BONNEVILLE POWER ADMINISTRATION

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, 2004

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EXECUTIVE SUMMARY

This report provides the 2003-2004 results from an ongoing project to monitor the behavior of wild spring/summer Chinook salmon juveniles in the Snake River Basin. We report estimated parr-to-smolt survival and arrival timing at Lower Granite Dam of wild fish PIT-tagged tagged in Idaho by the National Marine Fisheries Service (NMFS). We also report arrival timing at the dam of fish tagged in Oregon streams by the Oregon Department of Fish and Wildlife (ODFW).

Principal results from our tagging and interrogation activities during 2003-2004 are listed below:

1) In July and August 2003, we PIT tagged and released 18,346 wild Chinook salmon parr in 16 Idaho streams.

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

3) Of the 2,498 Chinook salmon parr PIT tagged and released in Valley Creek in summer 2003, 10.0% (251) were detected at two in-stream PIT-tag monitoring systems in lower Valley Creek from late summer 2003 to spring 2004. Of these, 59% were detected in late summer/fall, 32.3% in winter, and 8.8% in spring. The estimated parr-to-smolt survival to Lower Granite Dam for each of these groups was 6.6% for the late-summer/fall group, 16.9% for the winter group, and 43.9% for the spring group. An estimated 28 to 40% of all summer-tagged parr survived to move out of Valley Creek, and their estimated survival from that point to the dam was 13.2%. Overall estimated parr-to-smolt survival at the dam for all summer-tagged fish from this stream was 5.5%. Development and improvement of in-stream PIT-tag monitoring systems continued throughout 2003 and 2004.

4) At Little Goose Dam in 2004, length and weight was measured for 974 recaptured fish from 16 Idaho streams. Fish had grown an average of 41.3 mm in length and 8.5 g in weight over an average of 277 days. Their mean condition factor declined from 1.28 at release (parr) to 0.99 at recapture (smolt).

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

6) 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).

7) In 2004, detections at Lower Granite Dam peaked during low flows of 64.2 kcfs on 15 April for parr tagged during summer 2003 (from 16 streams in Idaho and 4 streams in Oregon). The 10th, 50th, and 90th percentile passage occurred on 16 April, and 3 May, and 26 May, respectively.

8) Estimated parr-to-smolt survival to Lower Granite Dam for Idaho and Oregon streams (combined) averaged 8.1% (range 4.1-18.0% depending on stream of origin). This was the lowest average survival rate measured in the last 12 years. It may have related to high parr densities in 2003 that resulted from a comparatively large number of wild spawners in 2002.

In 2004, the 50th and 90th percentile passage dates for wild fish passing Lower Granite Dam occurred in early and late May, respectively. In 2004, we observed close to normal climatic conditions, but flows were considered low during most of the spring. Clearly, complex interrelationships of several factors drive the annual migration timing of these stocks.

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INTRODUCTION

This report provides information on PIT-tagging of wild Chinook salmon parr in Idaho in 2003 and the subsequent monitoring of these fish and similarly tagged fish from Oregon. We report estimated parr-to-smolt survival and arrival timing of these fish at Lower Granite Dam, as well as interrogation data collected at several other sites throughout the Snake and Columbia River system. This research continues studies that began under Bonneville Power Administration (BPA) funding in 1991. Results from previous study years were reported by Achord et al. (1994; 1995a,b; 1996a; 1997; 1998; 2000; 2001a,b; 2002, 2003, 2004). Goals of this ongoing study are:

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 migration patterns.

4) Characterize the migration 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.

In 2003-2004, we also continued to measure water temperature, dissolved oxygen, specific conductance, turbidity, water depth, and pH at five monitoring stations in the Salmon River Basin, Idaho for the Baseline Environmental Monitoring Program. These data, along with parr/smolt migration, survival, and timing data, will help to discern patterns or characteristic relationships between fish movement/survival and environmental factors.

METHODS

Fish Collection and Tagging

Wild Chinook salmon parr in the Grande Ronde and Imnaha River drainages in northeast Oregon were tagged by the Oregon Department of Fish and Wildlife (ODFW) in 2003. All tagging, detection, and timing information for fish from these streams in 2003-2004 will be reported by ODFW. However, in concurrence with ODFW, we report here the arrival timing at Lower Granite Dam of summer-tagged fish from these Oregon streams.

In 2003, we used the same collection and PIT-tagging procedures to mark parr in Idaho streams as we used in previous years (see Matthews et al. 1990; Achord et al. 1994, 1995a,b, 2003, 2004).

Interrogation at In-stream PIT-Tag Monitors

Until recently, 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), juvenile fish bypass systems at collector dams, and a surface pair-trawl detection system operated in the Columbia River estuary. In an effort to detect fish closer to tagging sites, we began development of in-stream PIT-tag monitoring systems in Valley Creek in 2002 (Downing et al. 2004). We placed detector systems at two sites located 1.6 km apart (VC1 and VC2).

Development of the Valley Creek monitoring systems continued throughout 2003 and 2004; details of this development are described by Achord et al. (2004). In addition to continued improvements to the monitoring electronics, we replaced the antennas at both sites with larger 3.0-m long by 61-cm high (outside dimensions) antennas (constructed of 7.6 cm PVC pipe). 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 (PSMFC 1996). Here we report data collected at the Valley Creek sites from August 2003 through July 2004.

Juvenile Migrant Traps

Some fish PIT tagged as parr in natal rearing areas are subsequently collected at migrant traps (Figure 1). During fall 2003 and spring 2004, juvenile migrant fish traps were operated at Knox Bridge on the South Fork of the Salmon River, on Lake Creek, near Chinook Campground on the Secesh River, on Marsh Creek, and near the Sawtooth Hatchery on the upper Salmon River. Also during spring 2004, juvenile migrant fish traps were operated on the lower Salmon River near Whitebird, Idaho, and on the Snake River at Lewiston, Idaho. Traps were operated by the Nez Perce 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 from the anesthetic, all fish were released back to the streams or rivers.

Recaptures at Dams

While collecting and PIT tagging fish at the dams for various studies, NMFS and other personnel occasionally encounter wild fish that are already PIT tagged. In such cases, biological data are usually collected from these fish. To increase sample sizes for parr-to-smolt growth information on previously PIT-tagged wild fish, in 2004 we continued efforts begun in 2001 to utilize the PIT-tag separation-by-code system (Downing 2001) at Little Goose Dam. The system was programmed to separate up to a maximum of 100 wild fish from each stream so that we could take length and weight measurements from a sample of fish. 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 factor was calculated for these fish both at release and recapture.

Interrogation at Dams and Lower Columbia River

During spring and summer 2004, Chinook salmon that were PIT tagged as parr in 2003 and survived the winter migrated volitionally downstream through hydroelectric dams on the Snake and Columbia Rivers. Of the eight lower Snake River and Columbia River dams encountered by these fish, the following six were equipped with smolt collection and/or PIT-tag interrogation systems: Lower Granite, 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).

PIT-tagged fish were also monitored by a surface pair-trawl detector operated in the upper estuary of the Columbia River (approximately 150 km downstream from Bonneville Dam). For details of its operation, see Ledgerwood et al. (2004).

Migration Timing

We monitored within-season migration timing at Lower Granite Dam 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, which we compared to survival estimates from previous years.

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 arrival timing distribution at Lower Granite Dam between streams (in terms of the dates of 10th, median, and 90th passage percentiles) 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 (SEs) for fish from all 20 streams. This method assumed that the timing of passage percentiles had similar distributions among streams. The Student-Newmann-Keuls (SNK) multiple comparison method was used to make comparisons between streams for each statistic ($\alpha = 0.05$; Petersen 1985).

We also examined the migration timing at Lower Granite Dam of individual populations over a period of years to determine similarities or differences between years and between populations. We chose populations with 7 or more years of timing data for these analyses. Comparisons of the 10th, 50th, and 90th percentile passage dates were made among 18 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 (Peterson 1985). Statistical significance was set at $\alpha = 0.05$.

Environmental Information

In 2003-2004, we collected hourly measurements of water temperature, dissolved oxygen, specific conductance, turbidity, water depth, and pH from the following locations: 1) Marsh Creek, 2) Valley Creek, 3) Sawtooth Hatchery in the upper Salmon River, 4) South Fork of the 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 22 July to 30 August 2003, we collected 25,209 wild Chinook salmon parr in 16 Idaho streams (Figure 1) over a distance of about 35 stream kilometers and an area of approximately 304,519 m^2 (Table 1; Appendix Table 1). Of these fish, 18,346 were PIT tagged and released back into the streams along with the remaining non-tagged live fish. Some fish were not tagged because of small size, injury, precocious maturation, or because excess numbers were collected. In addition, some fish were collected for genetic and marine derived nutrient samples. Numbers of tagged fish released per stream ranged from 52 in Rush Creek to 2,498 in Valley Creek (Table 1; Appendix Tables 1 and 2a).

Fork lengths of all collected Chinook salmon parr ranged from 36 to 296 mm (mean 60.4 mm) and weights ranged from 0.4 to 23.5 g (mean 3.2 g). Fork lengths of tagged and released Chinook salmon parr ranged from 43 to 184 mm (mean 63.2 mm) (occasionally fish smaller than 55 mm are inadvertently tagged) and weights ranged from 1.0 to 11.4 g (mean 3.4 g; Appendix Table 1). In 2003, collection areas within the streams were further delineated by recording Global Positioning System (GPS) coordinates using Universal Transverse Mercator (UTM) grid (Appendix Table 2b).

Other than Chinook salmon parr, sculpin were the most abundant species observed during collection operations (Table 2). However, the counts of non-target fish were not from systematic sampling for these species and thus do not represent total abundances in the collection areas. The samples targeted only wild Chinook salmon.

Mortality associated with collection and tagging procedures was low, as was 24-h tag loss (only one in Loon Creek). Average collection mortality was 1.0%, average tagging and 24-hour delayed mortality was 0.1%, and average overall observed mortality was 1.1% (Table 3; Appendix Table 3).

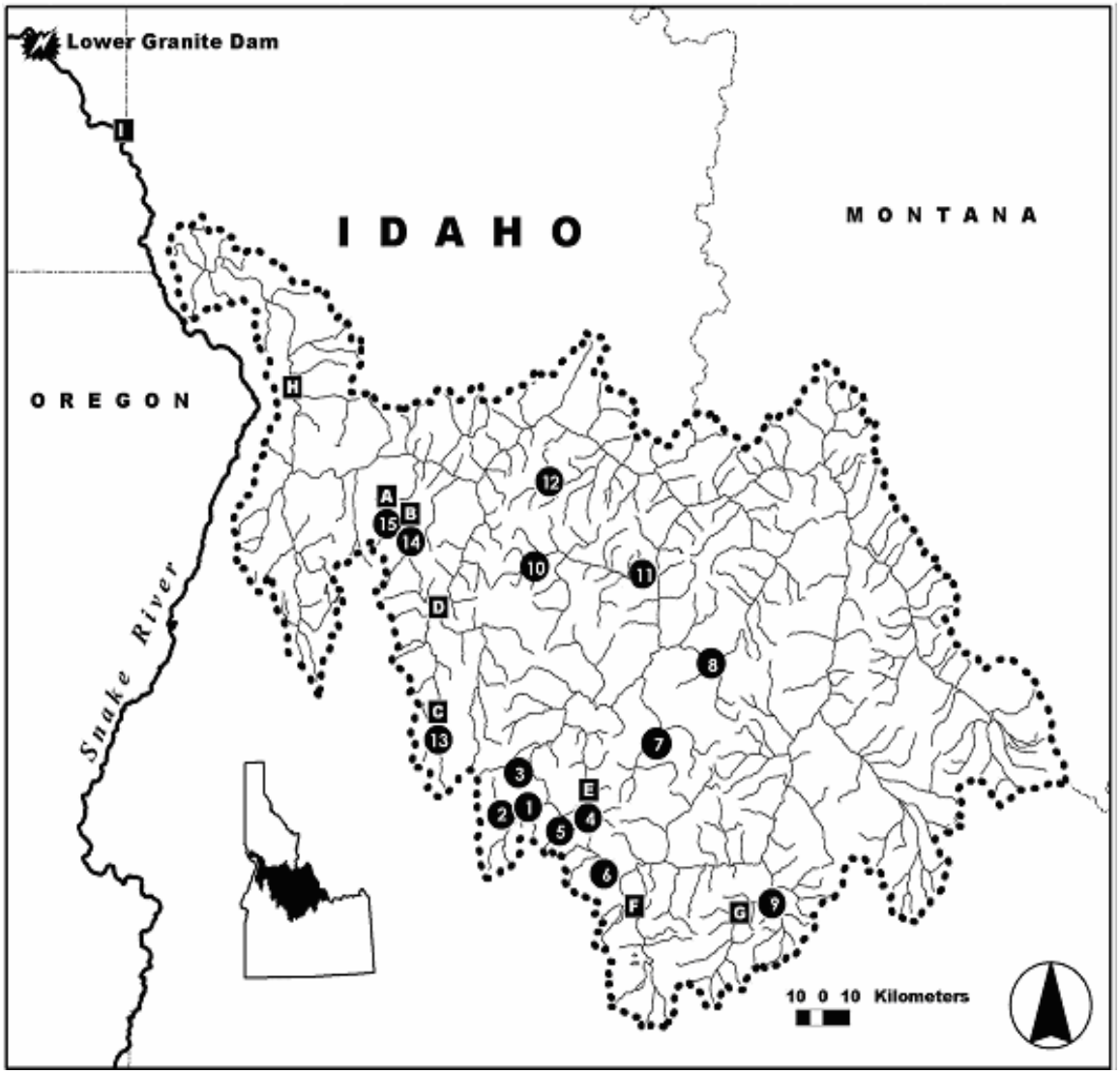

Figure 1. Wild spring/summer Chinook salmon parr were PIT tagged during 2003 in the following streams:

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

Juvenile migrant fish traps shown above are as follows:

A-Lake Creek Trap	D-Lower S.F. Salmon River Trap	G-East Fork Salmon River Trap
B-Secesh River Trap	E-Marsh Creek Trap	H-Salmon River Trap
C-South Fork Salmon River Trap	F-Sawtooth Trap	I-Snake River Trap

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 2003.

	Number of fish		Average length (mm)		Average weight (g)		Collection area to mouth of stream (km)	Estimated area sampled in stream (m^2)
	Collected	Tagged & released	Collected	Tagged	Collected	Tagged		
Bear Valley Creek	1,995	1,494	59.1	61.4	2.8	3.0	9-9.5 & 13-15	2,070
Elk Creek	1,819	1,520	61.4	62.9	3.1	3.3	0-3	20,459
Marsh Creek	1,812	1,535	63.3	64.6	3.5	3.7	11-14	10,614
Sulphur Creek	1,319	1,048	62.1	62.9	3.0	3.1	5-5.5	1,400
Cape Horn Creek	2,319	671	53.8	61.4	2.8	3.4	0-2 & 5-6	21,075
Valley Creek	3,152	2,498	61.1	62.8	3.4	3.5	4,6,18	34,989
Loon Creek	952	860	63.4	64.5	3.6	3.7	33-36	13,693
Camas Creek	1,201	1,005	60.5	62	3.2	3.3	22-23	18,223
Herd Creek	1,047	968	66.7	67.3	3.9	4.1	1-2.5	13,844
Big Creek (upper)	1,933	1,504	59.9	61.7	3.3	3.4	54-57	35,550
Big Creek (lower)	943	899	71.9	72.1	4.4	4.4	8-10	21,200
Rush Creek	59	52	71.7	71.8	---	---	0-1	1,600
W.F. Chamberlain	997	753	61.0	63.3	3.4	3.2	1-2	4,500
Chamberlain Cr	316	243	57.9	59.4	2.7	2.8	26-26.5	3,594
S.F. Salmon River	2,608	1,490	56.9	62.3	3.1	3.2	117-118 & 121-122	38,337
Secesh River	1,708	1,142	58.1	61.9	2.7	3.0	25-29	41,211
Lake Creek	1,029	664	58.0	61.5	3.1	3.2	1-2	22,160
Totals or averages	25,209	18,346	60.4	63.2	3.2	3.4	35	304,519

Table 2. Summary of species other than Chinook salmon parr observed during collection operations in Idaho in July and August 2003. Numbers of steelhead in parentheses were PIT tagged for the Idaho Department of Fish and Game.

Stream	Steelhead	Tagged steelhead	Unidentified fry	Brook trout	Cutthroat trout	Bull trout	Sculpin	Dace	Sucker	Whitefish	Shiner
Bear Valley Creek	16	(0)	39	24	0	0	1	16	1	598	0
Elk Creek	61	(0)	134	61	1	0	6	80	8	812	0
Marsh Creek	51	(0)	428	116	1	1	502	0	2	19	0
Sulphur Creek	6	(0)	98	0	8	1	11	71	3	38	0
Cape Horn Creek	49	(0)	46	117	0	1	706	0	0	0	0
Valley Creek	150	(89)	337	60	0	2	570	356	232	82	384
Loon Creek	98	(34)	588	0	0	3	0	0	0	14	1
Camas Creek	155	(70)	474	0	0	3	156	0	1	1	0
Herd Creek	188	(149)	0	0	0	3	273	0	0	14	0
Big Creek (upper)	142	(70)	698	167	1	9	2,844	3	0	0	0
Big Creek (lower)	199	(126)	408	0	5	2	100	114	25	2	0
Rush Creek	90	(67)	3	0	0	1	22	0	0	21	0
W.F. Chamberlain Cr	135	(56)	281	0	0	5	206	0	0	0	0
Chamberlain Creek	116	(30)	167	0	18	0	94	0	0	1	0
S. Fork Salmon River	294	(0)	1,242	49	0	1	741	22	0	19	0
Secesh River	105	(0)	495	14	0	3	453	215	0	5	0
Lake Creek	33	(0)	73	39	0	18	786	0	0	8	0
Totals	1,888	(691)	5,511	647	34	53	7,471	877	272	1,634	385

Table 3. Mortality percentages for wild Chinook salmon parr collected and PIT-tagged in Idaho in July and August 2003. Loon Creek was the only creek that experienced any tag loss and it was a single tag. None of the other streams sampled had any tag loss in 2003.

	Mortality		
Tagging location	Collection	Tagging & 24-hour	Overall
Bear Valley Creek	0.0	0.0	0.4
Elk Creek	1.3	0.1	1.5
Marsh Creek	0.5	0.1	0.6
Sulphur Creek	0.1	0.5	0.5
Cape Horn Creek	1.2	0.0	0.9
Valley Creek	0.6	0.2	0.8
Loon Creek	0.4	0.1	0.5
Camas Creek	1.2	0.2	1.5
Herd Creek	2.7	0.0	2.7
Big Creek (upper)	1.3	0.0	1.3
Big Creek (lower)	4.7	0.0	4.7
Rush Creek	11.9	0.0	11.9
West Fork Chamberlain Creek	0.0	0.4	0.3
Chamberlain Creek	2.2	0.0	2.2
South Fork Salmon River	0.5	0.0	0.5
Secesh River	1.1	0.3	1.3
Lake Creek	0.1	0.0	0.1
Totals or averages	1.0	0.1	1.1

Detections at In-stream PIT-Tag Monitors

From 4 to 6 August 2003, 2,498 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). Between 4 August 2003 and 30 June 2004, the two in-stream detectors (VC1 and VC2) had 251 unique detections of these summer-tagged Chinook salmon juveniles (Figure 2). The upstream monitor (VC1) detected 67 Chinook salmon, and the downstream monitor (VC2) detected 204, of which 184 had not been detected upstream. Average travel time for the 20 fish detected at both monitoring sites was 3 h and 44 min (range 19 min to 17 h, 43 min). Of the 251 total detections, 148 (59%) occurred in late-summer/fall (August, September, October); 81 (32.3%) were detected in winter (November, December, January, February); and 22 (8.8%) were detected in spring (March, April, May, June) (Figure 2). An estimated 28 to 40% of all summer-tagged parr survived to migrate out of this stream.

Wild fish passed both monitors predominately during hours of darkness, with over 90% passing between 1800 and 0600 PST.

Recaptures at Traps and Dams

A total of 507 wild fish PIT-tagged in summer 2003 were recaptured at traps above Lower Granite Dam from summer-fall 2003 to summer 2004, and 975 were recaptured in the separation-by-code system at the Little Goose Dam juvenile fish facility (Table 4). Weight gain and length increases varied depending on the time between tagging and recapture.

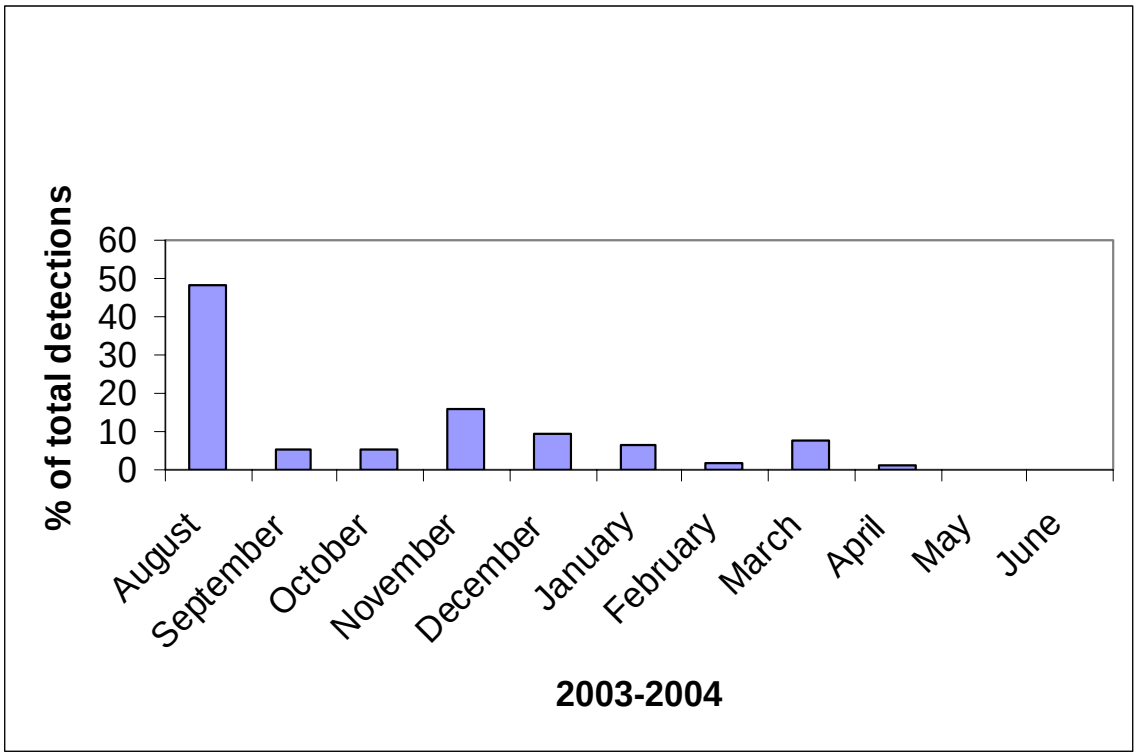

Figure 2. Percent of total detections, by month, of 251 spring/summer Chinook salmon parr, pre-smolts, and smolts detected at the upper and lower in-stream PIT-tag monitoring antennas in lower Valley Creek from August 2003 through June 2004. A total of 2,498 Chinook salmon parr were PIT tagged and released in areas from 3 to 16 km above these antennas from 4 to 6 August 2003.

Table 4. Recapture information on PIT-tagged wild spring/summer Chinook salmon from Idaho that were tagged in summer 2003 and recaptured by the separation-by-code system in the juvenile fish bypass system at Little Goose Dam in 2004 and at traps and dams in the summer and fall of 2003 and spring of 2004.

	Number	Length gain (mm)			Weight gain (g)			Condition factor		Recapture interval (days)	
	recaptured	n	range	mean	n	range	mean	release	recapture	range	mean
Streams											
Bear Valley Cr.	68	68	29-62	43.4	47	4.3-15.0	8.9	1.27	0.99	267-323	294
Elk Cr.	79	79	22-68	44.4	48	4.6-19.1	9.5	1.34	0.99	263-327	295
Sulphur Cr.	27	27	21-57	40.5	2	7.1-8.8	8.0	1.37	0.99	263-301	279
Marsh Cr.	86	86	16-61	38.0	29	1.2-20.3	7.8	1.27	0.97	265-323	284
Cape Horn Cr.	23	23	25-50	37.3	7	5.6-9.2	6.9	1.31	1.01	256-300	278
Valley Cr.	89	89	21-69	44.0	36	2-14.8	9.2	1.31	1.00	261-319	287
Loon Cr.	96	96	16-62	41.3	54	4.3-15.4	8.2	1.33	0.99	253-305	277
Camas Cr.	78	78	25-65	43.7	23	2.7-16.3	8.1	1.41	0.99	254-308	279
Herd Cr	80	80	21-63	41.0	8	5.8-13.2	8.2	1.29	0.97	252-317	270
Big Cr. (upper)	94	94	24-64	42.1	46	3.8-14.4	8.8	1.35	1.02	253-310	280
S. F. Salmon River	73	72	14-62	40.3	37	1.6-15.5	8.1	1.22	1.01	239-307	268
Big Cr. (lower)	89	89	20-54	36.8	85	3.6-15.2	8.1	1.17	0.96	242-276	254
W.F. Chamberlain Cr.	38	38	32-57	42.2	5	6.7-11.6	8.7	1.34	0.97	242-311	262
Secesh River	33	33	19-64	41.0	21	2.7-18.3	8.9	1.22	0.98	234-292	257
Lake Creek.	22	22	26-53	38.2	14	4.2-10.9	7.3	1.30	1.02	235-295	264
Stream totals/averages	975	974	14-69	41.3	462	1.2-20.3	8.5	1.28	0.99	234-327	277

Table 4. Continued.

	Number recaptured	Length gain (mm)			Weight gain (g)			Condition factor		Recapture interval (days)	
		n	range	mean	n	range	mean	release	recapture	range	mean
Traps											
South Fork Salmon River											
Knox-fall	124	102	0-7	2.0	29	-1.6-1	-0.2	1.24	1.10	1-58	22
Knox-spring	21	20	6-24	14.6	5	0.3-2.6	1.4	1.23	1.08	208-252	220
Lower-fall	--	--	--	--	--	--	--	--	--	--	--
Lake Creek											
Fall	110	90	0-11	2.3	48	-1.3-1.0	-0.2	1.29	1.07	1-61	20
Spring	4	4	9-37	18.0	1	1.7-1.7	1.7	1.20	1.27	210-346	258
Secesh R. (fall)	83	70	0-11	1.2	21	-0.8-0.6	-0.4	1.33	1.09	1-62	20
Secesh R. (spring)	3	3	11-14	12.7	2	1.5-1.6	1.6	1.16	1.00	217-243	227
Marsh Creek											
Fall	157	94	0-12	1.7	1	-0.8	-0.8	1.29	1.03	1-55	7
Spring	3	3	15-27	22.7	0	--	--	1.48	0.98	238-240	239
Salmon R. (spring only)	0	0	--	--	0	--	--	--	--	--	--
Snake R. (spring only)	2	2	46-48	47.0	0	--	--	1.64	--	274-288	281
Total Traps	507	388			107						
Collector Dams											
Lower Granite	1	0	--	--	0	--	--	--	--	292-292	292
McNary	4	1	35-35	35.0	1	7.2-7.2	7.2	1.45	1.11	222-296	260
Total Dams	5	1			1						

Detections at Dams

Based on expanded detections (1,472 fish)† at Lower Granite Dam from 1 April to 16 July 2004, estimated survival from parr to smolt for Idaho fish averaged 8.0% (range 4.1-18.0%; Table 5; Appendix Tables 4-19). An additional 336 first-time detections (unadjusted) were recorded at Little Goose, Lower Monumental, McNary, John Day, and Bonneville Dams (Appendix Tables 4-18 and 20-22). No first-time detections occurred at the PIT-tag trawl near the mouth of the Columbia River. By comparing all first-time detections at interrogation dams (1,342) to the expanded number of detections at Lower Granite Dam (1,472), we estimated that 9.1% of the wild fish from Idaho passed through the dams undetected.

For parr tagged in Idaho, average fork length at release was 63.2 mm (Table 1; Appendix Table 1). However, among fish from this group that were detected the following spring at the dams, average fork length at release was significantly higher (65.7 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 85-89 mm (but numbers for this length category were too low to evaluate) ($P<0.02$; Figure 3).

We again in 2004 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 3.7 mm larger when released than fish migrating after May. These data suggest that fish size influences migration timing or overwinter location.

In 2004, for the first time we were able to look at estimated survival rates to Lower Granite Dam of juveniles previously passively monitored leaving a stream. We estimated a 13.2% overall survival rate to the dam for Chinook salmon juveniles previously detected at the Valley Creek in-stream PIT-tag monitors. The overall parr-to-smolt estimated survival rate for fish from this stream was 5.5% (Table 5). The estimated survival rates for the various groups of fish leaving this stream in 2003-2004 were 6.6% for fish leaving the stream in late-summer/fall, 16.9% for fish leaving the stream in winter, and 43.9% for fish leaving the stream in spring.

† 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 2004. Expanded numbers used for parr-to-smolt survival estimates are shown with standard errors in parenthesis. See Table 1 for numbers released.

	Lower Granite Dam Detections				
	Observed		Expanded		
Stream	N	%	N	%	SE (%)
Bear Valley Creek	63	4.2	86	5.8	(1.0)
Elk Creek	83	5.5	117	7.7	(1.0)
Marsh Creek	83	5.4	129	8.4	(1.0)
Cape Horn Creek	26	3.9	39	5.8	(1.0)
Sulphur Creek	26	2.5	43	4.1	(1.0)
Valley Creek	108	4.3	138	5.5	(1.0)
Loon Creek	91	10.6	118	13.7	(2.0)
Camas Creek	73	7.3	101	10.0	(1.0)
Herd Creek	81	8.4	111	11.5	(2.0)
Big Creek (upper)	100	6.6	140	9.3	(1.0)
Big (lower)/Rush Creeks	95	10.0	171	18.0	(3.0)
W. F. Chamberlain Creek*	48	4.8	82	8.2	(2.0)
S. Fork Salmon River	73	4.9	103	6.9	(1.0)
Secesh River	30	2.6	49	4.3	(1.0)
Lake Creek	26	3.9	45	6.8	(2.0)
Totals or averages	1,006	5.5	1,472	8.0	(0.4)

* Includes fish from Chamberlain Creek.

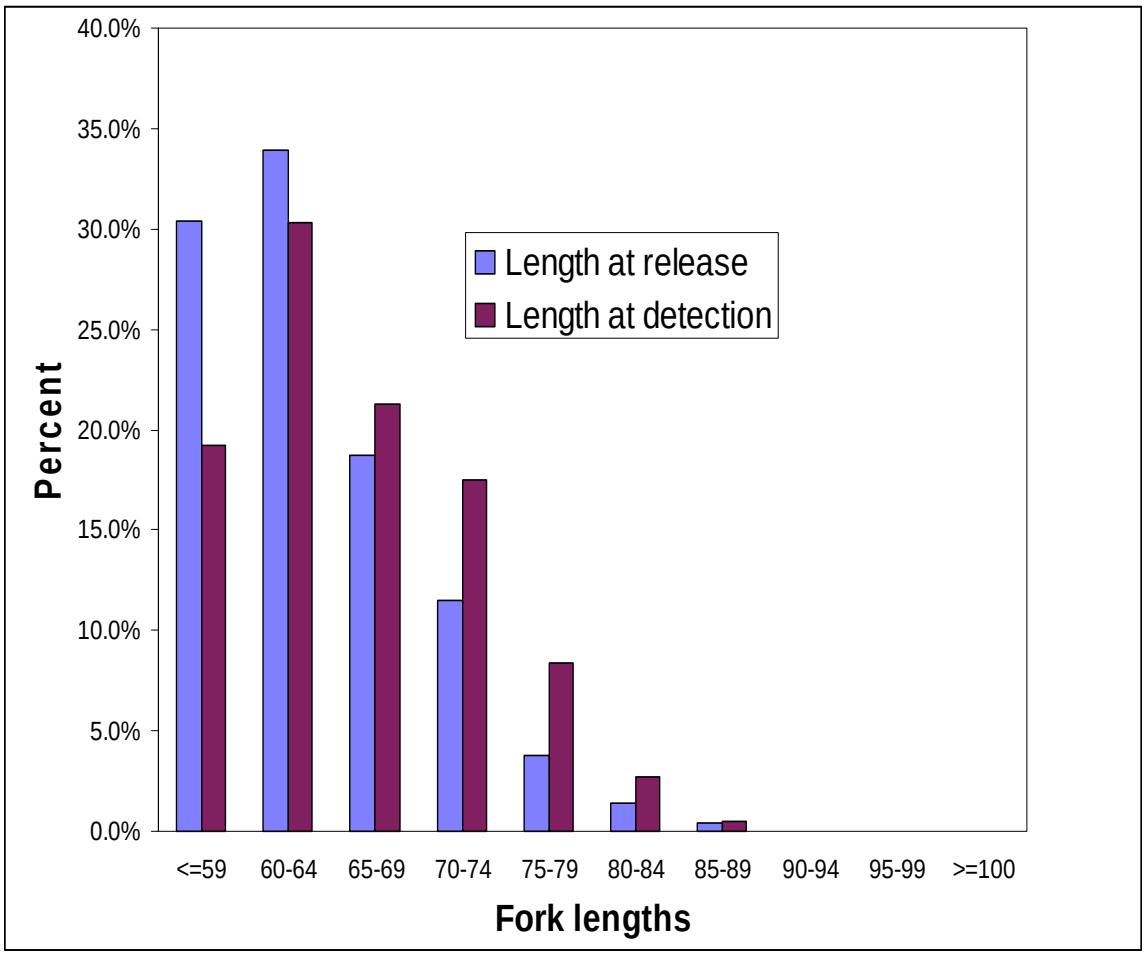

Figure 3. Percent by fork length increments, of PIT-tagged wild spring/summer Chinook salmon parr released in Idaho streams in 2003 (n = 18,307) and percent of fish detected for these length increments at dams in spring and summer 2004 (n = 1,341).

Migration Timing

Lower Granite Dam

Passage timing at Lower Granite Dam varied for fish from the 20 Idaho and Oregon streams (Figure 4). In comparisons among all 20 Idaho and Oregon streams (Tables 6a-6b, Figure 4), fish from the Secesh River had a significantly earlier timing for 10th percentile passage than fish from all the other streams (P <0.05). The 10th percentile passage date of fish from Valley Creek was significantly later than that of fish from all other streams except Loon, Camas, Elk, Big (upper), and Catherine Creeks and the Imnaha River (P <0.05). The SEs on these passage estimates ranged from 0.1 to 5.2 d (median 1.8 d). Overall, the 10th percentile passage dates for fish from all 20 streams ranged from 4 April to 25 April (Tables 6a-6b).

In comparisons of the 50th percentile passage date at the dam, fish from Big (lower)/Rush Creeks were significantly earlier than fish from all other streams except Chamberlain/W. F. Chamberlain Creeks, Lake, Sulphur, Marsh, and Herd Creeks, and the Minam and Secesh Rivers (P <0.05). Fish from Catherine Creek were significantly later than fish from all other streams except Big (upper), Valley, Elk, Camas, and Bear Valley Creeks and the South Fork Salmon River (P <0.05). The SEs on these passage estimates ranged from 0.5 to 5.8 d (median 2.2 d). The overall 50th percentile passage dates for fish from all 20 streams ranged from 23 April to 15 May (Tables 6a-6b).

In terms of the 90th percentile passage date at the dam, fish from Big(lower)/Rush Creeks were significantly earlier than fish from all other streams except Chamberlain/W. F. Chamberlain Creeks, Herd, Marsh, Sulphur, and Loon Creeks (P <0.05). Fish from Catherine Creek were significantly later than fish from all other streams except Big (upper) and Elk Creeks, and Lostine and South Fork Salmon Rivers. The SEs on these passage estimates ranged from 0.9 to 6.6 d (median 3.1 d). The overall 90th percentile passage dates for fish from all streams ranged from 4 May to 11 June (Tables 6a-6b).

For the number of days encompassing the middle 80th percentile passage (10th to 90th percentile), Big(lower)/Rush Creeks fish had a significantly more condensed distribution, (19 d) than fish from all other streams except Chamberlain/W. F. Chamberlain Creeks, Loon, Herd, Marsh, Sulphur, and Valley Creeks, and the Imnaha River (22-33 d; P <0.05; Tables 6a-6b). Timing of the middle 80th percentile passage for Secesh River fish was significantly more protracted (54 d) than for fish from all other streams except Cape Horn, Bear Valley, Lake, Elk, Big (upper), and Catherine Creeks, and Minam, South Fork Salmon, and Lostine Rivers (38-51 d; P <0.05; Tables 6a-6b). The SEs for these passage estimates range from 0.9 to 8.0 d (median 3.8 d).

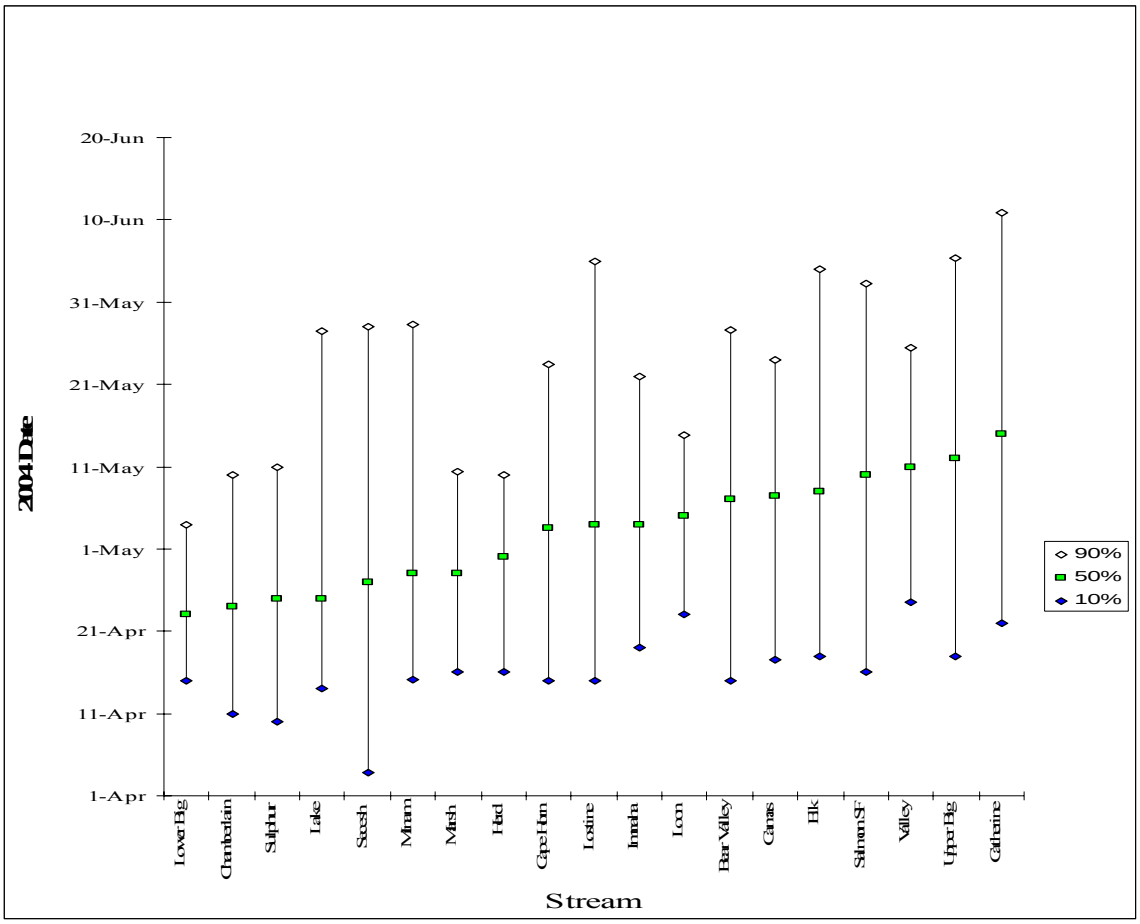

Figure 4. Estimated passage distributions at Lower Granite Dam for wild spring/summer Chinook salmon smolts from streams of Idaho and Oregon in 2004. Chamberlain and West Fork Chamberlain Creeks are combined and Big Creek is divided into lower and upper portions for these analyses. See Appendix Tables 4-18 for daily estimated passage numbers from Idaho streams at the dam.

Table 6a. Accumulated and 2004 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[a]	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
2004	15 April	07 May	28 May	13 April-05 July
Elk Creek				
1990[a]	---	---	---	---
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
2004	18 April	08 May	04 July	14 April-July 12
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	---	---	---	---
1999	24 April	19 May	27 May	22 April-29 may
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
2004	10 April	25 April	11 May	02 April-24 May

Table 6a. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
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
2004	15 April	04 May	24 May	14 April-28 May
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
2004	18 April	08 May	24 May	16 April-04 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]	---	---	---	---
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
2004	16 April	28 April	10 May	03 April-30 May

Table 6a. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
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
2004	25 April	11 May	26 May	04 April-16 June
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
2004	23 April	05 May	15 May	15 April-26 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
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]	---	---	---	---
2004[a]	---	---	---	---

Table 6a. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
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
2004	16 April	30 April	10 May	12 April-21 June
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
2004	16 Apr	10 May	02 June	08 April-19 June
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
2004	18 April	12 May	05 June	15 April-17 June

Table 6a. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
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
2004	15 April	23 April	04 May	06 April-15 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
2004[c]	11 April	24 April	10 May	07 April-23 June
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
2004	04 April	27 April	28 May	01 April-13 June

Table 6a. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
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
2004	14 April	25 April	28 May	09 April-16 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 2004 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
2004	22 April	15 May	11 June	15 April-25 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]	---	---	---	---
2004	---	---	---	---
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]	---	---	---	---
1999[b]	---	---	---	---
2000[b]	---	---	---	---
2001[b]	---	---	---	---
2002[b]	---	---	---	---
2003[b]	---	---	---	---
2004	---	---	---	---

Table 6b. Continued.

Year	Percentile passage dates at Lower Granite Dam 10th	50th	90th	Range
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
2004	19 April	04 May	22 May	18 April-8 June
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-03 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
2004	15 April	04 May	05 June	14 April-15 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
2004	15 April	28 April	28 May	08 April-31 May

[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.

Migration timing at Lower Granite Dam based on streams with 7 or more years of data indicated that dates of the 10th, 50th, and 90th passage percentile varied between streams (Table 7.) Secesh River fish had a significantly earlier timing at Lower Granite Dam for the 10th percentile passage than fish from all other streams except Lake and Big(lower)/Rush Creeks and Lostine and Imnaha (upper) Rivers (P <0.05). Also, Big Creek (upper) fish had significantly later migration timing at the dam than all the other streams except Loon Creek (P<0.05).

For the 50th percentile passage at Lower Granite Dam, Big(lower)/Rush Creeks had significantly earlier arrival timing than fish from all the other streams except Lake and Herd Creeks and the Secesh River (P <0.05). Fish from Big Creek (upper) had significantly later timing at the dam than fish from all other streams (P <0.05). For the 90th percentile passage at the dam, Big(lower)/Rush Creeks fish had significantly earlier timing than fish from all other streams except Herd, Loon, Marsh, Sulphur, and Elk Creeks, and Imnaha (upper), Lostine, and the Secesh Rivers (P <0.05). Fish from Big Creek (upper) had significantly later timing than fish from all other streams except the South Fork Salmon River, Lake, Catherine, Valley, and Chamberlain/W. F. Chamberlain Creeks (P <0.05).

Comparison with Flows

We grouped first-time detections (expanded) at Lower Granite Dam of all Idaho and Oregon streams combined and compared their collective timing with river flows during the same periods (Figure 5 and Appendix Table 19). Overall, passage at the dam during 2004 occurred between early-April and mid-July, with the middle 80th percentile passage occurring from 16 April to 26 May (Table 8). The peak passage date was 15 April, which coincided with low flow of 64.2 kcfs (Appendix Table 19).

Environmental Information

Environmental factors varied by month and between locations (Appendix Tables 23-27), as did the percentage of fish collected and/or detected at adjacent traps (Appendix Figures 1-7).

Table 7. The 95% confidence intervals for the percentile passage date ranges and mean passage dates, with standard errors (SE), at Lower Granite Dam for wild spring/summer Chinook salmon smolts from streams in Idaho and Oregon.

	Percentile passage dates at Lower Granite Dam									
	10th			50th			90th			
Stream	Mean	95% CI	SE (d)	Mean	95% CI	SE (d)	Mean	95% CI	SE (d)	Data years
Secesh River	14 April	11-17 April	(1)	26 April	23-29 April	(4)	1 June	23 May-09 June	(4)	16
S. Fork Salmon R.	19 April	15-23 April	(2)	10 May	06-14 May	(2)	6 June	2-11 June	(2)	15
Catherine Creek	26 April	23-30 April	(2)	14 May	10-17 May	(2)	4 June	29 May-9 June	(3)	14
Imnaha R. (upper)	17 April	14-20 April	(1)	2 May	28 April-6 May	(2)	22 May	17-28 May	(2)	12
Bear Valley Creek	22 April	18-27 April	(2)	8 May	5-12 May	(2)	2 June	27 May-7 June	(2)	13
Big Creek (upper)	1 May	25 April-7 May	(3)	21 May	14-28 May	(3)	12 June	1-24 June	(5)	10
Elk Creek	20 April	15-25 April	(2)	6 May	2-11 May	(2)	30 May	24 May-05 June	(3)	12
Valley Creek	25 April	20-30 April	(2)	14 May	9-19 May	(2)	6 June	30 May-13 June	(3)	13
Marsh Creek	19 April	16-22 April	(1)	5 May	30 April-10 May	(2)	26 May	20-31 May	(2)	11
Lake Creek	15 April	11-19 April	(2)	30 April	26 April-3 May	(2)	4 June	26 May-13 June	(4)	12
Lostine River	16 April	12-21 April	(2)	4 May	30 April-8 May	(2)	22 May	17-27 May	(2)	13
Sulphur Creek	21 April	14-28 April	(3)	11 May	1-20 May	(4)	29 May	20 May-7 June	(4)	8

Table 7. Continued.

Stream	Percentile passage dates at Lower Granite Dam									Data years
	10th			50th			90th			
	Mean	95% CI	SE (d)	Mean	95% CI	SE (d)	Mean	95% CI	SE (d)	
Cape Horn Creek	24 April	17 April-2 May	(3)	14 May	6-21 May	(3)	4 June	25 May-14 June	(4)	8
Big (lower)/Rush Cr.	18 April	15-21 April	(1)	27 April	25-29 April	(1)	12 May	7-17 May	(2)	8
East Fork Salmon R.	19 April	15-24 April	(2)	1 May	25 April-07 May	(2)	18 May	13-23 May	(2)	7
Loon Creek	27 April	22 April-01 May	(2)	11 May	7-15 May	(2)	23 May	18-28 May	(2)	7
Herd Creek	19 April	14-24 April	(2)	29 April	25 April-3 May	(2)	15 May	10-19 May	(2)	8
Grand Ronde R. (upper)	1 May	23 April-10 May	(3)	24 May	13 May-04 June	(4)	12 June	21 May-3 July	(8)	5
Imnaha R. (lower)	12 April	5-20 April	(2)	25 April	14 April-5 May	(3)	9 May	2-15 May	(2)	4
Chamberlain./WF Chamberlain Cr.	20 April	14-26 April	(2)	5 May	26 April-14 May	(4)	6 June	18 May-25 June	(8)	7
Camas Creek	27 April	21 April-3 May	(2)	16 May	9-23 May	(3)	29 May	24 May-3 June	(2)	6
Minam River	18 April	11-25 April	(2)	5 May	25 April-15 May	(3)	25 May	18-31 May	(2)	4

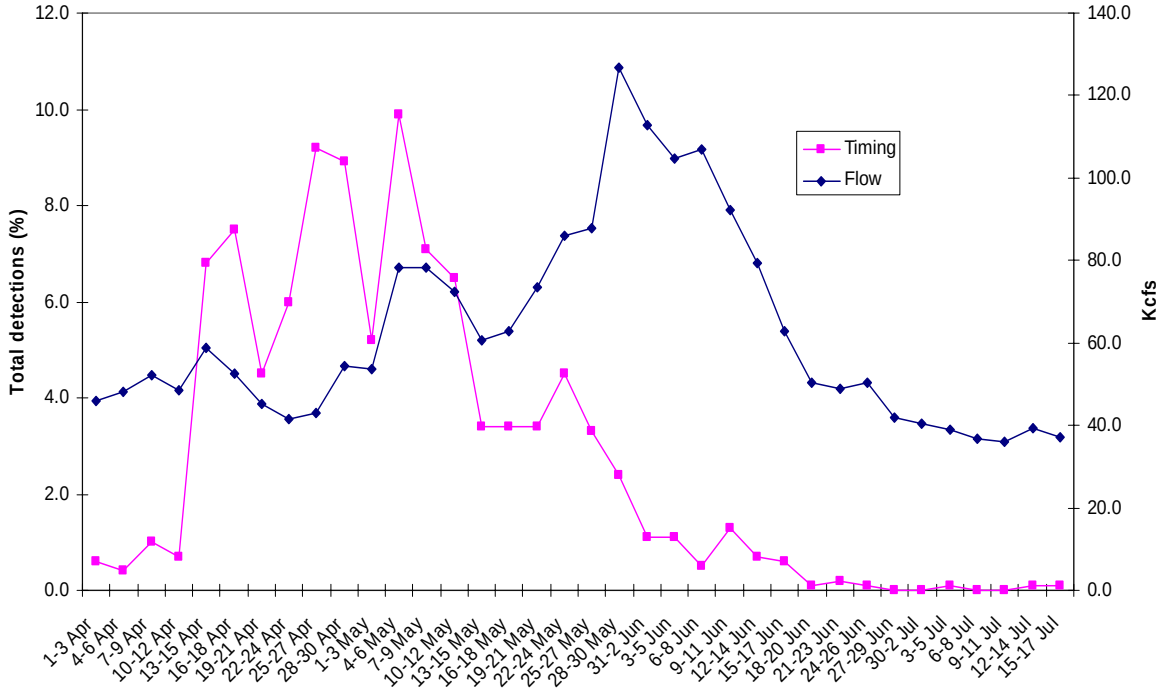

Figure 5. Overall migration timing of PIT-tagged wild spring/summer Chinook salmon smolts with associated river flows at Lower Granite Dam, 2004. Daily detections from 16 Idaho and 4 Oregon streams were pooled in 3-day intervals and expanded based on daily detection probability. River flows at the dam were averaged daily over the same periods.

Table 8. Accumulated and 2004 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.

	Passage periods at Lower Granite Dam			
Year	10%	50%	90%	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
2004	16 April	03 May	26 May	01 April-16 July

[a] No fish were tagged from the Middle Fork of the 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 2003 were comparable to those in earlier years (Achord et al. 1992, 1994, 1995a,b, 1996a,b, 1997, 1998, 2000, 2001a,b, 2002, 2003, 2004).

The in-stream PIT-tag monitoring system used in Valley Creek in 2003-2004, enabled us to calculate survival estimates and migration timing for wild Chinook salmon juveniles leaving this stream. However, only 251 (10%) total juvenile Chinook salmon were detected at these monitors. In order to increase the precision of these estimates, we will either need to increase the antenna size or number, or the tagging sample size.

Results from in-stream monitoring indicated that a high proportion of wild juvenile Chinook salmon moved out of Valley Creek during the winter (32.3%). This finding has important implications for intensive fish-monitoring studies throughout Idaho because these studies use rotary screw traps, which are inoperable during winter in most areas. Perhaps a combination of rotary screw traps and in-stream PIT-tag monitoring may be appropriate for some locations or studies.

Overall mean growth from the parr to smolt stage was almost identical to that measured in 2003 (Achord et al. 2004). Mean growth in 2004 was less than in 2001, when we observed mean daily growth rates of 0.16 mm and 0.042 g for wild fish from many of the same streams (Achord et al. 2002). High densities of parr in these streams during summer 2002 and 2003 may have contributed to these reduced growth rates (especially weight) of wild fish observed in 2004.

For combined Idaho and Oregon steams, annual parr-to-smolt survival estimates over the last 12 years have ranged from 8.1 to 24.4%, with an average annual survival rate of 16.9%. We measured the lowest parr-to-smolt survival estimates in 2003 and 2004, at 8.8 and 8.1%, respectively. These low estimates may have resulted from the much higher parr density in these years: wild adult returns to the Snake River basin in 2001 and 2002 were more than an order of magnitude greater than returns from 1994 to 1996 when we measured the highest subsequent parr to smolt survival (20.6 to 24.4%).

In 2004, 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 migration timing of wild fish. We also observed that the 50th and 90th passage percentiles at Lower Granite Dam occurred in early and late May, respectively, similar to timing observed in warm years.

In 2004, climate conditions were close to normal, but flows were low during most of the spring. As noted in our previous reports, wild Chinook salmon smolt passage timing at Lower Granite Dam for individual wild populations has been highly variable and usually protracted, with timing patterns for some populations ranging from early to late spring. However, shifts in the passage timing distribution for these populations 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 at the dam.

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, 2003.

	Number of fish			Collected				Released			
				Length (mm)		Weight (g)		Length (mm)		Weight (g)	
	Collected	Tagged	Tagged and released	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Bear Valley Creek											
22-24 July	1,995	1,496	1,494	44-123	59.1	0.8-7.8	2.8	50-85	61.4	1.0-7.8	3.0
Elk Creek											
25-29 July	1,819	1,522	1,520	44-81	61.4	0.7-8.3	3.1	52-81	62.9	1.7-8.3	3.3
Marsh Creek											
30 July; 1 Aug	1,812	1,535	1,535	41-86	63.3	0.9-8.1	3.5	51-86	64.6	1.8-8.1	3.7
Sulphur Creek											
31-Jul	1,319	1,053	1,048	42-122	62.1	1.7-5.2	3.0	43-93	62.9	2.0-5.2	3.1
Cape Horn Creek											
01-02 Aug	2,319	671	671	37-118	53.8	0.6-17.8	2.8	49-94	61.4	1.4-11.4	3.4
Valley Creek											
04-06 Aug	3,152	2,504	2,498	43-167	61.1	0.9-23.5	3.4	50-167	62.8	1.5-8.9	3.5
Loon Creek											
08-Aug	952	861	860	46-85	63.4	1.2-7.7	3.6	52-85	64.5	2.0-7.7	3.7
Camas Creek											
08-Aug	1,201	1,007	1,005	44-116	60.5	1.1-7.5	3.2	50-84	62.0	1.7-7.5	3.3
Herd Creek											
11-Aug	1,047	968	968	44-184	66.7	1.3-7.9	3.9	52-184	67.3	1.6-7.9	4.1
Big Creek (upper)											
15-16 Aug	1,933	1,504	1,504	43-110	59.9	1.0-15.4	3.3	50-90	61.7	1.7-7.4	3.4
Big Creek (lower)											
21-Aug	943	899	899	53-105	71.9	1.6-14	4.4	55-105	72.1	1.5-14	4.4
Rush Creek											
22-Aug	59	52	52	52-96	71.7	---	---	61-84	71.8	---	---
West Fork Chamberlain Creek											
21-Aug	997	756	753	42-110	61.0	1.7-13.9	3.4	52-92	63.3	1.7-6.6	3.2
Chamberlain Creek											
22-Aug	316	243	243	41-93	57.9	1.1-10.6	2.7	51-82	59.4	1.5-4.4	2.8
South Fork Salmon River											
25-26 Aug	2,608	1,490	1,490	38-138	56.9	0.7-10.7	3.1	50-138	62.3	1.5-9.2	3.2
Secesh River											
28-29 Aug	1,708	1,146	1,142	39-97	58.1	0.7-10.5	2.7	48-97	61.9	1.3-9.4	3.0
Lake Creek											
30-Aug	1,029	664	664	36-296	58.0	0.4-11.2	3.1	50-103	61.5	1.2-11.2	3.2
Total/mean	25,209	18,371	18,346	36-296	60.4	0.4-23.5	3.2	43-184	63.2	1.0-11.4	3.4

Appendix Table 2a. Summary of tagging dates, start tagging times and temperatures (°C), release dates, times, and temperatures, methods of capture, distance (in kilometers) from the mouth of the stream to the release point, number released (in 2003), 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 2004.

	Tagging				Release					Detection	
	Date	Time (PST)	Temp (°C)	Capture method	Date	Time (PST)	Temp. (°C)	River km	n	n	(%)
Bear Valley Creek											
SA03203.BV1	22 Jul	0543	14.0	Beach seine	23 Jul	0400	14.0	9	127	7	5.5
SA03203.BV2	22 Jul	0711	15.0	Beach seine	22 Jul	0940	15.0	13	540	36	6.7
SA03204.BV1	23 Jul	0704	15.0	Beach seine	23 Jul	0945	16.0	13	509	24	4.7
SA03205.BV1	24 Jul	0600	14.0	Beach seine	25 Jul	0415	14.0	15	318	23	7.3
Elk Creek											
SA03206.EC1	25 Jul	0615	14.0	Beach seine	26 Jul	0450	14.0	0	153	12	7.8
SA03206.EC2	25 Jul	0915	14.0	Beach seine	25 Jul	0915	15.5	2	571	46	8.0
SA03209.EC1	28 Jul	0532	13.0	Beach seine	28 Jul	0930	14.5	3	102	05	4.9
SA03209.EC2	28 Jul	0919	14.5	Shock	28 Jul	1200	15.5	2	303	14	4.6
SA03210.EC1	29 Jul	0628	13.5	Shock	29 Jul	0815	14.0	2	391	33	8.4
Marsh Creek											
SA03211.MC1	30 Jul	0744	10.0	Beach seine	31 Jul	0520	10.0	12	132	06	4.5
SA03211.MC2	30 Jul	0912	13.0	Shock	30 Jul	1130	16.0	12	386	37	9.6
SA03212.MC1	31 Jul	0513	10.0	Shock	31 Jul	0700	10.0	14	164	15	9.1
SA03212.MC2	31 Jul	0647	10.0	Shock	31 Jul	1130	16.0	14	665	47	7.1
SA03213.MC1	1 Aug	0536	09.0	Shock	1Aug	0700	09.0	2	100	07	7.0
SA03213.MC2	1 Aug	0630	09.0	Shock	1Aug	0700	09.0	2	88	03	3.4

Appendix Table 2a. Continued.

	Tagging				Release					Detection	
	Date	Time (PST)	Temp (°C)	Capture method	Date	Time (PST)	Temp. (°C)	River km	n	n	(%)
Cape Horn Creek											
SA03213.CH1	1 Aug	0700	09.5	Shock	2 Aug	0600	11.0	2	122	7	5.6
SA03213.CH2	1 Aug	0811	11.0	Shock	1 Aug	1045	12.0	2	328	16	4.9
SA03214.CH1	2 Aug	0431	08.5	Shock	2 Aug	0500	08.5	6	74	2	2.7
SA03214.CH2	2 Aug	0641	08.5	Shock	2 Aug	1000	11.0	6	147	12	8.2
Sulphur Creek											
SA03212.SU1	31 Jul	0823	11.0	Beach seine	1 Aug	0730	11.0	5	183	4	2.2
SA03212.SU2	31 Jul	0956	13.0	Beach seine	31 Jul	1230	16.5	5	865	34	3.9
Valley Creek											
SA03216.VC1	4 Aug	0600	12.5	Beach seine	5 Aug	0430	13.0	4	96	1	1.0
SA03216.VC2	4 Aug	0641	12.5	Beach seine	4 Aug	1100	17.0	7	1,035	34	3.3
SA03217.VC1	5 Aug	0735	14.0	Shock	5 Aug	1145	20.0	7	746	41	5.5
SA03218.VC1	6 Aug	0605	10.5	Shock	6 Aug	1000	13.5	18	621	49	7.9
Loon Creek											
SA03220.LN1	8 Aug	0616	09.5	Shock	9 Aug	0500	09.5	36	98	11	11.2
SA03220.LN2	8 Aug	0724	11.0	Shock	8 Aug	1215	13.0	35	715	99	13.8
SA03220.LN3	8 Aug	1238	14.0	Shock	8 Aug	1330	15.5	36	47	3	6.4

Appendix Table 2a. Continued.

	Tagging				Release					Detection	
	Date	Time (PST)	Temp (°C)	Capture method	Date	Time (PST)	Temp. (°C)	River km	n	n	(%)
Camas Creek											
SA03220.CA1	8 Aug	0830	10.5	Shock	9 Aug	0800	10.0	23	149	17	11.4
SA03220.CA2	8 Aug	0952	11.0	Shock	8 Aug	1400	16.0	23	856	84	9.8
Herd Creek											
SA03223.HC1	11 Aug	0648	09.5	Shock	12 Aug	0800	11.0	2	129	18	14.0
SA03223.HC2	11 Aug	0753	11.0	Shock	11 Aug	1200	17.0	2	839	97	11.6
Big Creek (upper)											
SA03227.BC1	15 Aug	0550	08.5	Shock	16 Aug	0500	09.0	56	136	13	9.6
SA03227.BC2	15 Aug	0709	09.0	Shock	15 Aug	1330	13.0	56	928	70	7.5
SA03228.BC1	16 Aug	0543	07.5	Shock	16 Aug	0900	11.0	57	440	35	8.0
Big Creek (lower)											
SA03233.LB1	21 Aug	1010	14.5	Shock	22 Aug	0645	14.5	9	109	12	11.1
SA03233.LB2	21Aug	1106	14.5	Shock	21 Aug	1530	15.5	10	790	128	16.2
Rush Creek											
SA03234.RC1	22 Aug	0733	14.5	Shock	22 Aug	0930	15.0	1	52	03	5.9
W.F. Chamberlain Creek											
SA03233.WC1	21 Aug	0844	09.0	Beach seine	22 Aug	1300	13.0	2	120	11	9.2
SA03233.WC2	21Aug	0937	10.0	Beach seine	21 Aug	1230	13.5	2	633	36	5.7

Appendix Table 2a. Continued.

	Tagging				Release					Detection	
	Date	Time (PST)	Temp (°C)	Capture method	Date	Time (PST)	Temp. (°C)	River km	n	n	(%)
Chamberlain Creek											
SA03234.CB1	22 Aug	0707	13.0	Shock	22 Aug	1130	13.0	26	243	14	5.8
South Fork Salmon River											
SA03237.SF1	25 Aug	0641	10.5	Shock	26 Aug	0500	11.0	118	91	06	6.6
SA03237.SF2	25 Aug	0755	11.0	Shock	25Aug	1230	15.5	118	591	42	7.1
SA03238.SF1	26 Aug	0626	09.0	Shock	26Aug	1300	14.5	123	808	50	6.2
Secesh River											
SA03240.SE1	28 Aug	0643	10.5	Shock	29 Aug	0525	09.5	27	88	04	4.5
SA03240.SE2	28 Aug	0724	11.0	Shock	28 Aug	1130	14.5	27	348	12	3.4
SA03241.SE1	29 Aug	0553	09.5	Shock	29 Aug	1215	15.0	29	706	30	4.2
Lake Creek											
SA03242.LC1	30 Aug	0600	07.5	Shock	31 Aug	0620	07.0	2	103	10	9.6
SA03242.LC2	30 Aug	0706	07.5	Shock	30 Aug	1200	12.5	2	561	23	4.1

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 2003. Hand-held Garmin GPS III-plus units were used.

Date	Section covered	UTM start		UTM end	
		Northing	Easting	Northing	Easting
Bear Valley Creek					
7/22/03	Entire stream	4920697	11TO633071	---	11TO632881
7/23/03	Entire stream	4919095	11TO630221	4918946	11TO629970
7/24/03	Entire stream	4918758	11TO629591	4918613	11TO629674
Elk Creek					
7/25/03	Entire stream	4918770	11TO629542	4918806	11TO629470
7/28/03	Entire stream	4918564	11TO629168	4918749	11TO628837
7/28/03	Left bank	4919079	11TO628628	4919303	11TO628336
7/28/03	Right bank	4919079	11TO628628	4919303	11TO628336
7/29/03	Right bank	4919348	11TO628101	4919425	11TO628076
7/29/03	Left bank	4919348	11TO628101	4919425	11TO628076
Marsh Creek					
7/30/03	Entire stream	4917020	11TO646040	4916230	11TO646870
7/30/03	Entire stream	4917020	11TO646040	4916230	11TO646870
7/31/03	Entire stream	4916230	11TO646870	4915590	11TO647370
7/31/03	Entire stream	4916230	11TO646870	4915590	11TO647370
8/1/03	Right bank	---	---	---	---
Sulphur Creek					
7/31/03	Entire stream	4933054	11TO630949	4932717	11TO630576
Cape Horn Cr					
8/1/03	Left bank	4917130	11TO645830	4916290	11TO645380
8/1/03	Right bank	4917130	11TO645830	4916290	11TO645380
8/2/03	Left bank	4913580	11TO643560	4912960	11TO643070
8/2/03	Right bank	4913580	11TO643560	4912960	11TO643070
Valley Creek					
8/4/03	Entire stream	4899599	11TO661066	4899799	11TO660665
8/5/03	Left bank	4900600	11TO659703	4900696	11TO659530
8/5/03	Right bank	4900618	11TO659709	4901582	11TO659426
8/6/03	Entire stream	4906193	11TO657788	4906397	11TO657599
8/6/03	Entire stream	4906316	11TO657667	4906096	11TO657273

Appendix Table 2b. Continued.

Date	Section covered	UTM start		UTM end	
		Northing	Easting	Northing	Easting
Camas Creek					
8/8/03	Right bank	4968467	11TO696386	4967684	11TO697017
8/8/03	Left bank	4968467	11TO696386	4967684	11TO697017
Loon Creek					
8/8/03	Right bank	4942058	11TO674895	4939176	11TO672270
8/8/03	Right bank	4942058	11TO674895	4941027	11TO674062
Herd Creek					
8/11/03	Entire stream	4891761	11TO716670	4891651	11TO716794
8/11/03	Right bank	4892105	11TO716233	4891875	11TO716488
Big Creek (upper)					
8/15/03	Left bank	4996670	11TO631579	4995266	11TO631347
8/15/03	Right bank	4996670	11TO631579	4995266	11TO631347
8/16/03	Left bank	4994426	11TO630823	4994016	11TO630700
8/16/03	Right bank	4994426	11TO630823	4994016	11TO630700
Big Creek (lower)					
8/21/03	Left bank	4996502	11TO670257	4996665	11TO668865
8/21/03	Right bank	4996502	11TO670257	4996665	11TO668865
W.F. Chamberlain Creek					
8/21/03	Entire stream	5027529	11TO641790	5027785	11TO641514
Chamberlain Creek					
8/22/03	Entire stream	5026359	11TO642252	5026109	11TO642036
Rush Creek					
8/22/03	Entire stream	4996786	11TO668323	4996466	11TO668198
S. Fork Salmon River					
8/25/03	Right bank	4943869	11TO603567	4943376	11TO603594
8/25/03	Left bank	4943869	11TO603567	4943376	11TO603594
8/26/03	Right bank	4940570	11TO604714	4940319	11TO604772
8/26/03	Left bank	4940570	11TO604714	4940319	11TO604772
Secesh River					
8/28/03	Left bank	5006282	11TO593137	5007224	11TO593492
8/28/03	Right bank	5006282	11TO593137	5007224	11TO593492
8/29/03	Right bank	5007224	11TO593492	5008085	11TO593646
8/29/03	Left bank	5007224	11TO593492	5008085	11TO593646
Lake Creek					
8/30/03	Left bank	5012376	11TO586105	5013008	11TO60585
8/30/03	Right bank	5012376	11TO586105	5013048	11TO58577

Appendix Table 3. Summary of observed total mortality for PIT-tagged wild Chinook salmon parr collected from Idaho streams during July and August 2003. 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 portion of rejects that are precocious males are in parentheses.

					Observed mortality			
	Number collected	Number tagged	Number rejected	Percent rejected (%)	Collection & handling	Post tagging delayed	Number	Percent (%)
Bear Valley Creek				24.4	5	2	7	0.4
Elk Creek	1,819	1,522	272 (0)	15.0	25	2	27	1.5
Marsh Creek	1,812	1,535	268 (0)	14.8	9	0	9	0.6
Sulphur Creek	1,319	1,053	264 (6)	20.0	2	5	7	0.5
Cape Horn Creek	2,319	671	1,628 (15)	70.2	20	0	20	0.9
Valley Creek	3,152	2,504	630 (15)	20.0	18	6	24	0.8
Loon Creek	952	861	87 (0)	9.1	4	1	5	0.5
Camas Creek	1,201	1,007	178 (1)	14.8	16	2	18	1.5
Herd Creek	1,047	968	51 (0)	4.9	28	0	28	2.7
Big Creek (upper)	1,933	1,504	403 (13)	20.8	26	0	26	1.3
Big Creek (lower)	943	899	0 (0)	0.0	44	0	44	4.7
Rush Creek	59	52	7 (0)	11.9	7	0	7	11.9
W.F. Chamberlain	997	756	241 (5)	24.2	0	3	3	0.3
Chamberlain Creek	316	243	66 (2)	20.9	7	0	7	2.2
S.F. Salmon River	2,608	1,490	1,106 (3)	42.4	12	0	12	0.5
Secesh River	1,708	1,146	544 (3)	31.9	18	4	22	1.3
Lake Creek	1,029	664	364 (2)	35.4	1	0	1	0.1
Totals or averages	25,209	18,371	6,596	26.2	242	25	267	1.1

Appendix Table 4. Detections during 2004 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 1,494 wild Chinook salmon from Bear Valley Creek released 22-24 July 2003. 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
13 Apr	1	3	1				
15 Apr	2	7					
16 Apr			1				
19 Apr			2				
20 Apr			1				
21 Apr				2			
22 Apr				1			
23 Apr	2	4	3	2			
24 Apr			1	1			
25 Apr	4	6	1				
26 Apr	4	5	1				
27 Apr	2	2	1		1		
28 Apr	4	5					
29 Apr	1	1	1				
30 Apr	3	4	1				
02 May	1	1	1				
03 May	2	2					
05 May	2	2					
06 May			1				
07 May	1	1					
09 May	1	1					
10 May	2	2					
11 May	5	6	1				
12 May	1	1					
13 May	1	1					
14 May	1	1					
15 May	2	2					
20 May	2	2					
21 May	3	3					
22 May	1	1					
24 May	2	2					
25 May	2	2					
26 May	2	3	1				
27 May	4	6					
28 May	1	2	1				
31 May	1	2					
01 Jun	1	2					
03 Jun			1				
08 Jun	1	2					
05 July	1	1					
Totals	63	85	20	6	1		

Appendix Table 5. Detections during 2004 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 1,520 wild Chinook salmon from Elk Creek released 25-29 July 2003. 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
13-Apr			1				
14-Apr	1	3					
15-Apr	1	4					
16-Apr	1	3	1				
18-Apr	1	3					
19-Apr	1	4	1				
20-Apr			1				
21-Apr	1	2					
22-Apr				2			
23-Apr	3	6	2	1			
24-Apr	2	4	2				
25-Apr			2				
26-Apr	3	4					
27-Apr	2	2		1			
28-Apr	1	1	1				
29-Apr	5	6			1		
30-Apr	4	5					
02-May	1	1	1				
03-May	2	2					
04-May	2	2					
05-May						1	
06-May	2	3					
07-May	1	1			1		
08-May	3	4					
09-May	4	5					
10-May	2	2					
11-May	2	2					
12-May	1	1	1				
13-May	2	2					
14-May	1	1					
15-May	1	1					
16-May	1	1					
17-May	1	1					

Appendix Table 5. Continued.

	Elk Creek (continued)						
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
18-May	4	5					
19-May	1	1					
20-May			1				
21-May	3	3		1			
22-May	1	1					
23-May	5	6					
26-May	4	5					
29-May	1	2					
31-May	1	2					
05-Jun	1	2	1				
06-Jun			3				
09-Jun	1	2					
12-Jun	2	2	1				
13-Jun	1	1					
14-Jun	1	1					
17-Jun	1	1					
26-Jun	1	1					
12-Jul	1	1					
Totals	83	116	19	5	2	1	

Appendix Table 6. Detections during 2004 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 1,535 wild Chinook salmon from Marsh Creek released 30 July-01 August 2003. Release sites were 630-632 km above Lower Granite Dam.

	Lower Granite		Marsh Creek First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
03-Apr	1	3					
14-Apr	1	3					
15-Apr	1	4					
16-Apr	4	14					
19-Apr			2				
20-Apr	2	8					
22-Apr	1	2	2				
23-Apr	4	7	1				
24-Apr	6	11	1				
25-Apr	3	4	3	1			
26-Apr	3	4	1		1		
27-Apr	1	1	3				
28-Apr	3	4	3				
29-Apr	4	5					
30-Apr	4	5					
01-May	2	2					
02-May	4	5					
03-May	2	2					
04-May	5	6	1				
05-May	6	7			1		
06-May	4	5	2				
07-May	2	2	2				
08-May	4	5					
09-May	2	2					
10-May	3	3					
11-May	2	2					
12-May	1	1					
14-May	1	1					
17-May			1				
19-May	1	1					
20-May	1	1	1				
21-May	1	1					
23-May	1	1					
24-May	1	1					
28-May	1	2					
30-May	1	2	2				
05-Jun			1				
07-Jun			2				
16-Jun			1				
Totals	83	127	29	1	2		

Appendix Table 7. Detections during 2004 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 671 wild Chinook salmon from Cape Horn Creek released 01-02 August 2003. Release sites were 629-636 km above Lower Granite Dam.

	Lower Granite		Cape Horn Creek First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
13-Apr			1				
14-Apr	1	3					
15-Apr	1	4					
17-Apr	1	3					
18-Apr			1				
20-Apr			1				
24-Apr				1			
25-Apr	1	1	1				
26-Apr	2	2					
27-Apr			2				
29-Apr	2	2	1				
30-Apr	2	2					
03-May	1	1					
04-May	3	4					
06-May	2	3					
07-May	1	1					
08-May	2	2					
09-May	1	1					
11-May	1	1					
12-May	1	1	1				
20-May			1				
23-May	1	1					
24-May	1	1					
25-May				1			
26-May	1	1					
28-May	1	2					
Totals	26	36	9	2			

Appendix Table 8. Detections during 2004 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 1,048 wild Chinook salmon from Sulphur Creek released 31 July 2003. Fish were released 604 km above Lower Granite Dam.

	Lower Granite		Sulphur Creek First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
02-Apr	1	3					
10-Apr	1	3					
15-Apr	1	4					
17-Apr			1				
16-Apr	1	3					
19-Apr	1	4					
24-Apr			1				
25-Apr	3	4	1				
26-Apr	2	2					
27-Apr			2				
28-Apr	1	1	2				
29-Apr	1	1		1	1		
01-May	1	1					
03-May	1	1			1		
04-May	1	1					
06-May	1	1					
07-May	1	1					
08-May	3	4	2				
10-May	1	1					
11-May	2	2					
21-May	1	1					
22-May	1	1					
24-May	1	1					
Totals	26	40	9	1	2		

Appendix Table 9. Detections during 2004 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 2,498 wild Chinook salmon from Valley Creek released 04-06 August 2003. Release sites were 743-756 km above Lower Granite Dam.

	Lower Granite		Valley Creek First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
04-Apr	1	3					
14-Apr	1	3					
15-Apr	1	4					
19-Apr			1				
21-Apr	1	2		2			
24-Apr	1	2	1				
25-Apr	2	3					
26-Apr	4	5	1				
28-Apr	5	6	3				
29-Apr	2	2	1				
30-Apr	2	2					
01-May	2	2					
02-May	2	2					
03-May	2	2					
04-May	4	5					
05-May	4	5					
06-May	2	3	1				
07-May	4	5	2				
08-May	4	5					
09-May	2	2					
10-May	2	2					
11-May	6	7					
12-May	1	1					
13-May	2	2					
14-May	3	3					
15-May	5	6					
16-May	5	6					
17-May	5	6					
18-May	6	7					
19-May	2	2					
20-May	1	1					
21-May	6	7					
22-May	4	5					
23-May			2				
24-May	2	2					
25-May	2	2	1				
26-May	2	3					
27-May	3	4					
28-May	1	2					
29-May	1	2					
31-May			1				
03-Jun			1				
12-Jun	1	1					
14-Jun	1	1					
15-Jun	1	1					
Totals	108	137	15	2			

Appendix Table 10. Detections during 2004 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 860 wild Chinook salmon from Loon Creek released 08-09 August 2003. 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
15-Apr	1	4					
16-Apr			1				
17-Apr	1	3					
19-Apr	1	4					
23-Apr	1	2					
24-Apr	2	4					
25-Apr	3	4					
26-Apr	2	2					
27-Apr	2	2					
28-Apr	5	6	4				
29-Apr	2	2	1				
30-Apr	2	2					
01-May	3	4					
03-May	5	6					
04-May	6	7	1		1		
05-May	12	14	2				
06-May	1	1	1				
07-May	4	5					
08-May	7	8					
09-May	4	5					
10-May	11	12	1				
11-May	2	2					
12-May			2				
13-May	1	1					
14-May	1	1	2				
15-May	2	2					
16-May			2				
17-May	1	1					
18-May	3	3					
19-May	1	1					
20-May	2	2				1	
22-May	1	1					
24-May	1	1					
26-May	1	1					
01-Jun			1				
07-Jun			1				
Totals	91	113	19		1	1	

Appendix Table 11. Detections during 2004 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 1,005 wild Chinook salmon from Camas Creek released 08-09 August 2003. Release sites were 526-528 km above Lower Granite Dam.

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

Appendix Table 11. Continued.

	Camas Creek (continued)						
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
17-May	2	2					
18-May	1	1					
19-May	3	3					
20-May	1	1	2				
21-May	2	2	1				
22-May	2	2					
23-May	2	2					
24-May	5	6					
25-May	2	2					
26-May	1	1					
27-May	1	1					
28-May	1	2					
04-Jun	1	2					
05-Jun			1				
07-Jun				1			
09-Jun			1				
13-Jun				1			
Totals	73	94	23	3	2		

Appendix Table 12. Detections during 2004 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 968 wild Chinook salmon from Herd Creek released 11-12 August 2003. Fish were released 699 km above Lower Granite Dam.

	Herd Creek						
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
12-Apr	2	6					
14-Apr	1	3					
16-Apr	1	3					
18-Apr	1	3	2				
19-Apr			1				
20-Apr			3	1			
21-Apr			1				
22-Apr	2	4					
23-Apr	4	7	1				
24-Apr			2				
25-Apr	1	1	4				
26-Apr	7	8	2				
27-Apr	3	4	2				
28-Apr	6	7	1				
29-Apr	5	6	1				
30-Apr	5	6					
01-May	3	4					
02-May	2	2					
03-May	2	2			2		
04-May	5	6					
05-May	3	4	1				
06-May	3	4					
07-May	5	6	2				
08-May	2	2	2		1		
09-May	3	3	1				
10-May	6	7					
11-May	2	2					
13-May	1	1					
14-May	1	1					
15-May							1
17-May				1			
18-May	1	1					
20-May	1	1	1				
21-May	1	1					
22-May	1	1	1				
21-Jun	1	1					
Totals	81	107	28	2	3		1

Appendix Table 13. Detections during 2004 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 1,504 wild Chinook salmon from Big Creek (upper) released 15-16 August 2003. 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
15-Apr	1	4					
18-Apr	4	14					
23-Apr	1	2	1	1			
24-Apr	2	4					
25-Apr	2	3					
26-Apr	4	5					
27-Apr	3	4					
28-Apr	2	2					
29-Apr	2	2					
03-May	3	3					
04-May	4	5					
05-May	4	5					
07-May	4	5					
08-May	1	1					
10-May	4	5	1				
11-May	2	2	1				
12-May	5	6					
13-May	2	2	1				
14-May	3	3					
15-May	6	7					
16-May	2	2					
18-May	2	2					
19-May	1	1	1				
20-May	3	3					
22-May	4	5					
23-May	4	5					
24-May	2	2					
26-May	1	1					
27-May	2	3	1				
28-May	1	2					
29-May	1	2					
30-May	3	5		1			
31-May	1	2	1				
01-Jun	1	2					
02-Jun			2				
03-Jun	1	2					
05-Jun	1	2					
06-Jun			3				
07-Jun	1	2					
09-Jun	2	3	1				
10-Jun	4	5					
11-Jun	1	1					
14-Jun	1	1	2				
15-Jun	1	1					
17-Jun	1	1					
29-Jun				1			
Totals	100	139	15	3			

Appendix Table 14. Detections during 2004 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 951 wild Chinook salmon from Big (lower)/Rush Creeks released 21-22 August 2003. Release sites were 486-489 km above Lower Granite Dam.

	Big Creek (lower)/Rush Creek						
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
06-Apr	1	4					
07-Apr	1	2					
14-Apr	1	3					
15-Apr	5	18					
16-Apr	5	17					
17-Apr	1	3					
18-Apr	2	7	1				
19-Apr	2	8	5				
20-Apr	1	4	2				
21-Apr	4	10	1	1			
22-Apr	2	4					
23-Apr	4	7	3	2			
24-Apr	2	4	5	1	1		
25-Apr	9	13	5	1			
26-Apr	7	8	1				
27-Apr	2	2	1				
28-Apr	9	11	1	1	2		
29-Apr	3	4	1				
30-Apr	8	10			2		
01-May	3	4			3		
02-May	1	1	2		1		
03-May	2	2			1		
04-May	7	8			1		
05-May	3	4					
06-May	1	1	1				
07-May	4	5					
08-May	1	1					
09-May	2	2					
10-May	1	1					
11-May			1				
15-May	1	1					
28-May				1			
Totals	95	169	30	7	11		

Appendix Table 15. Detections during 2004 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 996 wild Chinook salmon from West Fork Chamberlain Creek released 21-22 Aug. 2003. 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
07-Apr	1	2					
09-Apr	1	3					
11-Apr	1	4					
13-Apr	1	3					
14-Apr	1	3					
15-Apr	2	7					
17-Apr	2	7					
18-Apr	1	3					
19-Apr			1				
20-Apr			1	1			
21-Apr			1				
22-Apr	1	2					
23-Apr	3	6					
24-Apr	3	5	4				
25-Apr	2	3					
27-Apr	2	2	1				
29-Apr	4	5					
30-Apr	1	1					
01-May	1	1					
02-May	1	1					
03-May	2	2					
04-May	3	4					
05-May	3	4					
06-May	2	3					
09-May	1	1					
10-May	2	2					
15-May	1	1					
16-May	1	1					
17-May	1	1	1				
22-May	1	1					
23-May	1	1					1
25-May	1	1					
26-May			1				
18-Jun			1				
23-Jun	1	1					
Totals	48	81	11	1			1

a Includes fish from Chamberlain Creek

Appendix Table 16. Detections during 2004 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 1,490 wild Chinook salmon from South Fork Salmon River released 25-26 Aug. 2003. 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
08-Apr	1	2					
15-Apr	1	4					
16-Apr	2	7					
17-Apr				1			
18-Apr	1	3					
20-Apr			1				
21-Apr				1			
22-Apr				1			
24-Apr	1	2	1	1			
25-Apr	1	1					
26-Apr	1	1	1				
27-Apr	1	1					
28-Apr	1	1	1		1		
01-May	2	2					
03-May	1	1					
04-May	5	6					
05-May	2	2					
06-May	2	3					
07-May	4	5					
08-May	2	2					
09-May	1	1					
10-May	5	6	1				
11-May	3	3					
12-May	1	1					
14-May	1	1		1			
15-May			2				
16-May	5	6					
18-May			4				

Appendix Table 16. Continued.

	South Fork Salmon River (continued)						
	Lower Granite		First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
19-May	2	2					
20-May	1	1					
21-May	3	3					
22-May	2	2					
23-May	2	2					
24-May	2	2	1				
25-May	1	1					
26-May	2	3					
27-May	1	1					
28-May	2	3		1			
30-May	2	3					
31-May	1	2					
01-Jun			1				
02-Jun	1	2					
03-Jun	1	2			1		
05-Jun	1	2	2				
09-Jun	1	2					
11-Jun	1	1					
12-Jun			1				
13-Jun			1				
17-Jun	1	1					
19-Jun	1	1					
16-Jul	1	1					
Totals	73	98	17	6	2		

Appendix Table 17. Detections during 2004 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 1,142 wild Chinook salmon from Secesh River released 28-29 Aug. 2003. 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
01-Apr	1	5					
08-Apr	1	2					
15-Apr	1	4					
17-Apr				1			
18-Apr			3				
20-Apr	1	4					
21-Apr			1				
22-Apr	1	2		1			
23-Apr				1			
24-Apr	1	2	2	1			
25-Apr	1	1					
26-Apr	2	2					
27-Apr	2	2	1				
28-Apr	1	1					
29-Apr	1	1					
01-May					1		
02-May	2	2	1				
04-May	1	1					
05-May	1	1					
07-May			1				
10-May	1	1					
14-May	1	1					
15-May	1	1					
16-May	1	1					
21-May	2	2					
22-May	1	1					
24-May	1	1					
28-May	2	3					
06-Jun			1				
08-Jun	1	2					
10-Jun	1	1					
13-Jun	1	1	1				
Totals	30	45	11	4	1		

Appendix Table 18. Detections during 2004 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 664 wild Chinook salmon from Lake Creek released 30 Aug. 2003. Release sites were 451-452 km above Lower Granite Dam.

	Lower Granite		Lake Creek First Detections				
Detection date	First detection	Expanded	Little Goose	Lower Monumental	McNary	John Day	Bonneville
09-Apr	1	3					
14-Apr	1	3					
15-Apr	2	7		1			
16-Apr	2	7					
21-Apr			1				
22-Apr				1			
25-Apr	2	3					
26-Apr	2	2					
27-Apr			1				
30-Apr	1	1					
04-May	2	2					
09-May	1	1					
10-May	1	1					
12-May	1	1					
14-May	2	2					
16-May	1	1					
19-May	1	1					
22-May	1	1					
23-May	1	1					
28-May	2	3					
04-Jun			1				
05-Jun			1				
06-Jun			1				
11-Jun	1	1					
16-Jun	1	1					
Totals	26	42	5	2			

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 2004, 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
01 Apr	50.4	0.0	8.9	1	5	1	5
02 Apr	48.2	0.0	8.9	1	3	1	3
03 Apr	39.3	4.6	8.9	1	3	1	3
04 Apr	44.9	18.2	10.0	1	3	1	3
06 Apr	44.8	19.3	10.0	1	4	1	4
07 Apr	48.8	18.8	10.0	2	4	3	7
08 Apr	52.8	15.3	10.0	2	4	2	5
09 Apr	54.7	24.3	11.1	2	6	2	6
10 Apr	49.5	18.7	11.7	1	3	1	3
11 Apr	49.2	18.7	12.2	1	4	1	4
12 Apr	46.8	18.5	12.2	2	6	2	6
13 Apr	54.6	18.3	11.7	2	6	2	5
14 Apr	64.2	18.4	11.7	8	24	9	31
15 Apr	64.2	18.4	11.7	20	75	23	83
16 Apr	56.6	18.3	11.7	18	61	21	72
17 Apr	50.9	18.3	11.7	6	19	6	20
18 Apr	49.6	18.3	11.1	9	30	11	38
19 Apr	46.8	18.3	10.6	6	24	9	37
20 Apr	45.2	18.4	10.6	5	20	6	24
21 Apr	43.8	18.5	10.6	6	14	7	17
22 Apr	42.4	18.6	10.6	7	14	8	18
23 Apr	42.1	4.6	11.1	23	43	24	45
24 Apr	40.1	0.0	10.6	20	38	23	41
25 Apr	41.5	0.0	12.2	34	47	41	60
26 Apr	41.8	0.0	12.2	48	56	55	67
27 Apr	45.6	0.0	12.2	22	24	27	33
28 Apr	54.6	0.0	11.7	40	47	48	58
29 Apr	54.1	0.0	11.7	34	39	40	49
30 Apr	54.7	0.0	12.8	34	40	41	49
01 May	50.1	0.0	13.3	18	21	21	25
02 May	50.3	0.0	12.2	15	16	21	25
03 May	60.9	0.0	12.2	26	27	34	40
04 May	70.4	0.0	12.2	54	64	64	76
05 May	79.1	3.7	12.8	41	49	52	63
06 May	85.3	2.6	12.8	20	27	27	34
07 May	80.5	0.0	12.8	33	39	39	48
08 May	78.7	0.0	12.8	30	35	36	43
09 May	75.2	0.0	12.8	24	26	28	32
10 May	73.1	0.0	12.8	46	51	50	57
11 May	72.2	0.0	12.8	32	35	36	41

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
12 May	72.1	0.0	12.2	13	14	13	15
13 May	64.1	0.0	12.2	10	10	11	12
14 May	59.5	0.0	12.2	17	17	18	20
15 May	57.9	0.0	11.7	19	21	24	28
16 May	55.9	0.0	11.7	17	19	19	22
17 May	68.2	0.0	12.8	10	11	11	13
18 May	64.9	0.0	12.8	17	19	22	25
19 May	67.7	0.0	13.3	12	12	17	19
20 May	75.5	0.0	13.3	12	12	12	13
21 May	77.6	0.0	13.3	22	23	24	27
22 May	83.6	0.0	13.3	20	22	26	30
23 May	84.6	0.0	13.3	17	19	20	23
24 May	89.7	0.0	13.3	18	19	20	25
25 May	86.7	0.0	12.8	8	8	13	16
26 May	84.2	0.0	12.8	14	18	16	21
27 May	92.8	4.4	12.8	11	15	15	21
28 May	122.4	29.9	12.8	12	21	14	23
29 May	132.4	39.4	12.2	3	6	4	7
30 May	125.8	34.2	11.7	6	10	7	12
31 May	120.8	28.4	11.1	4	8	7	13
01 Jun	114.8	22.2	11.7	2	4	2	5
02 Jun	103.1	11.4	11.7	1	2	1	2
03 Jun	100.4	18.9	11.7	2	4	2	5
04 Jun	105.1	22.5	11.7	3	7	3	7
05 Jun	108.9	19.0	14.4	3	6	4	8
07 Jun	110.6	21.7	14.4	1	2	2	3
08 Jun	102.0	9.5	13.9	2	4	3	5
09 Jun	97.6	5.6	13.9	4	7	5	8
10 Jun	90.5	0.0	13.9	5	6	6	8
11 Jun	88.1	0.0	13.9	3	3	5	6
12 Jun	83.8	0.0	13.3	3	3	3	4
13 Jun	77.2	0.0	13.3	2	2	3	4
14 Jun	76.5	0.0	13.9	3	3	3	4
15 Jun	72.6	0.0	14.4	2	2	4	5
16 Jun	60.7	0.0	14.4	1	1	1	1
17 Jun	55.2	0.0	16.1	3	3	3	4
19 Jun	49.3	0.0	17.2	1	1	1	1
21 Jun	46.2	0.0	17.8	1	1	2	2
23 Jun	48.4	0.0	17.8	1	1	1	1
25 Jun	52.9	0.0	17.8	0	0	1	1
26 Jun	43.6	0.0	18.9	1	1	1	1
05 Jul	36.2	0.0	20.0	1	1	1	1
12 Jul	37.8	0.0	20.0	1	1	1	1
16 Jul	37.6	0.0	20.0	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 2004, 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
13 Apr	57.0	20.6	10.9	3
16 Apr	57.2	20.6	11.1	3
17 Apr	51.1	19.0	11.1	2
18 Apr	51.4	20.1	11.1	7
19 Apr	48.4	18.3	11.1	13
20 Apr	45.8	16.9	11.7	10
21 Apr	45.3	15.0	11.7	6
22 Apr	44.7	15.6	11.7	2
23 Apr	42.6	7.4	11.7	12
24 Apr	40.0	0.0	11.7	23
25 Apr	41.7	0.0	11.7	19
26 Apr	41.9	0.0	11.7	9
27 Apr	44.6	0.0	11.0	14
28 Apr	53.4	0.0	11.0	18
29 Apr	54.4	0.0	11.1	6
30 Apr	54.0	0.0	11.7	1
01 May	48.9	0.0	11.7	1
02 May	50.5	0.0	11.7	5
03 May	61.7	0.0	11.7	1
04 May	70.7	0.0	11.7	2
05 May	77.8	0.0	11.7	3
06 May	85.4	0.0	11.7	6
07 May	81.1	0.0	11.7	8
08 May	78.3	0.0	11.7	4
09 May	73.5	0.0	11.7	1
10 May	73.8	0.0	11.7	5
11 May	71.4	0.0	12.8	3
12 May	72.0	0.0	12.8	4
13 May	65.2	0.0	12.8	1
14 May	58.5	0.0	12.8	2
15 May	58.4	0.0	12.8	3
16 May	56.3	0.0	12.8	2
17 May	68.7	0.0	12.8	2
18 May	64.4	0.0	12.8	4

Appendix Table 20. Continued.

Date	Average flow (kcfs)	Average spill (kcfs)	Scroll-case water temperature	Numbers detected
17 May	68.7	0.0	12.8	2
18 May	64.4	0.0	12.8	4
21 May	78.2	0.0	12.2	1
22 May	83.5	0.0	12.2	1
23 May	83.0	0.0	12.2	2
24 May	89.9	0.0	12.8	1
25 May	87.4	0.0	12.8	1
26 May	84.8	0.0	13.3	2
27 May	93.7	0.0	13.3	1
28 May	117.3	4.4	13.3	1
30 May	124.3	12.7	13.3	2
31 May	119.2	5.5	13.3	2
01 June	115.0	4.5	13.3	2
02 June	105.1	3.5	13.3	2
03 June	100.3	0.0	13.3	2
04 June	104.1	0.0	13.3	1
05 June	109.5	0.9	13.3	6
06 June	108.2	0.0	13.9	8
07 June	111.2	0.0	13.9	3
09 June	102.0	0.0	15.0	2
12 June	84.3	0.0	14.4	2
13 June	76.3	0.0	14.4	2
14 June	75.7	0.0	14.4	2
16 June	60.3	0.0	14.4	1
18 June	54.2	0.0	14.4	1

Appendix Table 21. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Lower Monumental Dam during 2004, with associated river flows (kcfs), spill (kcfs), and water temperatures (ºC) at the dam.

Date	Average flow (kcfs)	Average spill (kcfs)	Scroll-case water temperature	Numbers detected
15 Apr	69.8	0.0	11.1	1
17 Apr	50.6	0.0	11.1	2
20 Apr	46.2	0.0	11.7	2
21 Apr	46.2	0.0	11.7	6
22 Apr	46.3	0.0	11.7	7
23 Apr	42.0	0.0	11.7	7
24 Apr	42.3	4.5	11.7	5
25 Apr	45.3	11.6	11.7	2
27 Apr	46.5	8.0	11.7	1
28 Apr	55.1	10.9	11.1	1
29 Apr	56.9	13.8	11.1	1
14 May	60.0	5.9	12.8	1
17 May	72.8	0.0	12.8	1
21 May	83.1	0.0	12.2	1
25 May	94.0	0.0	13.3	1
28 May	124.2	3.9	13.3	2
30 May	130.1	14.6	12.8	1
07 Jun	118.4	6.0	12.8	1
13 Jun	79.0	0.0	14.4	1
29 Jun	38.6	0.0	18.9	1

Appendix Table 22. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at McNary Dam during 2004, with associated river flows (kcfs), spill (kcfs), and water temperatures (ºC) at the dam. Two first-time detections occurred at John Day Dam: the first was on 5 May for a fish tagged at Elk Creek; the second was on 20 May for a fish tagged at Loon Creek. Two first-time detections also occurred at Bonneville dam: the first was on 15 May for a fish tagged at Herd Creek; the second was on 23 May for a fish tagged at West Fork Chamberlain Creek.

Date	Average flow (kcfs)	Average spill (kcfs)	Scroll-case water temperature	Numbers detected
24 Apr	155.0	39.1	10.9	1
26 Apr	154.1	37.3	11.6	1
27 Apr	179.3	55.5	11.3	1
28 Apr	179.3	55.5	11.3	3
29 Apr	175.4	58.0	12.1	2
30 Apr	166.5	55.1	11.9	2
01 May	164.7	52.1	12.3	4
02 May	164.5	52.9	12.3	1
03 May	170.2	57.4	12.5	4
04 May	206.9	87.2	12.8	2
05 May	226.0	98.7	12.7	1
07 May	211.6	81.8	12.8	2
08 May	202.2	87.3	12.7	2
03 Jun	232.8	78.1	15.1	1

Appendix Table 23. Monthly environmental data collected from Marsh Creek (rkm 179.5 from the mouth of the Middle Fork Salmon River) from August 2003 through July 2004.

	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	6.9	2.5	0.1	0.0	0.0	0.0	0.0	0.0	0.1	1.6	3.6	6.9
Max	15.9	15.9	12.6	3.4	4.5	3.0	5.3	8.8	12.0	12.6	15.9	15.9
Mean	11.3	8.8	5.6	0.7	0.7	0.4	0.9	2.9	4.2	6.4	9.4	11.6
						Dissolved Oxygen (ppm)						
Min	---	---	---	---	11.4	11.0	10.5	10.0	9.1	---	---	---
Max	---	---	---	---	14.2	13.1	13.1	12.6	12.1	---	---	---
Mean	---	---	---	---	12.7	11.7	11.7	11.4	10.7	---	---	---
						Specific Conductance (µS/cm)						
Min	65.0	69.0	73.0	63.0	49.0	44.0	53.0	53.0	35.0	20.0	21.0	14.0
Max	74.0	81.0	79.0	85.0	72.0	68.0	68.0	68.0	55.0	48.0	31.0	35.0
Mean	70.5	72.9	75.8	72.6	63.7	63.0	64.6	62.5	46.5	30.0	25.7	28.5
						Turbidity (ntu)						
Min	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.5	1.3	1.2	14.7	---
Max	31.9	41.4	1.3	3.7	2.1	49.7	49.7	49.8	23.6	36.9	49.4	---
Mean	0.8	2.0	0.4	0.3	0.2	4.4	8.6	15.5	4.6	6.4	34.5	---
						Depth (ft)						
Min	1.0	0.7	0.3	0.3	0.3	0.3	0.3	0.4	1.1	1.9	2.0	1.5
Max	1.4	1.3	1.4	1.9	1.5	2.2	1.7	1.4	2.1	2.8	2.8	2.1
Mean	1.2	1.0	1.0	0.9	0.9	1.3	0.8	0.9	1.7	2.4	2.3	1.8
						pH						
Min	7.3	7.4	7.4	7.4	7.4	7.2	7.4	7.1	6.9	7.1	7.3	7.2
Max	8.9	9.0	9.1	8.4	8.5	8.2	8.7	7.9	8.3	7.9	8.4	8.4
Mean	7.8	7.9	7.9	7.7	7.6	7.5	7.6	7.5	7.3	7.3	7.6	7.6

Appendix Table 24. Monthly environmental data collected from the Salmon River near Sawtooth Hatchery (rkm 627.9) from August 2003 through July 2004.

	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	9.2	5.3	1.4	0.0	---	---	---	---	2.7	5.0	7.4	9.9
Max	15.9	15.9	13.9	5.7	---	---	---	---	14.1	15.0	15.9	15.9
Mean	13.1	10.9	7.9	2.2	---	---	---	---	7.3	9.7	12.2	13.3
						Dissolved Oxygen (ppm)						
Min	6.6	8.0	---	11.2	---	---	---	---	7.1	7.3	6.2	7.6
Max	10.4	12.0	---	14.2	---	---	---	---	10.6	12.6	11.3	11.2
Mean	8.8	9.7	---	12.4	---	---	---	---	8.6	10.0	8.9	8.9
						Specific Conductance (µS/cm)						
Min	136.0	140.0	144.0	135.0	---	---	---	---	94.0	69.0	65.0	85.0
Max	152.0	158.0	158.0	159.0	---	---	---	---	122.0	101.0	89.0	126.0
Mean	143.5	152.6	151.5	145.8	---	---	---	---	105.4	84.1	80.3	108.0
						Turbidity (ntu)						
Min	0.0	0.0	0.0	0.0	---	---	---	---	1.0	1.7	1.3	0.3
Max	1.0	13.6	32.5	42.5	---	---	---	---	49.1	39.4	27.8	2.9
Mean	0.3	0.5	0.3	1.1	---	---	---	---	3.0	5.4	4.6	1.0
						Depth (feet)						
Min	1.6	1.3	0.9	0.9	---	---	---	---	1.6	1.9	2.2	1.9
Max	2.1	1.9	2.2	1.9	---	---	---	---	2.3	2.6	2.6	2.5
Mean	1.8	1.7	1.7	1.4	---	---	---	---	2.0	2.2	2.4	2.1
						pH						
Min	7.9	8.0	8.0	7.9	---	---	---	---	7.7	7.6	7.6	7.6
Max	8.8	9.1	9.2	9.1	---	---	---	---	8.3	8.5	8.7	8.9
Mean	8.3	8.4	8.4	8.3	---	---	---	---	8.0	8.0	8.0	8.1

Appendix Table 25. Monthly environmental data collected from Valley Creek (rkm 609.4 from the mouth of the Salmon River) from August 2003 through July 2004.

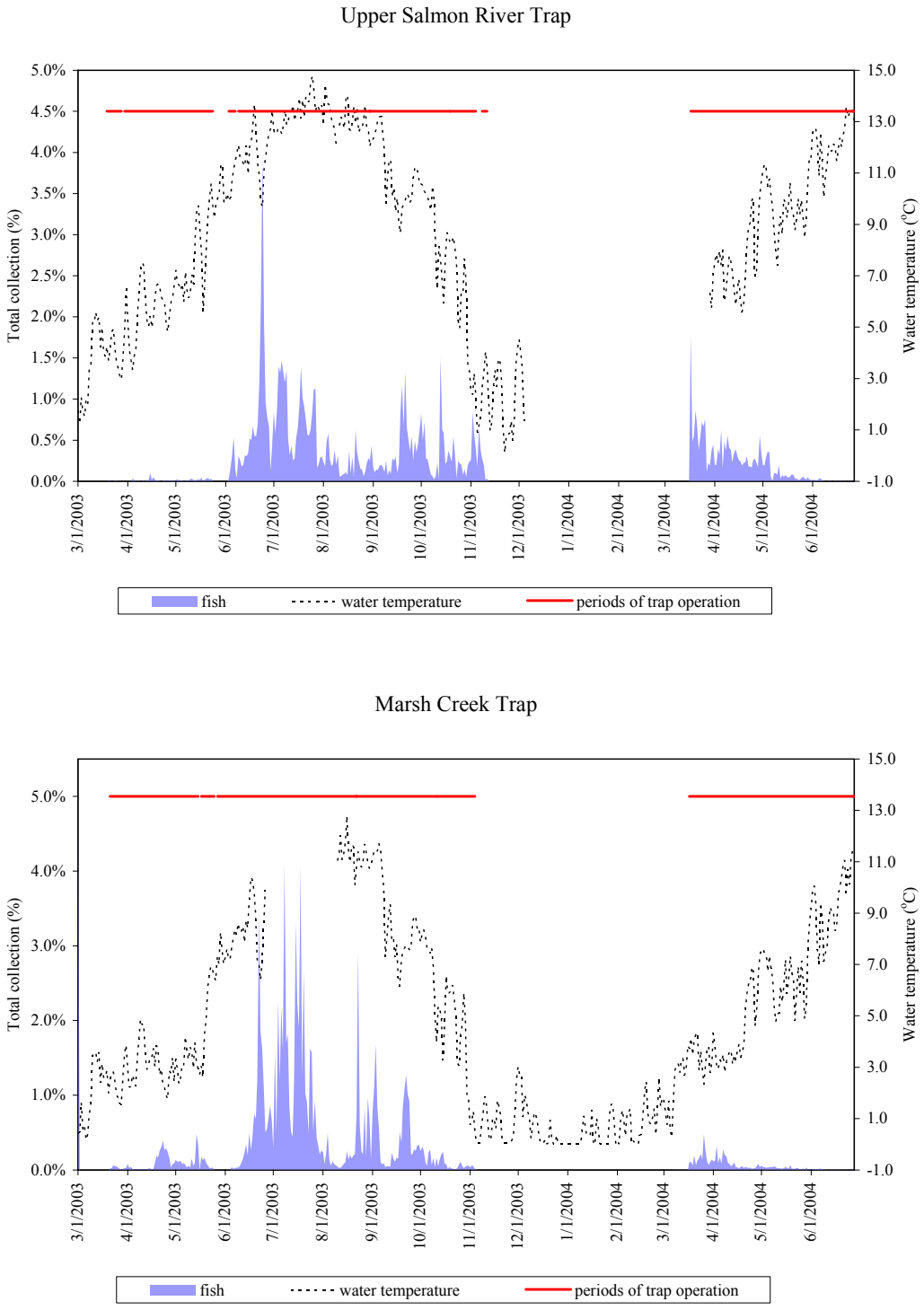
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	9.3	3.2	0.6	0.0	0.0	0.0	0.1	0.0	1.7	4.0	6.8	9.0
Max	15.9	15.9	15.0	4.6	3.2	1.1	1.8	9.8	14.7	15.0	15.9	15.9
Mean	13.2	10.7	7.2	1.0	0.9	0.5	0.6	3.0	6.7	8.9	11.6	13.2
						Dissolved Oxygen (ppm)						
Min	---	---	---	8.3	8.6	12.7	13.2	---	---	---	---	---
Max	---	---	---	9.6	14.1	14.1	14.2	---	---	---	---	---
Mean	---	---	---	9.1	12.7	13.3	13.8	---	---	---	---	---
						Specific Conductance (µS/cm)						
Min	59.0	78.0	74.0	82.0	73.0	81.0	83.0	62.0	50.0	40.0	43.0	48.0
Max	87.0	88.0	90.0	102.0	95.0	92.0	98.0	99.0	63.0	58.0	51.0	70.0
Mean	75.6	82.7	82.4	88.5	83.3	86.2	90.8	85.1	57.0	47.1	47.3	59.3
						Turbidity (ntu)						
Min	0.5	0.3	0.2	0.1	0.0	0.0	0.4	0.4	1.3	1.6	1.3	0.8
Max	30.7	2.2	2.7	14.6	12.4	5.8	8.8	38.2	34.8	19.9	20.5	47.5
Mean	1.6	0.9	0.7	1.2	0.9	0.8	1.3	3.9	4.0	4.6	3.1	3.2
						Depth (ft)						
Min	1.1	0.8	0.5	0.6	0.4	0.2	0.5	0.5	1.2	1.6	1.9	1.5
Max	1.6	1.4	1.6	1.6	1.4	1.3	1.5	1.6	2.0	2.4	2.4	2.1
Mean	1.3	1.2	1.2	1.0	0.9	1.0	0.9	1.2	1.6	2.0	2.1	1.7
						pH						
Min	7.3	7.7	7.8	7.7	7.5	7.4	7.5	7.4	7.4	7.2	7.3	7.4
Max	8.4	8.6	8.7	8.4	8.2	8.1	8.2	8.2	8.4	8.2	8.5	8.4
Mean	7.9	8.0	8.0	7.9	7.8	7.6	7.7	7.8	7.8	7.6	7.7	7.8

Appendix Table 26. Monthly environmental data collected from Secesh River (27 km upstream from its confluence with the South Fork Salmon River) from August 2003 through July 2004.

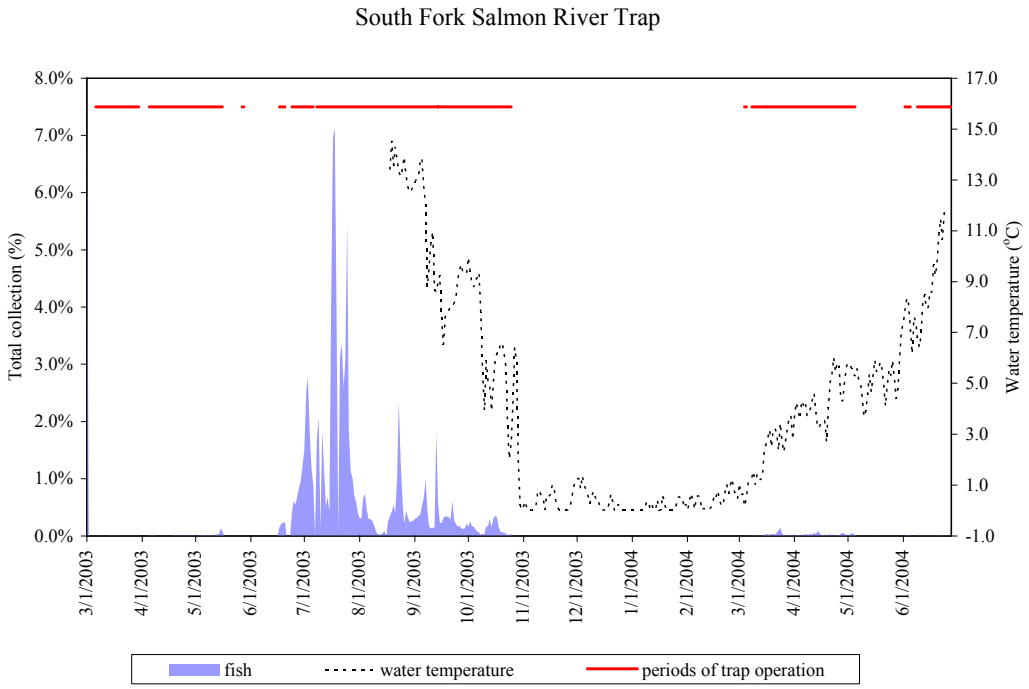
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	---	---	---	0.0	0.1	0.1	0.1	0.0	0.4	0.9	4.5	---
Max	---	---	---	0.2	0.1	0.1	0.1	6.3	8.8	9.1	15.1	---
Mean	---	---	---	0.1	0.1	0.1	0.1	0.4	3.6	5.2	8.9	---
						Dissolved Oxygen (ppm)						
Min	---	---	---	10.3	10.4	10.3	10.4	9.8	9.0	8.5	7.4	---
Max	---	---	---	11.5	11.1	11.0	10.9	11.3	11.1	10.6	9.4	---
Mean	---	---	---	10.7	10.7	10.6	10.6	10.5	10.3	9.5	8.6	---
						Specific Conductance (µS/cm)						
Min	---	---	---	32.0	32.0	34.0	34.0	26.0	20.0	17.0	18.0	---
Max	---	---	---	41.0	36.0	36.0	36.0	36.0	29.0	23.0	27.0	---
Mean	---	---	---	35.4	34.3	35.4	35.9	32.6	24.0	19.5	21.5	---
						Turbidity (ntu)						
Min	---	---	---	0.0	0.1	0.1	0.1	0.2	0.8	1.1	0.9	---
Max	---	---	---	3.2	4.0	0.6	2.0	14.0	11.4	46.4	15.6	---
Mean	---	---	---	0.7	0.9	0.3	0.5	1.8	2.8	6.1	2.7	---
						Depth (ft)						
Min	---	---	---	1.4	1.6	1.8	2.2	1.7	1.9	2.6	2.3	---
Max	---	---	---	2.5	2.7	2.9	3.3	3.7	3.0	3.7	3.6	---
Mean	---	---	---	1.9	2.1	2.5	2.9	3.0	2.4	3.1	2.9	---
						pH						
Min	---	---	---	7.2	7.1	7.1	6.9	6.9	7.0	6.8	6.7	---
Max	---	---	---	7.6	7.3	7.2	7.1	7.2	7.4	7.4	7.5	---
Mean	---	---	---	7.3	7.2	7.1	7.0	7.1	7.1	7.0	7.0	---

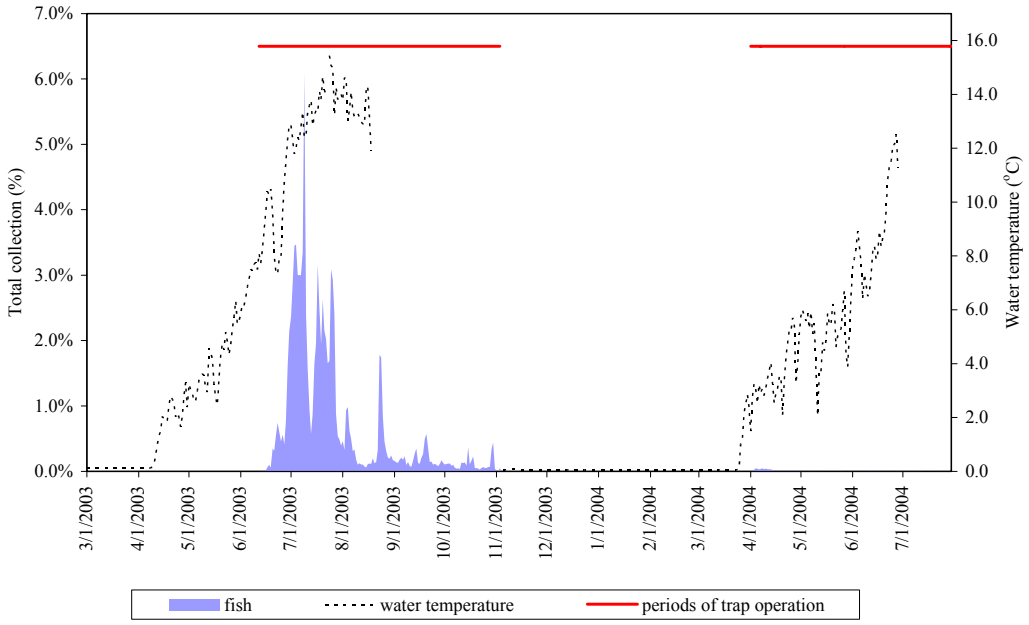
Appendix Table 27. Monthly environmental data collected from South Fork Salmon River (112 km from its confluence with the Salmon River) from August 2003 through July 2004.

	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	---	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.3	0.0	8.1
Max	---	15.9	12.4	1.6	2.0	1.2	3.0	6.7	9.3	9.0	15.4	15.9
Mean	---	9.9	6.0	0.3	0.4	0.1	0.4	2.0	4.2	5.2	8.4	13.2
						Dissolved Oxygen (ppm)						
Min	---	---	8.9	8.4	9.2	1.1	---	---	8.4	11.0	---	---
Max	---	---	14.2	14.1	11.9	10.9	---	---	13.7	14.2	---	---
Mean	---	---	13.7	11.5	10.5	9.4	---	---	11.2	13.2	---	---
						Specific Conductance (µS/cm)						
Min	---	52.0	57.0	47.0	43.0	42.0	45.0	38.0	33.0	24.0	23.0	25.0
Max	---	61.0	76.0	82.0	63.0	63.0	65.0	63.0	46.0	35.0	35.0	47.0
Mean	---	56.8	65.2	58.6	56.1	57.5	58.3	50.7	38.8	27.9	29.1	37.8
						Turbidity (ntu)						
Min	---	---	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.2	0.5	0.0
Max	---	---	49.7	46.3	11.7	4.4	3.4	13.6	8.7	19.5	14.6	43.2
Mean	---	---	6.9	0.6	0.3	0.1	0.2	1.7	2.8	3.9	2.2	1.5
						Depth (ft)						
Min	---	0.7	0.4	0.4	0.3	0.3	0.4	0.4	1.2	1.6	1.6	1.0
Max	---	1.3	1.5	2.0	1.8	2.4	1.9	1.6	2.0	2.5	2.5	2.5
Mean	---	1.0	1.0	1.1	1.0	1.4	0.9	1.1	1.6	2.0	1.9	1.4
						pH						
Min	---	7.3	7.4	7.3	7.5	7.7	7.6	7.3	7.3	7.1	7.1	6.9
Max	---	8.7	8.5	8.4	8.0	8.1	8.6	8.4	7.8	7.6	8.1	8.3
Mean	---	7.7	7.6	7.7	7.7	7.7	7.8	7.6	7.4	7.3	7.4	7.6

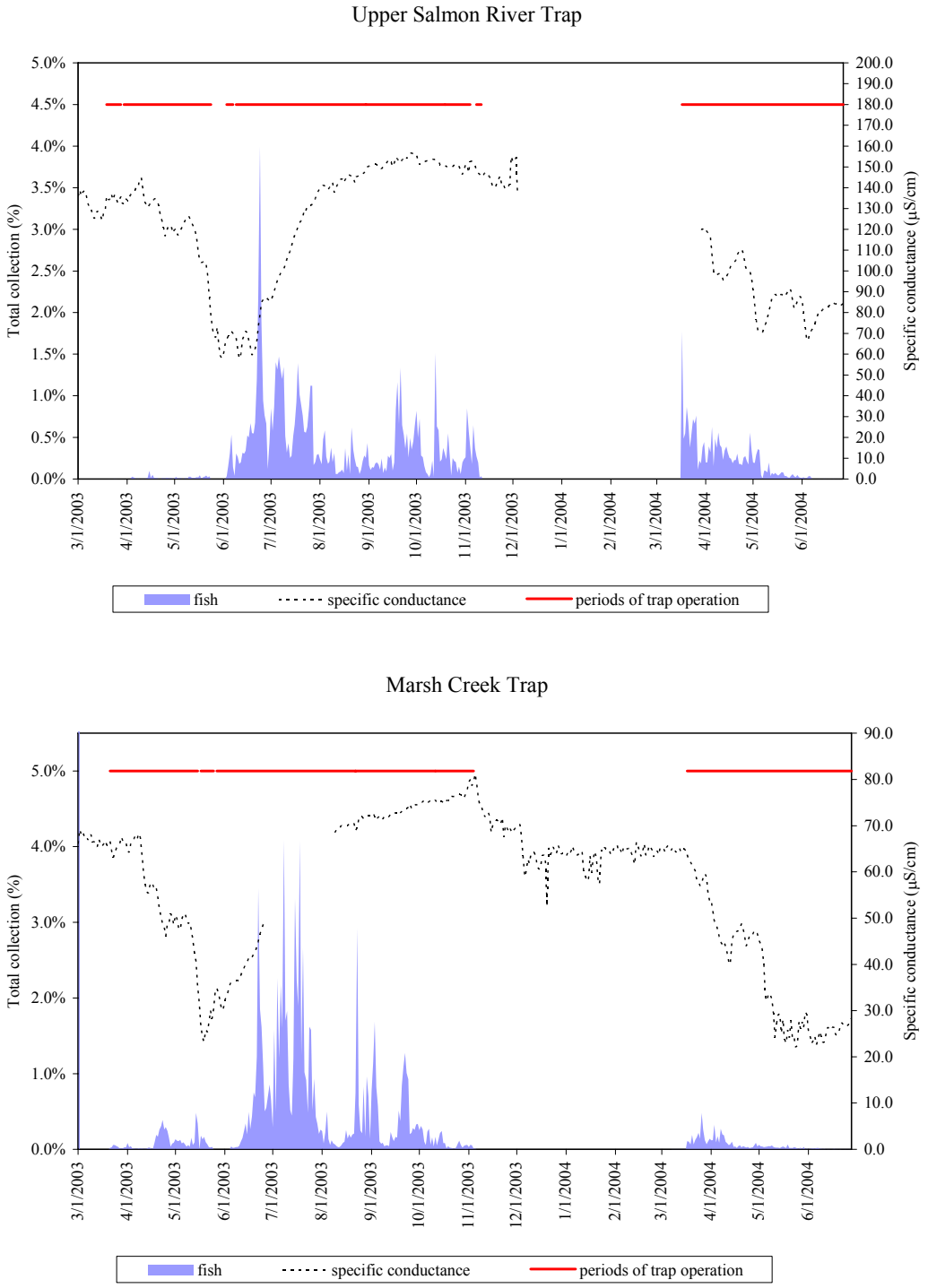


Appendix Figure 1. Daily passage of wild Chinook salmon fry, parr, and smolts at four migrant traps, expressed as percentages of total collected, and plotted against average daily water temperatures collected near traps. Periods of trap operation are also shown.

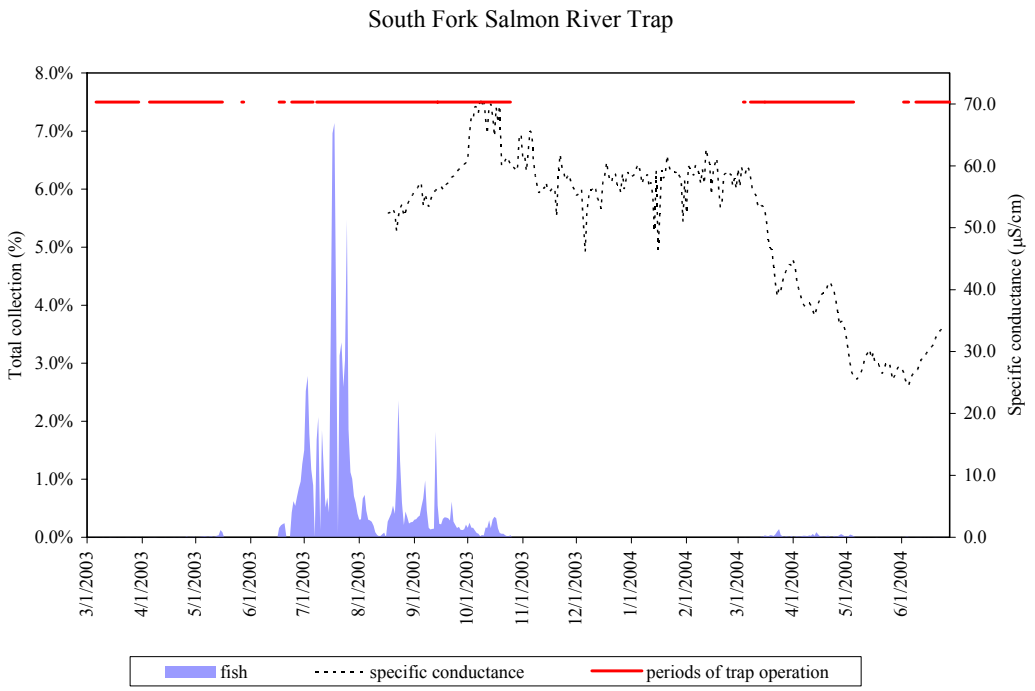


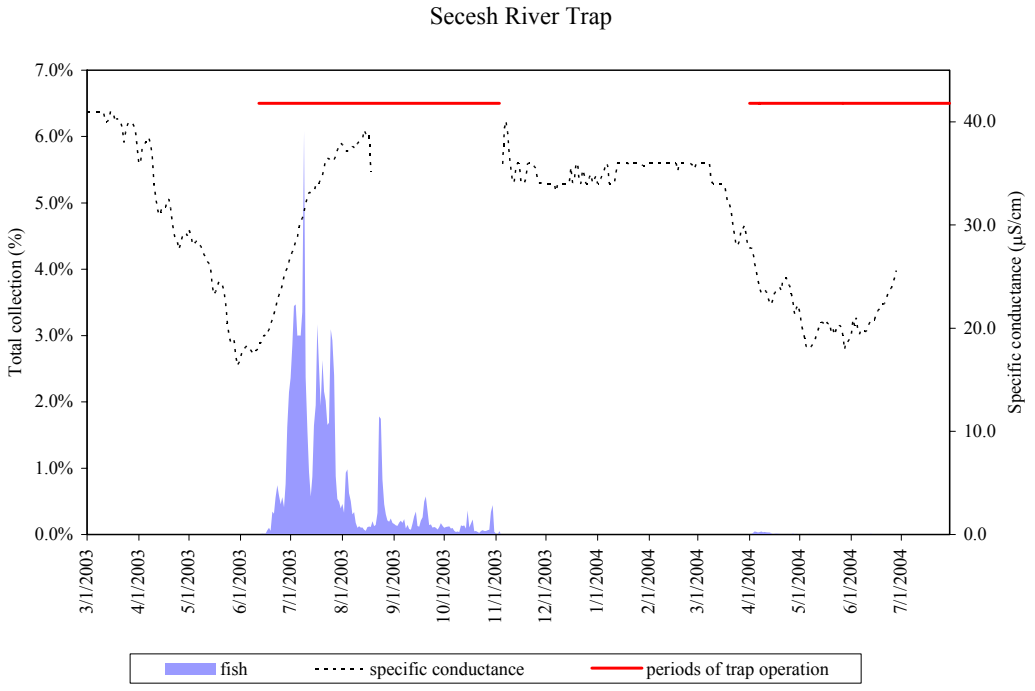


Appendix Figure 1. Continued.

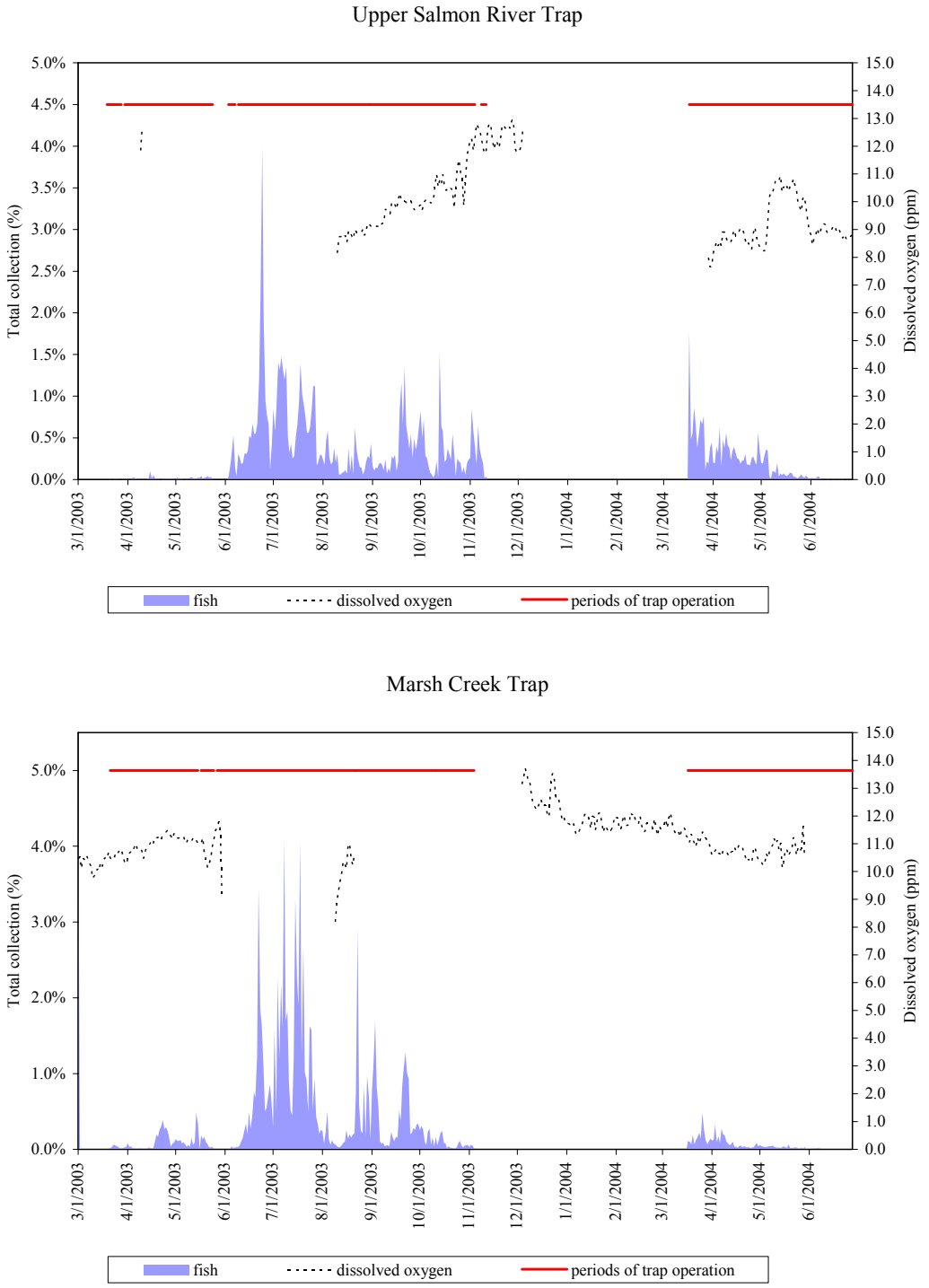


Appendix Figure 2. Daily passage of wild Chinook salmon fry, parr, and smolts at four migrant traps, expressed as percentages of total collected, and plotted against average daily specific conductance collected near traps. Periods of trap operation are also shown.

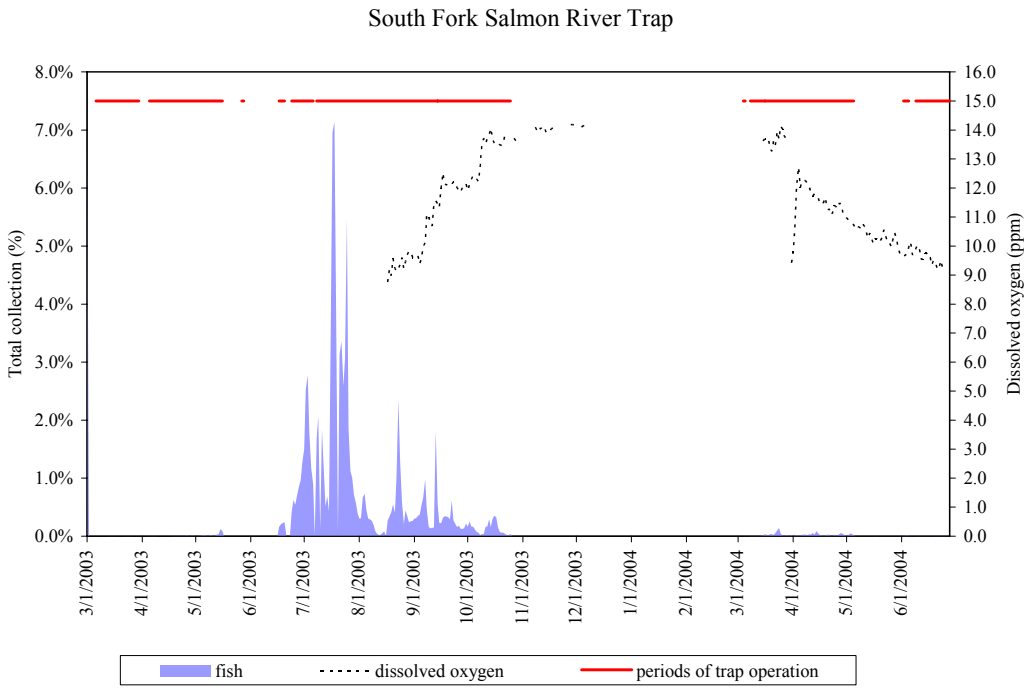


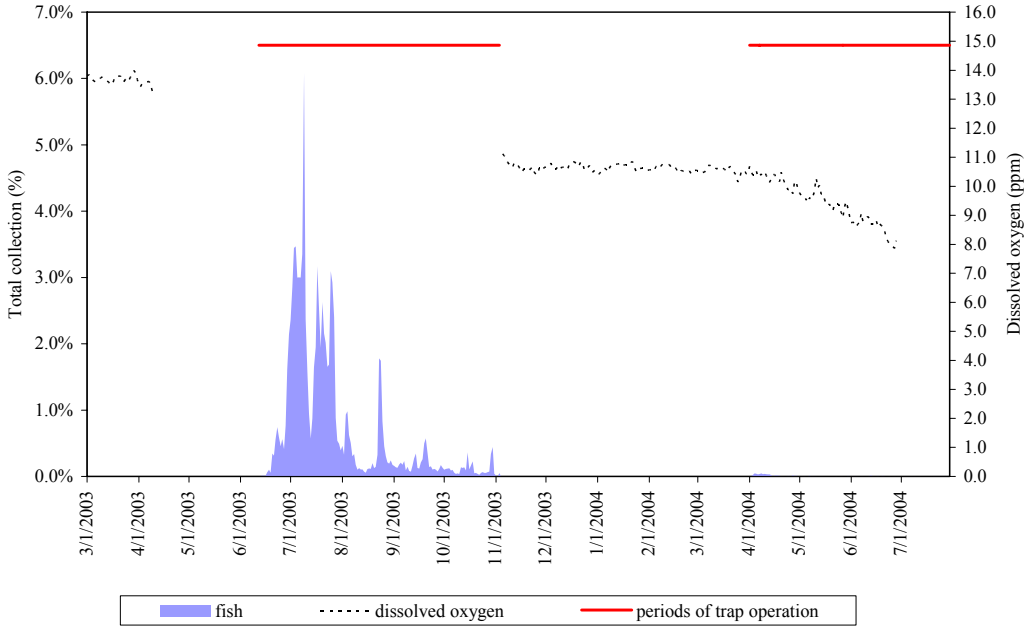


Appendix Figure 2. Continued.

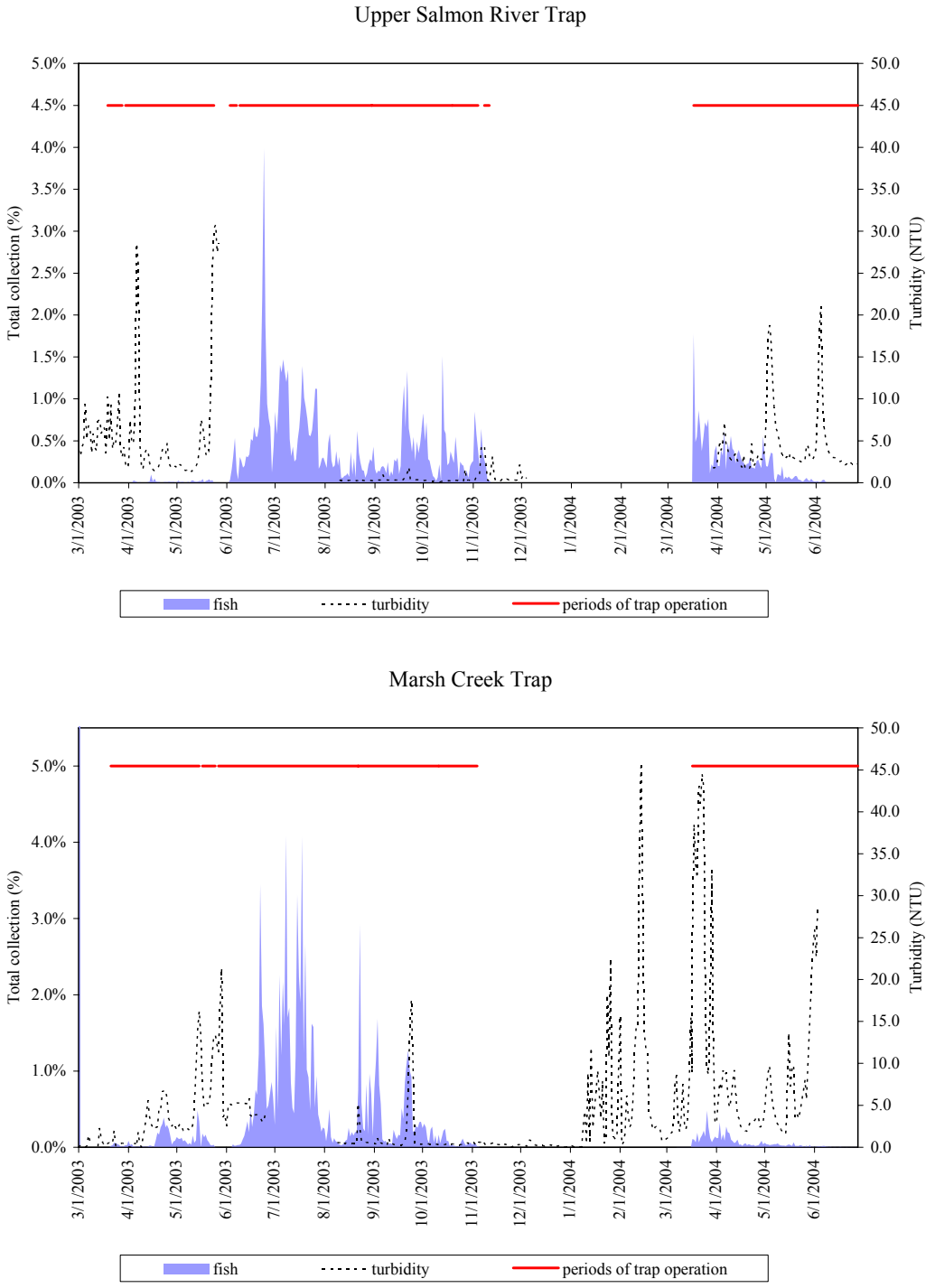


Appendix Figure 3. Daily passage of wild Chinook salmon fry, parr, and smolts at four migrant traps, expressed as percentages of total collected, and plotted against average daily dissolved oxygen collected near traps. Periods of trap operation are also shown.

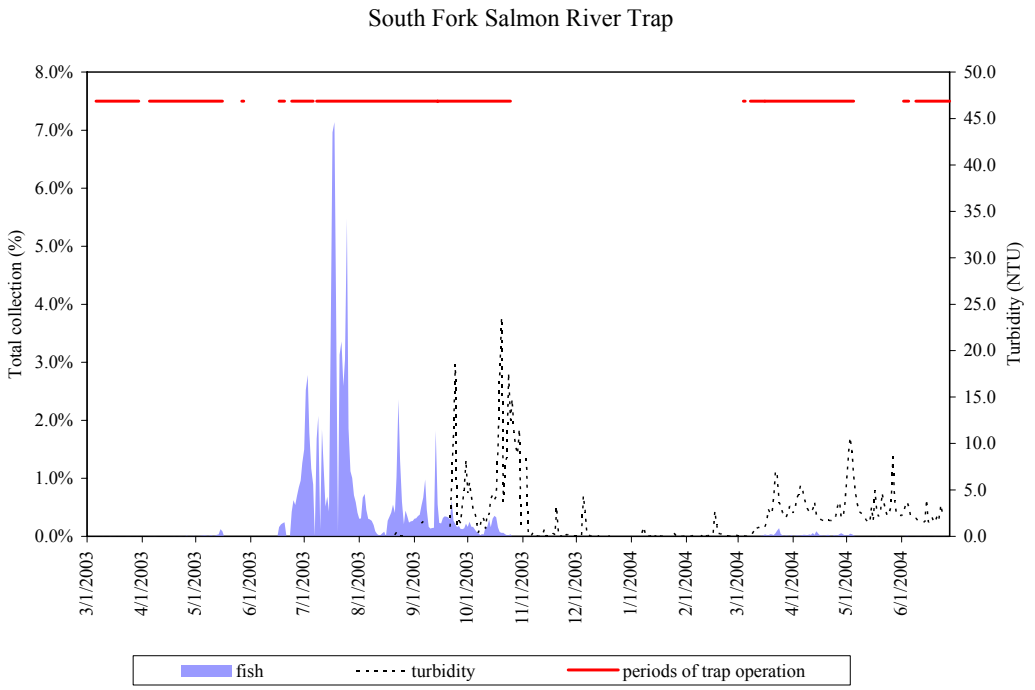


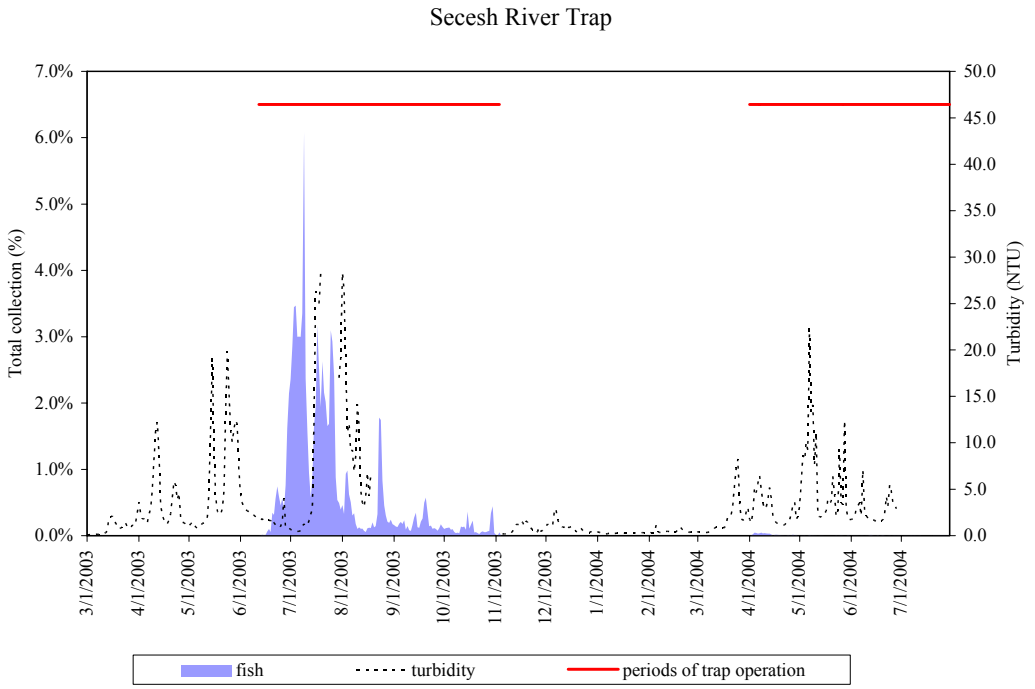


Appendix Figure 3. Continued.

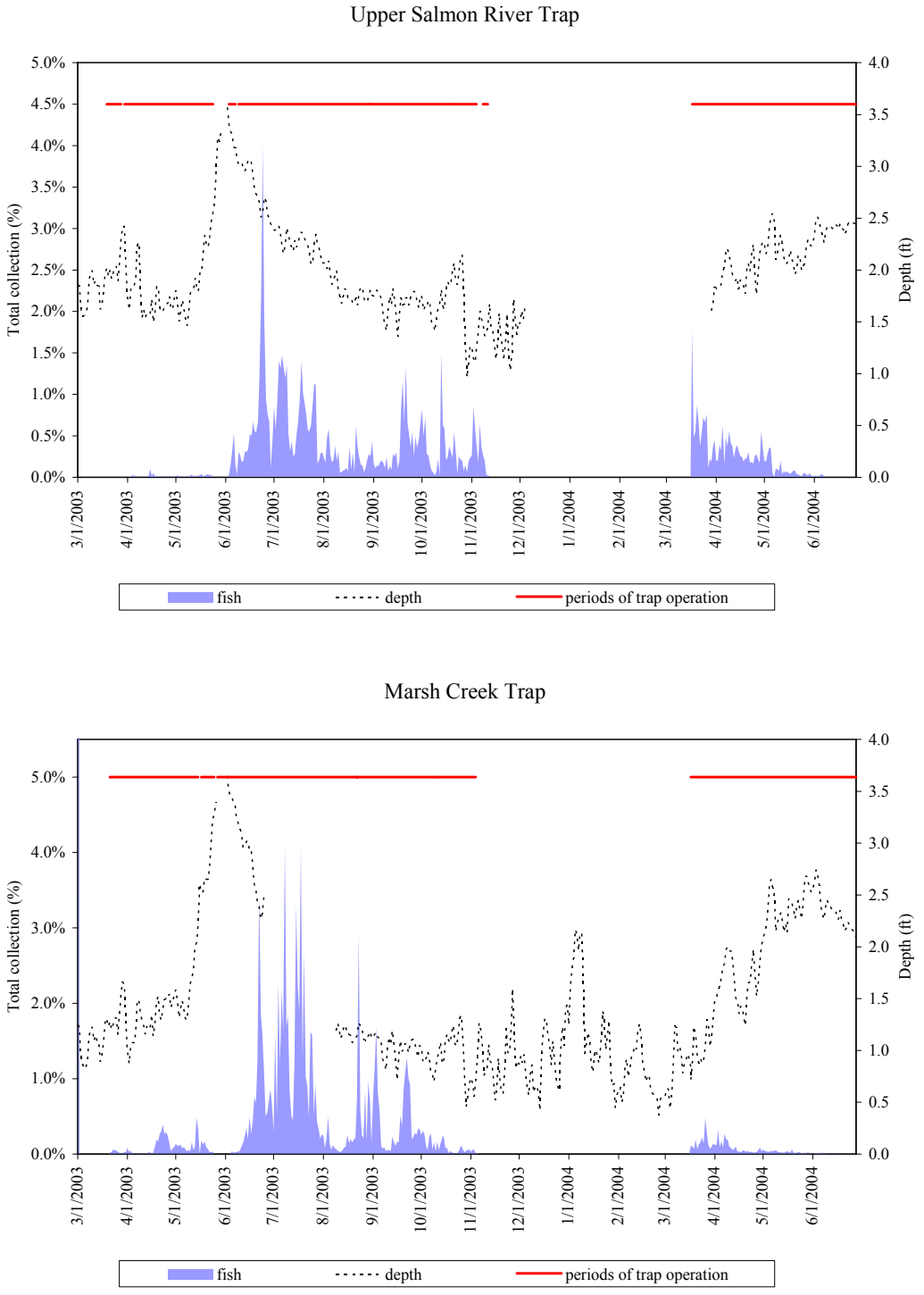


Appendix Figure 5. Daily passage of wild Chinook salmon fry, parr, and smolts at four migrant traps, expressed as percentages of total collected, and plotted against average daily turbidity collected near traps. Periods of trap operation are also shown.

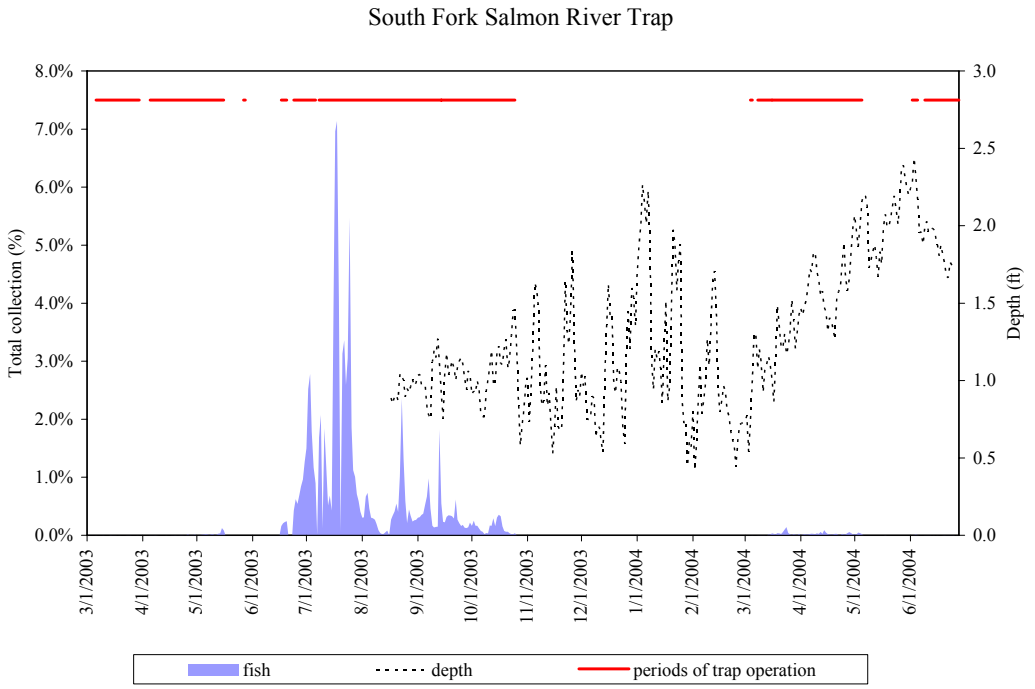


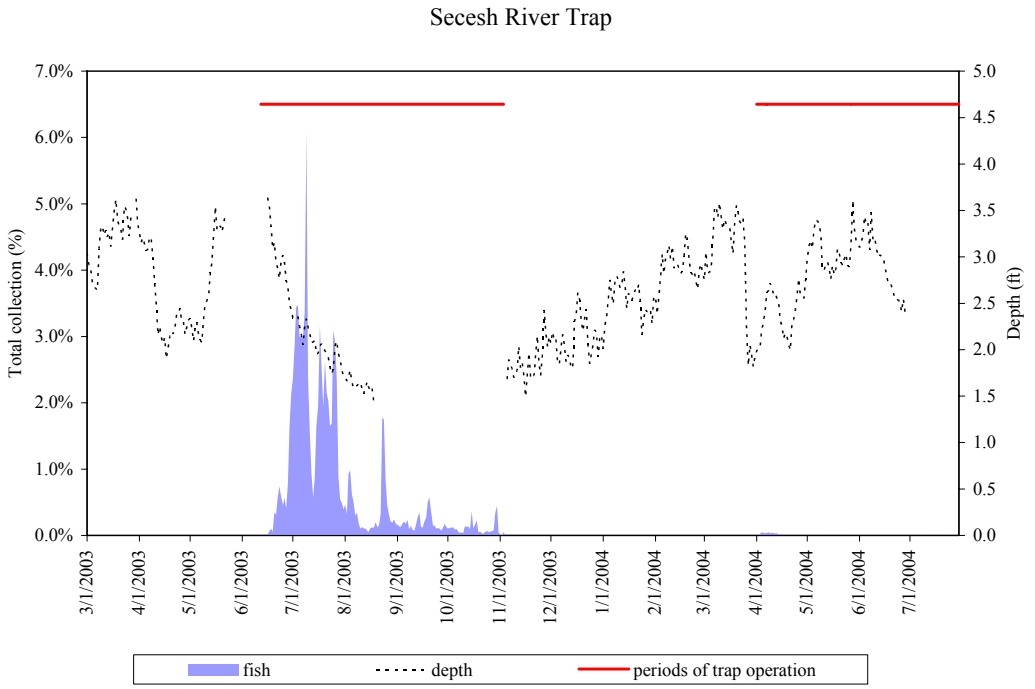


Appendix Figure 5. Continued.

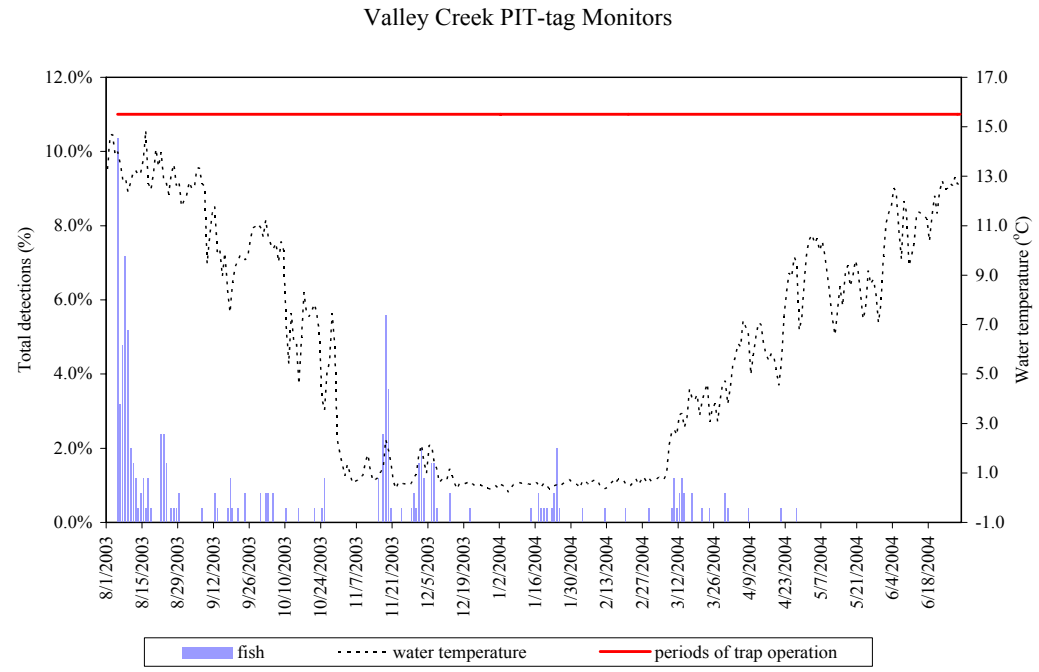


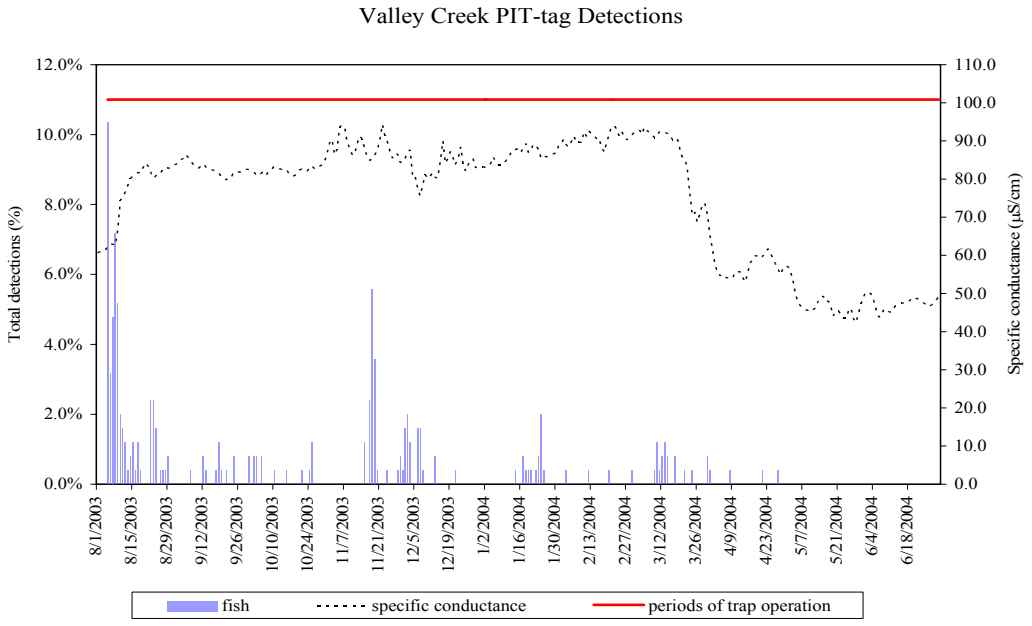
Appendix Figure 6. Daily passage of wild Chinook salmon fry, parr, and smolts at four migrant traps, expressed as percentages of total collected, and plotted against average daily depth collected near traps. Periods of trap operation are also shown.



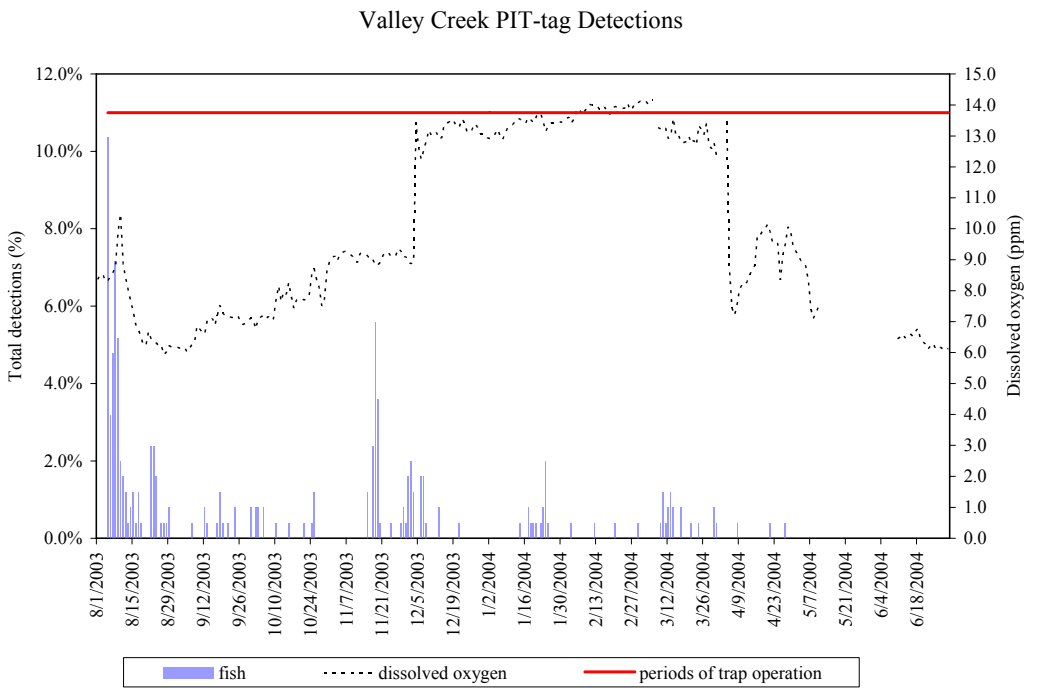


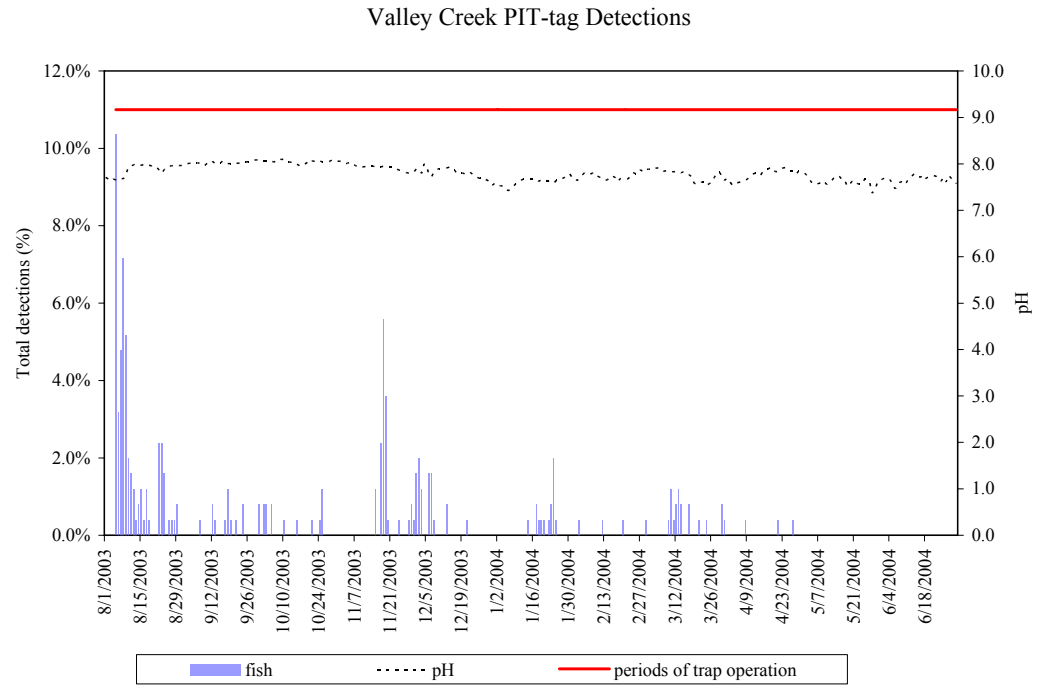
Appendix Figure 6. Continued.



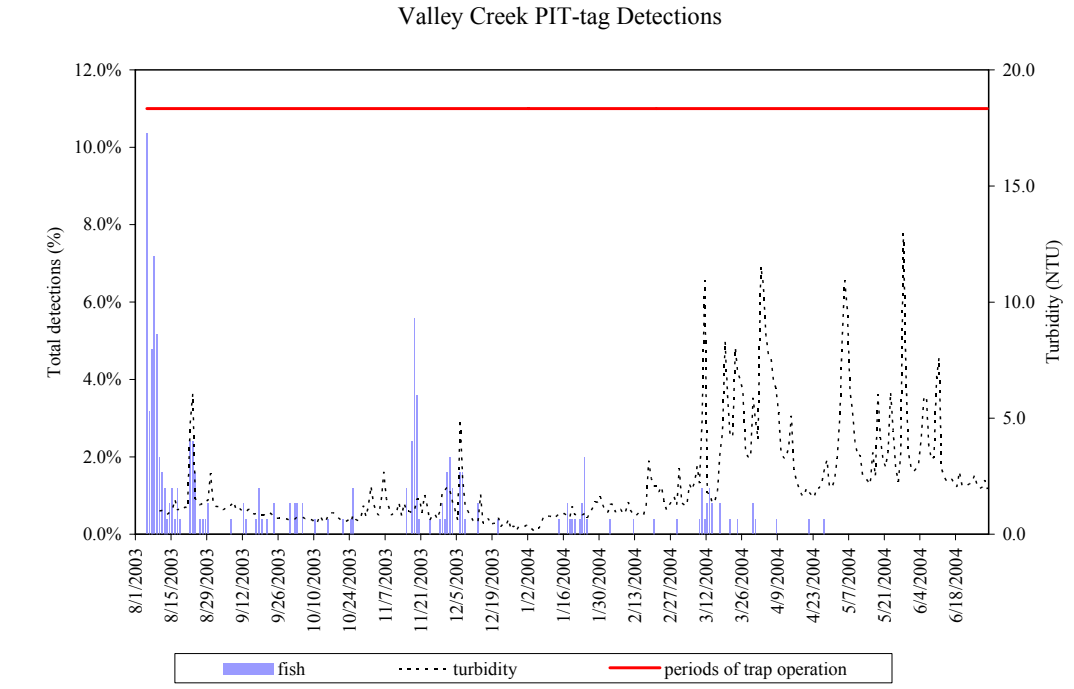


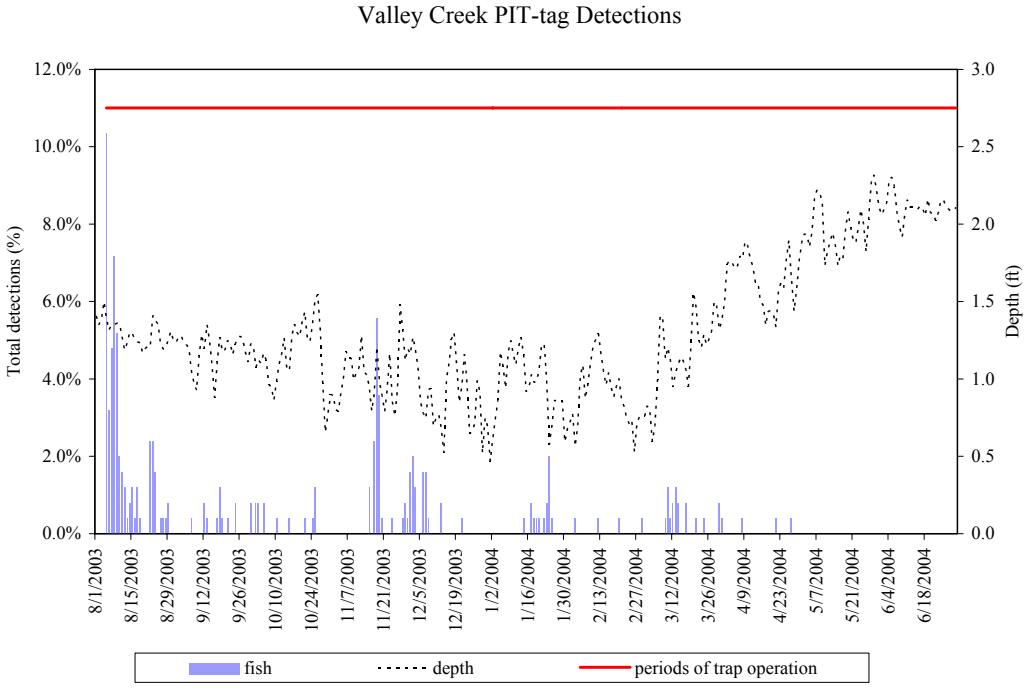
Appendix Figure 7. Combined daily PIT-tag detections of wild Chinook salmon parr at in-stream PIT-tag detectors in Valley Creek, expressed as percentages of total collected, and plotted against average daily aquatic conditions collected near the detectors. Periods of operation for the detectors are also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





Appendix Figure 7. Continued.





Appendix Figure 7. Continued.