Monitoring the Migrations of Wild Snake River Spring/Summer Chinook Salmon Juveniles, 2011-2012

Jesse J. Lamb, Stephen Achord, Benjamin P. Sandford, Gordon A. Axel, Steven G. Smith, Matthew G. Nesbit, Kenneth W. McIntyre, and Beth L. Sanderson

Fish Ecology Division, Northwest Fisheries Science Center
National Marine Fisheries Service, National Oceanic and Atmospheric Administration
2725 Montlake Boulevard East
Seattle, Washington 98112-2097

Report of research for

Division of Fish and Wildlife
Bonneville Power Administration
U.S. Department of Energy
P.O. Box 3621
Portland, Oregon 97208-3621

Project 1991-028-00, Contract No. CR-205016
Covering the period from mid-July 2011 to mid-July 2012

April 2013

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 2011 to mid-2012. In summer 2011, 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 included migration behavior and estimated survival of fish to in-stream PIT-tag monitors, as well as estimated arrival timing and survival to Lower Granite Dam. Principal results from tagging and interrogation during 2011-2012 are listed below:

1) From July to September 2011, we PIT tagged and released 17,593 wild Chinook salmon parr in 14 Idaho streams or sample areas.

2) Overall observed mortality from collection, handling, tagging, and after a 24-h holding period was 1.3%.

3) **Valley Creek—**Of the 3,732 wild Chinook salmon parr collected and PIT tagged in Valley Creek during summer 2011, 1,856 were tagged using 12-mm tags and; 1,876 using 9-mm tags. Between late summer 2011 and spring 2012, 757 (40.8%) of fish tagged with 12-mm tags and 356 (19.0%) of fish tagged with 9-mm tags were detected at two in-stream PIT-tag monitoring systems in lower Valley Creek.

   Of the 757 detections for the 12-mm tag group, 73.8% occurred during late summer/fall, 20.2% in winter, and 6.0% in spring. Of the 356 detections for the 9-mm group, 59.6% occurred during late summer/fall, 28.9% in winter, and 11.5% in spring. Estimated parr-to-smolt survival to Lower Granite Dam for fish with 12-mm tags was 21.4% for the late summer/fall group, 31.7% for the winter group, and 43.0% for the spring group. Estimated parr-to-smolt survival to Lower Granite for fish with 9-mm tags was 19.9% for the late summer/fall group, 40.7% for the winter group, and 39.6% for the spring group.

   Based on detections at downstream dams, the overall detection efficiency of Valley Creek upper (VC1) and lower (VC2) monitors was 80.0% for fish with 12-mm tags and 38.0% for those with 9-mm tags. Using these efficiencies, an estimated 51.0% of all parr with 12-mm tags and 50.0% of parr with 9-mm tags survived to migrate past the Valley Creek monitors. Survival from the Valley Creek monitors to Lower Granite Dam was 24.7% for fish with 12-mm tags and 28.2% for fish with 9-mm tags. Overall estimated parr-to-smolt survival to Lower Granite dam for fish from this stream was 14.0%.

4) **Big Creek—**A total of 1,466 Chinook salmon parr were PIT tagged and released in upper Big Creek during summer 2011 (710 with 12-mm tags and 756 with 9-mm tags). Of these fish, 86 (5.9%) were detected at two in-stream PIT-tag monitoring systems in lower Big Creek from late summer 2011 to spring 2012. Of these 86 detections, 70.9% occurred in late summer/fall, 19.8% in winter, and 9.3% in spring. Estimated parr-to-smolt survival to Lower Granite Dam was 41.9% for the late summer/fall group, 26.4% for the winter group, and 69.4% 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 17.6%. Using this efficiency rate, we estimated that 33.4% 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 41.4%. Overall estimated parr-to-smolt survival for all summer-tagged parr from this stream (area) to the dam was 11.8%.

   A total of 1,551 Chinook salmon parr were PIT tagged and released to lower Big Creek during summer 2011 (776 with 12-mm tags and 775 with 9-mm tags). Of these fish, 303 (19.5%) were detected at the two in-stream PIT-tag monitoring systems in lower Big Creek from late summer 2011 to spring 2012. Of the 303 detections, 67.3% occurred in late summer/fall, 27.7% in winter, and 5.0% in spring. Estimated parr-to-smolt survival to Lower Granite Dam was 27.5% for the late summer/fall group and 35.1% 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 23.9%. Using this efficiency rate, we estimated that 81.8% of all summer-tagged parr survived to the lower Big Creek monitors, and their estimated survival from that point to Lower Granite Dam was 28.2%. Overall estimated parr-to-smolt survival for all summer-tagged parr from this stream (area) to the dam was 22.6%.

5) **Secesh River and Lake Creek—**A total of 1,793 Chinook salmon parr were PIT tagged and released in the Secesh River and Lake Creek in summer 2011 (889 with 12-mm tags and 894 with 9-mm tags). Of these fish, 240 (13.4%) were detected at the in-stream PIT-tag monitoring system in the lower Secesh River (near Zena Creek) from late summer 2011 to spring 2012. Of these 240 detections, 93.8% occurred in late summer/fall and 6.2% in winter/spring. Estimated parr-to-smolt survival to Lower Granite Dam was 18.7% for the summer/fall group. Using detections at both the in-stream monitors and the dam, we estimated that 63.0% 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 17.5%. Overall estimated parr-to-smolt survival to the dam for all summer-tagged parr from these streams (areas) was 12.0%.

6) **South Fork Salmon River—**A total of 1,516 Chinook salmon parr were PIT tagged and released in the upper South Fork Salmon River during summer 2011 (766 with 12-mm tags and 750 with 9-mm tags). Of these fish, 106 (7.0%) were detected at the in-stream PIT-tag monitoring system in the South Fork Salmon River near Krassel Creek from late summer 2011 to spring 2012. Of these 106 detections, 63.2% occurred in late summer/fall and 36.8% in winter/spring. At the Guard Station Road Bridge in-stream monitor, only 11 fish were detected from releases to the Secesh and South Fork Salmon Rivers and Lake Creek. High bed load movement prior to summer 2011 buried a portion of the Guard Station Road Bridge array, resulting in few of our tagged fish being detected during 2011 and spring 2012. Using the detection efficiency of the Krassel in-stream monitor (20.5%), we estimated that 34.1% of all summer-tagged parr survived to the monitor and their estimated survival from that point to Lower Granite Dam was 29.0%. Overall estimated parr-to-smolt survival to the dam for all summer-tagged parr from this stream (area) was 12.3%.

7) At Lower Granite Dam in 2012, length and/or weight were measured for 757 recaptured fish from 14 Idaho stream populations. Fish had grown an average of 36.1 mm in length and 7.5 g in weight over an average of 262 d. Their mean condition factor declined from 1.36 at release (parr) to 1.10 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 18 fish arrived at the dam after May.

10) In 2012, peak detections at Lower Granite Dam of parr tagged during summer 2011 (from the 14 stream populations in Idaho and 3 streams in Oregon) occurred from 24 to 28 April during increasing flows of 143.7-186.3 kcfs. Respective dates of the 10th, 50th, and 90th passage percentiles were 16 April, 26 April, and 21 May.

11) In 2011-2012, average estimated parr-to-smolt survival to Lower Granite Dam for Idaho and Oregon streams combined was 14.3% (range 6.3-26.9% depending on stream of origin). For fish from Idaho streams, average estimated parr-to-smolt survival was 14.4%.

    In 2012, we observed moderate-high to high flows early in the spring migration season, with the highest flows occurring during late April and early May. Clearly, complex interrelationships of several ecological and biological factors drive the annual migration timing of these populations.

Contents

Introduction

This report provides information on wild Chinook salmon parr that we PIT tagged in Idaho in 2011 and subsequently monitored, along with PIT-tagged fish from Oregon. We report estimated survival and timing of these fish to Lower Granite Dam as well as interrogation data at several other sites throughout the Snake and Columbia River hydropower 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, 2002-2012). The goals of this ongoing study are to:

1) Characterize the migration timing, growth, 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/survival patterns are apparent
3) Determine which environmental factors influence these patterns
4) Characterize the migrational behavior and estimated 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 2011-2012, we collected water temperature, dissolved oxygen, specific conductance, water depth, and pH data at five 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 eight 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 thus help in recovery planning for these threatened populations.

Methods

Fish Collection and Tagging

National Marine Fisheries Service (NMFS) personnel tagged fish in 14 Idaho streams or sample areas during 2011 (Figure 1). Fish were not sampled in Camas Creek due to extreme turbidity during planned work and in Cape Horn Creek due to logistical and other unresolved issues. 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, 2011).

At six tagging locations during 2011, fish were PIT tagged using both standard 12-mm TX1400SST(PL) tags and 9-mm TX49011B9(PL) tags (Table 1A). We compared detection efficiencies of the two tags on PIT-tag monitors at in-stream arrays, as well as at hydropower facilities. In 2011, fish were tagged using individual single-use hypodermic needles that were pre-loaded with either the 12-mm or 9-mm PIT tags. 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. In addition, anesthetized fish were randomly selected from a pan during tagging, and a system was set up to rotate between preloaded 12-mm and 9-mm tags to maintain equal and randomized tagging numbers. All other tagging criteria remained the same as in previous years (i.e. 55-mm fork length minimum for 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 2011. All tagging, detection, and timing information for fish from these streams in 2011 2012 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.

Downstream Detection and Recapture

In-stream PIT-Tag Monitors

Until recently, opportunities to monitor the migration of PIT-tagged wild juvenile fish were limited to in-stream 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 in-stream PIT-tag monitoring systems. We placed the first in-stream detection systems at two sites in Valley Creek during 2002, and development and improvement of these systems has continued since then. Recent development of these systems is discussed below; further detail can be found in Achord et al. (2004-2005, 2009-2012). 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).

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 range ~43 cm) of the SST tag compared to the ST tag (maximum range ~20 cm). From 1 August 2007 through the first week of September 2007, a single in-stream 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.

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 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 2011-2012 as in 2008.

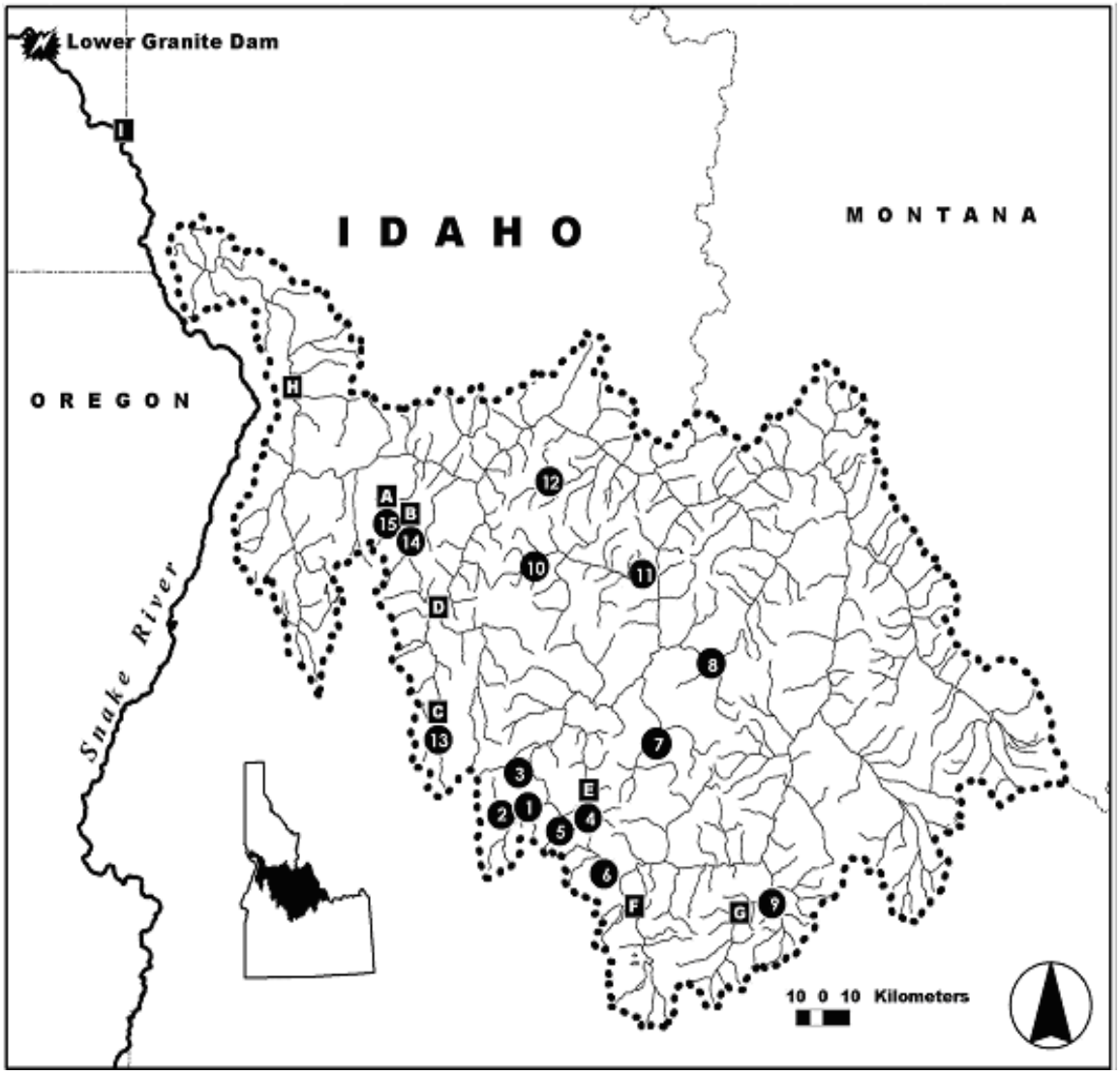


Figure 1. Wild spring/summer Chinook salmon parr were PIT tagged during 2010 in the following stream or sample areas:

1-Bear Valley Creek (and **Trap)**
2-Elk Creek
3-Sulphur Creek
4-Marsh Creek
5-Cape Horn Creek (not sampled)
6-Valley Creek
7-Loon Creek
8-Camas Creek (not sampled)
9-Herd Creek
10-Big Creek (upper)
11-Big Creek (lower)(and **Trap**)
12-Chamberlain/WF Chamberlain Creeks
13-South Fork Salmon River
14-Secesh River
15-Lake Creek

Juvenile migrant fish traps shown above are as follows:

A-Lake Creek Trap
B-Secesh River Trap
C-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

With the development of PVC-pipe antennas and new anchoring systems, we decided to install three of these rectangular antennas at Big Creek. Upper and lower lower monitoring systems (TAY-a and TAY-b) were installed at lower Big Creek in summer 2008. Beginning in 2009, high spring flows and ice on Big Creek created difficulties with anchors, and the arrays were damaged. Several different configurations of antenna arrays since 2009 have led to the current design of a single array stretching the width of the stream located at both the upper and lower sites. Each array consists of six PVC-pipe antennas anchored with duck billed anchors and held in place with three nylon ratchet straps per antenna. The arrays have been in place since May 2011 and continue to be maintained and improved.

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 are located 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 monitor tagged fish from the Secesh and South Fork Salmon Rivers and Lake Creek.

From late July 2011 through June 2012, detection data from wild PIT-tagged Chinook salmon juveniles were collected from five in-stream 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. The ISEMP project personnel continue with development and maintenance of all in-stream PIT-tag monitoring systems associated with this project.

Juvenile Migrant Traps

Some fish PIT tagged as parr in natal rearing areas were subsequently collected at migrant traps (Figure 1). During fall 2011 and spring 2012, juvenile migrant traps were operated at the following locations:

- South Fork Salmon River at Knox Bridge
- South Fork Salmon River below the mouth of the Secesh River
- Lake Creek
- Secesh River near Chinook Campground and near the stream mouth
- Marsh Creek
- Lower Big Creek at Taylor Ranch
- Upper Salmon River near the Sawtooth Hatchery
- Bear Valley Creek near Fir Creek Campground

Also during spring 2012, 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, Shoshone-Bannock Tribes, and Idaho Department of Fish and Game (IDFG). Generally, fish at these traps were anesthetized, scanned for PIT tags, and then measured and weighed. Untagged 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 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 study fish from the population passing the dam (Downing et al. 2001).

During 2011-2012, operation of the fish facility at Little Goose Dam did not allow for fish to be recaptured during the month of April using the SbyC system. This led to the decision to recapture fish at Lower Granite Dam in 2012. The SbyC system was programmed to separate up to a maximum of 100 wild fish from each stream with a maximum of 20 collected per day. 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 Lower Granite 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 Dams

During spring and summer 2012, wild Chinook salmon smolts that had been PIT-tagged as parr in 2011 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 into juvenile bypass systems were 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 pair-trawl fitted with a PIT-tag detection antenna in the upper Columbia River estuary ~150 km downstream from Bonneville Dam (Ledgerwood et al. 2004).

Data Analyses

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 in-stream monitors, this migration corridor was divided into two smaller segments: 1) a stream segment, which spanned from the point of release to the lower in-stream monitor, and 2) a river segment, which spanned from the lower in-stream 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 in-stream 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 monitoring sites at Valley Creek and Lower Big Creek, 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 in-stream 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 in-stream 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 in-stream 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 and for each of the three periods when fish were detected by in-stream monitors: late summer/fall (August-October), winter (November-February), and spring (March-June). For in-stream monitor estimates, we first grouped detected fish by seasonal period of detection. Then, for each cohort (overall release or in-stream 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, we totaled the number of fish that were detected at upper or lower in-stream monitors during each seasonal period and that survived to Lower Granite Dam. This total was 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 with auxiliary data following the method of Schaefer (1951) modified by Sandford and Smith (2002), as shown in the steps below. These auxiliary data were from 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 in-stream 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 in-stream monitor group were used for bootstrap distributions of passage at Lower Granite Dam.

Migration Timing

For each stream, we monitored within-season migration timing to 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 stream populations. This method assumed that the timing of passage percentiles had similar distributions among streams. We used the

Student-Newman-Keuls (SNK) multiple comparison method 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 the 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 2011-2012, we also collected hourly measurements of water temperature (°C), dissolved oxygen (ppm), specific conductance (µS/cm), water depth (ft), and pH from the following five locations: Marsh Creek, Valley Creek, Sawtooth Hatchery in the upper Salmon River, the 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 in-stream PIT-tag monitoring system (VC2). In 2011-2012, we also collected hourly water temperatures and depths in Sulphur, Chamberlain, West Fork Chamberlain, Big (upper), Cape Horn, Herd, Camas, and Lake Creeks.

Results

Fish Collection and Tagging

From 19 July to 2 September 2011, we collected 24,941 wild Chinook salmon parr from 14 Idaho stream populations (Figure 1). These populations were sampled over a distance of about 36.7 stream km and an area of approximately 367,401 m^2 (Table 1A; Appendix Table 1A). Of the fish collected, 12,542 were PIT tagged using standard 12-mm TX1400SST(PL) tags and 5,051 were tagged using 9-mm TX49011B9(PL) tags. All tagged fish were 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 501 in Lake Creek to 3,732 in Valley Creek (Table 1A-1B; Appendix Tables 1A-1B).

Table 1A. 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 2011.

Tagging location	Number of fish		Average length (mm)		Average weight (g)		Collection area to stream mouth (km)	Est. stream area sampled (m^2)
	Collected	Tagged & released	Collected	Tagged	Collected	Tagged		
Bear Valley Creek	1,573	1,000	57.7	59.6	2.7	2.9	8.5-9, 13-13.5	17,857
Elk Creek	1,145	999	61.3	61.9	3.1	3.1	0-2.3	25,562
Marsh Creek	1,854	1,000	57.0	60.6	2.9	3.1	12-13, 14-14.5	24,445
Sulphur Creek	1,256	1,000	60.5	61.9	3.3	3.4	6-9	29,369
Valley Creek	5,039	3,732	60.3	62.8	3.6	3.3	4-7, 8.5-10, 11-13, 17-18.6	60,359
Herd Creek	1,129	999	63.7	63.6	4.4	4.1	1-3	15,401
Loon Creek	1,172	1,001	61.7	62.8	3.6	3.8	29-31	26,338
Big Creek (upper)	2,094	1,466	60.5	63.0	4.0	3.6	57.5-62	44,144
Big Creek (lower)	1,643	1,551	71.5	71.8	5.0	5.1	8-11.5	33,465
WF Chamberlain Cr	2,164	993	57.8	62.0	2.9	2.9	1-2	2,650
Chamberlain Cr	944	543	57.5	61.4	3.1	3.0	26-27	11,714
S Fork Salmon R	1,618	1,516	65.1	65.7	3.9	4.0	117-118	18,488
Secesh River	2,149	1,292	58.1	62.6	3.3	3.3	25-29	38,080
Lake Creek	1,161	501	55.2	61.5	3.6	3.4	1-2.3	19,529
Totals/averages	24,941	17,593	60.6	63.4	3.5	3.5	36.7	367,401

Table 1B. Summary of PIT tagging and release of wild Chinook salmon parr with average fork lengths and weights for fish tagged in streams with both 9-mm TX49011B(PL) tags and standard 12-mm TX1400SST(PL) tags from July to September 2011. See Table 1A for other stream-related information.

	Tagged and released		Average length (mm)		Average weight (g)	
Tagging location	12 mm	9 mm	12 mm	9 mm	12 mm	9 mm
Valley Creek	1,856	1,876	62.8	62.8	3.3	3.3
Big Creek (upper)	710	756	63.3	62.7	3.7	3.6
Big Creek (lower)	776	775	72.2	71.5	5.2	5.0
SF Salmon River	766	750	66.1	65.4	4.0	3.9
Secesh River	648	644	62.5	62.6	3.3	3.2
Lake Creek	251	250	61.1	61.4	3.3	3.3
Totals or averages	5,007	5,051	64.7	64.4	3.7	3.6

In 2011, the mean fork length of all Chinook salmon parr collected was 60.6 mm and the mean weight was 3.5 g. The mean fork length of Chinook salmon parr that were tagged and released was 63.4 mm, and the mean weight was 3.5 g (Table 1A; Appendix Table 1A). Collection areas within streams were further delineated by recording Global Positioning System (GPS) coordinates using the Universal Transverse Mercator (UTM) 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 in 2011 was low (Table 3; Appendix Table 3). Overall, collection mortality was 1.2%, tagging and 24-h delayed mortality was 0.1%, and total observed mortality was 1.3%. In addition, 9 lost tags (0.05%) were observed prior to release.

Table 2. Summary of species other than Chinook salmon parr observed during collection operations in Idaho from July to September 2011. Some steelhead were PIT tagged in Big Creek for the Idaho Department of Fish and Game.

Streams	Steelhead	Tagged Steelhead	Unidentified fry	Brook Trout	Cutthroat Trout	Bull Trout	Sculpin	Dace	Sucker	Whitefish	Redside Shiner
Bear Valley Creek	41	0	112	203	0	0	380	44	21	15	0
Elk Creek	102	0	80	358	0	0	580	9	55	106	0
Marsh Creek	48	0	86	97	0	0	530	0	4	28	0
Sulphur Creek	129	0	25	0	2	0	1,173	0	62	66	0
Valley Creek	191	0	1,018	518	0	11	1,225	286	49	684	66
Loon Creek	116	0	1,266	0	0	1	379	0	0	43	0
Big Creek (upper)	273	64	420	677	5	8	1,531	0	0	2	0
Big Creek (lower)	151	98	792	0	0	3	352	58	13	0	0
Herd Creek	224	0	23	0	0	1	288	0	0	69	0
W Fork Chamberlain Cr	69	0	58	0	0	0	16	0	0	6	0
Chamberlain Cr	246	0	245	0	0	3	337	0	0	3	0
SFSalmon River	141	0	650	16	0	1	26	10	0	19	0
Secesh River	219	0	856	60	0	16	497	27	0	3	0
Lake Creek	42	0	78	19	0	24	606	2	0	5	0
Totals	1,992	162	5,709	1,948	7	68	7,920	436	204	1,049	66

Table 3. Mortality percentages for wild Chinook salmon parr collected and PIT-tagged in Idaho from July to September 2011. There were 9 lost tags for the study.

	Mortality (%)		
Tagging Location	Collection	24 h	Overall
Bear Valley Creek	1.1	0.0	1.1
Elk Creek	2.1	0.1	2.2
Marsh Creek	1.1	0.0	1.1
Sulphur Creek	2.5	0.0	2.5
Valley Creek	1.1	0.3	1.4
Loon Creek	1.4	0.0	1.4
Big Creek (upper)	2.2	0.0	2.2
Big Creek (lower)	2.0	0.0	2.0
Herd Creek	1.1	0.4	1.4
West Fork Chamberlain Creek	0.1	0.1	0.1
Chamberlain Creek	0.0	0.2	0.1
South Fork Salmon River	0.3	0.4	0.7
Secesh River	0.9	0.0	0.9
Lake Creek	0.7	0.0	0.7
Averages	1.2	0.1	1.3

Detections at In-stream PIT-Tag Monitors

Valley Creek

From 1 to 5 August 2011, 3,732 of the collected wild Chinook salmon parr were PIT tagged and released in Valley Creek. Of these fish, 1,856 were tagged with 12-mm tags and 1,876 with 9-mm tags; all fish were released in natal rearing areas 3-10 km above the upper in-stream monitor in lower Valley Creek (VC1; Table 1A). Between 1 August 2011 and 30 June 2012, 757 fish with 12-mm tags and 356 fish with 9-mm tags were detected at the two Valley Creek sites (Figures 2A and 2B).

Median downstream travel time between the upstream and downstream Valley Creek monitors (VC1 to VC2) was approximately 0.7 h (range 0.5 h-93.5 d) for the 285 12-mm PIT tagged fish detected at both sites. Of the 757 detections of 12-mm tags, 559 (73.8%) occurred in late summer/fall (Aug-Oct), 153 (20.2%) in winter (Nov-Feb), and 45 (6.0%) in spring (Mar-Jun; Figure 2A). Median downstream travel time between the upstream and downstream Valley Creek monitors was approximately 0.5 h (range 0 h-80.9 d) for the 42 fish with 9-mm tags detected at both sites. Of the 356 detections of 9-mm tags, 212 (59.6%) occurred in late summer/fall (Aug-Oct), 103 (28.9%) in winter (Nov-Feb), and 41 (11.5%) in spring (Mar-Jun; Figure 2B).

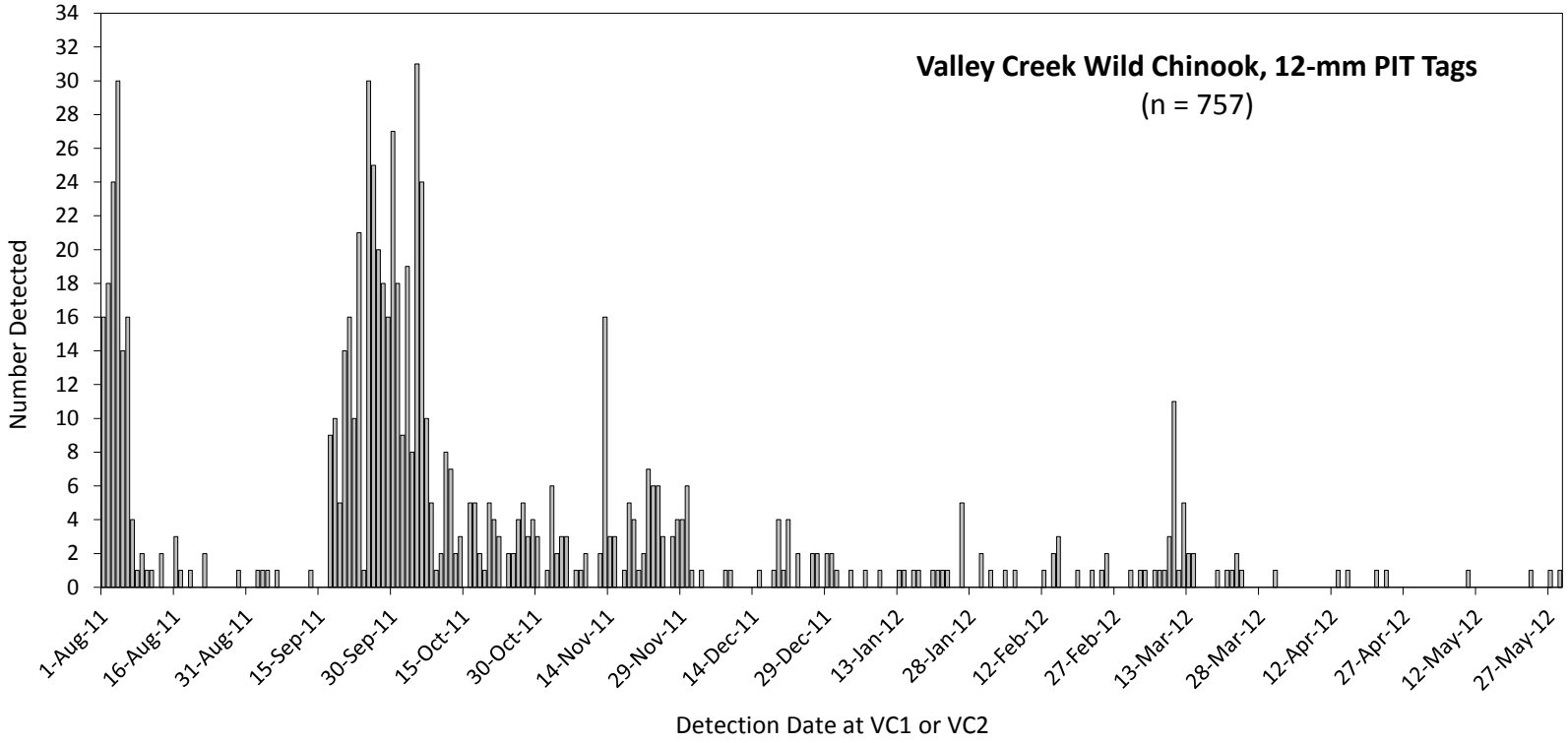


Figure 2A. Detections of 757 PIT-tagged wild spring/summer Chinook salmon parr, pre-smolts, and smolts at the upper and lower in-stream monitoring systems in lower Valley Creek (VC1 and VC2), August 2011-June 2012. A total of 1,856 parr were tagged with 12-mm PIT tags and released 3-10 km above these antennas during 1-5 August 2011.

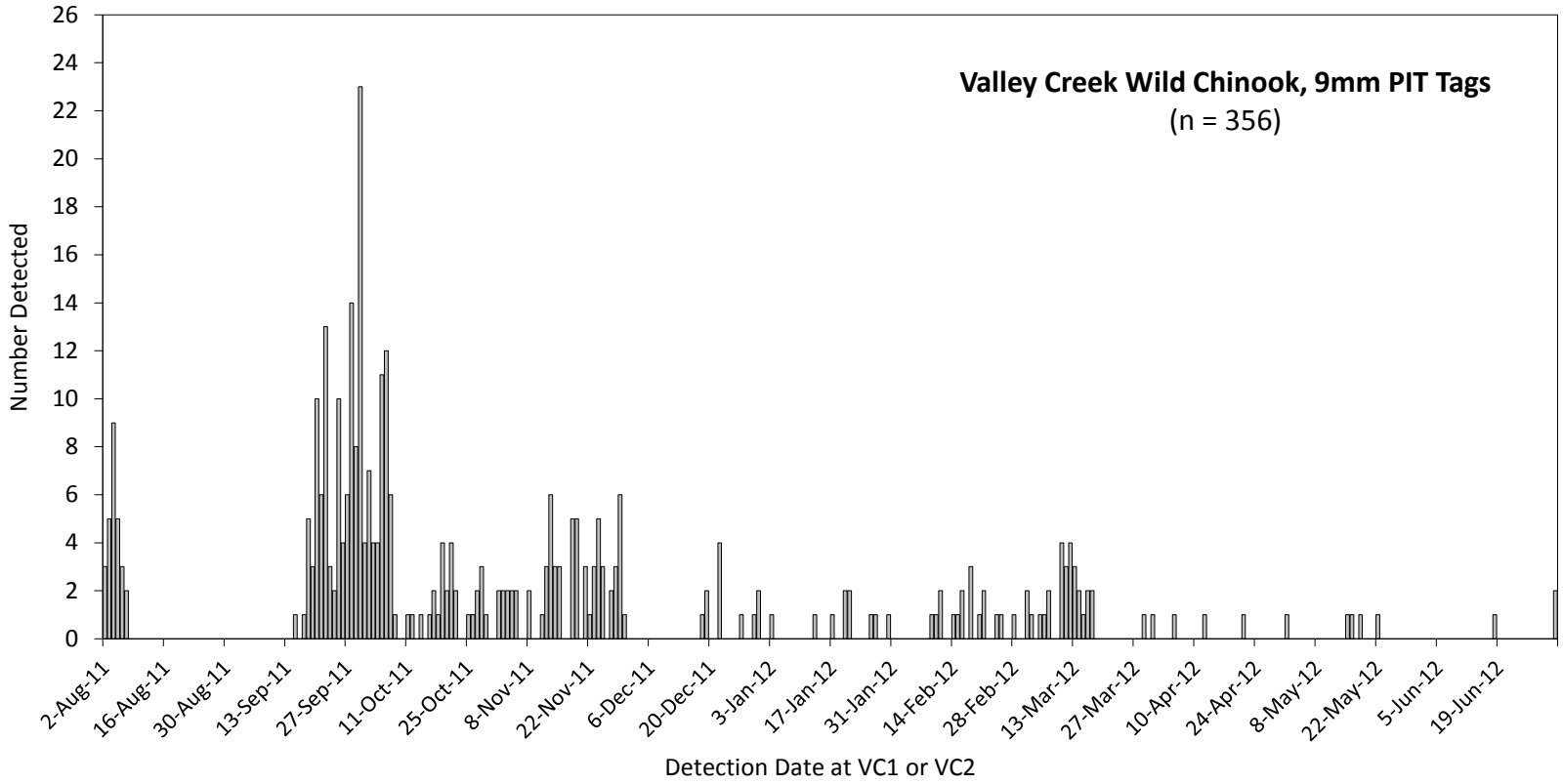


Figure 2B. Detections of 356 PIT-tagged wild spring/summer Chinook salmon parr, pre-smolts, and smolts at the upper and lower in-stream monitoring antennas in lower Valley Creek (VC1 and VC2), August 2011-June 2012. A total of 1,876 parr were tagged with 9-mm PIT tags and released 3-10 km above these antennas during 1-5 August 2011.

Based on detections at downstream dams, the overall efficiency of Valley Creek monitors was 80.0% for fish with 12-mm tags and 38.0% for fish with 9-mm tags. Based on these efficiencies, an estimated 51.0% (SE ± 1.9%; 95% CI 47.1-54.8%) of all 12-mm PIT tagged parr survived to migrate past the Valley Creek monitors, and an estimated 50.0% (± 3.7%; 42.7-57.3%) of all 9-mm PIT tagged parr survived to migrate past the Valley Creek monitors. Their survival from the Valley Creek monitors to Lower Granite Dam was 24.7% (± 2.8%; 19.7-30.3%) for 12-mm PIT tagged fish and 28.2% (± 4.4%; 19.5-37.5%) for 9-mm PIT tagged fish. For fish detected from August 2011 to June 2012, we found no significant relationship between timing of detection in lower Valley Creek and fork length at tagging for the 12-mm or 9-mm tag groups, $P = 0.329$ and $P = 0.791$ respectively (Figures 3A and 3B).

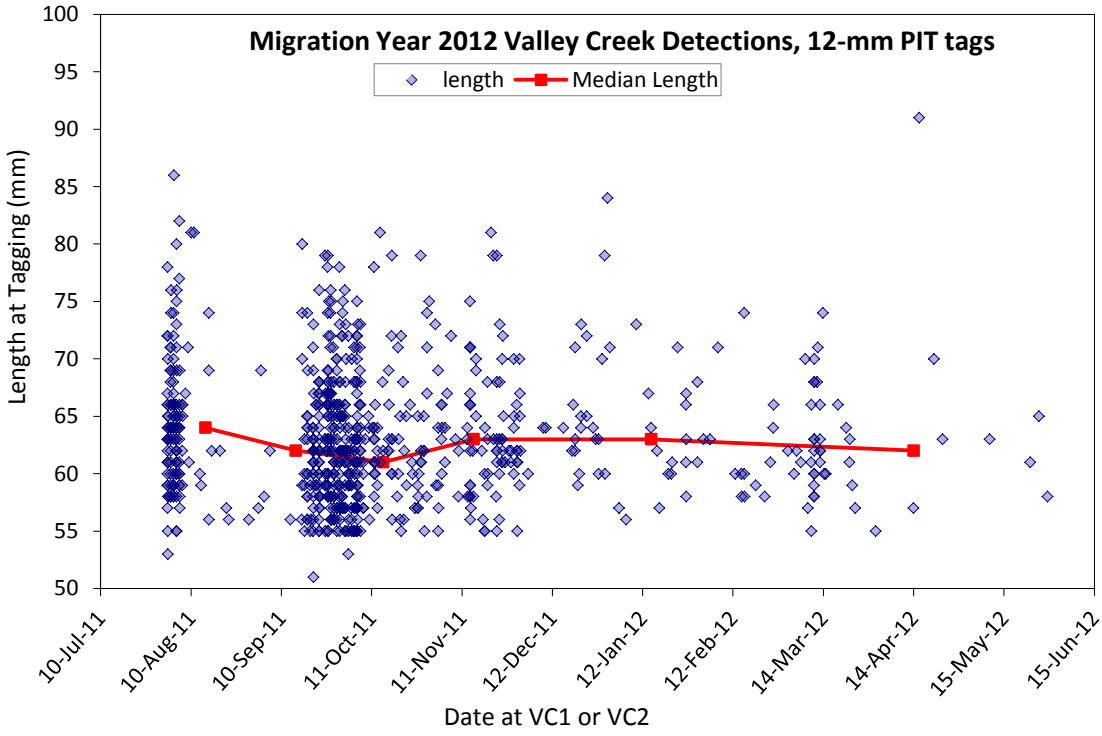


Figure 3A. Fork length and median fork length of 757 summer-tagged parr (12-mm tag) that migrated in 2012 and were detected at the upper and lower in-stream PIT-tag monitoring antennas in lower Valley Creek, August 2011-June 2012.

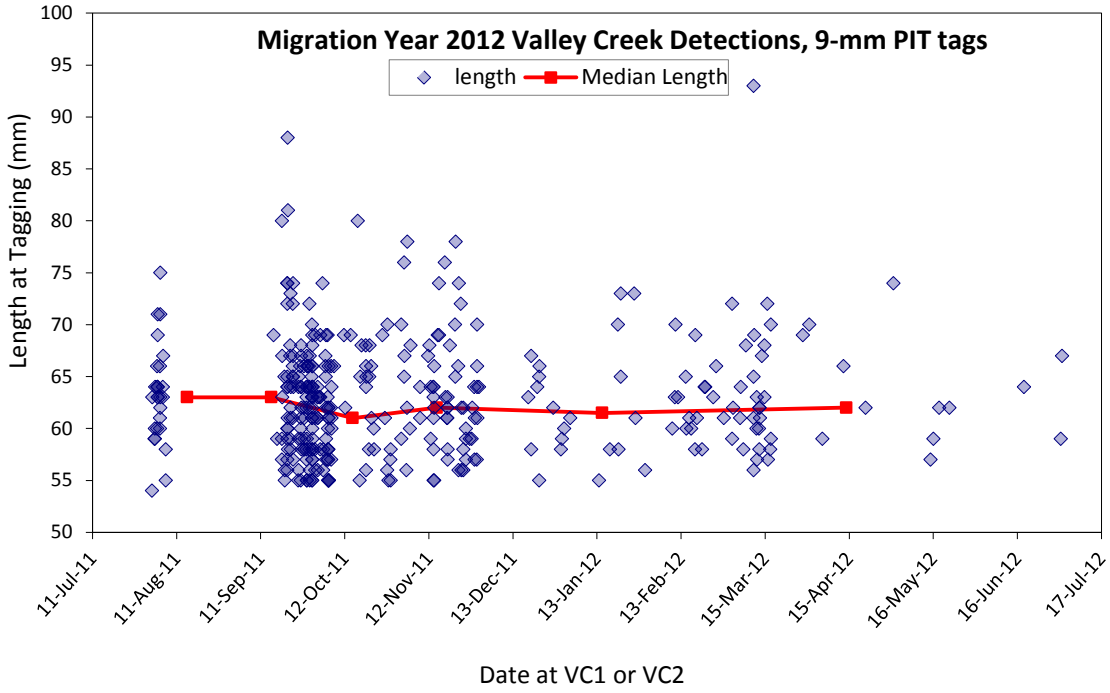


Figure 3B. Fork length and median fork length of 356 summer-tagged parr (9-mm tag) that migrated in 2012 and were detected on the upper and lower in-stream PIT-tag monitoring antennas in lower Valley Creek, August 2011-June 2012.

Lower Big Creek

From 31 August to 2 September 2011, 1,551 wild Chinook salmon parr from lower Big Creek were collected and PIT tagged in lower Big Creek. Of these fish, 776 were tagged with 12-mm tags and 775 with 9-mm tags. All were released in natal rearing areas 0-3 km above the in-stream PIT-tag monitors in lower Big Creek at Taylor Ranch (Table 1A). Between 1 September 2011 and 30 June 2012, 303 of these fish were detected at least once on either the upper or lower Taylor Ranch monitors (TAY-a and TAY-b combined; Figure 4A). Of these 303 detections, 204 (67.3%) occurred in late summer/fall, 84 (27.7%) in winter, and 15 (5.0%) in spring (Figure 4A).

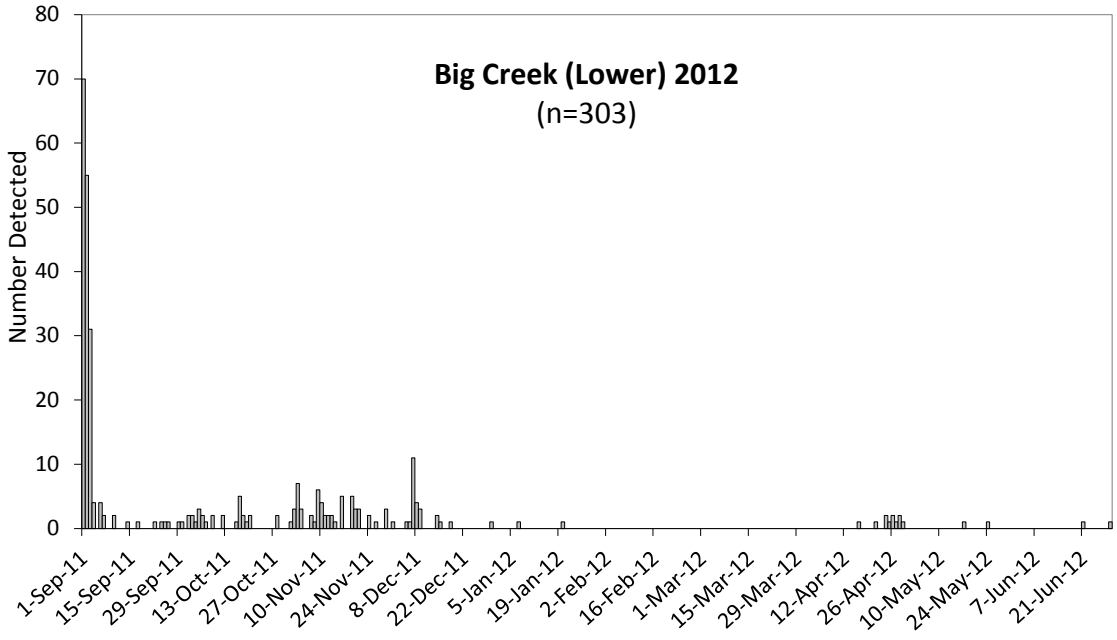


Figure 4A. Detections of 303 PIT-tagged wild spring/summer Chinook salmon parr, pre-smolts, and smolts from lower Big Creek at the upper (TAY-a) and lower (TAY-b) in-stream PIT-tag monitoring antennas at Taylor Ranch in lower Big Creek from September 2011 through June 2012. A total of 1,551 Chinook salmon parr were PIT tagged; 776 fish with 12-mm tags and 775 with 9-mm tags. Fish were released 0-3 km above these antennas from 1 to 2 September 2011.

Based on detections at downstream dams, the overall detection efficiency of the upstream and downstream monitors at lower Big Creek was 23.9%. Using this detection efficiency rate, we estimated that 81.8% (SE ± 7.3%, 95% CI 67.3-96.4%) 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 28.2% (± 5.0%, 18.6-38.5%). Detection data collected from September 2011 to June 2012 indicated no statistically significant relationship between fork length at tagging and timing of detection in lower Big Creek (P = 0.268; Figure 4B).

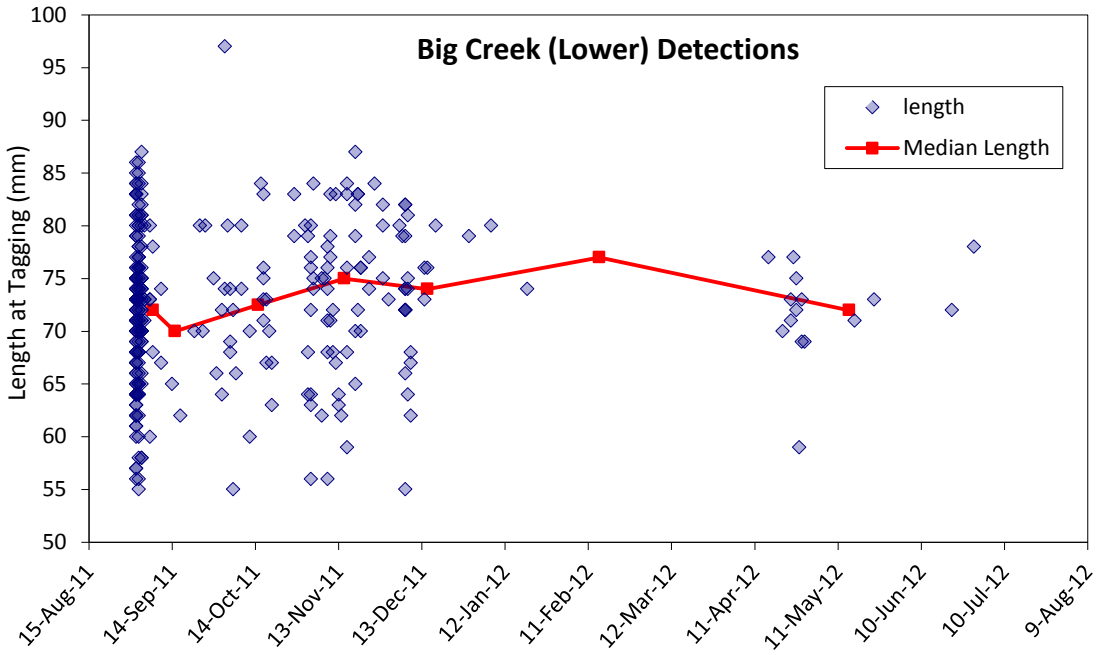


Figure 4B. Length at tagging (FL) and median fork length of 303 summer-tagged parr from lower Big Creek that were detected at Taylor Ranch upper and lower in-stream PIT-tag monitoring antennas, September 2011-June 2012.

Upper Big Creek

From 15 to 16 August 2011, 1,466 wild Chinook salmon parr from upper Big Creek were collected and PIT tagged. Of these fish, 710 were tagged with a 12-mm tag and 756 were tagged with a 9-mm tags. All fish were released in natal rearing areas 49-52 km upstream from the Taylor Ranch in-stream monitors in lower Big Creek (Table 1A). Between August 2011 and June 2012, the upper and lower monitoring sites had 86 unique detections of these fish (Figure 5A). Of these 86 detections, 61 (70.9%) occurred in late summer/fall, 17 (19.8%) in winter, and 8 (9.3%) in spring (Figure 5A).

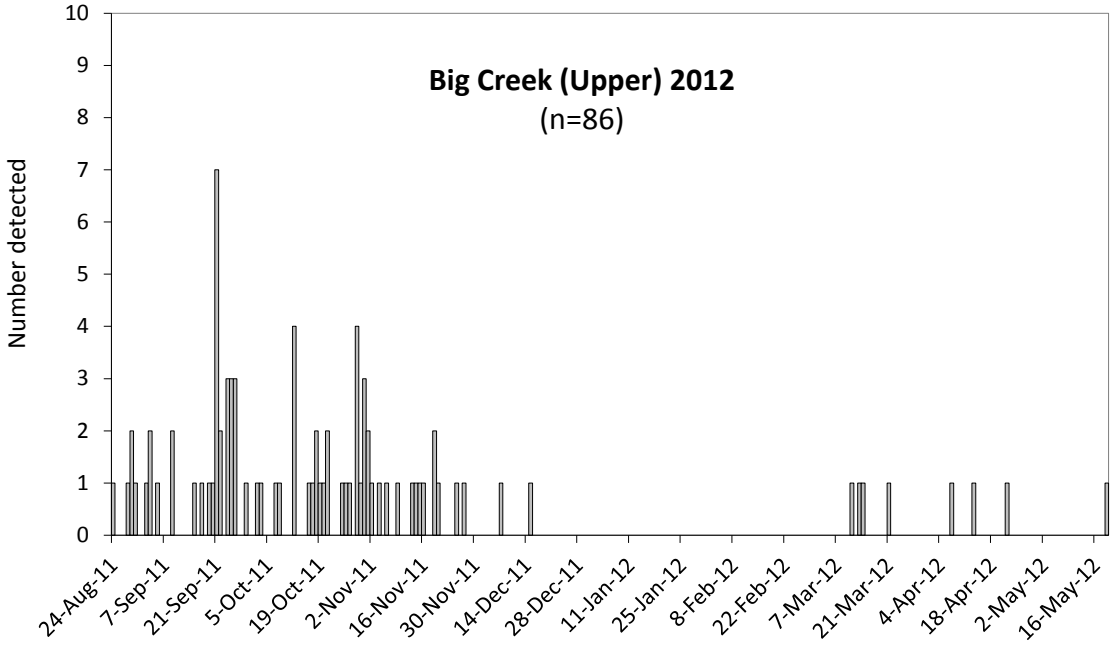


Figure 5A. Detections of 86 PIT-tagged wild spring/summer Chinook salmon parr, pre-smolts, and smolts from upper Big Creek at the upper (TAY-a) and lower (TAY-b) in-stream PIT-tag monitoring antennas at Taylor Ranch in lower Big Creek from September 2011 through June 2012. A total of 1,466 Chinook salmon parr were PIT tagged; 710 with 12-mm tags and 756 with 9-mm tags. Fish were released 49-52 km above these antennas from 15 to 16 August 2011.

Based on detections at downstream dams, the overall efficiency of the upper or lower in-stream monitors at Taylor Ranch in lower Big Creek in detecting these fish was 17.6%. Based on this efficiency, an estimated 33.4% (SE ± 5.6%, 95% CI 22.3-44.5%) of all summer-tagged parr survived to migrate past the downstream monitors, and their survival from the downstream monitors to Lower Granite Dam was 41.4% (± 12.1%, 19.8-67.6%). Detection data collected from August 2011 to June 2012 indicated a statistically significant relationship between fork length at tagging in upper Big Creek ($P = 0.036$) and timing of detection on the upper and lower monitors (TAY-a and TAY-b) at Taylor Ranch (Figure 5B).

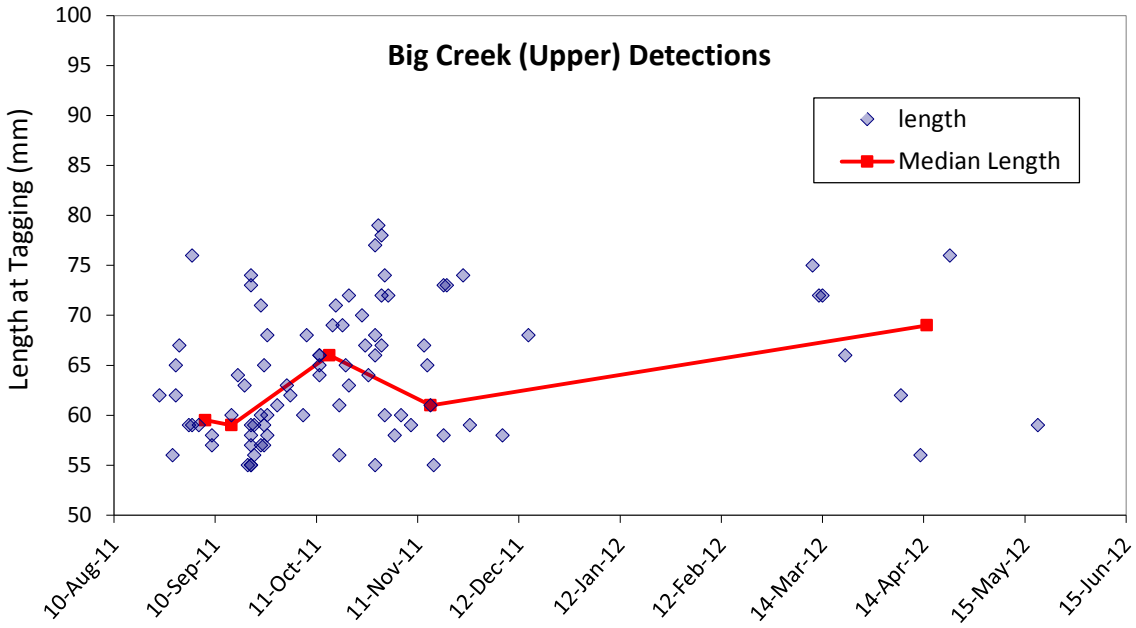


Figure 5B. Length at tagging (FL) and median fork length of 86 summer-tagged parr from upper Big Creek that were detected at Taylor Ranch upper and lower in-stream PIT-tag monitoring antennas, August 2011-June 2012.

South Fork Salmon River

From 18 to 19 August 2011, 1,516 wild Chinook salmon parr from the South Fork Salmon River were collected and PIT tagged. Of these fish, 766 were tagged with 12-mm tags and 750 with 9-mm tags; all were released in natal rearing areas (Table 1A). These fish were released 52-53 km above the in-stream 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 2011 to June 2012, 106 of these fish were detected at the South Fork Salmon River monitor near Krassel Creek, and only 3 were detected at the site near Guard Station Road Bridge (few detections are a result of bed load movement burying a portion of the array during 2011-12). Of the 106 detections at the Krassel Creek monitor, 67 (63.2%) occurred in late summer/fall and 39 (36.8%) in winter/spring (Figure 6A).

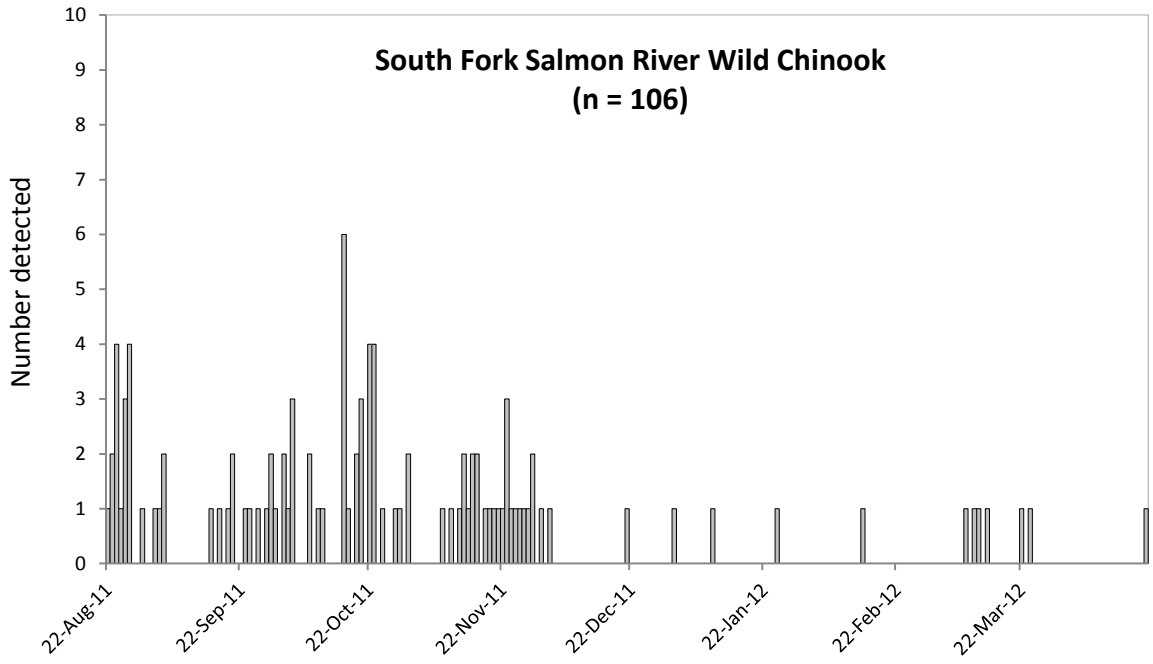


Figure 6A. Detections of 106 PIT-tagged wild spring/summer Chinook salmon parr, pre-smolts, and smolts at the Krassel in-stream PIT-tag monitoring antennas in the South Fork Salmon River from August 2011 through April 2012. A total of 1,516 Chinook salmon parr were PIT tagged using 12-mm (766 fish) and 9-mm (750 fish) tags and released in the South Fork Salmon in areas from approximately 52-53 km above these antennas from 18 to 19 August 2011.

Based on detections at downstream dams, overall detection efficiency of the in-stream monitor at Krassel Creek was 20.5%. Using this detection efficiency rate, we estimated that 34.1% (SE ±4.7%, 95% CI 24.8-43.4%) of all summer-tagged parr from this stream (area) survived to migrate past the monitors at Krassel, and their survival from the monitors to Lower Granite Dam was 29.0% (± 7.9%; 14.8-44.2%). Detection data collected from August 2011 to June 2012 indicated no statistically significant relationship between fork length at tagging and timing of detection for parr tagged and released in the South Fork Salmon river (P = 0.268; Figure 6B).

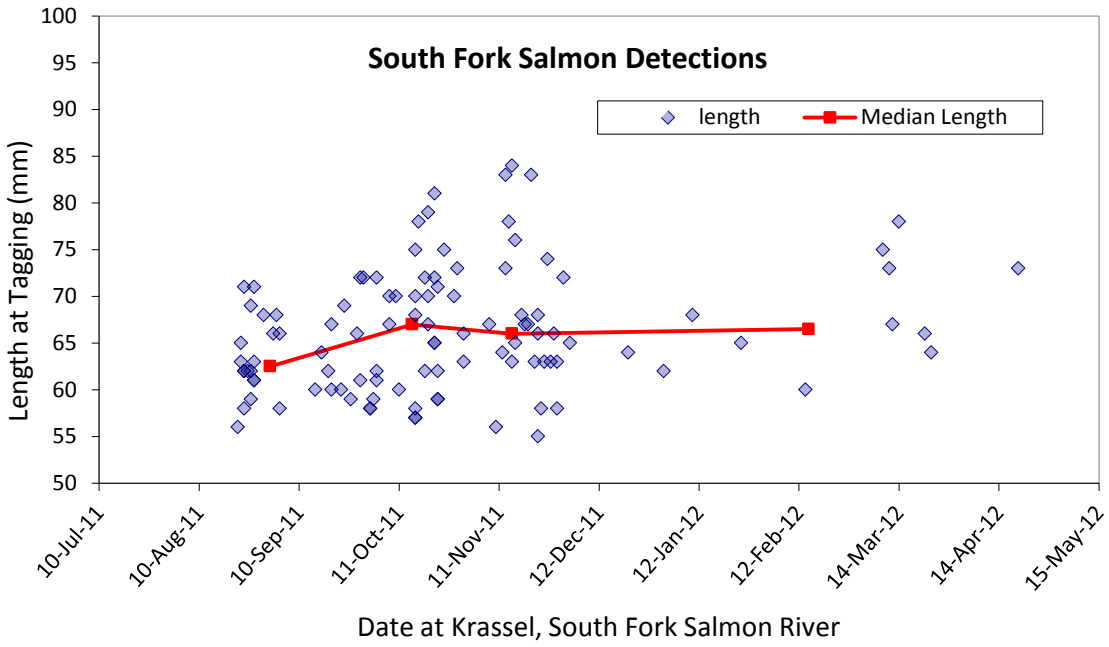


Figure 6B. Length at tagging (FL) and median fork length of 106 summer-tagged parr from the South Fork Salmon River that were detected at the in-stream PIT-tag monitoring site at Krassel in the South Fork Salmon River, August 2011-June 2012.

Secesh River and Lake Creek

From 26 to 28 August 2011, 1,793 wild Chinook salmon parr from the Secesh River and Lake Creek were collected and PIT tagged. Of the fish tagged, 899 were tagged using 12-mm PIT tags, 894 were tagged using 9-mm PIT tags, and all were released in or near their natal rearing areas (Table 1A). Release sites were 21-42 km above the in-stream 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 2011 to June 2012, 240 of these fish were detected at the lower Secesh River site near Zena Creek Ranch (Figure 7A), but only 8 were detected in the lower South Fork Salmon River near Guard Station Road Bridge. Of the 240 detections near Zena Creek, 225 (93.8%) occurred in late summer/fall, and the other 15 (6.2%) occurred in winter/spring (Figure 97A).

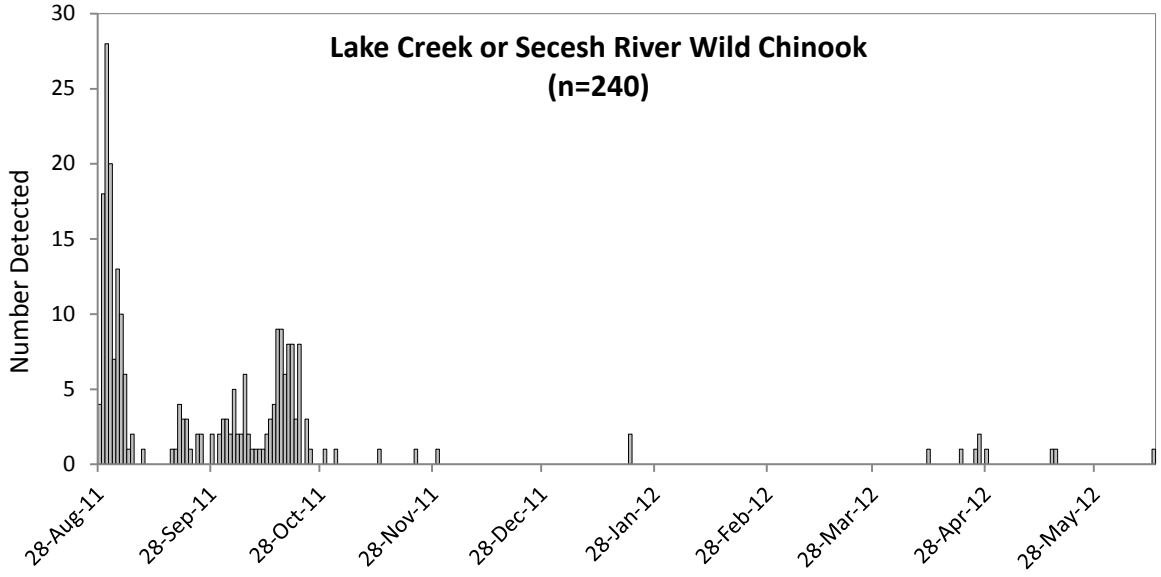


Figure 7A. Detections of 240 PIT-tagged wild spring/summer Chinook salmon parr, pre-smolts, and smolts from the Secesh River or Lake Creek at the Zena Creek Ranch in-stream PIT-tag monitoring antennas in lower Secesh River from August 2011 through June 2012. A total of 1,793 Chinook salmon parr were PIT tagged using 12-mm (899 fish) and 9-mm (894 fish) tags and released in areas from (approximately) 21 to 42 kilometers above these antennas from 26 to 28 August 2011.

An estimated 63.0% (SE ±8.7%, 95% CI 45.6-80.4%) of all summer-tagged parr from these streams survived to migrate passed these monitors, and their subsequent survival to Lower Granite Dam was 17.5% (± 4.4%, 9.6-26.8%). For fish detected from August 2011 to June 2012, we found no significant relationship between timing of detection in the lower Secesh River and fork length at tagging (P = 0.115; Figure 7B).

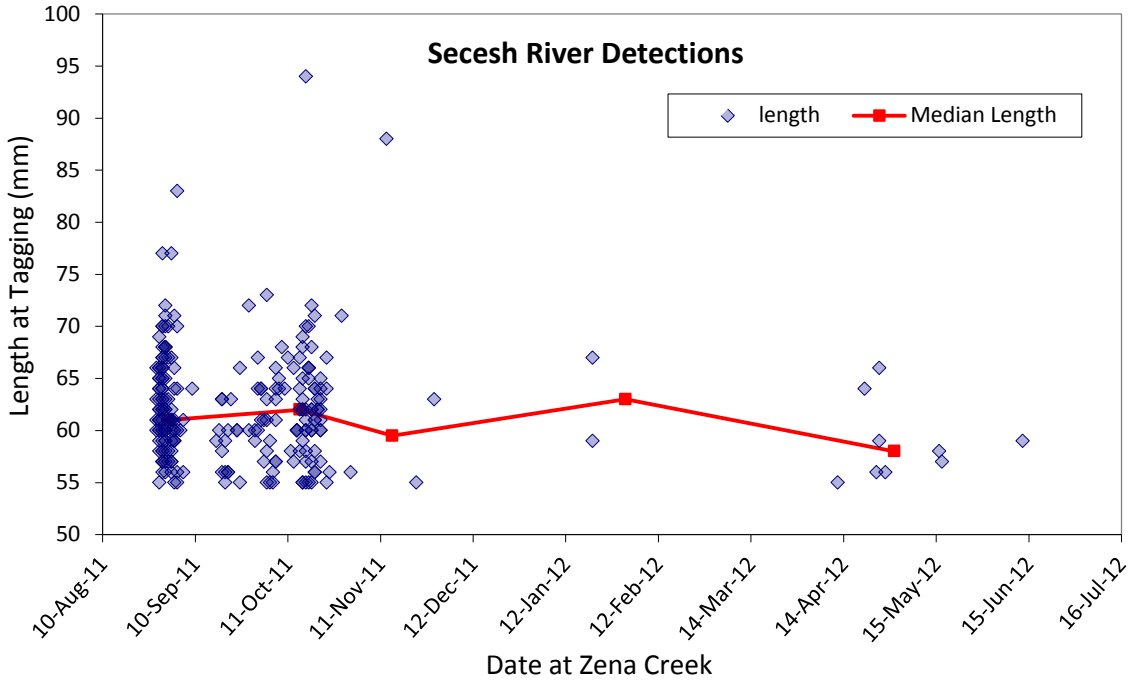


Figure 7B. Length at tagging (FL) and median fork length of 240 summer-tagged parr from the Secesh River and Lake Creek that were detected at the in-stream PIT-tag monitoring site in the lower Secesh River near Zena Creek, August 2011-June 2012.

Recaptures at Traps and Dams

A total of 1,118 wild fish PIT-tagged in summer 2011 were recaptured at traps above Lower Granite Dam from summer-fall 2011 to spring 2012, and 759 were recaptured in the separation-by-code (SbyC) system at Lower Granite Dam (Table 4). Overall parr-to-smolt growth measured at Lower Granite Dam indicated a mean growth rate of 0.14 mm/d and mean weight gain of 0.029 g/d.

Table 4. Length, weight, and condition of wild spring/summer Chinook salmon PIT-tagged in Idaho during summer 2011 and recaptured either in the separation-by-code system at Lower Granite Dam in 2012 or at traps during summer-fall 2011 and spring-summer 2012. 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 Lower Granite.

	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 in SbyC at Lower Granite Dam										
Bear Valley Creek	30	264-326	285	30	26-52	38.2	16	5.1-10.6	7.5	1.33	1.02
Elk Creek	48	257-328	284	48	16-59	36.2	26	2.8-16.7	8.3	1.3	1.03
Sulphur Creek	52	259-310	278	52	23-57	36.7	26	4.4-15.3	7.9	1.33	1.03
Marsh Creek	57	252-306	277	57	16-59	37.8	31	2.7-13.1	7.4	1.32	1.07
Valley Creek	97	242-270	261	97	21-62	38.8	32	3.8-13.3	7.4	1.26	1.04
Loon Creek	92	235-300	264	92	19-66	35.8	61	3.5-23.3	7.8	1.25	1.07
Big Creek (upper)	54	235-311	269	54	22-52	36.2	27	4.1-14	8.7	1.32	1.08
Big Creek (lower)	95	214-241	233	93	11-50	30.7	18	1.3-9.4	6.2	1.12	1
South Fork Salmon R.	65	233-293	257	65	7-59	31.5	55	1.7-17.1	6.2	1.29	1.04
WF Chamberlain Cr	38	237-277	251	38	16-54	38.0	20	3.4-13.4	8.2	1.15	1.02
Chamberlain Creek	10	222-262	244	10	14-57	34.4	10	1.4-13.5	7.2	1.3	1.05
Secesh River	66	220-274	240	66	14-59	37.8	37	3.4-10.9	7.4	1.21	1.02
Lake Creek	11	226-307	251	11	18-52	34.7	6	1.6-15.2	7.6	1.22	1.05
Herd Creek	44	240-287	269	44	23-61	38.5	30	3.4-12.2	7.7	1.28	1.04
Totals or averages	759	214-328	262	757	7-66	36.1	395	1.3-23.3	7.5	1.29	1.04
	Wild spring/summer Chinook salmon recaptured at traps										
Big Cr (Taylor Ranch)											
Upper Big Creek											
Fall	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

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)										
Bear Valley Creek											
Bear Valley Origin											
Fall	14	1-98	34	3	3-20	12.3	1	N/A	1.9	1.26	1.16
Elk Creek Origin											
Fall	10	2-95	17	1	N/A	11.0	1	N/A	0.7	1.28	1.16
Big Cr (Taylor Ranch)											
Upper Big Creek Origin											
Fall	90	6-83	48	90	0-17	6.1	38	-0.9-1.6	0.0	1.41	1.08
Spring	1	N/A	238	1	N/A	14.0	1	N/A	1.4	1.34	1.00
Lower Big Creek Origin											
Fall	147	1-67	7	146	-1-24	1.5	26	-1.4-1.6	0.0	1.37	1.18
SF Salmon R. (Knox)											
Fall	284	1-67	21	273	-4-13	2.4	222	-2.2-3.3	-0.2	1.34	1.12
Spring	7	216-225	219	7	9-18	13.0	6	0.6-2.9	1.7	1.29	1.08
Lake Creek											
Fall	71	1-63	28	71	-4-13	3.9	52	-2.4-1.4	-0.2	1.37	1.1
Secesh River Upper trap											
Lake Creek Origin											
Fall	43	3-51	30	43	-1-14	4.7	34	-1.9-1.2	-0.1	1.34	1.03
Secesh River Origin											
Fall	2	0-3	2	1	N/A	1.0	0	N/A	N/A	1.10	1.08
Secesh River Lower trap											
Secesh River Origin											
Fall	191	1-60	18	191	-3-17	2	110	-1.2-1.0	-0.3	1.26	1.07
Spring	2	229-234	231	2	8-10	9.0	2	0.2-0.5	0.4	1.31	0.98

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)										
Secesh River Lower Trap (Continued)											
Lake Creek Origin											
Fall	48	4-64	32	48	-1-12	4.7	32	-1.1-1.1	-0.2	1.37	1.02
Marsh Creek Upper trap											
Fall	155	0-86	16	155	-2-23	3.4	0	N/A	N/A	1.32	N/A
Spring	2	254-304	279	2	20-33	26.5	0	N/A	N/A	1.19	0.79
Marsh Creek Lower trap											
Fall	29	1-94	36	29	-2-25	8.0	0	N/A	N/A	1.30	N/A
Salmon River											
Spring	15	195-250	222	15	10-30	21.7	0	N/A	N/A	1.28	N/A
Snake River											
Spring	7	231-301	251	6	7-44	29	0	N/A	N/A	1.40	N/A
Totals	1,118	0-304	96	1,084	-4-44	9.7	18	-2.4-3.3	0.4	1.31	1.06

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 14.4% (SE 0.5%; Table 5; Appendix Tables 5-18). This estimate was based on expanded detections at Lower Granite Dam from 25 March to 2 July 2012 (2,529 fish).[1] An additional 1,162 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 5-17 and 19-24).

Table 5. Summary of observed and expanded detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Lower Granite Dam in 2012. Expanded numbers are parr-to-smolt survival estimates and standard error percentages (SE%). See Table 1A for numbers released.

	Lower Granite Dam Detections			
	Observed		Expanded	
	N	(%)	N	(%) SE
Bear Valley Creek	31	3.1	88	8.8(1.6)
Elk Creek	52	5.2	150	15.0(2.1)
Marsh Creek	58	5.8	158	15.8(2.1)
Sulphur Creek	53	5.3	148	14.8(2.0)
Valley Creek	193	5.2	522	14.0(1.0)
Loon Creek	95	9.5	269	26.9(2.8)
Herd Creek	48	4.8	137	13.7(2.1)
Big Creek (upper)	57	3.9	173	11.8(1.7)
Big Creek (lower)	129	8.3	350	22.6(1.9)
WF Chamberlain/Chamberlain Cr	54	3.5	145	9.5(1.3)
SF Salmon River	68	4.5	186	12.3(1.5)
Secesh River	71	5.5	184	14.3(1.7)
Lake Creek	11	2.2	31	6.3(1.9)
Totals or averages	920	5.2	2,542	14.4(0.5)

[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 in-stream PIT tag monitors, we estimated an overall survival rate to Lower Granite Dam of 24.7 ± 2.8% (95% CI 19.7-30.3%) for fish with 12-mm tags and 28.2 ± 4.4% (19.5-37.5%) for fish with 9-mm tags. Estimated overall parr-to-smolt survival for fish from this stream was 14.0 ± 1.0% (12.2-15.9%; Table 5). For fish with 12-mm tags, estimated survival to Lower Granite Dam in 2011-2012 was 21.4 ± 3.2% (15.2-28.1%) for fish leaving Valley Creek in late summer/fall, 31.7 ± 6.5% (19.7-45.3%) for fish leaving in winter, and 43.0 ± 15.6% (17.1-77.4%) for fish leaving in spring. For fish with 9-mm tags, estimated survival to Lower Granite was 19.9 ± 4.8% (10.6-30.0%) for fish leaving Valley Creek in late summer/fall, 40.7 ± 9.7% (23.3-60.0%) for fish leaving in winter, and 39.6 ± 14.0% (12.6-67.8%) for fish leaving in spring.

Big Creek—For Chinook salmon juveniles PIT tagged in lower Big Creek and detected at the Big Creek in-stream PIT tag monitors, overall survival to Lower Granite Dam was estimated at 28.2 ± 5.0% (18.6-38.5%). Overall parr-to-smolt estimated survival for fish from this stream (area) was 22.6 ± 1.9% (19.0-26.5%; Table 5). During 2011-2012, estimated survival was 27.5 ± 5.8% (16.3-38.3%) for lower Big Creek fish detected in late summer/fall, 35.1 ± 10.7% (15.6-57.5%) 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 in-stream monitors, overall survival to Lower Granite Dam was estimated at 41.4 ± 12.1% (19.8-67.6%). Overall parr-to-smolt survival for fish from upper Big Creek was estimated at 11.8 ± 1.7% (8.8-15.2%; Table 5). For upper Big Creek fish detected at the Big Creek monitors, estimated survival to Lower Granite Dam in 2011-2012 was 41.9 ± 13.0% (18.8-68.2%) for fish detected in late summer/fall, 26.4 ± 18.0% (0.0-66.0%) for fish detected in winter, and 69.4 ± 70.9% (0.0-242.7%) for fish detected in spring.

Secesh River and Lake Creek—In 2012, we estimated an overall survival rate to Lower Granite Dam of 17.5 ± 4.4% (9.6-26.8%) for Chinook salmon juveniles previously detected at the lower Secesh River in-stream PIT tag monitors near Zena Creek. For fish detected at this monitoring site, estimated survival rates to the dam in 2011-2012 were 18.7 ± 4.6% (10.1-28.2%) for fish detected in late summer/fall. For fish detected in winter and spring there were not enough detections (15) to determine the survival rates to Lower Granite Dam. The overall parr-to-smolt estimated survival rate for fish from these streams was 12.0 ± 1.4% (9.4-14.9%).

South Fork Salmon River—For Chinook salmon juveniles PIT tagged in the South Fork Salmon River and detected on the in-stream monitor located near Krassel Creek, overall survival to Lower Granite Dam was 29.0 ± 7.9% (14.8-44.2%). At the Krassel monitor, estimated survival to the dam was 29.9 ± 10.0% (12.3-52.5%) for fish detected in late summer/fall, 18.7 ± 12.6% (0.0-47.0%) for fish detected in winter, and 68.3 ± 41.3% (0.0-161.5%) for fish detected in spring. In 2011-2012, overall parr-to-smolt survival for fish from the South Fork Salmon was estimated at 12.3 ± 1.5% (9.3-15.4%; Table 5).

Relationship Between Length and Detection at Dams

For fish from all Idaho streams combined, average fork length at release was 63.4 mm (Table 1A; Appendix Table 1). Among these fish, the average fork length at release was significantly longer for fish detected the following spring at dams than for fish not detected at the dams (64.9 vs. 63.1 mm; $P < 0.01$). Fish that were larger at release also tended to pass Lower Granite Dam earlier than their smaller cohorts ($P < 0.001$; Figure 8).

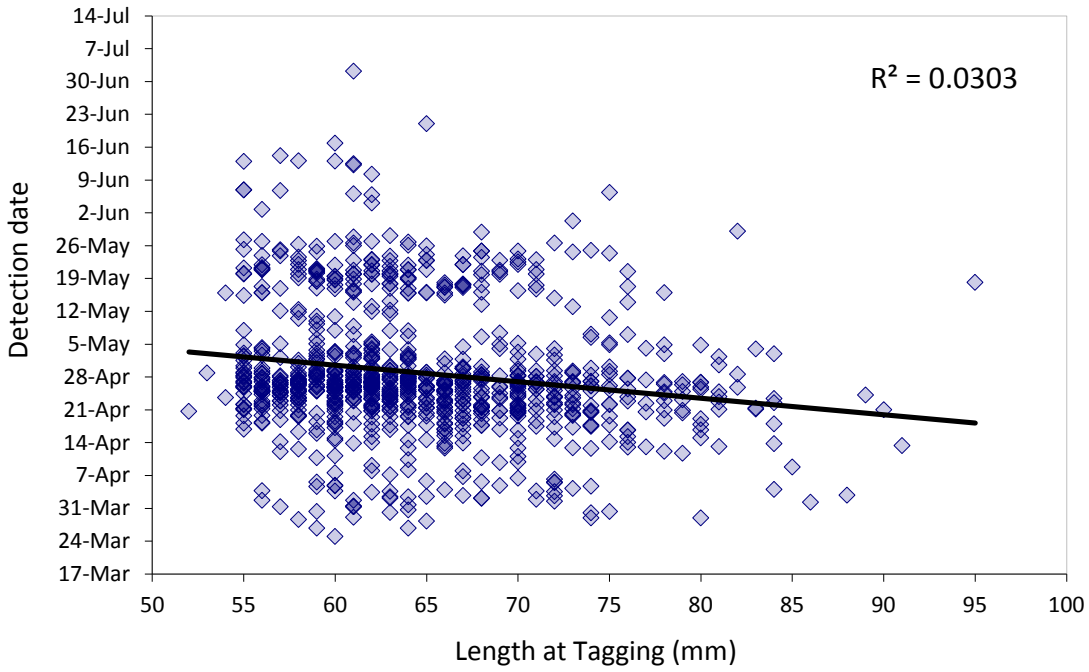


Figure 8. Relationship between fork length of wild Chinook salmon parr from Idaho at tagging (in 2011) to detection date at Lower Granite Dam in 2012 (n = 2,077).

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 smallest length bin (59 mm or less), significantly less detected fish were observed than expected ($P < 0.0001$) and for the four largest length bins significantly more detected fish were observed than expected ($P < 0.02$ for all four; Figure 9). For the length bin 60-64, expected and observed detections were similar ($P = 0.3536$).

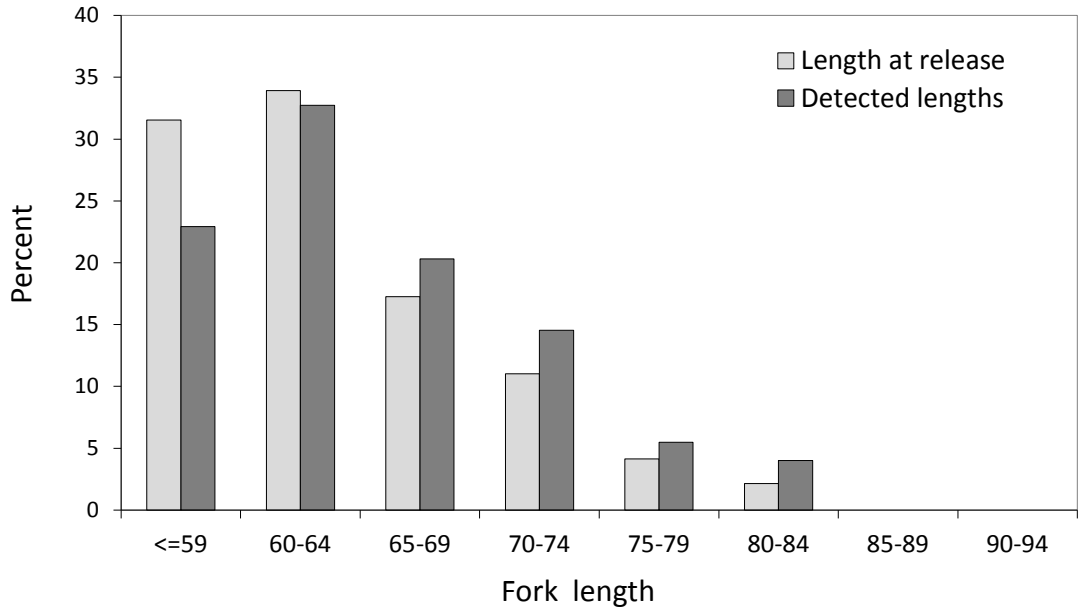


Figure 9. Percent by fork length increments (mm), of PIT-tagged wild spring/summer Chinook salmon parr released in Idaho streams in 2011 (n = 17,577) and percent of fish detected for these length increments at dams in spring and summer 2012 (n = 2,077).

In 2012, 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 4.7 mm larger at release than fish migrating after May. However, only 18 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 Idaho and Oregon stream populations (Figure 10). Comparisons among these 16 populations showed that the 10th percentile passage dates of fish from lower Big, Sulphur, and Loon Creeks was significantly later than that of fish from Valley Creek, Secesh and Imnaha Rivers (P <0.05; Appendix Table 4A-4B, Figure 10). Standard errors of these estimates ranged 0.7-6.0 d (median 1.64 d). Overall, the 10th percentile passage date for fish from all 16 stream populations ranged from 4 to 24 April (Appendix Tables 4A-4B).

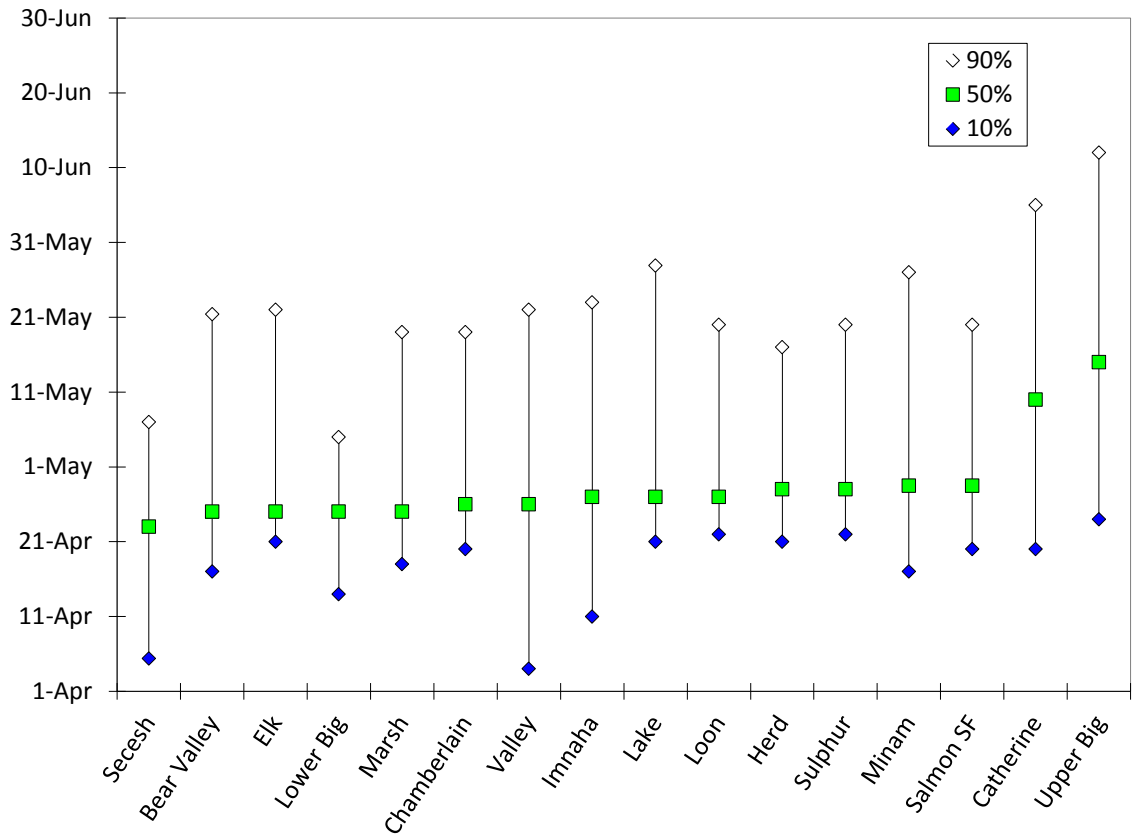


Figure 10. Estimated passage distribution at Lower Granite Dam in 2012 for wild spring/summer Chinook salmon smolts from streams of Idaho and Oregon. Big Creek is divided into lower and upper portions. Chamberlain and West Fork Chamberlain Creeks were combined for these analyses. See Appendix Tables 5-17 for daily estimated passage numbers from Idaho streams.

In comparisons of the 50th percentile passage date at Lower Granite Dam, fish from the Secesh River were significantly earlier than fish from all other streams (P <0.05). Fish from upper Big Creek were significantly later than fish from all other streams (P <0.05). Standard errors of these estimates ranged 0.2-3.8 d (median 0.70 d). The 50th percentile passage date for fish from all 16 stream populations ranged from 23 April to 15 May (Appendix Tables 4A-4B).

In terms of the 90th percentile passage date at the dam, fish from lower Big Creek and the Secesh River were significantly earlier than fish from all other streams (P <0.05). Fish from upper Big Creek were significantly later than fish from all other stream populations (P <0.05). Standard errors of these estimates ranged 0.5-20.1 d (median 2.42 d). The 90th percentile passage date for fish from all streams combined ranged from 5 May to 12 June (Appendix Tables 4A-4B).

In comparisons of the middle 80th percentile passage period (10th to 90th percentile), fish from Valley and upper Big Creeks displayed significantly more protracted timing at the dam than fish from all other stream populations (48-49 d vs. 21-32 d; P <0.05) with the exception of Minam and Imnaha River, and Bear Valley, Lake, and Catherine Creek (34-46 d). Standard errors of these estimates ranged from 1.6-20.6 d (median 3.65 d). Overall, the 80th percentile passage range for fish from all 16 streams was 21-49 d.

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 the Lostine, Minam, and upper Imnaha River (P <0.05). Also, upper Big Creek fish had significantly later migration timing at the dam than fish from all other streams except Camas, Catherine, and Loon Creek (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 passage 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 Lake, and Valley Creeks, and the South Fork of the Salmon River (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	11-16 April, 14 April (1)	24-29 April, 26 April (1)	23 May-4 June, 29 May (3)	23
South Fork Salmon River	16-23 April, 20 April (2)	6-12 May, 9 May (1)	31 May-8 June, 3 June (2)	21
Catherine Creek	23-29 April, 26 April (1)	11-19 May, 15 May (2)	29 May-9 June, 3 June (3)	22
Imnaha River (upper)	13-18 April, 16 April (1)	29 April-5 May, 2 May (1)	19-27 May, 23 May (2)	20
Bear Valley Creek	18-24 April, 21 April (1)	4-10 May, 7 May (1)	25 May-3 June, 30 May (2)	21
Big Creek (upper)	26 April-3 May, 30 April (2)	13-22 May, 18 May (2)	29 May-13 June, 5 June (4)	18
Elk Creek	17-24 April, 20 April (2)	1-8 May, 5 May (1)	23 May-1 June, 28 May (2)	20
Valley Creek	21-28 April, 24 April (2)	8-16 May, 12 May (2)	29 May-8 June, 3 June (2)	21
Marsh Creek	17-23 April, 20 April (1)	1-8 May, 4 May (2)	19-26 May, 23 May (2)	18
Lake Creek	13-19 April, 16 April (2)	27 April-4 May, 1 May (2)	23 May-5 June, 30 May (3)	19
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)	1-13 May, 7 May (3)	20 May-31 May, 26 May (3)	14
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)	16-21 April, 19 April (1)	26 April-1 May, 29 April (1)	8-14 May, 11 May (1)	16
Loon Creek	23 April-30 April, 27 April (2)	4-13 May, 8 May (2)	17-25 May , 21 May (2)	14
Herd Creek	17-24 April, 21 April (2)	28 April-5 May, 1 May (2)	12-19 May, 15 May (1)	14
Chamb/WF Chamberlain Cr	17-24 April, 21 April (2)	29 April-7 May, 3 May (2)	16 May-6 June, 26 May (5)	14
Camas Creek	24-30 April, 27 April (1)	8-16 May, 12 May (2)	22-28 May, 25 May (2)	13
Minam River	14-20 April, 17 April (2)	2-9 May, 5 May (2)	20-27 May, 24 May (2)	14

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 11 and Appendix Table 18). Overall, passage at the dam during 2012 occurred between late March and early July, with the middle 80th percentile passage occurring from 16 April to 21 May (Table 7). The peak passage date occurred during high flows of 167.5 kcfs on 25 April (Appendix Table 18).

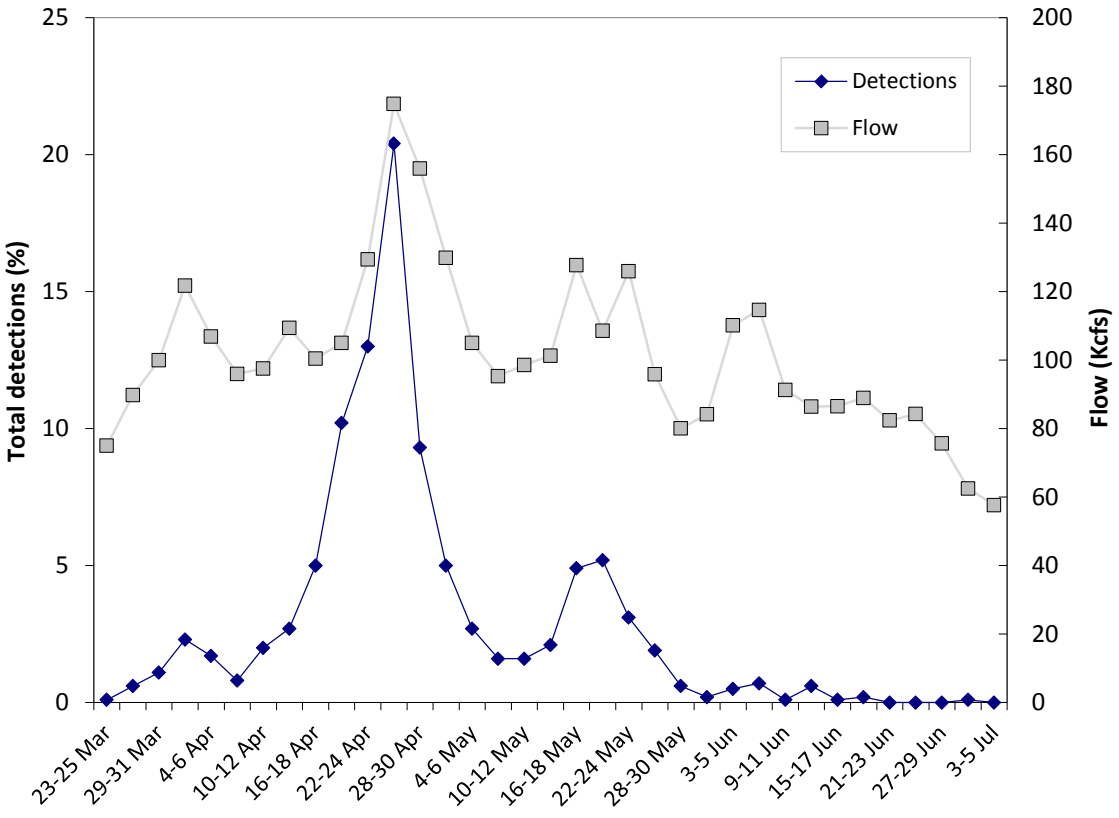


Figure 11. Overall migration timing of PIT-tagged wild spring/summer Chinook salmon smolts with associated river flows at Lower Granite Dam 2012. Daily detections from Idaho and Oregon streams were pooled in 3-d intervals and expanded based on daily detection probability. River flows at the dam were averaged daily over the same intervals.

Table 7. Annual passage dates at Lower Granite Dam from 1989 to 2012 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.

	Timing of passage percentiles at Lower Granite Dam			
Year	10th	50th	90th	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
2012	**16 April**	**26 April**	**21 May**	**25 March-02 July**

Environmental Information

Environmental water quality factors varied by month and between locations (Appendix Tables 25-40), as did the percentage of fish collected and/or detected at adjacent traps or in-stream 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 2011 were comparable to those in earlier years (Achord et al. 1992, 1994-1998, 2000-2012). Detection data from in-stream 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 2012. Based on detections of PIT tagged fish at Lower Granite Dam, the detection efficiency of Valley Creek monitors (VC1 and VC2) in 2011-2012 was 80.0% for fish with 12-mm tags and 38.0% for fish tagged with 9-mm tags.

The variation in detection efficiencies observed at the Valley Creek in-stream arrays is most likely due to the larger read range of the 12-mm vs. the 9-mm PIT tag. Detection rates at Lower Granite Dam were not significantly different between 12-mm vs. 9-mm PIT tagged fish overall ($P = 0.585$). Survival to Lower Granite Dam was also similar between fish with 12- and 9-mm tags, at 14.0 and 15.0%, respectively.

In every study year since 2008, we have had sufficient detection numbers to estimate survival from the Big Creek monitors to Lower Granite Dam. However, detection rates at these monitors ranged only 9.2-12.9% during 2008 to 2012. These low detection rates have resulted in extreme variability in 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 the Big Creek monitoring sites will be conducted by the ISEMP Project.

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

Prior to 2012, recapture of Idaho wild PIT-tagged migrants was conducted at Little Goose Dam (Achord et al. 1992, 1994, 1998, 2000, 2012). During 2012, fish were recaptured at Lower Granite Dam because of changes in Little Goose Dam operations. The juvenile bypass system was changed to “primary bypass” mode in April 2010, resulting in a large number (19-22%) of our early migrating wild fish that went undetected by the separation-by-code system during the 2010 and 2011 migration years.

From measurements taken at Lower Granite Dam, overall mean growth during the parr-to-smolt stage was 0.14 mm/d for our study fish during 2011-2012. This was comparable to the overall growth rates measured in previous years, which range 0.13-0.16 mm/d (Achord et al. 2002-2012). The overall mean weight gain of 0.029 g/d in 2011-2012 was also comparable to that measured in previous years.

Annual parr-to-smolt survival estimates for the combined Idaho and Oregon populations over the last 20 years have ranged 8.1-24.4%, with an overall average annual survival rate of 16.3% (Figure 12). The lowest parr-to-smolt survival rates were estimated in 2004 and 2005 (8.1 and 8.4%, respectively). These low estimates may have resulted from stream conditions with much higher parr density during these same years (Figure 13). 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%).

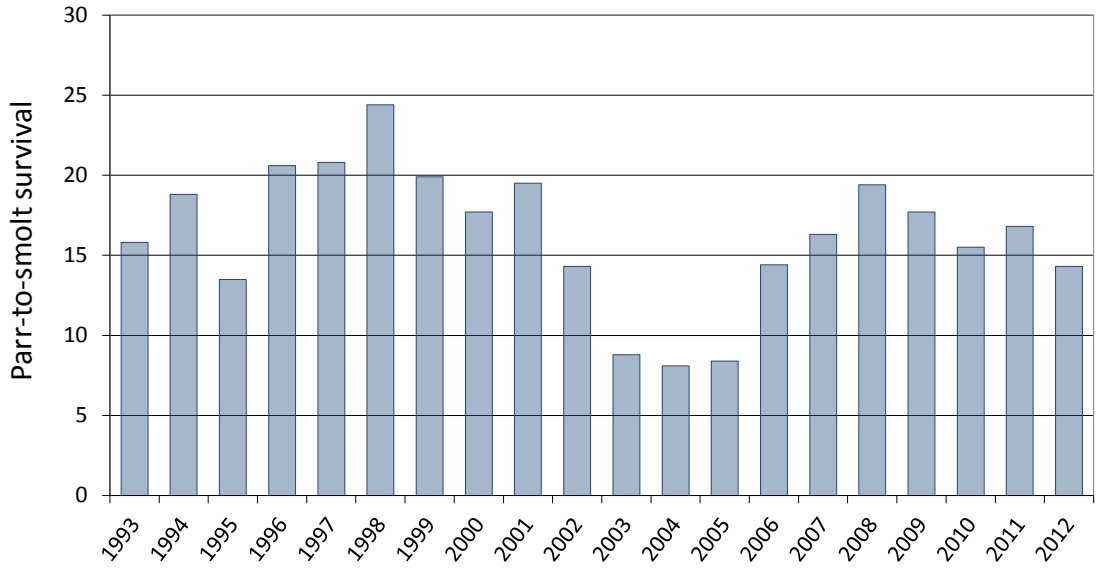


Figure 12. Overall estimated rates of parr-to-smolt survival to Lower Granite Dam for wild spring/summer Chinook salmon from Idaho and Oregon streams from 1993 to 2012. Overall average standard error ± 0.7% (yearly range 0.2-1.8%).

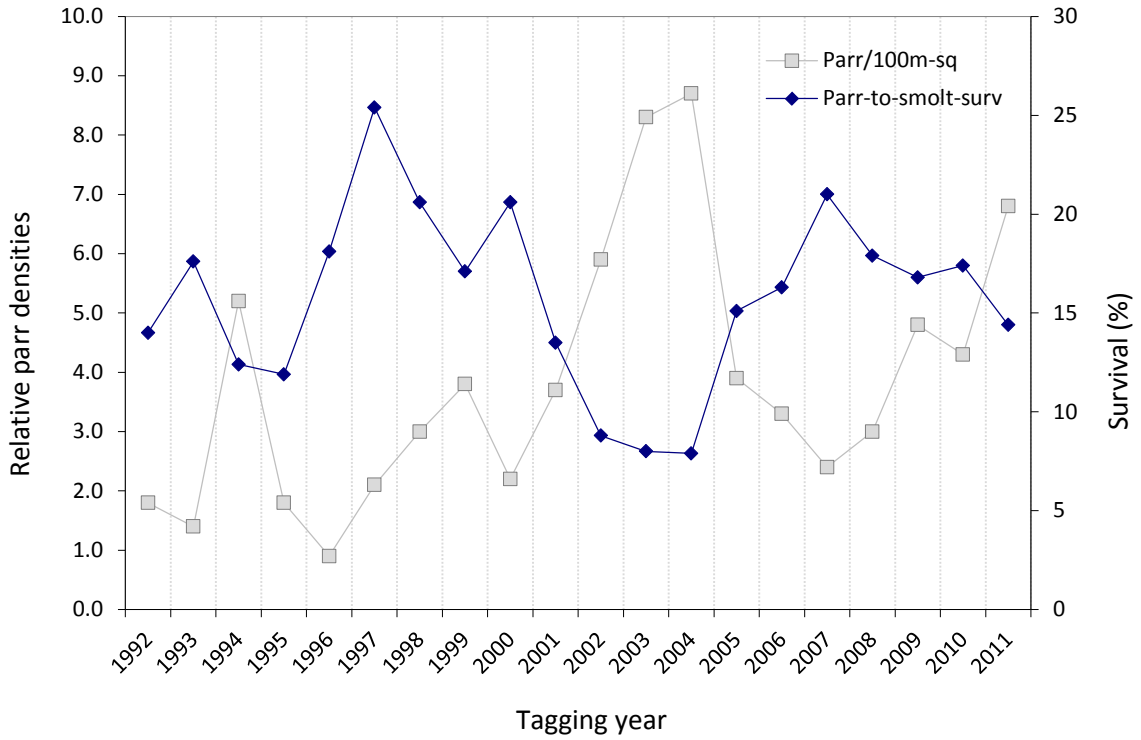


Figure 13. Annual average relative Chinook salmon parr densities (per 100 m^2) in areas sampled in all Idaho streams from 1992 to 2011 plotted against subsequent annual smolt survival estimate to Lower Granite Dam the following year.

In 2012, 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 in-stream monitors at Valley Creek over the last 8 years have shown no biologically meaningful relationship between length at tagging and migration timing (Achord et. al. 2006-2012; Figure 3A and 3B). Variable relationships between length at tagging and migration timing have been observed in data from the lower Big Creek monitors since 2008, and in data from the lower Secesh River monitors in 2010-2011 and 2011-2012. These data also have shown no biologically meaningful relationship between size and timing (Achord et. al. 2010-2012; Figures 4B and 7B,). The mixed results over these years show that 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 tagged fish probably initiate smoltification earlier in spring than their smaller tagged cohorts; thus they begin moving downstream sooner and arrive at Lower Granite Dam earlier.

In spring 2012, we observed that for populations from the combined streams overall, the 50th and 90th passage percentiles occurred in late April and late May, respectively at Lower Granite Dam.

In 2012, moderate-to-high flows occurred early in the migration period. In early spring, prevailing weather conditions were wetter than normal, contributing to flows in the Snake River basin that were much higher than average. 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 in-stream 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.

Acknowledgements

We thank the Bonneville Power Administration for funding this project. Thanks to Nathan Dumdei, Louis Tullos, Richard Nelson, Bill Muir, Randy Absolon, Ron Marr, Gabriel Brooks, Neala Kendall, Scott Davidson, and Richard Ledgerwood for their excellent assistance in collecting and PIT tagging fish for this study. Also, thanks to personnel from the Idaho Department of Fish and Game and the Nez Perce Tribe for providing data from trapping operations in natal rearing areas. Also, thanks to Chris Jordan and the ISEMP personnel for continuing to develop and maintain the in-stream PIT arrays located throughout the study area.

References

Achord, S., G. A. Axel, E. E. Hockersmith, B. P. Sandford, M. B. Eppard, and G. M. Matthews. 2001a. Monitoring the migrations of wild Snake River spring/summer Chinook salmon smolts, 1999. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., G. A. Axel, E. E. Hockersmith, B. P. Sandford, M. B. Eppard, and G. M. Matthews. 2001b. Monitoring the migrations of wild Snake River spring/summer Chinook salmon smolts, 2000. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., G. A. Axel, E. E. Hockersmith, B. P. Sandford, M. B. Eppard, and G. M. Matthews. 2002. Monitoring the migrations of wild Snake River spring/summer Chinook salmon smolts, 2001. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., M. B. Eppard, E. E. Hockersmith, B. P. Sandford, G. A. Axel, and G. M. Matthews. 2000. Monitoring the migrations of wild Snake River spring/summer Chinook salmon smolts, 1998. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., M. B. Eppard, E. E. Hockersmith, B. P. Sandford, and G. M. Matthews. 1997. Monitoring the migrations of wild Snake River spring/summer Chinook salmon smolts, 1996. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., M. B. Eppard, E. E. Hockersmith, B. P. Sandford, and G. M. Matthews. 1998. Monitoring the migrations of wild Snake River spring/summer Chinook salmon smolts, 1997. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., M. B. Eppard, B. P. Sandford, and G. M. Matthews. 1996a. Monitoring the migrations of wild Snake River spring/summer Chinook salmon smolts, 1995. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., J. R. Harmon, D. M. Marsh, B. P. Sandford, K. W. McIntyre, K. L. Thomas, N. N. Paasch, and G. M. Matthews. 1992. Research related to transportation of juvenile salmonids on the Columbia and Snake Rivers, 1991. Report to U.S. Army Corps of Engineers, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., E. E. Hockersmith, B. P. Sandford, R. A. McNatt, B. E. Feist, and G. M. Matthews. 2003. Monitoring the migrations of wild Snake River spring/summer Chinook salmon smolts, 2002. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., J. M. Hodge, B. P. Sandford, E. E. Hockersmith, K. W. McIntyre, N. N. Paasch, and J. G. Williams. 2005. Monitoring the migrations of wild Snake River spring/summer Chinook salmon smolts, 2004. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., D. J. Kamikawa, B. P. Sandford, and G. M. Matthews. 1995a. Monitoring the migrations of wild Snake River spring/summer Chinook salmon smolts, 1993. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., D. J. Kamikawa, B. P. Sandford, and G. M. Matthews. 1995b. Monitoring the migrations of wild Snake River spring/summer Chinook salmon smolts, 1994. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., G. M. Matthews, O. W. Johnson, and D. M. Marsh. 1996b. Use of Passive Integrated Transponder (PIT) tags to monitor migration timing of Snake River Chinook salmon smolts. North American Journal of Fisheries Management 16:302-313.

Achord, S., G. M. Matthews, D. M. Marsh, B. P. Sandford, and D. J. Kamikawa. 1994. Monitoring the migrations of wild Snake River spring and summer Chinook salmon smolts, 1992. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., R. A. McNatt, E. E. Hockersmith, B. P. Sandford, K. W. McIntyre, N. N. Paasch, J. G. Williams, and G. M. Matthews. 2004. Monitoring the migrations of wild Snake River spring/summer Chinook salmon smolts, 2003. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., B. P. Sandford, E. E. Hockersmith, J. M. Hodge, K. W. McIntyre, N. N. Paasch, L. G. Crozier, and J. G. Williams. 2006. Monitoring the migrations of wild Snake River spring/summer Chinook salmon juveniles, 2004-2005. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., B. P. Sandford, E. E. Hockersmith, J. J. Lamb, K. W. McIntyre, N. N. Paasch, and R. W. Zabel. 2012. Monitoring the migrations of wild Snake River spring/summer Chinook salmon juveniles, 2010-2011. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., B. P. Sandford, E. E. Hockersmith, K. W. McIntyre, N. N. Paasch, and J. G. Williams. 2007a. Monitoring the migrations of wild Snake River spring/summer Chinook salmon juveniles, 2005-2006. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/publications/ index.cfm.

Achord, S., B. P. Sandford, E. E. Hockersmith, M. G. Nesbit, N. D. Dumdei, J. J. Lamb, K. W. McIntyre, N. N. Paasch, and J. G. Williams. 2008. Monitoring the migrations of wild Snake River spring/summer Chinook salmon juveniles, 2006-2007. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., B. P. Sandford, E. E. Hockersmith, M. G. Nesbit, N. D. Dumdei, J. J. Lamb, K. W. McIntyre, N. N. Paasch, and J. G. Williams. 2009. Monitoring the migrations of wild Snake River spring/summer Chinook salmon juveniles, 2007-2008. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., B. P. Sandford, E. E. Hockersmith, M. G. Nesbit, N. D. Dumdei, J. J. Lamb, K. W. McIntyre, N. N. Paasch, and J. G. Williams. 2010. Monitoring the migrations of wild Snake River spring/summer Chinook salmon juveniles, 2008-2009. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., B. P. Sandford, E. E. Hockersmith, M. G. Nesbit, N. D. Dumdei, J. J. Lamb, K. W. McIntyre, N. N. Paasch, S. G. Smith, and R. W. Zabel. 2011. Monitoring the migrations of wild Snake River spring/summer Chinook salmon juveniles, 2009-2010. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Achord, S., R. W. Zabel, and B. P. Sandford. 2007b. Migration timing, growth, and estimated parr-to-smolt survival rates of wild Snake River spring/summer Chinook salmon from the Salmon River basin, Idaho, to the lower Snake River. Transactions of the American Fisheries Society 136:142-154.

Connolly, P. J., I. G. Jezorek, and K. D. Martens. 2008. Measuring the performance of two stationary interrogation systems for detecting downstream and upstream movement of PIT-tagged salmonids. North American Journal of Fisheries Management 28:402-417.

Cormack, R. M. 1964. Estimates of survival from the sightings of marked animals. Bometrika 51:429-438.

Downing, S. L., E. F. Prentice, B. W. Peterson, E. P. Nunnallee, and B. F. Jonasson. 2001. Development and evaluation of passive integrated transponder tag technology, annual report: 1999 to 2000. Report to the Bonneville Power Administration, Portland, OR. Available www.nwfsc.noaa.gov/ publications/index.cfm.

Efron, B., and R. J. Tibshirani. 1993. An introduction to the bootstrap. Chapman and Hall, Norwell, MA, 436 p.

Jolly, G. M. 1965. Explicit estimates from capture-recapture data with both death and immigration—stochastic model. Biometrika 52:225-247.

Lady, J. M., P. Westhagen, and J. R. Skalski. 2003. USER 2.1 User Specified Estimation Routine. Columbia Basin Research, University of Washington, Seattle, WA. Available at www.cbr.washington.edu/paramest/user/ UserManual/UserManual.pdf. (January 2008).

Ledgerwood, R. D., B. A. Ryan, E. M. Dawley, E. P. Nunnallee, and J. W. Ferguson. 2004. A Surface Trawl to Detect Migrating Juvenile Salmonids Tagged with Passive Integrated Transponder tags. North American Journal of Fisheries Management 24:440-451.

Matthews, G. M., N. N. Paasch, S. Achord, K. W. McIntyre, and J. R. Harmon. 1997. A technique to minimize the adverse effects associated with handling and marking salmonid smolts. The Progressive Fish-Culturist 59:307-309.

Matthews, G. M., J. R. Harmon, S. Achord, O. W. Johnson, and L. A. Kubin. 1990. Evaluation of transportation of juvenile salmonids and related research on the Snake and Columbia Rivers, 1989. Report to the U.S. Army Corp of Engineers. Available www.nwfsc.noaa.gov/ publications/index.cfm.

NWFSC (Northwest Fisheries Science Center). 2007. The baseline water quality environmental monitoring program. Online database available at https://www.webapps.nwfsc.noaa.gov/WaterQuality/ (March 2011).

Petersen, R. G. 1985. Design and analysis of experiments. Marcel Dekker, New York, 429 p.

Prentice, E. F., T. A. Flagg, and C. S. McCutcheon. 1990. PIT-tag monitoring systems for hydroelectric dams and fish hatcheries. American Fisheries Society Symposium 7:323-334.

PSMFC (Pacific States Marine Fisheries Commission). 1996. The Columbia Basin PIT Tag Information System. Online interactive database available at www.ptagis.org (March 2012).

Sandford, B. P., and S. G. Smith. 2002. Estimation of smolt-to-adult return percentages for Snake River Basin anadromous salmonids, 1990-1997. Journal of Agricultural, Biological, and Environmental Statistics 7(2):243-263.

Schaefer, M. B. 1951. Estimation of the size of animal populations by marking experiments. U.S. Fish and Wildlife Service Fishery Bulletin 52:191-203.

Seber, G. A. F. 1965. A note on the multiple recapture census. Biometrika 52:249-259.

Appendix: Data Tables and Figures

Appendix Table 1A. 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, 2011.Some length-weight data includes recaptured tagged fish.

				Collection				Tagging and release			
	Fish (N)			Length (mm)		Weight (g)		Length (mm)		Weight (g)	
	Collected	Tagged	Released	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Bear Valley Creek	1,573	1,001	1,000	42-122	57.7	0.9-25.9	2.7	55-78	59.6	1.7-7.0	2.9
Elk Creek	1,145	1,001	999	49-124	61.3	1.3-27	3.1	55-81	61.9	1.7-6.8	3.1
WF Chamberlain Cr	2,164	995	993	40-97	57.8	1.7-8.6	2.9	55-91	62.0	1.7-6.6	2.9
Valley Creek	5,039	3,747	3,732	40-143	60.3	1.1-43.6	3.6	51-93	62.8	1.4-12.2	3.3
Chamberlain Creek	944	544	543	42-104	57.5	1.6-13.4	3.1	55-96	61.4	1.6-10.6	3.0
Big Creek (upper)	2,094	1,466	1,466	40-124	60.5	0.9-26.3	4.0	54-90	63.0	1.9-10.4	3.6
Big Creek (lower)	1,643	1,551	1,551	49-108	71.5	1.8-9	5.0	55-104	71.8	2.4-9.0	5.1
Loon Creek	1,172	1,001	1,001	43-81	61.7	1.1-7.8	3.6	52-81	62.8	1.9-7.8	3.8
Marsh Creek	1,854	1,000	1,000	39-103	57.0	1-16.4	2.9	54-84	60.6	1.9-7.9	3.1
Sulphur Creek	1,256	1,000	1,000	42-137	60.5	0.8-35.6	3.3	55-94	61.9	1.7-17.6	3.4
Lake Creek	1,161	502	501	40-116	55.2	1.5-17.2	3.6	51-97	61.5	1.9-13.8	3.4
SF Salmon River	1,618	1,523	1,516	47-140	65.1	1.1-36	3.9	55-91	65.7	2-9.8	4.0
Secesh River	2,149	1,293	1,292	40-114	58.1	1-16.8	3.3	55-105	62.6	1.7-12.5	3.3
Herd Creek	1,129	1,003	999	46-146	63.7	1.3-45.2	4.4	54-117	63.6	1.9-19.6	4.1
Total or mean	24,941	17,627	17,593	39-146	60.6	0.8-45.2	3.5	51-118	63.4	1.4-19.6	3.5

Appendix Table 1B. Summary of number tagged and released and minimum, maximum, and mean lengths and weights of wild Chinook salmon parr, collected and PIT tagged in selected Idaho streams, 2011. Table contains data from streams where fish were tagged with both 9-mm TX149011B(PL) and standard 12-mm TX1400SST(PL) PIT tags. See Appendix Table 1A and Table 1 for other stream-related information.

	Number of fish tagged and released		12 mm tags TX1400SST(PL)				9 mm tags TX149011B(PL)			
			Length		Weight		Length		Weight	
	12 mm	9 mm	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Valley Creek	1,856	1,876	51-91	62.8	1.4-9.4	3.3	52-93	62.8	1.6-12.2	3.3
Big Creek (upper)	710	756	55-90	63.3	2-10.4	3.7	54-87	62.7	1.9-8.4	3.6
Big Creek (lower)	776	775	55-100	72.2	2.5-8.3	5.2	55-104	71.5	2.4-9	5.0
Lake Creek	251	250	55-97	61.1	1.9-11.2	3.3	51-96	61.6	2-13.8	3.3
S Fork Salmon R	766	750	55-91	66.1	2-8.4	4.0	55-91	65.4	2-9.8	3.9
Secesh River	648	644	55-101	62.5	1.9-8.2	3.3	55-105	62.6	1.7-12.5	3.2
Total or mean	5,007	5,051	51-101	64.7	1.4-11.2	3.7	51-105	64.4	1.6-13.8	3.6

Appendix Table 2A. Summary of tagging and release data, including date, temperature, and time (PST). Method of capture is shown with distance (km) from the mouth of the stream to the release point. Number of tagged (non-recapture) released (in 2011), and number/percent of first-time detections (unadjusted) for each tag group at seven downstream dams and the PIT-tag trawl at the mouth of the Columbia River during 2012.

	Tagging			Capture	Release					Detected	
	Date	Time	Temp (°C)	method	Date	Time	Temp (°C)	rkm	N	N	(%)
Bear Valley Creek											
SA11200.BV1	7/19/11	---	11.0	SHOCK	7/19/11	09:45	12.0	09	533	40	7.5
SA11201.BV1	7/20/11	---	10.0	SHOCK	7/20/11	08:15	10.0	13	332	25	7.5
SA11201.BV2	7/20/11	---	10.0	SHOCK	7/21/11	04:50	10.0	13	135	8	5.9
Elk Creek											
SA11202.EC1	7/21/11	---	10.0	SHOCK	7/22/11	06:00	10.5	01	113	9	8.0
SA11202.EC2	7/21/11	---	10.0	SHOCK	7/21/11	12:00	12.5	01	699	86	12.3
SA11203.EC1	7/22/11	---	10.5	SHOCK	7/22/11	08:15	11.0	02	187	19	10.2
Marsh Creek											
SA11206.MC1	7/25/11	---	09.0	SHOCK	7/26/11	05:00	08.0	12	119	15	12.6
SA11206.MC2	7/25/11	---	09.0	SHOCK	7/25/11	10:00	12.5	13	544	63	11.6
SA11207.MC1	7/26/11	---	08.0	SHOCK	7/26/11	08:15	09.5	14	337	36	10.7
Sulphur Creek											
SA11210.SU1	7/29/11	---	08.5	SHOCK	7/30/11	05:10	08.0	08	103	7	6.8
SA11210.SU2	7/29/11	---	08.5	SHOCK	7/29/11	11:40	11.5	07	386	31	8.0
SA11211.SU1	7/30/11	---	08.0	SHOCK	7/30/11	10:40	10.0	09	511	61	11.9
Valley Creek											
SA11213.VC1	8/01/11	---	12.5	BSEINE	8/02/11	04:40	11.0	05	155	16	10.3
SA11213.VC2	8/01/11	---	12.5	SHOCK	8/02/11	04:40	11.0	05	121	21	17.4
SA11213.VC3	8/01/11	---	12.5	BSEINE	8/02/11	04:40	11.0	05	76	16	21.1
SA11213.VC4	8/01/11	---	12.5	SHOCK	8/02/11	04:40	11.0	05	78	11	14.1
SA11213.VC5	8/01/11	---	12.5	BSEINE	8/01/11	09:40	14.0	05	103	9	8.7
SA11213.VC6	8/01/11	---	12.5	SHOCK	8/01/11	09:40	14.0	05	73	14	19.2
SA11213.VC7	8/01/11	---	12.5	BSEINE	8/01/11	09:40	14.0	05	125	28	22.4
SA11213.VC8	8/01/11	---	12.5	SHOCK	8/01/11	09:40	14.0	05	129	16	12.4

Appendix Table 2A. Continued.

	Tagging			Capture	Release					Detected	
	Date	Time	Temp (°C)	method	Date	Time	Temp (°C)	rkm	N	N	(%)
Valley Creek											
SA11214.VC1	8/02/11	---	11.0	BSEINE	8/03/11	04:05	10.0	05	198	36	18.2
SA11214.VC2	8/02/11	---	11.0	SHOCK	8/03/11	04:05	10.0	05	200	27	13.5
SA11214.VC3	8/02/11	---	11.0	BSEINE	8/02/11	10:40	11.5	05	36	4	11.1
SA11214.VC4	8/02/11	---	11.0	SHOCK	8/02/11	10:40	11.5	05	83	10	12.0
SA11215.VC1	8/03/11	---	12.0	BSEINE	8/04/11	04:05	12.0	09	241	22	9.1
SA11215.VC2	8/03/11	---	12.0	SHOCK	8/04/11	04:05	12.0	09	252	13	5.2
SA11215.VC3	8/03/11	---	12.0	BSEINE	8/03/11	11:20	17.0	09	200	9	4.5
SA11215.VC4	8/03/11	---	12.0	SHOCK	8/03/11	11:20	17.0	09	210	22	10.5
SA11216.VC1	8/04/11	---	09.5	BSEINE	8/05/11	04:05	10.0	12	210	25	11.9
SA11216.VC2	8/04/11	---	09.5	SHOCK	8/05/11	04:05	10.0	12	216	24	11.1
SA11216.VC3	8/04/11	---	09.5	BSEINE	8/04/11	10:40	12.5	12	301	30	10.0
SA11216.VC4	8/04/11	---	09.5	SHOCK	8/04/11	10:40	12.5	12	144	21	14.6
SA11217.VC3	8/05/11	---	08.0	BSEINE	8/05/11	10:05	11.0	18	227	26	11.5
SA11217.VC4	8/05/11	---	08.0	SHOCK	8/05/11	10:05	11.0	18	354	50	14.1
Big Creek (upper)											
SA11227.BC1	8/15/11	---	07.0	SHOCK	8/16/11	05:45	07.0	60	124	12	9.7
SA11227.BC2	8/15/11	---	07.0	SHOCK	8/15/11	12:30	11.0	58	761	73	9.6
SA11228.BC1	8/16/11	---	07.0	SHOCK	8/16/11	11:30	11.0	60	581	46	7.9
Big Creek (lower)											
SA11243.LB1	8/31/11	---	13.0	SHOCK	9/01/11	10:00	13.0	10	208	36	17.3
SA11244.LB1	9/01/11	---	11.5	SHOCK	9/01/11	11:40	14.0	10	973	193	19.8
SA11245.LB1	9/02/11	---	10.0	SHOCK	9/02/11	08:10	10.0	11	370	81	21.9
Loon Creek											
SA11223.LN1	8/11/11	---	07.2	SHOCK	8/12/11	05:00	07.5	29	119	21	17.6
SA11223.LN2	8/11/11	---	08.0	SHOCK	8/11/11	11:45	13.0	30	553	116	21.0
SA11224.LN1	8/12/11	---	07.5	SHOCK	8/12/11	08:40	08.5	31	329	79	24.0

Appendix Table 2A. Continued.

	Tagging			Capture	Release				Detected		
	Date	Time	Temp (°C)	Method	Date	Time	Temp (°C)	km	N	N	(%)
Herd Creek											
SA11220.HC1	8/08/11	---	08.0	SHOCK	8/09/11	06:20	09.0	01	122	11	9.0
SA11220.HC2	8/08/11	---	08.0	SHOCK	8/08/11	10:00	11.5	03	567	71	12.5
SA11221.HC1	8/09/11	---	09.0	SHOCK	8/09/11	08:40	10.2	03	310	42	13.5
S Fork Salmon R											
SA11230.SF1	8/18/11	---	09.0	SHOCK	8/19/11	05:45	09.0	117	119	16	13.4
SA11230.SF2	8/18/11	---	09.0	SHOCK	8/18/11	11:00	11.0	117	813	81	10.0
SA11231.SF1	8/19/11	---	09.0	SHOCK	8/19/11	08:45	09.0	118	584	59	10.1
WF Chamberlain Cr											
SA11235.WC1	8/23/11	---	08.0	BSEINE	8/23/11	11:30	12.0	02	993	91	9.2
Chamberlain Cr											
SA11236.CB1	8/24/11	---	09.0	SHOCK	8/25/11	05:05	11.0	27	110	8	7.3
SA11236.CB2	8/24/11	---	09.0	SHOCK	8/24/11	09:30	11.0	26	433	26	6.0
Secesh River											
SA11238.SE1	8/26/11	---	11.0	SHOCK	8/27/11	06:00	11.0	26	99	9	9.1
SA11238.SE2	8/26/11	---	11.0	SHOCK	8/26/11	12:00	15.0	26	417	43	10.3
SA11239.SE1	8/27/11	---	11.0	SHOCK	8/27/11	12:15	15.0	27	776	90	11.6
Lake Creek											
SA11240.LC1	8/28/11	---	09.0	SHOCK	8/28/11	12:10	13.0	02	501	28	5.6

Appendix Table 2B. Universal Transverse Mercator grid coordinates for each sampling area at the start and end of daily collections for each crew in 2011.

Stream and dates	Section covered	UTM start		UTM end	
		Northing	Easting	Northing	Easting
Bear Valley Cr					
7/19/2011	right bank	4920610	11T633161	4920744	11T633062
7/19/2011	left bank	4920744	11T633161	4920717	11T629630
7/20/2011	left bank	4919097	11T630248	4918942	11T629989
7/20/2011	right bank	4919114	11T630215	4919009	11T629749
Elk Creek					
7/21/2011	right bank	4918811	11T629159	4918678	11T628879
7/21/2011	left bank	4918811	11T629490	4918644	11T629431
7/22/2011	right bank	4919298	11T628176	4919412	11T627997
7/22/2011	left bank	4919309	11T628175	4919319	11T628006
Marsh Creek					
7/25/2011	right bank	4917097	11T646304	4916685	11T646520
7/25/2011	left bank	4917103	11T646291	4916616	11T646521
7/26/2011	left bank	4915900	11T647173	4915663	11T647376
7/26/2011	right bank	4915890	11T647139	4915646	11T647360
Sulphur Creek					
7/29/2011	both banks	----------	----------	4932749	11T630669
7/29/2011	both banks	4933105	11T631147	4932514	11T630375
7/30/2011	right bank	4932514	11T630375	4932484	11T629675
7/30/2011	left bank	4932514	11T630375	4932484	11T629675
Valley Creek					
8/1/2011	both banks	4899454	11T661381	4899651	11T661008
8/1/2011	entire stream	4899454	11T661381	----------	----------
8/2/2011	entire stream	4900781	11T659494	4901030	11T659545
8/2/2011	entire stream	4899780	11T660686	4899794	11T660571
8/2/2011	both banks	4900589	11T659666	4900781	11T659494
8/2/2011	both banks	4899780	11T660686	4899794	11T660571
8/3/2011	both banks	4901634	11T659408	4901634	11T659270
8/3/2011	entire stream	4901944	11T659257	4902471	11T659202
8/4/2011	entire stream	4903811	11T659049	4904428	11T658901
8/4/2011	both banks	4904142	11T658960	4904459	11T658952
8/4/2011	both banks	4903767	11T659024	4904473	11T658886
8/5/2011	entire stream	4906256	11T657493	4906481	11T657284
8/5/2011	both banks	4906311	11T657595	4906583	11T657056
8/5/2011	left bank	4906486	11T657411	4906532	11T657141
Big Creek-Upper					
8/15/2011	left bank	4997311	11T632253	4995556	11T631348
8/15/2011	right bank	4997199	11T632181	4995974	11T631349
8/16/2011	left bank	4995556	11T631348	4994735	11T631218
8/16/2011	right bank	4995541	11T631329	4994651	11T631154

Appendix Table 2B. Continued.

Stream and dates	Section covered	UTM start		UTM end	
		Northing	Easting	Northing	Easting
Big Creek-Lower					
8/31/2011	right bank	4996599	11T670820	4996575	11T670129
8/31/2011	left bank	4996469	11T670288	4996407	11T669751
9/1/2011	right bank	----------	----------	----------	----------
9/1/2011	left bank	4996407	11T669751	4996937	11T668916
9/2/2011	left bank	4996786	11T668508	4996769	11T668165
9/2/2011	right bank	4996829	11T668570	4996818	11T668166
Loon Creek					
8/11/2011	right bank	----------	----------	4941025	11T674063
8/11/2011	left bank	----------	----------	4941086	11T674082
8/12/2011	right bank	4941025	11T674063	4940375	11T673373
8/12/2011	left bank	4941009	11T674041	4940447	11T673525
Herd Creek					
8/8/2011	left bank	4892007	11T716277	4891708	11T716712
8/8/2011	right bank	4892096	11T716236	4891699	11T716710
8/9/2011	left bank	4891708	11T716712	4891424	11T716925
8/9/2011	right bank	4891708	11T716712	4891430	11T716862
SF Salmon R.					
8/18/2011	left bank	4944110	11T603599	4943829	11T603518
8/18/2011	right bank	4944116	11T603597	4943630	11T603583
8/19/2011	left bank	4943448	11T603630	4943166	11T603523
8/19/2011	right bank	4943418	11T603599	4943021	11T603446
WF Chamberlain Cr					
8/23/2011	entire stream	5027437	11T641009	5027625	11T641658
Chamberlain Cr					
8/24/2011	right bank	5026440	11T642322	5026062	11T642032
8/24/2011	left bank	5026431	11T642310	5026005	11T641940
Secesh River					
8/26/2011	left bank	5005770	11T592914	5007189	11T593506
8/26/2011	right bank	5005738	11T592867	5007216	11T593499
8/27/2011	left bank	----------	----------	5008441	11T593528
8/27/2011	right bank	----------	11T593470	5008413	11T593479
Lake Creek					
8/28/2011	right bank	5012370	11T586073	5013227	11T585575
8/28/2011	left bank	5012370	11T586073	5013047	11T585696

Appendix Table 3. Summary of observed total mortality for PIT-tagged wild Chinook salmon parr collected from Idaho streams from July to September 2011. 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 9 lost tags: 1 each from Elk Creek, S Fork Salmon River, W Fork Chamberlain Creek, Secesh River, Lake Creek, and Bear Valley Creek and 3 from Valley Creek.

					Observed mortality			
	Number of fish		Rejected		Collection and handling	Tagging delayed	Total	
Stream	Collected	Tagged	N	(%)			N	(%)
Bear Valley Creek	1,573	1,001	554 (4)	35.3	18	0	18	1.1
Elk Creek	1,145	1,001	120 (3)	10.6	24	1	25	2.2
Marsh Creek	1,854	1,000	834 (1)	45.0	20	0	20	1.1
Sulphur Creek	1.256	1,000	225 (5)	17.9	31	0	31	2.5
Valley Creek	5,039	3,747	1,234 (33)	24.5	58	12	70	1.4
Loon Creek	1,172	1,001	155 (0)	13.2	16	0	16	1.4
Herd Creek	1,129	1,003	114 (13)	9.8	12	4	16	1.4
Big Cr (upper)	2,094	1,466	582 (42)	27.8	46	0	46	2.2
Big Cr (lower)	1,643	1,551	59 (1)	3.6	33	0	33	2.0
WF Chamberlain Cr	2,164	995	1,167 (3)	53.9	2	1	3	0.1
Chamberlain Cr	944	544	400 (5)	42.4	0	1	1	0.1
SF Salmon R	1,618	1,523	90 (1)	5.6	5	6	11	0.7
Secesh River	2,149	1,293	836? (10)	38.9	20	0	20	0.9
Lake Creek	1,161	502	651 (10)	56.1	8	0	8	0.7
Totals or average	24,941	17,627	7,021 (131)	28.1	293	25	318	1.3

Appendix Table 4A. Accumulated and 2012 passage dates at Lower Granite Dam for PIT-tagged wild spring/summer Chinook salmon smolts from streams in Idaho.

	Percentile passage dates at Lower Granite Dam			
Year	10th	50th	90th	Range
Bear Valley Creek				
1990	19 April	05 May	31 May	11 April-18 July
1991	03 May	20 May	12 June	18 April-23 June
1992	15 April	02 May	24 May	07 April-28 June
1993	29 April	16 May	22 June	22 April-27 July
1994	22 April	06 May	29 May	16 April-15 July
1995	28 April	18 May	12 June	13 April-20 July
1996[a]1997[a]	---	---	---	---
1998	25 April	06 May	23 May	31 March-25 June
1999	23 April	03 May	07 June	20 April-21 June
2000	18 April	07 May	02 June	14 April-02 July
2001	08 May	16 May	28 May	26 April-17 June
2002	16 April	04 May	31 May	12 April-26 June
2003	14 April	05 May	28 May	12 April-14 June
2004	15 April	07 May	28 May	13 April-05 July
2005	20 April	05 May	23 May	20 April-10 June
2006	13 April	01 May	19 May	11 April-20 May
2007	18 April	03 May	13 May	08 April-24 May
2008	30 April	14 May	27 May	24 April-10 June
2009	22 April	01 May	27 May	18 April-16 June
2010	25 April	18 May	07 June	25 April-12 June
2011	17 April	09 May	30 May	04 April-09 June
2012	**17 April**	**25 April**	**21 May**	**29 March-10 June**
Elk Creek				
1991	03 May	20 May	16 June	25 April-24 June
1992	11 April	30 April	28 May	05 April-17 July
1993	02 May	16 May	11 June	21 April-26 June
1994	23 April	04 May	21 May	18 April-09 July
1995	18 April	11 May	05 June	10 April-09 July
1990[a] 1996[a] 1997[a]	---	---	---	---
1998	07 April	02 May	15 May	04 April-21 June
1999	21 April	03 May	27 May	01 April-08 July
2000	15 April	28 April	19 May	13 April-28 May
2001	30 April	11 May	27 May	30 April-27 May
2002	16 April	29 April	02 June	13 April-05 July
2003	20 April	06 May	29 May	31 March-30 May
2004	18 April	08 May	04 July	14 April-12 July
2005	27 April	11 May	29 May	18 April-12 June
2006	15 April	27 April	26 May	06 April-11 June
2007	16 April	02 May	14 May	14 April-31 May
2008	02 May	11 May	23 May	25 April-16 June
2009	25 April	30 April	18 May	19 April-07 June

Appendix Table 4A. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Elk Creek (Continued)				
2010	23 April	01 May	04 June	22 April-19 June
2011	13 April	04 May	27 May	05 April-21 June
2012	**21 April**	**25 April**	**22 May**	**01 April-12 June**
Sulphur Creek				
1990	18 April	30 April	31 May	11 April-27 June
1991a 1994[a]	---	---	---	---
1992	16 April	03 May	23 May	10 April-01 June
1993	28 April	16 May	12 June	24 April-28 June
1995	02 May	23 May	09 June	11 April-09 July
1996a -1999[a]	---	---	---	---
2000	15 April	07 May	24 May	12 April-30 May
2001[a] 2002[a] 2007[a]	---	---	---	---
2003	02 May	25 May	08 May	22 April-24 June
2004	10 April	25 April	11 May	02 April-24 May
2005	01 May	07 May	22 May	22 April-05 June
2006	11 April	28 April	17 May	11 April- 17 May
2008	03 May	12 May	02 June	27 April-04 June
2009	22 April	29 April	18 May	02 April-21 May
2010	26 April	06 May	23 May	25 April-06 June
2011	18 April	05 May	16 May	04 April-04 June
2012	**22 April**	**28 April**	**20 May**	**13 April-04 June**
Cape Horn Creek				
1990[a]1996-1998[a]	---	---	---	---
1991	24 April	16 May	28 May	19 April-06 June
1992	12 April	28 April	30 May	10 April-01 June
1993	08 May	19 May	26 June	05 May-01 July
1994a	---	---	---	---
1995	29 April	14 May	19 June	14 April-28 July
1999	29 April	22 May	29 May	25 April-12 June
2000	01 May	24 May	01 June	20 April-09 July
2001[a] 2002[a] 2009[a]	---	---	---	---
2003	21 April	17 May	01 June	15 April-18 June
2004	15 April	04 May	24 May	14 April-28 May
2005	29 April	09 May	24 May	11 April-29 May
2006	23 April	30 April	14 June	22 April-14 June
2007	13 April	06 May	19 May	09 April-20 May
2008	03 May	18 May	23 May	25 April-03 June
2010	28 April	08 May	26 May	27 April-20 June
2011[b]	---	---	---	---
2012[a]	---	---	---	---
Camas Creek				
1993	03 May	16 May	27 May	24 April-24 June
1994	30 April	15 May	26 May	24 April-11 July
1995	27 April	12 May	05 June	17 April-11 June

Appendix Table 4A. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Camas Creek (continued)				
1997-1999[a]	---	---	---	---
2000	26 April	25 May	02 June	13 April-24 June
2001- 2002, 1996[a]	---	---	---	---
2003	02 May	24 May	30 May	26 April-06 June
2004	18 April	08 May	24 May	16 April-04 June
2005	29 April	07 May	28 May	12 April-19 June
2006	20 April	30 April	17 May	20 April-03 June
2007	23 April	06 May	16 May	19 April-19 May
2008	05 May	14 May	21 May	27 April-31 May
2009	25 April	08 May	22 May	25 April-05 June
2010	25 April	08 May	26 May	24 April-07 June
2011	04 April	15 May	23 May	07 April-11 June
2012[a]	---	---	---	---
Marsh Creek				
1990	17 April	29 April	31 May	09 April-01 July
1991	26 April	20 May	09 June	17 April-18 June
1992	17 April	07 May	02 June	10 April-13 July
1993	29 April	15 May	27 May	24 April-10 August
1994	23 April	04 May	18 May	16 April-08 August
1995	17 April	09 May	24 May	11 April-08 July
1996-1998[a]	---	---	---	---
1999	21 April	01 May	25 May	11 April-13 June
2000	21 April	28 April	27 May	14 April-16 June
2001[a]	---	---	---	---
2002	18 April	04 May	23 May	14 April-26 May
2003	14 April	05 May	29 May	03 April-09 June
2004	16 April	28 April	10 May	03 April-30 May
2005	27 April	06 May	18 May	22 April-04 June
2006	12 April	30 April	18 May	11 April-03 June
2007[a]	---	---	---	---
2008	29 April	07 May	18 May	24 April-20 May
2009	23 April	30 April	18 May	20 April-22 May
2010	27 April	10 May	24 May	24 April-06 June
2011	10 April	09 May	16 May	04 April-08 June
2012	**18 April**	**25 April**	**19 May**	**01 April-26 May**
Valley Creek				
1989	24 April	14 May	12 June	09 April-17 June
1990	16 April	08 May	05 June	12 April-29 June
1991	11 May	20 May	20 June	21 April-13 July
1992	15 April	30 April	27 May	13 April-04 June
1993	30 April	16 May	02 June	24 April-06 June
1994	24 April	04 May	03 June	22 April-09 June
1995	04 May	02 June	08 July	22 April-18 July
1996, 1997, 1998[a]	---	---	---	---

Appendix Table 4A. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Valley Creek (Continued				
1999	24 April	13 May	12 June	19 April-01 July
2000	20 April	12 May	29 May	13 April-14 July
2001	10 May	19 May	01 June	28 April-03 July
2002	24 April	20 May	03 June	19 April-19 June
2003	14 April	17 May	28 May	01 April-31 May
2004	25 April	11 May	26 May	04 April-16 June
2005	27 April	15 May	08 June	23 April-20 June
2006	30 April	24 May	15 June	16 April-17 June
2007	20 April	03 May	20 May	13 April-24 May
2008	28 April	11 May	26 May	21 April-06 June
2009	24 April	04 May	04 June	10 April-18 June
2010	30 April	13 May	28 May	27 April-22 June
2011	27 April	14 May	02 June	06 April-16 June
2012	**4 April**	**26 April**	**22 May**	**25 March-16 June**
Loon Creek				
1993	05 May	12 May	17 May	03 May-5 June
1994	29 April	10 May	24 May	22 April-07 June
1995	23 April	11 May	28 May	13 April-07 June
1996[a]1997[a]1998[a]	---	---	---	---
1999	30 April	18 May	27 May	22 April-16 June
2000	22 April	08 May	24 May	14 April-01 June
2001[a]2002[a]2007[a]	---	---	---	---
2003	30 April	17 May	28 May	21 April-30 May
2004	23 April	05 May	15 May	15 April-26 May
2005	04 May	10 May	24 May	20 April-03 June
2006	20 April	02 May	19 May	10 April- 21 May
2008	07 May	17 May	26 May	28 April-29 May
2009	24 April	30 April	19 May	16 April-21 May
2010	27 April	11 May	25 May	23 April-04 June
2011	30 April	14 May	19 May	11 April-05 June
2012	**22 April**	**27 April**	**20 May**	**28 March-06 June**
East Fork Salmon River—discontinued-see previous reports				
Herd Creek				
1992	14 April	20 April	10 May	13 April-18 May
1993	26 April	30 April	18 May	26 April-31 May
1994[b]	---	---	---	---
1995	18 April	03 May	14 May	11 April-28 May
1996[a]1997[a] 1998[a]	---	---	---	---
1999	20 April	29 April	10 May	30 March-20 May
2000	16 April	25 April	18 May	14 April-19 May
2001	30 April	04 May	14 May	28 April-07 June
2002[b]	---	---	---	---
2003	16 April	03 May	26 May	06 April-29 May
2004	16 April	30 April	10 May	12 April-21 June

Appendix Table 4A. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Herd Creek (Continued)				
2005	27 April	07 May	22 May	20 April-13 June
2006	16 April	25 April	06 May	10 April-16 May
2007[b]	---	---	---	---
2008	29 April	10 May	19 May	24 April-23 May
2009[a]	---	---	---	---
2010	29 April	08 May	24 May	25 April-06 June
2011	14 April	12 May	18 May	05 April-31 May
2012	**21 April**	**28 April**	**17 May**	**31 March-21 May**
South Fork Salmon River				
1989	25 April	13 May	14 June	16 April-20 June
1990[a]	---	---	---	---
1991	20 April	16 May	10 June	17 April-13 July
1992	14 April	29 April	27 May	07 April-27 July
1993	29 April	16 May	02 June	26 April-28 June
1994	27 April	15 May	28 June	22 April-09 July
1995	20 April	10 May	10 June	13 April-13 July
1996	19 April	15 May	09 June	19 April-03 July
1997	13 April	28 April	12 June	07 April-15 June
1998	25 April	12 May	15 June	02 April-07 August
1999	31 March	04 May	01 June	27 March-11 June
2000	20 April	18 May	31 May	12 April-20 July
2001	29 April	14 May	01 June	26 April-07 July
2002	15 April	03 May	24 May	11 April-09 June
2003	19 April	16 May	03 June	19 April-12 June
2004	16 April	10 May	02 June	08 April-19 June
2005	28 April	12 May	30 May	22 April-19 June
2006	28 April	11 May	16 June	27 April-18 June
2007[a]2008[a]	---	---	---	---
2009	24 April	03 May	26 May	02 April-30 May
2010	25 April	05 May	20 May	23 April-05 June
2011	07 April	04 May	22 May	03 April-05 June
2012	**20 April**	**28 April**	**20 May**	**07 April-06 June**
Big Creek (upper)				
1990	27 April	30 May	22 June	17 April-18 July
1991	18 May	10 June	26 June	26 April-01 July
1992	22 April	08 May	03 June	15 April-26 June
1993	08 May	18 May	26 May	26 April-15 June
1994	03 May	19 May	19 July	25 April-30 August
1995	05 May	23 May	09 June	02 May-26 June
1996[a] 1997[a]1998[a]	---	---	---	---
1999	28 April	14 May	03 June	25 April-19 June
2000	30 April	27 May	14 June	15 April-29 June
2001[a] 2002[a]	---	---	---	---
2003	06 May	25 May	01 June	01 May-21 June
2004	18 April	12 May	05 June	15 April-17 June

Appendix Table 4A. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Big Creek (upper) Continued				
2005	27 April	07 May	23 May	20 April-07 June
2006	26 April	08 May	25 May	19 April-10 June
2007	19 April	06 May	20 May	15 April-18 June
2008	06 May	20 May	23 May	25 April-05 June
2009	26 April	19 May	28 May	22 April-07 June
2010	01 May	20 May	05 June	25 April-13 June
2011	07 May	16 May	24 May	25 April-01 June
2012	**24 April**	**15 May**	**12 Jun**	**06 April-20 June**
Big Creek (lower)/Rush Creeks				
1993	24 April	29 April	13 May	21 April-16 May
1994	23 April	29 April	11 May	21 April-15 June
1995	19 April	01 May	14 May	11 April-05 June
1996[a]	---	---	---	---
1997[a]	---	---	---	---
1998[a]	---	---	---	---
1999	19 April	28 April	23 May	04 April-30 May
2000	19 April	30 April	13 May	16 April-26 May
2001[a]	---	---	---	---
2002	15 April	25 April	07 May	12 April-22 May
2003	14 April	26 April	18 May	12 April-25 May
2004	15 April	23 April	04 May	06 April-15 May
2005[d]	22 April	02 May	09 May	06 April-15 May
2006[d]	11 April	22 April	03 May	10 April-22 May
2007[d]	18 April	27 April	06 May	06 April-12 May
2008[d]	29 April	12 May	20 May	23 April-20 May
2009[d]	24 April	28 April	07 May	03 April-21 May
2010[d]	24 April	29 April	06 May	22 April-05 June
2011[d]	09 April	02 May	14 May	06 April-21 May
2012[d]	**14 April**	**25 April**	**5 May**	**02 April-22 May**
West Fork Chamberlain Creek				
1992[c]	15 April	26 April	03 June	12 April-24 June
1993	28 April	15 May	23 June	23 April-22 July
1994[c]	24 April	01 May	05 July	24 April-04 September
1995[c]	16 April	09 May	20 June	12 April-22 September
1996[a]-1997[a]	---	---	---	---
1998[a]	---	---	---	---
1999[a]2000[a]2001[a]	---	---	---	---
2002	26 April	04 May	20 May	18 April-29 May
2003[c]	23 April	20 May	26 May	21 April-26 May
2004[c]	11 April	24 April	10 May	07 April-23 June
2005[c]	26 April	03 May	13 May	20 April-30 May
2006	15 April	01 May	08 May	14 April-19 May
2007[c]	17 April	02 May	11 May	17 April-24 May
2008[a]	---	---	---	---

Appendix Table 4A. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
West Fork Chamberlain Creek (Continued)				
2009[c]	24 April	29 April	18 May	13 April-25 June
2010[c]	24 April	30 April	21 May	23 April-08 July
2011[c]	22 April	09 May	27 May	03 April-27 June
2012[c]	**20 April**	**26 April**	**19 May**	**01 April-26 May**
Secesh River				
1989	20 April	27 April	09 June	09 April-19 July
1990	14 April	22 April	07 June	10 April-13 July
1991	20 April	27 April	14 June	13 April-20 July
1992	13 April	29 April	04 June	05 April-03 July
1993	26 April	16 May	16 June	22 April-15 July
1994	22 April	26 April	11 July	21 April-07 August
1995	14 April	01 May	24 May	10 April-10 July
1996	14 April	25 April	29 May	12 April-15 July
1997	10 April	18 April	04 May	04 April-11 July
1998	08 April	24 April	28 May	03 April-06 July
1999	03 April	23 April	25 May	29 March-21 June
2000	13 April	23 April	04 June	12 April-11 July
2001	16 April	28 April	13 May	06 April-13 June
2002	13 April	21 April	17 May	11 April-01 July
2003	18 April	30 April	01 June	03 April-04 July
2004	04 April	27 April	28 May	01 April-13 June
2005	23 April	03 May	26 May	04 April-19 June
2006	13 April	24 April	23 May	08 April-08 June
2007	09 April	22 April	16 May	05 April-23 May
2008[a]	---	---	---	---
2009	19 April	28 April	17 May	11 April-02 June
2010	20 April	28 April	06 June	20 April-22 June
2011	07 April	01 May	07 June	03 April-27 June
2012	**5 April**	**23 April**	**7 May**	**02 April-26 May**
Lake Creek				
1989	23 April	02 May	16 June	12 April-01 July
1990[a]	---	---	---	---
1991[a]	---	---	---	---
1992[a]	---	---	---	---
1993	23 April	09 May	22 June	22 April-25 June
1995	17 April	10 May	10 June	14 April-20 July
1996	15 April	21 April	19 May	15 April-02 June
1997	11 April	25 April	02 July	07 April-22 September
1998	04 April	25 April	26 May	02 April-16 July
1999	20 April	26 April	27 May	08 April-20 June
2000	13 April	04 May	04 June	13 April-18 July
2001[a]	---	---	---	---
2002	16 April	29 April	03 June	13 April-03 June
2003	06 April	06 May	04 June	06 April-20 June

Appendix Table 4A. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Lake Creek (Continued)				
2004	14 April	25 April	28 May	09 April-16 June
2005	20 April	28 April	29 May	19 April-19 June
2006	17 April	28 April	19 May	17 April-19 May
2007	08 April	27 April	03 May	08 April-14 May
2008	30 April	07 May	23 May	25 April-24 May
2009	23 April	03 May	30 May	04 April-20 June
2010[b]	---	---	---	---
2011	12 April	11 May	16 May	10 April-12 June
2012	**21 April**	**27 April**	**27 May**	**09 April-02 July**

[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 2012 passage dates at Lower Granite Dam for PIT-tagged wild spring/summer Chinook salmon smolts from streams in Oregon.

	Percentile passage dates at Lower Granite Dam			
Year	10th	50th	90th	Range
Catherine Creek				
1991	01 May	14 May	08 June	17 April-23 June
1992	16 April	01 May	21 May	09 April-29 June
1993	06 May	18 May	05 June	29 April-26 June
1994	25 April	11 May	20 May	13 April-26 July
1995	01 May	19 May	09 June	26 April-02 July
1996 [a]	19 April	13 May	29 May	14 April-14 June
1997	08 May	14 May	01 June	24 April-10 June
1998	28 April	21 May	28 May	24 April-04 June
1999	26 April	25 May	15 June	26 April-26 June
2000	30 April	08 May	23 May	12 April-06 June
2001	29 April	17 May	17 June	28 April-03 July
2002	24 April	10 May	18 June	15 April-01 July
2003	26 April	10 May	09 June	14 April-09 June
2004	22 April	15 May	11 June	15 April-25 June
2005	20 April	12 May	23 May	14 April-02 June
2006	28 April	16 May	30 May	26 April-06 June
2007	19 April	29 April	17 May	19 April-19 May
2008	06 May	07 June	02 July	30 April-02 July
2009	24 April	13 May	21 May	12 April-13 June
2010	29 April	04 June	19 June	24 April-21 June
2011	02 May	09 May	08 June	14 April-25 June
2012	**20 April**	**10 May**	**5 June**	**11 April-20 June**
Grande Ronde River (upper)				
1989	12 May	06 June	19 June	27 April-22 July
1990 [b]	---	---	---	---
1991 [b]	---	---	---	---
1992 [b]	---	---	---	---
1993	05 May	16 May	25 May	23 April-20 June
1994	28 April	23 May	07 July	23 April-29 August
1995	27 April	29 May	12 June	12 April-01 July
1996 [c]	26 April	17 May	29 May	19 April-06 June
1997 [b]-**2012 [b]**	---	---	---	---
Imnaha River (lower)				
1989	11 April	30 April	11 May	04 April-05 June
1990	10 April	18 April	09 May	05 April-27 May
1991	20 April	01 May	13 May	14 April-15 May
1992	10 April	21 April	03 May	06 April-21 May
1993 [b] -**2012 [b]**	---	---	---	---
Imnaha River (upper)				
1993	24 April	14 May	28 May	15 April-23 June
1994	24 April	08 May	09 June	20 April-11 August
1995	13 April	02 May	03 June	10 April-07 July

Appendix Table 4B. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Imnaha River (upper) (continued)				
1996	16 April	26 April	18 May	14 April-12 June
1997	11 April	19 April	11 May	03 April-02 June
1998	11 April	28 April	13 May	03 April-24 May
1999	22 April	08 May	26 May	17 April-03 June
2000	14 April	02 May	24 May	12 April-16 June
2001	21 April	30 April	16 May	08 April-28 May
2002	16 April	04 May	17 May	15 April-31 May
2003	22 April	08 May	26 May	17 April-31 May
2004	19 April	04 May	22 May	18 April-8 June
2005	19 April	03 May	27 May	05 April-11 June
2006	12 April	29 April	15 May	03 April-04 June
2007	13 April	25 April	13 May	05 April-24 May
2008	17 April	06 May	22 May	14 April-01 June
2009	13 April	05 May	20 May	04 April-09 June
2010	24 April	10 May	09 June	23 April-24 June
2011	04 April	07 May	01 June	01 April-16 June
2012	**11 April**	**27 April**	**23 May**	**30 March-30 May**
Lostine River				
1990[d]	---	---	---	---
1991	29 April	14 May	26 May	20 April-09 July
1992	16 April	30 April	11 May	12 April-02 June
1993	23 April	03 May	17 May	17 April-01 June
1994	22 April	30 April	16 May	19 April-07 June
1995	12 April	02 May	17 May	08 April-09 June
1996	23 April	15 May	07 June	17 April-19 June
1997	17 April	28 April	16 May	09 April-21 May
1998[b]	---	---	---	---
1999	30 March	09 May	27 May	29 March-29 May
2000	13 April	08 May	25 May	13 April-03 June
2001	25 April	09 May	22 May	10 April-12 June
2002	11 April	21 April	13 May	28 March-29 May
2003	13 April	08 May	26 May	11 April-03 June
2004	15 April	04 May	05 June	14 April-15 June
2005	16 April	29 April	26 May	05 April-18 June
2006	14 April	26 April	16 May	05 April-09 June
2007	14 April	03 May	15 May	05 April-21 May
2008	22 April	11 May	29 May	10 April-14 June
2009	13 April	28 April	15 May	02 April-21 May
2010	27 April	14 May	06 June	24 April-17 June
2011	09 April	05 May	04 June	04 April-26 June
2012[b]	---	---	---	---

Appendix Table 4B. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Minam River				
1999	08 April	28 April	25 May	31 March-02 June
2000	15 April	03 May	22 May	10 April-29 May
2001	25 April	07 May	23 May	08 April-12 June
2002	17 April	03 May	20 May	16 April-31 May
2003	17 April	13 May	29 May	13 April-01 June
2004	15 April	28 April	28 May	08 April-31 May
2005	19 April	08 May	21 May	08 April-08 June
2006	13 April	08 May	20 May	11 April-06 June
2007	11 April	27 April	12 May	04 April-22 May
2008	23 April	08 May	21 May	17 April-11 June
2009	24 April	13 May	22 May	11 April-06 June
2010	25 April	15 May	05 June	23 April-16 June
2011	17 April	12 May	02 June	03 April-04 June
2012	**17 April**	**28 April**	**27 May**	**01 April-08 June**

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

Appendix Table 5. Detections during 2012 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,000 wild Chinook salmon from Bear Valley Creek released 19-21 July 2011. Release sites were 629-635 km above Lower Granite Dam.

	Bear Valley Creek							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
29 Mar	1	2						
07 Apr	1	2						
14 Apr	1	2						
16 Apr	1	2						
17 Apr	1	2						
18 Apr			1					
19 Apr	1	2						
21 Apr	1	2	1					
22 Apr	2	5						
23 Apr	1	3						
24 Apr	6	19	1	2				
25 Apr	2	7	1					
26 Apr	3	9	2	1				
27 Apr	1	3	5	1				
28 Apr	2	6	2		1			
29 Apr			4					
30 Apr			1			1	1	
01 May				2				
02 May			1					
03 May			2					
04 May	1	2	1					
07 May			1					
08 May			1					
18 May	1	3						
20 May	2	5	1					
21 May	1	2						
22 May	1	2	1	1				
23 May			1					
24 May				1				
25 May				1				
27 May						1		
05 June			1					
06 June			1					
10 June	1	7						
Totals	31	87	29	9	1	2	1	0

Appendix Table 6. Detections during 2012 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 999 wild Chinook salmon from Elk Creek released 21-22 July 2011. Release sites were 634-638 km above Lower Granite Dam.

	Elk Creek							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
01 Apr	1	2						
12 Apr	1	2						
13 Apr			1					
14 Apr	1	2						
15 Apr			1					
16 Apr	1	2						
17 Apr			1					
18 Apr			1					
19 Apr	1	2	1			1		
20 Apr	1	2	2					
21 Apr	5	11	2	1				
22 Apr	4	10						
23 Apr	2	6	1			1		
24 Apr	4	13	1					
25 Apr	8	28						
26 Apr	4	12	2	2				
27 Apr	3	9	5					
28 Apr	1	3	5			1	1	
29 Apr	2	6		2		1		
30 Apr			1			1		
01 May			4	3				
02 May	1	3	2					
03 May			1					
04 May	1	2					1	
06 May			1					
07 May	1	3	1				1	
09 May	1	3		1	1			
10 May			1					1
11 May	1	3		1				
15 May	1	3						
20 May	1	2						
21 May	2	4	1					
22 May	1	2						
24 May	1	2	1	1				
29 May			1					
31 May				1				
06 June	1	6						
12 June	1	6						
17 June							1	
20 June						1		
28 June			1					
Totals	52	149	38	12	1	6	4	1

Appendix Table 7. Detections during 2012 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,000 wild Chinook salmon from Marsh Creek released 25-26 July 2011. Release sites were 632-635 km above Lower Granite Dam.

	Marsh Creek							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
01 Apr	2	5						
02 Apr			1					
03 Apr			1					
11 Apr			1					
12 Apr	1	2						
13 Apr			1					
16 Apr	1	2						
17 Apr	2	4						
18 Apr	4	8						
19 Apr	1	2						
20 Apr	2	4						
21 Apr	2	4	3					
22 Apr	4	10		1				
23 Apr	4	11	2					
24 Apr	4	13	2	1				
25 Apr	5	18	2	3				
26 Apr	3	9	1					
27Apr	6	18	2	1	1	1		
28 Apr	4	12	2	2				
29 Apr	1	3	1	1				
30 Apr	1	3						
01 May	1	3	1	1			1	
02 May	2	6	4					
03 May			2				1	
04 May				2				
05 May				1				
07 May			1	1				
08 May					1			
09 May	1	3						
11 May			2		1			
16 May			2			1		
19 May	1	3	1					
20 May	2	5						
21 May	2	4	1					
22 May	1	2	1					
26 May	1	3						
29 May			1					
Totals	58	157	35	14	3	2	2	0

Appendix Table 8. Detections during 2012 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,000 wild Chinook salmon from Sulphur Creek released 29-30 July 2011. Fish were released 604-606 km above Lower Granite Dam.

	Sulphur Creek							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
13 Apr	1	2			1			
15 Apr				1				
17 Apr	1	2				1		
19 Apr	1	2						
20 Apr	3	6	1					
21 Apr	1	2	2					
22 Apr	1	2						
23 Apr	5	14	1					
24 Apr	2	6		1				
25 Apr	7	25						
26 Apr	1	3	1	1				
27 Apr	1	3	4					
28 Apr	4	12	3					
29 Apr	2	6	1			1		
30 Apr	1	3	1	1		1		
01 May	1	3		1				
02 May	2	6	2					
03 May	3	7	1					
04 May				1			2	
05 May				1		1		
06 May			1	1		1		
07 May	1	3			1			
08 May	1	3						
10 May							1	
13 May	1	3	1					
14 May	1	3						
16 May	2	5			1			
18 May	1	3				1		
19 May	2	5	2					
20 May	3	7	1		1			
21 May	1	2		1				
25 May	1	3						
26 May	1	3						
28 May			1					
04 Jun	1	3						
25 Jun			1					
Totals	53	147	24	9	4	6	3	0

Appendix Table 9. Detections during 2012 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 3,732 wild Chinook salmon from Valley Creek released 1-05 August 2011. Release sites were 743-750 km above Lower Granite Dam.

	Valley Creek							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
25 Mar	1	2						
26 Mar	2	5						
28 Mar	3	7						
29 Mar								
30 Mar	5	13						
31 Mar	4	10						
01 Apr	1	2	1					
02 Apr	3	7	2					
03 Apr	2	5	1					
04 Apr	4	10						
05 Apr	2	5						
07 Apr			1					
08 Apr	2	5	1					
09 Apr			1					
10 Apr	2	4						
11 Apr	1	2						
12 Apr	3	6	1					
13 Apr	2	4		1				
14 Apr	3	6	3					
15 Apr	1	2	1					
16 Apr	5	10		1				
17 Apr	3	6		1				
18 Apr	2	4	1					
19 Apr	4	8	3					
20 Apr	11	23	2	1				
21 Apr	5	11	2					
22 Apr	6	14	4					
23 Apr	6	17	1	2				
24 Apr	6	19	4					
25 Apr	12	42	6	3				
26 Apr	17	53	6	1	1			
27 Apr	8	24	21	2	1	1		
28 Apr	8	25	12	3	1			
29 Apr	6	19	18	5				
30 Apr			9	4		5	2	
01 May	3	8	12	3	2	1	2	
02 May	7	19	2		2	2	3	
03 May	4	10	1	4		2	2	
04 May	2	5	3	2			2	
05 May				1			1	
06 May	1	3	2	4		1	1	
07 May	1	3	2	1				
08 May			2				2	
09 May			1			2		

Appendix Table 9. Continued.

	Valley Creek (continued)							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
10 May			3	1				
11 May	1	3	3					
12 May	1	3	1	1				
13 May	1	3		1		1	1	
14 May			1	1				
15 May	1	3			1			
16 May	3	8		1				
17 May	4	11		1				1
18 May	3	8	2	2				
19 May	2	5						
20 May	1	2	5					
22 May	3	6	5	1			1	
23 May	6	13	3				1	
24 May	1	2	2	1				
25 May	1	3						
26 May			1				1	
27 May					1			
28 May	1	3				1		
29 May	1	3						
31 May	1	4						
02 Jun			1					
05 Jun	1	4						
06 Jun	1	6						
08 Jun			1			1		
10 Jun			1					
14 Jun	1	4		1		1		
16 Jun	1	9						
17 Jun							1	
18 Jun						1		
25 Jun			1					
27 Jun			1					
02 Jul							1	
Totals	193	521	157	50	9	19	21	1

Appendix Table 10. Detections during 2012 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 999 wild Chinook salmon from Herd Creek released 08-09 August 2011. Fish were released 699-701 km above Lower Granite Dam. One fish was detected in the estuary trawl on 30 May 2012.

	Herd Creek							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
31 Mar	1	3						
03 Apr	1	2						
13 Apr	1	2						
14 Apr	1	2						
15 Apr	1	2						
17 Apr	1	2						
20 Apr			1					
21 Apr	1	2						
22 Apr	1	2	1					
23 Apr			1					
25 Apr	3	11						
26 Apr	6	19	1	1				
27 Apr	2	6	7		1			
28 Apr	8	25	4	1				
29 Apr	1	3	3	2	2			
30 Apr	2	7	4			1		
01 May			3	1				
02 May	1	3	3			1		
03 May			1	2		1		
04 May			1				1	
05 May	1	3	1	2				
06 May	2	6	1	2	1			
07 May			1	2	2		1	
10 May	1	3					1	
11 May						1		
12 May					1			
14 May						1		
15 May	3	9				1		
16 May	4	11						
17 May	3	8	1	1		1		
18 May	1	3	1					
19 May	1	3						
20 May			1					
21 May	1	2	2					
23 May			1					
25 May							1	
26 May			1					
27 May			1					
28 May			1					
31 May			1					
Totals	48	139	43	14	7	7	4	0

Appendix Table 11. Detections during 2012 at 4 Snake and 3 Columbia River dams for 1,001 PIT-tagged wild Chinook salmon from Loon Creek released 11-12 August 2011. Release sites were 550-553 km above Lower Granite Dam. One fish was detected at the trawl on 7 May 2012.

	Loon Creek							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
28 Mar	1	2						
02 Apr	2	5						
10 Apr			1					
13 Apr					1			
17 Apr	1	2	1					
18 Apr	3	6						
19 Apr	2	4						
20 Apr	1	2	1					
21 Apr	2	4	1					
22 Apr	6	14						
23 Apr	4	11	2	3				
24 Apr	5	16	2					
25 Apr	11	39	1					
26 Apr	5	16	1	1				
27 Apr	7	21	10	2				
28 Apr	8	25	17	3				
29 Apr	6	19	8					
30 Apr	2	7	2	2		1		
01 May	2	5	2	2				
02 May	2	6	2	2			1	
03 May	1	2	2	2			2	
04 May	1	2		1			2	
05 May	1	3	2	1		1	2	
06 May				1		1		
07 May	1	3	3	1			1	
08 May			1	1				
09 May								1
10 May	1	3	1					
11 May	1	3	1	1				
12 May			1	1				
13 May			1					
15 May			1					
16 May	2	5					2	
17 May	5	13	4					
18 May				1				
19 May	1	3	1					
20 May	2	5						
21 May	2	4	2	1			1	
22 May	2	4	1	1				
23 May	1	2	1					
24 May	1	2	2	1				
25 May	1	3						
27 May	1	2						
06 Jun	1	6					1	
12 Jun			1					
Totals	95	269	76	28	1	3	12	1

Appendix Table 12. Detections during 2012 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,466 wild Chinook salmon from Big Creek (upper) released 15-16 August 2011. Release sites were 535-538 km above Lower Granite Dam.

	Big Creek (Upper)							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
06 Apr	1	2						
17 Apr	1	2						
19 Apr	2	4						
20 Apr	3	6						
23 Apr	1	3	1					
24 Apr	1	3	1					
25 Apr	5	18						
26 Apr	2	6	2					
27 Apr	3	9	4	1				
28 Apr	2	6	2	2				
29 Apr			4		1			
30 Apr			3	1				
01 May				2	1			
02 May	1	3	1	2	1			
03 May	2	5	1	4				
04 May	1	2		1				
05 May	1	3	1	2		1	1	
06 May			1	1				
07 May	1	3	1			1		
08 May			1					1
09 May				1				
10 May	1	3	1					
11 May				1				
12 May			2					
13 May	1	3			1			
14 May					1			
15 May	3	9	2					
17 May	2	5						
19 May	2	5	1					
20 May	4	9	3					
21 May	1	2	1			1		
22 May			1			1		
23 May	1	2	1					
24 May	1	2	2					
25 May	2	5						
26 May	4	12						
27 May	1	2	1					
28 May			1					
29 May			1					
30 May			2					
02 Jun	1	3						
06 Jun	1	6						
07 Jun			1					
12 Jun	2	11						
13 Jun	2	11						
20 Jun	1	6						
25 Jun							1	
27 Jun			1					
Totals	57	171	44	18	5	4	2	1

Appendix Table 13. Detections during 2012 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,551 wild Chinook salmon from Big Creek (lower) released 31 August-02 September 2011. Release sites were 489-491 km above Lower Granite Dam. On fish was detected in the estuary trawl on 12 May 2012.

	Big Creek (Lower)							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
02 Apr	2	5						
03 Apr	1	2						
04 Apr	2	5						
05 Apr	1	2						
06 Apr	2	5						
08 Apr	1	2	1					
09 Apr	1	2						
10 Apr	1	2			1			
11 Apr	1	2						
12 Apr	1	2						
13 Apr	2	4						
14 Apr	2	4	2					
15 Apr	1	2	1			1		
16 Apr	2	4	1					
17 Apr	4	8	2					
18 Apr	1	2						
19 Apr	5	10	3	1				
20 Apr	8	17	1					
21 Apr	6	13	4					
22 Apr	7	17	4	1				
23 Apr	5	14	1	1				
24 Apr	8	26	5	2	1			
25 Apr	11	39		2			1	
26 Apr	15	47	7	3				
27 Apr	10	31	24	3	1			
28 Apr	6	18	7	5		1		
29 Apr	2	6	7	3	2	1		
30 Apr	1	3	2	5	1	2	1	
01 May	2	5	7	5			1	
02 May	1	3	5	5			1	
03 May	1	2	2	4	2	2	1	
04 May	2	5	4	1		1	1	
05 May	3	8	3	2			1	
06 May	1	3	1				1	
07 May	1	3	1	1		1	1	
08 May						1	1	
10 May			1			1		
11 May		1	1					
13 May	2	6		1				
14 May			1					
15 May	1	3						

Appendix Table 13. Continued.

	Big Creek (Lower)							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
16 May						1		
17 May	2	5					1	
18 May	1	3				1		
19 May	1	3						
20 May	1	2	1					
21 May				1				
22 May	1	2						
23 May			1					
24 May			1					
05 Jun								1
Totals	129	348	101	46	8	13	11	1

Appendix Table 14. Detections during 2012 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,536 wild Chinook salmon from West Fork Chamberlain/Chamberlain Creeks released 23-25 August 2011. Release sites were 437-439 km above Lower Granite Dam. One fish was detected at the trawl on 4 May 2012.

	West Fork Chamberlain/Chamberlain Creek							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
01 Apr	1	2						
15 Apr	2	4						
17 Apr	1	2	1					
19 Apr	2	4	1					
20 Apr	3	6		1				
21 Apr	3	7	1					
22 Apr	7	17						
23 Apr	2	6	2					
24 Apr	2	6	1					
25 Apr	2	7	1					
26 Apr	4	12	4					
27 Apr	2	6	7	2				
28 Apr	4	12	1	4	1	1		
29 Apr	2	6	3	2				
30 Apr	3	10	2	1		1		
01 May	1	3	3				1	
02 May	3	8	1	2				
03 May			2			1	2	
04 May				3				
05 May				1				
07 May			2					
08 May	1	3	1					
10 May				1				
12 May	1	3						
15 May	1	3						
19 May	1	3	1					
20 May	2	5		1	1			1
21 May	1	2	1		1			
22 May			1					
23 May	1	2	1	1				
24 May	1	2						
26 May	1	3			1			
29 May								1
31 May			1					
05 Jun			1					
Totals	54	144	39	19	4	3	3	2

Appendix Table 15. Detections during 2012 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,516 wild Chinook salmon from South Fork Salmon River released 18-19 August 2011. Release sites were 467-469 km above Lower Granite Dam.

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

Appendix Table 15. Continued.

	South Fork Salmon River							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
27 May				1				
28 May	1	3						
31 May			1					
01 Jun				1				
02 Jun			1	1	1			
03 Jun								
04 Jun								
06 Jun	1	6						
11 Jun							1	
17 Jun							1	
Totals	68	184	55	15	6	4	8	

Appendix Table 16. Detections during 2012 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 1,292 wild Chinook salmon from Secesh River released 26-27 August 2011. Release sites were 429-431 km above Lower Granite Dam.

	Secesh River							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
02 Apr	2	5						
03 Apr	3	7						
04 Apr	1	2						
05 Apr	2	5						
07 Apr	1	2		1				
09 Apr	1	2						
10 Apr			2					
12 Apr	2	4	1					
13 Apr	3	6						
14 Apr	1	2	1	1				
15 Apr	1	2	1					
16 Apr	2	4						
17 Apr	3	6	1					
18 Apr	1	2						
19 Apr	1	2	1					
20 Apr	2	4						
21 Apr	5	11		1				
22 Apr	4	10	2					
23 Apr	9	26	3					
24 Apr	3	10	2	1				
25 Apr	3	11	1	1				
26 Apr	4	12	4	1				
27 Apr	3	9	6					
28 Apr	2	6	5	3				
29 Apr	2	6	4				1	
01 May	1	3	1	2				
02 May				2			1	
03 May	1	2		1			1	
04 May	1	2		1				
05 May				1				
06 May							1	
07 May	1	3				1		
08 May								
09 May					1			
10 May	1	3					1	
11 May					1			
12 May			1				1	
13 May				1				
14 May							1	
16 May	1	3						
18 May	1	3	1				1	

Appendix Table 16. Continued.

	Secesh River							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
19 May	1	3	1					
21 May					1			
24 May	1	2						
26 May	1	3						
28 May			1					
30 May						1		
01 Jun			1					
29 Jun				1				
Totals	71	183	40	18	3	2	8	0

Appendix Table 17. Detections during 2012 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 501 wild Chinook salmon from Lake Creek released 28 August 2011. Release site was 451 km above Lower Granite Dam.

	Lake Creek							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
09 Apr	1	2						
20 Apr			1					
21 Apr	1	2						
23 Apr	1	3	1					
24 Apr	1	3	1					
26 Apr	1	3						
27 Apr	1	3	1	1				
28 Apr			1					
29 Apr	2	6						
30 Apr			1					
04 May				1		1		
07 May							1	
09 May					1			
11 May			1					
17 May							1	
18 May	1	3						
20 May						1		
21 May				1				
24 May	1	2						
05 Jun				1				
28 Jun			1					
02 Jul	1	3						
Totals	11	30	8	4	1	2	2	0

Appendix Table 18. Daily detections and expanded detection numbers (i.e., estimated detection efficiency) of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho and Oregon at Lower Granite Dam during 2012, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

	Average	Average	**Water**	**Idaho only**		**Idaho and Oregon**	
Date	flow (kcfs)	spill (kcfs)	temperature	Detected	Expanded	Detected	Expanded
25 Mar	76.1	0.9	6.1	1	2	1	2 (0.463)
26 Mar	86.8	12.8	6.4	2	5	2	5 (0.437)
27 Mar	94.2	7.5	6.9	0	0	0	0
28 Mar	88.3	5.3	7.4	4	9	4	9 (0.426)
29 Mar	88.4	0.0	7.3	1	2	1	2 (0.437)
30 Mar	96.8	25.8	7.5	5	13	6	15 (0.397)
31 Mar	114.7	24.5	7.6	5	13	5	13 (0.392)
01 Apr	127.9	24.2	7.8	5	12	6	15 (0.406)
02 Apr	126.1	21.0	7.8	9	22	10	24 (0.409)
03 Apr	111.3	27.8	7.5	7	17	9	21 (0.420)
04 Apr	106.1	20.1	7.3	7	17	8	19 (0.418)
05 Apr	108.3	20.2	7.3	5	12	6	14 (0.422)
06 Apr	106.3	20.3	7.3	3	7	4	9 (0.435)
07 Apr	99.9	23.2	7.3	3	7	3	7 (0.448)
08 Apr	95.3	20.3	7.5	3	7	3	7 (0.436)
09 Apr	92.6	20.3	7.7	3	7	3	7 (0.439)
10 Apr	92.3	20.0	8.0	3	6	3	6 (0.463)
11 Apr	97.3	20.3	8.4	3	6	6	13 (0.474)
12 Apr	103.0	23.4	8.9	8	16	12	25 (0.485)
13 Apr	112.1	21.5	9.2	9	19	11	23 (0.476)
14 Apr	111.2	28.6	9.2	10	21	11	23 (0.478)
15 Apr	104.8	26.1	9.1	6	12	7	14 (0.496)
16 Apr	100.1	21.1	9.1	13	27	18	37 (0.487)
17 Apr	99.8	20.1	9.0	19	40	20	42 (0.480)
18 Apr	101.3	21.2	8.6	12	25	15	31 (0.488)
19 Apr	104.3	24.4	8.7	22	45	24	49 (0.487)
20 Apr	104.2	24.4	9.1	38	81	47	100 (0.469)
21 Apr	106.3	20.4	9.3	34	76	38	85 (0.445)
22 Apr	115.3	24.3	9.8	45	109	46	111 (0.414)
23 Apr	129.2	40.6	10.5	41	116	44	125 (0.352)
24 Apr	143.7	58.4	10.9	44	142	49	159 (0.309)
25 Apr	167.5	79.7	11.0	73	256	80	281 (0.285)
26 Apr	170.5	77.1	10.3	68	212	75	234 (0.321)
27 Apr	186.3	92.5	9.7	53	162	63	193 (0.327)
28 Apr	178.4	84.4	8.9	51	156	54	166 (0.326)
29 Apr	154.3	60.9	8.6	30	93	32	99 (0.324)
30 Apr	135.1	43.2	8.7	13	44	13	44 (0.294)
01 May	137.8	46.9	9.3	12	33	15	41 (0.367)
02 May	130.4	37.8	9.7	21	58	23	63 (0.363)
03 May	121.4	28.7	9.8	14	35	15	37 (0.404)
04 May	113.7	42.2	10.0	12	29	17	42 (0.407)
05 May	103.9	43.9	10.0	7	19	7	19 (0.372)
06 May	97.4	23.5	10.2	4	13	5	16 (0.313)
07 May	98.9	22.7	10.5	8	23	10	29 (0.341)
08 May	93.6	30.1	10.9	2	5	3	8 (0.396)
09 May	93.4	42.6	11.2	2	5	4	11 (0.380)
10 May	96.9	25.3	11.3	4	11	8	22 (0.372)
11 May	101.4	20.1	11.7	3	8	4	10 (0.392)

Appendix Table 18. Continued.

Date	Average flow (kcfs)	Average spill (kcfs)	**Water** temperature	**Idaho only**		**Idaho and Oregon**	
				Detected	Expanded	Detected	Expanded
12 May	97.5	20.3	11.8	4	11	5	14 (0.365)
13 May	95.1	20.2	11.6	5	15	8	24 (0.339)
14 May	101.6	20.2	11.5	2	5	4	10 (0.400)
15 May	107.3	20.5	11.9	10	29	10	29 (0.347)
16 May	120.2	30.6	12.3	12	32	15	40 (0.378)
17 May	133.8	48.4	12.6	17	45	22	58 (0.380)
18 May	129.2	44.8	12.2	9	25	15	42 (0.356)
19 May	112.4	32.0	11.6	15	41	17	47 (0.364
20 May	106.2	21.5	11.2	22	52	24	57 (0.423)
21 May	106.9	21.3	11.4	12	24	15	31 (0.490)
22 May	118.1	31.8	11.5	10	20	11	22 (0.496)
23 May	137.7	47.4	11.4	9	19	12	25 (0.471)
24 May	122.1	30.5	11.1	8	18	10	22 (0.446)
25 May	109.6	25.9	10.9	5	13	5	13 (0.397)
26 May	96.1	20.2	11.1	9	27	12	36 (0.331)
27 May	81.8	20.2	11.2	2	4	3	6 (0.466)
28 May	77.6	20.1	11.0	2	5	2	5 (0.379)
29 May	81.1	20.1	11.1	1	3	3	9 (0.317)
30 May	81.6	20.1	11.1	0	0	1	5 (0.214)
31 May	79.2	20.3	11.6	1	4	1	4 (0.279
01 Jun	80.0	20.3	12.2	0	0	0	0
02 Jun	93.1	20.4	12.8	1	3	1	3 (0.329)
03 Jun	103.0	20.4	13.4	0	0	0	0
04 Jun	106.4	20.5	13.8	1	3	2	6 (0.351)
05 Jun	121.1	35.8	12.9	1	4	3	11 (0.267)
06 Jun	130.3	48.7	12.6	5	28	6	33 (0.180
07 Jun	111.5	34.5	12.2	0	0	0	0
08 Jun	102.1	49.0	11.6	0	0	2	10 (0.201)
09 Jun	91.8	56.9	11.2	0	0	0	0
10 Jun	91.6	50.0	11.1	1	7	1	7 (0.152)
11 Jun	90.5	31.2	11.3	0	0	0	0
12 Jun	81.0	29.4	11.6	3	17	3	17 (0.174)
13 Jun	83.7	51.1		2	11	2	11 (0.187)
14 Jun	94.6	32.5	12.6	1	4	1	4 (0.249)
15 Jun	89.1	25.9	13.3	0	0	0	0
16 Jun	86.1	31.1	13.8	1	9	1	9 (0.107)
17 Jun	84.3	41.4	14.0	0	0	0	0
18 Jun	83.7	41.6	14.3	0	0	0	0
19 Jun	94.0	37.6	14.6	0	0	0	0
20 Jun	89.2	21.4	14.5	1	6	2	12 (0.163)
21 Jun	82.3	20.5	13.9	0	0	0	0
22 Jun	81.2	34.5	13.6	0	0	0	0
23 Jun	83.6	34.3	14.4	0	0	0	0
24 Jun	86.1	29.4	15.2	0	0	0	0
25 Jun	83.9	21.1	15.8	0	0	0	0
26 Jun	82.7	38.1	16.2	0	0	0	0
27 Jun	86.4	25.2	16.3	0	0	0	0
28 Jun	75.0	19.7	16.2	0	0	0	0
29 Jun	65.5	23.5	15.6	0	0	0	0
30 Jun	64.1	29.7	15.9	0	0	0	0
01 Jul	61.2	37.4	16.4	0	0	0	0
02 Jul	62.3	31.3	16.9	1	3	1	3 (0.294)

Appendix Table 19. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Little Goose Dam during 2012, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

Date	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected
01 Apr	119.6	16.4	7.5	1
02 Apr	112.3	12.0	7.6	3
03 Apr	104.5	36.9	7.7	2
07 Apr	96.1	30.2	7.5	2
08 Apr	93.5	28.0	7.6	2
09 Apr	88.6	26.6	7.7	2
10 Apr	89.3	26.8	7.8	3
11 Apr	93.6	28.0	8.0	1
12 Apr	98.3	30.6	8.3	2
13 Apr	108.0	32.7	8.8	2
14 Apr	106.6	37.1	9.2	6
15 Apr	100.2	32.4	9.5	4
16 Apr	95.3	29.0	9.6	1
17 Apr	96.7	28.9	9.4	7
18 Apr	96.4	29.5	9.4	5
19 Apr	101.7	32.4	9.5	9
20 Apr	98.7	34.3	9.3	10
21 Apr	103.6	31.0	9.1	17
22 Apr	109.5	32.8	9.6	13
23 Apr	122.8	38.9	10.0	18
24 Apr	136.6	63.1	10.6	21
25 Apr	158.2	70.4	11.3	14
26 Apr	160.2	59.7	11.3	31
27 Apr	178.4	72.0	10.6	103
28 Apr	168.3	63.3	10.1	62
29 Apr	144.5	44.5	9.6	58
30 Apr	127.2	42.3	9.2	28
01 May	129.6	41.9	8.9	37
02 May	122.7	38.9	9.0	25
03 May	114.9	34.4	9.5	17
04 May	109.6	44.7	9.7	11
05 May	98.6	37.6	9.8	8
06 May	93.8	28.0	10.1	8
07 May	95.2	29.0	10.3	14
08 May	88.1	30.4	10.6	6
09 May	90.4	39.1	10.7	1

Appendix Table 19. Continued.

Date	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected
10 May	94.7	29.9	11.0	9
11 May	97.4	29.2	11.3	7
12 May	91.4	27.3	11.5	6
13 May	92.7	27.7	11.9	2
14 May	97.6	29.1	12.2	2
15 May	101.8	30.3	12.3	3
16 May	114.7	38.4	12.1	3
17 May	127.5	46.7	12.3	6
18 May	122.1	38.9	12.5	6
19 May	104.9	34.5	12.6	7
20 May	103.8	31.2	12.6	13
21 May	100.4	29.1	12.2	9
22 May	112.1	29.6	11.5	11
23 May	130.2	38.8	11.4	10
24 May	116.5	31.3	11.5	8
26 May	91.3	27.3	11.5	2
27 May	77.1	22.9	11.2	2
28 May	74.1	22.2	11.2	4
29 May	80.8	24.2	11.4	3
30 May	78.0	23.4	11.7	2
31 May	77.9	23.2	11.7	3
01 Jun	77.4	23.1	11.7	1
02 Jun	88.0	26.4	11.8	2
05 Jun	114.4	36.8	13.3	2
06 Jun	123.7	49.2	13.4	1
07 Jun	107.1	37.8	12.7	1
08 Jun	94.5	46.3	12.6	1
10 Jun	87.8	38.4	12.0	1
12 Jun	77.1	30.0	11.7	1
25 Jun	79.8	25.5	14.8	2
27 Jun	84.5	26.8	15.8	2
28 Jun	72.4	22.6	16.2	2

Appendix Table 20. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Lower Monumental Dam during 2012, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

Date	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected
07 Apr	101.4	28	7.4	1
13 Apr	113.1	30.0	8.3	2
14 Apr	113.4	29.1	8.7	1
15 Apr	105.3	26.1	9.2	1
16 Apr	100.0	26.0	9.5	1
17 Apr	101.9	25.9	9.6	1
19 Apr	106.6	25.9	9.6	1
20 Apr	103.6	28.9	9.6	2
21 Apr	107.7	25.9	9.7	2
22 Apr	114.9	25.9	9.5	2
23 Apr	127.3	25.4	9.7	6
24 Apr	142.0	68.1	10.3	7
25 Apr	171.3	76.5	10.9	10
26 Apr	168.1	68.7	11.4	11
27 Apr	192.6	90.4	11.2	14
28 Apr	180.1	67.3	10.7	24
29 Apr	153.6	42.7	10.3	16
30 Apr	133.8	36.6	9.9	14
01 May	136.3	43.2	9.5	24
02 May	129.3	38.5	9.1	14
03 May	119.7	35.4	9.2	18
04 May	115.4	43.0	9.4	14
05 May	102.5	32.4	9.7	13
06 May	96.9	23.6	9.9	9
07 May	100.2	27.6	10.1	6
08 May	92.2	29.6	10.5	1
09 May	92.7	34.5	10.8	2
10 May	97.1	26.1	11.0	2
11 May	102.0	26.0	11.2	3
12 May	95.1	25.4	11.5	3
13 May	96.0	25.2	11.8	3
14 May	98.9	24.7	12.1	1
15 May	105.4	24.6	12.6	0
16 May	117.2	27.4	12.9	1
17 May	131.5	43.7	12.7	2
18 May	125.7	32.4	12.6	3
20 May	110.4	26.2	13.0	1
21 May	102.1	24.9	13.0	4
22 May	115.4	23.6	12.7	3
23 May	135.4	35.1	12.0	1
24 May	122.3	25.4	11.7	4
25 May	109.1	25.3	11.8	1
27 May	80.3	26.2	11.9	1
31 May	78.9	28.0	12.1	1
01 Jun	78.2	26.8	12.4	1
02 Jun	91.4	25.9	12.6	1
05 Jun	117.1	31.7	13.1	1
14 Jun	97.4	25.9	12.6	1
29 Jun	65.0	17.4	16.0	1

Appendix Table 21. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Ice Harbor Dam during 2012, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

Date	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected
10 Apr	94.81	66.48	7.94	1
13 Apr	116.03	75.85	8.39	2
24 Apr	144.72	99.78	10.35	1
26 Apr	170.19	102.89	11.09	1
27 Apr	192.23	123.47	11.42	4
28 Apr	184.35	116.82	11.47	3
29 Apr	156.32	88.63	11.12	5
30 Apr	134.85	78.02	10.82	2
01 May	141.78	76.81	10.41	3
02 May	132.58	73.31	9.94	3
03 May	123.37	71.55	9.6	2
06 May	98.5	58.68	9.88	1
07 May	100.04	64.74	10.26	4
08 May	95.42	55.71	10.56	2
09 May	93.43	66.71	10.81	3
10 May	97.58	36.56	10.98	1
11 May	103.3	30.83	11.15	3
13 May	97.84	65.47	11.68	1
14 May	98.67	42.03	12.11	1
15 May	106.48	32.02	12.49	1
16 May	119.36	54.02	12.85	1
17 May	132.94	74.5	13.2	0
18 May	131.55	81.9	13.1	0
20 May	110.68	45.45	13.03	2
21 May	105.38	33.55	13.19	2
26 May	95.58	30.43	12.08	1
27 May	80.36	24.04	12.19	1
02 Jun	91.63	27.43	12.83	1

Appendix Table 22. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at McNary Dam during 2012, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

Date	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected
15 Apr	294.49	144.39	7.95	1
17 Apr	288.29	142.06	8.22	1
19 Apr	299.64	151.92	8.41	1
23 Apr	333.26	182.31	9.59	1
27 Apr	394.67	239.95	10.07	2
28 Apr	394.87	221.66	10.36	3
29 Apr	381	206.27	10.8	3
30 Apr	382.61	210.45	10.72	13
01 May	393.15	221.25	10.4	1
02 May	397.62	224.22	10.08	4
03 May	398.75	225.28	9.87	6
04 May	393.17	219.53	9.72	2
05 May	379.92	206.89	9.59	4
06 May	355.51	181.14	9.84	4
07 May	347.56	173.77	10.19	3
08 May	344.69	170.75	10.45	1
09 May	340.26	183.09	10.79	2
10 May	334.2	164.53	11.18	2
11 May	353.25	177.48	11.29	1
13 May	298.29	123.16	11.92	1
14 May	312.29	136.58	12.39	1
15 May	337.87	162.54	12.76	1
16 May	326.25	150.59	13.03	2
17 May	345.11	168.73	13.25	1
18 May	387.37	213.74	13.39	2
20 May	353.34	178.33	13.22	1
21 May	362.66	192.03	13	1
27 May	336.88	166.75	12.32	1
28 May	297.54	125.65	12.54	1
30 May	295.01	121.17	13.24	1
08 Jun	354.68	198.48	13.11	1
14 Jun	339.5	190.22	13.99	1
18 Jun	331.11	201.19	14.75	1
20 Jun	353.75	233.33	14.63	1

Appendix Table 23. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at John Day Dam during 2012, with associated river flows (kcfs), spill (kcfs), and water temperatures (°C) at the dam.

Date	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected
25 Apr	408.53	146.16	10.34	1
28 Apr	420.91	159.2	10.63	1
29 Apr	389.17	147.67	10.72	2
30 Apr	384.74	145.52	10.88	4
01 May	401.24	175.42	11.09	5
02 May	410.86	176.83	11.26	6
03 May	407.1	173.84	11.11	9
04 May	405.14	166.02	10.83	9
05 May	387.97	161.27	10.59	5
06 May	378.63	152.4	10.56	3
07 May	359.2	144.34	10.58	6
08 May	338.26	131.76	10.57	4
10 May	344.71	137.44	10.84	3
12 May	346.72	109.85	11.51	1
13 May	313.89	99.18	11.86	1
14 May	302.04	118.75	12.13	1
16 May	323.91	102.41	12.6	2
17 May	345.62	126.9	12.99	2
18 May	385.68	148.73	13.32	1
21 May	357.08	120.97	13.76	1
22 May	359.07	136.88	13.72	2
23 May	369.67	140.84	13.45	1
24 May	378.67	132.62	13.2	1
25 May	358.25	111.13	13	1
26 May	341.95	131.96	12.81	2
06 Jun	339.63	147.05	14.1	1
11 Jun	343.1	145.67	13.68	1
17 Jun	331.77	139.3	14.92	3
25 Jun	416.83	173.52	15.75	1
02 Jul	371.25	145.82	15.86	1

Appendix Table 24. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Bonneville Dam during 2012, 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	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected
Detection at Bonneville Dam				
08 May	350.7	127	11.05	1
09 May	336.7	114	10.98	1
10 May	357.9	129.2	10.8	1
17 May	347.1	113	12.68	1
20 May	378.1	140.1	13.52	1
29 May	300.3	99.5	13.21	1
05 Jun	313	99	14.03	1
Detection in the estuary trawl array				
04 May				1
07 May				1
12 May				1
30 May				1

Appendix Table 25. Monthly environmental data collected from Marsh Creek (rkm 179.8 from the mouth of the Middle Fork Salmon River) from August 2011 through July 2012.

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min.	5.9	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.6	5.5
Max.	17.6	14.2	12.2	4.1	1.9	2.2	4.4	7.7	8.6	12.2	15.3	18.2
Ave.	11.2	8.9	5.0	1.0	0.2	0.2	0.8	2.1	2.3	5.3	7.7	11.8
						Dissolved oxygen (ppm)						
Min.	8.6	10.4	10.6	11.1	11.9	12.0	11.8	11.3	11.2	5.9	7.6	5.4
Max.	12.6	14.1	15.1	14.1	14.0	14.0	14.9	14.8	14.1	13.3	10.4	9.4
Ave.	10.4	12.0	12.9	12.5	12.7	12.8	13.1	12.9	12.6	11.3	9.0	7.4
						Specific conductance (µS/cm)						
Min.	61.0	69.0	47.0	49.0	49.0	49.0	47.0	50.0	31.0	29.0	30.0	43.0
Max.	73.0	75.0	75.0	61.0	64.0	61.0	61.0	61.0	59.0	42.0	44.0	55.0
Ave.	67.2	72.1	69.2	57.5	59.3	57.7	57.9	57.9	48.4	35.8	37.5	49.7
						Turbidity (ntu)						
Min.	---	---	---	---	---	---	---	---	---	---	---	---
Max.	---	---	---	---	---	---	---	---	---	---	---	---
Ave.	---	---	---	---	---	---	---	---	---	---	---	---
						Depth (ft)						
Min.	0.9	0.9	0.7	0.5	0.7	1.0	0.4	0.3	0.9	2.1	2.1	1.5
Max.	1.6	1.5	1.5	1.9	2.9	3.2	2.0	1.6	3.3	3.4	3.4	2.2
Ave.	1.3	1.2	1.1	1.0	1.9	1.9	1.1	0.8	1.7	2.8	2.6	1.9
						pH						
Min.	7.2	7.4	7.3	7.3	7.1	7.1	7.2	7.1	6.5	6.5	6.9	7.2
Max.	8.4	8.6	8.6	8.8	9.4	8.1	8.1	8.1	7.7	7.4	7.6	8.2
Ave.	7.6	7.7	7.6	7.6	7.4	7.4	7.5	7.5	7.0	6.9	7.2	7.6

Appendix Table 26. Monthly environmental data collected from the Salmon River near Sawtooth Hatchery (rkm 618) from August 2011 through July 2012.

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min.	9.1	6.9	1.2	0.0	0.0	0.0	0.0	0.1	0.5	2.9	5.5	9.1
Max.	18.5	16.1	12.8	5.1	3.3	3.6	4.9	8.6	11.2	13.9	17.2	19.4
Ave.	13.6	11.1	7.0	2.1	0.6	0.7	1.4	3.5	5.2	7.7	10.9	14.5
						Dissolved oxygen (ppm)						
Min.	6.7	7.7	6.3	0.2	0.1	0.1	0.1	0.1	0.0	9.6	9.2	5.9
Max.	10.6	12.1	15.1	15.1	9.0	14.2	14.9	15.1	15.1	15.2	12.8	14.4
Ave.	8.9	9.5	10.4	5.2	1.7	4.4	6.0	8.4	5.3	13.7	10.8	9.7
						Specific conductance (µS/cm)						
Min.	104.0	127.0	113.0	127.0	133.0	126.0	121.0	105.0	52.0	48.0	37.0	52.0
Max.	147.0	148.0	136.0	157.0	157.0	157.0	157.0	157.0	150.0	95.0	75.0	76.0
Ave.	119.0	131.7	123.3	139.8	144.9	141.1	132.7	129.7	100.3	59.8	52.8	62.6
						Turbidity (ntu)						
Min.	---	---	---	---	---	---	---	---	---	---	---	---
Max.	---	---	---	---	---	---	---	---	---	---	---	---
Ave.	---	---	---	---	---	---	---	---	---	---	---	---
						Depth (ft)						
Min.	1.2	1.2	1.0	0.9	1.1	0.7	0.9	0.7	1.3	2.1	2.0	1.5
Max.	2.0	1.8	2.0	2.2	2.4	2.0	1.8	1.8	3.2	2.9	3.0	2.2
Ave.	1.6	1.5	1.6	1.4	1.6	1.5	1.3	1.3	2.0	2.5	2.3	1.8
						pH						
Min.	8.0	7.7	7.8	7.3	7.2	7.4	7.6	7.5	7.2	7.3	7.4	7.5
Max.	8.7	8.8	8.5	8.4	7.9	8.0	8.2	8.3	8.3	8.4	8.5	8.8
Ave.	8.3	8.2	8.1	7.8	7.5	7.7	7.8	7.9	7.7	7.7	7.8	8.0

Appendix Table 27. 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) from August 2011 through July 2012.

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min.	8.3	5.5	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3	-0.2	1.0	4.5	8.3
Max.	21.4	17.3	14.4	4.2	0.1	0.2	0.9	7.6	10.9	13.1	16.8	21.5
Ave.	14.0	11.1	6.0	0.4	-0.1	-0.2	0.0	1.1	3.3	6.8	10.2	14.4
						Dissolved oxygen (ppm)						
Min.	---	---	7.9	8.5	9.4	9.4	9.7	7.9	6.6	7.0	8.1	8.0
Max.	---	---	10.5	10.5	10.6	10.5	10.6	10.5	9.9	11.0	11.4	11.1
Ave.	---	---	9.0	9.7	9.9	9.9	10.0	9.6	8.6	8.5	9.8	9.5
						Specific conductance (µS/cm)						
Min.	42.0	54.0	53.0	56.0	54.0	57.0	59.0	48.0	33.0	31.0	38.0	42.0
Max.	57.0	67.0	69.0	70.0	72.0	68.0	69.0	102	85.0	51.0	49.0	63.0
Ave.	50.0	59.4	59.4	60.9	65.0	62.0	63.1	65.3	49.3	36.5	43.3	50.7
						Turbidity (ntu)						
Min.	---	---	---	---	---	---	---	---	---	---	---	---
Max.	---	---	---	---	---	---	---	---	---	---	---	---
Ave.	---	---	---	---	---	---	---	---	---	---	---	---
						Depth (ft)						
Min.	0.9	0.9	0.6	0.7	1.1	0.7	0.7	0.6	1.4	2.2	2.2	1.6
Max.	1.9	1.5	1.7	1.9	1.9	2.0	1.7	1.7	3.5	3.0	3.3	2.5
Ave.	1.4	1.2	1.2	1.3	1.5	1.4	1.3	1.2	2.2	2.6	2.6	2.1
						pH						
Min.	7.5	7.8	7.4	7.3	7.1	7.1	7.3	7.1	6.9	7.1	6.8	6.9
Max.	8.8	8.7	8.7	7.9	7.9	7.6	7.8	7.8	7.4	7.8	7.7	7.8
Ave.	8.0	8.2	8.0	7.6	7.4	7.3	7.5	7.5	7.1	7.4	7.2	7.3

Appendix Table 28. Monthly environmental data collected from the South Fork Salmon River (rkm 112 from its confluence with the main Salmon River) from August 2011 through July 2012.

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min.	8.7	6.7	0.2	---	---	---	---	---	---	---	---	---
Max.	18.7	15.7	13.8	---	---	---	---	---	---	---	---	---
Ave.	13.7	10.9	6.8	---	---	---	---	---	---	---	---	---
						Dissolved oxygen (ppm)						
Min.	7.4	8.4	8.7	---	---	---	---	---	---	---	---	---
Max.	10.6	11.3	12.8	---	---	---	---	---	---	---	---	---
Ave.	8.7	9.5	10.5	---	---	---	---	---	---	---	---	---
						Specific conductance (µS/cm)						
Min.	36.0	44.0	41.0	---	---	---	---	---	---	---	---	---
Max.	46.0	59.0	52.0	---	---	---	---	---	---	---	---	---
Ave.	40.8	47.4	47.8	---	---	---	---	---	---	---	---	---
						Turbidity (ntu)						
Min.	---	---	---	---	---	---	---	---	---	---	---	---
Max.	---	---	---	---	---	---	---	---	---	---	---	---
Ave.	---	---	---	---	---	---	---	---	---	---	---	---
						Depth (ft)						
Min.	1.0	1.0	0.8	---	---	---	---	---	---	---	---	---
Max.	1.7	1.5	1.8	---	---	---	---	---	---	---	---	---
Ave.	1.4	1.3	1.2	---	---	---	---	---	---	---	---	---
						pH						
Min.	7.7	7.8	7.8	---	---	---	---	---	---	---	---	---
Max.	9.3	9.3	9.2	---	---	---	---	---	---	---	---	---
Ave.	8.0	8.2	8.1	---	---	---	---	---	---	---	---	---

Appendix Table 29. Monthly environmental data collected from the Secesh River (rkm 27 from its confluence with the South Fork Salmon River) from August 2011 through July 2012.

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min.	7.7	4.8	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.7	2.5	7.6
Max.	18.0	14.6	11.1	1.9	0.1	0.1	0.1	0.1	6.2	9.2	13.1	19.8
Ave.	12.6	9.4	4.3	0.1	0.1	0.1	0.1	0.1	1.4	4.5	7.1	13.6
						Dissolved oxygen (ppm)						
Min.	0.0	9.2	9.8	12.8	12.7	12.9	13.0	12.7	12.5	11.7	10.5	9.0
Max.	12.2	13.3	15.1	15.1	14.3	14.7	13.8	13.9	15.1	15.2	14.5	13.9
Ave.	3.5	10.7	11.9	13.5	13.4	13.4	13.4	13.3	13.7	13.3	12.6	11.1
						Specific conductance (µS/cm)						
Min.	28.0	32.0	28.0	28.0	30.0	30.0	30.0	28.0	28.0	---	---	28.0
Max.	37.0	40.0	41.0	32.0	32.0	33.0	33.0	33.0	28.0	---	---	31.0
Ave.	31.5	35.7	35.0	30.3	31.3	31.4	31.9	30.7	28.0	---	---	28.9
						Turbidity (ntu)						
Min.	---	---	---	---	---	---	---	---	---	---	---	---
Max.	---	---	---	---	---	---	---	---	---	---	---	---
Ave.	---	---	---	---	---	---	---	---	---	---	---	---
						Depth (ft)						
Min.	0.9	0.8	0.5	0.6	1.3	1.6	2.1	2.7	1.3	2.3	2.2	1.1
Max.	2.2	1.4	1.7	2.3	2.7	3.1	3.3	4.0	4.5	3.9	3.6	2.3
Ave.	1.5	1.1	1.1	1.2	1.7	2.3	2.6	3.3	3.0	3.0	2.8	1.6
						pH						
Min.	6.9	7.2	7.2	7.3	7.1	7.1	7.1	6.9	6.9	7.0	7.0	7.1
Max.	8.9	8.8	8.6	7.7	7.4	7.3	7.3	7.2	7.3	7.6	7.7	8.8
Ave.	7.6	7.6	7.5	7.4	7.2	7.2	7.2	7.1	7.1	7.2	7.3	7.6

Appendix Table 30. Monthly environmental data collected from Big Creek near Taylor Ranch (rkm 10 from its confluence with the Middle Fork Salmon River) from August 2011 through July 2012.

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min.	10.9	8.4	0.4	-0.4	-0.4	-0.5	3.1	3.7	4.5	9.5	10.9	8.4
Max.	18.6	16.3	13.4	3.8	0.3	-0.2	8.3	10.6	14.1	18.9	18.6	16.3
Ave.	14.3	11.6	6.4	0.4	-0.4	-0.4	5.6	6.8	9.1	14.1	14.3	11.6
						Dissolved oxygen (ppm)						
Min.	10.3	8.7	0.3	---	---	---	---	---	11.4	9.2	1.4	0.0
Max.	13.6	15.1	15.1	---	---	---	---	---	13.8	15.0	12.5	1.7
Ave.	11.2	11.2	10.2	---	---	---	---	---	12.6	12.6	7.0	0.5
						Specific conductance (µS/cm)						
Min.	91.0	121.0	116.0	118.0	104.0	93.0	50.0	42.0	43.0	56.0	91.0	121.0
Max.	130.0	135.0	132.0	141.0	155.0	140.0	63.0	108.0	58.0	99.0	130.0	135.0
Ave.	107.1	126.0	125.4	126.0	131.2	125.7	56.6	57.6	52.0	69.4	107.1	126.0
						Turbidity (ntu)						
Min.	---	---	---	---	---	---	---	---	---	---	---	---
Max.	---	---	---	---	---	---	---	---	---	---	---	---
Ave.	---	---	---	---	---	---	---	---	---	---	---	---
						Depth (ft)						
Min.	2.9	3.1	2.7	2.2	2.2	2.3	3.9	3.7	3.5	2.8	2.9	3.1
Max.	3.8	3.8	4.1	3.3	4.1	4.3	5.8	5.7	5.2	3.8	3.8	3.8
Ave.	3.4	3.5	3.4	2.7	3.0	3.3	4.8	4.4	4.2	3.3	3.4	3.5
						pH						
Min.	7.8	7.7	7.7	7.7	7.8	7.8	7.8	7.3	7.8	7.5	7.8	7.7
Max.	9.6	9.4	9.3	9.0	9.0	8.4	8.0	8.4	9.0	9.0	9.6	9.4
Ave.	8.6	8.3	8.2	8.0	8.1	8.0	7.9	7.8	8.1	7.9	8.6	8.3

Appendix Table 31. 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) from August 2011 through July 2012.

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min.	---	---	---	---	---	---	---	---	---	---	---	---
Max.	---	---	---	---	---	---	---	---	---	---	---	---
Ave.	---	---	---	---	---	---	---	---	---	---	---	---
						Depth (ft)						
Min.	---	---	---	---	---	---	---	---	---	---	---	---
Max.	---	---	---	---	---	---	---	---	---	---	---	---
Ave.	---	---	---	---	---	---	---	---	---	---	---	---

Appendix Table 32. Monthly environmental data collected from Sulphur Creek (rkm 10 from its confluence with the Middle Fork Salmon River) from August 2011 through July 2012.

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min.	6.8	5.1	0.2	-0.1	-2.0	0.0	0.0	0.0	0.0	0.8	2.9	8.3
Max.	16.2	12.8	10.8	3.2	0.6	0.7	2.4	5.0	5.9	8.2	12.2	14.2
Ave.	10.9	8.5	5.0	1.0	-0.7	0.1	0.5	1.3	2.1	3.8	7.0	11.3
						Depth (ft)						
Min.	0.5	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.8	1.9	1.6	1.2
Max.	1.0	1.0	1.3	1.1	19.7	1.6	1.3	1.1	3.4	3.8	3.6	3.1
Ave.	0.7	0.8	0.8	0.5	3.4	0.6	0.5	0.5	1.7	2.7	2.5	1.5

Appendix Table 33. Monthly environmental data collected from upper Big Creek (rkm 60 from its confluence with the Middle Fork Salmon River) from August 2011 through July 2012.

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min.	6.7	5.4	2.0	0.2	0.0	0.0	0.0	0.0	0.0	1.7	2.3	5.0
Max.	14.3	13.1	11.2	4.4	2.5	3.0	3.9	5.6	7.5	8.7	10.9	14.6
Ave.	9.9	8.4	5.7	2.2	0.9	0.9	1.1	1.9	3.0	4.2	5.5	9.6
						Depth (ft)						
Min.	1.5	1.5	1.1	1.2	1.4	1.0	1.2	1.1	1.4	1.9	2.3	1.6
Max.	2.4	2.1	2.2	2.3	2.6	2.6	2.4	2.4	3.9	3.8	3.9	2.7
Ave.	2.0	1.8	1.8	1.7	1.9	1.8	1.7	1.7	2.2	2.6	2.9	2.1

Appendix Table 34. Monthly environmental data collected from Chamberlain Creek (rkm 25 from its confluence with the main Salmon River) from August 2011 through July 2012.

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min.	7.9	5.2	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	1.0	3.4	8.3
Max.	18.7	15.3	12.9	2.5	0.0	0.0	1.6	5.1	7.5	9.1	15.5	20.7
Ave.	13.1	9.8	5.1	0.1	0.0	0.0	0.1	1.2	2.8	4.7	8.5	14.1
						Depth (ft)						
Min.	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.1	0.9	0.6	0.1
Max.	0.6	0.6	0.8	0.9	18.7	1.7	1.5	1.0	2.4	2.5	2.3	0.8
Ave.	0.4	0.3	0.4	0.4	1.7	0.5	0.3	0.2	0.9	1.5	1.2	0.5

Appendix Table 35. 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) from August 2011 through July 2012.

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min.	6.8	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	3.2	6.9
Max.	16.3	12.8	11.0	2.1	0.2	0.5	1.2	4.2	6.7	8.8	15.3	18.5
Ave.	11.4	8.6	4.6	0.2	0.0	0.1	0.2	1.0	2.3	4.4	7.9	12.5
						Depth (ft)						
Min.	0.6	0.6	0.3	0.3	0.4	0.0	0.1	0.0	0.6	1.8	1.1	0.8
Max.	1.1	1.2	1.5	1.5	1.6	1.3	1.2	1.4	3.2	3.1	2.8	1.8
Ave.	0.9	1.0	1.0	0.8	1.0	0.8	0.6	0.6	1.6	2.4	1.8	1.1

Appendix Table 36. 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) from August 2011 through July 2012.

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min.	6.6	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.0	6.9
Max.	15.8	12.7	10.3	1.9	0.0	0.0	0.0	1.1	5.1	8.0	12.2	16.8
Ave.	11.0	8.4	4.1	0.0	0.0	0.0	0.0	0.1	1.2	3.4	6.4	12.0
						Depth (ft)						
Min.	0.8	0.8	0.5	0.3	1.0	0.8	0.7	0.4	0.8	1.4	1.9	1.2
Max.	1.8	1.3	1.6	1.8	2.6	2.5	3.0	3.4	2.9	3.0	3.0	2.1
Ave.	1.4	1.1	1.1	1.0	1.7	1.6	1.3	1.2	1.5	2.2	2.3	1.6

Appendix Table 37. Monthly environmental data collected from Cape Horn Creek (rkm 180 from the mouth of the Middle Fork Salmon River; 150m above the Marsh Creek monitoring site) from August 2011 through July 2012.

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min.	4.9	3.2	0.0	0.0	-1.5	0.0	0.0	0.0	0.0	0.5	1.9	4.6
Max.	16.1	13.2	10.8	2.9	0.0	0.1	0.5	4.6	7.6	9.7	13.3	16.8
Ave.	9.4	7.6	4.1	0.1	-0.2	0.0	0.0	0.6	2.2	3.7	6.4	10.0
						Depth (ft)						
Min.	---	---	---	---	---	---	---	---	---	---	---	---
Max.	---	---	---	---	---	---	---	---	---	---	---	---
Ave.	---	---	---	---	---	---	---	---	---	---	---	---

Appendix Table 38. 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) from August 2011 through July 2012.

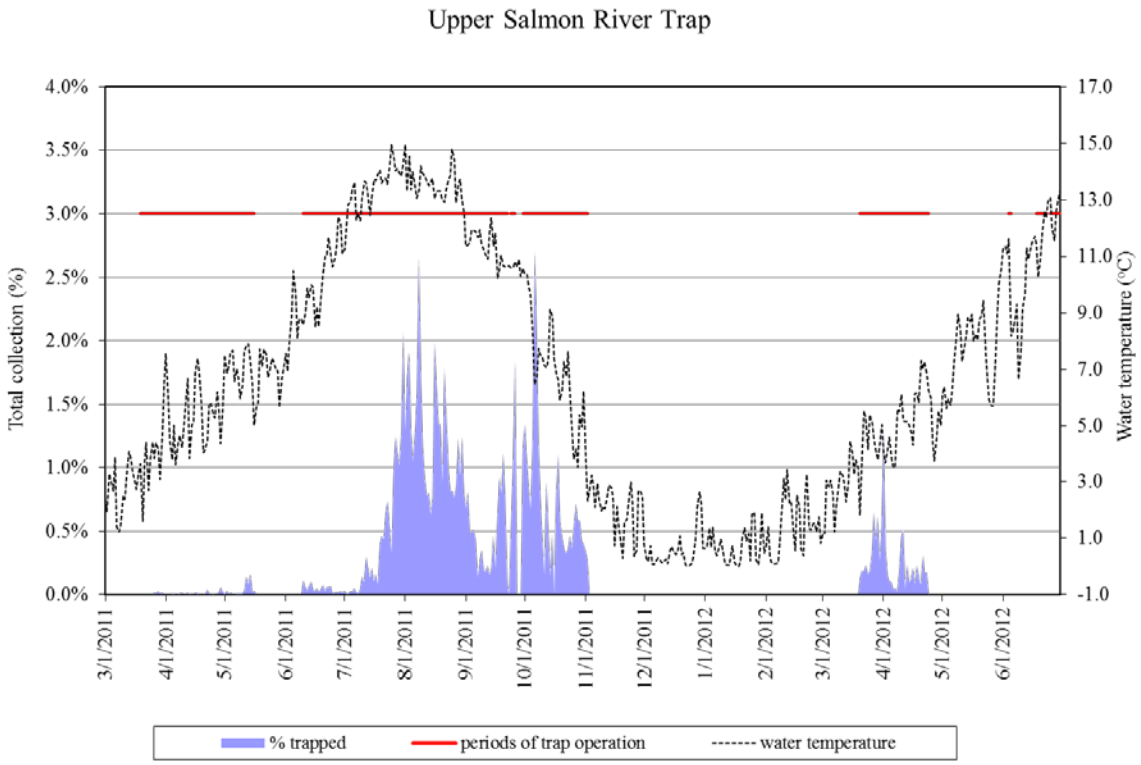
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (^{o}C)						
Min.	7.2	7.2	1.9	0.3	0.4	0.5	1.0	1.3	1.2	1.5	3.8	6.5
Max.	16.5	13.2	12.2	5.1	1.8	2.8	3.5	7.1	12.5	14.3	16.5	17.1
Ave.	11.6	10.0	6.5	2.2	0.6	1.2	1.8	3.4	5.8	7.4	9.5	12.2
						Depth (ft)						
Min.	1.0	1.1	0.8	0.7	0.8	0.5	0.6	0.4	0.9	1.4	1.4	1.2
Max.	2.2	1.7	1.8	1.8	1.7	1.8	1.6	1.7	2.1	2.0	2.2	1.8
Ave.	1.6	1.4	1.4	1.2	1.3	1.2	1.1	1.0	1.4	1.7	1.8	1.5

Appendix Table 39. Monthly environmental data collected from Camas Creek (rkm 23 from its confluence with the Middle Fork Salmon River) from August 2011 through July 2012.

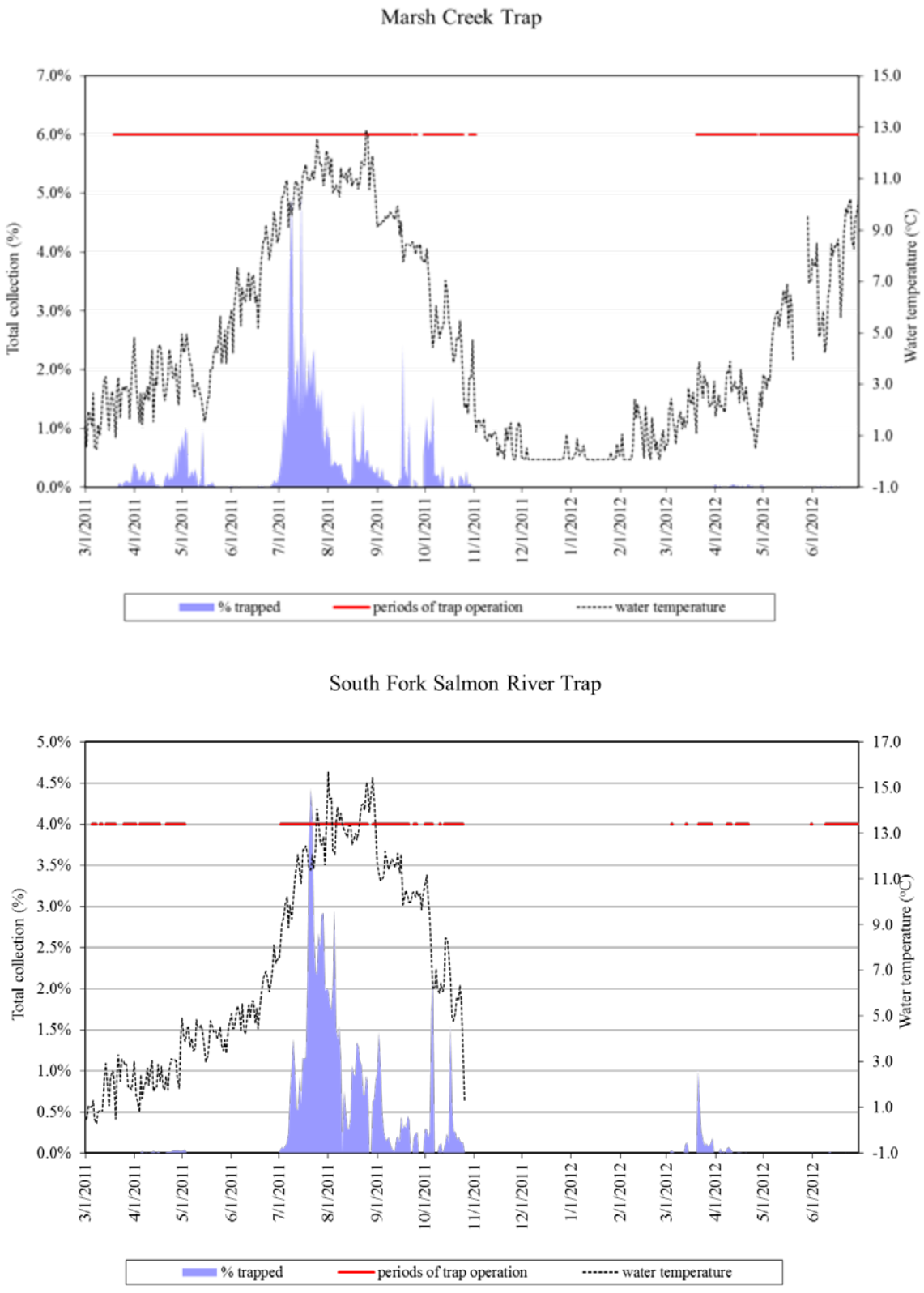
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min.	7.8	5.8	0.1	0.0	0.0	0.0	0.0	0.0	0.2	3.1	4.0	7.7
Max.	17.0	14.5	11.9	3.6	0.1	0.2	0.4	5.9	10.9	11.6	17.1	19.5
Ave.	12.2	10.0	5.6	0.3	0.1	0.1	0.1	1.2	4.5	6.7	9.6	13.7
						Depth (ft)						
Min.	1.8	1.7	1.4	1.3	1.9	1.3	1.1	1.0	1.8	2.9	2.3	2.0
Max.	2.8	2.4	2.5	2.4	3.2	2.8	2.4	2.3	5.7	4.4	3.9	2.7
Ave.	2.3	2.1	2.0	.8	2.5	2.2	1.7	1.7	2.8	3.5	3.0	2.3

Appendix Table 40. Monthly environmental data collected from Loon Creek (rkm 31 from its confluence with the Middle Fork Salmon River) from August 2011 through July 2012.

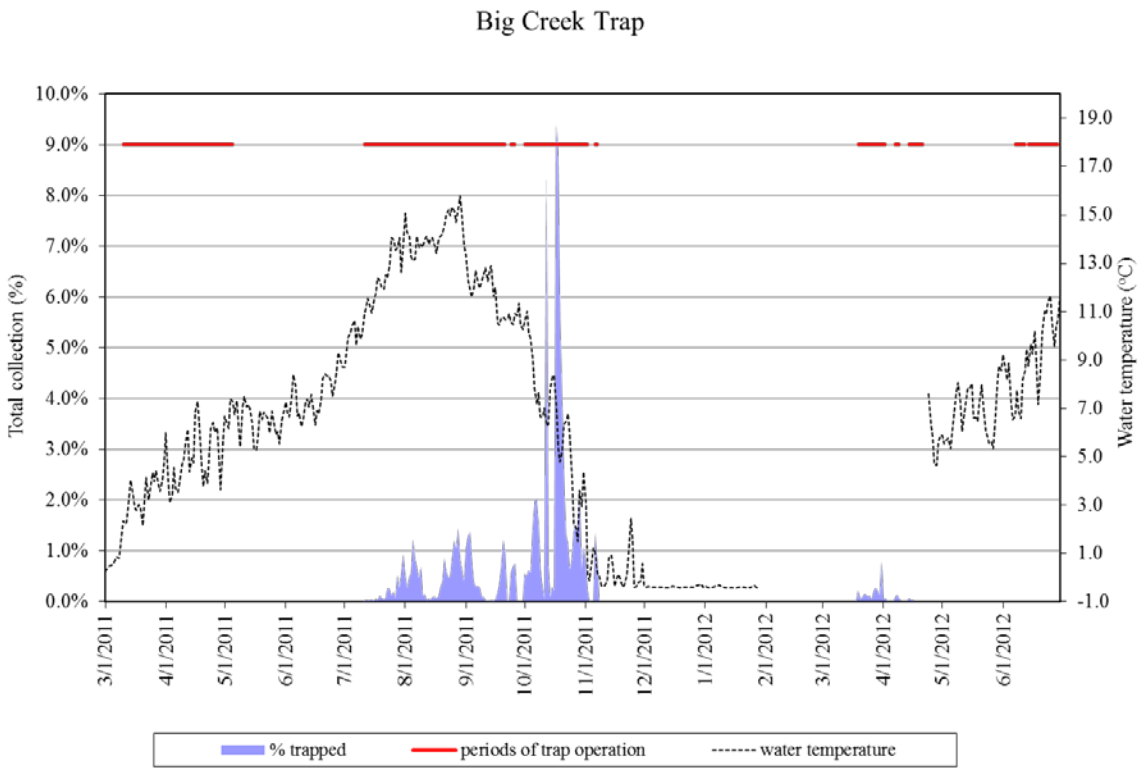
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min.	7.4	---	---	---	---	---	---	---	---	---	---	---
Max.	14.0	---	---	---	---	---	---	---	---	---	---	---
Ave.	10.2	---	---	---	---	---	---	---	---	---	---	---
						Depth (ft)						
Min.	2.4	---	---	---	---	---	---	---	---	---	---	---
Max.	2.9	---	---	---	---	---	---	---	---	---	---	---
Ave.	2.6	---	---	---	---	---	---	---	---	---	---	---

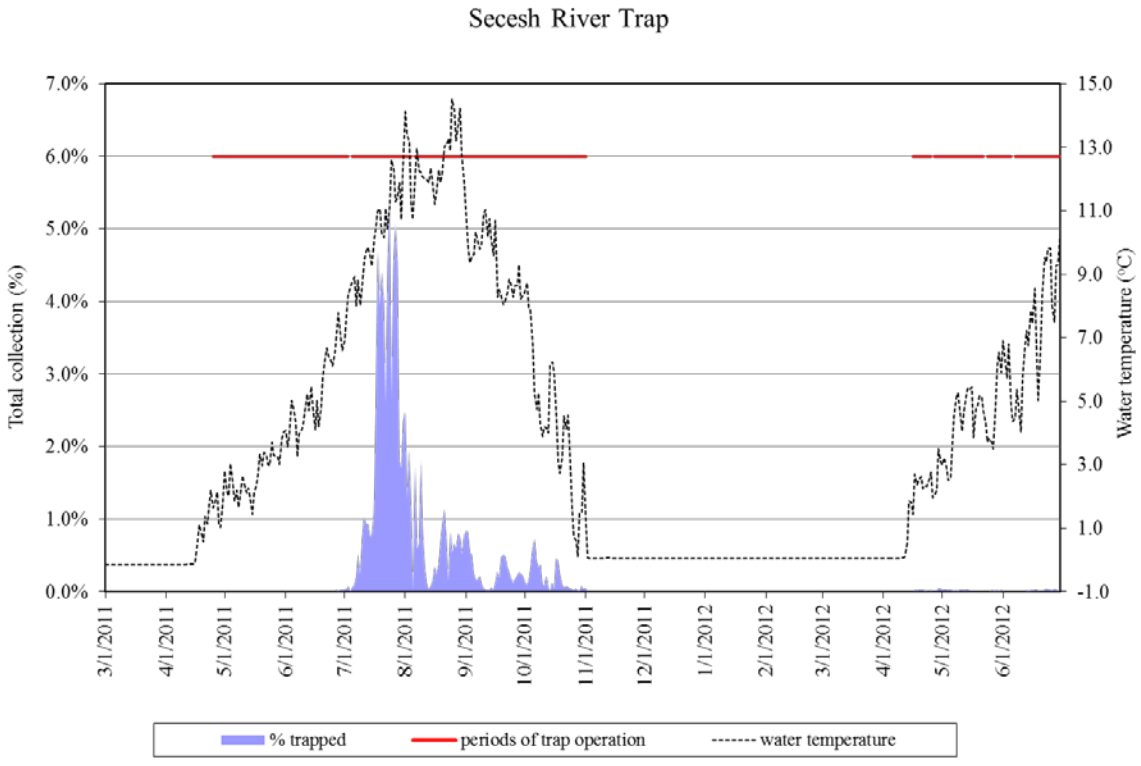


Appendix Figure 1. Daily passage of wild Chinook salmon fry, parr, and smolts at six migrant traps, expressed as percentages of total collected, and plotted against average daily water temperatures collected near traps. Periods of trap operation are also shown.

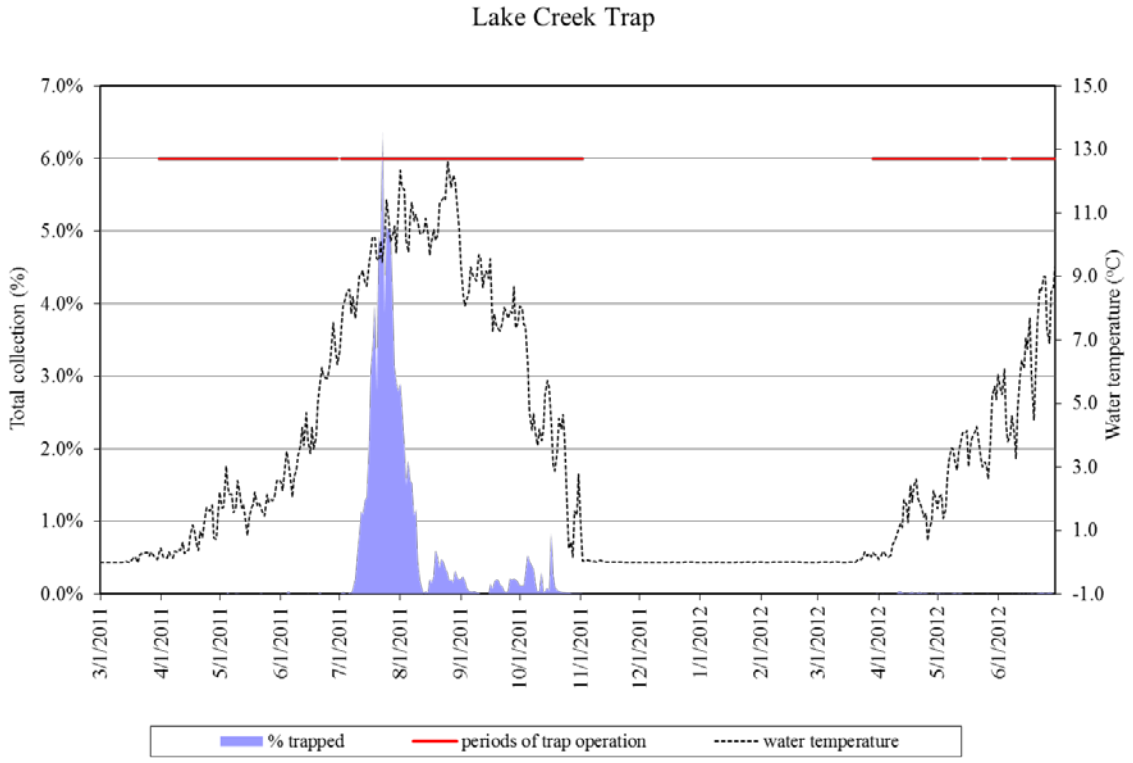


Appendix Figure 1. Continued.

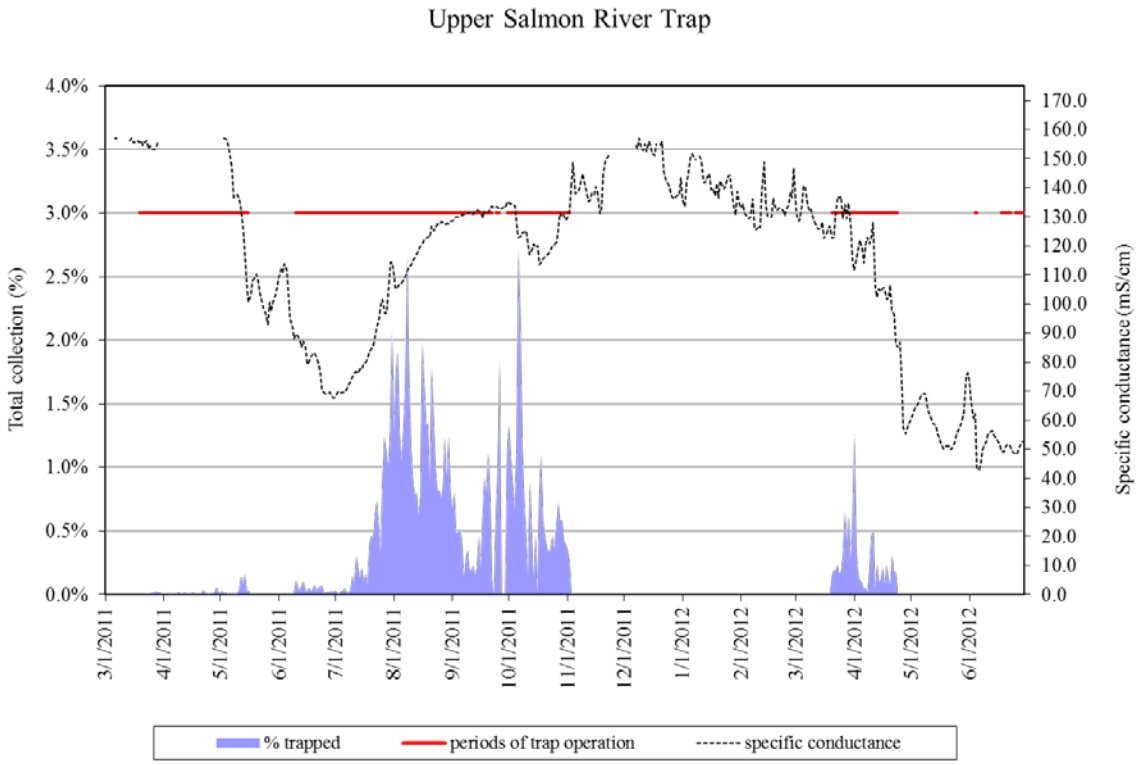




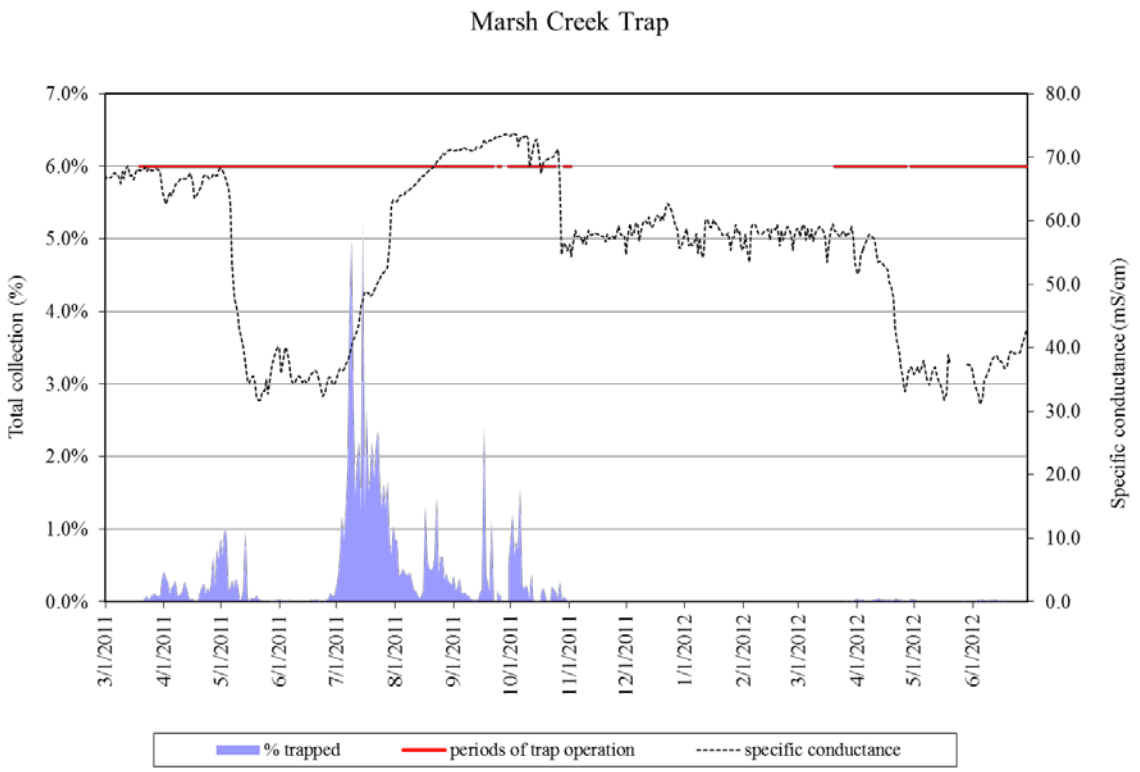
Appendix Figure 1. Continued

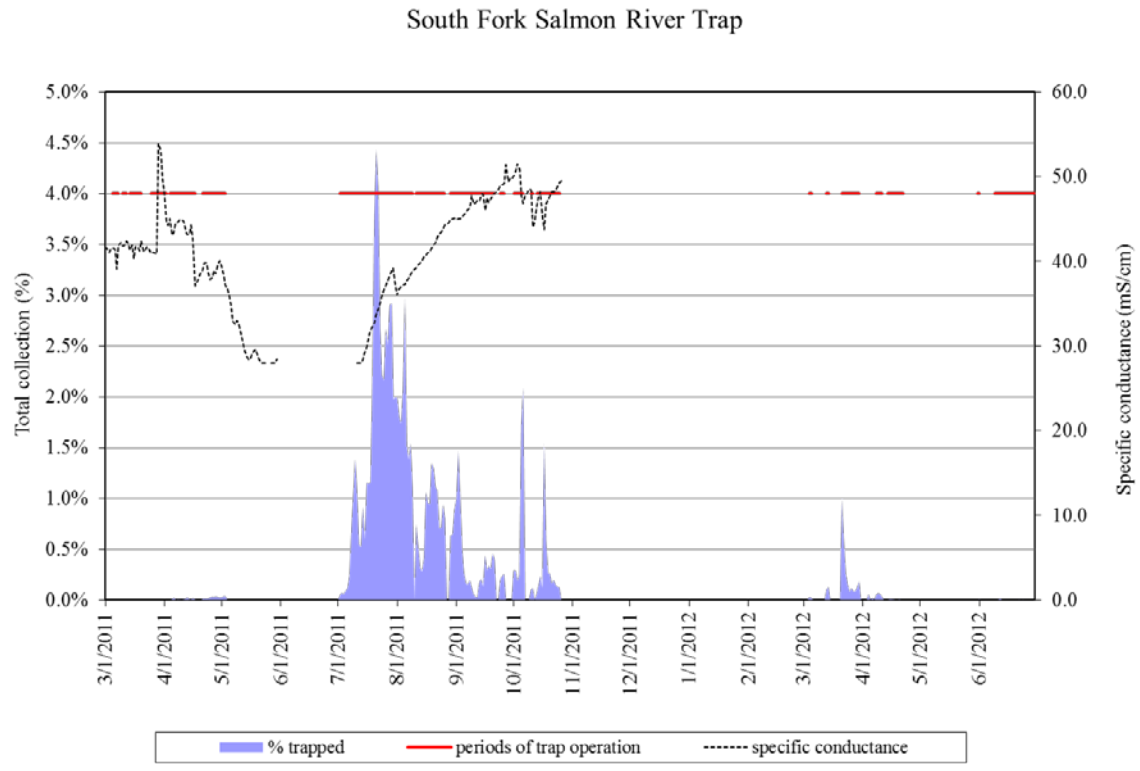


Appendix Figure 1. Continued.

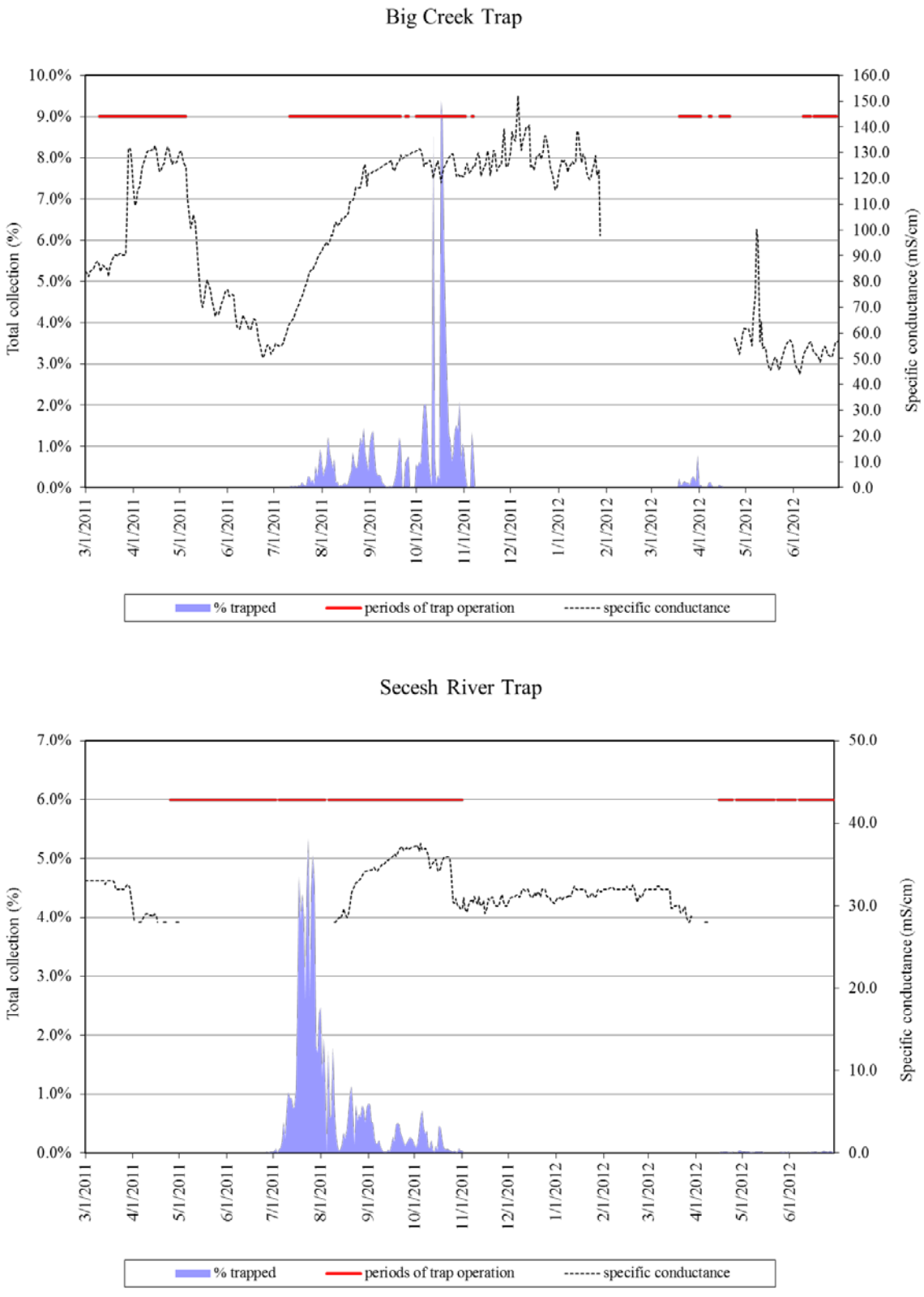


Appendix Figure 2. Daily passage of wild Chinook salmon fry, parr, and smolts at five migrant traps, expressed as percentages of total collected, and plotted against average daily specific conductance collected near traps. Periods of trap operation are also shown.

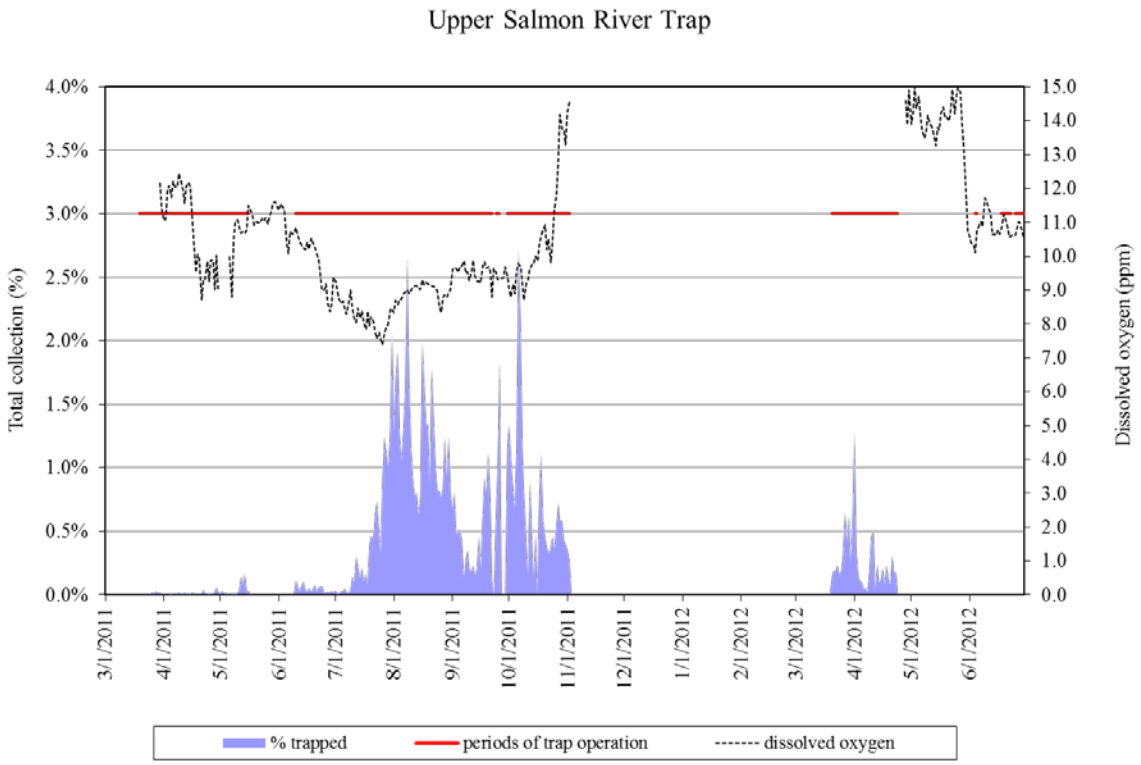




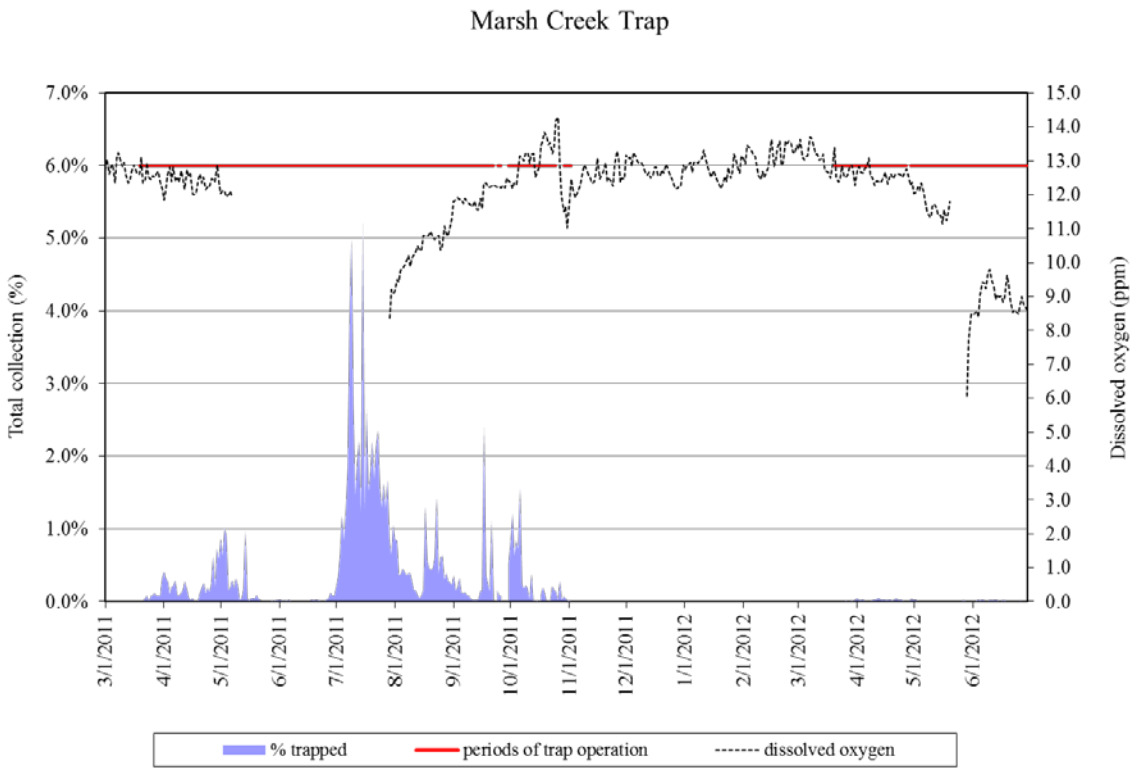
Appendix Figure 2. Continued.

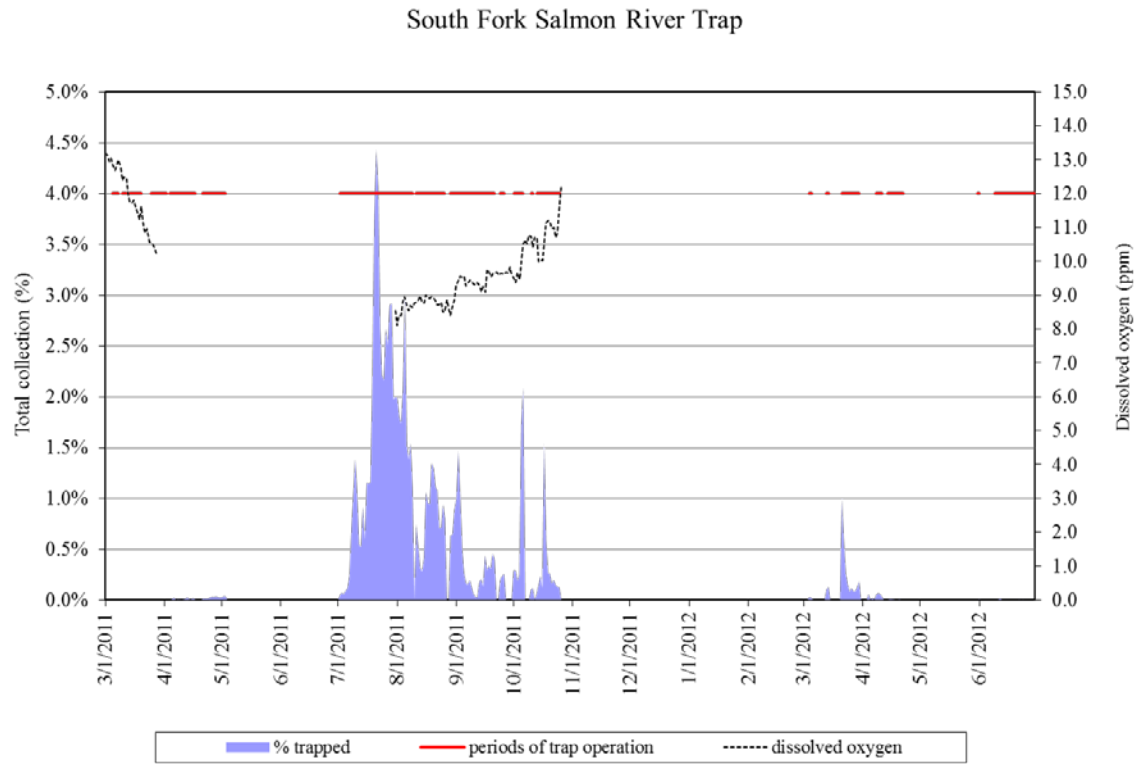


Appendix Figure 2. Continued.

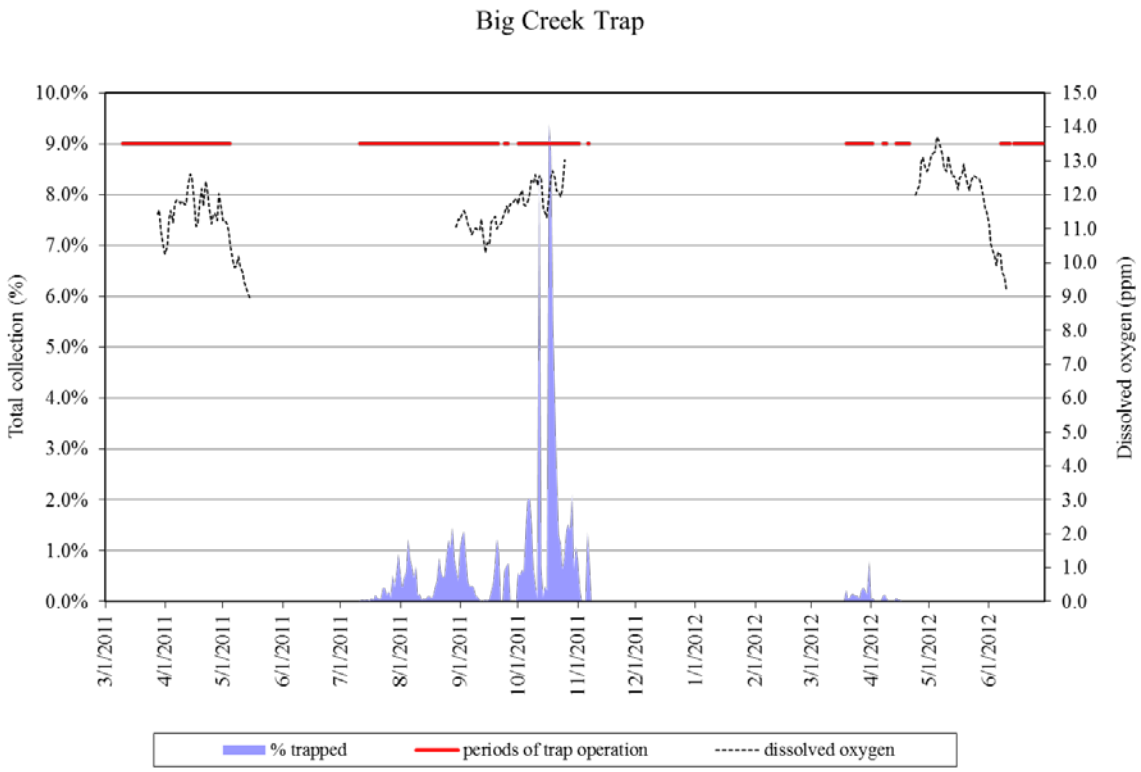


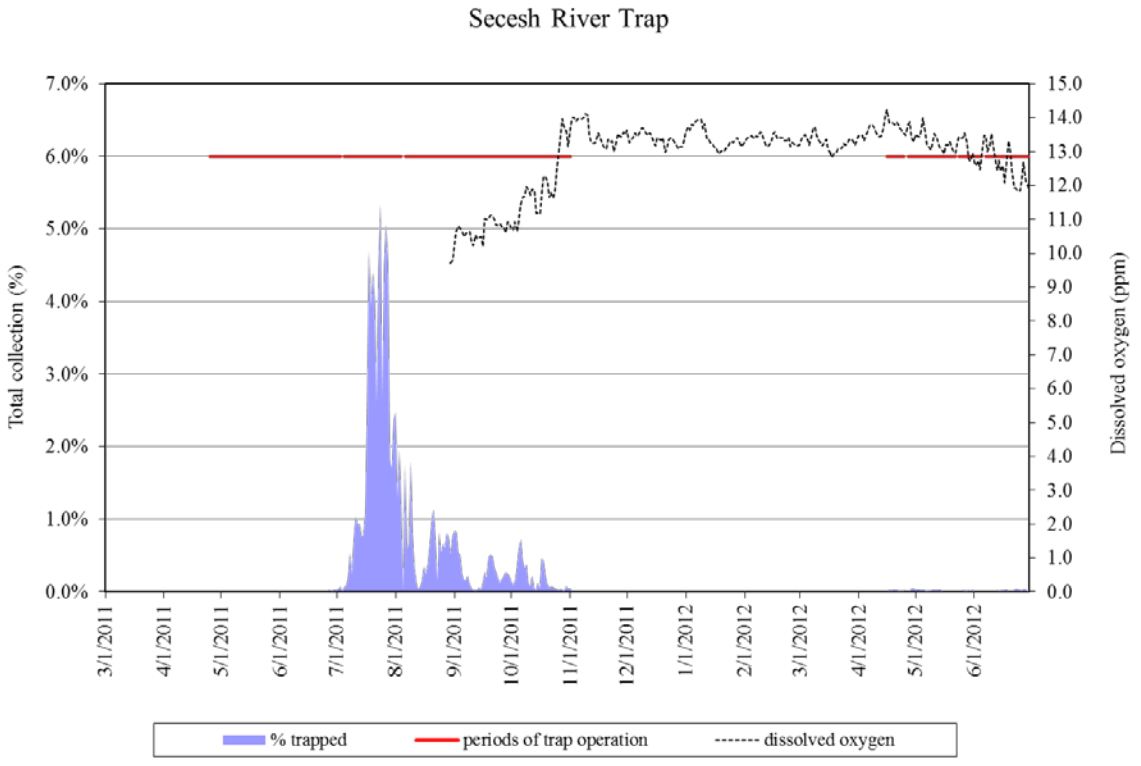
Appendix Figure 3. Daily passage of wild Chinook salmon fry, parr, and smolts at five migrant traps, expressed as percentages of total collected, and plotted against average daily dissolved oxygen collected near traps. Periods of trap operation are also shown.



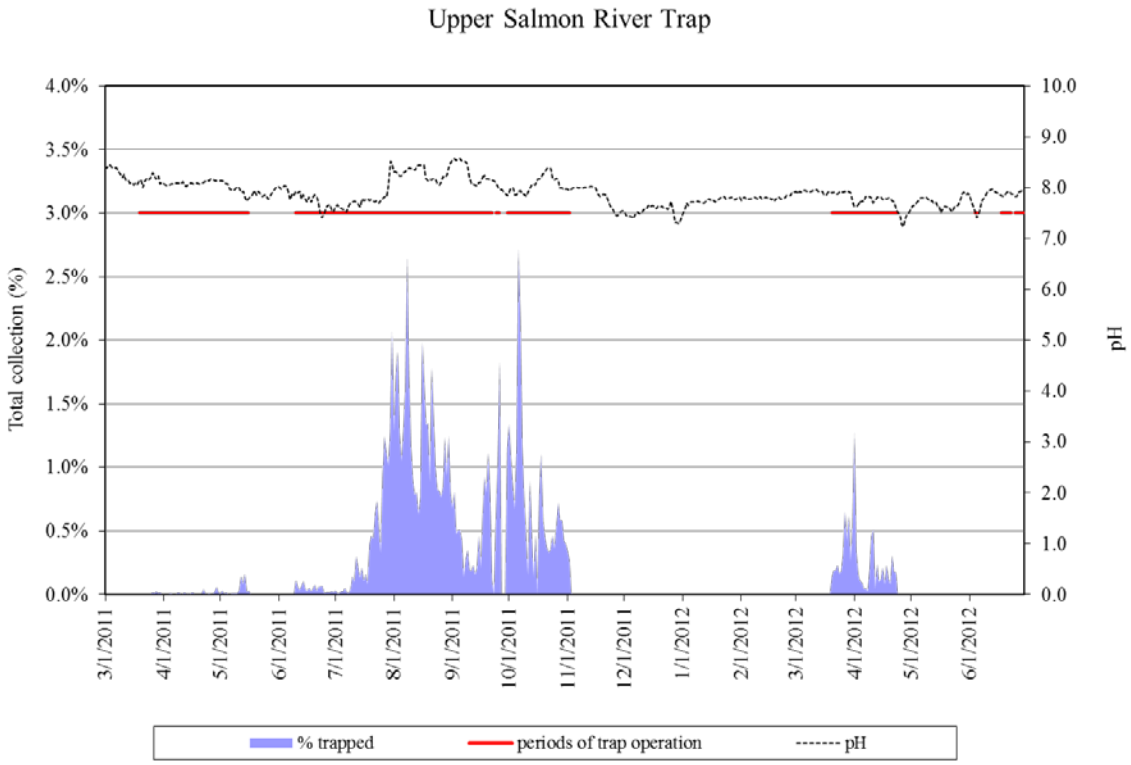


Appendix Figure 3. Continued

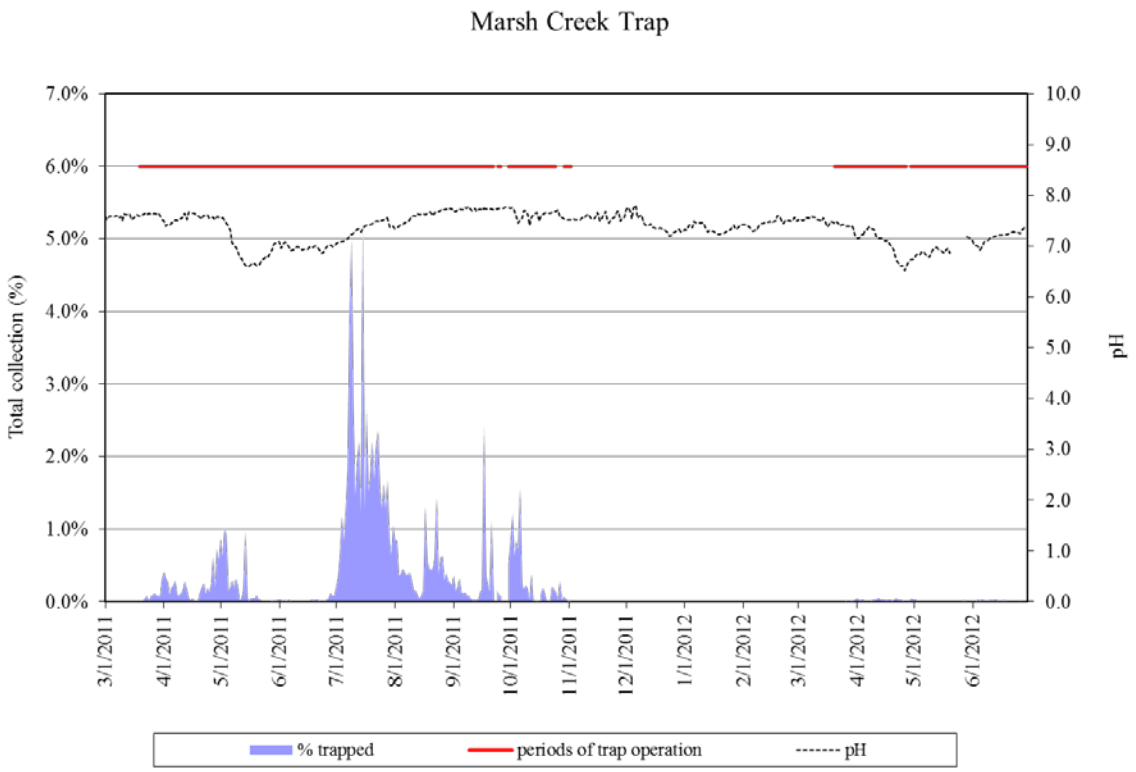


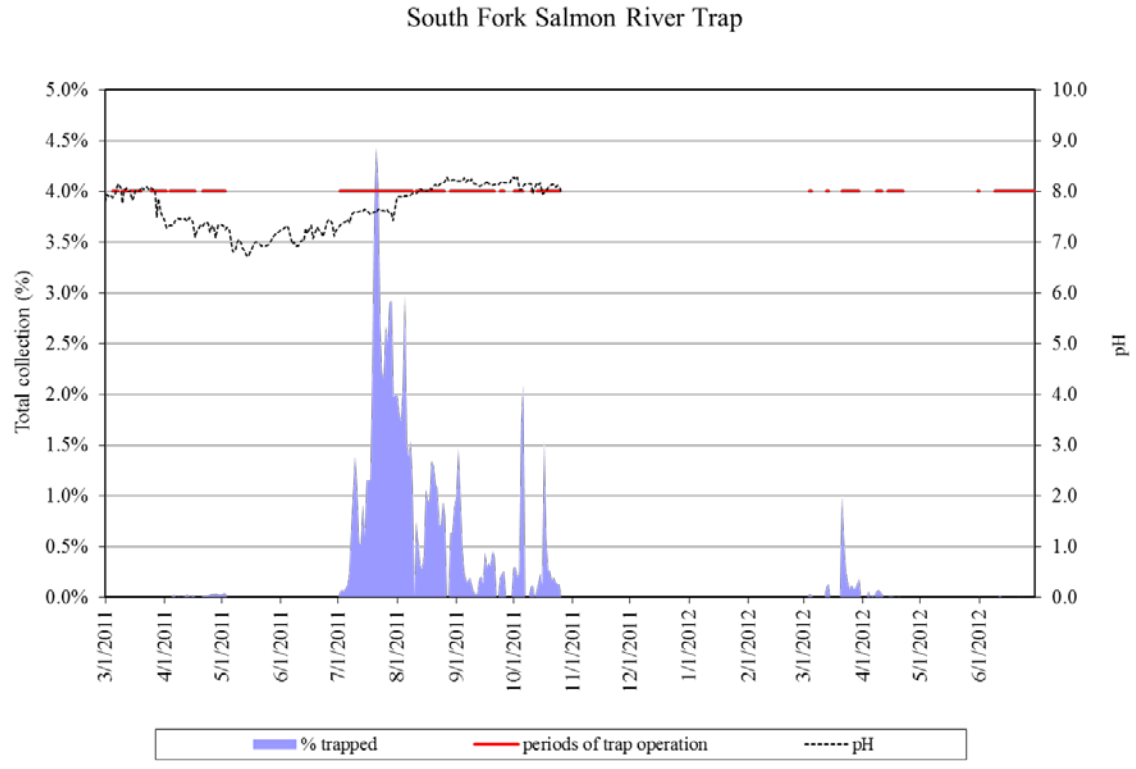


Appendix Figure 3. Continued.

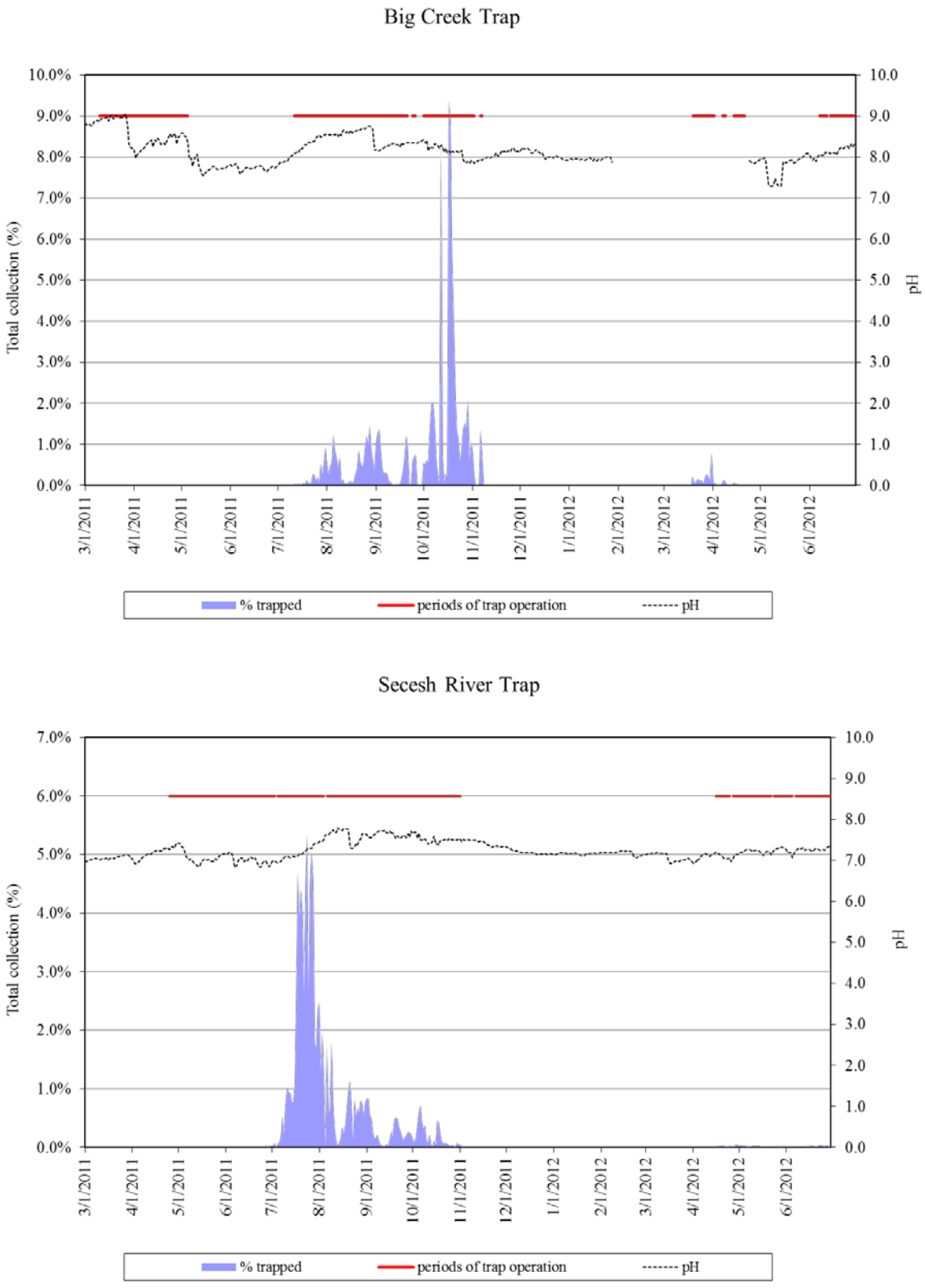


Appendix Figure 4. Daily passage of wild Chinook salmon fry, parr, and smolts at five migrant traps, expressed as percentages of total collected, and plotted against average daily pH collected near traps. Periods of trap operation are also shown.

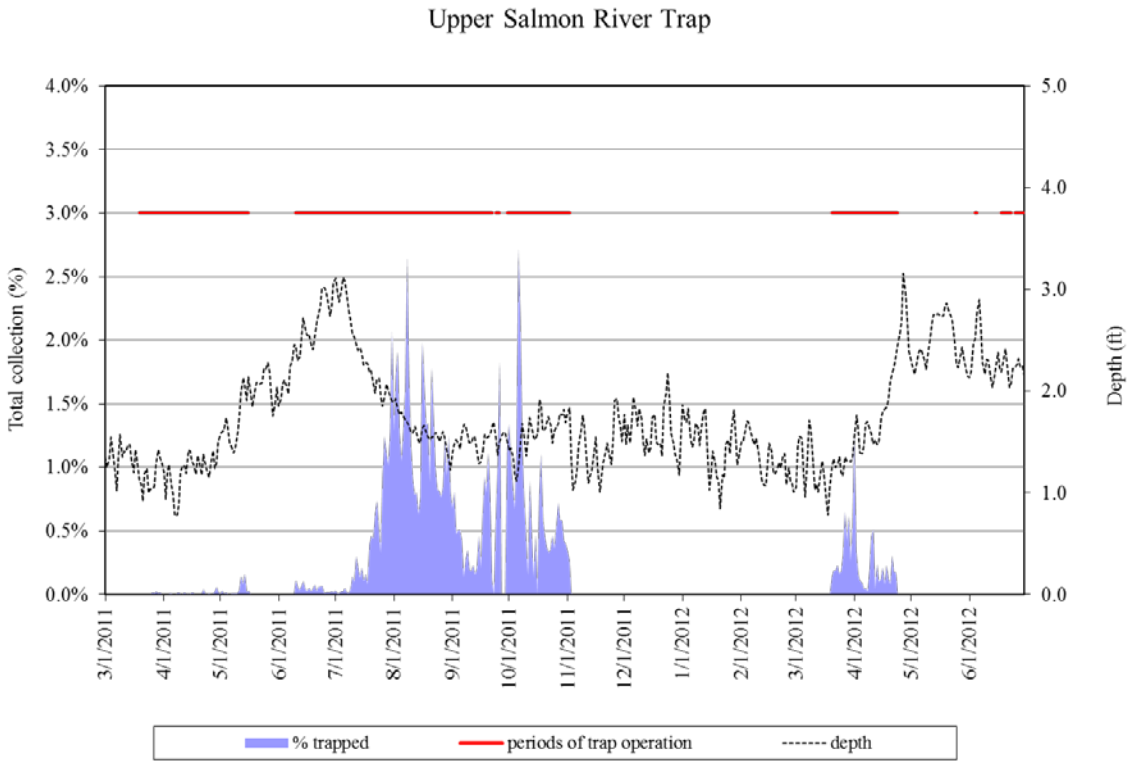




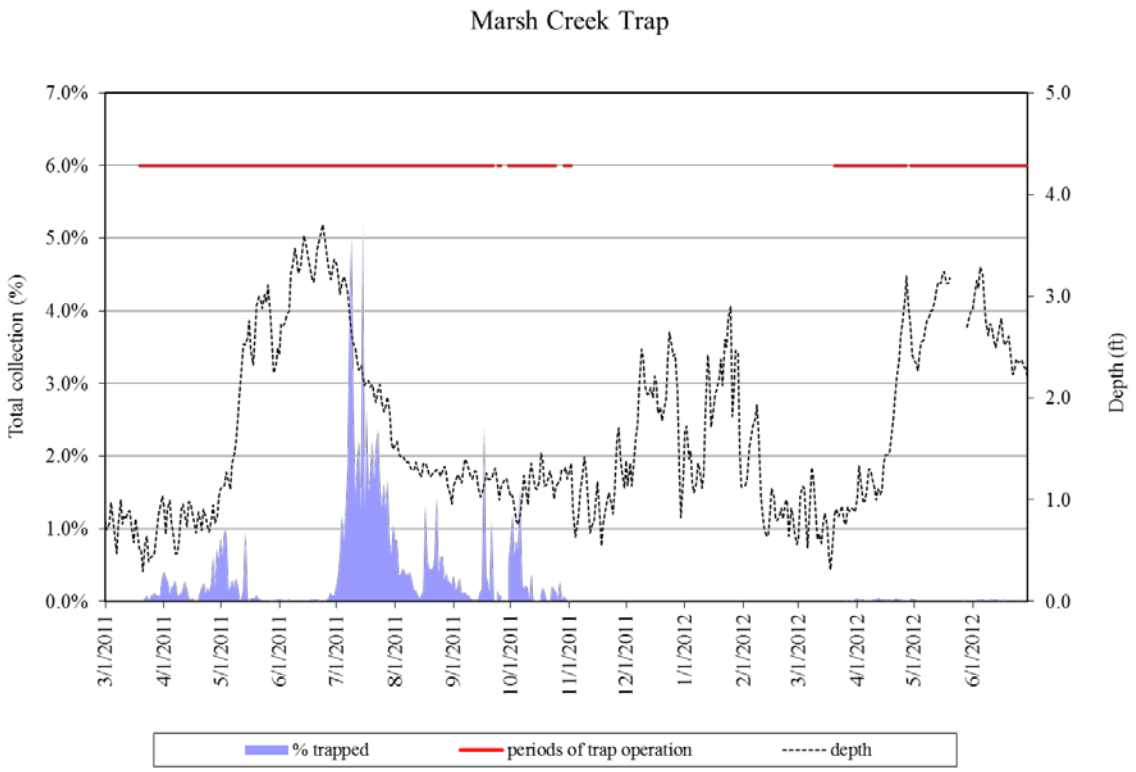
Appendix Figure 4. Continued.

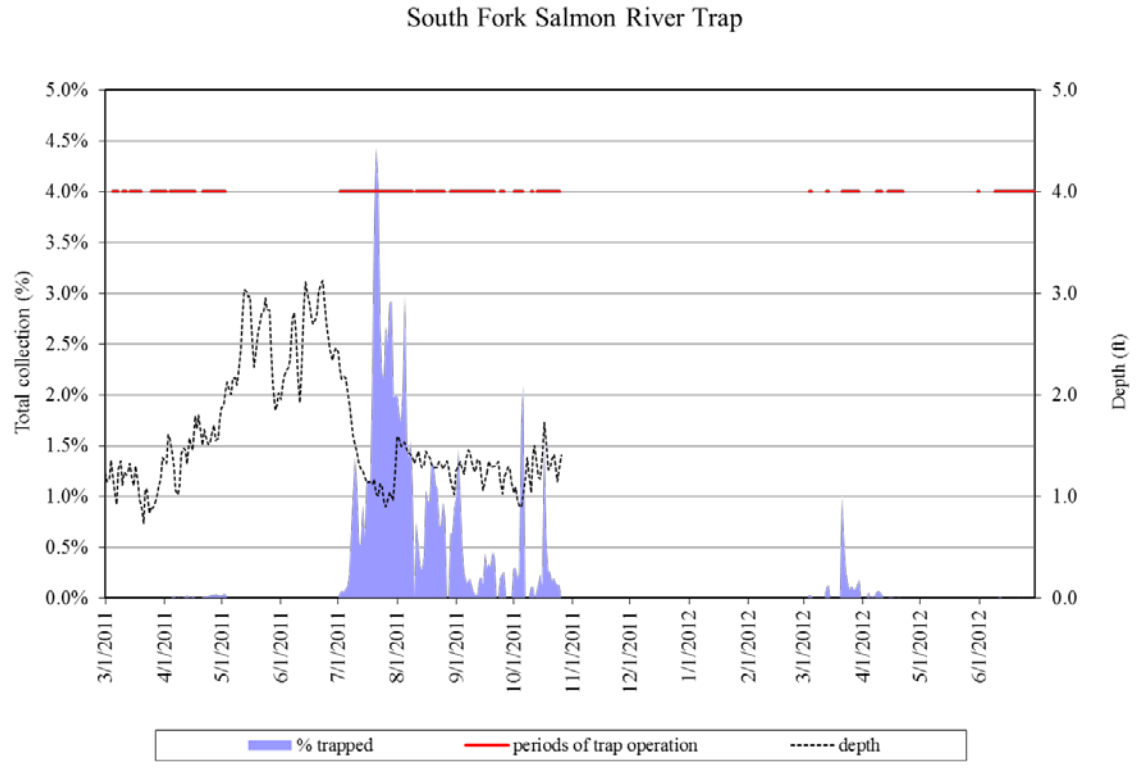


Appendix Figure 4. Continued.

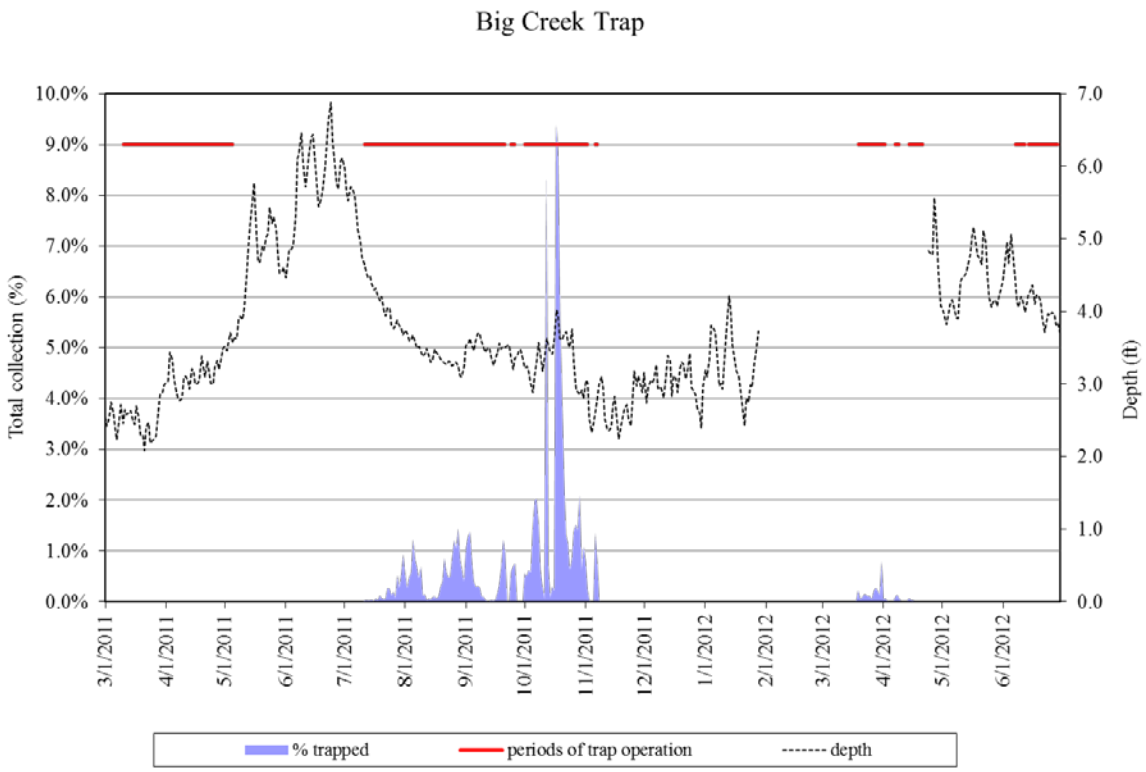


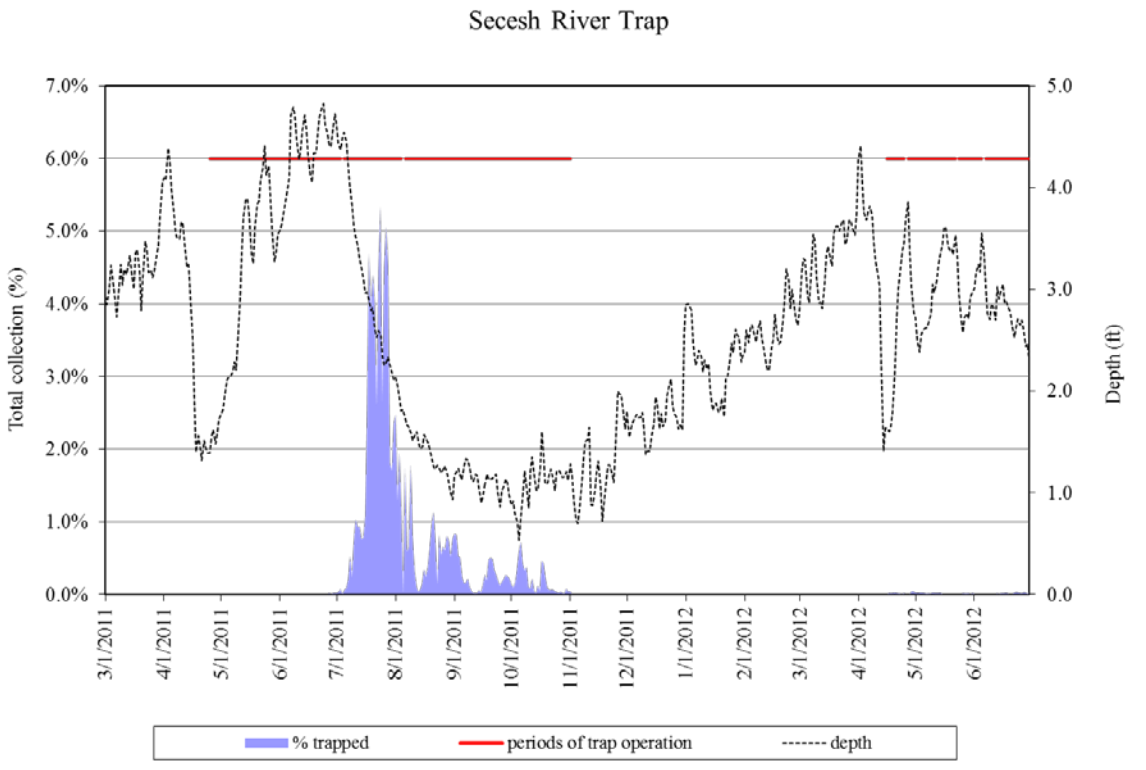
Appendix Figure 5. Daily passage of wild Chinook salmon fry, parr, and smolts at six migrant traps, expressed as percentages of total collected, and plotted against average daily depth collected near traps. Periods of trap operation are also shown.



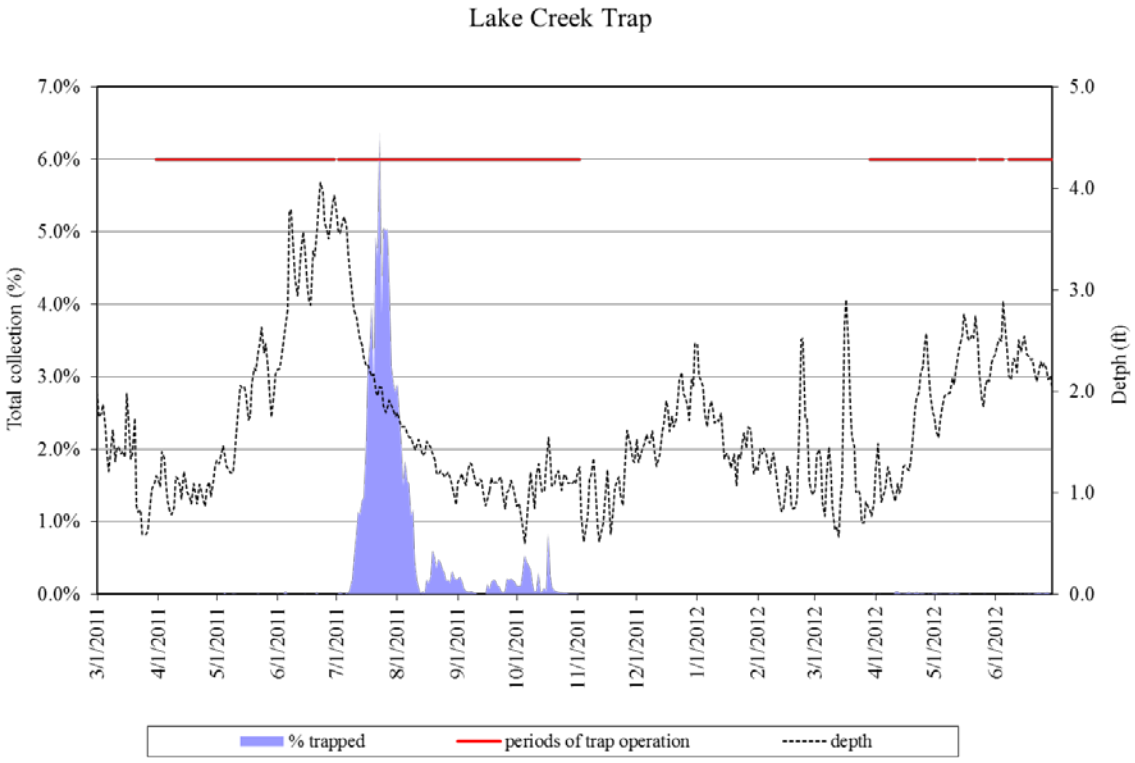


Appendix Figure 5. Continued.

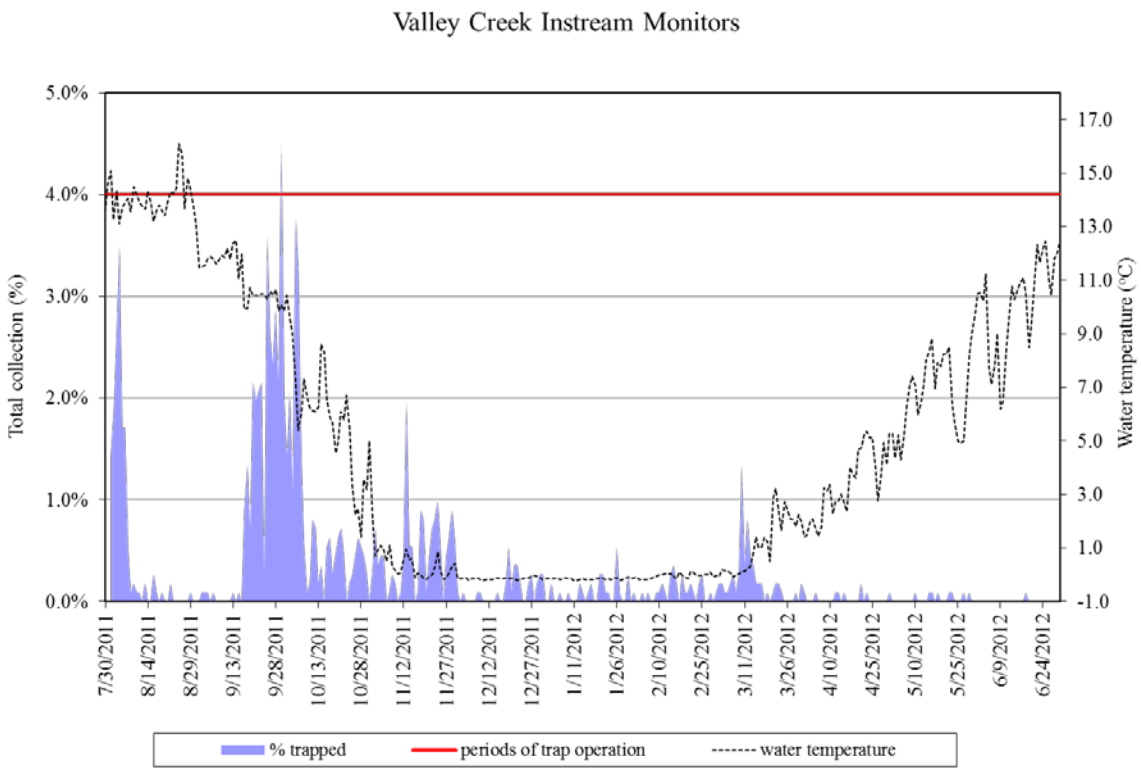




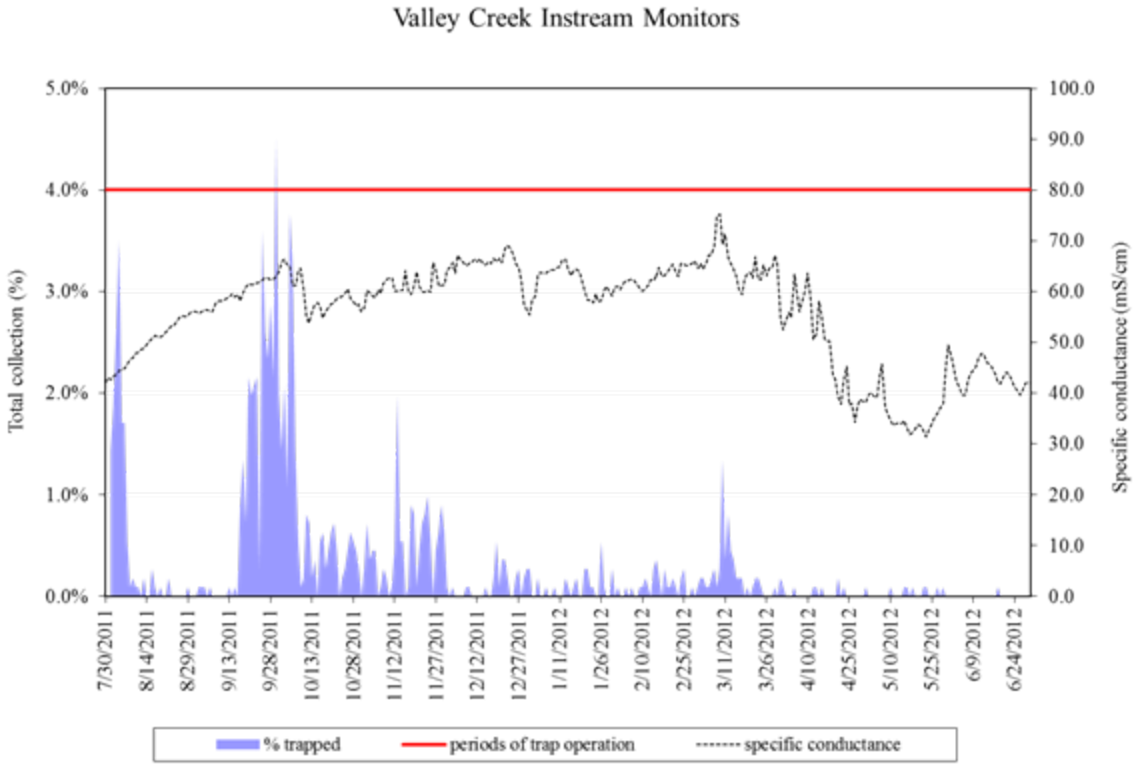
Appendix Figure 5. Continued.

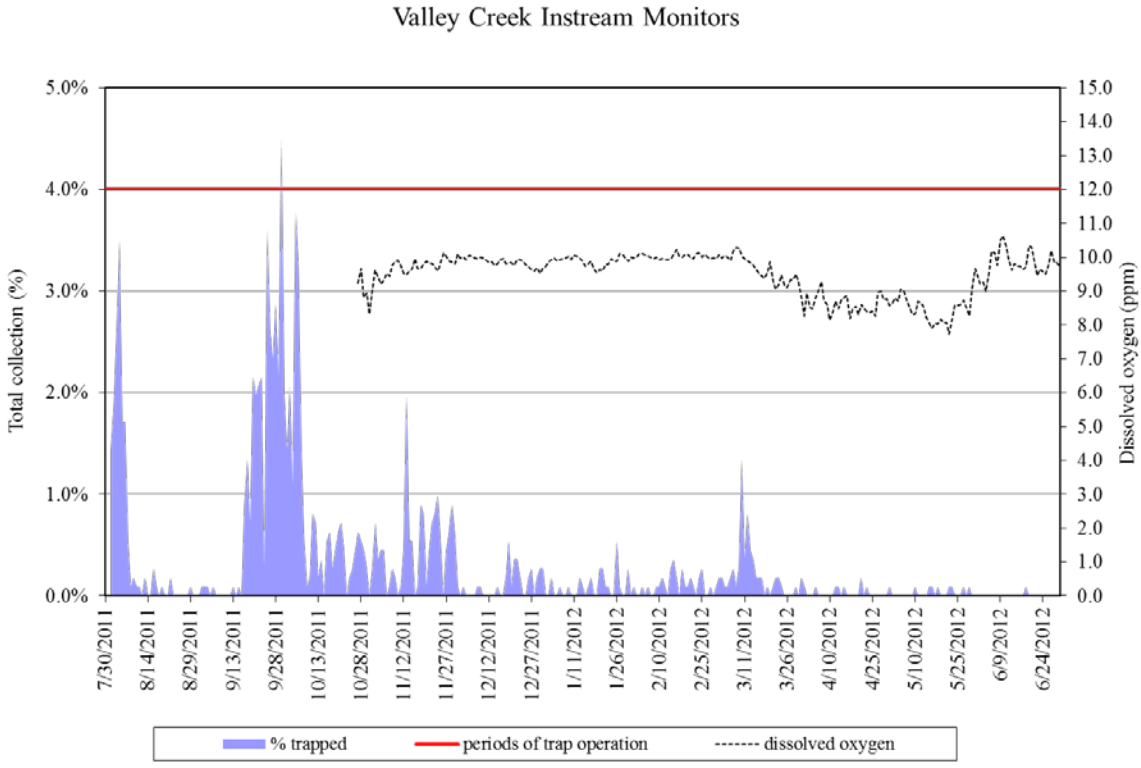


Appendix Figure 5. Continued.

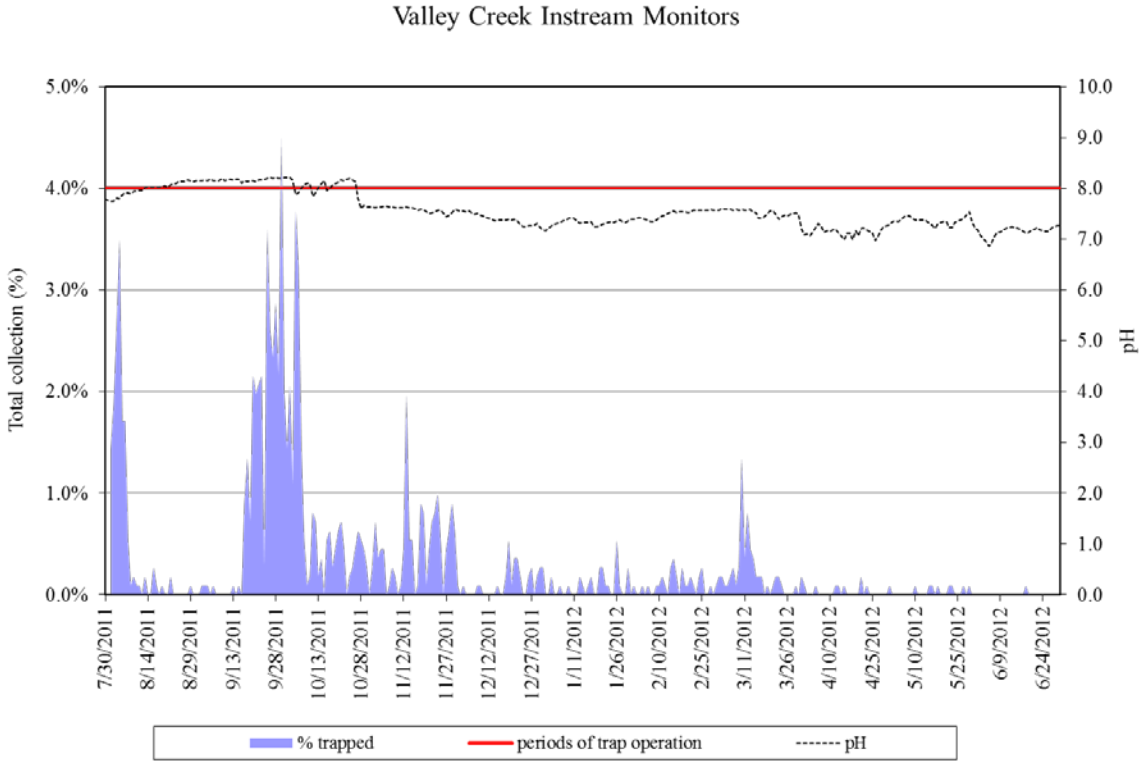


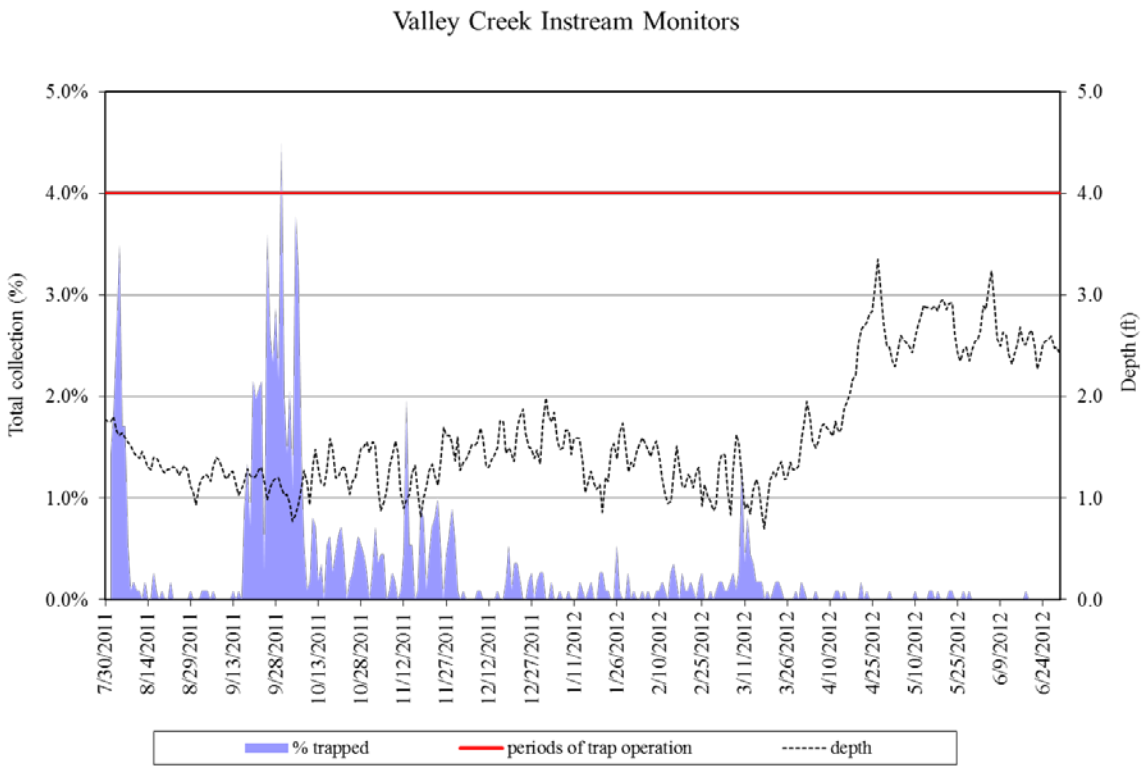
Appendix Figure 6. Combined daily PIT-tag detections of wild Chinook salmon parr at in-stream PIT-tag detectors in Valley Creek, expressed as percentages of total detected (12- and 9-mm PIT tagged fish), and plotted against average daily aquatic conditions collected near the detectors. Periods of operation for the detectors are also shown.





Appendix Figure 6. Continued.





Appendix Figure 6. Continued.