Monitoring the Migrations of Wild Snake River Spring/Summer Chinook Salmon Smolts

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Monitoring the Migrations of Wild Snake River Spring/Summer Chinook Salmon Smolts, 2003

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EXECUTIVE SUMMARY

This report details the 2003 results from an ongoing project to monitor the migration behavior of summer-tagged wild spring/summer chinook salmon juveniles in the Snake River Basin. The report also discusses trends in the cumulative data collected for this project from Oregon and Idaho streams since 1989.

The project was initiated after detection data from passive-integrated-transponder tags (PIT tags) had shown distinct differences in migration patterns between wild and hatchery fish for three consecutive years. NOAA Fisheries (National Marine Fisheries Service--NMFS) investigators first observed these data in 1989. The data originated from tagging and interrogation operations begun in 1988 to evaluate smolt transportation for the U.S. Army Corps of Engineers.

In 1991, the Bonneville Power Administration began a cooperative effort with NOAA Fisheries to expand tagging and interrogation of wild fish. Project goals were to characterize the juvenile migration timing of these fish, to determine whether consistent migration patterns would emerge, and to investigate the influence of environmental factors on the timing and distribution of these migrations.

In 1992, the Oregon Department of Fish and Wildlife (ODFW) began an independent program of PIT tagging wild chinook salmon parr in the Grande Ronde and Imnaha River Basins in northeast Oregon. Since then, ODFW has reported all tagging, detection, and timing information on fish from these streams. However, with ODFW concurrence, will continue to report arrival timing of these fish at Lower Granite Dam.

We continued to tag fish from Idaho after 1992. Principal results from our tagging and interrogation during 2002-2003 are listed below:

1) In July and August 2002, we PIT tagged and released 14,290 wild chinook salmon parr in 15 Idaho streams.

2) Average overall observed mortality from collection, handling, tagging, and after a 24-hour holding period was 1.1%.

3) Of the 2,266 chinook salmon parr PIT tagged and released in Valley Creek in summer 2002, 3.2% (72) were detected at two in-stream PIT-tag monitoring systems in lower Valley Creek in summer-fall 2002 and spring 2003. Of these stream-detected fish, 9.7% (7) were detected as smolts at downstream dams in 2003.

Development and improvements of the in-stream PIT-tag monitoring systems continued throughout 2002 and 2003.

4) Estimated parr-to-smolt survival to Lower Granite Dam for Idaho and Oregon streams averaged 8.8% (range 2.8-19.3% depending on stream of origin).

5) Length and weights were taken on 426 recaptured fish from 15 Idaho streams at Little Goose Dam in 2003. Fish had grown an average of 42.4 mm in length and 8.9 g in weight over an average of 282 d. Their mean condition factor declined from 1.41 at release (parr) to 1.00 at recapture (smolt).

6) Fish that were larger at release were detected at a significantly higher rate the following spring and summer than their smaller cohorts ($P < 0.001$).

7) Fish that migrated through Lower Granite Dam in April and May were significantly larger at release than fish that migrated after May ($P < 0.001$).

8) In 2003, peak detections at Lower Granite Dam of parr tagged during the late summer in 2002 (from the 15 streams in Idaho and 4 streams in Oregon) occurred during high (and rapidly increasing flows) flows of 146.7 kcfs on 26 May. The 10th, 50th, and 90th percentile passage occurred on 18 April, 11 May, and 29 May, respectively.

The estimated parr-to-smolt survival from streams of origin from Idaho and Oregon combined to Lower Granite Dam from 1993-2003 are shown as follows:

Migration year	Parr-to-smolt survival (%)
1993	15.3
1994	18.8
1995	13.5
1996	20.6
1997	20.8
1998	24.4
1999	19.9
2000	17.7
2001	19.5
2002	14.3
2003	8.8

Over these years, the parr-to-smolt survival estimates for individual populations have varied widely, ranging from 2.8% for South Fork Salmon River in 2003 to 47.6% for Elk Creek in 1998. There has been a strong inverse relationship between parr densities in summer and estimated parr-to-smolt survival to Lower Granite Dam the following year. The highest parr densities in the streams occurred in 1994, 2001, and 2002; while the lowest parr densities occurred in 1995, 1996, and 1997.

Annual arrival timing of individual stocks at Lower Granite Dam provides the basis to determine similarities or differences in migration patterns between years or between stocks. This report details our findings on arrival timing distributions for individual stocks in 2003, as well as arrival timing patterns for several stocks over the years.

We have observed a 2- to 3-week shift in timing of combined wild stocks passing Lower Granite Dam between relatively warm and relatively cold years. In the warm years of 1990, 1992, 1994, 1998, and 2001 the median passage date at the dam was between 2 and 9 May, and 90% of all wild fish passed between 23 May and 7 June. In the cold years of 1989, 1991, and 1993 median passage did not occur until mid-May, and the 90th percentile had not passed until mid-June (except during high flows in 1993 when the 90th percentile passed by the end of May). In both 1992 and 2001, we experienced near record low flows in the Snake River. The overall migration timing patterns of wild fish at the dam were similar in these 2 years; however, the timing in 1992 was earlier than 2001 due to the very warm spring in 1992.

In 1995, weather conditions in late winter and early spring were moderate compared to those of the previous 6 years, flows were normal, and the median and 90th percentile passage occurred on 9 May and 4 June, respectively. In 1996 and 1997, too few Idaho fish were detected to make meaningful comparisons of timing with other years.

In 1999, we experienced different climatic conditions than in all previous migration years. In late winter, a near-record snow pack in the Snake River Basin resulted in high flows during the early spring period (late March); however, the ensuing flows were moderated by very dry and cold conditions during mid-to-late spring and early summer. The fluctuating medium-to-high flows throughout the spring moved wild fish through Lower Granite Dam as observed in warmer years, with 50% passing by 3 May and 90% passing by 28 May.

In 2000, more typical temperatures and climatic conditions occurred throughout the spring, along with slightly below-normal flows, with the highest flows occurring in

April. Consequently, we observed a wild fish migration pattern similar to those seen in warm years, with 50 and 90% passage occurring in early and late May, respectively.

In 2002, the 50 and 90% passage at Lower Granite Dam also occurred in early and late May, respectively. However, in 2002, temperatures were slightly lower than normal and climatic conditions were cooler than normal throughout the spring; flows were close to normal, with the highest flows occurring in mid-April and late-May. In 2003, the 50 and 90% passage of wild fish at the dam occurred on 11 and 29 May, respectively. Climatic conditions were cooler than normal throughout spring, similar to conditions in 2002, while flows were below normal until the last week of May, when high flows occurred. Although our previous observations support the importance of annual climatic conditions influencing the overall migration timing of stocks at Lower Granite Dam; clearly, complex interrelationships among several factors drive the annual migrational timing of the stocks.

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INTRODUCTION

Background

In 1988, NOAA Fisheries (previously referred to as National Marine Fisheries Service-NMFS) began a cooperative study with the U.S. Army Corps of Engineers to mark wild Snake River spring and summer chinook salmon parr with passive integrated transponder (PIT) tags for transportation research. This project continued through mid-1991, with migrating smolts monitored as they passed Lower Granite, Little Goose, and McNary Dams during spring and summer 1989-1991 (Matthews et al. 1990, 1992; Achord et al. 1992, 1996b).

Information from these 3 years of study demonstrated that the migration timing of wild stocks through Lower Granite Dam differs among stream of origin and also differs from the migration timing of hatchery-reared fish. Migrations of wild spring chinook salmon were consistently later and more protracted, and exhibited more variable timing patterns over the 3 years, than those of their hatchery-reared counterparts. In contrast, the migrations of wild summer chinook salmon during these same years were earlier, though also more protracted, than those of their hatchery counterparts.

The present study began in mid-1991, when NOAA Fisheries and the Bonneville Power Administration (BPA) began a cooperative ongoing project to monitor the annual migrations of wild chinook salmon smolts (Achord et al.1994; 1995a,b; 1996a; 1997; 1998; 2000; 2001a,b; 2002, 2003).

Project Goals

Prior to 1992, decisions on dam operations and use of stored water relied on recoveries of branded hatchery fish, index counts at traps and dams, and flow patterns at the dams. The advent of PIT-tag technology provided the opportunity to precisely track the smolt migrations of many wild stocks as they pass through the hydroelectric complex and other monitoring sites on their way to the ocean. With the availability of the PIT tag, a more complete approach to these decisions was undertaken starting in 1992 with the addition of PIT-tag detections of several wild spring and summer chinook salmon stocks at Lower Granite Dam.

Using data from these detections, we initiated development of a database on wild fish, addressing several goals of the Columbia River Basin Fish and Wildlife Program of the Pacific Northwest Electric Power Planning Council and Conservation Act (NPPC 1980). Section 304(d) of the program states, "The monitoring program will provide information on the migrational characteristics of the various stocks of salmon and steelhead within the Columbia Basin." Further, Section 201(b) urges conservation of genetic diversity, which will be possible only if wild stocks are preserved. Section 5.9A.1 of the 1994 Fish and Wildlife Program states that field monitoring of smolt movement will be used to determine the best timing for water storage releases and Section 5.8A.8 states that continued research is needed on survival of juvenile wild fish before they reach the first dam with special attention to water quantity, quality, and several other factors.

In addition to addressing several sections of these Fish and Wildlife Programs, our research addresses some of the "Reasonable and Prudent Alternatives (RPAs)" in the 2000 NMFS Biological Opinion (NMFS 2001). Section 9.6.5.2, Action 180 advocates a regional monitoring effort on the population status of wild fish stocks and the environmental status of their natal streams and tributaries. Section 9.6.5.5, Action 199 further states that "the required research/monitoring activities will provide data and information necessary to develop annual management strategies to help mitigate hydropower system impacts and to answer important questions related to system operations." Appendix H Research Action 1193 calls for "research to produce information on the migrational characteristics of Columbia and Snake River basin salmon and steelhead." The smolt monitoring program produces information on the migrational characteristics of various salmon and steelhead stocks and provides management information for implementing flow and spill measures designed to improve passage conditions in the mainstem lower Snake and Columbia Rivers."

The goals of this ongoing study are as follows

1) Characterize the migration timing and estimate parr-to-smolt survival of different stocks of wild Snake River spring/summer chinook salmon smolts at Lower Granite Dam.

2) Determine whether consistent migration patterns are apparent.

3) Determine what environmental factors influence these patterns.

4) Characterize the migrational behavior and estimate survival of different wild juvenile fish stocks as they emigrate from their natal rearing areas .

This study provides critical information for recovery planning, and ultimately recovery for these ESA-listed wild fish stocks.

This report provides information on PIT tagging of wild chinook salmon parr in 2002 and the subsequent monitoring of these fish. Fish were monitored as they migrated through two in-stream PIT-tag monitoring systems in lower Valley Creek and at juvenile migrant traps in 2002 and 2003 as well as through interrogation systems at Lower Granite, Little Goose, Lower Monumental, McNary, John Day, and Bonneville Dams during 2003. Fish were also monitored by the PIT-tag trawl in the mouth of the Columbia River in 2003.

In 2002-2003, we also continued to collect environmental data for the Baseline Environmental Monitoring Program, which was developed from 1993 to 1997. The project was designed to collect data for use in conjunction with data on parr and smolt movements to discern patterns or characteristic relationships between these movements and environmental factors. Water quality data collected consist of water temperature, dissolved oxygen, specific conductance, turbidity, water depth, and pH measured at five monitoring stations in the Salmon River Basin, Idaho.

METHODS

Fish Collection and Tagging

In 1992, Oregon Department of Fish and Wildlife (ODFW) began PIT tagging wild chinook salmon parr in the Grande Ronde and Imnaha River drainages in northeast Oregon. All tagging, detection, and timing information for fish from these streams in 2002-2003 will be reported by ODFW. However, with ODFW's concurrence, NOAA Fisheries will continue to report the timing at Lower Granite Dam of summer-tagged fish from these Oregon streams.

Collection and PIT-tagging procedures described by Matthews et al. (1990) and Achord et al. (1994; 1995a,b; 2003) were used for our field work in 2002. However, in 2002 we started recording Global Positioning System (GPS) UTM coordinates in streams to more specifically identify areas where collections occurred.

Interrogation at In-stream PIT-Tag Monitors

Until recently, the opportunities to monitor migrating PIT-tagged wild juvenile fish were limited to a few in-stream or river traps (these traps required operators and were not passive monitoring sites); the juvenile fish bypass systems at some dams, and the PIT-tag detector trawl system operated seasonally at the mouth of the Columbia River. A natural progression in the wild fish monitoring study would logically include other areas above the hydropower system, such as in streams near the rearing areas.

Valley Creek, one of the study streams in our wild fish monitoring study, was chosen as an evaluation site for the development of in-stream PIT-tag interrogation systems. Two of these prototype systems (VC1 and VC2) were deployed in lower Valley Creek near Stanley, Idaho on 9 July 2002. The sites were located 1.6 km apart, but VC1 was operated on a utility and telephone grid, while VC2 was not. One rectangular shaped 1.8-m long by 61-cm high (open area) hybrid antenna (constructed of 10.2 cm PVC pipe) was secured in the main thalweg at each site. Stream width at both sites averaged about 18 m during low to medium flows, thus the antennas usually covered about 10% of the stream width. The antennas were connected to transceivers via 15-m long electrical cables at both locations. All electronics at both locations were housed in 2.4-m long enclosed utility trailers. The more complicated of the two systems was the downstream site (VC2), which also required stand-alone power and communication equipment.

The instrument trailer of the stand-alone system at VC2 housed the following electronics: four 12V DC 110 amp-h glass-mat storage batteries connected in series and shielded from other electronics; one FS1000A-24V DC transceiver; one notebook computer; one two-way satellite communication system (Starband[1]); one power inverter; DC power disconnect and breaker panel; generator relay; and data-control board. Batteries were charged by several solar panels and a backup propane generator that could be started remotely.

The instrument trailer at the upstream site (VC1) was supplied with grid power and housed the same electronics as VC2 except for the satellite communication system (we used a phone line), and the equipment associated with stand-alone power. In summary, both systems were set up to automatically interrogate, store, and transmit data to the PIT Tag Information System (PTAGIS), a database operated by the Pacific States Marine Fisheries Commission in Portland, Oregon (PSMFC 1996).

Both in-stream PIT-tag monitoring systems were operational from 9 July 2002 to 28 October 2002, when the downstream monitoring system (VC2) was taken out of service. It was redeployed on 8 April 2003, but was taken out of service on 11 April and redeployed on 1 May 2003. The upstream system (VC1) operated continuously from deployment to 30 May 2003. We report data collected at these sites through 30 May 2003, when both units were taken out of service due to flooding.

Juvenile Migrant Traps

During fall 2002 and spring 2003, juvenile migrant fish traps were operated on Lake Creek, on the Secesh River near Chinook Campground, at Knox Bridge on the South Fork Salmon River, on the lower South Fork Salmon River below its confluence with the Secesh River (fall-only), on Marsh Creek, near the Sawtooth Hatchery on the upper Salmon River, and on the East Fork Salmon River (Figure 1). Also during spring 2003, juvenile migrant fish traps were operated on the lower Salmon River near Whitebird, Idaho, and on the Snake River at Lewiston, Idaho (Figure 1). Traps were operated by the Nez Perce Tribe, Shoshone-Bannock Tribe, and the Idaho Department of Fish and Game.

Generally, fish at these traps were anesthetized, scanned for PIT tags, and then measured for length and weight. Upon recovery, all fish were released back to the streams or rivers.

1 Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

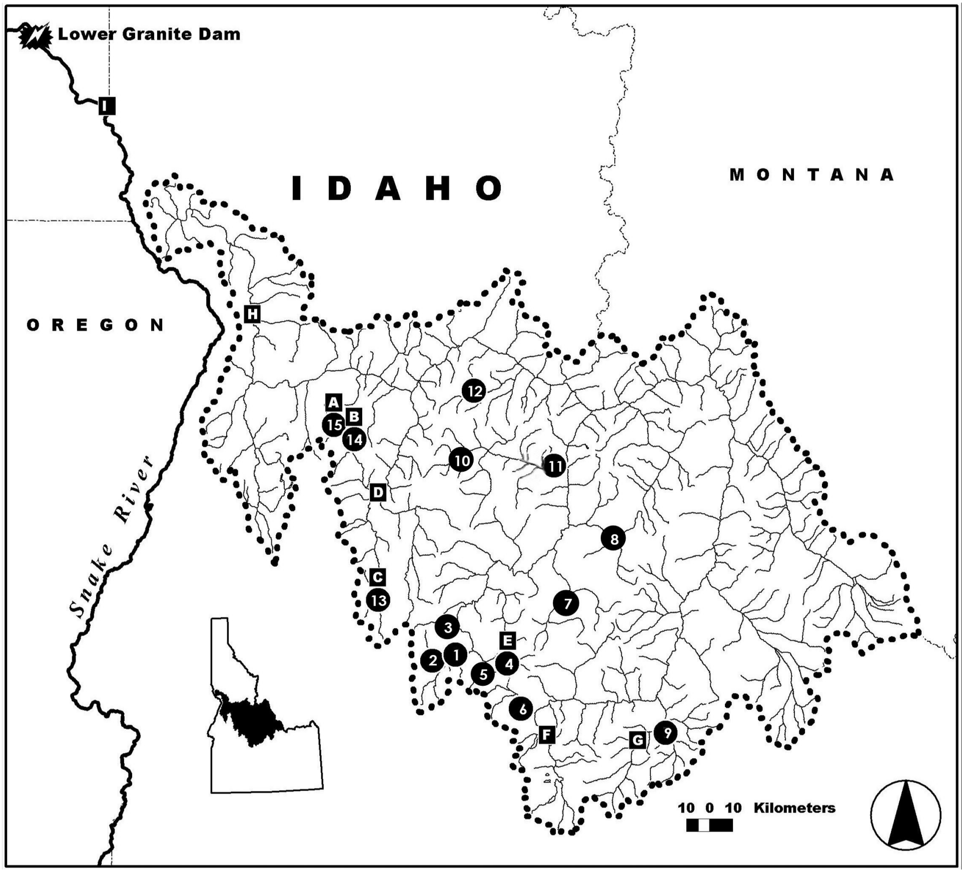

Figure 1. Wild spring/summer chinook salmon parr were PIT tagged during 2002 in the following streams:

1–Bear Valley Creek
2–Elk Creek
3–Sulphur Creek
4–Marsh Creek
5–Cape Horn Creek
6–Valley Creek
7–Loon Creek
8–Camas Creek
9–Herd Creek
10–Big Creek (upper)
11–Big Creek (lower)
12–W. F. Chamberlain/Chamberlain Creeks
13–South Fork Salmon River
14–Secesh River
15–Lake Creek

Juvenile migrant fish traps shown above are as follows:

A–Lake Creek Trap
B–Secesh River Trap
C–Knox Bridge
D–Lower South Fork Salmon River Trap
E–Marsh Creek Trap
F–Sawtooth Trap
G–East Fork Salmon River Trap
H–Salmon River Trap
I–Snake River Trap

Recaptures at Dams

While collecting and PIT tagging fish at the dams for various studies, NOAA Fisheries and other personnel occasionally encounter wild fish that are already PIT tagged. In such cases, biological data from these fish are collected, although very few such fish are handled in this manner at the dams. However, in 2001, NOAA Fisheries began a concerted effort to gather parr-to-smolt growth information on these previously PIT-tagged wild fish from various streams. In 2002 and 2003, we continued this work.

We utilized the PIT-tag separation-by-code system (Downing 2001) at Little Goose Dam to collect this information. A maximum of 100 wild fish from each stream was programmed for separation at this dam for length and weight measurements. All fish that were separated at the dam were handled using water-to-water transfers and other best handling practices. After handling, all tagged and untagged fish were returned to the bypass system for release below the dam.

In addition to length and weight measurements on these wild smolts at Little Goose Dam, a Fulton-type condition factor (CF) was calculated as

$$CF = \frac{weight(g)}{length(mm)^3} \times 10^5$$

Condition factors were calculated for these fish both at release and recapture.

Interrogation at Dams

During spring and summer 2003, surviving chinook salmon PIT tagged for this study migrated volitionally downstream through hydroelectric dams on the Snake and Columbia Rivers. Of the eight dams the smolts passed, the following six were equipped with smolt collection and/or PIT-tag interrogation systems: Lower Granite (Figure 1), Little Goose, and Lower Monumental Dams on the Snake River, and McNary, John Day, and Bonneville Dams on the Columbia River.

At these six dams, all smolts guided from turbine intakes into juvenile bypass systems were electronically monitored for PIT tags. The PIT-tag interrogation systems were the same as those described by Prentice et al. (1990). Dates and times to the nearest second were automatically recorded on a computer as PIT-tagged fish passed each detector. Detection data were transferred once daily to PTAGIS (PSMFC 1996).

Migration Timing

During the years from 1993 to 1997, migration timing of wild fish at each interrogation dam was analyzed based on first-time detection numbers expanded relative to the proportion of daily spill (Achord et al. 1995a,b; 1996a, 1997, 1998). This produced a spill-adjusted or indexed number of PIT-tagged fish passing each dam daily for individual or combined populations.

Since 1998, within-season migration timing at Lower Granite Dam has been based on daily detection numbers (of all wild PIT-tagged chinook salmon smolts) expanded relative to estimated daily detection probabilities. Detection probabilities were calculated using the methods of Sandford and Smith (2002) to provide an estimate of the number of PIT-tagged wild spring/summer chinook salmon smolts that passed the dam each day. These daily totals were then summed to obtain a yearly survival estimate. Therefore, timing statistics were calculated based on estimated passage distributions. In 2001, we recalculated all migration timing and parr-to-smolt survival estimates from 1993 to1997 using the Sandford and Smith (2002) methods described above and use those estimates in all current and future documents. At interrogation dams below Lower Granite Dam, first-time detections were not expanded per above procedures.

Migration timing at Lower Granite Dam was calculated by totaling the (expanded) number of detections in 3-day intervals and dividing by total detections during the season. This method was applied to detection data for fish from combined streams.

There was no straightforward way of comparing Lower Granite Dam arrival statistics (10th, median, and 90th percentiles) between streams to find statistically significant differences. We used an approach analogous to analysis of variance with multiple comparisons. Bootstrap methods were used to calculate estimates of the standard error for each statistic (Efron and Tibshirani 1993). A "representative" estimate of variance for each statistic was then calculated as the median of the standard errors for fish from all 19 streams. The assumption was made that the timing percentiles had similar distributions among streams. The Student-Newmann-Keuls (SNK) multiple comparison method ($\alpha = 0.05$) was used to make comparisons between streams for each statistic (Petersen 1985).

We also examined the migration timing at Lower Granite Dam of individual stocks over a period of years to determine similarities or differences between years and between stocks. We chose stocks with 9 or more years of timing data for these analyses. Comparisons of the 10th, 50th, and 90th percentile passage dates were made among 11 streams using a two-factor analysis of variance (ANOVA). Year was considered a random factor and stream a fixed factor. Residuals were visually examined to assess normality. Treatment means were compared using Fisher's least significant difference procedure (Peterson 1985). Statistical significance was set at $\alpha = 0.05$.

Environmental Information

Environmental data were collected from water quality monitoring systems at the following locations: 1) Marsh Creek, 2) Valley Creek, 3) Sawtooth Hatchery in the upper Salmon River, 4) South Fork Salmon River (Knox Bridge), and 5) Secesh River (near Chinook Campground). All monitoring systems except the system at Valley Creek were close to juvenile migrant fish traps. The water quality monitor at Valley Creek was located near our in-stream PIT-tag monitoring system (VC2).

RESULTS

Fish Collection and Tagging

From 23 July to 28 August 2002, we collected 18,961 wild chinook salmon parr in 15 Idaho streams (Figure 1) over a distance of about 35.3 stream kilometers and approximately 328,857 m^2 (Table 1; Appendix Table 1). Of these fish, 14,290 were PIT tagged and released back into the streams; the remainder were not tagged because of size, injury, precocious maturation, or because they were collected for genetic studies or were extra collected fish. Numbers released per stream ranged from 34 in Chamberlain Creek to 2,266 in Valley Creek (Table 1 and Appendix Tables 1 and 2a).

Fork lengths of all collected chinook salmon parr ranged from 36 to 195 mm (mean 60.2 mm) and weights ranged from 0.9 to 28.1 g (mean 3.6 g). Fork lengths of tagged and released chinook salmon parr ranged from 46 to 127 mm (mean 63.2 mm) (occasionally fish smaller than 55 mm are inadvertently tagged) and weights ranged from 1.1 to 19.0 g (mean 3.6 g; Appendix Table 1). In 2002, collection areas within the streams were further delineated by recording GPS coordinates using the Universal Transverse Mercator grid (UTM; Appendix Table 2b).

Other than chinook salmon parr, sculpin were the most abundant species observed during collection operations (Table 2). However, the records of these observations do not represent total abundances of fish in the areas of collection, as we targeted collecting chinook salmon not other coincident species.

Mortality associated with collection and tagging procedures was low, and 24-hour tag loss was zero (Table 3; Appendix Table 3). Average collection mortality was 0.7%, and average tagging and 24-hour delayed mortality was 0.4%. The average overall observed mortality was 1.1%.

Detections at In-stream PIT-Tag Monitors

From 2 to 6 August 2002, 2,266 wild chinook salmon parr were collected, PIT tagged, and released in natal rearing areas from 3 to 16 km above the upstream PIT-tag in-stream monitor in lower Valley Creek (Table 1). An additional 91 juvenile steelhead were also PIT tagged and released in these areas (Table 2).

Table 1. Summary of collection, PIT tagging, and release of wild chinook salmon parr with average fork lengths and weights, approximate distances, and estimated areas sampled in streams of Idaho during July and August 2002.

Tagging location	Number of fish		Average fish length (mm)		Average fish weight (g)		Collection area to mouth of stream (km)	Estimated area sampled in streams (m^2)
	Collected	Tagged and released	Collected	Tagged	Collected	Tagged		
Bear Valley Creek	1,121	1,022	61.6	62.3	3.2	3.3	9-10 & 13-14	26,246
Elk Creek	999	975	62.1	62.2	3.6	3.6	0-1	15,134
Marsh Creek	1,082	997	64.7	65.6	4.4	4.5	11-13	10,875
Cape Horn Creek	1,066	562	54.3	59.5	3	2.9	0-0.5 & 5.5-7	12,184
Sulphur Creek	588	560	63.9	64.2	--	--	4-8	16,998
Valley Creek	3,239	2,266	58.8	61.9	3.3	3.4	4, 6-9, & 17	50,346
Loon Creek	893	830	64	64.7	3.9	3.9	33-37	30,385
Camas Creek	1,233	976	58.7	60.7	3	3	21-23	21,357
Herd Creek	820	799	75.9	75.9	6.2	6.2	1-5	29,704
Big Creek (upper)	1,533	1,004	57.2	60.8	3.4	3.4	54-57	30,238
Big Creek (lower)	748	720	67.4	67.8	4.3	4.3	8-10	26,412
W.F. Chamberlain	853	761	62.2	63.3	2.9	2.9	1-2	1,280
Chamberlain Creek	49	34	57.2	60.5	--	--	25-25.3	1,350
S. Fork Salmon River	1,779	1,035	56.3	60.5	2.9	2.9	117 & 123	10,140
Secesh River	1,708	1,040	57	61.1	3	3	25-27	25,109
Lake Creek	1,250	709	56.7	62.3	3.5	3.5	1-2	21,099
Totals or averages	18,961	14,290	60.2	63.2	3.6	3.6	35.3	328,857

Table 2. Summary of species other than chinook salmon parr observed during collection operations in Idaho in July and August 2002. Numbers of steelhead in parentheses were PIT tagged for the Idaho Department of Fish and Game.

Streams	Steelhead		Unidentified fry	Brook trout	Cutthroat trout	Bull trout
Bear Valley Creek	13	(130)	863	174	1	1
Elk Creek	6	(68)	83	269	0	1
Marsh Creek	4	(27)	296	126	0	0
Cape Horn Creek	3	(21)	8	57	0	9
Sulphur Creek	56	(104)	214	0	0	0
Valley Creek	1	(91)	551	105	0	0
Loon Creek	133	(296)	1,042	0	3	13
Camas Creek	4	(124)	1,015	0	0	4
Herd Creek	463	(308)	628	0	0	12
Big Creek (upper)	43	(65)	356	141	2	5
Big Creek (lower)	1	(83)	839	0	4	0
W. F. Chamberlain Creek	2	(65)	24	0	0	5
Chamberlain Creek	0	(4)	2	0	0	0
S. Fork Salmon River	37	(222)	536	12	0	8
Secesh River	90	(0)	256	4	0	2
Lake Creek	111	(0)	65	65	0	20
Totals	967	(1,608)	6,778	953	10	80

	Sculpin	Dace	Sucker	Whitefish	Shiner
Bear Valley Creek	41	191	71	447	0
Elk Creek	22	21	12	102	0
Marsh Creek	97	1	2	127	0
Cape Horn Creek	421	0	0	0	0
Sulphur Creek	1,143	67	0	19	0
Valley Creek	820	1,558	221	60	520
Loon Creek	796	7	0	0	0
Camas Creek	0	0	0	0	0
Herd Creek	985	3	1	165	0
Big Creek (upper)	1,442	0	0	1	0
Big Creek (lower)	93	90	47	1	0
W. F. Chamberlain Creek	6	0	0	0	0
Chamberlain Creek	18	0	0	0	0
S. Fork Salmon River	151	18	0	4	0
Secesh River	335	195	0	2	0
Lake Creek	958	9	0	12	0
Totals	7,328	2,160	354	940	520

Table 3. Mortality percentages for wild chinook salmon parr collected and PIT tagged in Idaho in July and August 2002. No tag loss occurred during the study in 2002.

	Mortality (%)		
Tagging location	Collection	Tagging & 24-hour	Overall
Bear Valley Creek	0.1	1.2	1.2
Elk Creek	0.5	0.7	1.2
Marsh Creek	0.0	0.0	0.0
Cape Horn Creek	0.4	0.0	0.4
Sulphur Creek	1.7	0.2	1.9
Valley Creek	0.6	0.3	0.9
Loon Creek	0.0	0.0	0.0
Camas Creek	2.0	0.0	2.0
Herd Creek	2.6	0.0	2.6
Big Creek (upper)	0.4	0.1	0.5
Big Creek (lower)	1.1	0.1	1.2
W. F. Chamberlain Creek	0.0	0.1	0.1
Chamberlain Creek	0.0	0.0	0.0
S. Fork Salmon River	0.0	1.2	1.2
Secesh River	0.2	1.0	1.2
Lake Creek	2.2	0.1	2.2
Totals or averages	0.7	0.4	1.1

From 2 August 2002 to 30 May 2003, 74 chinook salmon and 2 steelhead juveniles were detected at the 2 in-stream PIT-tag monitoring systems in lower Valley Creek. Two of the chinook that had been tagged at the Sawtooth Trap were from the upper Salmon River, and one of the steelhead was from a hatchery outplant. The upstream monitor (VC1) detected 29 chinook salmon and 1 steelhead and the downstream monitor (VC2) detected 45 chinook salmon and 1 steelhead. Only three chinook salmon were detected during spring 2003. All detections at the monitoring sites were unique, and no fish was detected at both sites. A total of 12 (16.7%) chinook salmon (both sites combined) were detected within 24 hours of release upstream and 38 (52.8%) chinook salmon detections occurred within 1 week of release.

Wild fish passed both monitors predominately during darkness hours. Only 10.5% of the fish passed the monitors from 06:00 to 18:00, while 89.5% passed from 18:00 to 06:00. In fact, 68.1% of all fish passed these monitors between 21:00 and 03:00.

Recaptures at Traps

A total of 666 wild fish PIT-tagged in summer 2002 were recaptured above Lower Granite Dam from summer-fall 2002 to summer 2003 (Table 4). Of these, 651 were recaptured in summer-fall 2002 and 15 were recaptured in spring-summer 2003.

For the 136 fish recaptured at the South Fork Salmon River trap at Knox Bridge in summer-fall 2002, length increased an average of 0.08 mm/d, but weight decreased an average of 0.02 g/d between release in natal rearing areas and recapture at the trap (Table 4). For the 2 fish recaptured at this trap in spring 2003, growth averaged 0.06 mm/d in length and 0.008 g/d in weight between release (summer 2002) and recapture.

The trap on the lower South Fork Salmon River recaptured 4 of the summer-tagged upstream released fish in summer-fall 2002 and none were recaptured at this trap in spring 2003 (Table 4). The 4 recaptured fish in the fall had grown an average of 0.08 mm/d in length and gained an average of 0.02 g/d (based on only one fish) in weight between release and recapture.

The trap on the Secesh River recaptured 58 of the summer-tagged Lake Creek fish in summer-fall 2002 and none was recaptured at this trap in spring 2003 (Table 4). The 58 recaptured fish in the fall had grown an average of 0.16 mm/d in length and gained no weight between release and recapture.

Table 4. Recapture information on PIT-tagged wild spring/summer chinook salmon from Idaho that were tagged in summer 2002 and recaptured by the separation-by-code system in the juvenile fish bypass system at Little Goose Dam in 2003 and at traps and dams in the summer and fall of 2002 and spring and summer of 2003.

	Number	Length gain (mm)			Weight gain (g)			Condition factor		Recapture interval (days)	
	recaptured	n	range	mean	n	range	mean	release	recapture	range	mean
Recaptures at Little Goose Dam											
Bear Valley Cr.	35	35	30-68	44.0	35	4.6-20.6	9.0	1.37	0.99	267-323	296
Elk Cr.	26	26	23-62	44.0	21	4.3-14.4	8.6	1.5	1.01	266-321	297
Sulphur Cr.	20	20	24-52	37.4	0	–	–	–	1.04	276-315	302
Marsh Cr.	27	27	27-64	42.0	0	–	–	–	0.99	259-316	288
Cape Horn Cr.	20	20	23-67	47.1	12	7.6-15.8	10.5	1.47	1.03	262-307	291
Valley Cr.	54	54	29-70	48.0	17	5.1-19.2	11.1	1.46	1.02	255-306	289
Loon Cr.	44	44	19-59	44.1	13	6.2-12.9	8.6	1.37	1.04	259-298	285
Camas Cr.	22	22	21-59	44.5	6	4.3-10.8	8.0	1.34	1.02	259-305	288
Herd Cr	25	25	20-54	36.1	17	1.8-12.7	6.7	1.38	0.96	252-297	276
Big Cr. (upper)	48	48	25-67	43.5	12	4.5-14.6	9.5	1.56	1.03	254-315	283
S. F. Salmon Riv.	11	11	21-59	38.1	0	–	–	–	0.99	244-287	267
Big Cr. (lower)	48	48	15-63	37.0	1	–	9.5	1.13	0.95	240-277	254
W.F. Chamberlain Cr.	21	20	25-58	46.2	3	6.7-12.6	10.2	1.14	0.95	245-284	268
Secesh Riv.	11	11	30-54	41.9	5	5.5-11.0	8.0	1.23	0.97	230-282	253
Lake Cr.	15	15	17-53	30.7	5	2.6-7.5	5.0	1.36	1.04	231-299	263
Totals or averages	427	426	15-70	42.4	147	1.8-20.6	8.9	1.41	1.00	230-323	282
Recaptures at traps											
South Fork Salmon River											
Knox-fall	136	67	0-5	1.6	3	-0.8-(-0.2)	-0.5	1.37	1.09	2-50	20
Knox-spr.	2	2	11-19	15.0	1	–	2.1	1.41	1.05	242-255	248
Lower-fall	4	2	3-4	3.5	1	–	0.8	1.24	1.17	8-67	44
Lake Creek											
Fall	84	84	0-10	3.8	17	-0.5-0.8	0.1	1.29	1.07	1-61	25
Spring	4	4	13-50	33.2	2	2.8-8.5	5.6	1.17	1.19	227-346	314
Secesh R. (fall-only)	58	58	0-12	4.7	26	-1.1-0.6	0.0	1.39	1.10	4-51	29
Marsh Creek											
Fall	369	365	0-22	5.7	6	–	–	1.36	1.23	0-93	31
Spring	4	4	19-61	39.0	1	--	11.5	1.01	1.27	236-379	312
Salmon R. (spr.-only)	2	2	36-62	49.0	0	–	–	1.32	–	242-283	262
Snake R. (spr.-only)	3	3	29-39	35.0	0	–	–	1.42	–	285-290	288
Totals	666	591			57						
Recaptures at other collector dams											
Lower Granite	3	0	--	–	0	--	-	–	–	244-284	266
Bonneville	2	0	-	–	0	--	–	–	–	306-314	310
Totals	5	0	-	–	0	--	---	--	--	--	---

The trap on Lake Creek recaptured 84 summer-tagged fish in summer-fall 2002 and 4 in spring 2003 (Table 4). Growth of the 84 fish recaptured in 2002 averaged 0.15 mm/d in length and 0.004 g/d in weight between release and recapture. For the 4 fish recaptured in spring-summer 2003, growth averaged 0.11 mm/d in length and 0.018 g/d in weight over a 314 day (average) period.

The Marsh Creek trap recaptured 369 summer-tagged fish in summer-fall 2002 and 4 summer-tagged fish were recaptured at this trap during spring 2003 (Table 4). The 365 fish (4 were not measured) recaptured in summer-fall had grown an average of 0.18 mm/d in length. None of these fish had been weighed at both release and recapture. The 4 fish recaptured in spring-summer 2003 had grown an average of 0.12 mm/d in length. Only one of these fish had been weighed: it gained 0.037 g/d over a 312 day period.

The Salmon River trap recaptured 2 summer-tagged fish in spring 2003. They had grown an average of 0.19 mm/d in length (no weights were recorded; Table 4). The Snake River trap recaptured 3 summer-tagged fish in spring 2003. They had grown an average of 0.12 mm/d in length, and no weights were recorded.

Recaptures at Dams

From 14 April to 26 June 2003, 427 PIT-tagged wild fish from Idaho streams were recaptured in the separation-by-code system at the Little Goose Dam juvenile fish facility (Table 4). We gathered parr-to-smolt growth information on 426 of these fish. Between tagging in 2002 and recapture in 2003, overall mean length increased by 42.4 mm (range 15-70 mm) and overall mean weight increased by 8.9 g (range 1.8-20.6 g), over a mean recapture interval of 282 d (range 230-323 d). Average growth rates in length between tagging and recapture ranged from 0.13 to 0.18 mm/d and weight gain averaged from 0.028 to 0.039 g/d for fish from these 15 streams. The mean condition factor decreased from 1.41 at release (parr) to 1.00 at recapture (smolt) for these wild fish.

Of the five other PIT-tagged wild fish recaptured and handled at the dams, none were measured and weighed (Table 4).

Detections at Dams

Based on expanded detections (1,262 fish)[2] at Lower Granite Dam from 31 March to 4 July 2003, estimated survival from parr to smolt for Idaho fish averaged 8.8% (range 2.8-19.3%; Table 5; Appendix Tables 4-18). An additional 491 first-time detections (unadjusted) were recorded at Little Goose, Lower Monumental, McNary, John Day, and Bonneville Dams (Appendix Tables 4-18 and 20-24). By comparing all first-time detections at interrogation dams (990) to the expanded number of detections at Lower Granite Dam (1,262), we estimated that 21.6% of the wild fish from Idaho passed through the dams undetected.

In 2002, we collected adequate numbers of parr in Bear Valley Creek, Elk Creek, and Marsh Creek, by both electrofishing and seining, to conduct statistical analyses of the percentages detected at dams the following year. We found no significant differences between collection methods ($P > 0.05$) in percentages detected at dams (unadjusted): 7.4% for electrofishing (108/1,468), and 7.0% for seining (107/1,526).

For parr tagged in Idaho, average fork length at release was 63.2 mm (Appendix Table 1). However, among fish from this group that were detected the following spring at dams, average fork length at release was significantly higher 65.2 mm ($P < 0.01$). The release-length distribution of detected fish was also significantly different from that of released fish in all length categories except 80-84 mm and 85-89 mm ($P < 0.033$; Figure 2).

We also found a significant difference in fork lengths at time of release for fish that migrated through Lower Granite Dam in April and May compared to fish that migrated after May ($P < 0.01$). Fish migrating through the dam in April and May were on average 6.4 mm larger at release than fish migrating after May. These data suggest that fish size influences migration timing or overwintering location.

2 Due to rounding of numbers, the expanded detection numbers at Lower Granite Dam in Table 5 may vary slightly from expanded detection numbers in Appendix Tables 4-19.

Table 5. Summary of observed and expanded detections of PIT-tagged wild spring/summer chinook salmon smolts from Idaho at Lower Granite Dam in 2003. Estimates of parr-to-smolt survival were calculated using the expanded numbers. See Table 1 for numbers released.

	Lower Granite Dam Detections			
	Observed		Expanded	
Stream	N	%	N	%
Bear Valley Creek[a]	41	4.0	100	9.8
Elk Creek	27	2.8	69	7.1
Marsh Creek	50	5.0	130	13.0
Cape Horn Creek	25	4.4	63	11.2
Sulphur Creek	25	4.5	61	10.9
Valley Creek[a]	50	2.2	129	5.7
Loon Creek	61	7.3	160	19.3
Camas Creek	27	2.8	73	7.5
Herd Creek	37	4.6	98	12.3
Big Creek (upper)	41	4.1	103	10.3
Big Creek (lower)	59	8.2	137	19.0
W. F. Chamberlain Creek[b]	17	2.1	41	5.2
S. Fork Salmon River	12	1.2	29	2.8
Secesh River	16	1.5	40	3.8
Lake Creek	11	1.6	29	4.1
Totals or averages	499	3.5	1,262	8.8

a One additional fish from each of these streams were first-time detections at the PIT-tag trawl in the mouth of the Columbia River.

b Includes fish from Chamberlain Creek.

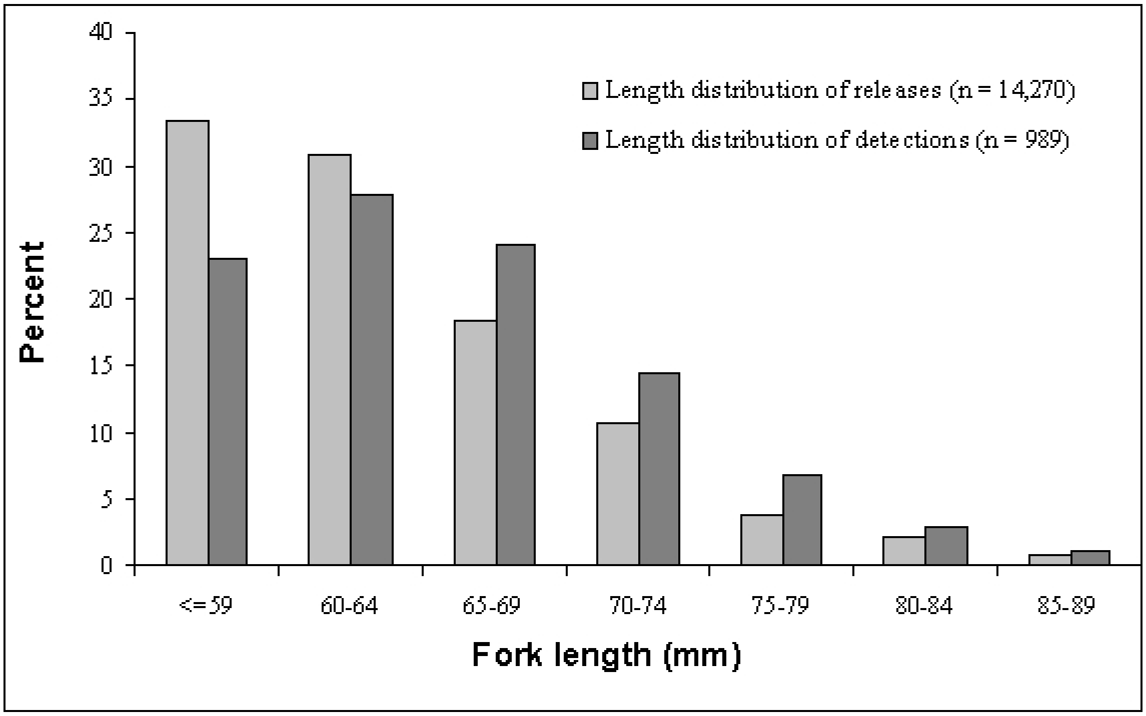

Figure 2. Length distribution by fork-length increment of PIT-tagged wild spring/summer chinook salmon parr released in Idaho streams in 2002 (n = 14,270) compared to the length distribution of fish detected at dams in spring and summer 2003 (n = 989).

Migration Timing

Lower Granite Dam

Passage timing at Lower Granite Dam varied for fish from the 19 Idaho and Oregon streams (Figure 3). In comparisons among all 19 Idaho and Oregon streams (Tables 6a-6b; Figure 3), fish from Lake Creek had significantly earlier timing for the 10th percentile passage than fish from all other streams. The 10th percentile passage date of fish from upper Big Creek was significantly later than that of fish from all other streams except Loon, Camas, and Sulphur Creeks ($P < 0.05$). Overall, the 10th percentile passage dates for fish from all 19 streams ranged from 6 April to 6 May (Tables 6a-6b).

In comparisons of the 50th percentile passage date, fish from Big Creek (lower) were significantly earlier than fish from all other Idaho and Oregon streams except the Secesh, Lostine, and Imnaha Rivers and Herd, Bear Valley, Marsh, Elk, and Lake Creek ($P < 0.05$). Fish from Sulphur Creek were significantly later than fish from all other streams except South Fork Salmon, and Minam Rivers and Cape Horn, Loon, Valley, West Fork Chamberlain/Chamberlain, Camas, and (upper) Big Creeks ($P < 0.05$). The overall 50th percentile passage distributions for fish from all 19 streams ranged from 26 April to 25 May (Tables 6a-6b).

In terms of the 90th percentile passage date at the dam, fish from lower Big Creek were significantly earlier than fish from all other streams, while fish from Catherine Creek were significantly later than all other streams except the Secesh and South Fork Salmon Rivers and Cape Horn, upper Big, Lake, and Sulphur Creeks ($P < 0.05$). The overall 90th percentile passage date ranged from 18 May to 9 June for fish from all streams (Tables 6a-6b).

For the number of days encompassing the middle 80th percentile passage (10th to 90th percentile), Big Creek (upper) fish had a significantly more condensed distribution, (26 d) than fish from the Secesh and South Fork Salmon Rivers or from Bear Valley, Catherine, Valley, Marsh, and Lake Creeks (44-59 d; $P < 0.05$; Tables 6a-6b). Timing of the middle 80th percentile passage for Lake Creek fish was significantly more protracted (59 days) than for fish from all other streams (26-45 d; $P < 0.05$).

Table 6a. Accumulated and 2003 passage dates at Lower Granite Dam for PIT-tagged wild spring/summer chinook salmon smolts from streams in Idaho.

	Percentile passage dates at Lower Granite Dam			
Year	10th	50th	90th	Range
Bear Valley Creek				
1990	19 April	05 May	31 May	11 April-18 July
1991	03 May	20 May	12 June	18 April-23 June
1992	15 April	02 May	24 May	07 April-28 June
1993	29 April	16 May	22 June	22 April-27 July
1994	22 April	06 May	29 May	16 April-15 July
1995	28 April	18 May	12 June	13 April-20 July
1996[a]	---	---	---	---
1997[a]	---	---	---	---
1998	25 April	06 May	23 May	31 March-25 June
1999	23 April	03 May	07 June	20 April-21 June
2000	18 April	07 May	02 June	14 April-02 July
2001	08 May	16 May	28 May	26 April-17 June
2002	16 April	04 May	31 May	12 April-26 June
2003	**14 April**	**05 May**	**28 May**	**12 April-14 June**
Elk Creek				
1990[b]	---	---	---	---
1991	03 May	20 May	16 June	25 April-24 June
1992	11 April	30 April	28 May	05 April-17 July
1993	02 May	16 May	11 June	21 April-26 June
1994	23 April	04 May	21 May	18 April-09 July
1995	18 April	11 May	05 June	10 April-09 July
1996[a]	---	---	---	---
1997[a]	---	---	---	---
1998	07 April	02 May	15 May	04 April-21 June
1999	21 April	03 May	27 May	01 April-08 July
2000	15 April	28 April	19 May	13 April-28 May
2001	30 April	11 May	27 May	30 April-27 May
2002	16 April	29 April	02 June	13 April-05 July
2003	**20 April**	**06 May**	**29 May**	**31 March-30 May**
Sulphur Creek				
1990	18 April	30 April	31 May	11 April-27 June
1991[a]	---	---	---	---
1992	16 April	03 May	23 May	10 April-01 June
1993	28 April	16 May	12 June	24 April-28 June
1994[a]	---	---	---	---
1995	02 May	23 May	09 June	11 April-09 July
1996[a]	---	---	---	---
1997[a]	---	---	---	---
1998[a]	---	---	---	---
1999	24 April	19 May	27 May	22 April-29 May

Table 6a. Continued.

	Percentile passage dates at Lower Granite Dam			
Year	10th	50th	90th	Range
Sulphur Creek(Continued)				
2000	15 April	07 May	24 May	12 April-30 May
2001[a]	---	---	---	---
2002[a]	---	---	---	---
2003	**02 May**	**25 May**	**08 June**	**22 April-24 June**
Cape Horn Creek				
1990[a]	---	---	---	---
1991	24 April	16 May	28 May	19 April-06 June
1992	12 April	28 April	30 May	10 April-01 June
1993	08 May	19 May	26 June	05 May-01 July
1994[a]	---	---	---	---
1995	29 April	14 May	19 June	14 April-28 July
1996[a]	---	---	---	---
1997[a]	---	---	---	---
1998[a]	---	---	---	---
1999	29 April	22 May	29 May	25 April-12 June
2000	01 May	24 May	01 June	20 April-09 July
2001[a]	---	---	---	---
2002[a]	---	---	---	---
2003	**21 April**	**17 May**	**01 June**	**15 April-18 June**
Camas Creek				
1993	03 May	16 May	27 May	24 April-24 June
1994	30 April	15 May	26 May	24 April-11 July
1995	27 April	12 May	05 June	17 April-11 June
1996[a]	---	---	---	---
1997[a]	---	---	---	---
1998[a]	---	---	---	---
1999[a]	---	---	---	---
2000	26 April	25 May	02 June	13 April-24 June
2001[a]	---	---	---	---
2002[a]	---	---	---	---
2003	**02 May**	**24 May**	**30 May**	**26 April-06 June**
Marsh Creek				
1990	17 April	29 April	31 May	09 April-01 July
1991	26 April	20 May	09 June	17 April-18 June
1992	17 April	07 May	02 June	10 April-13 July
1993	29 April	15 May	27 May	24 April-10 August
1994	23 April	04 May	18 May	16 April-08 August
1995	17 April	09 May	24 May	11 April-08 July
1996[a]	---	---	---	---
1997[a]	---	---	---	---

Table 6a. Continued.

	Percentile passage dates at Lower Granite Dam			
Year	10th	50th	90th	Range
Marsh Creek (Continued)				
1998[a]	---	---	---	---
1999	21 April	01 May	25 May	11 April-13 June
2000	21 April	28 April	27 May	14 April-16 June
2001[a]	---	---	---	---
2002	18 April	04 May	23 May	14 April-26 May
2003	**14 April**	**05 May**	**29 May**	**03 April-09 June**
Valley Creek				
1989	24 April	14 May	12 June	09 April-17 June
1990	16 April	08 May	05 June	12 April-29 June
1991	11 May	20 May	20 June	21 April-13 July
1992	15 April	30 April	27 May	13 April-04 June
1993	30 April	16 May	02 June	24 April-06 June
1994	24 April	04 May	03 June	22 April-09 June
1995	04 May	02 June	08 July	22 April-18 July
1996[a]	---	---	---	---
1997[a]	---	---	---	---
1998[a]	---	---	---	---
1999	24 April	13 May	12 June	19 April-01 July
2000	20 April	12 May	29 May	13 April-14 July
2001	10 May	19 May	01 June	28 April-03 July
2002	24 April	20 May	03 June	19 April-19 June
2003	**14 April**	**17 May**	**28 May**	**01 April-31 May**
Loon Creek				
1993	05 May	12 May	17 May	03 May-5 June
1994	29 April	10 May	24 May	22 April-07 June
1995	23 April	11 May	28 May	13 April-07 June
1996[a]	---	---	---	---
1997[a]	---	---	---	---
1998[a]	---	---	---	---
1999	30 April	18 May	27 May	22 April-16 June
2000	22 April	08 May	24 May	14 April-01 June
2001[a]	---	---	---	---
2002[a]	---	---	---	---
2003	**30 April**	**17 May**	**28 May**	**21 April-30 May**
East Fork Salmon River				
1989	22 April	03 May	18 May	07 April-08 June
1990[a]	---	---	---	---
1991	22 April	09 May	26 May	16 April-20 June
1992	13 April	21 April	16 May	10 April-03 June
1993	25 April	06 May	18 May	22 April-01 June

Table 6a. Continued.

	Percentile passage dates at Lower Granite Dam			
Year	10th	50th	90th	Range
East Fork Salmon River (Continued)				
1994	22 April	28 April	17 May	20 April-25 May
1995	14 April	28 April	10 May	11 April-27 May
1996[a]	---	---	---	---
1997[a]	---	---	---	---
1998[a]	---	---	---	---
1999[a]	---	---	---	---
2000	21 April	07 May	25 May	15 April-27 May
2001[a]	---	---	---	---
2002[a]	---	---	---	---
2003[a]	---	---	---	---
Herd Creek				
1992	14 April	20 April	10 May	13 April-18 May
1993	26 April	30 April	18 May	26 April-31 May
1994[b]	---	---	---	---
1995	18 April	03 May	14 May	11 April-28 May
1996[a]	---	---	---	---
1997[a]	---	---	---	---
1998[a]	---	---	---	---
1999	20 April	29 April	10 May	30 March-20 May
2000	16 April	25 April	18 May	14 April-19 May
2001	30 April	04 May	14 May	28 April-07 June
2002[b]	---	---	---	---
2003	**16 April**	**03 May**	**26 May**	**06 April-29 May**
South Fork Salmon River				
1989	25 April	13 May	14 June	16 April-20 June
1990[a]	---	---	---	---
1991	20 April	16 May	10 June	17 April-13 July
1992	14 April	29 April	27 May	07 April-27 July
1993	29 April	16 May	02 June	26 April-28 June
1994	27 April	15 May	28 June	22 April-09 July
1995	20 April	10 May	10 June	13 April-13 July
1996	19 April	15 May	09 June	19 April-03 July
1997	13 April	28 April	12 June	07 April-15 June
1998	25 April	12 May	15 June	02 April-07 August
1999	31 March	04 May	01 June	27 March-11 June
2000	20 April	18 May	31 May	12 April-20 July
2001	29 April	14 May	01 June	26 April-07 July
2002	15 April	03 May	24 May	11 April-09 June
2003	**19 April**	**16 May**	**03 June**	**19 April-12 June**

Table 6a. Continued.

	Percentile passage dates at Lower Granite Dam			
Year	10th	50th	90th	Range
Big Creek (upper)				
1990	27 April	30 May	22 June	17 April-18 July
1991	18 May	10 June	26 June	26 April-01 July
1992	22 April	08 May	03 June	15 April-26 June
1993	08 May	18 May	26 May	26 April-15 June
1994	03 May	19 May	19 July	25 April-30 August
1995	05 May	23 May	09 June	02 May-26 June
1996[a]	---	---	---	---
1997[a]	---	---	---	---
1998[a]	---	---	---	---
1999	28 April	14 May	03 June	25 April-19 June
2000	30 April	27 May	14 June	15 April-29 June
2001[a]	---	---	---	---
2002[a]	---	---	---	---
2003	**06 May**	**25 May**	**01 June**	**01 May-21 June**
Big (lower)/Rush Creeks				
1993	24 April	29 April	13 May	21 April-16 May
1994	23 April	29 April	11 May	21 April-15 June
1995	19 April	01 May	14 May	11 April-05 June
1996[a]	---	---	---	---
1997[a]	---	---	---	---
1998[a]	---	---	---	---
1999	19 April	28 April	23 May	04 April-30 May
2000	19 April	30 April	13 May	16 April-26 May
2001[a]	---	---	---	---
2002	15 April	25 April	07 May	12 April-22 May
2003	**14 April**	**26 April**	**18 May**	**12 April-25 May**
West Fork Chamberlain Creek				
1992[c]	15 April	26 April	03 June	12 April-24 June
1993	28 April	15 May	23 June	23 April-22 July
1994[c]	24 April	01 May	05 July	24 April-04 September
1995[c]	16 April	09 May	20 June	12 April-22 September
1996[a]	---	---	---	---
1997[a]	---	---	---	---
1998[a]	---	---	---	---
1999[a]	---	---	---	---
2000[a]	---	---	---	---
2001[a]	---	---	---	---
2002	26 April	04 May	20 May	18 April-29 May
2003[c]	**23 April**	**20 May**	**26 May**	**21 April-26 May**

Table 6a. Continued.

	Percentile passage dates at Lower Granite Dam			
Year	10th	50th	90th	Range
Secesh River				
1989	20 April	27 April	09 June	09 April-19 July
1990	14 April	22 April	07 June	10 April-13 July
1991	20 April	27 April	14 June	13 April-20 July
1992	13 April	29 April	04 June	05 April-03 July
1993	26 April	16 May	16 June	22 April-15 July
1994	22 April	26 April	11 July	21 April-07 August
1995	14 April	01 May	24 May	10 April-10 July
1996	14 April	25 April	29 May	12 April-15 July
1997	10 April	18 April	04 May	04 April-11 July
1998	08 April	24 April	28 May	03 April-06 July
1999	03 April	23 April	25 May	29 March-21 June
2000	13 April	23 April	04 June	12 April-11 July
2001	16 April	28 April	13 May	06 April-13 June
2002	13 April	21 April	17 May	11 April-01 July
2003	**18 April**	**30 April**	**01 June**	**03 April-04 July**
Lake Creek				
1989	23 April	02 May	16 June	12 April-01 July
1990[a]	---	---	---	---
1991[a]	---	---	---	---
1992[a]	---	---	---	---
1993	23 April	09 May	22 June	22 April-25 June
1994	21 April	28 April	19 May	20 April-24 June
1995	17 April	10 May	10 June	14 April-20 July
1996	15 April	21 April	19 May	15 April-02 June
1997	11 April	25 April	02 July	07 April-22 September
1998	04 April	25 April	26 May	02 April-16 July
1999	20 April	26 April	27 May	08 April-20 June
2000	13 April	04 May	04 June	13 April-18 July
2001[a]	---	---	---	---
2002	16 April	29 April	03 June	13 April-03 June
2003	**06 April**	**06 May**	**04 June**	**06 April-20 June**

[a] No parr were tagged the summer prior to this migration year.

[b] Insufficient numbers detected to estimate timing.

[c] Includes fish from Chamberlain Creek.

Table 6b. Accumulated and 2003 passage dates at Lower Granite Dam for PIT-tagged wild spring/summer chinook salmon smolts from streams in Oregon.

	Percentile passage dates at Lower Granite Dam			
Year	10th	50th	90th	Range
Catherine Creek				
1991	01 May	14 May	08 June	17 April-23 June
1992	16 April	01 May	21 May	09 April-29 June
1993	06 May	18 May	05 June	29 April-26 June
1994	25 April	11 May	20 May	13 April-26 July
1995	01 May	19 May	09 June	26 April-02 July
1996[a]	19 April	13 May	29 May	14 April-14 June
1997	08 May	14 May	01 June	24 April-10 June
1998	28 April	21 May	28 May	24 April-04 June
1999	26 April	25 May	15 June	26 April-26 June
2000	30 April	08 May	23 May	12 April-06 June
2001	29 April	17 May	17 June	28 April-03 July
2002	24 April	10 May	18 June	15 April-01 July
2003	**26 April**	**10 May**	**09 June**	**14 April-09 June**
Grande Ronde River (upper)				
1989	12 May	06 June	19 June	27 April-22 July
1990[b]	---	---	---	---
1991[b]	---	---	---	---
1992[b]	---	---	---	---
1993	05 May	16 May	25 May	23 April-20 June
1994	28 April	23 May	07 July	23 April-29 August
1995	27 April	29 May	12 June	12 April-01 July
1996[c]	26 April	17 May	29 May	19 April-06 June
1997[b]	---	---	---	---
1998[b]	---	---	---	---
1999[b]	---	---	---	---
2000[b]	---	---	---	---
2001[b]	---	---	---	---
2002[b]	---	---	---	---
2003[b]	**---**	**---**	**---**	**---**
Imnaha River (lower)				
1989	11 April	30 April	11 May	04 April-05 June
1990	10 April	18 April	09 May	05 April-27 May
1991	20 April	01 May	13 May	14 April-15 May
1992	10 April	21 April	03 May	06 April-21 May
1993[b]	---	---	---	---
1994[b]	---	---	---	---
1995[b]	---	---	---	---
1996[b]	---	---	---	---
1997[b]	---	---	---	---
1998[b]	---	---	---	---

Table 6b. Continued.

	Percentile passage dates at Lower Granite Dam			
Year	10th	50th	90th	Range
Imnaha River (lower)(Continued)				
1999[b]	---	---	---	---
2000[b]	---	---	---	---
2001[b]	---	---	---	---
2002[b]	---	---	---	---
2003[b]				
Imnaha River (upper)				
1993	24 April	14 May	28 May	15 April-23 June
1994	24 April	08 May	09 June	20 April-11 August
1995	13 April	02 May	03 June	10 April-07 July
1996	16 April	26 April	18 May	14 April-12 June
1997	11 April	19 April	11 May	03 April-02 June
1998	11 April	28 April	13 May	03 April-24 May
1999	22 April	08 May	26 May	17 April-03 June
2000	14 April	02 May	24 May	12 April-16 June
2001	21 April	30 April	16 May	08 April-28 May
2002	16 April	04 May	17 May	15 April-31 May
2003	**22 April**	**08 May**	**26 May**	**17 April-31 May**
Lostine River				
1990[d]	---	---	---	---
1991	29 April	14 May	26 May	20 April-09 July
1992	16 April	30 April	11 May	12 April-02 June
1993	23 April	03 May	17 May	17 April- 01 June
1994	22 April	30 April	16 May	19 April- 07 June
1995	12 April	02 May	17 May	08 April-09 June
1996	23 April	15 May	07 June	17 April-19 June
1997	17 April	28 April	16 May	09 April-21 May
1998[b]	---	---	---	---
1999	30 March	09 May	27 May	29 March-29 May
2000	13 April	08 May	25 May	13 April-3 June
2001	25 April	09 May	22 May	10 April-12 June
2002	11 April	21 April	13 May	28 March-29 May
2003	**13 April**	**08 May**	**26 May**	**11 April-03 June**
Minam River				
1999	08 April	28 April	25 May	31 March-02 June
2000	15 April	03 May	22 May	10 April-29 May
2001	25 April	07 May	23 May	08 April-12 June
2002	17 April	03 May	20 May	16 April-31 May
2003	**17 April**	**13 May**	**29 May**	**13 April-01 June**

[a] Includes fish tagged from summer 1995 through spring 1996.
[b] No parr were tagged the summer prior to this migration year.
[c] All fish tagged at traps in fall or spring for this migration year.
[d] Insufficient numbers detected to estimate timing.

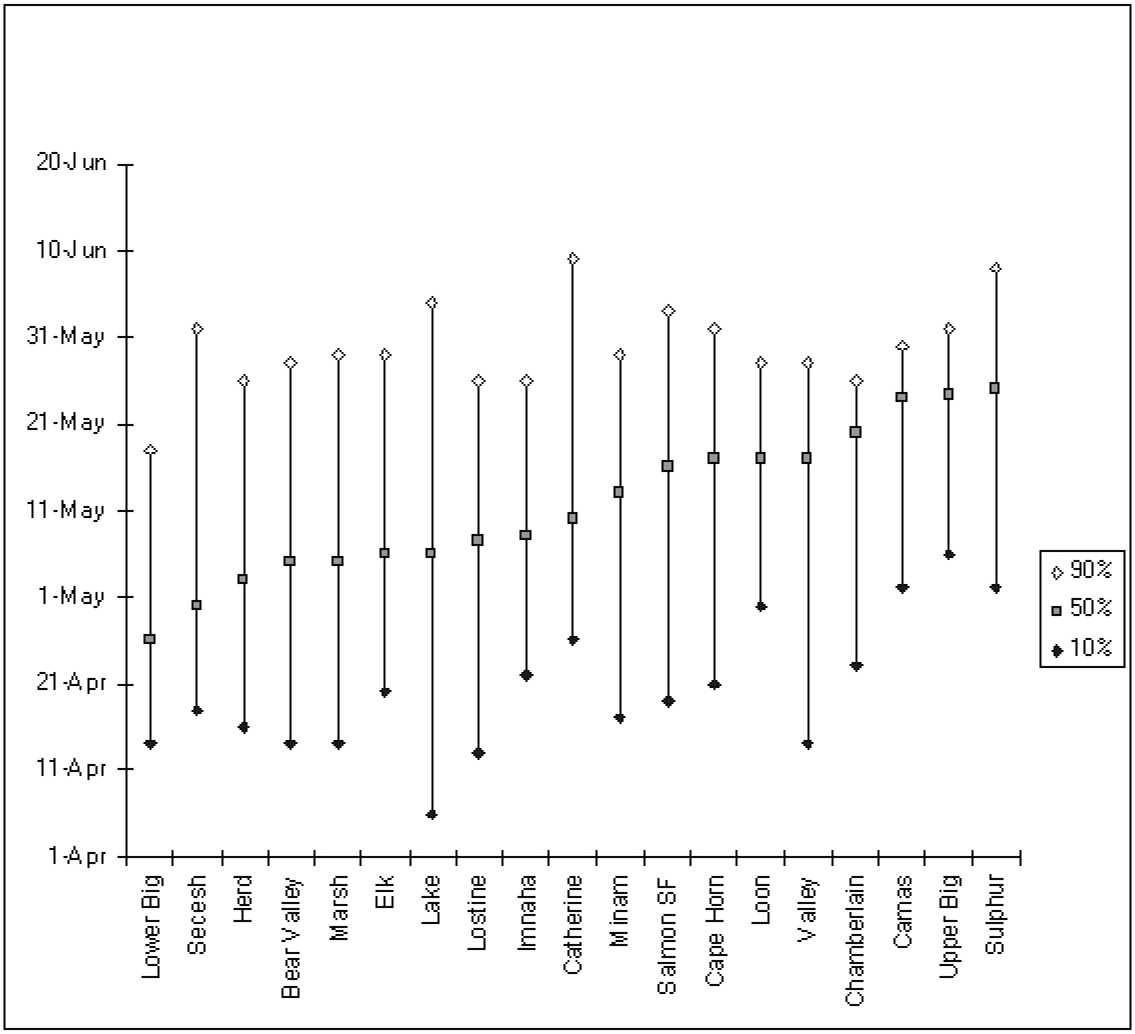

Figure 3. Estimated passage distributions at Lower Granite Dam for wild spring/summer chinook salmon smolts from streams in Idaho and Oregon in 2003. Chamberlain and West Fork Chamberlain Creeks are combined and Big Creek is divided into lower and upper portions for these analyses. See Appendix Tables 4-18 for daily estimated passage numbers from Idaho streams at the dam.

Comparison with Flows

We grouped first-time detections (expanded) at Lower Granite Dam for wild fish from all Idaho and Oregon streams combined and compared their collective timing with river flows and spill during the 2003 juvenile migration season (Figure 4 and Appendix Table 19). Overall, passage at the dam during 2003 occurred between late March and early July, with the middle 80th percentile passage occurring from 18 April to 29 May (Table 7). The peak passage date was 26 May which coincided with high (and rapidly increasing) flow of 146.7 kcfs (Appendix Table 19).

Environmental Information

In 2002-2003, we collected hourly measurements of water temperature, dissolved oxygen, specific conductance, turbidity, water depth, and pH from 5 environmental monitoring stations in the Salmon River Basin. We recorded these measurements, as well as those from previous years, in a baseline environmental database.

Appendix Tables 25-29 provide a monthly summary of environmental information collected from the five environmental monitoring sites (Marsh Creek, Valley Creek, Sawtooth Hatchery, Knox Bridge, and Secesh River) from August 2002 to July 2003. Environmental data collected during 2002-2003 are presented in Appendix Figures 1-7, which compare various water quality parameters to chinook salmon fry, parr, and smolt movements through adjacent traps (Figure 1) and in-stream PIT-tag monitors in 2002-2003.

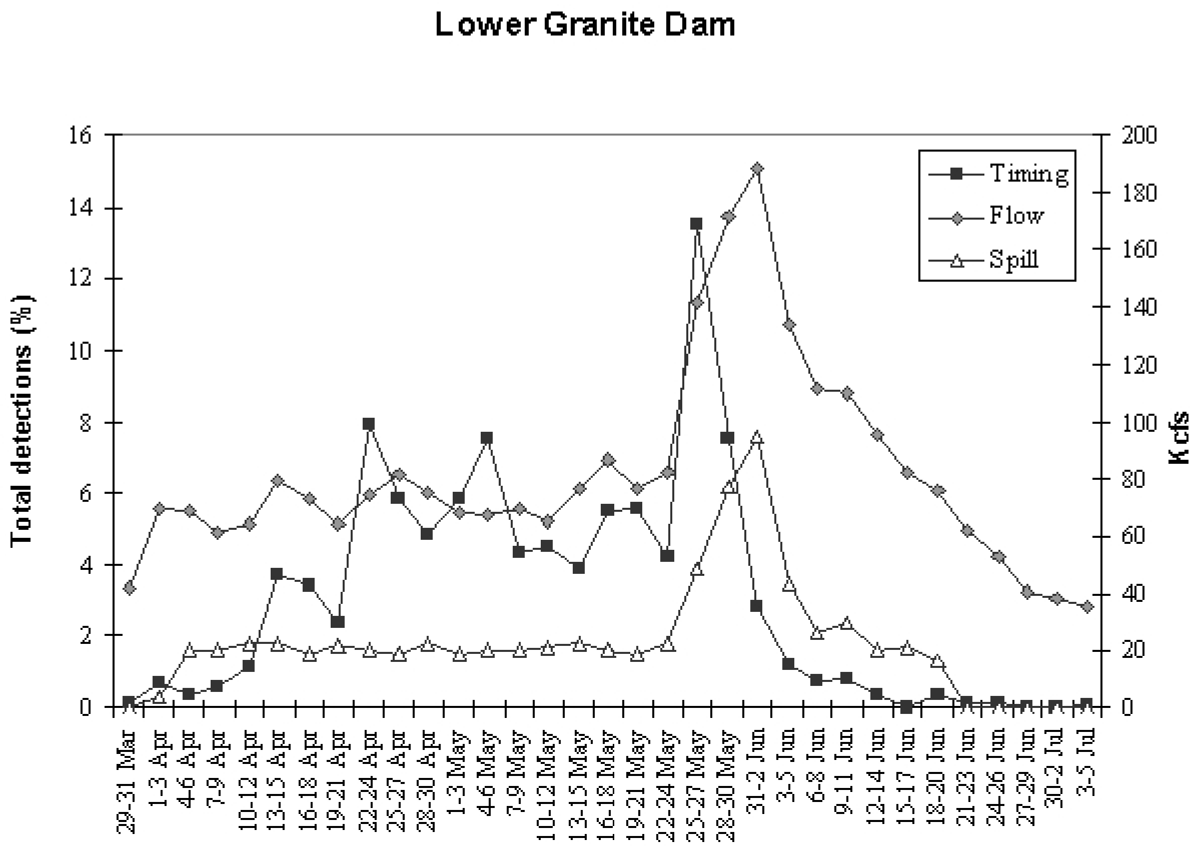

Figure 4. Overall migration timing of PIT-tagged wild spring/summer chinook salmon smolts with associated river flows and spill at Lower Granite Dam, 2003. Daily detections from 15 Idaho and 4 Oregon streams were pooled in 3-day intervals and expanded based on daily detection probability. River flows and spill at the dam were averaged daily over the same periods.

Table 7. Accumulated and 2003 passage dates at Lower Granite Dam for combined populations of wild spring/summer chinook salmon smolts PIT tagged as summer parr in Idaho and Oregon streams.

	Percentile passage dates at Lower Granite Dam			
Year	10th	50th	90th	Range
1989[a]	23 April	14 May	13 June	04 April-22 July
1990	19 April	07 May	07 June	05 April-18 July
1991	01 May	18 May	12 June	13 April-20 July
1992	15 April	02 May	27 May	05 April-27 July
1993	26 April	14 May	31 May	14 April-10 August
1994	22 April	08 May	01 June	13 April-04 Sept.
1995	17 April	09 May	04 June	08 April-22 Sept.
1996[a,b]	15 April	27 April	19 May	09 April-15 July
1997[a,b]	12 April	24 April	18 May	31 March-22 Sept.
1998[b]	11 April	02 May	23 May	31 March-07 Aug.
1999	20 April	03 May	28 May	27 March-08 July
2000	17 April	07 May	30 May	10 April-20 July
2001	26 April	09 May	27 May	06 April-07 July
2002	16 April	03 May	30 May	28 March-05 July
2003	**18 April**	**11 May**	**29 May**	**31 March-04 July**

a No fish were tagged from the Middle Fork Salmon River drainage for this migration year.
b This migration year represented by a much higher proportion of fish from Oregon streams than other years.

DISCUSSION

Mortality rates associated with collection and tagging in 2002 were comparable to those in earlier years (Achord et al. 1992; 1994; 1995a,b; 1996a,b; 1997; 1998; 2000, 2001a,b; 2002; 2003). Because of low numbers detected at the in-stream PIT-tag monitors in Valley Creek, we were unable to calculate statistically meaningful estimates of survival and migration timing for wild chinook salmon juveniles leaving this stream. However, with the installation of larger antennas (3.0-m long by 46-cm high) at both monitoring sites in 2003, along with many other developments and improvements to the systems in 2003, we should have a much improved probability of detecting sufficient numbers of fish for these analyses in the future.

From 1995 to 2000, average length gains between summer tagging and recapture for fish trapped at Knox Bridge in fall ranged from 0.09 to 0.15 mm/d over an average of from 19 to 51.5 d. In 2001, the average length gain fell to 0.05 mm/d over an average of 27 d, and in 2002 average length increases were only 0.08 mm/d over an average of 20 d. The variability in growth rates of wild fish from the South Fork Salmon River between late summer and fall indicated a trend of lower growth rates in years with higher parr density.

For fish recaptured at the Lake Creek trap, we saw no density-dependent trends in growth. Length increases between summer tagging and fall recapture averaged 0.12, 0.13, 0.13, and 0.15 mm/d over an average of 25, 38, 23, and 25 d in 1998, 1999, 2001, and 2002, respectively. For fish recaptured at the Secesh River trap, average length between summer tagging and fall recapture increased by 0.09, 0.12, 0.13, and 0.16 mm/d over an average of 22, 33, 34, and 29 d in 1998, 1999, 2001, and 2002, respectively.

We cannot explain why we observed increased growth rates in fall for these summer-tagged parr in Lake Creek and the Secesh River, while we observed the opposite trend of decreased growth rates in recent years for summer-tagged parr in the South Fork Salmon River. These streams are in the same drainage and have experienced recent high parr densities within the streams. Perhaps nutrient recharge from increased spawning (carcasses) in Lake Creek and the Secesh River in recent years has contributed to the increased growth rates but has not had the same effect in the South Fork Salmon River for unknown reasons.

For fish trapped at Marsh Creek, average length gains between summer tagging and fall recapture were 0.15, 0.15, 0.11, and 0.18 mm/d over an average of 51.2, 33, 49, and 31 d for 1994, 1998, 2001, and 2002, respectively. Again, it may be that nutrient recharge from increased spawning in this stream in recent years has contributed to the dramatic increase in parr growth rates in 2002.

Overall mean growth from the parr to smolt stage for wild fish from Idaho streams was 42.4 mm in length and 8.9 g in weight over an average recapture interval of 282 d as measured at Little Goose Dam in 2003. Thus, the mean growth rate was 0.15 mm and 0.032 g/d. The same measurements in 2002 were 39.7 mm and 9.0 g over an average interval of 275 d. Mean growth in 2002 was 0.14 mm/d and 0.033 g/d (Achord et al. 2003).

These 2002 and 2003 growth rates were lower than those observed in 2001, when we observed mean growth rates of 0.16 mm/d and 0.042 g/d for wild fish from many of the same streams (Achord et al. 2002). The higher densities of parr in the streams in summers 2001 and 2002 compared to summer 2000 and cool springs in 2002 and 2003, compared to 2001, may have contributed to the reduced growth (especially weight) of wild fish observed in 2002 and 2003, compared to 2001.

Over the years, spring detection rates at the dams (unadjusted) have been 80% higher (range 45.1-107.3%) for wild chinook salmon detected as parr at traps the previous summer-fall than for the overall population of tagged parr. This consistent trend suggests higher survival for fall migrants and may indicate substantial mortality for parr that remain in the streams from summer to fall.

The annual, combined parr-to-smolt survival estimates for the wild stocks from Idaho and Oregon streams to Lower Granite Dam were as follows:

Migration year	Parr-to-smolt survival (%)
1993	15.3
1994	18.8
1995	13.5
1996	20.6
1997	20.8
1998	24.4
1999	19.9
2000	17.7
2001	19.5
2002	14.3
2003	8.8

The higher parr densities observed in natal rearing areas in summer 2002 may have contributed to the lower parr-to-smolt survival estimates to Lower Granite Dam in

2003 (Achord et al. 2003b). Another high parr density year, 1994, also produced an overall low parr-to-smolt survival estimate in 1995 (13.5%).

Length-distribution curves for data collected over the last 15 years have generally shown that wild fish released and subsequently detected at dams are slightly larger at release than fish released but not detected. The reason for this difference in detection rates is unknown, but we speculated that larger fish survived better than smaller fish. However, Zabel and Achord (2004) compared length, weight, and condition index for these stocks to parr-to-smolt survival over a 5-year period (migration years 1993, 1994, 1995, 1999, and 2000) and found that mean population length and weight were not related to survival, although year and site effects were observed.

Consistent patterns across years of selection for length and weight were found, but condition factor was selectively neutral. These results imply that the relative size of individuals within populations was important, but the average size of a population was not, at least in terms of performance during the juvenile life stage.

Another consistent trend that has emerged over the years is the difference in arrival timing at Lower Granite Dam with respect to size at release. In 2003, we again observed that wild fish detected at the dam in April and May had been significantly larger at release than fish migrating after May. This suggests that size is an important factor related to either the initiation of the smolt stage or to other life-history dynamics that affect the migration timing of wild fish.

Annual overall climatic variation is an important factor controlling the overall migrational timing and passage dynamics of wild spring/summer chinook salmon smolts at Lower Granite Dam. In the warm years of 1990, 1992, 1994, 1998, and 2001, the median passage date at the dam was between 2 and 9 May, and 90% of all wild fish passed between 23 May and 7 June. In the cold years of 1989, 1991, and 1993, median passage did not occur until mid-May, and the 90th percentile had not passed until mid-June (except during high flows in 1993, when the 90th percentile passed by the end of May).

Within these 8 years, we saw a consistent 2- to 3-week shift in timing of wild fish at the dam between relatively warm and relatively cold years. In 1995, intermediate weather conditions prevailed in late winter and early spring (compared to the previous 6 years) along with normal flows at the dam, and passage dates of 9 May and 4 June for the 50 and 90th percentile passage, respectively, were observed for these combined wild populations.

In 1999, we experienced different climatic conditions than in all previous migration years. In late winter, a near-record snow pack in the Snake River Basin resulted in high flows early in the migration period (during late March); however, the ensuing flows were moderated by very dry and cold conditions during the remaining spring and early summer. Fluctuating, medium-to-high flows throughout the spring moved the wild fish through Lower Granite Dam as observed in warmer years, with the 50th percentile passing by 3 May and the 90th by 28 May (Achord et al. 2001a). Flow during 2000 was slightly below normal, with highest flow occurring in April, along with more seasonal temperatures and climatic conditions throughout the spring. Consequently, we observed a wild fish migration pattern similar to a warm year, with the 50th percentile passage occurring by 7 May and the 90th by 30 May.

In 2002, the 50th and 90th percentile of wild fish at Lower Granite Dam also passed in early and late May, respectively. However, in 2002, temperatures were slightly lower than normal temperatures and climatic conditions were slightly cooler throughout the spring. Flows in 2002 were close to normal, with the highest occurring in mid-April and late-May. In 2003, the 50th and 90th percentile of wild fish passing the dam occurred on 11 and 29 May, respectively. Climate was similar to 2002, with cooler conditions throughout the spring and lower flows until the last week of May, when high flows occurred.

An important objective of this study is to examine the migration timing at Lower Granite Dam of individual stocks over a period of years to determine similarities or differences between years and between stocks. We now have at least 9 years of migration-timing data for fish from 11 of the study streams, and this allowed us to construct 95% confidence intervals for the 10th, 50th, and 90th percentile passage dates at Lower Granite Dam for fish from these streams (Table 8).

Results showed that Secesh River fish had a significantly earlier timing of the 10th percentile passage than fish from South Fork Salmon River or from Elk, Bear Valley, Marsh, Valley, Catherine, or upper Big Creeks ($P < 0.05$). The 10th percentile passage of fish from Secesh River was also earlier than those of fish from the Lostine or Imnaha Rivers or Lake Creek, though the differences were not significant ($P > 0.05$). Secesh River fish also had significantly earlier arrival timing at the dam for the 50th percentile passage than fish from all the other streams except Lake Creek ($P < 0.05$). However, for the 90th percentile passage fish from the Lostine River had significantly earlier timing at the dam than fish from other streams except the Imnaha and Secesh Rivers and Elk and Marsh Creeks ($P < 0.05$).

Table 8. The 95% confidence interval passage dates at Lower Granite Dam for wild fish from 8 streams in Idaho and 3 streams in Oregon that have 9 or more years of migration timing data from1989 to 2003.

		Percentile passage periods at Lower Granite Dam			
Stream	95% CI	10%	50%	90%	Data years
Secesh River	Lo CI	12 April	23 April	23 May	15
	Up CI	18 April	30 April	10 June	
	Mean	15 April	26 April	01 June	
South Fork Salmon River	Lo CI	15 April	06 May	02 June	14
	Up CI	24 April	14 May	12 June	
	Mean	19 April	10 May	07 June	
Catherine Creek	Lo CI	23 April	10 May	28 May	13
	Up CI	01 May	17 May	09 June	
	Mean	27 April	13 May	03 June	
Imnaha River (upper)	Lo CI	14 April	27 April	16 May	11
	Up CI	21 April	07 May	29 May	
	Mean	17 April	02 May	23 May	
Bear Valley Creek	Lo CI	18 April	04 May	28 May	12
	Up CI	28 April	13 May	08 June	
	Mean	23 April	09 May	02 June	
Big Creek (upper)	Lo CI	27 April	15 May	31 May	9
	Up CI	08 May	30 May	26 June	
	Mean	03 May	22 May	13 June	
Elk Creek	Lo CI	14 April	01 May	23 May	11
	Up CI	26 April	11 May	06 June	
	Mean	20 April	06 May	30 May	
Valley Creek	Lo CI	19 April	09 May	30 May	12
	Up CI	01 May	20 May	14 June	
	Mean	25 April	14 May	07 June	
Marsh Creek	Lo CI	16 April	01 May	23 May	10
	Up CI	23 April	11 May	01 June	
	Mean	20 April	06 May	27 May	
Lake Creek	Lo CI	11 April	26 April	26 May	11
	Up CI	19 April	04 May	14 June	
	Mean	15 April	30 April	05 June	
Lostine River	Lo CI	11 April	30 April	16 May	12
	Up CI	22 April	09 May	26 May	
	Mean	16 April	04 May	21 May	

We also examined the length of time that encompassed the middle 80th-percentile passage at Lower Granite Dam as a measure of protracted or compressed timing for wild stocks from individual streams and from all streams combined. The middle 80th percentile passage at the dam averaged 42 d (range 29 to 51 d) for fish from these 11 streams over the years. The middle 80th percentile passage for fish from the Lostine and Imnaha Rivers and from Marsh and Catherine Creek occurred over a significantly shorter period (35-38.4 d) than that of fish from the Secesh and South Fork Salmon River or Lake Creek (47.3-50.6 d; $P < 0.05$). Fish from the Lostine and Imnaha Rivers and from Marsh and Catherine Creek also had shorter passage durations at the dam than fish from Bear Valley, Elk, upper Big, and Valley Creeks, but these differences were not significant (39.8-42.3 d; $P > 0.05$).

In examining wild chinook salmon smolt passage timing at Lower Granite Dam over the last 15 years, it has become clear that several factors influence passage timing. The migration timing of individual wild stocks has been highly variable and usually protracted at Lower Granite Dam, with timing patterns for some stocks ranging from early to late spring. However, shifts in the passage timing distribution for these stocks have been less than 1 to 5 weeks over all years. Complex yearly interrelationships between flow and annual climatic conditions are primary factors contributing to passage timing. However, water temperatures in streams above the dam, turbidity, physiological development, variability in stock behavior, fish size, and other yet unknown factors may all contribute substantially to wild smolt passage timing.

As additional environmental monitors, in-stream PIT-tag monitors, and traps are installed in study streams, we can more accurately monitor fry, parr, and smolt movements out of rearing areas and examine the relationships between these movements and environmental conditions within the streams. Mapped over time, this information, along with weather and climate data, may provide tools for the prediction of movement in different wild fish stocks. Such tools are vital to recovery planning for threatened or (ESA) endangered species of Pacific salmon.

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APPENDIX

Data Tables and Figures

Appendix Table 1. Summary of tagging dates, numbers collected, tagged, released, and minimum, maximum, and mean lengths and weights of wild chinook salmon parr, collected and PIT tagged in various Idaho streams, 2002.

Tagging dates	Number of fish: Collected	Number of fish: Tagged	Number of fish: Released	Length (collected): Range	Length (collected): Mean	Weight (collected): Range	Weight (collected): Mean	Length (tagged & released): Range	Length (tagged & released): Mean	Weight (tagged & released): Range	Weight (tagged & released): Mean
Bear Valley Creek											
23-25 Jul	1,121	1,035	1,022	45-111	61.6	1.2-21.9	3.2	50-103	62.3	1.5-19.0	3.3
Elk Creek											
26 Jul	999	983	975	46-118	62.1	1.2-28.1	3.6	50-82	62.2	1.9-7.6	3.6
Marsh Creek											
30-31 Jul	1,082	997	997	42-127	64.7	1.9-8.1	4.4	52-127	65.6	1.9-8.1	4.5
Cape Horn Creek											
31 Jul; 01 Aug	1,066	562	562	36-138	54.3	1.1-18.2	3	48-84	59.5	1.1-6.6	2.9
Sulphur Creek											
31 Jul; 01 Aug	588	561	560	47-113	63.9	--	--	50-79	64.2	--	--
Valley Creek											
02-06 Aug	3,239	2,276	2,266	38-127	58.8	0.9-12.0	3.3	46-96	61.9	1.6-12.0	3.4
Loon Creek											
08-09 Aug	893	831	830	46-84	64	1.6-7.5	3.9	53-84	64.7	1.6-7.5	3.9
Camas Creek											
09 Aug	1,233	976	976	40-86	58.7	1.9-7.7	3	50-86	60.7	1.9-7.7	3
Herd Creek											
12-13 Aug	820	799	799	55-96	75.9	1.9-12.9	6.2	55-96	75.9	1.9-12.9	6.2
Big Creek (upper)											
15-16 Aug	1,533	1,006	1,004	37-195	57.2	1.1-6.0	3.4	48-123	60.8	1.9-6.0	3.4
Big Creek (lower)											
21 Aug	748	721	720	46-90	67.4	3.1-5.6	4.3	52-90	67.8	3.1-5.6	4.3
West Fork Chamberlain Creek											
20 Aug	853	762	761	45-93	62.2	1.7-5.7	2.9	49-93	63.3	1.7-5.7	2.9
Chamberlain Creek											
21 Aug	49	34	34	43-75	57.2	--	--	52-75	60.5	--	--
South Fork Salmon River											
23-24 Aug	1,779	1,056	1,035	37-104	56.3	1.9-5.5	2.9	50-82	60.5	1.9-5.5	2.9
Secesh River											
26-27 Aug	1,708	1,057	1,040	40-100	57	1.8-6.1	3	51-81	61.1	1.8-6.1	3
Lake Creek											
28 Aug	1,250	710	709	36-104	56.7	1.4-10.1	3.5	49-104	62.3	1.4-10.1	3.5
Totals or means	18,961	14,366	14,290	36-195	60.2	0.9-28.1	3.6	46-127	63.2	1.1-19	3.6

Appendix Table 2a. Summary of tagging dates, start tagging times and temperatures (°C), release dates, times, and temperatures, method of capture, distance (in kilometers) from the mouth of the stream to the release point, number released (in 2002), and number/percent of first-time detections (unadjusted) for each tag group at six downstream dams and the PIT-tag trawl at the mouth of the Columbia River during 2003.

	Tagging				Release					Detected	
Group	Date	Time	Temp. (○C)	Capture method	Date	Time	Temp. (○C)	River km	n	n	%
Bear Valley Creek											
SA02204.BV1	23 Jul	10:18	13.5	Bch. Seine	24 Jul	06:00	14.0	9	100	4	4.0
SA02204.BV2	23 Jul	09:18	14.5	Bch. Seine	24 Jul	06:00	14.0	10	180	19	10.6
SA02205.BV1	24 Jul	05:00	14.0	Bch. Seine	24 Jul	07:10	14.5	10	176	14	8.0
SA02205.BV2	24 Jul	06:39	14.0	Shock	24 Jul	09:40	15.5	10	290	24	8.3
SA02206.BV1	25 Jul	05:07	12.5	Shock	25 Jul	10:00	14.0	14	276	19	6.9
Elk Creek											
SA02207.EC1	26 Jul	04:48	12.5	Bch. Seine	27 Jul	06:00	13.0	1	148	6	4.1
SA02207.EC2	26 Jul	06:38	11.0	Bch. Seine	26 Jul	09:00	13.0	1	418	24	5.7
SA02207.EC3	26 Jul	08:31	13.0	Shock	26 Jul	11:00	15.0	1	409	23	5.6
Marsh Creek											
SA02211.MC1	30 Jul	06:02	06.0	Shock	31 Jul	05:30	06.0	11	84	8	9.5
SA02211.MC2	30 Jul	08:45	10.0	Shock	31 Jul	12:00	11.0	11	409	34	8.3
SA02212.MC1	31 Jul	05:13	06.0	Bch. Seine	31 Jul	11:00	09.0	12	504	40	7.9
Cape Horn Creek											
SA02212.CH1	31 Jul	08:11	09.0	Shock	01 Aug	07:15	11.0	1	166	10	6.0
SA02213.CH1	01 Aug	05:45	03.0	Shock	01 Aug	10:00	10.0	5	197	21	10.7
SA02213.CH2	01 Aug	07:55	05.0	Bch. Seine	01 Aug	11:00	10.0	5	35	2	5.7
SA02213.CH3	01 Aug	09:22	06.0	Shock	01 Aug	13:00	10.0	6	164	19	11.6
Sulphur Creek											
SA02212.SU1	31 Jul	08:20	11.5	Bch. Seine	01 Aug	05:00	08.0	5	12	0	0.0
SA02212.SU2	31 Jul	08:35	11.5	Shock	01 Aug	05:00	08.0	5	114	8	7.0
SA02212.SU3	31 Jul	10:25	12.5	Shock	31 Jul	12:00	14.5	5	122	10	8.2
SA02213.SU1	01 Aug	06:31	08.0	Shock	01 Aug	15:00	14.5	7	312	32	10.3

Appendix Table 2a. Continued.

	Tagging				Release					Detected	
Group	Date	Time	Temp. (◦C)	Capture method	Date	Time	Temp. (◦C)	River km	n	n	%
Valley Creek											
SA02214.VC1	02 Aug	06:09	11.0	Shock	03 Aug	04:30	08.0	4	111	4	3.6
SA02214.VC2	02 Aug	08:08	12.0	Shock	02 Aug	11:30	15.0	4	318	11	3.5
SA02214.VC3	02 Aug	10:24	11.0	Bch. Seine	02 Aug	11:30	15.0	4	142	4	2.8
SA02217.VC1	05 Aug	06:10	11.5	Shock	05 Aug	10:00	16.5	8	732	42	5.7
SA02218.VC1	06 Aug	05:23	10.0	Shock	06 Aug	09:30	12.5	9	693	27	3.9
SA02218.VC2	06 Aug	10:11	09.0	Shock	06 Aug	11:30	15.0	18	270	24	8.9
Loon Creek											
SA02220.LN1	08 Aug	10:42	05.5	Shock	09 Aug	07:30	05.5	33	147	21	14.3
SA02220.LN2	08 Aug	12:35	09.0	Shock	08 Aug	13:00	11.0	34	344	46	13.4
SA02221.LN1	09 Aug	09:37	07.0	Shock	09 Aug	13:00	11.0	36	339	39	11.5
Camas Creek											
SA02221.CA1	09 Aug	05:58	07.0	Shock	09 Aug	11:30	13.0	23	976	58	5.9
Herd Creek											
SA02224.HC1	12 Aug	06:03	08.5	Shock	13 Aug	05:00	08.0	1	119	10	8.4
SA02224.HC2	12 Aug	09:53	13.0	Shock	13 Aug	05:00	08.0	2	26	1	3.8
SA02225.HC1	13 Aug	06:44	08.0	Shock	13 Aug	09:30	12.5	3	654	59	9.0
Big Creek (upper)											
SA02227.BC1	15 Aug	05:53	07.0	Shock	16 Aug	05:30	08.0	55	103	17	16.5
SA02227.BC2	15 Aug	06:47	07.0	Shock	15 Aug	11:30	12.5	56	646	58	9.0
SA02228.BC1	16 Aug	05:06	08.0	Bch. Seine	16 Aug	07:30	08.0	56	80	9	11.3
SA02228.BC2	16 Aug	05:50	08.0	Shock	16 Aug	07:30	08.0	56	175	13	7.4
Big Creek (lower)											
SA02233.LB1	21 Aug	09:24	11.0	Shock	22 Aug	05:30	09.5	10	115	19	16.5
SA 02233.LB2	21 Aug	07:19	11.0	Shock	21 Aug	09:30	13.0	9	605	100	16.5
West Fork Chamberlain Creek											
SA02232.WC1	20 Aug	08:45	09.0	Bch. Seine	21 Aug	06:35	09.0	2	123	8	6.5
SA02232.WC2	20 Aug	09:36	10.0	Bch. Seine	20 Aug	11:30	13.0	2	638	27	4.2

Appendix Table 2a. Continued.

	Tagging				Release					Detected	
Group	Date	Time	Temp. (◦C)	Capture method	Date	Time	Temp. (◦C)	River km	n	n	%
Chamberlain Creek											
SA02233.CB1	21 Aug	09:48	11.0	Shock	21 Aug	10:00	11.0	25	34	2	5.9
South Fork Salmon River											
SA02235.SF1	23 Aug	06:08	08.0	Shock	24 Aug	05:30	06.0	117	63	3	4.8
SA02235.SF2	23 Aug	07:23	08.0	Shock	23 Aug	13:00	15.0	118	783	23	2.9
SA02236.SF1	24 Aug	07:11	06.0	Shock	24 Aug	09:30	08.5	123	189	2	1.1
Secesh River											
SA02238.SE1	26 Aug	05:39	08.0	Shock	27 Aug	06:00	09.0	26	79	3	3.8
SA02238.SE2	26 Aug	06:43	08.0	Shock	26 Aug	12:00	12.0	26	746	15	2.0
SA02239.SE1	27 Aug	06:08	09.0	Shock	27 Aug	08:00	09.0	27	215	7	3.3
Lake Creek											
SA02240.LC1	28 Aug	05:46	08.5	Shock	29 Aug	06:00	07.5	2	68	0	0.0
SA02240.LC2	28 Aug	06:48	08.5	Shock	28 Aug	12:00	12.5	2	641	23	3.6

Appendix Table 2b. Universal Transverse Mercator grid coordinates of Global Positioning System that identify sampling areas at the beginning and end of daily collections in streams for each collection crew in 2002. Hand-held Garmin GPS III- plus units were used.

	Crew #1				Crew #2			
	UTM		UTM		UTM		UTM	
Streams and	Start		End		Start		End	
dates	northing	easting	northing	easting	northing	easting	northing	easting
Bear Valley Creek								
23 July	4920697	0633071	4907250	0632881	—	---	—	---
24 July	4920790	0632766	4920848	0632199	4920799	0632787	—	---
25 July	4919119	0630283	4918633	0629657	4919064	0630097	—	---
Elk Creek								
26 July	4918803	0629525	4918819	0629461	4918828	0629520	4918602	0629049
26 July	4918819	0622946	4918789	0628832	—	—	—	---
Marsh Creek								
30 July	4917206	0646006	4917097	0646305	—	---	—	---
31 July	4916488	0646845	4915820	0647244	—	—	—	---
Cape Horn Creek								
31 July	4917436	0645791	4917168	0645619	—	---	—	---
01 August	4913230	0643048	4913083	0642911	4913553	0643211	4913050	0642821
Sulphur Creek								
31 July	4918626	0629137	4932638	0630414	—	---	---	---
01 August	4932588	0630348	4932434	0629580	—	—	—	---
Valley Creek								
02 August	4899705	0660752	4899791	0660676	4899436	0661195	4899578	0661131
05 August	—	—	—	—	4900617	0659701	4901907	0659310
06 August	4901907	0659310	4902245	0659302	4906309	0657649	4906439	0657494
Loon Creek								
08 August	4941679	0674570	4940526	0673463	—	---	—	---
09 August	4940252	0673264	4939525	0672509	—	—	—	---
Camas Creek								
08 Aug	—	---	4967304	0697334	—	---	—	---
Herd Creek								
12 August	4892107	0716216	4891057	0717206	---	0697328	4891069	0717200
13 August	4891703	0716710	4890069	0717896	4890880	0717492	4890079	0717897
Big Creek (upper)								
15 August	4996670	0631579	4995567	0631327	4996679	0631581	4995537	0631343
16 August	4995552	0631334	4995083	0631404	4995567	0631327	4995347	---

Appendix Table 2b. Continued.

	Crew #1				Crew #2			
	UTM		UTM		UTM		UTM	
Streams and	Start		End		Start		End	
dates	northing	easting	northing	easting	northing	easting	northing	easting
Big Creek (lower)								
20 August	4996498	0670256	4996745	0669154	—	---	—	---
West Fork Chamberlain Creek								
20 August	5027767	0641533	—	---	—	---	—	---
Chamberlain Creek								
21 August	5026358	0642243	5026108	0642033	—	---	--	–
South Fork Salmon River								
23 August	4943987	0603511	4943400	0603627	—	---	—	---
24 August	4939985	0604736	4939912	0604731	—	—	—	---
Secesh River								
26 August	5006529	0593277	5007224	0593483	—	---	—	---
27 August	5007220	0593481	5007432	0593465	—	—	—	---
Lake Creek								
28 August	5012375	0586117	5013314	0585538	—	---	–	---—

Appendix Table 3. Summary of observed total mortality for PIT-tagged wild chinook salmon parr collected from Idaho streams during July and August 2002. Number rejected includes fish too small to tag, precocious males, injured fish, fish collected for genetic evaluation, previously tagged fish, and in some cases extra collected fish. The proportion of rejects that are precocious males are in parentheses.

					Observed mortality			
							Total	
Stream	Number collected	Number tagged	Number rejected	Percent rejected (%)	Collec-tion	Tagging and delayed	Num.	%
Bear Valley Creek	1,121	1,035	86 (0)	7.7	1	13	14	1.2
Elk Creek	999	983	16 (0)	1.6	5	7	12	1.2
Marsh Creek	1,082	997	85 (9)	7.9	0	0	0	0.0
Cape Horn Creek	1,066	562	504 (0)	47.3	4	0	4	0.4
Sulphur Creek	588	561	27 (2)	4.6	10	1	11	1.9
Valley Creek	3,239	2,276	963 (1)	29.7	20	10	30	0.9
Loon Creek	893	831	62 (0)	6.9	0	0	0	0.0
Camas Creek	1,233	976	257 (0)	20.8	25	0	25	2.0
Herd Creek	820	799	21 (0)	2.6	21	0	21	2.6
Big Creek (upper)	1,533	1,006	527 (0)	34.4	6	2	8	0.5
Big Creek (lower)	748	721	27 (0)	3.6	8	1	9	1.2
W.F. Chamberlain Creek	853	762	91 (0)	10.7	0	1	1	0.1
Chamberlain Creek	49	34	15 (0)	30.6	0	0	0	0.0
S. Fork Salmon R.	1,779	1,056	723 (0)	40.6	0	21	21	1.2
Secesh River	1,708	1,057	651 (11)	38.1	3	17	20	1.2
Lake Creek	1,250	710	540 (12)	43.2	27	1	28	2.2
Totals or averages	18,961	14,366	4,595	24.2	130	74	204	1.1

Appendix Table 4. Detections during 2003 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 1,022 wild chinook salmon from Bear Valley Creek released 23-25 July 2002. Release sites were 629-634 km above Lower Granite Dam.

Bear Valley Creek							
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
12 Apr	1	3					
13 Apr	1	3					
14 Apr	2	6					
15 Apr	1	3					
16 Apr			2				
17 Apr	1	3					
18 Apr	1	3					
22 Apr	1	2	1				
23 Apr	5	11	1				
24 Apr	1	2	1				
25 Apr	2	4	3		1		
26 Apr	1	2					
27 Apr			1				
30 Apr	1	3			1		
01 May					2		
02 May			1				
03 May	1	3					
04 May			1				
05 May	1	3					
06 May	1	2					
07 May	1	2	1				
08 May	1	3					
10 May	1	4					
12 May					1		
14 May					1		
16 May	3	6					
17 May	1	2					
23 May	1	2					
24 May	1	2					
25 May	2	4	1				
26 May	3	8	1				
27 May				1			
28 May	2	7	1				1
29 May						1	
30 May			1				
31 May			3				
02 Jun			2		1		
03 Jun					1		
04 Jun	1	2	1				
05 Jun	1	2				1	
06 Jun				1			
09 Jun	1	2					
10 Jun							1
11 Jun			1				
14 Jun	1	2					
17 Jun						1	
Totals	41	100	23	2	8	3	2

Appendix Table 5. Detections during 2003 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 976 wild chinook salmon from Elk Creek released 26 July 2002. Release sites were 634-635 km above Lower Granite Dam.

Elk Creek							
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
31 Mar	1	2					
18 Apr	1	3	1				
20 Apr	1	3					
22 Apr	2	5	1				
23 Apr	1	2	1				
24 Apr	3	6					
26 Apr	2	4	1				
30 Apr	1	3					
03 May	1	3					
06 May	3	7	1				
08 May				1			
09 May	1	4					
13 May	1	3					
14 May			1				
16 May	1	2					
20 May	2	4					
21 May			1				
23 May			1				
24 May			1				
26 May	2	5					
27 May	2	6	1				
28 May			2	1			
29 May	1	4	1				
30 May	1	4					
31 May			1	1			
01 Jun			1		1		
02 Jun			2	2			
03 Jun			1				
04 Jun					1		
10 Jun			1				
Totals	27	69	19	5	2	0	0

Appendix Table 6. Detections during 2003 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 997 wild chinook salmon from Marsh Creek released 30-31 July 2002. Release sites were 630-632 km above Lower Granite Dam.

	Marsh Creek						
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
03 Apr	1	3					
09 Apr	1	3					
11 Apr	1	4					
14 Apr	1	3					
15 Apr	1	3	1				
16 Apr	1	3					
18 Apr	2	5					
21 Apr	1	3					
22 Apr	1	2					
23 Apr	2	4					
24 Apr	1	2	1				
25 Apr	2	4					
26 Apr	1	2	1				
27 Apr	1	2					
28 Apr	1	3					
30 Apr	2	6					
01 May					1		
03 May	2	7			2		
04 May	1	4			1		
05 May	1	3		1			
06 May	1	2	2				
07 May			1				
08 May	1	3					
09 May	1	4					
12 May	1	3	1				
13 May	1	3			1		
14 May			1				
15 May	1	2			1		
16 May	1	2				1	
17 May	2	4			1		
18 May	1	2	1			1	
19 May	2	4					
21 May	1	2					
22 May	1	2	1				
23 May	1	2					
24 May	1	2					1
25 May	3	6	2	1			
26 May	1	3	2	1			
27 May	1	3					
28 May	1	3	1	1			
29 May	1	4					
30 May	2	7					
31 May			1			1	
04 Jun					1		
09 Jun	1	2					
Totals	50	130	16	4	8	3	1

Appendix Table 7. Detections during 2003 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 562 wild chinook salmon from Cape Horn Creek released 31 July-1 August 2002. Release sites were 629-636 km above Lower Granite Dam.

Cape Horn Creek							
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
15 Apr	1	3					
18 Apr			1				
19 Apr			1				
21 Apr	1	3					
23 Apr	1	2					
24 Apr	1	2					
25 Apr					1		
26 Apr			1				
27 Apr			1				
30 Apr	2	6					
03 May	1	3					
04 May			1				
05 May	1	3					
06 May	2	4					
07 May	1	2					
16 May	1	2	1				
17 May	1	2		1			
18 May							1
20 May	2	4					
21 May	1	2	1				
22 May	2	5	1				
24 May			1				
25 May	2	4					
26 May	1	3					
27 May	1	3	1	1			
28 May	1	3	1				
29 May			1				
31 May			1				
01 Jun	1	3	1		1		
02 Jun			2				
03 Jun			1		1		
05 Jun					2		
08 Jun						1	
18 Jun	1	3					
19 Jun				1			
Totals	25	63	17	3	5	1	1

Appendix Table 8. Detections during 2003 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 560 wild chinook salmon from Sulphur Creek released 31 July-1 August 2002. Release sites were 604-608 km above Lower Granite Dam.

Sulphur Creek							
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
22 Apr	1	2					
23 Apr	1	2					
02 May	2	6					
03 May			1				
05 May	1	3					
11 May	1	3					
14 May			1		1		
16 May			1				
17 May			1		1		
19 May	1	2					
20 May	1	2					
23 May	1	2					1
24 May	1	2					
25 May	3	6					
27 May	2	6					
28 May	1	3	1				
31 May			3				
01 Jun				2			
02 Jun	2	6	1				
04 Jun	1	2	1				
05 Jun	1	2	1			1	
06 Jun			1				
07 Jun	1	3	1				
08 Jun	1	2			1		
09 Jun			1				
10 Jun					1		
11 Jun	1	2			1		
13 Jun	1	2					
17 Jun						1	
24 Jun	1	1			1		
Totals	25	61	14	2	6	2	1

Appendix Table 9. Detections during 2003 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 2,266 wild chinook salmon from Valley Creek released 2-6 August 2002. Release sites were 743-756 km above Lower Granite Dam.

Valley Creek							
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
01 Apr	1	2					
02 Apr	1	2					
07 Apr	1	3					
13 Apr	1	3					
14 Apr	1	3					
16 Apr	1	3	1				
21 Apr			1				
22 Apr	1	2		1			
23 Apr	4	9					
24 Apr	1	2	1				
26 Apr			3				
27 Apr	1	2					
29 Apr			1				
30 Apr	2	6	1				
01 May	1	3					
03 May						1	
04 May						1	
05 May	2	5					
06 May	1	2					
09 May			1				
10 May	1	4					
12 May	1	3			1		
13 May	1	3	1				
15 May	1	2	1				
16 May	2	4	2				
17 May	1	2	1				
19 May					1		
20 May	3	6	1			1	
24 May	3	6	2		1		
25 May	4	8	2	1			
26 May	5	13	1				1
27 May	4	12					
28 May	2	7	1	1	1		
29 May	1	4	1			1	
30 May	1	4	2				
31 May	1	3	4				
01 Jun			4	2		1	
02 Jun				2			
03 Jun			3		1		
04 Jun			1		1		
07 Jun							1
12 Jun						1	
14 Jun					1		
29 Jun				1			
05 Jul			1				
09 Jul			1				
Totals	50	129	38	8	7	6	2

Appendix Table 10. Detections during 2003 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 831 wild chinook salmon from Loon Creek released 8-9 August 2002. Release sites were 555-559 km above Lower Granite Dam.

Loon Creek							
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
21 Apr	1	3					
22 Apr	2	5					
23 Apr			1				
24 Apr	1	2					
26 Apr	1	2					
30 Apr	2	6					
01 May	1	3					
02 May	2	6					
04 May	1	4	2		1		
05 May	1	3			1		
06 May	2	4	1				
07 May	1	2	1				
08 May	1	3					
10 May	2	7					
11 May	3	10					
12 May	3	9					
13 May				1	2		
14 May			2				
15 May	2	4				1	
16 May	3	6	1		1		
17 May	1	2					1
18 May	4	8					
19 May	2	4					
20 May	1	2	1				
21 May			1				
22 May	1	2					
23 May	3	6	1			1	
24 May	1	2	2				
25 May	5	10	4	1			
26 May	3	8	2				
27 May	6	18	2				
28 May	2	7		1	1		
29 May	2	8		1			
30 May	1	4	1				
31 May			1	1			
01 Jun			1	1	1		
02 Jun			1				
03 Jun			1	1			
06 Jun						1	
07 Jun						1	
Totals	61	160	26	7	7	4	1

Appendix Table 11. Detections during 2003 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 976 wild chinook salmon from Camas Creek released 9 August 2002. Release sites were 526-528 km above Lower Granite Dam.

Camas Creek							
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
24 Apr			1				
25 Apr			1				
26 Apr	1	2	1				
30 Apr	1	3					
02 May	1	3					
04 May	1	4					
05 May	2	5					
06 May	2	4	1				
11 May				1			
12 May	1	3					
14 May					1		
16 May				1			
17 May	1	2	1				
18 May	1	2				1	
19 May	1	2					
22 May	1	2					
23 May	1	2					
24 May	2	4				1	
25 May	1	2	1				
26 May	2	5			1		
27 May	1	3	2	1			
28 May				1			
29 May	3	12	1				
30 May	2	7	1	1			
31 May			3	1			
01 Jun			1				
02 Jun			2	1			
03 Jun			1	1			
05 Jun				1			
06 Jun	2	5		1			
Totals	27	73	17	10	2	2	0

Appendix Table 12. Detections during 2003 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 799 wild chinook salmon from Herd Creek released 12 -13 August 2002. Release sites were 699-703 km above Lower Granite Dam.

Herd Creek							
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
06 Apr	1	3					
11 Apr	1	4					
16 Apr	1	3					
18 Apr	1	3					
20 Apr			1				
21 Apr	2	5					
22 Apr	1	2					
23 Apr	4	9					
25 Apr			2				
26 Apr	1	2			1		
27 Apr	1	2		1			
29 Apr	1	3					
30 Apr	2	6					
02 May	2	6					
03 May	2	7					
04 May	1	4					
05 May	1	3					
06 May	1	2					
07 May	1	2	1			1	
08 May							1
12 May	1	3					
13 May	2	6	1		1		
14 May	1	3	1				
17 May	3	5	1		1	1	
19 May	1	2					
20 May					2		
21 May	1	2	1				
22 May					1		
24 May			2				
25 May	1	2	2	1			
26 May	1	3					
28 May	1	3	1				
29 May	1	4	1				
31 May					1	1	
01 Jun			2			2	
02 Jun				1			
04 Jun			1				
Totals	37	98	17	3	7	5	1

Appendix Table 13. Detections during 2003 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 1,004 wild chinook salmon from Big Creek (upper) released 15 -16 August 2002. Release sites were 530-533 km above Lower Granite Dam.

Big Creek (upper)							
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
26 Apr			2				
27 Apr			1				
01 May	1	3					
02 May	1	3					
03 May			1				
04 May	1	4					
05 May			1				
06 May	1	2	1				
07 May			2				
08 May	2	6					
09 May	1	4		1			
11 May				1			
12 May	1	3					
14 May	1	3					
16 May	2	4	1	1			
17 May					1		
18 May	2	4			1		
19 May	4	8	1			1	
20 May	2	4					
23 May	1	2					
24 May	1	2	4	1		1	
25 May	6	12	3				
26 May	3	8		1			
27 May					1		
28 May			1	2			
29 May	1	4	1				
30 May	1	4					
31 May	4	12	1	1			
01 Jun	1	3	2	1			
02 Jun	1	3	6				
03 Jun			2				
04 Jun			1				
05 Jun			1		1		
06 Jun							1
07 Jun					1		
08 Jun	1	2	1				
09 Jun							1
10 Jun	1	2					
11 Jun					1		
14 Jun					1		
17 Jun			1				
20 Jun					1		
21 Jun	1	2					
12 Jul			1				
Totals	41	103	35	9	8	2	2

Appendix Table 14. Detections during 2003 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 720 wild chinook salmon from Big Creek (lower) released 21 August 2002. Release sites were 486-488 km above Lower Granite Dam.

Big Creek (lower)							
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
12 Apr	1	3					
13 Apr	1	3					
14 Apr	3	8					
15 Apr	1	3					
17 Apr	1	3	1				
18 Apr			1				
19 Apr	1	3	1				
20 Apr	2	5					
21 Apr	2	5					
22 Apr	3	7					
23 Apr	2	4	2		1		
24 Apr	2	4	4				
25 Apr	5	10			1		
26 Apr	7	13	3		1		
27 Apr	5	10					
28 Apr	1	3	3	2			
29 Apr			1	1			
30 Apr			1		1		
01 May					1		
02 May					1		
03 May	2	7	3		1		
04 May	1	4	3				
05 May	4	11			1		
06 May	2	4	2				
07 May	1	2	2			1	
08 May	1	3		1			
09 May			1		1		
13 May			3				
14 May						1	
15 May	1	2			1		
16 May			1				
17 May	3	5			1		
18 May	2	4	1		1		
19 May	2	4			1		
20 May	2	4					
22 May						2	
25 May	1	2	1		1		
26 May					1		
29 May					1		
30 May							1
03 Jun					1		
Totals	59	137	34	4	17	4	1

Appendix Table 15. Detections during 2003 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 795 wild chinook salmon from West Fork Chamberlain Creek released 20-21 August 2002. Release sites were 437-438 km above Lower Granite Dam.

West Fork Chamberlain Creek[a]								
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
21 Apr	1	3	1				
23 Apr	1	2					
28 Apr			1				
29 Apr			1				
30 Apr	1	3	1				
03 May	1	3			1		
04 May			2				
05 May	1	3	2				
06 May	1	2					
11 May					1		
14 May			1				
15 May			1				
17 May					1		
18 May	1	2					
19 May	1	2					
20 May	2	4					
24 May	2	4	1				
25 May	1	2					
26 May	4	11					
27 May			1				
28 May			1	1			
01 Jun			1				
02 Jun							1
16 Jun						1	
Totals	17	41	14	1	3	1	1

a Includes fish from Chamberlain Creek

Appendix Table 16. Detections during 2003 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 1,035 wild chinook salmon from South Fork Salmon River released 23-24 August 2002. Release sites were 467-473 km above Lower Granite Dam.

South Fork Salmon River							
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
19 Apr	2	6					
22 Apr	1	2	1				
23 Apr			1				
26 Apr			2				
27 Apr	1	2					
02 May	1	3					
16 May	1	2	1				
24 May					1		
25 May	2	4	1				
26 May	1	3					
27 May	1	3	1				
28 May			1				
31 May						1	
03 Jun	1	2					
04 Jun			1		1		
05 Jun						1	
06 Jun			1		1		
12 Jun	1	2					
21 Jun					1		
Totals	12	29	10	0	4	2	0

Appendix Table 17. Detections during 2003 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 1,057 wild chinook salmon from Secesh River released 26-27 August 2002. Release sites were 429-431 km above Lower Granite Dam.

Secesh River							
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
03 Apr	1	3					
18 Apr	3	8					
22 Apr					1		
23 Apr	2	4			1		
24 Apr	1	2					
26 Apr	1	2					
30 Apr	1	3	1				
01 May	1	3					
05 May					1		
07 May	2	5					
13 May	1	3					
16 May						1	
17 May	1	2					
28 May				1			
31 May			1				
01 Jun	1	3	1				
04 Jun			1				
04 Jul	1	1					
Totals	16	40	4	1	3	1	0

Appendix Table 18. Detections during 2003 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 709 wild chinook salmon from Lake Creek released 28 August 2002. Release sites were 451-452 km above Lower Granite Dam.

Lake Creek							
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
06 Apr	1	3					
07 Apr	1	3					
13 Apr	2	6					
14 Apr			1				
22 Apr			1				
26 Apr	1	2	1				
28 Apr					1		
02 May					1		
06 May	1	2					
09 May			1				
15 May	1	2					
30 May	1	4			1		
31 May	1	3					
04 Jun	1	2		1			
05 Jun			1				
09 Jun			1				
11 Jun			1				
20 Jun	1	2					
23 Jun			1				
Totals	11	29	8	1	3	0	0

Appendix Table 19. Daily and expanded detections of PIT-tagged wild spring/summer chinook salmon smolts from Idaho and Oregon at Lower Granite Dam during 2003, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

				Idaho Only		Idaho and Oregon	
Date	Average flow (kcfs)	Average spill (kcfs)	Scroll-case water temperature	Numbers detected	Expanded numbers detected	Numbers detected	Expanded numbers detected
31 Mar	42.5	0.0	6.7	1	2	1	2
01 Apr	61.7	0.0	6.7	1	2	1	2
02 Apr	69.8	0.0	7.2	1	2	1	2
03 Apr	76.3	10.2	7.8	2	6	2	6
06 Apr	66.8	19.4	6.1	2	5	2	5
07 Apr	62.5	20.0	6.1	2	6	2	6
09 Apr	61.3	20.7	6.7	1	3	1	3
11 Apr	64.6	19.8	7.2	2	7	3	11
12 Apr	68.5	20.2	7.8	2	6	2	6
13 Apr	73.9	20.2	8.3	5	14	7	20
14 Apr	82.3	25.5	8.9	7	20	9	25
15 Apr	82.2	20.5	8.9	4	12	4	12
16 Apr	75.4	15.0	8.9	3	8	4	11
17 Apr	73.8	20.3	8.3	2	6	5	14
18 Apr	70.4	20.3	8.3	8	22	10	27
19 Apr	65.0	20.0	7.8	3	8	3	8
20 Apr	63.6	25.4	8.3	3	8	3	8
21 Apr	65.2	20.5	8.3	8	20	8	20
22 Apr	67.6	15.3	8.3	13	30	15	35
23 Apr	74.3	20.4	8.9	23	50	26	57
24 Apr	80.7	25.5	9.4	11	23	14	29
25 Apr	81.0	20.5	9.4	9	18	12	24
26 Apr	82.1	15.4	9.4	16	31	21	40
27 Apr	81.3	20.8	9.4	9	19	12	25
28 Apr	79.3	26.1	9.4	2	5	3	8
29 Apr	72.6	20.5	9.4	1	3	2	6
30 Apr	73.1	20.5	8.9	15	48	19	60
01 May	70.8	20.5	9.4	4	12	6	19
02 May	67.5	15.8	9.4	9	26	10	29
03 May	65.8	20.7	9.4	10	35	12	42
04 May	63.4	25.5	9.4	6	22	6	22
05 May	65.7	20.5	9.4	15	40	17	45
06 May	73.3	15.2	9.4	18	39	22	48
07 May	69.7	20.3	9.4	7	16	9	21
08 May	70.4	20.4	8.3	6	17	11	32
09 May	68.0	20.5	8.9	3	11	4	14
10 May	66.1	25.6	8.9	4	15	5	18

Appendix Table 19. Continued.

Date	Average flow (kcfs)	Average spill (kcfs)	Scroll-case water temperature	Idaho Only		Idaho and Oregon	
				Numbers detected	Expanded numbers detected	Numbers detected	Expanded numbers detected
11 May	64.0	20.5	10.0	4	14	4	14
12 May	65.2	15.7	---	8	25	12	37
13 May	72.4	20.8	10.0	6	18	8	25
14 May	78.2	25.5	10.0	2	6	5	15
15 May	79.2	20.5	10.6	6	13	9	20
16 May	87.0	15.3	11.1	14	26	18	33
17 May	89.7	20.4	10.6	14	25	15	27
18 May	83.8	25.6	10.6	11	22	12	24
19 May	83.8	20.5	10.0	14	27	17	33
20 May	72.1	15.4	9.4	15	32	17	36
21 May	74.4	20.4	8.9	3	6	7	15
22 May	72.0	25.6	9.4	5	12	6	15
23 May	79.7	20.5	10.0	8	16	9	18
24 May	95.7	20.5	10.0	12	25	15	31
25 May	122.7	30.6	10.0	31	63	33	67
26 May	146.7	53.8	10.0	26	69	28	74
27 May	155.2	61.4	10.0	18	53	22	65
28 May	156.8	63.0	10.0	10	33	10	33
29 May	172.1	77.9	10.0	10	41	12	49
30 May	186.2	91.9	10.0	9	32	9	32
31 May	208.2	114.3	10.0	6	19	7	22
01 Jun	190.8	96.5	11.7	3	9	4	12
02 Jun	165.9	72.2	11.7	3	10	3	10
03 Jun	149.1	55.6	12.2	1	2	2	5
04 Jun	133.0	43.2	12.2	3	7	4	9
05 Jun	118.1	30.1	12.2	2	5	2	5
06 Jun	114.7	27.0	12.8	2	5	2	5
07 Jun	108.7	24.5	13.3	1	3	1	3
08 Jun	111.0	26.0	13.3	2	5	2	5
09 Jun	109.0	31.3	14.4	2	4	4	9
10 Jun	110.5	31.0	14.4	1	2	1	2
11 Jun	109.7	25.8	14.4	1	2	1	2
12 Jun	101.8	20.8	14.4	1	2	1	2
13 Jun	97.3	20.1	15.0	1	2	1	2
14 Jun	86.0	20.3	15.0	1	2	1	2
18 Jun	80.2	20.3	16.7	1	3	1	3
20 Jun	74.2	10.1	17.2	1	2	1	2
21 Jun	70.1	0.0	17.2	1	2	1	2
24 Jun	58.9	0.0	16.1	1	1	1	1
04 Jul	35.1	0.0	20	1	1	1	1

Appendix Table 20. Daily first-time detections of PIT-tagged wild spring/summer chinook salmon smolts from Idaho at Little Goose Dam during 2003, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

Date	Average flow (kcfs)	Average spill (kcfs)	Scroll-case water temperature	Numbers detected
14 Apr	79.6	20.0	8.3	1
15 Apr	82.8	18.8	8.3	1
16 Apr	75.8	18.5	8.9	3
17 Apr	70.8	18.6	---	1
18 Apr	68.9	18.5	8.9	3
19 Apr	65.3	18.7	9.4	2
20 Apr	61.5	18.5	9.4	1
21 Apr	63.3	17.8	9.4	2
22 Apr	69.1	17.6	9.4	4
23 Apr	72.1	17.7	---	6
24 Apr	80.3	17.6	10.0	8
25 Apr	79.9	17.9	10.0	6
26 Apr	80.1	18.2	10.0	15
27 Apr	79.6	18.9	10.0	3
28 Apr	78.3	19.2	10.0	4
29 Apr	70.9	19.0	10.0	3
30 Apr	73.4	18.4	10.6	4
02 May	65.2	19.6	10.6	1
03 May	65.5	19.0	10.6	5
04 May	62.2	17.8	10.6	9
05 May	63.3	17.7	10.6	3
06 May	75.2	18.4	10.0	8
07 May	68.9	19.0	10.6	8
09 May	68.9	20.3	10.6	3
12 May	65.7	19.7	10.6	1
13 May	70.5	18.7	10.6	5
14 May	75.9	18.1	11.1	7
15 May	79.9	18.3	11.1	2
16 May	85.7	17.9	11.1	8
17 May	89.1	18.5	11.1	4
18 May	81.6	19.9	11.1	2
19 May	84.1	20.4	11.1	1
20 May	72.0	20.4	11.7	2
21 May	75.5	20.4	11.7	4

Appendix Table 20. Continued.

Date	Average flow (kcfs)	Average spill (kcfs)	Scroll-case water temperature	Numbers detected
22 May	66.9	18.9	11.7	2
23 May	78.4	18.0	11.7	2
24 May	94.3	17.0	11.7	13
25 May	120.8	19.8	11.7	17
26 May	141.2	25.5	11.7	6
27 May	153.8	36.7	11.7	8
28 May	151.9	38.7	11.7	11
29 May	169.7	53.6	12.2	6
30 May	181.2	65.1	12.8	5
31 May	206.4	90.8	12.8	19
01 Jun	187.7	73.5	12.2	14
02 Jun	165.9	52.6	12.2	16
03 Jun	144.8	37.3	12.2	9
04 Jun	133.5	28.9	12.8	7
05 Jun	116.0	18.1	12.8	3
06 Jun	114.3	17.6	12.8	2
07 Jun	105.2	16.2	12.8	1
08 Jun	108.6	14.8	12.8	1
09 Jun	106.9	19.9	13.9	2
10 Jun	109.8	28.7	14.4	1
11 Jun	108.5	28.8	14.4	2
17 Jun	83.3	19.6	15.6	1
23 Jun	56.3	0.0	16.7	1
05 Jul	35.5	0.0	18.3	1
09 Jul	36.1	0.0	18.9	1
12 Jul	36.1	0.0	20.0	1

Appendix Table 21. Daily first-time detections of PIT-tagged wild spring/summer chinook salmon smolts from Idaho at Lower Monumental Dam during 2003, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

Date	Average flow (kcfs)	Average spill (kcfs)	Scroll-case water temperature	Numbers detected
22 Apr	69.5	31	10.0	1
27 Apr	79.1	35.8	10.0	1
28 Apr	78.5	34.8	10.0	2
29 Apr	71.1	31.3	---	1
05 May	62.6	29.4	10.6	1
08 May	67.5	31.6	10.0	2
09 May	66.4	30.8	10.0	1
11 May	59.9	30.0	10.6	2
13 May	69.5	32.5	10.6	1
16 May	84.1	34.3	10.6	2
17 May	88.7	34.5	11.1	1
24 May	91.2	26.0	11.7	1
25 May	118.1	23.5	11.7	4
26 May	139.7	25.5	11.7	2
27 May	153.0	30.5	12.2	3
28 May	150.9	32.5	13.3	9
29 May	166.6	47.8	12.8	1
30 May	180.9	59.2	12.8	1
31 May	203.4	83.2	12.8	4
01 Jun	189.2	70.0	12.8	6
02 Jun	164.6	43.8	12.8	6
03 Jun	140.7	29.7	12.8	2
04 Jun	134.6	27.8	13.3	1
05 Jun	113.5	26.0	13.3	1
06 Jun	112.5	22.6	13.3	2
19 Jun	72.4	33.3	16.1	1
29 Jun	40.1	0.0	18.3	1

Appendix Table 22. Daily first-time detections of PIT-tagged wild spring/summer chinook salmon smolts from Idaho at McNary Dam during 2003, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

Date	Average flow (kcfs)	Average spill (kcfs)	Scroll-case water temperature	Numbers detected
22 Apr	228.1	102.7	9.5	1
23 Apr	231.9	101.1	9.7	2
25 Apr	201.8	77.3	9.7	3
26 Apr	238.8	90.9	9.6	2
28 Apr	207.9	70.5	9.8	1
30 Apr	225.6	69.5	10.3	2
01 May	222.6	70.7	10.5	4
02 May	192.8	69.6	10.5	2
03 May	201.2	68.8	10.7	4
04 May	203	67.7	10.9	2
05 May	220.9	68.8	10.7	3
09 May	224.1	73.9	10.7	1
11 May	180.2	65.1	11	1
12 May	189.8	69.1	11.2	2
13 May	218	79.9	11.6	4
14 May	256.5	102.7	11.7	3
15 May	226.4	73.3	11.8	2
16 May	242.7	72.7	11.7	1
17 May	241.3	71.4	11.5	6
18 May	224.9	71.2	11.3	2
19 May	217.8	71.8	11.5	2
20 May	215.6	72.6	11.4	2
22 May	245.2	82.4	12	1
24 May	259.7	90.1	12.6	2
25 May	221.2	65.8	12.7	1
26 May	248.3	76.8	12.9	2
27 May	291.9	117.8	13.2	1
28 May	298.8	124.9	13.2	2
29 May	329	153	13.4	1
30 May	352.5	176.3	13.7	1
31 May	352.4	176.8	14	1
01 Jun	320.2	144.9	13.8	3
02 Jun	289.6	115.4	13.9	1
03 Jun	294.5	121.4	14.3	4

Appendix Table 22. Continued.

Date	Average flow (kcfs)	Average spill (kcfs)	Scroll-case water temperature	Numbers detected
04 Jun	296.7	125.9	14.6	4
05 Jun	273.8	98.8	14.7	3
06 Jun	262.8	92.5	14.7	1
07 Jun	285.9	115.1	15	1
08 Jun	283.9	108.1	15.1	1
10 Jun	278.5	108.1	15.5	1
11 Jun	305.2	130.1	15.7	2
14 Jun	284.4	109.4	15.9	2
20 Jun	174.1	32	16.2	1
21 Jun	194.1	19.5	15.9	1
24 Jun	188.3	15.6	16.1	1

Appendix Table 23. Daily first-time detections of PIT-tagged wild spring/summer chinook salmon smolts from Idaho at John Day Dam during 2003, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

Date	Average flow (kcfs)	Average spill (kcfs)	Scroll-case water temperature	Numbers detected
03 May	195.7	60	11.7	1
04 May	195.7	52.9	11.7	1
07 May	237.6	52.5	11.7	2
14 May	265	72.3	12.2	1
15 May	218.2	64.8	12.2	1
16 May	244.4	64.3	12.2	2
17 May	237.9	56.6	12.2	1
18 May	239	60.2	12.2	2
19 May	222.6	61.4	12.2	1
20 May	212.3	48.7	12.8	1
22 May	248.8	58.3	13.9	2
23 May	248.6	64.8	13.9	1
24 May	247.2	60.5	13.9	2
29 May	269.2	55.8	13.9	2
31 May	356.9	86.5	---	3
01 Jun	321.9	70.8	13.9	3
05 Jun	276.4	59	15	3
06 Jun	267.8	62.7	15	1
07 Jun	275.8	62.9	17.2	1
08 Jun	269	65.7	17.2	1
12 Jun	297.3	70.7	16.1	1
16 Jun	253	70.6	17.2	1
17 Jun	254.6	69.9	17.8	2

Appendix Table 24. Daily first-time detections of PIT-tagged wild spring/summer chinook salmon smolts from Idaho at Bonneville Dam during 2003, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

Date	Average flow (kcfs)	Average spill (kcfs)	Scroll-case water temperature	Numbers detected
08 May	226.8	100	10.6	1
17 May	245.6	148.7	11.1	1
18 May	254.9	100.2	11.1	1
23 May	268.4	96.3	12.2	1
24 May	272.4	137.7	12.2	1
26 May	276.6	94.9	12.8	1
28 May	338.9	130.5	12.8	1
30 May	343.4	139.6	12.8	1
02 Jun	325.3	107.8	13.9	1
06 Jun	295.2	90.1	13.9	1
07 Jun	280.9	134.1	15	1
09 Jun	277.7	88.6	15	1
10 Jun	290.9	89.2	15	1

Appendix Table 25. Monthly environmental data collected from Marsh Creek (RKm 179.5 from the mouth of the Middle Fork Salmon River) from August 2002 through July 2003.

	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	4.8	2.7	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	-----
Max	18.6	16.9	10.6	5.1	3.7	4.4	4.1	8.3	10.2	14.2	15.1	-----
Mean	11.2	8.8	4.1	1.2	0.5	1.4	0.5	2.2	3.1	4.6	8.3	-----
						Dissolved Oxygen (ppm)						
Min	-----	-----	-----	9.1	11.1	10.2	9.6	9.1	9.4	9.1	-----	-----
Max	-----	-----	-----	15.2	12.6	12.7	11.9	11.5	12.2	13.1	-----	-----
Mean	-----	-----	-----	12.2	11.8	11.4	10.7	10.4	11.0	11.1	-----	-----
						Specific Conductance (µS/cm)						
Min	63.0	71.0	60.0	59.0	59.0	57.0	57.0	61.0	45.0	21.0	28.0	-----
Max	78.0	83.0	83.0	70.0	69.0	71.0	72.0	74.0	70.0	52.0	51.0	-----
Mean	70.0	76.4	76.8	65.4	64.1	63.2	65.5	66.4	57.4	37.9	40.0	-----
						Turbidity (ntu)						
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.2	-----
Max	221.7	314.2	5.0	10.3	16.1	6.9	101.6	19.0	16.5	333.0	8.3	-----
Mean	4.6	1.9	0.7	0.0	0.0	0.0	0.0	0.0	2.6	11.0	4.5	-----
						Depth (feet)						
Min	0.9	0.7	0.7	0.7	0.6	1.1	0.8	0.7	0.8	1.2	2.2	-----
Max	1.4	1.3	1.6	2.2	2.7	2.3	2.4	1.9	1.7	4.1	4.0	-----
Mean	1.1	1.1	1.0	1.5	1.5	1.5	1.4	1.2	1.3	2.4	3.0	-----
						pH						
Min	7.5	7.4	7.5	7.4	7.4	7.3	7.2	7.4	7.0	6.6	6.9	-----
Max	8.7	8.6	8.6	8.8	9.1	8.9	8.3	8.3	8.1	8.0	7.9	-----
Mean	7.8	7.8	7.8	7.8	7.7	7.7	7.6	7.7	7.4	7.1	7.2	-----

Appendix Table 26. Monthly environmental data collected from the Salmon River near Sawtooth Hatchery (RKm 627.9) from August 2002 through July 2003.

	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	8.1	5.8	0.3	0.0	0.0	0.0	0.0	0.0	0.3	2.4	6.6	10.1
Max	19.4	18.2	12.0	5.8	4.3	6.5	5.2	10.4	11.9	14.7	18.7	21.1
Mean	13.2	11.0	6.2	2.5	1.1	1.9	1.3	3.8	5.6	8.3	11.8	15.5
						Dissolved Oxygen (ppm)						
Min	9.4	-----	6.7	7.2	8.8	7.4	6.9	-----	-----	-----	-----	-----
Max	14.3	-----	8.1	11.2	11.6	11.0	10.4	-----	-----	-----	-----	-----
Mean	11.2	-----	7.2	8.7	9.8	9.2	8.2	-----	-----	-----	-----	-----
						Specific Conductance (µS/cm)						
Min	160.0	176.0	147.0	132.0	124.0	123.0	120.0	114.0	115.0	51.0	52.0	85.0
Max	183.0	202.0	200.0	160.0	152.0	141.0	149.0	146.0	149.0	127.0	89.0	140.0
Mean	173.9	184.6	175.9	140.1	137.5	131.2	132.7	132.6	131.5	102.4	70.5	114.7
						Turbidity (ntu)						
Min	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.3	0.3	1.0	-----	-----
Max	1.1	0.9	14.4	7.1	39.0	17.5	55.8	30.1	13.0	69.6	-----	-----
Mean	0.2	0.3	1.0	0.6	3.1	2.3	5.7	4.4	2.8	10.1	-----	-----
						Depth (feet)						
Min	1.8	2.2	1.7	1.4	1.3	1.9	1.6	1.5	1.4	1.4	2.3	2.0
Max	2.7	2.8	3.0	2.5	2.7	2.7	2.4	2.5	2.3	3.9	3.9	2.5
Mean	2.3	2.5	2.5	2.2	2.0	2.2	1.9	1.9	1.7	2.2	2.9	2.3
						pH						
Min	7.9	8.1	8.1	8.0	8.0	7.9	7.9	8.1	7.9	7.2	7.4	7.7
Max	8.9	8.9	8.9	9.2	9.3	9.5	9.4	9.5	9.2	8.7	8.9	9.0
Mean	8.4	8.4	8.4	8.4	8.3	8.4	8.4	8.5	8.3	8.0	7.9	8.2

Appendix Table 27. Monthly environmental data collected from Valley Creek (RKm 609.4 from the mouth of the Salmon River) from August 2002 through July 2003.

	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	7.5	4.6	0.3	0.1	-----	-----	-----	-----	0.5	1.6	5.8	9.2
Max	21.8	19.8	12.6	5.5	-----	-----	-----	-----	11.0	16.1	18.7	23.4
Mean	14.3	11.3	5.2	1.9	-----	-----	-----	-----	4.6	7.9	11.2	16.0
						Dissolved Oxygen (ppm)						
Min	6.7	5.0	7.8	-----	-----	-----	-----	-----	8.8	7.3	7.6	7.0
Max	12.2	9.7	10.8	-----	-----	-----	-----	-----	11.2	11.4	10.5	10.2
Mean	8.7	8.1	9.4	-----	-----	-----	-----	-----	10.0	9.4	8.8	8.4
						Specific Conductance (µS/cm)						
Min	74.0	77.0	76.0	81.0	-----	-----	-----	-----	46.0	36.0	34.0	39.0
Max	98.0	96.0	95.0	96.0	-----	-----	-----	-----	78.0	64.0	43.0	62.0
Mean	83.5	89.6	86.9	87.6	-----	-----	-----	-----	59.2	53.3	39.0	49.2
						Turbidity (ntu)						
Min	0.3	0.3	0.3	0.4	-----	-----	-----	-----	0.0	0.1	0.6	0.0
Max	17.2	9.3	28.8	29.7	-----	-----	-----	-----	29.0	29.1	10.0	19.2
Mean	1.3	0.9	2.8	12.2	-----	-----	-----	-----	7.1	8.2	3.8	0.9
						Depth (feet)						
Min	0.6	0.6	0.8	0.5	-----	-----	-----	-----	0.9	1.2	2.1	1.4
Max	1.2	1.3	1.4	1.6	-----	-----	-----	-----	1.9	3.7	3.6	2.2
Mean	0.9	1.0	1.0	1.2	-----	-----	-----	-----	1.5	2.1	2.7	1.8
						pH						
Min	7.6	7.7	7.6	7.9	-----	-----	-----	-----	7.2	6.8	6.9	7.1
Max	8.5	8.6	8.6	8.4	-----	-----	-----	-----	8.4	8.5	8.1	8.2
Mean	8.0	8.0	8.0	8.1	-----	-----	-----	-----	7.5	7.5	7.2	7.5

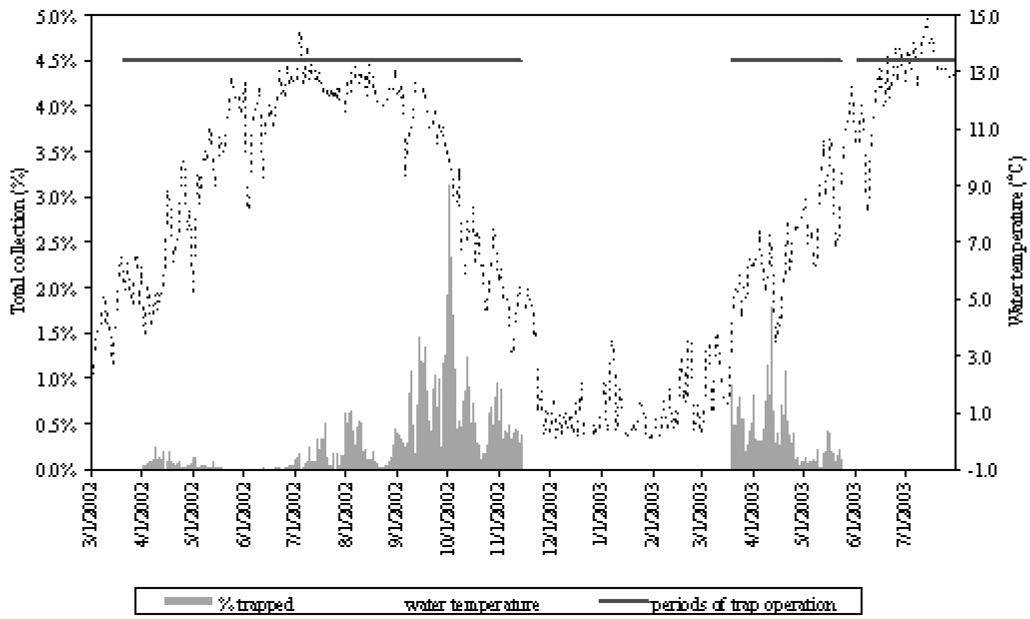
Appendix Table 28. Monthly environmental data collected from the Secesh River (27 km upstream from its confluence with the South Fork Salmon River) from August 2002 through July 2003.

	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	7.1	3.5	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.3	3.0	8.6
Max	15.8	15.9	8.4	0.3	0.2	0.1	0.1	0.1	5.9	10.3	15.8	15.9
Mean	11.5	9.3	2.4	0.1	0.1	0.1	0.1	0.1	1.4	4.0	8.5	13.5
						Dissolved Oxygen (ppm)						
Min	7.6	7.6	9.6	12.2	12.5	13.6	13.6	13.4	11.6	7.8	2.9	0.9
Max	10.0	10.8	13.8	14.2	14.2	14.2	14.2	14.2	13.8	12.5	8.2	3.3
Mean	8.7	9.2	11.3	13.3	13.6	13.9	13.9	13.7	12.9	10.4	5.4	1.8
						Specific Conductance (µS/cm)						
Min	34.0	36.0	36.0	38.0	39.0	38.0	38.0	36.0	27.0	16.0	16.0	26.0
Max	43.0	42.0	43.0	47.0	49.0	41.0	41.0	41.0	40.0	30.0	27.0	40.0
Mean	38.4	38.4	39.3	41.0	41.1	40.6	40.1	40.2	32.6	24.1	20.4	33.3
						Turbidity (ntu)						
Min	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.4	0.5	0.5	0.2
Max	22.6	2.4	38.9	3.8	4.3	1.7	1.6	4.3	21.8	45.1	40.3	48.4
Mean	0.5	0.2	3.9	0.6	0.5	0.4	0.3	0.8	3.6	6.2	2.0	14.0
						Depth (feet)						
Min	1.3	1.2	1.2	1.1	1.6	2.7	2.5	2.6	1.8	2.0	2.4	1.7
Max	1.9	1.8	1.9	2.4	2.8	3.3	3.4	3.7	3.7	3.7	3.7	2.4
Mean	1.7	1.5	1.5	1.9	2.1	2.9	3.0	3.2	2.5	2.8	3.1	2.1
						pH						
Min	7.3	7.3	7.4	7.1	7.0	6.9	6.9	6.7	6.7	6.1	6.2	6.3
Max	8.6	8.9	8.7	7.5	7.5	7.1	7.0	7.0	7.0	7.0	7.1	7.3
Mean	7.7	7.7	7.6	7.2	7.1	7.0	6.9	6.9	6.9	6.7	6.6	6.8

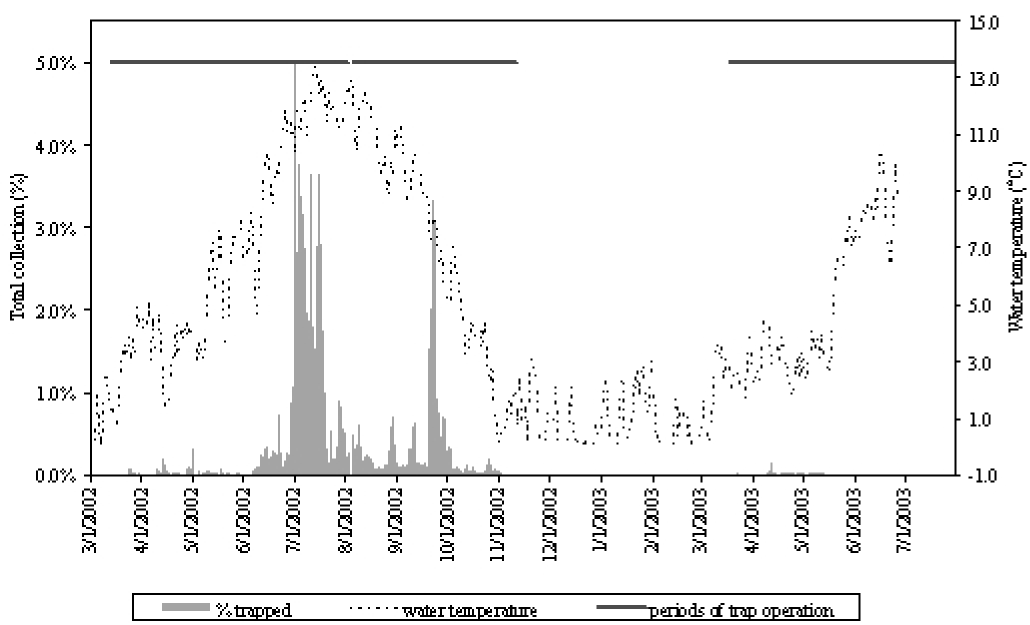
Appendix Table 29. Monthly environmental data collected from South Fork Salmon River (112 km from its confluence with the Salmon River) from August 2002 through July 2003.

	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	8.0	5.0	0.0	0.0	0.0	0.0	-----	-----	0.3	0.9	3.0	8.0
Max	18.8	17.1	8.9	3.4	1.5	1.8	-----	-----	7.0	9.2	15.4	20.8
Mean	13.2	10.2	3.5	0.8	0.3	0.7	-----	-----	3.4	4.5	7.5	14.5
						Dissolved Oxygen (ppm)						
Min	8.2	8.4	10.3	13.3	15.2	16.1	-----	-----	12.1	12.6	8.1	5.2
Max	13.6	11.8	14.6	16.2	17.3	17.7	-----	-----	16.1	15.4	14.3	11.2
Mean	10.4	10.0	12.1	14.4	16.0	16.6	-----	-----	14.0	14.3	12.6	8.5
						Specific Conductance (µS/cm)						
Min	48.0	51.0	59.0	45.0	42.0	49.0	-----	-----	30.0	18.0	19.0	29.0
Max	61.0	64.0	80.0	80.0	74.0	66.0	-----	-----	41.0	33.0	29.0	48.0
Mean	56.0	59.6	64.1	63.6	63.3	61.6	-----	-----	33.5	27.6	22.3	39.8
						Turbidity (ntu)						
Min	0.0	0.0	0.0	0.0	0.0	0.0	-----	-----	1.6	1.3	0.8	-0.2
Max	39.1	89.0	5.8	7.1	13.2	1.1	-----	-----	9.1	65.1	14.2	5.9
Mean	1.9	0.3	0.0	0.1	0.3	0.1	-----	-----	3.1	6.7	3.5	0.5
						Depth (feet)						
Min	0.3	0.1	0.0	0.5	0.5	1.3	-----	-----	1.3	1.4	1.4	0.8
Max	1.5	0.7	1.5	2.2	2.4	2.2	-----	-----	1.8	4.0	3.5	1.5
Mean	1.0	0.4	0.4	1.4	1.3	1.5	-----	-----	1.6	2.3	2.3	1.2
						pH						
Min	7.2	7.4	7.5	7.4	7.4	7.5	-----	-----	5.5	6.9	6.3	5.2
Max	8.6	8.6	8.1	7.9	8.0	8.1	-----	-----	9.6	9.7	9.6	8.8
Mean	7.7	7.7	7.6	7.6	7.6	7.6	-----	-----	8.5	9.3	8.8	7.5

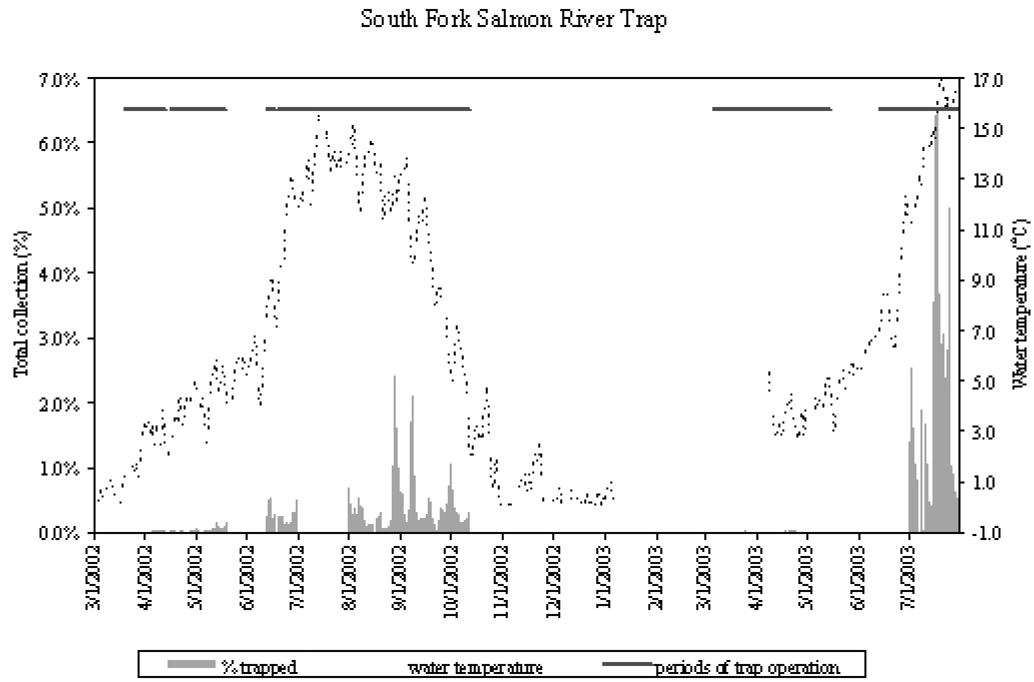
Upper Salmon River Trap

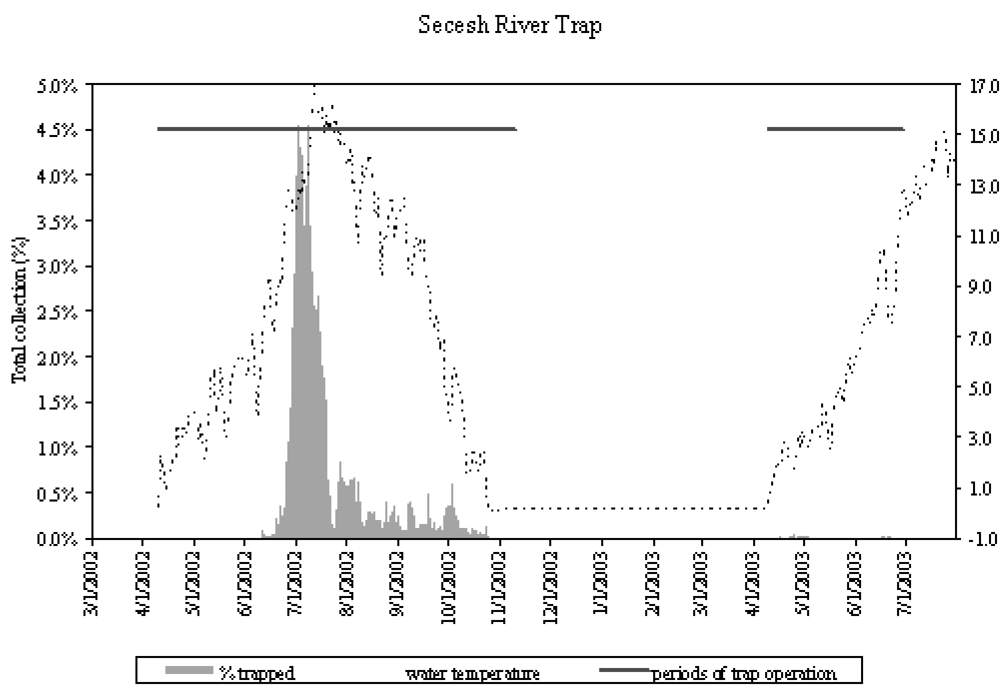


Marsh Creek Trap



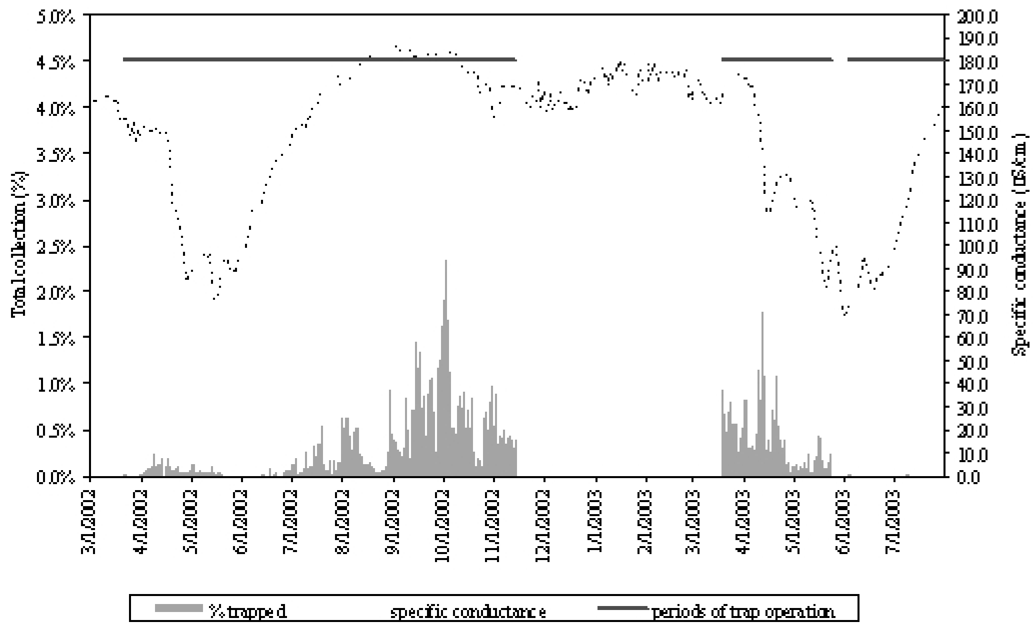
Appendix Figure 1. Daily passage of wild chinook salmon fry, parr, and smolts at four migrant traps, expressed as percentages of total collected, and plotted against average daily water temperatures collected near traps. Periods of trap operation are also shown.



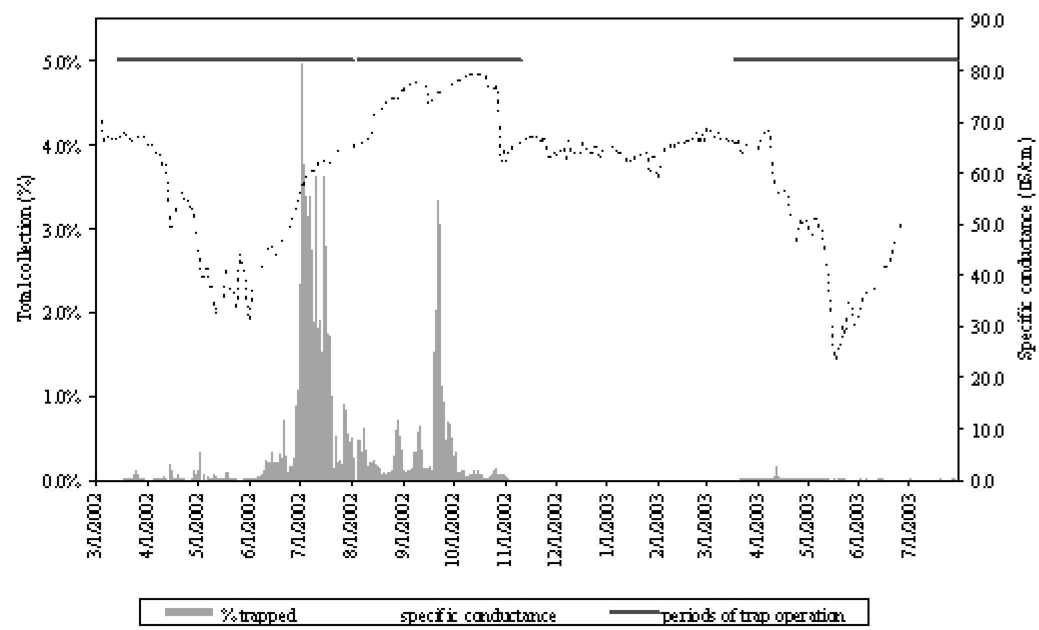


Appendix Figure 1. Continued.

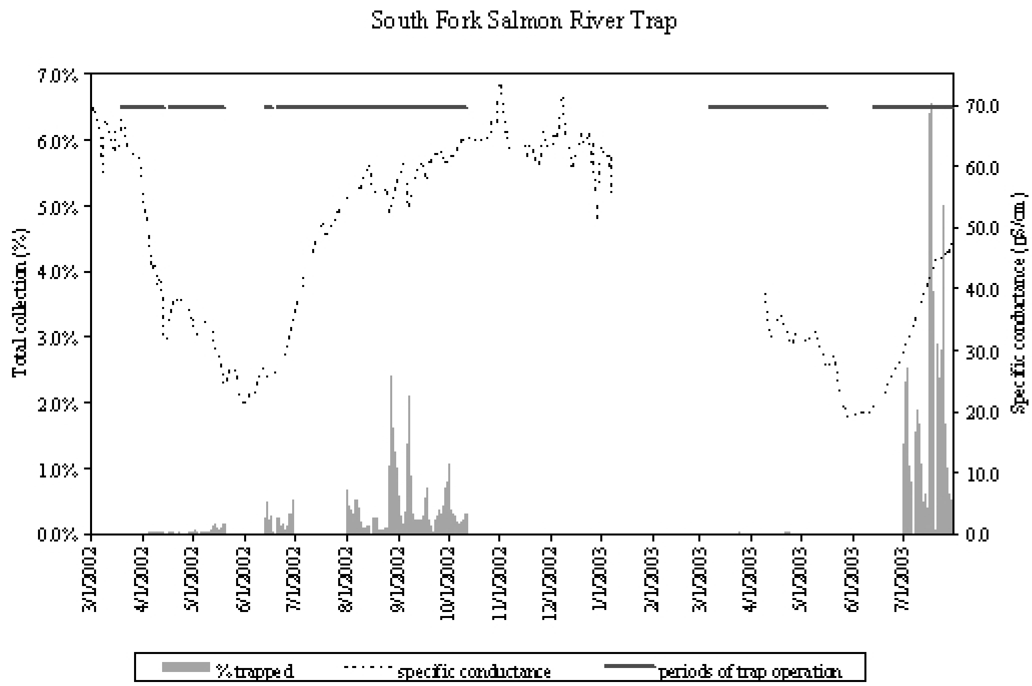
Upper Salmon River Trap

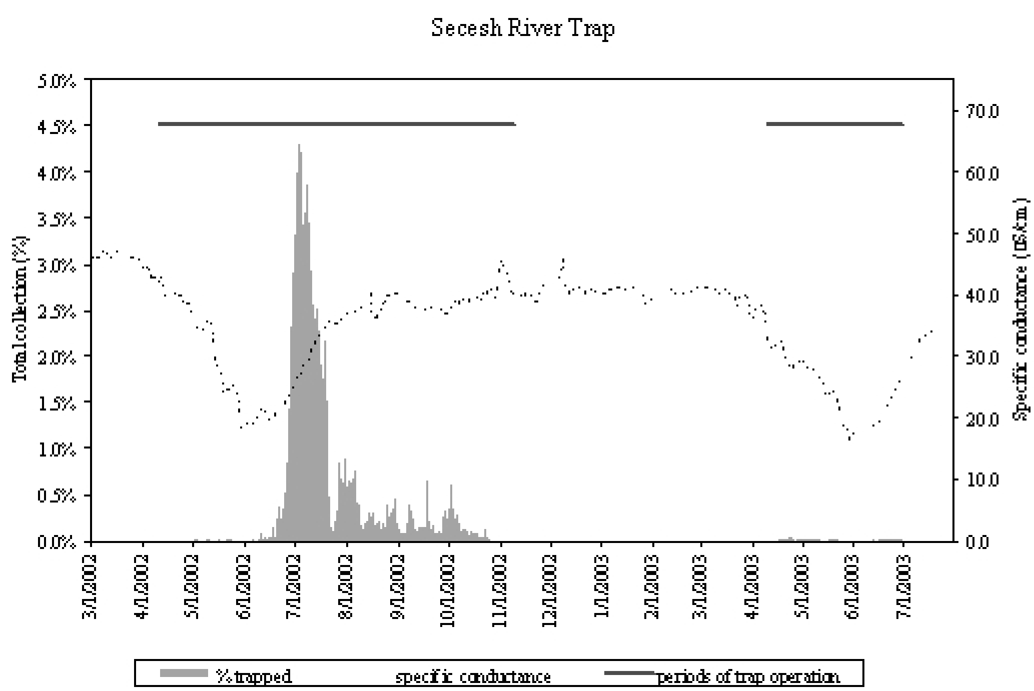


Marsh Creek Trap

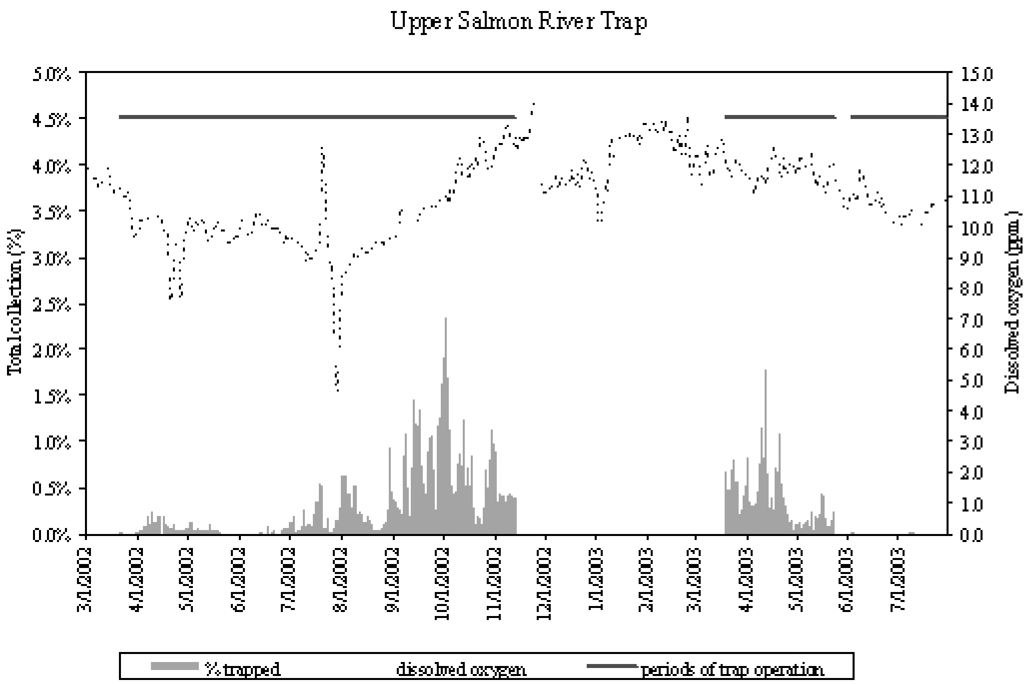


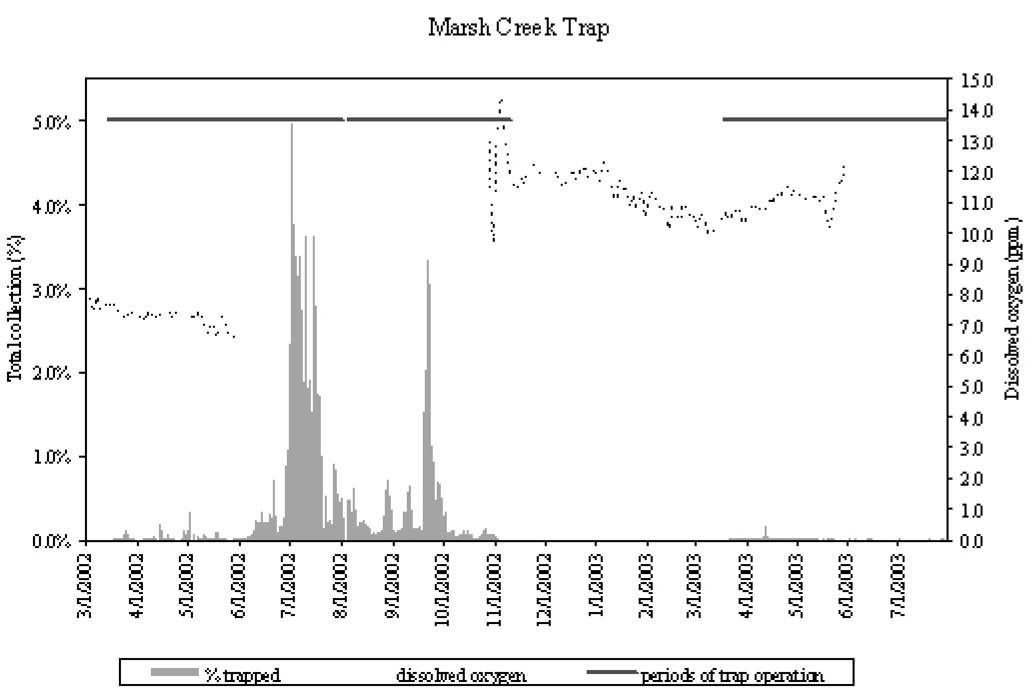
Appendix Figure 2. Daily passage of wild chinook salmon fry, parr, and smolts at four migrant traps, expressed as percentages of total collected, and plotted against average daily specific conductance collected near traps. Periods of trap operation are also shown.



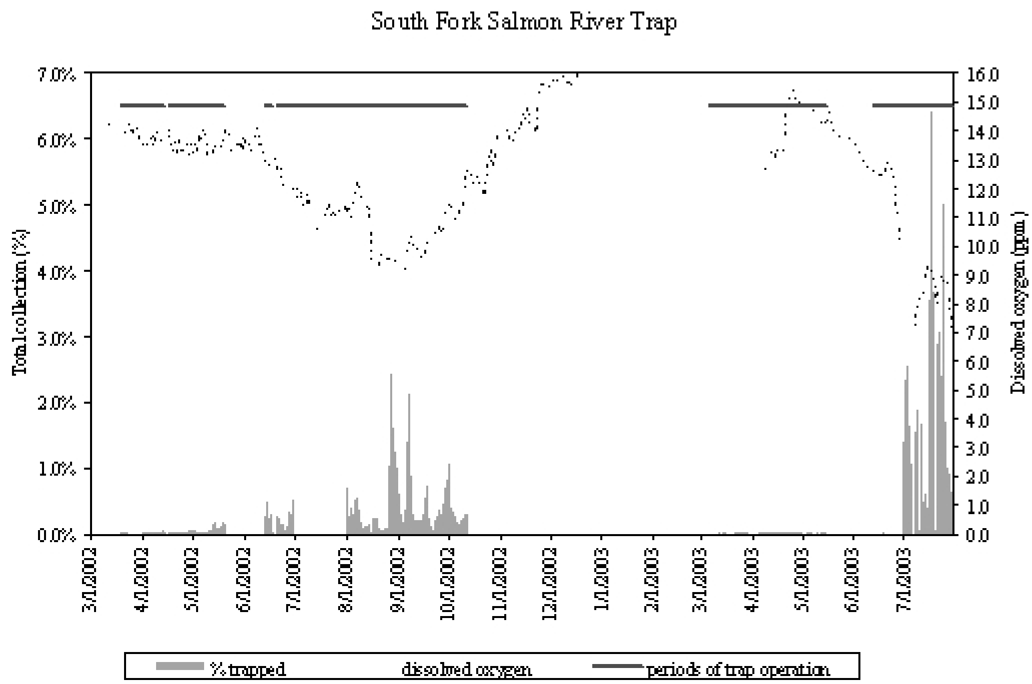


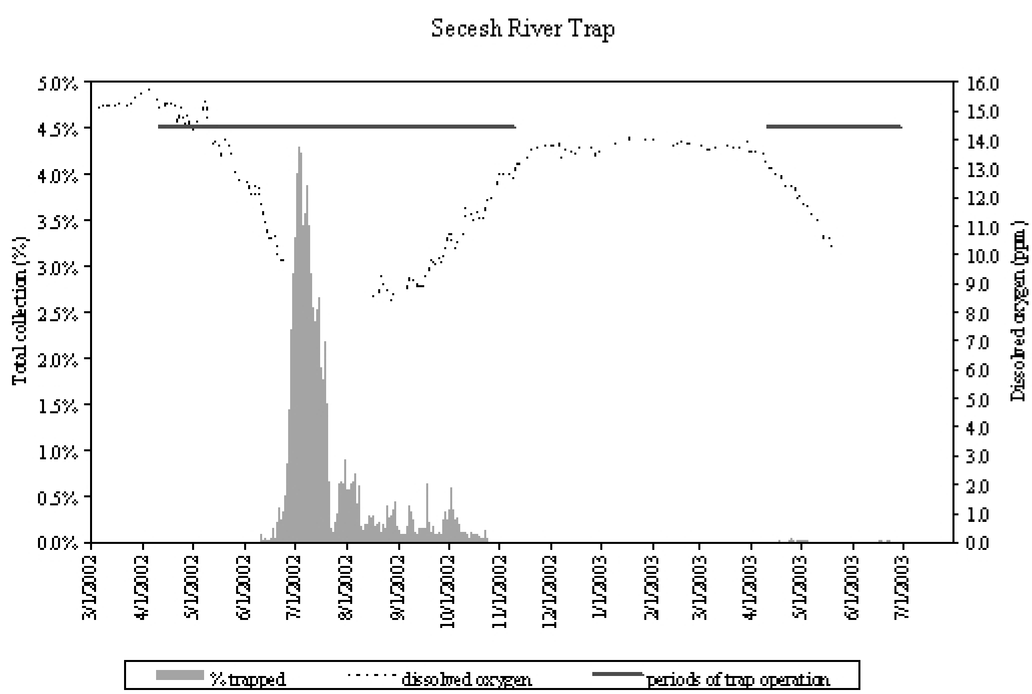
Appendix Figure 2. Continued.





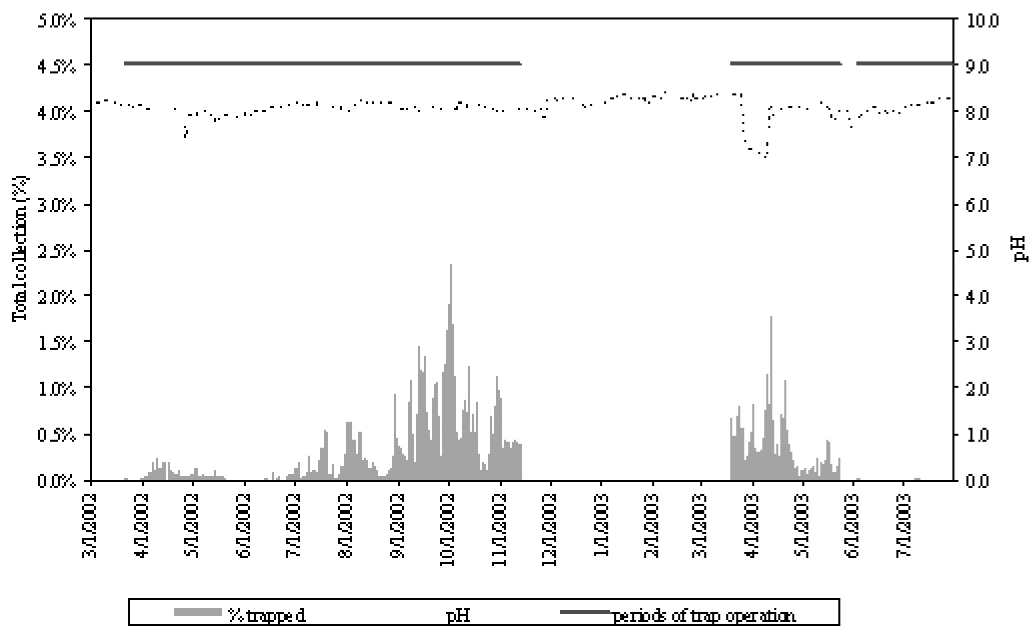
Appendix Figure 3. Daily passage of wild chinook salmon fry, parr, and smolts at four migrant traps, expressed as percentages of total collected, and plotted against average daily dissolved oxygen collected near traps. Periods of trap operation are also shown.



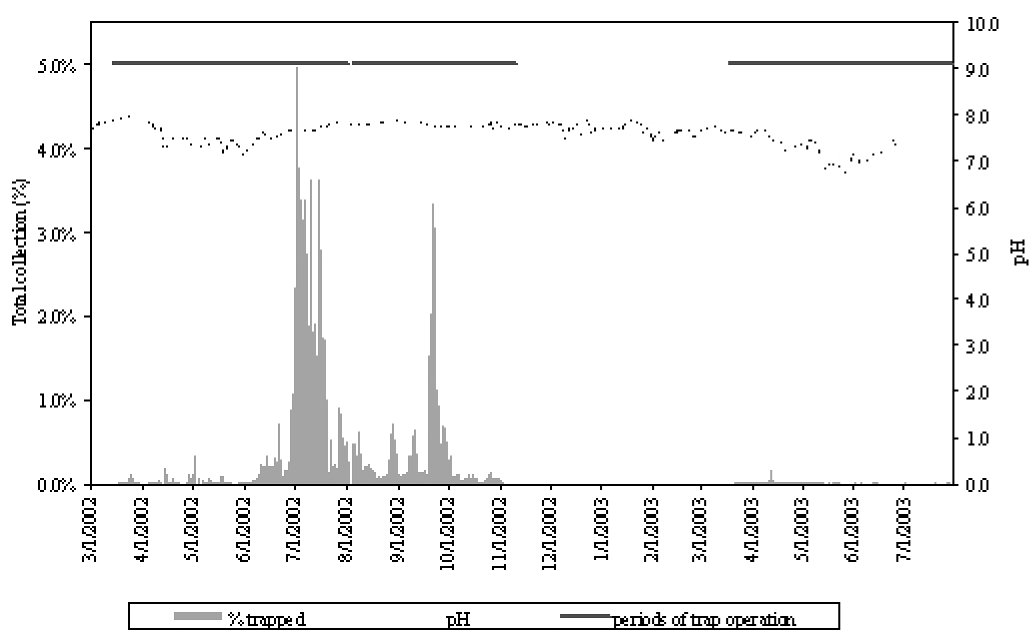


Appendix Figure 3. Continued.

Upper Salmon River Trap

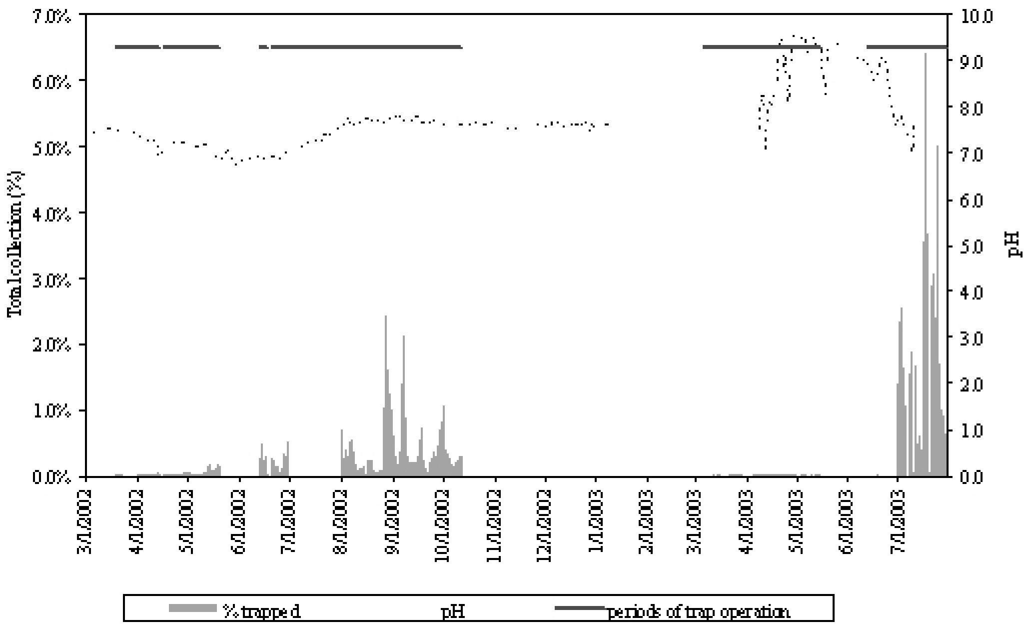


Marsh Creek Trap

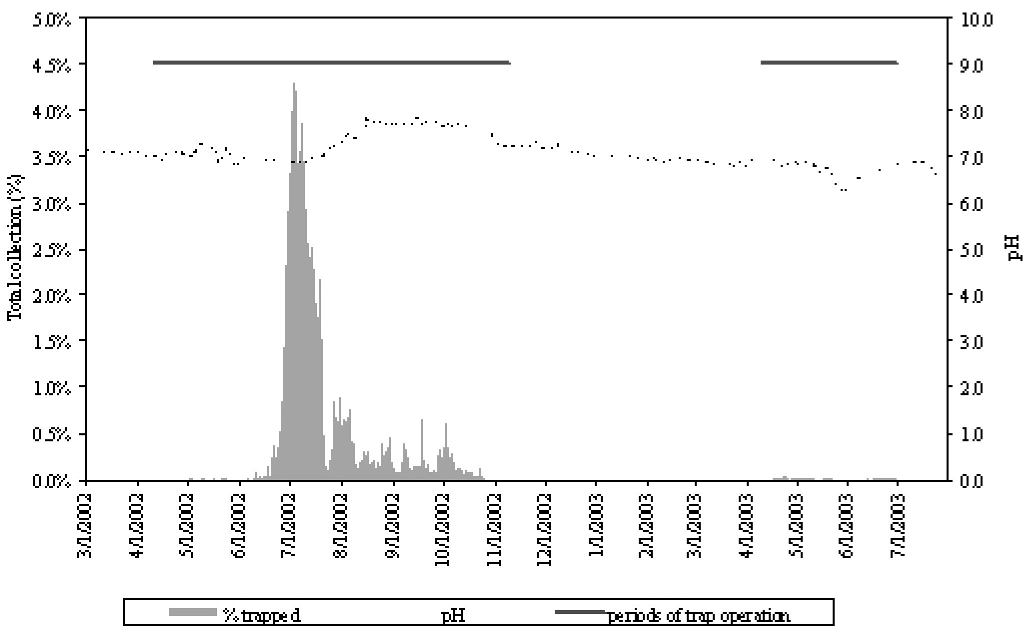


Appendix Figure 4. Daily passage of wild chinook salmon fry, parr, and smolts at four migrant traps, expressed as percentages of total collected, and plotted against average daily pH collected near traps. Periods of trap operation are also shown.

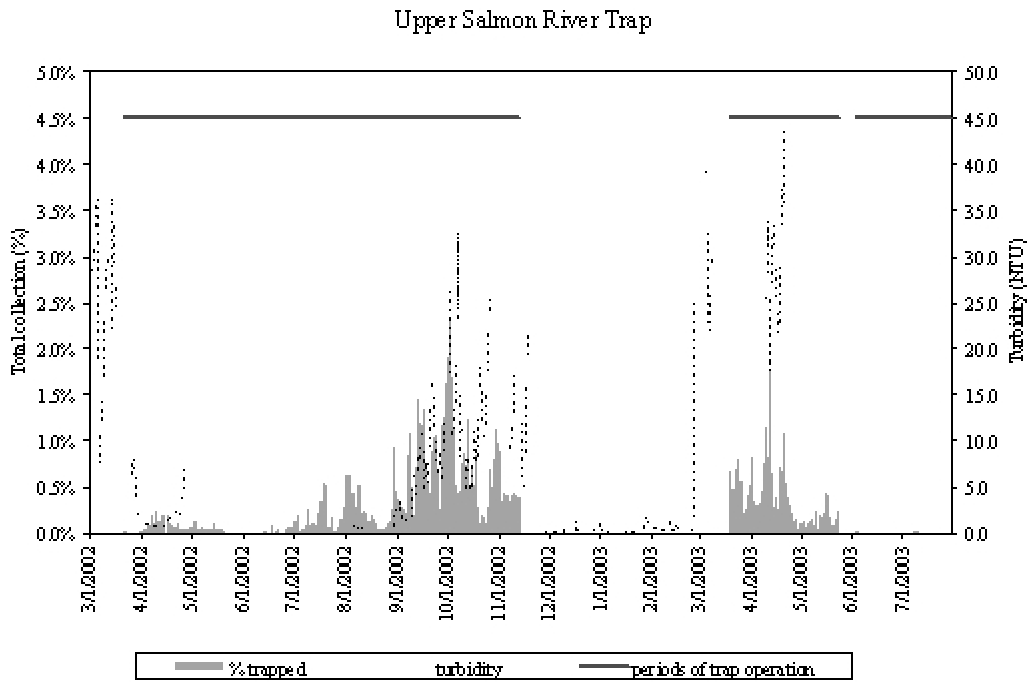
South Fork Salmon River Trap

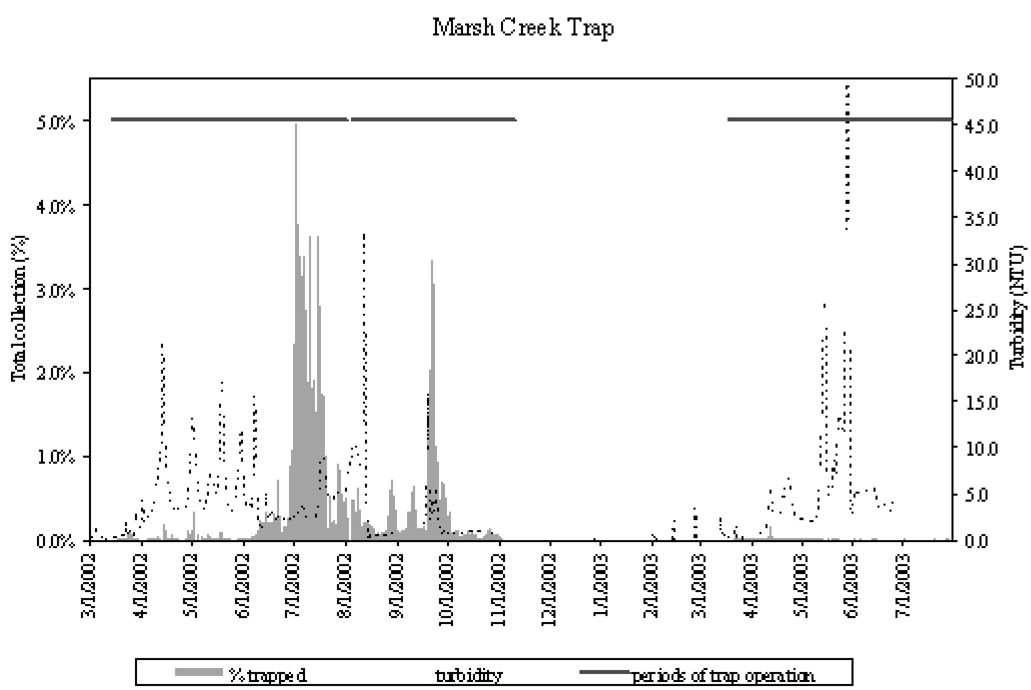


Secesh River Trap

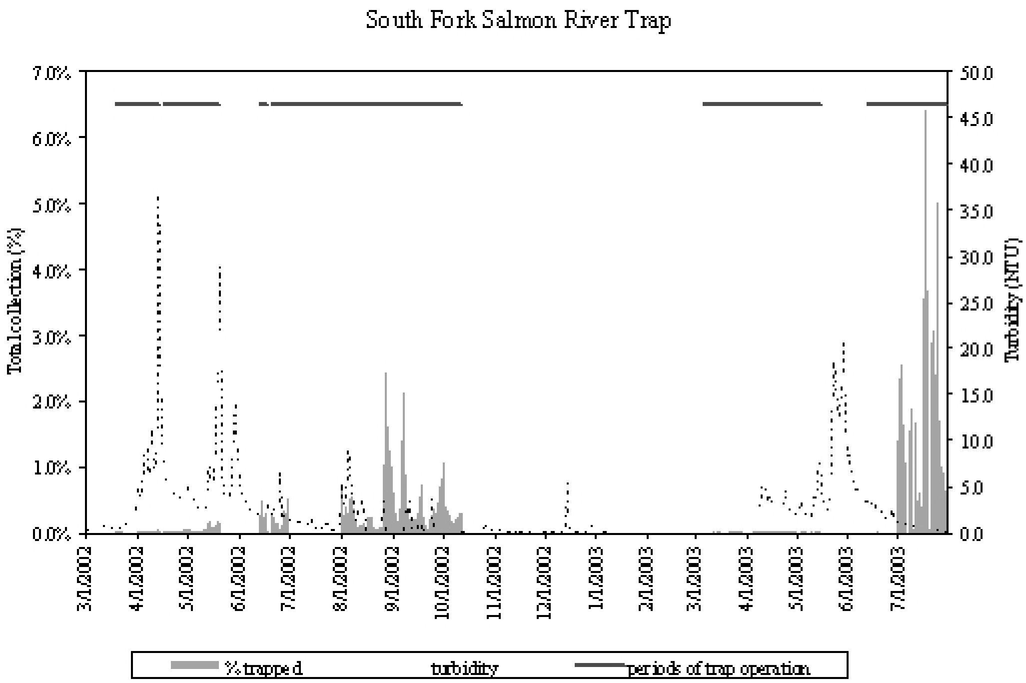


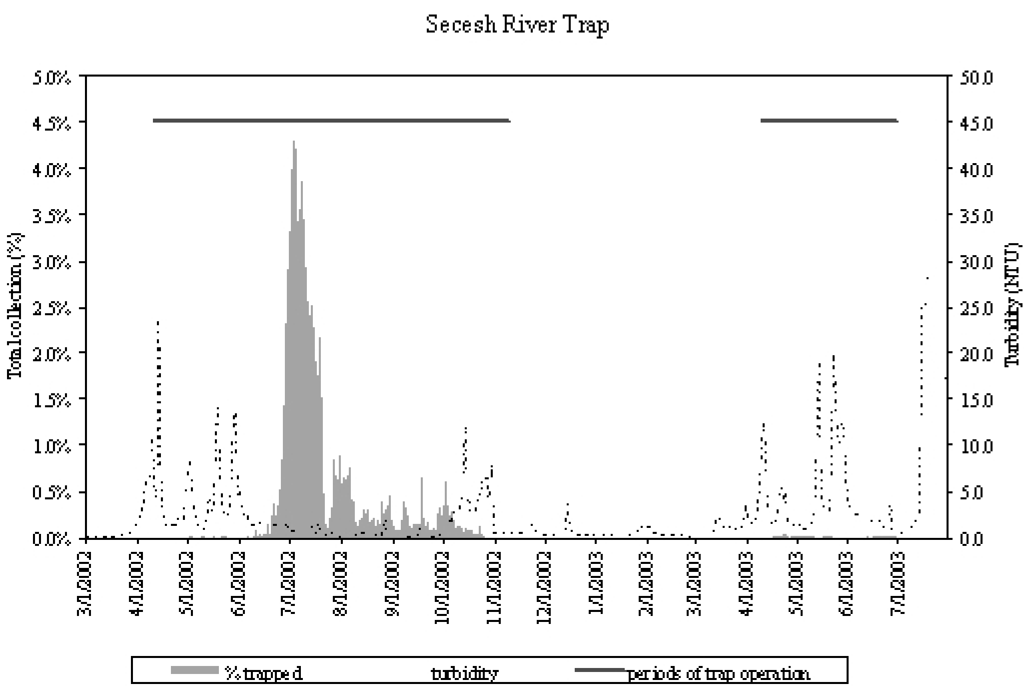
Appendix Figure 4. Continued.





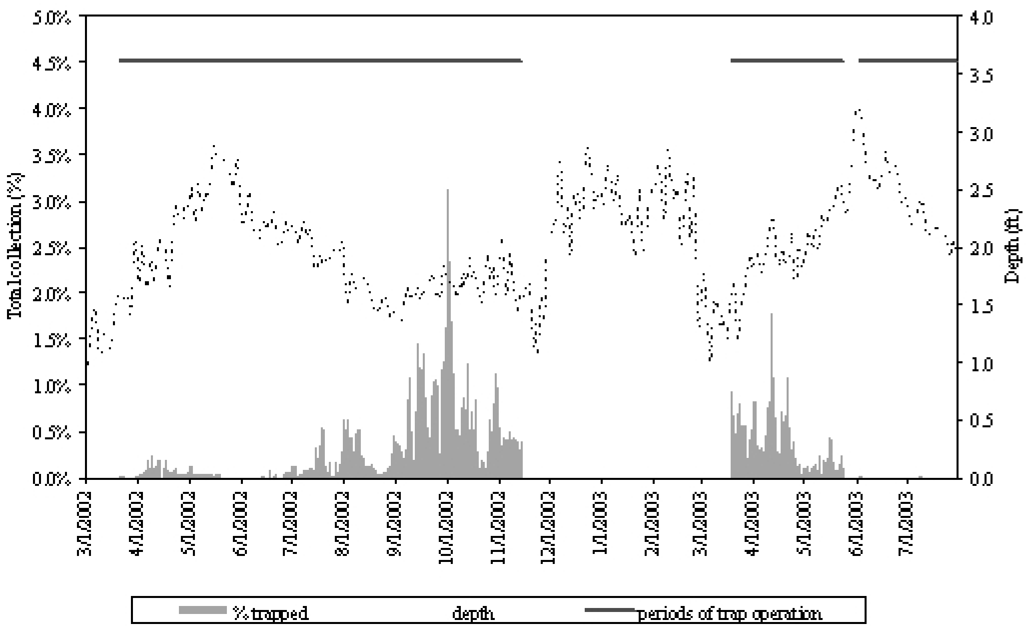
Appendix Figure 5. Daily passage of wild chinook salmon fry, parr, and smolts at four migrant traps, expressed as percentages of total collected, and plotted against average daily turbidity collected near traps. Periods of trap operation are also shown.



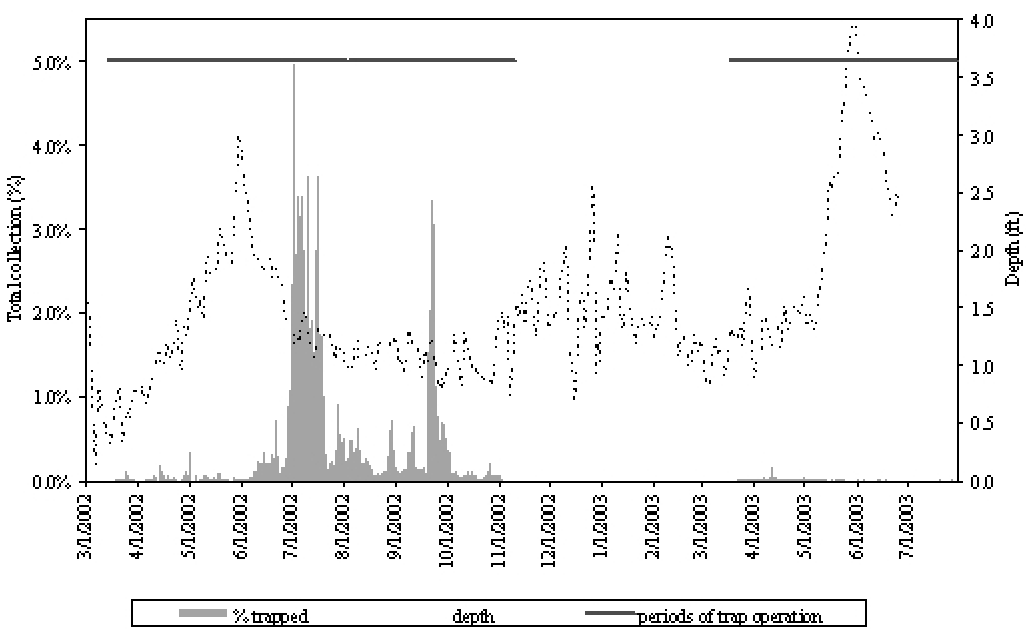


Appendix Figure 5. Continued.

Upper Salmon River Trap

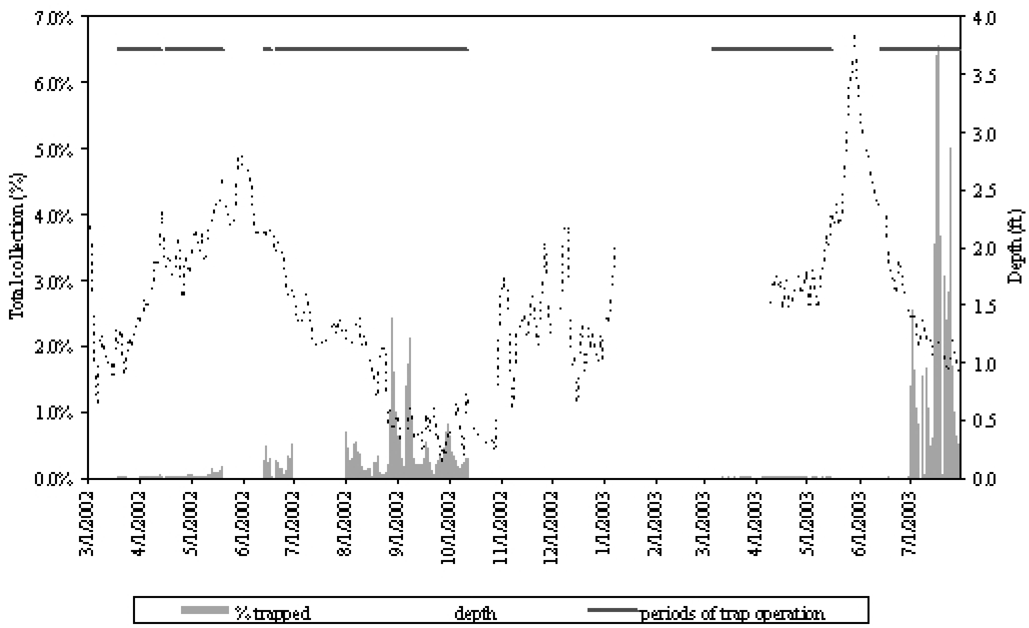


Marsh Creek Trap

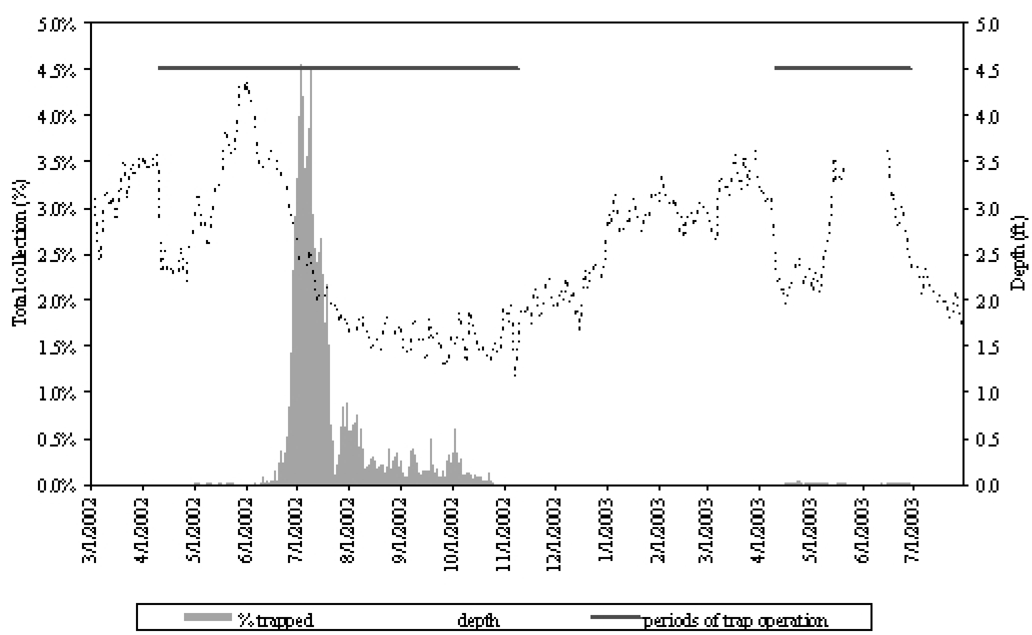


Appendix Figure 6. Daily passage of wild chinook salmon fry, parr, and smolts at four migrant traps, expressed as percentages of total collected, and plotted against average daily depth collected near traps. Periods of trap operation are also shown.

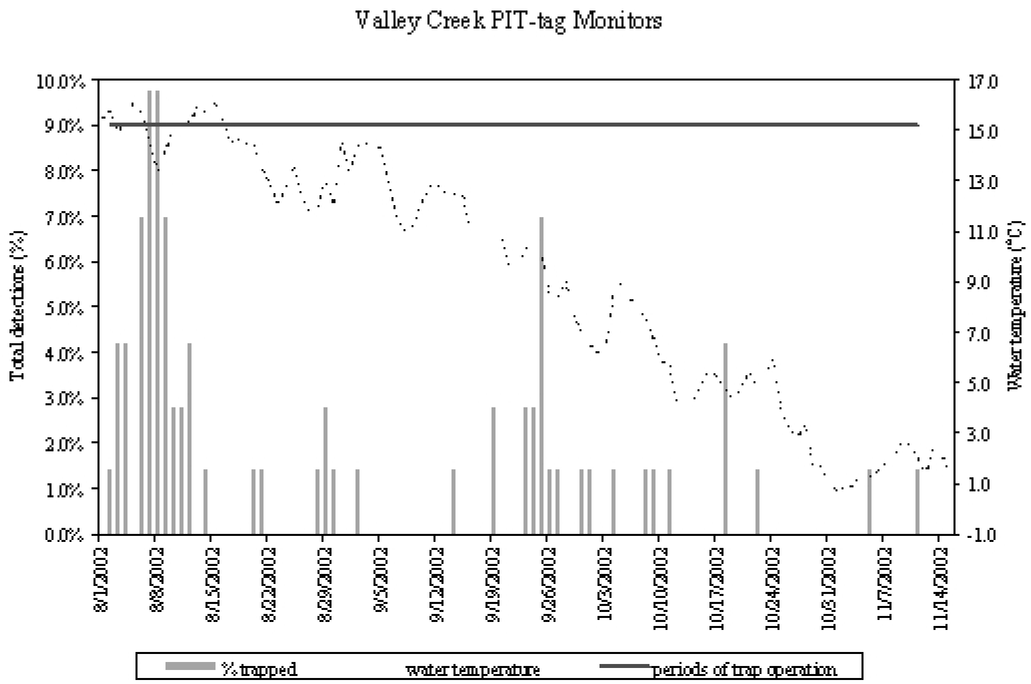
South Fork Salmon River Trap

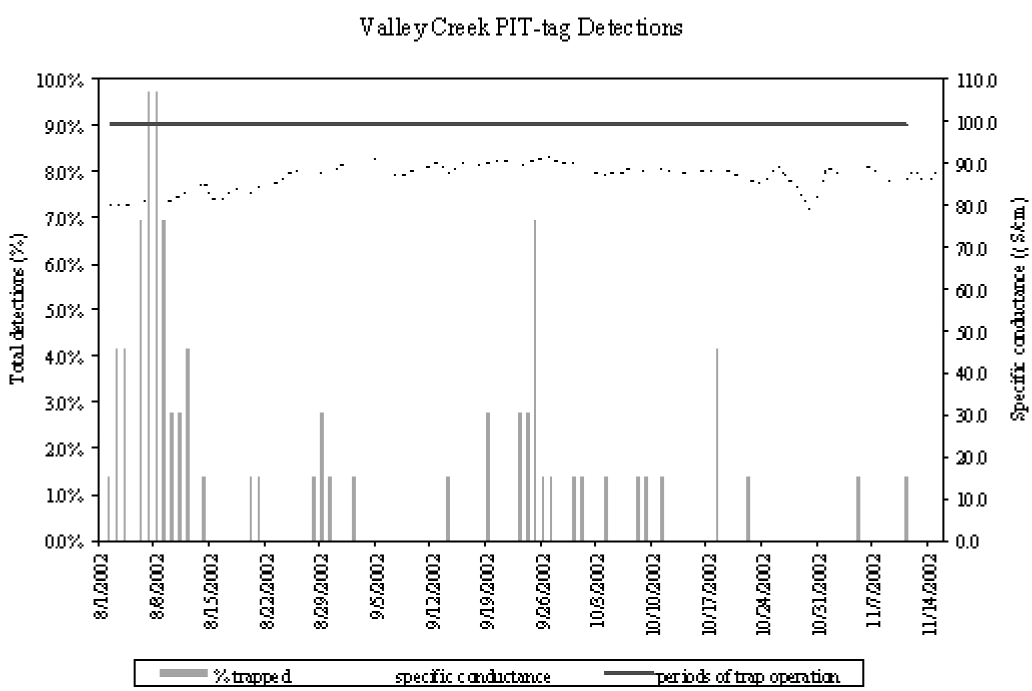


Secesh River Trap

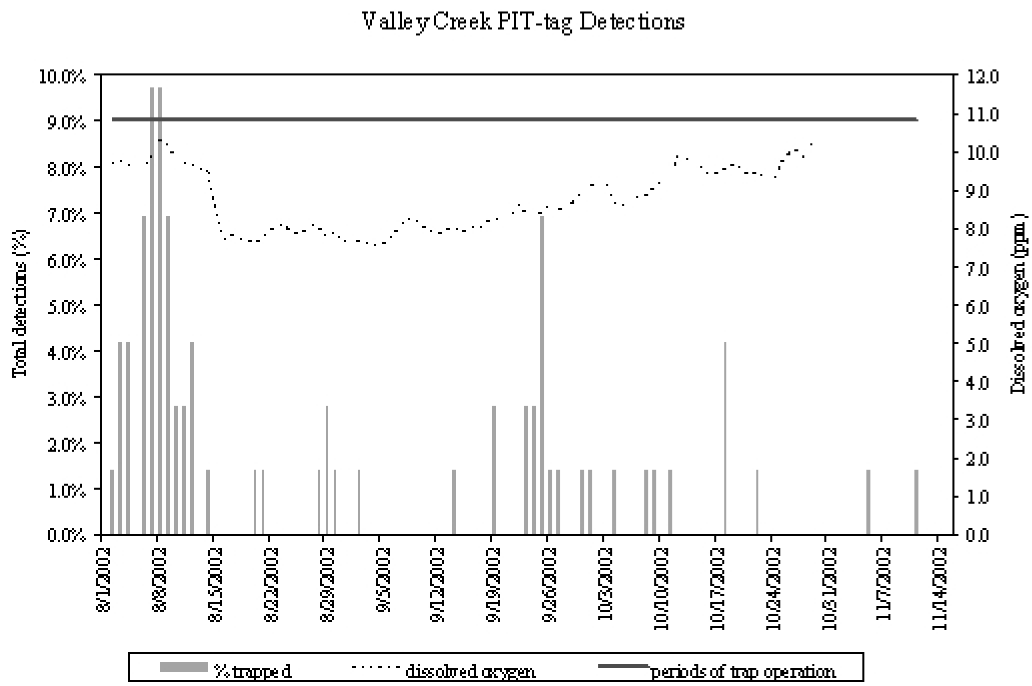


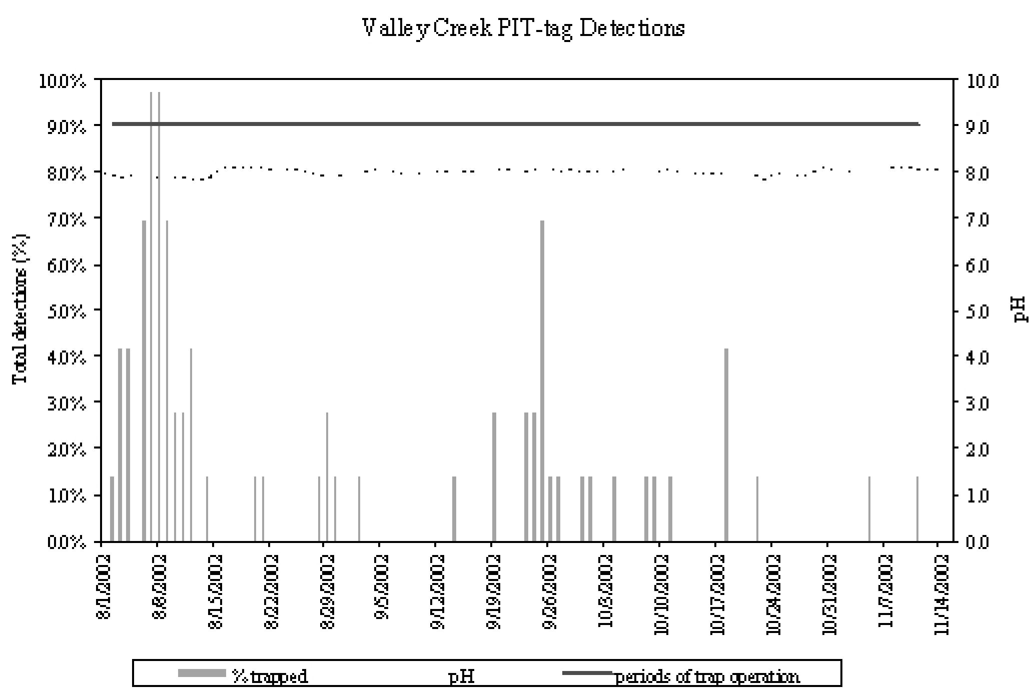
Appendix Figure 6. Continued.



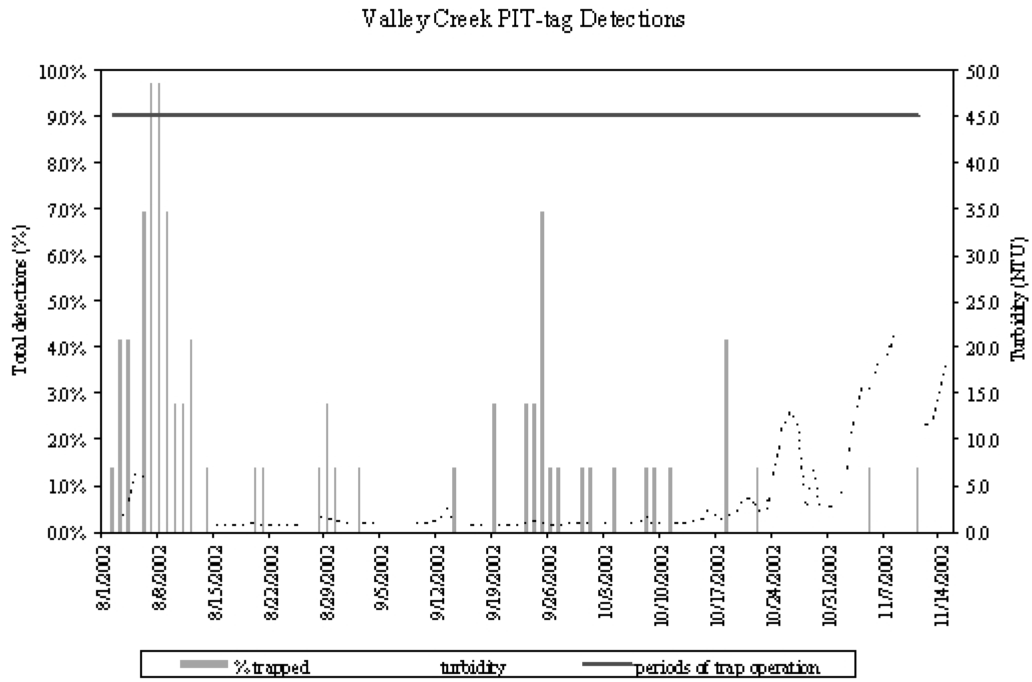


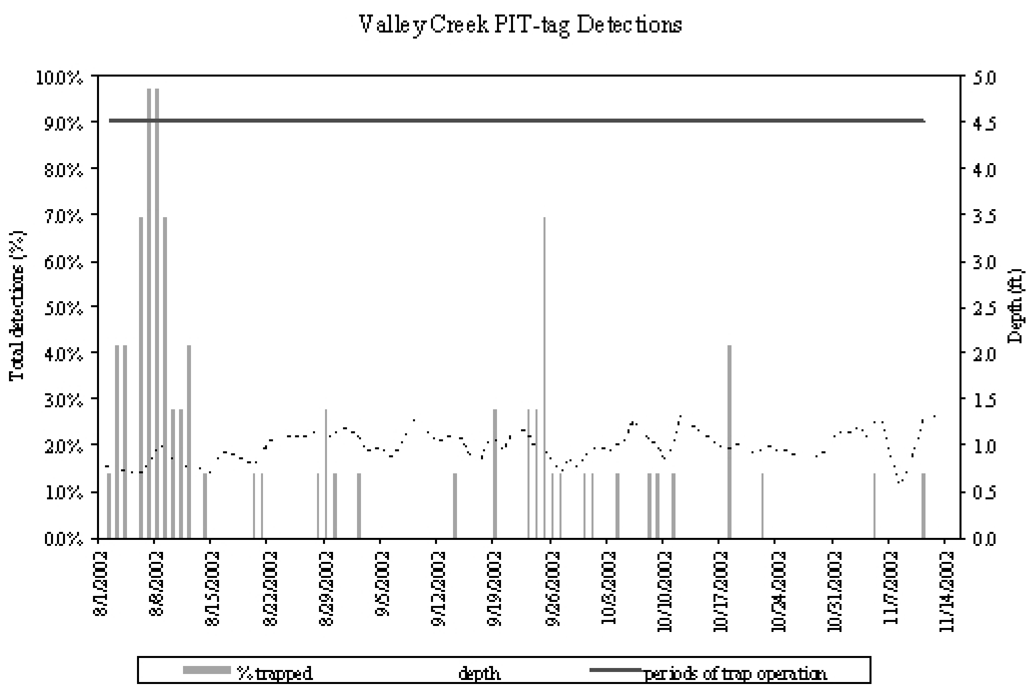
Appendix Figure 7. Combined daily PIT-tag detections of wild chinook salmon parr at in-stream PIT-tag detectors in Valley Creek, expressed as percentages of total collected, and plotted against average daily aquatic conditions collected near the detectors. Periods of operation for the detectors are also shown.





Appendix Figure 7. Continued.





Appendix Figure 7. Continued.