Monitoring the Migrations of Wild Snake River Spring/Summer Chinook Salmon Juveniles, 2013-2014

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Executive Summary

From late summer 2013 to mid-2014, we continued a multi-year research project to monitor the migration behavior and survival of wild juvenile spring/summer Chinook salmon in the Snake River Basin. In this report, we present data and analyses from detections of fish marked with passive integrated transponder (PIT) tags in summer 2013 and monitored through spring 2014. Fish from Idaho streams were tagged by the National Marine Fisheries Service while those from Oregon streams were tagged by the Oregon Department of Fish and Wildlife.

Our analyses included estimates of survival from release to instream PIT-tag monitors and from instream monitors to Lower Granite Dam, as well as from release to Lower Granite Dam. We also report median dates of arrival at the dam for each stream population. Principal results from tagging and interrogation during 2013-2014 are listed in Table E for the five individual streams that have PIT-tag monitoring systems and for Lower Granite Dam (Appendix Table 43 shows monitoring locations for each stream population in 2014). For all streams combined:

- We PIT tagged 13,667 wild Chinook salmon parr and released them to 15 Idaho streams or sample areas during July-August 2013.
- Overall observed mortality from collection, handling, tagging, and after a 24-h holding period was 1.2%.

In 2014, we recaptured study fish using the separation-by-code system at Lower Granite Dam. We measured length and/or weight for 479 of these fish, which represented 13 of the Idaho stream populations tagged in summer 2013 (no fish were recaptured from Marsh or Cape Horn Creek). Fish had grown an average of 30.6 mm in length and 6.3 g in weight over an average of 260 d. Their mean condition factor declined from 1.30 at release (parr) to 1.06 at recapture (smolt). For fish tagged as parr in 2013, mean length at release was significantly greater for fish detected during spring and summer 2014 that for those that were never detected ($P < 0.0001$). In addition, fish that arrived at Lower Granite Dam in April were significantly larger (FL) at release than those that arrived during May-June ($P < 0.0001$).

For tagged parr from all 15 Idaho and 3 Oregon populations, peak detections at Lower Granite Dam occurred during 22-26 April 2014, a time of moderate flows (77.3-82.0 kcfs). Respective dates of the 10th, 50th, and 90th passage percentiles were 15 and 27 April, and 21 May 2014. For fish from these Idaho and Oregon streams

combined, the average estimated rate of survival to Lower Granite Dam (parr-to-smolt survival) was 10.2% (range 5.0-19.8% depending on stream of origin). For fish from Idaho streams only, average estimated parr-to-smolt survival was 10.6%.

Table E. Numbers and proportions of wild spring/summer Chinook salmon released during 2013 and detected during 2013 and 2014. Results shown are for the five Idaho streams with monitoring systems for the passive integrated transponder (PIT) tag. Fish were tagged with either 12- or 9-mm PIT tags.

		Instream monitoring systems						Survival (%)		
		Detection		Detection period						
Stream	Released (n)	n	(%)	Late summer/ fall (%)	Winter (%)	Spring (%)	Detection efficiency (%)	To instream monitor	Monitor to Lower Granite Dam	Release to Lower Granite Dam
Valley Creek										
12-mm	1,249	386	30.9	93.5	3.9	2.6	48.9	63.2	9.1	5.1
9-mm	1,246	170	13.6	90.0	4.1	5.9	15.4	88.7	3.5	5.3
Total	2,495									
Big Creek (12-mm only)										
Upper	1,000	117	11.7	88.9	8.5	2.6	19.3	60.6	27.0	16.0
Lower	1,000	321	32.1	88.8	6.8	4.4	43.7	73.5	16.8	12.9
Secesh River & Lake Creek										
12-mm	571									
9-mm	566									
Total	1,137	93	8.2	92.5	7.5	0.0	---	55.2	29.0	16.0
South Fork Salmon River										
12-mm	501									
9-mm	499									
Total	1,000	53	5.3	79.2	20.8	0.0	10.9	48.8	34.1	10.8

Contents

Introduction

In 1991, the National Marine Fisheries Service (NMFS) conducted a biological status review of Snake River spring/summer-run Chinook salmon *Oncorhynchus tshawytscha* in response to petitions to list these stocks as threatened or endangered under the U.S. Endangered Species Act (ESA). These populations were evaluated as an evolutionarily significant unit (ESU) by a NMFS biological review team. Based on these evaluations, the team concluded that the Snake River spring/summer-run Chinook salmon comprises an evolutionarily significant unit (ESU) that is at risk of extinction (Matthews and Waples 1991).

The Snake River spring/summer-run Chinook salmon ESU was listed as threatened under the ESA in 1992. Since that time, this ESU has been the focus of a recovery plan whose goal is to restore its populations to self-sustaining levels. The plan serves as base of coordination for recovery efforts from federal, state, tribal, and municipal entities, as well as from private groups and individuals. Recovery efforts focus on both the salmon populations and their habitats.

In their analysis of potential recovery strategies, Kareiva et al. (2000) found that "modest reductions in first-year mortality or estuarine mortality would reverse current population declines" for Snake River spring/summer-run Chinook salmon. Their finding supports prioritization of the juvenile stage as an efficient approach toward allocation of resources for recovery goals.

For Pacific salmon *Oncorhynchus* spp., tagging and recapture studies have been at the center of research to improve survival of juvenile downstream migrants. Tagging studies began in the mid-1950s, and advances in technology have provided continued improvement for various tagging methods. However, until the late 1980s, methods such as freeze-branding, index counts at traps and dams, and analyses of flow patterns provided limited data to inform management decisions on fish passage. Since introduction of the passive integrated transponder (PIT) tag, a more complete approach has been available. Because it is small and biologically inert, a fish can retain the PIT tag throughout its life cycle. The tag allows multiple detections of an individual fish without physical recapture.

Since introduction of the PIT tag in the late 1980s, its use has expanded from about 50,000 to more than 2 million fish tagged annually. Used in conjunction with automated data collection methods, the PIT tag has provided integration of tagging and detection information for a broad mixture of wild/natural and hatchery stocks, ages, and

year classes. The Columbia Basin PIT Tag Information System (PTAGIS) was established as a repository for shared PIT tagging and detection data (PSMFC 1996).

Data from PIT tag detections have provided insight for decisions on programs to enhance juvenile passage at dams, such as spill and transportation. However, the need remains for data upon which to base decisions for these and other restoration and recovery efforts. Major gaps remain in understanding Columbia Basin stocks, their life patterns and survival at different points in their life cycles. Our research directly addresses these data gaps for wild Snake River spring/summer Chinook salmon at the parr-to-smolt stage.

In addition to acquiring data for the NWPPC and several other fish and wildlife programs; our research also addresses "Reasonable and Prudent Alternatives" in the 2000 NMFS Biological Opinion (NMFS 2000). For example, section 9.6.5.2, action 180 advocates a regional monitoring effort on the population status of wild fish stocks and the environmental status of their natal streams and tributaries. Section 9.6.5.5, Action 199 and Appendix H, research action 1193 call for

> ...research to produce information on the migrational characteristics of Columbia and Snake River basin salmon and steelhead. The smolt monitoring program produces information on the migrational characteristics of various salmon and steelhead stocks...and provides management information for implementing flow and spill measures designed to improve passage conditions in the mainstem lower Snake and Columbia Rivers (NMFS 2000).

More recently, in response to the remanded biological opinion, the *Final Updated Proposed Action for the FCRPS Biological Remand* proposed that researchers should

> …implement and maintain the Columbia River Basin PIT Tag Information System. Expand the system to systematically plan PIT tag efforts in the pilot study basins such that production and survival can be estimated throughout the system for wild and hatchery fish. Also, continue development and implementation of new fish detection and tagging techniques (Action Agencies 2004).

Clearly, the migratory performance of wild fish (e.g., run timing/survival) is important and should continue to be monitored. To this end, marking wild/natural parr with PIT tags in their natal streams during the summer of their first year of life provides the opportunity to precisely track these stocks through instream PIT tag monitors, traps, and the hydroelectric complex during their parr/smolt migrations from late summer to spring.

This report provides information on wild Chinook salmon parr that were PIT tagged and released by NMFS in Idaho during 2013. We subsequently monitored these fish during spring and early summer 2014, along with fish from Oregon streams that were PIT tagged by the Oregon Department of Fish and Wildlife. 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; Lamb et al. 2013, 2014). 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 patterns in migration/survival are apparent
3. Determine which environmental factors may influence patterns in migration/survival
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 of these wild fish populations, all of which remain listed as threatened under the U.S. Endangered Species Act of 1973 (NMFS 2008).

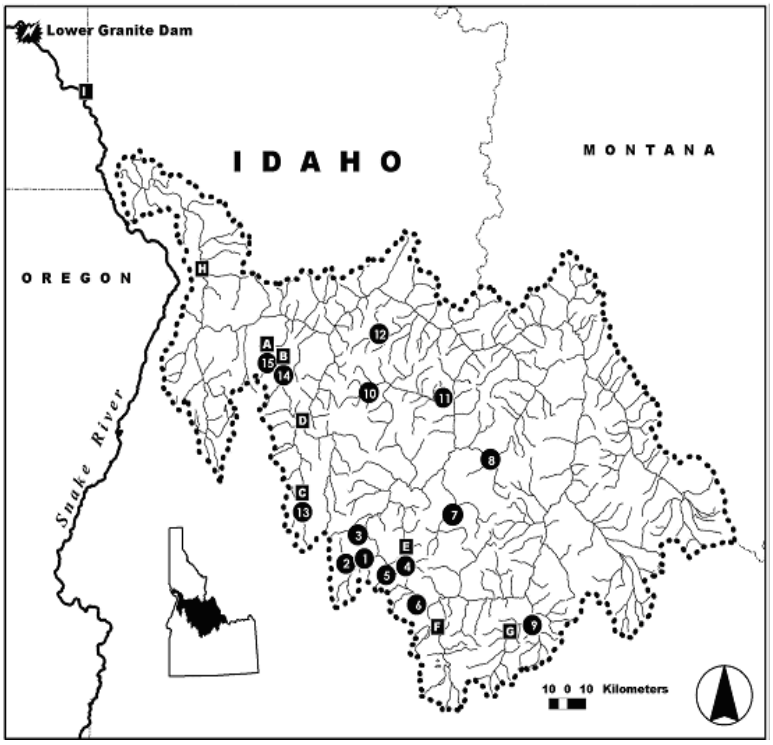
During 2013-2014, we collected water temperature and depth at 15 locations, in the Salmon River Basin, Idaho, for the Baseline Environmental Monitoring Program. These environmental data can be compared with parr/smolt migration, survival, and timing data to discern patterns or characteristic relationships that may exist. Understanding of such relationships will provide additional insights for the recovery planning of these threatened populations.

Methods

Fish Collection and Tagging

National Marine Fisheries Service (NMFS) personnel tagged fish in 15 Idaho streams or sample areas during 2013 (Figure 1). Fish were not sampled in Sulphur Creek due to low redd counts the previous spawning year (2013). Fish were collected and tagged using safe handling methods developed for this study; these methods are detailed by Matthews et al. (1990, 1997) and in previous reports from this study (Achord et al. 1994, 1995a,b, 2003, 2004, 2010, 2011; Lamb et al. 2013, 2014).

For the third consecutive year, fish were tagged using both a standard 12-mm PIT tag (TX1400SST-PL) and a smaller, 9-mm tag (TX49011B9-PL). The 9-mm tags were used at four tagging locations: South Fork Salmon River, Secesh River, Lake Creek, and Valley Creek (Table 1b). We compared detection efficiencies between the two tags at instream monitoring systems and at monitoring systems in the juvenile bypass facilities of Snake and Columbia River dams.



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

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

Figure 1. Map showing the streams, sample areas, and juvenile migrant traps where wild spring/summer Chinook salmon parr were PIT tagged during 2013.

In 2013, fish were tagged using individual single-use hypodermic needles that were pre-loaded with either 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. Anesthetized fish were randomly selected during tagging, and a system was set up to rotate between preloaded 12- 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 Catherine Creek and the Lostine, Minam, and Imnaha River drainages of northeast Oregon in summer 2013. All tagging, detection, and timing information for fish from these streams in 2013-2014 will be reported by ODFW. However, with ODFW's concurrence, we report here the timing and overall estimated survival to Lower Granite Dam of these fish.

Downstream Detection and Recapture

Instream PIT-Tag Monitors

The first instream PIT-tag monitoring systems were installed at two sites in Valley Creek during 2002 in an effort to detect fish closer to their natal rearing sites. Development and improvement of these systems has continued since, and instream monitoring systems have been added throughout the Salmon River basin (discussed individually below). Systems are set up to automatically interrogate, store, and transmit data from passing tagged fish to the Columbia River PIT-Tag Information System (PTAGIS), a regional shared database operated by the Pacific States Marine Fisheries Commission (PSMFC 1996). The history and development of these instream detection systems has been reported by Achord et al. (2004-2005, 2009-2012) and Lamb et al (2013-2014).

From late July 2013 through June 2014, detection data from wild PIT-tagged Chinook salmon juveniles were collected from traditional instream detection systems at seven sites: Valley Creek, Big Creek, South Fork Salmon River (Krassel Creek), lower South Fork Salmon River (Guard Station Road Bridge), lower Secesh River and two upper Salmon River sites (rkm 460 and rkm 437). Project personnel from the Integrated Status and Effectiveness Monitoring Program (ISEMP) continued with the responsibility for development and maintenance of all instream PIT-tag monitoring systems during this period.

During this period, the interrogation sites on Valley Creek (VC1 & VC2), Big Creek (TAY), and the two upper Salmon River sites (rkm 460 & rkm 437) remained in good working order and in the same configuration as in 2013. We continued to monitor PIT-tagged wild fish at these sites and at three monitoring sites on the South Fork of the Salmon River drainage: the lower Secesh River near Zena Creek Ranch (rkm 5), the lower South Fork Salmon River at Guard Station Road Bridge (rkm 30), and the South Fork Salmon River near Krassel Creek (rkm 65).

Juvenile Migrant Traps

Some fish PIT tagged as parr in natal rearing areas were subsequently collected at migrant traps (Figure 1). During fall 2013 and spring 2014, 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 near the stream mouth
- Secesh River near Chinook Campground and near the stream mouth
- Marsh Creek slightly upstream of the confluence with Cape Horn Creek
- Marsh Creek below the confluence with Cape Horn Creek and near Lola Campground
- Lower Big Creek at Taylor Ranch
- Upper Salmon River near the Sawtooth Hatchery
- Bear Valley Creek near Fir Creek Campground

Also during spring 2014, 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 stream or river.

Recaptures at Dams

At Lower Granite Dam, sampling was conducted from April through July 2014 in an effort to recapture study fish tagged as parr the previous year (2013). Recaptures were obtained by programming the PIT-tag separation by code (SbyC) system to divert tagged study fish from the population passing the dam (Downing et al. 2001). The SbyC system was programmed to divert a maximum of 100 fish from each stream, at a maximum collection rate of 10 fish per day. All recaptured fish were handled using water-to-water transfers and other best handling practices. After taking weight and length measurements, all tagged and untagged fish were returned to the river via the bypass system.

In addition to recording fork length (mm) and weight (g) measurements for these wild smolts at Lower Granite Dam, we calculated a Fulton-type condition factor (CF) 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 2014, wild Chinook salmon smolts that had been PIT-tagged as parr in 2013 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 at designated intervals each day. Tagged fish encountered a final opportunity for detection on a pair-trawl fitted with a PIT-tag detection antenna and operated in the upper Columbia River estuary ~150 km downstream from Bonneville Dam (Ledgerwood et al. 2004; Magie et al. 2010).

Data Analyses

Estimates of Detection and Survival

For release groups from each stream population, we estimated survival probability from release as parr to arrival at Lower Granite Dam as smolts; we also estimated detection probabilities at the dam for each group. For monitored streams, this migration corridor was divided into two smaller segments: 1) a stream segment, which spanned from the point of release to the lower instream monitor, and 2) a river segment, which spanned from the lower instream monitor to the dam. Methods used for estimates in each of these segments are described individually below.

Stream Segment—For estimates of parr-to-smolt survival in each stream segment, we constructed a detection history for each fish that included detection or non-detection at 1) one or both of the upper and lower instream monitors and/or 2) any downstream dam. This produced four possible detection histories. Counts of fish with each detection history were fitted to a multinomial model, with cell probabilities parameterized as functions of detection and survival probability. We used 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 each at Valley Creek, Lower Big Creek, and on the upper Salmon River, 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 has shown that detection at an upper instream monitor was not independent of detection at a lower monitor, violating a critical assumption required by the CJS model. An additional, untestable assumption of 100% survival between the upper and lower instream monitors would have allowed us to model the dependency between these detection probabilities; however, sample size in many cases was not sufficient to obtain useful estimates from this model. Therefore, we used the CJS method.

River Segment—For the river segment, we estimated survival from release to Lower Granite Dam for all individual streams. For fish from stream segments with instream monitors, we also estimated survival from the downstream monitor to Lower Granite Dam. Through the use of auxiliary data (described below), we estimated separate probabilities of survival for each stream overall and for each of three detection periods: late summer/fall (August-October), winter (November-February), and spring (March-June). For estimates from the lowermost instream monitor to the dam, we first grouped detected fish by seasonal period of detection. Then, for each cohort (for the stream overall or for 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 instream monitoring systems, we totaled the number of fish that were detected at upper or lower systems during each seasonal period and that survived to Lower Granite Dam. This total was divided by the total number detected on system monitors during each seasonal period to derive estimates of survival to Lower Granite Dam by season. For monitored streams, we also estimated an overall parr-to-smolt survival rate to Lower Granite Dam by calculating the weighted mean of the three seasonal survival estimates, where each season was weighted according to the proportion of total detections that occurred during that season.

Auxiliary data—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 summarized 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 that passed detected or undetected from all wild Chinook salmon PIT-tagged and released upstream from Lower Granite Dam. Thus a series of daily detection probabilities was developed as follows:

1) Fish detected on day *i* at Little Goose Dam that had previously been detected at Lower Granite 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 fish detected at Lower Granite.
3) This process was repeated for all days with detections at Little Goose Dam.
4) Detected and non-detected fish known to have passed 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).

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

Migration Timing

For each stream, we monitored within-season migration timing to Lower Granite Dam based on daily detection numbers of all wild PIT-tagged Chinook smolts at the dam. 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 2013-2014, we collected hourly measurements of water temperature (°C) and water depth (ft) from 15 locations using water quality data loggers (In-Situ[†] Level Troll 300). Monitors were positioned in all Idaho streams where annual sampling of juvenile Chinook salmon parr has been conducted during this study, with the exception of Big Creek. Water quality data for Big Creek was collected and provided to us by Quantitative Consultants, Inc. in association with the ISEMP project. In streams with juvenile migrant fish traps, monitors were placed in close proximity to trap locations in order to reflect environmental changes that occur locally. Data collected were compared with juvenile migration timing at specific locations (Appendix Figures 1-6).

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

Results

Fish Collection and Tagging

From 30 July to 28 August 2013, we collected 18,100 wild Chinook salmon parr from 15 Idaho stream populations (Figure 1). These populations were sampled over a distance of about 26.2 stream km and over an area of approximately 318,949 m^2 (Table 1a; Appendix Table 1a). Of the fish collected, 11,356 were PIT tagged using standard 12-mm tags, and 2,311 were tagged using 9-mm tags (Biomark TX1400SST and TX49011B9).

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 315 in Lake Creek to 2,495 in Valley Creek (Tables 1a-1b; Appendix Tables 1a-1b).

In 2013, the mean fork length of all Chinook salmon parr collected was 62.9 mm and the mean weight was 3.7 g. The mean fork length of Chinook salmon parr that were tagged and released was 65.5 mm, and the mean weight was 3.6 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) coordinate system (Appendix Table 2b).

Other than Chinook salmon parr, sculpin (genus *Cottus*) 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, while other species were collected only incidentally.

Mortality associated with collection and tagging procedures in 2013 was low (Table 3; Appendix Table 3). Overall, collection mortality was 1.1%, tagging and 24-h delayed mortality was 0.1%, and total observed mortality was 1.2%. In addition, 2 lost tags (0.01%) were observed prior to release.

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 through August 2013.

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		
Camas Creek	736	500	59.8	62.8	3.4	3.3	21-21.8	12,006
Herd Creek	591	553	74.2	72.8	5.8	5.0	1-4	15,660
Loon Creek	575	500	65.4	66.1	3.9	3.9	28-31	18,139
Valley Creek	3,568	2,495	60.1	63.3	3.5	3.4	3.8-5.5 & 7-7.5	34,897
Marsh Creek	1,206	997	64.0	65.7	3.8	3.8	11.2-11.8	15,772
Cape Horn Cr	1,895	1,000	56.1	62.3	3.6	3.4	0.2-1	33,996
Bear Valley Cr	1,140	999	65.1	65.2	3.8	3.7	8.5-9.4 &12-12.4	25,285
Elk Creek	1,130	990	66.5	66.4	4.3	4.2	0-1.5	20,872
Big Cr (upper)	1,368	1,000	61.0	63.4	3.6	3.5	57.5-60	37,801
SF Salmon R	1,051	1,000	66.9	67.1	3.6	3.6	117.2-118.4	21,480
WF Chamberlain Cr	1,593	996	63.4	64.5	3.1	3.1	1.2-1.8	5,000
Chamberlain Cr	597	500	62.6	63.9	3.3	3.3	24.2-24.8	7,292
Secesh River	1,126	822	62.1	65.4	3.7	3.7	24.5-28	26,777
Lake Creek	464	315	61.9	64.9	4.0	3.8	1-2.4	14,762
Big Cr (lower)[a]	1,060	1,000	72.0	72.2	--	--	7-10.4	29,210
Total/average	18,100	13,667	62.9	65.5	3.7	3.6	26.2	318,949

[a] Only two weights were taken on Big Creek (lower) during 2013.

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 through August 2013. See Table 1a for other stream-related information.

Tagging location	Tagged and released		Average length (mm)		Average weight (g)	
	12 mm	9 mm	12 mm	9 mm	12 mm	9 mm
Valley Creek	1,249	1,246	63.2	63.4	3.5	3.3
S Fork Salmon R	501	499	67.3	67.0	3.7	3.6
Secesh River	414	408	65.4	65.3	3.7	3.6
Lake Creek	157	158	64.7	65.0	3.8	3.8
Totals or averages	2,321	2,311	64.6	64.6	3.6	3.5

Table 2. Summary of species other than Chinook salmon parr observed during fish collections in Idaho, July-August 2013. Steelhead greater than 80 mm 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
Camas Creek	126	0	336	0	0	2	0	0	0	6	0
Herd Creek	540	0	100	0	0	1	376	0	0	37	0
Loon Creek	100	0	103	0	4	2	245	0	0	26	0
Valley Creek	62	0	299	25	0	24	953	125	13	66	24
Marsh Creek	60	0	195	116	0	2	238	0	0	5	0
Cape Horn Creek	39	0	114	30	0	13	416	0	0	1	0
Bear Valley Creek	116	0	363	308	0	5	362	6	56	0	0
Elk Creek	117	0	214	167	0	10	188	4	95	6	0
Big Creek (upper)	198	155	510	227	0	5	1,353	0	0	0	0
S Fork Salmon R	411	0	712	2	0	4	11	6	2	4	0
WF Chamberlain Cr	64	0	31	0	0	11	38	0	0	0	0
Chamberlain Cr	91	0	57	0	0	0	174	0	0	0	0
Secesh River	132	0	239	19	0	7	232	24	0	0	0
Lake Creek	46	0	34	30	0	8	559	1	0	0	0
Big Cr (lower)	471	96	325	2	0	0	253	91	31	0	0
Totals	2,573	251	3,632	926	4	94	5,398	257	197	151	24

Table 3. Mortality percentages for wild Chinook salmon parr collected and PIT-tagged in Idaho from July through August 2013. There were also 2 lost tags for the study.

	Mortality (%)		
Tagging Location	Collection	24 h	Overall
Camas Creek	2.0	0.0	2.0
Herd Creek	2.2	0.2	2.4
Loon Creek	1.9	0.2	2.1
Valley Creek	0.8	0.1	0.9
Marsh Creek	1.4	0.1	1.5
Cape Horn Creek	0.8	0.0	0.8
Bear Valley Creek	2.0	0.1	2.1
Elk Creek	1.9	0.1	2.0
Big Creek (upper)	0.9	0.1	1.0
S Fork Salmon River	0.7	0.1	0.8
W Fork Chamberlain Cr	0.1	0.2	0.3
Chamberlain Creek	0.2	0.0	0.2
Secesh River	0.7	0.1	0.8
Lake Creek	0.6	0.0	0.6
Big Creek (lower)	1.9	0.1	2.0
Averages	1.1	0.1	1.2

Detections at Instream Monitors

Valley Creek

From 4 to 6 August 2013, we PIT tagged 2,495 wild Chinook salmon parr and released them to Valley Creek. Of these fish, 1,249 were tagged with 12-mm tags and 1,246 with 9-mm tags; all fish were released in natal rearing areas 3-10 km above the upper instream monitor in lower Valley Creek (VC1; Table 1a). Between 5 August 2013 and 9 June 2014, 386 fish with 12-mm tags and 170 fish with 9-mm tags were detected at the two Valley Creek monitoring sites (Figure 2). Also, 3 Valley Creek fish and 21 Herd Creek fish (3.8%) were detected on the two new instream monitors on the upper Salmon River (rkm 437 & 460).

For the 129 fish marked with a 12-mm tag and detected at both Valley Creek monitors, median downstream travel time between the upstream and downstream monitors (VC1 to VC2) was 13.5 h (range 0.3 h-109.5 d). Of the 386 detections of 12-mm tags in Valley Creek, 361 (93.5%) occurred in late summer/fall, 15 (3.9%) in winter, and 10 (2.6%) in spring (Figure 2a). For the 18 fish marked with a 9-mm tag and detected at both monitors, median downstream travel time between the upstream and downstream Valley Creek monitors was 11.2 h (range 0.4 h-241.5 d). Of the 170 detections of 9-mm tags in Valley Creek, 153 (90.0%) occurred in late summer/fall, 7 (4.1 %) in winter, and 10 (5.9%) in spring (Figure 2b).

Based on detections at downstream dams, the overall efficiency of Valley Creek monitors was 48.9% for fish with 12-mm tags and 15.4% for fish with 9-mm tags. Based on these efficiencies, an estimated 63.2% (SE = 9.5, 95% CI = 44.3-82.1%) of all parr marked with a 12-mm tag survived to migrate past the Valley Creek monitors, and an estimated 88.7% (28.2%; 32.3-145.0%) of all parr marked with a 9-mm tag survived to pass these monitors.

Survival from the Valley Creek monitors to Lower Granite Dam was 9.1% (2.2%; 5.1-13.7%) for fish with 12-mm tags and 3.5% (1.8%; 0.0-7.1%) for those with 9-mm tags. Detection data collected from August 2013 to June 2014 indicated a statistically significant relationship between fork length at tagging and timing of detection on the Valley Creek monitors for both the 12-mm and 9-mm tag groups ($P < 0.001$ and $P = 0.066$, respectively; Figures 3a and 3b).

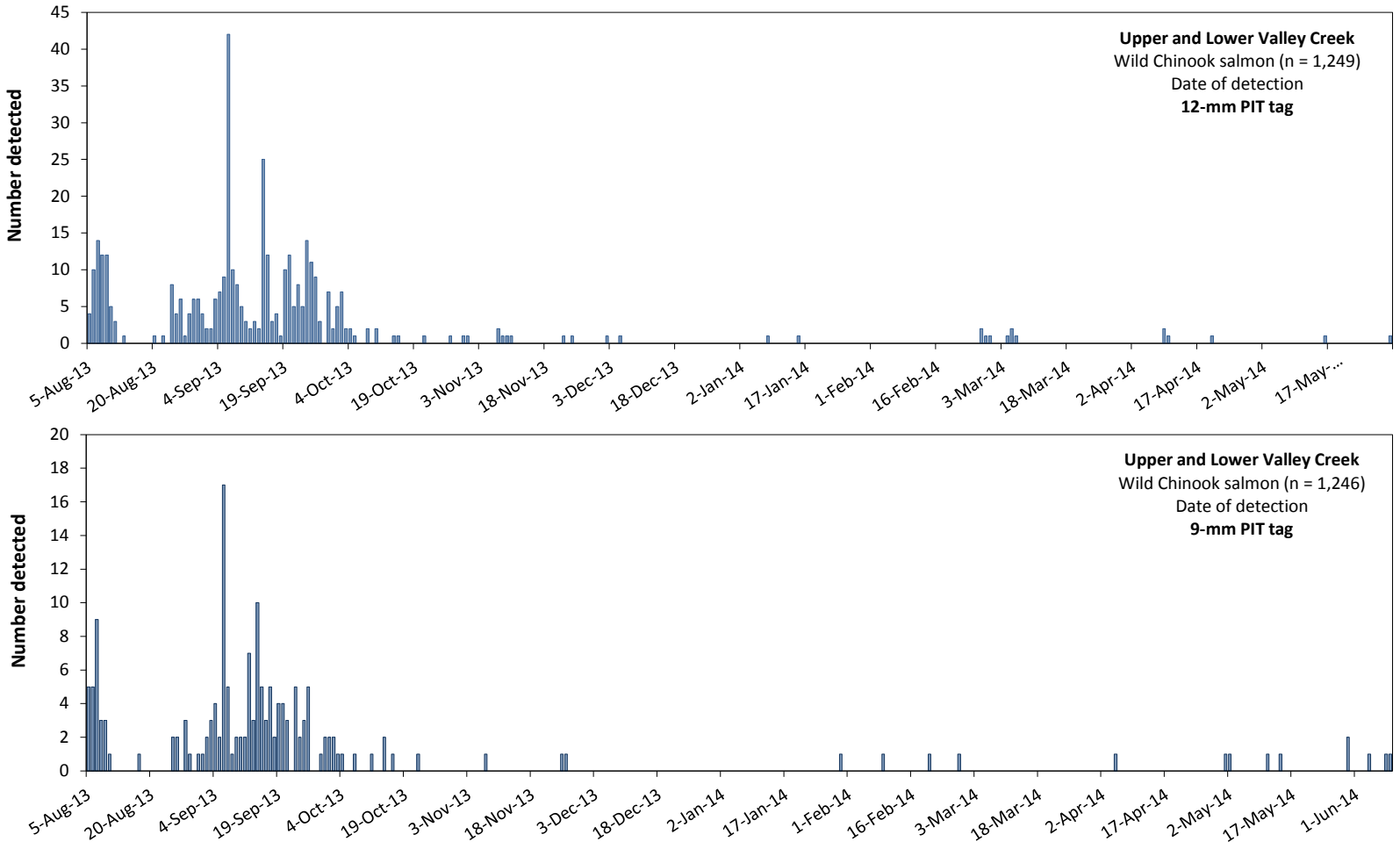


Figure 2. Detections at Valley Creek instream monitors (VC1 and VC2) of wild spring/summer Chinook salmon collected as parr from Valley Creek, August 2013-June 2014. We tagged a total of 1,249 parr with 12-mm tags (upper panel) and 1,246 with 9-mm tags (lower panel). Fish were released 3-10 km above these antennas during 4-6 August 2013.

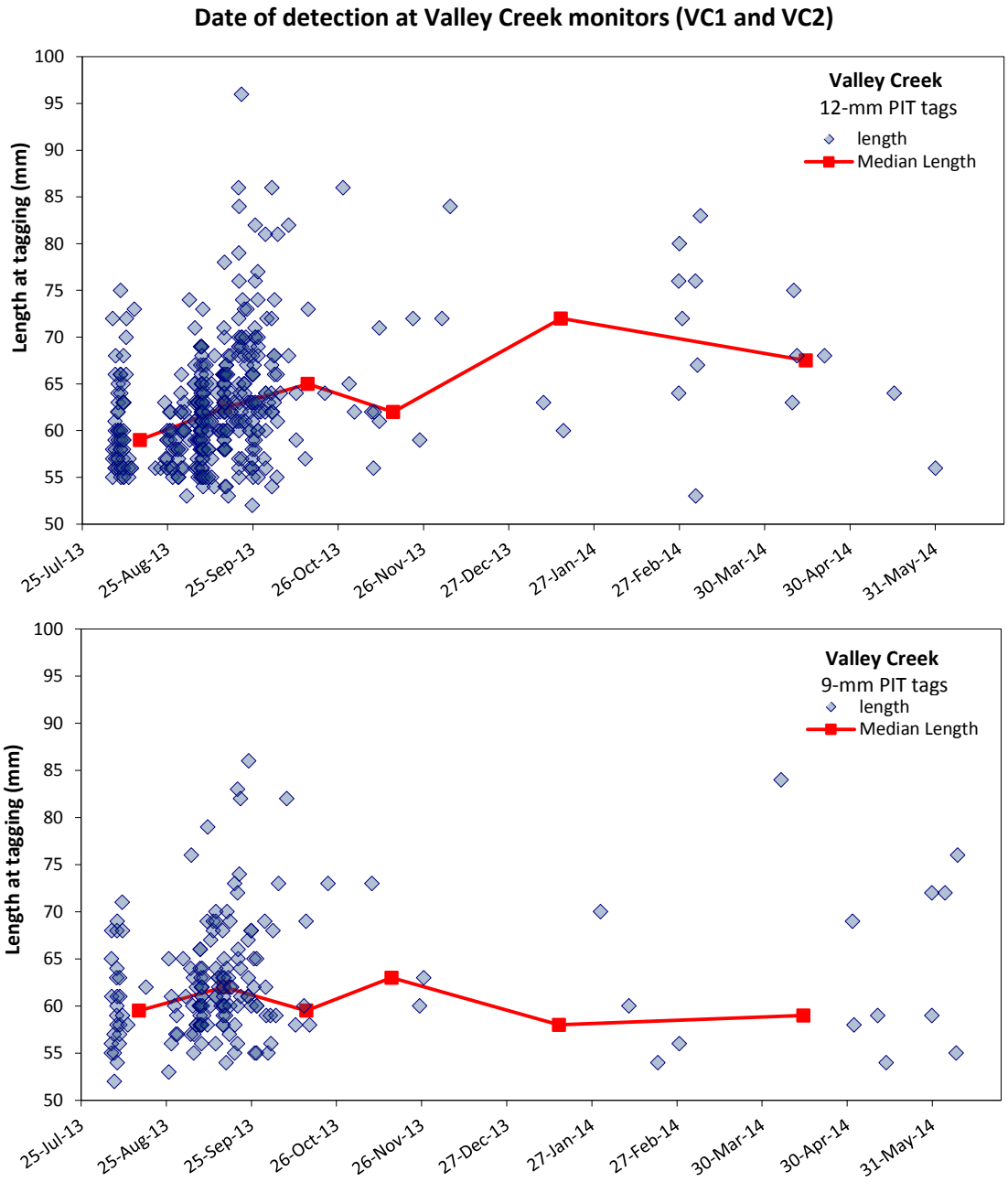


Figure 3. Fork length vs. date of detection for 386 fish tagged as parr with 12-mm tags (upper panel) and 170 tagged with 9-mm PIT tags (lower panel) in Valley Creek. Fish were detected on the upper and lower instream PIT-tag monitoring antennas in lower Valley Creek (VC1 orVC2) from August 2013 through June 2014.

Lower Big Creek

From 27 to 28 August 2013, we collected and tagged 1,000 wild Chinook salmon parr from lower Big Creek. All were marked with 12-mm PIT tags and released in natal rearing areas 0-3 km above the instream PIT-tag monitors in lower Big Creek at Taylor Ranch (Table 1a). Between 28 August 2013 and 30 May 2014, 321 of these fish were detected at least once on either the upper or lower Taylor Ranch monitors (Figure 4a). Of these 321 detections, 285 (88.8%) occurred in late summer/fall, 22 (6.8%) in winter, and 14 (4.4%) in spring (Figure 4a).

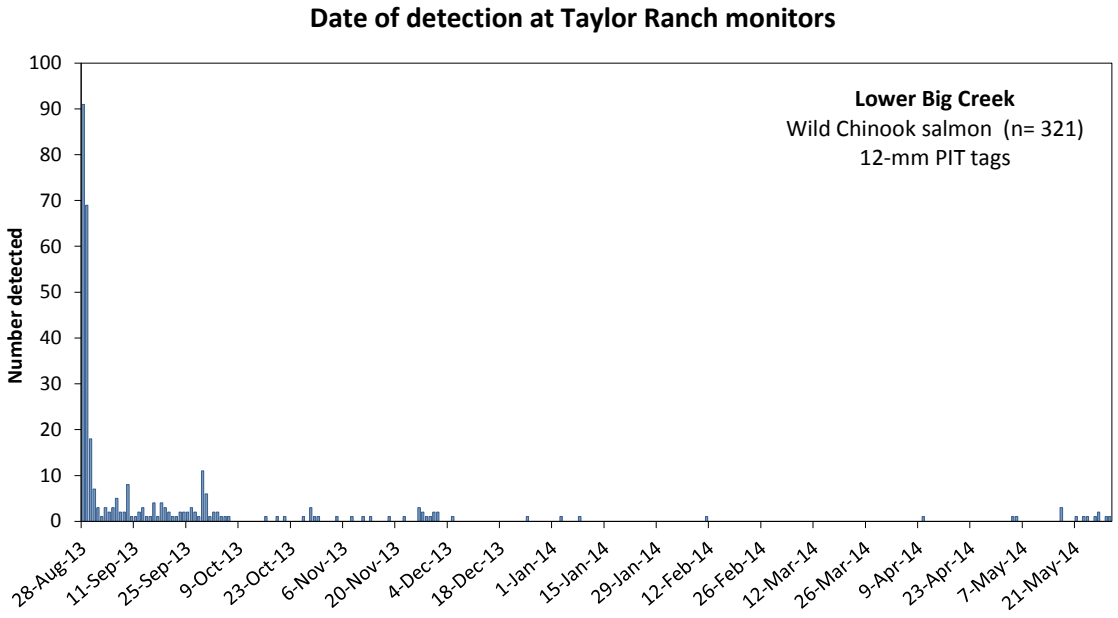


Figure 4a. Detections of 321 wild spring/summer Chinook salmon parr, pre-smolts, and smolts from lower Big Creek. Fish were detected at the upper or lower instream monitoring systems at Taylor Ranch (TAY-a and TAY-b) in lower Big Creek. A total of 1,000 parr were tagged with 12-mm PIT tags and released 0-3 km above monitoring systems on 28 August 2013.

Based on detections at downstream dams, the overall detection efficiency of both PIT-tag monitoring systems at lower Big Creek was 43.7%. Using this detection efficiency rate, we estimated that 73.5% (SE = 8.5%; 95% CI = 56.5-90.5%) of all tagged parr from this stream survived to migrate past the monitors at lower Big Creek, and their survival from the monitors to Lower Granite Dam was 16.8% (3.4%, 10.6-23.9%). Detection data collected from August 2013 through May 2014 did not indicate a statistically significant relationship between fork length at tagging and timing of detection in lower Big Creek (P = 0.441; Figure 4b).

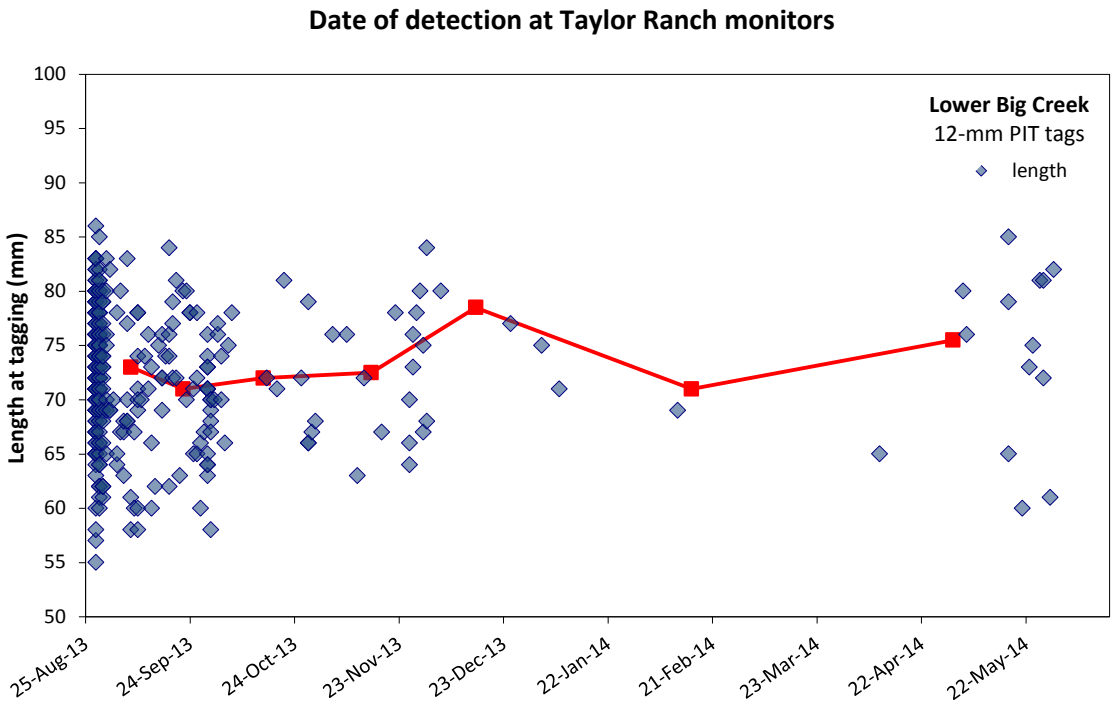


Figure 4b. Fork length at tagging vs. date of detection for 321 wild spring/summer Chinook tagged at lower Big Creek and detected at Taylor Ranch upper and lower instream PIT-tag monitoring antennas (TAY-a and TAY-b), August 2013-May 2014.

Upper Big Creek

From 14 to 15 August 2013, we collected and tagged 1,000 wild Chinook salmon parr from upper Big Creek. All fish were tagged with 12-mm tags and released in natal rearing areas 49-52 km upstream from the Taylor Ranch instream monitors in lower Big Creek (Table 1a). Between August 2013 and April 2014, the upper and lower monitoring sites had 117 unique detections of these fish (Figure 5a). Of these 117 detections, 104 (88.9%) occurred in late summer/fall, 10 (8.5%) in winter, and 3 (2.6%) in spring (Figure 5a).

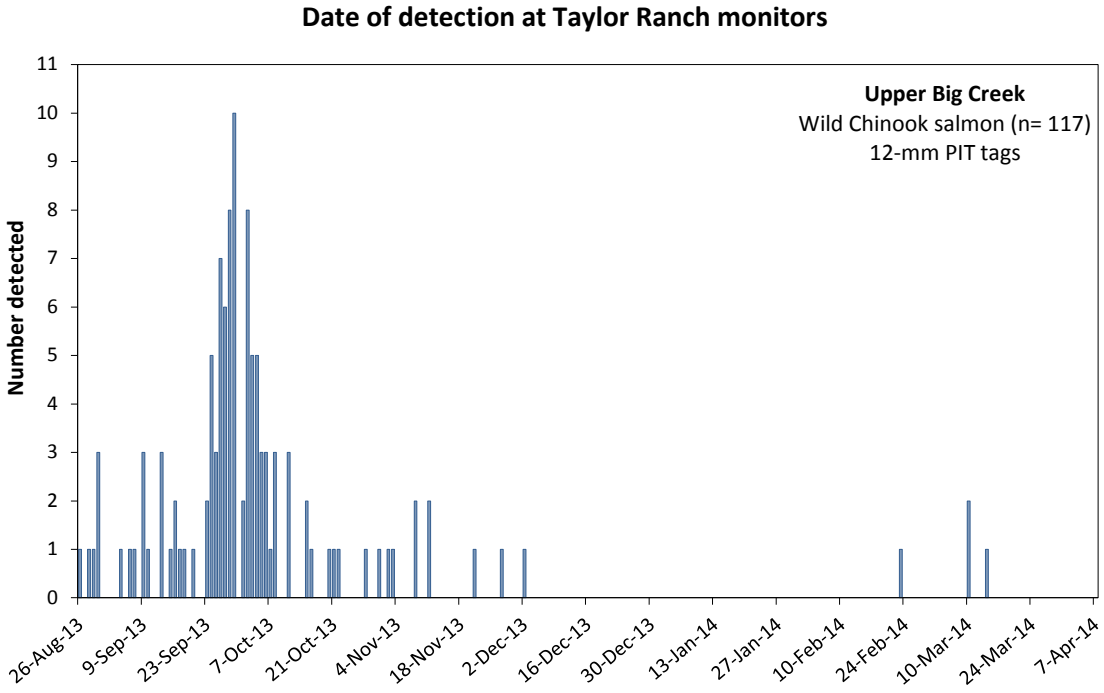


Figure 5a. Detections of 117 PIT-tagged wild spring/summer Chinook salmon parr, pre-smolts, and smolts from upper Big Creek at the upper (TAY-a) and lower (TAY-b) instream PIT-tag monitoring antennas at Taylor Ranch in lower Big Creek from August 2013 through April 2014. A total of 1,000 Chinook salmon parr were PIT tagged with 12-mm tags and released 49-52 km above these antennas from 14 to 15 August 2013.

Based on detections at downstream dams, the overall efficiency of the upper or lower instream monitors at Taylor Ranch in lower Big Creek in detecting these fish was 19.3%. Based on this efficiency, an estimated 60.6% (SE = 10.6%; 95% CI = 39.5-81.8%) of tagged parr survived to migrate past the downstream monitors, and their survival from the downstream monitors to Lower Granite Dam was 27.0% (6.7%, 15.0-40.7%). Detection data collected from August 2013 through May 2014 indicated a statistically significant relationship between fork length at tagging in upper Big Creek (P = 0.006) and timing of detection on the upper and lower monitors (TAY-a and TAY-b) at Taylor Ranch (Figure 5b).

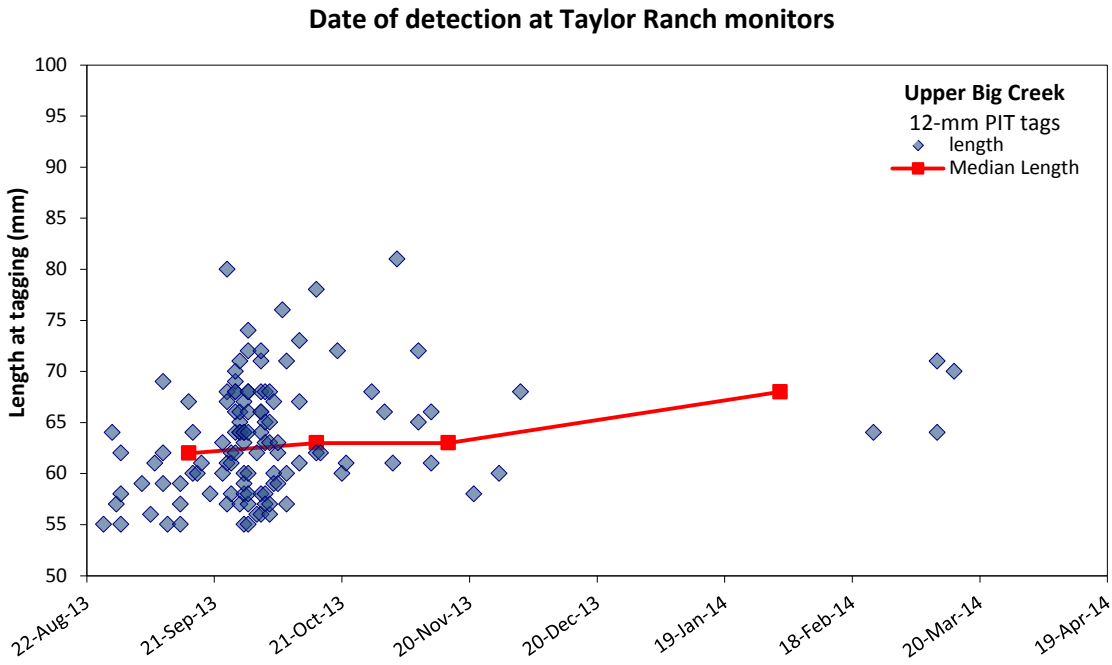


Figure 5b. Fork length at tagging vs. date of detection for 117 wild Chinook salmon tagged as parr from upper Big Creek and detected at Taylor Ranch upper and lower instream PIT-tag monitoring antennas (TAY-a, TAY-b), August 2013-April 2014.

South Fork Salmon River

From 17 to 18 August 2013, we collected and tagged 1,000 wild Chinook salmon parr from the South Fork Salmon River (Table 1a). Of these fish, 501 were tagged with 12-mm tags and 499 with 9-mm tags; all fish were released in natal rearing areas 52-53 km above the instream monitor near Krassel Creek (rkm 65) and 87-88 km above the monitor in the lower South Fork Salmon River at Guard Station Road Bridge (rkm 30). From August 2013 to April 2014, 53 of these fish were detected at the South Fork Salmon River monitor near Krassel Creek. No fish were detected at the site near Guard Station Road Bridge (SFG) during 2013-2014. Of the 53 detections at the Krassel Creek monitor, 42 (79.2%) occurred in late summer/fall and 11 (20.8%) in winter/spring (Figure 6a).

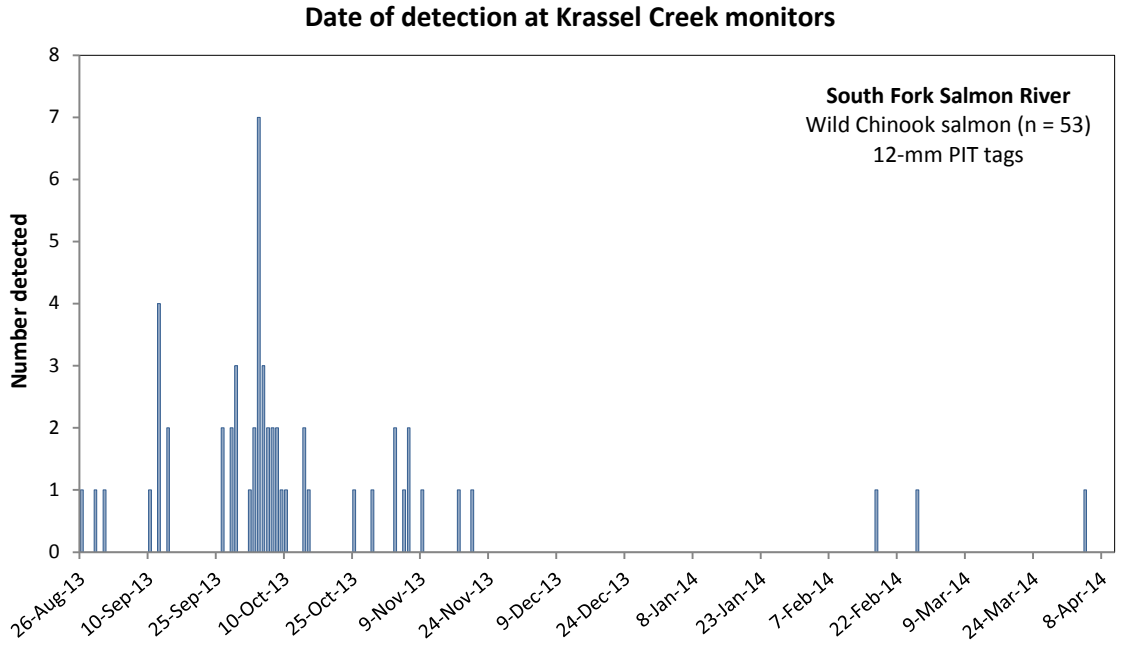


Figure 6a. Detections of 53 PIT-tagged wild spring/summer Chinook salmon parr, pre-smolts, and smolts at the Krassel instream PIT-tag monitoring antennas in the South Fork Salmon River, August 2013-April 2014. A total of 1,000 Chinook salmon parr were PIT tagged using 12-mm tags and released to the South Fork Salmon River in areas from approximately 52-53 km upstream from these antennas during 17-18 August 2013.

Based on detections at downstream dams, overall detection efficiency of the instream monitor at Krassel Creek was 10.9%. Using this detection efficiency rate, we estimated that 48.8% (SE = 13.5%; 95% CI = 21.8-75.7%) of all summer-tagged parr from this stream (area) survived to migrate past the monitors at Krassel Creek, and their survival from the monitors to Lower Granite Dam was 34.1% (10.5%; 15.2-55.7%). Detection data collected from August 2013 to April 2014 indicated no statistically significant difference between fork length at tagging and timing of detection for parr tagged and released in the South Fork Salmon river (P = 0.826; Figure 6b).

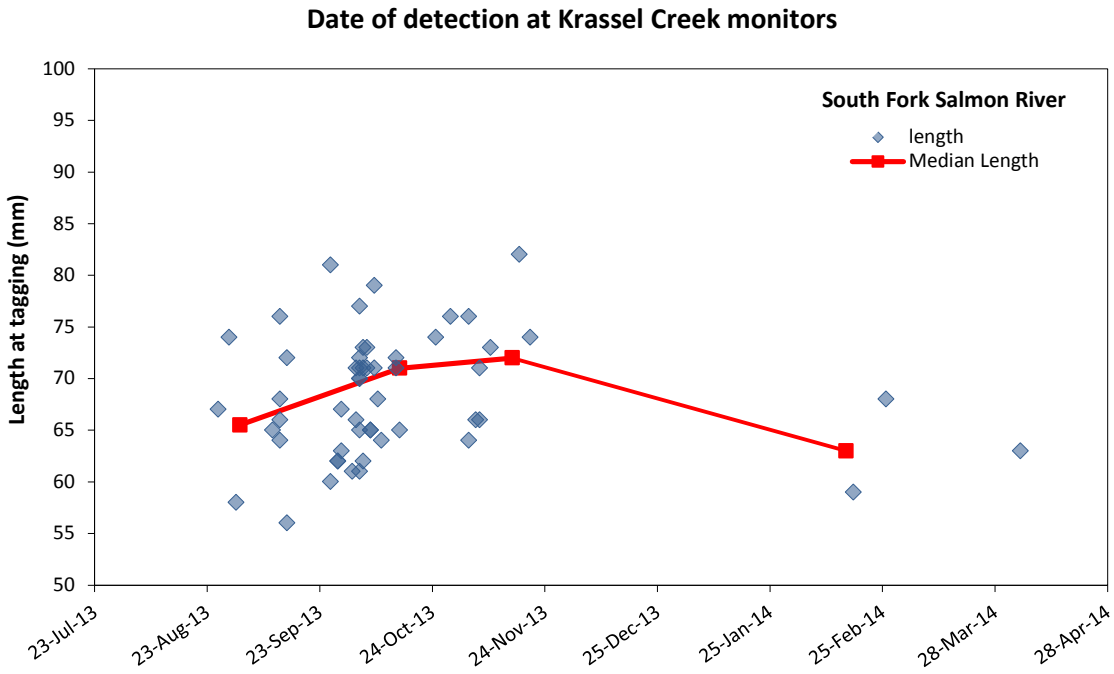


Figure 6b. Fork length at tagging vs. date of detection for 53 wild spring/summer Chinook salmon tagged as parr in the South Fork Salmon River and detected at the instream PIT-tag monitoring site at Krassel Creek in the South Fork Salmon River, August 2013-April 2014.

Secesh River and Lake Creek

From 23 to 25 August 2012, we collected and tagged 1,137 wild Chinook salmon parr from the Secesh River and Lake Creek. Of these fish, 571 were tagged using 12-mm PIT tags, 566 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 instream monitors near Zena Creek Ranch (ZEN) in the lower Secesh River, and ~55-76 km above the South Fork Salmon River monitoring site at Guard Station Road Bridge (SFG).

From August 2013 to June 2014, 85 of the 12-mm tagged fish and 8 of the 9-mm tagged fish were detected on instream monitors near Zena Creek Ranch (Figure 7). As a result of bed-load movement that buried the instream arrays, only 1 fish was detected at the monitor near Guard Station Road Bridge. Of the 93 detections near Zena Creek, 86 (92.5%) occurred in late summer/fall and 7 (7.5%) in winter, with no detections in spring of 2014 (Figure 7).

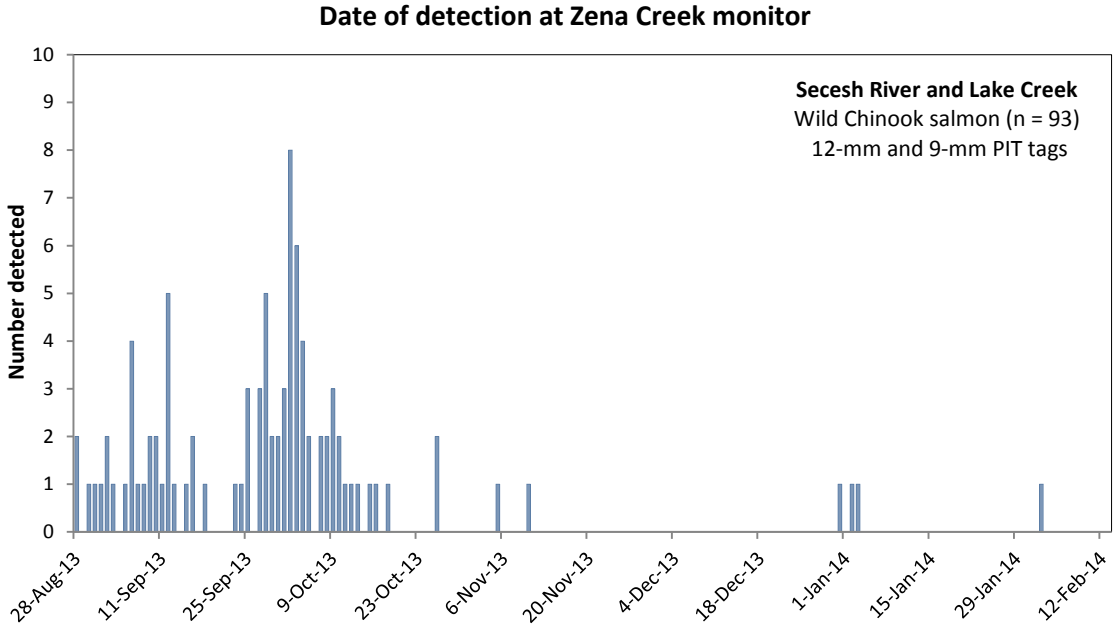


Figure 7. Detections at the Zena Creek Ranch instream monitoring site from wild spring/summer Chinook salmon collected as parr from the Secesh River or Lake Creek, August 2013-April 2014. A total of 571 fish were tagged with 12-mm PIT tags, while 566 were tagged with 9-mm PIT tags. All fish were released in areas ~21-42 km upstream from these antennas during 23-25 August 2013.

An estimated 55.2% (SE = 11.7%; 95% CI = 31.8-78.6%) of all tagged parr from Lake Creek and the Secesh River survived to migrate past the Zena Creek monitors. Survival from Zena Creek to Lower Granite Dam was 29.0% (8.1%; 12.9-44.7%) with an overall estimated survival of 16.0% (5.7%; 4.6-27.4%) from the two streams. Detection data collected from August 2013 to April 2014 indicated no statistically significant difference between fork length at tagging and timing of detection for parr tagged and released in the Secesh River and Lake Creek (P = 0.205; Figure 8).

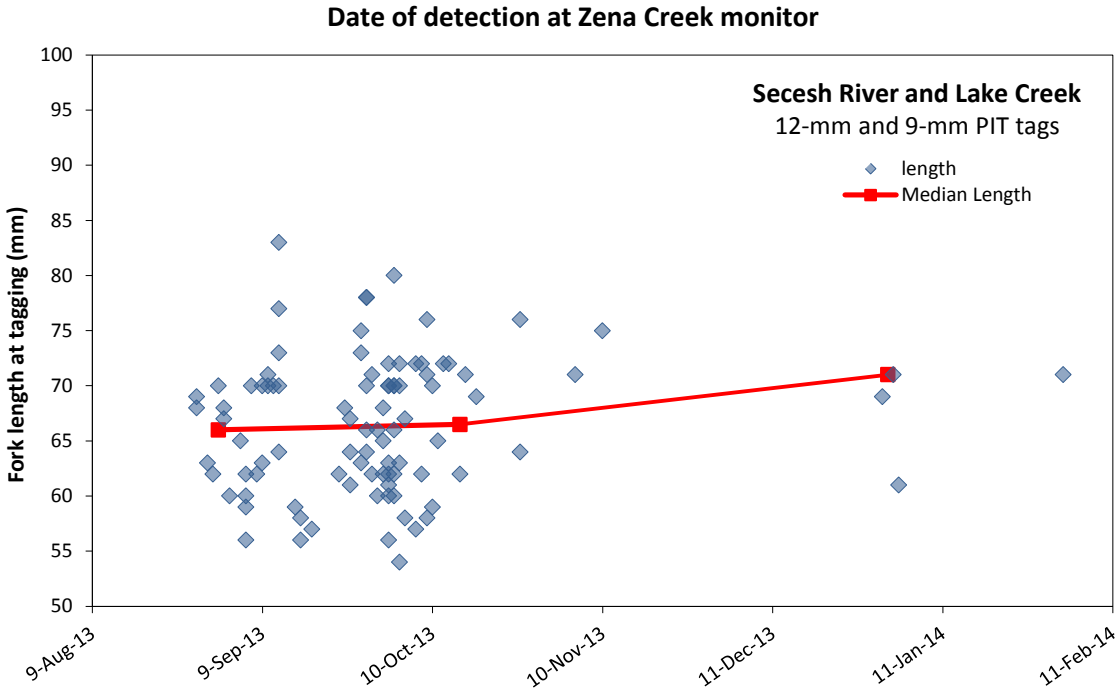


Figure 8. Length at tagging vs. date of detection for fish collected as parr from the Secesh River and Lake Creek. Detections were 93 fish with both 12-mm and 9-mm PIT tags. All fish were detected at the instream monitoring site in the lower Secesh River near Zena Creek Ranch, August 2013-April 2014.

Recaptures at Traps and Dams

A total of 520 wild spring/summer Chinook salmon PIT-tagged in summer 2013 were recaptured at traps above Lower Granite Dam from summer-fall 2013 to spring 2014. During 2014, 479 fish were recaptured in the separation-by-code (SbyC) system at Lower Granite Dam for examinations of length, weight, and condition (Table 4). Overall parr-to-smolt growth measured at Lower Granite Dam indicated a mean growth rate of 0.12 mm/d and mean weight gain of 0.024 g/d.

Table 4. Fork length, weight, and condition factor of wild spring/summer Chinook salmon PIT-tagged in Idaho during summer 2013 and recaptured either in the separation-by-code system at Lower Granite Dam in 2014 or at traps during summer-fall 2013 and spring-summer 2014. No fish were recaptured at dams other than Lower Granite. Precocious males were not included in the analysis.

	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
	Recaptures in separation-by-code diversion at Lower Granite Dam										
Bear Valley Creek	20	247-310	271	20	19-46	31	18	3.1-10.7	6.1	1.37	1.07
Big Creek (upper)	61	245-291	269	61	12-50	33	42	1.6-12.3	6.6	1.37	1.12
Big Creek (lower)	51	223-253	239	51	14-39	25	0	N/A	N/A	N/A	1.04
Camas Creek	33	261-301	278	33	20-53	34	19	2.8-12.8	6.6	1.35	1.08
Chamberlain Creek	16	240-269	251	16	14-49	30	11	3.0-11.5	6.6	1.27	1.07
W Fork Chamberlain Cr	24	237-266	250	24	20-40	29	6	3.5-7.2	5.8	1.15	1.02
Elk Creek	38	246-303	261	38	12-42	29	23	2.2-8.3	5.6	1.40	1.08
Herd Creek	46	254-315	272	46	13-51	30	6	4.3-10.6	6.5	1.12	1.00
Lake Creek	12	229-281	245	12	11-47	26	11	2.1-11.1	5.3	1.36	1.09
Loon Creek	37	257-292	272	37	24-60	35	15	4.1-9.4	6.6	1.21	1.06
S Fork Salmon R	42	228-291	253	42	13-54	30	28	3.0-14.8	6.9	1.22	1.04
Secesh River	45	223-272	240	45	14-52	31	23	2.4-11.3	6.5	1.25	1.06
Valley Creek	54	243-302	269	53	10-66	32	27	1.9-9.4	6.1	1.26	1.06
Totals or averages	479	223-315	260	478	10-66	31	229	1.6-14.8	6.3	1.3	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
	Recaptures at traps										
Bear Valley Creek											
Bear Valley origin, fall	15	0-18	4	12	2-6	3.3	6	-0.6-(-0.1)	-0.4	1.37	1.09
Elk Cr origin, fall	18	1-38	7	15	1-5	3.3	6	-1.1-1.0	-0.2	1.37	1.08
Big Creek (Taylor Ranch)											
Upper Big Cr origin, fall	31	25-81	53	31	0-14	4.8	22	-0.9-2.9	0.2	1.37	1.15
Lower Big Cr origin, fall	41	1-62	4	41	-5-10	0.1	0	N/A	N/A	N/A	1.17
S Fork Salmon R (Knox)											
Fall	135	1-78	23	134	-6-11	1.8	68	-2.9-3.6	-0.1	1.22	1.08
Lake Creek											
Fall	50	1-68	21	50	-6-15	0.5	37	-2.4-1.2	-0.7	1.40	1.11
Spring	2	229-250	240	2	7-12	9.5	1	N/A	3	0.80	1.14
Secesh River upper trap											
Secesh R origin, fall	27	1-41	8	26	-7-5	-0.9	27	-2.3-0.6	-0.7	1.19	1.05
Lake Cr origin											
Fall	22	3-36	20	22	-2-7	1.9	15	-2.5-0.2	-0.8	1.35	1.05
Spring	1	N/A	231	1	N/A	9.0	0	N/A	N/A	N/A	1.04
Secesh River lower trap											
Secesh R origin, fall	23	5-88	39	22	-4-15	3.2	17	-2.7-3.5	0.4	1.34	1.06
Lake Cr origin, fall	6	29-63	46	6	-1-8	4.3	1	N/A	-0.1	1.34	1.09

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
	Recaptures at traps										
Marsh Creek upper trap											
Fall	81	1-85	18	81	-5-17	0.9	1	N/A	-0.2	1.26	1.09
Spring	5	231-245	235	5	7-20	12.8	0	N/A	N/A	1.29	N/A
Marsh Creek lower trap											
Cape Horn Cr origin											
Fall	28	1-73	24	28	-2-9	4.1	0	N/A	N/A	1.36	N/A
Spring	2	251-258	255	2	18-20	19.0	0	N/A	N/A	N/A	N/A
Marsh Creek origin											
Fall	20	1-83	30	20	1-14	4.5	0	N/A	N/A	1.23	N/A
Spring	1	N/A	232	1	N/A	23.0	0	N/A	N/A	1.50	N/A
Salmon River											
Spring	9	191-249	235	9	14-31	24.4	0	N/A	N/A	1.17	N/A
Snake River											
Spring	3	243-253	248	3	28-36	31.7	0	N/A	N/A	N/A	N/A
Totals	**520**	**0-258**	**31**	**511**	**-7-36**	**2.7**	**201**	**-2.9-3.6**	**-0.3**	**1.29**	**1.10**

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 10.6% (SE 0.4%; Table 5; Appendix Tables 5-19). This estimate was based on expanded detections at Lower Granite Dam from 1 April to 15 June 2014 (1,451 fish). An additional 533 first-time detections (not expanded) were recorded at Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, and Bonneville Dam, and in the PIT-tag detection trawl in the upper Columbia River estuary (Appendix Tables 5-19).

Table 5. Summary of observed and expanded detections at Lower Granite Dam for PIT-tagged wild spring/summer Chinook salmon smolts from Idaho streams in 2014. Expanded detections are parr-to-smolt survival estimates shown with standard error in parenthesis. See Table 1a for numbers released.

	Lower Granite Dam detections			
	Observed		Expanded*	
	N	Survival (%)	N	Survival (%) SE
Bear Valley Creek	25	2.5	63	6.3 (1)
Camas Creek	38	7.6	82	16.3 (3)
Cape Horn Creek	59	5.9	137	13.7 (2)
Chamberlain Creek	20	4.0	46	8.7 (2)
West Fork Chamberlain Cr	24	2.4	55	5.5 (1)
Elk Creek	39	3.9	88	8.9 (1)
Herd Creek	48	8.7	110	19.8 (3)
Lake Creek	12	3.8	28	8.8 (3)
Big Creek (lower)	58	5.8	129	12.9 (2)
Loon Creek	44	8.8	95	19.1 (3)
Marsh Creek	51	5.1	110	11.0 (2)
S Fork Salmon River	46	4.6	108	10.8 (2)
Secesh River	50	6.1	114	13.8 (2)
Big Creek (upper)	69	6.9	160	16.0 (2)
Valley Creek	57	2.3	130	5.2 (1)
Totals or averages	640	4.7	1,451	10.6 (0)

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

Valley Creek—For Chinook salmon juveniles detected at the Valley Creek instream PIT tag monitors, we estimated an overall survival rate to Lower Granite Dam of 9.1% (SE = 2.2; CI = 5.1-13.7%) for fish with 12-mm tags and 3.5% (1.8%; 0.0-7.1%) for fish with 9-mm tags. Estimated overall parr-to-smolt survival for fish from this stream was 5.2% (0.7%; 3.9-6.6%; Table 5).

Big Creek—For Chinook salmon juveniles PIT tagged in lower Big Creek and detected on instream monitors in Big Creek, overall survival to Lower Granite Dam was estimated at 16.8% (3.4%; 10.6-23.9%). Overall parr-to-smolt survival for fish from this stream (area) was estimated at 12.9% (1.7%; 9.7-16.4%; Table 5).

For Chinook salmon juveniles PIT tagged in upper Big Creek and detected on the instream monitors at lower Big Creek, overall survival to Lower Granite Dam was estimated at 27.0% (6.7%; 15.0-40.7%). Overall parr-to-smolt survival for fish from upper Big Creek was estimated at 16.0% (1.9%; 12.5-19.9%; Table 5).

Secesh River and Lake Creek—For Chinook salmon juveniles detected at the Zena instream PIT tag monitor on the South Fork Salmon River, we estimated an overall survival to Lower Granite Dam of 29.0% (8.1%; 12.9-44.7%). Overall parr-to-smolt survival for fish from the Secesh River and Lake Creek was estimated at 13.8% (1.9%; 10.3-17.7%) and 8.8% (2.5%; 4.2-13.9%), respectively, for fish with 12- and 9-mm tags.

South Fork Salmon River—For Chinook salmon juveniles PIT tagged in the South Fork Salmon River and detected on the instream monitor near Krassel Creek, overall survival to Lower Granite Dam was 34.1% (10.5%; 15.2-55.7%). In 2012-2013, overall parr-to-smolt survival for fish from the South Fork Salmon was estimated at 10.8% (1.7%; 7.6-14.1%; Table 5).

Relationship between Length and Detection at Dams

For tagged fish from all Idaho streams combined, average fork length at release was 65.5 mm (Table 1a; Appendix Table 1). Among these fish, average fork length at release was significantly longer for fish detected the following spring at dams than for fish not detected at the dams (67.7 vs. 65.2 mm; $P < 0.001$). Fish that were larger at release also tended to pass Lower Granite Dam earlier than their smaller cohorts ($P < 0.001$; Figure 9).

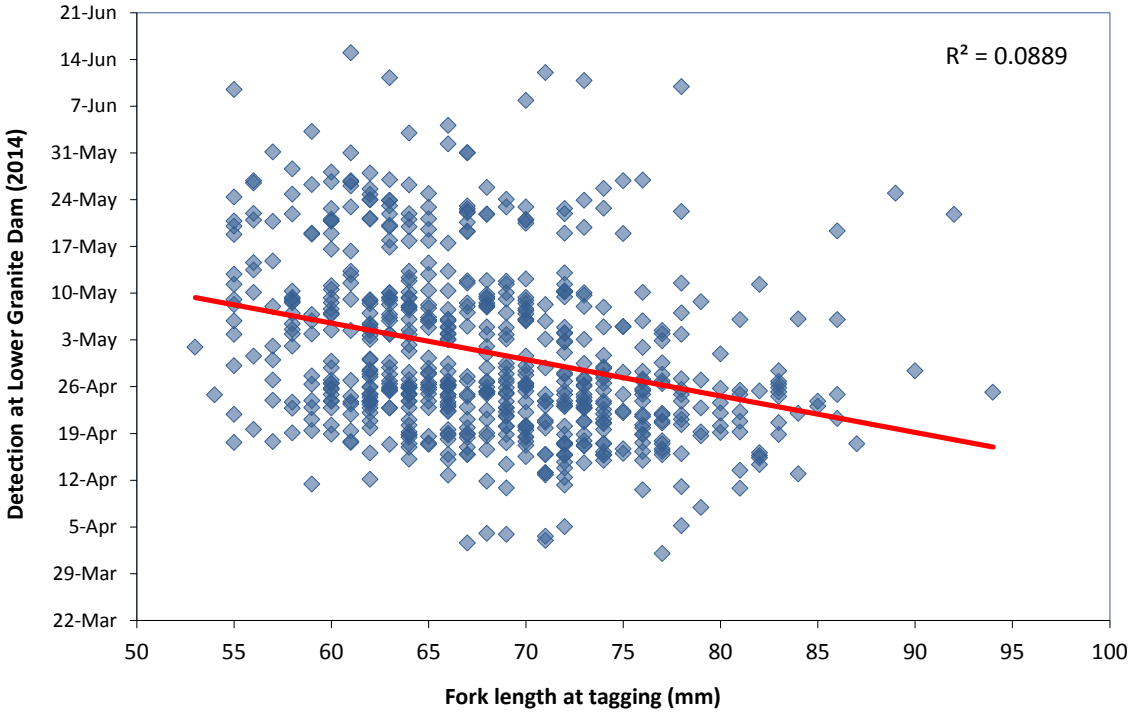


Figure 9. Relationship between fork length of wild Chinook salmon parr from Idaho at tagging (in 2013) and Lower Granite Dam 2014 detection date (n = 1,168).

To examine this relationship further, we grouped all Idaho fish into 5-mm length bins and compared length distributions using a series of chi-square tests. 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 bins (64 mm or less), significantly fewer detected fish were observed than expected ($P < 0.03$) and for the four largest length bins significantly more detected fish were observed than expected ($P < 0.003$ for all four; Figure 10).

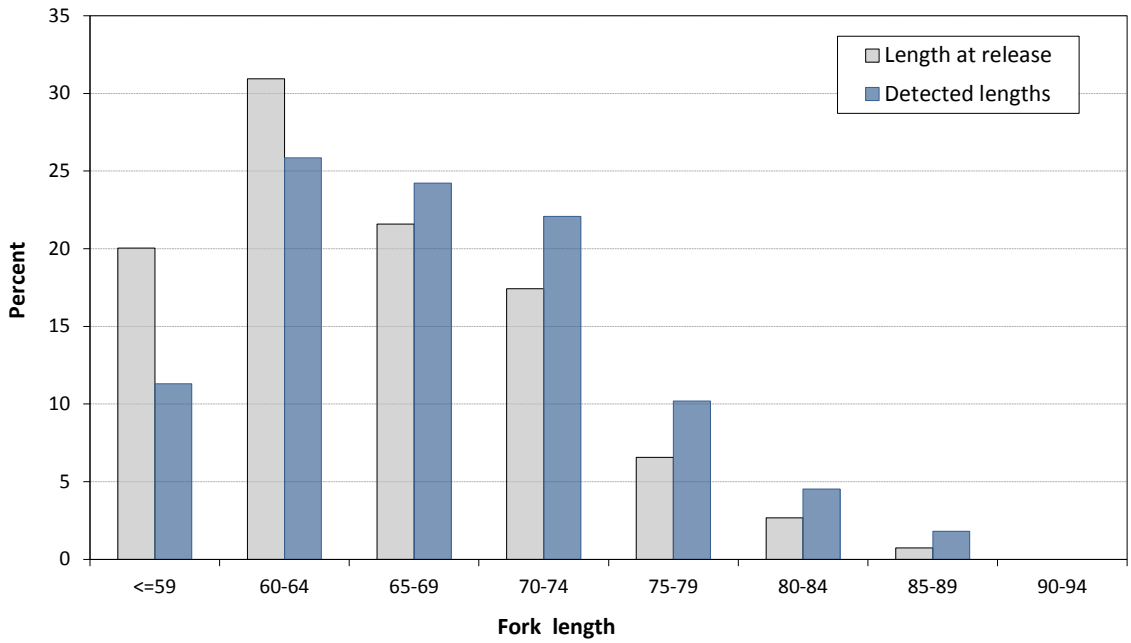


Figure 10. Distribution of fork length increments (mm), of PIT-tagged wild spring/summer Chinook salmon parr released in Idaho streams in 2013 (n = 13,619) and percent of fish detected for these length increments at dams in spring and summer 2014 (n = 1,168).

We found a significant difference in fork length at time of release between fish that passed Lower Granite Dam in April vs. those that passed during May and June 2014 ($P < 0.0001$). Fish that passed the dam in April were on average 4.2 mm larger at release than fish that passed in May and were 3.7 mm larger than those that passed in June. 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 11). Comparisons among these 19 populations showed that the 10th percentile passage dates of fish from the Imnaha River were significantly earlier than those of fish from all other streams ($P < 0.05$; Figure 11; Appendix Table 4a-4b). Standard errors of these estimates ranged 0.5-4.9 d (median 1.3 d). Overall, the 10th percentile passage date for fish from all 19 stream populations ranged 20 d, from 4 to 24 April (Appendix Tables 4a-4b).

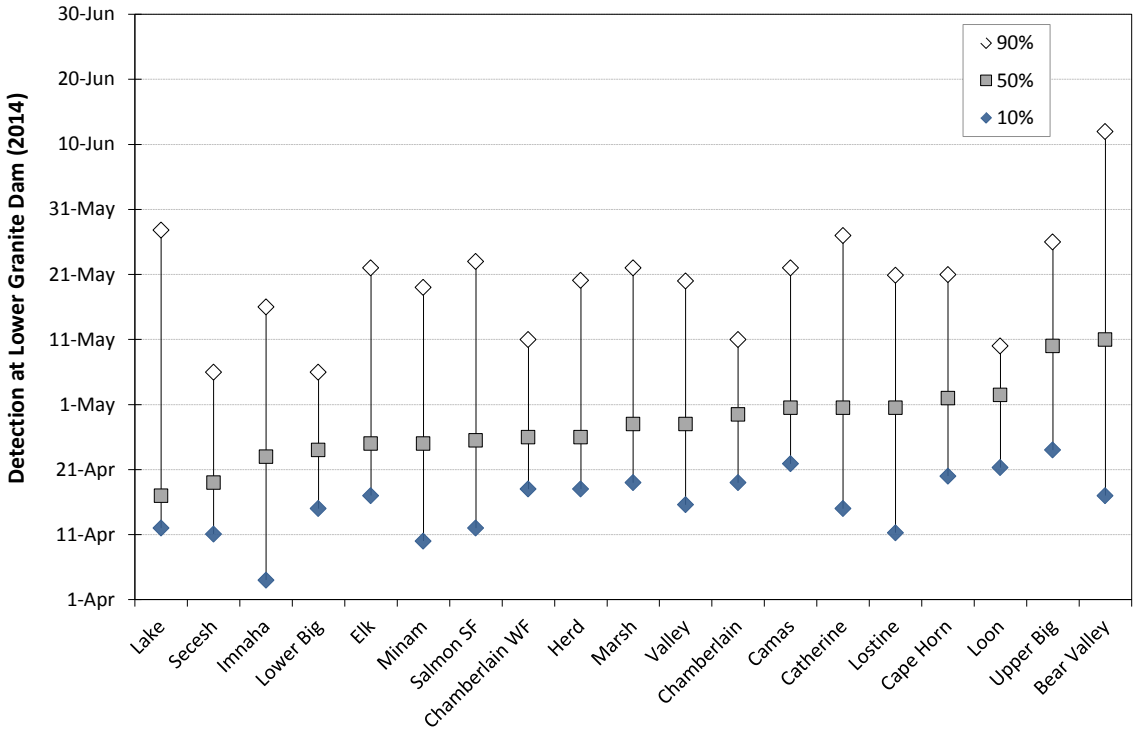


Figure 11. Estimated passage distribution at Lower Granite Dam in 2014 for wild spring/summer Chinook salmon smolts from streams of Idaho and Oregon. Big Creek is divided into lower and upper portions. Chamberlain and West Fork Chamberlain Creeks were combined for these analyses. See Appendix Tables 5-19 for daily estimated passage numbers from Idaho streams.

In comparisons of the 50th percentile passage date at Lower Granite Dam, fish from Lake Creek and Secesh River were significantly earlier than those of fish from other streams. Fish from upper Big and Bear Valley Creeks were significantly later than fish from all other streams. Standard errors of these estimates ranged 0.6- 4.0 d (median 1.7 d). The 50th percentile passage date for fish from all 19 stream populations ranged 24 d, from 17 April to 11 May (Appendix Tables 4a-4b).

In terms of the 90th percentile passage date at the dam, fish from upper Bear Valley Creek were significantly later than fish from all other stream populations. Standard errors of these estimates ranged 0.9-8.4 d (median 2.6 d). The 90th percentile passage date for fish from all streams combined ranged 37 d, from 6 May to 12 June (Appendix Tables 4a-4b).

In comparisons of the middle 80th percentile passage period (10-90th percentile), fish from the Bear Valley Creek again had a significantly longer middle passage period than fish from all other stream populations (56 vs. 19-46 d). Standard errors of these estimates ranged 1.1-8.3 d (median 3.4 d). Overall, the middle 80^{th} percentile passage period for fish from all 19 streams ranged 19-56 d.

Detection data at Lower Granite Dam for fish from streams with 8 or more years of data has shown clear variation among these 19 stream populations in arrival timing of the 10th, 50th, and 90th passage percentiles (Table 6). Timing of the 10th passage percentile at Lower Granite Dam was significantly earlier for Imnaha River fish than for fish from all other streams. Timing of the 50th passage percentile at Lower Granite Dam was significantly later for upper Big and Bear Valley Creek fish than for fish from all other streams in 2014. Also, Bear Valley Creek fish had significantly later timing of the 90th passage percentile at the dam than fish from all other streams.

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

	Percentile passage dates at Lower Granite Dam (95% CI, mean, SE)			
Stream	10th (SE)	50th (SE)	90th (SE)	Data years
Secesh River	11-17 April, 14 April (1)	24-29 April, 26 April (1)	21 May-3 June, 28 May (3)	25
Catherine Creek	22-28 April, 25 April (1)	10-18 May, 14 May (2)	28 May-7 June, 2 June (3)	24
South Fork Salmon River	16-22 April, 19 April (2)	5-11 May, 8 May (1)	28 May-7 June, 2 June (2)	23
Bear Valley Creek	18-24 April, 21 April (1)	4-10 May, 7 May (1)	25 May-3 June, 29 May (2)	23
Valley Creek	20-27 April, 24 April (2)	8-15 May, 11 May (2)	28 May-7 June, 2 June (2)	23
Imnaha River (upper)	13-18 April, 15 April (1)	29 April-4 May, 2 May (1)	18-26 May, 22 May (2)	22
Lostine River	13-20 April, 17 April (2)	1-6 May, 4 May (1)	18-26 May, 22 May (2)	22
Elk Creek	17-23 April, 20 April (1)	1-7 May, 4 May (1)	23 May-31 May, 27 May (2)	22
Lake Creek	13-19 April, 16 April (1)	27 April-3 May, 30 April (1)	22 May-4 June, 29 May (3)	21
Big Creek (upper)	26 April-3 May, 29 April (2)	13-21 May, 17 May (2)	28 May-11 June, 4 June (3)	20
Marsh Creek	17-22 April, 20 April (1)	1-7 May, 4 May (1)	19-26 May, 23 May (2)	19
Big Creek (lower)	16-21 April, 18 April (1)	26 April-30 April, 28 April (1)	8-13 May, 11 May (1)	18
Sulphur Creek	17-26 April, 22 April (2)	2-13 May, 7 May (3)	19 May30 May, 25 May (3)	15
Minam River	14-20 April, 17 April (1)	1-8 May, 5 May (2)	19-26 May, 23 May (2)	16
Loon Creek	23 April-29 April, 26 April (2)	4-12 May, 8 May (2)	16-23 May , 20 May (2)	16
Herd Creek	17-23 April, 20 April (1)	28 April-5 May, 1 May (2)	13-18 May, 16 May (1)	16
Chamb/WF Chamberlain Cr	18-24 April, 21 April (1)	29 April-6 May, 3 May (2)	15 May-3 June, 25 May (4)	16
Camas Creek	24-30 April, 27 April (1)	7-14 May, 11 May (2)	21-27 May, 24 May (2)	15
Cape Horn Creek	18-28 April, 23 April (2)	5-15 May, 10 May (2)	22 May-4 June, 28 May (3)	15

Comparison with River Flows

We grouped first-time detections (expanded) at Lower Granite Dam of tagged fish from all Idaho and Oregon streams combined and compared their collective timing with river flows during the same periods (Figure 12 and Appendix Table 20). Overall, passage at the dam during 2014 occurred between late March and early June, with the middle 80th percentile passage period occurring over 36 d, from 15 April to 21 May (Table 7). The peak passage date (taken from expanded detection numbers) occurred during intermediate flows of 67.1 kcfs on 17 April (Appendix Table 19).

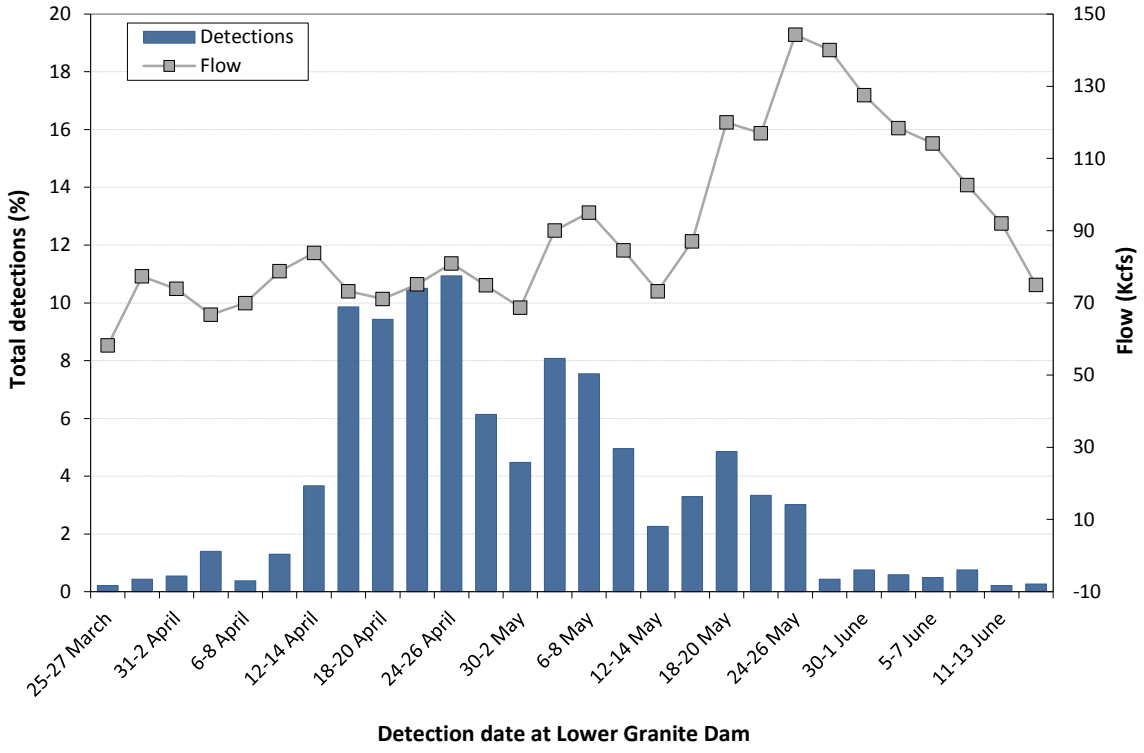


Figure 12. Overall migration timing of PIT-tagged wild spring/summer Chinook salmon smolts with associated river flows at Lower Granite Dam 2014. Daily detections from Idaho and Oregon streams were expanded based on daily detection probability and pooled in 3-d intervals. Daily river flows at the dam were averaged over the same intervals.

Table 7. Annual passage dates at Lower Granite Dam from 1989 to 2014 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
2013	19 April	6 May	15 May	27 March-09 June
2014	**15 April**	**27 April**	**21 May**	**25 March-15 June**

Environmental Information

Environmental water quality metrics varied by month and between locations (Appendix Tables 27-42), as did the percentage of fish collected and/or detected at adjacent traps or instream PIT tag monitors (Appendix Figures 1 and 2). 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

Detection data have been collected from instream monitoring systems in Valley Creek for 11 years, from 2003 to 2014. These data have enabled annual estimates of survival and migration timing for wild Chinook juveniles leaving this stream from late summer to the following spring. Based on detections of PIT tagged fish at Lower Granite Dam, the detection efficiency of Valley Creek monitors (VC1 and VC2) in 2013-2014 was 48.9% for fish with 12-mm tags and 15.4% for fish tagged with 9-mm tags.

This difference in detection efficiencies between tags was most likely due to the greater read range of the 12-mm vs. the 9-mm PIT tag. Detection rates at Lower Granite Dam were not significantly different between 12- and 9-mm PIT tagged fish overall (0.52 vs. 0.45, resp., $P = 0.277$). Estimated survival to Lower Granite Dam was very similar between fish with 12- and 9-mm tags, at 8.1 and 8.3%, respectively ($P = 0.944$).

Since 2008, we have had sufficient detection numbers at the Big Creek monitors to estimate survival to Lower Granite Dam. However, detection rates at these monitors ranged only 9.2-12.9% during 2008 to 2012. In 2013 and 2014, increased detection rates of 29.2 and 21.9%, respectively, for fish tagged at Big Creek resulted from improvements to electronic components of the detection system. These higher detection rates allow us to make more precise survival estimates. Continued development and maintenance of the Big Creek monitoring sites will be conducted by the ISEMP Project.

There is a need for new survival models appropriate for the data collected from instream 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.

During 2014, we recaptured wild PIT-tagged migrants from Idaho streams at Lower Granite Dam. Recapture procedures were the same as 2013, with a maximum collection of 10 fish per day captured from each stream in an effort to collect growth data from recaptures spread over the course of the entire migration season (April-July).

Growth data was collected on 479 recaptured wild PIT-tagged migrants. From these measurements, overall mean growth during the parr-to-smolt stage was 0.12 mm/d for our study fish during 2013-2014. This was comparable to overall growth rates measured in previous years (Achord et al. 2002-2012; Lamb et al. 2013-2014). The overall mean weight gain of 0.024 g/d in 2013-2014 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 22 years have ranged 8.1-24.4%, with an overall average annual survival rate of 15.3% (Figure 13). 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 (Figure 14). Returns of wild adults to the Snake River basin from 2001 to 2003 were more than one 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%).

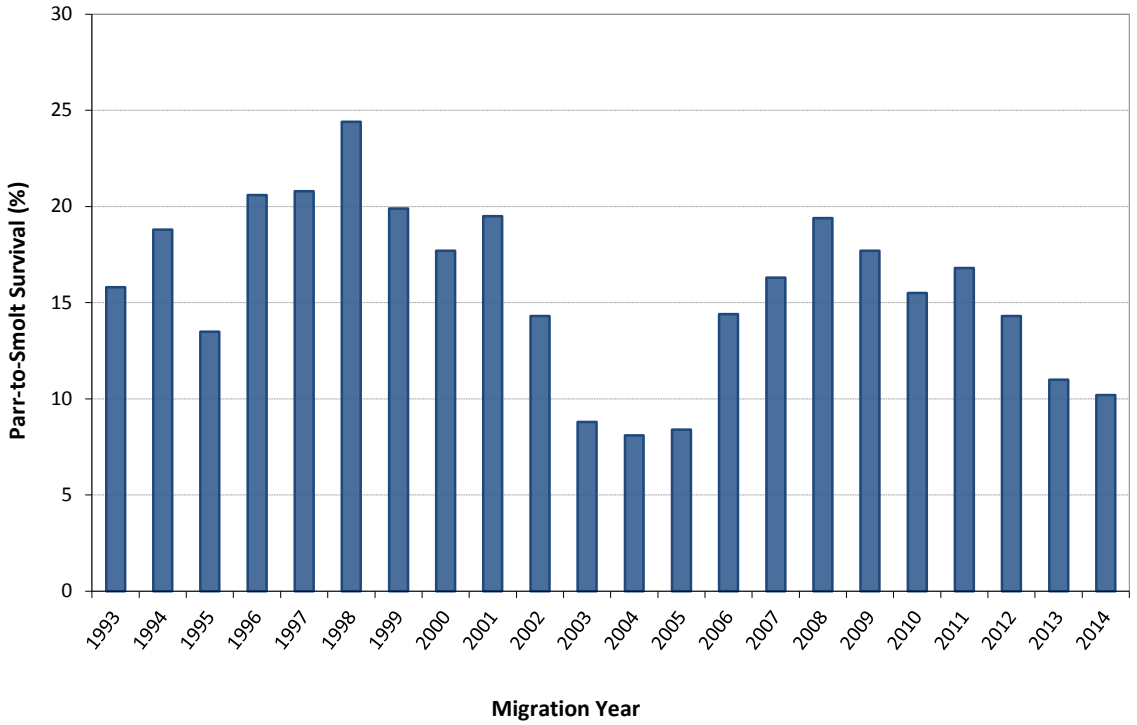


Figure 13. Overall estimated rates of parr-to-smolt survival to Lower Granite Dam for wild spring/summer Chinook salmon from Idaho and Oregon streams from 1993 to 2014. Overall average standard error was ± 0.7% (yearly range 0.2-1.8%).

In 2014, we again observed that wild fish detected at the dam early in the migration season (April and May) had been significantly larger at release than fish detected after May. We have consistently observed this relationship between length at tagging and migration timing at Lower Granite Dam.

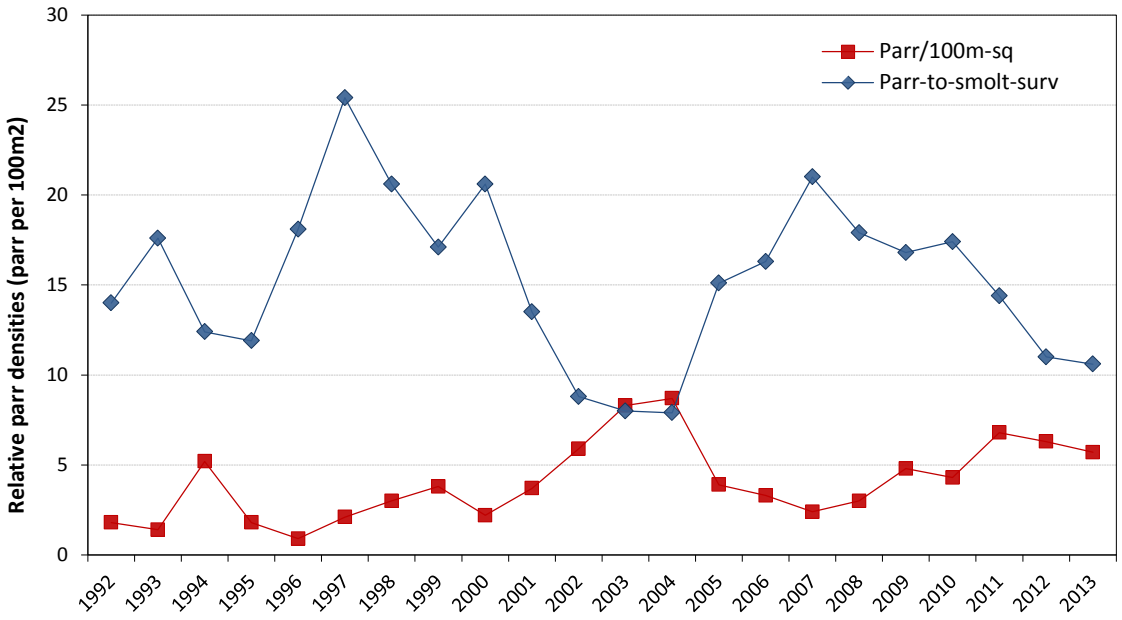


Figure 14. Annual average relative Chinook salmon parr densities (per 100 m^2) in areas sampled in all Idaho streams from 1992 to 2013 versus annual smolt survival estimate to Lower Granite Dam the following year.

During 2013-2014, fish with 12-mm PIT tags that arrived early at Valley Creek instream monitors tended to be significantly smaller in length than those arriving later in the season. However, 9-mm PIT tagged fish showed no statistical difference between sizes in migration timing to the Valley Creek monitors. This finding was similar to that observed in previous years (2004-2012), when no biologically meaningful relationship was seen between length at tagging and migration timing (Achord et. al. 2006-2012; Lamb et al. 2013-2014; Figure 3a and 3b). Therefore, these differences were most likely due to environmental factors that affected migration timing, and were probably not directly related to parr size at tagging.

Relationships between length at tagging and migration timing have been variable based on data from the lower Big Creek monitors since 2008 and on data from the lower Secesh River monitors in 2010-2014. These data also have shown no biologically meaningful relationship between size and timing (Achord et. al. 2010-2012; Lamb et al. 2013-2014; Figures 4b and 8). 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 2014, we observed that for populations from the combined streams overall, arrival at Lower Granite Dam occurred during mid-April for the 10th and 50th passage percentiles, while passage of the 90th percentile occurred during mid-May.

In 2014, flows were moderate during the peak of the migration period, with higher flows occurring late in the migration after the middle 80% of juveniles had passed Lower Granite Dam. Late precipitation during spring contributed to average or lower-than- average Snake River flows during the majority of the smolt passage period.

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 play an important role in 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 also contribute substantially to the migration timing of wild smolts.

As additional instream PIT-tag monitors, traps, and environmental monitors are installed in study streams, we can more accurately examine the relationships between environmental conditions within the streams and 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 and endangered populations of Pacific salmon.

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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, 2013. 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
Camas Creek	736	500	500	42-127	59.8	1.1-28.5	3.4	55-82	62.8	1.8-6.2	3.3
Herd Creek	591	554	553	56-142	74.2	2.7-35.5	5.8	56-91	72.8	2.7-9.1	5.0
Loon Creek	575	501	500	46-80	65.4	1.1-7.7	3.9	55-80	66.1	1.6-7.7	3.9
Valley Creek	3,568	2,500	2,495	35-131	60.1	0.9-26.4	3.5	55-96	63.3	1.6-11.6	3.4
Marsh Creek	1,206	998	997	41-115	64.0	1.9-7.8	3.8	55-86	65.7	1.9-7.8	3.8
Cape Horn Creek	1,895	1,001	1,000	35-131	56.1	1.5-28.7	3.6	55-90	62.3	1.5-9.4	3.4
Bear Valley Creek	1,140	1,000	999	48-116	65.1	1.2-20.7	3.8	55-85	65.2	1.8-7.6	3.7
Elk Creek	1,130	991	990	50-120	66.5	1.8-25.1	4.3	55-84	66.4	2.0-8.2	4.2
Big Creek (upper)	1,368	1,001	1,000	42-111	61.0	1.7-13.9	3.6	55-96	63.4	1.7-10.3	3.5
S.F. Salmon River	1,051	1,001	1,000	51-83	66.9	1.6-7.6	3.6	55-83	67.1	1.6-7.6	3.6
W.F. Chamberlain	1,593	1,000	996	46-95	63.4	1.5-8.9	3.1	55-95	64.5	1.5-8.9	3.1
Chamberlain Creek	597	500	500	48-103	62.6	1.2-6.6	3.3	55-84	63.9	1.2-6.6	3.3
Secesh River	1,126	823	822	43-98	62.1	1.3-11.9	3.7	55-84	65.4	1.3-8.3	3.7
Lake Creek	464	315	315	44-105	61.9	1.6-13.6	4.0	55-89	64.9	1.9-10.4	3.8
Big Creek (lower)	1,060	1,001	1,000	51-94	72.0	--	--	55-94	72.2	--	--
Total or mean	**18,100**	**13,685**	**13,667**	**35-142**	**62.9**	**0.9-35.5**	**3.7**	**55-96**	**65.5**	**1.2-23.1**	**3.6**

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, 2013. 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	1,249	1,246	55-96	63.2	1.8-11.6	3.5	55-92	63.4	1.6-10.0	3.3
S Fork Salmon River	501	499	56-83	67.3	1.6-6.5	3.7	55-82	67.0	1.9-7.6	3.6
Secesh River	414	408	55-84	65.4	1.4-8.3	3.7	55-82	65.3	1.3-7.2	3.6
Lake Creek	157	158	55-87	64.7	1.9-10.4	3.8	55-89	65.0	1.9-9.8	3.8
Total or mean	2,321	2,311	55-96	64.6	1.4-11.6	3.6	55-92	64.6	1.3-10.0	3.5

Appendix Table 2a. Summary of tagging dates and temperatures (°C), release dates, times (PST), and temperatures, methods of capture, distance (in kilometers) from the mouth of the stream to the release point, number of tagged (non-recapture) released (in 2012), 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 2014.

	Tagging				Release					Detected	
Group	Date	Time	Temp (°C)	Capture method	Date	Time	Temp (°C)	River km	N	n	(%)
Camas Creek											
GAA13211.CA1	7/30/13	---	10.3	SHOCK	7/30/13	10:50	15.0	23	100	12	12.0
GAA13211.CA2	7/30/13	---	10.3	SHOCK	7/30/13	12:00	16.0	23	400	62	15.5
Herd Creek											
GAA13212.HC1	7/31/13	---	8.8	SHOCK	8/1/13	9:00	11.0	3	111	16	14.4
GAA13212.HC2	7/31/13	---	12	SHOCK	7/31/13	12:45	12.5	3	442	75	17.0
Loon Creek											
GAA13214.LN1	8/2/13	---	11.3	SHOCK	8/3/13	5:00	8.2	30	113	16	14.2
GAA13214.LN2	8/2/13	---	11.3	SHOCK	8/3/13	5:30	8.2	30	139	26	18.7
GAA13215.LN1	8/3/13	---	8.2	SHOCK	8/3/13	8:30	9.0	30	248	37	14.9
Valley Creek											
GAA13216.VC1	8/4/13	---	9.2	SHOCK	8/5/13	5:55	9.4	5	114	5	4.4
GAA13216.VC2	8/4/13	---	11	SHOCK	8/4/13	12:15	17.0	5	977	30	3.1
GAA13217.VC1	8/5/13	---	9.4	BSEINE	8/5/13	10:45	15.1	5	913	37	4.1
GAA13218.VC1	8/6/13	---	10.5	SHOCK	8/6/13	9:45	14.5	7	491	25	5.1
Marsh Creek											
GAA13219.MC1	8/7/13	---	7.1	SHOCK	8/8/13	5:20	8.0	12	112	13	11.6
GAA13219.MC2	8/7/13	---	7.1	SHOCK	8/7/13	12:15	13.7	12	885	89	10.1

Appendix Table 2a. Continued.

	Tagging				Release					Detected	
Group	Date	Time	Temp (°C)	Capture method	Date	Time	Temp (°C)	River km	N	n	(%)
Cape Horn Creek											
GAA13220.CH1	8/8/13	---	7.5	SHOCK	8/9/13	5:20	7.3	1	106	16	15.1
GAA13220.CH2	8/8/13	---	7.5	SHOCK	8/8/13	12:05	12.0	1	638	72	11.3
GAA13221.CH1	8/9/13	---	7.3	SHOCK	8/9/13	8:30	7.7	1	256	25	9.8
Bear Valley Cr											
GAA13222.BV1	8/10/13	---	11.7	SHOCK	8/11/13	5:00	12.0	9	109	8	7.3
GAA13222.BV2	8/10/13	---	11.7	SHOCK	8/10/13	10:20	15.0	9	468	26	5.6
GAA13223.BV1	8/11/13	---	11.7	SHOCK	8/11/13	9:00	12.2	13	422	20	4.7
Elk Creek											
GAA13223.EC1	8/11/13	---	12.2	SHOCK	8/12/13	5:37	9.9	1	111	7	6.3
GAA13223.EC2	8/11/13	---	12.2	SHOCK	8/11/13	12:10	15.6	1	609	50	8.2
GAA13224.EC1	8/12/13	---	11.2	SHOCK	8/12/13	9:05	11.7	3	270	13	4.8
Big Creek (upper)											
GAA13226.BC1	8/14/13	---	7.8	SHOCK	8/15/10	5:45	7.6	59	101	13	12.9
GAA13226.BC2	8/14/13	---	8.1	SHOCK	8/14/13	11:45	12.6	58	404	43	10.6
GAA13227.BC1	8/15/10	---	7.6	SHOCK	8/15/10	11:15	12.6	59	495	58	11.7
S Fork Salmon R											
GAA13229.SF1	8/17/13	---	11.2	SHOCK	8/18/13	5:00	11.0	118	101	6	5.9
GAA13229.SF2	8/17/13	---	11.1	SHOCK	8/17/13	11:45	16.2	118	777	72	9.3
GAA13230.SF1	8/18/13	---	11.0	SHOCK	8/18/13	7:15	11.1	118	122	14	11.5
W Fork Chamberlain Cr											
GAA13232.WC1	8/20/13	---	9.6	BSEINE	8/20/13	11:50	14.4	2	996	54	5.4

Appendix Table 2a. Continued.

	Tagging				Release					Detected	
Group	Date	Time	Temp (°C)	Capture method	Date	Time	Temp (°C)	River km	N	n	(%)
Chamberlain Cr											
GAA13233.CB1	8/21/13	---	9.3	SHOCK	8/22/13	5:00	11.0	25	111	4	3.6
GAA13233.CB2	8/21/13	---	9.5	SHOCK	8/21/13	9:35	12.1	25	389	34	8.7
Secesh River											
GAA13234.SE1	8/23/13	---	12.0	SHOCK	8/24/13	5:35	11.0	26	120	15	12.5
GAA13235.SE2	8/23/13	---	12.0	SHOCK	8/23/13	10:50	15.2	26	309	35	11.3
GAA13236.SE1	8/24/13	---	11.0	SHOCK	8/24/13	10:15	13.5	26	393	36	9.2
Lake Creek											
GAA13237.LC1	8/25/13	---	9.6	SHOCK	8/25/13	10:45	12.0	2	315	22	7.0
Big Creek (lower)											
GAA13239.LB1	8/27/13	---	12.9	SHOCK	8/28/13	8:10	11.0	10	607	44	7.2
GAA13240.LB1	8/28/13	---	12.9	SHOCK	8/28/13	9:10	12.9	10	393	43	10.9

Appendix Table 2b. Universal Transverse Mercator grid coordinates for each sampling area at the start and end of daily collections for each crew in 2012.

Stream and dates	Section covered	UTM start		UTM end	
		Northing	Easting	Northing	Easting
Camas Creek					
7/30/2013	right bank	4968521	11T696357	4967884	11T696901
7/30/2013	left bank	4968511	11T696370	4967998	11T696674
Herd Creek					
7/31/2013	left bank	4892123	11T716220	4891073	11T717319
7/31/2013	right bank	4892106	11T716220	4891035	11T717302
Loon Creek					
8/2/2013	left bank	4942230	11T675159	4941943	11T674789
8/2/2013	right bank	4942230	11T675159	4941943	11T674789
8/3/2013	right bank	4941028	11T674046	4940428	11T673492
8/3/2013	left bank	4941023	11T674069	4940683	11T673757
Valley Creek					
8/4/2013	right bank	4899467	11T661384	4899704	11T660776
8/4/2013	left bank	4899453	11T661374	4899709	11T660748
8/5/2013	both banks	4899729	11T660726	4899747	11T660579
8/6/2013	right bank	4901895	11T659312	4902293	11T659326
8/6/2013	left bank	4891896	11T659295	4902469	11T659153
Marsh Creek					
8/7/2013	right bank	4917108	11T646289	4916859	11T646366
8/7/2013	left bank	4917117	11T646297	4916624	11T646469
8/7/2013	left bank	4916614	11T646695	4916683	11T646613
Cape Horn Creek					11T660623
8/8/2013	right bank	4917297	11T645750	4916092	11T645112
8/8/2013	left bank	4917310	11T645770	4916093	11T645112
8/9/2013	right bank	4915891	11T644866	4915458	11T644427
8/9/2013	left bank	4915880	11T644845	4915597	11T644632
Bear Valley Creek					
8/10/2013	right bank	4920745	11T633213	4921089	11T632839
8/10/2013	left bank	4920677	11T633191	4920940	11T632707
8/11/2013	right bank	4919135	11T630247	4918985	11T629850
8/11/2013	left bank	4919115	11T630280	4918963	11T630001
Elk Creek					
8/11/2013	right bank	4918887	11T629516	4918595	11T629298
8/11/2013	left bank	4918808	11T629501	4918579	11T629067
8/12/2013	right bank	4918585	11T629055	4918737	11T628866
8/12/2013	left bank	4918579	11T629067	4918689	11T628764
Big Creek (upper)					
8/14/2013	right bank	4997382	11T632237	4996143	11T631508
8/14/2013	left bank	4997557	11T632279	4996127	11T631562
8/15/2013	right bank	4996143	11T631508	4994810	11T631275
8/15/2013	left bank	4996101	11T631497	4995171	11T631380

Appendix Table 2b. Continued.

Stream and dates	Section covered	UTM start		UTM end	
		Northing	Easting	Northing	Easting
Sout Fork Salmon River					
8/17/2013	right bank	4944118	11T603591	4943378	11T603597
8/17/2013	left bank	4944139	11T603609	4943398	11T603614
8/18/2013	right bank	4943378	11T603597	4943194	11T603517
8/18/2013	left bank	4943381	11T603613	4943181	11T603524
West Fork Chamberlain Creek					
8/20/2013	both banks	5027448	11T641981	5027706	11T641639
Chamberlain Creek					
8/21/2013	left bank	5026522	11T642338	5026139	11T642081
8/21/2013	right bank	5026522	11T642338	5026275	11T642212
Secesh River					
8/23/2013	left bank	5006046	11T592986	5007291	11T593328
8/23/2013	right bank	5006032	11T592861	5007426	11T593443
8/24/2013	left bank	5007452	11T593460	5008343	11T593581
8/24/2013	right bank	5007426	11T593443	5008343	11T593581
Lake Creek					
8/25/2013	left bank	5012384	11T586048	5013132	11T585521
8/25/2013	right bank	5012361	11T586052	5013223	11T585578
Big Creek (lower)					
8/27/2013	right bank	4996587	11T670800	4996571	11T669996
8/27/2013	left bank	4996563	11T670807	4996323	11T669692
8/28/2013	right bank	4996650	11T669260	4996843	11T668525
8/28/2013	left bank	4996657	11T669239	4996791	11T668449

Appendix Table 3. Summary of collection and tagging total mortality as well as numbers of wild Chinook salmon parr from Idaho streams and tagged or rejected, July-August 2012. 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 22 lost tags; 3 from Bear Valley Creek, 2 from Elk Creek, 9 from Sulphur Creek, 6 from Valley Creek, 1 from Upper Big Creek, and 1 from the Secesh River.

	Number of fish		Rejected		Observed mortality			
					Collection		Total	
Stream	Collected	Tagged	N	(%)	and handling	Tagging delayed	N	(%)
Camas Creek	736	500	236 (1)	32.1	15	0	15	2.0
Herd Creek	591	554	37 (23)	6.3	13	1	14	2.4
Loon Creek	575	501	74	12.9	11	1	12	2.1
Valley Creek	3,568	2,500	1,068 (13)	29.9	30	4	34	0.9
Marsh Creek	1,206	998	208 (3)	17.2	17	1	18	1.5
Cape Horn Creek	1,895	1,001	894 (17)	47.2	16	0	16	0.8
Bear Valley Creek	1,140	1,000	140 (6)	12.3	23	1	24	2.1
Elk Creek	1,130	991	139 (7)	12.3	22	1	23	2.0
Big Creek (upper)	1,368	1,001	367 (13)	26.8	13	1	14	1.0
S Fork Salmon R	1,051	1,001	50	4.8	7	1	8	0.8
W F Chamberlain Cr	1,593	1,000	593	37.2	1	4	5	0.3
Chamberlain Cr	597	500	97 (2)	16.2	1	0	1	0.2
Secesh River	1,126	823	303 (4)	26.9	8	1	9	0.8
Lake Creek	464	315	149 (9)	32.1	3	0	3	0.6
Big Creek (lower)	1,060	1,001	59	5.6	20	1	21	2.0
Totals or average	**18,100**	**13,685**	**4,414(98)**	**24.4**	**200**	**17**	**217**	**1.2**

Appendix Table 4a. Accumulated and 2013 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
2013	22 April	2 May	13 May	20 April-20 May
2014	**17 April**	**11 May**	**12 June**	**13 April-15 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
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

Appendix Table 4a. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Elk Creek (Continued)				
2009	25 April	30 April	18 May	19 April-07 June
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
2013	22 April	7 May	14 May	22 April-20 May
2014	**17 April**	**25 April**	**22 May**	**14 April-9 June**
Sulphur Creek				
1990	18 April	30 April	31 May	11 April-27 June
1991[a]	---	---	---	---
1992	16 April	03 May	23 May	10 April-01 June
1993	28 April	16 May	12 June	24 April-28 June
1994[a]	---	---	---	---
1995	02 May	23 May	09 June	11 April-09 July
1996[a]-1999[a]	---	---	---	---
2000	15 April	07 May	24 May	12 April-30 May
2001[a] 2002[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
2007[a]	---	---	---	---
2008	03 May	12 May	02 June	27 April-04 June
2009	23 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
2013	22 April	11 May	15 May	12 April-21 May
2014[a]	**---**	**---**	**---**	**---**
Cape Horn Creek				
1991	24 April	16 May	28 May	19 April-06 June
1992	12 April	28 April	30 May	10 April-01 June
1993	08 May	19 May	26 June	05 May-01 July
1994[a]	---	---	---	---
1995	29 April	14 May	19 June	14 April-28 July
1996[a]-1998[a]	---	---	---	---
1999	29 April	22 May	29 May	25 April-12 June
2000	01 May	24 May	01 June	20 April-09 July
2001[a] 2002[a]	---	---	---	---
2003	21 April	17 May	01 June	15 April-18 June
2004	15 April	04 May	24 May	14 April-28 May
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

Appendix Table 4a. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Cape Horn Creek (Continued)				
2009[a]	---	---	---	---
2010	28 April	08 May	26 May	27 April-20 June
2011	4 April	1 May	14 May	04 April-14 May
2012[a] 2013[a]	---	---	---	---
2014	**20 April**	**2 May**	**21 May**	
Camas Creek				
1993	03 May	16 May	27 May	24 April-24 June
1994	30 April	15 May	26 May	24 April-11 July
1995	27 April	12 May	05 June	17 April-11 June
1996[a]-1999[a]	---	---	---	---
2000	26 April	25 May	02 June	13 April-24 June
2001[a] 2002[a]	---	---	---	---
2003	02 May	24 May	30 May	26 April-06 June
2004	18 April	08 May	24 May	16 April-04 June
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	26 April	12 May	26 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]	---	---	---	---
2013	5 May	7 May	15 May	05 May-16 May
2014	**22 April**	**1 May**	**22 May**	**16 April-26 May**
Marsh Creek				
1990	17 April	29 April	31 May	09 April-01 July
1991	26 April	20 May	09 June	17 April-18 June
1992	17 April	07 May	02 June	10 April-13 July
1993	29 April	15 May	27 May	24 April-10 August
1994	23 April	04 May	18 May	16 April-08 August
1995	17 April	09 May	24 May	11 April-08 July
1996[a]-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	24 April	30 April	18 May	20 April-22 May

Appendix Table 4a. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Marsh Creek (Continued)				
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
2013a	---	---	---	---
2014	**19 April**	**28 April**	**22 May**	**15 April-31 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[a]-1998[a]	---	---	---	---
1999	24 April	13 May	12 June	19 April-01 July
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	25 April	05 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
2013	18 April	7 May	21 May	14 April-09 June
2014	**16 April**	**28 April**	**20 May**	**4 April-3 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]-1998[a]	---	---	---	---
1999	30 April	18 May	27 May	22 April-16 June
2000	22 April	08 May	24 May	14 April-01 June
2001[a]2002[a]	---	---	---	---
2003	30 April	17 May	28 May	21 April-30 May
2004	23 April	05 May	15 May	15 April-26 May
2005	04 May	10 May	24 May	20 April-03 June
2006	20 April	02 May	19 May	10 April- 21 May
2007[a]	---	---	---	---
2008	07 May	17 May	26 May	28 April-29 May
2009	26 April	03 May	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
2013	24 April	6 May	13 May	13 April-22 May
2014	**21 April**	**3 May**	**10 May**	**17 April-21 May**

Appendix Table 4a. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
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]-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
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
2013	14 April	10 May	16 May	08 April-22 May
2014	**18 April**	**26 April**	**20 May**	**10 April-10 June**
South Fork Salmon River				
1989	25 April	13 May	14 June	16 April-20 June
1990[a]	---	---	---	---
1991	20 April	16 May	10 June	17 April-13 July
1992	14 April	29 April	27 May	07 April-27 July
1993	29 April	16 May	02 June	26 April-28 June
1994	27 April	15 May	28 June	22 April-09 July
1995	20 April	10 May	10 June	13 April-13 July
1996	19 April	15 May	09 June	19 April-03 July
1997	13 April	28 April	12 June	07 April-15 June
1998	25 April	12 May	15 June	02 April-07 August
1999	31 March	04 May	01 June	27 March-11 June
2000	20 April	18 May	31 May	12 April-20 July
2001	29 April	14 May	01 June	26 April-07 July
2002	15 April	03 May	24 May	11 April-09 June
2003	19 April	16 May	03 June	19 April-12 June
2004	16 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	25 April	04 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

Appendix Table 4a. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
South Fork Salmon River (Continued)				
2012	20 April	28 April	20 May	07 April-06 June
2013	14 April	29 April	9 May	13 April-21 May
2014	**12 April**	**26 April**	**23 May**	**1 April-4 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]-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
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	28 April	20 May	29 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
2013	30 April	14 May	30 May	23 April-30 May
2014	**24 April**	**10 May**	**26 May**	**16 April-31 May**
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]-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	29 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

Appendix Table 4a. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Big Creek (lower) (Continued)				
2013[d]	20 April	2 May	11 May	13 April- 18 May
2014[d]	**15 April**	**24 April**	**6 May**	**7 April-9 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]-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]	---	---	---	---
2009[c]	24 April	30 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
2013[c]	29 April	7 May	16 May	11 April- 23 May
2014[c]	**18 April**	**26 April**	**11 May**	**12 April-17 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	20 April	28 April	19 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

Appendix Table 4a. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Secesh River (Continued)				
2012	5 April	23 April	7 May	02 April-26 May
2013	29 April	7 May	18 May	08 April-15 May
2014	**11 April**	**19 April**	**6 May**	**3 April-25 May**
Lake Creek				
1989	23 April	02 May	16 June	12 April-01 July
1990[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
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	24 April	04 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
2013	13 April	29 April	11 May	08 April-22 May
2014	**12 April**	**17 April**	**28 May**	**11 April-1 June**

[a] No parr were tagged the summer prior to this migration year.
[b] Insufficient numbers detected to estimate timing.
[c] Includes fish from Chamberlain Creek.
[d] No fish were tagged in Rush Creek for this migration year.

Appendix Table 4b. Accumulated and 2014 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
2013	13 April	2 May	12 May	13 April-14 May
2014	**15 April**	**1 May**	**27 May**	**12 April-9 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]-**2014** [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] -**2014** [b]	---	---	---	---

Appendix Table 4b. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Imnaha River (upper)				
1993	24 April	14 May	28 May	15 April-23 June
1994	24 April	08 May	09 June	20 April-11 August
1995	13 April	02 May	03 June	10 April-07 July
1996	16 April	26 April	18 May	14 April-12 June
1997	11 April	19 April	11 May	03 April-02 June
1998	11 April	28 April	13 May	03 April-24 May
1999	22 April	08 May	26 May	17 April-03 June
2000	14 April	02 May	24 May	12 April-16 June
2001	21 April	30 April	16 May	08 April-28 May
2002	16 April	04 May	17 May	15 April-31 May
2003	22 April	08 May	26 May	17 April-31 May
2004	19 April	04 May	22 May	18 April-8 June
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
2013	16 April	2 May	12 May	27 March-21 May
2014	**4 April**	**23 April**	**16 May**	**29 March-24 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
Lostine River (continued)				
2013[d]	---	---	---	---
2014	**11 April**	**1 May**	**21 May**	**27 March-27 May**
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
2013	15 April	7 May	15 May	06 April-19 May
2014	**10 April**	**25 April**	**19 May**	**25 March-26 May**

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

Appendix Table 5. Detections during 2014 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 999 wild Chinook salmon from Bear Valley Creek released 10-11 August 2013. Release sites were 629-635 km above Lower Granite Dam. One fish was detected in the estuary trawl on 20 May 2014.

	Bear Valley Creek							
	Lower Granite		First Detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
13 Apr	1	2						
14 Apr	1	2						
15 Apr	1	2						
17 Apr	1	5						
19 Apr	1	3						
20 Apr			1					
21 Apr	2	5						
22 Apr			1					
23 Apr			4					
25 Apr	1	2	1	1				
26 Apr				1				
29 Apr				1				
02 May				1				
03 May				1				
04 May			1					
05 May			1					
06 May	1	3		1				
07 May	1	2						
08 May	1	2						
09 May				1				
10 May	1	2						
11 May	1	2	2					
12 May	1	2						
16 May	1	3						
19 May						1		
20 May	2	4					1	
23 May			1					
24 May	1	2	1			1		
25 May			1	1				
26 May	3	7						
27 May			1					
02 June					1			
11 June	1	2						
12 June	1	4						
15 June	1	5						
02 July			1					
Totals	25	63	16	8	1	2	1	0

Appendix Table 6. Detections during 2014 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 990 wild Chinook salmon from Elk Creek released 11-12 August 2013. 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
14 Apr	1	2						
15 Apr	2	5						
17 Apr	2	5						
18 Apr	4	10						
19 Apr			1					
20 Apr	2	5						
21 Apr	1	2	2					
22 Apr	2	4		1				
23 Apr	3	5	2					
24 Apr	3	5						
25 Apr	3	5						
26 Apr	1	2		1				
28 Apr	2	5	1			1		
29 Apr						1	1	
30 Apr	1	3	1					
01 May			2					
03 May	1	3	1					1
04 May	3	7						
05 May			1					
06 May			1	1				
07 May	1	2						
09 May	1	2	1	1				
10 May	1	2	1					
14 May	1	3						
22 May	1	2				1		
24 May	1	2						
25 May			1					
27 May								
29 May			2					
05 June				1				
07 June	1	2						
09 June	1	4						
21 June							1	
25 June								1
27 June			1					
08 July						1		
Totals	39	88	18	5	0	4	2	2

Appendix Table 7. Detections during 2014 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 2,495 wild Chinook salmon from Valley Creek released 4-6 August 2013. 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
4 April	1	2						
0 April	1	2						
3 April	2	5						
4 April	1	2						
5 April	1	2						
6 April	2	5						
7 April	1	3						
8 April			1					
9 April	1	3						
0 April	5	13	1					
1 April			2	1				
2 April	1	2	1					
3 April	3	5	3					
4 April	2	4						
5 April	4	7						
6 April	2	4		1				
7 April	2	4						
8 April	4	9	2	1				
9 April	1	3				1		
0 April	2	6						
1 May			1	1				
3 May	1	3			1			
4 May	1	2	2					
5 May			3	2				
6 May	2	5	1					
8 May	1	2						
9 May	3	5						
0 May	1	2						
1 May	1	2						
2 May			1					
3 May	1	3						
5 May			1					
6 May	1	3						1
8 May	1	3						
9 May	1	2						
0 May	1	2	1	1				
1 May	1	2						
3 May				1				
4 May	1	2						
5 May	1	2	1					
6 May	1	2			1			
8 May				1	1			
9 May						1		
2 Jun				1				
03 Jun	2	4						
14 Jun						1		
16 Jun			1					
29 Jun						1		
Totals	57	130	22	10	2	4	1	1

Appendix Table 8. Detections during 2014 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 553 wild Chinook salmon from Herd Creek released 31 July 2013. Fish were released 699-701 km above Lower Granite Dam. One fish was detected in the estuary trawl on 27 May 2014.

	Herd Creek							
	Lower Granite		First detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
10 April	1	2						
16 April	1	3						
17 April	1	3						
18 April	3	7						
19 April	3	8						
20 April	3	8	1					
21 April	2	5						
22 April	2	4	1	1				
23 April	3	5	3					
24 April	2	4	4	1				
25 April	3	5	2					
26 April	5	10	2					
27 April	2	4						
28 April	1	2						
29 April	2	5						
30 April			1					
03 May	1	3	1			1		
04 May			2					
05 May	1	2	1		1	1		
06 May	1	3		2				
07 May			1	1				
08 May	1	2	2					
09 May							1	
10 May	2	4						
11 May			1				2	
12 May			1		1			
14 May			1					
15 May			1				1	
17 May	1	3						
18 May	1	3				1		
19 May	1	2						
20 May	1	2	1					
21 May	2	4	1					
22 May	1	2						
01 Jun						1		
10 Jun	1	5						
Totals	48	110	27	5	2	4	4	0

Appendix Table 9. Detections during 2014 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 500 wild Chinook salmon from Loon Creek released 2-3 August 2013. Release sites were 550-553 km above Lower Granite Dam.

	Loon Creek							
	Lower Granite		First detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
17 April	1	3						
20 April	2	5						
21 April	1	2						
22 April	2	4						
23 April	4	7	1					
24 April	2	4						
25 April	2	4						
26 April	3	6						
27 April	2	4	1					
28 April	1	2		1	1	1		
29 April				1				
01 May	1	3	1					
02 May	1	3		2				
03 May	2	5	3	1				
04 May	3	7						
05 May	2	5	2	1				
06 May	2	5	1			1		
07 May	1	2						
08 May	3	5	1	1				
09 May	2	4	1	1				
10 May	3	6					1	
11 May	1	2		1				
14 May			2					
16 May				1				
17 May			1				1	
18 May			1					
20 May	1	2						
21 May	2	4						
22 May				1				
24 May			1			1		
25 May			1					
02 Jun			1					
Totals	44	95	18	11	1	3	2	0

Appendix Table 10. Detections during 2014 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,000 wild Chinook salmon from Big Creek (upper) released 14-15 August 2013. 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
16 April	1	3						
18 April	1	2						
19 April			1					
20 April	1	3						
21 April	1	2	1					
22 April	1	2						
23 April	1	2						
24 April	2	4						
25 April	2	4						
26 April	1	2	1	1				
27 April	1	2						
28 April	1	2						
29 April	1	3		1				
01 May	1	3	1					
03 May	6	16		1				
04 May	3	7						
05 May	1	2	1					
06 May	3	8	1	1				
07 May	3	6	3			1		
08 May	2	4	1					
09 May			1				1	
10 May	3	6	2					
11 May	3	7						
12 May	4	9				1		
13 May			1					
14 May	1	3	1					
16 May			1					
17 May	1	3	1			1		
18 May	1	3		1				
19 May	1	2				2		
20 May	1	2	1					
21 May	5	10	1				1	
22 May	3	6						
23 May	2	5						
24 May	2	5	1					
25 May	1	2	1					
26 May	3	7	1	1				
27 May	1	2		1				
28 May	2	4		2				
29 May			2					
31 May	2	6	1					
01 June			1					
04 June				1				
10 June							1	
30 June				1				
Totals	69	160	26	11	0	5	3	0

Appendix Table 11. Detections during 2014 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,000 wild Chinook salmon from Big Creek (lower) released 27-28 August 2013. Release sites were 489-491 km above Lower Granite Dam.

	Big Creek (lower)							
	Lower Granite		First detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
07 April	1	2						
11 April	1	2						
14 April			1					
15 April	4	10						
16 April	3	8	1					
17 April	2	5						
18 April	2	5	1			1		
19 April	2	5	3					
20 April	2	5						
21 April	2	5	1					
22 April	5	10	2					
23 April	2	4	2					
24 April	5	9						
25 April	7	12	1					
26 April	2	4	1					
28 April	1	2						
29 April	1	3						
30 April	1	3					1	
01 May	1	3						
02 May	3	8	1					
03 May	1	3				1		
04 May			2					
05 May	3	7						
06 May	1	3	1			2		
07 May	1	2	1				1	
08 May	3	5					1	
09 May	2	4	1					
22 May			1					
25 May				2				
Totals	58	129	20	2	0	4	3	0

Appendix Table 12. Detections during 2014 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 500 wild Chinook salmon from Chamberlain Creek released 21-22 August 2013. Release sites were 437-439 km above Lower Granite Dam.

	Chamberlain Creek							
	Lower Granite		First detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
17 Apr	1	3	1					
18 Apr	1	2						
21 Apr	1	2						
22 Apr	2	4	1					
23 Apr	3	5		1				
24 Apr			1					
25 Apr	1	2	1					
26 Apr	2	4						
28 Apr			1	1				
02 May						1		
03 May	1	3						
04 May	1	2	1					
05 May			3	1				
06 May	1	3	1	1				
07 May			1					
08 May	2	4		1				
09 May								
10 May	1	2	1					
11 May	2	5		1			1	
17 May	1	3						
19 May				1				
22 May			1					
24 May			1					
25 May			1	1				
26 May			1					
28 May				1			1	
29 May			2					
Totals	20	43	18	9	0	1	2	0

Appendix Table 13. Detections during 2014 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 996 wild Chinook salmon from W.F. Chamberlain Creek released 20 August 2013. Release sites were 437-439 km above Lower Granite Dam. One fish was detected in the estuary trawl on 22 May 2014.

	West Fork Chamberlain Creek							
	Lower Granite		First detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
12 Apr	1	2						
17 Apr	1	3						
18 Apr	1	2	2					
19 Apr	1	3						
20 Apr	2	5						
21 Apr	1	2						
22 Apr	2	4	1					
23 Apr	1	2						
24 Apr	2	4						
26 Apr	3	6						
28 Apr	1	2						
29 Apr	1	3	1					
03 May	2	5				1		
04 May	1	2	2	1				
05 May			1					
06 May	1	3					1	
07 May				1				
09 May				1				
10 May				1				
11 May	2	5						
13 May	1	3		1				
18 May							1	
19 May						1		
03 Jun				1				
15 Jun								
Totals	24	55	7	6	0	2	2	0

Appendix Table 14. Detections during 2014 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,000 wild Chinook salmon from South Fork Salmon River released 17-18August 2013. 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
01 April	1	2						
02 April	1	2						
03 April	2	4						
09 April			1					
10 April			1					
12 April	2	4		1				
15 April	2	5						
16 April	1	3						
17 April	2	5						
18 April	2	5	2	1				
19 April	3	8	2					
20 April			3					
21 April	1	2	4					
22 April			2	2				
23 April	3	5	2					
24 April	1	2	1	1				
25 April	4	7	3					
26 April	1	2				1		
27 April	4	9						
28 April	2	5	1			1		
29 April			1					
30 April	1	3						
02 May	1	3				1		
04 May	1	2	2					
05 May	2	5	1					
07 May	1	2						
09 May			1					
10 May	1	2						
16 May				1				
17 May	1	3	2					
18 May						1		
19 May	2	4						
21 May	1	2						
22 May			1					
23 May	2	5					1	
25 May				1			1	
26 May				1				
27 May			1					
04 Jun	1	7						
13 Jun						1		
Totals	46	108	31	8	0	5	2	0

Appendix Table 15. Detections during 2014 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 822 wild Chinook salmon from Secesh River released 23-24 August 2013. 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
03 April	1	2						
05 April	2	4						
10 April	1	2	1					
11 April	2	4						
12 April	1	2	1					
13 April	1	2						
14 April	3	7		2				
15 April	1	2						
16 April	1	3	1	1				
17 April	6	15	1					
18 April	4	10						
19 April	4	10	2					
20 April	3	8	3					
21 April	1	2	4					
22 April	5	10	3					
23 April	2	4						
24 April	1	2						
25 April	2	4	1		1			
26 April	2	4	2			1		
27 April	1	2	1					
29 April			1					
30 April							1	
02 May							1	
03 May			1					
04 May							1	
06 May	1	3						
07 May								
08 May	2	4	1					
09 May			1					
11 May						1		
13 May							1	
16 May						1		
21 May	1	2						
22 May	1	2						
25 May	1	2						
05July				1				
Totals	50	114	24	4	1	3	4	0

Appendix Table 16. Detections during 2014 of PIT-tagged smolts by date at three Snake River dams and three Columbia River dams for 315 wild Chinook salmon from Lake Creek released 25 August 2013. 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
03 April	1	2						
05 April	2	4						
10 April	1	2	1					
11 April	2	4						
12 April	1	2	1					
13 April	1	2						
14 April	3	7		2				
15 April	1	2						
16 April	1	3	1	1				
17 April	6	15	1					
18 April	4	10						
19 April	4	10	2					
20 April	3	8	3					
21 April	1	2	4					
22 April	5	10	3					
23 April	2	4						
24 April	1	2						
25 April	2	4	1		1			
26 April	2	4	2			1		
27 April	1	2	1					
29 April			1					
30 April							1	
02 May							1	
03 May			1					
04 May							1	
06 May	1	3						
07 May								
08 May	2	4	1					
09 May			1					
11 May						1		
13 May							1	
16 May						1		
21 May	1	2						
22 May	1	2						
25 May	1	2						
05July				1				
Totals	50	114	24	4	1	3	4	0

Appendix Table 17. Detections during 2014 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 500 wild Chinook salmon from Camas Creek released 30 July 2013. Release sites were 524-526 km above Lower Granite Dam.

	Camas Creek							
	Lower Granite		First detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
16 April	1	3						
19 April	1	3						
20 April								
21 April	1	2	1					
22 April	2	4						
23 April	1	2						
24 April	1	2	1					
25 April	3	5						
26 April	6	11	2					
28 April	1	2	1					
29 April	1	3	3					
30 April	1	3						
01 May	1	3	1					
02 May			1	1				
04 May	2	5	1	2				
05 May	1	2	2	1	1			
06 May	1	3		1				
07 May				1				
08 May	3	5						
09 May	2	4						
11 May	1	2					1	
12 May								
14 May			1					
15 May			1	1				
16 May								
17 May			1					
18 May								
19 May	1	2		1		1		
20 May	1	2						
21 May	1	2	1					
22 May	2	4		1				
23 May	1	2						
24 May	1	2		1				
25 May			1					
26 May	1	2						
27 May				1				
28 May			1					
30 May							1	
31 May						1		
05 June							1	
Totals	38	82	19	11	1	2	3	0

Appendix Table 18. Detections during 2014 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 997 wild Chinook salmon from Marsh Creek released 7-8 August 2013. Release sites were 632-635 km above Lower Granite Dam. One fish was detected in the estuary trawl on 23 May 2014.

	Marsh Creek							
	Lower Granite		First detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
15 April	2	5						
16 April	1	3						
17 April	1	3						
19 April	1	3						
21 April			2					
22 April	3	6	1					
23 April	4	7						
24 April	4	7	1					
25 April	2	4	2	1				
26 April	2	4		1				
27 April	3	7		1				
28 April	3	7				1		
30 April			3					
01 May			1					
03 May	2	5						
04 May	2	5	1					
05 May	1	2	2	2		1		
06 May	1	3	2	2				
07 May			1					
08 May	2	4				1		
09 May	5	9	1					
10 May	1	2			1	1		
11 May	1	2	2					
13 May	1	3				1		
14 May				1				
15 May			2					
16 May	1	3					1	
17 May							1	
18 May				1				
19 May			2					
20 May	2	4						
21 May							1	
22 May	2	4		1	1			
25 May	1	2	2					
26 May	1	2	1					
27 May			1					
28 May	1	2						
30 May			1					
31 May	1	3						
02 June								1
17 June			1					
Totals	51	110	29	10	2	5	3	1

Appendix Table 19. Detections during 2014 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,000 wild Chinook salmon from Cape Horn Creek released 8-9 August 2013. Release site was 630 km above Lower Granite Dam.

	Cape Horn Creek							
	Lower Granite		First detections					
Detection date	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
15 April	2	5						
17 April	1	3						
18 April	1	2						
19 April	1	3	1					
20 April	1	3	2					
21 April	2	5						
22 April	2	4	1					
23 April	4	7	3					
24 April	2	4	2					
25 April	1	2	1					
26 April	4	8	1	1				
27 April	3	7		1		1		
28 April	2	5		1				
29 April	1	3	3	1				
30 April	3	8	3	1				
02 May	2	6		2				
03 May	2	5	2	1				
04 May			1					
05 May	2	5	1			1		
06 May	1	3		1				
07 May	6	13						
08 May	1	2			1			
09 May	2	4	3				1	
10 May				1		1		
11 May			1					
12 May								
13 May	2	5	1			1		
14 May	1	3	1					
17 May							1	
18 May	2	5		1				
19 May						1		
20 May	2	4					1	
21 May	1	2						
22 May	1	2						
23 May			1	1				
24 May	1	2	1					
25 May			2					
26 May	1	2						
31 May	1	3					1	
06 June					1			
09 June	1	4						
Totals	59	137	31	12	2	5	4	0

Appendix Table 20. 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 2014, with associated river flow, spill, and water temperatures at the dam.

Lower Granite Dam							
	Average	Average	Water temp	Idaho only		Idaho and Oregon	
Date	flow (kcfs)	spill (kcfs)	(°C)	Detected	Expanded	Detected	Expanded
25 Mar	57	0	6.43	0	0	1	2 (0.503)
26 Mar	56.5	0	6.43	0	0	0	0
27 Mar	61.2	0	6.63	0	0	1	2 (0.545)
28 Mar	67.4	0	6.82	0	0	1	2 (0.544)
29 Mar	74.4	0	7.07	0	0	2	4 (0.549)
30 Mar	90.2	0	7.3	0	0	1	2 (0.574)
31 Mar	85.5	0	7.29	0	0	2	4 (0.562)
01 Apr	67.7	5	7.32	1	2	1	2 (0.561)
02 Apr	68.5	0	7.15	1	2	2	4 (0.521)
03 Apr	63.4	20.3	7.23	3	6	4	8 (0.485)
04 Apr	66.6	20.7	7.31	1	2	4	9 (0.466)
05 Apr	70.3	20.4	7.56	2	4	4	9 (0.453)
06 Apr	67.1	20.2	7.79	0	0	1	2 (0.450)
07 Apr	71.8	20.2	7.93	1	2	2	4 (0.447)
08 Apr	70.9	21.8	8.03	0	0	0	0
09 Apr	71	20.5	8.33	0	0	1	2 (0.439)
10 Apr	83.5	20.7	8.71	3	7	5	11 (0.448)
11 Apr	81.7	20.6	9.03	4	9	5	11 (0.456)
12 Apr	84.3	22.2	8.9	5	11	9	20 (0.453)
13 Apr	84.2	20.6	8.74	4	9	7	16 (0.435)
14 Apr	83	21.6	8.92	6	15	13	32 (0.408)
15 Apr	78.7	31.3	8.82	17	42	24	59 (0.405)
16 Apr	69.6	20.5	8.65	11	29	15	39 (0.381)
17 Apr	71.4	21.6	8.6	23	59	33	84 (0.391)
18 Apr	72.4	21.6	8.33	20	49	25	61 (0.407)
19 Apr	70.2	24.8	8.24	18	47	21	55 (0.381)
20 Apr	70.6	22.9	8.55	21	55	22	58 (0.379)
21 Apr	73.4	20.6	9.19	16	39	20	49 (0.410)
22 Apr	77.3	20.4	9.47	29	57	34	66 (0.512)
23 Apr	74.7	20.5	9.55	35	64	44	80 (0.551)
24 Apr	77.7	21.4	9.49	27	49	32	58 (0.552)
25 Apr	83.1	22.8	8.94	36	64	43	76 (0.564)
26 Apr	82	20.6	8.57	34	65	36	69 (0.525)
27 Apr	79.5	30.8	8.5	18	40	20	44 (0.450)
28 Apr	73.7	23.8	8.55	19	44	20	47 (0.430)
29 Apr	71.3	20.5	8.72	8	20	9	23 (0.398)
30 Apr	65.7	20.5	8.81	9	25	10	28 (0.359)
01 May	66.4	20.4	8.97	4	12	9	27 (0.334)
02 May	74	20.4	9.42	7	19	10	28 (0.359)
03 May	78.8	28.8	10.19	19	50	25	66 (0.377)
04 May	89.3	20.6	11.13	17	39	21	49 (0.432
05 May	102	26.2	11.43	13	32	14	35 (0.401)

Appendix Table 20. Continued.

Lower Granite Dam							
				Idaho only		Idaho and Oregon	
Date	Average flow (kcfs)	Average spill (kcfs)	Water temp (°C)	Detected	Expanded	Detected	Expanded
06 May	103.9	36.2	11.08	16	44	21	57 (0.366)
07 May	93.4	20.6	10.7	14	30	18	39 (0.465
08 May	87.7	20.3	10.3	21	38	24	44 (0.547)
09 May	83.3	20.3	10.07	17	31	19	34 (0.555)
10 May	87	22.8	10.16	14	28	14	28 (0.497)
11 May	83.4	20.2	10.46	12	27	13	30 (0.440)
12 May	76.9	20.3	10.43	5	12	8	19 (0.425)
13 May	72.5	20.4	10.25	5	13	5	13 (0.376)
14 May	70.3	20.3	10.14	3	9	3	9 (0.316)
15 May	73.6	20.7	10.47	0	0	0	0
16 May	88	27.8	11.07	3	10	6	20 (0.307)
17 May	99.5	28.8	11.74	4	12	6	18 (0.332)
18 May	117.9	36.8	12.09	5	13	9	24 (0.377)
19 May	124.4	33.6	11.64	7	15	12	25 (0.474)
20 May	117.6	27.8	10.72	11	23	14	30 (0.473)
21 May	108.1	20.6	10.53	14	29	17	35 (0.479)
22 May	114.7	25.4	11	11	23	11	23 (0.475)
23 May	128.2	38.6	11.42	5	12	7	17 (0.411)
24 May	138.4	47.2	11.88	7	17	9	21 (0.420)
25 May	148.9	57.8	11.77	5	12	7	16 (0.426)
26 May	145.5	54.4	11.54	10	24	14	33 (0.421)
27 May	142.9	51.6	11.53	1	2	3	7 (0.452)
28 May	140.6	49.1	11.59	3	3	3	6 (0.493)
29 May	136.6	45.6	11.32	0	0	1	2 (0.434)
30 May	132.5	48.7	11.19	0	0	0	0
31 May	128.6	38.2	11.71	4	11	4	11 (0.356)
01 Jun	121.5	34.2	12.23	1	3	1	3 (0.350)
02 Jun	120.2	31.3	12.44	0	0	0	0
03 Jun	116.5	31	12.71	2	4	2	4 (0.446)
04 Jun	118.6	33.1	12.79	1	7	1	7 (0.588)
05 Jun	116.2	29.6	12.85	0	0	0	0
06 Jun	116.5	26.8	13.11	0	0	1	2 (0.418)
07 Jun	109.8	20.5	13.28	1	2	4	7 (0.588)
08 Jun	105.7	23.3	13.33	0	0	0	0
09 Jun	103.5	20.4	13.42	2	8	2	8 (0.265)
10 Jun	98.7	20.3	13.64	1	5	1	5 (0.219)
11 Jun	95.1	20.3	14.05	1	2	1	2 (0.468)
12 Jun	92.4	20.4	14.19	1	4	1	4 (0.254)
13 Jun	88.5	20.4	14	0	0	0	0
14 Jun	82	20.3	14.07	0	0	0	0
15 Jun	72.9	20.3	14.03	1	5	1	5 (0.199)

Appendix Table 21. First detection dates of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Little Goose Dam during 2014, with associated river flow, spill, and water temperature at the dam.

	Little Goose Dam			
Date	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected
09 Apr	69.7	20.9	8.73	1
10 Apr	83.7	25.1	8.7	2
11 Apr	80.7	24.0	8.82	0
12 Apr	84.7	26.6	9.01	1
13 Apr	83.5	25.1	9.12	0
14 Apr	83.5	25.7	9.45	1
15 Apr	79.1	31.1	9.49	0
16 Apr	70.3	21.2	9.35	1
17 Apr	72.4	22.5	9.34	3
18 Apr	74.1	22.9	9.23	7
19 Apr	68.4	24.1	9.22	11
20 Apr	72.4	23.8	9.18	11
21 Apr	70.9	21.3	8.9	18
22 Apr	80.3	24.0	8.88	15
23 Apr	73.4	22.0	8.87	22
24 Apr	76.3	23.7	9.2	10
25 Apr	81.3	25.6	9.49	12
26 Apr	78.7	23.7	9.81	9
27 Apr	61.8	28.9	9.81	2
28 Apr	76.7	26.2	9.57	6
29 Apr	79.4	23.8	9.1	9
30 Apr	67.2	20.0	9.09	8
01 May	65.4	19.6	9.27	7
02 May	72.9	21.8	9.73	2
03 May	77.6	28.9	9.95	8
04 May	87.7	26.4	10.12	15
05 May	100.2	33.3	10.43	19
06 May	101.5	34.9	11.18	8
07 May	91.3	27.5	11.9	7
08 May	86.2	25.8	11.8	5
09 May	79.7	23.9	11.76	10
10 May	86.3	25.9	11.48	6
11 May	81.4	24.5	11.11	4
12 May	74.4	22.3	10.7	2
13 May	71.5	21.4	10.81	2
14 May	67.3	20.2	10.96	6
15 May	70.1	20.9	11.28	5
16 May	84.0	28.1	11.65	1
17 May	95.6	33.0	11.44	5

Appendix Table 21. Continued.

Little Goose Dam				
Date	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected
18 May	113.8	37.0	11.61	1
19 May	119.0	35.6	12.16	2
20 May	112.8	33.6	12.47	3
21 May	104.1	31.2	12.6	3
22 May	108.4	32.3	11.96	3
23 May	121.9	36.2	11.33	2
24 May	132.7	34.6	11.71	5
25 May	140.0	34.6	12.19	11
26 May	139.1	34.5	12.49	3
27 May	135.9	34.6	12.38	3
28 May	132.9	34.7	11.99	1
29 May	130.0	34.6	11.99	6
30 May	127.2	34.5	11.94	2
31 May	123.1	34.5	11.99	1
01 Jun	116.2	31.7	12.06	1
02 Jun	114.1	29.0	12.26	1
03 Jun	110.8	28.9	13.03	0
04 Jun	113.3	29.0	13.38	0
05 Jun	110.9	32.2	13.63	0
06 Jun	112.1	32.8	13.64	0
07 Jun	105.0	31.4	13.6	0
08 Jun	101.9	30.7	13.88	0
09 Jun	100.2	29.9	14.23	0
10 Jun	93.8	28.1	14.35	0
11 Jun	91.0	27.3	14.14	0
12 Jun	89.1	26.7	14.47	0
13 Jun	85.5	25.6	14.33	0
14 Jun	78.4	23.4	14.57	0
15 Jun	72.0	21.6	14.6	0
16 Jun	66.9	20.1	14.42	1
17 Jun	69.3	20.8	14.27	1
27 Jun	64.4	19.3	16.25	1
02 July	63.3	18.9	17.11	1

Appendix Table 22. First detection dates of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Lower Monumental Dam during 2014, with associated river flow, spill, and water temperature at the dam.

	Lower Monumental Dam			
Date	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected
12 Apr	85.9	27.0	9.17	1
13 Apr	84.9	26.0	9.15	0
14 Apr	83.4	26.8	9.32	2
15 Apr	79.6	28.0	9.66	0
16 Apr	70.0	28.0	9.9	1
17 Apr	72.1	28.6	9.87	0
18 Apr	74.9	29.6	9.72	1
19 Apr	69.1	29.6	9.67	0
20 Apr	71.7	29.6	9.73	0
21 Apr	70.6	29.6	9.6	1
22 Apr	82.5	29.6	9.54	4
23 Apr	73.0	29.9	9.39	1
24 Apr	75.9	29.9	9.31	2
25 Apr	83.0	29.1	9.33	4
26 Apr	78.4	28.0	9.57	6
27 Apr	63.8	28.9	9.86	2
28 Apr	79.4	30.0	10.07	4
29 Apr	79.4	30.0	10.22	5
30 Apr	68.8	30.0	10.03	1
01 May	64.2	29.9	9.9	1
02 May	72.0	28.4	9.79	6
03 May	78.4	27.4	9.95	4
04 May	89.8	27.4	10.09	3
05 May	98.6	27.0	10.18	7
06 May	101.1	27.3	10.38	10
07 May	91.1	26.8	10.73	3
08 May	85.6	27.0	11.44	2
09 May	79.6	26.9	11.96	4
10 May	88.3	28.5	11.98	2
11 May	81.9	27.9	11.8	2
12 May	75.2	26.4	11.56	0
13 May	72.1	28.0	11.31	1
14 May	68.0	26.3	11.2	1
15 May	72.2	26.9	11.21	1
16 May	87.3	26.1	11.52	2
17 May	96.1	29.9	11.85	0

Appendix Table 22. Continued.

Lower Monumental Dam				
Date	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected
18 May	113.5	31.2	11.57	3
19 May	121.0	27.7	11.54	2
20 May	114.0	25.2	12.03	1
21 May	104.1	24.4	12.66	0
22 May	107.2	23.5	12.93	3
23 May	123.1	26.8	12.65	2
24 May	131.8	32.8	11.91	1
25 May	140.9	33.1	11.89	3
26 May	139.6	33.1	12.29	2
27 May	136.2	37.3	12.64	2
28 May	134.2	37.2	12.56	4
29 May	130.7	35.5	12.29	0
30 May	127.7	36.3	12.15	0
31 May	123.0	38.0	12.24	0
01 Jun	117.9	36.1	12.44	0
02 Jun	112.6	35.9	12.27	1
03 Jun	113.3	35.7	12.6	1
04 Jun	114.2	35.9	13.11	1
05 Jun	112.1	29.3	13.41	1
30 Jun	68.9	17.0	16.39	1
05 July	58.1	16.9	17.33	1

Appendix Table 23. First detection dates of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Ice Harbor Dam during 2014, with associated river flow, spill, and water temperature at the dam.

	Ice Harbor Dam			
Date	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected
25 Apr	85.9	58.9	9.64	1
26 Apr	80.8	55.6	9.57	0
27 Apr	66.8	54.3	9.55	0
28 Apr	81.7	31.4	9.72	1
29 Apr	81.2	24.4	10.02	0
30 Apr	71.8	43.7	10.31	0
01 May	65.3	51.6	10.54	0
02 May	75.6	56.7	10.67	0
03 May	79.6	60.5	10.72	0
04 May	92.7	38.4	10.67	0
05 May	100.1	44.6	10.66	2
06 May	106.0	71.1	10.58	0
07 May	95.2	61.6	10.72	0
08 May	89.3	39.8	10.98	1
09 May	81.3	24.4	11.38	0
10 May	90.9	35.6	11.79	1
11 May	83.4	24.9	12.16	0
12 May	77.3	44.8	12.21	1
13 May	73.9	54.4	12.33	0
14 May	69.8	28.5	12.18	0
15 May	72.9	23.1	12.11	0
16 May	88.9	61.0	12.19	0
17 May	100.1	72.6	12.13	0
18 May	116.7	86.7	12.22	0
19 May	126.0	82.3	12.1	0
20 May	119.9	59.6	12.03	0
21 May	105.3	37.2	12.33	0
22 May	112.0	56.6	12.86	1
23 May	128.4	79.7	13.32	0
24 May	136.5	80.7	13.12	0
25 May	148.7	80.6	12.39	0
26 May	145.2	80.4	12.28	1
27 May	142.9	72.4	12.57	0
28 May	140.3	80.1	12.88	1
02 Jun	118.8	57.6	12.85	1
06 Jun	115.0	44.8	13.8	1

Appendix Table 24. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at McNary Dam during 2014, with river flow, spill, and water temperature at the dam.

	McNary Dam			
Date	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected
18 Apr	253.9	112.8	8.68	1
26 Apr	265.7	150.3	9.17	2
27 Apr	263.5	115.0	9.21	1
28 Apr	258.9	108.2	9.34	4
29 Apr	282.8	133.7	9.61	1
30 Apr	264.2	120.9	10.01	0
01 May	252.1	114.6	10.4	0
02 May	264.1	125.6	10.69	2
03 May	264.8	122.1	10.95	4
04 May	289.1	145.7	11.17	0
05 May	301.5	167.3	11.35	3
06 May	320.1	169.7	11.24	3
07 May	284.1	136.9	11.34	1
08 May	286.8	135.2	11.5	1
09 May	291.3	139.3	11.51	0
10 May	263.0	111.8	11.5	2
11 May	270.3	119.3	11.67	1
12 May	288.9	139.5	11.89	1
13 May	278.5	147.5	12.19	2
14 May	262.2	151.1	12.43	0
15 May	266.1	149.7	12.78	0
16 May	293.2	169.3	12.84	1
17 May	318.8	180.0	12.71	1
18 May	331.3	183.8	12.68	2
19 May	347.3	196.0	12.63	6
20 May	346.4	201.0	12.83	0
21 May	322.3	177.0	12.94	0
22 May	322.3	173.8	13.22	1
23 May	351.6	200.1	13.42	0
24 May	353.1	203.1	13.54	2
25 May	362.1	211.1	13.63	0
26 May	359.6	209.1	13.53	0
27 May	375.5	227.9	13.4	0
28 May	360.4	220.5	13.38	0
29 May	348.7	207.6	13.29	1
30 May	356.4	220.0	13.45	0
31 May	332.0	193.3	13.62	1
01 Jun	325.4	177.5	13.92	1
13 Jun	250.7	100.7	15.69	1
14 Jun	243.8	97.7	15.38	1
29 Jun	288.5	144.6	16.55	1
02 Jul	288.0	144.1	17.26	1
08 Jul	245.8	123.3	18.71	1

Appendix Table 25. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at John Day Dam during 2014, with associated river flow, spill, and water temperature at the dam.

	John Day Dam			
Date	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected
29 Apr	290.6	87.2	10.04	2
30 Apr	261.3	87.1	10.11	2
01 May	254.3	102.1	10.23	0
02 May	252.9	96.8	10.38	1
03 May	268.4	105.8	10.46	0
04 May	279.9	106.1	10.84	1
05 May	292.6	117.5	11.23	0
06 May	327.7	120.6	11.55	1
07 May	297.1	89.3	11.78	1
08 May	290.8	90.6	11.99	1
09 May	284.9	113.3	12.02	3
10 May	249.9	96.0	11.95	1
11 May	285.6	85.6	12	4
12 May	292.5	98.1	12.19	0
13 May	285.1	113.6	12.28	1
14 May	254.2	97.1	12.61	0
15 May	261.4	82.8	12.8	1
16 May	281.4	117.6	12.8	1
17 May	317.2	125.1	13.08	3
18 May	330.8	129.8	13.37	1
19 May	351.5	139.9	13.53	0
20 May	348.8	143.9	13.62	2
21 May	328.6	137.5	13.51	2
22 May	314.7	135.0	13.67	0
23 May	347.9	144.4	13.79	1
24 May	354.7	142.1	13.86	0
25 May	362.0	147.4	13.94	1
26 May	358.9	149.6	14.02	0
27 May	376.1	154.7	14.26	0
28 May	365.4	140.3	14.26	1
29 May	356.9	140.3	14.22	0
30 May	357.6	140.3	14.18	1
31 May	332.8	116.3	14.19	1
01 Jun	327.6	117.6	14.18	0
05 Jun	329.8	112.3	14.95	1
10 Jun	297.3	118.6	15.92	1
21 Jun	264.7	84.1	15.76	1

Appendix Table 26. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Bonneville Dam during 2014, with associated river flow, spill, and water temperature at the dam. Table also includes first-time detections at the PIT-tag trawl (TWX) near the mouth of the Columbia River.

	Bonneville Dam			
Date	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected
Detection at Bonneville Dam				
03 May	267.3	100.6	10.95	1
04 May	295.8	100.3	10.97	0
05 May	286.5	106.6	11.18	0
16 May	270.9	103.8	13.28	1
02 Jun	357.9	147.4	14.84	1
25 Jun	282.0	95.2	16.86	1
Detection in the estuary trawl array (TWX)				
20 May				1
21 May				0
22 May				1
23 May				1
24 May				0
25 May				0
26 May				0
27 May				1

Appendix Table 27. Monthly environmental data collected from Marsh Creek (179.8 km from the mouth of the Middle Fork Salmon River) from August 2013 through July 2014.

	Marsh Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min.	6.4	3.5	0.6	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.1	4.0	6.9
Max.	18.2	17.0	9.0	5.7	1.9	2.3	6.1	6.9	9.2	13.6	15.7	19.4
Ave.	11.8	9.2	4.0	1.3	0.2	0.1	0.9	2.1	2.7	5.6	9.0	13.1
Depth (ft)												
Min.	0.0	0.2	0.2	0.0	0.1	0.1	0.0	0.0	0.1	1.6	1.2	0.8
Max.	0.8	1.9	1.3	1.7	2.0	2.2	1.6	1.1	1.8	3.0	2.4	1.5
Ave.	0.6	0.6	0.8	0.8	1.2	1.1	0.5	0.5	1.0	2.3	1.7	1.1

Appendix Table 28. Monthly environmental data collected from the Salmon River near Sawtooth Hatchery (rkm 618) from August 2013 through July 2014.

	Salmon River											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min.	8.8	5.9	2.5	-0.1	-0.1	-0.1	-0.1	-0.1	0.7	2.9	6.4	9.5
Max.	19.2	17.9	10.9	6.8	3.4	4.2	7.1	8.1	11.2	13.4	16.7	20.6
Ave.	13.5	11.3	6.1	2.9	0.7	0.7	1.8	3.7	5.5	7.9	11.3	15.1
Depth (ft)												
Min.	1.4	1.2	1.0	0.7	0.9	0.9	0.7	0.7	0.9	1.7	2.0	1.8
Max.	1.7	2.2	2.3	1.9	2.5	2.2	1.5	1.9	2.3	2.9	2.7	2.4
Ave.	1.6	1.6	1.7	1.5	1.6	1.5	1.2	1.3	1.5	2.2	2.3	2.1

Appendix Table 29. Monthly environmental data collected from Valley Creek (rkm 609.4 from the mouth of the Salmon River; 0.4 km from the mouth of Valley Creek) from August 2013 through July 2014.

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

Appendix Table 30. Monthly environmental data collected from the South Fork Salmon River (rkm 112 from its confluence with the main Salmon River) from August 2013 through July 2014.

	South Fork Salmon River											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min.	9.9	3.9	0.8	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	1.7	3.8	8.1
Max.	20.8	18.9	7.7	5.5	1.0	1.4	3.3	4.8	8.3	9.6	14.9	21.4
Ave.	15.1	11.5	4.0	1.2	0.0	0.1	0.6	1.6	3.4	5.2	8.5	15.3
Depth (ft)												
Min.	1.0	0.7	0.7	0.5	1.1	0.7	0.7	0.7	1.3	2.4	1.8	1.2
Max.	1.5	3.0	2.0	2.5	3.2	2.8	1.9	2.8	2.8	4.6	3.6	2.1
Ave.	1.2	1.2	1.4	1.5	2.1	1.8	1.2	1.8	2.2	3.2	2.5	1.6

Appendix Table 31. Monthly environmental data collected from the Secesh River (rkm 27 from its confluence with the South Fork Salmon River) from August 2013 through July 2014.

	Secesh River											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min.	9.8	3.4	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	1.0	3.9	8.0
Max.	19.1	18.0	7.1	3.5	0.0	0.0	0.0	0.2	7.3	8.7	12.1	19.5
Ave.	14.0	10.4	2.9	0.3	0.0	0.0	0.0	0.0	2.0	4.4	7.5	14.2
Depth (ft)												
Min.	1.0	0.7	0.8	0.5	1.2	1.9	2.0	2.3	1.2	2.4	2.4	1.3
Max.	1.3	2.6	2.0	2.6	2.6	3.0	3.2	4.0	2.7	4.5	3.8	2.6
Ave.	1.2	1.2	1.3	1.4	2.0	2.4	2.6	3.1	2.0	3.4	3.0	1.8

Appendix Table 32. 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 2013 through July 2014.

	Bear Valley Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min.	10.6	4.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3	10.3
Max.	19.8	18.1	8.5	3.9	0.1	0.1	0.6	0.9	7.6	12.3	15.5	21.0
Ave.	14.9	11.2	4.3	0.7	0.0	0.0	0.0	0.1	1.9	5.1	10.6	15.7
Depth (ft)												
Min.	2.8	2.6	2.5	2.3	2.7	3.2	2.5	2.4	2.6	3.8	3.4	3.0
Max.	3.2	4.3	4.2	3.8	3.8	4.2	4.1	3.9	4.1	6.3	5.2	3.6
Ave.	3.0	3.0	3.1	3.1	3.4	3.6	3.6	3.1	3.3	5.1	4.1	3.3

Appendix Table 33. Monthly environmental data collected from Sulphur Creek (rkm 10 from its confluence with the Middle Fork Salmon River) from August 2013 through July 2014.

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

Appendix Table 34. Monthly environmental data collected from upper Big Creek (rkm 60 from its confluence with the Middle Fork Salmon River) from August 2013 through July 2014.

	Big Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min.	7.3	4.9	2.3	0.3	0.0	0.0	0.0	0.0	0.8	1.7	3.0	5.2
Max.	15.9	14.8	7.4	5.9	2.6	2.6	4.6	5.4	8.4	9.0	10.5	15.5
Ave.	10.6	9.0	4.5	2.6	1.0	0.9	1.3	1.9	3.3	4.4	6.0	10.6
Depth (ft)												
Min.	1.3	1.1	1.2	0.8	1.0	1.0	0.8	0.8	1.1	1.9	2.1	1.6
Max.	1.7	3.4	2.7	2.0	2.4	2.7	1.9	2.3	2.3	3.8	3.4	2.7
Ave.	1.5	1.5	1.8	1.6	1.6	1.6	1.2	1.5	1.8	2.7	2.7	2.1

Appendix Table 35. Monthly environmental data collected from Chamberlain Creek (rkm 25 from its confluence with the main Salmon River) from August 2013 through July 2014.

	Chamberlain Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min.	8.4	3.8	0.0	0.0	0.0	-1.3	-0.1	0.0	0.0	1.1	3.7	7.9
Max.	20.3	17.5	7.1	4.8	0.1	1.2	2.8	5.0	8.1	9.4	13.6	19.9
Ave.	13.6	10.1	3.5	0.7	0.0	0.0	0.3	1.3	2.9	4.6	8.5	14.2
Depth (ft)												
Min.	0.2	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.2	1.4	1.4	0.7
Max.	0.7	1.2	1.1	2.4	1.9	18.7	1.6	1.0	1.6	3.1	2.6	1.6
Ave.	0.5	0.4	0.7	0.9	0.9	1.0	0.4	0.5	0.9	2.1	1.9	1.1

Appendix Table 36. 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 2013 through July 2014.

	West Fork Chamberlain Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min.	6.9	3.6	0.1	-0.1	-2.0	0.1	0.1	0.0	0.1	1.1	4.7	6.6
Max.	18.0	15.6	6.9	4.2	0.8	1.2	2.1	4.0	7.4	9.1	13.6	18.6
Ave.	12.3	9.3	3.0	0.7	-0.2	0.3	0.4	1.1	2.3	4.4	8.3	12.9
Depth (ft)												
Min.	---	---	---	---	---	---	---	---	---	---	---	---
Max.	---	---	---	---	---	---	---	---	---	---	---	---
Ave.	---	---	---	---	---	---	---	---	---	---	---	---

Appendix Table 37. 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 2013 through July 2014.

	Lake Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min.	8.1	2.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.8	7.0
Max.	16.3	16.0	6.1	2.7	0.0	0.0	0.7	2.1	6.8	7.7	12.3	17.8
Ave.	12.3	9.2	2.6	0.4	0.0	0.0	0.0	0.3	1.9	3.3	7.1	12.9
Depth (ft)												
Min.	0.7	0.4	0.4	0.1	0.5	0.5	0.2	0.1	0.4	1.4	1.7	0.9
Max.	1.3	1.6	1.3	2.3	2.2	1.8	2.1	1.5	1.7	3.3	2.8	1.9
Ave.	1.0	0.8	0.9	1.1	1.4	1.3	1.0	0.8	1.0	2.2	2.2	1.4

Appendix Table 38. Monthly environmental data collected from Cape Horn Creek (rkm 180 from the mouth of the Middle Fork Salmon River; 150 m above the Marsh Creek monitoring site) from August 2013 through July 2014.

	Cape Horn Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min.	5.4	2.8	0.1	0.0	0.1	0.1	0.0	0.0	0.0	1.2	3.0	5.3
Max.	17.7	16.3	8.5	4.6	0.2	0.1	1.3	5.4	9.1	9.6	13.4	17.3
Ave.	10.8	8.3	3.3	0.7	0.1	0.1	0.1	1.1	2.9	4.0	7.0	10.9
Depth (ft)												
Min.	---	---	---	---	---	---	---	---	---	---	---	---
Max.	---	---	---	---	---	---	---	---	---	---	---	---
Ave.	---	---	---	---	---	---	---	---	---	---	---	---

Appendix Table 39. 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 2013 through July 2014.

	Herd Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min.	8.7	5.5	3.0	0.5	0.2	0.7	0.6	1.3	1.8	3.5	4.4	7.5
Max.	18.2	17.3	9.6	6.1	4.0	2.8	4.9	6.9	10.8	14.3	16.2	18.5
Ave.	12.9	10.9	5.6	2.5	0.8	1.1	1.8	3.5	5.9	8.6	9.9	13.5
Depth (ft)												
Min.	0.9	0.7	1.0	0.7	0.8	0.9	0.7	0.6	0.9	1.2	1.5	1.3
Max.	1.5	1.6	1.8	2.1	1.8	1.8	1.5	1.6	1.9	2.1	2.1	1.9
Ave.	1.2	1.2	1.4	1.4	1.4	1.4	1.1	1.2	1.3	1.6	1.8	1.6

Appendix Table 40. Monthly environmental data collected from Camas Creek (rkm 23 from its confluence with the Middle Fork Salmon River) from August 2013 through July 2014.

	Camas Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min.	8.9	4.4	0.4	0.1	0.1	0.1	0.1	0.1	0.2	2.7	5.4	7.5
Max.	19.0	17.4	7.4	4.8	0.3	0.3	0.9	5.0	9.9	11.2	15.2	18.9
Ave.	13.6	10.8	3.8	1.0	0.1	0.1	0.2	1.4	4.2	6.6	9.2	13.7
Depth (ft)												
Min.	1.6	1.4	1.5	1.1	1.4	1.3	1.2	1.2	1.5	2.7	2.6	2.1
Max.	2.1	2.5	2.5	2.9	2.6	2.7	2.2	2.3	3.2	6.0	4.5	2.9
Ave.	1.9	1.8	2.0	2.0	2.0	1.9	1.6	1.8	2.4	4.0	3.3	2.5

Appendix Table 41. Monthly environmental data collected from Loon Creek (rkm 31 from its confluence with the Middle Fork Salmon River) from August 2013 through July 2014.

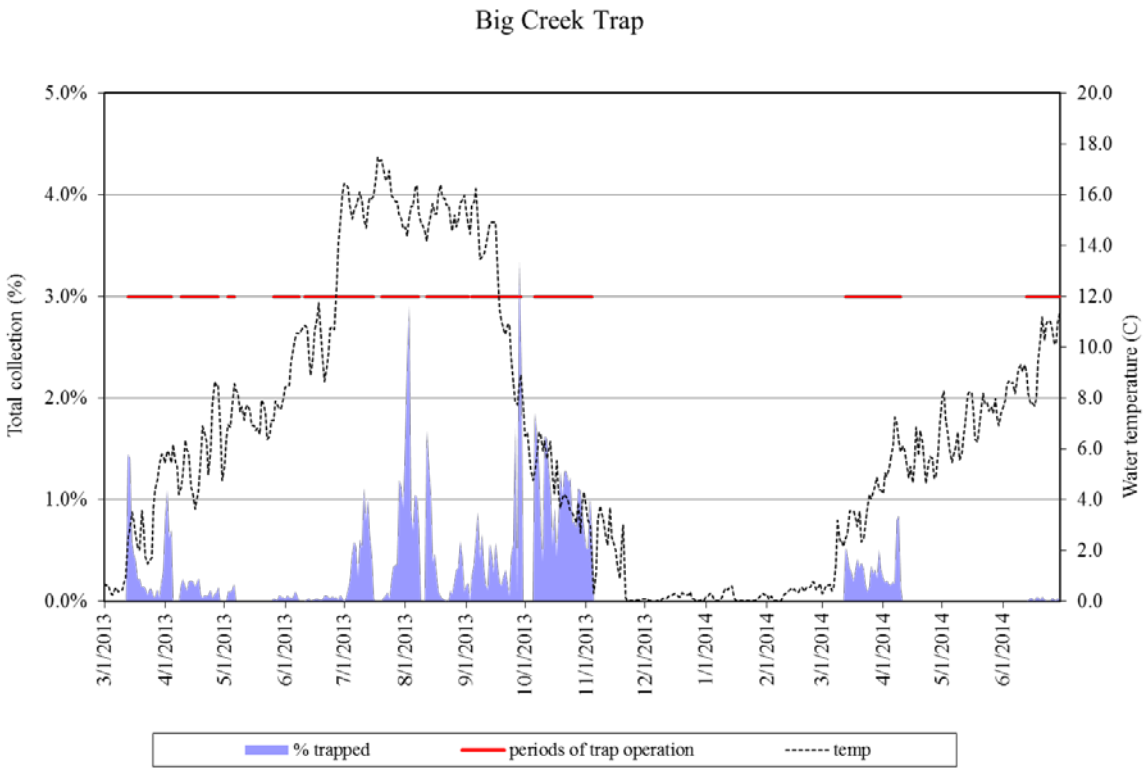
	Loon Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min.	7.7	4.5	1.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	2.3	4.1	6.4
Max.	18.5	18.5	8.4	5.6	2.4	0.0	4.3	6.7	10.0	10.8	12.7	17.2
Ave.	12.4	9.9	4.1	1.3	0.0	-0.1	0.5	2.2	4.2	5.6	7.5	11.8
Depth (ft)												
Min.	0.3	1.0	1.0	0.7	0.8	1.4	0.8	0.7	0.9	1.9	2.3	0.6
Max.	1.7	2.2	2.1	2.8	3.7	3.1	2.5	1.8	2.4	4.1	3.5	2.7
Ave.	1.4	1.4	1.6	1.6	2.2	2.1	1.5	1.4	1.8	2.8	2.8	2.2

Appendix Table 42. Monthly environmental data collected from Big Creek near Taylor Ranch (rkm 10 from its confluence with the Middle Fork Salmon River) from August 2013 through July 2014.

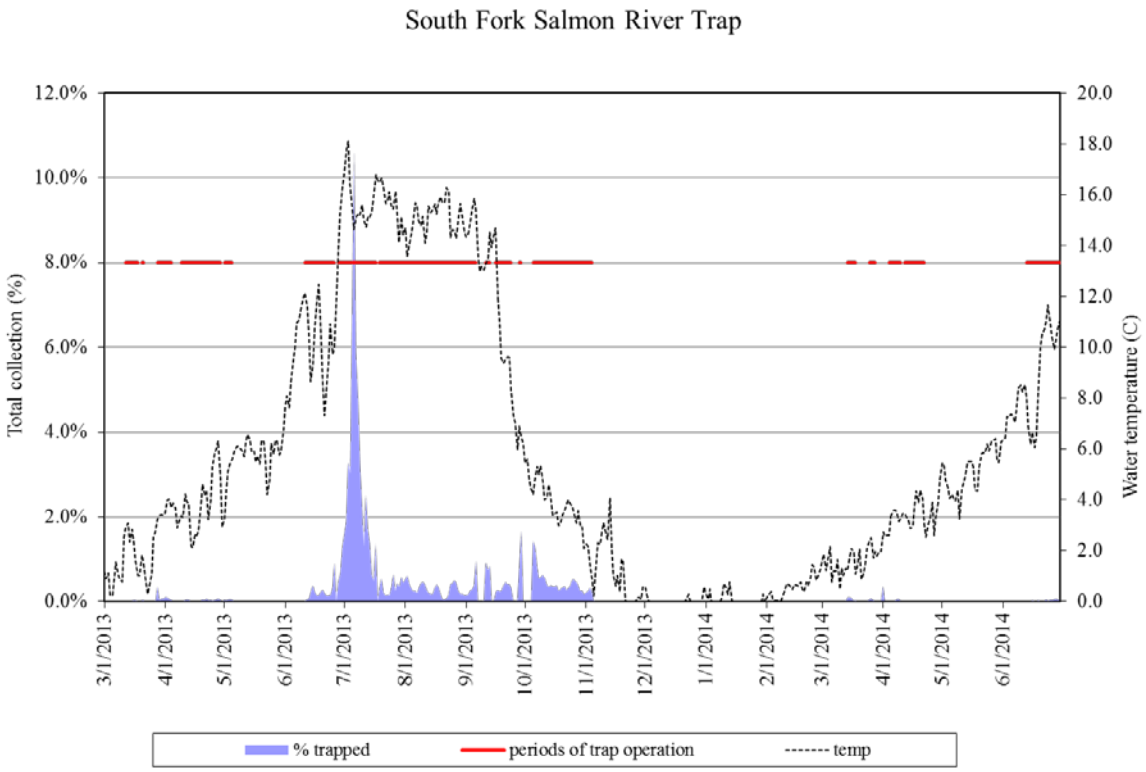
	Big Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min.	12.8	10.8	3.8	1.1	0.1	0.1	0.2	1.5	3.8	5.2	7.5	12.7
Max.	18.2	14.4	6.0	2.3	0.2	0.2	0.6	4.1	7.8	9.0	11.2	17.9
Ave.	15.3	12.4	4.9	1.7	0.1	0.2	0.4	2.7	5.7	7.1	9.3	15.2
Depth (ft)												
Min.	0.6	0.6	0.9	0.6	1.0	1.2	0.9	1.2	1.8	3.1	2.9	1.7
Max.	0.8	0.7	1.0	0.8	8.0	1.4	1.0	1.4	1.9	3.4	3.1	1.8
Ave.	0.7	0.7	0.9	0.7	3.5	1.3	0.9	1.3	1.8	3.3	3.0	1.7

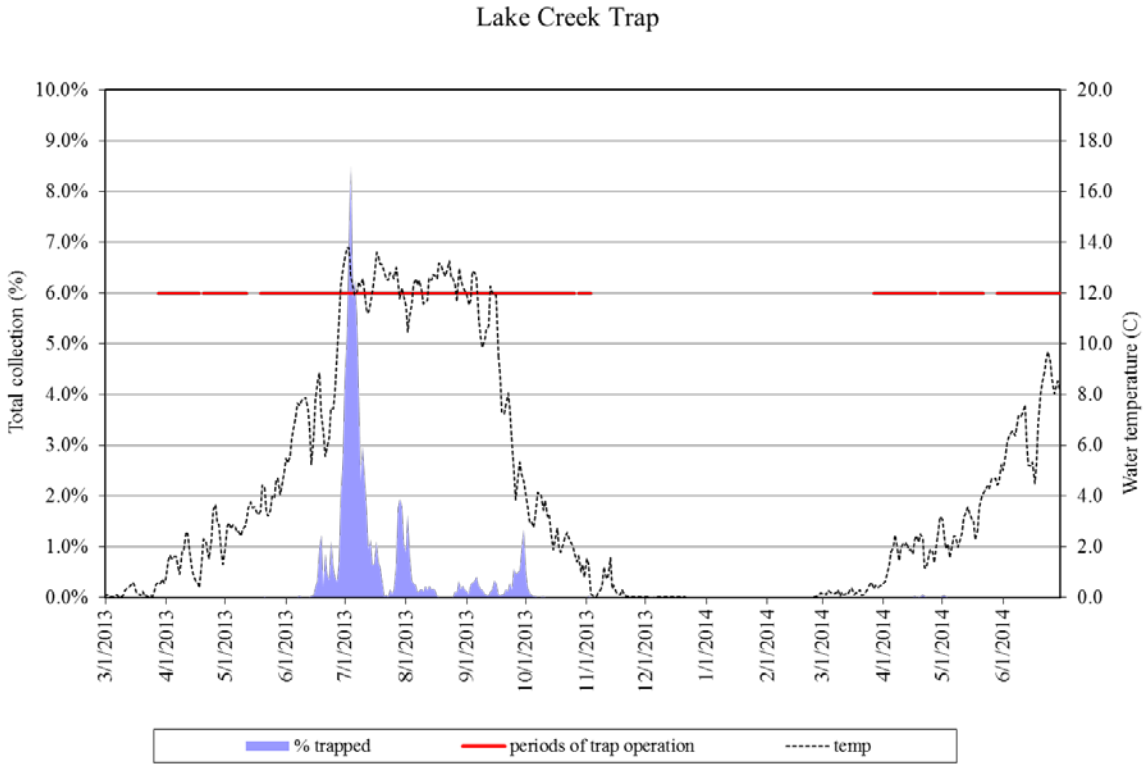
Appendix Table 43. Site details for all instream monitoring locations used in PIT-tag studies of wild spring/summer Chinook salmon parr, 2014.

Fish collection site	Instream monitoring site			PTAGIS site code
	Description	River or Creek	rkm	
Valley Creek	Valley Creek, upstream	Valley Creek	2	VC1
Valley Creek	Valley Creek, downstream	Valley Creek	1	VC2
Valley Creek, Herd Cr	Upper Salmon River, upstream	Salmon River	460	USE
Valley Creek, Herd Cr	Upper Salmon River, downstream	Salmon River	437	USI
Upper and Lower Big Cr	Taylor Ranch, upstream	Big Creek	12	TAY-a
Upper and Lower Big Cr	Taylor Ranch, downstream	Big Creek	11	TAY-b
Secesh River and Lake Cr	Zena Creek	Lower Secesh R	5	ZEN
South Fork Salmon River	Krassel Creek	S Fork Salmon R	65	KRS
South Fork Salmon River	Guard Station Road Bridge	S Fork Salmon R	30	SFG

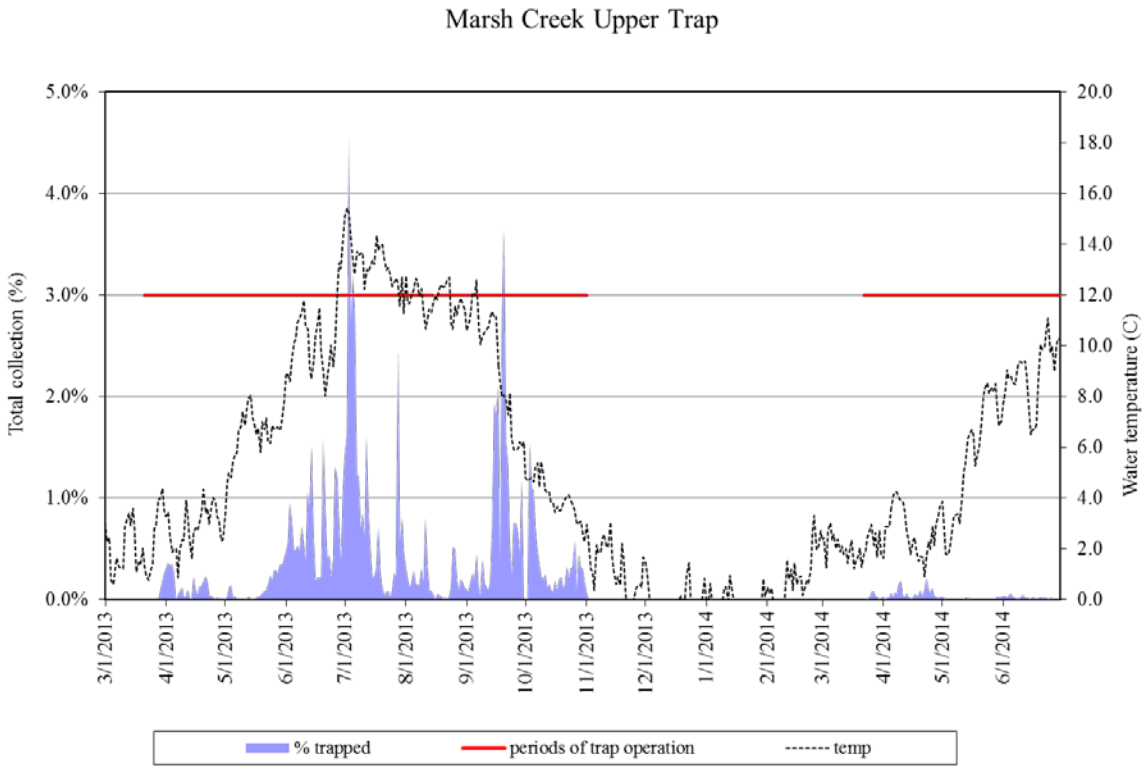


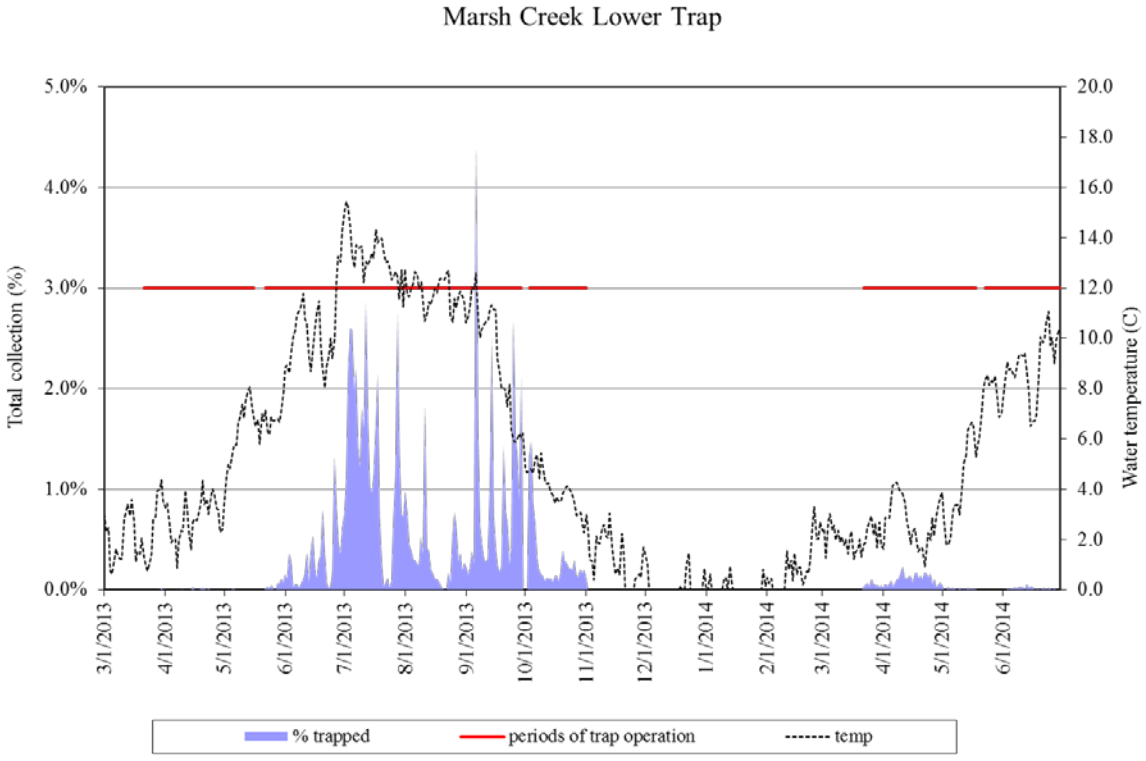
Appendix Figure 1. Daily passage of wild Chinook salmon fry, parr, and smolts at seven migrant traps, expressed as percentages of total collected, and plotted against average daily water temperatures collected near traps. Periods of trap operation are also shown.



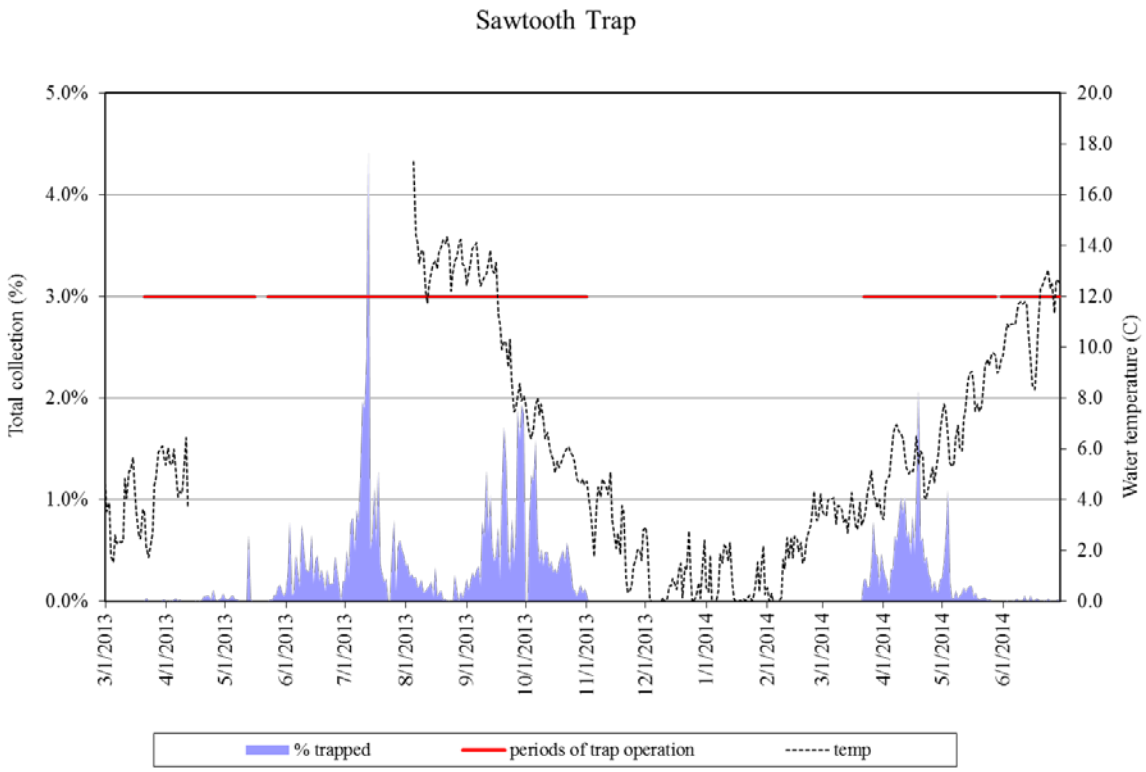


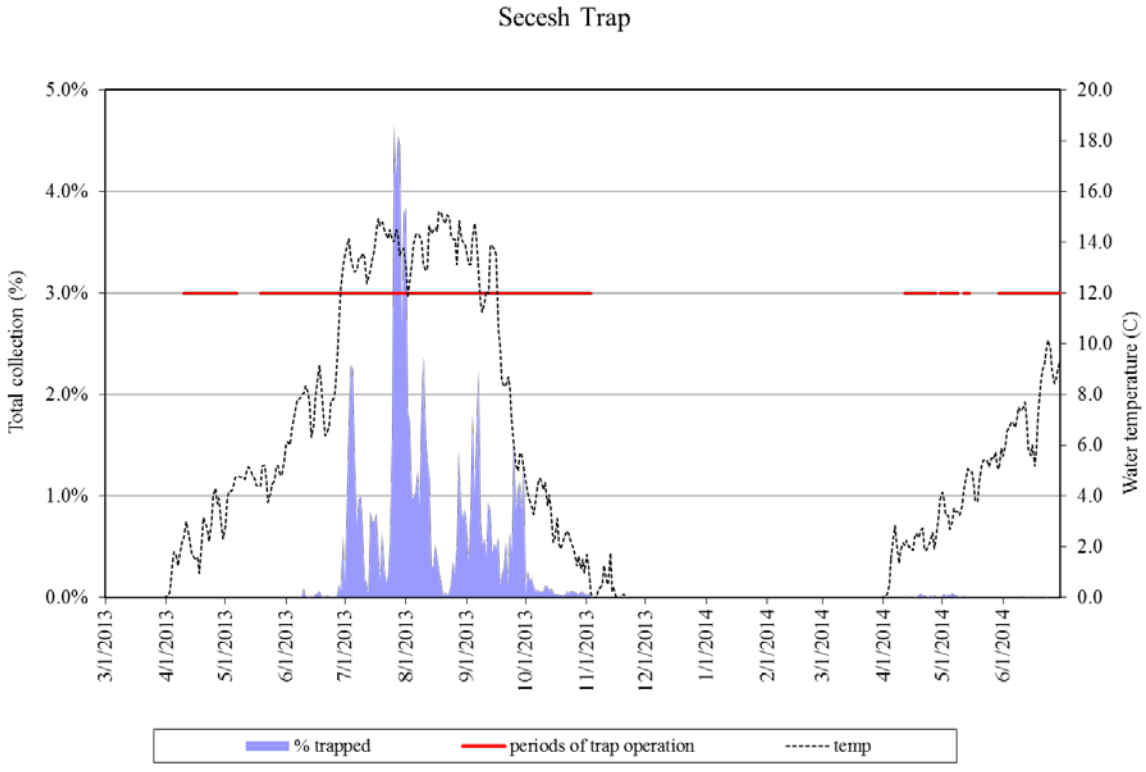
Appendix Figure 1. Continued.



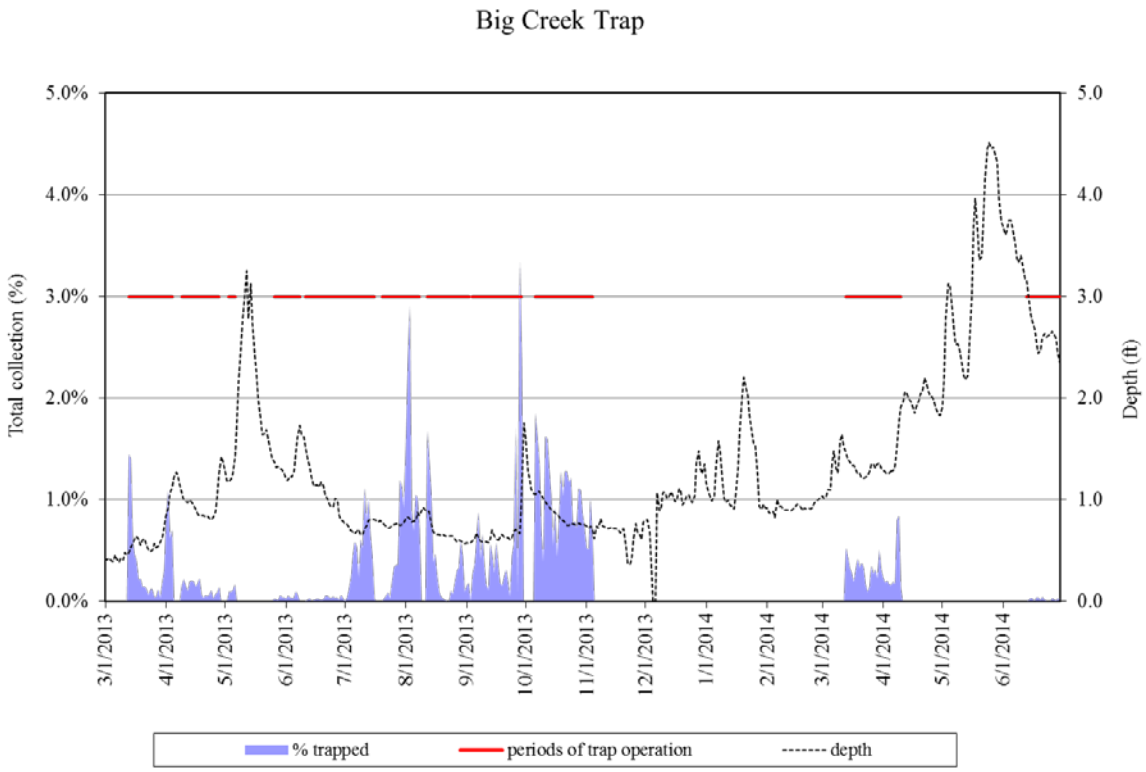


Appendix Figure 1. Continued

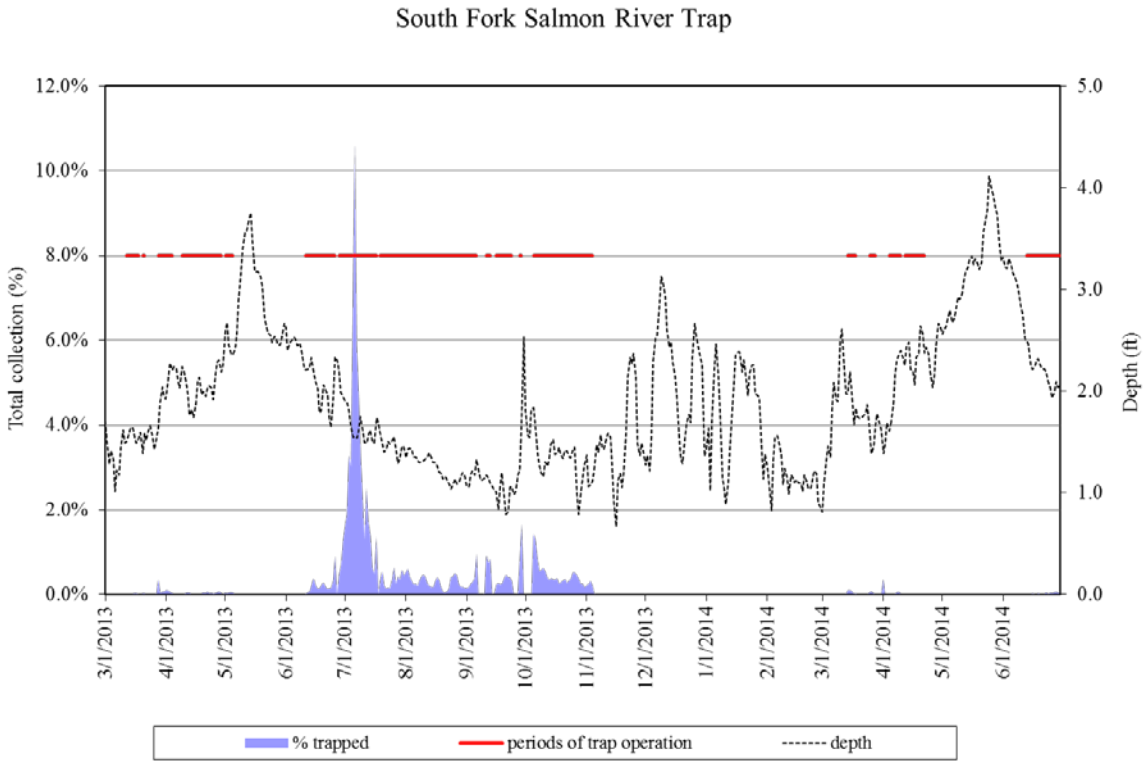


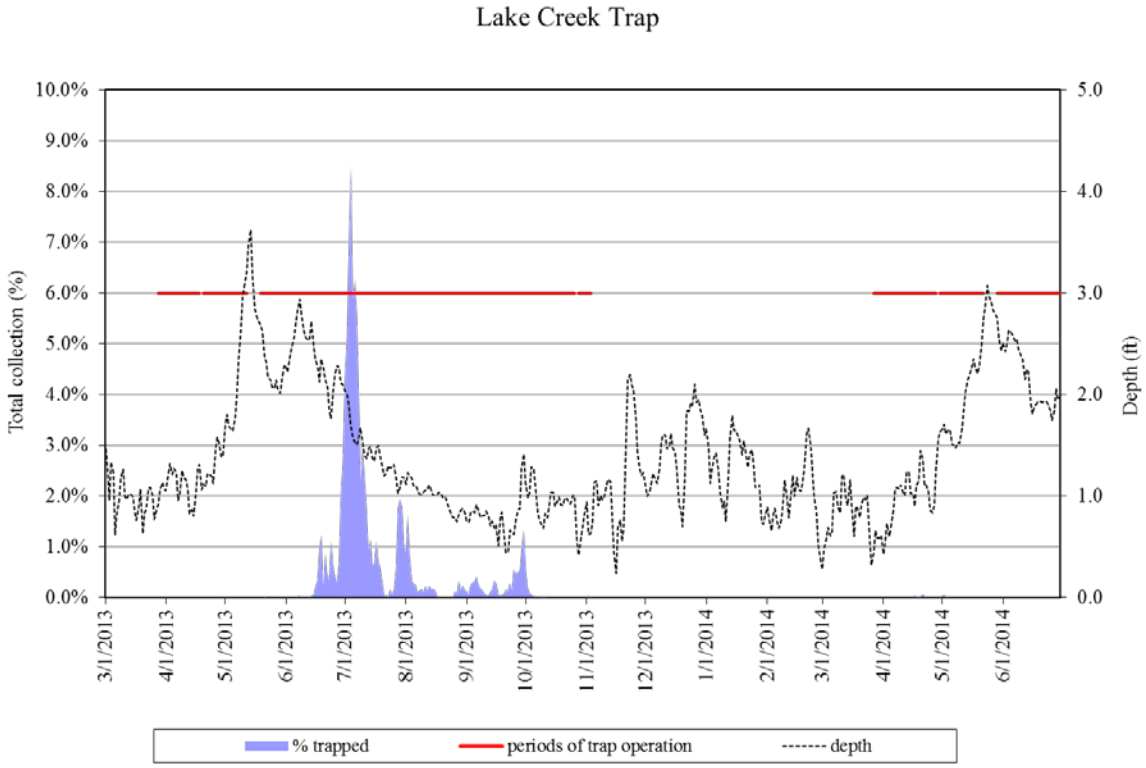


Appendix Figure 1. Continued.

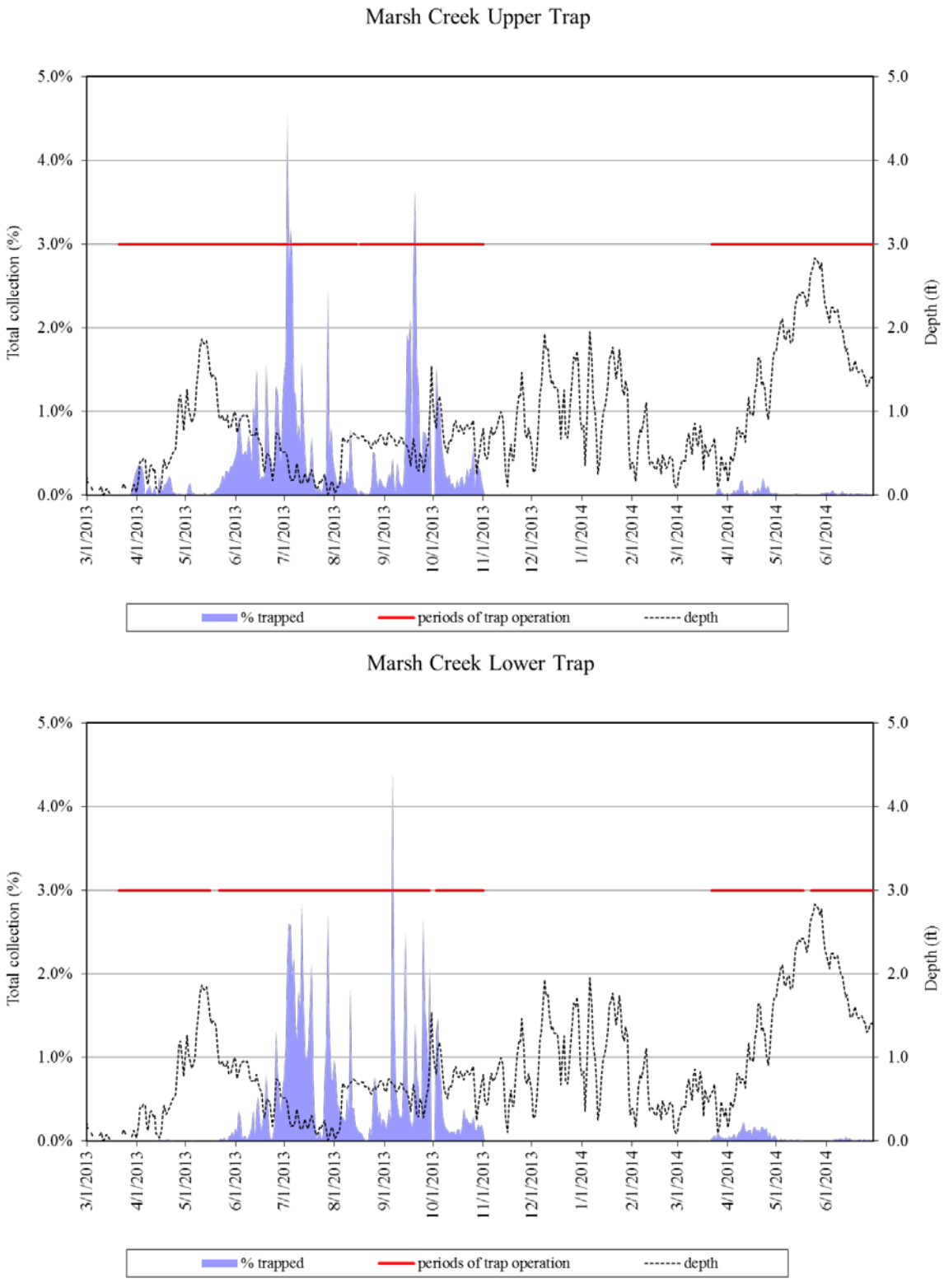


Appendix Figure 2. Daily passage of wild Chinook salmon fry, parr, and smolts at seven migrant traps, expressed as percentages of total collected, and plotted against average daily depth collected near traps. Periods of trap operation are also shown.

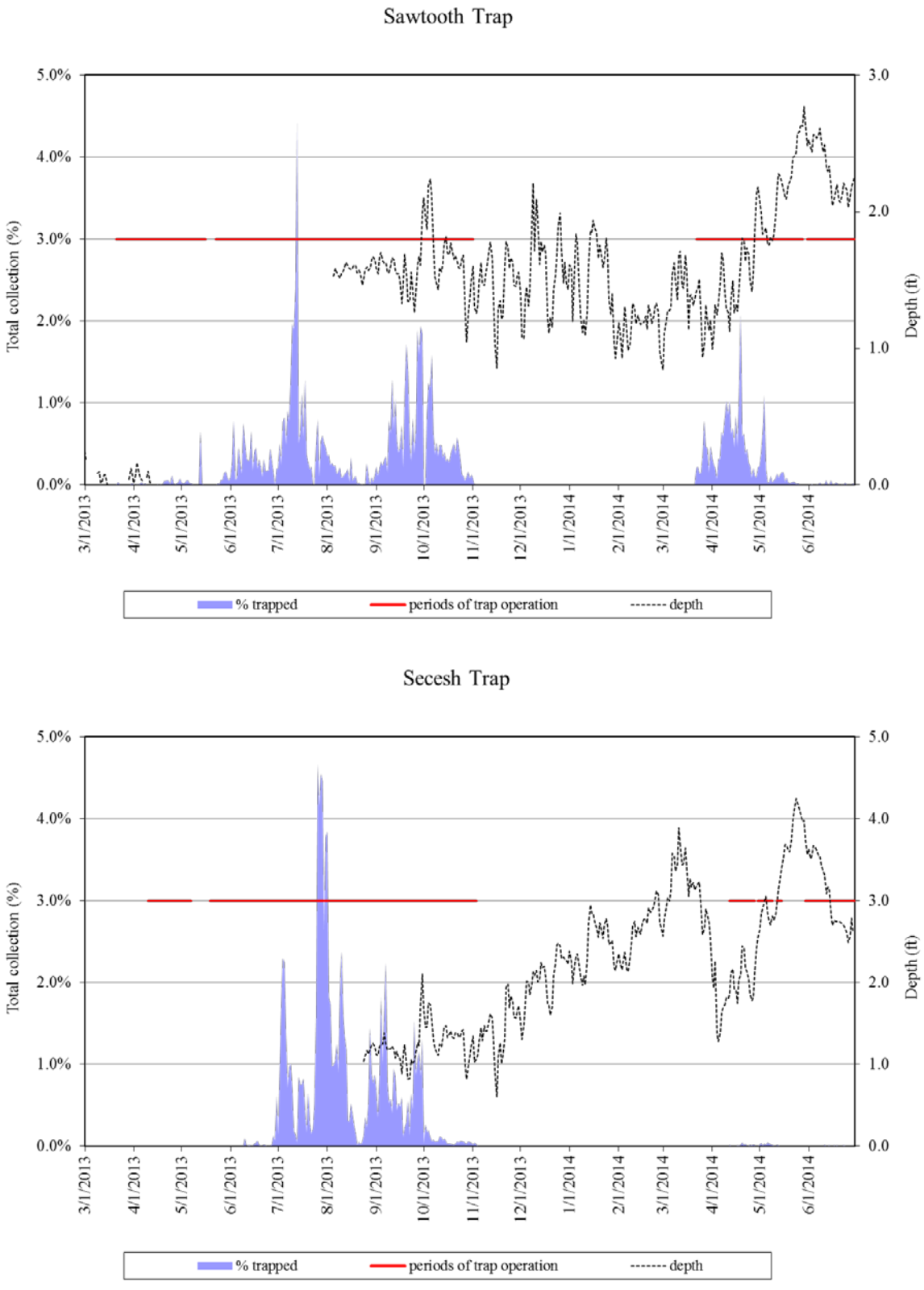




Appendix Figure 2. Continued.



Appendix Figure 2. Continued.



Appendix Figure 2. Continued.