Monitoring the Migrations of Wild Snake River Spring/Summer Chinook Salmon Juveniles, 2014-2015

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Executive Summary

From late summer 2014 to mid-2015, we continued a multiyear research project to monitor the migration behavior and survival of wild juvenile spring/summer Chinook salmon in the Snake River Basin. Wild parr were collected in natal tributaries, implanted with passive integrated transponder (PIT) tag, and released near their respective collection sites. In this report, we present data and analyses from detections of fish tagged in summer 2014 and monitored through spring 2015.

Our analyses included estimates of survival from release to instream PIT-tag monitors in tributaries and from instream monitors to Lower Granite Dam. These estimates are summarized in Table E for populations from the five tributaries that have instream PIT-tag monitoring systems (Appendix Table 29). For the remaining populations and for all stream populations combined, we report detection and survival estimates from release to Lower Granite Dam, median dates of arrival at the dam, and growth rate and condition for subsamples of these fish. These results are summarized below:

- During July-August 2014, we PIT tagged 12,497 wild Chinook salmon parr and released them to 16 Idaho streams or sample areas.

- Overall observed mortality from collection, handling, tagging, and after a 24-h holding period was 1.1%.

- During 2015, we recaptured 202 of these fish using the separation-by-code system at Lower Granite Dam. Recaptures included fish from all 16 Idaho populations.

- For the 202 recaptured fish, average growth was 38.1 mm in length and 8.9 g in weight over an average period of 264 d. Mean condition factor declined from 1.30 at release (parr) to 1.07 at recapture (smolt). Among fish tagged and released as parr in 2014, mean length at release was significantly greater for fish detected during spring and summer 2015 that for those that were never detected ($P < 0.0001$).

- For tagged parr from all 16 Idaho populations, peak detections at Lower Granite Dam occurred during 24-26 April 2015. Respective dates of the 10th, 50th, and 90th passage percentiles were 22 and 30 April, and 17 May 2015.

- For fish from all Idaho streams combined, the average estimated rate of survival to Lower Granite Dam (parr-to-smolt survival) was 11.2% (range 5.6-38.4%).

Table E. Numbers and proportions of wild spring/summer Chinook salmon released during 2014 and detected during 2014 and 2015. Results shown are for the five Idaho streams with PIT-tag monitoring systems installed. Abbreviations: DE, detection efficiency; LGR, Lower Granite Dam.

	Instream monitoring systems						Survival (%)		
	Detected		Detection period (%)			Instream detection efficiency	Release to instream monitor	to Lower Granite	
Released (n)	(n)	(%)	Late summer/ fall	Winter	Spring	(%)		From instream monitor	From release site
Valley Creek									
2,000	518	25.9	73.2	26.1	0.7	60.5	42.8	19.7	6.7
Upper Big Creek									
999	133	13.3	78.2	18.8	3.0	26.8	49.6	32.0	17.7
Lower Big Creek									
1,000	263	26.3	81.4	17.9	0.7	30.5	86.3	20.7	19.1
Secesh River									
964	199	20.6	94.0	3.5	2.5	46.0	44.9	13.2	11.4
Lake Creek									
496	76	15.3	89.5	7.9	2.6	52.9	52.9	30.1	6.0
South Fork Salmon River									
199	27	13.6	70.4	29.6	0.0	22.2	61.1	32.0	8.5

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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). Combined Snake River spring/summer run Chinook populations were evaluated as a single evolutionarily significant unit (ESU) by NMFS biological review team. Based on these evaluations, the team concluded that the Snake River spring/summer-run Chinook salmon ESU was well below the threshold for threatened status and only slightly above the threshold for endangered status under the ESA (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 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 an 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 since that time have continued to improve various tagging methods. However, until the late 1980s, resource managers relied on methods that could provide only limited information on fish passage, such as freeze-branding, index counts at traps and dams, and analyses of flow patterns.

In the late 1980s the passive integrated transponder (PIT) tag was introduced to the fisheries community. Each PIT tag contains a unique code, which allows researchers to track and record the movements of individual fish. Because it is small and biologically inert, a PIT tag can be retained throughout the fish's life cycle. The tag allows multiple detections of an individual fish without physical recapture.

Since its introduction, use of the PIT tag has expanded from about 50,000 to more than 2 million fish tagged annually. These tagging efforts, along with automated data collection methods have provided large data sets 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 shared repository for these 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.

This report includes information on tagging and release of wild Chinook salmon parr from Idaho streams during 2014. We subsequently monitored these fish during spring and early summer 2015, 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, 2015). 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.

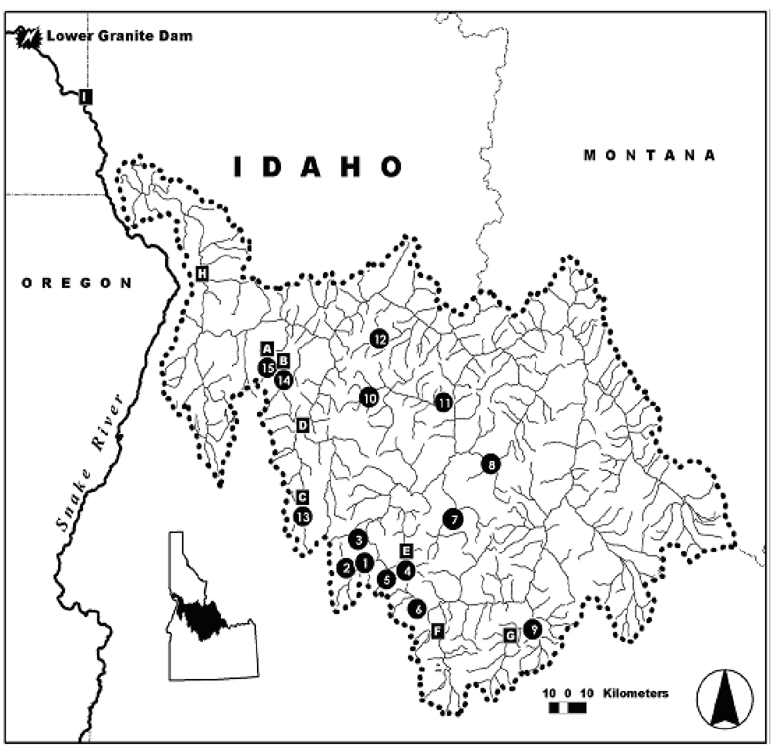
This study provides critical information for recovery planning and ultimately recovery of these wild fish populations, all of which remain listed as threatened under the U.S. Endangered Species Act of 1973 (NMFS 2008).

During 2014-2015, we collected water temperature and depth measured at 16 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 16 Idaho streams or sample areas during 2014 (Figure 1). Fish collection followed the safe handling methods developed for this study and detailed by Matthews et al. (1990, 1997). Anesthetized fish were randomly selected for tagging, provided they met the 55-mm minimum fork length requirement. In 2014, fish were tagged using individual single-use hypodermic needles pre-loaded with 12-mm PIT tags. This method ensured that each fish was tagged with a sterile, sharp needle, thus minimizing stress and injury during the tagging process. All other tagging criteria remained the same as in previous years of this study (Achord et al. 1994, 1995a,b, 2003, 2004, 2010, 2011; Lamb et al. 2013, 2014, 2015).



1-Bear Valley Creek (and Trap)
2-Elk Creek
3-Sulphur Creek
4-Marsh Creek
5-Cape Horn Creek
6-Valley Creek
7-Loon Creek
8-Camas Creek
9-Herd Creek
10-Big Creek (upper)
11-Big Creek (lower)(and Trap)
12-Chamberlain/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 2014.

Downstream Detection and Recapture Sites

Instream Monitoring Systems

In 2002, the first instream PIT-tag monitoring systems were installed at two sites in Valley Creek. These systems were designed 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).

Instream monitoring systems are set up to automatically interrogate, store, and transmit data from passing tagged fish. Detection data are uploaded to the Columbia River PIT-Tag Information System (PTAGIS), a regional shared database operated by the Pacific States Marine Fisheries Commission (PSMFC 1996). Complete detail on the history and development of these systems was reported by Achord et al. (2004-2005, 2009-2012) and Lamb et al (2013-2015).

From late July 2014 through June 2015, we collected detection data from wild PIT-tagged Chinook salmon juveniles passing 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 the 2014-2016 data collection period, 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 were operated in the same configuration as in 2014. 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 2014 and spring 2015, 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
- 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 2015, 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, study fish recaptured 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.

Recapture at Lower Granite Dam

At Lower Granite Dam, sampling was conducted from April through July 2015 in an effort to recapture subsamples of study fish tagged as parr in summer 2014. 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 15 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) 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 both at release (using release data associated with the PIT tag code) and recapture.

Interrogation Systems at Dams

During spring and summer 2015, wild Chinook salmon smolts that had been PIT-tagged as parr in 2014 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 each release group from each stream population, we estimated detection probability at Lower Granite Dam. Estimates of survival probability from release as parr to arrival at Lower Granite Dam as smolts were then estimated for each group. For monitored streams, this reach 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. To estimate survival, 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 probability of detection at an upper instream monitor was not independent of detection probability at a lower monitor.

This pattern of detection violated a critical assumption required by the CJS model—that of independent probabilities of detection (recapture) at each location. 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 groups from individual streams. For fish from stream segments with instream monitors, we also estimated survival from the downstream monitor to Lower Granite Dam.

We estimated separate probabilities of survival to Lower Granite Dam 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 detection data—Daily detection probabilities at Lower Granite Dam were estimated using data not only from our tagged study fish, but from all Snake River wild Chinook salmon that were PIT tagged and released upstream from the dam. These "auxiliary" detection data were detections of fish released for other studies, but detections from both sources were combined for detection probability and survival estimates.

Using these combined data, we estimated detection probability following the method of Schaefer (1951) and modified by Sandford and Smith (2002). Briefly, for each day of the migration season, we estimated numbers of tagged fish that passed Lower Granite Dam and were detected as well as numbers of tagged fish that were not detected. 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 an estimated day of passage at Lower Granite Dam, assuming that the passage distribution for these fish was proportionate to that of detected fish 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 slightly modified the method of Sandford and Smith (2002) for estimates in the early and late periods, or tails, of the passage distribution. This modification was necessary because for fish passing very early or late in the distribution, there were often no detections at Little Goose Dam; thus process described above was not applicable.

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

Migration Timing

For each stream, we estimated migration timing to Lower Granite Dam based on daily detection numbers at the dam for tagged study fish. 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 each daily detection total by its corresponding daily detection probability estimate. Next, migration timing statistics were calculated based on [the expanded?] detections (i.e., passage dates of the 10th, median, and 90th percentiles of the tagged population from each stream).

For each migration timing statistic, we used the bootstrap method of Efron and Tibshirani (1993) to estimate the standard error (SE). Then, we calculated a "representative" estimate of variance for each statistic as the median of the SEs for fish from all stream populations. This method assumed a similar distribution of passage percentile times 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 2014-2015, we collected hourly measurements of water temperature (°C) and depth (ft) from 12 locations using water quality data loggers (In-Situ† Level Troll 300). Data loggers were used 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 provided 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 1-2).

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

Results

Fish Collection and Tagging

From 28 July to 27 August 2014, we collected 14,036 wild Chinook salmon parr from 16 Idaho stream populations (Figure 1). Fish were collected over a distance of about 32.9 stream km and over an area of approximately 320,600 m^2 (Table 1; Appendix Table 1). Of the fish collected, 12,497 were PIT tagged using standard 12-mm tags.

All tagged fish were released back into the streams along with the remaining untagged live fish. Collected fish were rejected for tagging if they had been previously tagged, were too small or injured, had matured precociously, or if sufficient numbers of fish had already been tagged. Numbers of tagged fish released per stream or sample area ranged from 198 in Loon Creek to 2,000 in Valley Creek (Tables 1; Appendix Table 1).

In 2014, the mean fork length of all Chinook salmon parr collected was 66.8 mm and the mean weight was 4.0 g. The mean fork length of Chinook salmon parr that were tagged and released was 66.8 mm, and the mean weight was 3.9 g (Table 1; Appendix Table 1). Collection areas within streams were further delineated by recording Global Positioning System (GPS) coordinates using the Universal Transverse Mercator (UTM) coordinate system (Appendix Table 3).

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 4). Overall, collection mortality was 1.1%, tagging and 24-h delayed mortality was 0.1%, and total observed mortality was 1.1%. In addition, 1 lost tag was observed prior to release.

Table 1. Summary of collection, PIT tagging, and release of wild Chinook salmon parr with average fork lengths and weights (includes recaptured tagged fish), approximate distances, and estimated areas sampled in streams of Idaho from July through August 2014.

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	686	497	60.1	62.3	3.0	3.3	21.0-22.6	15,600
Herd Creek	516	502	70.8	70.8	4.7	4.7	1.0-4.0	11,345
Loon Creek	210	198	66.8	66.8	3.7	3.6	28.0-31.0	12,902
Valley Creek	2,133	2,000	67.5	67.4	3.8	3.7	3.8-5.5 & 6.0-7.2	27,159
Marsh Creek	1,122	1,000	66.6	67.0	4.0	4.0	11.2-11.8	16,230
Cape Horn Creek	958	750	64.3	65.0	4.1	3.8	0.2-1.5	15,393
Bear Valley Creek	1,070	1,000	67.9	68.1	4.1	4.2	8.5-9.5 & 12-13.2	29,408
Elk Creek	1,093	1,000	71.9	71.2	4.7	4.4	0.0-1.7	22,100
Sulphur Creek	424	398	67.4	67.5	4.1	4.2	4.8-7.2	16,011
Big Creek (upper)	1,167	999	65.4	66.1	3.5	3.6	57.5-60.2	31,916
Secesh River	1,196	964	62.1	64.0	3.1	3.3	24.2-27.2	32,878
West Fork Chamberlain Creek	756	750	69.4	69.4	4.0	4.0	1.2-2.2	5,700
Chamberlain Creek	799	744	63.5	64.1	3.2	3.3	24.2-26	13,488
Lake Creek	655	496	62.2	63.9	3.4	3.6	1.0-1.8	20,093
South Fork Salmon River	199	199	68.4	68.4	4.5	4.5	117.5-118.4	10,220
Big Creek (lower)	1,052	1,000	74.1	74.2	5.3	5.3	7.0-10.8	40,157
Totals/averages	14,036	12,497	66.8	66.8	4.0	3.9	32.9	320,600

Table 2. Summary of species other than Chinook salmon parr observed during collection operations in Idaho from July through August 2014. 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	198	0	356	0	0	2	0	0	0	3	0
Herd Creek	165	0	249	0	0	3	312	0	0	25	0
Loon Creek	71	0	53	0	1	2	66	0	0	2	0
Valley Creek	55	0	237	216	0	1	620	123	43	361	3
Marsh Creek	36	0	56	174	0	1	318	0	0	30	0
Cape Horn Creek	142	0	21	42	0	1	780	0	0	6	0
Bear Valley Creek	144	0	539	220	0	1	297	21	509	28	0
Elk Creek	56	0	159	211	0	0	80	36	439	479	0
Sulphur Creek	105	0	245	0	1	0	365	0	7	12	0
Big Creek (upper)	316	171	255	311	1	8	1,675	0	0	0	0
Secesh River	121	0	166	15	0	7	593	73	0	0	0
W Fork Chamberlain Cr	16	0	23	0	0	3	19	0	0	3	0
Chamberlain Cr	60	0	172	0	0	0	275	0	0	1	0
Lake Creek	36	0	30	15	0	11	646	0	0	2	0
S Fork Salmon River	101	0	211	2	0	1	14	9	0	3	0
Big Creek (lower)	215	92	795	0	3	0	184	90	106	2	0
Totals	1,837	263	3,567	1,206	6	41	6,244	352	1,104	957	3

Table 3. Mortality percentages for wild Chinook salmon parr collected and PIT-tagged in Idaho from July through August 2014. There was also 1 lost tags for the study.

	Mortality (%)		
Tagging Location	Collection	24 h	Overall
Camas Creek	1.5	0.1	1.6
Herd Creek	0.4	0.0	0.4
Loon Creek	0.9	0.0	0.9
Valley Creek	0.8	0.0	0.8
Marsh Creek	1.5	0.0	1.5
Cape Horn Creek	0.4	0.0	0.4
Bear Valley Creek	2.1	0.0	2.1
Elk Creek	2.5	0.0	2.5
Sulphur Creek	2.6	0.0	2.6
Big Creek (upper)	1.1	0.0	1.1
Secesh River	0.6	0.0	0.6
West Fork Chamberlain Creek	0.0	0.1	0.1
Chamberlain Creek	0.6	0.0	0.6
Lake Creek	0.3	0.0	0.3
South Fork Salmon River	0.0	0.0	0.0
Big Creek (lower)	1.7	0.0	0.0
Averages	1.1	0.0	1.1

Detection and Survival to Instream Monitoring Sites

Valley Creek

We released 2,000 tagged wild Chinook salmon parr to Valley Creek during 1-3 August 2014 (Table 1). All fish were released in natal rearing areas 3-10 km above the upper instream monitor in lower Valley Creek (PTAGIS site code VC1). Of these fish, 518 were detected on one or both Valley Creek instream monitors between 2 August 2014 and 11 June 2015 (Table 4; Figure 2). In addition, 17 fish from Valley Creek releases and 9 fish from Herd Creek releases (1.8%) were detected on the two newer instream monitors on the upper Salmon River at rkm 437 and 460 (site codes USI, USE).

For the 139 tagged fish detected on both Valley Creek monitors, median downstream travel time between the upstream and downstream monitors (VC1 to VC2) was 9.6 h (range 0.3 h-271.1 d). Of the 518 detections in Valley Creek, 379 (73.2%) occurred in late summer/fall, 135 (26.1%) in winter, and 4 (0.8%) in spring (Figure 2).

Based on detections at downstream dams, overall detection efficiency for both Valley Creek monitors was 60.5%. Based on this efficiency, we estimated that 42.8% of the tagged parr released to Valley Creek had survived to pass the Valley Creek instream monitors (Table 4). We found a statistically significant relationship for these fish between fork length at tagging and time of detection on Valley Creek monitors, with relatively smaller fish moving downstream earlier ($P < 0.001$; Figure 3).

Table 4. Detection numbers and estimated detection efficiency (DE) at instream monitoring arrays for wild spring/summer Chinook detected from late summer and fall 2014 to spring 2015.

Stream population	Released (n)	Detected (n)	Detected (%)	Detection efficiency (%)	Season detected (%) Summer/fall	Season detected (%) Winter	Season detected (%) Spring	Survival to instream monitor (%) Mean	Survival SE	Survival 95% CI
Valley Creek	2,000	518	25.9	60.5	73.2	26.1	0.7	42.8	5.3	32.3-53.4
Upper Big Creek	999	133	13.3	26.8	78.2	18.8	3.0	49.6	8.4	32.8-66.5
Lower Big Creek	1,000	263	26.3	30.5	81.4	17.9	0.7	86.3	13.7	8.8-113.7
Secesh River	964	199	20.6	46.0	94.0	3.5	2.5	44.9	6.7	31.6-58.2
Lake Creek	496	76	15.3	52.9	89.5	7.9	2.6	29.3	6.6	16.1-42.6
S Fork Salmon R	199	27	13.6	22.2	70.4	29.6	0.0	61.1	25.1	0.9-11.2

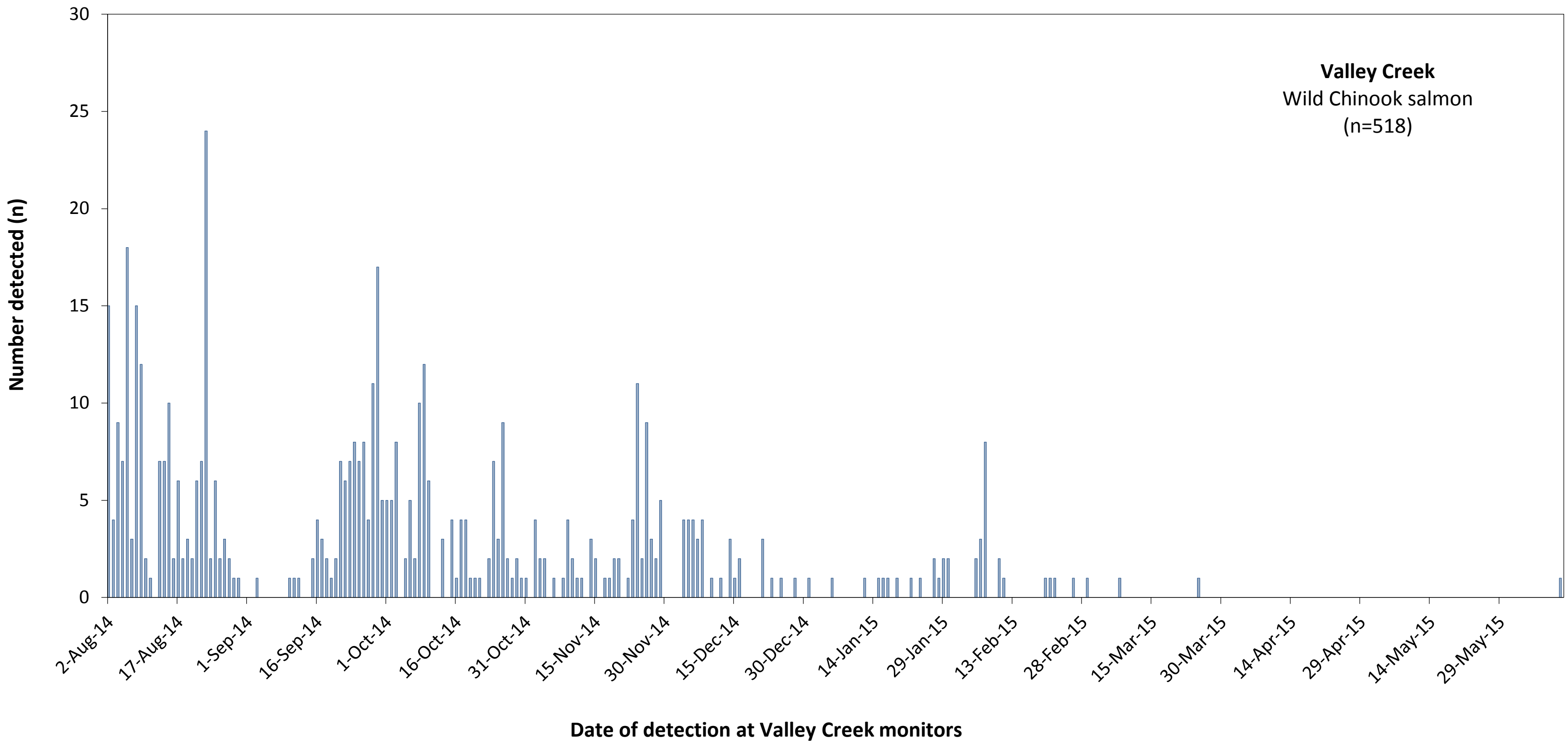


Figure 2. Dates of detection for 518 wild spring/summer Chinook salmon parr, pre-smolts, and smolts at the upper and lower in-stream monitoring arrays in lower Valley Creek (VC1 and VC2) from August 2014 to June 2015. A total of 2,000 parr were tagged with 12-mm PIT tags and released 3-10 km above these antenna arrays during 1-3 August 2014.

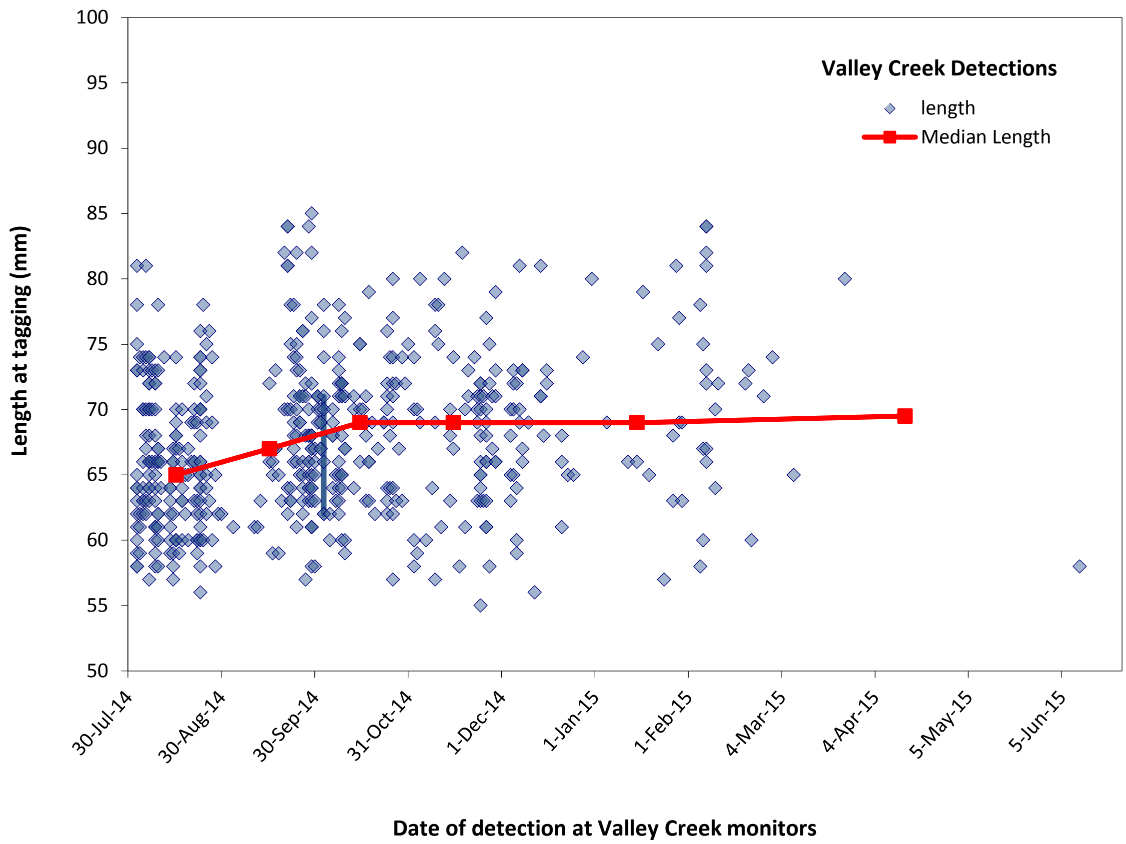


Figure 3. Fork length vs. date of detection for 518 fish tagged as parr with 12-mm tags in Valley Creek. Fish were detected either or both the upper and lower instream PIT-tag monitoring antenna arrays in lower Valley Creek (VC1 and/or VC2) from August 2014 through June 2015.

Upper Big Creek

We released 999 tagged wild Chinook salmon parr to upper Big Creek during 14-15 August 2014 (Table 1). All fish were released in natal rearing areas 49-52 km upstream from the upper and lower Taylor Ranch instream monitors in lower Big Creek (site code TAY-a and TAY-b). Of these 999 fish, 133 were detected on one or both instream monitors at Taylor Ranch between August 2014 and May 2015 (Table 4; Figure 6). Of the 133 fish detected, 104 (78.2%) were detected in late summer/fall, 25 (18.8%) in winter, and 4 (3.0%) in spring (Figure 4).

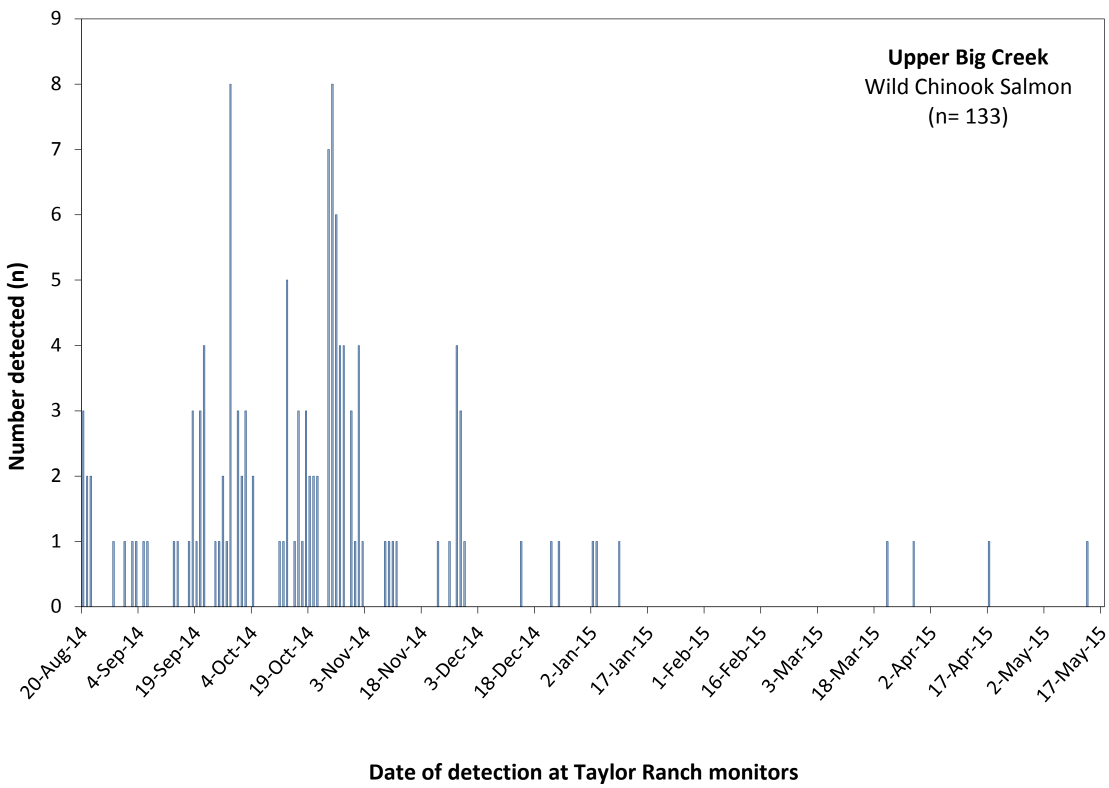


Figure 4. Detections of 133 wild spring/summer Chinook salmon parr, pre-smolts, and smolts from upper Big Creek. Fish were detected at the upper or lower instream monitoring systems at Taylor Ranch (TAY-a and TAY-b) in lower Big Creek. A total of 999 parr were tagged with 12-mm PIT tags and released 49-52 km above monitoring systems on 15 August 2014.

Based on detections at downstream dams, overall detection efficiency was 26.8% for both the upper and lower instream monitors at Taylor Ranch in lower Big Creek. Based on this detection efficiency, survival to the downstream array at Taylor Ranch was 49.6% for fish released to upper Big Creek (Table 4). Detection data for these fish indicated no significant relationship between fork length at tagging (P = 0.079) and timing of detection for fish from upper Big Creek (Figure 5).

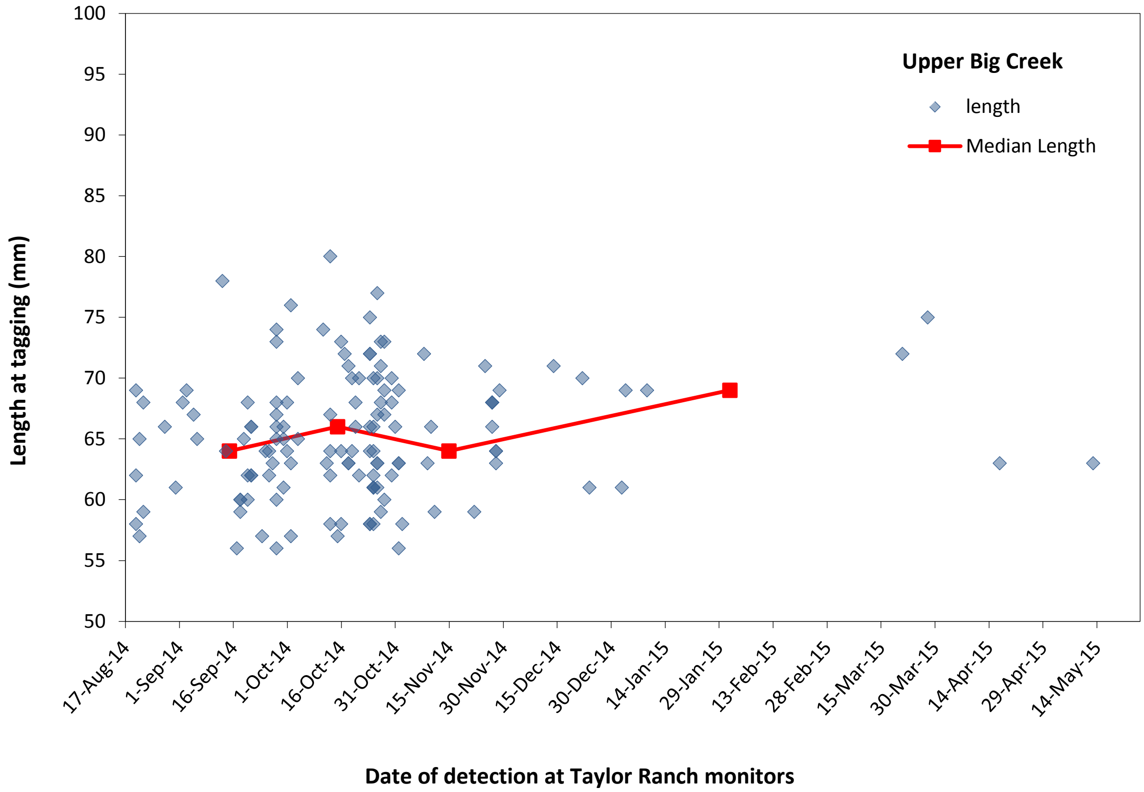


Figure 5. Fork length at tagging vs. date of detection for 133 wild spring/summer Chinook tagged at upper Big Creek and detected at Taylor Ranch upper and lower instream PIT-tag monitoring antennas (TAY-a and TAY-b), August 2014-May 2015.

Lower Big Creek

We released 1,000 tagged wild Chinook salmon parr to lower Big Creek during 26-27 August 2014 (Table 1). All were released in natal rearing areas 0-3 km above the two instream monitoring arrays near Taylor Ranch in lower Big Creek (PTAGIS site code TAY-a and TAY-b). Of these fish, 263 were detected on one or both arrays at Taylor Ranch between 27 August 2014 and 7 April 2015 (Figure 6). Of these 263 detections, 214 (81.4%) occurred in late summer/fall, 47 (17.9%) in winter, and 2 in spring 2015 (Table 4; Figure 6).

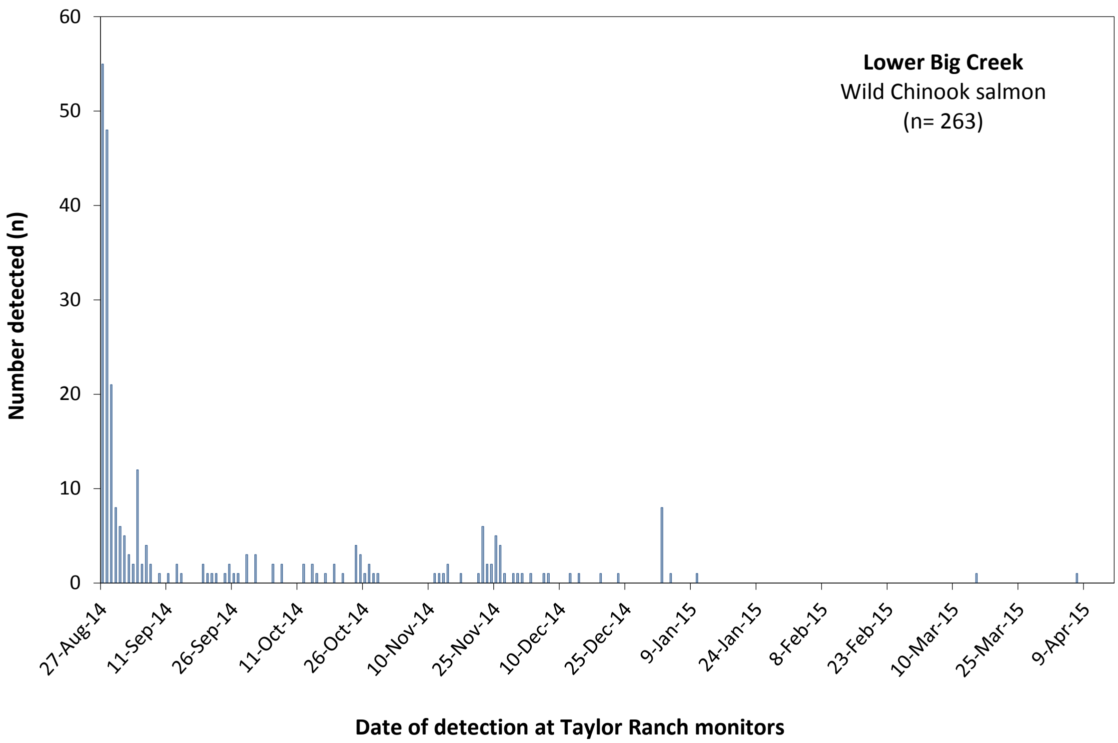


Figure 6. Detections of 263 wild spring/summer Chinook salmon parr, pre-smolts, and smolts from lower Big Creek. Fish were detected at the upper or lower instream monitoring systems at Taylor Ranch (TAY-a and TAY-b) in lower Big Creek. A total of 1,000 parr were tagged with 12-mm PIT tags and released 0-3 km above monitoring systems on 27 August 2014.

Based on detections at downstream dams, overall detection efficiency was 30.5% for both instream monitoring arrays at Taylor Ranch on lower Big Creek. Using this detection efficiency rate, we estimated that 86.3% of the tagged parr from this stream survived to pass the Taylor Ranch arrays on lower Big Creek (Table 4). We found no significant relationship between fork length at tagging and timing of detection for these fish (*P* = 0.782; Figure 7).

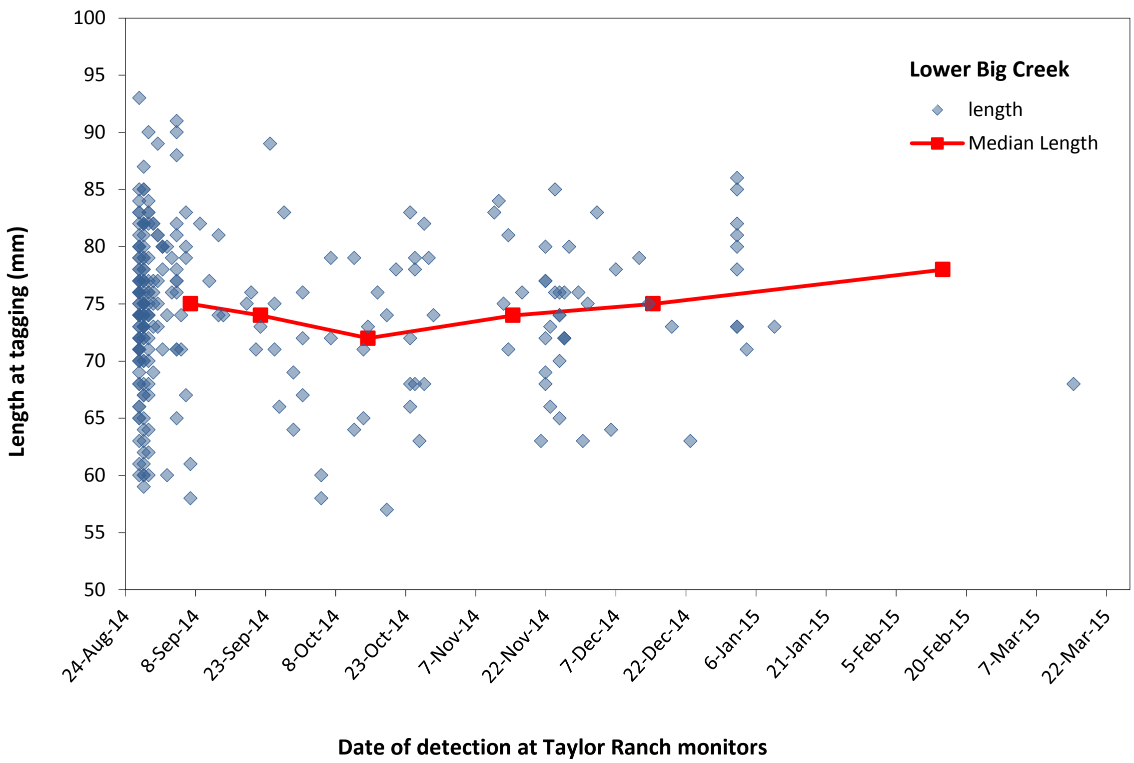


Figure 7. Fork length at tagging vs. date of detection for 263 wild spring/summer Chinook tagged at lower Big Creek and detected at Taylor Ranch upper and lower instream PIT-tag monitoring antennas (TAY-a and TAY-b), August 2014-March 2015.

South Fork Salmon River

We released 199 tagged wild Chinook salmon parr to South Fork Salmon River on 23 August 2014 (Table 1). All 199 fish were released in natal rearing areas 52-53 km above the instream monitor near Krassel Creek at rkm 65 (site code KRS). These release sites were 87-88 km above the instream monitor in the lower South Fork Salmon River at Guard Station Road Bridge (rkm 30; site code SFG). Of these 199 fish, 27 were detected on instream monitors near Krassel Creek on the South Fork Salmon River from August 2014 to April 2015, and none were detected on the monitors near Guard Station Road Bridge. Of the 27 detections at the Krassel Creek monitor, 21 (77.8%) occurred in late summer/fall and 6 (22.2%) in winter/spring (Figure 8).

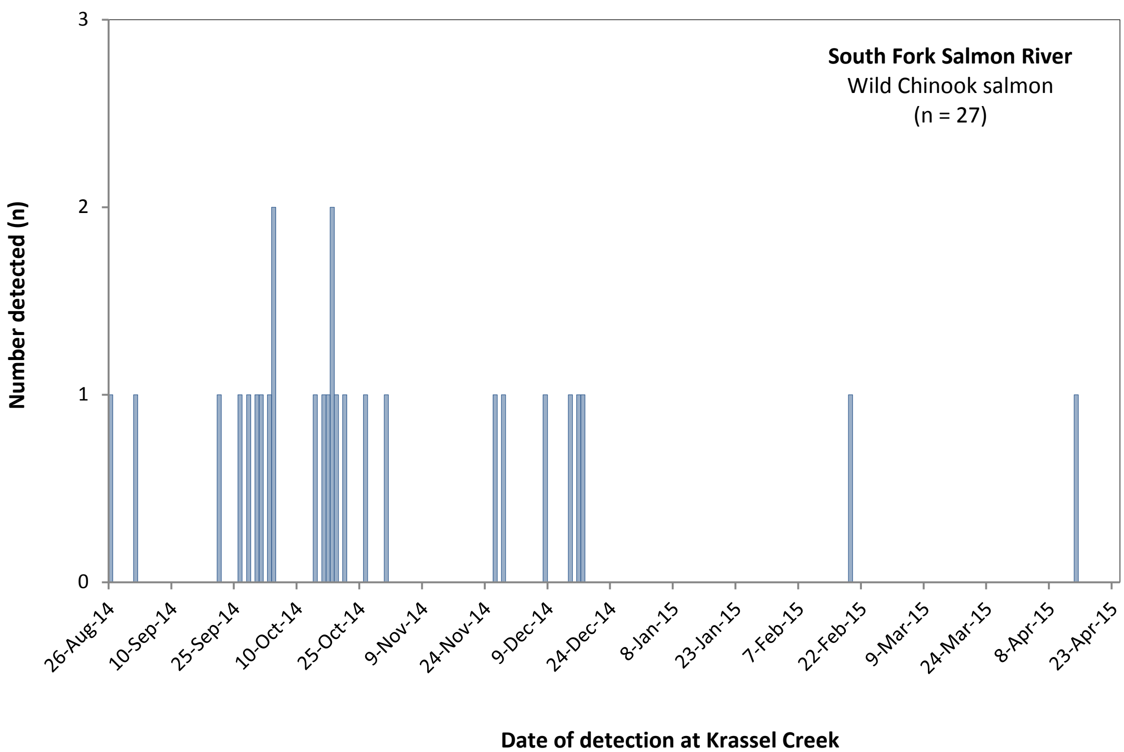


Figure 8. Detections of 27 PIT-tagged wild spring/summer Chinook salmon parr, pre-smolts, and smolts at the Krassel instream PIT-tag monitoring antennas in the South Fork Salmon River from August 2014 through April 2015. A total of 199 Chinook salmon parr were PIT tagged using 12-mm tags and released in the South Fork Salmon in areas from approximately 52-53 km above these antennas from 23 August 2014.

Based on detections at downstream dams, overall detection efficiency of the instream monitoring array at Krassel Creek was 22.2%. Using this detection efficiency rate, we estimated survival of 61.1% to the instream monitoring array at Krassel Creek for all tagged parr from the South Fork Salmon River. We found no significant relationship between fork length at tagging and timing of detection for these fish (P = 0.43; Figure 9).

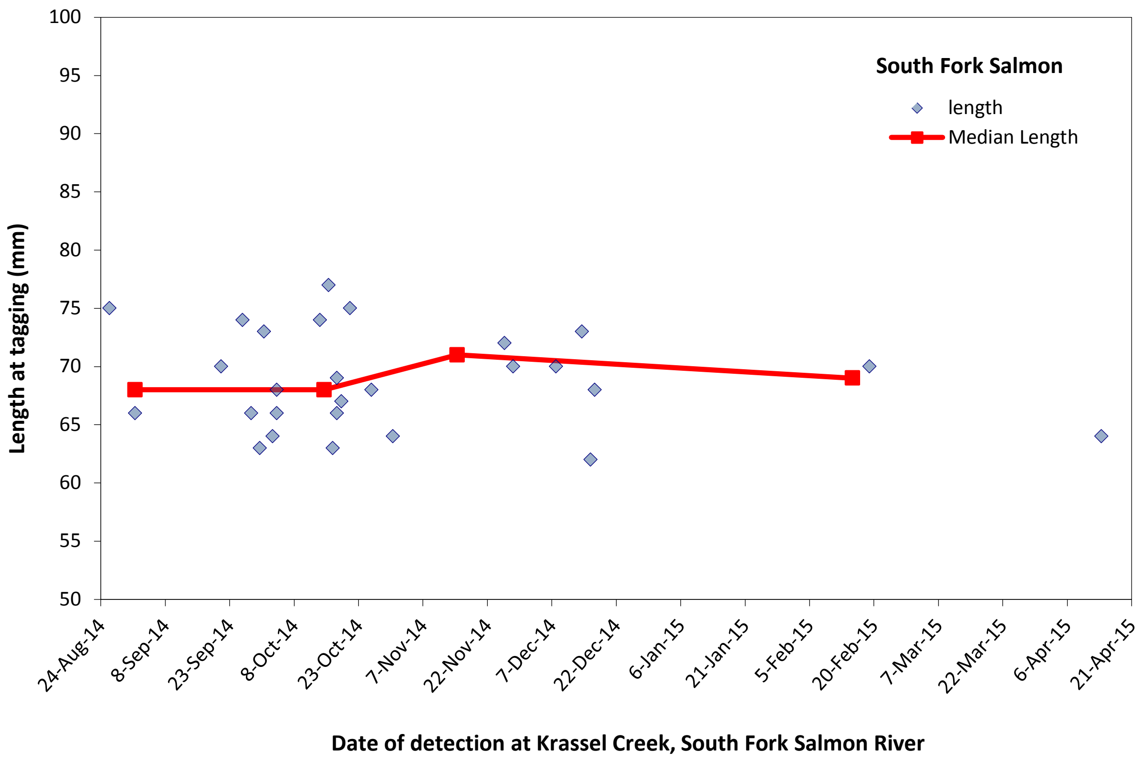


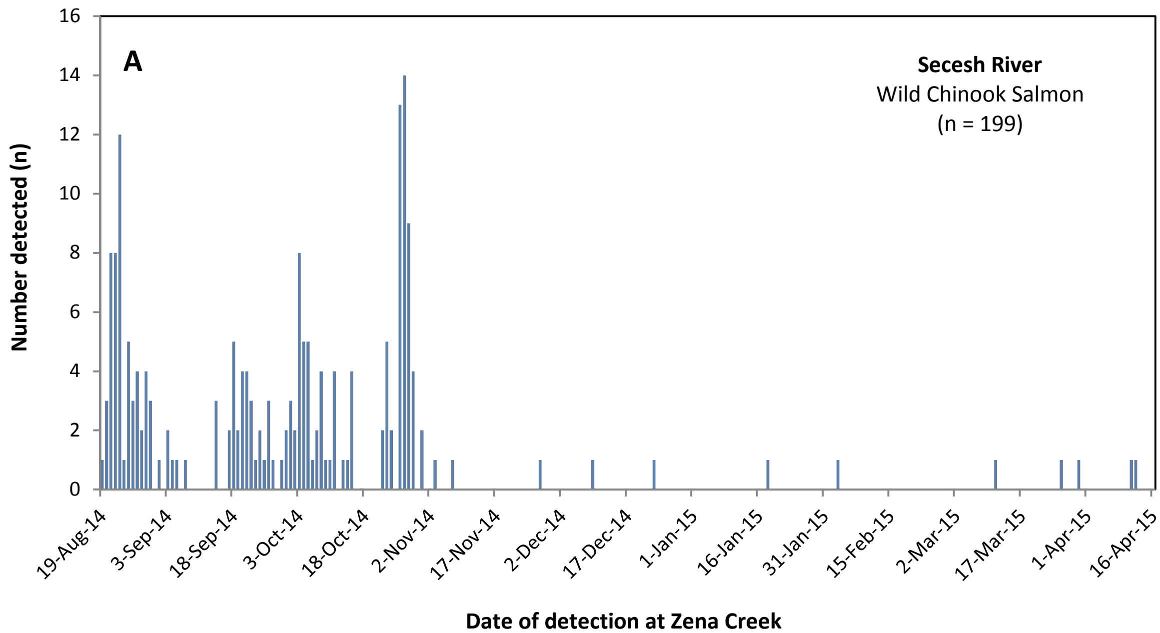
Figure 9. Fork length at tagging vs. date of detection for 27 wild spring/summer Chinook salmon tagged as parr in the South Fork Salmon River and detected at the instream PIT-tag monitoring site at Krassel Creek in the South Fork Salmon River (KRS), August 2014-April 2015.

Secesh River and Lake Creek

We collected and tagged 964 wild Chinook salmon parr from the Secesh River during 16-17 August and an additional 496 from Lake Creek on 22 August 2014. All fish were released in or near their natal rearing areas. These release sites were 21-42 km above the instream monitors near Zena Creek Ranch (site code ZEN) in the lower Secesh River, and ~55-76 km above the South Fork Salmon River monitoring site at Guard Station Road Bridge (site code SFG).

From August 2014 to May 2015, 199 of the Secesh River fish and 76 of the Lake Creek tagged fish were detected on instream monitors near Zena Creek Ranch (Figure 10). As a result of bed-load movement that buried the instream arrays, only 2 fish were detected at the monitor near Guard Station Road Bridge. Of the 199 Secesh River detections near Zena Creek, 187 (94.0%) occurred in late summer/fall and 12 (6.0%) in winter/spring 2014-2015 (Figure 10A). Of the 76 detections from Lake Creek, 68 (89.5%) occurred in late summer/fall and 8 (10.5%) in winter/spring 2014-2015 (Figure 10B).

Based on detections at downstream dams, overall detection efficiency of instream monitoring array at Zena Creek was 46.0% for parr from the Secesh River (n = 199) and 52.9% for those from Lake Creek (n = 76; Table 4). Based on these detection efficiencies, we estimated survival to the Zena Creek instream monitoring array was 44.9% for parr from the Secesh River and 29.3% for those from Lake Creek (Table 4). Detection data indicated no significant relationship between fork length at tagging and timing of detection for releases from either the Secesh River (P = 0.31) or Lake Creek (P = 0.30; Figure 11).



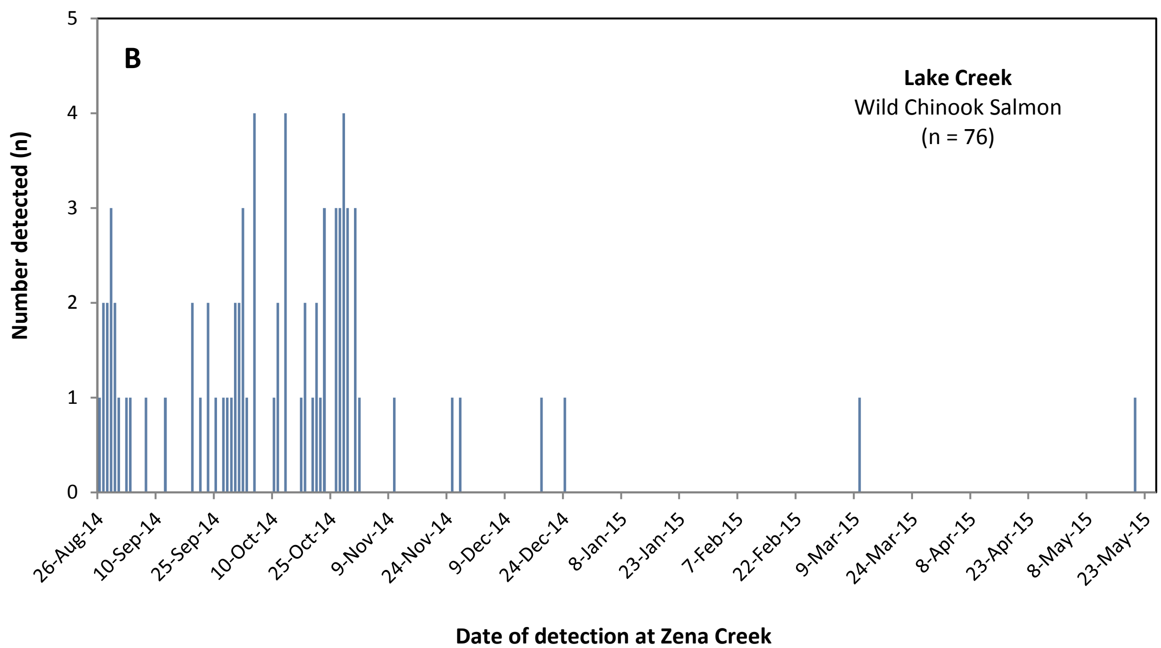
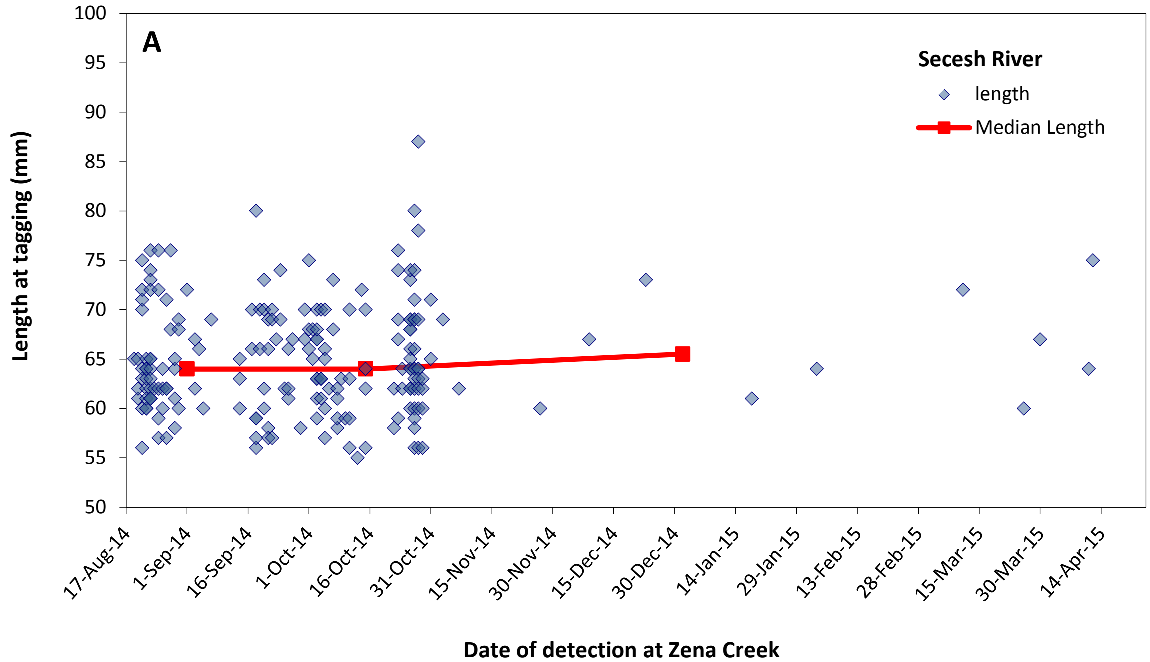


Figure 10. Detections on instream monitors at Zena Creek Ranch from wild spring/summer Chinook salmon from the Secesh River (A) and Lake Creek (B), August 2014-April 2015. We tagged and released 964 fish from the Secesh River during 16-17 August 2014 and an additional 496 fish from Lake Creek on 22 August. All fish were released in areas ~21-42 km above the Zena Creek antennas.



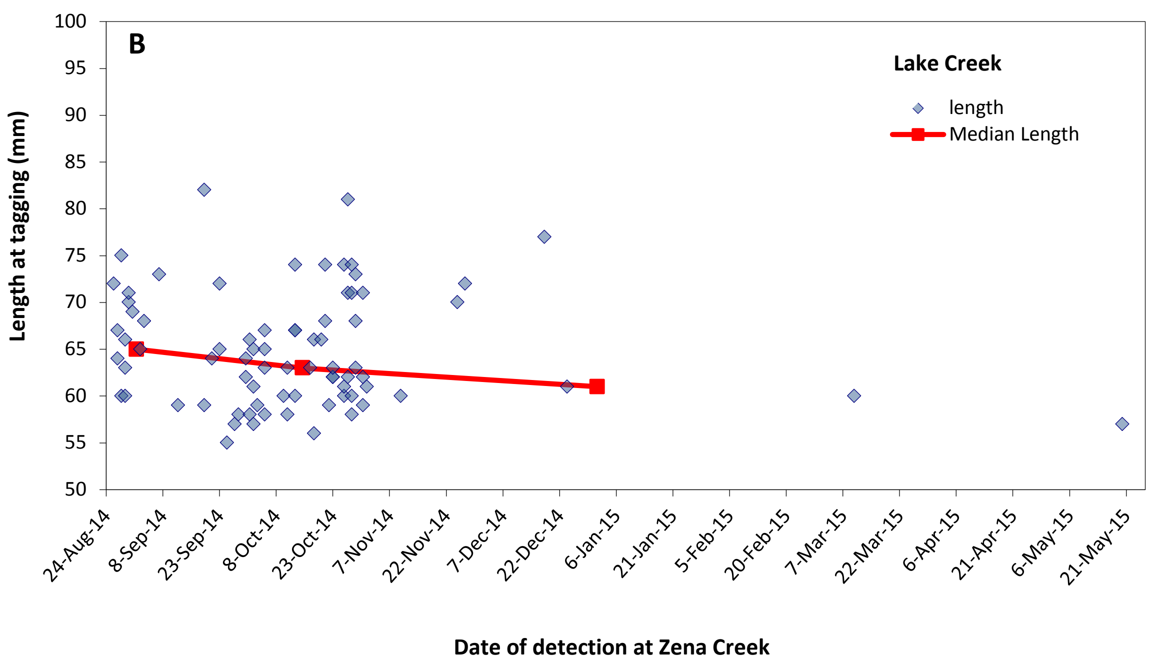


Figure 11. Length at tagging vs. date of detection for fish collected as parr from the Secesh River (A) and Lake Creek (B). Detections were 199 fish and 76 fish for the Secesh River and Lake Creek, respectively. All fish were detected at the instream monitoring site in the lower Secesh River near Zena Creek Ranch, August 2014-April 2015.

Growth and Condition of Recaptured Fish

A total of 554 wild spring/summer Chinook salmon tagged in summer 2014 were recaptured at traps above Lower Granite Dam from summer-fall 2014 to spring 2015. We recaptured 202 fish in the separation-by-code (SbyC) system at Lower Granite Dam for examination of length, weight, and condition (Table 5). Overall mean growth for all of these fish combined was 0.14 mm/d in length and 0.034 g/d in weight.

Table 5. Fork length, weight, and condition factor of wild spring/summer Chinook salmon PIT-tagged in Idaho during summer 2014 and recaptured either in the separation-by-code system at Lower Granite Dam in 2015 or at traps during summer-fall 2014 and spring-summer 2015. One fish was recaptured at the McNary Dam fish facility and one at Bonneville Dam in spring 2015. Precocious males were not included in the analysis.

	Recaptured fish			Length gain (mm)			Weight and condition factor (CF)				
		Days to recapture						Weight gain (g)		Mean CF	
Origin	n	range	mean	n	range	mean	n	range	Mean	release	recapture
	Wild spring/summer Chinook salmon recaptured in SbyC at Lower Granite Dam										
Bear Valley Creek	11	251-301	271	11	16-55	35	11	2.9-15.9	8.5	1.34	1.1
Big Creek (upper)	28	254-284	268	28	21-51	38	24	3.6-16.8	9.5	1.31	1.09
Big Creek (lower)	24	226-265	245	24	24-52	36	24	3.3-15.0	8.6	1.3	1.05
Camas Creek	7	271-300	285	7	36-64	49	6	7.9-18.2	11.8	1.32	1.11
Cape Horn Creek	7	251-280	268	7	28-50	39	4	7.2-11.4	9.3	1.42	1.06
Chamberlain Creek	14	226-271	253	14	23-56	44	14	4.7-14.9	10.0	1.22	1.06
W Fork Chamberlain Cr	14	248-272	254	14	25-44	35	4	5.5-9.5	8	1.18	0.98
Elk Creek	18	237-285	262	18	22-50	35	18	4.3-13.3	8.5	1.28	1.08
Herd Creek	7	269-283	279	7	26-57	38	6	5.3-15.8	9.1	1.32	1.01
Lake Creek	5	235-255	246	5	32-47	37	5	6.1-10.6	7.5	1.3	1.05
Loon Creek	10	271-287	280	10	33-52	41	9	7.2-12.9	9.8	1.22	1.09
Marsh Creek	9	259-288	270	9	21-57	35	9	2.4-12.1	7.4	1.39	1.05
S Fork Salmon River	3	225-261	243	3	31-42	36	3	5.4-8.4	7	1.43	1.03
Secesh River	15	232-299	257	15	25-55	37	10	4.8-10.7	8.1	1.08	1.05
Sulphur Creek	11	255-279	266	11	25-51	37	11	5.0-10.1	7.8	1.41	1.1
Valley Creek	19	264-293	276	19	30-54	41	8	4.7-14.5	10	1.32	1.08
Totals or averages	202	225-301	264	202	16-64	38	166	2.4-18.2	8.9	1.30	1.07

Table 5. Continued.

	Recaptured fish						Weight and condition factor (CF)				
		Days to recapture		Length gain (mm)				Weight gain (g)		Mean CF	
Trap/origin/season	n	range	mean	n	range	mean	n	range	Mean	release	recapture
	Wild spring/summer Chinook salmon recaptured at traps										
Bear Valley Creek											
Bear Valley—fall	15	7-88	40	8	0-27	8.5	8	-0.9-3.9	0.8	1.25	1.08
Elk Creek—fall	11	4-77	34	9	-2-14	6.1	9	-0.9-1.9	0.5	1.26	1.05
Big Creek (Taylor)											
Upper Big Creek—fall	24	10-74	44	23	-2-12	3.8	21	-0.9-1.7	0.0	1.34	1.12
Upper Big Creek—spring	4	217-249	226	4	8-26	17.8	4	1.2-4.2	2.4	1.40	1.07
Lower Big Creek—fall	41	1-52	4	40	-7-9	-0.6	41	-1.6-1.7	-0.6	1.26	1.16
S Fork Salmon R (Knox)											
Fall	43	1-55	22	43	-1-18	5.6	39	-1.2-1.8	0.1	1.37	1.10
Secesh River (lower trap)											
Secesh River–fall	81	3-75	38	80	-4-18	4.9	60	-1.0-3.2	0.4	1.25	1.08
Secesh River—spring	3	219-248	233	3	10-19	14.7	2	0.7-2.6	1.6	1.40	0.97
Lake Creek—fall	30	6-81	43	29	-1-13	4.5	30	-1.1-1.2	-0.1	1.28	1.08
Marsh Creek (upper trap)											
Fall	212	1-83	16	211	-12-18	0.1	0	---	---	1.25	---

Table 5. Continued.

Trap/origin/run time	Recaptured fish			Length gain (mm)			Weight and condition factor (CF)				
		Days to recapture						Weight gain (g)		Mean CF	
	n	range	mean	n	range	mean	n	range	Mean	release	recapture
Wild spring/summer Chinook salmon recaptured at traps (continued)											
Marsh Creek (lower trap)											
Cape Horn Creek—fall	39	1-86	29	37	-3-13	3.5	0	---	---	1.42	---
Marsh Creek—fall	29	1-81	25	29	-3-19	3.1	0	---	---	1.24	---
E Fork Salmon River											
Herd Creek—fall	2	78-92	85	0	---	---	0	---	---	1.14	---
Valley Creek—fall	5	1-2	1	1	---	-2.0	0	---	---	1.09	---
Salmon River—spring	12	205-271	234	12	18-39	28.5	0	---	---	1.33	---
\											
Snake River—spring	1	---	240	1	---	20	0	---	---	1.63	---
Wild spring/summer Chinook salmon recaptured at Columbia River dams											
McNary Dam—spring	1	---	235	1	---	39	1	---	6.6	1.37	0.93
Bonneville Dam—spring	1	---	273	0	---	---	0	---	---	1.16	---
Total/mean	**554**	**1-271**	**101**	**531**	**-12-39**	**9.8**	**215**	**-1.6-3.9**	**1.17**	**1.22**	**1.06**

Detection and Survival to Downstream Dams

Parr-to-Smolt Survival

For fish from all Idaho streams combined, we estimated an average annual parr-to-smolt survival probability of 11.2% (SE 1.0%; Table 6; Appendix Tables 6-21). This estimate was based on expanded detections at Lower Granite Dam from 25 March to 12 June 2014 (n = 1,398). An additional 442 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 6-21).

Table 6. Summary of observed and expanded detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Lower Granite Dam in 2015. Proportions of detected fish from the expanded numbers are parr-to-smolt survival estimates, shown with SE of the estimated.

		Lower Granite Dam detections				
	Tagged and	Observed		Expanded (parr-to-smolt survival)		
Stream	released (n)	(n)	(%)	(n)*	(%)	SE (%)
Bear Valley Creek	1,000	11	1.1	80	8.0	3
Camas Creek	497	8	1.6	51	10.2	4
Cape Horn Creek	750	11	1.5	74	9.8	3
Chamberlain Creek	744	16	2.2	79	10.7	3
W Fork Chamberlain Cr	750	14	1.9	88	11.8	4
Elk Creek	1,000	18	1.8	122	12.2	3
Herd Creek	502	7	1.4	29	5.7	3
Lake Creek	496	5	1.0	28	5.7	3
Big Creek (lower)	1,000	25	2.5	191	19.0	5
Loon Creek	198	10	5.1	76	38.4	15
Marsh Creek	1,000	9	0.9	56	5.6	2
South Fork Salmon R	199	4	2.0	17	8.5	5
Secesh River	964	17	1.8	110	11.4	3
Sulphur Creek	398	0	0.0	86	21.7	7
Big Creek (upper)	999	30	3.0	177	17.7	4
Valley Creek	2,000	20	1.0	134	6.7	2
Totals or averages	12,497	217	1.7	1,398	11.2	1

* Due to rounding, the expanded detection numbers at Lower Granite Dam in Table 6 may vary slightly from those in Appendix Tables 6-21.

Valley Creek—For Chinook salmon juveniles released to Valley Creek and detected on instream monitoring arrays, we estimated an overall survival rate to Lower Granite Dam of 19.7% and an overall parr-to-smolt rate of 6.7% (Table 7).

Big Creek—For Chinook salmon juveniles released to lower Big Creek and detected on instream monitors near Taylor Ranch, overall estimated survival to Lower Granite Dam was 20.7%, and overall parr-to-smolt survival was 19.1% (Table 7).

For Chinook salmon juveniles released in upper Big Creek and detected on the instream monitoring arrays at Taylor Ranch, overall survival to Lower Granite Dam was estimated at 32.0% and overall parr-to-smolt survival at 17.7% (Table 7).

Secesh River and Lake Creek—For Chinook salmon juveniles released to the Secesh River and detected at the instream monitor array on Zena Creek in the South Fork Salmon River, overall survival to Lower Granite Dam was estimated at 13.2%, and overall estimated parr-to-smolt survival was 11.4% (Table 7). For fish released to Lake Creek and detected on the Zena Creek array, estimated survival to Lower Granite Dam was 30.1%, and overall estimated parr-to-smolt survival was estimated 6.0%.

South Fork Salmon River—For wild Chinook salmon juveniles released to the South Fork Salmon River and detected on the instream monitoring array near Krassel Creek, overall estimated survival to Lower Granite Dam was 32.0% and overall estimated parr-to-smolt survival was 8.5% (Table 7).

Table 7. Estimated survival to Lower Granite Dam with overall estimated parr-to-smolt survival for study populations passing instream instream PIT-tag monitoring arrays, 2014-2015.

		Estimated survival to Lower Granite Dam (%)			Estimated parr-to-smolt survival (%)		
Stream population	Instream monitor	Overall mean	SE	95% CI	Overall mean	SE	95% CI
Valley Creek	Valley Creek	19.7	5.6	10.2-32.6	6.7	2.0	4.0-10.0
Upper Big Creek	Taylor Ranch	32.0	13.1	9.8-61.9	17.7	4.0	11.0-25.0
Lower Big Creek	Taylor Ranch	20.7	7.7	7.9-37.8	19.1	5.0	10.0-31.0
Secesh River	Zena Creek	13.2	6.4	2.2-27.5	1.4	3.0	5.0-19.0
Lake Creek	Zena Creek	30.1	16.4	4.8-68.0	6.0	3.0	1.0-12.0
S Fork Salmon R	Krassel Creek	32.0	23.1	0.0-85.2	8.5	5.0	1.0-19.0

Relationship between Length at Tagging and Detection at Dams

For tagged fish from all Idaho streams combined, average fork length at release was 66.8 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 (69.1 vs. 67.4 mm; $P < 0.001$). Fish that were larger at release also tended to pass Lower Granite Dam earlier than their smaller cohorts ($P < 0.03$; Figure 12).

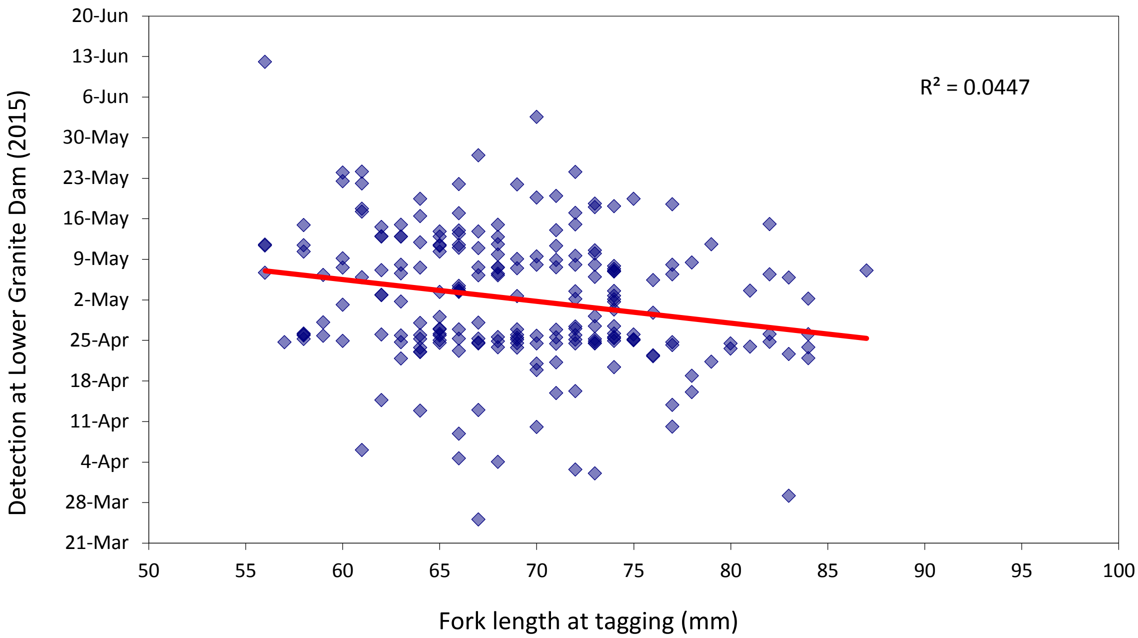


Figure 12. Relationship between fork length of wild Chinook salmon parr from Idaho at tagging (2014) and Lower Granite Dam 2015 detection date (n = 656).

To examine this relationship further, we grouped all Idaho fish into 5-mm length bins and compared length distribution using a series of chi-square tests. Length distribution of all fish was compared to that of fish detected at 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 ($P < 0.002$), and for the largest length bins (80-84 mm) significantly more detected fish were observed than expected ($P < 0.001$; Figure 13).

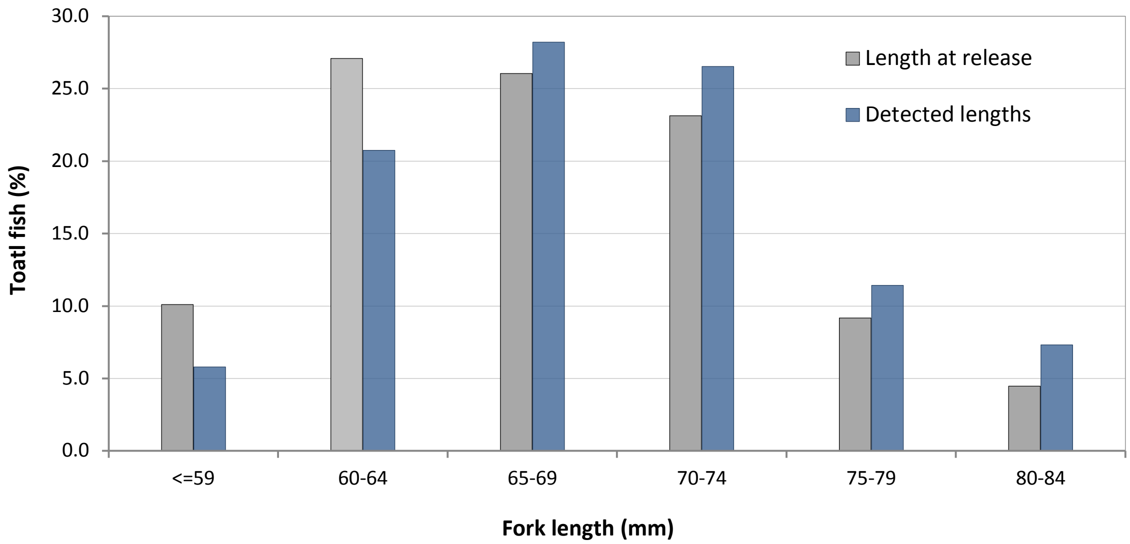


Figure 13. Distribution of fork lengths for wild spring/summer Chinook salmon parr PIT tagged and released in Idaho streams, 2014 (n = 12,437) with proportions detected at dams in spring/summer 2015 by length increment (n = 656).

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 1.9 mm larger at release than those that passed in May and 7.1 mm larger than those that passed in June. These data suggest that fish size may have influenced migration timing or overwintering location.

Migration Timing

Dates of Passage at Lower Granite Dam

Passage timing at Lower Granite Dam varied for fish from Idaho stream populations (Figure 14). Comparisons of the 10th percentile passage date among these 16 populations showed that fish from the South Fork Salmon River passed significantly earlier than fish from nine other streams ($P < 0.05$; Figure 14; Appendix Table 5). The 10th percentile passage date for South Fork Salmon River fish was also earlier than that of fish from the Secesh River, Lake Creek, Elk Creek, Marsh Creek, Bear Valley Creek, and lower Big Creek, although the difference was not significant. Standard errors of these estimates ranged 0.5-12.2 d (median 4.2 d). Overall, the 10th percentile passage date for fish from all 16 stream populations ranged 24 d, from 4 to 28 April (Appendix Table 5).

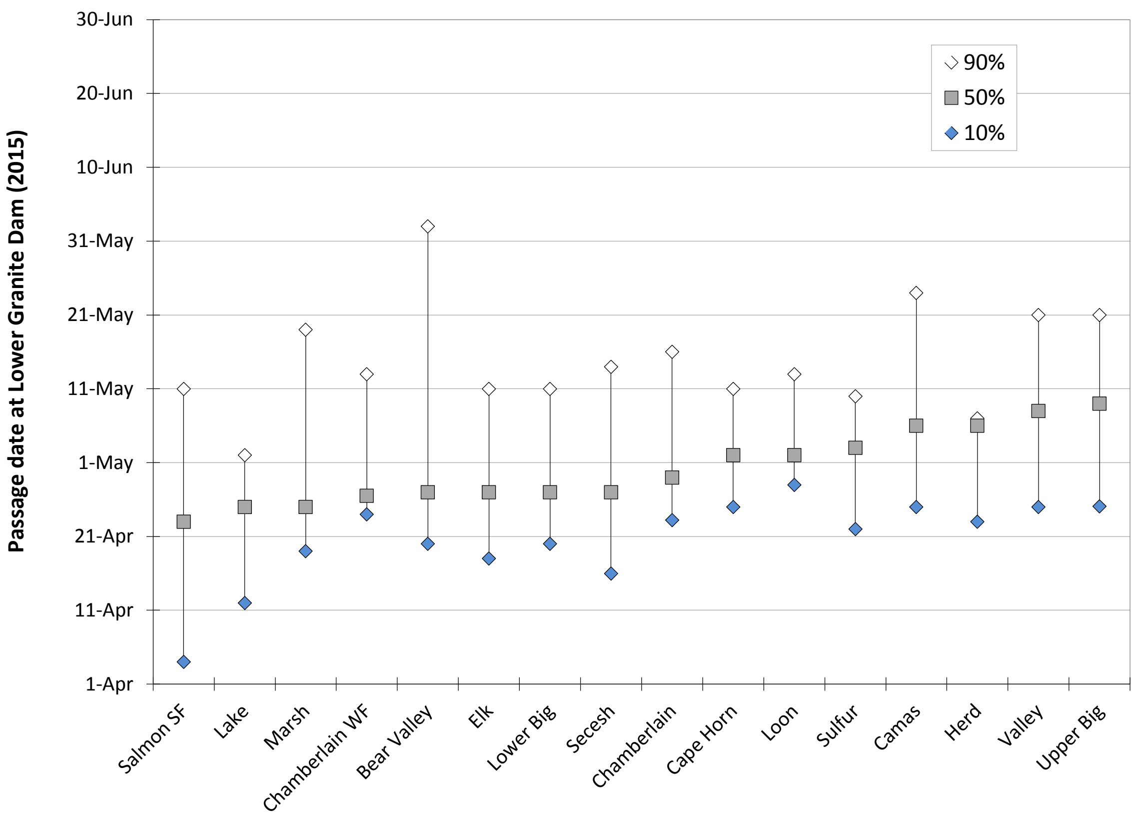


Figure 14. Estimated passage distribution at Lower Granite Dam in 2015 for wild spring/summer Chinook salmon smolts from streams of Idaho. Big Creek is divided into lower and upper portions. Chamberlain and West Fork Chamberlain Creeks were combined for these analyses. See Appendix Tables 6-21 for daily estimated passage numbers.

In comparisons of the 50th percentile passage date at Lower Granite Dam, there was no significant difference between individual stream populations. Standard errors of these estimates ranged 1.9-12.6 d (median 4.1 d). The 50th percentile passage date for fish from all 16 stream populations ranged 26 d, from 23 April to 9 May (Appendix Table 5).

In terms of the 90th percentile passage date at the dam, fish from Bear Valley Creek were significantly later than fish from all other stream populations. Standard errors of these estimates ranged 0.7-14.9 d (median 4.0 d). The 90th percentile passage date for fish from all streams combined ranged 30 d, from 2 May to 2 June (Appendix Tables 5).

In comparisons of the middle 80th percentile passage period (10-90th percentile), there was no significant difference between individual stream populations. Standard errors of these estimates ranged 2.7-15.8 d (median 6.6 d). Overall, the middle 80^{th} percentile passage period for fish from all 16 streams ranged 15-43 d.

Detection data at Lower Granite Dam for fish from streams with 8 or more years of data has shown clear variation among these 16 stream populations in arrival timing of the 10th, 50th, and 90th passage percentiles (Table 8). Timing of the 10th passage percentile at Lower Granite Dam was significantly earlier for Secesh River and Lake Creek fish than for fish from all other streams. Timing of the 50th passage percentile at Lower Granite Dam was significantly later for upper Big Creek fish in comparison to fish from all other streams. Also, upper Big Creek fish had significantly later timing of the 90th passage percentile at the dam than fish from all other streams.

Table 8. Mean passage dates at Lower Granite Dam for the 10th, 50th, and 90th percentile of each Idaho stream population of wild spring/summer Chinook salmon. Data shown reflect the combined years of data on ach population. Standard error of the estimate is shown for with date range for the 95% confidence interval about each mean passage date.

	Passage dates at Lower Granite Dam									
	10th percentile			50th percentile (median)			90th percentile			
Stream	Mean date	SE (d)	Date range of 95% CI	Mean date	SE (d)	Date range of 95% CI	Mean date	SE (d)	Date range of 95% CI	Data years
Secesh River	14 Apr	1	12-17 Apr	26 Apr	1	24-29 Apr	27 May	3	21 May-2 Jun	26
South Fork Salmon R	18 Apr	2	15-22 Apr	7 May	2	4-10 May	1 Jun	2	27 May-6 Jun	24
Bear Valley Creek	21 Apr	1	18-24 Apr	7 May	1	4-10 May	29 May	2	25 May-2 Jun	24
Valley Creek	24 Apr	2	20-27 Apr	11 May	2	8-15 May	2 Jun	2	28 May-6 Jun	24
Elk Creek	20 Apr	1	17-23 Apr	4 May	1	1-7 May	26 May	2	22-30 May	23
Lake Creek	16 Apr	1	13-18 Apr	30 Apr	1	26 Apr-3 May	27 May	3	21 May-3 Jun	22
Big Creek (upper)	29 Apr	2	26 Apr-2 May	17 May	2	13-21 May	4 Jun	3	28 May-10 Jun	21
Marsh Creek	20 Apr	1	17-22 Apr	4 May	1	30 Apr -7 May	22 May	2	19-26 May	20
Big Creek (lower)	18 Apr	1	16-21 Apr	28 Apr	1	26-30 Apr	11 May	1	8-13 May	19
Loon Creek	26 Apr	1	23-29 Apr	7 May	2	4-11 May	19 May	2	15-23 May	17
Herd Creek	20 Apr	1	17-23 Apr	2 May	2	28 Apr-5 May	15 May	1	12-18 May	17
W Fork Chamberlain Cr	21 Apr	1	18-24 Apr	2 May	2	29 Apr-6 May	24 May	4	15 May-2 Jun	17
Sulphur Creek	22 Apr	2	18-25 Apr	7 May	2	2-12 May	24 May	3	18-29 May	16
Camas Creek	27 Apr	1	24-30 Apr	10 May	2	7-14 May	24 May	1	21-27 May	16
Cape Horn Creek	23 Apr	2	18-28 Apr	9 May	2	5-14 May	27 May	3	21 May-2 Jun	16
Chamberlain	21 Apr	2	25 Mar-17 May	27 Apr	2	8 Apr-16 May	13 May	3	4 Apr-20 Jun	2

Relationship Between Flow Volume and Dam Passage Timing

We grouped first-time detections (expanded) at Lower Granite Dam of tagged fish from all Idaho streams combined and compared their timing distribution with river flows during the same period (Figure 15 and Appendix Table 22). For these fish, the overall passage distribution ranged from late March to early June 2015. In 2015, the overall middle 80th percentile passage period occurred over 26 d, from 22 April to 17 May (Table 9). The peak passage date (taken from expanded detection numbers) occurred on 25 April during intermediate flows of 56.2 kcfs (Appendix Table 22).

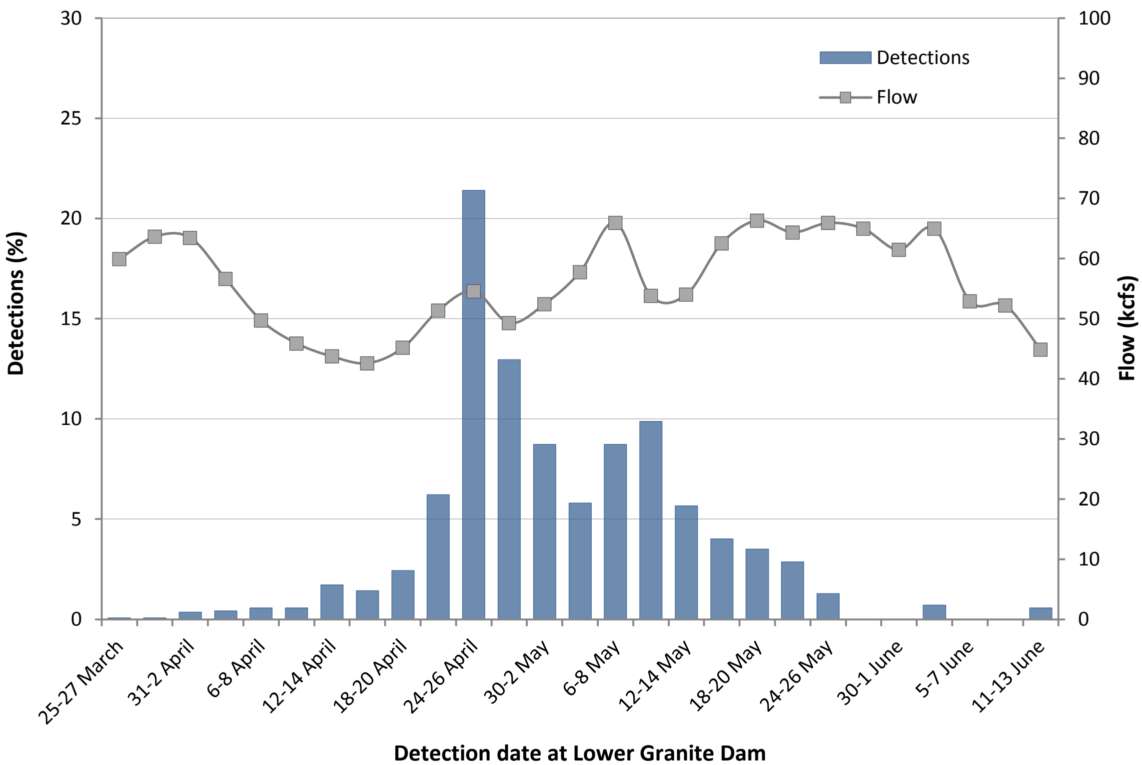


Figure 15. Overall migration timing of PIT-tagged wild spring/summer Chinook salmon smolts with associated river flows at Lower Granite Dam 2015. Daily detections from all Idaho streams were expanded based on daily detection probability and pooled in 3-d intervals. Daily river flows at the dam were averaged over the same intervals.

Table 9. Annual passage dates at Lower Granite Dam from 1989 to 2015 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 higher proportions of Oregon fish and 2015 did not include data from Oregon fish.

	Mean date of passage percentiles at Lower Granite Dam			
Year	10th	50th	90th	Range
1989	23 Apr	14 May	13 Jun	4 Apr-22 Jul
1990	19 Apr	7 May	7 Jun	5 Apr-18 Jul
1991	1 May	18 May	12 Jun	13 Apr-20 Jul
1992	15 Apr	2 May	27 May	5 Apr-27 Jul
1993	26 Apr	14 May	31 May	14 Apr-10 Aug
1994	22 Apr	8 May	1 Jun	13 Apr-4 Sep
1995	17 Apr	9 May	4 Jun	8 Apr-22 Sep
1996	15 Apr	27 Apr	19 May	9 Apr-15 Jul
1997	12 Apr	24 Apr	18 May	31 Mar-22 Sep
1998	11 Apr	2 May	23 May	31 Mar-7 Aug
1999	20 Apr	3 May	28 May	27 Mar-8 Jul
2000	17 Apr	7 May	30 May	10 Apr-20 Jul
2001	26 Apr	9 May	27 May	6 Apr-7 Jul
2002	16 Apr	3 May	30 May	28 Mar-5 Jul
2003	18 Apr	11 May	29 May	31 Mar-4 Jul
2004	16 Apr	3 May	26 May	1 Apr-16 Jul
2005	25 Apr	7 May	24 May	4 Apr-20 Jun
2006	18 Apr	2 May	22 May	3 Apr-18 Jun
2007	15 Apr	30 Apr	14 May	5 Apr-18 Jun
2008	30 Apr	11 May	23 May	10 Apr-2 Jul
2009	23 Apr	2 May	20 May	2 Apr-25 Jun
2010	26 Apr	9 May	29 May	20 Apr-8 Jul
2011	14 Apr	10 May	24 May	1 Apr-27 Jun
2012	16 Apr	26 Apr	21 May	25 Mar-2 Jul
2013	19 Apr	6 May	15 May	27 Mar-9 Jun
2014	15 Apr	27 Apr	21 May	25 Mar-15 Jun
2015	**22 Apr**	**30 Apr**	**17 May**	**25 Mar-12 Jun**

Environmental Information

Environmental water quality metrics varied by month and between locations (Appendix Tables 30-45), 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

Instream PIT-tag monitoring systems in Valley Creek have been operating for 12 years, from 2003 to 2015. We have used data from these systems to estimate annual survival and migration timing for tagged wild Chinook juveniles leaving this stream from late summer to the following spring. Based on detections of tagged fish at Lower Granite Dam, the detection efficiency of Valley Creek monitors (VC1 and VC2) in 2014-2015 was 42.8%.

At Big Creek, we have had sufficient detection numbers from the instream monitoring systems to estimate survival to Lower Granite Dam only since 2008. However, detection rates at these monitors ranged only 9.2-12.9% during 2008-2012. Starting in 2013, detection rates at the Big Creek instream PIT-tag monitoring systems, and these systems had detection efficiency rates of 29.2, 21.9%, and 19.8% in 2013, 2014, and 2015, respectively. These increase rates of detection efficiency resulted from improvements to electronic components of the detection system. These higher detection rates have provided data for more precise survival estimates for fish tagged at Big Creek. Development and maintenance of the Big Creek monitoring systems is conducted by staff of the Integrated Status and Effectiveness Monitoring Program (ISEMP).

There is a continuing need for new survival models that can incorporate the data collected from instream PIT-tag monitoring sites. This need increases with the addition of data collected each year from existing sites, as well as with new data expected from sites planned for the Salmon River basin and throughout the Columbia River Basin.

During 2015, we recaptured wild PIT-tagged migrants from Idaho streams at Lower Granite Dam. Recapture procedures differed only slightly from 2014, with a maximum collection of 15 fish per day (10 fish in 2014) 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 202 recaptured wild PIT-tagged migrants. From these measurements, overall mean growth during the parr-to-smolt stage was 0.14 mm/d for our study fish during 2014-2015. This was comparable to overall growth rates measured in previous years (Achord et al. 2002-2012; Lamb et al. 2013-2015). The overall mean weight gain of 0.034 g/d in 2014-2015 was also comparable to that measured in previous years.

Annual parr-to-smolt survival estimates have ranged 7.9-25.4% for Idaho populations over the last 23 years, with an overall rate of 15.2% averaged over all years (Figure 16). The lowest parr-to-smolt survival rates were estimated in 2004 and 2005 (8.1 and 7.9%, respectively). These low rates of estimate survival may have resulted from stream conditions with much higher parr density (Figure 17). Returns of wild adults to the Snake River basin from 2001 to 2003 were more than one order of magnitude greater than those from 1997 to 1999, when estimates of parr-to-smolt survival were higher than the overall average (18.1-25.4%).

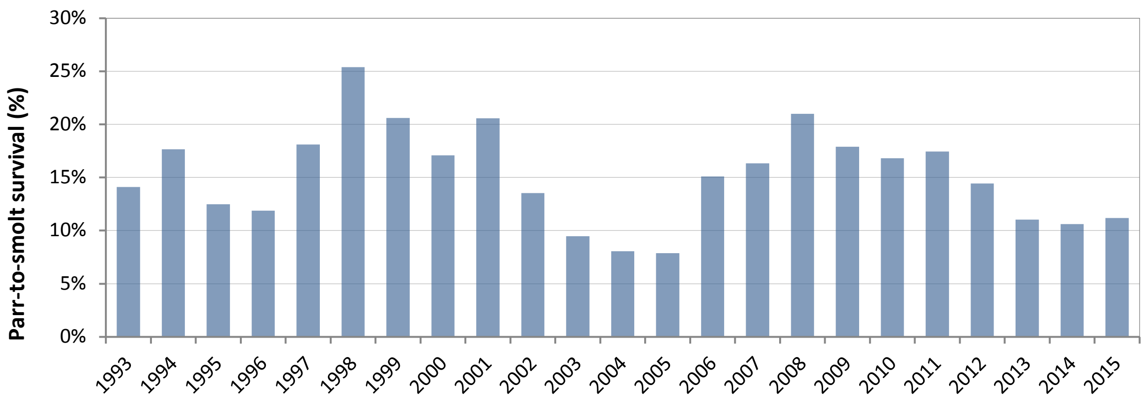


Figure 16. Overall estimated rates of parr-to-smolt survival to Lower Granite Dam for wild spring/summer Chinook salmon from all Idaho streams combined, 1993-2015. SE ranged ±0.2-1.8% over all years and averaged ±0.8%.

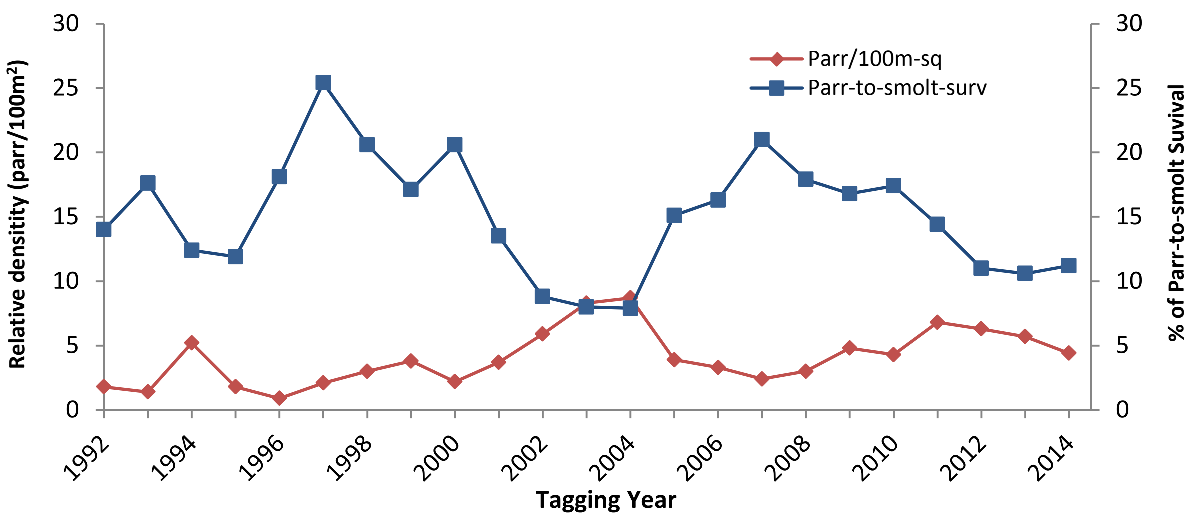


Figure 17. Annual average relative Chinook salmon parr densities (per 100 m^2) in areas sampled in all Idaho streams from 1992 to 2013 versus annual smolt survival estimate to Lower Granite Dam the following year.

In 2015, we again observed that wild fish detected at the dam early in the migration season (April) had been significantly larger at release than fish detected in May and June. Over multiple study years, we have consistently observed this relationship between length at tagging and migration timing at Lower Granite Dam.

During 2014-2015, fish that arrived early at Valley Creek instream monitors tended to be significantly smaller in length than those arriving later in the season (P <0.001). Relationships between length at tagging and downstream movement to the instream monitoring systems have been variable over the past 3 years. However, during 2004-20012 we observed no biologically meaningful relationship between length at tagging and movement toward these monitors (Achord et. al. 2006-2012; Lamb et al. 2013-2014; Figure 3). Therefore, these differences were most likely due to multiple environmental factors that affected migration timing and were probably not directly related to parr size at tagging.

Relationships between length at tagging and arrival time at instream monitors have been variable based on data from fish release to Big Creek since 2008 and from fish released to the lower Secesh River monitors in 2010-2015 (Achord et al 2010-2012; Lamb et al 2013-2014). During 2015, detection data showed no significant relationships between size and downstream movement to instream monitors for fish from Big Creek (upper and lower), South Fork Salmon River, Lake Creek, and the Secesh River (Figures 5, 6, 9, and 11, respectively).

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 2015, the 10th and 50th passage percentiles from the combined Idaho stream populations arrived at Lower Granite Dam during mid-to-late April, while the 90th passage percentile arrived in mid-May.

In 2015, lack of precipitation and a low snow pack led to lower-than-average flows during the peak migration period (<70 kcfs). Therefore, flows likely had less impact on arrival timing at Lower Granite Dam in 2015 than in previous years. However, low Snake River flows during the juvenile migration likely led to large concentrations of fish passing through the removable spillway weir (RSW) at Lower Granite Dam. At present, this passage route has no capability for PIT-tag interrogation. Therefore, a large number of PIT-tagged juveniles passed Lower Granite Dam without the possibility for detection or recapture.

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 climate conditions play an important role in migration timing. 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 1. Summary of numbers collected, tagged, released (with tags), and minimum, maximum, and mean lengths and weights of wild Chinook salmon parr, collected and PIT tagged in various Idaho streams, 2014. Some length-weight data includes recaptured tagged fish.

	Fish (N)			Collection				Tagging and release			
				Length (mm)		Weight (g)		Length (mm)		Weight (g)	
	Collected	Tagged	Released	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Camas Creek	686	498	497	44-118	60.1	1.1-20.8	3.0	55-118	62.3	1.8-20.4	3.3
Herd Creek	516	502	502	54-93	70.8	1.7-13.8	4.7	58-90	70.8	1.9-11.6	4.7
Loon Creek	210	198	198	51-98	66.8	1.6-10.3	3.7	55-85	66.8	1.7-7.4	3.6
Valley Creek	2,133	2,000	2,000	43-153	67.5	0.8-46.2	3.8	55-90	67.4	1.4-9.3	3.7
Marsh Creek	1,122	1,000	1,000	41-122	66.6	0.9-24.5	4.0	55-93	67.0	1.5-10.9	4.0
Cape Horn Creek	958	750	750	41-133	64.3	0.9-35.6	4.1	54-86	65.0	1.5-9.9	3.8
Bear Valley Creek	1,070	1,000	1,000	49-87	67.9	1.0-9.3	4.1	56-87	68.1	1.6-9.3	4.2
Elk Creek	1,093	1,000	1,000	54-134	71.9	1.4-30.1	4.7	56-88	71.2	1.9-9.0	4.4
Sulphur Creek	424	398	398	52-89	67.4	1.3-8.8	4.1	56-89	67.5	1.7-8.8	4.2
Big Creek (upper)	1,167	999	999	42-132	65.4	0.9-29.5	3.5	54-94	66.1	1.6-10.2	3.6
Secesh River	1,196	964	964	44-108	62.1	0.7-16.6	3.1	55-102	64.0	1.3-8.5	3.3
W Fork Chamberlain	756	751	750	52-105	69.4	1.4-14.4	4.0	55-89	69.4	2.0-8.5	4.0
Chamberlain Creek	799	744	744	47-105	63.5	0.8-10.5	3.2	54-87	64.1	1.7-9.0	3.3
Lake Creek	655	496	496	44-148	62.2	1.0-17.2	3.4	55-126	63.9	1.7-9.3	3.6
S Fork Salmon R	199	199	199	56-79	68.4	2.1-7.3	4.5	56-79	68.4	2.1-7.3	4.5
Big Creek (lower)	1,052	1,000	1,000	47-137	74.1	1.2-29.1	5.3	56-137	74.2	1.9-29.1	5.3
Total or mean	**14,036**	**12,499**	**12,497**	**41-153**	**66.8**	**0.7-46.2**	**4.0**	**54-137**	**66.8**	**1.4-29.1**	**3.9**

Appendix Table 2. Summary of tagging and releases dates and times with river temperature, distance from the mouth of the stream to the release point, and number of fish released in 2014. Fish were captured by electroshocking (SHOCK) or beach seine (BSEINE).

	Tagged				Released				
	Date (2014)	Time (PST)	Temp (°C)	Capture Method	Date (2014)	Time (PST)	Temp (°C)	Distance (km)	Fish (n)
Camas Creek									
GAA14209.CA	28 Jul	---	10.0	SHOCK	28 Jul	10:30	12.0	23	686
Herd Creek									
GAA14210.HC	29 Jul	---	9.0	SHOCK	30 Jul	7:22	10.0	3	102
GAA14210.HC2	29 Jul	---	9.0	SHOCK	29 Jul	9:55	12.0	3	403
Loon Creek									
GAA14212.LN	31 Jul	---	9.0	SHOCK	31 Jul	12:35	13.1	30	110
GAA14212.LN2	31 Jul	---	9.0	SHOCK	31 Jul	10:55	12.1	30	98
Valley Creek									
GAA14213.VC	1 Aug	---	11.7	SHOCK	2 Aug	5:20	13.0	5	110
GAA14213.VC2	1 Aug	---	11.7	SHOCK	1 Aug	9:55	15.0	5	349
GAA14214.VC3	2 Aug	---	12.0	BSEINE	2 Aug	10:05	16.0	5	905
GAA14215.VC4	3 Aug	---	13.0	SHOCK	3 Aug	9:13	15.0	7	747
Marsh Creek									
GAA14216.MC	4 Aug	---	9.5	SHOCK	5 Aug	5:23	8.0	12	105
GAA14216.MC2	4 Aug	---	9.5	SHOCK	4 Aug	10:37	11.5	12	1,000
Cape Horn Creek									
GAA14217.CH	5 Aug	---	7.2	SHOCK	6 Aug	4:55	7.0	1	119
GAA14217.CH2	5 Aug	---	7.2	SHOCK	5 Aug	12:10	10.0	1	835
Bear Valley Creek									
GAA14218.BV	6 Aug	---	14.0	SHOCK	7 Aug	5:10	12.0	9	100
GAA14218.BV2	6 Aug	---	14.0	SHOCK	6 Aug	9:00	14.0	9	542
GAA14219.BV3	7 Aug	---	13.4	SHOCK	7 Aug	9:06	13.7	14	396
Elk Creek									
GAA14219.EC	7 Aug	---	13.7	BSEINE	8 Aug	8:00	13.6	1	399
GAA14220.EC2	8 Aug	---	13.6	SHOCK	8 Aug	10:15	15.6	1	663
Sulphur Creek									
GAA14224.SU	12 Aug	---	10.7	SHOCK	13 Aug	5:05	10.5	6	103
GAA14224.SU2	12 Aug	---	10.7	SHOCK	12 Aug	12:15	12.4	6	310
Big Creek (upper)									
GAA14226.BC	14 Aug	---	9.8	SHOCK	15 Aug	6:00	8.9	59	114
GAA14226.BC2	14 Aug	---	9.8	SHOCK	15 Aug	6:00	8.9	59	459
GAA14227.BC3	15 Aug	---	8.9	SHOCK	15 Aug	9:30	10.1	59	581

Appendix Table 2. Continued.

	Tagging				Release				
	Date (2014)	Time (PST)	Temp (°C)	Capture Method	Date (2014)	Time (PST)	Temp (°C)	Distance (km)	Fish (n)
Secesh River									
GAA14228.SE	16 Aug	---	10.4	SHOCK	17 Aug	6:02	10.0	26	114
GAA14228.SE2	16 Aug	---	10.4	SHOCK	16 Aug	11:25	14.0	26	388
GAA14229.SE3	17 Aug	---	10.0	SHOCK	17 Aug	11:25	12.9	26	689
West Fork Chamberlain Creek									
GAA14231.WC	19 Aug	---	9.2	BSEINE	19 Aug	13:30	13.8	2	755
Chamberlain Creek									
GAA14232.CB	20 Aug	---	9.9	SHOCK	21 Aug	5:40	10.0	25	123
GAA14232.CB2	20 Aug	---	9.9	SHOCK	20 Aug	11:00	14.5	25	671
Lake Creek									
GAA14234.LC	22 Aug	---	8.2	SHOCK	22 Aug	11:25	11.0	2	653
South Fork Salmon River									
GAA14235.SF	23 Aug	---	8.1	SHOCK	23 Aug	9:30	9.6	118	199
Big Creek (lower)									
GAA14238.LB	26 Aug	---	11.9	SHOCK	27 Aug	7:05	12.1	10	604
GAA14239.LB2	27 Aug	---	12.1	SHOCK	27 Aug	10:28	14.7	10	414

Appendix Table 3. Universal Transverse Mercator grid coordinates from global positioning system used to identify sampling areas during daily collections in streams for each collection crew, 2014.

Stream and date		UTM Start		UTM End	
(2014)	Section covered	northing	easting	northing	easting
Camas Creek					
28 July	right bank	4968563	11T696322	4966605	11T697621
28 July	left bank	4968631	11T696442	4966605	11T697636
Herd Creek					
29 July	left bank	4892111	11T716228	4891188	11T717193
29 July	right bank	4892103	11T716222	4891249	11T717068
Loon Creek					
31 July	left bank	4941352	11T674294	4940207	11T673255
31 July	right bank	4941320	11T674258	4939856	11T672809
Valley Creek					
1 Aug	right bank	4899465	11T661381	4899742	11T660582
1 Aug	left bank	4899456	11T661381	4899717	11T660730
2 Aug	both banks	4899717	11T660730	4899793	11T660580
3 Aug	right bank	4900553	11T659805	4900781	11T659920
3 Aug	left bank	4900545	11T659779	4900781	11T659920
Marsh Creek					
4 Aug	right bank	4917104	11T646294	4916572	11T646654
4 Aug	left bank	4917108	11T646298	4916572	11T646703
Cape Horn Creek					
5 Aug	left bank	4917368	11T645744	4916369	11T645276
5 Aug	right bank	4917389	11T645763	4916361	11T645269
5 Aug	left bank	4915418	11T644195	4915231	11T644080
Bear Valley Creek					
6 Aug	right bank	4920736	11T633392	4920830	11T632062
6 Aug	left bank	4920733	11T633334	4920915	11T632677
7 Aug	right bank	4919101	11T630199	4918719	11T629623
7 Aug	left bank	4919113	11T630282	4918931	11T629605
Elk Creek					
7 Aug	both banks	4918795	11T629502	4918750	11T629423
8 Aug	right bank	4918803	11T629521	4918624	11T629035
8 Aug	left bank	4918776	11T629628	4918857	11T628772
Sulphur Creek					
12 Aug	left bank	4933214	11T0631246	4932434	11T629667
12 Aug	right bank	4933207	11T0631151	4932434	11T629667
Big Creek (upper)					
14 Aug	right bank	4997259	11T632204	4996164	11T631326
14 Aug	left bank	4997256	11T632206	4995559	11T631325
15 Aug	right bank	499559	11T631325	4996164	11T631326
15 Aug	left bank	499559	11T631325	4994854	11T631297

Appendix Table 3. Continued.

		UTM Start		UTM End	
Stream and dates	Section covered	northing	easting	northing	easting
Secesh River					
16 Aug	right bank	5005874	11T592931	5007208	11T593518
16 Aug	left bank	5005874	11T592931	5007208	11T593518
17 Aug	right bank	5007208	11T593518	5008480	11T593534
17 Aug	left bank	5007208	11T593518	5008480	11T593534
W Fork Chamberlain Cr					
19 Aug	both banks	5027448	11T642005	5027855	11T641435
Chamberlain Creek					
21 Aug	left bank	5026618	11T642356	5026005	11T641930
21 Aug	right bank	5026564	11T642366	5025908	11T641771
Lake Creek					
22 Aug	left bank	5012338	11T586124	5013224	11T585495
22 Aug	right bank	5012367	11T586122	5013232	11T585493
S Fork. Salmon R					
23 Aug	left bank	4944113	11T603609	4943408	11T603623
23 Aug	right bank	4944111	11T603583	4943166	11T603511
Big Creek (lower)					
26 Aug	right bank	4996456	11T670593	4996756	11T669158
26 Aug	left bank	4996565	11T670806	4996756	11T670593
27 Aug	right bank	4996756	11T669158	4996771	11T669026
27 Aug	left bank	4996762	11T669134	4996791	11T667807

Appendix Table 4. Summary of observed total mortality for PIT-tagged wild Chinook salmon parr collected from Idaho streams from July through August 2014. 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 was also 1 lost tags from Camas Creek.

Stream	Number collected (n)	Number Tagged (n)	Number Rejected (n)	Percent Rejected (%)	Observed mortality (n) Collection and handling	Tagging and delayed	Total (n)	Total (%)
Camas Creek	686	497	178	25.9	10	1	11	1.6
Herd Creek	516	502	12	2.3	2	0	2	0.4
Loon Creek	210	198	0	0.0	2	0	2	0.9
Valley Creek	2,133	2,000	116	5.4	17	0	17	0.8
Marsh Creek	1,122	1,000	105	9.4	17	0	17	1.5
Cape Horn Creek	958	750	204	21.3	4	0	4	0.4
Bear Valley Creek	1,070	1,000	47	4.4	23	0	23	2.1
Elk Creek	1,093	1,000	66	6.0	27	0	27	2.5
Sulphur Creek	424	398	15	3.5	11	0	11	2.6
Big Creek (upper)	1,167	999	155	13.3	13	0	13	1.1
Secesh River	1,196	964	225	18.8	7	0	7	0.6
W Fork Chamberlain Cr	756	750	5	0.7	0	1	1	0.1
Chamberlain Creek	799	744	50	6.3	5	0	5	0.6
Lake Creek	655	496	157	24.0	2	0	2	0.3
South Fork Salmon R	199	199	0	0.0	0	0	0	0.0
Big Creek (lower)	1,052	1,000	34	3.2	18	0	18	0.0
Totals or average	14,036	12,497	1,369	9.7	158	2	160	1.1

Appendix Table 5. Passage percentiles by date at Lower Granite Dam for wild spring/summer Chinook salmon smolts PIT-tagged and released from Idaho streams, 1989-2014.

	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
2015	**20 April**	**27 April**	**2 June**	**13 April- 2 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

Appendix Table 5. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Elk Creek (Continued)				
2008	02 May	11 May	23 May	25 April-16 June
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
2015	**18 April**	**27 April**	**11 May**	**2 April-19 May**
Sulphur Creek				
1990	18 April	30 April	31 May	11 April-27 June
1991[a]	---	---	---	---
1992	16 April	03 May	23 May	10 April-01 June
1993	28 April	16 May	12 June	24 April-28 June
1994[a]	---	---	---	---
1995	02 May	23 May	09 June	11 April-09 July
1996[a] -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]	**---**	**---**	**---**	**---**
2015	**22 April**	**3 May**	**10 May**	**14 April-17 May**
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

Appendix Table 5. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Cape Horn Creek (Continued)				
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
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	15 April-9 June
2015	**25 April**	**2 May**	**11 May**	**12 April-17 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
2015	**25 April**	**6 May**	**24 May**	**25 April-24 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

Appendix Table 5. Continued.

	Percentile passage dates at Lower Granite Dam			
Year	10th	50th	90th	Range
Marsh Creek (Continued)				
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
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
2015	**19 April**	**25 April**	**19 May**	**19 April-19 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
2015	**25 April**	**8 May**	**21 May**	**23 April-22 May**
Loon Creek				
1993	05 May	12 May	17 May	03 May-5 June
1994	29 April	10 May	24 May	22 April-07 June
1995	23 April	11 May	28 May	13 April-07 June
1996[a]-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

Appendix Table 5. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Loon Creek (Continued)				
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
2015	**28 April**	**2 May**	**13 May**	**27 April-12 May**
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
2015	**23 April**	**6 May**	**7 May**	**23 April-7 May**
South Fork Salmon River				
1989	25 April	13 May	14 June	16 April-20 June
1990[a]	---	---	---	---
1991	20 April	16 May	10 June	17 April-13 July
1992	14 April	29 April	27 May	07 April-27 July
1993	29 April	16 May	02 June	26 April-28 June
1994	27 April	15 May	28 June	22 April-09 July
1995	20 April	10 May	10 June	13 April-13 July
1996	19 April	15 May	09 June	19 April-03 July
1997	13 April	28 April	12 June	07 April-15 June
1998	25 April	12 May	15 June	02 April-07 August

Appendix Table 5. Continued.

	Percentile passage dates at Lower Granite Dam			
Year	10th	50th	90th	Range
South Fork Salmon River (continued)				
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
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
2015	**4 April**	**23 April**	**11 May**	**4 April-11 May**
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
2015	**25 April**	**9 May**	**21 May**	**25 April-24 May**

Appendix Table 5. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Big Creek (lower)/Rush Creek				
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
2013[d]	20 April	2 May	11 May	13 April- 18 May
2014[d]	15 April	24 April	6 May	7 April-9 May
2015[d]	**20 April**	**27 April**	**11 May**	**29 March-18 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
2015[c]	**24 April**	**27 April**	**13 May**	**23 April-18 May**

Appendix Table 5. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Secesh River				
1989	20 April	27 April	09 June	09 April-19 July
1990	14 April	22 April	07 June	10 April-13 July
1991	20 April	27 April	14 June	13 April-20 July
1992	13 April	29 April	04 June	05 April-03 July
1993	26 April	16 May	16 June	22 April-15 July
1994	22 April	26 April	11 July	21 April-07 August
1995	14 April	01 May	24 May	10 April-10 July
1996	14 April	25 April	29 May	12 April-15 July
1997	10 April	18 April	04 May	04 April-11 July
1998	08 April	24 April	28 May	03 April-06 July
1999	03 April	23 April	25 May	29 March-21 June
2000	13 April	23 April	04 June	12 April-11 July
2001	16 April	28 April	13 May	06 April-13 June
2002	13 April	21 April	17 May	11 April-01 July
2003	18 April	30 April	01 June	03 April-04 July
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
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
2015	**16 April**	**27 April**	**14 May**	**4 April-12 June**
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

Appendix Table 5. Continued.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Lake Creek (continued)				
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
2015	**12 April**	**25 April**	**2 May**	**12 April- 2 May**

[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 6. Detection and expanded detection numbers at Lower Granite Dam in 2015 with first detections by date at Snake and Columbia River dams for 1,000 wild Chinook salmon PIT-tagged and released from Bear Valley Creek, 6-7 August 2014. Release sites were 629-635 km upstream from Lower Granite Dam.

	Bear Valley Creek							
Detection	Lower Granite		First detection					
date (2015)	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
13 Apr	1	6						
20 Apr	1	8						
22 Apr				1				
23 Apr	1	4						
24 Apr	2	8	2	1				
25 Apr			1					
27 Apr	1	24						
28 Apr						1		
29 Apr			1					
02 May				1				
03 May	1	7	1			1		
04 May						1		
05 May						1		
06 May						1		
07 May	1	3	1			1		
08 May				1				
09 May								1
10 May				1		1		
12 May			1					
13 May			1					
15 May						1		
18 May	1	5						
21 May								1
26 May	1	5				1		
27 May								
31 May						1		
02 Jun	1	10						
03 Jun					1			
30 Jun							1	
Totals	11	80	8	5	1	10	1	2

Appendix Table 7. Detection and expanded detection numbers at Lower Granite Dam in 2015 with first detections by date at Snake and Columbia River dams for 1,000 wild Chinook salmon PIT-tagged and released from Elk Creek, 7-8 August 2014. Release sites were 634-638 km upstream from Lower Granite Dam.

	Elk Creek							
Detection	Lower Granite		First detection					
date (2015)	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
2 Apr	1	3						
15 Apr	1	6						
18 Apr	1	8						
20 Apr			1					
21 Apr	1	7						
22 Apr			2					
23 Apr	2	8	1	1				
24 Apr	2	8						
25 Apr	1	6						
26 Apr	2	14						
27 Apr	1	24	1			1		
29 Apr	1	8	1			1		
1 May						2		
2 May						2		
3 May	2	14						1
4 May						1		
5 May			1					
6 May	1	4				4		
7 May						2		
9 May					1	1		
10 May						1		
11 May	1	5	1		1	1		
12 May			1			2		
15 May						1		
16 May			1					
17 May				1			1	
18 May						1		
19 May	1	8						
22 May								1
26 May								1
29 May								
3 June							1	
4 June						1		
5 June						1		
Totals	18	122	10	2	2	22	2	3

Appendix Table 8. Detection and expanded detection numbers at Lower Granite Dam in 2015 with first detections by date at Snake and Columbia River dams for 2,000 wild Chinook salmon PIT-tagged and released from Valley Creek, 1-3 August 2014. Release sites were 743-750 km upstream from Lower Granite Dam. One fish was detected on the PIT trawl (TWX) in the Columbia River estuary on 15 May 2015.

	Valley Creek							
Detection date (2015)	Lower Granite		First detection					
	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
23 Apr	1	4	1					
24 Apr	1	4	1					
25 Apr	3	18						
26 Apr	1	7						
27 Apr			1					
28 Apr			1					
01 May	1	8						
02 May	1	10						
03 May			1					
05 May								
06 May			1			2		
07 May	1	3						
08 May	3	23				1		
09 May	2	17						
10 May			2					
11 May								
12 May	1	4		1				
13 May			2					
14 May	2	12						
15 May	1	8	1					1
18 May			1					
19 May			1					
21 May	1	7						
22 May	1	11						
23 May						1	1	
24 May								1
08 Jun						1		
Totals	20	134	13	1	0	5	1	2

Appendix Table 9. Detection and expanded detection numbers at Lower Granite Dam in 2015 with first detections by date at Snake and Columbia River dams for 502 wild Chinook salmon PIT-tagged and released from Herd Creek, 29 July 2014. Fish were released 699-701 km upstream from Lower Granite Dam. Two fish were detected on the PIT Trawl (TWX) in the Columbia River estuary on 11 & 18 May 2015.

	Herd Creek							
Detection date (2015)	Lower Granite		First detection					
	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
23 April	1	4						
25 April			1					
26 April			1					
30 April			1					
01 May	1	8	1					
02 May				1	1			
03 May			1			1		
05 May			1			1		
06 May	3	11						
07 May	2	6						
11 May						1		
13 May			1					
15 May						1		
16 May						1		
18 May								1
25 May						1		
04 Jun						1		
Totals	7	29	7	1	1	7	0	1

Appendix Table 10. Detection and expanded detection numbers at Lower Granite Dam in 2015 with first detections by date at Snake and Columbia River dams for 198 wild Chinook salmon PIT-tagged and released from Loon Creek, 31 July 2014. Release sites were 550-553 km upstream from Lower Granite Dam.

	Loon Creek							
Detection date (2015)	Lower Granite		First detection					
	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
28 April	1	20						
02 May	2	19	1					
03 May	1	7						
06 May	1	4		2		1		
07 May	1	3	1					
09 May	1	8						
11 May	1	5				1		
12 May			1					
13 May	2	10	1					
15 May			2					
17 May			1				1	
21 May			1					
Totals	10	76	8	2	0	2	1	0

Appendix Table 11. Detection and expanded detection numbers at Lower Granite Dam in 2015 with first detections by date at Snake and Columbia River dams for 999 wild Chinook salmon PIT-tagged and released from Big Creek (upper), 14-15 August 2014. Release sites were 535-538 km upstream from Lower Granite Dam.

	Big Creek (upper)							
Detection	Lower Granite		First detection					
date (2015)	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
25 April	3	18						
26 April	1	7						
29 April	1	8						
30 April			3					
01 May			1					
02 May			2					
03 May	1	7	1					
05 May	3	13				1		
06 May	1	4		1				
07 May	4	11	1			1		
08 May	1	8	1			1		
09 May	2	17						
10 May			1			1		
11 May	2	11						
12 May	1	4	1					
13 May	1	5	2	1				1
14 May	2	12		1		1	1	
15 May			1			1		
16 May	2	19	3					
17 May			1	1			1	
18 May						1		
19 May	2	17		1		1		
20 May			1			2	1	
21 May	1	7		1				
22 May						1		
23 May	1	5						1
24 May	1	7						
25 May								1
26 May			1					
27 May				1				
29 May				1				
05 June			1					
16 June							1	
18 June								1
19 June			1					
27 June								1
30 June			1					
Totals	30	177	23	8	0	11	4	5

Appendix Table 12. Detection and expanded detection numbers at Lower Granite Dam in 2015 with first detections by date at Snake and Columbia River dams for 1,000 wild Chinook salmon PIT-tagged and released from Big Creek (lower), 26-27 August 2014. Release sites were 489-491 km upstream from Lower Granite Dam.

	Big Creek (lower)							
Detection	Lower Granite		First detection					
date (2015)	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
29 Mar	1	1						
10 April	2	8						
15 April			1					
16 April	1	7						
20 April	1	8						
21 April	2	14				1		
22 April	1	7	1					
23 April								
24 April	1	4	1					
25 April	2	12		1				
26 April	2	14						
27 April	1	24	1					
28 April			2					
29 April			1	1				
30 April	1	31	3					
01 May						1		
02 May	2	19	1					
03 May			2			4		
04 May	1	6		1		2		
05 May			2	1		4		
06 May	1	4		1	1			
07 May				1		1		
08 May			1					2
09 May			1					
10 May	1	7				3		1
11 May	3	16	1					
12 May	1	4	1		1	2		1
13 May						1		
14 May						1		
15 May					1		1	
18 May	1	5	1					1
19 May								1
20 May			1					
Totals	25	191	21	6	3	20	1	6

Appendix Table 13. Detection and expanded detection numbers at Lower Granite Dam in 2015 with first detections by date at Snake and Columbia River dams for 744 wild Chinook salmon PIT-tagged and released from Chamberlain Creek, 20 August 2014. Release sites were 437-439 km upstream from Lower Granite Dam.

	Chamberlain Creek							
Detection date (2015)	Lower Granite		First detection					
	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
25 Mar	1	1						
02 Apr	1	3						
11 Apr			1					
22 Apr			2					
23 Apr	1	4						
24 Apr	3	12						
25 Apr	2	12						
26 Apr	1	7						
29 Apr	1	8						
01 May	1	8						
02 May			1			1		
05 May						2		
06 May	1	4						
07 May						1		
09 May				1				
10 May			1					
11 May	1	5						1
12 May	2	7				1		
13 May							1	
16 May	1	10	1					
18 May								1
19 May								2
20 May							1	1
21 May								1
24 May							1	
25 May								1
04 June			1					
Totals	16	79	7	1	0	5	3	7

Appendix Table 14. Detection and expanded detection numbers at Lower Granite Dam in 2015 with first detections by date at Snake and Columbia River dams for 750 wild Chinook salmon PIT-tagged and released from W.F. Chamberlain Creek, 19 August 2014. Release sites were 437-439 km upstream from Lower Granite Dam.

	West Fork Chamberlain Creek							
Detection	Lower Granite		First detection					
date (2015)	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
23 Apr	1	4						
24 Apr	4	16	1					
25 Apr	3	18						
26 Apr	1	7		1				
27 Apr	1	24						
02 May						1		
03 May						1		
04 May						1		
05 May				1				
07 May	1	3						
08 May	1	8				1		
12 May			1				2	
13 May	1	5						
16 May			1					
18 May	1	5	2					
19 May				1				
26 May							1	
05 Jun			1					
19 Jun							1	
Totals	14	88	6	3	0	4	4	0

Appendix Table 15. Detection and expanded detection numbers at Lower Granite Dam in 2015 with first detections by date at Snake and Columbia River dams for 199 wild Chinook salmon PIT-tagged and released from South Fork Salmon River, 23 August 2014. Release sites were 467-469 km upstream from Lower Granite Dam.

	South Fork Salmon River							
Detection	Lower Granite		First detection					
date (2015)	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
04 April	1	3						
08 April	1	5						
23 April	1	4						
24 April						1		
26 April			1					
04 May				1		1		
05 May				1				
08 May						1		
10 May			1		1			
11 May	1	5	1					
12 May				1				
16 May			1					
17 May			1					
20 May				1				
05 July				1				
Totals	4	17	5	5	1	3	0	0

Appendix Table 16. Detections during 2015 of PIT-tagged smolts by date at Snake and Columbia River dams for 964 wild Chinook salmon PIT-tagged and released from Secesh River, 16-17 August 2014. Release sites were 429-431 km upstream from Lower Granite Dam.

	Secesh River							
Detection	Lower Granite		First detection					
date (2015)	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
04 April	1	3						
06 April	1	3						
09 April			1					
16 April	1	7						
18 April			1					
21 April	1	7	2					
22 April	1	7						
23 April			1					
24 April	4	16	1	1				
25 April	2	12						
26 April			2	1		1		
27 April	1	24						
28 April						1		
29 April				1				
30 April						2		
01 May						1		
02 May						1		
04 May						1		
05 May				1		1		
06 May						1		
07 May						1		
08 May	1	8				1		
11 May				1				
12 May	1	4				1		
13 May								
14 May	2	12	1					
16 May			1					1
18 May								1
25 May			1					
30 May						1		
31 May						1		
12 June	1	8						
19 June							1	
Totals	17	110	11	5	0	14	1	2

Appendix Table 17. Detections during 2015 of PIT-tagged smolts by date at Snake and Columbia River dams for 496 wild Chinook salmon PIT-tagged and released from Lake Creek, 22 August 2014. Release site was 451 km upstream from Lower Granite Dam.

	Lake Creek							
Detection	Lower Granite		First detection					
date (2015)	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
12 April	1	5	1					
24 April	2	8						
25 April	1	6	1					
02 May	1	10		1				
04 May				1				
07 May				1				
08 May						2		
10 May						1		
16 May				1				1
19 May								1
03 June							1	
Totals	5	28	2	4	0	3	1	2

Appendix Table 18. Detection and expanded detection numbers at Lower Granite Dam and first detections by date at Snake and Columbia River dams for 497 wild Chinook salmon PIT-tagged and released from Camas Creek, 28 July 2014. Release sites were 524-526 km upstream from Lower Granite Dam.

	Camas Creek							
Detection	Lower Granite		First detection					
date (2015)	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
24 April			1					
25 April	2	12	1					
26 April	1	7						
29 April			1					
05 May	1	4						
06 May	1	4		1		1		
08 May			1			1		
10 May	1	7	2					
11 May			1					
12 May			1			1		
13 May			1					
14 May						1		
16 May			1					
17 May			1					
19 May						1		
20 May								1
22 May	1	11						
24 May	1	7						
25 May			1					
26 May							1	
31 May			1			1		
04 June								1
Totals	8	51	13	1	0	6	1	2

Appendix Table 19. Detection and expanded detection numbers at Lower Granite Dam and first detections by date at Snake and Columbia River dams for 1,000 wild Chinook salmon PIT-tagged and released from Marsh Creek, 4 August 2014. Release sites were 632-635 km upstream from Lower Granite Dam.

	Marsh Creek							
Detection date (2015)	Lower Granite		First detection					
	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
19 April	1	9						
22 April	1	7						
23 April			1					
24 April	1	4				1		
25 April	2	12						
26 April	1	7						
28 April				1				
30 April				1				
01 May			1					
03 May			2					
04 May						1		
05 May			2	4				
06 May			1					
07 May	1	3						
08 May			1					
10 May			1		1			
11 May								
13 May			1			1		
14 May				1				1
15 May						1		
17 May	1	6						
18 May			2	1		1		
19 May	1	8						
20 May						1		
21 May			1			1		
23 May			1					
25 May			1					
27 May						1		
Totals	9	56	15	8	1	8	0	1

Appendix Table 20. Detection and expanded detection numbers at Lower Granite Dam and first detections by date at Snake and Columbia River dams from 750 wild Chinook salmon PIT-tagged and released from Cape Horn Creek, 5 August 2014. Release site was 630 km upstream from Lower Granite Dam.

	Cape Horn Creek							
Detection	Lower Granite		First detection					
date (2015)	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
12 April	1	5						
23 April			1					
25 April	2	12						
26 April	2	14						
02 May	1	10						
03 May	1	7	1			1		
05 May			1					
06 May			1			1		
07 May						1		
08 May	1	8	2			1		
09 May			2					
10 May	1	7						
11 May	1	5	1	1		1		
12 May			1					
13 May			1					
14 May								2
15 May			1			1		
17 May	1	6	1	1				
18 May			1					
19 May			1	1				
20 May				1				
22 May						1	1	
26 May			1					
28 May				1				1
31 May			1					
02 June					1			
14 June						1		
Totals	11	74	17	5	1	8	1	3

Appendix Table 21. Detection and expanded detection numbers at Lower Granite Dam and first detections by date at Snake and Columbia River dams from 398 wild Chinook salmon PIT-tagged and released at Sulphur Creek on 12 August 2014. Release site was 606 km upstream from Lower Granite Dam.

Detection date (2015)	Sulphur Creek							
	Lower Granite		First detection					
	First detection	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
14 Apr	1	7						
22 Apr	1	7						
4 Apr	1	4						
5 Apr			1					
6 Apr						1		
7 Apr			2					
8 Apr	1	20						
1 May			1					
3 May	2	14						
5 May			1	2				
6 May	1	4						
7 May	1	3						
9 May	1	8	1			1		
10 May	2	14						
12 May							1	
14 May								1
15 May								1
16 May			1					
17 May	1	6					1	
22 May								1
26 May			1					
27 May			1					
3 June							1	
Totals	12	86	9	2	0	2	3	3

Appendix Table 22. Daily detections and expanded detection numbers (i.e., estimated detection efficiency) of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Lower Granite Dam during 2015 with associated river conditions at the dam.

Date (2015)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Lower Granite Dam	
				Detected (n)	Expanded
25 Mar	56.2	0	8.58	1	1
26 Mar	63.8	0	8.49	0	0
27 Mar	59.8	0	8.45	0	0
28 Mar	59.6	0	8.12	0	0
29 Mar	66.6	0	8.17	1	1
30 Mar	64.8	0	8.93	0	0
31 Mar	59.6	0	9.22	0	0
01 Apr	61.5	0	9.11	0	0
02 Apr	69.3	0	8.93	2	5
03 Apr	59.5	20.2	8.98	0	0
04 Apr	56.2	20.2	8.78	2	6
05 Apr	54.2	20.1	8.53	0	0
06 Apr	50.7	20.2	8.3	1	3
07 Apr	50.3	20.2	8.24	0	0
08 Apr	48.2	20.2	8.27	1	5
09 Apr	46.1	20.2	8.23	0	0
10 Apr	46.6	20.2	8.54	2	8
11 Apr	45.0	20.1	8.76	0	0
12 Apr	45.0	20.2	9.01	2	11
13 Apr	42.8	20.2	9.39	1	6
14 Apr	43.4	20.3	9.54	1	7
15 Apr	43.6	20.2	9.58	1	6
16 Apr	41.2	20.2	9.56	2	14
17 Apr	43.0	20.2	9.53	0	0
18 Apr	45.2	20.2	9.46	1	8
19 Apr	43.2	20.2	9.63	1	9
20 Apr	47.1	20.2	10.12	2	17
21 Apr	47.3	20.3	10.45	4	27
22 Apr	50.7	20.3	10.33	4	27
23 Apr	56.1	20.4	10.83	8	33
24 Apr	53.7	20.3	11	21	82
25 Apr	56.2	20.4	11.15	23	135
26 Apr	53.8	20.3	10.82	12	82
27 Apr	50.2	20.3	10.63	5	119
28 Apr	50.0	20.3	10.64	2	39
29 Apr	47.7	20.3	10.49	3	23
30 Apr	51.0	20.4	10.61	1	31
01 May	52.6	20.2	11.06	3	24
02 May	53.7	20.1	11.12	7	67
03 May	54.6	20	11.24	8	58
04 May	55.9	20.3	11.61	1	6
05 May	62.8	20.3	11.93	4	17
06 May	67.2	20.3	12.3	10	36
07 May	65.7	20.2	12.34	12	33

Appendix Table 22. Continued.

Date (2015)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Lower Granite Dam Detected (n)	Lower Granite Dam Expanded
08 May	65.0	20.3	12.04	7	53
09 May	57.2	20.2	11.76	6	50
10 May	53.0	20.2	11.77	5	35
11 May	51.2	20.2	11.8	10	53
12 May	52.9	20.2	11.9	6	22
13 May	51.4	20.4	12.25	4	20
14 May	57.8	20.3	12.8	6	37
15 May	56.3	20.2	12.79	1	8
16 May	59.9	20.3	12.74	3	29
17 May	71.5	20.3	13.05	3	19
18 May	71.3	20.5	12.87	3	16
19 May	63.4	20.5	12.23	4	33
20 May	64.3	20.4	12.18	0	0
21 May	64.5	20.4	12.78	2	13
22 May	64.3	20.3	13.2	2	22
23 May	64.3	20.4	15.23	1	5
24 May	67.7	20.5	15.39	2	13
25 May	66.1	20.4	17.33	0	0
26 May	64.0	20.3	16.23	1	5
27 May	64.2	20.4	16.13	0	0
28 May	67.1	20.3	16.9	0	0
29 May	63.6	20.4	16.72	0	0
30 May	60.3	20.5	16.43	0	0
31 May	61.0	20.3	17.02	0	0
01 Jun	63.1	20.3	17.03	0	0
02 Jun	63.4	20.4	16.67	1	10
03 Jun	65.7	20.4	16.67	0	0
04 Jun	65.9	20.2	16.17	0	0
05 Jun	55.8	20.1	16.22	0	0
06 Jun	50.8	20.3	15.78	0	0
07 Jun	52.1	20.2	15.94	0	0
08 Jun	53.5	20.2	17	0	0
09 Jun	54.2	20.2	--	0	0
10 Jun	48.9	20.1	17.94	0	0
11 Jun	46.7	20.3	18.56	0	0
12 Jun	44.3	20.2	19.17	1	8
Total	**56.1**	**18.0**	**12.02**	**217**	**1,398**

Appendix Table 23. Daily first-time detections at Little Goose Dam for wild spring/summer Chinook salmon smolts in 2015. Fish were PIT-tagged and from Idaho streams during 2014. River conditions at the dam are shown.

	Little Goose Dam			
Date (2015)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected (n)
09 Apr	43	29.77	9.27	1
10 Apr	44.8	29.91	9.26	0
11 Apr	44.3	29.8	9.12	1
12 Apr	42.4	29.95	9	1
13 Apr	39.6	30.05	8.95	0
14 Apr	42.3	30.02	9	0
15 Apr	40.8	29.9	9.1	1
16 Apr	38.1	29.92	9.1	0
17 Apr	40.8	29.9	9.45	0
18 Apr	42.3	30.02	9.48	1
19 Apr	43.1	29.93	9.9	0
20 Apr	47.1	29.94	10.69	1
21 Apr	43.5	29.89	10.71	2
22 Apr	48.7	29.98	10.77	5
23 Apr	54.9	29.87	10.76	5
24 Apr	52.1	29.94	10.79	7
25 Apr	54.8	29.93	10.97	5
26 Apr	52.7	29.79	11.04	4
27 Apr	45.4	29.96	11.1	5
28 Apr	50.5	29.9	11.59	3
29 Apr	45	29.78	11.73	4
30 Apr	50.3	29.82	11.88	7
01 May	50.1	29.94	11.71	4
02 May	53.5	29.72	11.83	5
03 May	52.3	29.83	11.78	9
04 May	52.8	29.73	11.8	0
05 May	62.2	29.9	12.24	8
06 May	64.8	29.94	12.35	3
07 May	64.2	29.91	12.38	3
08 May	63.2	29.91	12.46	6
09 May	53.7	29.98	12.94	4
10 May	50.8	29.92	13.38	8
11 May	50.8	29.92	13.45	5
12 May	50.3	30.02	13.03	8
13 May	51.1	29.94	12.8	10
14 May	54.7	29.98	12.88	1
15 May	55.8	29.93	12.89	5

Appendix Table 23. Continued.

	Little Goose Dam			
Date (2015)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected (n)
16 May	58.8	29.93	12.95	10
17 May	69.4	29.83	13.3	5
18 May	70.8	29.94	13.65	7
19 May	61.7	29.98	13.73	2
20 May	61.8	29.77	13.96	2
21 May	61.4	29.97	13.97	2
22 May	64.1	29.95	13.76	0
23 May	61.5	29.92	15.64	1
24 May	64.7	30.14	15.33	0
25 May	64.6	30.03	15.86	3
26 May	61.9	30.05	15.27	3
27 May	63.4	29.97	16.02	1
28 May	62.8	29.94	16.95	0
29 May	62.3	29.86	17.09	0
30 May	58	30	18.65	0
31 May	58.6	29.86	18.08	1
01 Jun	60.4	29.97	19.37	0
02 Jun	61.6	29.87	16.58	0
03 Jun	61.6	30.03	16.32	0
04 Jun	64.7	29.98	16.39	1
05 Jun	54.1	29.94	16.72	2
06 Jun	47.9	30.06	16.89	0
07 Jun	50.4	29.96	17.06	0
08 Jun	50.9	29.86	16.89	0
09 Jun	52.5	29.71	16.78	0
10 Jun	46.6	30.04	16.94	0
11 Jun	44.8	29.91	17.39	0
12 Jun	44.2	29.86	18.44	0
13 Jun	40.6	29.8	18.83	0
14 Jun	35	30	19.39	0
15 Jun	31.8	29.25	19.17	0
16 Jun	35.3	30.31	19.44	0
17 Jun	29.9	35.79	19.28	0
18 Jun	33.8	31.36	19.78	0
19 Jun	31.5	33.65	20	1
20 Jun	29.7	35.69	20.33	0
21 Jun	28.8	36.81	20.17	0
22 Jun	31.2	30.77	20.22	0
23 Jun	29	29.66	19.78	0
24 Jun	30.8	30.52	20.44	0
25 Jun	30.6	30.39	20.56	0
26 Jun	31.8	34.59	20.28	0
27 Jun	31.8	34.91	20.39	0
28 Jun	35.8	31.01	20.44	0
29 Jun	35.4	29.94	20.72	0
30 Jun	28.4	29.93	20.67	1
Totals	**49.0**	**30.35**	**14.72**	**175**

Appendix Table 24. Daily first-time detections at Lower Monumental Dam in 2015 of wild spring/summer Chinook salmon smolts with river conditions at the dam. Fish were PIT-tagged and released from Idaho streams during summer 2014.

	Lower Monumental Dam			
Date (2015)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected (n)
22 Apr	50.7	55.42	10.47	1
23 Apr	57.1	49.04	10.9	1
24 Apr	54.2	51.66	11.05	2
25 Apr	54.6	51.1	10.88	1
26 Apr	53.3	52.53	10.8	2
27 Apr	47.4	59.07	11.06	0
28 Apr	53.4	50.94	11.26	1
29 Apr	47	55.53	11.38	2
30 Apr	52.2	50.19	11.79	1
01 May	51.1	50.88	12.08	0
02 May	54.8	46.17	12.01	3
03 May	53	46.42	12.1	0
04 May	55.1	41.74	12.13	3
05 May	61.7	37.76	12.25	10
06 May	65.1	35.64	12.26	5
07 May	65.3	36.6	12.24	2
08 May	63.6	36.64	12.31	1
09 May	53.3	43.71	12.6	1
10 May	53	43.77	12.78	1
11 May	51.4	45.33	12.98	2
12 May	51.7	45.26	13.3	2
13 May	50.1	46.91	13.58	1
14 May	57.3	41.36	13.54	2
15 May	56.4	43.79	13.16	0
16 May	59.9	44.41	13.29	1
17 May	70.8	37.43	13.43	3
18 May	72.2	36.43	13.29	1
19 May	63.5	41.73	13.51	3
20 May	63.5	40	13.98	2
21 May	63.1	38.51	14.24	1
22 May	64.8	36.11	14.34	0
23 May	62	36.94	15.23	0
24 May	67.3	34.18	15.76	0
25 May	64.8	36.88	15.61	0
26 May	63.8	36.68	15.32	0
27 May	65.2	36.5	15.89	1
28 May	63.7	36.42	15.93	1
29 May	64.3	37.33	15.26	1
05 July	20.9	42.11	21.17	1
Totals	**57.5**	**43.31**	**13.21**	**59**

Appendix Table 25. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at Ice Harbor Dam during 2015, with associated river flows and water temperatures at the dam.

	Ice Harbor Dam			
Date (2015)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected (n)
02 May	55.7	80.25	11.9	1
03 May	53.1	80.6	12.32	0
04 May	56.9	80.84	12.62	0
05 May	63.1	79.24	12.64	0
06 May	65.5	73.28	12.86	1
07 May	68.1	73.57	12.7	0
08 May	63.6	41.35	12.7	0
09 May	52.8	29.92	12.85	1
10 May	52.9	29.87	12.98	2
11 May	52.3	29.64	13.16	1
12 May	52.4	70.23	13.27	1
13 May	51.5	80.19	13.36	0
14 May	57.6	41.49	13.38	0
15 May	55.5	30.09	13.44	1
02 Jun	62.7	30.14	16.67	1
03 Jun	63.3	69.04	16.8	2
Totals	**57.94**	**57.48**	**13.4**	**11**

Appendix Table 26. Daily first-time detections at McNary Dam in 2015 of wild spring/summer Chinook salmon smolts PIT tagged and released from Idaho streams in summer 2014. Associated river conditions at the dam are shown.

	McNary Dam			
Date (2015)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected (n)
21 Apr	161.1	39.98	10.59	1
22 Apr	162.3	40.05	10.62	0
23 Apr	166.5	39.88	10.94	0
24 Apr	159.8	39.99	10.86	2
25 Apr	157.4	40.22	10.78	0
26 Apr	159.4	40.15	10.75	2
27 Apr	167.6	40.04	11.15	1
28 Apr	165.5	40.06	11.3	2
29 Apr	145.9	40.1	11.44	1
30 Apr	128.7	40.02	11.81	2
01 May	178.7	40.24	12.1	4
02 May	179.5	40.17	12.39	5
03 May	179	40.28	12.85	8
04 May	189.6	40.08	12.65	8
05 May	170.9	40.14	12.55	10
06 May	172.3	40.1	12.48	11
07 May	179.9	39.97	12.62	8
08 May	162.3	40.23	12.86	9
09 May	162.7	40.2	13.39	2
10 May	144.5	40.21	13.34	6
11 May	144.6	40.18	13.29	5
12 May	173.3	40.22	13.3	7
13 May	187.7	40.17	13.36	2
14 May	193.1	40.13	13.3	3
15 May	206.7	40.15	13.09	6
16 May	180.6	39.98	12.88	1
17 May	167.5	39.82	13.3	0
18 May	209.7	40.39	13.82	3
19 May	204.7	40.25	14.3	2
20 May	193.3	40.25	14.29	3
21 May	217.7	40.24	14.41	1
22 May	213.1	40.22	14.94	2
23 May	203.2	40.06	14.57	1
24 May	220.7	40.14	14.95	0
25 May	218.4	40.16	15.5	1
26 May	212.2	40.2	15.83	1
27 May	219.2	40.19	15.84	1
28 May	209.3	40.32	15.89	0
29 May	205.7	40.25	16.19	0
30 May	197.6	40.18	16.17	1
31 May	200.6	40.23	16.38	3

Appendix Table 26. Continued.

	McNary Dam			
Date (2015)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected (n)
01 Jun	202.6	40.08	16.51	0
02 Jun	191.1	40.24	16.61	0
03 Jun	180.3	40.32	16.5	0
04 Jun	184.7	40.17	16.67	2
05 Jun	184.7	40.28	16.78	1
06 Jun	179.2	40.23	17.39	0
07 Jun	179.5	40.22	17.33	0
08 Jun	192	40.21	17.78	1
09 Jun	206.4	40.12	18.11	0
10 Jun	177.6	40.15	18.17	0
11 Jun	166.7	40.19	18.17	0
12 Jun	173.4	40.08	18.22	0
13 Jun	160.6	39.98	18.56	0
14 Jun	151.7	39.95	18.5	1
Totals	**181.9**	**40.15**	**14.3**	**130**

Appendix Table 27. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts from Idaho at John Day Dam during 2015, with associated river conditions the dam.

	John Day Dam			
Date (2015)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected (n)
12 May	166.2	39.59	13.67	3
13 May	186.2	38.18	13.65	1
14 May	193.3	29.95	13.93	1
15 May	198.1	31.45	14.15	1
16 May	179.5	39.78	14.13	0
17 May	168.7	38.23	14.26	4
18 May	205.7	29.9	14.61	0
19 May	200.6	31.61	14.7	0
20 May	194.1	39.82	14.72	2
21 May	212.4	37.95	14.83	0
22 May	201.8	30.03	14.72	1
23 May	203	31.53	14.86	1
24 May	223.8	39.77	15.18	1
25 May	210.4	38.55	15.59	0
26 May	211.9	29.92	15.79	2
27 May	219.6	31.56	15.94	0
28 May	212	39.86	16.45	0
29 May	205	38.2	16.86	0
30 May	181.4	30.04	16.91	0
31 May	195.6	31.6	17.4	0
01 Jun	196	40.05	17.68	0
02 Jun	195.2	38.37	17.48	0
03 Jun	176.3	30.12	17.48	2
16 Jun	167.2	31.76	19.44	1
19 Jun	123.6	30.1	19.61	2
30 Jun	148.8	31.65	21.89	1
Totals	**191.4**	**34.60**	**16.00**	**23**

Appendix Table 28. Daily first-time detections of PIT-tagged wild spring/summer Chinook salmon smolts and river conditions at Bonneville Dam, 2015. First-time detections on the pair trawl (TWX) operated in the estuary are also shown.

Date (2015)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected (n)
		Bonneville Dam		
03 May	188.1	52.79	12.8	1
04 May	191.5	51.85	13.02	0
05 May	175.2	56.56	13.11	0
06 May	171.9	57.71	13.23	0
07 May	172.1	57.76	13.22	0
08 May	172.6	57.88	13.29	2
09 May	157.3	63.51	13.61	1
10 May	146.4	68.51	14	1
11 May	145.8	68.86	14	0
12 May	176.6	56.46	13.94	2
13 May	184	53.97	13.98	1
14 May	192.9	51.48	13.95	5
15 May	205.1	48.46	14.06	2
16 May	172.6	58	14.18	2
17 May	171.1	58.74	14.53	0
18 May	208.8	47.65	14.9	4
19 May	205.9	48.18	15.07	4
20 May	198.4	50	15.24	2
21 May	210.2	47.1	15.37	2
22 May	202.1	49.08	15.38	2
23 May	200	49.85	15.25	1
24 May	213.2	47	15.1	1
25 May	218.5	45.9	15.1	2
26 May	213.7	46.75	15.43	1
27 May	218.5	45.81	15.83	0
28 May	215.1	46.26	16.44	1
04 Jun	183.8	54.41	17.83	1
05 Jun	185.6	53.66	18.22	0
06 Jun	185.9	53.47	18.5	0
18 Jun	132.6	65.91	19.83	1
27 Jun	157.5	59.3	21.28	1
		Estuary pair trawl		
08 May	---	---	---	1
11 May	---	---	---	1
14 May	---	---	---	1
18 May	---	---	---	1
23 May	---	---	---	1

Appendix Table 29. Site details for all instream monitoring locations used in PIT-tag studies of wild spring/summer Chinook salmon parr, 2014-2015.

Fish collection site	Instream monitoring site: Description	River or Creek	rkm	PTAGIS site code
Valley Creek	Valley Creek, upstream	Valley Creek	2	VC1
Valley Creek	Valley Creek, downstream	Valley Creek	1	VC2
Valley Creek, Herd Cr	Upper Salmon R, upstream	Salmon River	460	USE
Valley Creek, Herd Cr	Upper Salmon R, 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 Table 30. Monthly environmental data collected from Marsh Creek (rkm 179.8 from the mouth of the Middle Fork Salmon River) from August 2014 to July 2015.

	Marsh Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature (°C)												
Min	6.2	3.0	1.7	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	2.4	5.6	6.7
Max	18.2	15.0	11.6	6.9	3.4	4.5	4.9	7.9	11.5	14.1	20.7	20.6
Mean	11.8	9.1	5.7	1.5	0.8	0.6	1.4	2.3	3.9	7.3	11.8	12.5
Depth (ft)												
Min	0.1	0.2	0.1	0.0	0.0	0.2	0.0	0.0	0.5	1.0	0.6	0.3
Max	1.1	0.7	0.8	1.3	1.5	1.8	0.9	1.3	1.6	1.6	1.6	0.8
Mean	0.7	0.4	0.5	0.5	0.4	0.8	0.5	0.7	1.0	1.3	1.0	0.6

Appendix Table 31. Monthly environmental data collected from the Salmon River near Sawtooth Hatchery (rkm 618) from August 2014 to July 2015.

	Salmon River											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	8.9	6.1	3.4	-0.1	-0.1	-0.1	-0.1	-0.1	0.6	4.6	7.8	9.2
Max	19.3	16.5	13.2	8.3	4.8	5.0	6.0	10.6	12.9	15.2	21.5	21.3
Mean	13.5	11.3	7.8	2.9	1.7	1.3	2.6	4.5	6.4	9.2	13.6	14.3
						Depth (ft)						
Min	1.3	1.2	1.1	0.7	0.6	0.9	0.6	0.6	1.0	1.3	1.4	1.1
Max	2.0	1.7	1.8	1.8	1.7	2.6	1.5	1.6	1.8	2.1	2.1	1.8
Mean	1.6	1.5	1.4	1.3	1.2	1.3	1.1	1.2	1.3	1.7	1.8	1.5

Appendix Table 32. 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 2014 to July 2015.

	Valley Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	8.1	4.6	1.9	0.0	0.0	0.2	0.0	0.0	0.1	4.8	7.8	9.3
Max	21.8	18.0	14.1	8.5	3.7	1.3	5.5	10.4	13.2	15.8	23.8	24.0
Mean	14.4	11.6	7.1	1.8	0.9	0.5	1.4	3.3	5.9	9.0	14.0	15.6
						Depth (ft)						
Min	1.0	0.9	0.8	0.8	0.5	1.0	0.7	0.7	1.2	1.7	1.4	0.9
Max	1.8	1.4	1.5	1.6	1.5	1.6	1.9	2.3	2.0	2.3	2.2	1.5
Mean	1.4	1.1	1.2	1.2	1.1	1.3	1.3	1.6	1.6	2.0	1.8	1.2

Appendix Table 33. Monthly environmental data collected from the South Fork Salmon River (rkm 112 from its confluence with the main Salmon River) from August 2014 to July 2015.

	South Fork Salmon River											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	---	---	---	---	---	---	---	---	---	---	---	---
Max	---	---	---	---	---	---	---	---	---	---	---	---
Mean	---	---	---	---	---	---	---	---	---	---	---	---
						Depth (ft)						
Min	---	---	---	---	---	---	---	---	---	---	---	---
Max	---	---	---	---	---	---	---	---	---	---	---	---
Mean	---	---	---	---	---	---	---	---	---	---	---	---

Appendix Table 34. Monthly environmental data collected from the Secesh River (rkm 27 from its confluence with the South Fork Salmon River) from August 2014 to July 2015.

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

Appendix Table 35. 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 2014 to July 2015.

	Bear Valley/Elk Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
	Temperature (°C)											
Min	8.1	5.8	2.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	8.7	9.6
Max	23.2	15.8	11.7	6.3	0.7	0.2	0.5	6.9	9.0	14.0	22.3	22.4
Mean	14.2	11.0	6.3	1.1	0.1	0.0	0.1	1.5	4.1	8.1	14.3	15.5
	Depth (ft)											
Min	0.0	2.7	2.6	2.5	2.5	3.3	2.6	2.6	3.0	3.5	3.0	2.8
Max	3.5	3.2	3.5	3.9	4.1	4.0	3.8	3.9	4.3	4.3	3.7	3.3
Mean	3.1	3.0	3.0	3.2	3.2	3.7	3.3	3.3	3.6	3.9	3.3	3.0

Appendix Table 36. Monthly environmental data collected from Sulphur Creek (rkm 10 from its confluence with the Middle Fork Salmon River) from August 2014 to July 2015.

	Sulphur Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
	Temperature (°C)											
Min	6.9	3.9	2.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	1.9	6.6	8.0
Max	15.8	12.9	9.2	5.2	3.0	2.4	3.2	6.9	9.4	13.1	19.5	19.2
Mean	10.9	8.9	5.7	1.7	0.9	0.2	1.0	2.0	3.5	6.4	11.7	12.6
	Depth (ft)											
Min	0.6	0.5	0.4	0.3	0.1	0.7	0.4	0.5	0.8	1.3	0.8	0.6
Max	1.3	1.0	1.2	1.6	1.6	2.1	2.2	1.7	2.0	2.0	1.4	1.0
Mean	0.8	0.7	0.8	0.9	0.8	1.2	1.0	1.2	1.3	1.6	1.0	0.8

Appendix Table 37. Monthly environmental data collected from upper Big Creek (rkm 60 from its confluence with the Middle Fork Salmon River) from August 2014 to July 2015.

	Big Creek (upper)											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
	Temperature (°C)											
Min	7.4	4.6	3.2	0.1	0.0	0.0	0.0	0.0	0.4	2.2	4.6	7.2
Max	15.4	13.5	11.0	6.4	3.7	3.4	4.3	7.6	8.9	10.1	17.1	17.0
Mean	10.5	8.7	6.1	2.6	1.7	1.2	1.7	2.7	3.7	5.2	9.3	11.1
	Depth (ft)											
Min	1.3	1.2	1.0	1.0	0.9	1.3	1.1	1.1	1.4	2.0	1.6	1.3
Max	1.8	1.7	1.8	1.9	2.3	2.4	2.5	2.6	2.4	3.0	3.0	1.8
Mean	1.6	1.4	1.5	1.6	1.5	1.7	1.7	1.9	1.8	2.4	2.2	1.5

Appendix Table 38. Monthly environmental data collected from Chamberlain Creek (rkm 25 from its confluence with the main Salmon River) from August 2014 to July 2015.

	Chamberlain Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
	Temperature (°C)											
Min	7.0	2.4	1.2	0.0	0.0	0.0	0.0	0.0	0.0	2.0	7.1	7.8
Max	19.4	15.8	12.0	5.8	2.7	1.3	3.8	7.7	9.1	13.8	22.6	22.5
Mean	12.9	9.6	5.6	1.0	0.4	0.0	0.9	2.3	3.7	6.4	12.8	14.5
	Depth (ft)											
Min	0.5	0.4	0.3	0.2	0.2	0.6	0.3	0.4	0.7	1.2	0.7	0.4
Max	1.0	0.9	1.0	2.2	1.7	2.0	1.4	1.6	1.8	2.1	1.7	0.9
Mean	0.8	0.6	0.7	1.0	0.8	1.2	0.9	1.1	1.2	1.6	1.1	0.7

Appendix Table 39. 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 2014 through July 2015.

	West Fork Chamberlain Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
	Temperature (°C)											
Min	6.6	2.0	1.3	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	1.9	6.3	6.7
Max	21.9	13.0	9.6	4.4	2.2	1.7	3.3	6.7	8.6	14.2	19.9	19.8
Mean	11.6	8.3	4.9	0.7	0.3	0.0	0.7	1.6	3.0	6.3	11.5	12.9
	Depth (ft)											
Min	---	---	---	---	---	---	---	---	---	---	---	---
Max	---	---	---	---	---	---	---	---	---	---	---	---
Mean	---	---	---	---	---	---	---	---	---	---	---	---

Appendix Table 40. 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 2014 to July 2015.

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

Appendix Table 41. 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 2014 through July 2015.

	Cape Horn Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
	Temperature (°C)											
Min	5.0	2.0	0.6	0.0	0.0	0.1	0.0	0.0	0.0	1.8	4.5	5.5
Max	16.9	14.4	10.9	6.1	2.7	0.3	4.3	8.7	10.1	11.8	19.2	19.4
Mean	10.1	8.1	4.8	1.0	0.4	0.1	0.6	2.2	3.5	5.7	9.9	11.0
	Depth (ft)											
Min	---	---	---	---	---	---	---	---	---	---	---	---
Max	---	---	---	---	---	---	---	---	---	---	---	---
Mean	---	---	---	---	---	---	---	---	---	---	---	---

Appendix Table 42. 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 2014 through July 2015.

	Herd Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
	Temperature (°C)											
Min	7.8	5.3	2.8	0.7	0.5	0.2	0.6	0.8	1.1	4.9	6.5	8.9
Max	18.3	15.6	12.7	7.1	4.0	3.9	5.1	10.0	12.4	12.0	16.7	17.9
Mean	12.6	10.7	7.3	2.6	1.4	1.0	2.3	4.5	6.3	8.2	10.8	13.0
	Depth (ft)											
Min	0.9	0.8	0.9	0.6	0.6	1.0	0.7	0.7	0.8	1.1	1.6	1.4
Max	1.6	1.3	1.7	1.6	1.6	1.6	1.6	1.6	1.6	2.1	2.2	1.8
Mean	1.3	1.1	1.3	1.2	1.2	1.4	1.2	1.3	1.2	1.6	1.9	1.6

Appendix Table 43. Monthly environmental data collected from Camas Creek (rkm 23 from its confluence with the Middle Fork Salmon River) from August 2014 through July 2015.

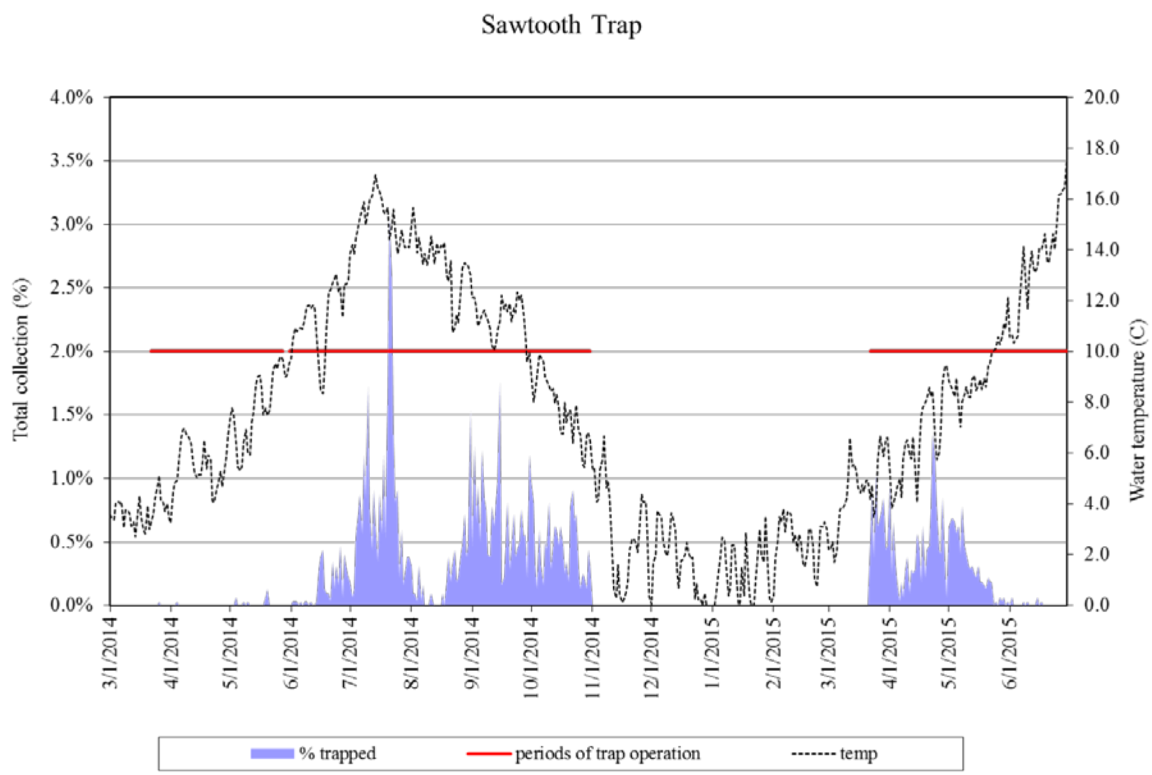
	Camas Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	8.1	5.8	2.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	8.7	9.6
Max	23.2	15.8	11.7	6.3	0.7	0.2	0.5	6.9	9.0	14.0	22.3	22.4
Mean	13.8	11.0	6.3	1.1	0.1	0.0	0.1	1.5	4.1	8.1	14.3	15.5
						Depth (ft)						
Min	0.0	2.7	2.6	2.5	2.5	3.3	2.6	2.6	3.0	3.5	3.0	2.8
Max	3.5	3.2	3.5	3.9	4.1	4.0	3.8	3.9	4.3	4.3	3.7	3.3
Mean	3.1	3.0	3.0	3.2	3.2	3.7	3.3	3.3	3.6	3.9	3.3	3.0

Appendix Table 44. Monthly environmental data collected from Loon Creek (rkm 31 from its confluence with the Middle Fork Salmon River) from August 2014 through July 2015.

	Loon Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	7.1	3.9	2.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	3.1	5.4	6.8
Max	17.8	15.2	12.4	7.0	3.6	3.6	5.0	9.8	11.1	11.7	18.5	18.7
Mean	11.9	9.8	6.2	1.9	0.8	0.1	1.4	3.1	4.6	6.5	10.1	12.2
						Depth (ft)						
Min	0.9	0.8	0.7	0.6	0.4	1.0	0.8	0.8	1.2	1.7	1.6	1.2
Max	1.6	1.4	1.5	2.6	2.2	2.5	1.8	2.0	2.2	2.5	2.5	1.8
Mean	1.3	1.1	1.1	1.2	1.2	1.6	1.4	1.5	1.6	2.2	2.0	1.5

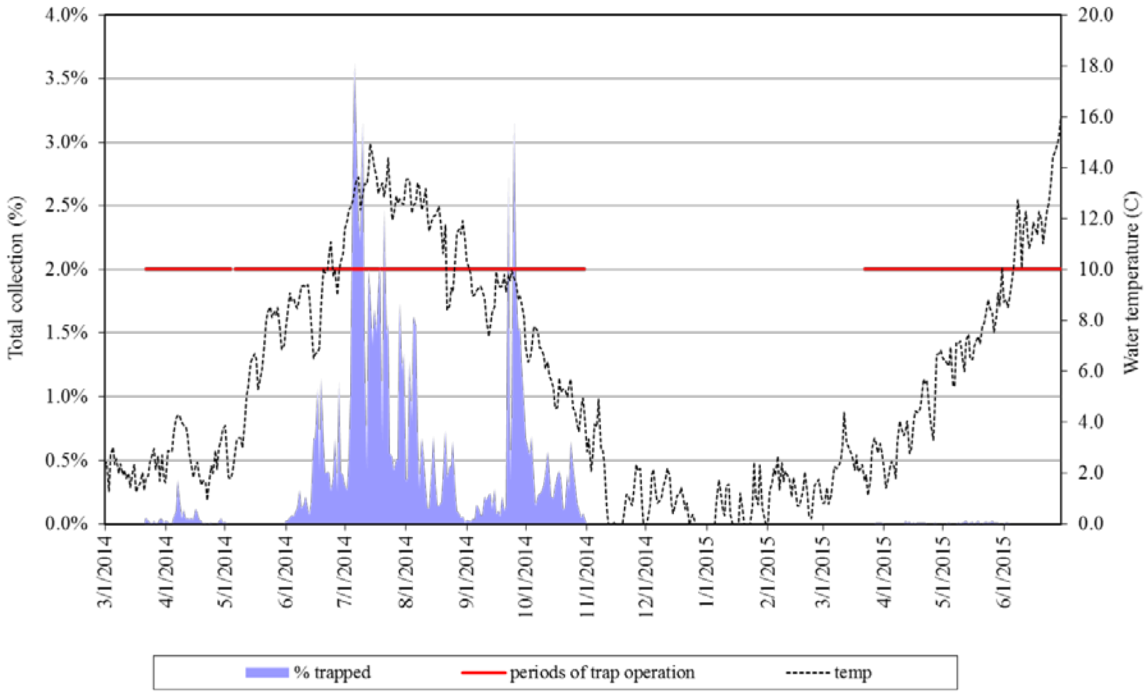
Appendix Table 45. Monthly environmental data collected from Big Creek near Taylor Ranch (rkm 10 from its confluence with the Middle Fork Salmon River) from August 2014 through July 2015.

	Big Creek											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
						Temperature (°C)						
Min	10.5	6.5	3.5	---	-3.9	-0.5	-0.1	-0.1	1.2	4.9	7.7	10.5
Max	19.2	15.9	12.3	---	2.5	1.7	4.3	8.8	10.9	12.5	20.7	21.3
Mean	14.9	12.1	7.5	---	0.4	0.1	1.5	4.1	6.0	8.1	13.1	16.1
						Depth (ft)						
Min	1.3	1.3	1.1	---	0.1	1.0	1.1	1.5	1.5	1.7	1.4	1.3
Max	1.5	1.4	1.4	---	2.7	1.5	1.9	1.9	2.2	2.2	1.7	1.4
Mean	1.4	1.3	1.3	---	1.2	1.3	1.3	1.7	1.9	2.0	1.5	1.4

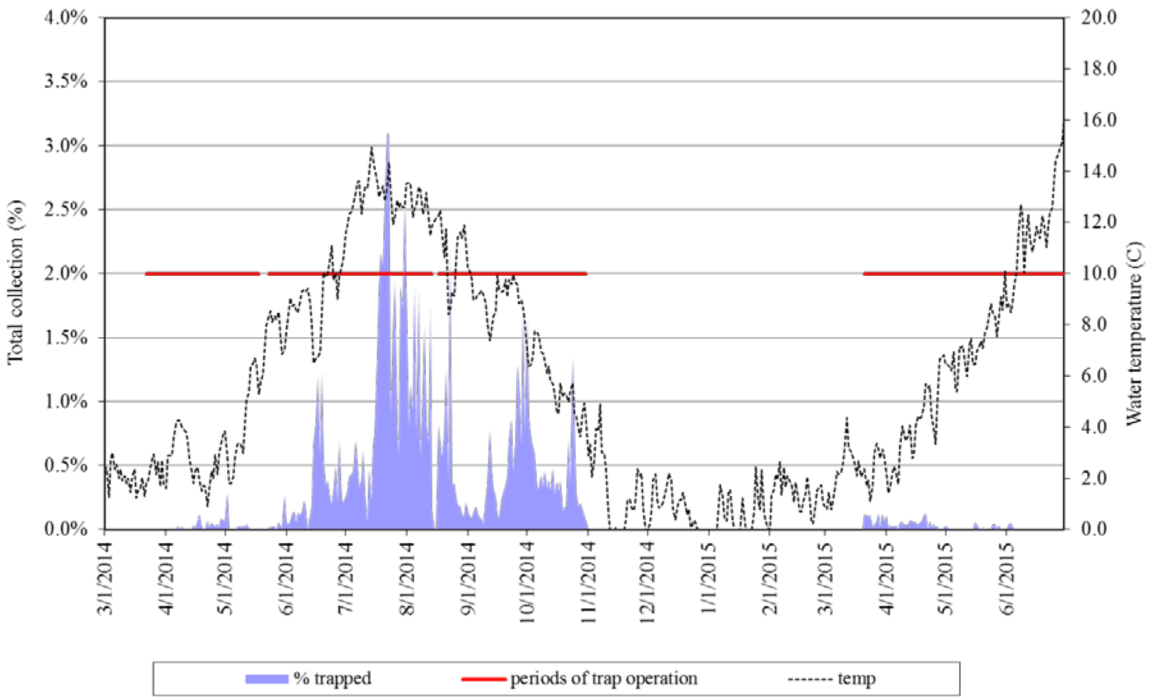


Appendix Figure 1. Daily passage of wild Chinook salmon fry, parr, and smolts at four migrant traps, expressed as percentages of total collected, and plotted against average daily water temperatures collected near traps. Periods of trap operation are also shown.

Marsh Creek Upper Trap

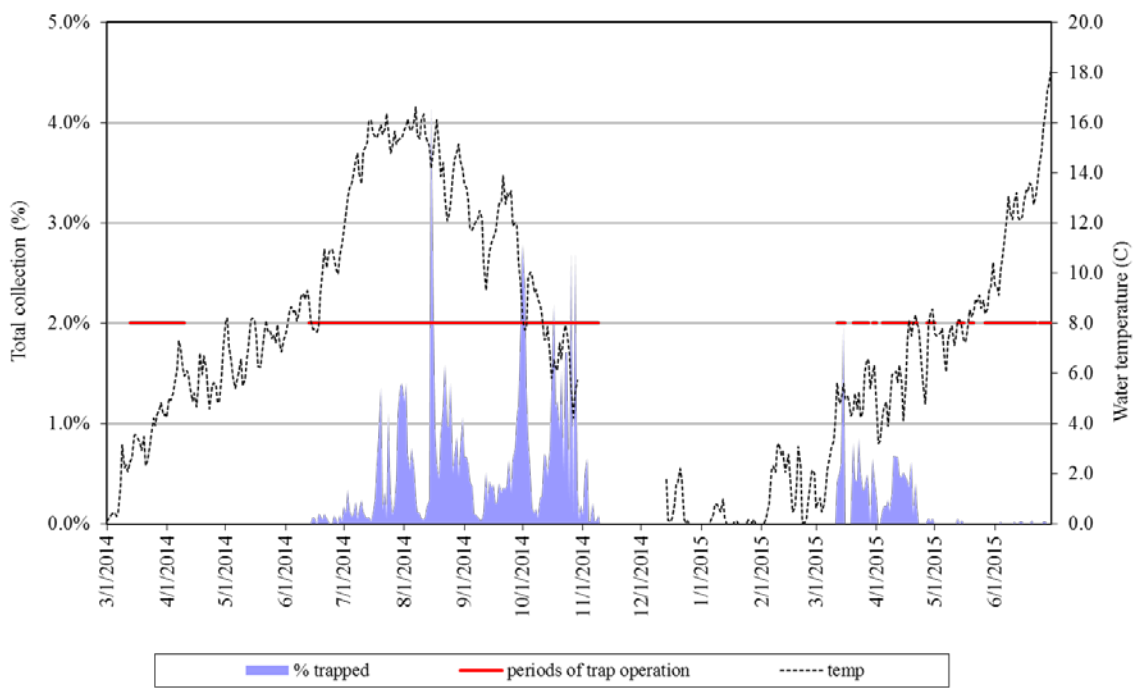


Marsh Creek Lower Trap

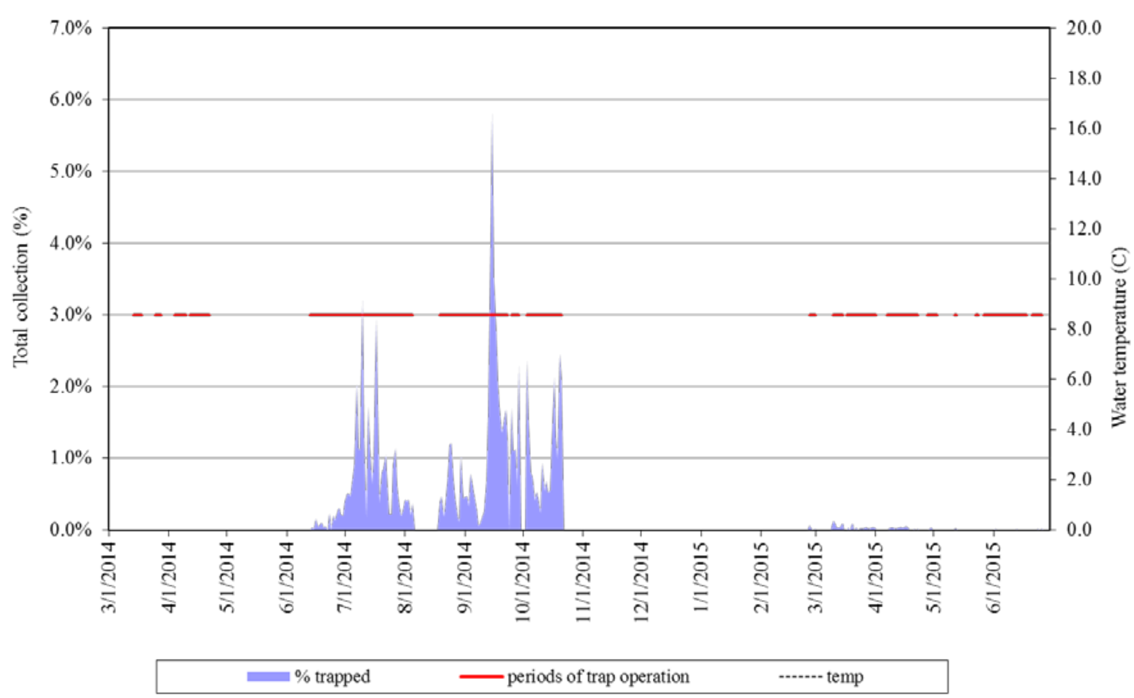


Appendix Figure 1. Continued.

Big Creek Trap

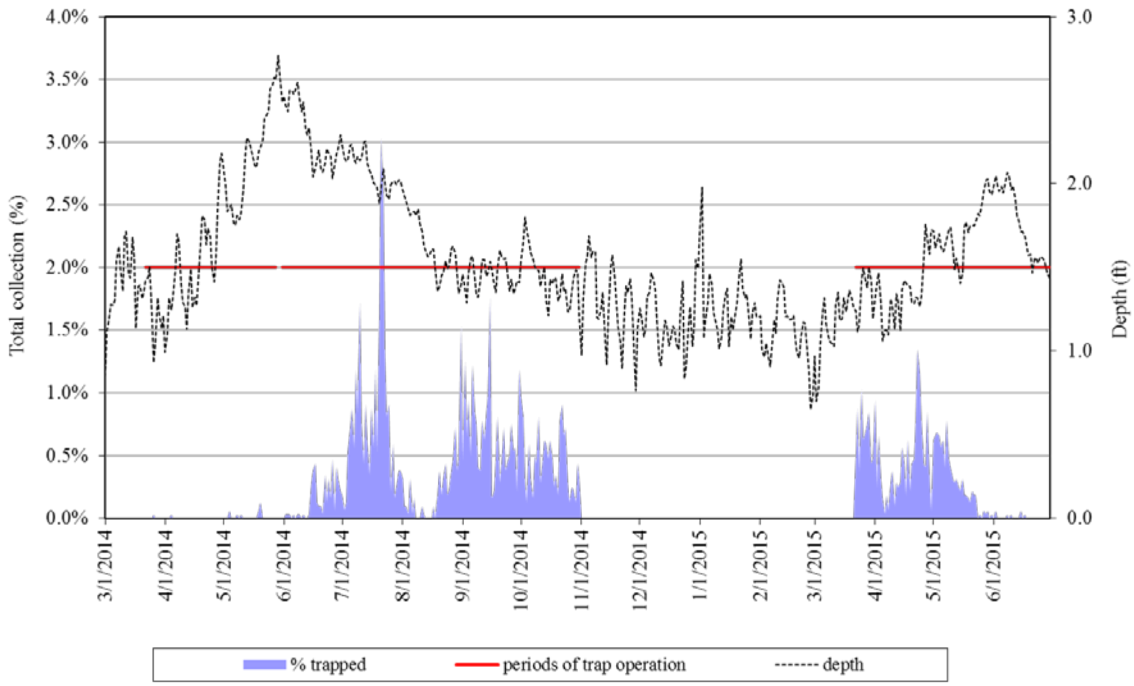


South Fork Salmon River Trap



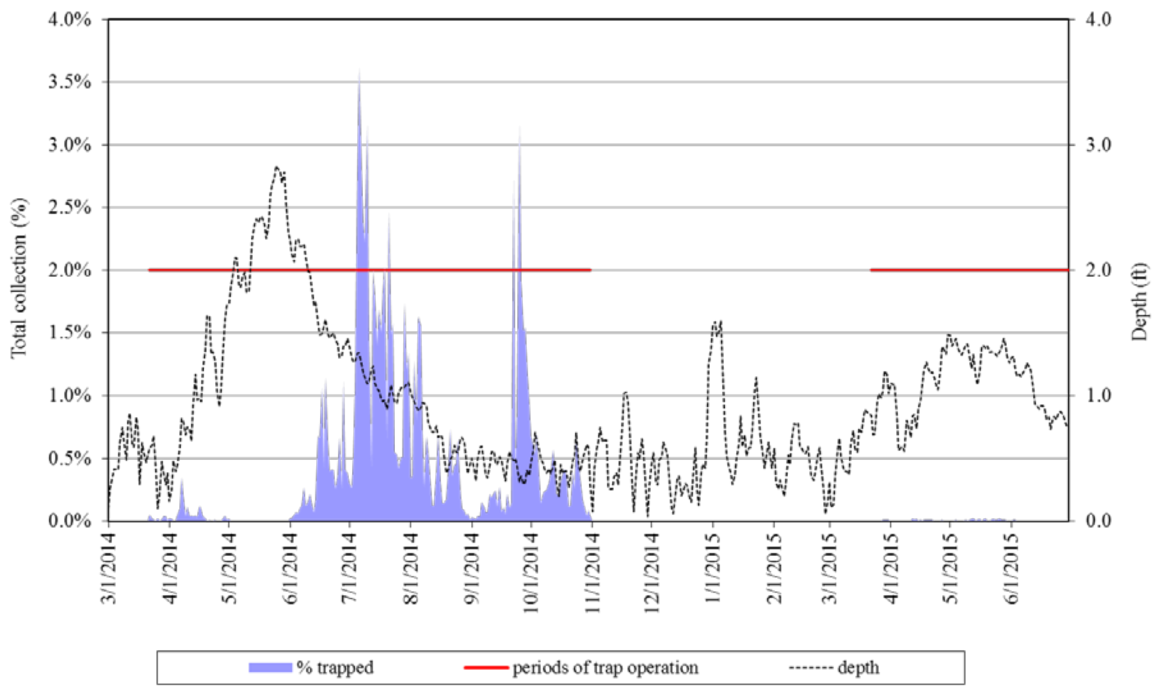
Appendix Figure 1. Continued.

Sawtooth Trap

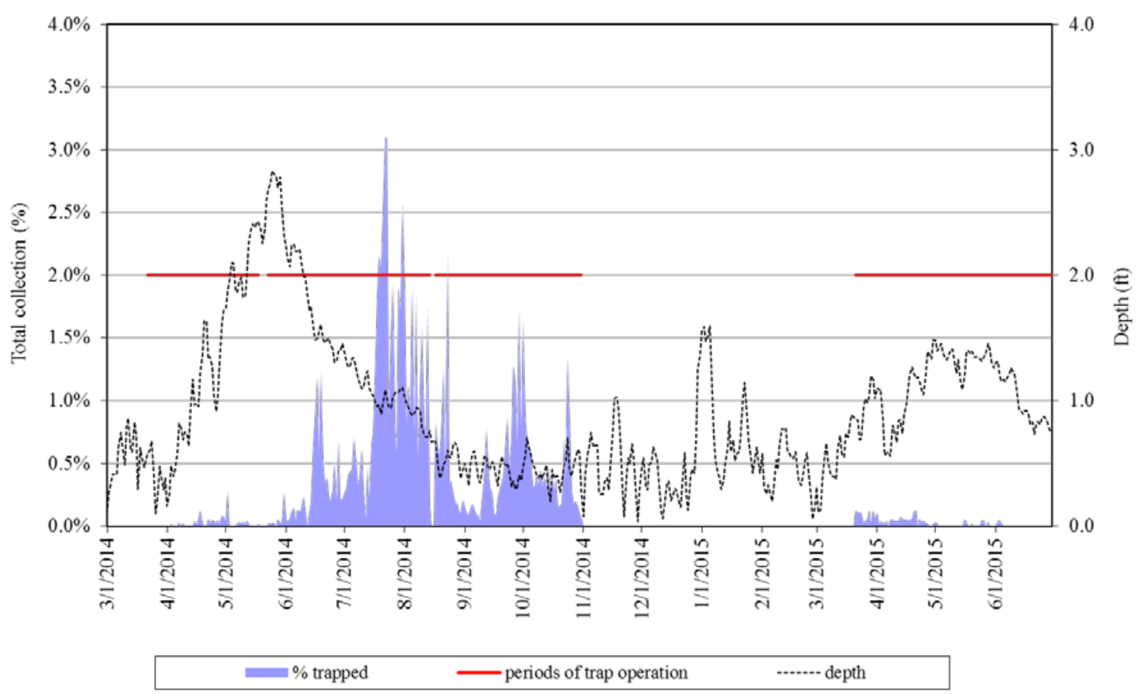


Appendix Figure 2. Daily passage of wild Chinook salmon fry, parr, and smolts at four migrant traps, expressed as percentages of total collected, and plotted against average daily depth collected near traps. Periods of trap operation are also shown.

Marsh Creek Upper Trap

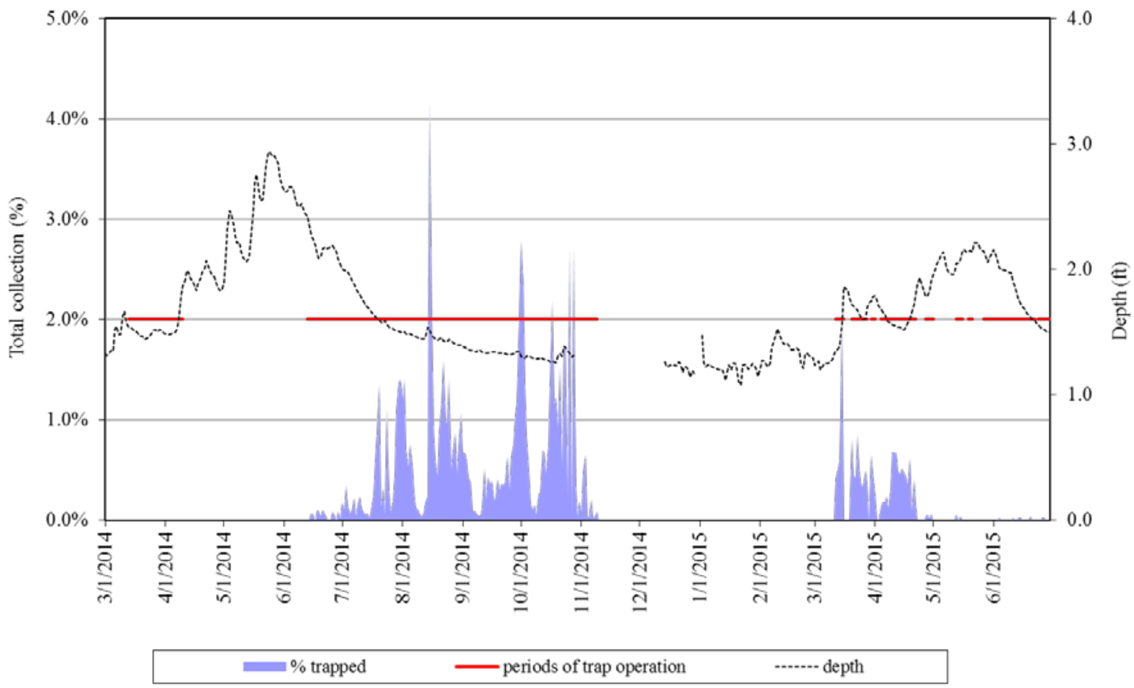


Marsh Creek Lower Trap

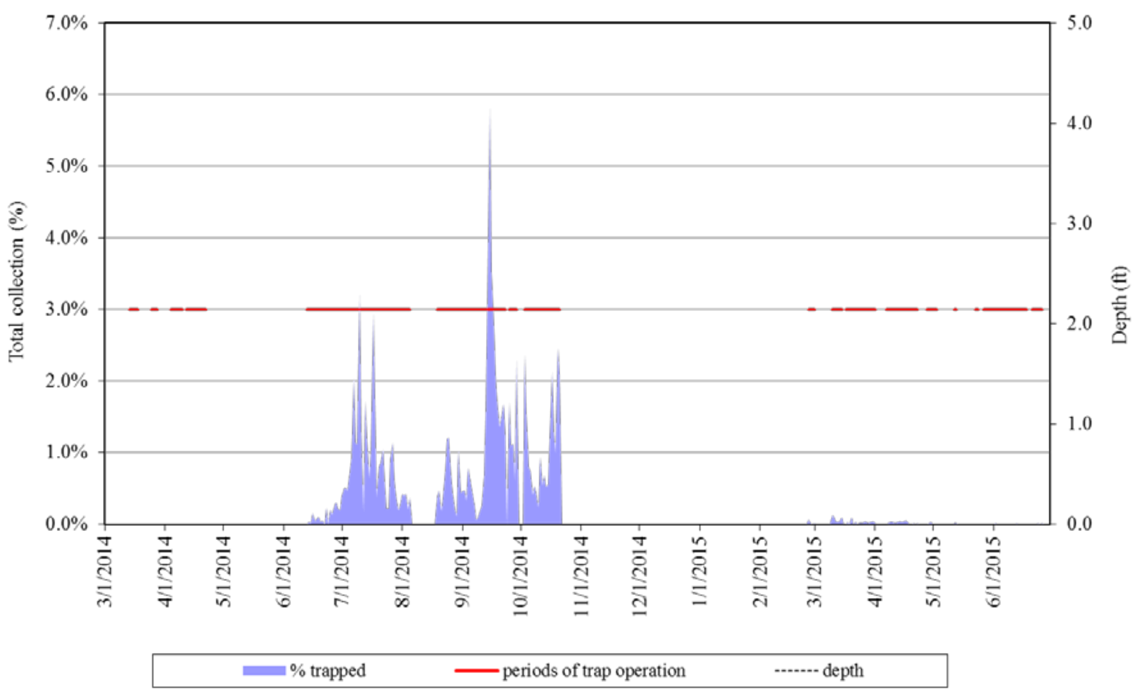


Appendix Figure 2. Continued.

Big Creek Trap



South Fork Salmon River Trap



Appendix Figure 2. Continued.