Monitoring the Migrations of Wild Snake River Spring/Summer Chinook Salmon Juveniles, 2010-2011

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EXECUTIVE SUMMARY

This report provides results from an ongoing project to monitor the migration behavior and survival of wild juvenile spring/summer Chinook salmon in the Snake River Basin. Data reported are from detections of PIT-tagged fish from late summer 2010 to mid-2011. In summer 2010, the National Marine Fisheries Service (NMFS) tagged fish in Idaho streams, and the Oregon Department of Fish and Wildlife (ODFW) tagged fish in Oregon streams. Our analyses include migration behavior and estimated survival of fish at instream PIT-tag monitors and arrival timing and estimated survival to Lower Granite Dam. Principal results from tagging and interrogation during 2010-2011 are listed below:

1) From July to September 2010, we PIT tagged and released 15,210 wild Chinook salmon parr in 16 Idaho streams or sample areas.

2) Overall observed mortality from collection, handling, tagging, and after a 24-h holding period was 1.4%.

3) **Valley Creek—**Of the 2,513 Chinook salmon parr PIT tagged and released in Valley Creek in summer 2010, 764 (30.4%) were detected at two instream PIT-tag monitoring systems in lower Valley Creek from late summer 2010 to spring 2011. Of these 764 detected fish, 59.9% were detected in late summer/fall, 32.6% in winter, and 7.5% in spring. Estimated parr-to-smolt survival to Lower Granite Dam was 17.9% for the late summer/fall group, 22.2% for the winter group, and 65.3% for the spring group. Based on detections at downstream dams, the overall detection efficiency of Valley Creek upper (VC1) or lower (VC2) monitors was 75.9%. Using this efficiency rate, we estimated that 40.1% of all summer-tagged parr survived to pass the Valley Creek monitors, and their survival from the downstream monitors to Lower Granite Dam was 22.8%. Overall estimated parr-to-smolt survival to the dam for all summer-tagged parr from this stream was 8.0%.

4) **Big Creek—**Of the 1,145 Chinook salmon parr PIT tagged and released in upper Big Creek during summer 2010, 46 (4.0%) were detected at two instream PIT-tag monitoring systems in lower Big Creek from late summer 2010 to spring 2011. Of these 46 fish, 78.3% were detected in late summer/fall, 13.0% in winter, and 8.7% in spring. Estimated parr-to-smolt survival to Lower Granite Dam for each of these groups was 18.4% for the late summer/fall group, 0.0% for the winter group, and 163.3% for the spring group. Based on detections at downstream dams, the overall detection efficiency of Big Creek upper (TAY-a) or lower (TAY-b) monitors was 8.8%. Using this efficiency rate, we estimated that 45.8% of all summer-tagged parr from upper Big Creek survived to pass the monitors on lower Big Creek, and

their survival from the downstream monitors to Lower Granite Dam was 28.6%. Overall estimated parr-to-smolt survival for all summer-tagged parr from this stream (area) to the dam was 12.1%.

Of the 1,413 Chinook salmon parr that were PIT tagged and released to lower Big Creek during summer 2010, 244 (17.3%) were detected at the two instream PIT-tag monitoring systems in lower Big Creek from late summer 2010 to spring 2011. Of these 244 fish, 73.4% were detected in late summer/fall, 20.5% in winter, and 6.1% in spring. Estimated parr-to-smolt survival to Lower Granite Dam for each of these groups was 28.8% for the late summer/fall group and 27.4% for the winter group. No fish from the spring group were detected at the dam. Based on detections at downstream dams, the overall detection efficiency of Big Creek upper (TAY-a) or lower (TAY-b) monitors was 20.1%. Using this efficiency rate, we estimated that 86.0% of all summer-tagged parr survived to the lower Big Creek monitors, and their estimated survival from that point to Lower Granite Dam was 26.7%. Overall estimated parr-to-smolt survival for all summer-tagged parr from this stream (area) at the dam was 23.2%.

Increasing the number of fish tagged and/or the number of antennas should provide better precision for these survival estimates in the future. Development and maintenance of the instream PIT-tag monitoring systems for both Valley and Big Creeks was turned over to the Integrated Status and Effectiveness Monitoring Program (ISEMP) project in 2010.

5) **Secesh River—**Of the 1,459 Chinook salmon parr PIT tagged and released in the Secesh River and Lake Creek in summer 2010, 247 (16.9%) were detected at the instream PIT-tag monitoring system in the lower Secesh River (near Zena Creek) from late summer 2010 to spring 2011. Of these 247 fish, 82.6% were detected in late summer/fall, 14.2% in winter, and 3.2% in spring. Estimated parr-to-smolt survival to Lower Granite Dam for each of these groups was 37.2% for the late summer/fall group, 21.3% for the winter group, and 70.3% for the spring group. Using detections at both the instream monitors and at the dam, we estimated that 48.8% of all summer-tagged parr survived to the lower Secesh River monitors near Zena Creek and their estimated survival from that point to Lower Granite Dam was 36.0%. Overall estimated parr-to-smolt survival to the dam for all summer-tagged parr from these streams (areas) was 15.4%.

6) **South Fork Salmon River—**Of the 1,034 Chinook salmon parr PIT tagged and released in the upper South Fork Salmon River during summer 2010, only 11 were detected at the instream PIT-tag monitoring system in the South Fork Salmon River near Krassel Creek from late summer 2010 to spring 2011. For our study fish, detection efficiency of the Krassel Creek monitoring site declined from 52.7% in 2009-2010 to 1-2% in 2010-2011.

At the two additional instream PIT-tag monitoring systems (one in the lower South Fork Salmon River and one at Guard Station Road Bridge), only 8 fish were detected from releases to the Secesh and South Fork Salmon Rivers and Lake Creek. The three South Fork Salmon River monitoring sites were developed by the ISEMP.

7) At Little Goose Dam in 2011, length and/or weight were measured for 458 recaptured fish from 16 Idaho stream populations. Fish had grown an average of 41.1 mm in length and 9.1 g in weight over an average of 278 d. Their mean condition factor declined from 1.29 at release (parr) to 1.04 at recapture (smolt).

8) Mean length at release was significantly greater for fish that were detected than for fish that were not detected the following spring and summer ($P < 0.0001$).

9) Fish that arrived at Lower Granite Dam in April and May had been significantly larger (FL) at release than fish arriving after May ($P < 0.0001$), although only 40 fish migrated after May.

10) In 2011, peak detections at Lower Granite Dam of parr tagged during summer 2010 (from the 16 stream populations in Idaho and 4 streams in Oregon) occurred from 10 to 14 May during increasing flows of 101.1-140.2 kcfs. Respective dates of the 10th, 50th, and 90th passage percentiles were 14 April, 10 May, and 24 May.

11) In 2010-2011, average estimated parr-to-smolt survival to Lower Granite Dam for Idaho and Oregon streams combined was 16.8% (range 8.0-35.9% depending on stream of origin). For fish from Idaho streams, average estimated parr-to-smolt survival was 17.4%.

In 2011, we observed moderate-high to high flows throughout the spring migration season, with the highest flows later in the season (June) accompanied by weather in the Snake River basin that was cooler and wetter than normal. Clearly, complex interrelationships of several factors drive the annual migration timing of these populations.

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INTRODUCTION

This report provides information on wild Chinook salmon parr that we PIT tagged in Idaho in 2010 and subsequently monitored, along with PIT-tagged fish from Oregon. We report estimated survival and timing of these Chinook salmon juveniles to Lower Granite Dam as well as interrogation data 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; 2002-2011). The goals of this ongoing study are to:

1) Characterize the migration timing and estimate parr-to-smolt survival of different populations of wild Snake River spring/summer Chinook salmon at Lower Granite Dam
2) Determine whether consistent migration patterns are apparent
3) Determine which environmental factors influence these patterns
4) Characterize the migrational behavior and estimate survival of different wild juvenile fish populations as they migrate from their natal rearing areas.

This study provides critical information for recovery planning, and ultimately recovery for these wild fish populations, which are listed as threatened under the U.S. Endangered Species Act.

During 2010-2011, we collected water temperature, dissolved oxygen, specific conductance, water depth, and pH data at six monitoring stations, in the Salmon River Basin, Idaho, for the Baseline Environmental Monitoring Program. In addition, we measured hourly water temperature and depth parameters in 10 additional streams. These environmental data can be compared with parr/smolt migration, survival, and timing data to discern patterns or characteristic relationships that may exist and that may help in recovery planning for threatened populations.

METHODS

Fish Collection and Tagging

The Oregon Department of Fish and Wildlife (ODFW) PIT tagged wild Chinook salmon parr in the Grande Ronde and Imnaha River drainages in northeast Oregon in 2010. All tagging, detection, and timing information for fish from these streams in 2010-2011 will be reported by ODFW. However, with ODFW's concurrence, we report here the timing and overall estimated survival to Lower Granite Dam of fish tagged in summer from these Oregon streams.

National Marine Fisheries Service (NMFS) personnel tagged fish in Idaho streams during 2010 (Figure 1). Fish were collected and tagged using safe handling methods developed for this study; these methods are detailed in Matthews et al. (1990; 1997) and in previous reports from this study (Achord et al. 1994; 1995a; b; 2003; 2004; 2010). However, in 2010 fish were tagged using individual single-use hypodermic needles that were pre-loaded with tags. This new system uses a specially designed tagging gun-style injector for rapid insertion of tags and disposal of each needle. This system ensured that each fish was tagged with a sterile, sharp needle, thus subjecting the fish to less stress and injury during the tagging process.

Instream PIT-Tag Monitors

Until recently, opportunities to monitor the migration of PIT-tagged wild juvenile fish were limited to instream or inriver traps, the juvenile fish bypass systems at dams, and a PIT-tag detection trawl system operated in the upper Columbia River estuary. In an effort to detect fish closer to their natal rearing sites, we began development of instream PIT-tag monitoring systems. We placed the first instream detection systems at two sites in Valley Creek during 2002, and development and improvement of these systems has continued since then. More recent development of these systems is discussed below; further detail can be found in Achord et al. (2004; 2005; 2009; 2010; 2011). Briefly, both systems were set up to automatically interrogate, store, and transmit data to the Columbia River PIT-Tag Information System (PTAGIS), a regional shared database operated by the Pacific States Marine Fisheries Commission (PSMFC 1996).

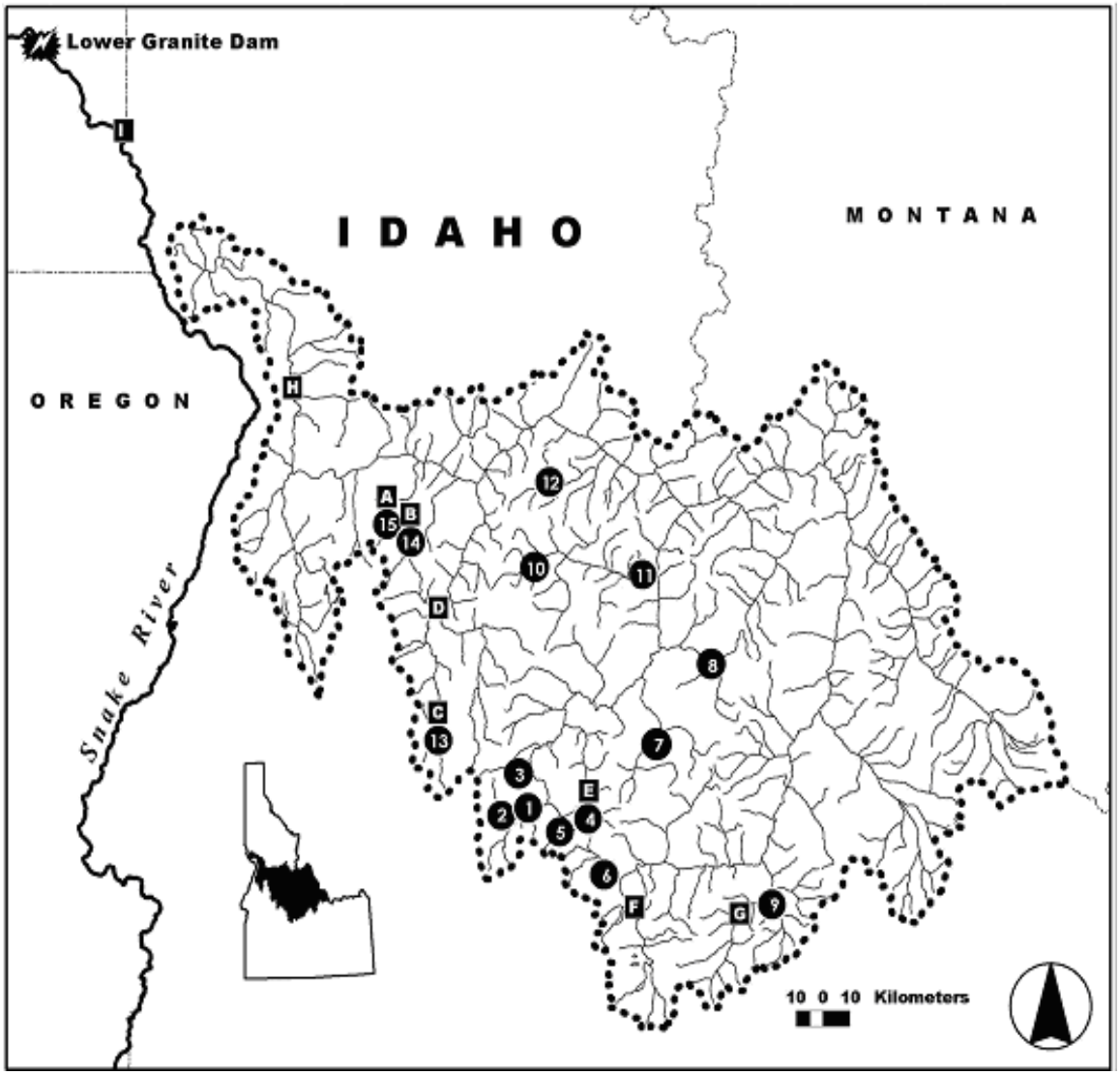

Figure 1. Wild spring/summer Chinook salmon parr were PIT tagged during 2010 in the following streams or sample areas:

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

Juvenile migrant fish traps shown above are as follows:

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

In summer 2007, NMFS transitioned from using the 12-mm TX1411ST PIT tag to the new 12-mm TX1411SST tag. The main reason for this change was the extended detection range (maximum about 43 cm) of the SST tag compared to the ST tag (maximum range about 20 cm). From 1 August 2007 through the first week of September 2007, a single instream antenna was operated at each Valley Creek site. Starting the second week of September 2007, multiplex transceivers were installed, allowing two antennas to operate at each Valley Creek site.

These antennas were constructed of 12.7-mm polyethylene (60-cm base × 3-m long × 17-cm high) and placed end-to-end (with a gap in-between). One of the antennas at the upstream Valley Creek site failed after about 2 months of operation and was not replaced until mid-2008. In addition, as development of this system continued throughout 2007-2008; the monitoring systems operated intermittently.

In summer 2008, four specially designed rectangular antennas were staked to the substrate with duck-billed anchors at the upper Valley Creek monitoring site (VC1). The new antennas were constructed from 10.2-cm (4 inch) diameter schedule-80 PVC pipe. Each antenna was rectangular (3 m long × 0.8 m wide) with two supporting cross-members. Two of these antennas were also installed at the lower Valley Creek monitoring site (VC2) for a total of three antennas at this site (two new antennas placed end-to-end and one 60-cm-wide antenna placed 2 m below them). Both monitoring systems have operated throughout the annual monitoring periods with few problems.

In summer 2010, six new rectangular antennas were staked to the substrate with duck-billed anchors at the lower Valley Creek monitoring site (VC2). These antennas had the same materials and design as the antennas added in 2008, but were longer (6 m long × 0.8 m wide). Both arrays at the lower Valley Creek site now consist of three ~20-ft antennas placed parallel to each other at approximately 5 m apart; thus, both arrays cover the entire stream width. The antennas and configuration for the upper Valley Creek site (VC1) remained the same in 2010-2011 as in 2008.

With the development of PVC-pipe antennas and the new anchoring systems, we decided to install three of these rectangular antennas at Big Creek. Upper (TAY-a) and lower (TAY-b) monitoring systems were installed at lower Big Creek in summer 2008, and remained in place through spring. An additional antenna was installed at the lower monitoring site. The three PVC-pipe antennas installed at this site were washed out during high flows in mid-May 2009, and the remaining antenna flooded at this site about the same time. However, the duck-billed anchors held, and we discovered that stronger straps were needed for attaching antennas to the stakes. All three lost antennas were recovered intact. Despite these problems, both systems operated well through mid-spring 2009. These systems also operated well from late summer 2009 to late spring 2010,

when the cables became dislodged from antennas at both sites. Improvements to these two monitoring sites continued from 2010 through 2011.

In 2009-2010, we began monitoring summer-tagged wild fish at three monitoring sites in the South Fork of the Salmon River drainage developed by the Integrated Status and Effectiveness Monitoring Program (ISEMP project 2003-017-00). These sites were in the lower Secesh River near Zena Creek Ranch (rkm 5), in the lower South Fork Salmon River at Guard Station Road Bridge (rkm 30), and in the South Fork Salmon River near Krassel Creek (rkm 65). These three sites monitored tagged fish from the Secesh and South Fork Salmon Rivers and Lake Creek.

Detection data from wild PIT-tagged Chinook salmon juveniles were collected from five instream detection system sites: Valley Creek, Big Creek, South Fork Salmon River (Krassel), lower South Fork Salmon River (Guard Station Road Bridge), and lower Secesh River from late July 2010 through June 2011.

Juvenile Migrant Traps

Some fish PIT tagged as parr in natal rearing areas were subsequently collected at migrant traps (Figure 1). During fall 2010 and spring 2011, juvenile migrant fish traps were operated at Knox Bridge on the South Fork of the Salmon River, South Fork Salmon River below the mouth of the Secesh River, on Lake Creek, on the Secesh River near Chinook Campground and near the stream mouth, on Marsh Creek, in lower Big Creek at Taylor Ranch, and near the Sawtooth Hatchery on the upper Salmon River.

Also during spring 2011, juvenile migrant fish traps were operated in Idaho on the lower Salmon River near Whitebird and on the Snake River at Lewiston. Traps were operated by the Nez Perce Tribe and the Idaho Department of Fish and Game (IDFG). Generally, fish at these traps were anesthetized, scanned for PIT tags, and then measured for length and weight. Some of these fish were also PIT tagged at the traps. Upon recovery from the anesthetic, all fish were released back to the streams or rivers.

Recaptures at Dams

Since 2001, we have recaptured our study fish at Little Goose Dam to collect information on growth during the parr-to-smolt stage. Recapture is accomplished by programming the PIT-tag separation-by-code (SbyC) system to divert wild tagged fish from the population passing Little Goose Dam (Downing et al. 2001).

In 2011, we continued this effort, and the SbyC system was programmed to separate up to a maximum of 100 wild fish from each stream. All recaptured fish were handled using water-to-water transfers and other best handling practices. After handling, all tagged and untagged fish were returned to the river via the bypass system.

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

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

Condition factor was calculated for these fish both at release (using release data associated with the PIT tag code) and recapture.

Interrogation Systems at Snake and Lower Columbia River Dams

During spring and summer 2011, wild Chinook salmon smolts that had been PIT-tagged as parr in 2010 began volitional migration downstream. Of the eight dams encountered by these smolts on the lower Snake and Columbia Rivers, seven were equipped with smolt collection and/or PIT-tag interrogation systems. These were Lower Granite, Little Goose, Lower Monumental, and Ice Harbor Dam on the Snake River, and McNary, John Day, and Bonneville Dam on the Columbia River.

At these seven dams, all smolts guided from turbine intakes into juvenile bypass systems were electronically monitored for PIT tags by interrogation systems similar to those described by Prentice et al. (1990). Dates and times to the nearest second were automatically recorded as PIT-tagged fish passed each detector. Detection data were transferred to PTAGIS, a regional database, at designated intervals each day. Tagged fish were also monitored using a surface pair-trawl fitted with a PIT-tag detection antenna and operated in the upper Columbia River estuary ~150 km downstream from Bonneville Dam (Ledgerwood et al. 2004).

Data Analyses

Probability Estimates of Detection and Survival

For the PIT-tagged release groups from each stream population, we estimated survival probabilities from release as parr to arrival at Lower Granite Dam as smolts as well as detection probabilities at the dam. For streams with instream monitors, this migration corridor was divided into two smaller segments: 1) a stream segment, which spanned from the point of release to the lower instream monitor, and 2) a river segment, which spanned from the lower instream monitor to the dam.

***Stream segment*—**For estimates of parr-to-smolt survival in each stream segment, we constructed a detection history for each fish that included detection or non-detection at 1) one or both of the upper and lower instream monitors and/or 2) any downstream dam. This produced four possible detection histories. Counts of fish with each detection history were fitted to a multinomial model, with cell probabilities parameterized as functions of detection and survival probability. The model was the Cormack-Jolly-Seber (CJS) single-release model with multiple recapture (Cormack 1964; Jolly 1965; Seber 1965). The CJS model is used extensively for estimates of survival of PIT-tagged fish in the Columbia River basin.

Because there were two monitor sites at the Valley Creek and Lower Big Creek locations, it would have been possible to use information from just those sites to estimate detection and survival probabilities using a method similar to that described by Connolly et al. (2008). However, evidence from past detection data showed that detection at an upper instream monitor was not independent of detection at a lower monitor, violating a critical assumption required by the CJS model. An additional untestable assumption of 100% survival between the upper and lower instream monitors would have allowed us to model the dependency between these detection probabilities; however, sample size in many cases was not sufficient to obtain useful estimates from this model. Therefore, we chose the CJS method described above.

***River segment*—**For the river segment, we estimated survival from release to Lower Granite Dam for all streams. For segments with instream monitors, we also estimated survival from the downstream monitor to Lower Granite Dam. Through the use of auxiliary data (see below), we estimated separate probabilities of survival for each stream overall or each of the three periods when fish were detected by instream monitors: late summer and fall (August-October), winter (November-February), and spring (March-June). For instream monitor estimates, we first grouped detected fish by seasonal period of detection. Then, for each cohort (overall release or instream seasonal groups), we compiled a temporal distribution of detections at Lower Granite Dam (i.e., a daily count of the number of fish from each period detected at the dam on each day).

Each daily count at the dam was then divided by the estimated probability of detection at Lower Granite Dam on that day (see below) to derive an estimate of the total number of fish from each cohort that passed Lower Granite Dam on that day. Daily passage estimates were then summed to give an estimate of the total number of fish from each cohort that survived to Lower Granite Dam. For each stream, this total was divided by the total number of fish released in that stream to derive an estimate of survival to Lower Granite Dam. For streams with monitors, the total that were detected at the upper and lower instream monitors during each seasonal period and survived to Lower Granite was also divided by the total number detected at the monitors during each seasonal period to derive estimates of survival to Lower Granite Dam by season. For streams with monitors, we also estimated an overall parr-to-smolt survival rate to Lower Granite Dam by calculating the weighted average of the three seasonal survival estimates, where each season was weighted according to the proportion of total detections that occurred during that season.

Daily detection probabilities at Lower Granite Dam were estimated as shown in the steps below using auxiliary data with the method of Schaefer (1951) modified by Sandford and Smith (2002). The auxiliary data were for all wild Chinook salmon tagged and released in the Snake River Basin upstream from the dam. For each day of the migration season, we estimated numbers of all wild Chinook salmon PIT-tagged and released upstream from Lower Granite Dam that passed the dam detected or undetected. Thus a series of daily probabilities of detection was developed as follows:

1) Fish detected on day *i* at Little Goose Dam that had previously been detected at Lower Granite Dam were tabulated according to day of passage at Lower Granite Dam.
2) Fish detected on day *i* at Little Goose Dam that had *not* previously been detected at Lower Granite Dam were assigned to an estimated day of passage at Lower Granite Dam, assuming that their passage distribution at Lower Granite Dam was proportionate to that of detected fish.
3) This process was repeated for all days with detections at Little Goose Dam.
4) Detected and non-detected fish passing Lower Granite Dam on day *i* were summed.
5) Detection probability on day *i* was estimated by dividing the number of fish detected at Lower Granite Dam on day *i* by the sum of detected and (estimated) non-detected fish passing that day.

We modified the method slightly (see Sandford and Smith 2002) for estimates in the tails of the passage distribution where the above process was not applicable (e.g., for days when no detections occurred at Little Goose Dam).

Bootstrap methods were used to derive standard errors for the estimated probability of survival for each stream from both release and instream monitors to Lower Granite Dam (Achord et al. 2007b). Auxiliary data were used to derive bootstrap distributions of daily detection probability estimates. Lower Granite Dam detection data for each release or instream monitor group were used for bootstrap distributions of passage at Lower Granite Dam.

Migration Timing

For each stream, we monitored within-season migration timing at Lower Granite Dam based on daily detection numbers at the dam of all wild PIT-tagged Chinook smolts. Streams where wild parr were tagged for this study varied in temperature, elevation, mean flow, and population size. Therefore, to compare arrival timing at Lower Granite Dam between streams, we used an approach analogous to analysis of variance with multiple comparisons.

First, detections at Lower Granite Dam were expanded (i.e., weighted) by dividing daily detection totals by the daily detection probability estimates obtained above. Next, migration timing statistics (i.e., passage dates of the 10th, median, and 90th percentiles of the tagged population from each stream) were calculated based on these expanded detections. The bootstrap method of Efron and Tibshirani (1993) was used to calculate estimates of standard errors (SEs) for each migration timing statistic. Then, a "representative" estimate of variance for each statistic was calculated as the median of the SEs for fish from all 18 stream populations. This method assumed that the timing of passage percentiles had similar distributions among streams. The Student-Newman- Keuls (SNK) multiple comparison method was used to compare each statistic between streams ($\alpha = 0.05$; Petersen 1985).

We also examined arrival timing at Lower Granite Dam of individual populations over a period of years to determine similarities or differences between years and between populations. Comparisons of the 10th, 50th, and 90th percentile passage dates were made among 19 streams or sample areas using a two-factor analysis of variance (ANOVA). Year was considered a random factor, and stream a fixed factor. Residuals were visually examined to assess normality. Treatment means were compared using Fisher's least significant difference procedure (Peterson 1985), with $\alpha = 0.05$.

Environmental Information

In 2010-2011, we also collected hourly measurements of water temperature (°C), dissolved oxygen (ppm), specific conductance (µS/cm), water depth (ft), and pH from the following six locations: Marsh Creek, Valley Creek, Sawtooth Hatchery in the upper Salmon River, South Fork of the Salmon River (Knox Bridge), Secesh River, and Big Creek (lower) at Taylor Ranch. All environmental 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 instream PIT-tag monitoring system (VC2). In 2010-2011, we also collected hourly water temperatures and depths in Bear Valley/Elk Creek and in Sulphur, Chamberlain, West Fork Chamberlain, upper Big, Cape Horn, Herd, Loon, Camas, and Lake Creeks.

RESULTS

Fish Collection and Tagging

From 20 July to 3 September 2010, we collected 18,163 wild Chinook salmon parr from 16 Idaho stream populations (Figure 1). These populations were sampled over a distance of about 47.2 stream km and an area of approximately 419,507 m^2 (Table 1; Appendix Table 1). Of the fish collected, 15,210 were PIT tagged and released back into the streams along with the remaining untagged live fish. Collected fish were rejected for tagging if they had been previously tagged, were too small or injured, had matured precociously, or if sufficient numbers of fish had already been tagged. Numbers of tagged fish released per stream or sample area ranged from 141 in Cape Horn Creek to 2,513 in Valley Creek (Table 1; Appendix Tables 1-2a).

Table 1. Summary of collection, PIT tagging, and release of wild Chinook salmon parr with average fork lengths and weights (includes recaptured tagged fish), approximate distances, and estimated areas sampled in streams of Idaho from July to September 2010.

	Number of fish		Average length (mm)		Average weight (g)		Distance: collection area to stream mouth (km)	Estimated area sampled in streams (m2)
Tagging location	Collected	Tagged & released	Collected	Tagged	Collected	Tagged		
Bear Valley Cr	1,195	1,004	60.7	61.9	3.1	3.1	8-11, 13-14.6	34,816
Elk Creek	1,098	1,025	64.3	63.6	3.8	3.4	0-4	34,116
Marsh Creek	1,221	1,030	62.9	64.1	3.8	3.6	11.5-15	36,959
Cape Horn Creek	396	141	53.6	59.5	3.4	2.7	1-2	7,991
Sulphur Creek	694	671	68.8	68.0	4.5	4.2	5-9	29,100
Valley Creek	2,938	2,513	62.7	63.9	3.4	3.4	4, 7, 11-13	50,379
Loon Creek	874	828	66.2	66.7	3.8	3.9	29-32.5	27,961
Camas Creek	562	506	62.6	63.4	3.3	3.3	21-22.5	14,813
Big Cr (upper)	1,918	1,145	58.6	62.5	3.2	3.0	56-60	35,278
Big Cr (lower)	1,488	1,413	76.2	76.2	5.5	5.5	8-11.4	39,058
Herd Creek	1,092	1,017	68.4	68.1	4.6	4.4	1-3.5	16,612
WF Chamberlain Cr	791	727	64.4	65.3	3.4	3.4	1-2	1,100
Chamberlain Cr	976	697	59.5	62.4	3.4	3.3	24-26	16,265
S Fork Salmon R	1,052	1,034	69.8	69.7	4.4	4.3	117-120	24,693
Secesh River	1,243	1,001	62.7	64.4	3.4	3.4	24-27	33,803
Lake Creek	625	458	58.8	61.1	3.1	3.1	1-3	16,563
Totals or averages	18,163	15,210	63.8	65.0	3.8	3.6	47.2	419,507

In 2010, the mean fork length of all Chinook salmon parr collected was 63.8 mm and the mean weight was 3.8 g. The mean fork length of Chinook salmon parr that were tagged and released was 65.0 mm, and the mean weight was 3.6 g (Table 1; Appendix Table 1). Collection areas within streams were further delineated by recording Global Positioning System coordinates using Universal Transverse Mercator grid (Appendix Table 2b).

Other than Chinook salmon parr, sculpin was the most abundant fish observed during collection operations (Table 2). However, records of non-target fish do not represent their total abundances in the collection areas, as we targeted Chinook salmon for collection, not other coincident species.

Mortality associated with collection and tagging procedures was low (Table 3; Appendix Table 3). Overall, collection mortality was 1.0%, tagging and 24-h delayed mortality was 0.5%, and observed mortality was 1.4%. In addition, 11 lost tags (0.07%) were observed during field work in 2010.

Table 2. Summary of species other than Chinook salmon parr observed during collection operations in Idaho from July to September 2010. Numbers of steelhead in parentheses were PIT tagged for the Idaho Department of Fish and Game.

Streams	Steelhead	Tagged Steelhead	Unidentified Fry	Brook trout	Cutthroat trout	Bull Trout
Bear Valley Creek	212	(0)	312	580	0	0
Elk Creek	131	(0)	121	323	0	2
Marsh Creek	111	(0)	133	586	0	0
Cape Horn Creek	32	(0)	6	26	0	7
Sulphur Creek	126	(0)	280	0	6	0
Valley Creek	336	(0)	1,127	270	0	1
Loon Creek	271	(0)	1,131	0	0	3
Camas Creek	76	(0)	1,163	0	0	2
Big Creek (upper)	437	(127)	261	342	1 (1)	23
Big Creek (lower)	510	(119)	1,091	0	0	2
Herd Creek	139	(0)	549	0	0	4
West Fork Chamberlain Cr	48	(0)	49	0	0	3
Chamberlain Cr	216	(0)	399	1	0	3
S Fork Salmon River	466	(0)	378	19	0	6
Secesh River	149	(0)	332	23	0	9
Lake Creek	17	(0)	60	31	0	12
Totals	3,277	(246)	7,392	2,201	7 (1)	77

Table 2. Continued.

Streams	Sculpin	Dace	Sucker	Whitefish	Shiner
Bear Valley Creek	1,210	24	179	67	0
Elk Creek	1,232	18	178	197	0
Marsh Creek	1,418	0	1	11	0
Cape Horn Creek	231	0	0	0	0
Sulphur Creek	2,098	0	3	17	0
Valley Creek	1,009	85	23	43	11
Loon Creek	495	0	0	8	0
Camas Creek	0	0	0	7	0
Big Creek (upper)	2,843	0	0	1	0
Big Creek (lower)	346	87	11	17	0
Herd Creek	291	0	0	19	0
West Fork Chamberlain Cr	16	0	0	7	0
Chamberlain Cr	555	0	0	9	0
S. F. Salmon River	36	57	0	1	0
Secesh River	651	47	0	5	0
Lake Creek	341	4	0	3	0
Totals	12,772	322	395	412	11

Table 3. Mortality percentages for wild Chinook salmon parr collected and PIT-tagged in Idaho from July to September 2010. There were 11 lost tags for the study.

	Mortality %		
Tagging location	Collection	Tagging and post tagging (24-h)	Overall
Bear Valley Creek	0.5	0.3	0.8
Elk Creek	0.7	0.6	1.3
Marsh Creek	0.7	0.5	1.1
Cape Horn Creek	1.0	0.7	1.3
Sulphur Creek	0.7	0.1	0.9
Valley Creek	1.2	0.04	1.2
Loon Creek	0.5	1.0	1.4
Camas Creek	2.1	0	2.1
Big Creek (upper)	1.7	3.8	4.0
Big Creek (lower)	2.0	0	2.0
Herd Creek	2.3	0.1	2.4
West Fork Chamberlain Creek	0	0	0.0
Chamberlain Creek	0.3	0	0.3
South Fork Salmon River	0.4	0	0.4
Secesh River	0.8	0	0.8
Lake Creek	0.8	0	0.8
Averages	1.05	0.5	1.44

Detections at Instream PIT-Tag Monitors

Valley Creek

From 2 to 4 August 2010, 2,513 wild Chinook salmon parr were collected, PIT tagged, and released in natal rearing areas 3-10 km above the upper instream monitor in lower Valley Creek (VC1; Table 1). Between 2 August 2010 and 30 June 2011, the 10 instream antennas comprising the two Valley Creek sites detected 764 of these fish at least once (Figure 2). Median downstream travel time between the upstream and downstream Valley Creek monitors was approximately 15.6 h (range 37 min-107 d) for the 319 fish detected at both sites. Of the 764 detections, 458 (59.9%) occurred during late summer/fall (Aug-Oct); 249 (32.6%) in winter (Nov-Feb); and 57 (7.5%) in spring (Mar-Jun; Figure 2).

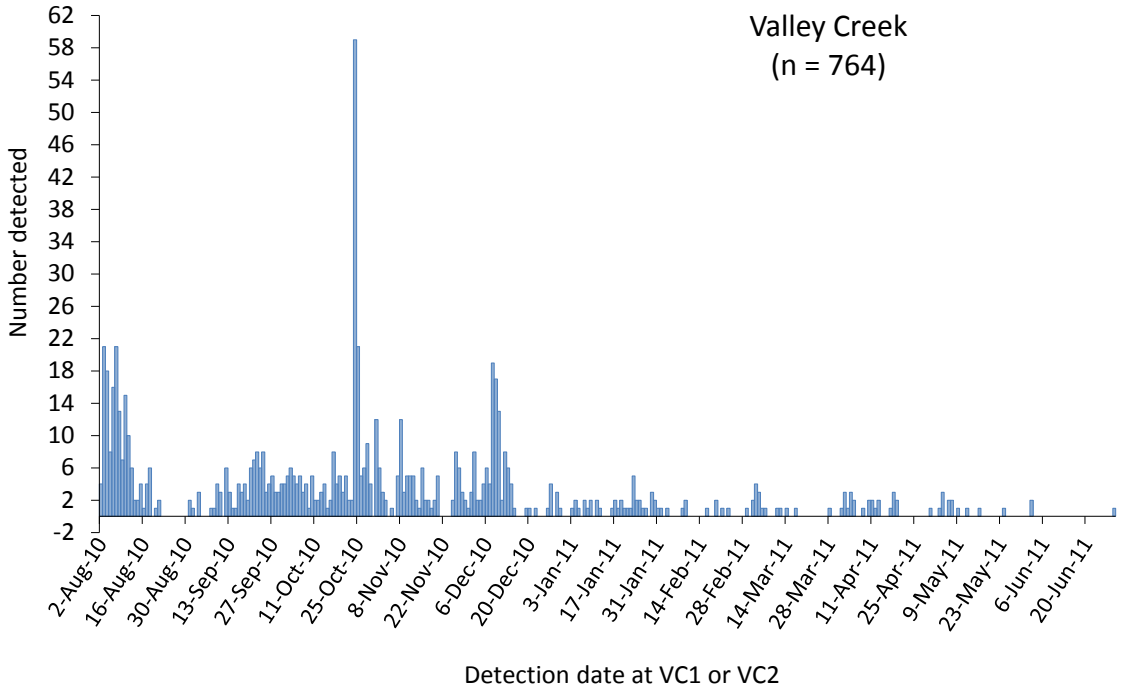

Figure 2. Detections of 764 PIT-tagged wild spring/summer Chinook salmon parr, pre-smolts, and smolts at the upper (VC1) and lower (VC2) in-stream PIT-tag monitoring antennas in lower Valley Creek from August 2010 through June 2011. A total of 2,513 Chinook salmon parr were PIT tagged and released in areas from 3 to 10 kilometers above these antennas from 2 to 4 August 2010.

Based on detections at downstream dams, the overall efficiency of Valley Creek monitors in detecting these fish was 75.9%. Based on this efficiency, an estimated 40.1% (SE = 1.8%; 95% CI 36.4-43.7%) of all summer-tagged parr survived to migrate past the Valley Creek monitors. Their survival from the Valley Creek monitors to Lower Granite Dam was 22.8% (SE = 2.8%; 95% CI 17.6-28.7%). For fish detected from August 2010 to June 2011, we found no significant relationship between timing of detection in lower Valley Creek and fork length at tagging (P = 0.451; Figure 3).

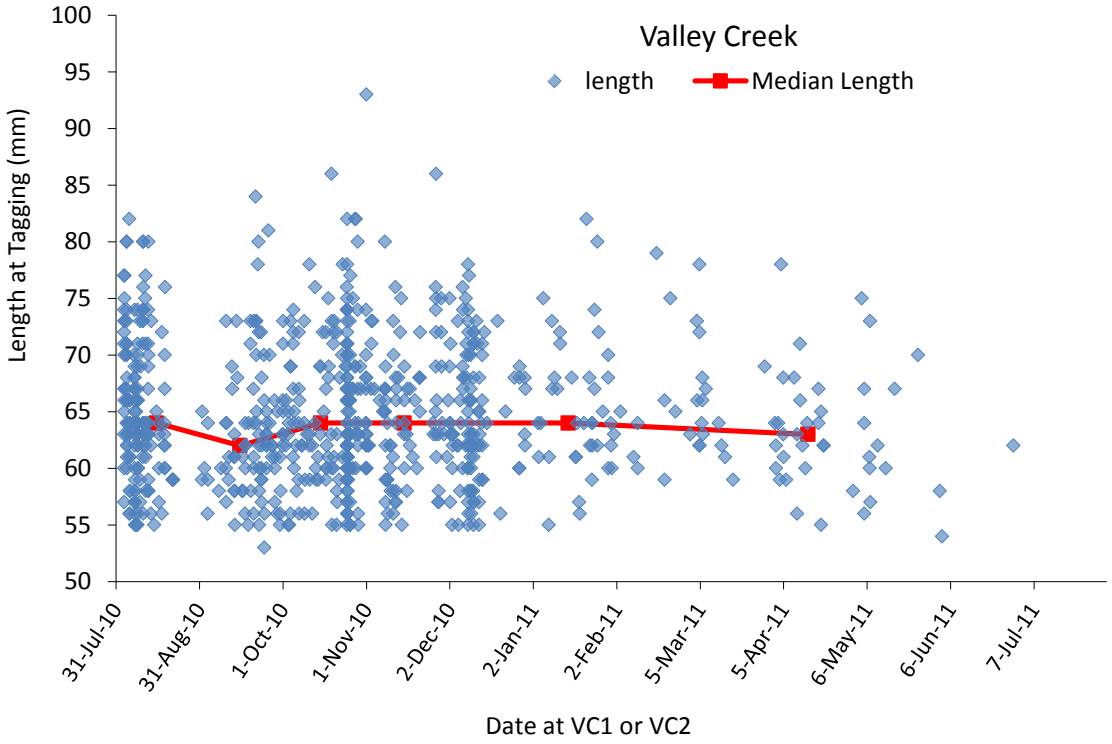

Figure 3. Fork length and median fork length of 764 summer-tagged parr from migration year 2011 that were detected at the upper and lower in-stream PIT-tag monitoring antennas in lower Valley Creek from August 2010 through June 2011.

Lower Big Creek

From 2 to 3 September 2010, 1,413 wild Chinook salmon parr from lower Big Creek were collected, PIT tagged, and released in natal rearing areas 0-3 km above the instream PIT-tag monitors in lower Big Creek at Taylor Ranch (Table 1). Between 2 August 2010 and 30 June 2011, 244 of these fish were detected at least once on the upper and lower Taylor Ranch monitors combined (TAY-a, TAY-b; Figure 4). Of these 244 detections, 179 (73.4%) occurred in late summer/fall (Aug-Oct); 50 (20.5%) in winter (Nov-Feb); and 6 (6.1%) in spring (Mar-Jun; Figure 4).

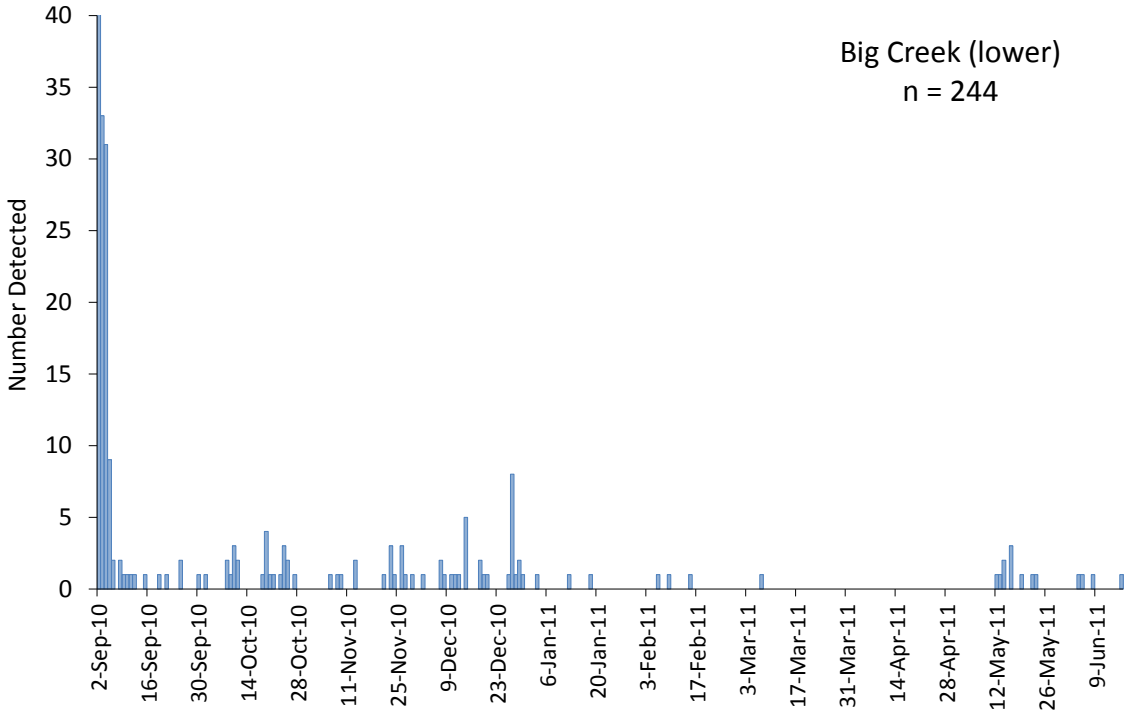

Figure 4. Detections of 244 PIT-tagged wild spring/summer Chinook salmon parr, pre-smolts, and smolts from lower Big Creek at the upper (TAY-a) and lower (TAY-b) in-stream PIT-tag monitoring antennas at Taylor Ranch in lower Big Creek from September 2010 through June 2011. A total of 1,413 Chinook salmon parr were PIT tagged and released in areas from 0 to 3 kilometers above these antennas from 2 to 3 September 2010.

Based on detections at downstream dams, the overall detection efficiency of the upstream and downstream monitors at lower Big Creek was 20.1%. Using this detection efficiency rate, we estimated that 86.0% (SE 9.0%, 95% CI 68.1-104%) of all summer-tagged parr from this stream (area) survived to migrate past the monitors at lower Big Creek, and their survival from the monitors to Lower Granite Dam was 26.7% (SE = 4.9%; 95% CI 17-35.9%). Detection data collected from September 2010 to June 2011 indicated a statistically significant relationship between fork length at tagging and timing of detection in lower Big Creek (P = 0.031; Figure 5).

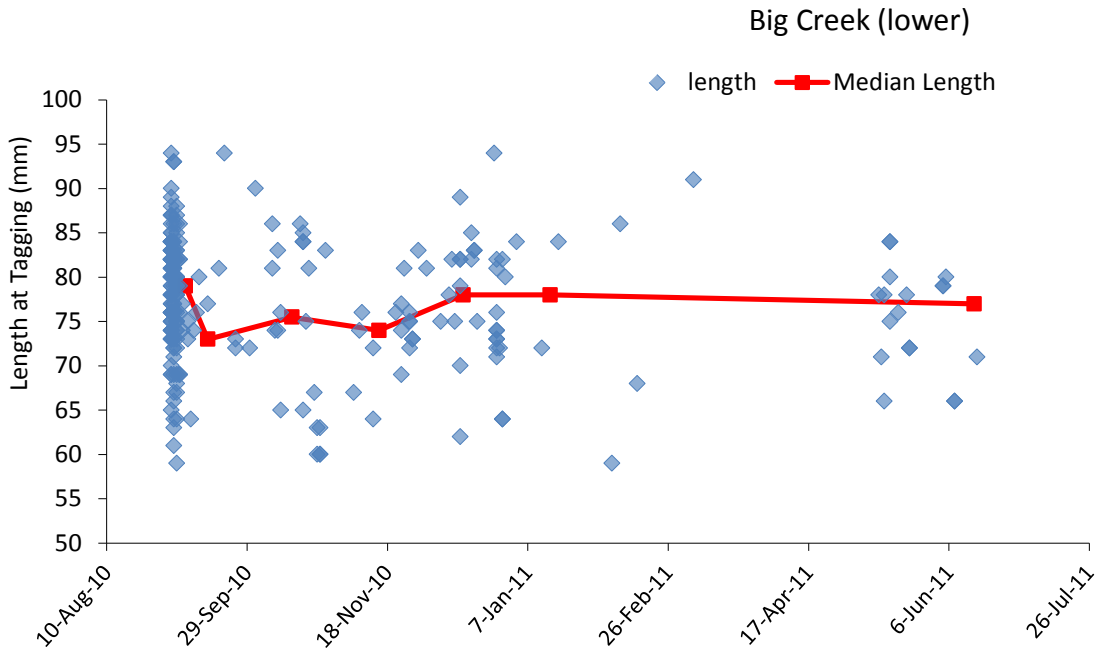

Figure 5. Length at tagging (FL) and median fork length of 244 summer-tagged parr from lower Big Creek that were detected at Taylor Ranch upper and lower in-stream PIT-tag monitoring antennas, September 2010-June 2011.

Upper Big Creek

From 16 to 17 August 2010, 1,145 wild Chinook salmon parr from upper Big Creek were collected, PIT tagged, and released in natal rearing areas 49-52 km upstream from the Taylor Ranch instream monitors in lower Big Creek (Table 1). Between August 2010 and June 2011, the upper and lower monitoring sites had 46 unique detections of these fish (Figure 6). Of these 46 detections, 36 (78.3%) occurred in late summer/fall, 6 (13.0%) in winter, and 4 (8.7%) in spring (Figure 6).

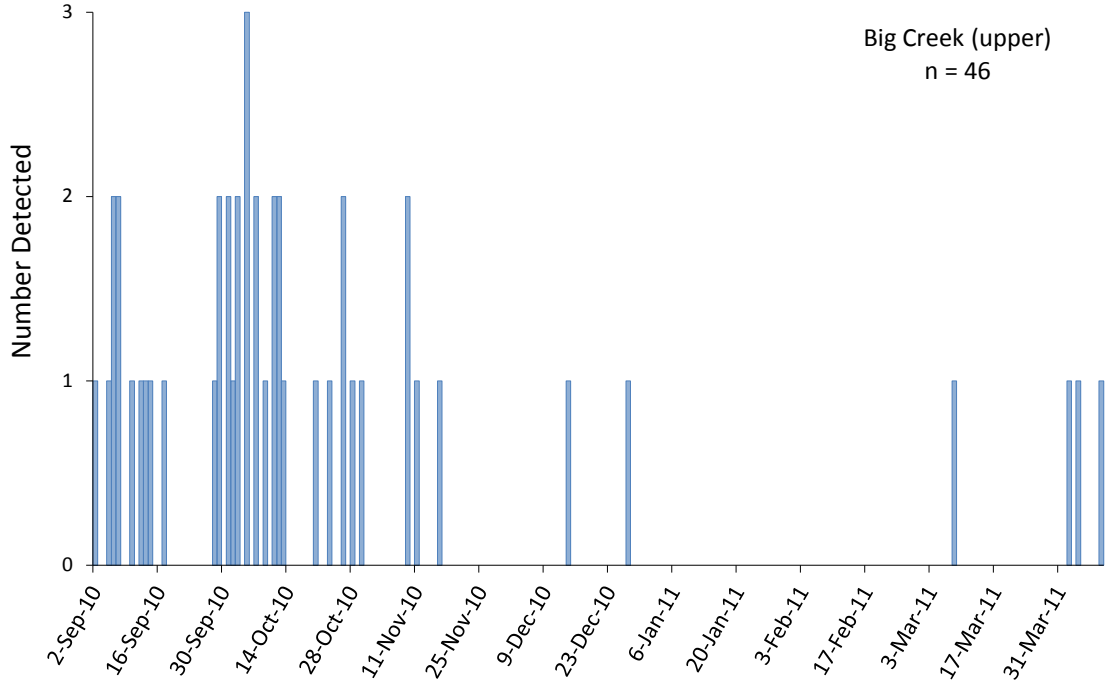

Figure 6. Detections of 46 PIT-tagged wild spring/summer Chinook salmon parr, pre-smolts, and smolts from upper Big Creek at the upper (TAY-a) and lower (TAY-b) in-stream PIT-tag monitoring antennas at Taylor Ranch in lower Big Creek from September 2010 through June 2011. A total of 1,145 Chinook salmon parr were PIT tagged and released in areas 49-52 kilometers above these antennas from 16 to 17 August 2010.

Based on detections at downstream dams, the overall efficiency of the upper or lower instream monitors at Taylor Ranch in lower Big Creek in detecting these fish was 8.8%. Based on this efficiency, an estimated 45.8% (SE = 12.3%, 95% CI 21.1-70.5%) of all summer-tagged parr survived to migrate past the downstream monitors, and their survival from the downstream monitors to Lower Granite Dam was 28.6% (SE = 10.8%, 95% CI 9.4-50.7%). Detection data collected from August 2010 to June 2011 indicated a statistically significant relationship between fork length at tagging in upper and lower Big Creek and timing of detection on the upper and lower monitors (TAY-a and TAY-b, respectively) at Taylor Ranch ($P = 0.031$; Figures 5 and 7).

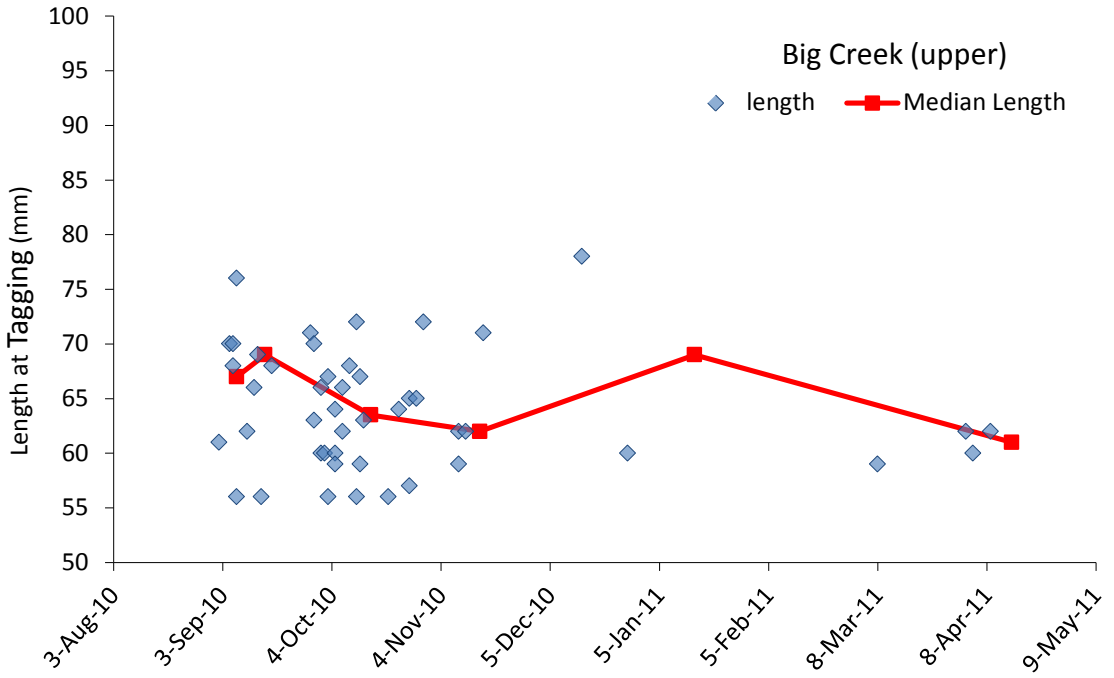

Figure 7. Length at tagging (FL) and median fork length of 46 summer-tagged parr from upper Big Creek that were detected at Taylor Ranch upper and lower in-stream PIT-tag monitoring antennas, August 2010-June 2011.

South Fork Salmon River

From 19 to 20 August 2010, 1,034 wild Chinook salmon parr from the South Fork Salmon River were collected, PIT tagged, and released in natal rearing areas (Table 1). These fish were released 52-53 km above the instream monitor near Krassel Creek (rkm 65) and 87-88 km above the monitor in the lower South Fork Salmon River at Guard Station Road Bridge (rkm 30). From August 2010 to June 2011, only 11 of these fish were detected at the South Fork Salmon River monitor near Krassel Creek, and only 4 were detected at the site near Guard Station Road Bridge. Because the efficiency of the Krassel monitoring site for detecting tagged fish plummeted to 1-2% for 2010-2011, compared to 52.7% in 2009-2010, no further estimates based on these detections are made downstream. However, the overall parr-to-smolt estimated survival from this stream to Lower Granite Dam is 20.1% for 2010-2011 (see Table 5).

Secesh River and Lake Creek

From 27 to 30 August 2010, 1,459 wild Chinook salmon parr from the Secesh River and Lake Creek were collected, PIT tagged, and released in or near their natal rearing areas (Table 1). Release sites were 21-42 km above the instream PIT-tag monitors near Zena Creek Ranch, and ~55-76 km above the South Fork Salmon River monitoring site at Guard Station Road Bridge. From August 2010 to June 2011, 247 of these fish were detected at the lower Secesh River site near Zena Creek Ranch (Figure 8), but only 4 were detected at the lower South Fork Salmon River near Guard Station Road Bridge. Of the 247 detections near Zena Creek, 204 (82.6%) occurred in late summer/fall, 35 (14.2%) in winter, and 8 (3.2%) in spring (Figure 8). An estimated 48.8% (SE = 4.5%, 95% CI 39.8-57.9%) of all summer-tagged parr from these streams survived to migrate passed these monitors, and their subsequent survival to Lower Granite Dam was 36.0% (SE = 5.6%, 95% CI 25.5-47.6%). For fish detected from August 2010 to June 2011, we found a significant relationship between timing of detection in the lower Secesh River and fork length at tagging ($P < 0.001$; Figure 9).

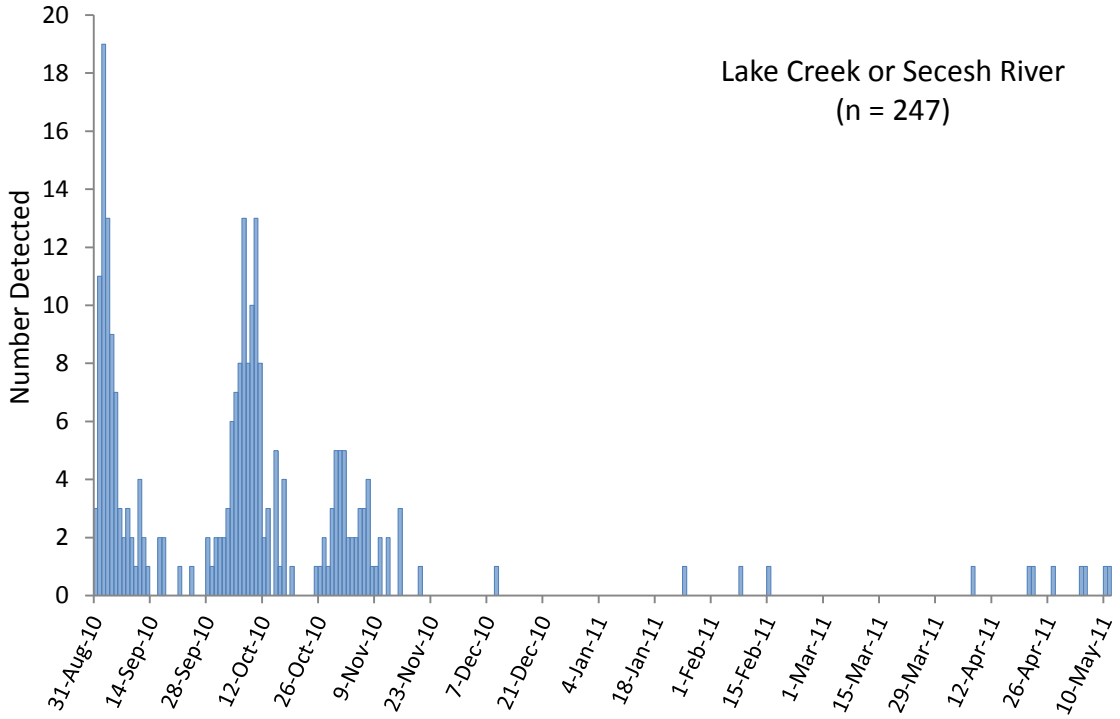

Figure 8. Detections of 247 PIT-tagged wild spring/summer Chinook salmon parr, pre-smolts, and smolts from the Secesh River or Lake Creek at the Zena Creek Ranch in-stream PIT-tag monitoring antennas in lower Secesh River from August 2010 through June 2011. A total of 1,459 Chinook salmon parr were PIT tagged and released in areas from (approximately) 21 to 42 kilometers above these antennas from 27 to 30 August 2010.

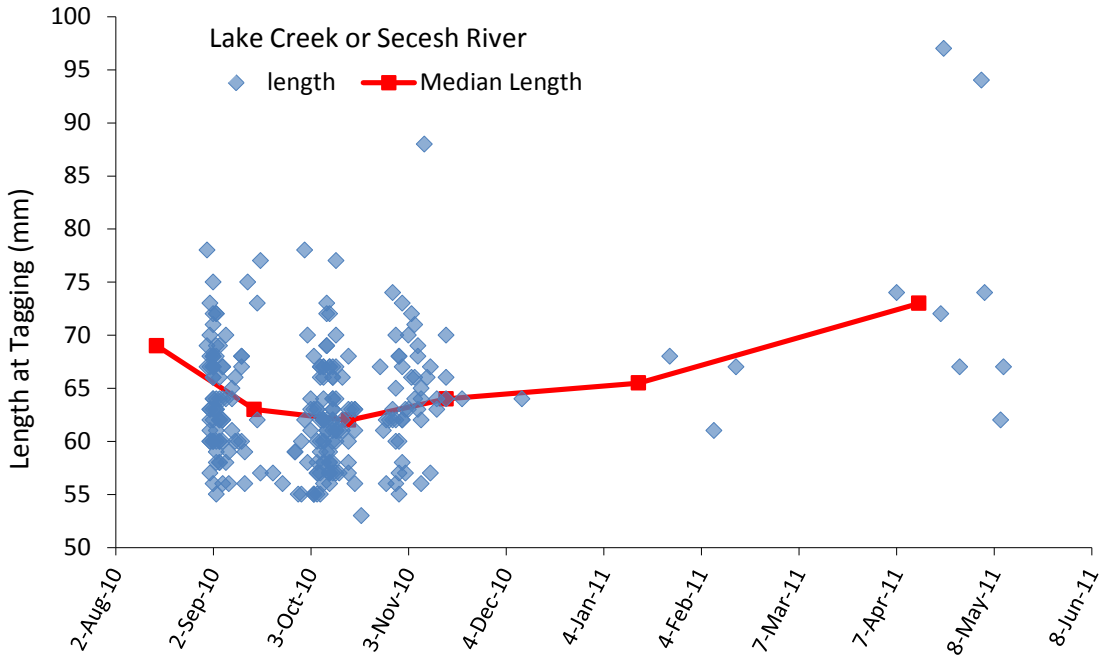

Figure 9. Length at tagging (FL) and median fork length of 247 summer-tagged parr from the Secesh River and Lake Creek that were detected at the in-stream PIT-tag monitoring site in the lower Secesh River near Zena Creek, August 2010-June 2011.

Recaptures at Traps and Dams

A total of 1,013 wild fish PIT-tagged in summer 2010 were recaptured at traps above Lower Granite Dam from summer-fall 2010 to spring 2011, and 463 were recaptured in the separation-by-code system at the Little Goose Dam juvenile fish facility (Table 4). Overall parr-to-smolt growth measured at Little Goose Dam indicated a mean growth rate of 0.15 mm/d and mean weight gain of 0.033 g/d.

Table 4. Length, weight, and condition of wild spring/summer Chinook salmon PIT-tagged in Idaho during summer 2010 and recaptured either in the separation-by-code system at Little Goose Dam (2011) or at traps during summer-fall 2010 and spring-summer 2011. Condition factor and weight gain could be calculated only for fish that had been weighed at tagging. No fish were recaptured at dams other than Little Goose.

	Recaptured fish						Weight and condition factor (CF)				
		Days to recapture		Length gain (mm)				Weight gain (g)		Mean CF	
	n	range	mean	n	range	Mean	n	range	Mean	release	recapture
Wild spring/summer Chinook salmon recaptured at Little Goose Dam											
Bear Valley Creek	26	290-330	301	26	31-75	47.2	23	5-20	10.4	1.33	1.02
Elk Creek	41	280-339	298	41	25-61	42.6	33	5-16	8.8	1.3	1.03
Sulphur Creek	19	281-312	287	19	32-51	39.9	19	6-14	8.8	1.33	1.03
Marsh Creek	43	277-323	293	43	28-62	43.6	30	5-16	9.9	1.32	1.07
Valley Creek	39	275-324	290	39	34-59	45.3	31	5-15	10.9	1.26	1.04
Loon Creek	40	266-299	277	40	23-57	39.8	38	6-16	9.2	1.25	1.07
Camas Creek	30	273-311	286	30	25-62	42	28	5-18	9	1.29	1.02
Big Creek (upper)	30	265-314	275	30	25-55	42.6	21	4-15	9.8	1.32	1.08
Big Creek (lower)	63	245-284	254	61	24-60	36.3	20	6-10	8.5	1.12	1
South Fork Salmon R.	26	259-293	268	24	20-50	36.9	24	4-14	8.8	1.29	1.04
West Fork Chamberlain Cr	21	255-307	267	20	27-58	43	14	6-14	10	1.15	1.02
Chamberlain Creek	22	247-287	261	22	25-62	47	14	5-20	10.8	1.3	1.05
Secesh River	19	253-291	263	19	20-63	43.7	12	4-17	8.8	1.21	1.02
Lake Creek	8	253-301	267	8	16-54	41.5	4	6-12	9.1	1.22	1.05
Herd Creek	35	271-307	279	35	26-75	41.8	23	6-25	9.7	1.28	1.04
Cape Horn Creek	1	N/A	289	1	N/A	25	1	N/A	3	1.67	1.04
Totals or averages	463	245-339	278	458	16-75	41.1	335	4-25	9.1	1.29	1.04
Wild spring/summer Chinook salmon recaptured at traps											
Upper Big Creek (Taylor)											
summer-fall 2010	92	15-87	50	91	-2-20	6.2	67	-1-4	0.6	1.26	1.1
Spring	3	229-249	242	3	15-26	20.3	1	N/A	2.4	1	1.06
Lower Big Creek (Taylor)											
summer-fall 2010	116	1-67	8	116	-7-10	-1.6	38	-2-3	-0.2	1.16	1.15

Table 4. Continued.

	Recaptured fish						Weight and condition factor (CF)				
		Days to recapture		Length gain (mm)				Weight gain (g)		Mean CF	
	n	range	mean	n	range	Mean	n	range	Mean	release	Recapture
	Wild spring/summer Chinook salmon recaptured at traps (continued)										
SF Salmon River (Knox)											
summer-fall 2010	205	1-65	21	201	-4-16	3.5	157	-2-4	0.2	1.24	1.12
spring 2011	5	212-251	234	5	17-26	21.8	3	4-5	4.1	1.26	1.04
Lake Creek											
summer-fall 2010	72	1-56	30	63	-2-14	4.6	29	-2-2	0.1	1.42	1.13
spring 2011	3	215-255	240	3	14-20	16.3	2	0-3	1.8	1.27	1.09
SF Salmon River (lower)											
summer-fall 2010	42	25-89	65	40	4-20	10.1	30	0-3	1	1.31	1.08
spring 2011	6	196-210	204	6	9-19	14.2	4	1-3	1.7	1.28	1.04
Secesh River Upper trap											
summer-fall 2010	45	2-71	39	44	2-10	5.8	18	-1-1	0.2	1.4	1.08
spring 2011	1	N/A	253	1	N/A	14	0	N/A	N/A	N/A	1.18
Secesh River Lower trap											
summer-fall 2010	76	4-73	27	76	-4-17	2.9	31	-1-2	0.2	1.22	1.13
spring 2011	3	279-293	284	3	82-93	87	1	N/A	4.8	1.42	1.18
Marsh Creek Upper trap											
summer-fall 2010	221	1-92	47	221	-1-27	12.3	0	N/A	N/A	1.34	N/A
spring 2011	1	N/A	301	1	N/A	27	0	N/A	N/A	N/A	1.07
Marsh Creek Lower trap											
summer-fall 2010	100	1-99	48	100	-2-24	10.8	1	N/A	3.1	1.34	1.21
spring 2011	2	261-275	268	2	25-30	27.5	1	N/A	8.7	N/A	1.08
Salmon River											
spring 2011	15	219-261	241	15	13-49	32	0	N/A	N/A	N/A	N/A
Snake River											
spring 2011	4	213-280	250	4	17-53	36.5	0	N/A	N/A	1.28	N/A
Yankee Fork											
summer-fall 2010	1	N/A	45	1	N/A	12	1	N/A	2.6	1.03	1.1
Totals	1,013	1-293	145	996	-7-93	18.2	384	-2-5	2.1	1.26	1.1

Detection at Dams

Parr-to-Smolt Survival Estimates

For fish from all Idaho streams combined, we estimated an average annual parr-to-smolt survival probability of 17.4% (SE 1.0%; Table 5; Appendix Tables 5-20). This estimate was based on expanded detections at Lower Granite Dam from 1 April to 27 June 2011 (2,653 fish).[1] An additional 1,060 first-time detections (not expanded) were recorded at Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, and Bonneville Dam, and in the PIT-tag detection trawl in the upper Columbia River estuary (Appendix Tables 5-19 and 21-26). By comparing all first-time detections at interrogation dams and the trawl (2,093) to the expanded number of detections at Lower Granite Dam (2,653), we estimated that 21.1% of the wild fish from Idaho passed the dams without being detected.

Table 5. Summary of observed and expanded detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Lower Granite Dam in 2011. Expanded numbers are parr-to-smolt survival estimates (%); standard errors in parenthesis. See Table 1 for numbers released.

	Lower Granite Dam Detections			
	Observed		Expanded	
Stream	N	%	N	% (SE)
Bear Valley Creek	58	5.8	145	14.4 (2)
Elk Creek	71	6.9	180	17.6 (2)
Marsh Creek	91	8.8	232	22.5 (2)
Cape Horn Creek	9	6.4	22	15.6 (5)
Sulphur Creek	49	7.3	121	18.0 (3)
Valley Creek	75	3.0	201	8.0 (1)
Loon Creek	82	9.9	214	25.9 (3)
Camas Creek	66	13.0	182	35.9 (4)
Herd Creek	76	7.5	204	20.0 (2)
Big Creek (upper)	52	4.5	138	12.1 (2)
Big Creek (lower)	136	9.6	328	23.2 (2)
WF Chamberlain/Chamberlain Cr	101	7.1	253	17.8 (2)
S Fork Salmon River	80	7.7	208	20.1 (2)
Secesh River	68	6.8	177	17.6 (2)
Lake Creek	19	4.1	49	10.6 (2)
Totals or averages	1,033	6.8	2,653	17.4 (1)

[1] Due to rounding, the expanded detection numbers at Lower Granite Dam in Table 5 may vary slightly from those in Appendix Tables 5-20.

Valley Creek—For Chinook salmon juveniles detected at the Valley Creek instream PIT-tag monitors, we estimated an overall survival rate to Lower Granite Dam of 22.8% in 2011 (SE = 2.8%; 95% CI 17.6-28.7%). Estimated overall parr-to-smolt survival for fish from this stream was 8.0% (SE 0.9%; 95% CI 6.2-9.9%; Table 5). Estimated survival to Lower Granite Dam in 2010-2011 was 17.9% (SE = 3.2%; 95% CI 12.1-24.7%) for fish leaving Valley Creek in late summer/fall, 22.2% (SE = 4.9%; 95% CI 13-32.1%) for fish leaving in winter, and 65.3% (SE = 18.1%; 95% CI 31.8-100.7%) for fish leaving in spring.

Big Creek—For Chinook salmon juveniles PIT tagged in lower Big Creek and detected at the Big Creek instream PIT-tag monitors, overall survival to Lower Granite Dam was estimated at 26.7% (SE = 4.9%; 95% CI 17-35.9%). Overall parr-to-smolt estimated survival for fish from this stream (area) was 23.2% (SE 1.9%; 95% CI 19.5-27.2%; Table 5). During 2010-2011, estimated survival was 28.8% (SE = 5.9%; 95% CI 18-41.5%) for lower Big Creek fish detected in late summer/fall, 27.4% (SE = 10.6%; 95% CI 9.1-50.7%) for fish detected in winter, and 0% for fish detected in spring.

For Chinook salmon juveniles PIT tagged in upper Big Creek and detected on the lower Big Creek instream monitors, overall survival to Lower Granite Dam was estimated at 28.6% (SE = 10.8%; 95% CI 9.4-50.7%). Overall parr-to-smolt survival for fish from upper Big Creek was estimated at 12.1% (SE = 1.7%; 95% CI 8.9-15.7%; Table 5). For upper Big Creek fish detected at the Big Creek monitors, estimated survival to Lower Granite Dam in 2010-2011 was 18.4% (SE = 10%; 95% CI 0-37.9%) for upper Big Creek fish detected in late summer/fall, 0.0% for fish detected in winter, and 163.3% (SE = 83.6%; 0-329.4%) for fish detected in spring.

Secesh River and Lake Creek—In 2011, we estimated a 36.0% (SE = 5.6%; 95% CI 25.5-47.6%) overall survival rate to Lower Granite Dam for Chinook salmon juveniles previously detected at the lower Secesh River instream PIT-tag monitors near Zena Creek. For fish detected at this monitoring site, estimated survival rates to the dam in 2010-2011 were 37.2% (SE = 6.4%; 95% CI 25.1-49.6%) for fish detected in late summer/fall, 21.3% (SE = 11.9%; 95% CI 0-48.2%) for fish detected in winter, and 70.3% (SE = 44.4%; 95% CI 0-167.4%) for fish detected in spring. The overall parr-to-smolt estimated survival rate for fish from these streams was 15.4% (SE 2.2%; 95% CI 11.0-19.8%).

Relationship between Length and Detection

For fish from all Idaho streams combined, average fork length at release was 65.0 mm (Table 1; Appendix Table 1). Among these fish, the average fork length at release of fish detected the following spring at dams was significantly longer than that of fish not detected at the dams (67.3 vs. 65.4 mm; $P < 0.01$). Also, fish that were larger at release tended to pass Lower Granite Dam earlier than their smaller cohorts ($P < 0.001$; Figure 10).

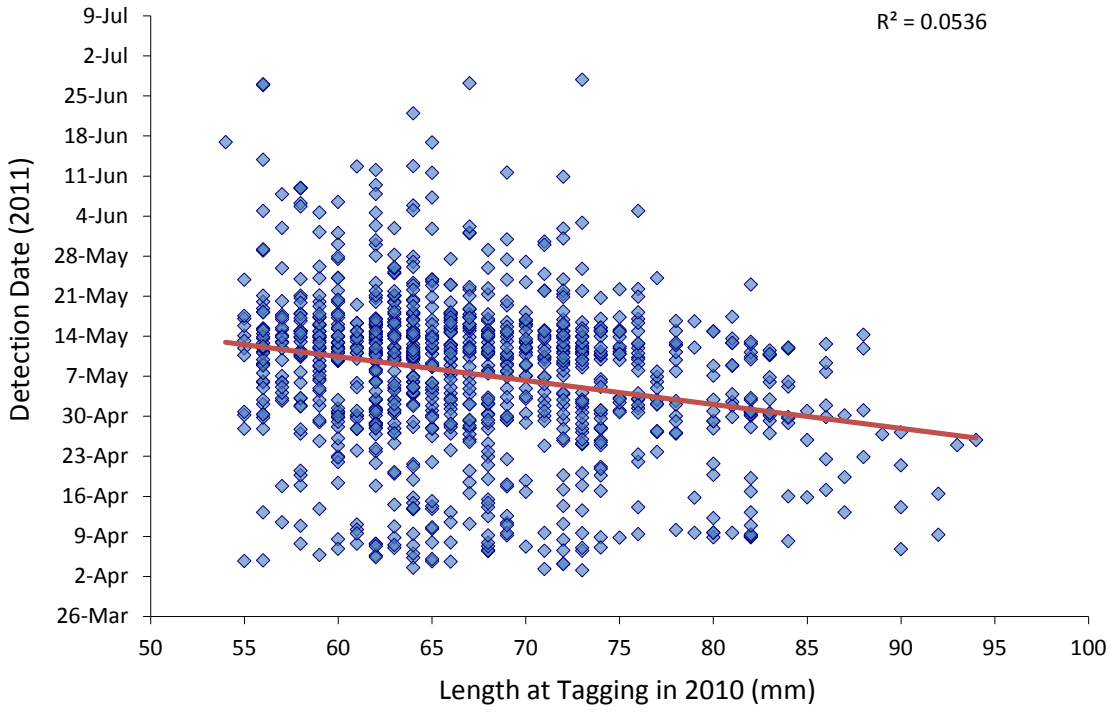

Figure 10. The relationship between fork length of Idaho parr at tagging (in 2010) to detection date at Lower Granite Dam in 2011 (n = 1,023).

All Idaho fish were grouped in 5-mm length bins, and their length distributions were compared using a series of chi-square tests. The length distributions of all fish were compared to those of fish detected at the dams in spring. The expected number of detected fish from each length bin was based on the proportion of released fish in each bin and was compared to the observed number. For the two smallest length bins (60-64 mm and 59 mm or less), significantly less detected fish were observed than expected ($P < 0.0001$ for both) and for the three largest length bins significantly more detected fish were observed than expected ($P < 0.02$ for all three; Figure 11). For the length bin 65-69, expected and observed detections were similar ($P = 0.067$).

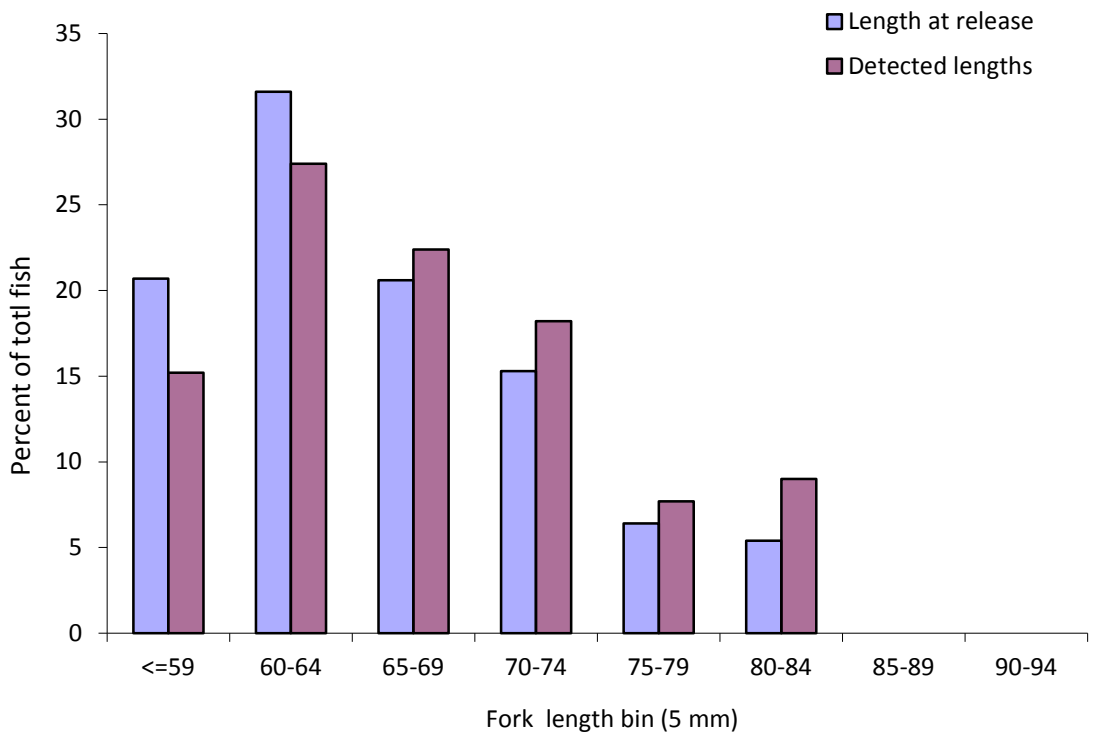

Figure 11. Percent by fork length increments (mm), of PIT-tagged wild spring/summer Chinook salmon parr released in Idaho streams in 2010 (n = 15,123) and percent of fish detected for these length increments at dams in spring and summer 2011 (n = 2,073).

In 2011, we found a significant difference in fork length at time of release between fish that passed Lower Granite Dam in April and May and fish that passed after May ($P < 0.0001$). Fish migrating through the dam in April and May were on average 4.8 mm larger at release than fish migrating after May. However, only 40 fish migrated through the dam after May. These data suggest that fish size may have influenced migration timing or overwintering location.

Migration Timing

Lower Granite Dam

Passage timing at Lower Granite Dam varied for fish from the 19 Idaho and Oregon stream populations (Figure 12). Comparisons among these 19 populations (Appendix Table 4a-4b, Figure 12) showed that fish from Cape Horn Creek and the upper Imnaha River had a significantly earlier passage timing of the 10th percentile than fish from all the other streams except Big (lower), Marsh, Lake, Elk, and Herd Creeks and the South Fork Salmon, Secesh, and Lostine Rivers (P <0.05). The 10th percentile passage date of fish from upper Big Creek was significantly later than that of fish from all other streams except Camas, Catherine, and Loon Creeks (P <0.05). Standard errors of these estimates ranged 0.8-5.9 d (median 2.36 d). Overall, the 10th percentile passage date for fish from all 19 stream populations ranged from 4 April to 7 May (Appendix Tables 4a-4b).

In comparisons of the 50th percentile passage date at Lower Granite Dam, fish from Big (lower) and Cape Horn Creeks and Secesh River were significantly earlier than fish from all other streams except Elk and Sulphur Creeks and South Fork Salmon and Lostine Rivers (P <0.05). Fish from Big (upper) and Camas Creeks were significantly later than fish from all other streams except Valley, Loon, and Herd Creeks and the Minam River (P <0.05). Standard errors of these estimates ranged 0.4-7.8 d (median 1.17 d). The 50th percentile passage date for fish from all 19 stream populations ranged from 1 May to 16 May (Appendix Tables 4a-4b).

In terms of the 90th percentile passage date at the dam, fish from Big (lower) and Cape Horn Creeks were significantly earlier than fish from all other streams except Lake, Marsh, Sulphur, Herd, and Loon Creeks (P <0.05). Fish from Catherine Creek were significantly later than fish from all other stream populations except Secesh, Lostine, and Minam Rivers and Valley Creek (P <0.05). Standard errors of these estimates ranged from 0.2 to 6.7 d (median 1.64 d). The 90th percentile passage date for fish from all streams combined ranged from 14 May to 8 June (Appendix Tables 4a-4b).

For the number of days encompassing the middle 80th percentile passage (10th to 90th percentile), fish from Big (upper), Camas, and Loon Creeks had a significantly more condensed distribution (17-19 d) than did fish from all other streams (34-61 d; P <0.05) except Sulphur Creek (28 d) (Appendix Tables 4a-4b). Fish from the Secesh, Imnaha, and Lostine Rivers displayed significantly more protracted timing at the dam than fish from all other stream populations (56-61 d vs. 17-46 d; P <0.05). Standard errors of these estimates ranged 0.8-7.7 d (median 3.23 d).

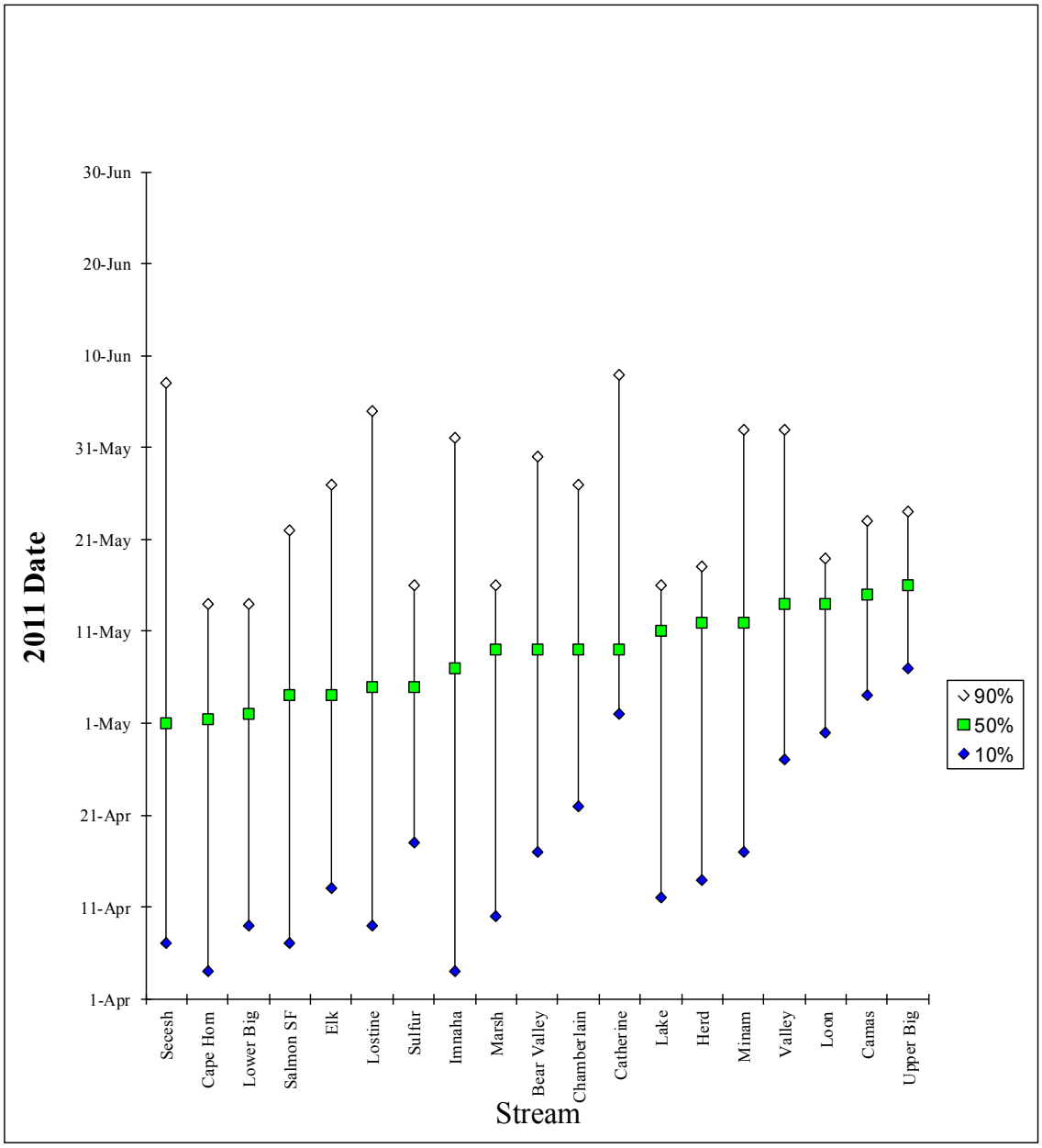

Figure 12. Estimated passage distribution at Lower Granite Dam in 2011 for wild spring/summer Chinook salmon smolts from streams of Idaho and Oregon. Big Creek is divided into lower and upper portions and Chamberlain and W.F. Chamberlain Creeks were combined for these analyses. See Appendix Tables 5-20 for daily estimated passage numbers from Idaho streams.

Detection data at Lower Granite Dam for fish from streams with 8 or more years of data has shown clear variation in arrival timing of the 10th, 50th, and 90th percentiles among these 19 stream populations (Table 6). Secesh River fish had significantly earlier passage timing of the 10th population percentile at Lower Granite Dam than fish from all other streams except Lake Creek, and Lostine, Minam, and upper Imnaha Rivers (P <0.05). Also, upper Big Creek fish had significantly later migration timing at the dam than fish from all other streams (P <0.05).

Secesh River fish had significantly earlier arrival timing at Lower Granite Dam of the 50th population percentile than fish from all other streams except lower Big Creek (P <0.05). Fish from upper Big Creek had significantly later timing of the 50th percentile at the dam than fish from all other streams except Catherine Creek (P <0.05). Lower Big Creek fish had significantly earlier timing of the 90th percentile at the dam than fish from all other streams except Herd Creek (P <0.05). Fish from upper Big and Catherine Creeks had significantly later passage timing of the 90th percentile than fish from all other streams except Bear Valley, Cape Horn, Lake, and Valley Creeks, and the Secesh and South Fork of the Salmon Rivers (P <0.05).

Table 6. The 95% confidence interval (CI) and mean passage dates (10th, 50th, and 90th percentiles), with standard errors (SE) in days, at Lower Granite Dam for wild spring/summer Chinook salmon smolts from streams in Idaho and Oregon over all data years.

	Percentile passage dates at Lower Granite Dam (95% CI, mean, SE)			
Stream	10th (SE)	50th (SE)	90th (SE)	Data years
Secesh River	11-17 April, 14 April (1)	24-29 April, 26 April (1)	24 May-5 June, 30 May (3)	22
South Fork Salmon River	16-23 April, 20 April (2)	6-12 May, 9 May (1)	31 May-9 June, 4 June (2)	20
Catherine Creek	24-29 April, 27 April (1)	11-19 May, 15 May (2)	29 May-9 June, 3 June (3)	21
Imnaha River (upper)	13-19 April, 16 April (1)	30 April-5 May, 3 May (1)	19-27 May, 23 May (2)	19
Bear Valley Creek	18-25 April, 21 April (2)	5-11 May, 8 May (1)	26 May-3 June, 30 May (2)	20
Big Creek (upper)	26 April-4 May, 30 April (2)	13-23 May, 18 May (2)	28 May-13 June, 5 June (4)	17
Elk Creek	17-24 April, 20 April (2)	2-8 May, 5 May (1)	24 May-1 June, 28 May (2)	19
Valley Creek	22-29 April, 25 April (2)	9-17 May, 13 May (2)	30 May-9 June, 4 June (2)	20
Marsh Creek	17-23 April, 20 April (1)	2-8 May, 5 May (1)	19-27 May, 23 May (2)	17
Lake Creek	13-19 April, 16 April (2)	27 April-4 May, 1 May (2)	23 May-6 June, 30 May (3)	18
Lostine River	13-20 April, 16 April (2)	1-7 May, 4 May (1)	19-27 May, 23 May (2)	20
Sulphur Creek	17-26 April, 22 April (2)	2-14 May, 8 May (3)	20 May-1 June, 26 May (3)	13
Cape Horn Creek	18-29 April, 23 April (3)	6-15 May, 11 May (2)	22 May-4 June, 29 May (3)	14
Big Creek (lower)	16-22 April, 19 April (1)	26 April-1 May, 29 April (1)	8-15 May, 11 May (1)	15
E. Fork Salmon River	15-24 April, 19 April (2)	25 April-7 May, 1 May (2)	13-23 May, 18 May (2)	7
Loon Creek	23 April-1 May, 27 April (2)	5-13 May, 9 May (2)	17-25 May , 21 May (2)	13
Herd Creek	17-24 April, 21 April (2)	28 April-5 May, 1 May (2)	12-19 May, 15 May (2)	13
Grand Ronde River (upper)	23 April-10 May, 1 May (3)	13 May-4 June, 24 May (4)	21 May-3 July, 12 June (8)	5
Imnaha River (lower)	5-20 April, 12 April (2)	14 April-5 May, 25 April (3)	2-15 May, 9 May (2)	4
Chamb/WF Chamberlain Cr	17-24 April, 21 April (2)	29 April-8 May, 3 May (2)	16 May-7 June, 27 May (5)	13
Camas Creek	24-30 April, 27 April (1)	8-16 May, 12 May (2)	22-28 May, 25 May (2)	13
Minam River	14-21 April, 17 April (2)	2-10 May, 6 May (2)	20-27 May, 23 May (2)	13

Comparison with River 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 13 and Appendix Table 20). Overall, passage at the dam during 2011 occurred between early April and late-June, with the middle 80th percentile passage occurring from 14 April to 24 May (Table 7). The peak passage date occurred during moderate flows of 99.0 kcfs on 11 May (Appendix Table 20).

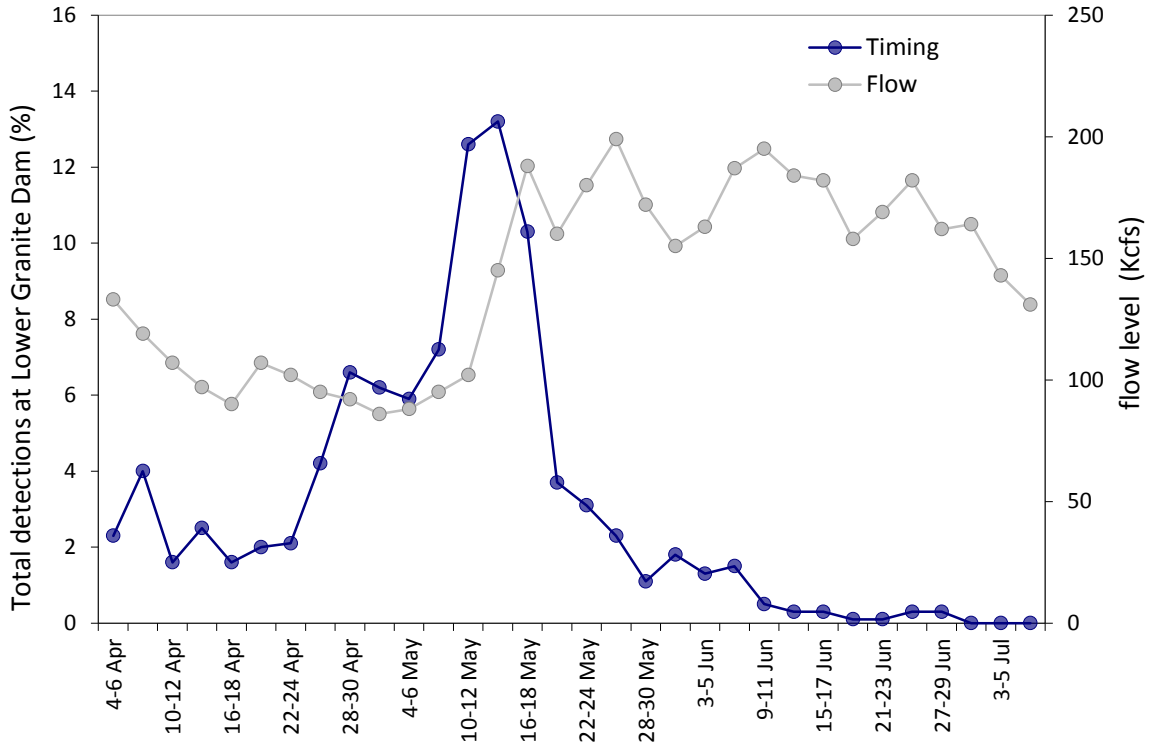

Figure 13. Overall migration timing of PIT-tagged wild spring/summer Chinook salmon smolts with associated river flows at Lower Granite Dam, 2011. Daily detections from Idaho and Oregon streams were pooled in 3-day intervals and expanded based on daily detection probability. River flows at the dam were averaged daily over the same periods.

Table 7. Annual passage dates at Lower Granite Dam from 1989 to 2011 for combined populations of wild spring/summer Chinook salmon smolts PIT tagged the previous summers as parr in Idaho and Oregon streams. No fish were tagged in the middle fork Salmon River for migration years 1989, 1996, and 1997. Years from 1996 to 1998 had much higher proportions of Oregon fish.

	Passage periods at Lower Granite Dam			
	10%	50%	90%	Range
1989	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	15 April	27 April	19 May	09 April-15 July
1997	12 April	24 April	18 May	31 March-22 Sept.
1998	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
2005	25 April	07 May	24 May	04 April – 20 June
2006	18 April	02 May	22 May	03 April – 18 June
2007	15 April	30 April	14 May	05 April-18 June
2008	30 April	11 May	23 May	10 April-02 July
2009	23 April	02 May	20 May	02 April-25 June
2010	26 April	09 May	29 May	20 April-08 July
2011	**14 April**	**10 May**	**24 May**	**01 April–27 June**

Environmental Information

Environmental water quality factors varied by month and between locations (Appendix Tables 27-42), as did the percentage of fish collected and/or detected at adjacent traps or instream PIT-tag monitors (Appendix Figures 1-6). In 2007, Northwest Fisheries Science Center personnel completed the Water Quality Baseline Environmental Monitoring website for storage and dissemination of water quality data collected during this study since 1993 (NWFSC 2007). This website also has links to weather, climate, and stream flow data in the Salmon River basin.

DISCUSSION

Mortality rates associated with collection and tagging in 2010 were comparable to those in earlier years (Achord et al. 1992; 1994-1998; 2000-2011). Detection data from instream PIT-tag monitoring systems in Valley Creek have enabled us to estimate survival and migration timing for wild Chinook salmon juveniles leaving this stream from late summer to the following spring. We now have survival estimates and timing information for Valley Creek fish from 2003 to 2011. In 2008, monitoring systems in Valley Creek were improved with the addition of multiplex transceivers and a total of 7 antennas. These improvements increased the accuracy of our survival estimates. In 2008-2009, 23.5% of the tagged fish we released were detected at the monitors; however, in 2009-2010, only 18.4% were detected. Extensive improvements to the Valley Creek monitoring systems in 2010-2011 resulted in detection of 30.4% of the tagged fish we released.

Although we have had a sufficient number of detections to estimate survival from the Big Creek monitors in every study year since 2008, these monitors detected only 9.2, 9.5, and 11.3%, of the tagged fish, in 2008-2009, 2009-2010, and 2010-2011, respectively. These low detection rates have resulted in extreme variability in our annual estimates of survival to Lower Granite Dam (range 0.0-163.3%). More precise survival estimates may be obtained in the future by increasing the number of fish tagged or by improving detection efficiency at this site (e.g., by adding more antennas). Continued development and maintenance of these instream monitoring sites will be conducted by the ISEMP Project.

There is also a need for new survival models that are appropriate for the data collected from instream PIT-tag monitoring sites. This need increases with additional years of data collected from existing instream sites, as well as new data expected from sites planned for the Salmon River basin and for additional streams throughout the Columbia River Basin.

From measurements taken at Little Goose Dam, overall mean growth during the parr-to-smolt stage was 0.15 mm/d for our study fish during 2010-2011. This was comparable to the overall growth rates measured in previous years, which range 0.13-0.16 mm/d (Achord et al. 2002-2011). The overall mean weight gain of 0.033 g/d in 2010-2011 was also comparable to that measured in previous years.

Operation of the juvenile fish bypass system at Little Goose Dam was changed in April 2010. This operational change precluded the detection and separation of wild fish for measurement throughout April 2010 and through 28 April 2011. The “primary

bypass" mode of operation is continuous except for brief sampling periods. We estimated that during primary bypass operation at Little Goose Dam, we missed detections for 22 and 19.4% of the early (April) wild PIT-tagged migrants in 2010 and 2011, respectively. Therefore, since this operational mode at Little Goose Dam will continue into the foreseeable future, we will move all separation-by-code activities to Lower Granite Dam in 2012.

Annual parr-to-smolt survival estimates for the combined Idaho and Oregon populations over the last 19 years have ranged 8.2-24.4%, with an overall average annual survival rate of 16.4% (Figure 14). The lowest parr-to-smolt survival rates were estimated in 2004 and 2005 (8.2 and 8.4%, respectively). These low estimates may have resulted from stream conditions with much higher parr density during these same years (Figure 15). Returns of wild adults to the Snake River basin from 2001 to 2003 were more than an order of magnitude greater than those from 1994 to 1996, when we measured the highest rates of parr-to-smolt survival (20.6 to 24.4%).

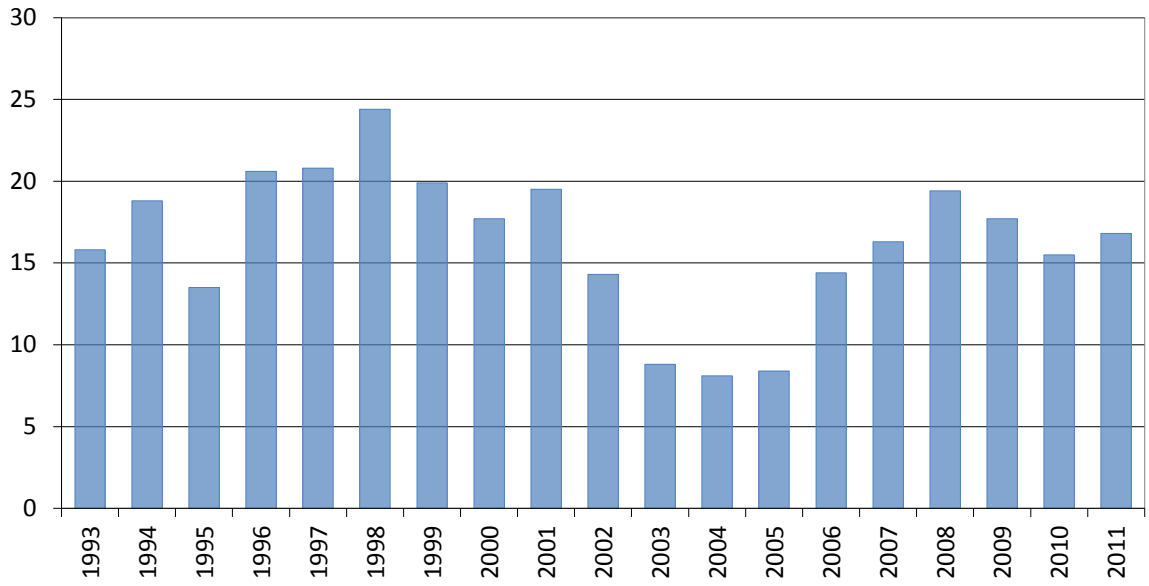

Figure 14. The overall estimated parr-to-smolt survival rates for wild spring/summer Chinook salmon from Idaho and Oregon streams to Lower Granite Dam from 1993 to 2011. Overall average standard error = 0.7% (yearly range 0.2-1.8%).

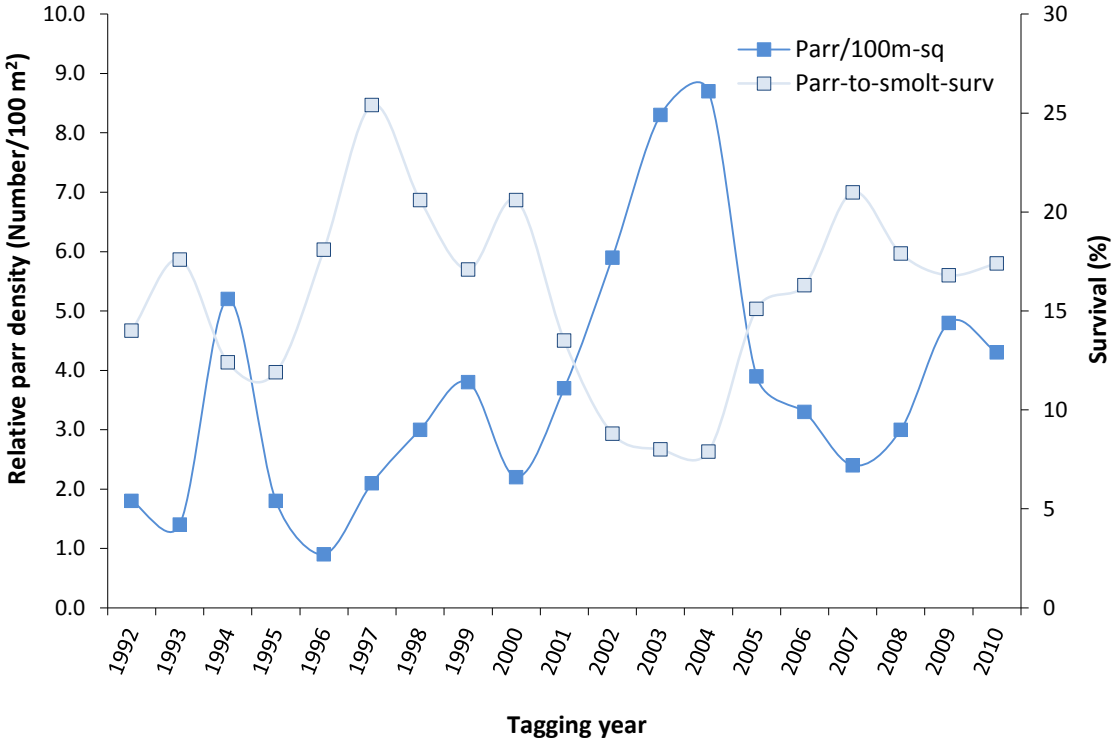

Figure 15. Annual average relative Chinook salmon parr densities (per 100 m^2) in areas sampled in all Idaho streams from 1992 to 2010 plotted against subsequent annual smolt survival estimate to Lower Granite Dam the following year.

In 2011, fish that were larger at tagging tended to arrive at Lower Granite Dam earlier than fish that were smaller at tagging. In addition, we observed that wild fish detected at the dam early in the migration season (April and May) had been significantly larger at release than fish migrating after May. Over the two decades of this wild fish study, we have consistently observed this relationship between length at tagging and migration timing at Lower Granite Dam.

In contrast, detections on the instream monitors at Valley Creek over the last 7 years have shown no biologically meaningful relationship between length at tagging and migration timing (Achord et. al. 2006-2011; Figure 3). Variable relationships between length at tagging and migration timing have been observed in data from the lower Big Creek monitors Creek since 2008, and in data from the lower Secesh River monitors in 2010-2011. These data also have shown no biologically meaningful relationship between size and timing (Achord et. al. 2010, 2011; Figures 5, 7, and 9). The mixed results over these years show that the initiation of movement from natal

rearing streams to larger rivers by parr, pre-smolts, and smolts was probably not related to parr size at tagging. However, larger fish probably initiate smoltification earlier than smaller tagged fish in spring, thus arriving at Lower Granite Dam earlier.

In spring 2011, we observed that for populations from the combined streams overall, the 50th and 90th passage percentiles occurred in mid and late May, respectively at Lower Granite Dam.

In 2011, moderate-to-high flows occurred throughout the migration period. In spring and early summer prevailing weather conditions were cooler and wetter than normal, with flows in the Snake River basin that were much higher than normal. As we have reported previously, smolt passage timing at Lower Granite Dam for individual wild Chinook salmon populations has been highly variable and usually protracted, with timing patterns for some populations ranging from early to late spring. Complex yearly interrelationships between flow and annual climate conditions are primary factors contributing to migration timing. However, water temperatures in streams above the dam, turbidity, physiological development, variability in stock behavior, fish size, and other yet unknown factors may all contribute substantially to wild smolt passage timing.

As additional instream PIT-tag monitors, traps, and environmental monitors are installed in study streams, we can more accurately examine the relationships between environmental conditions within the streams and the movements of fry, parr, and smolts out of their natal rearing areas. Mapped over time, this information, along with weather and climate data, may provide tools for the prediction of movement in different wild fish populations. 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 numbers collected, tagged, released (with tags), and minimum, maximum, and mean lengths and weights of wild Chinook salmon parr, collected and PIT tagged in various Idaho streams, 2010. The length-weight data includes recaptured tagged fish.

				Collection				Tagging and release			
	Number of fish			Length		Weight		Length		Weight	
Stream	Collected	Tagged	Released	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Bear Valley Creek	1,195	1,010	1,004	46-124	60.7	0.7-22.9	3.1	55-82	61.9	1.6-7.3	3.1
Elk Creek	1,098	1,031	1,025	48-128	64.3	1.1-31.6	3.8	55-80	63.6	1.9-6.9	3.4
West Fork Chamberlain Creek	791	727	727	49-113	64.4	1.3-19.3	3.4	53-97	65.3	1.5-9.5	3.4
Valley Creek	2,938	2,517	2,513	39-130	62.7	0.8-30.0	3.4	53-121	63.9	1.4-25.1	3.4
Camas Creek	562	506	506	48-84	62.6	0.9-8.0	3.3	55-84	63.4	1.7-8.0	3.3
Chamberlain Creek	976	697	697	34-125	59.5	1.1-12.3	3.4	53-105	62.4	1.6-6.6	3.3
Big Creek (upper)	1,918	1,194	1,145	40-119	58.6	0.7-23.4	3.2	53-108	62.5	1.4-17.0	3.0
Big Creek (lower)	1,488	1,413	1,413	51-107	76.2	1.6-13.4	5.5	58-104	76.2	1.6-10.3	5.5
Loon Creek	874	836	828	49-224	66.2	1.2-18.7	3.8	55-224	66.7	1.7-7.6	3.9
Marsh Creek	1,221	1,035	1,030	42-125	62.9	1.5-31.7	3.8	53-93	64.1	1.8-12.7	3.6
Sulphur Creek	694	672	671	52-142	68.8	1.6-38.8	4.5	55-83	68.0	1.7-7.8	4.2
Lake Creek	625	458	458	41-97	58.8	1.2-8.7	3.1	52-97	61.1	1.2-7.3	3.1
South Fork Salmon River	1,052	1,034	1,034	56-114	69.8	2.1-18.8	4.4	56-89	69.7	2.1-10.3	4.3
Secesh River	1,243	1,001	1,001	46-115	62.7	1.5-13.3	3.4	52-102	64.4	1.7-13.3	3.4
Cape Horn Creek	396	142	141	35-108	53.6	0.8-17.8	3.4	55-79	59.5	1.1-5.7	2.7
Herd Creek	1,092	1,019	1,017	48-140	68.4	0.9-37.6	4.6	55-130	68.1	1.8-31.0	4.4
Total or mean	18,163	15,292	15,210	45-125	63.8	1.2-21.6	3.8	54-105	65.0	1.6-11.6	3.6

Appendix Table 2a. Summary of conditions and time at tagging and release, including methods of capture, distance from mouth of stream to release point, number of tagged fish (non-recapture) released in 2010. The number and percent of first-time detections (in 2011) is also shown for each tagging group (detections are unadjusted and include 7 downstream dams and the PIT-tag trawl at the mouth of the Columbia River.

	Tagging (2010)		Capture	Release					Detection (2011)	
Stream	Date	(°C)	method	Date	Time	(°C)	km	n	n	%
Bear Valley Creek										
SA10201.BV1	7/20/10	10.0	SHOCK	7/21/10	06:00	10.0	09	128	20	15.6
SA10201.BV2	7/20/10	10.0	SHOCK	7/20/10	11:00	13.0	10	420	46	10.9
SA10202.BV1	7/21/10	09.0	SHOCK	7/21/10	08:00	10.0	13	178	13	7.3
SA10202.BV2	7/21/10	09.0	SHOCK	7/22/10	05:30	10.0	14	278	37	13.3
Elk Creek										
SA10203.EC1	7/22/10	10.0	BSEINE	7/23/10	05:00	11.0	01	164	20	12.2
SA10203.EC2	7/22/10	10.0	SHOCK	7/22/10	10:45	14.5	02	361	68	18.8
SA10204.EC1	7/23/10	11.0	SHOCK	7/23/10	11:30	15.0	04	500	62	12.4
Marsh Creek										
SA10206.MC1	7/25/10	08.0	SHOCK	7/26/10	05:15	09.0	11	113	23	20.3
SA10206.MC2	7/25/10	08.0	SHOCK	7/25/10	10:45	13.0	12	358	52	14.5
SA10207.MC1	7/26/10	10.0	SHOCK	7/26/10	10:15	11.0	14		105	18.8
Sulpur Creek										
SA10211.SU1	7/30/10	10.0	SHOCK	7/31/10	05:00	10.0	06	123	14	11.4
SA10211.SU2	7/30/10	10.0	SHOCK	7/30/10	10:00	12.5	07	148	23	15.5
SA10212.SU1	7/31/10	10.0	SHOCK	7/31/10	10:30	12.0	08	400	57	14.2
Cape Horn Creek										
SA10208.CH1	7/27/10	08.0	SHOCK	7/27/10	09:00	10.0	01	141	13	9.2
Valley Creek										
SA10214.VC1	8/2/10	09.5	SHOCK	8/03/10	05:00	09.5	05	137	6	4.4
SA10214.VC2	8/2/10	10.0	SHOCK	8/02/10	10:40	13.5	05	718	52	7.2
SA10215.VC1	8/3/10	12.0	SHOCK	8/03/10	10:00	15.0	07	939	63	6.7
SA10216.VC1	8/4/10	09.0	SHOCK	8/04/10	11:00	13.0	12	719	45	6.3
Big Creek (upper)										
SA10228.BC1	8/16/10	07.5	SHOCK	8/17/10	05:00	07.6	57	115	9	7.8
SA10228.BC2	8/16/10	08.0	SHOCK	8/16/10	12:30	13.3	58	484	50	10.3
SA10229.BC1	8/17/10	07.6	SHOCK	8/17/10	10:45	11.5	60	546	55	10.1

Appendix Table 2a. Continued.

Stream	Tagging (2010) Date	Tagging (2010) (°C)	Capture method	Release Date	Release Time	Release (°C)	Release km	Release n	Detection (2011) n	Detection (2011) %
Big Creek (lower)										
SA10244.LB1	9/1/10	10.4	SHOCK	9/02/10	07:30	10.5	10	569	122	21.4
SA10245.LB1	9/2/10	09.2	SHOCK	9/02/10	11:30	12.6	11	698	136	19.5
SA10246.LB1	9/3/10	09.8	SHOCK	9/03/10	08:30	10.5	12	146	26	17.8
Loon Creek										
SA10224.LN1	8/12/10	07.2	SHOCK	8/13/10	05:00	08.1	29	116	24	20.7
SA10224.LN2	8/12/10	08.0	SHOCK	8/12/10	11:00	11.0	30	340	65	19.1
SA10225.LN1	8/13/10	08.1	SHOCK	8/13/10	10:00	10.5	32	372	84	22.6
Camas Creek										
SA10218.CA1	8/6/10	10.0	SHOCK	8/07/10	05:05	10.0	21	137	28	20.4
SA10218.CA2	8/6/10	10.0	SHOCK	8/06/10	10:00	12.0	23	369	94	25.5
Herd Creek										
SA10221.HC1	8/9/10	09.0	SHOCK	8/10/10	05:40	08.3	01	123	20	16.3
SA10221.HC2	8/9/10	09.0	SHOCK	8/09/10	11:00	09.5	02	602	79	13.1
SA10222.HC1	8/10/10	08.5	SHOCK	8/10/10	08:00	08.4	03	292	39	13.4
South Fork Salmon R										
SA10231.SF1	8/19/10	11.0	SHOCK	8/20/10	06:00	10.0	117	112	19	17.0
SA10231.SF2	8/19/10	11.0	SHOCK	8/19/10	10:40	14.0	118	600	98	16.3
SA10232.SF1	8/20/10	10.0	SHOCK	8/20/10	08:10	09.5	119	322	48	14.9
WF Chamberlain Cr										
SA10236.WC1	8/24/10	06.0	BSEINE	8/24/10	10:20	12.0	02	727	86	11.8
Chamberlain Creek										
SA10237.CB1	8/25/10	08.0	SHOCK	8/26/10	05:10	08.0	24	129	21	16.3
SA10237.CB2	8/25/10	09.0	SHOCK	8/25/10	10:20	12.0	25	404	73	18.1
SA10237.CB3	8/25/10	12.0	SHOCK	8/25/10	11:20	14.0	26	164	17	10.4
Secesh River										
SA10239.SE1	8/27/10	10.0	SHOCK	8/28/10	05:15	09.5	25	119	16	13.4
SA10239.SE2	8/27/10	10.0	SHOCK	8/27/10	12:15	13.5	26	406	58	14.3
SA10240.SE1	8/28/10	09.5	SHOCK	8/28/10	09:40	10.0	27	476	61	12.8
Lake Creek										
SA10242.LC1	8/30/10	04.5	SHOCK	8/30/10	11:45	07.7	02	458	46	10.0

Appendix Table 2b. Universal Transverse Mercator grid coordinates of Global Positioning System that identifies sampling areas at the beginning and end of daily collections in streams for each collection crew in 2010.

Streams and dates	Section covered	UTM start		UTM end	
		Northing	Easting	Northing	Easting
Bear Valley Cr					
7/20/2010	right bank	4920610	11T633158	4920880	11T632033
7/20/2010	left bank	4920613	11T633191	4920776	11T632262
7/21/2010	left bank	4919132	11T630312	4918715	11T629672
7/21/2010	right bank	4919145	11T630285	4918715	11T629672
Elk Creek					
7/22/2010	entire stream	----------	----------	----------	----------
7/22/2010	right bank	----------	----------	4918700	11T628791
7/22/2010	left bank	----------	----------	4918574	11T629002
7/23/2010	right bank	----------	----------	4919265	11T627744
7/23/2010	left bank	4918979	11T628805	4919348	11T627538
Marsh Creek					
7/25/2010	right bank	4917116	11T646305	4915833	11T647256
7/25/2010	left bank	4917116	11T646305	4915833	11T647256
7/26/2010	left bank	4915759	11T647351	4915073	11T648128
7/26/2010	right bank	4915744	11T647344	4914960	11T648138
Sulphur Creek					
7/30/2010	left bank	4933194	11T631143	4932563	11T630409
7/30/2010	right bank	4933194	11T631143	4932563	11T630409
7/31/2010	right bank	4932565	11T630402	4932459	11T629581
7/31/2010	left bank	4932565	11T630402	4932459	11T629581
Cape Horn Cr					
7/27/2010	left bank	4916764	11T645394	4916089	11T645108
7/27/2010	right bank	4916764	11T645394	4916177	11T645178
Valley Creek					
8/2/2010	right bank	4899472	11T661379	4899821	11T660583
8/2/2010	left bank	4899461	11T661382	4899790	11T660695
8/3/2010	right bank	4900565	11T659777	4901384	11T659411
8/3/2010	left bank	4900553	11T659769	4901402	11T659405
8/4/2010	left bank	4903764	11T659022	4904764	11T658865
8/4/2010	right bank	4903764	11T659022	4904483	11T658955
Big Creek-Upper					
8/16/2010	left bank	4997282	11T632217	4996208	11T631557
8/16/2010	right bank	4997273	11T632210	4996213	11T631565
8/17/2010	left bank	4996200	11T631560	4995467	11T631346
8/17/2010	right bank	4996213	11T631565	4995565	11T631330
Big Creek-Lower					
9/1/2010	right bank	4996499	11T670253	4996629	11T669503
9/1/2010	left bank	4996499	11T670253	4996597	11T669417
9/2/2010	right bank	4996597	11T669444	4996841	11T668291
9/2/2010	left bank	4996597	11T669444	4996841	11T668291
9/3/2010	left bank	4996847	11T668415	4996799	11T667957
9/3/2010	right bank	4996847	11T668415	4996799	11T667957

Appendix Table 2b. Continued.

Streams and dates	Section covered	UTM start Northing	UTM start Easting	UTM end Northing	UTM end Easting
Loon Creek					
8/12/2010	right bank	4942247	11T675167	4941028	----------
8/12/2010	left bank	4942247	11T675167	4941028	----------
8/13/2010	right bank	4941028	----------	4940164	11T673192
8/13/2010	left bank	4941028	----------	4940032	11T673023
Camas Creek					
8/6/2010	left bank	4968505	11T696388	4967535	11T697065
8/6/2010	right bank	4968505	11T696388	4967554	11T697033
Herd Creek					
8/9/2010	left bank	4892111	11T716222	4891190	11T717196
8/9/2010	right bank	4892114	11T716237	4891417	11T716861
8/10/2010	left bank	4890967	11T717363	4890679	11T717530
8/10/2010	right bank	4890967	11T717363	4890679	11T717530
South Fork Salmon River					
8/19/2010	left bank	4944193	11T603574	4943001	11T603454
8/19/2010	right bank	4944549	11T603569	4943001	11T603454
8/20/2010	left bank	4943001	11T603454	4942682	11T603440
8/20/2010	right bank	4943001	11T603454	4942649	11T603317
West Fork Chamberlain Creek					
8/24/2010	entire stream	5027449	11T641971	5027631	11T641713
Chamberlain Creek					
8/25/2010	right bank	5026715	11T642387	5026001	11T641939
8/25/2010	left bank	5026715	11T642387	5026001	11T641939
Secesh River					
8/27/2010	left bank	5005536	11T592768	5006898	11T593332
8/27/2010	right bank	5005536	11T592768	5006898	11T593332
8/28/2010	left bank	5006984	11T593474	5007663	11T593474
8/28/2010	right bank	5006984	11T593474	5007663	11T593474
Lake Creek					
8/30/2010	right bank	5012350	11T586036	5012350	11T585498
8/30/2010	left bank	5012330	11T586017	5013154	11T585569

Appendix Table 3. Summary of observed total mortality for PIT-tagged wild Chinook salmon parr collected from Idaho streams from July to September 2010. 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. There were also 11 lost tags; 4 from upper Big Creek, 1 from Herd Creek, 3 from Valley Creek, and 3 from Bear Valley Creek.

					Observed mortality			
					Collection		Total	
Stream	Number collected	Number Tagged	Number Rejected	Percent Rejected (%)	and handling	Tagging delayed	No.	(%)
Bear Valley Creek	1,195	1,010	185 (4)	15.5	6	3	9	0.7
Elk Creek	1,098	1,031	67 (20)	6.1	8	6	14	1.3
Marsh Creek	1,221	1,035	186 (9)	15.2	9	5	14	1.1
Cape Horn Creek	396	142	254 (10)	64.1	4	1	5	1.3
Sulphur Creek	694	672	22 (10)	3.2	5	1	6	0.9
Valley Creek	2,938	2,517	421 (14)	14.3	34	1	35	1.2
Loon Creek	874	836	46 (1)	5.3	4	8	12	1.4
Camas Creek	562	506	56	10.0	12	0	12	2.1
Herd Creek	1,092	1,019	73 (11)	6.7	25	1	26	2.4
Big Creek (upper)	1,918	1,194	724 (26)	37.7	32	45	77	4.0
Big Creek (lower)	1,488	1,413	75 (1)	5.0	30	0	30	2.0
WF Chamberlain Cr	791	727	64 (1)	8.1	0	0	0	0.0
Chamberlain Creek	976	697	279 (8)	28.6	3	0	3	0.3
S. F. Salmon River	1,052	1,034	18 (3)	1.7	4	0	4	0.4
Secesh River	1,243	1,001	242 (3)	19.5	10	0	10	0.8
Lake Creek	625	458	167 (6)	26.7	5	0	5	0.8
Totals or average	18,163	15,292	2,879 (127)	15.8	191	71	262	1.44

Appendix Table 4a. Accumulated and 2011 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			
	10th	50th	90th	Range
Bear Valley Creek				
1990	19 Apr	5 May	31 May	11 Apr-18 Jul
1991	3 May	20 May	12 Jun	18 Apr-23 Jun
1992	15 Apr	2 May	24 May	7 Apr-28 Jun
1993	29 Apr	16 May	22 Jun	22 Apr-27 Jul
1994	22 Apr	6 May	29 May	16 Apr-15 Jul
1995	28 Apr	18 May	12 Jun	13 Apr-20 Jul
1996a 1997a	---	---	---	---
1998	25 Apr	6 May	23 May	31 Mar-25 Jun
1999	23 Apr	3 May	7 Jun	20 Apr-21 Jun
2000	18 Apr	7 May	2 Jun	14 Apr-2 Jul
2001	8 May	16 May	28 May	26 Apr-17 Jun
2002	16 Apr	4 May	31 May	12 Apr-26 Jun
2003	14 Apr	5 May	28 May	12 Apr-14 Jun
2004	15 Apr	7 May	28 May	13 Apr-5 Jul
2005	20 Apr	5 May	23 May	20 Apr-10 Jun
2006	13 Apr	1 May	19 May	11 Apr-20 May
2007	18 Apr	3 May	13 May	8 Apr-24 May
2008	30 Apr	14 May	27 May	24 Apr-10 Jun
2009	22 Apr	1 May	27 May	18 Apr-16 Jun
2010	25 Apr	18 May	7 Jun	25 Apr-12 Jun
2011	**17 Apr**	**9 May**	**30 May**	**4 Apr-9 Jun**
Elk Creek				
1991	3 May	20 May	16 Jun	25 Apr-24 Jun
1992	11 Apr	30 Apr	28 May	5 Apr-17 Jul
1993	2 May	16 May	11 Jun	21 Apr-26 Jun
1994	23 Apr	4 May	21 May	18 Apr-9 Jul
1995	18 Apr	11 May	5 Jun	10 Apr-9 Jul
1990a 1996a 1997a	---	---	---	---
1998	7 Apr	2 May	15 May	4 Apr-21 Jun
1999	21 Apr	3 May	27 May	1 Apr-8 Jul
2000	15 Apr	28 Apr	19 May	13 Apr-28 May
2001	30 Apr	11 May	27 May	30 Apr-27 May
2002	16 Apr	29 Apr	2 Jun	13 Apr-5 Jul
2003	20 Apr	6 May	29 May	31 Mar-30 May
2004	18 Apr	8 May	4 Jul	14 Apr-12 Jul
2005	27 Apr	11 May	29 May	18 Apr-12 Jun
2006	15 Apr	27 Apr	26 May	6 Apr-11 Jun
2007	16 Apr	2 May	14 May	14 Apr-31 May
2008	2 May	11 May	23 May	25 Apr-16 Jun
2009	25 Apr	30 Apr	18 May	19 Apr-7 Jun
2010	23 Apr	1 May	4 Jun	22 Apr-19 Jun
2011	**13 Apr**	**4 May**	**27 May**	**5 Apr-21 Jun**

Appendix Table 4a. Continued.

	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Sulphur Creek				
1990	18 Apr	30 Apr	31 May	11 Apr-27 Jun
1991a 1994a	---	---	---	---
1992	16 Apr	3 May	23 May	10 Apr-1 Jun
1993	28 Apr	16 May	12 Jun	24 Apr-28 Jun
1995	2 May	23 May	9 Jun	11 Apr-9 Jul
1996a -1999a	---	---	---	---
2000	15 Apr	7 May	24 May	12 Apr-30 May
2001a 2002a 2007a	---	---	---	---
2003	2 May	25 May	8 May	22 Apr-24 Jun
2004	10 Apr	25 Apr	11 May	2 Apr-24 May
2005	1 May	7 May	22 May	22 Apr-5 Jun
2006	11 Apr	28 Apr	17 May	11 Apr- 17 May
2008	3 May	12 May	2 Jun	27 Apr-4 Jun
2009	22 Apr	29 Apr	18 May	2 Apr-21 May
2010	26 Apr	6 May	23 May	25 Apr-6 Jun
2011	**18 Apr**	**5 May**	**16 May**	**4 Apr-4 Jun**
Cape Horn Creek				
1990a1996a-1998a	---	---	---	---
1991	24 Apr	16 May	28 May	19 Apr-6 Jun
1992	12 Apr	28 Apr	30 May	10 Apr-1 Jun
1993	8 May	19 May	26 Jun	5 May-01 Jul
1994a	---	---	---	---
1995	29 Apr	14 May	19 Jun	14 Apr-28 Jul
1999	29 Apr	22 May	29 May	25 Apr-12 Jun
2000	1 May	24 May	1 Jun	20 Apr-09 Jul
2001a 2002a 2009a	---	---	---	---
2003	21 Apr	17 May	1 Jun	15 Apr-18 Jun
2004	15 Apr	4 May	24 May	14 Apr-28 May
2005	29 Apr	9 May	24 May	11 Apr-29 May
2006	23 Apr	30 Apr	14 Jun	22 Apr-14 Jun
2007	13 Apr	6 May	19 May	9 Apr-20 May
2008	3 May	18 May	23 May	25 Apr-3 Jun
2010	28 Apr	8 May	26 May	27 Apr-20 Jun
2011b	---	---	---	---
Camas Creek				
1993	3 May	16 May	27 May	24 Apr-24 Jun
1994	30 Apr	15 May	26 May	24 Apr-11 Jul
1995	27 Apr	12 May	5 Jun	17 Apr-11 Jun
1997a1998a1999a	---	---	---	---
2000	26 Apr	25 May	2 Jun	13 Apr-24 Jun
2001a 2002a1996a	---	---	---	---
2003	2 May	24 May	30 May	26 Apr-6 Jun
2004	18 Apr	8 May	24 May	16 Apr-4 Jun
2005	29 Apr	7 May	28 May	12 Apr-19 Jun
2006	20 Apr	30 Apr	17 May	20 Apr-3 Jun
2007	23 Apr	6 May	16 May	19 Apr-19 May
2008	5 May	14 May	21 May	27 Apr-31 May
2009	25 Apr	8 May	22 May	25 Apr-5 Jun
2010	25 Apr	8 May	26 May	24 Apr-7 Jun
2011	**4 Apr**	**15 May**	**23 May**	**7 Apr-11 Jun**

Appendix Table 4a. Continued.

	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Marsh Creek				
1990	17 Apr	29 Apr	31 May	9 Apr-01 Jul
1991	26 Apr	20 May	9 Jun	17 Apr-18 Jun
1992	17 Apr	7 May	2 Jun	10 Apr-13 Jul
1993	29 Apr	15 May	27 May	24 Apr-10 August
1994	23 Apr	4 May	18 May	16 Apr-08 August
1995	17 Apr	9 May	24 May	11 Apr-08 Jul
1996a1997a1998a	---	---	---	---
1999	21 Apr	1 May	25 May	11 Apr-13 Jun
2000	21 Apr	28 Apr	27 May	14 Apr-16 Jun
2001a	---	---	---	---
2002	18 Apr	4 May	23 May	14 Apr-26 May
2003	14 Apr	5 May	29 May	3 Apr-9 Jun
2004	16 Apr	28 Apr	10 May	3 Apr-30 May
2005	27 Apr	6 May	18 May	22 Apr-4 Jun
2006	12 Apr	30 Apr	18 May	11 Apr-3 Jun
2007a	---	---	---	---
2008	29 Apr	7 May	18 May	24 Apr-20 May
2009	23 Apr	30 Apr	18 May	20 Apr-22 May
2010	27 Apr	10 May	24 May	24 Apr-6 Jun
2011	**10 Apr**	**9 May**	**16 May**	**4 Apr-8 Jun**
Valley Creek				
1989	24 Apr	14 May	12 Jun	9 Apr-17 Jun
1990	16 Apr	8 May	5 Jun	12 Apr-29 Jun
1991	11 May	20 May	20 Jun	21 Apr-13 Jul
1992	15 Apr	30 Apr	27 May	13 Apr-4 Jun
1993	30 Apr	16 May	2 Jun	24 Apr-6 Jun
1994	24 Apr	4 May	3 Jun	22 Apr-9 Jun
1995	4 May	2 Jun	08 Jul	22 Apr-18 Jul
1996a1997a1998a	---	---	---	---
1999	24 Apr	13 May	12 Jun	19 Apr-01 Jul
2000	20 Apr	12 May	29 May	13 Apr-14 Jul
2001	10 May	19 May	1 Jun	28 Apr-03 Jul
2002	24 Apr	20 May	3 Jun	19 Apr-19 Jun
2003	14 Apr	17 May	28 May	1 Apr-31 May
2004	25 Apr	11 May	26 May	4 Apr-16 Jun
2005	27 Apr	15 May	8 Jun	23 Apr-20 Jun
2006	30 Apr	24 May	15 Jun	16 Apr-17 Jun
2007	20 Apr	3 May	20 May	13 Apr-24 May
2008	28 Apr	11 May	26 May	21 Apr-6 Jun
2009	24 Apr	4 May	4 Jun	10 Apr-18 Jun
2010	30 Apr	13 May	28 May	27 Apr-22 Jun
2011	**27 Apr**	**14 May**	**2 Jun**	**6 Apr-16 Jun**

Appendix Table 4a. Continued.

	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Loon Creek				
1993	5 May	12 May	17 May	3 May-5 Jun
1994	29 Apr	10 May	24 May	22 Apr-7 Jun
1995	23 Apr	11 May	28 May	13 Apr-7 Jun
1996a1997a1998a	---	---	---	---
1999	30 Apr	18 May	27 May	22 Apr-16 Jun
2000	22 Apr	8 May	24 May	14 Apr-1 Jun
2001a2002a2007a	---	---	---	---
2003	30 Apr	17 May	28 May	21 Apr-30 May
2004	23 Apr	5 May	15 May	15 Apr-26 May
2005	4 May	10 May	24 May	20 Apr-3 Jun
2006	20 Apr	2 May	19 May	10 Apr-21 May
2008	7 May	17 May	26 May	28 Apr-29 May
2009	24 Apr	30 Apr	19 May	16 Apr-21 May
2010	27 Apr	11 May	25 May	23 Apr-4 Jun
2011	**30 Apr**	**14 May**	**19 May**	**11 Apr-5 Jun**
East Fork Salmon River				
Discontinued—see previous reports				
Herd Creek				
1992	14 Apr	20 Apr	10 May	13 Apr-18 May
1993	26 Apr	30 Apr	18 May	26 Apr-31 May
1994b	---	---	---	---
1995	18 Apr	3 May	14 May	11 Apr-28 May
1996a1997a 1998a	---	---	---	---
1999	20 Apr	29 Apr	10 May	30 March-20 May
2000	16 Apr	25 Apr	18 May	14 Apr-19 May
2001	30 Apr	4 May	14 May	28 Apr-7 Jun
2002b	---	---	---	---
2003	16 Apr	3 May	26 May	6 Apr-29 May
2004	16 Apr	30 Apr	10 May	12 Apr-21 Jun
2005	27 Apr	7 May	22 May	20 Apr-13 Jun
2006	16 Apr	25 Apr	6 May	10 Apr-16 May
2007b	---	---	---	---
2008	29 Apr	10 May	19 May	24 Apr-23 May
2009 a	---	---	---	---
2010	29 Apr	8 May	24 May	25 Apr-6 Jun
2011	**14 Apr**	**12 May**	**18 May**	**5 Apr-31 May**

Appendix Table 4a. Continued.

	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
South Fork Salmon River				
1989	25 Apr	13 May	14 Jun	16 Apr-20 Jun
1990a	---	---	---	---
1991	20 Apr	16 May	10 Jun	17 Apr-13 Jul
1992	14 Apr	29 Apr	27 May	7 Apr-27 Jul
1993	29 Apr	16 May	2 Jun	26 Apr-28 Jun
1994	27 Apr	15 May	28 Jun	22 Apr-09 Jul
1995	20 Apr	10 May	10 Jun	13 Apr-13 Jul
1996	19 Apr	15 May	09 Jun	19 Apr-03 Jul
1997	13 Apr	28 Apr	12 Jun	07 Apr-15 Jun
1998	25 Apr	12 May	15 Jun	02 Apr-07 Aug
1999	31 Mar	04 May	01 Jun	27 Mar-11 Jun
2000	20 Apr	18 May	31 May	12 Apr-20 July
2001	29 Apr	14 May	01 Jun	26 Apr-07 July
2002	15 Apr	03 May	24 May	11 Apr-09 Jun
2003	19 Apr	16 May	03 Jun	19 Apr-12 Jun
2004	16 Apr	10 May	02 Jun	08 Apr-19 Jun
2005	28 Apr	12 May	30 May	22 Apr-19 Jun
2006	28 Apr	11 May	16 Jun	27 Apr-18 Jun
2007[a]2008[a]	---	---	---	---
2009	24 Apr	03 May	26 May	02 Apr-30 May
2010	25 Apr	05 May	20 May	23 Apr-05 Jun
2011	**07 Apr**	**04 May**	**22 May**	**03 Apr-05 Jun**
Big Creek (upper)				
1990	27 Apr	30 May	22 Jun	17 Apr-18 Jul
1991	18 May	10 Jun	26 Jun	26 Apr-01 Jul
1992	22 Apr	8 May	3 Jun	15 Apr-26 Jun
1993	8 May	18 May	26 May	26 Apr-15 Jun
1994	3 May	19 May	19 Jul	25 Apr-30 Aug
1995	5 May	23 May	9 Jun	2 May-26 Jun
1996a 1997a1998a	---	---	---	---
1999	28 Apr	14 May	3 Jun	25 Apr-19 Jun
2000	30 Apr	27 May	14 Jun	15 Apr-29 Jun
2001a 2002a	---	---	---	---
2003	6 May	25 May	1 Jun	1 May-21 Jun
2004	18 Apr	12 May	5 Jun	15 Apr-17 Jun
2005	27 Apr	7 May	23 May	20 Apr-7 Jun
2006	26 Apr	8 May	25 May	19 Apr-10 Jun
2007	19 Apr	6 May	20 May	15 Apr-18 Jun
2008	6 May	20 May	23 May	25 Apr-5 Jun
2009	26 Apr	19 May	28 May	22 Apr-7 Jun
2010	1 May	20 May	5 Jun	25 Apr-13 Jun
2011	**7 May**	**16 May**	**24 May**	**25 Apr-1 Jun**

Appendix Table 4a. Continued.

	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Big (lower)/Rush Creeks				
1993	24 Apr	29 Apr	13 May	21 Apr-16 May
1994	23 Apr	29 Apr	11 May	21 Apr-15 Jun
1995	19 Apr	1 May	14 May	11 Apr-5 Jun
1996[a]	---	---	---	---
1997[a]	---	---	---	---
1998[a]	---	---	---	---
1999	19 Apr	28 Apr	23 May	4 Apr-30 May
2000	19 Apr	30 Apr	13 May	16 Apr-26 May
2001[a]	---	---	---	---
2002	15 Apr	25 Apr	7 May	12 Apr-22 May
2003	14 Apr	26 Apr	18 May	12 Apr-25 May
2004	15 Apr	23 Apr	4 May	6 Apr-15 May
2005[d]	22 Apr	2 May	9 May	6 Apr-15 May
2006[d]	11 Apr	22 Apr	3 May	10 Apr-22 May
2007[d]	18 Apr	27 Apr	6 May	6 Apr-12 May
2008[d]	29 Apr	12 May	20 May	23 Apr-20 May
2009[d]	24 Apr	28 Apr	7 May	3 Apr-21 May
2010[d]	24 Apr	29 Apr	6 May	22 Apr-5 Jun
2011[d]	**9 Apr**	**2 May**	**14 May**	**6 Apr-21 May**
West Fork Chamberlain Creek				
1992[c]	15 Apr	26 Apr	3 Jun	12 Apr-24 Jun
1993	28 Apr	15 May	23 Jun	23 Apr-22 Jul
1994[c]	24 Apr	1 May	5 Jul	24 Apr-4 Sep
1995[c]	16 Apr	9 May	20 Jun	12 Apr-22 Sep
1996[a]-1997[a]	---	---	---	---
1998[a]	---	---	---	---
1999[a]2000[a]2001[a]	---	---	---	---
2002	26 Apr	4 May	20 May	18 Apr-29 May
2003[c]	23 Apr	20 May	26 May	21 Apr-26 May
2004[c]	11 Apr	24 Apr	10 May	7 Apr-23 Jun
2005[c]	26 Apr	3 May	13 May	20 Apr-30 May
2006	15 Apr	1 May	8 May	14 Apr-19 May
2007[c]	17 Apr	2 May	11 May	17 Apr-24 May
2008[a]	---	---	---	---
2009[c]	24 Apr	29 Apr	18 May	13 Apr-25 Jun
2010[c]	24 Apr	30 Apr	21 May	23 Apr-8 Jul
2011[c]	**22 Apr**	**9 May**	**27 May**	**3 Apr-27 Jun**

Appendix Table 4a. Continued.

	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Secesh River				
1989	20 Apr	27 Apr	9 Jun	9 Apr-19 Jul
1990	14 Apr	22 Apr	7 Jun	10 Apr-13 Jul
1991	20 Apr	27 Apr	14 Jun	13 Apr-20 Jul
1992	13 Apr	29 Apr	4 Jun	5 Apr-3 Jul
1993	26 Apr	16 May	16 Jun	22 Apr-15 Jul
1994	22 Apr	26 Apr	11 Jul	21 Apr-7 Aug
1995	14 Apr	1 May	24 May	10 Apr-10 Jul
1996	14 Apr	25 Apr	29 May	12 Apr-15 Jul
1997	10 Apr	18 Apr	4 May	4 Apr-11 Jul
1998	8 Apr	24 Apr	28 May	3 Apr-6 Jul
1999	3 Apr	23 Apr	25 May	29 Mar-21 Jun
2000	13 Apr	23 Apr	4 Jun	12 Apr-11 Jul
2001	16 Apr	28 Apr	13 May	6 Apr-13 Jun
2002	13 Apr	21 Apr	17 May	11 Apr-1 Jul
2003	18 Apr	30 Apr	1 Jun	3 Apr-4 Jul
2004	4 Apr	27 Apr	28 May	1 Apr-13 Jun
2005	23 Apr	3 May	26 May	4 Apr-19 Jun
2006	13 Apr	24 Apr	23 May	8 Apr-8 Jun
2007	9 Apr	22 Apr	16 May	5 Apr-23 May
2008a	---	---	---	---
2009	19 Apr	28 Apr	17 May	11 Apr-2 Jun
2010	20 Apr	28 Apr	6 Jun	20 Apr-22 Jun
2011	**7 Apr**	**1 May**	**7 Jun**	**3 Apr-27 Jun**
Lake Creek				
1989	23 Apr	2 May	16 Jun	12 Apr-1 Jul
1990[a]	---	---	---	---
1991[a]	---	---	---	---
1992[a]	---	---	---	---
1993	23 Apr	9 May	22 Jun	22 Apr-25 Jun
1995	17 Apr	10 May	10 Jun	14 Apr-20 Jul
1996	15 Apr	21 Apr	19 May	15 Apr-2 Jun
1997	11 Apr	25 Apr	2 Jul	7 Apr-22 Sep
1998	4 Apr	25 Apr	26 May	2 Apr-16 Jul
1999	20 Apr	26 Apr	27 May	8 Apr-20 Jun
2000	13 Apr	4 May	4 Jun	13 Apr-18 Jul
2001[a]	---	---	---	---
2002	16 Apr	29 Apr	3 Jun	13 Apr-3 Jun
2003	6 Apr	6 May	4 Jun	6 Apr-20 Jun
2004	14 Apr	25 Apr	28 May	9 Apr-16 Jun
2005	20 Apr	28 Apr	29 May	19 Apr-19 Jun
2006	17 Apr	28 Apr	19 May	17 Apr-19 May
2007	8 Apr	27 Apr	3 May	8 Apr-14 May
2008	30 Apr	7 May	23 May	25 Apr-24 May
2009	23 Apr	3 May	30 May	4 Apr-20 Jun
2010[b]	---	---	---	---
		11 May	**16 May**	**10 Apr-12 Jun**

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.
d No fish were tagged in Rush Creek for this migration year.

Appendix Table 4b. Accumulated and 2011 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	1 May	14 May	8 Jun	17 Apr-23 Jun
1992	16 Apr	1 May	21 May	9 Apr-29 Jun
1993	6 May	18 May	5 Jun	29 Apr-26 Jun
1994	25 Apr	11 May	20 May	13 Apr-26 July
1995	1 May	19 May	9 Jun	26 Apr-02 Jul
1996 [a]	19 Apr	13 May	29 May	14 Apr-14 Jun
1997	8 May	14 May	1 Jun	24 Apr-10 Jun
1998	28 Apr	21 May	28 May	24 Apr-4 Jun
1999	26 Apr	25 May	15 Jun	26 Apr-26 Jun
2000	30 Apr	8 May	23 May	12 Apr-6 Jun
2001	29 Apr	17 May	17 Jun	28 Apr-03 Jul
2002	24 Apr	10 May	18 Jun	15 Apr-01 Jul
2003	26 Apr	10 May	9 Jun	14 Apr-9 Jun
2004	22 Apr	15 May	11 Jun	15 Apr-25 Jun
2005	20 Apr	12 May	23 May	14 Apr-2 Jun
2006	28 Apr	16 May	30 May	26 Apr-6 Jun
2007	19 Apr	29 Apr	17 May	19 Apr-19 May
2008	6 May	7 Jun	02 Jul	30 Apr-02 Jul
2009	24 Apr	13 May	21 May	12 Apr-13 Jun
2010	29 Apr	4 Jun	19 Jun	24 Apr-21 Jun
2011	**2 May**	**9 May**	**8 Jun**	**14 Apr-25 Jun**
Grande Ronde River (upper)				
1989	12 May	6 Jun	19 Jun	27 Apr-22 Jul
1990 [b]	---	---	---	---
1991 [b]	---	---	---	---
1992 [b]	---	---	---	---
1993	5 May	16 May	25 May	23 Apr-20 Jun
1994	28 Apr	23 May	07 Jul	23 Apr-29 Aug
1995	27 Apr	29 May	12 Jun	12 Apr-01 Jul
1996 [c]	26 Apr	17 May	29 May	19 Apr-6 Jun
1997-**2011** [b]	---	---	---	---
Imnaha River (lower)				
1989	11 Apr	30 Apr	11 May	4 Apr-5 Jun
1990	10 Apr	18 Apr	9 May	5 Apr-27 May
1991	20 Apr	1 May	13 May	14 Apr-15 May
1992	10 Apr	21 Apr	3 May	6 Apr-21 May
1993-**2011** [b]	---	---	---	---
Imnaha River (upper)				
1993	24 Apr	14 May	28 May	15 Apr-23 Jun
1994	24 Apr	8 May	9 Jun	20 Apr-11 Aug
1995	13 Apr	2 May	3 Jun	10 Apr-07 Jul
1996	16 Apr	26 Apr	18 May	14 Apr-12 Jun
1997	11 Apr	19 Apr	11 May	3 Apr-2 Jun
1998	11 Apr	28 Apr	13 May	3 Apr-24 May
1999	22 Apr	8 May	26 May	17 Apr-3 Jun
2000	14 Apr	2 May	24 May	12 Apr-16 Jun
2001	21 Apr	30 Apr	16 May	8 Apr-28 May
2002	16 Apr	4 May	17 May	15 Apr-31 May

Appendix Table 4b. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Imnaha River (upper) (continued)				
2003	22 Apr	8 May	26 May	17 Apr-31 May
2004	19 Apr	4 May	22 May	18 Apr-8 Jun
2005	19 Apr	3 May	27 May	5 Apr-11 Jun
2006	12 Apr	29 Apr	15 May	3 Apr-4 Jun
2007	13 Apr	25 Apr	13 May	5 Apr-24 May
2008	17 Apr	6 May	22 May	14 Apr-1 Jun
2009	13 Apr	5 May	20 May	4 Apr-9 Jun
2010	24 Apr	10 May	9 Jun	23 Apr-24 Jun
2011	**4 Apr**	**7 May**	**1 Jun**	**1 Apr-16 Jun**
Lostine River				
1990[d]	---	---	---	---
1991	29 Apr	14 May	26 May	20 Apr-09 Jul
1992	16 Apr	30 Apr	11 May	12 Apr-2 Jun
1993	23 Apr	3 May	17 May	17 Apr-1 Jun
1994	22 Apr	30 Apr	16 May	19 Apr-7 Jun
1995	12 Apr	2 May	17 May	8 Apr-9 Jun
1996	23 Apr	15 May	7 Jun	17 Apr-19 Jun
1997	17 Apr	28 Apr	16 May	9 Apr-21 May
1998[b]	---	---	---	---
1999	30 Mar	9 May	27 May	29 Mar-29 May
2000	13 Apr	8 May	25 May	13 Apr-3 Jun
2001	25 Apr	9 May	22 May	10 Apr-12 Jun
2002	11 Apr	21 Apr	13 May	28 Mar-29 May
2003	13 Apr	8 May	26 May	11 Apr-3 Jun
2004	15 Apr	4 May	5 Jun	14 Apr-15 Jun
2005	16 Apr	29 Apr	26 May	5 Apr-18 Jun
2006	14 Apr	26 Apr	16 May	5 Apr-9 Jun
2007	14 Apr	3 May	15 May	5 Apr-21 May
2008	22 Apr	11 May	29 May	10 Apr-14 Jun
2009	13 Apr	28 Apr	15 May	2 Apr-21 May
2010	27 Apr	14 May	6 Jun	24 Apr-17 Jun
2011	**9 Apr**	**5 May**	**4 Jun**	**4 Apr-26 Jun**
Minam River				
1999	8 Apr	28 Apr	25 May	31 Mar-2 Jun
2000	15 Apr	3 May	22 May	10 Apr-29 May
2001	25 Apr	7 May	23 May	8 Apr-12 Jun
2002	17 Apr	3 May	20 May	16 Apr-31 May
2003	17 Apr	13 May	29 May	13 Apr-1 Jun
2004	15 Apr	28 Apr	28 May	8 Apr-31 May
2005	19 Apr	8 May	21 May	8 Apr-8 Jun
2006	13 Apr	8 May	20 May	11 Apr-6 Jun
2007	11 Apr	27 Apr	12 May	4 Apr-22 May
2008	23 Apr	8 May	21 May	17 Apr-11 Jun
2009	24 Apr	13 May	22 May	11 Apr-6 Jun
2010	25 Apr	15 May	5 Jun	23 Apr-16 Jun
2011	**17 Apr**	**12 May**	**2 Jun**	**3 Apr-4 Jun**

[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.

Appendix Table 5. Detections during 2011 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,004 wild Chinook salmon from Bear Valley Creek released 20-22 July 2010. Release sites were 629-635 km above Lower Granite Dam.

	Bear Valley Creek							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
4 Apr	1	3						
7 Apr	2	6						
11 Apr	1	3						
17 Apr	1	3						
19 Apr			2					
21 Apr						1		
22 Apr			1					
23 Apr	1	3						
25 Apr								
26 Apr				1				
27 Apr	2	4						
28 Apr	2	4		2				
29 Apr	2	4						
30 Apr	3	6	1					
1 May	1	2	3					
2 May	3	6	1					
3 May	2	4				1		
4 May	1	2	2					
5 May	2	5	1	1	1	1		
6 May	1	2	1	1			1	
7 May	2	5	1					
8 May			1		1			
9 May	5	11		1		1		
10 May	2	4		3	1			
11 May	5	12						
12 May			2					
13 May	3	8	1	2	1			
14 May	1	3		1				
15 May	1	4					1	
16 May					1			
17 May	2	8	1	1				
18 May	1	3	1					
19 May	1	2	1					
20 May	1	2		1			1	
21 May	2	5	1					
22 May							1	
23 May	1	3	1	1	1			
24 May								
25 May					1			
26 May								
27 May	1	3						
28 May						1		
29 May								
30 May	1	2			1			

Appendix Table 5. Continued.

	Bear Valley Creek							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
1 Jun	1	3						
2 Jun			1					
3 Jun							1	
4 Jun								
5 Jun								
6 Jun	2	6						
7 Jun						1		
8 Jun								
9 Jun	1	4						
11 Jun								
12 Jun								
13 Jun								
14 Jun			1					
20 Jun								
Total	59	145	24	15	8	6	5	0

Appendix Table 6. Detections during 2011 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,025 wild Chinook salmon from Elk Creek released 22-23 July 2010. Release sites were 634-638 km above Lower Granite Dam.

	Elk Creek							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
5 Apr	1	3						
6 Apr	1	3						
7 Apr	1	3						
8 Apr	1	3						
10 Apr	1	3	1					
13 Apr	1	3						
15 Apr	1	3	1					
17 Apr	3	8	1	1				
18 Apr			1	1				
19 Apr			1					
20 Apr			1					
21 Apr								
22 Apr	2	5	1					
23 Apr			2	1				
25 Apr	2	5		1				
26 Apr	2	5	1					
27 Apr	2	4						
28 Apr	1	2		2				
29 Apr	1	2	1		1			
30 Apr	4	8	1					
1 May	5	11	1					
2 May	2	4						
3 May	3	7	4	1				
4 May	4	9	2			1		
5 May	1	2	2					
6 May	1	2		1				
7 May	1	2	1					
8 May	3	7	4		2			
9 May	1	2	1			1		
10 May	2	4	1					
11 May	2	5	1	1				
12 May	2	4	2					
13 May	2	5	2	1				
14 May	2	5	1				1	
15 May	1	4	1	2		1		
16 May	3	11	1	1				
17 May			1					
18 May			2					
19 May								
20 May					1		1	
21 May	1	3			2			
22 May	1	3		2	1			

Appendix Table 6. Continued.

	Elk Creek							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
23 May	1	3	1				1	
24 May				1	1			
25 May	2	6						
26 May							1	
27 May	1	3		1				
28 May	1	2		2				
29 May					1			
30 May								
31 May					1			
1 Jun								
3 Jun								
4 Jun	1	3	1					
5 Jun			1					
6 Jun					1			
7 Jun								
8 Jun	2	8						
9 Jun								
11 Jun	1	2						
12 Jun								
21 Jun	1	2						
04 Jul								
08 Jul								
Totals	71	180	42	19	11	3	4	0

Appendix Table 7. Detections during 2011 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,030 wild Chinook salmon from Marsh Creek released 25-26 July 2010. Release sites were 632-635 km above Lower Granite Dam.

	Marsh Creek							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
4 Apr	1	3						
5 Apr	2	6						
6 Apr	1	3						
8 Apr	1	3						
9 Apr	2	6						
10 Apr	1	3	1					
13 Apr	1	3						
14 Apr	3	8						
15 Apr	1	3	1					
17 Apr			1					
19 Apr	1	3	1					
20 Apr				1				
21 Apr			2					
22 Apr	1	3						
23 Apr	1	3						
24 Apr			2					
25 Apr	1	2		1				
26 Apr	1	2	1					
27Apr	2	4	1					
28 Apr	2	4	2					
29 Apr	4	8				1		
30 Apr	4	8	3	1				
1 May	2	4	1	1				
2 May	1	2				1		
3 May			1	1				
4 May	7	16			2			
5 May	2	5	1	1				
6 May	1	2	1	2				
7 May	1	2	2					
8 May	3	7				1		
9 May	4	9	1		1			
10 May	6	13	1					
11 May	9	21	2					
12 May	1	2	3					
13 May	6	15	1	2				
14 May	4	10	1	2				
15 May	3	11	1	3		1		
16 May	6	23	3	1	1			
17 May	1	4	3	2				
18 May			1	4				
19 May	2	5	1	1	1	1		
20 May	1	2					1	

Appendix Table 7. Continued.

	Marsh Creek							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
21 May			1	1				
22 May								
23 May			1	3			1	
24 May				1				
25 May				1				
26 May							1	
27 May				1				
28 May								
29 May							1	
30 May				1			1	
31 May								
3 Jun								
4 Jun								
6 Jun								
8 Jun	1	4						
9 Jun								
10 Jun								
11 Jun			1					
14 Jun							1	
Totals	91	232	42	31	5	5	6	

Appendix Table 8. Detections during 2011 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 141 wild Chinook salmon from Cape Horn Creek released 27 July 2010. Release site was 630 km above Lower Granite Dam.

	Cape Horn Creek							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
4 Apr	1	3						
7 Apr	1	3						
17 Apr	1	3						
25 Apr				1				
27 Apr	1	2						
28 Apr								
29 Apr								
30 Apr								
1 May								
2 May								
3 May								
4 May			1					
5 May								
6 May	1	2						
7 May								
8 May								
9 May	1	2						
10 May	1	2						
11 May	1	2						
12 May			1					
14 May	1	3						
16 May								
17 May								
18 May								
19 May				1				
20 May								
21 May								
22 May								
23 May								
24 May								
25 May								
26 May								
27 May								
28 May								
1 Jun								
2 Jun								
3 Jun								
4 Jun								
5 Jun								
7 Jun								
20 Jun								
Totals	9	22	2	2	0	0	0	0

Appendix Table 9. Detections during 2011 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 671 wild Chinook salmon from Sulphur Creek released 30-31 August 2010. Fish were released 604-606 km above Lower Granite Dam.

	Sulphur Creek							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
4 Apr	1	3						
5 Apr			1					
8 Apr			1					
13 Apr	1	3						
14 Apr	1	3						
16 Apr			1	1				
18 Apr	1	3	1					
19 Apr			1					
20 Apr	1	3						
21 Apr	1	3						
22 Apr	1	3						
23 Apr	1	3						
24 Apr	3	8		1				
25 Apr	1	2		1			1	
26 Apr								
27 Apr	1	2	1					
28 Apr								
29 Apr	3	6		1				
30 Apr	3	6						
1 May	2	4						
2 May	1	2						
3 May				1				
4 May			2					
5 May	4	9						
6 May	1	2				1		
7 May	4	10	2					
8 May	1	2						
9 May	2	4	2		1			
10 May	1	2						
11 May	2	5						
12 May	1	2	1					
13 May	4	10	1				1	
14 May	3	8		4	1			
16 May	1	4		2	2			
17 May	1	4	2					
18 May				1	2			
19 May			2					
20 May				1				
21 May				1				
22 May	1	3						
23 May				1				

Appendix Table 9. Continued.

	Sulphur Creek							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
25 May				1				
26 May								
29 May				2				
4 Jun	1	3						
6 Jun								
8 Jun								
11 Jun								
18 Jun								
Totals	49	121	18	18	6	1	2	0

Appendix Table 10. Detections during 2011 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 2,513 wild Chinook salmon from Valley Creek released 02-04 August 2010. Release sites were 743-750 km above Lower Granite Dam.

	Valley Creek							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
6 Apr	1	3						
7 Apr	1	3						
10 Apr	1	3						
13 Apr	1	3	1					
17 Apr			1			1		
18 Apr	2	5						
19 Apr			1					
21 Apr								
22 Apr				2				
23 Apr			2	1				
24 Apr								
25 Apr								
26 Apr	1	2	1					
27 Apr	1	2						
28 Apr								
29 Apr	4	8						
30 Apr	1	2						
1 May			1	1				
2 May	6	13	2	1				
3 May	1	2						
4 May								
5 May	3	7	1	1				
6 May	2	5		1				
7 May								
8 May				1				
9 May			1			2		
10 May	2	4	2	1				
11 May	4	9						
12 May	3	7						
13 May	4	10	2					
14 May	7	18	2	1	1			
15 May	2	7	1	3			1	
16 May	3	11		1			1	
17 May	3	12	2	1	1			
18 May	1	3	3	3				
19 May	1	2	2					
20 May	1	2	1	1		1		
21 May			1	2				
22 May	2	6	4	1				
23 May				1	1			
24 May	1	3		3				
25 May	2	6		1	1			
26 May	3	11		1				
27 May	1	3			1			

Appendix Table 10. Continued.

	Valley Creek							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
28 May	1	2				1		
29 May	1	3		1	1	1	1	
30 May				1				
31 May	1	3				1		
1 Jun			1	1				
2 Jun	3	11	2					
3 Jun			1		1			
4 Jun	1	3						
5 Jun	1	2						
10 Jun								
11 Jun			2					
12 Jun	1	2						
13 Jun					1			
16 Jun	1	2						
17 Jun			1			1		
18 Jun								
22 Jun								
23 Jun								
24 Jun								
25 Jun								
29 Jun			1					
Totals	75	201	39	32	8	8	4	0

Appendix Table 11. Detections during 2011 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 506 wild Chinook salmon from Camas Creek released 06-07 August 2010. Release sites were 524-526 km above Lower Granite Dam. Plus 1 detected at the trawl on 3 June 2011.

	Camas Creek							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
7 Apr	1	3						
9 Apr	1	3	1					
16 Apr			1					
17 Apr			1					
21 Apr						1		
23 Apr	1	3						
24 Apr			1					
27 Apr	1	2						
1 May	1	2						
2 May	1	2						
3 May	1	2	1					
4 May	1	2	1					
6 May	2	5						
7 May	3	7	1	1				
8 May	1	2						
10 May	3	6		1	1			
11 May	6	14		1				
12 May	5	11	1					
13 May	3	8		1				
14 May	4	10	2					
15 May	6	22						
16 May	2	8						
17 May	6	24	4	4				
18 May	2	6			1			
19 May	1	2	2	2				
20 May	5	12	2	1			1	
21 May	2	5	3	1	1			
22 May				4			1	
23 May	2	5	2					
24 May			1					
25 May	2	6					1	
29 May				1	1			
31 May				1				
1 Jun	1	3						
2 Jun				1				
6 Jun			1					
7 Jun	1	4						
8 Jun				1				
12 Jun	1	2	1					
16 Jun				1				
Totals	66	182	26	21	4	1	3	0

Appendix Table 12. Detections during 2011 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,017 wild Chinook salmon from Herd Creek released 09-10 August 2010. Fish were released 699-701 km above Lower Granite Dam.

	Herd Creek							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
5 Apr	1	3						
6 Apr	1	3						
7 Apr	1	3						
9 Apr	3	8						
11 Apr			1					
13 Apr	1	3						
14 Apr	1	3						
16 Apr					1			
19 Apr	2	5	1	1	1			
20 Apr			1		2			
22 Apr				1				
23 Apr			1					
25 Apr				1	1			
26 Apr	1	2		1			1	
28 Apr	2	4	1		1			
29 Apr			1		1			
30 Apr	2	4						
1 May			1					
2 May	4	8						
4 May	2	5	2					
6 May	2	5	2					
7 May	2	5				1	1	
8 May	2	5	1					
9 May	2	4	1					
10 May	7	15						
11 May	7	16						
12 May	3	7	4					
13 May	4	10	2	1				
14 May	4	10		2				
15 May	3	11	1					
16 May	5	19	1					
17 May	6	24	1	3				
18 May	2	6	2	3				
19 May	1	2				1		
20 May							2	
21 May	2	5	1	1			1	
22 May				1				
23 May				1				
24 May	2	6		1				
27 May				2				
29 May				1			1	
31 May	1	3						
2 Jun			1					
12 Jun			1					
Totals	76	204	27	20	7	2	6	0

Appendix Table 13. Detections during 2011 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 828 wild Chinook salmon from Loon Creek released 12-13 August 2010. Release sites were 550-553 km above Lower Granite Dam. Plus 1 detected at the trawl on 29 May 2011.

	Loon Creek							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
11 Apr	1	3						
17 Apr	1	3						
18 Apr	2	5						
25 Apr	1	2	1					
27 Apr	2	4	2					
28 Apr								
29 Apr				1				
30 Apr	2	4						
1 May								
2 May	2	4					1	
3 May	2	4						
4 May								
5 May			1					
6 May			2			1		
7 May	1	2		1				
8 May	3	7						
9 May	1	2	1					
10 May	5	11	3	1				
11 May	9	21	1	1				
12 May	6	13	2					
13 May	7	18	3					
14 May	12	31	1	2				
15 May	4	14	2	4		1		
16 May	5	19	2	3				
17 May	3	12	4	2	2			
18 May	4	12	5	2	1			
19 May	1	2	3	3	1			
20 May	2	5	1		3			
21 May	1	3			1			
22 May			4	4	1		2	
23 May							2	
24 May	1	3		2		1		
25 May				1				
26 May				2	1			
27 May	1	3						
28 May	1	2						
29 May				1				
30 May	1	2						
31 May								
2 Jun			1					
3 Jun							1	
4 Jun				1				
5 Jun	1	2						
14 Jun							1	
Totals	82	214	39	31	10	3	7	0

Appendix Table 14. Detections during 2011 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,145 wild Chinook salmon from Big Creek (upper) released 16-17 August 2010. Release sites were 535-538 km above Lower Granite Dam.

	Big Creek (upper)							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
25 Apr	1	2						
27 Apr	1	2						
28 Apr	1	2						
29 Apr			1					
30 Apr								
1 May			2	1				
2 May								
3 May	1	2						
4 May								
5 May	1	2						
6 May	1	2						
7 May	1	2		1				
8 May			1			1		
9 May			1					
10 May	1	2	1					
11 May	3	7	1					
12 May	6	13						
13 May	3	8	5		1			
14 May	7	18		1		1		
15 May	1	4	1					
16 May	1	4	2	3				
17 May	4	16	1	2				
18 May	2	6	3	2	1	2		
19 May	2	5	1	1	1			
20 May	2	5	2	1	2			
21 May	6	15	2	1	1			
22 May	1	3	1	3	1		2	
23 May	1	3	1	1				
24 May	1	3		2	1			
25 May								
26 May								
27 May							1	
28 May								
29 May							1	
30 May								
31 May	1	3						
1 Jun	3	10						
9 Jun								
10 Jun								
11 Jun								
13 Jun								
16 Jun								
26 Jun			1					
Totals	52	138	27	19	8	4	4	0

Appendix Table 15. Detections during 2011 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,413 wild Chinook salmon from Big Creek (lower) released 2-3 September 2010. Release sites were 489-491 km above Lower Granite Dam.

	Big Creek (lower)							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
6 Apr	1	3						
7 Apr	1	3	1					
8 Apr	5	14						
9 Apr	6	17						
10 Apr	2	6	1					
12 Apr	1	3	1					
13 Apr	1	3	1					
14 Apr	3	8						
15 Apr	3	8						
16 Apr	2	5	1					
17 Apr	1	3		1				
18 Apr			2	2				
19 Apr	3	8	2	1		1		
20 Apr			1	1				
21 Apr	2	5	1					
22 Apr	2	5		1				
23 Apr	2	5	1					
24 Apr	1	3						
25 Apr	3	7	2					
26 Apr	1	2	1					
27 Apr	5	11					1	
28 Apr	1	2				1		
29 Apr	6	12	1					
30 Apr	8	17	2					
1 May	6	13	2					
2 May	4	8	4	2				
3 May	4	9						
4 May	1	2	3	1				
5 May	2	5	5					
6 May	5	12	2		1	1		
7 May	4	10	1					
8 May	3	7	5	1		1		
9 May	8	18			1			
10 May	5	11	1	4	1			
11 May	7	16	1		1			
12 May	9	20	5	2	1	1		
13 May	5	13	4	1				
14 May	9	23		5				1
15 May			6	7	1	1		
16 May	1	4	2	4			1	
17 May	2	8	3	2	2			
18 May			1	5	3			
19 May			3	1				
20 May			2	1	2		1	

Appendix Table 15. Continued.

	Big Creek (lower)							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
21 May	1	3	1	1	1		2	
22 May				1			1	
23 May						2		
24 May				2			1	
25 May								
26 May								
27 May				1				
31 May							1	
10 Jun			1					
Totals	136	328	70	47	14	8	8	1

Appendix Table 16. Detections during 2011 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,424 wild Chinook salmon from West Fork Chamberlain/Chamberlain Creeks released 24-26 August 2010. Release sites were 437-439 km above Lower Granite Dam.

	West Fork Chamberlain and Chamberlain Creeks							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
3 Apr	1	3						
4 Apr	1	3						
8 Apr	1	3						
9 Apr	1	3						
10 Apr			1					
13 Apr	1	3						
19 Apr	2	5	1					
20 Apr			2					
21 Apr	1	3						
22 Apr	1	3						
23 Apr	1	3						
24 Apr	1	3						
25 Apr	1	2		1		1		
26 Apr	1	2	1					
27 Apr	6	13	1					
28 Apr	3	6						
29 Apr	2	4	3	1				
30 Apr	5	11	2					
1 May	3	6	1	2	1			
2 May	4	8	1	2				
3 May			1	1				
4 May	1	2	1			1		
5 May	5	11			1	2		
6 May	2	5	2					
7 May	6	14						
8 May			1					
9 May	5	11	2	2		1		
10 May	3	6	1	1				1
11 May	8	19	1	1				
12 May	3	7	3	2				
13 May	5	13	6	2				
14 May	5	13	2	1	1		1	
15 May	3	11	2	3				
16 May	4	15		3				
17 May	1	4	2	1		1		
18 May			1	1	1			
19 May						1		
20 May					1			

Appendix Table 16. Continued.

	West Fork Chamberlain and Chamberlain Creeks							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
21 May	1	3						
22 May				2				
23 May	2	5		1			1	
24 May	1	3		2				
25 May								
26 May							1	
27 May	1	3		1	2			
29 May								
30 May	3	7						
1 Jun	1	3		1	1			
3 Jun								
6 Jun								
7 Jun			1					
10 Jun								
12 Jun	1	2		2				
13 Jun	1	2		2				
14 Jun			1					
16 Jun	1	2						
18 Jun			1					
26 Jun			1					
27 Jun	2	7						
08 Jul								
Totals	101	253	42	35	8	7	3	1

Appendix Table 17. Detections during 2011 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,034 wild Chinook salmon from South Fork Salmon River released 19-20 August 2010. Release sites were 467-469 km above Lower Granite Dam.

	South Fork Salmon River							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
3 Apr	1	3						
4 Apr	1	3						
6 Apr	1	3						
7 Apr	5	14						
9 Apr	3	8						
10 Apr			1					
11 Apr	2	5						
12 Apr	1	3		2				
13 Apr	1	3						
15 Apr			1					
16 Apr	2	5	1					
17 Apr			1					
18 Apr			1					
19 Apr				1				
20 Apr	1	3		1				
21 Apr	2	5						
22 Apr				1				
23 Apr			1					
24 Apr	1	3	1	1				
25 Apr								
26 Apr	1	2	1					
27 Apr	1	2	1					
28 Apr	1	2						
29 Apr	2	4	1	1				
30 Apr	6	13	2	1				
1 May	3	6	2	1				
2 May	6	13						
3 May	1	2		3				
4 May	2	5	2					
5 May	1	2	3	1				
6 May	1	2		1		1		
7 May			1					
8 May			1	1	1			
9 May	2	4	1					
10 May	3	6				1		
11May			1					
12 May	4	9	4					
13 May	1	3	4	1				
14 May	1	3		2				
15 May	5	18		2				
16 May	2	8	1	3	1			
17 May	1	4	4	2				
18 May	2	6		1	1		1	
19 May	2	5	1	1				
20 May	1	2						

Appendix Table 17. Continued.

	South Fork Salmon River							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
21 May	1	3		1				
22 May	3	9		2				
23 May	3	8		1				
24 May				2				
25 May						1	1	
26 May	1	4						
27 May							1	
28 May								
29 May	1	3		1			1	
1 Jun					1		1	
2 Jun								
3 Jun								
4 Jun								
5 Jun	1	2						
7 Jun			1					
8 Jun				1				
9 Jun								
10 Jun								
Totals	80	208	38	35	4	3	5	0

Appendix Table 18. Detections during 2011 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 1,001 wild Chinook salmon from Secesh River released 27-28 August 2010. Release sites were 429-431 km above Lower Granite Dam.

	Secesh River							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
3 Apr	1	3						
4 Apr	1	3						
5 Apr	1	3						
6 Apr	2	6						
7 Apr	2	6	1					
10 Apr	2	6						
11 Apr	2	5	1					
13 Apr	2	5	2					
14 Apr				1				
15 Apr	1	3	1	1				
16 Apr	1	3						
17 Apr			1		1			
19 Apr			1	1				
20 Apr	2	5						
21 Apr	1	3	3					
22 Apr	1	3	1					
23 Apr			1		1			
24 Apr	1	3	1					
25 Apr	3	7						
26 Apr	1	2		1				
27 Apr	3	7						
28 Apr	5	10						
29 Apr	2	4			1			
30 Apr	1	2	2	2				
1 May								
2 May	2	4	1				1	
3 May	3	7	1	1				
4 May	1	2	1					
5 May			1			2		
6 May				1				
7 May			1			1		
8 May	1	2	1			1		
9 May	2	4	1				1	
10 May	1	2						
11 May	5	12						
12 May	3	7	3					
13 May			4	1				
15 May								
16 May	1	4		1				
17 May	1	4						
18 May	1	3						
19 May			1	2				
20 May	1	2	1					

Appendix Table 18. Continued.

	Secesh River							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
21 May								
22 May				1				
23 May	2	6			1			
24 May					1			
25 May				2				
27 May	1	3						
29 May	1	3						
30 May					1			
31 May								
1 Jun	1	3		1			1	
2 Jun				1				
4 Jun	1	3		1			1	
5 Jun				1				
6 Jun								
7 Jun	2	8						
8 Jun								
9 Jun								
10 Jun	1	2						
11 Jun					1			
14 Jun							1	
16 Jun					1			
26 Jun	1	4						
27 Jun	1	4						
Totals	68	177	31	19	8	4	5	0

Appendix Table 19. Detections during 2011 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 458 wild Chinook salmon from Lake Creek released 30 August 2010. Release site was 451 km above Lower Granite Dam.

	Lake Creek							
	Lower Granite							
Detection date	First Detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
10 Apr	1	3						
12 Apr	1	3						
20 Apr	1	3						
28 Apr	1	2						
30 Apr	2	4	2					
1 May			1					
2 May	1	2						
4 May				1				
5 May			1					
6 May			1	2				
7 May								
8 May								
9 May	1	2						
10 May	2	4						
11 May	1	2	1					
12 May	1	2		1				
13 May	2	5						
14 May	1	3		2				
15 May	1	4		1				
16 May	2	8						
17 May				1				
18 May			1	1				
19 May								
20 May			1	1		1		
21 May								
22 May								
23 May			1					
24 May				2				
25 May								
26 May								
27 May								
28 May								
29 May				1				
30 May								
31 May								
1 Jun								
3 Jun								
5 Jun			1					
12 Jun	1	2						
16 Jun			1					
25 Jun			1					
Totals	19	49	12	13	0	1	0	0

Appendix Table 20. Daily and expanded detections (with estimated detection efficiencies) of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho and Oregon at Lower Granite Dam during 2011, 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)	water temperature	Number of detections	Expanded detections	Number of detections	Expanded detections (est.det.eff.)
1 Apr	123.9	50.6	7.3	0	0	1	6 (0.155)
2 Apr	130.6	57.4	7.3	0	0	1	4 (0.273)
3 Apr	137.8	64.3	7.5	3	10	6	20 (0.293)
4 Apr	124.3	51.2	7.1	7	22	10	32 (0.317)
5 Apr	138.6	65.2	6.8	5	14	6	17 (0.345)
6 Apr	137.4	64.5	6.9	8	24	9	27 (0.338)
7 Apr	127.3	54.8	7.0	15	43	18	52 (0.347)
8 Apr	117.0	44.5	6.8	8	22	9	25 (0.367)
9 Apr	113.2	42.4	6.9	16	44	19	53 (0.361)
10 Apr	108.9	40.3	7.3	8	22	10	28 (0.362)
11 Apr	105.3	33.2	7.8	6	16	6	16 (0.369)
12 Apr	106.7	34.5	8.0	3	8	3	8 (0.378)
13 Apr	101.0	29.0	8.1	10	27	11	30 (0.369)
14 Apr	98.8	26.9	7.9	8	22	10	27 (0.367)
15 Apr	89.9	21.5	8.0	6	16	9	23 (0.387)
16 Apr	82.6	20.1	8.0	5	13	6	15 (0.388)
17 Apr	89.4	21.1	8.3	7	18	10	25 (0.395)
18 Apr	96.6	25.5	8.8	5	13	5	13 (0.397)
19 Apr	104.8	33.0	9.0	8	20	8	20 (0.395)
20 Apr	106.8	35.9	8.6	5	13	7	18 (0.385)
21 Apr	109.8	37.7	8.6	7	18	10	26 (0.382)
22 Apr	104.9	38.4	8.7	8	21	9	24 (0.375)
23 Apr	102.0	30.3	9.0	7	19	8	22 (0.372)
24 Apr	98.2	26.4	9.0	7	18	8	21 (0.387)
25 Apr	93.8	25.1	9.2	13	31	15	36 (0.419)
26 Apr	95.8	27.0	9.5	9	21	11	25 (0.437)
27 Apr	96.4	24.6	9.7	28	63	34	76 (0.446)
28 Apr	93.6	21.7	9.8	19	39	25	51 (0.493)
29 Apr	92.0	20.2	9.8	26	52	34	68 (0.502)
30 Apr	90.3	20.2	9.8	41	87	44	93 (0.471)
1 May	88.5	20.2	9.5	23	49	29	62 (0.470)
2 May	84.8	20.1	9.5	37	78	44	93 (0.473)
3 May	86.0	20.2	9.6	18	39	21	46 (0.461)
4 May	87.1	20.1	9.9	20	47	26	60 (0.430)
5 May	90.0	20.1	10.2	21	48	28	64 (0.440)
6 May	86.0	20.1	10.5	20	47	29	68 (0.424)
7 May	87.3	20.2	10.9	25	60	34	81 (0.419)
8 May	95.3	23.8	11.0	17	40	22	52 (0.426)
9 May	101.7	24.4	11.0	34	76	44	99 (0.445)
10 May	101.1	20.1	10.9	44	95	54	116 (0.464)
11 May	99.0	20.0	10.6	69	160	77	178 (0.432)
12 May	104.8	22.2	10.8	47	103	52	114 (0.458)
13 May	119.8	34.9	11.4	49	124	54	137 (0.394)

Appendix Table 20. Continued.

Date	Average flow (kcfs)	Average spill (kcfs)	water temperature	Idaho only		Idaho and Oregon	
				Number of detections	Expanded detections	Number of detections	Expanded detections (est.det.eff.)
14 May	140.2	49.9	11.4	61	155	65	165 (0.393)
15 May	175.3	84.0	11.7	30	108	34	123 (0.277)
16 May	203.4	111.3	11.0	36	137	40	153 (0.262)
17 May	188.7	97.5	9.9	31	123	31	123 (0.252)
18 May	173.0	83.7	9.6	15	44	19	56 (0.342)
19 May	158.6	64.7	10.0	11	25	12	28 (0.435)
20 May	158.7	55.7	10.9	14	33	16	37 (0.428)
21 May	163.2	60.3	11.9	17	44	21	54 (0.390)
22 May	171.0	61.2	12.1	10	29	11	32 (0.339)
23 May	182.6	74.8	11.9	10	27	14	37 (0.375)
24 May	187.6	77.2	11.6	6	17	11	30 (0.363)
25 May	196.1	85.2	11.0	6	19	6	19 (0.315)
26 May	200.0	95.8	10.6	4	15	7	26 (0.269)
27 May	201.7	91.2	10.8	6	17	10	29 (0.345)
28 May	182.3	72.1	10.6	3	7	3	7 (0.409)
29 May	171.7	61.6	10.7	3	8	5	13 (0.378)
30 May	162.1	51.7	11.2	5	12	6	14 (0.415)
31 May	157.2	51.0	11.4	3	9	5	15 (0.344)
1 Jun	154.5	44.3	11.7	7	23	9	30 (0.304)
2 Jun	154.3	45.4	11.6	3	11	4	14 (0.280)
3 Jun	169.6	59.6	11.3	0	0	2	6 (0.325)
4 Jun	160.4	51.0	11.2	4	12	8	23 (0.343)
5 Jun	158.2	50.1	11.7	3	7	5	12 (0.431)
6 Jun	161.8	52.7	12.2	2	6	4	12 (0.329)
7 Jun	188.1	77.6	12.4	3	11	4	15 (0.262)
8 Jun	211.2	99.5	11.9	3	12	5	20 (0.254)
9 Jun	206.5	97.1	11.2	1	4	2	7 (0.271)
10 Jun	197.0	86.4	11.0	1	2	1	2 (0.408)
11 Jun	182.6	72.0	11.3	2	5	3	7 (0.410)
12 Jun	178.8	70.2	11.9	3	7	4	9 (0.449)
13 Jun	183.2	72.5	12.5	1	2	1	2 (0.459)
14 Jun	188.9	77.9	12.6	0	0	0	0
15 Jun	189.4	78.5	12.5	0	0	0	0
16 Jun	184.5	74.5	12.4	2	4	4	9 (0.454)
17 Jun	173.4	63.3	12.0	0	0	1	2 (0.454)
18 Jun	158.7	50.3	12.2	0	0	1	2 (0.487)
19 Jun	154.2	44.7	12.4	0	0	0	0
20 Jun	161.8	51.7	12.4	0	0	0	0
21 Jun	158.6	48.0	12.4	1	2	1	2 (0.420)
22 Jun	167.4	56.5	13.0	0	0	0	0
23 Jun	181.6	70.2	13.7	0	0	0	0
24 Jun	191.6	80.2	13.5	0	0	0	0
25 Jun	182.8	71.7	13.0	0	0	1	2 (0.468)
26 Jun	172.6	62.5	13.0	1	4	2	7 (0.268)
27 Jun	163.6	53.3	13.3	3	11	3	11 (0.269)
28 Jun	159.1	48.6	13.5	0	0	0	0
29 Jun	162.1	51.6	14.0	0	0	0	0
30 Jun	171.8	73.9	14.3	0	0	0	0

Appendix Table 21. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Little Goose Dam during 2011, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

	Little Goose Dam			
Date	Flow (mean kcfs)	Spill (mean kcfs)	Water temperature (°C)	Detections (n)
5 Apr	129.7	37.8	7.6	1
7 Apr	121.8	36.5	6.9	2
8 Apr	111.4	33.5	7.1	1
9 Apr	108.5	35.0	7.4	1
10 Apr	107.0	35.5	7.2	5
11 Apr	99.4	29.9	7.2	2
12 Apr	104.2	31.1	7.4	1
13 Apr	98.3	29.4	7.7	4
15 Apr	88.3	26.5	8.1	4
16 Apr	79.1	23.8	8.2	4
17 Apr	87.5	26.3	8.4	7
18 Apr	92.9	27.8	8.4	5
19 Apr	102.6	30.7	8.4	11
20 Apr	102.0	30.6	8.4	5
21 Apr	105.6	31.7	8.9	6
22 Apr	102.4	30.6	8.8	3
23 Apr	97.1	29.0	8.6	8
24 Apr	95.6	28.7	8.9	5
25 Apr	90.7	27.3	9.0	3
26 Apr	93.7	28.2	9.2	6
27 Apr	91.7	27.5	9.1	6
28 Apr	91.1	27.4	9.3	3
29 Apr	88.3	26.5	9.5	8
30 Apr	87.2	26.2	9.8	15
1 May	86.6	26.0	9.8	15
2 May	79.9	23.9	10.0	9
3 May	83.4	25.0	10.0	8
4 May	85.7	25.6	9.7	17
5 May	86.3	25.8	9.8	16
6 May	84.9	25.4	10.0	11
7 May	84.2	25.3	10.4	10
8 May	91.4	27.4	10.5	15
9 May	98.7	29.6	10.8	12
10 May	96.8	38.8	11.2	10
11 May	97.7	29.2	11.3	9
12 May	101.8	32.7	11.5	31
13 May	113.8	41.7	11.2	35
14 May	134.2	62.8	11.1	9
15 May	167.7	97.0	11.8	15
16 May	195.4	124.7	11.7	12

Appendix Table 21. Continued.

	Little Goose Dam			
Date	Flow (mean kcfs)	Spill (mean kcfs)	Water temperature (°C)	Detections (n)
17 May	183.4	112.6	11.4	28
18 May	164.3	93.1	10.7	20
19 May	152.6	79.0	10.2	17
20 May	147.0	104.4	10.3	10
21 May	155.9	82.5	11.0	10
22 May	163.0	91.7	11.8	9
23 May	173.2	98.7	12.4	7
24 May	174.1	151.1	12.4	1
25 May	178.4	172.6	12.1	0
26 May	182.7	177.2	11.5	0
28 May	167.3	161.6	11.1	0
29 May	158.7	153.2	11.2	0
30 May	148.2	142.7	11.1	0
31 May	142.5	136.9	11.3	0
1 Jun	142.9	105.2	11.6	1
2 Jun	146.2	56.3	11.5	5
3 Jun	161.6	71.5	11.6	1
4 Jun	152.8	64.8	11.7	1
5 Jun	149.0	63.2	11.5	2
6 Jun	151.7	61.5	11.6	1
7 Jun	177.1	87.1	12.1	2
8 Jun	200.8	111.4	12.5	0
9 Jun	195.0	105.3	12.1	0
10 Jun	188.6	98.7	11.6	1
11 Jun	173.1	83.1	11.2	3
12 Jun	169.0	78.8	11.5	2
14 Jun	180.0	91.2	12.3	2
16 Jun	174.0	83.4	12.5	1
17 Jun	166.2	75.8	12.3	1
18 Jun	149.2	59.0	12.3	1
25 Jun	173.3	63.8	14.0	1
26 Jun	159.4	50.5	13.5	2
29 Jun	152.2	47.1	13.9	1

Appendix Table 22. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Lower Monumental Dam during 2011, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

	Lower Monumental Dam			
Date	Flow (mean kcfs)	Spill (mean kcfs)	Water temperature (°C)	Detections (n)
12 Apr	108.6	26.2	7.5	2
14 Apr	98.3	27.0	7.7	1
15 Apr	91.7	26.9	8.0	1
16 Apr	82.2	27.9	8.3	1
17 Apr	89.3	27.9	8.5	2
18 Apr	96.1	27.9	8.5	3
19 Apr	106.1	28.2	8.5	4
20 Apr	104.7	29.7	8.5	3
22 Apr	104.9	30.0	8.9	5
23 Apr	99.5	29.5	9.1	2
24 Apr	97.3	28.3	9.1	2
25 Apr	92.8	28.1	9.1	6
26 Apr	95.8	28.5	9.1	3
28 Apr	94.1	29.8	9.4	4
29 Apr	90.9	29.9	9.3	4
30 Apr	90.5	29.7	9.5	4
1 May	88.3	29.6	9.8	6
2 May	81.1	29.7	10.1	5
3 May	83.4	29.8	10.1	8
4 May	88.8	29.9	10.1	2
5 May	88.5	29.9	10.3	4
6 May	87.2	29.9	10.2	9
7 May	84.8	29.7	10.1	3
8 May	92.8	29.6	10.3	3
9 May	101.9	27.8	10.6	3
10 May	100.0	28.1	10.8	11
11 May	101.0	27.9	11.2	4
12 May	103.6	27.1	11.5	5
13 May	116.3	27.0	11.7	12
14 May	139.0	28.7	11.6	23
15 May	173.5	57.9	11.4	25
16 May	209.7	93.2	11.8	22
17 May	198.7	83.5	11.8	21
18 May	173.2	64.7	11.5	23
19 May	160.6	48.9	10.8	12
20 May	155.4	46.9	10.5	7
21 May	162.2	55.8	10.7	9
22 May	169.9	54.9	11.2	21

Appendix Table 22. Continued.

	Lower Monumental Dam			
Date	Flow (mean kcfs)	Spill (mean kcfs)	Water temperature (°C)	Detections (n)
23 May	180.8	64.3	12.0	10
24 May	189.2	72.6	12.4	18
25 May	193.5	76.7	12.4	6
26 May	200.2	83.8	12.0	3
27 May	206.8	91.9	11.4	6
28 May	184.4	68.9	11.1	2
29 May	171.1	55.4	11.3	8
30 May	158.4	44.6	11.3	2
31 May	151.7	58.2	11.3	1
1 Jun	154.1	40.8	11.7	3
2 Jun	152.0	40.7	12.0	2
4 Jun	158.2	44.0	12.2	2
5 Jun	155.0	43.0	12.3	1
8 Jun	215.2	104.0	12.7	2
9 Jun	211.2	96.9	12.8	1
12 Jun	177.2	60.2	11.8	2
13 Jun	178.3	61.3	12.0	2
16 Jun	180.9	64.6	13.0	1

Appendix Table 23. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Ice Harbor Dam during 2011, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

	Ice Harbor Dam			
Date	Flow (mean kcfs)	Spill (mean kcfs)	Water temperature (°C)	Detections (n)
17 Apr	90.4	61.4	8.4	1
23 Apr	101.6	65.6	8.9	1
29 Apr	91.9	27.4	9.4	2
1 May	90.5	61.5	9.6	1
4 May	92.4	39.7	10.1	2
5 May	89.8	27.1	10.4	2
6 May	87.1	49.9	10.6	1
8 May	94.3	41.7	10.6	4
9 May	104.7	36.0	10.6	3
10 May	99.3	34.7	10.8	3
11 May	102.9	34.1	11.2	1
12 May	104.9	54.1	11.5	1
13 May	117.7	67.6	11.9	2
14 May	143.2	72.0	12.2	3
15 May	175.2	93.6	12.1	1
16 May	213.8	131.0	11.8	6
17 May	202.1	120.8	12.0	5
18 May	178.7	97.0	12.1	10
19 May	166.9	87.2	12.0	4
20 May	160.9	82.7	11.4	11
21 May	168.6	93.4	11.1	6
22 May	174.3	92.5	11.2	3
23 May	186.9	103.3	11.6	3
24 May	191.9	108.6	12.3	3
25 May	198.4	114.9	12.7	3
26 May	204.2	121.5	12.6	1
27 May	209.2	127.6	12.2	3
28 May	190.9	109.1	11.7	1
29 May	178.3	95.5	11.5	4
30 May	163.8	83.6	11.7	2
31 May	156.4	81.6	11.8	1
1 Jun	160.4	79.8	11.9	2
3 Jun	175.2	93.6	12.1	1
6 Jun	162.1	81.1	12.8	1
11 Jun	186.7	106.2	12.8	1
13 Jun	184.7	101.1	12.3	1
16 Jun	187.6	105.1	13.0	1

Appendix Table 24. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at McNary Dam during 2011, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

	McNary Dam			
Date	Flow (mean kcfs)	Spill (mean kcfs)	Water temperature (°C)	Detections (n)
17 Apr	248.4	100.1	7.4	1
19 Apr	252.7	103.7	7.9	1
21 Apr	277.7	127.4	8.1	2
25 Apr	257.4	112.8	8.7	1
28 Apr	255.8	106.6	8.6	1
29 Apr	246.0	98.9	8.6	1
2 May	255.9	106.9	9.2	1
3 May	251.3	102.4	9.2	1
4 May	248.6	99.4	9.2	2
5 May	247.5	99.0	9.5	5
6 May	249.1	99.9	9.8	4
7 May	249.7	100.1	9.9	2
8 May	249.3	99.8	10.1	4
9 May	277.5	129.0	10.4	5
10 May	265.6	118.9	10.2	1
12 May	295.4	151.1	11.2	1
14 May	347.3	209.8	11.3	1
15 May	385.8	250.3	11.6	4
17 May	437.8	299.4	11.2	1
18 May	422.0	279.6	11.3	2
19 May	421.5	279.6	11.5	3
20 May	416.4	273.4	11.7	2
23 May	480.2	333.0	11.2	2
24 May	473.1	325.5	11.3	1
25 May	470.1	321.4	11.7	1
28 May	495.5	346.4	12.0	2
29 May	499.4	349.9	11.8	1
31 May	473.5	324.0	12.0	1
7 Jun	493.6	342.9	13.1	1
17 Jun	478.5	304.2	13.6	1

Appendix Table 25. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at John Day Dam during 2011, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

	John Day Dam			
Date	Flow (mean kcfs)	Spill (mean kcfs)	Water temperature (°C)	Detections (n)
25 Apr	264.6	79.4	8.8	1
26 Apr	247.0	74.4	8.9	1
27 Apr	270.1	85.5	9.1	1
2 May	250.8	100.2	9.7	2
6 May	260.4	103.9	10.0	1
7 May	245.1	93.7	10.2	1
9 May	281.8	88.9	10.5	1
13 May	347.0	103.7	11.6	1
14 May	351.8	105.3	11.7	2
15 May	383.6	122.6	11.8	2
16 May	438.6	148.7	11.9	2
18 May	457.9	187.1	12.1	1
20 May	467.3	186.9	12.0	7
21 May	474.3	194.7	12.2	3
22 May	476.7	193.8	12.3	7
23 May	493.6	214.9	12.2	5
24 May	495.3	220.0	12.0	1
25 May	490.8	200.2	11.8	2
26 May	483.0	205.7	11.7	3
27 May	501.7	217.4	11.9	2
29 May	518.3	236.6	12.4	5
30 May	509.1	233.6	12.4	1
31 May	512.0	235.0	12.4	1
1 Jun	495.7	235.7	12.5	2
3 Jun	498.0	225.6	12.7	2
4 Jun	513.8	230.4	12.7	2
14 Jun	500.6	239.9	14.1	3

Appendix Table 26. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Bonneville Dam during 2011, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam. Table also includes first-time detections at the PIT-tag trawl (TWX) near the mouth of the Columbia River.

Date	Flow (mean kcfs)	Spill (mean kcfs)	Water temperature (°C)	Detections (n)
	Bonneville Dam			
10 May	301.6	99.5	11.0	1
14 May	358.8	129.2	11.8	1
	Estuary trawl PIT-tag detection (TWX)			
29 May				1
3 Jun				1

Appendix Table 27. Monthly environmental data collected from Marsh Creek (rkm 179.8 from the mouth of the Middle Fork Salmon River), August 2010-July 2011.

	Marsh Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	5.2	2.7	0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.2	1.4	4.5
Max	17.7	14.8	12.0	6.9	3.9	3.0	4.7	6.5	9.7	10.5	14.2	17.2
Mean	11.1	8.0	5.1	1.7	0.5	0.6	0.6	2.1	3.1	3.7	7.2	10.7
Dissolved oxygen (ppm)												
Min	8.9	9.9	10.3	10.2	11.4	11.5	11.7	11.2	10.3	8.0	---	8.0
Max	13.1	14.4	15.2	13.1	13.4	13.8	14.2	15.1	14.8	14.4	---	10.1
Mean	10.8	12.1	12.7	11.7	12.2	12.5	12.9	12.7	12.4	11.4	---	9.0
Specific conductance (µS/cm)												
Min	56.0	57.0	58.0	53.0	59.0	53.0	51.0	61.0	59.0	28.0	31.0	34.0
Max	63.0	65.0	66.0	70.0	78.0	72.0	73.0	70.0	70.0	70.0	41.0	64.0
Mean	59.1	61.3	63.7	64.2	65.7	64.5	65.6	67.4	65.8	43.5	35.6	45.6
Turbidity (ntu)												
Min	---	---	---	---	---	---	---	---	---	---	---	---
Max	---	---	---	---	---	---	---	---	---	---	---	---
Mean	---	---	---	---	---	---	---	---	---	---	---	---
Depth (ft)												
Min	0.4	0.5	0.4	0.1	0.5	0.6	0.2	0.3	0.4	1.0	2.3	1.5
Max	1.2	1.2	1.3	1.7	2.5	2.4	2.0	1.1	1.1	3.3	3.8	3.4
Mean	0.9	0.9	0.9	1.0	1.3	1.4	0.8	0.7	0.8	2.2	3.2	2.4
pH												
Min	7.4	7.4	7.2	7.1	7.2	7.1	7.2	7.3	7.2	6.5	6.8	6.9
Max	8.6	8.6	8.4	8.5	8.7	7.9	8.2	8.2	8.4	8.0	7.3	8.0
Mean	7.8	7.8	7.6	7.4	7.4	7.4	7.5	7.6	7.6	6.9	7.0	7.3

Appendix Table 28. Monthly environmental data collected from the Salmon River near Sawtooth Hatchery (rkm 618), August 2010-July 2011.

	Salmon River											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	8.1	6.0	2.5	-0.1	-0.1	-0.1	-0.1	0.0	0.1	2.1	4.8	7.9
Max	19.5	17.1	13.9	8.0	5.1	4.2	5.6	9.6	11.3	12.3	15.9	18.3
Mean	13.2	10.6	7.5	2.9	1.2	1.1	1.3	3.2	5.3	6.9	9.8	13.4
Dissolved oxygen (ppm)												
Min	4.6	4.5	0.2	10.0	---	---	---	9.8	5.3	5.3	7.1	6.0
Max	8.3	8.7	14.5	15.2	---	---	---	14.0	15.1	13.4	14.2	10.3
Mean	6.2	6.6	5.7	13.0	---	---	---	11.7	10.9	10.9	10.1	8.2
Specific conductance (µS/cm)												
Min	121.0	143.0	126.0	143.0	149.0	147.0	---	150.0	158.0	90.0	67.0	67.0
Max	149.0	158.0	158.0	158.0	158.0	158.0	---	158.0	158.0	158.0	117.0	115.0
Mean	137.0	149.3	147.2	153.3	155.2	154.9	---	155.8	158.0	116.3	86.3	82.3
Turbidity (ntu)												
Min	---	---	---	---	---	---	---	---	---	---	---	---
Max	---	---	---	---	---	---	---	---	---	---	---	---
Mean	---	---	---	---	---	---	---	---	---	---	---	---
Depth (ft)												
Min	0.8	0.9	0.9	0.8	0.5	1.1	0.7	0.9	0.7	1.3	1.8	1.8
Max	1.6	1.6	2.1	2.4	1.9	2.5	2.5	1.7	1.6	2.3	3.1	3.2
Mean	1.3	1.3	1.5	1.6	1.4	1.6	1.3	1.3	1.2	1.9	2.5	2.4
pH												
Min	7.9	8.1	7.9	7.7	7.8	7.8	7.9	7.8	7.8	7.6	7.3	7.3
Max	9.0	9.1	9.3	8.7	8.9	9.0	8.9	9.1	8.6	8.6	8.6	8.7
Mean	8.4	8.5	8.5	8.1	8.2	8.2	8.3	8.2	8.1	7.9	7.8	7.7

Appendix Table 29. Monthly environmental data collected from Valley Creek (rkm 609.4 from the mouth of the Salmon River; 0.4 km from the mouth of Valley Creek), August 2010-July 2011.

	Valley Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	7.8	4.6	1.1	0.1	0.1	0.1	0.1	0.1	0.1	1.0	3.9	7.4
Max	22.0	18.6	14.9	7.9	3.0	0.8	1.3	7.5	10.4	13.9	16.1	18.9
Mean	14.3	10.5	6.7	2.1	0.4	0.3	0.4	1.9	3.6	5.8	9.7	12.7
Dissolved oxygen (ppm)												
Min	6.8	7.4	8.4	10.3	12.4	12.6	13.2	10.7	10.0	8.3	8.1	7.5
Max	9.7	10.8	12.1	13.6	13.9	14.4	14.7	14.4	14.9	14.4	12.8	11.3
Mean	8.1	9.2	10.4	12.2	13.1	13.4	13.8	13.3	11.9	11.2	10.0	9.0
Specific conductance (µS/cm)												
Min	56.0	64.0	57.0	78.0	72.0	78.0	83.0	85.0	74.0	44.0	39.0	37.0
Max	68.0	71.0	84.0	97.0	95.0	98.0	104.0	106.0	87.0	78.0	54.0	48.0
Mean	63.3	67.7	69.3	86.5	86.6	89.0	91.7	94.1	80.7	53.9	45.8	41.3
Turbidity (ntu)												
Min	---	---	---	---	---	---	---	---	---	---	---	---
Max	---	---	---	---	---	---	---	---	---	---	---	---
Mean	---	---	---	---	---	---	---	---	---	---	---	---
Depth (ft)												
Min	0.6	0.7	0.7	0.6	0.6	1.3	0.7	0.8	0.9	1.6	2.2	1.7
Max	1.4	1.4	1.9	2.1	1.9	2.0	2.1	1.7	1.7	3.2	3.3	3.4
Mean	1.1	1.1	1.2	1.5	1.4	1.7	1.3	1.3	1.4	2.4	2.9	2.6
pH												
Min	7.4	7.5	7.2	7.2	7.3	7.1	7.2	7.4	7.3	6.9	7.0	7.0
Max	8.3	8.2	8.2	7.9	7.9	7.8	8.0	8.2	8.3	8.5	8.4	8.2
Mean	7.6	7.6	7.7	7.5	7.5	7.4	7.6	7.7	7.6	7.5	7.4	7.5

Appendix Table 30. Monthly environmental data collected from the South Fork Salmon River (rkm 112 from its confluence with the main Salmon River), August 2010-July 2011.

	South Fork Salmon River											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	7.9	5.4	1.2	0.0	0.0	0.0	0.0	-0.1	-0.5	0.9	2.1	4.4
Max	19.9	15.8	13.4	6.7	1.8	1.9	2.6	5.5	7.5	8.7	11.4	17.3
Mean	13.6	10.1	6.5	2.0	0.3	0.2	0.3	1.7	2.3	4.1	5.7	11.1
Dissolved oxygen (ppm)												
Min	5.9	8.7	9.6	10.6	13.3	13.9	13.0	9.8	---	---	---	---
Max	10.8	11.8	13.7	14.2	14.8	15.2	15.2	14.0	---	---	---	---
Mean	8.1	10.2	11.4	12.5	13.9	14.3	13.9	11.9	---	---	---	---
Specific conductance (µS/cm)												
Min	39.0	40.0	33.0	31.0	28.0	28.0	32.0	33.0	35.0	28.0	28.0	28.0
Max	54.0	47.0	48.0	45.0	44.0	44.0	48.0	55.0	50.0	41.0	28.0	40.0
Mean	45.7	43.8	44.2	39.1	39.2	38.2	41.0	42.4	41.7	31.9	28.0	33.9
Turbidity (ntu)												
Min	---	---	---	---	---	---	---	---	---	---	---	---
Max	---	---	---	---	---	---	---	---	---	---	---	---
Mean	---	---	---	---	---	---	---	---	---	---	---	---
Depth (ft)												
Min	0.3	0.8	0.8	0.7	0.3	1.2	0.6	0.7	1.0	1.8	1.8	0.8
Max	1.5	1.4	1.7	2.3	2.8	3.1	3.1	1.5	1.9	3.3	3.4	2.6
Mean	0.8	1.1	1.2	1.5	1.6	2.0	1.5	1.1	1.5	2.4	2.6	1.4
pH												
Min	6.3	5.7	5.5	7.3	7.4	7.2	7.3	7.3	6.8	6.6	6.5	6.9
Max	8.4	7.6	7.7	8.6	8.3	8.6	9.5	9.7	8.5	8.4	8.8	8.8
Mean	7.4	6.4	6.3	7.5	7.6	7.5	7.8	8.0	7.3	7.0	7.2	7.5

Appendix Table 31. Monthly environmental data collected from the Secesh River (rkm 27 from its confluence with the South Fork Salmon River), August 2010-July 2011.

	Secesh River											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	6.3	4.6	0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	1.7	3.9
Max	17.8	15.5	11.9	5.8	-0.1	-0.2	-0.2	-0.2	5.8	7.1	11.4	15.3
Mean	11.7	9.2	4.9	0.7	-0.2	-0.2	-0.2	-0.2	0.6	2.7	5.2	9.9
Dissolved oxygen (ppm)												
Min	9.3	10.3	11.7	13.3	13.7	14.2	13.2	11.7	8.3	3.5	0.6	0.0
Max	13.9	14.9	15.2	15.2	15.2	15.2	15.0	13.6	11.8	9.2	4.0	0.9
Mean	11.4	12.6	14.0	14.5	14.3	14.6	14.0	12.7	10.2	6.2	1.9	0.3
Specific conductance (µS/cm)												
Min	31.0	32.0	30.0	28.0	28.0	30.0	32.0	30.0	28.0	28.0	---	---
Max	40.0	44.0	44.0	34.0	33.0	33.0	34.0	34.0	30.0	28.0	---	---
Mean	35.3	37.6	36.5	30.5	30.9	31.6	32.8	32.6	28.7	28.0	---	---
Turbidity (ntu)												
Min	---	---	---	---	---	---	---	---	---	---	---	---
Max	---	---	---	---	---	---	---	---	---	---	---	---
Mean	---	---	---	---	---	---	---	---	---	---	---	---
Depth (ft)												
Min	0.6	0.6	0.5	0.5	1.0	1.8	2.0	2.4	1.2	1.7	3.5	2.1
Max	1.3	1.5	1.6	2.0	2.2	2.8	2.9	4.1	4.5	4.5	5.0	4.8
Mean	0.9	0.9	1.0	1.4	1.8	2.3	2.6	3.2	2.6	3.2	4.4	3.3
pH												
Min	7.2	7.1	7.1	6.8	6.8	6.8	6.9	7.0	6.9	6.8	6.7	6.8
Max	7.4	7.3	7.9	7.9	7.1	7.1	7.1	7.2	7.8	7.8	7.5	7.8
Mean	7.2	7.2	7.2	7.2	6.9	6.9	7.0	7.1	7.2	7.1	7.0	7.1

Appendix Table 32. Monthly environmental data collected from Big Creek near Taylor Ranch (rkm 10 from its confluence with the Middle Fork Salmon River), August 2010-July 2011.

	Big Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	---	7.7	2.4	-0.1	-0.1	-0.1	-0.1	-0.1	1.5	3.7	4.8	6.6
Max	---	16.3	13.0	6.3	0.8	0.6	1.2	7.7	9.5	11.1	11.8	16.8
Mean	---	11.3	7.1	2.4	0.0	0.0	0.1	2.6	5.0	6.5	7.6	11.5
Dissolved oxygen (ppm)												
Min	---	9.9	10.5	---	---	---	---	9.9	9.4	8.4	---	---
Max	---	14.8	15.2	---	---	---	---	13.1	14.9	13.1	---	---
Mean	---	11.7	12.3	---	---	---	---	11.1	11.6	10.1	---	---
Specific conductance (µS/cm)												
Min	---	108.0	77.0	78.0	63.0	73.0	78.0	81.0	107.0	66.0	49.0	53.0
Max	---	126.0	136.0	104.0	102.0	101.0	102.0	134.0	135.0	136.0	78.0	90.0
Mean	---	117.3	100.6	83.3	84.1	83.8	86.0	91.6	125.5	89.3	62.3	70.0
Turbidity (ntu)												
Min	---	---	---	---	---	---	---	---	---	---	---	---
Max	---	---	---	---	---	---	---	---	---	---	---	---
Mean	---	---	---	---	---	---	---	---	---	---	---	---
Depth (ft)												
Min	---	2.4	2.1	2.0	1.7	2.5	1.9	2.0	2.7	3.2	4.3	3.7
Max	---	3.1	3.3	3.4	4.9	3.6	3.9	3.1	3.6	6.0	7.2	6.2
Mean	---	2.8	2.8	2.8	2.8	2.9	2.6	2.5	3.1	4.5	5.8	4.6
pH												
Min	---	7.9	8.0	8.2	8.3	8.3	8.3	7.9	7.8	7.5	7.5	7.7
Max	---	9.0	9.1	9.1	9.0	8.9	9.7	10.0	9.3	9.3	8.0	9.2
Mean	---	8.4	8.4	8.4	8.4	8.5	8.7	8.8	8.3	7.9	7.7	8.2

Appendix Table 33. Monthly environmental data collected from Bear Valley/Elk Creek (rkm 14 from the confluence of Bear Valley Creek with the Middle Fork Salmon River; 50 m below the mouth of Elk Creek), August 2010-July 2011.

	Bear Valley/Elk Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	7.9	5.8	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	8.8
Max	19.2	15.6	13.0	6.0	0.2	0.2	0.2	1.0	7.6	8.5	15.3	17.7
Mean	13.8	10.0	6.1	1.3	0.0	0.0	0.0	0.1	1.6	3.2	8.9	13.3
Depth (ft)												
Min	2.6	2.7	2.6	2.5	2.5	3.2	2.6	2.4	2.6	3.2	4.6	3.3
Max	3.4	3.4	3.4	3.7	3.7	4.1	4.0	3.5	3.5	5.8	6.2	5.0
Mean	3.1	3.1	3.1	3.2	3.3	3.7	3.3	2.9	3.0	4.4	5.4	3.9

Appendix Table 34. Monthly environmental data collected from Sulphur Creek (rkm 10 from its confluence with the Middle Fork Salmon River), August 2010-July 2011.

	Sulphur Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	6.1	4.4	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.9	6.8
Max	15.7	13.4	10.5	5.7	2.9	2.4	2.7	4.6	6.2	7.5	8.8	13.6
Mean	10.6	7.9	5.4	1.9	0.6	0.5	0.4	1.6	2.2	3.0	5.2	9.6
Depth (ft)												
Min	0.6	0.7	0.8	0.5	0.3	0.8	0.5	0.5	1.0	1.7	2.8	0.2
Max	1.4	1.4	1.6	1.9	1.6	1.9	1.8	1.5	1.8	3.8	4.7	3.9
Mean	1.1	1.1	1.3	1.2	1.1	1.4	1.1	1.0	1.4	2.8	3.9	2.6

Appendix Table 35. Monthly environmental data collected from upper Big Creek (rkm 60 from its confluence with the Middle Fork Salmon River), August 2010-July 2011.

	Big Creek (upper)											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	6.1	5.0	2.6	0.0	0.0	0.0	0.0	0.1	0.5	1.7	2.3	3.6
Max	15.0	13.0	11.3	7.2	3.4	3.1	4.2	5.7	7.0	8.4	9.3	13.3
Mean	9.7	8.0	5.9	3.0	1.3	1.2	1.1	2.1	2.8	3.9	4.9	8.0
Depth (ft)												
Min	1.4	1.5	1.2	1.1	0.8	1.5	1.1	1.2	1.4	1.9	2.3	2.3
Max	2.2	2.2	2.3	2.4	2.4	2.7	2.5	2.1	2.1	3.4	4.3	4.1
Mean	1.9	1.9	1.9	1.8	1.7	1.9	1.7	1.6	1.8	2.5	3.3	3.0

Appendix Table 36. Monthly environmental data collected from Chamberlain Creek (rkm 25 from its confluence with the main Salmon River), August 2010-July 2011.

	Chamberlain Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	5.5	4.2	0.9	0.0	0.0	0.1	0.0	0.0	0.2	1.0	2.5	5.8
Max	17.9	15.3	12.9	6.4	0.6	0.5	2.0	3.4	5.3	7.8	12.6	17.0
Mean	12.6	9.1	5.3	1.3	0.4	0.3	0.2	1.1	2.3	3.7	6.2	11.5
Depth (ft)												
Min	0.3	0.4	0.1	0.1	0.0	0.4	0.0	0.0	0.5	1.0	1.6	0.5
Max	1.4	1.1	1.1	1.7	1.5	2.5	3.0	1.2	1.2	2.7	3.4	2.2
Mean	0.9	0.7	0.8	0.8	0.9	1.2	1.0	0.5	0.8	1.8	2.3	1.0

Appendix Table 37. Monthly environmental data collected from West Fork Chamberlain Creek (rkm 25 from the confluence of Chamberlain Creek with the main Salmon River; 1 rkm from the mouth of West Fork Chamberlain Creek), August 2010-July 2011.

	West Fork Chamberlain Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	5.0	3.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	6.2
Max	18.1	13.1	11.1	5.8	0.4	0.2	2.2	4.1	6.4	7.3	12.1	15.7
Mean	11.3	8.1	4.7	1.1	0.0	0.0	0.2	0.9	1.7	3.1	6.1	10.6
Depth (ft)												
Min	0.2	0.3	0.2	0.0	0.0	0.3	0.0	0.0	0.2	0.8	2.1	0.9
Max	1.7	1.2	1.1	1.3	0.9	1.0	1.1	1.0	1.1	3.5	3.3	2.5
Mean	1.1	0.7	0.7	0.6	0.5	0.7	0.5	0.4	0.6	2.2	2.8	1.4

Appendix Table 38. Monthly environmental data collected from Lake Creek (rkm 46 from the confluence of the Secesh River with the South Fork Salmon River; 1 rkm above the mouth of Lake Creek), August 2010-July 2011.

	Lake Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	4.4	3.9	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.8	3.5
Max	17.4	13.2	10.5	4.6	0.1	0.0	0.0	1.3	3.9	6.0	10.8	14.0
Mean	11.3	8.0	4.4	0.8	0.0	0.0	0.0	0.1	0.7	1.9	4.4	9.2
Depth (ft)												
Min	0.7	0.8	0.6	0.6	0.7	1.4	0.9	0.5	0.7	1.1	2.1	1.7
Max	1.5	1.5	1.5	2.2	2.1	3.1	2.7	2.3	1.5	2.7	4.4	4.0
Mean	1.2	1.1	1.1	1.3	1.6	2.1	1.9	1.3	1.0	1.8	3.3	2.6

Appendix Table 39. Monthly environmental data collected from Cape Horn Creek (rkm 180 from the mouth of the Middle Fork Salmon River; 150 m above the Marsh Creek monitoring site), August 2010-July 2011.

	Cape Horn Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	4.6	2.5	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.7	3.4
Max	16.4	14.2	12.0	6.0	0.6	0.2	0.2	4.9	8.9	10.5	11.7	14.9
Mean	9.7	7.0	4.4	1.2	0.0	0.0	0.0	0.7	2.1	3.3	5.1	8.5
Depth (ft)												
Min	0.1	---	---	---	---	---	---	---	---	---	---	---
Max	1.4	---	---	---	---	---	---	---	---	---	---	---
Mean	1.0	---	---	---	---	---	---	---	---	---	---	---

Appendix Table 40. Monthly environmental data collected from Herd Creek (rkm 15 from the confluence of the Salmon River and East Fork Salmon River; 1 rkm above the mouth of Herd Creek), August 2010-July 2011.

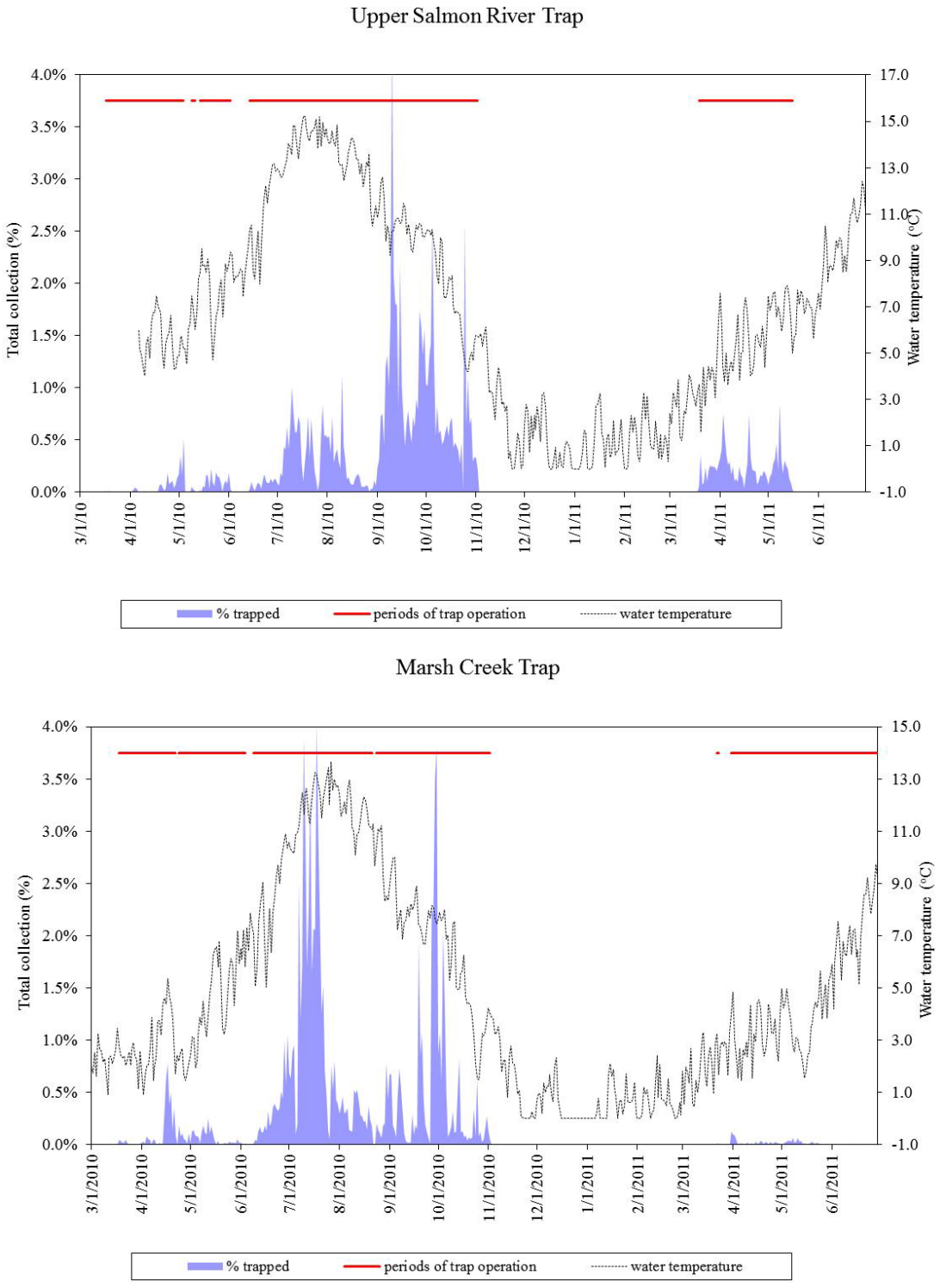
	Herd Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	6.5	4.9	1.5	0.0	0.0	0.0	0.0	0.0	0.1	1.8	3.3	6.2
Max	17.0	15.8	13.4	7.5	3.8	3.3	5.4	9.2	12.3	14.5	13.9	16.2
Mean	11.3	9.5	6.5	2.4	0.8	0.6	0.7	2.8	4.9	7.1	8.0	10.8
Depth (ft)												
Min	0.9	1.0	0.8	0.5	0.3	0.9	0.5	0.6	0.7	1.0	1.6	1.7
Max	1.9	1.8	1.9	1.9	1.6	1.6	1.8	1.6	1.4	2.0	3.0	2.8
Mean	1.5	1.4	1.5	1.3	1.2	1.3	1.1	1.0	1.1	1.6	2.3	2.2

Appendix Table 41. Monthly environmental data collected from Camas Creek (rkm 23 from its confluence with the Middle Fork Salmon River), August 2010-July 2011.

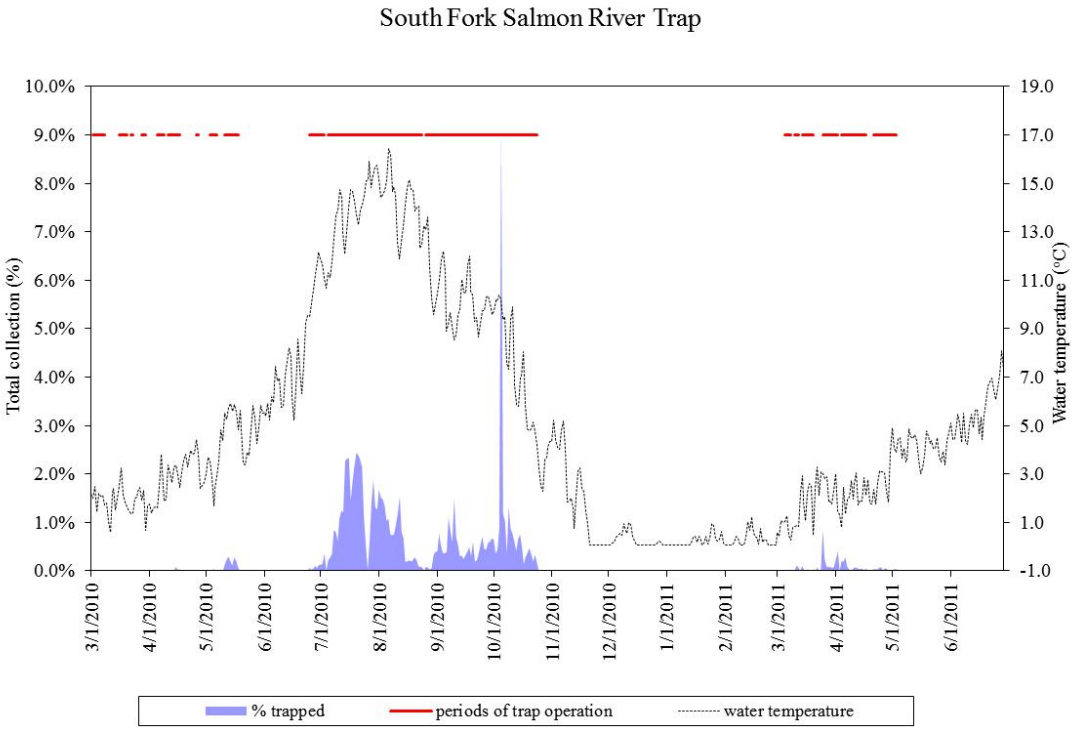
	Camas Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	9.2	---	---	---	---	---	---	---	---	---	---	---
Max	17.2	---	---	---	---	---	---	---	---	---	---	---
Mean	13.0	---	---	---	---	---	---	---	---	---	---	---
Depth (ft)												
Min	1.2	---	---	---	---	---	---	---	---	---	---	---
Max	1.4	---	---	---	---	---	---	---	---	---	---	---
Mean	1.3	---	---	---	---	---	---	---	---	---	---	---

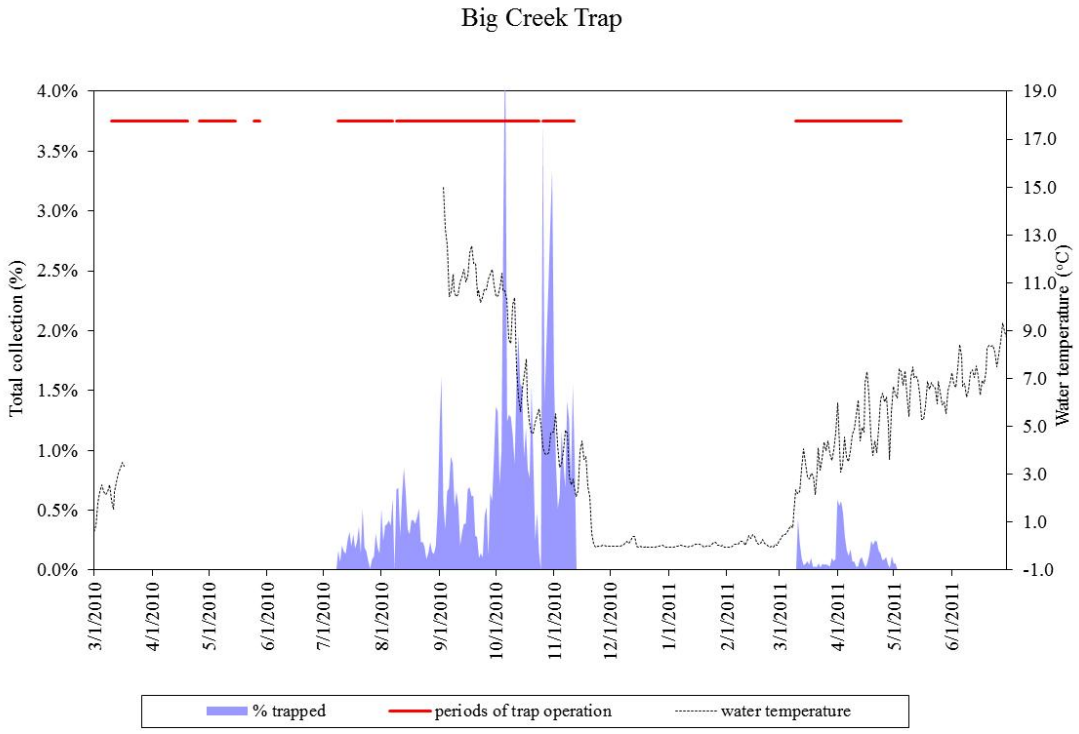
Appendix Table 42. Monthly environmental data collected from Loon Creek (rkm 31 from its confluence with the Middle Fork Salmon River), August 2010-July 2011.

	Loon Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	6.8	4.9	1.8	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.2	4.7
Max	16.8	14.9	13.0	7.0	3.1	1.0	2.5	6.8	9.7	11.2	10.5	14.9
Mean	10.9	8.7	6.1	2.0	0.3	0.0	0.2	1.7	3.7	5.4	6.1	9.3
Depth (ft)												
Min	1.7	1.8	1.6	1.3	1.1	1.6	1.1	1.2	1.5	2.1	2.6	2.6
Max	2.7	2.5	2.6	2.7	4.1	4.2	4.1	2.2	2.2	3.4	4.5	4.1
Mean	2.3	2.2	2.2	2.1	2.2	2.7	2.0	1.7	1.9	2.7	3.6	3.2

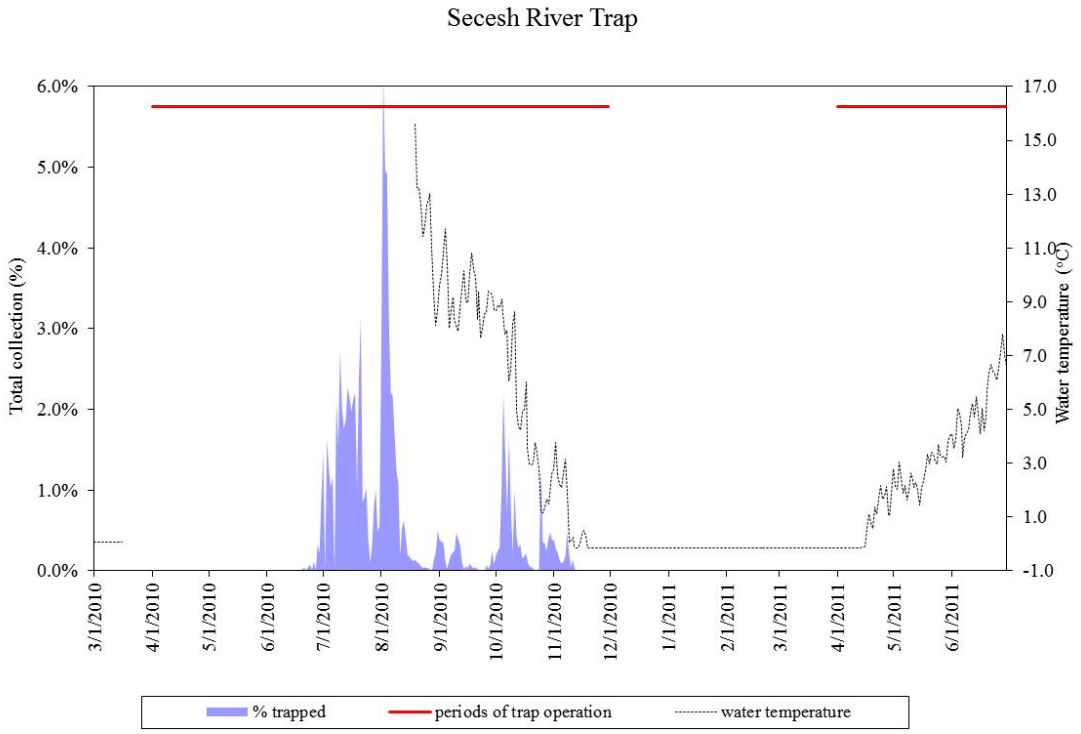


Appendix Figure 1. Daily passage of wild Chinook salmon fry, parr, and smolts at five migrant traps, expressed as percentages of total collected, and plotted against average daily water temperatures collected near traps. Periods of trap operation are also shown.

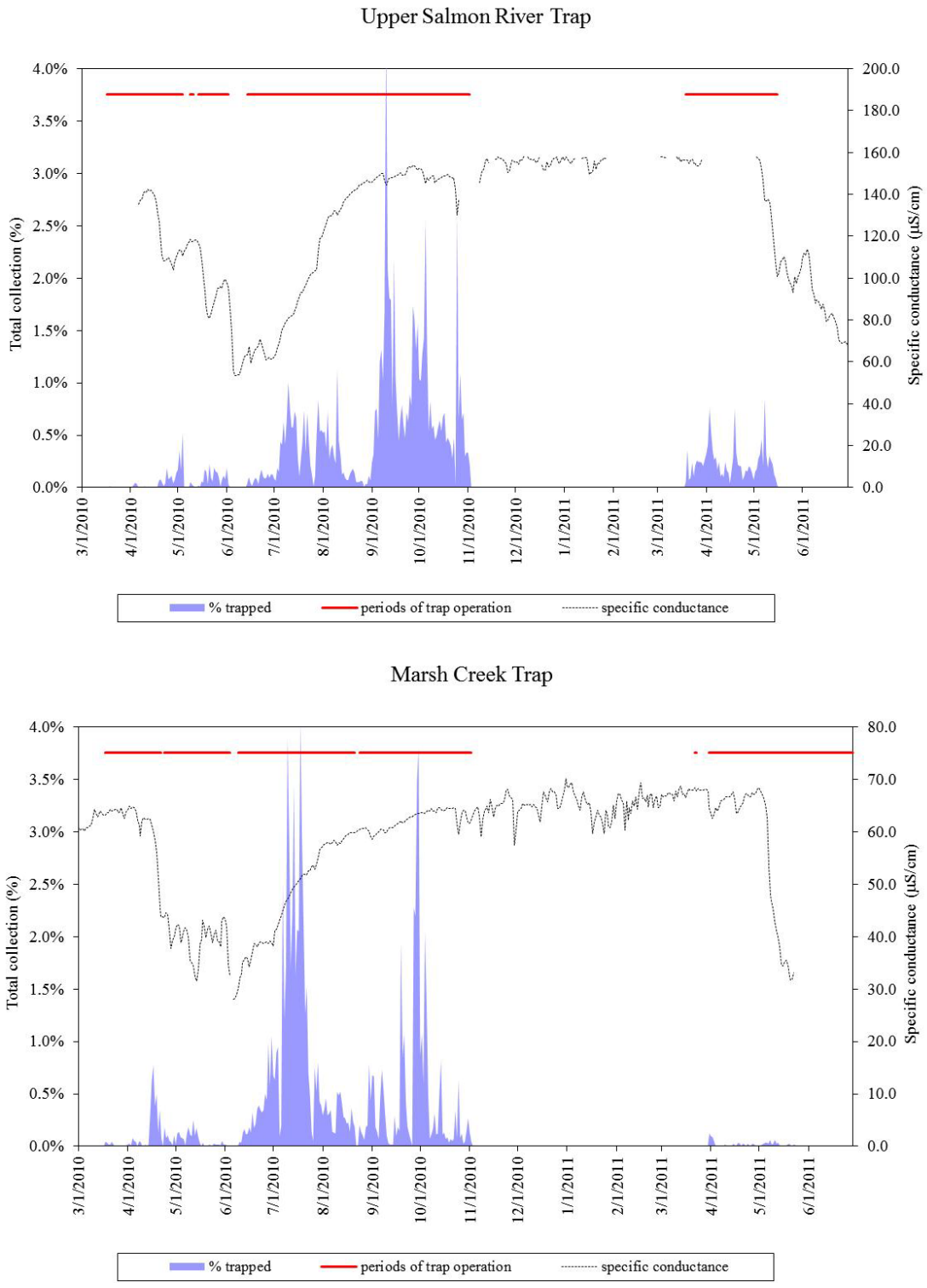




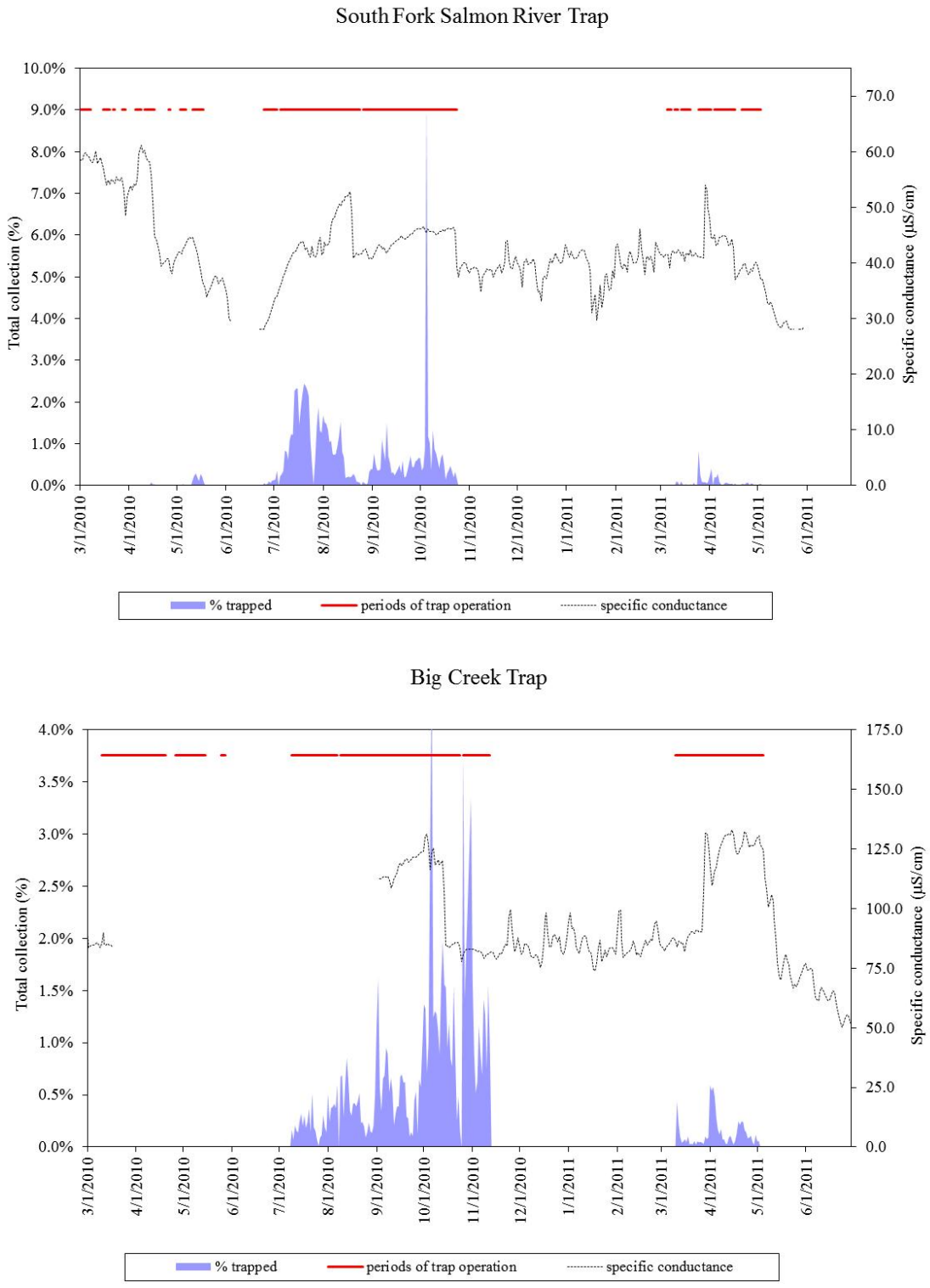
Appendix Figure 1. Continued.



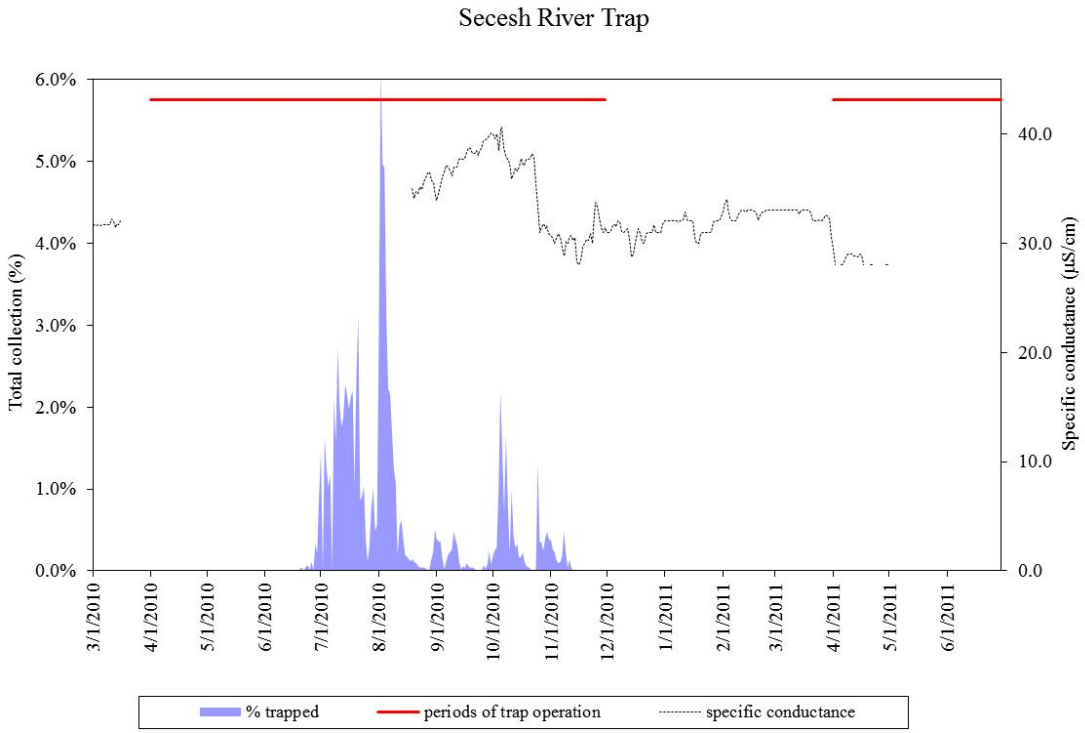
Appendix Figure 1. Continued.



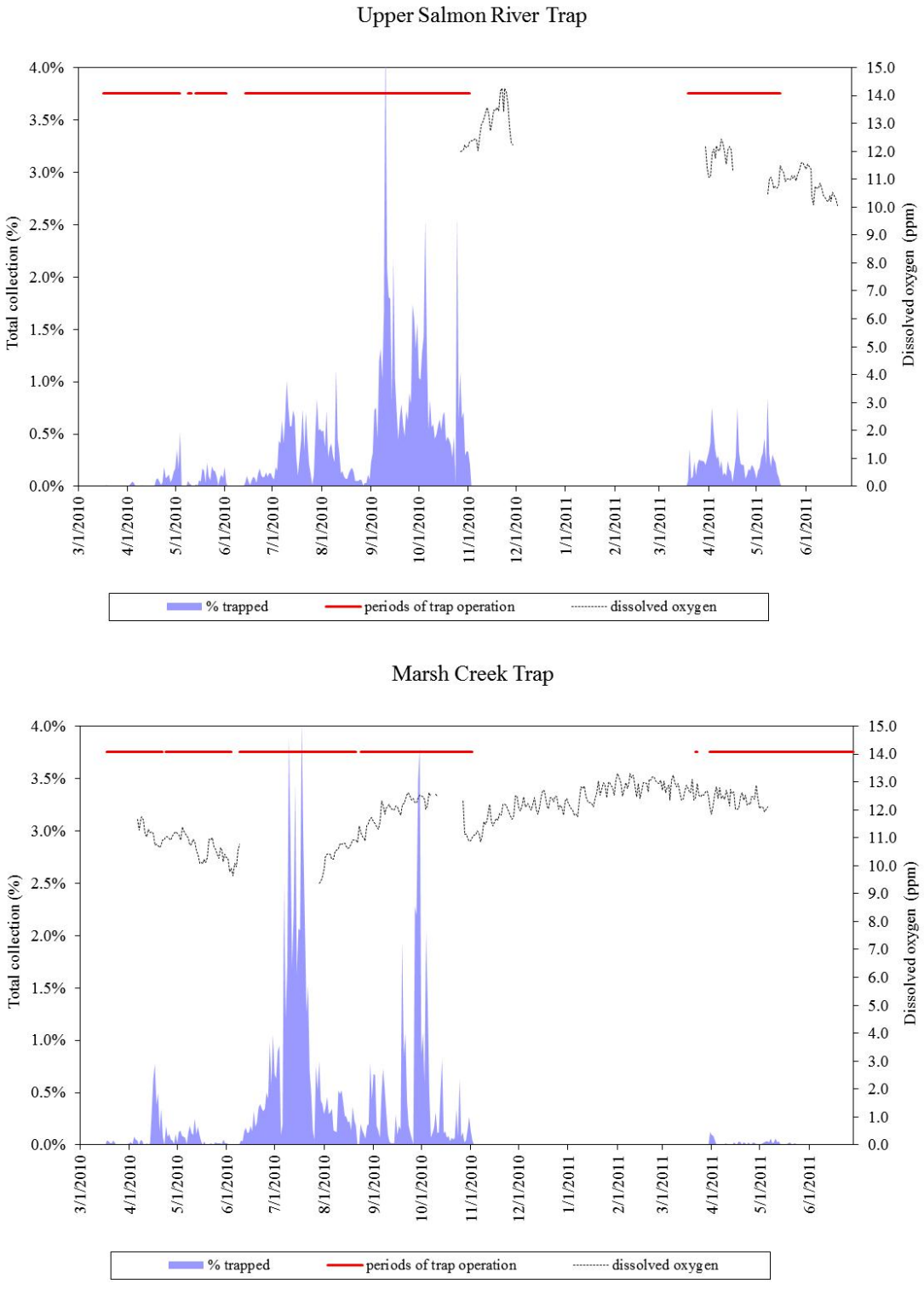
Appendix Figure 2. Daily passage of wild Chinook salmon fry, parr, and smolts at five migrant traps, expressed as percentages of total collected, and plotted against average daily specific conductance collected near traps. Periods of trap operation are also shown.



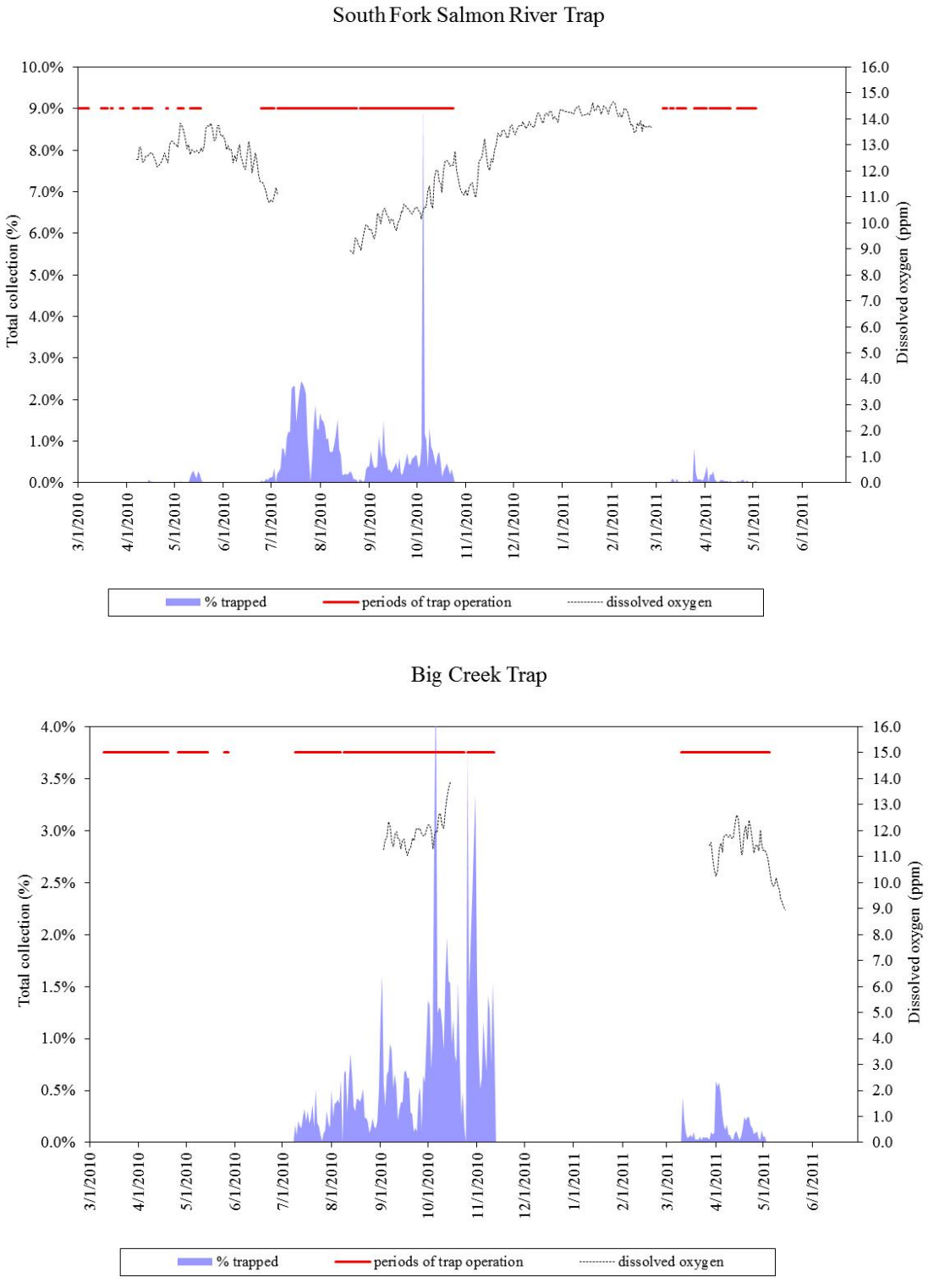
Appendix Figure 2. Continued.



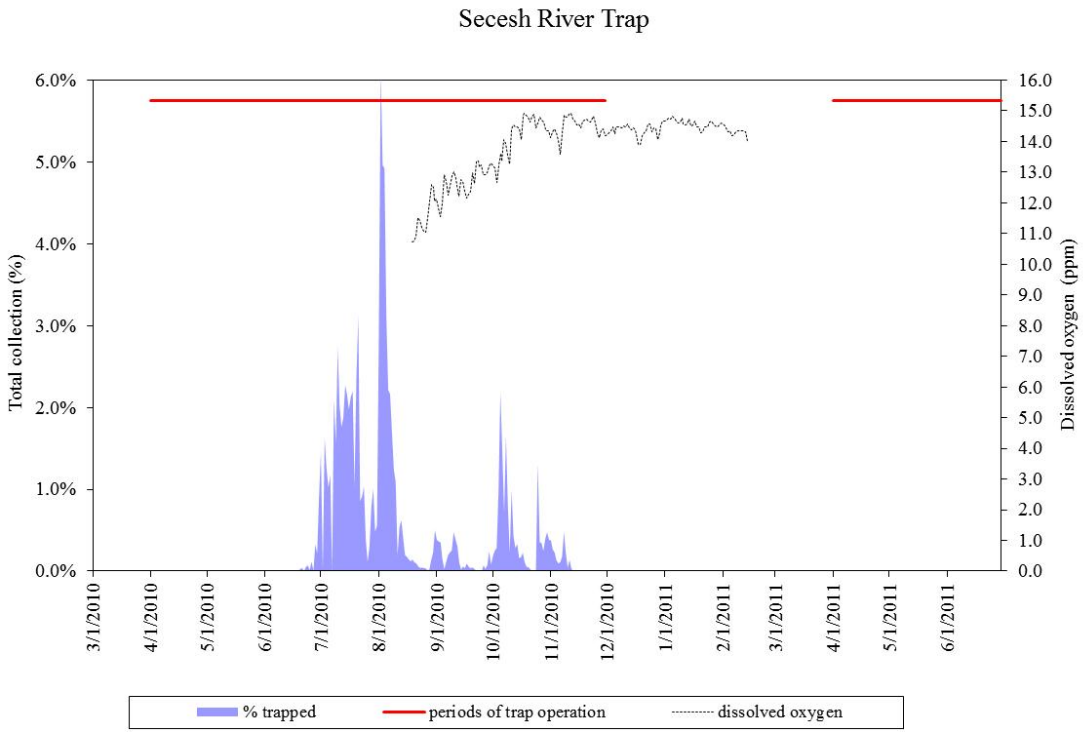
Appendix Figure 2. Continued



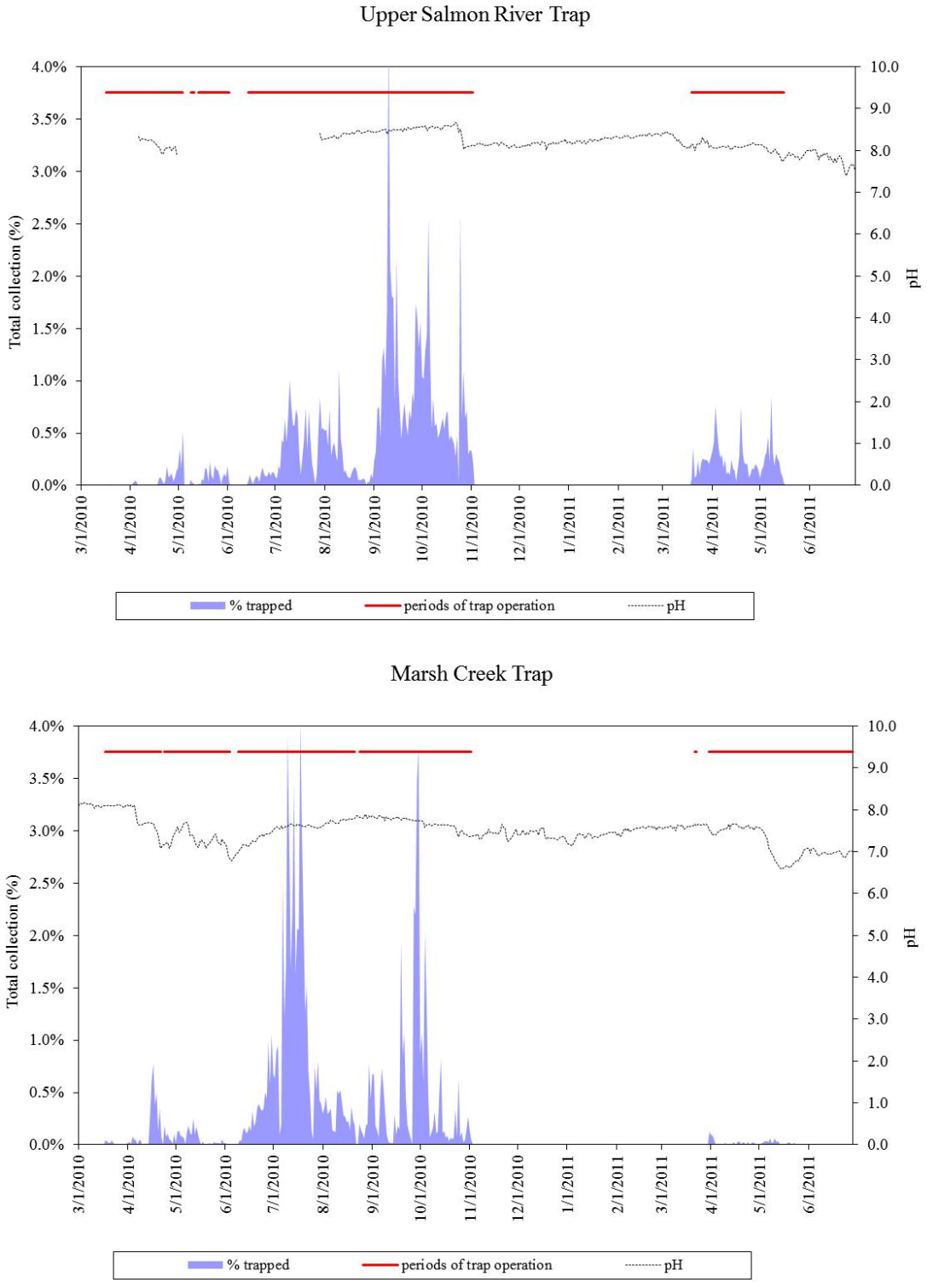
Appendix Figure 3. Daily passage of wild Chinook salmon fry, parr, and smolts at five migrant traps, expressed as percentages of total collected, and plotted against average daily dissolved oxygen collected near traps. Periods of trap operation are also shown.



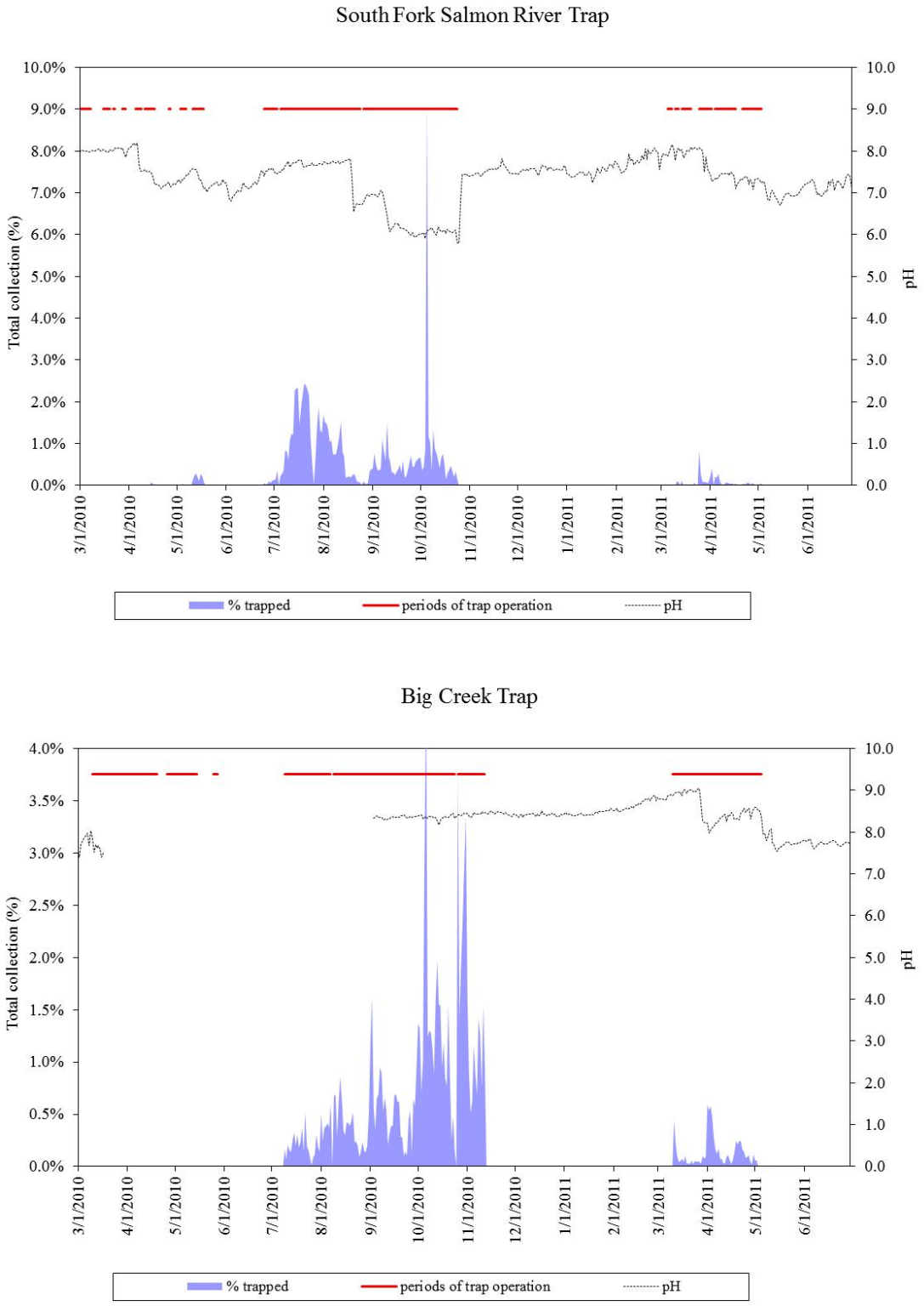
Appendix Figure 3. Continued.



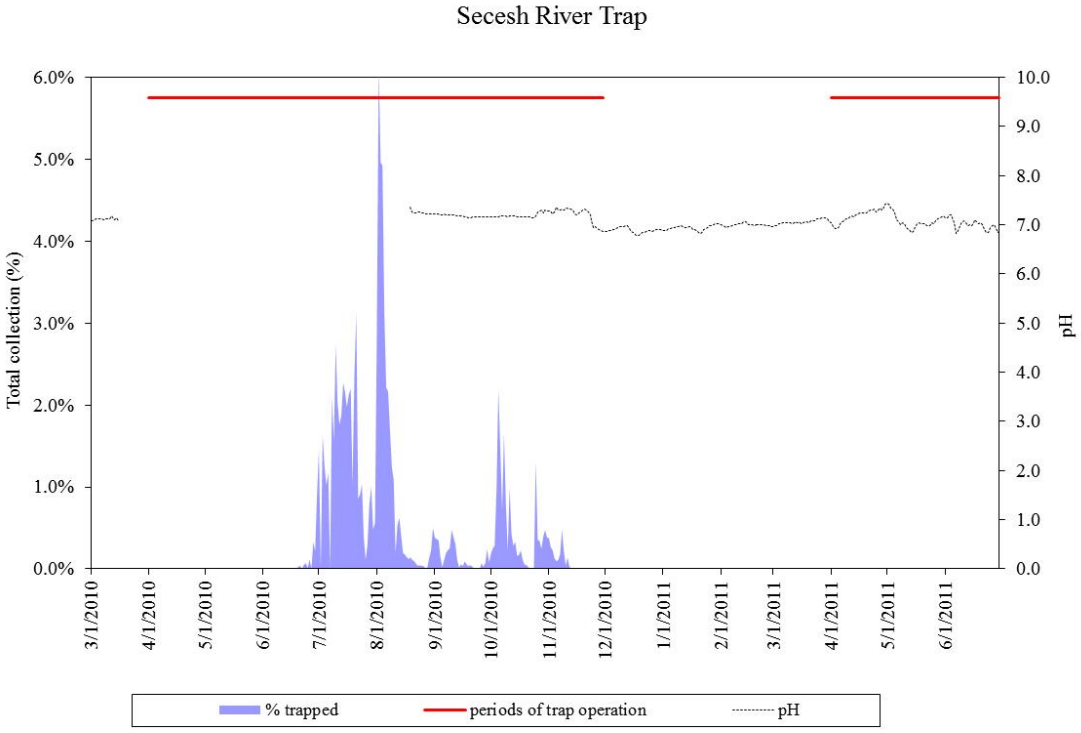
Appendix Figure 3. Continued.



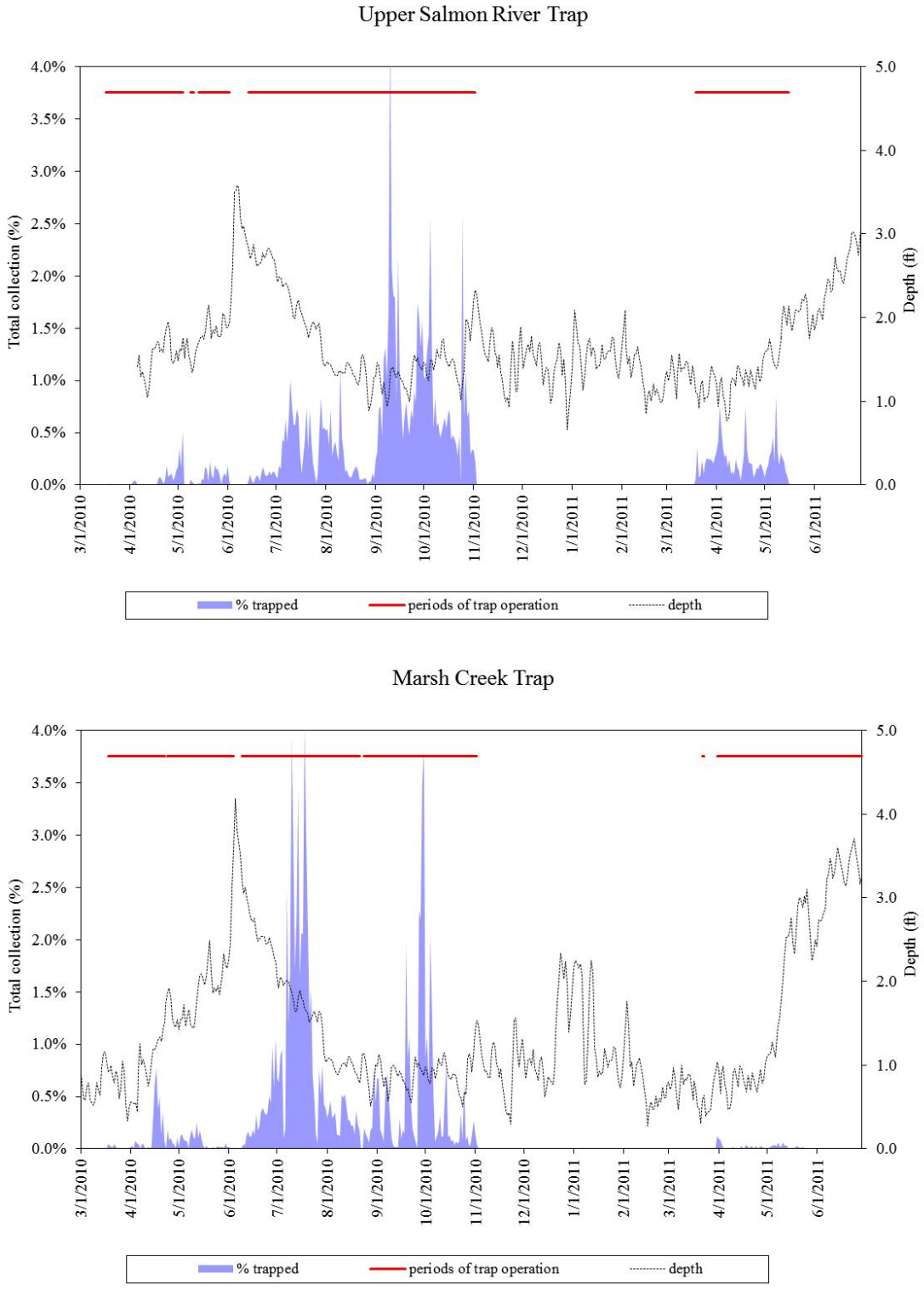
Appendix Figure 4. Daily passage of wild Chinook salmon fry, parr, and smolts at five migrant traps, expressed as percentages of total collected, and plotted against average daily pH collected near traps. Periods of trap operation are also shown.



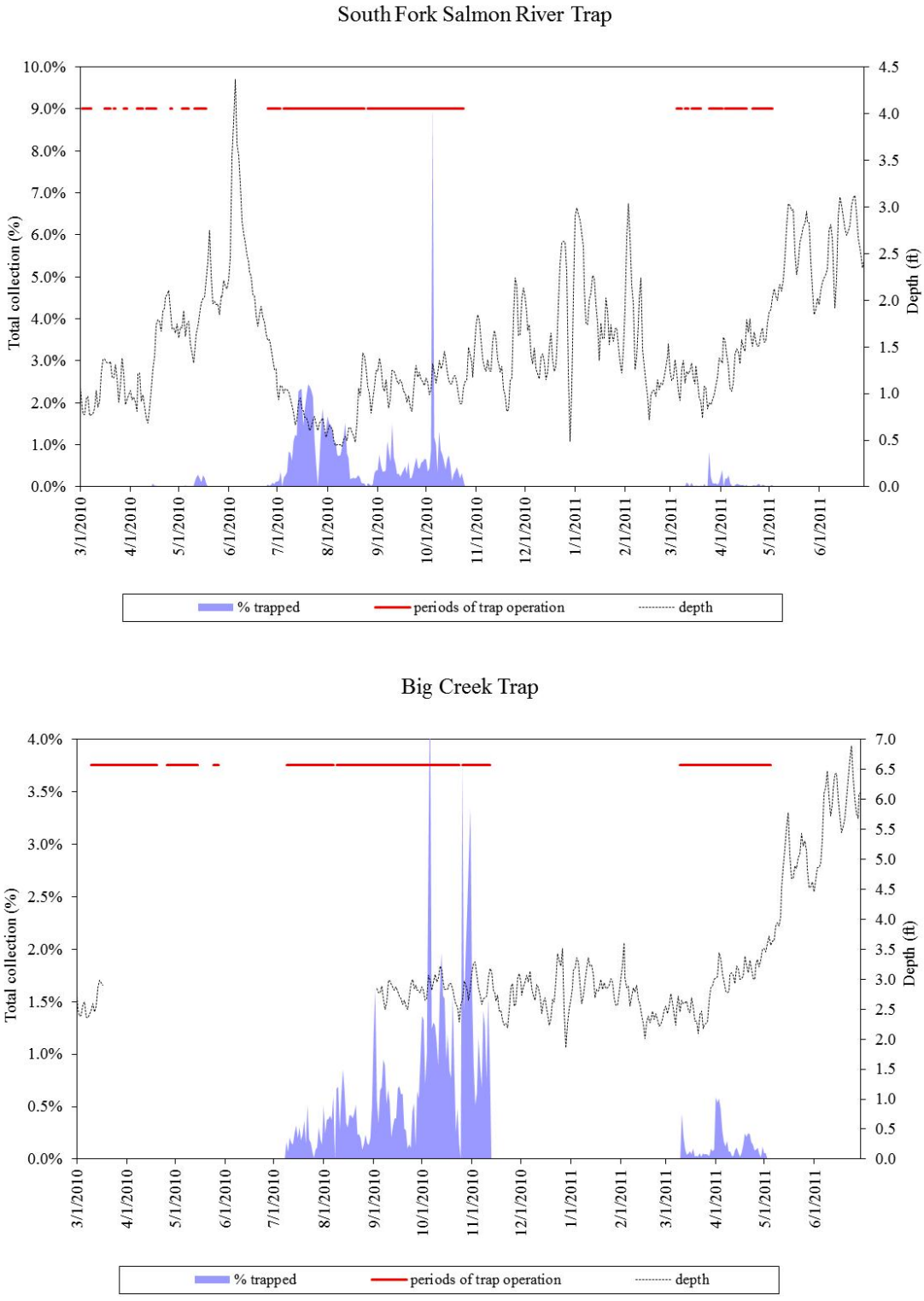
Appendix Figure 4. Continued.



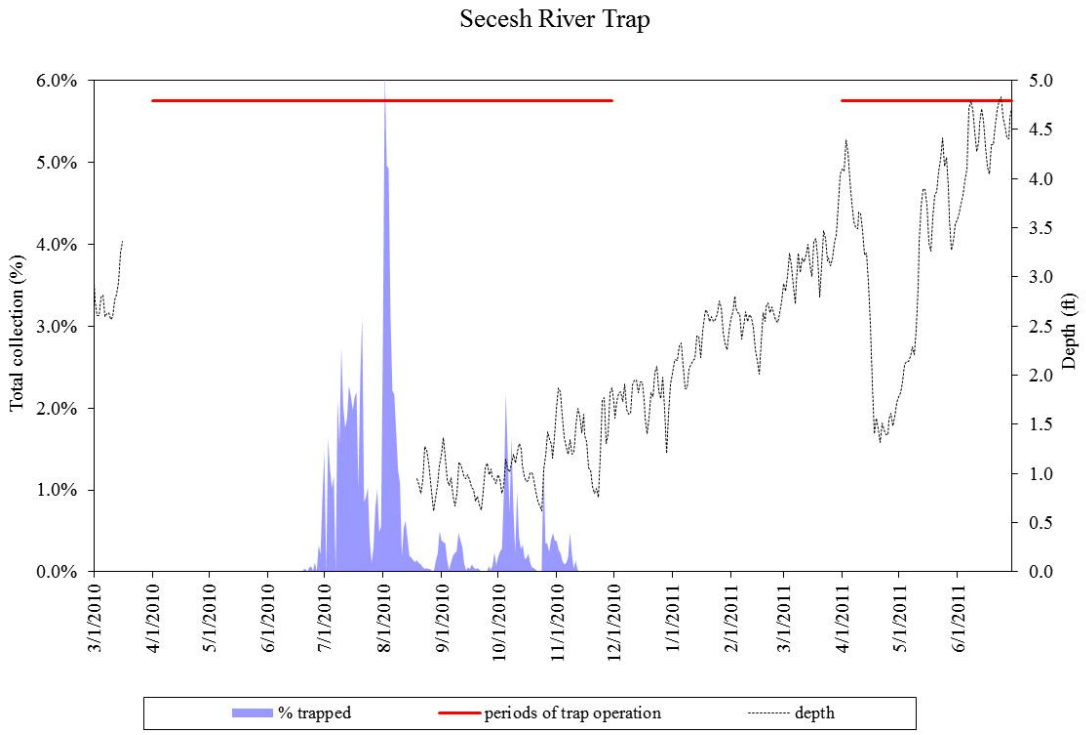
Appendix Figure 4. Continued.



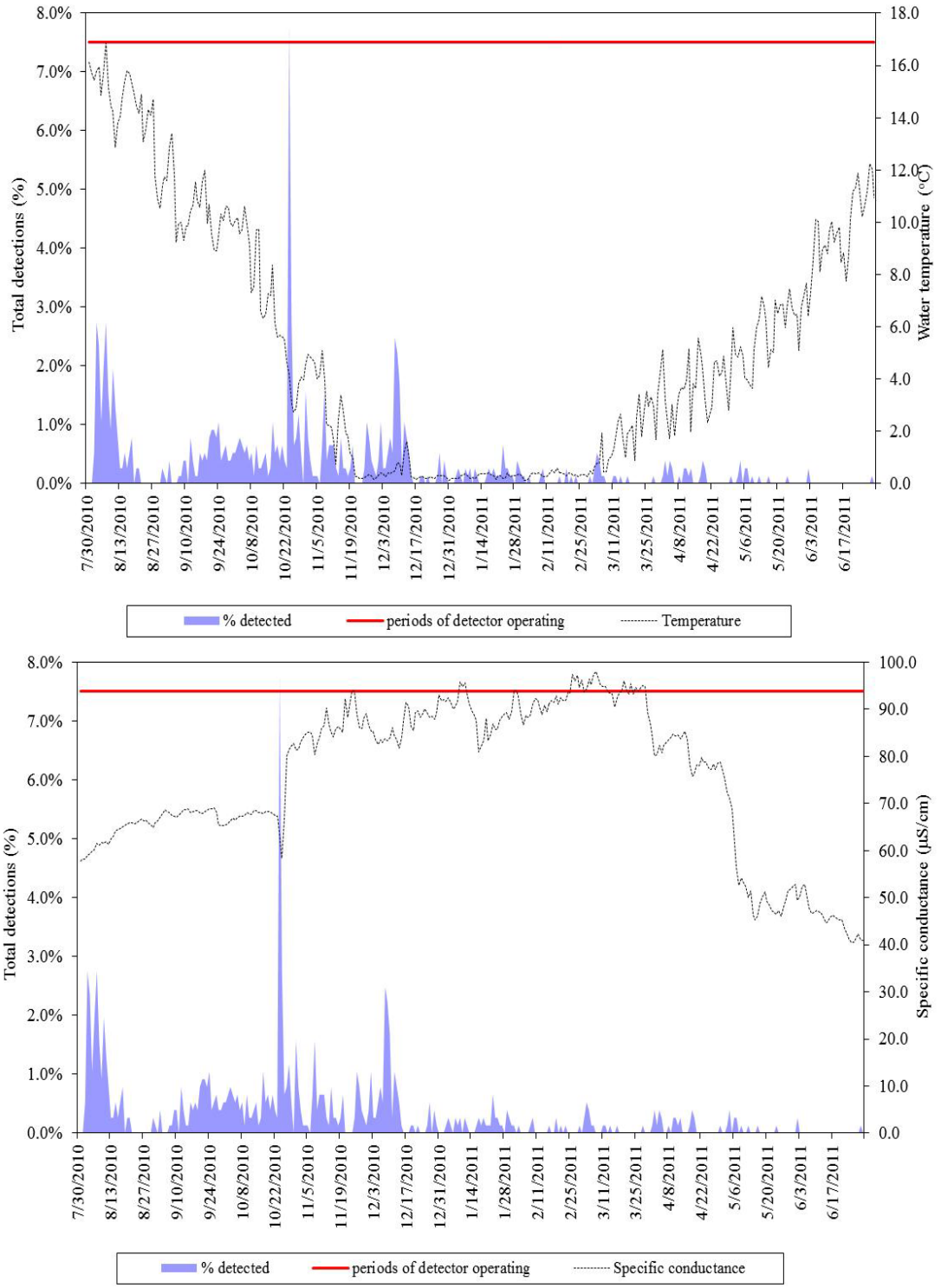
Appendix Figure 5. Daily passage of wild Chinook salmon fry, parr, and smolts at five migrant traps, expressed as percentages of total collected, and plotted against average daily depth collected near traps. Periods of trap operation are also shown.



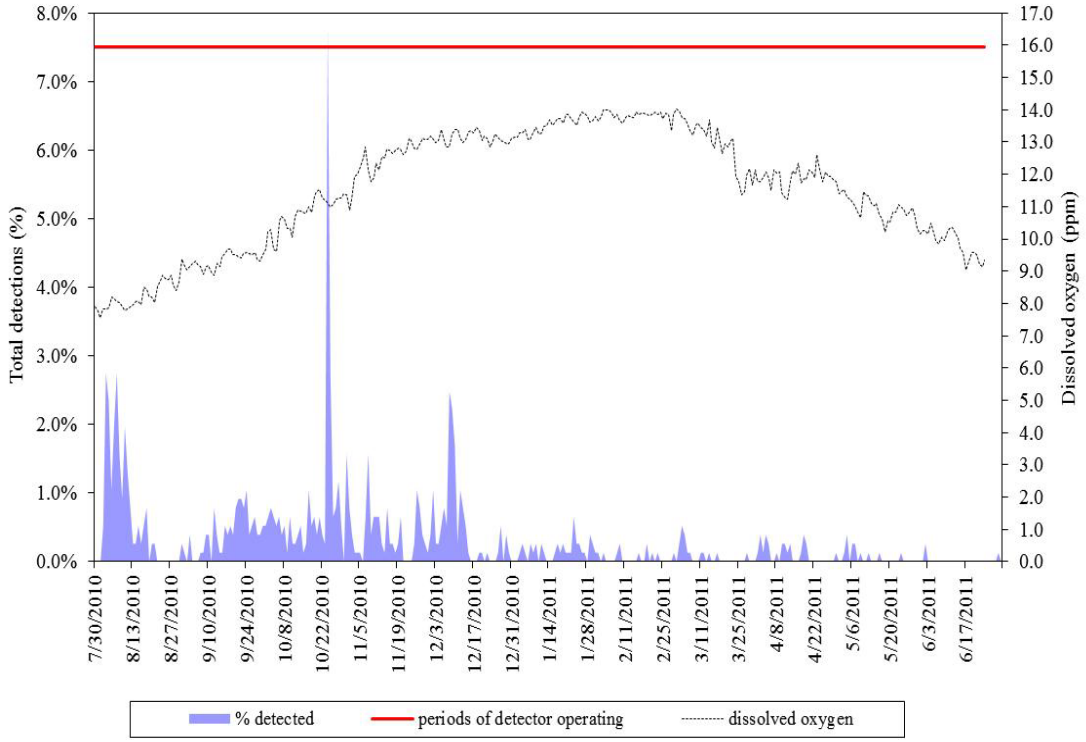
Appendix Figure 5. Continued.

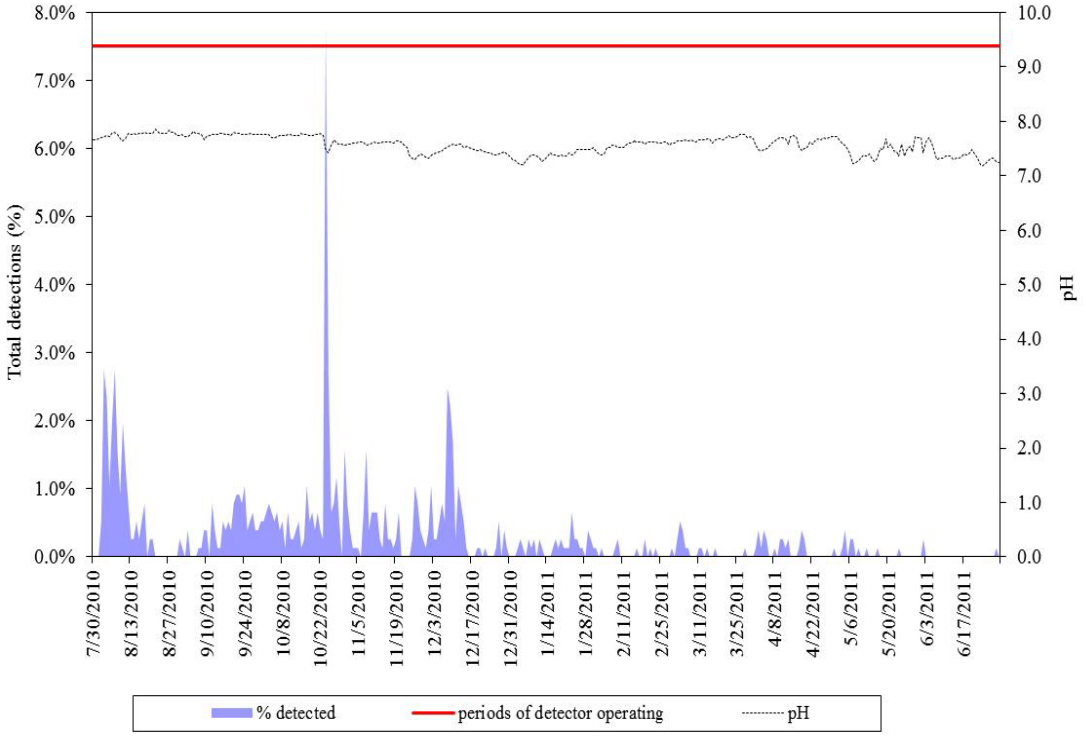


Appendix Figure 5. Continued.

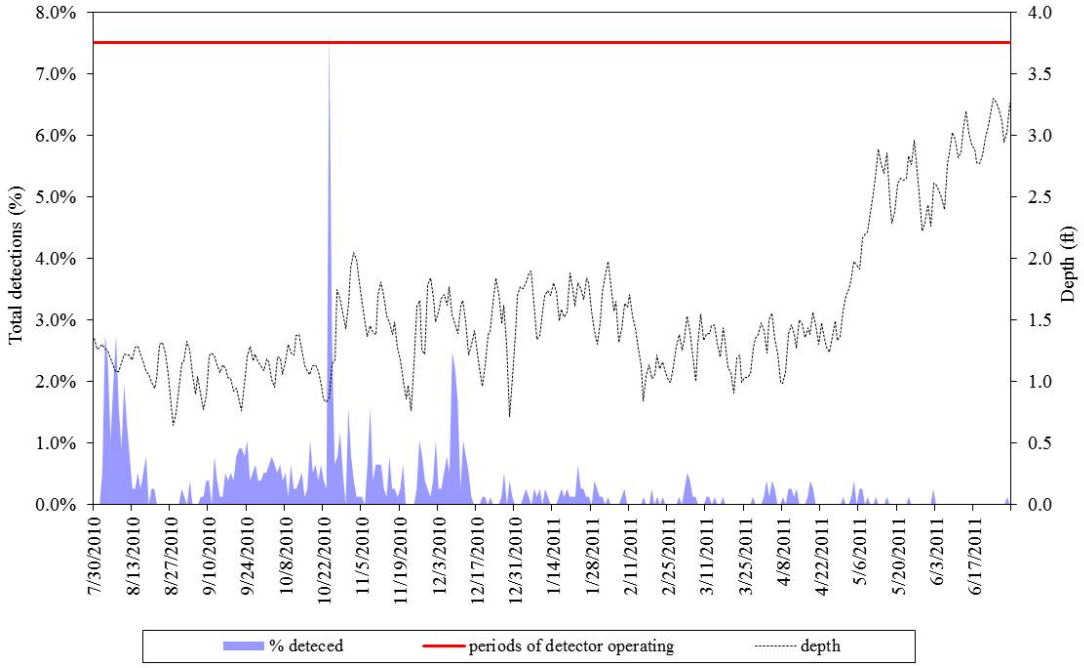


Appendix Figure 6. Combined daily PIT-tag detections of wild Chinook salmon parr at in-stream PIT-tag detectors in Valley Creek, expressed as percentages of total detected, and plotted against average daily aquatic conditions collected near the detectors. Periods of operation for the detectors are also shown.





Appendix Figure 6. Continued.



Appendix Figure 6. Continued.