0.22	0.55	0	0.69	0	0.02	0	0.20	0	0.24	0.07
2000	1834	7.69	0.55	1.09	0	0.87	0.49	0.11	0	0.82	0.11	0.33	0.76
2001	1017	4.03	0	0.39	0.10	0.69	0.20	0	0	0.10	0.10	0.10	0.49
2002	1593	7.09	1.26	0.63	0.06	1.44	0.31	0.25	0	0.56	0.25	0.25	0.69
Coho													
1988	2148	3.17	0.09	0.05	NA	0.28	NA	0.05	NA	0.61	0	0.05	NA
1989	2626	6.28	0.42	0.23	NA	0.42	NA	0.19	NA	0.30	0	0.19	NA
1990	3468	7.73	0.09	0.09	NA	0.43	NA	0.09	NA	0.40	0.06	0.46	NA
1991	1967	1.83	0.20	0.20	NA	0.36	NA	0.20	NA	0.15	0.10	0.31	NA
1992	1883	5.47	0.27	0.37	NA	0.32	NA	0.16	NA	0.64	0	0.32	NA
1993	2227	5.34	NA	0.45	NA	1.93	NA	0.27	NA	0.90	0	0.31	NA
1994	2725	6.68	NA	0.22	NA	1.10	NA	0.11	NA	1.10	0	0.33	NA
1995	2574	7.58	0.39	0.35	0.23	3.11	0.08	0.85	0.08	1.09	0.12	0.47	0.12
1996	2720	10.22	0.18	0.18	0	0.55	0	0.18	0.11	0.37	0.04	1.03	0.04
1997	2347	7.93	0.30	0.09	0.17	0.60	0	0.09	0	0.30	0.04	0.55	0
1998	1960	7.60	0.41	0.31	0.10	0.36	0.10	0.15	0	1.12	0.05	0.36	0
1999	2643	6.36	0.30	0.38	0.08	0.19	0	0.15	0	3.67	0.08	0.72	0
2000	178	5.06	0.56	0.56	0	1.69	0	0.56	0	2.81	0	0.56	0
2001	221	6.33	0	0.90	0	0.45	0	0.45	0	0.90	0	0.45	0
2002	539	11.32	3.15	0.56	0.19	1.86	0.19	0.56	0	4.08	0.19	1.11	0.74

Injury includes: HD- Head Injury; OP - Opercula Injury; PE - Pop Eye; BD - Body Injury; and HM - Hemorrhage
Disease includes: PAR - Parasites (mostly trematodes and copepods); COL - Columnaris; FUN - Fungus; and BKD - Bacterial Kidney Disease symptoms
Predation includes: BIRD - Marks from bird strikes; OT - Marks from other predators, including lamprey and other fish

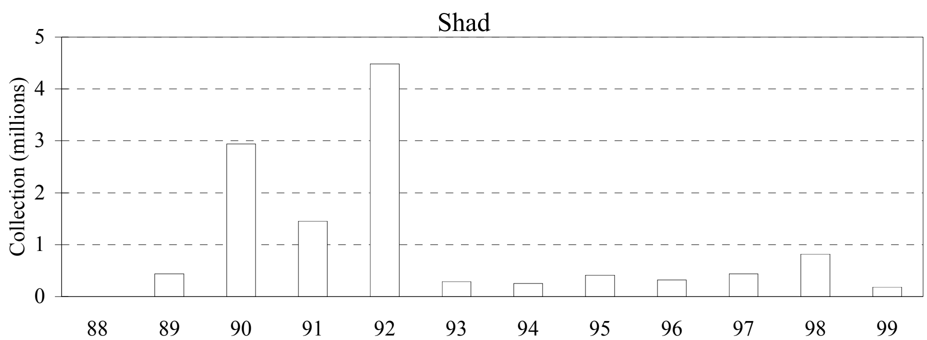
Table C-4. PH1 annual condition subsampling data, 1988-present, continued.

YEAR	No. Sampled	3-19% Descaled	INJURY					DISEASE				PREDATION	
			HD	OP	PE	BODY	HEM	PAR	COL	FUNG	BKD	BIRD	Other
Unclipped Steelhead													
1988	1403	7.48	0.78	0.29	NA	0.78	NA	1.50	NA	0.50	0	3.85	NA
1989	2319	10.48	0.43	0.73	NA	1.21	NA	3.32	NA	1.03	0.04	2.50	NA
1990	1042	10.08	0.38	0.19	NA	1.44	NA	4.03	NA	1.25	0	2.11	NA
1991	706	2.55	0.85	0.71	NA	1.56	NA	8.22	NA	0.71	0	1.56	NA
1992	590	5.59	0.17	0.17	NA	0.68	NA	5.59	NA	0.34	0	2.20	NA
1993	1250	6.56	NA	0.24	NA	1.60	NA	6.64	NA	0.72	0	5.84	NA
1994	1429	9.24	NA	0.49	NA	2.59	NA	8.33	NA	0.49	0	2.80	NA
1995	419	9.79	1.43	1.19	0.24	2.86	0	19.33	0	0.24	0	3.10	0.48
1996	789	9.00	0.25	0.63	0	0.38	0	8.11	0	0.25	0	1.52	0
1997	1306	6.89	0.61	0.77	0	1.23	0	4.59	0	0.23	0	2.07	0
1998	768	10.94	0.65	0.52	0	0.91	0	4.56	0	0.39	0	1.95	0
1999	1067	9.37	0.28	0.47	0	0.47	0	9.75	0	0.84	0	1.78	0
2000	1022	13.80	0.88	0.88	0.10	0.88	0.39	8.71	0.10	0.88	0	6.36	0.49
2001	92	1.47	0	0.49	0	0	0.49	7.35	0	0	0	0	0
2002	204	25.98	0.98	1.96	0	3.92	0	6.37	0	1.96	0	6.37	0
Clipped Steelhead													
1988													
1989													
1990	1366	21.52	0.88	0.73	NA	1.46	NA	0.15	NA	3.07	0	6.15	NA
1991	1024	9.67	0.29	4.39	NA	0.88	NA	0.20	NA	0.78	0.20	3.81	NA
1992	735	11.02	0.41	2.99	NA	1.09	NA	0.41	NA	1.22	0	4.76	NA
1993	1669	16.12	NA	1.86	NA	3.18	NA	2.22	NA	1.44	0	0	NA
1994	1595	21.63	NA	3.13	NA	3.64	NA	0.94	NA	0.56	0	8.40	NA
1995	1278	25.67	1.64	3.36	0.23	5.71	0.16	2.11	0	3.05	0.08	8.29	0.31
1996	1789	27.56	0.28	3.47	0	2.12	0	0.11	0	0.78	0.06	10.01	0
1997	1978	25.28	1.06	2.68	0.15	2.07	0.05	0.05	0.15	0.40	0	6.77	0.05
1998	1011	25.32	0.69	2.77	0	2.08	0	0.30	0	1.58	0	7.52	0
1999	2158	19.32	0.32	3.06	0	0.93	0	0.42	0	1.02	0	5.70	0
2000	1057	20.06	0.95	2.55	0.09	1.89	0.47	0.47	0	0.57	0	11.54	1.23
2001	23	13.04	0	8.70	0	0	4.35	4.35	0	0	0	8.70	0
2002	238	32.35	2.94	4.62	0	8.40	0.42	1.68	0	5.88	0	9.24	1.26
Sockeye													
1988	686	9.62	0	0	NA	0	NA	0	NA	0	0	0	NA
1989	1397	16.11	0.50	0.50	NA	0.36	NA	0	NA	0.07	0.07	0.07	NA
1990	1425	14.88	1.26	0.77	NA	0.49	NA	0.07	NA	0.14	0.07	0.14	NA
1991	621	11.27	0.97	2.25	NA	0.81	NA	0	NA	0.32	0	0.32	NA
1992	131	17.56	0.76	2.29	NA	0.76	NA	0	NA	0	0	0	NA
1993	940	23.83	NA	2.34	NA	3.09	NA	0.32	NA	0.43	0	0.21	NA
1994	1047	26.65	NA	1.91	NA	1.43	NA	0	NA	0.29	0	0.19	NA
1995	829	23.88	0.84	2.41	0.12	1.09	0.24	0	0	0.72	0	0.24	0
1996	307	13.36	0	1.30	0	1.63	0	0.33	0	0	0	0	0
1997	215	25.58	1.40	2.79	0	0.47	0	0	0	0	0	0	0
1998	595	26.55	2.02	2.86	0.17	0.34	0.34	0	0	1.18	0	0	0
1999	869	31.42	1.61	3.45	0	0.35	0	0	0	0.35	0	0.12	0
2000	18	27.78	0	0	0	0	0	0	0	0	0	0	0
2001	5	40.00	0	0	0	0	20.00	0	0	0	0	0	0
2002	479	33.82	7.72	5.64	0	5.43	3.34	0	0	1.46	0	0.63	1.88

Injury includes: HD- Head Injury; OP - Opercula Injury; PE - Pop Eye; BD - Body Injury; and HM - Hemorrhage
Disease includes: PAR - Parasites (mostly trematodes and copepods); COL - Columnaris; FUN - Fungus; and BKD - Bacterial Kidney Disease symptoms
Predation includes: BIRD - Marks from bird strikes; OT - Marks from other predators, including lamprey and other fish

Table C-5. PH1 mark recapture data, 2002.

	Species	Location	Color	Release Site	Release	No. Recaptured
Elastomer tags	Yearling Fall Chinook	Left	Blue	Snake River	150,000	1
	Yearling Spring Chinook	Left	Orange	Yakima River	136,700	5
		Right	Orange	Yakima River	128,900	2
		Right	Red	Yak., Tucannon, Wallowa Rvrs.	276,764	4
	Yearling Unknown Chinook	Left	Green	Yakima R., Clearwater Rvr. MF	295,500	8
		Left	Red	Yakima River, Snake River	596,000	4
		Right	Green	Yakima River, Snake River	292,500	4
	Summer Steelhead	Left	Green	Wenatchee River	93,000	18
		Left	Red	Wenatchee River, Touchet River	165,500	6
		Left	Yellow	Methow River	88,000	1
		Right	Green	Wenatchee River	75,000	4
		Right	Orange	Wentachee River	54,000	2
		Right	Red	Tucannon River	57,955	4
				Total Elastomer tags =	2,409,819	**63**



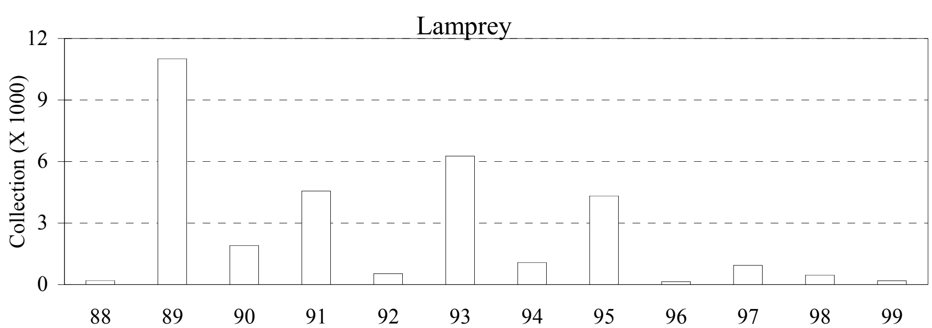


Figure C-5. PH1 annual shad and lamprey collection totals, 1988-1999. Recording of collection detail ceased in 2000 when sampling began in the new juvenile monitoring facility.

Table C-6. PH1 incidental catch summary using collection estimates, 1988-present.

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000*	2001	2002
American shad (Adult)	17	39		8	46	78	85	1,130	104	1,097	64	75	5		11
American shad (Juvenile)	2,362	435,653	2,939,363	1,481,768	4,479,820	288,463	252,474	414,487	318,190	437,715	820,864	187,300	493	1	
Bluegill/ Pumpkinseed								283	167	235	530	31	1		1
Bullhead								33	5	10	12	12	1		
Carp										630	16	18			1
Channel catfish											4	259	2		
Chiselmouth								54	11	25	4	31			
Crappie								54	20	87	117	8			
Cutthroat trout											10	4			
Kokanee								597		82	9	53			1
Largemouth bass								60	56	57	4	12			
Northern pikeminnow	243	698	520	893	672	264	311	979	21	50	124	47	3	2	3
Pacific lamprey (Adult)	37	63		4	86	148	47	213	60	48	26	23	3	5	
Pacific lamprey (Brown)								118			14	4	4		1
Pacific lamprey (Silver)	204	34,756	1,909	4,571	531	6,269	1,074	4,216	146	945	450	185	3		3
Peamouth	754	1,413	224	853	1,053	1,603	4,669	2,227	823	1,175	899	385	178	1	1
Rainbow trout											6	34			
Redside shiner	264	384	56	224	67	377	269	677	259	128	39	85			1
Sand roller								194			11	28			2
Sculpin	177	193	47	12	136	268	56	233	60	87	4	21	1	43	5
Smallmouth bass	228	5	88	31	162	251	122	567	59	805	52	43			
Sucker								218	150	122	99	18			
Threespine stickleback	1,017	2,473	4,527	2,006	6,581	6,583	78,779	5,931	88	175	81	91	8	6	498
Walleye		3	20	4	15	13									
White sturgeon											4				
Whitefish	33	34	58	121	41	75	65	665	73	113	84	10			
Yellow perch										87		7	1		1

Note: Incidental catch has not been expanded to collection since 2000 in PH1.

Table C-7. PH1 gas bubble trauma (GBT) examination summary, 2002. Exams performed in PH2 after 23 July.

			Incidence of Gas Bubble Trauma symptoms					
			% of monthly sample			Smolt Affected		Monthly % of Season Totals
Month	**Species**	**Sample Size**	Eyes	unpaired fins ranks 1, 2	unpaired fins ranks 3, 4	Number	Percent	
April	Spring Chinook	390	0.00%	0.00%	0.00%	0	0.00%	0.00%
	Unclipped Steelhead	55	0.00%	0.00%	0.00%	0	0.00%	0.00%
	Clipped Steelhead	14	0.00%	0.00%	0.00%	0	0.00%	0.00%
Monthly Total		459	0.00%	0.00%	0.00%	0	0.00%	**0.00%**
May	Spring Chinook	467	0.00%	0.00%	0.00%	0	0.00%	0.00%
	Unclipped Steelhead	25	0.00%	0.00%	0.00%	0	0.00%	0.00%
	Clipped Steelhead	41	0.00%	0.00%	0.00%	0	0.00%	0.00%
Monthly Total		533	0.00%	0.00%	0.00%	0	0.00%	**0.00%**
June	Spring Chinook	91	0.00%	0.00%	0.00%	0	0.00%	0.00%
	Fall Chinook	600	0.00%	0.00%	0.00%	0	0.00%	0.00%
	Unclipped Steelhead	33	0.00%	0.00%	0.00%	0	0.00%	0.00%
	Clipped Steelhead	47	0.00%	0.00%	0.00%	0	0.00%	0.00%
Monthly Total		680	0.00%	0.00%	0.00%	0	0.00%	**0.00%**
July	Fall Chinook	517						
Monthly Total		517	0.00%	0.00%	0.00%	0	0.00%	**0.00%**
August	Fall Chinook	548						
Monthly Total		548	0.00%	0.00%	0.00%	0	0.00%	**0.00%**
Season Totals	Spring Chinook	857	0.00%	0.00%	0.00%	0	0.00%	
	Fall Chinook	1665	0.00%	0.00%	0.00%	0	0.00%	
	Unclipped Steelhead	113	0.00%	0.00%	0.00%	0	0.00%	
	Clipped Steelhead	102	0.00%	0.00%	0.00%	0	0.00%	
Season Total		2737	0.00%	0.00%	0.00%	**0**	**0.00%**	

NOTE: GBT symptoms were ranked as follows: 0 = 0% coverage, 1 = 1-5% coverage, 2 = 6-25% coverage, 3 = 26-50% coverage, and 4 = greater than 50% coverage.

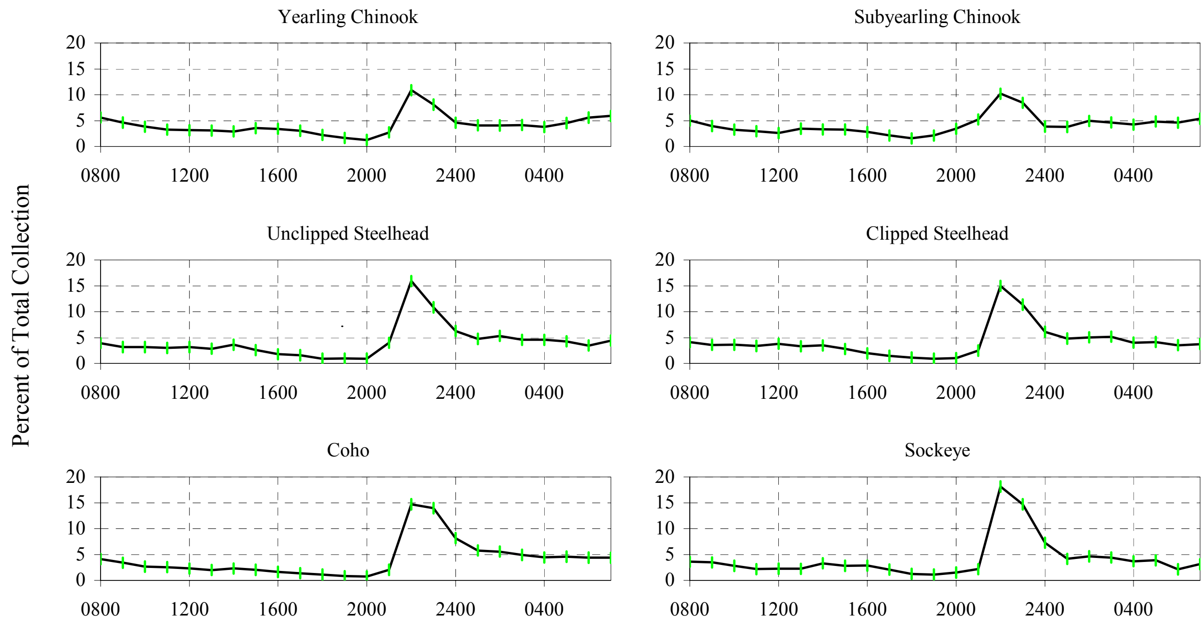


Figure C-6. PH1 average diel passage, 1992-1995, with standard deviation.

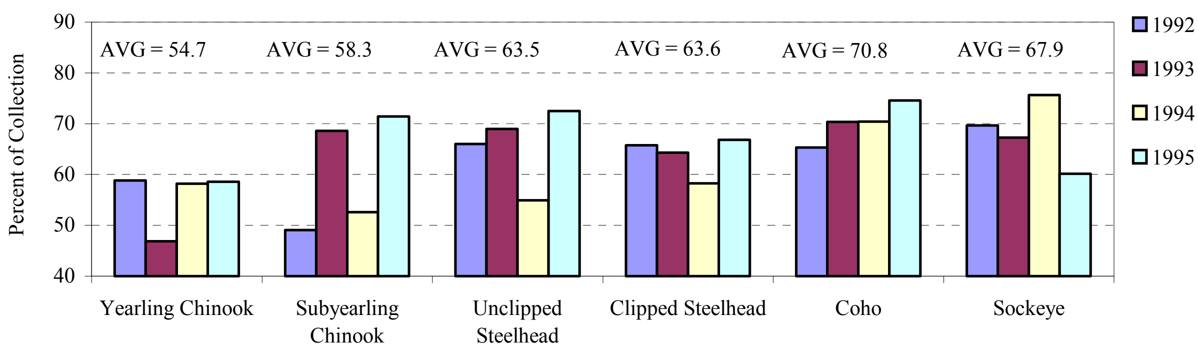


Figure C-7. PH1 percent night passage (1800-0600), 1992-1995, by species.

Table C-8. PH1 percent night passage (1800-0600) for 1992-95.

YEAR	Yearling Chinook	Subyearling Chinook	Unclipped Steelhead	Clipped Steelhead	Coho	Sockeye	All Species Combined
1992	58.8	49.1	66.0	65.7	65.3	69.7	53.4
1993	46.9	68.6	68.9	64.3	70.4	67.3	62.9
1994	58.2	52.6	54.9	58.2	70.4	75.6	56.3
1995	58.6	71.4	72.5	66.8	74.6	60.2	68.1
AVG	54.7	58.3	63.5	63.6	70.8	67.9	59.8
MIN	46.9	49.1	54.9	58.2	65.3	60.2	53.4
MAX	58.8	71.4	72.5	66.8	74.6	75.6	68.1

Table C-9. PH1 percent of total passage per hour, 1992-1995.

Yearling Chinook

	0800	0900	1000	1100	Noon	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	MID	0100	0200	0300	0400	0500	0600	0700
AVG	5.8	4.5	3.8	3.2	3.1	3.0	2.9	3.6	3.4	3.1	2.3	1.7	1.2	2.5	10.5	7.8	4.5	4.1	4.0	4.1	3.8	4.7	5.8	6.4
MIN	4.4	3.4	3.1	2.7	2.5	2.4	2.4	2.8	3.1	2.5	1.9	1.4	1.0	1.5	7.9	6.6	3.5	3.5	3.1	3.5	3.4	3.6	4.3	3.8
MAX	6.7	5.4	4.8	4.0	4.0	3.6	3.6	4.3	3.8	3.9	2.6	2.2	1.5	3.9	12.9	10.5	5.2	4.7	5.7	4.5	4.3	6.2	6.8	7.7

Subyearling Chinook

	0800	0900	1000	1100	Noon	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	MID	0100	0200	0300	0400	0500	0600	0700
AVG	5.2	4.3	3.4	3.0	2.7	3.3	3.5	3.6	3.0	2.1	1.6	1.8	3.1	5.0	10.1	8.1	3.6	3.5	4.7	4.6	4.2	4.8	4.6	6.0
MIN	3.2	2.7	2.2	2.3	2.1	2.0	1.9	2.1	1.8	1.6	1.3	0.9	0.6	2.4	7.4	6.1	3.1	2.6	3.1	3.9	4.0	4.5	4.0	3.0
MAX	6.5	5.1	4.1	4.0	3.3	5.1	4.4	4.5	4.1	3.0	1.8	4.8	7.7	10.2	14.0	11.9	4.6	5.0	8.7	5.7	4.7	5.2	6.0	7.1

Unclipped Steelhead

	0800	0900	1000	1100	Noon	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	MID	0100	0200	0300	0400	0500	0600	0700
AVG	4.4	3.4	3.3	3.1	3.3	3.1	3.7	2.8	2.0	1.7	1.0	0.9	0.9	3.3	14.8	10.0	6.0	4.9	5.1	4.5	4.7	4.5	3.8	4.8
MIN	2.2	2.0	2.4	2.1	2.0	1.9	2.7	2.2	1.1	1.5	0.7	0.7	0.7	2.6	11.9	8.1	5.5	4.1	3.0	2.8	3.0	2.8	2.4	2.8
MAX	5.5	4.7	4.4	3.7	4.1	4.4	4.4	3.3	2.4	1.8	1.2	1.3	1.4	6.5	19.4	15.3	6.8	6.2	7.0	6.4	6.7	6.5	5.4	5.5

Clipped Steelhead

	0800	0900	1000	1100	Noon	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	MID	0100	0200	0300	0400	0500	0600	0700
AVG	4.2	3.7	3.6	3.3	3.8	3.2	3.2	2.8	2.1	1.6	1.1	0.9	1.0	2.2	14.0	9.4	5.8	5.1	5.7	5.9	4.8	5.0	3.8	3.9
MIN	3.5	2.8	3.1	2.5	3.2	2.6	2.3	2.3	1.3	1.3	1.0	0.8	0.9	1.5	11.0	6.5	5.5	4.3	3.6	3.9	2.7	3.0	2.4	2.4
MAX	4.6	4.4	4.7	4.4	4.0	3.9	4.3	3.7	2.6	1.8	1.3	1.1	1.2	3.4	20.8	16.1	6.9	5.7	6.6	7.1	6.4	7.1	4.6	4.6

Coho

	0800	0900	1000	1100	Noon	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	MID	0100	0200	0300	0400	0500	0600	0700
AVG	3.9	3.3	2.5	2.3	2.2	2.0	2.3	2.1	1.6	1.3	1.1	0.8	0.8	1.8	14.5	13.8	8.0	6.0	5.8	5.2	4.8	5.0	4.4	4.6
MIN	2.7	2.1	2.1	2.1	1.9	1.7	2.1	1.7	1.2	0.8	0.9	0.5	0.4	0.3	11.1	8.1	7.2	4.8	3.5	3.2	2.7	2.7	2.9	2.7
MAX	5.5	4.9	3.6	3.4	2.9	2.2	2.6	2.4	2.0	2.0	1.7	1.2	1.1	3.9	18.1	18.5	9.2	6.7	7.4	6.4	6.1	6.1	7.4	5.8

Sockeye

	0800	0900	1000	1100	Noon	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	MID	0100	0200	0300	0400	0500	0600	0700
AVG	3.9	2.8	2.5	2.5	2.1	2.1	3.1	2.9	2.7	2.4	1.6	1.5	1.7	2.7	17.3	10.6	5.8	4.7	5.8	5.2	4.7	4.8	3.2	3.5
MIN	1.7	1.6	1.9	1.6	1.3	1.3	2.5	1.6	2.1	0.4	0.4	0.1	0.1	0.1	14.4	5.1	3.3	3.1	2.9	2.9	1.8	1.9	0.4	2.2
MAX	5.0	5.8	4.5	2.8	3.5	3.9	4.9	5.4	4.7	4.6	2.5	2.7	3.4	5.4	21.0	26.1	11.5	5.4	7.0	6.1	5.5	5.7	4.3	3.9

All species combined

	0800	0900	1000	1100	Noon	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	MID	0100	0200	0300	0400	0500	0600	0700
AVG	5.1	4.1	3.3	2.9	2.7	3.0	3.2	3.3	2.9	2.2	1.6	1.6	2.3	3.8	11.2	9.0	4.6	4.1	4.8	4.7	4.2	4.8	4.7	5.7
MIN	3.3	2.7	2.5	2.5	2.4	2.3	2.3	2.8	2.3	2.1	1.5	0.9	0.8	3.0	9.1	6.6	4.3	3.2	3.3	4.3	3.7	4.1	3.8	3.4
MAX	6.0	4.8	4.0	3.8	3.2	4.2	3.7	3.8	3.5	2.7	1.8	3.0	4.1	5.6	14.8	10.0	5.3	5.0	7.4	5.3	4.6	5.1	6.1	6.8

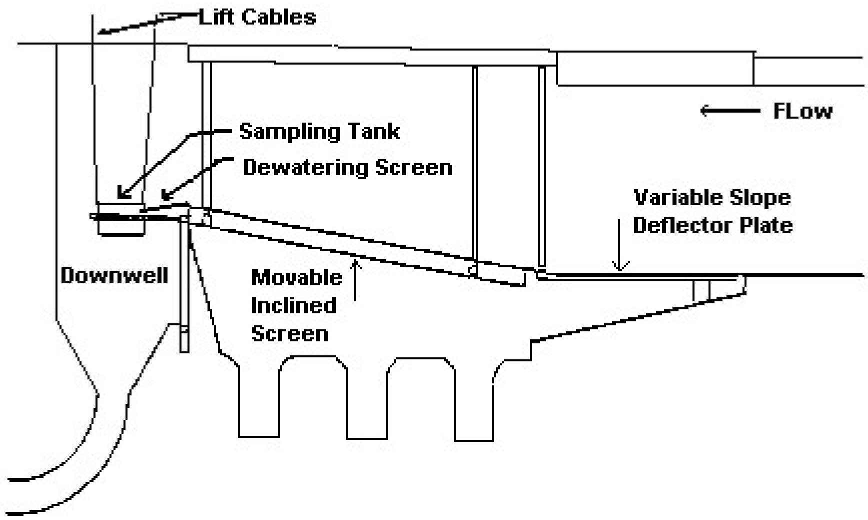


Figure C-8. PH1 inclined screen sampling system, 1986-present.

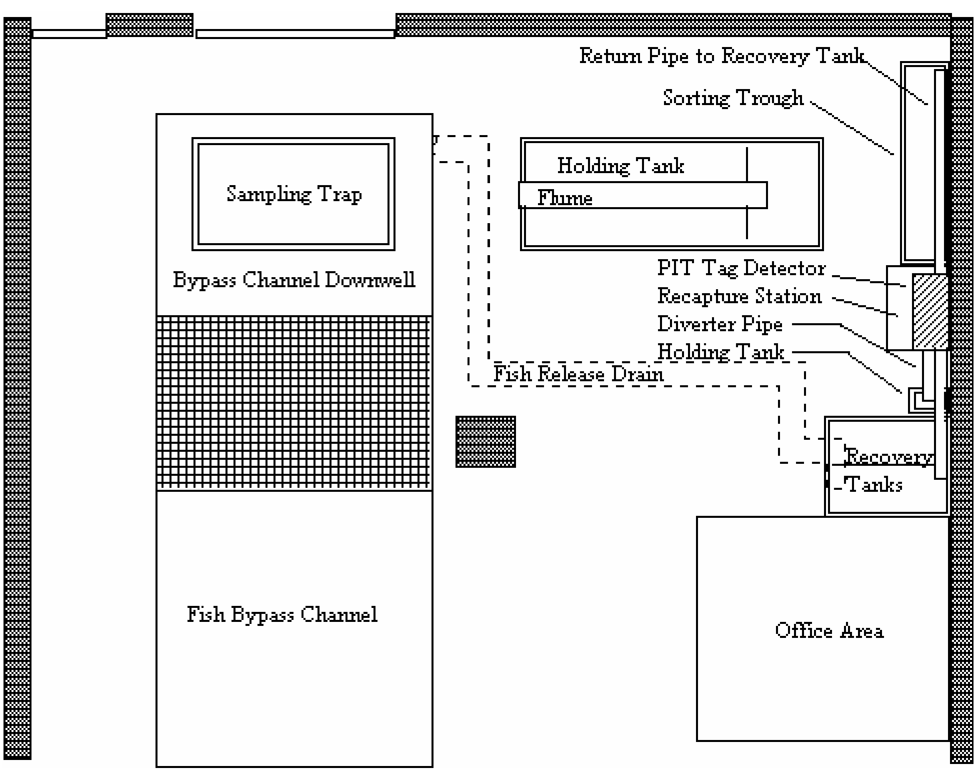


Figure C-9. PH1 laboratory layout.

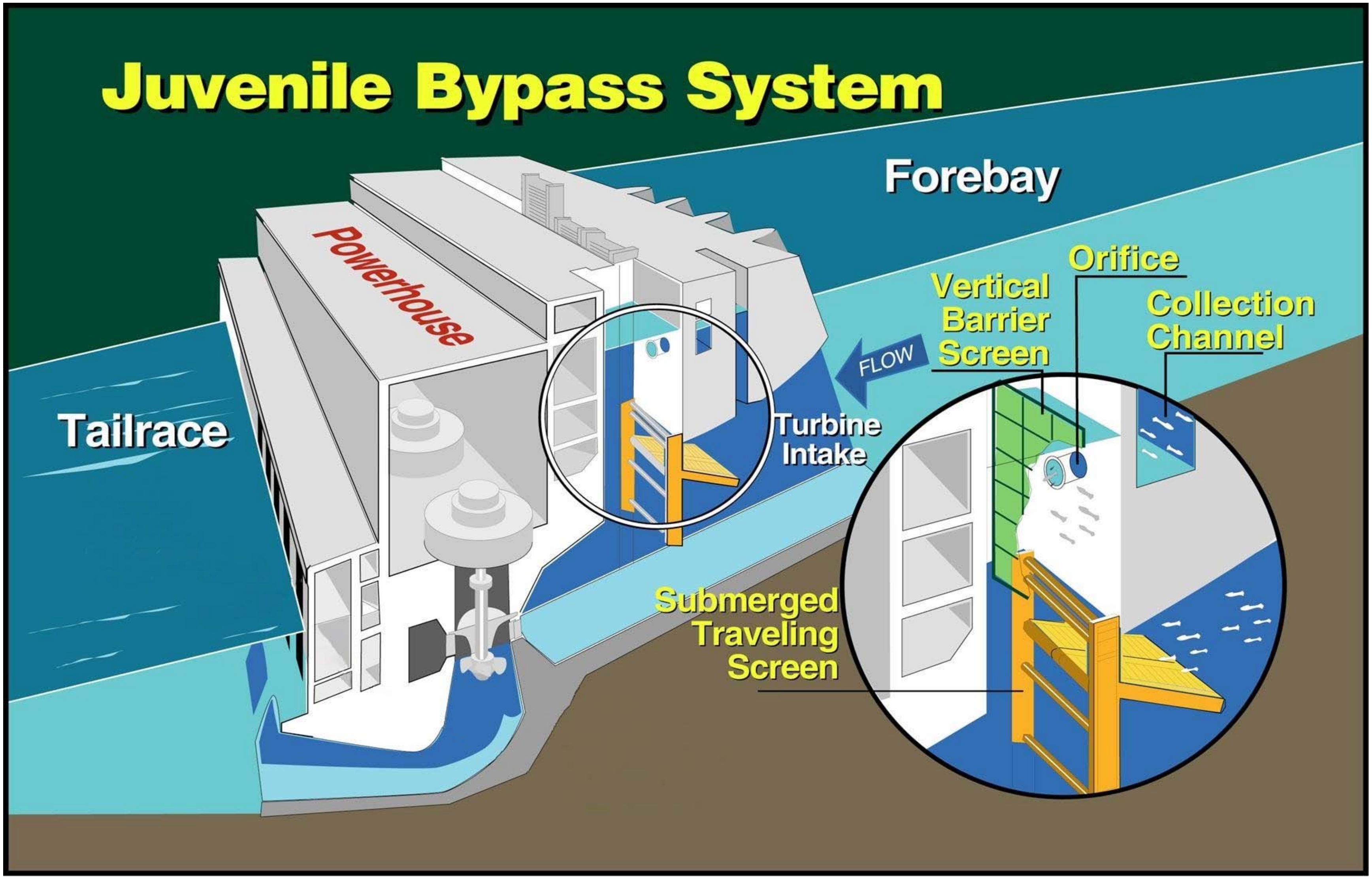


Figure C-10. Typical Submerged Traveling Screen Bypass System in use at Bonneville and John Day Dams.