FISHERY RESEARCH

IDAHO ANADROMOUS EMIGRANT MONITORING

2014 AND 2015 ANNUAL REPORT

Photo: Laurie Janssen

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ABBREVIATIONS AND ACRONYMS

Abbreviation	Definition
BY	Brood Year
DPS	Distinct Population Segment
IDFG	Idaho Department of Fish and Game
LGR	Lower Granite Dam
MPG	Major Population Group
PIT	Passive Integrated Transponder
RST	Rotary Screw Trap(s)

ABSTRACT

Use of rotary screw traps (RST) allows estimation of abundance and productivity of juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*O. mykiss*). Standardized operations of RST provide long-term status monitoring within and among populations or spawning aggregates. In this report, we compile juvenile anadromous emigrant monitoring activities by the Idaho Department of Fish and Game and resulting abundance and productivity estimates in the Salmon River and Clearwater River basins for the years 2014 and 2015. We report on 19 RST operations and present emigrant abundance, smolt survival, and juvenile productivity estimates.

Seasonal abundances of Chinook Salmon were estimated in 2014 and 2015 at 13 trap locations. Seasonal estimates of 2014 age-0, and 2015 age-1 emigrants were summed for total abundance of the brood year (BY) 2013 cohort, and ranged from 623 in Crooked River (Upper South Fork Clearwater River population) to 224,927 in Marsh Creek (Marsh Creek population). Number of smolts per female spawner at Lower Granite Dam for BY 2013 ranged from 3 in American River (Upper South Fork Clearwater River population) to 459 in Big Creek (Big Creek population). Productivity was generally lowest in the Dry Clearwater MPG and highest in the Middle Fork Salmon MPG.

Abundance of steelhead trout emigrants was estimated at 17 and 12 trap locations in 2014 and 2015, respectively. In 2014, steelhead trout emigrants ranged from 839 in Red River (Upper South Fork Clearwater River population) to 39,174 in Big Creek (Lower Middle Fork Salmon River population). In 2015, steelhead trout emigrants ranged from 78 in Crooked River (Upper South Fork Clearwater River population) to a high of 41,505 in Big Creek (Lower Middle Fork Salmon population). Average productivities for recent brood years (2010-2013) presented as emigrants at RST per adult female were: 192.6 (Fish Creek, Lochsa River population); 93.0 (Big Creek, Lower Middle Fork Salmon River population); 69.2 (Rapid River, Little Salmon River population); and 125.7 and 388.5 (Big Bear Creek and East Fork Potlatch River, Lower Clearwater River Mainstem population).

Several trap location changes were made during the two years of monitoring presented in this report. We describe historical monitoring and present plans for future operations that will improve status monitoring across the Salmon River and Clearwater River basins for the juvenile freshwater life phase of Chinook Salmon and steelhead trout. (e.g., new Lochsa River trap). Several traps are, or will be, paired with spawner escapement information, which will allow us to develop emigrant-to-female brood tables for both species at most monitoring locations.

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INTRODUCTION

Populations of Chinook Salmon *Oncorhynchus tshawytscha* and steelhead trout *O. mykiss* in the Snake River basin declined substantially following the construction of hydroelectric dams in the Snake and Columbia rivers. Raymond (1988) documented a decrease in survival of emigrating steelhead trout (hereafter steelhead) and spring-summer Chinook Salmon (hereafter Chinook Salmon) from the Snake River following the construction of dams on the lower Snake River during the late 1960s and early 1970s. Abundance rebounded slightly in the early 1980s, but then escapements over Lower Granite Dam (LGR) into the Snake River basin declined again (Busby et al. 1996). In recent years, abundances in the Snake River basin have slightly increased. The increase has been dominated by hatchery fish, while the returns of naturally produced Chinook Salmon and steelhead remain critically low. As a result, Snake River spring-summer Chinook Salmon were classified as threatened in 1992 under the Endangered Species Act (ESA). Within the Snake River spring-summer Chinook Salmon evolutionarily significant unit (ESU), there are seven major population groups (MPGs): Lower Snake River, Grande Ronde/Imnaha rivers, South Fork Salmon River, Middle Fork Salmon River, Upper Salmon River, Dry Clearwater River, and the Wet Clearwater River (Table 1). The Dry Clearwater River and the Wet Clearwater River MPGs are considered to be extirpated but have been mostly refounded with stocks from other Snake River MPGs. A total of 28 extant demographically independent populations have been identified in the ESU. Snake River steelhead was classified as threatened under the ESA in 1997. Within the Snake River steelhead distinct population segment (DPS), there are six MPGs: Lower Snake River, Grande Ronde River, Imnaha River, Clearwater River, Salmon River, and Hells Canyon Tributaries (ICBTRT 2003, 2005; NMFS 2011). However, the Hells Canyon MPG is considered to be extirpated. A total of 24 extant demographically independent populations have been identified.

Anadromous fish management programs in the Snake River basin include large-scale hatchery programs intended to mitigate for the impacts of hydroelectric dam construction and operation in the basin, and recovery planning and implementation efforts aimed at recovering ESA-listed wild salmon and steelhead stocks. The Idaho Department of Fish and Game (IDFG) anadromous fish program's long-range goal, consistent with basinwide mitigation and recovery programs, is to preserve Idaho's salmon and steelhead runs and recover them to provide benefit to all users (IDFG 2012). Management to achieve these goals requires an understanding of how salmonid populations function as well as regular status assessments (McElhany et al. 2000). However, specific data on some Snake River steelhead and Chinook Salmon populations are lacking, particularly key parameters such as abundance, age composition, genetic diversity, recruits per spawner, and survival rates (ICBTRT 2003).

Idaho Department of Fish and Game (IDFG) provides long-term, continuous research, monitoring and evaluation of the status of the state's populations of anadromous salmon and steelhead (*Oncorhynchus* spp.). Recommendations for monitoring to address population status assessments across the Columbia River basin include: 1) annual estimation of juvenile emigrant abundance across major populations, and 2) the productivity of both tributary emigrants and smolts through the Columbia River basin hydrosystem (Crawford and Rumsey 2011). These are two of several critical metrics necessary to assess overall trends in abundance and productivity within freshwater habitat.

Freshwater rearing of anadromous salmonids in Idaho is spatially extensive and emigration is protracted, especially for steelhead. Both Chinook Salmon and steelhead rear from headwater spawning areas to the lower Snake River throughout the year, with spatial distribution of multiple cohorts often overlapping temporally. With exceptions in a few locations (e.g. Pahsimeroi River, where a significant proportion of age-0 emigrants smolt), cohorts of Chinook Salmon are relatively easy to distinguish (Copeland et al. 2014). However, extensive ageing of steelhead emigrants is necessary to estimate population scale productivity because several cohorts emigrate together. Ideal locations to estimate abundance of juvenile emigrants at the population scale are downstream from most spawning and early-rearing habitat, yet high enough in streams to allow efficient population-specific sampling. Standardized sampling through time and across locations can allow long-term evaluations of population trends and comparisons, if traps are located appropriately downstream of important spawning and rearing habitats. Rotary screw traps (hereafter RST or trap[s]) have been the primary tool used by IDFG since the early 1990s: 1) to sample populations or spawning aggregates of interest to estimate juvenile emigrant abundance, and 2) to tag emigrants with passive integrated transponder (PIT) tags to estimate smolt survival through the hydrosystem (Venditti et al. 2015a; Copeland et al. 2015; Bowersox and Biggs 2012).

A collaborative effort across the Columbia River Basin offered guidance to standardize monitoring of juvenile emigrants (Crawford and Rumsey 2011) and to coordinate and prioritize monitoring work (the draft Anadromous Salmonid Monitoring Strategy, http://www.nwcouncil.org/fw/am/monitoring/monitoring-strategies. Since that collaborative process began, IDFG has continued some existing RST operations and strategically implemented new RST operations to contribute to the monitoring of Major Population Groups (MPGs) and populations most important to overall recovery goals. Our goal with this report is to consolidate all information generated by means of RST by IDFG that is relevant to assessing trends in abundance and productivity of juvenile Chinook Salmon and steelhead populations in their freshwater habitat.

We have three objectives for this report. The first objective is to provide estimates of emigrant abundance past RSTs by season and cohort for Chinook Salmon and steelhead. Lower Granite Dam (LGR) marks the end of freshwater rearing, as juveniles emigrate as smolts past that location. Therefore, the second objective is to estimate survival rate to LGR and abundance by season and cohort for Chinook Salmon. It is not straightforward to estimate survival to LGR for steelhead and therefore we do not estimate survival for this species in this report. The third objective is to present estimates of freshwater productivity for the monitored populations and spawning aggregates. Freshwater productivity of Chinook Salmon is estimated with use of redd survey data. For steelhead, we use age assignments based on scale patterns to decompose abundances into cohorts to estimate productivity from the natal reach using a brood table approach.

This is our first attempt to consolidate all RST data for both species in one report. We provide recommendations for additional information and trend analyses to be included in future reports to complete this change in reporting focus. In past years, individual projects have often reported only on data for which they were funded to collect. This first combined report includes two years of data, 2014 and 2015, which was necessary for inclusion of information that otherwise would not be reported, due to some project-specific objectives. Our goal going forward is to present comprehensive annual information, with historical trends, for freshwater rearing status for Chinook Salmon and steelhead.

STUDY AREA

The Clearwater River and Salmon River basins include portions of the Idaho Batholith, the Middle Rockies, and the Northern Rockies ecoregions (McGrath et al. 2002; Kohler et al. 2013). Most study streams drain areas with sterile granitic parent material associated with the

Idaho Batholith, resulting in relatively low-nutrient systems (McGrath et al. 2002; Sanderson et al. 2009). Three exceptions are the Potlatch River in the Clearwater River basin and the Lemhi and Pahsimeroi rivers in the Salmon River basin, all of which flow through predominately fertile basaltic geologies. Water quality is high and substrates range from sand and small gravels to cobbles and large boulders. Winters are harsh and growing seasons are short (45-100 d). This area is relatively dry with annual precipitation (primarily snowfall during spring, fall, and winter) ranging from 31 cm to 203 cm. Snowmelt influences most flow regimes with peak spring flows occurring during May and June and base flows occurring for the remainder of the year. Groundwater recharge heavily influences base flows in the Lemhi River and Pahsimeroi River.

Idaho Chinook Salmon and steelhead migrate long distances during their life cycle, travelling 1,451 km from the Pacific Ocean to the highest reaches of their spawning grounds in the Sawtooth National Recreation Area and climb from sea level to elevations over 2,000 m. Eight dams lie between Idaho and the Pacific Ocean including four Snake River dams and four Columbia River dams. The first dam Idaho Chinook Salmon and steelhead encounter during emigration is LGR on the Snake River, 695 km from the Pacific Ocean. In the Salmon River basin, juveniles migrate between 283 km and 747 km from RST before encountering LGR. In the Clearwater River basin, juveniles migrate between 98 km and 324 km before encountering LGR.

Rotary screw traps operated by IDFG to sample natural origin stream-type juvenile Chinook Salmon and summer-run steelhead are distributed throughout the Clearwater River and Salmon River basins in Idaho (Figures 1 and 2). Traps were located to sample emigration from all or most of the significant spawning reaches for either or both species. Details about RST coverage are given in Appendix A.

METHODS

Methods applied to operate traps, handle and tag fish, manage data, and estimate emigrant abundance and smolt survival were primarily adapted from Venditti et al. (2015a). Volkhardt et al. (2007) provides much detail regarding RST design/construction and recommendations regarding river placement and general trap operations in a wide range of stream sizes. Biologists with IDFG spent a great deal of time over many years to refine all protocols associated with all aspects of operating RST in Idaho rivers to ensure consistent information was collected and archived, fish were handled appropriately to minimize stress, and worker safety guidelines were followed.

We deployed traps as early in the spring as possible, typically early March, and fished them continuously until ice-up in the fall, typically early November. However, trap operations in some streams were unable to operate past June, limited by low stream flow or high stream temperatures. We positioned traps in the thalweg to maximize capture efficiency whenever flow conditions allowed. Program personnel checked traps and processed fish at least once daily during daylight hours. High water flows, debris, and ice prevented trap operation on some days. When we anticipated problems (e.g., high flows, ice, or debris) or when unusually high numbers of juveniles were passing (generally immediately following hatchery releases), we checked the traps several times throughout the day and night as necessary to avoid harm to fish and avoid damage or loss of the RST. We moved traps out of the thalweg or stopped fishing them (i.e., raised the cone) during those times until it was prudent to resume routine operation. Low stream flows and high water temperatures (>17C) may also have limited trap operations during the summer.

We processed fish collected in traps using standard protocols. All fish were removed from the trap box and placed in aerated holding containers. Chinook Salmon and steelhead were anesthetized in buffered Tricaine Methanesulfonate (MS-222), scanned for PIT tags, weighed to the nearest 0.1 g, and measured to the nearest 1 mm fork length (FL). We anesthetized no more than 30 juvenile fish at one time to reduce exposure time to the anesthetic. All salmonids were measured and weighed prior to release. Incidental catch of non-target species were enumerated daily, then released downstream. We allowed all fish to recover from handling in large, lidded plastic boxes with sufficient free flow of water or in buckets of water with aeration and temperature control prior to release.

Subsamples of the target species were taken for marking and collection of biological samples. Chinook Salmon ≥60mm FL and steelhead ≥80 mm FL were implanted with 12 mm PIT tags. The number of fish tagged daily was based on a predetermined percentage of the daily catch designed to distribute PIT tags proportionally over the entire trapping season. All PIT tagging followed established protocols (Kiefer and Forster 1991; PIT Tag Steering Committee 1992; CBFWA 1999). Single-use injectors were used at most traps instead of the traditional multiuse injectors (Venditti et al. 2013). Chinook Salmon <60mm FL represent a large fraction of the total emigrants of that species from some streams. In those locations we used Bismarck Brown Y stain to mark subsamples of fish that were >35mm FL for mark-recapture abundance estimates (Venditti et al. 2015a). We did not mark steelhead <80 mm FL, and therefore did not estimate abundance of that group, with two exceptions. Steelhead captured at the East Fork Potlatch River and Big Bear Creek traps that were between 60 and 79 mm FL were marked with a ventral fin clip and were included with PIT-tagged fish in mark-recapture abundance estimates. Scale samples were collected from steelhead ≥80 mm FL at most traps for ageing. We followed established protocols and methods to collect a systematic sample of scales from 100-200 steelhead seasonally (spring, summer and fall), and to subsequently assign ages to sampled fish (Wright et al. 2015).

We estimated trap efficiency with fish that were newly marked with either PIT tags or stain by releasing those fish upstream from the trap on a daily basis. We selected release sites approximately 0.4 km or at least two riffles and a pool upstream of the trap to maximize the probability that marked fish would mix randomly with the general population prior to their recapture. Release locations had adequate holding habitat to reduce immediate predation risk.

<u>Data Management, Sample Analyses and Population Estimation Methods</u>

Data generated from all RST operations were stored in common databases. All data associated with trap operations, such as catch and disposition of fish, are archived on a statewide IDFG database (https://fishandgame.idaho.gov/ifwis/portal/page/juvenile-fish-trapping). Data are queried from that database for input into mark-recapture abundance estimates, to develop length and age frequency summaries, and to summarize annual trap operations. Steelhead age data were archived in the BioSamples database housed at the IDFG Nampa Fisheries Research office.

We calculated emigrant population estimates from trap operations with the stratified Lincoln-Petersen estimator with Bailey's modification:

$$N = \sum_{i=1}^{k} c_i (m_i + 1)/(r_i + 1),$$

where N is abundance of juveniles emigrating in a given year, i is season (defined below for each species), c_i is the number of all fish captured in season i, m_i is the number of tagged fish released in season i, and r_i is number of recaptures in season i. The estimator was computed using an iterative maximization of the log likelihood, assuming fish are captured independently with probability p (equivalent to trap efficiency) and tagged fish mix thoroughly with untagged fish using software specifically developed for use with screw trap data (Hong 2002; Steinhorst et al. 2004). The 95% confidence intervals were computed with the bootstrap option (2,000 iterations).

Trap efficiency was monitored to detect changes relative to environmental conditions (e.g., flow and temperature), and efficiency strata were established based on these conditions, within the species-specific seasonal periods described above. This resulted in an improvement in overall efficiency estimation and, therefore, a tighter bound on emigration estimates. To maintain robustness for analysis, we targeted a lower limit of seven recaptures for any strata (Steinhorst et al. 2004). If a stratum did not contain a sufficient number of recaptures, it was included with the previous or subsequent stratum depending on stream and trap conditions and based on the professional judgment of the biologist responsible for the RST.

We estimated survival rates of PIT-tagged Chinook Salmon emigrants from RST to LGR, for each cohort for each season of operation. Tagging and tag interrogation data were queried from the PTAGIS database (www.ptagis.org). Potential interrogation sites were Lower Granite, Little Goose, Lower Monumental, McNary, John Day, and Bonneville dams and the estuary towed array. We assume that tagged fish represented untagged fish in each group. Detection histories of Chinook Salmon tagged at RST were used in a Cormack-Jolly-Seber model implemented by the Survival Under Proportional Hazards (SURPH) program (Lady et al. 2001) to estimate survival rate and detection probability simultaneously. Survival of steelhead emigrants through the hydrosystem cannot be estimated with SURPH because that model does not accommodate their variable multiyear freshwater rearing life history.

Chinook Salmon Emigrant Abundance, Survival and Productivity

Abundances of Chinook Salmon emigrants passing RST were estimated in 2014 and 2015 by their age and the season. Body size and overall appearance were used to distinguish cohorts (age-0 from age-1 fish) as two ages could be captured simultaneously, especially in the spring. Season designations followed standard calendar periods (Venditti et al. 2015a). Spring is defined as trap deployment through June 30, a period of time dominated by catch of age-1 fish that are smolting and will be emigrating past LGR the same year. Spring 2014 age-1 emigrants were omitted from this report to avoid duplication in reporting. Those data and estimates may be found in Venditti et al. (2015a) and Bowersox and Biggs (2014). Age-0 fish are also captured in the spring, with high variability, but are often too small to mark for evaluation. Summer was July 1 through August 31, a period of time when age-0 fish grow large enough to be marked with PIT tags. Fall was September 1 through the end of the trapping year, a period of time when age-0 fish appear to actively emigrate out of upper tributary rearing reaches (Venditti et al. 2015b). We found that emigrants of a given cohort PIT tagged within each of these time periods generally display distinct differences in overall survival rates to LGR (Venditti et al. 2015b). Complete cohort abundance at the RST is calculated by summing sequential seasonal emigration estimates (spring of age-0, summer of age-0, fall of age-0, then spring of age-1 fish). Complete cohort abundance of smolts at LGR is calculated by multiplying the seasonal emigration estimates by the corresponding survival estimates (RST to LGR) before summation.

We estimated juvenile productivity for brood year (BY) 2013 Chinook Salmon at two points on the landscape. We estimated productivity at RST by dividing the sum of seasonal emigrants by the number of adult female spawners that produced them. We estimated productivity at LGR by dividing the estimate of smolts at LGR by the number of adult female spawners. Number of adult female spawners was obtained by either redd counts upstream from RST or weir counts at locations with both an RST and a weir (Stiefel et al. 2015). We assumed one female per redd when using redd counts (Murdoch et al. 2009). Venditti et al. (2015a) and Bowersox and Biggs (2014) reported on BY 2012 productivity; and BY 2014 estimates are in-progress.

Steelhead Emigrant Abundance and Productivity

Abundance of steelhead emigrants was estimated in 2014 and 2015 by season. Seasonal bounds used the major periods of fish movement during spring and fall and are consistent with past reports (e.g., Copeland et al. 2015). Spring was the period of time from trap installation until May 31, a period of time when most steelhead emigrants past RST are smolting. Summer was from June 1 to August 14, a time period that emigrants generally continued to rear in freshwater for at least one more year. Fall was from August 15 until trap removal, a period of increased emigration past RST.

The productivity of steelhead was estimated by using age composition data to decompose juvenile abundances into brood years and comparing brood year production to the number of female spawners in streams with escapement monitoring via weirs or PIT tag arrays. Because the large majority of spring emigrants tagged are detected at LGR in the same year, age composition for spring samples was calculated separately from summer and fall age compositions, which were combined because those emigrants typically have similar age compositions that are different from spring collections. Sample proportions were directly applied to the seasonal estimates. Brood tables were constructed by summing emigrant abundances by cohort, then dividing by number of female spawners upstream from the RST to calculate brood year productivity.

RESULTS

During 2014, we operated RST in nine and eight long-established locations in the Salmon River and Clearwater River basins, respectively (Appendices B and C). These traps had operated annually at the same locations for no fewer than six years, and for as long as 21 years. The year of 2015 was a time of change. Traps in Colt Killed and Crooked Fork creeks were permanently removed from those streams at the end of 2014. Traps in American, Red, and upper South Fork Salmon rivers were permanently removed from those streams following the 2015 spring emigration; and traps in the lower South Fork Salmon and North Fork Salmon rivers began initial operations during summer 2015.

Most traps were operated during all three seasons (spring, summer, and fall). However, the two traps in the Potlatch River (Big Bear Creek and East Fork Potlatch River) operated only during the spring season during both 2014 and 2015 because low summer and fall stream flow was insufficient for operation. This is typical for those two traps and we assume emigration is negligible during summer and fall in the Potlatch River. These two traps were also the only RST to not sample Chinook Salmon, which is also routine.

Traps were generally very successful in operating for entire planned periods of time, and therefore can report reliable emigrant information for all seasons except winter. In both 2014 and 2015 all RST operated more than 70% of the days they were in place, with most locations exceeding 80% of days operated (Appendix B). High spring stream flow was the primary reason for traps not operating for multiple days. Frequent occurrence of elevated suspended fine sediment from a mudslide in the upper South Fork Salmon River in late summer of 2014 prevented operation of that trap during much of the fall of 2014 and spring of 2015 (Appendix B). An early spring thaw in 2015 may have influenced juvenile fish to emigrate out of Crooked, Red, and American rivers prior to trap deployments; and summer 2015 operation of these three traps was affected for several days because of low flows (Appendix B).

Chinook Salmon Emigrant Abundance, Survival and Productivity

In 2014 and 2015, Chinook Salmon juvenile emigrant catch and trap efficiencies were adequate to estimate abundances at eight traps across the three Salmon River MPGs, at the three traps in the Dry Clearwater River MPG and two traps in the Wet Clearwater River MPG (Table 2). Estimated number of emigrants was greatest at the lower Marsh Creek RST in both years. Abundances were lower at Clearwater River basin RST compared to Salmon River basin locations.

Seasonal survival rates to LGR were estimated for all locations where more than 150 emigrants were PIT tagged (Table 3). Survival rate to LGR was typically lower for fish that spent more time post-tagging in freshwater. Exceptions to this generality included upper Marsh Creek fall age-0 emigrants, with a survival rate of nearly 0.50, comparable to many rates observed for spring age-1 emigrants from other RST. A portion of age-0 fish trapped during spring 2014 in the Lemhi and Pahsimeroi rivers were observed at LGR the same year (age-0 smolts), contributing to the high survival rates observed for those groups. Spring age-1 emigrants from the Lemhi River had the highest survival rates observed among all RST locations (0.80) (Table 3). Smolt abundance at LGR was mostly influenced by seasonal emigrant abundance, with summer and fall age-0 fish generally having higher abundances of emigrants past RST than spring age-1 fish. With the exception of spring age-1 emigrants from Red River, survival to LGR of fish from the Clearwater River basin RST were generally an order of magnitude lower than those from the Salmon River basin (Table 3).

We estimated juvenile to adult productivity as emigrants at RST per female and smolts at LGR per female (Table 4). Total brood year 2013 juvenile Chinook Salmon emigrant abundances were generally lower in the Clearwater River basin; however, estimates varied widely among locations, ranging from a low of 623 in Crooked River (Dry Clearwater River MPG) to a high of 224,927 in lower Marsh Creek (Middle Fork Salmon River MPG). Productivities revealed similarities of intrinsic productivities within major watersheds; productivities were highest within the Middle Fork Salmon River MPG measured at the trap and at LGR.

Steelhead Emigrant Abundance and Productivity

During 2014 and 2015, seasonal juvenile steelhead emigrants were estimated at 19 trap locations operating across 11 steelhead populations (Table 5). Annual estimates were completed in 2014 (both spring and summer/fall seasons) at all traps operating that year. Big Creek produced the most emigrants in both years, exceeding 39,000 fish annually. Emigrants from Crooked Fork Creek exceeded 35,000 in 2014. Emigrant estimates increased from 2014 to 2015 at Rapid River, upper March Creek, Lemhi River, Hayden Creek, and upper Salmon River.

The relationship between steelhead abundance estimates at the upper and lower locations in Marsh Creek is variable, with unexpected higher estimates at the upper trap in the summer/fall season. We noted a very large disparity in the 2015 summer/fall estimates, with very large confidence limits at the upper trap. The very low steelhead emigrant estimates for spring of 2015 in Crooked River were likely influenced by early emigration due to a late winter thaw. Catch of steelhead <80 mm FL varied widely among traps and years (Appendix C). These subtaggable-sized steelhead were released, unmarked, downstream from traps; therefore we did not estimate abundances.

More than 3,200 scale samples were collected each year from juvenile steelhead at 14 traps in 2014 and 2015 (Table 6). Ages were not assigned to 363 and 424 samples collected in 2014 and 2015, respectively. Ages ranged from zero to 5 years, with most fish either 1 or 2 years of age. Pahsimeroi and upper Salmon rivers were notable exceptions in the Salmon River MPG with high proportions of age-0 emigrants captured in the summer/fall season (Table 6). No age-0 emigrants were observed in the Clearwater River MPG in 2015. No age-5 steelhead emigrants were observed in the Clearwater River MPG in either year. Table 6 reveals the general shift toward older aged fish during spring versus summer/fall emigration at most traps.

Juvenile steelhead productivity estimates were made for Rapid River and Big Creek (Salmon River MPG); Big Bear Creek, East Fork Potlatch River, and Fish Creek (Clearwater River MPG) since 2006, 2004, 2005, 2008, and 1995, respectively (Table 7). Complete cohort estimates are available through BY2010. However, the majority of emigrants leave at 1 to 3 years of age so we present analysis through BY 2013. Fish Creek has an average of 454 emigrants per female spawner over the period of record (Table 7, Figure 3). Juvenile productivity may be compared among populations with common cohort data (BY 2010-2013). Average emigrants per female spawner for those four cohorts were 69.2, 93.0, 125.7, 388.5, and 192.6 in Rapid River, Big Creek, Big Bear Creek, East Fork Potlatch River, and Fish Creek, respectively Of course, these numbers will change somewhat as cohort emigrations complete, especially with the addition of age-3 emigrants. The relationship between productivity and female spawner abundance provides insight to the varied intrinsic productivities and production capacities of different streams (Figure 3). Trend lines fitted to data points in Figure 3 reveal that all of these populations show indications of density-dependency, with juvenile productivity declining with increasing spawner escapement.

DISCUSSION

This report represents a fundamental change in the approach with which IDFG reports on RST operations that produce abundance and productivity information for Chinook Salmon and steelhead in Idaho. We report information across all trapping locations operated by IDFG to enable tracking of trends in status at the MPG and population scales. Both species are now reported together, which was not done previously. This report is largely limited to conveying 2014 and 2015 RST operations and related abundance and productivity estimates in a standardized format. In an effort to present comprehensive information for both 2014 and 2015, reporting of steelhead emigrant abundance in 2014, and associated productivity estimates for Fish Creek, Big Creek, and Rapid River was redundant with Copeland et al. (2015). We omitted 2014 spring age-1 Chinook Salmon emigrants from this report, as those data are reported by Venditti et al. (2015a) and Bowersox and Biggs (2014). Future reporting should include more in-depth analyses of long-term trends for juvenile abundance, smolt survival, and juvenile-to-adult productivity.

There was considerable change in RST locations during this reporting period. Trapping was discontinued at five locations. Traps in Crooked Fork and Colt Killed creeks were discontinued at the end of 2014. Traps in American, Red, and upper South Fork Salmon rivers were removed in July 2015, following the smolt emigration of BY 2013 Chinook Salmon. The South Fork Salmon River trap was relocated in summer 2015 to a more appropriate site for long-term monitoring, 50 km downstream from its former location. A new trap was deployed in the North Fork Salmon River in fall 2015. Starting in 2016, the Lower Marsh Creek trap will be the only RST operating in Marsh Creek. We were able to estimate both emigrants/female and smolts/female for seven Chinook Salmon populations across four of the five Idaho MPGs for BY 2013 (Table 6). The addition of the North Fork Salmon River trap will add a fifth population to the Upper Salmon River MPG that is monitored by IDFG. Note that there is no overlap of the populations monitored by IDFG and those monitored by the Nez Perce Tribe and the Shoshone-Bannock Tribes. We coordinated with the fishery program leaders for the tribes prior to this time of transition to ensure priority monitoring is complete across the landscape (NWPCC 2012).

In two cases, we have moved traps downstream to increase coverage of populations of Chinook Salmon and steelhead, which has generated a tradeoff with the continuity and precision of the existing series of abundance estimates. Because the new locations are in reaches with greater widths than old locations, we can expect lower precision of abundance estimates because of low and widely varying trapping efficiency. In Marsh Creek we had the opportunity to calibrate emigrant estimates between a long-established and new location. A simple regression comparing Chinook Salmon emigrant estimates from Upper Marsh Creek and Lower Marsh Creek from 2010 through 2015 showed a strong correlation between locations (Figure 4). This information will allow us to extend abundance and survival trends at the Lower Marsh Creek trap site back to 1993. This same exercise should be completed for steelhead emigrants.

The Lochsa River trap was operated during the summer and fall of 2015 on a trial basis (Appendix E). The primary purpose for the new Lochsa River RST is to PIT tag large numbers of emigrants for survival evaluations. We are hopeful this trap can be efficient enough to also allow estimation of abundance at the trap location to provide better trend status information for the Wet Clearwater River MPG. The trial operation of the Lochsa trap in 2015 provided project leaders with several ideas for improvements that can be implemented (Appendix E).

In most Idaho streams, juvenile Chinook Salmon smolt at age-1; however, in the Lemhi and Pahsimeroi rivers juvenile Chinook Salmon growth rates are faster than other areas resulting in some fish smolting at age-0 (Copeland and Venditti 2009). In this report we estimated the smolt survival rate using detections at LGR across 2014 and 2015 for BY 2013 fish that emigrated past the RST in spring of 2014. A method is being developed to estimate distinct abundance and survival rates for age-0 emigrants that smolt at age-0 versus those that smolt at age-1. Future reporting will include abundance and productivity estimates that are inclusive of this unique life history characteristic in these populations.

Productivity levels necessary for Chinook Salmon population replacement is dependent upon smolt-to-adult return (SAR) rates. For example 400, 200, and 100 smolts/redd are needed, respectively, for replacement at SARs of 0.5%, 1%, and 2%, respectively, assuming a 1:1 sex ratio. These SARs approximate the range observed for BY 2007-2012 Snake River Chinook Salmon (McCann et al. 2015).

Juvenile productivity estimates for Chinook Salmon, in terms of smolts per female, varied widely among our monitored populations. The number of emigrants is influenced by overall habitat area and quality upstream from traps, as well as intrinsic productivity unique to each stream. However, survival of emigrants from natal reaches to the end of freshwater rearing at LGR is also important. For example, Chinook Salmon from the Lemhi River consistently have smolt survival rates exceeding 0.5 and as high as 0.89 in recent years (Bowersox and Biggs 2012). The survival rate for BY 2013 was 0.82, but only 65 smolts at LGR per redd were estimated.

Productivity estimates must be interpreted with an understanding of unique and changing habitat conditions. We believe the BY 2013 productivity estimate for Chinook Salmon in the South Fork Salmon River (51 smolts at LGR per female) was negatively influenced by the 2014 mudslide that occurred during spawning upstream from the RST. High late winter stream flows in the Dry Clearwater River MPG prior to the 2015 spring trap installations likely triggered early emigration of Chinook Salmon smolts, thus negatively influencing those productivity estimates. Future reports will provide multiyear trends with interpretation for productivity for each monitored population, similar to the tables we presented here for steelhead.

Opportunities exist to expand steelhead productivity estimates to all populations included in this report, with the exception of Marsh Creek, where no adult escapement monitoring is done nor anticipated. Data from past years are available for the upper Salmon, Pahsimeroi, and Crooked rivers, and will be included in future reporting. The new lower South Fork Salmon River and North Fork Salmon River traps are paired with PIT tag arrays, providing the potential to estimate spawning escapement at those locations.

Juvenile productivity estimation for steelhead has been limited to calculations of emigrants per adult female spawner at RST in this report because of the complexity of age structure across populations and extended downstream rearing. The recent development of new modeling tools by the University of Washington allows estimation of cohort survival through the hydrosystem, accommodating the variation in age at migration of steelhead (Buchanan et al. 2015; Lady et al. 2014). Estimates of steelhead smolt survival through the hydrosystem will be presented in future reports when we develop the appropriate model structure.

An IDFG protocol manual for RST operation is needed, especially at this time of changes in monitoring goals, population parameter estimation, and reporting structure. All leaders of anadromous projects that rely on RST to meet objectives should contribute toward a protocol that can accommodate future trap operations.

Fish abundances generated from RST data using the Lincoln-Peterson estimator are considered conservative because no interpolation is attempted for time periods that traps are not operated. Recent development of a multiyear hierarchical Bayesian model will increase the accuracy and precision of estimates during periods of sparse and missing RST data (Oldemeyer 2015). Beginning in 2016, we plan to employ this model to maintain trends of past and future juvenile abundances for both Chinook Salmon and steelhead.

RECOMMENDATIONS

Listed here are a few key tasks that, if completed, will improve our understanding of population status and trends in the juvenile freshwater life stage of Chinook Salmon and steelhead, and improve reporting efficiency.

1. Adopt new models available to estimate steelhead survival rates to LGR.

2. Use Oldemeyer (2015) model to estimate emigrant abundance past RSTs for all data series.

3. Using new models for smolt survival and emigrant abundance, develop juvenile-to-adult productivity tables for both Chinook Salmon and steelhead for all years of RST operations critical to track trends at the population scale.

4. Develop a graphical representation of population trends that can be added to annually.

5. Publish protocols for methods used to operate RST and develop abundance estimates.

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LITERATURE CITED

Bowersox, B., and M. Biggs. 2012. Monitoring state restoration of salmon habitat in the Columbia Basin, Interim report for the National Oceanic and Atmospheric Administration, Idaho Department of Fish and Game, Boise

Bowersox, B., and M. Biggs. 2014. Monitoring state restoration of salmon habitat in the Columbia Basin, Semi-annual progress report for the Pacific States Marine Fisheries Commission. Report period: January 1, 2014-June 30, 2014. Idaho Department of Fish and Game, Boise.

Buchanan, R.A., J.R. Skalski, G. Mackey, C. Snow, and A.R. Murdoch. 2015. Estimating cohort survival through tributaries for salmonid populations with variable ages at migration, North American Journal of Fisheries Management, 35:5, 958-973, DOI: 10.1080/02755947.2015.1064837

Busby, P.J., T.C. Wainwright, G.J. Bryant, L.J. Lierheimer, R.S. Waples, F.W. Wauneta, and I.V. Lagomarsino. 1996. Status review of West Coast Steelhead from Washington, Idaho, Oregon, and California. NOAA Technical Memorandum NMFS-NWFSC-27.

CBFWA (Columbia Basin Fish and Wildlife Authority). 1999. PIT tag marking procedures manual.

Copeland, T., and D. A. Venditti. 2009. Contribution of three life history types in a Chinook salmon (*Oncorhynchus tshawytscha*) population. Canadian Journal of Fisheries and Aquatic Sciences 66:1658-1665.

Copeland, T., D.A. Venditti, and B.R. Barnett. 2014. The importance of juvenile migration tactics to adult recruitment in stream-type Chinook Salmon populations. Transactions of the American Fisheries Society 143:1460-1475.

Copeland, T., E.W. Ziolkowski, R.V. Roberts, and K.A. Apperson. 2015. Idaho steelhead monitoring and evaluation studies. 2014 annual report. Idaho Department of Fish and Game Report 13-07, Boise.

Crawford, B.A., and S.M. Rumsey. 2011. Guidance for monitoring recovery of Pacific Northwest salmon and steelhead listed under the Federal Endangered Species Act. U.S. Department of Commerce, National Marine Fisheries Service, NW Region.

Hong, T.H. 2002. Selection of strata with AIC for fish out-migration estimation. Master's Thesis. University of Idaho, Moscow.

ICBTRT (Interior Columbia Basin Technical Recovery Team). 2003. Independent populations of Chinook, steelhead, and sockeye for listed Columbia basin ESUs. ICBTRT draft report July 2003.

ICBTRT (Interior Columbia Basin Technical Recovery Team). 2005. Updated population delineation in the interior Columbia Basin. Memo to NMFS Northwest Regional Office May 11, 2005.

IDFG (Idaho Department of Fish and Game). 2012. Fisheries management plan 2012-2018. Boise.

Kiefer, R.B., and K.A. Forster. 1991. Intensive evaluation and monitoring of Chinook salmon and steelhead trout production, Crooked River and upper Salmon River sites. Idaho Department of Fish and Game Annual Progress Report for 1989 to U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Contract DE-A179-84BP 13381, Project 83-7. Portland, Oregon.

Kohler, A.E., P.C. Kusnierz, T. Copeland, D.A. Venditti, L. Denny, J. Gable, B.A. Lewis, R. Kinzer, B. Barnett, and M.S. Wipfli. 2013. Salmon-mediated nutrient flux in selected streams of the Columbia River basin, USA. Canadian Journal of Fisheries and Aquatic Sciences 70:502-512.

Lady, J., P. Westhagen, and J. Skalski. 2001. SURPH, Survival under Proportional Hazards. Available. Prepared for the Bonneville Power Administration. Project No. 1989-107-00, Contract Number DE-B179-90BP02341. Portland, Oregon. http://www.cbr.washington.edu/analysis/apps/surph/

Lady, J., J.R. Skalski, and R. Buchanan. 2014. Program TribPit: Cohort analysis of juvenile salmonid movement and survival in tributaries. Prepared for: U.S. Department of Energy, Bonneville Power Administration. Project No. 1989-107-00. Contract Number 59002. Portland, Oregon. http://www.cbr.washington.edu/analysis/apps/tribpit

McCann, J., B. Chockley, E., Cooper, H. Schaller, S. Haeseker, R. Lessard, C. Petrosky, E. Tinus, E. Van Dyke, and R. Ehlke. 2015. Comparative survival study of PIT-tagged spring/summer/fall Chinook, summer steelhead, and sockeye, 2015 annual report. Report to Bonneville Power Administration, project 1996-02-00, Portland, Oregon.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonids populations and the recovery of evolutionarily significant units. National Oceanic and Atmospheric Administration Technical Memorandum NMFS-NWFSC-42.

McGrath, C.L., A.J. Woods, J.M. Omernik, S.A. Bryce, M. Edmondson, J.A. Nesser, J. Shelden, R.C. Crawford, J.A. Comstock, and M.D. Plocher. 2002. Ecoregions of Idaho (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,350,000). Available at http://www.epa.gov/wed/pages/ecoregions/id_eco.htm. Accessed October 2015.

Murdoch, A. R., T. N. Pearsons, and T. W. Maitland. 2009. The number of redds constructed per female spring Chinook Salmon in the Wenatchee River basin. North American Journal of Fisheries Management 29:441-446.

NMFS (National Marine Fisheries Service). 2011. Five-year review: summary and evaluation of Snake River sockeye, Snake River spring-summer Chinook, Snake River fall-run Chinook, Snake River basin steelhead. NMFS, Northwest Region.

NWPCC (Northwest Power and Conservation Council). 2012. Anadromous salmonid monitoring strategy viable salmonid population criteria and subset of tributary habitat and hatchery effectiveness. Columbia Basin Coordinated Anadromous Monitoring Workshop. Version 07 September 2012. Portland, Oregon

PIT-Tag Steering Committee. 1992. PIT-Tag marking station procedural manual. Version 1.0. PSMFC, Gladstone, Oregon.

Oldemeyer, B.O. 2015. Juvenile Chinook Salmon life history variation: improved methods for migration monitoring in a wilderness environment. Master's thesis, University of Idaho, Moscow, Idaho.

Raymond, H.L. 1988. Effects of hydroelectric development and fisheries enhancement on spring and summer Chinook Salmon and steelhead in the Columba River basin. North American Journal of Fisheries Management 8:1-24.

Sanderson, B.L., H.J. Coe, C.D. Tran, K.H. Macneale, D.L. Harstad, and A.B. Goodwin. 2009. Nutrient limitation of periphyton in Idaho streams: results from nutrient diffusing substrate experiments. Journal of the North American Benthological Society 28:832-845.

Steinhorst, K., Y. Wu, B. Dennis, and P. Kline. 2004. Confidence intervals for fish out-migration estimates using stratified trap efficiency methods. Journal of Agricultural, Biological, and Environmental Statistics 9:284-299.

Stiefel, C. M. Amick, K.A. Apperson, M. Belnap, T. Copeland, M.P. Corsi, R. Hand, M. Pumfery, S. Putnam, R. Roberts, K.K. Wright. 2015. Idaho natural production monitoring and evaluation. Annual progress report February 1, 2014-January 31, 2015. Idaho Department of Fish and Game Report 15-14, Boise.

Venditti, D.A., R. Kinzer, K.A. Apperson, J. Flinders, M. Corsi, C. Bretz, K. Tardy, and B. Barnett. 2013. Idaho supplementation studies brood year 2010 synthesis report. Annual progress report to Bonneville Power Administration. Project number 1989-098-00. Portland, Oregon. Idaho Department of Fish and Game Report 13-09.

Venditti, D.A., R. Kinzer, B. Barnett, K.A. Apperson, K. Tardy, M.P. Corsi, M. Belnap, and C. Bretz. 2015a. Idaho supplementation studies, Brood Year 2012 Synthesis Report August 1, 2012 – July 31, 2014. Annual progress report to Bonneville Power Administration, Project No. 198909800, Portland, Oregon. Idaho Department of Fish and Game Report 15-16.

Venditti, D.A., R.N. Kinzer, K.A. Apperson, B.B. Barnett, M. Belnap, T. Copeland, M.P. Corsi, W.T. Gross, L. Janssen, R. Santo, K. Tardy, A. Teton. 2015b. Idaho supplementation studies project completion report 1991-2014. Completion report to the U.S. Department of Energy, Bonneville Power Administration. Contract numbers (IDFG) 67577, (NPT) 67566, (SBT) 67980. Project number 1989-098-00. Idaho Department of Fish and Game Report 15-18.

Volkhardt, G.C., S.L. Johnson, B.A. Miller, T.E. Nickelson, and D.E. Seiler. 2007. Rotary screw traps and inclined plane screen traps. Pages 235-266 in D.H. Johnson, B.M. Shrier, J.S. O'Neal, J.A. Knutzen, X. Augerot, T.A. O'Neil, and T.N. Pearsons. Salmonid field protocols handbook: techniques for assessing status and trends in salmon and trout populations. American Fisheries Society, Bethesda, Maryland.

Wright, K. K., W. Schrader, L. Reinhardt, K. Hernandez, C. Hohman, and T. Copeland. 2015. Process and methods for assigning ages to anadromous salmonids from scale samples. Idaho Department of Fish and Game Report 15-03.

TABLES

Table 1. Major population groups and independent populations within the Snake River steelhead distinct population segment (DPS) and spring-summer Chinook Salmon evolutionary significant unit (ESU; ICBTRT 2003, 2005; NMFS 2011).

Snake River steelhead DPS	
Major population group	Population name
Lower Snake River	1. Tucannon River 2. Asotin Creek
Grande Ronde River	3. Lower Grande Ronde River 4. Joseph Creek 5. Wallowa River 6. Upper Grande Ronde River
Imnaha River	7. Imnaha River
Clearwater River	8. Lower Clearwater River 9. North Fork Clearwater River (extirpated) 10. Lolo Creek 11. Lochsa River 12. Selway River 13. South Fork Clearwater River
Salmon River	14. Little Salmon and Rapid Rivers 15. Chamberlain Creek 16. South Fork Salmon River 17. Secesh River 18. Panther Creek 19. Lower Middle Fork Salmon River 20. Upper Middle Fork Salmon River 21. North Fork Salmon River 22. Lemhi River 23. Pahsimeroi River 24. East Fork Salmon River 25. Upper Salmon River
Hells Canyon Tributaries (extirpated) [a]	

Table 1. Continued.

Snake River spring-summer Chinook Salmon ESU	
Major population group	Population name
Lower Snake River	1. Tucannon River 2. Asotin Creek (extirpated) [a]
Grande Ronde/Imnaha Rivers	3. Wenaha River 4. Lostine River 5. Minam River 6. Catherine Creek 7. Upper Grande Ronde River 8. Imnaha River 9. Big Sheep Creek (extirpated) [a] 10. Lookinglass Creek (extirpated) [a]
South Fork Salmon River	11. Little Salmon River 12. South Fork Salmon River Mainstem 13. Secesh River 14. East Fork South Fork Salmon River
Middle Fork Salmon River	15. Chamberlain Creek 16. Middle Fork Salmon River below Indian Creek 17. Big Creek 18. Camas Creek 19. Loon Creek 20. Middle Fork Salmon River above and including Indian Creek 21. Sulphur Creek 22. Bear Valley Creek 23. Marsh Creek
Upper Salmon River	24. Panther Creek (extirpated) [a] 25. North Fork Salmon River 26. Lemhi River 27. Salmon River Lower Mainstem below Redfish Lake 28. Pahsimeroi River 29. East Fork Salmon River 30. Yankee Fork Salmon River 31. Valley Creek 32. Salmon River Upper Mainstem above Redfish Lake
Dry Clearwater River (extirpated) [a]	33. Potlatch River (extirpated) [a] 34. Lapwai Creek (extirpated) [a] 35. Lawyer Creek (extirpated) [a] 36. Upper South Fork Clearwater River (extirpated) [a]
Wet Clearwater River (extirpated) [a]	37. Lower North Fork Clearwater River (extirpated) 38. Upper North Fork Clearwater River (extirpated) 39. Lolo Creek (extirpated) [a] 40. Lochsa River (extirpated) [a] 41. Meadow Creek (extirpated) [a] 42. Moose Creek (extirpated) [a] 43. Upper Selway River (extirpated) [a]

[a] Reintroduced fish exist in extirpated areas except the North Fork Clearwater River.

Table 2. Trap catch and emigrant abundance estimates with confidence intervals (CI) for juvenile Chinook Salmon, by calendar year, season and age from rotary screw traps (RST) operated the Salmon River and Clearwater River basins in Idaho during 2014 and 2015. Instances where no estimate was made are noted NE.

Major Population Group, RST location and PTAGIS code	Calendar year operation	Season and age	Trap Catch	Point Estimate	Lower 95% CI	Upper 95% CI
South Fork Salmon River						
Rapid River	2014	Spring age-0	2	NE	NE	NE
RAPIDR	2014	Summer age-0	9	NE	NE	NE
	2014	Fall age-0	30	NE	NE	NE
	2015	Spring age-1	67	NE	NE	NE
	2015	Spring age-0	12	NE	NE	NE
	2015	Summer age-0	35	NE	NE	NE
	2015	Fall age-0	48	NE	NE	NE
Upper South Fork	2014	Spring age-0	150	NE	NE	NE
Salmon River	2014	Summer age-0	2,597	10,790	9,507	12,366
KNOXB	2014	Fall age-0	3,717	10,372	9,626	11,135
	2015	Spring age-1	84	409	256	681
	2015	Spring age-0	4,084	NE	NE	NE
Lower South Fork Salmon River	2015	Summer age-0	237	4,859	2,563	9,738
SFSRKT	2015	Fall age-0	6,052	92,771	78,717	109,450
Middle Fork Salmon River						
Big Creek	2014	Spring age-0	43	NE	NE	NE
BIG2C	2014	Summer age-0	2,127	44,463	34,273	56,499
	2014	Fall age-0	2,595	72,995	56,398	98,067
	2015	Spring age-1	919	10,204	8,053	13,038
	2015	Spring age-0	528	NE	NE	NE
	2015	Summer age-0	5,378	147,141	118,749	183,209
	2015	Fall age-0	6,813	161,014	131,520	201,325
Lower Marsh Creek	2014	Spring age-0	1,672	43,472	22,464	90,272
MARTR2	2014	Summer age-0	8,347	134,524	116,092	160,663
	2014	Fall age-0	3,853	44,866	35,116	59,752
	2015	Spring age-1	331	2,065	1,585	2,688
	2015	Spring age-0	7,598	93,990	66,610	136,476
	2015	Summer age-0	25,823	358,854	263,053	534,874
	2015	Fall age-0	18,375	131,324	112,297	153,604

Table 2. Continued.

Major Population Group, RST location and PTAGIS code	Calendar year operation	Season and age	Trap Catch	Point Estimate	Lower 95% CI	Upper 95% CI
Upper Marsh Creek	2014	Spring age-0	4,816	39,606	31,713	50,047
MARTRP	2014	Summer age-0	22,104	81,198	76,885	85,723
	2014	Fall age-0	10,154	39,037	34,885	44,073
	2015	Spring age-1	181	824	615	1,143
	2015	Spring age-0	26,520	228,900	189,343	278,025
	2015	Summer age-0	18,960	84,538	75,760	95,359
	2015	Fall age-0	15,664	51,772	47,986	55,680
Upper Salmon River						
North Fork Salmon River	2015	Summer age-0	404	724	635	822
SALRNF	2015	Fall age-0	3,171	7,981	7,347	8,636
Lemhi River (weir)	2014	Spring age-0	494	2,100	1,713	2,564
LEMHIW	2014	Summer age-0	35	160	76	336
	2014	Fall age-0	1,777	12,330	10,658	14,515
	2015	Spring age-1	1,219	6,288	5,453	7,207
	2015	Spring age-0	2,912	21,971	18,900	25,338
	2015	Summer age-0	390	2,428	1,851	3,183
	2015	Fall age-0	6,083	40,761	36,317	45,906
Hayden Creek	2014	Spring age-0	72	NE	NE	NE
HAYDNC	2014	Summer age-0	117	536	367	802
	2014	Fall age-0	1,384	6,164	5,350	7,117
	2015	Spring age-1	251	1,160	884	1,518
	2015	Spring age-0	3,560	59,431	49,533	70,641
	2015	Summer age-0	531	1,617	1,359	1,906
	2015	Fall age-0	4,226	15,441	14,081	16,874
Upper Salmon River	2014	Spring age-0	273	5,289	2,707	10,773
SAWTRP	2014	Summer age-0	846	12,106	9,355	15,758
	2014	Fall age-0	997	7,719	6,390	9,421
	2015	Spring age-1	750	5,240	4,232	6,451
	2015	Spring age-0	798	17,546	10,187	26,729
	2015	Summer age-0	1,827	18,872	15,560	23,066
	2015	Fall age-0	1,938	14,717	12,696	17,119

Table 2. Continued.

Major Population Group, RST location and PTAGIS code	Calendar year operation	Season and age	Trap Catch	Point Estimate	Lower 95% CI	Upper 95% CI
Pahsimeroi River	2014	Spring age-0	995	6,377	5,243	7,850
PAHTRP	2014	Summer age-0	94	2,209	779	3,525
	2014	Fall age-0	595	5,991	4,664	7,813
	2015	Spring age-1	641	3,486	3,231	4,678
	2015	Spring age-0	9,759	33,672	31,686	35,701
	2015	Summer age-0	980	5,290	4,384	6,413
	2015	Fall age-0	1,418	18,806	14,528	24,491
Dry Clearwater River						
Crooked River	2014	Spring age-0	0	NE	NE	NE
CROTRP	2014	Summer age-0	49	267	143	502
	2014	Fall age-0	10	55	7	55
	2015	Spring age-1	59	300	173	531
	2015	Spring age-0	0	NE	NE	NE
	2015	Summer age-0	1	NE	NE	NE
	2015	Fall age-0	58	NE	NE	NE
Red River	2014	Spring age-0	0	NE	NE	NE
REDTRP	2014	Summer age-0	56	NE	NE	NE
	2014	Fall age-0	504	3,331	2,474	4,816
	2015	Spring age-1	889	12,772	9,114	18,748
American River	2014	Spring age-0	0	NE	NE	NE
AMERR	2014	Summer age-0	0	NE	NE	NE
	2014	Fall age-0	1,266	5,153	4,438	6,125
	2015	Spring age-1	778	3,162	2,596	4,127
Wet Clearwater River						
Fish Creek	2014	Spring age-0	0	NE	NE	NE
FISHTRP	2014	Summer age-0	4	NE	NE	NE
	2014	Fall age-0	51	NE	NE	NE
	2015	Spring age-1	1	NE	NE	NE
	2015	Spring age-0	9	NE	NE	NE
	2015	Summer age-0	3	NE	NE	NE
	2015	Fall age-0	16	NE	NE	NE
Colt Killed Creek	2014	Spring age-0	37	NE	NE	NE
COLTKC	2014	Summer age-0	18	NE	NE	NE
	2014	Fall age-0	220	1,175	858	1,626
Crooked Fork Creek	2014	Spring age-0	51	NE	NE	NE
CFCTRP	2014	Summer age-0	144	1080	614	1,935
	2014	Fall age-0	2,653	13,519	12,118	15,048

Table 3. Brood year (BY) 2013 emigrant abundance, survival to Lower Granite Dam, and smolt abundance at Lower Granite Dam (LGR) for juvenile Chinook Salmon PIT tagged at rotary screw traps (RST) in the Salmon River and Clearwater River basins, Idaho. Seasons with insufficient emigrant catch or PIT tag detections in the hydrosystem for estimation are designated NE.

Major Population Group, RST location and PTAGIS code	Season and age	Emigrant abundance at RST	Number PIT tagged at RST	Survival rate to LGR (SE)	Smolt abundance to LGR
South Fork Salmon River					
Upper South Fork	Spring age-0	NE	1	NE	NE
Salmon River	Summer age-0	10,790	1,083	0.144 (0.027)	1,554
KNOXB	Fall age-0	10,372	1,905	0.217 (0.027)	2,251
	Spring age-1	409	83	NE	NE
	BY 2013 Total	**21,570**	**3,072**		**3,805**
Middle Fork Salmon River					
Big Creek	Spring age-0	NE	0	NE	
BIG2C	Summer age-0	44,463	1,088	0.176 (0.055)	7,825
	Fall age-0	72,995	1,744	0.281 (0.047)	20,512
	Spring age-1	10,204	804	0.462 (0.089)	4,714
	BY 2013 Total	**127,662**	**3,636**		**33,051**
Lower Marsh Creek	Spring age-0	43,472	207	0.080 (0.019)	3,478
MARTR2	Summer age-0	134,524	3768	0.167 (0.030)	22,466
	Fall age-0	44,866	847	0.182 (0.039)	8,166
	Spring age-1	2,065	311	0.256 (0.079)	529
	BY 2013 Total	**224,927**	**5,133**		**34,638**
Upper Marsh Creek	Spring age-0	39,606	550	0.129 (0.041)	5,109
MARTRP	Summer age-0	81,198	4,984	0.151 (0.018)	12,261
	Fall age-0	39,037	919	0.469 (0.231)	18,308
	Spring age-1	824	181	0.299 (0.129)	246
	BY 2013 Total	**160,665**	**6,634**		**35,925**
Upper Salmon River					0
Lemhi River weir	Spring age-0[a]	2,100	356	0.365 (0.104)	767
LEMHIW	Summer age-0	160	31	NE	
	Fall age-0	12,330	1,641	0.298 (0.043)	3,674
	Spring age-1	6,288	941	0.820 (0.160)	5,156
	BY 2013 Total	**20,877**	**2,969**		**9,597**
Hayden Creek	Spring age-0	NE	0	NE	
HAYDNC	Summer age-0	536	107	NE	
	Fall age-0	6,164	1,235	0.260 (0.044)	1,603
	Spring age-1	1,160	244	0.371 (0.083)	430
	BY 2013 Total	**7,860**	**1,586**		**2,033**
Upper Salmon River	Spring age-0	5,289	154	0.018 (0.018)	95
SAWTRP	Summer age-0	12,106	786	0.132 (0.053)	1,598
	Fall age-0	7,719	750	0.118 (0.022)	911
	Spring age-1	5,240	698	0.717 (0.209)	3,757
	BY 2013 Total	**30,354**	**2,388**		**6,361**
Pahsimeroi River	Spring age-0[a]	6,377	595	0.410 (0.063)	2,614
PAHTRP	Summer age-0	2,209	93	0.057 (0.025)	125
	Fall age-0	5,991	583	0.126 (0.034)	754
	Spring age-1	3,486	641	0.429 (0.087)	1,495
	BY 2013 Total	**18,063**	**1,912**		**4,988**

Table 3. Continued.

Major Population Group, RST location and PTAGIS code	Season and age	Emigrant abundance at RST	Number PIT tagged at RST	Survival rate to LGR (SE)	Smolt abundance to LGR
Dry Clearwater River					
Crooked River	Spring age-0	NE	0	NE	NE
CROTRP	Summer age-0	267	49	NE	NE
	Fall age-0	55	10	NE	NE
	Spring age-1	300	59	NE	NE
	BY 2013 Total	**623**	**118**		**NE**
Red River	Spring age-0	NE	0	NE	
REDTRP	Summer age-0	NE	21	NE	
	Fall age-0	3331	373	0.021(0.008)	70
	Spring age-1	12,772	882	0.364(0.320)	4,649
	BY 2013 Total	**16,103**	**1,255**		**4,719**
American River	Spring age-0	NE	0	NE	
AMERR	Summer age-0	NE	11	NE	
	Fall age-0	5,153	759	0.030(0.014)	155
	Spring age-1	3,162	776	0.075(0.010)	237
	BY 2013 Total	**8,315**	**1,546**		**392**
Wet Clearwater River					
Colt Killed Creek	Spring age-0	NE	0	NE	
COLTKC	Summer age-0	NE	1	NE	
	Fall age-0	1,175	191	0.131(0.054)	154
	BY 2013 Total	**NE**	**192**		**154**
Crooked Fork Creek	Spring age-0	NE	0	NE	
CFCTRP	Summer age-0	1080	77	0	
	Fall age-0	13,519	1647	0.140(0.020)	1,893
	BY 2013 Total	**14,599**	**1,724**		**1,893**

[a] Survival estimates include fish that were detected as smolts in 2014 and 2015.

Table 4. Estimated productivity for juvenile Chinook Salmon for brood year (BY) 2013, expressed as both emigrants at rotary screw trap (RST) per female and smolts at Lower Granite Dam (LGR) per female, for the Salmon River and Clearwater River basins, Idaho. Instances where no estimates were made are noted NE. Streams with insufficient information for estimation were omitted.

Major Population Group and RST location	Emigrants at RST	Smolts to LGR	2013 Redds above RST	Emigrants / Female at RST	Smolts / Female at LGR
South Fork Salmon River					
Upper South Fork Salmon River	21,570	3,804	75	288	51
Middle Fork Salmon River					
Big Creek	127,662	33,051	72	1,773	459
Lower Marsh Creek	224,927	34,638	171	1,315	202
Upper Marsh Creek	160,665	35,921	87	1,847	413
Upper Salmon River					
Lemhi River (upper)	20,877	9,597	97	215	99
Hayden Creek	7,860	2,033	34	231	60
Upper Salmon River	30,354	6,361	56	542	114
Pahsimeroi River	37,369	3,486	60	623	25
Dry Clearwater River					
Crooked River	355	NE	3	118	NE
Red River	16,103	4,719	84	192	56
American River	8,315	392	116	72	3

Table 5. Catch and emigrant abundance estimates, with confidence intervals (CI) for juvenile steelhead >80 mm FL, by calendar year and season from rotary screw traps (RST) operated in the Salmon River and Clearwater River basins in Idaho during 2014 and 2015. Estimates were combined across seasons when seasonal recaptures were <7fish. Instances where no estimate was made are noted NE.

Population, RST location and PTAGIS site code	Year	Season	Catch	Estimate	Lower 95% CI	Upper 95% CI
Little Salmon River						
Rapid River	2014	Spring	296	1,974	1,474	2,731
RAPIDR	2014	Sum/Fall	228	1,898	1,260	2,933
	2015	Spring	364	1,924	1,550	2,410
	2015	Sum/Fall	289	2,278	1,568	3,350
South Fork Salmon River						
Upper South Fork Salmon River	2014	Spring	132	591	412	852
KNOXB	2014	Sum/Fall	3,641	19,659	18,258	21,322
	2015	Spring	197	932	692	1,277
	2015	Summer	1,233	NE	NE	NE
Lower South Fork Salmon River SFSRKT	2015	Sum/Fall	437	10,514	6,724	16,843
Lower Middle Fork Salmon River						
Big Creek	2014	Spring	69	2,429	28,182	56,549
BIG2C	2014	Sum/Fall	1,036	36,745		
	2015	Spring	111	4,786	28,593	62,780
	2015	Sum/Fall	1,087	36,719		
Upper Middle Fork Salmon River						
Lower Marsh Creek	2014	Spring	136	3,536	1,444	7,215
MARTR2	2014	Sum/Fall	444	8,571	5,520	13,872
	2015	Spring	70	966	414	2,139
	2015	Sum/Fall	205	6,765	2,640	11,963
Upper Marsh Creek	2014	Spring	78	1,541	564	2,726
MARTRP	2014	Sum/Fall	661	9,282	6,467	13,480
	2015	Spring	50	500	200	1,025
	2015	Sum/Fall	335	19,028	6,938	28,968
North Fork Salmon River						
North Fork Salmon River SALRNF	2015	Sum/Fall	2,768	9,864	8,762	11,085
Lemhi River						
Lemhi River (weir)	2014	Spring	588	3,722	2,982	4,518
LEMHIW	2014	Sum/Fall	871	6,458	5,331	7,664
	2015	Spring	1,346	5,703	5,138	6,428
	2015	Sum/Fall	1,675	15,893	13,157	19,000

Table 5. Continued.

Population, location and PTAGIS site code	Year	Season	Catch	Estimate	Lower 95% CI	Upper 95% CI
Hayden Creek	2014	Spring	394	3,189	2,370	4,319
HAYDNC	2014	Sum/Fall	519	4,119	3,071	5,529
	2015	Spring	544	4,174	3,287	5,313
	2015	Sum/Fall	1,022	7,888	6,436	9,762
Upper Salmon River mainstem						
Upper Salmon River	2014	Spring	277	4,053	2,560	6,571
SAWTRP	2014	Sum/Fall	181	3,982	1,925	8,367
	2015	Spring	263	7,043	3,615	13,737
	2015	Sum/Fall	277	5,586	3,250	9,887
Pahsimeroi River						
Pahsimeroi River	2014	Spring	510	6,845	4,998	9808
PAHTRP	2014	Sum/Fall	590	8,302	6,179	11,305
	2015	Spring	605	4,096	3,336	5,059
	2015	Sum/Fall	948	7,790	6,407	9,531
South Fork Clearwater River						
Crooked River	2014	Spring	207	929	681	1,308
CROTRP	2014	Sum/Fall	24	300	50	225
	2015	Spring	7	78	9	72
	2015	Sum/Fall	6			
Red River	2014	Spring	22	276	400	1340
REDTRP	2014	Sum/Fall	74	563		
	2015	Spring	73	2,701	429	1,332
American River	2014	Spring	33	NE	NE	NE
AMERR	2014	Sum/Fall	7	NE	NE	NE
	2015	Spring	75	2,850	456	1,440
Lower Clearwater Mainstem						
East Fork Potlatch River[a] POTREF	2014	Spring	880	10,536	8,446	13,260
	2015	Spring	950	15,482	12,133	20,111
Big Bear Creek (Potlatch River)[a] BIGBEC	2014	Spring	2,414	8,476	7,796	9,247
	2015	Spring	3,105	8,554	7,787	9,546
Lochsa River						
Crooked Fork Creek	2014	Spring	327	11,917	5,980	25,037
CFCTRP	2014	Sum/Fall	1,068	23,100	16,705	33,170
Colt Killed Creek	2014	Spring	143	4,118	1,760	9,072
COLTKC	2014	Sum/Fall	211	2,622	1,602	4,568
Fish Creek	2014	Spring	14	130	17,608	20,754
FISHTRP	2014	Sum/Fall	5,338	18,925		
	2015	Spring	127	829	530	1,354
	2015	Sum/Fall	5,521	20,911	19,370	22,666

[a] Catch and estimates include steelhead >60 mm FL.

Table 6. Seasonal and total age composition estimates of juvenile steelhead >80 mm FL in 2014 and 2015 from rotary screw traps (RST) operated in the Salmon River and Clearwater River basins in Idaho.

Population and RST location	Year	Season	Total Aged	Estimated emigrant abundance by age					
				Age 0	Age 1	Age 2	Age 3	Age 4	Age 5
Little Salmon River									
Rapid River	2014	Spring	177	0	123	513	1,015	301	22
	2014	Sum/Fall	177	11	536	1,265	86	0	0
	2015	Spring	280	0	110	227	1,436	151	0
	2015	Sum/Fall	234	58	915	1,149	156	0	0
South Fork Salmon River									
Upper South Fork Salmon River	2014	Spring	48	0	99	418	74	0	0
	2014	Sum/Fall	297	0	12,643	6,884	132	0	0
	2015	Spring	74	0	365	554	13	0	0
	2015	Sum/Fall	94	NE	NE	NE	NE	NE	NE
Lower Middle Fork Salmon River									
Big Creek	2014	Spring	52	0	514	607	981	327	0
	2014	Sum/Fall	273	0	12,787	18,709	4,980	269	0
	2015	Spring	103	0	697	1,022	2,509	558	0
	2015	Sum/Fall	173	0	12,735	19,739	4,245	0	0
Upper Middle Fork Salmon River									
Lower Marsh Creek	2014	Spring	121	0	205	2,542	672	117	0
	2014	Sum/Fall	165	0	3,013	5,298	260	0	0
	2015	Spring	66	0	88	527	322	29	0
	2015	Sum/Fall	169	40	2,922	3,723	40	40	0
Upper Salmon River mainstem									
Upper Salmon River	2014	Spring	152	0	1,547	2,506	0	0	0
	2014	Sum/Fall	59	1,080	2,565	337	0	0	0
	2015	Spring	154	0	4,940	1,829	274	0	0
	2015	Sum/Fall	152	2,682	2,756	147	0	0	0

Table 6. Continued**.**

Population and RST location	Year	Season	Total Aged	Estimated emigrant abundance by age					
				Age 0	Age 1	Age 2	Age 3	Age 4	Age 5
Pahsimeroi River									
Pahsimeroi River	2014	Spring	113	0	5,391	1,393	61	0	0
	2014	Sum/Fall	211	2,361	5,351	590	0	0	0
	2015	Spring	380	0	2,791	1,283	22	0	0
	2015	Sum/Fall	251	5,525	2,141	124	0	0	0
South Fork Clearwater River									
Crooked River	2014	Spring	200	0	0	655	265	9	0
	2014	Sum/Fall	22	0	0	177	123	0	0
	2015	Spring	6	7	20	13	39	0	0
	2015	Sum/Fall	6						
Red River	2014	Spring	22	0	0	251	25	0	0
	2014	Sum/Fall	71	0	198	309	56	0	0
	2015	Spring	69	0	0	1,174	1,449	78	0
Lower Clearwater River Mainstem									
East Fork Potlatch River[a]	2014	Spring	146	0	5,654	4,497	385	0	0
	2015	Spring	159	0	9,527	4,947	1,008	0	0
Big Bear Creek[a]	2014	Spring	162	0	942	7,011	523	0	0
	2015	Spring	156	0	2,742	4,880	923	0	0
Lochsa River									
Fish Creek	2014	Spring	10	0	0	26	91	13	0
	2014	Sum/Fall	297	0	4,206	13,318	1,402	0	0
	2015	Spring	84	0	49	376	355	49	0
	2015	Sum/Fall	202	104	9,627	10,455	725	0	0

[a] Estimates include steelhead >60 mm FL.

Table 7. Estimated productivity for juvenile steelhead emigrants by cohort, expressed as emigrants at rotary screw trap (RST) per female spawner, for populations with estimates of female spawner abundance in the Salmon River and Clearwater River basins, Idaho. Accounting is incomplete for brood years with dashes in any age column.

Population and RST Location	Cohort	Number of emigrants by age (years) Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Sum	Female Parents	Productivity
Little Salmon River	2006	--	1,444	1,954	1,268	261	0	4,927	71	69.4
	2007	169	744	1,915	1,662	314	0	4,804	21	228.8
	2008	102	491	889	1,135	235	73	2,925	46	63.6
Rapid River	2009	18	287	1,532	813	816	22	3,488	63	55.4
	2010	0	495	1,868	1,884	301	0	4,548	116	39.2
	2011	0	811	1,465	1,101	151	--	3,528	101	34.9
	2012	25	426	1,778	1,592	--	--	3,821	57	67.0
	2013	0	659	1,376	--	--	--	2,035	15	135.7
	2014	11	1,025	--	--	--	--	1,036	16	64.8
	2015	58	--	--	--	--	--	58	54	1.1
Lower Middle Fork Salmon River	2004	--	--	--	--	1,399	0	1,399	--	--
	2005	--	--	--	7,968	243	0	8,211	--	--
	2006	--	--	19,267	3,378	224	8	22,877	--	--
	2007	--	18,826	12,277	4,883	1,014	0	37,000	--	--
Big Creek	2008	308	5,950	14,442	6,482	84	0	27,266	--	--
	2009	67	9,166	19,462	5,901	703	0	35,299	--	--
	2010	0	7,926	17,957	5,601	268	0	31,752	594	53.5
	2011	0	3,202	15,009	4,979	0	--	23,190	478	48.5
	2012	84	19,332	18,711	4,245	--	--	42,372	259	163.6
	2013	154	12,787	19,740	--	--	--	32,681	307	106.5
	2014	0	12,734	--	--	--	--	12,734	139	91.6
	2015	0	--	--	--	--	--	0	530	0.0
Lower Clearwater River	2005	0	3,115	5,542	72	0	0	8,729	154	56.7
	2006	3	2,366	2,328	879	0	0	5,576	23	242.4
	2007	0	3,088	4,328	241	0	0	7,657	80	95.7
Big Bear Creek	2008	40	1,348	6,092	168	0	0	7,648	47	162.7
	2009	0	3,749	3,332	277	0	0	7,358	61	120.6
	2010	13	336	6,539	1,049	0	0	7,937	151	52.6
	2011	0	4,209	11,106	523	0	--	15,838	57	277.9
	2012	30	10,494	7,011	932	--	--	18,467	216	85.5
	2013	0	942	4,880	--	--	--	5,822	67	86.9
	2014	0	2,742	--	--	--	--	2,742	138	19.9
	2015	0	--	--	--	--	--	0	61	0.0

Table 7. Continued.

Population and RST location	Cohort	Number of emigrants by age (years) Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Sum	Female Parents	Productivity
East Fork Potlatch River	2008	205	9,537	6,671	76	0	0	16,489	50	329.8
	2009	20	22,282	3,657	635	0	0	26,594	43	618.5
	2010	790	10,592	2,573	660	0	0	14,615	57	256.4
	2011	0	9,209	5,921	385	0	--	15,515	N/A[a]	N/A
	2012	430	33,743	4,497	1,008	--	--	39,678	57	696.1
	2013	49	5,654	4,947	--	--	--	10,650	50	213.0
	2014	0	9,527	--	--	--	--	9,527	40	238.2
	2015	0	--	--	--	--	--	0	48	0.0
Lochsa River	1995	--	8,614	8,693	1,944	115	0	19,366	37	523.4
	1996	0	5,144	9,088	1,684	141	0	16,057	26	617.6
Fish Creek	1997	112	6,512	10,425	1,928	86	0	19,063	13	1,466.4
	1998	58	11,840	13,225	2,964	49	0	28,136	46	611.7
	1999	384	9,223	18,137	1,868	31	0	29,643	62	478.1
	2000	146	9,882	6,591	1,987	0	0	18,606	19	979.3
	2001	278	10,179	22,772	1,598	0	0	34,827	57	611.0
	2002	0	19,994	21,751	2,386	0	0	44,131	163	270.7
	2003	504	19,615	22,792	2,638	172	0	45,721	241	189.7
	2004	325	26,594	16,257	2,168	76	0	45,420	129	352.1
	2005	1,491	11,225	12,408	1,367	97	0	26,588	82	324.2
	2006	379	9,323	9,762	1,468	173	0	21,105	74	285.2
	2007	56	4,742	10,662	1,551	0	0	17,011	49	347.2
	2008	0	6,188	12,152	1,218	0	0	19,558	87	224.8
	2009	60	16,407	31,484	3,088	120	0	51,159	157	325.9
	2010	0	15,899	19,405	2,627	13	0	37,944	131	289.6
	2011	0	8,207	25,570	1,492	49	--	35,318	398	88.7
	2012	73	8,238	13,344	1,081	--	--	22,736	126	180.4
	2013	0	4,205	10,831	--	--	--	15,036	71	211.8
	2014	0	9,676	--	--	--	--	9,676	38	254.6
	2015	105	--	--	--	--	--	105	348	0.3

[a] Weir was compromised and no reliable estimate of female parents could be produced.

FIGURES

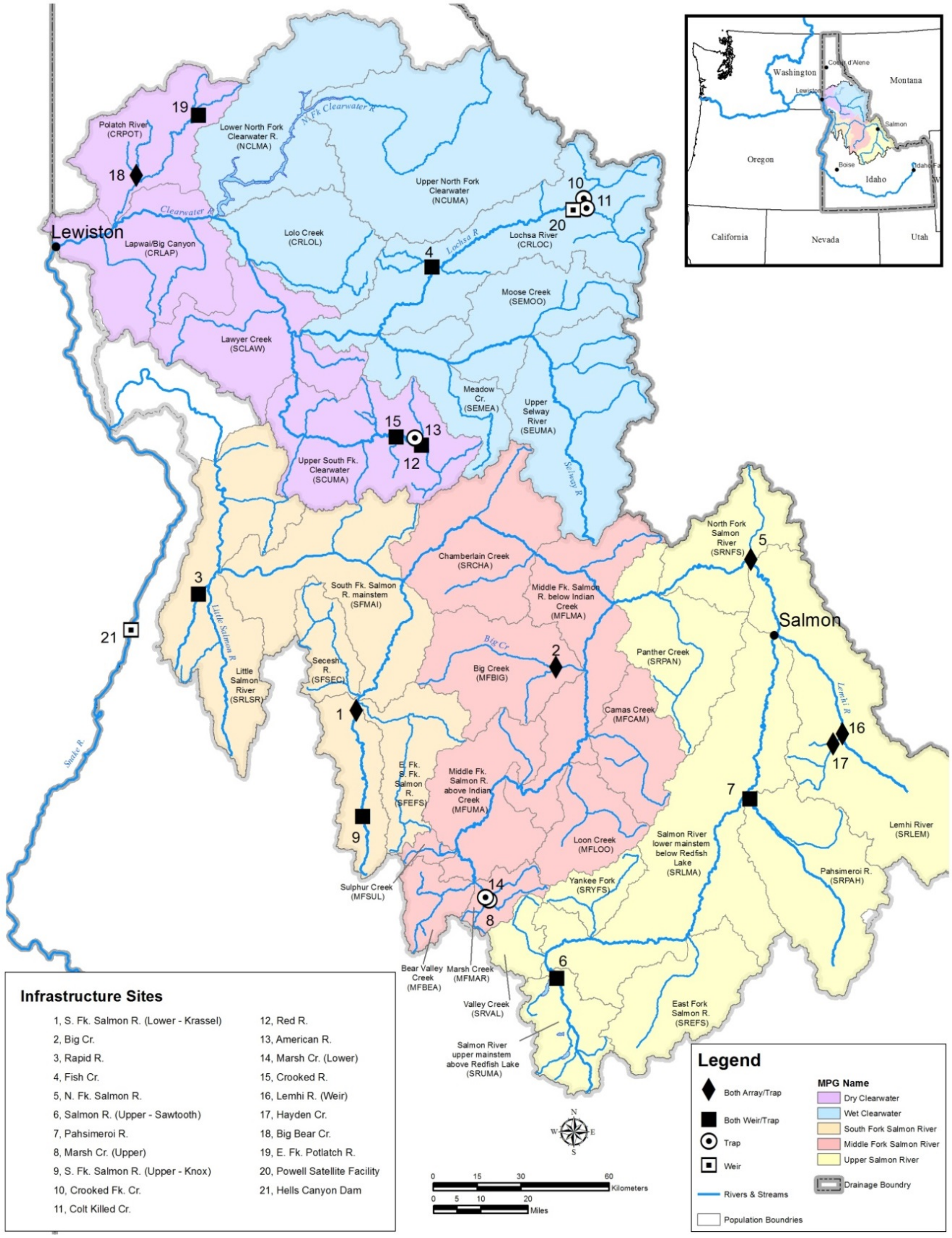

Figure 1. Location of rotary screw traps, weirs, and PIT arrays used by IDFG during 2014-2015 with reference to spring/summer Chinook Salmon population structure. Numbers correspond to infrastructure sites in the lower left inset. Chinook Salmon major population groups are highlighted and independent populations are delineated.

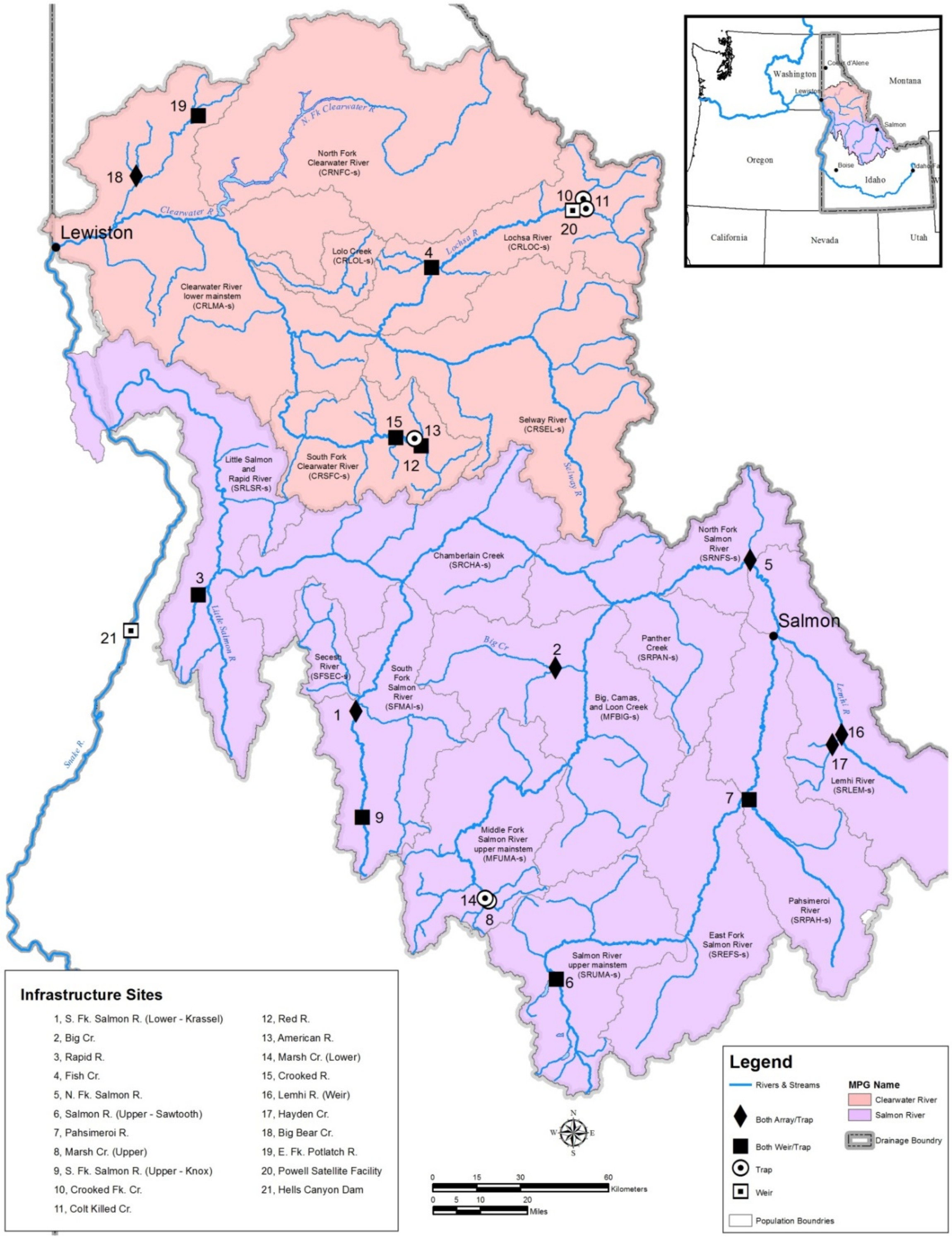

Figure 2. Location of rotary screw traps, weirs, and PIT arrays used by IDFG during 2014-2015 with reference to steelhead population structure. Numbers correspond to infrastructure sites in the lower left inset. Steelhead major population groups are highlighted and independent populations are delineated.

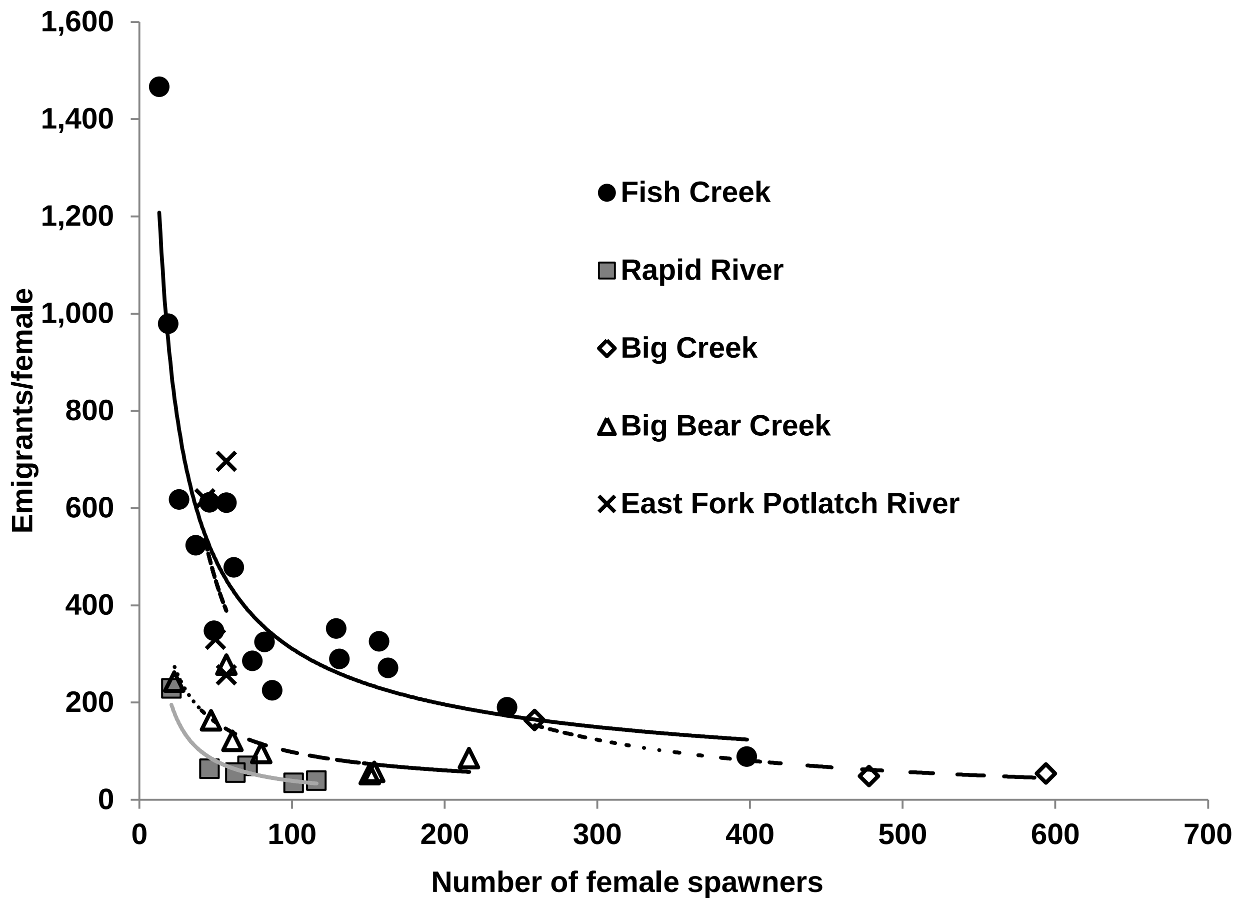

Figure 3. Relationship between juvenile productivity (emigrants/female spawner) and adult female spawner abundance for steelhead populations from Big Bear Creek (brood years 2005-2012), East Fork Potlatch River (brood years 2008-2010, 2012), Fish Creek (brood years 1995-2011), Rapid River (brood years 2006-2011), and Big Creek (brood years 2010-2012). Trend lines fit with a power function are shown for each data set.

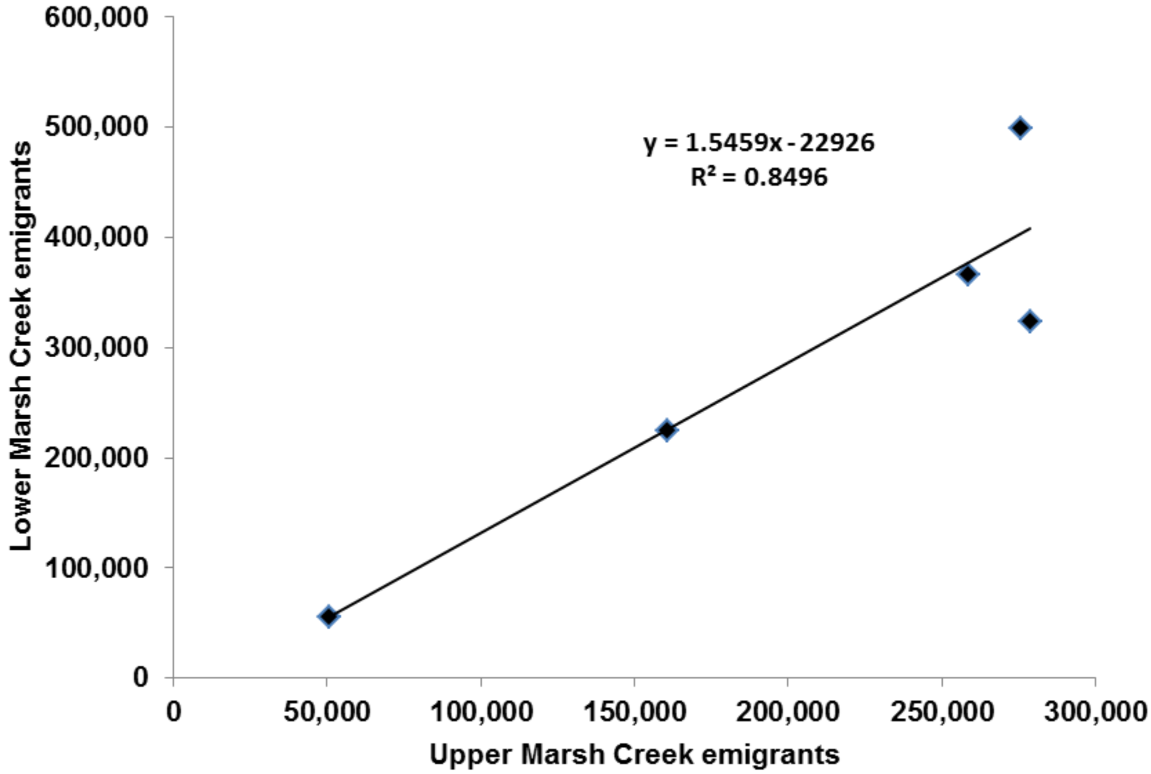

Figure 4. A comparison of total brood year Chinook Salmon emigrant estimates for BY 2009-2013 at the two traps on Marsh Creek. A simple regression shows the relationship of estimates between the two locations.

APPENDICES

Appendix A. Rotary screw traps operated by Idaho Department of Fish and Game to monitor Chinook Salmon and steelhead juvenile emigrants in Idaho. Major population group (MPG) and population for each species are identified. Funding projects include Idaho Steelhead Monitoring and Evaluation Studies (ISMES), Idaho Natural Production Monitoring and Evaluation Project (INPMEP), Idaho Supplementation Studies (ISS), Potlatch River and Lemhi River Intensively Monitored Watershed (IMW). History of operation and plans for future operation of each trap is provided.

Trap location (PTAGIS code)	**Chinook Salmon MPG /** *population*	**Steelhead Trout MPG /** *population*	**Funding project**	**Year of initial operation**	**Operation Plan**
Salmon River Basin					
Rapid River (RAPIDR)	**South Fork Salmon River /** *Little Salmon River*	**Salmon River /** *Little Salmon and Rapid Rivers*	ISMES	2007	To be operated indefinitely
Upper South Fork Salmon River (KNOXB)	**South Fork Salmon River /** *South Fork Salmon River*	**Salmon River** / *South Fork Salmon River*	ISS / INPMEP	1992	Discontinued June 30, 2015
Lower South Fork Salmon River (SFSRKT)	**South Fork Salmon River /** *South Fork Salmon River*	**Salmon River** / *South Fork Salmon River*	INPMEP	2015	To be operated indefinitely
Big Creek (BIG2C)	**Middle Fork Salmon River /** *Big Creek*	**Salmon River** / *Lower Middle Fork Salmon River*	ISMES	2007	To be operated indefinitely
Lower Marsh Creek (MARTR2)	**Middle Fork Salmon River** / *Marsh Creek*	**Salmon River /** *Upper Middle Fork Salmon River*	ISS / INPMEP	2009	To be operated indefinitely
Upper Marsh Creek (MARTRP)	**Middle Fork Salmon River /** *Marsh Creek*	**Salmon River** / *Upper Middle Fork Salmon River*	ISS / INPMEP	1992	Discontinued at end of 2015
North Fork Salmon River (SALRNF)	**Upper Salmon River /** *North Fork Salmon River*	**Salmon River /** *North Fork Salmon River*	ISMES	2015	To be operated indefinitely
Lemhi River (LEMHIW)	**Upper Salmon River /** *Lemhi River*	**Salmon River /** *Lemhi River*	Lemhi IMW	1992	To be operated indefinitely
Hayden Creek (HAYDNC)	**Upper Salmon River /** *Lemhi River*	**Salmon River /** *Lemhi River*	Lemhi IMW	2006	To be operated indefinitely
Upper Salmon River (SAWTRP)	**Upper Salmon River /** *Upper Salmon River mainstem*	**Salmon River** / *Upper Salmon River mainstem*	ISS / INPMEP	1992	To be operated indefinitely
Pahsimeroi River (PAHTRP)	**Upper Salmon River** / *Pahsimeroi River*	**Salmon River** */ Pahsimeroi River*	ISS / INPMEP	1992	To be operated indefinitely

Appendix A. Continued.

Trap location (PTAGIS code)	Chinook Salmon MPG / *population*	Steelhead Trout MPG / *population*	Funding project	Year of initial operation	Operation Plan
Clearwater River Basin					
Big Bear Creek (BIGBEC)	**Dry Clearwater River /** *Upper South Fork Clearwater River*	**Clearwater River /** *Lower Clearwater Mainstem*	Potlatch IMW	2004	To be operated indefinitely
East Fork Potlatch River (POTREF)	**Dry Clearwater River /** *Upper South Fork Clearwater River*	**Clearwater River /** *Lower Clearwater Mainstem*	Potlatch IMW	2007	To be operated indefinitely
Crooked River (CROTRP)	**Dry Clearwater River /** *Upper South Fork Clearwater River*	**Clearwater River /** *South Fork Clearwater River*	ISS / ISMES	1990	To be operated indefinitely
Red River (REDTRP)	**Dry Clearwater River /** *Upper South Fork Clearwater River*	**Clearwater River /** *South Fork Clearwater River*	ISS / INPMEP	1994	Discontinued June 30, 2015
American River (AMERR)	**Dry Clearwater River /** *Upper South Fork Clearwater River*	**Clearwater River /** *South Fork Clearwater River*	ISS / INPMEP	2000	Discontinued June 30, 2015
Fish Creek (FISHTRP)	**Wet Clearwater River /** *Lochsa River*	**Clearwater River** / *Lochsa River*	ISMES	1995	To be operated indefinitely
Colt Killed Creek (COLTKC)	**Wet Clearwater River /** *Lochsa River*	**Clearwater River** / *Lochsa River*	ISS / INPMEP	1998	Discontinued at end of 2014
Crooked Fork Creek (CFCTRP)	**Wet Clearwater River /** *Lochsa River*	**Clearwater River** / *Lochsa River*	ISS / INPMEP	1992	Discontinued at end of 2014

Appendix B. Rotary screw trap operations in the Salmon River and Clearwater River basins for 2014 and 2015, with brief summary of operations and logistical issues that possibly affected estimation of juvenile Chinook Salmon and steelhead emigrants.

		Trap Operation		
Location (PTAGIS site code)	**Year**	**Date range (mm/dd)**	**Total days operated / total days in date range**	**Operation summary and logistical issues**
Salmon River basin				
Rapid River (RAPIDR)	2014	04/19 – 11/06	161/201	Several inoperative periods throughout spring and summer, ranging from 4 to 15 days for high flows; intermittent operation during spring smolt release
	2015	04/20 – 11/07	187/202	Intermittent operation during spring smolt release; low snowpack allowed consistent operation for most of year.
Upper South Fork Salmon River (KNOXB)	2014	03/14 – 11/24	141/256	Not operated 4/23 – 6/12 due to high flows; frequently not operated after 8/6 due to high suspended sediment from upstream mudslide.
	2015	03/02 – 06/26	84/117	Not operated for 38 days during spring; low catch likely due to 2014 mudslide; trap permanently removed from site on July 1
Lower South Fork Salmon River (SFSRKT)	2015	07/31 – 11/08	101/101	2015 was the initial deployment of a trap at this site
Big Creek (BIG2C)	2014	03/13 – 11/11	177/244	Not operated for 61 days throughout season, largely due to a recurring mudslide upstream caused frequent high suspended sediment
	2015	03/12 – 11/09	213/243	Low snowpack allowed more consistent operation in spring than typical
Lower Marsh Creek (MARTR2)	2014	03/22 – 10/31	206/224	Consistent operation, not operated for only 6 days due to high or turbid water
	2015	03/21 – 11/02	220/227	Consistent operation, not operated for only 2 days due to high water
Upper Marsh Creek (MARTRP)	2014	03/22 – 10/31	215/224	Consistently operated throughout season
	2015	03/21 – 11/02	222/227	Consistently operated throughout season
North Fork Salmon River (SALRNF)	2015	08/11 – 11/15	91/97	2015 was the initial deployment of a trap at this site; high trapping efficiency required trap adjustment; floating detritus demanded frequent daily maintenance to keep trap operating.
Lemhi River Weir (LEMHIW)	2014	03/11 – 11/12	245/247	Consistent operation, not operated for only 2 days.
	2015	02/27 – 11/24	258/271	Consistent operation, not operated for only 3 days.
Hayden Creek (HAYDNC)	2014	03/12 – 11/12	246/246	Trap not operated for 34 days due to high flows
	2015	02/27 – 11/21	203/268	Trap not operated for 24 days due to high flows

Appendix B. Continued.

Location (PTAGIS site code)	Year	Trap Operation: Date range (mm/dd)	Trap Operation: Total days operated / total days in date range	Operation summary and logistical issues
Upper Salmon River (SAWTRP)	2014	03/22 – 10/31	222/224	Consistent operation, not operated for only 2 days
	2015	03/21 – 11/02	218/227	Consistent operation, not operated for 6 days in July due to limited access caused by hatchery road construction.
Pahsimeroi River (PAHTRP)	2014	02/27 – 11/11	245/258	Trap not operated 12 days in April due to hatchery releases
	2015	02/24 – 11/30	246/280	Trap not operated most of April due to hatchery releases; floating debris in fall required frequent maintenance.
Clearwater River basin				
Big Bear Creek (BIGBEC)	2014	02/25 – 05/27	92/92	Consistent operation through season
	2015	02/01 – 06/03	123/123	Trap not operated for 9 days due to low water
East Fork Potlatch River (POTREF)	2014	03/18 – 06/03	78/78	Consistent operation through season
	2015	02/24 – 06/03	100/100	Consistent operation through season
Crooked River (CROTRP)	2014	03/18 – 11/04	163/232	Trap not operated for 7 days in spring due to high water, 14 days due to lack of personnel, and 48 days due to low water.
	2015	03/23 – 10/20	181/212	May have missed most emigrants due to high water prior to operation. Trap not operated for 14 days due to lack of personnel, and 16 days due low water.
Red River (REDTRP)	2014	04/16 – 11/04	179/203	Trap not operated for 8 days in spring due to high water, 14 days due to lack of personnel, and 2 days due low water.
	2015	03/23 – 06/30	100/100	Consistent operation through season. May have missed most emigrants due to high water prior to operation; trap permanently removed from site on July 1.
American River (AMERR)	2014	03/19 – 11/11	206/238	Trap not operated 4 days in spring due to high water, 16 days due to lack of personnel, and 5 days due low water.
	2015	03/23 – 06/30	99/100	Consistent operation through season. May have missed most emigrants due to high water prior to operation; trap permanently removed from site on July 1
Fish Creek (FISHTRP)	2014	03/24 – 11/07	200/229	Trap not operated 20 days due to high spring water and heavy rain; warm temperatures prevented tagging 4 days in summer.
	2015	03/18 – 11/07	224/235	Consistent operation through season

Appendix B. Continued.

Location (PTAGIS site code)	Year	Trap Operation: Date range (mm/dd)	Trap Operation: Total days operated / total days in date range	Operation summary and logistical issues
Colt Killed Creek (COLTKC)	2014	03/25 – 11/05	188/226	Not operated for 40 days in spring due to high water; trap was permanently removed from site at end of 2014 season.
Crooked Fork Creek (CFCTRP)	2014	03/25 – 11/05	194/226	Not operated for 40 days in spring due to high water; trap was permanently removed from site at end of 2014 season.

Appendix C. Seasonal catch of juvenile steelhead <80 mm FL for 2014 and 2015 from rotary screw traps operated in streams in Idaho. Dashes indicate catch was accounted for in emigrant abundance estimates (Table 5).

Population, location and PTAGIS site code	Year	Season	Catch
Little Salmon River			
Rapid River	2014	Spring	0
RAPIDR	2014	Sum/Fall	0
	2015	Spring	0
	2015	Sum/Fall	0
South Fork Salmon River			
Upper South Fork Salmon River	2014	Spring	188
KNOXB	2014	Sum/Fall	1,116
	2015	Spring	0
	2015	Summer	0
Lower South Fork Salmon River	2015	Sum/Fall	0
SFSRKT			
Lower Middle Fork Salmon River			
Big Creek	2014	Spring	105
BIG2C	2014	Sum/Fall	139
	2015	Spring	0
	2015	Sum/Fall	0
Upper Middle Fork Salmon River			
Lower Marsh Creek	2014	Spring	149
MARTR2	2014	Sum/Fall	147
	2015	Spring	38
	2015	Sum/Fall	110
Upper Marsh Creek	2014	Spring	171
MARTRP	2014	Sum/Fall	220
	2015	Spring	60
	2015	Sum/Fall	485
North Fork Salmon River			
North Fork Salmon River	2015	Sum/Fall	0
SALRNF			
Lemhi River			
Lemhi River (weir)	2014	Spring	0
LEMHIW	2014	Sum/Fall	4
	2015	Spring	0
	2015	Sum/Fall	0
Hayden Creek	2014	Spring	0
HAYDNC	2014	Sum/Fall	98
	2015	Spring	0
	2015	Sum/Fall	0
Upper Salmon River mainstem			
Upper Salmon River	2014	Spring	41
SAWTRP	2014	Sum/Fall	121
	2015	Spring	36

Appendix C. Continued.

Population, location and PTAGIS site code	Year	Season	Catch
	2015	Sum/Fall	347
Pahsimeroi River			
Pahsimeroi River	2014	Spring	61
PAHTRP	2014	Sum/Fall	58
	2015	Spring	0
	2015	Sum/Fall	0
South Fork Clearwater River			
Crooked River	2014	Spring	0
CROTRP	2014	Sum/Fall	0
	2015	Spring	0
	2015	Sum/Fall	0
Red River	2014	Spring	0
REDTRP	2014	Sum/Fall	0
	2015	Spring	0
American River	2014	Spring	0
AMERR	2014	Sum/Fall	0
	2015	Spring	0
Lower Clearwater Mainstem			
East Fork Potlatch River POTREF	2014	Spring	--
	2015	Spring	--
Big Bear Creek (Potlatch River) BIGBEC	2014	Spring	--
	2015	Spring	--
Lochsa River			
Crooked Fork Creek	2014	Spring	7
CFCTRP	2014	Sum/Fall	30
Colt Killed Creek	2014	Spring	6
COLTKC	2014	Sum/Fall	14
Fish Creek	2014	Spring	0
FISHTRP	2014	Sum/Fall	0
	2015	Spring	0
	2015	Sum/Fall	0

Appendix D. 2016 Plan for operation of rotary screw traps by Idaho Department of Fish and Game.

REVISED 4-16-16

2016 Plan for IDFG Screw Traps and Biosampling Adult Steelhead and Chinook Salmon Released at Weirs

Bill Schrader, Brett Bowersox, Jeff DiLuccia, Greg Schoby, Dale Allen, and Tim Copeland, IDFG

The following plan was initially drafted in 2014 to facilitate the ISS project closeout, transfer equipment to other projects, prepare 2015 budgets for Bonneville Power Administration, and complete NOAA 4(d) Research Permit applications. Here it is updated for 2016. The plan describes IDFG screw trapping and biosampling of adult steelhead and Chinook salmon released at hatchery and research weirs. Operation of screw traps and weirs forms the basis for “Fish-in and Fish-out” population monitoring designed to track population level abundance and productivity and fish response to habitat improvement projects. We do not anticipate approval of Hatchery and Genetic Management Plans (HGMPs) until at least 2016, and therefore all sampling of wild and integrated adults at hatchery weirs will be conducted under a 4(d) permit; this permit will also cover non-hatchery weirs and screw traps (outside the SMP/CSS traps) operated by IDFG in tributaries of the Clearwater River and Salmon River basins. The Lemhi River weir will operate under a separate Section 10 permit. General contracting and permitting deadlines are as follows: BPA contracting 9/30/15 and NOAA Section 4(d) permitting 10/7/15.

The contracts and operations plan for IDFG screw traps is part of the closeout of ISS and transfer of most traps to other BPA projects that started in 2015 (Table 1; Figures 1 and 2). IDFG trap operators include Brian Knoth (Potlatch IMW), Jeff DiLuccia (Lemhi IMW), and Scott Putnam (Idaho SMP/CSS) as well as Idaho steelhead Monitoring and Evaluation Studies (ISMES) and Idaho Natural Production Monitoring and Evaluation (INPMEP) staff from Nampa Research and Regions 2, 3M, and 7 as indicated. Outside the Lemhi River and SMP/CSS traps, sampling will include collecting scales for ageing steelhead; tissue samples will be collected for genetic analysis of effective population size in steelhead (Fish Creek, Rapid River, Big Creek, Pahsimeroi River) and Chinook salmon (Big Creek, Marsh Creek). Ageing for both species in the Lemhi River is conducted separately by Quantitative Consultants Inc. Outside the Lemhi River and SMP/CSS traps, trap operators will be responsible to provide estimates of abundance and survival to Lower Granite Dam for each species at each screw trap.

The biosampling plan refers to sampling wild or integrated hatchery steelhead and Chinook salmon adults trapped and released at hatchery and research weirs (Table 2; Figures 1 and 2). Sampling will include collecting scales for ageing wild steelhead and collecting tissue samples for genetic analysis of all anadromous fish released at IDFG weirs. Although fish at hatchery racks are all handled due to normal hatchery operations, biosampling needs to be permitted through the 4(d) process until HGMPs are approved.

Appendix D. Table 1. Plan for contracts and operations of IDFG screw traps in 2016.

Map #	Trap	Subbasin	2015 Juvenile Permit	Migratory Year 2016 Status	Calendar Year 2016 Contract and Operator	Screw Trap Comments
IDFG Nampa Research Projects						
17	Sawtooth	Upper Salmon	19132	OPERATE	INPMEP-Carl Stiefel	
13	Pahsimeroi River	Upper Salmon	19132	OPERATE	INPMEP-Matt Belnap	Move to diversion intake
TBD	North Fork Salmon River	Upper Salmon	19132	OPERATE	ISMES-Matt Belnap	
11	Marsh Creek Upper	MF Salmon	19132	DISCONTINUE	N/A	Stored at Nampa Research
12	Marsh Creek Lower	MF Salmon	19132	OPERATE	INPMEP-Carl Stiefel	
3	Big Creek	MF Salmon	19132	OPERATE	ISMES-Kim Apperson	
16	Knox Bridge	SF Salmon	19132	DISCONTINUE	N/A	Moved to Krassel
TBD	Krassel	SF Salmon	19132	OPERATE	INPMEP-Kim Apperson	
14	Rapid River	Lower Salmon	19132	OPERATE	ISMES-Eric Stark	
4	Colt Killed Creek	Lochsa	19124	DISCONTINUE	N/A	Moved to NF Salmon
5	Crooked Fork Creek	Lochsa	19124	DISCONTINUE	N/A	Stored at Nampa Research
8	Fish Creek	Lochsa	19124	OPERATE	ISMES-Marika Dobos/Eric Stark	Transition to Region 2
TBD	Lochsa River Lower	Lochsa	19124	OPERATE	ISMES-Marika Dobos	Test operation of tandem trap
1	American River	SF Clearwater	19124	DISCONTINUE	N/A	Moved to tandem lower Lochsa trap
15	Red River	SF Clearwater	19124	DISCONTINUE	N/A	Moved to tandem lower Lochsa trap
6	Crooked River	SF Clearwater	19124	OPERATE	ISMES-Robert Hand	Steelhead monitoring, CSS PIT-tagging, kelt/habitat evaluation
31	Clear Creek	MF Clearwater	N/A	DISCONTINUE	N/A	Stored at Region 2
IDFG Potlatch IMW Project						
2	Big Bear Creek	Lower Clearwater	19124	OPERATE	Potlatch IMW-Brian Knoth	
7	EF Potlatch River	Lower Clearwater	19124	OPERATE	Potlatch IMW-Brian Knoth	
IDFG Lemhi IMW and ISEMP Projects						
10	Lemhi River Weir	Upper Salmon	19074	OPERATE	Lemhi IMW-Jeff DiLuccia	
9	Hayden Creek	Upper Salmon	19074	OPERATE	Lemhi IMW-Jeff DiLuccia	
25	Lemhi River L3AO	Upper Salmon	19074	OPERATE	QCI-Chris Beasley	Double check permitting authorization
IDFG Smolt Monitoring Project						
TBD	White Bird[(a)]	Lower Salmon	11-15-FPC-47	OPERATE	Idaho SMP/CSS-Scott Putnam	Permitted through FPC
TBD	Lewiston[(a)]	Lower Snake	11-15-FPC-47	OPERATE	Idaho SMP/CSS-Scott Putnam	Permitted through FPC

[(a)] White Bird and Lewiston are scoop and dipper traps, respectively, and not rotary screw traps.

Appendix D. Table 2. Plan for contracts and operations of IDFG adult weirs relative to sampling wild and integrated fish released at each weir in 2016. Scale and genetics sampling for steelhead and Chinook salmon are indicated.

IDFG Adult Weir (Map #)	Wild and Integrated Adult Sampling at Hatchery and Research Weirs							
	Steelhead				Spring-Summer Chinook Salmon			
	Collect Scales ?	Collect Genetics ?	2015 Adult Permit	2016 Contract & Operator	Collect Scales ?	Collect Genetics ?	2015 Adult Permit	2016 Contract & Operator
Sawtooth (17)	Yes	Yes	19132	ISMES-Sawtooth FH	No	Yes	19132	INPMEP-Sawtooth FH
EFSR (28)	Yes[(a)]	Yes	19132	ISMES-Sawtooth FH	N/A[(b)]	N/A[(b)]	N/A[(b)]	N/A[(b)]
Pahsimeroi (13)	Yes	Yes	19132	ISMES-Pahsimeroi FH	No	Yes	19132	INPMEP-Pahsimeroi FH
Lemhi River (TBD)	Yes	Yes	N/A	Lemhi IMW-Jeff Diluccia	No	Yes	N/A	Lemhi IMW-Jeff Diluccia
Challis Creek (TBD)	Yes	Yes	19132	Region 7-Matt Belnap	N/A	N/A	N/A	N/A
Iron Creek (TBD)	Yes	Yes	19132	Region 7-Matt Belnap	N/A	N/A	N/A	N/A
Carmen Creek (TBD)	Yes	Yes	19132	Region 7-Matt Belnap	N/A	N/A	N/A	N/A
Tower Creek (TBD)	Yes	Yes	19132	Region 7-Matt Belnap	N/A	N/A	N/A	N/A
Fourth of July Creek (TBD)	Yes	Yes	19132	Region 7-Matt Belnap	N/A	N/A	N/A	N/A
McCall SFSR (16)	Yes[(c)]	Yes[(c)]	19132	ISMES-Kim Apperson	No	Yes	19132	INPMEP-McCall FH
Rapid River (14)	Yes[(c)]	Yes[(c)]	19132	ISMES-Eric Stark	No	Yes	None	INPMEP-Rapid River FH
Hells Canyon Oxbow (TBD)	Yes	Yes	19124	ISMES-Oxbow FH	No	Yes	None	INPMEP-Oxbow FH
Powell (4, 5)	N/A[(c)]	N/A[(c)]	N/A	N/A	No	Yes	N/A[(d)]	INPMEP-Clearwater FH
Fish Creek (8)	Yes	Yes	19124	ISMES-Marika Dobos/Eric Stark	No	Yes	N/A[(d)]	ISMES-Marika Dobos/Eric Stark
Red River (15)	N/A[(c)]	N/A[(c)]	N/A	N/A	No	Yes	N/A[(d)]	INPMEP-Clearwater FH
Crooked River (6)	Yes[(c)]	Yes[(c)]	19124	ISMES-Robert Hand	No	Yes	N/A[(d)]	INPMEP-Clearwater FH
EF Potlatch River (7)	Yes	Yes	19124	Potlatch IMW-Brian Knoth	No	Yes	N/A[(d)]	Potlatch IMW-Brian Knoth

[(a)]) EFSR steelhead scales should be collected from all wild fish trapped; scales not needed from hatchery fish.

[(b)] EFSR hatchery rack not generally operated for Chinook broodstock collection; 2014 last year of biosampling for Captive Chinook project.

[(c)] Hatchery rack not generally operated for steelhead broodstock collection; opportunistic biosamples at McCall SFSR.

[(d)] Spring/summer Chinook are not listed in the Clearwater drainage and sampling them does not require a NMFS permit.

Appendix E. Summary of the 2015 trial operation of a tandem rotary screw trap in the Lochsa River in the Clearwater River basin, Idaho.

Lower Lochsa River Screw Trap

2015 Season Summary

Prepared by:

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December 2015

BACKGROUND

Steelhead trout *Oncorhynchus mykiss* populations have declined in the Snake River basin from historic levels. The decline has been brought about through a variety of anthropogenic factors including hydroelectric dams (Raymond 1988). Listing of steelhead under the Endangered Species Act (ESA) in 1997 has mandated recovery planning and monitoring of wild steelhead populations in Idaho. The Idaho Steelhead Monitoring and Evaluation (ISMES) project was initiated to address data gaps related to status assessments. A more recent work objective of the ISMES project is the operation of a screw trap on the main stem Lochsa River to provide information to assess the status of the Lochsa River wild steelhead population (Copeland et al. 2015). Monitoring juvenile steelhead emigrants on the main stem Lochsa River will supplement data collected from the screw trap and weir operated on Fish Creek (tributary of the Lochsa River) to provide a more comprehensive data set to assess juvenile emigration, migration timing, and factors influencing movement in the Lochsa River basin. Additionally, juvenile salmonids tagged at the Lochsa River screw trap will provide tag groups for annual estimates of smolt-to-adult return rates and juvenile survival through the hydroelectric system on the Columbia and Snake rivers as part of the goals for the Comparative Survival Study (McCann et al. 2015).

METHODS

Installation and permits

A five foot rotary screw trap was used to collect juvenile steelhead emigrants in the main stem Lochsa River. The site of the screw trap was located on the Lochsa River at Lowell, Idaho just upstream of where the Lochsa and Selway rivers meet (46.142759, -115.598049; Figure 1). As the first year of operations for this project, all applicable state and federal regulatory permits were obtained prior to implementation. The U.S. Forest Service determined there was no need for a conditional use permit since the trap was located on private ground and attached to a county bridge. Bonneville Power Administration (BPA) Environmental Compliance was completed for the project under the ESA and National Historic Preservation Act. The screw trap was engineered to be fixed to the 223 Road Bridge that crosses the Lochsa River (Figure 8). All engineering designs were completed and approved through the Idaho Department of Fish and Game (IDFG) engineering bureau. A winch system was operable from the bank that allowed the operator to move the screw trap longitudinally across the river. Specific design criteria and stress tolerances of the system are available through IDFG engineering.

Sampling and analysis

A standard operating protocol was followed to operate the screw trap and sample fish (PIT Tag Steering Committee 1999; Volkhardt et al. 2007). The screw trap was checked daily by the screw trap operator and all fish that were captured were identified to species and enumerated. Trout that were too small to be identified to species were categorized as age-0 trout. Juvenile steelhead, Chinook Salmon *O. tshawytscha* , and Coho Salmon *O. kisutch* were scanned and examined for previously inserted passive integrated transponder (PIT) tags or marks (i.e., fin clips), measured (fork length; mm), and weighed (g). Unmarked juvenile steelhead (>80 mm) and Chinook and Coho salmon that were >60 mm were inserted with a passive integrated transponder (PIT) tag. Fish that received PIT tags were held in totes for recovery and released approximately 500 m upstream of the screw trap in the littoral area on river left. All other fish were released downstream of the screw trap. Abundance of out-migrating juvenile steelhead and salmon was calculated using a Peterson mark-recapture estimator (Volkhardt et al. 2007):

$$N_i = \frac{\hat{n}_i \, M_i}{m_i} = n_i \hat{e}_i^{\,-1} \quad [1]$$

where

$$\hat{e}_i = \frac{m_i}{M_i} \quad [2]$$

and where
$\widehat{N}_i$ = Estimated number of downstream migrants during period ***i***
M_i = Number of fish marked and released during period ***i***
n_i = Number of fish captured during period ***i***
m_i = Number of marked fish captured during period ***i***
$\hat{e}_i$ = Estimated trap efficiency during period ***i***

RESULTS

The lower Lochsa River screw trap was installed on June 5 and operated until November 24 (115 d) in 2015. During the trapping season, the trap captured 3,952 fish comprised of 18 different species (Table 1). Redside shiners *Richardsonius balteatus* comprised 82% of the total catch and were the dominant species sampled. A total of 286 wild juvenile steelhead, Chinook and Coho salmon were captured during the 2015 trapping season. Of these, 220 were tagged with PIT tags including 51 steelhead, 168 Chinook Salmon, and one Coho Salmon (Table 2).

The fork length of PIT-tagged juvenile steelhead varied from 80–217 mm (mean = 133.8 mm) and mass varied from 4.8–104.3 g (mean = 30.4 g; Figure 3). For juvenile Chinook Salmon, fork length varied from 60–125 mm (mean = 80.9 mm) and mass varied from 2.0–27.1 g (mean = 5.9 g; Figure 3). Two PIT-tagged juvenile Chinook Salmon were the only salmonids recaptured at the Lochsa River screw trap during the season (Table 2). Therefore, abundance of out-migrating juvenile salmonids and trap efficiency could not be estimated for the 2015 trapping season.

Other salmonids that were captured during the trapping season included three Bull Trout *Salvelinus* confluentus that varied in length from 255–262 mm (mean = 258 mm), 23 Westslope Cutthroat Trout *O. clarkii lewisi* that varied in length from 124–410 mm (mean = 248 mm), and one resident Rainbow Trout (292 mm). One Bullhead Catfish *Ameiurus spp.* (190 mm) and one Smallmouth Bass *Micropterus dolomieu* (330 mm) were also captured. Four Pacific Lamprey *Entosphenus tridentatus* ammocetes were captured; including one found dead in the trap.

Catch rates of juvenile steelhead and Chinook Salmon fluctuated across the season and appeared to be associated with flow during the fall (Figure 4). In the early part of the trapping season (5 June–15 July), catch rates of juvenile salmonids were low (typically <3 fish per day). Although trap operations were not constant from 19 July–5 September, there were no juvenile salmonids captured during this period. Following 6 September, catch rates of both juvenile steelhead and Chinook Salmon increased (Figure 4). The highest daily catch for all species occurred during or immediately after discharge of the Lochsa River noticeably increased at the beginning of November (Figure 4).

DISCUSSION

Catch rates for juvenile steelhead in the Lochsa River during the summer were low and coincided with catch rates at the screw trap in Fish Creek (Stark et al., this report; Figure 5). However, catch of juvenile steelhead varied between the two screw traps in the fall (Figure 5). Despite having tagged and released 4,574 juvenile steelhead from 25 March through 7 November at the Fish Creek screw trap site in 2015, none were recaptured at the Lochsa River screw trap site. Interestingly, three fish that were tagged and released in Fish Creek in the fall of 2015 were detected at PIT-tag arrays in the South Fork Clearwater River in November and December, 2015.

The seasonal fluctuation in flow posed numerous challenges to operating the screw trap and trapping fish. When the mean daily discharge was below 350 cfs, only a small portion (~3 m) of the river in the thalweg region had sufficient depth that allowed the trap to effectively operate (Figure 6). Below 300 cfs, the trap was operating at an average of 3.7 revolutions per minute (rpm) in the thalweg region and constant vigil was needed when operating the trap in the thalweg region when flows approached 1,500 cfs. When flows exceeded 1,500 cfs, the water was too swift to operate the trap in the thalweg and required the operator to sample in the littoral region. The trap was able to effectively sample the littoral region when flows were between 800 and 4,000 cfs (Figure 6). Once flows exceeded 4,000 cfs, the trap could only operate in the slack water region where sampling efficiency was likely low (Figure 6). During high flows (>4,000 cfs) the operator could move the screw trap into the slack water region to either access the trap safely or sample in a safer region. However, a gravel bar that was above the flow level during low flows (<4,000 cfs) prevented movement of the trap into the slack water region and posed safety concerns to the operator when accessing the trap.

Based on the 10-year mean hydrograph for the Lochsa River (Figure 2), we would expect to effectively run the screw trap in the thalweg region of the main stem Lochsa River through mid-March or when flows are below 1,500 cfs. As flows increase during spring runoff, the trap can operate in the littoral region until flows exceed 4,000 cfs. The 10-year mean hydrograph suggests that flows typically sustain a high level (>4,000 cfs) from mid-Aril to early-July (2.5–3 months) in which the trap has to operate in the slack water region or be stopped. By mid- to late July the trap can again operate in the thalweg region. Annual variation in flow will affect the timing of when and where the screw trap will operate in the Lochsa River.

RECOMMENDATIONS

Trap operations

Due to low trapping efficiency, a tandem screw trap design is proposed to operate during the next trapping season in 2016. Both high and low flows could pose difficulties in operating a tandem design at the main stem Lochsa River site. Monthly flows during the trapping season in 2015 were low, averaging 333 cfs in August, 369 cfs in September, and 377 cfs in October compared to the 10-year monthly means of 604 cfs, 424 cfs, and 545 cfs, respectively. When flows are <400 cfs, it is unlikely that a tandem design can effectively operate at this site even in the thalweg region. We therefore recommend that a single cone be operated in the fall season to effectively sample the thalweg region and minimize damage to the trap. A tandem screw trap design has yet to be operated at this site and high flows may pose several technical difficulties and safety concerns. It is recommended to stop operation of a screw trap with a five feet diameter cone at or near 15 rpm due to safety concerns. We expect rpm of the Lochsa River screw trap to exceed this rate if left in the thalweg once river discharge approaches and exceeds 1,500 cfs. Debris associated with spring runoff increases risk to the operator especially when two traps are operating in tandem. Incorporating a tandem design that has the ability to quickly detach and remove one of the screw traps might alleviate some risk to the operator during high flow events.

Another concern was accessing the trap during high flow events. The Lochsa River is non-wadeable above certain flows. As situated now, the gravel bar causes difficulties in pulling the screw trap, using the winch system, to the slack water region where the operator can safely sample fish in high flows. The slack water region can be too deep to safely wade across to access the screw trap in the littoral region if the operator is unable to pull the screw trap over the gravel bar. The threshold for safely wading to the screw trap has not been tested and will vary. A device such as a barge can aid the operator in accessing the screw trap during high flows but may add additional risk. Because the trap operator will likely be working alone, we recommend operating the screw trap in the slack water region of the river during high flows or stop operations until flows decrease to more safe levels. The influence of the Selway River during high flows might also pose difficulties in operating the screw trap in the slack water region during high flows.

Screw trap modifications

It would be beneficial to have added protection on the bottom of the pontoons and the trap box to prevent damage from sliding or rubbing on the substrate. Longer bridles to the pontoons may be beneficial to the sampling efficiency when fishing near the concrete bridge pillar. Flows are deflected around this pillar and the "slack water" behind the pillar effects trapping efficiency when operating in the littoral region during certain flows. Longer bridles would allow the trap to operate further downstream of this obstruction and may increase the volume of water that can be sampled. An extension of 10 feet would allow the trap to operate downstream of the slow water.

Upstream release site

The low recapture rate for fish that were released upstream of the screw trap may be a result of sampling a low proportion of the flow in a large river system or the location of the release site. Marked fish were released in the littoral region of the river not far upstream of the trap (~500 m; Figure 7). Fish could easily avoid being recaptured if they remain in the littoral region of the river on their downstream migration. Releasing fish in an area further upstream and closer to the thalweg might allow the probability of recapturing a marked fish comparable to unmarked fish.

REFERENCES

Copeland, T., E. W. Ziolkowski, R. V. Roberts, and K. A. Apperson. 2015. Idaho steelhead monitoring and evaluation studies. Idaho Department of Fish and Game, Project 15-12, Annual Report, Boise.

McCann, J. B. Chockley, E. Cooper, H. Schaller, S. Haeseker, R. Lessard, C. Petrosky, E. Tinus, E. Van Dyke, R. Ehlke, and M. DeHart. 2015. Comparative survival study of PIT-tagged spring/summer/fall Chinook, summer steelhead, and Sockeye. Annual Report to the Bonneville Power Administration, Project 1996-020-00, Portland, Oregon.

PIT Tag Steering Committee. 1999. PIT tag marking procedures manual.

Raymond, H. L. 1988. Effects of hydroelectric development and fisheries enhancement on spring and summer Chinook Salmon and steelhead in the Columbia River basin. North American Journal of Fisheries Management 8:1–24.

Volkhardt, G. C., S. L. Johnson, B. A. Miller, T. E. Nickelson, and D. E. Seiler. 2007. Rotary screw traps and inclined plane screen traps. Pages 235–266 *in* D.H. Johnson, B. M. Shrier, J. S. O’Neal, J. A. Knutzen, X. Augerot, T. A O’Neil, and T. N. Pearson, editors. 2007. Salmonid field protocols handbook: techniques for assessing status and trends in salmon and trout populations. American Fisheries Society. Bethesda, Maryland.

Appendix E. Table 1. Catch and species composition for the Lochsa River screw trap, June 5th–November 24th, 2015.

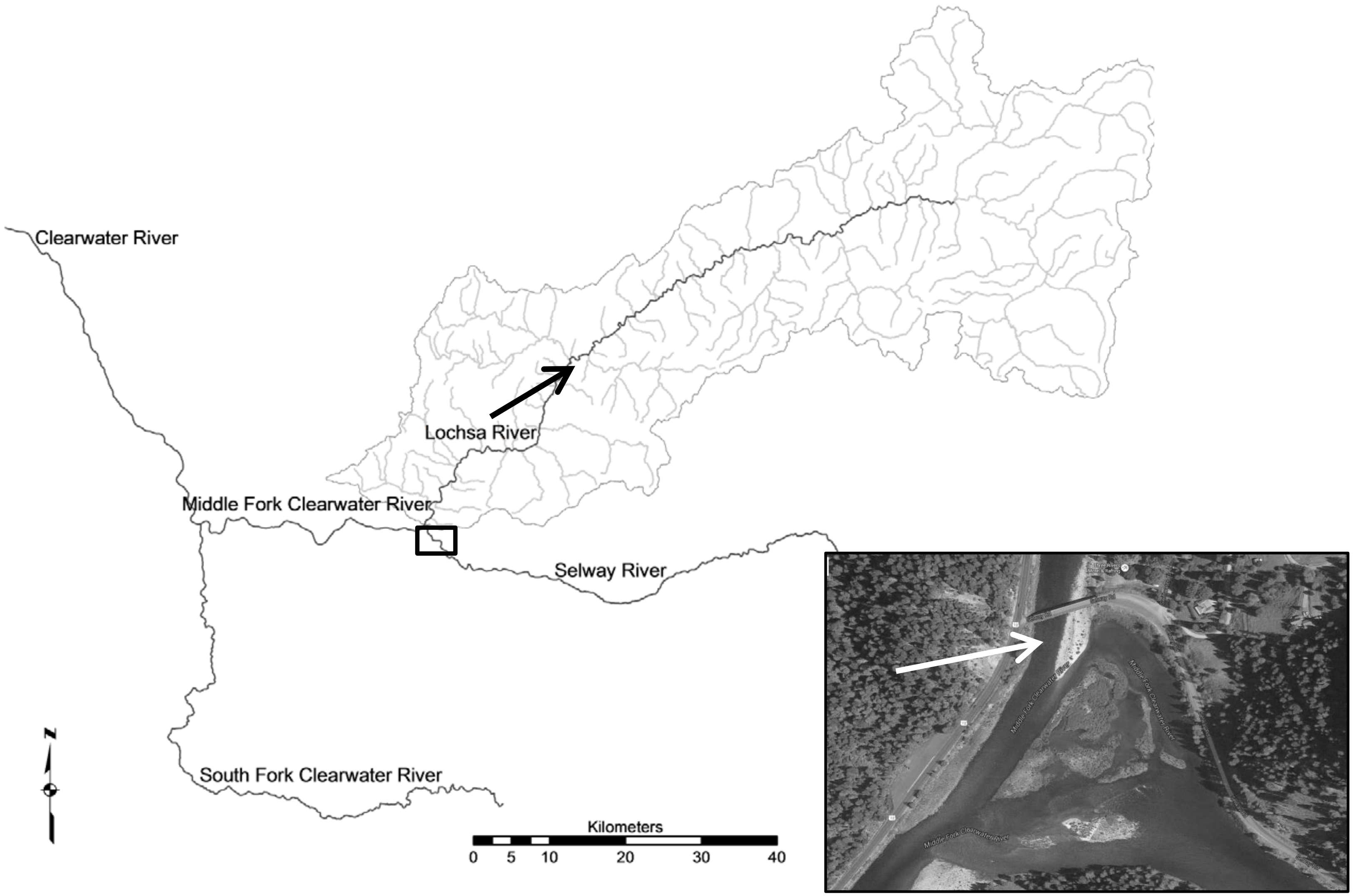
Species	**Captured alive**	**Mortality***	**Total captured**
Bridgelip Sucker	91	2	93
Bull Trout	3	0	3
Bullhead	1	0	1
Cutthroat Trout	23	0	23
Dace (unknown spp.)	38	0	38
Lamprey	3	1	4
Longnose Dace	45	2	47
Mountain Whitefish	60	1	61
Northern Pikeminnow	41	0	41
Peamouth	2	0	2
Rainbow Trout	1	0	1
Redside Shiner	3240	13	3253
Sculpin (spp.)	47	11	58
Smallmouth Bass	1	0	1
Speckled Dace	30	6	36
Steelhead	74	1	75
Chinook Salmon (natural)	211	1	212
Chinook Salmon (hatchery)	2	0	2
Coho Salmon	1	0	1

* Mortalities found dead in trap

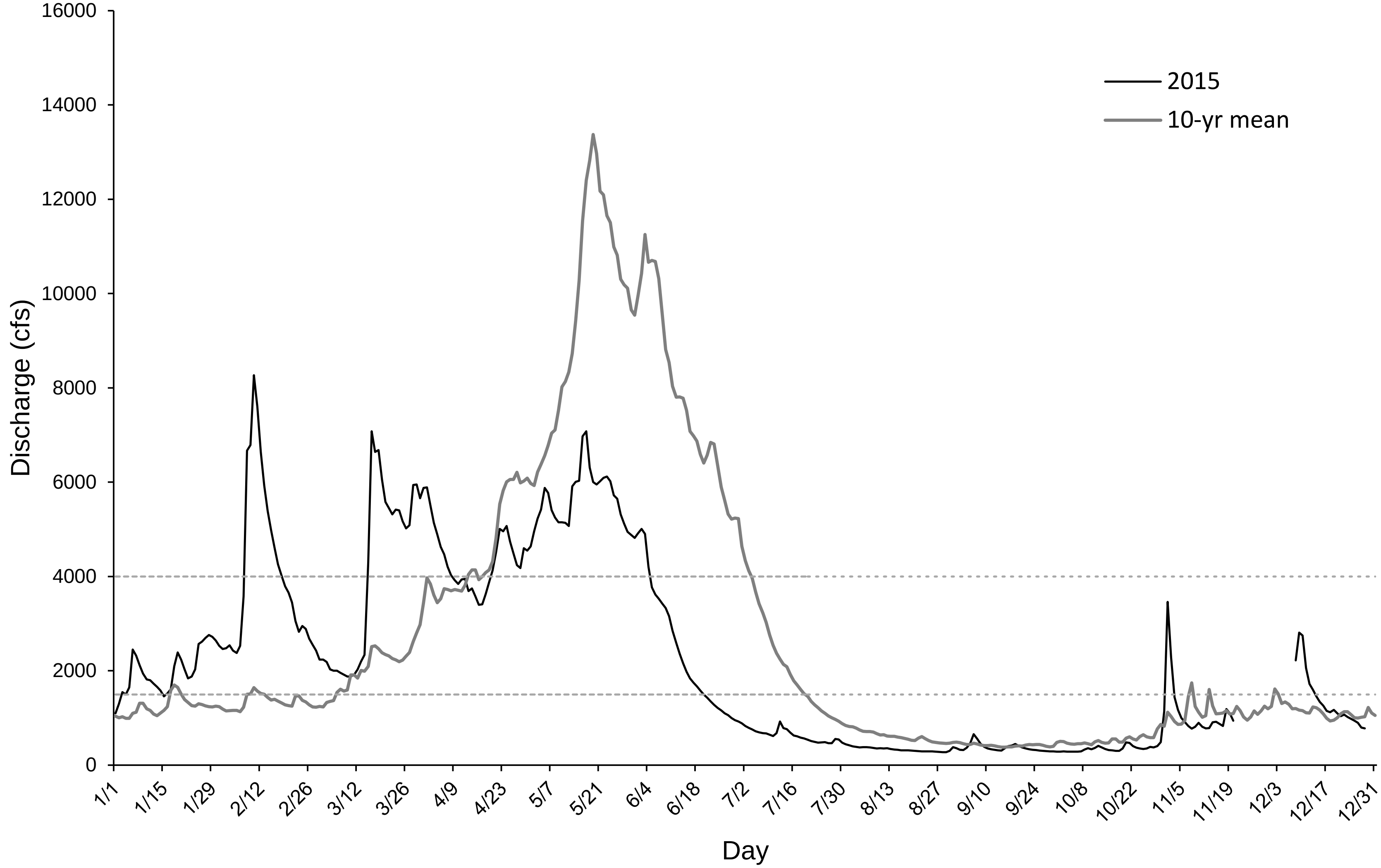
Appendix E. Table 2. Catch and tagging totals for juvenile salmonids captured in the Lochsa River screw trap in 2015.

	PIT tagged									
Species	**Released upstream of trap**	**Released downstream of trap**	**Recaptured**	**Released unmarked (<60 mm)**	**Released unmarked (>60 mm)**	**Ventral clip**	**Age-0**	**Mortality***	**Adults**	**Total**
Steelhead	49	2	0	1	0	2	20	1	0	75
Chinook (W)	157	10	2	6	18	4	14	1	0	212
Chinook (H)	0	1	0	0	0	0	0	0	1	2
Coho	1	0	0	0	0	0	0	0	0	1

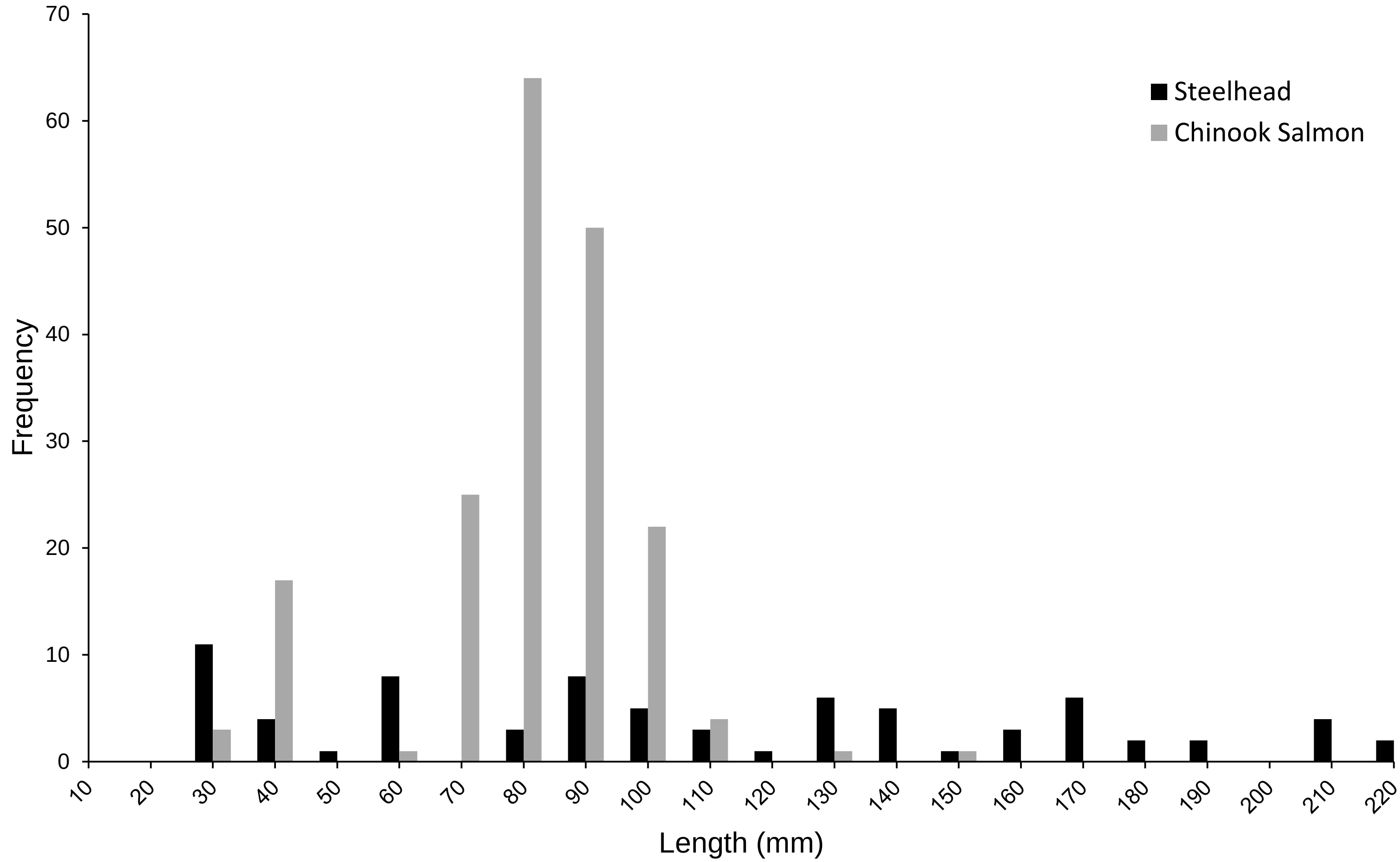
*natural mortalities found dead in trap; mortalities not caused by injury from trap or handling



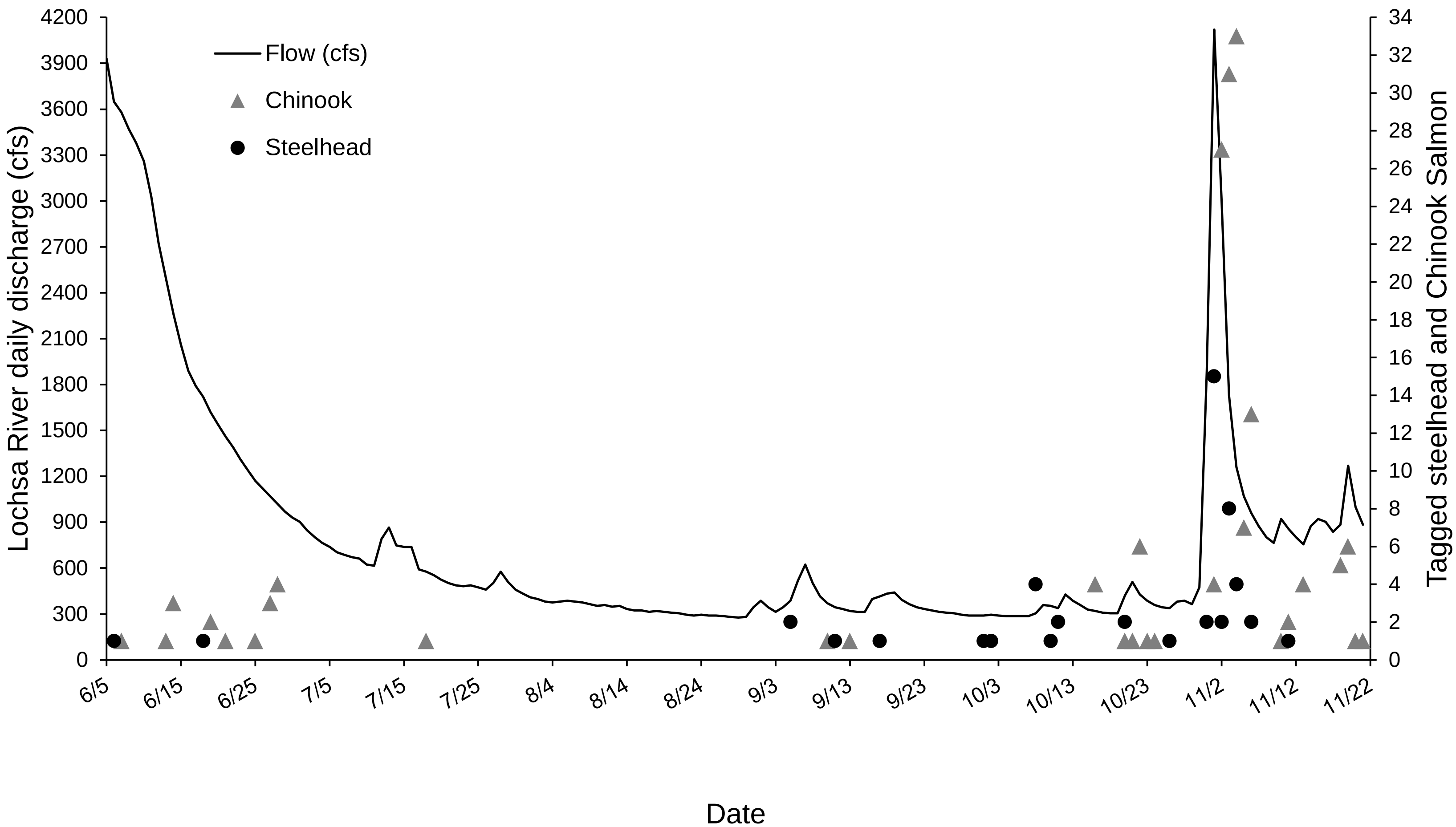
Appendix E. Figure 1. The Lochsa River drainage within the Clearwater River basin in Idaho. Includes the location of the screw traps at Fish Creek (black arrow) and at the confluence of the Lochsa River (white arrow in inset).



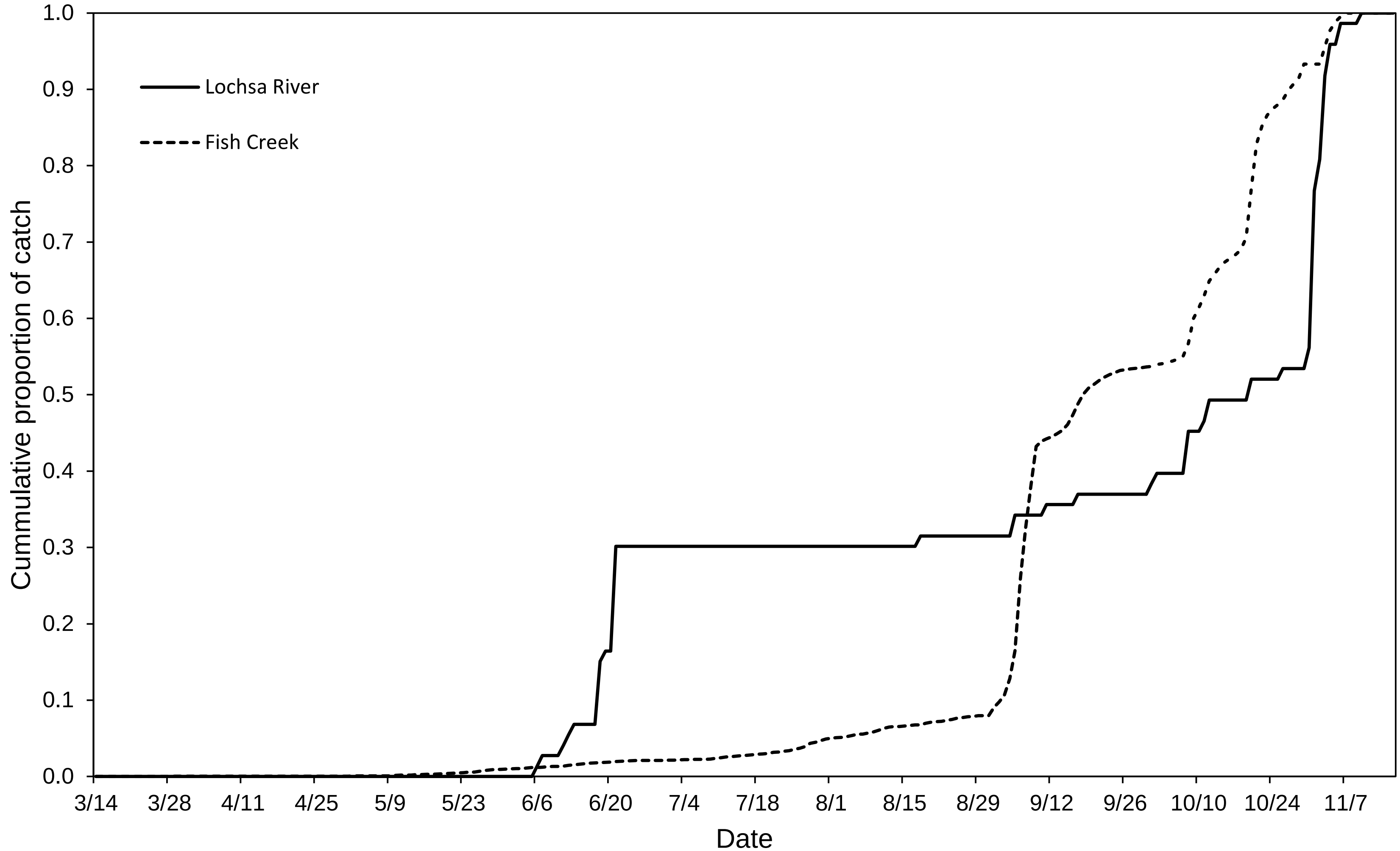
Appendix E. Figure 2. Mean daily discharge from 2005–2015 on the main stem Lochsa River, Idaho (USGS gage 13337000) and mean daily discharge in 2015. Dotted lines represent 1,500 and 4,000 cfs, thresholds for operating the screw trap at certain locations.



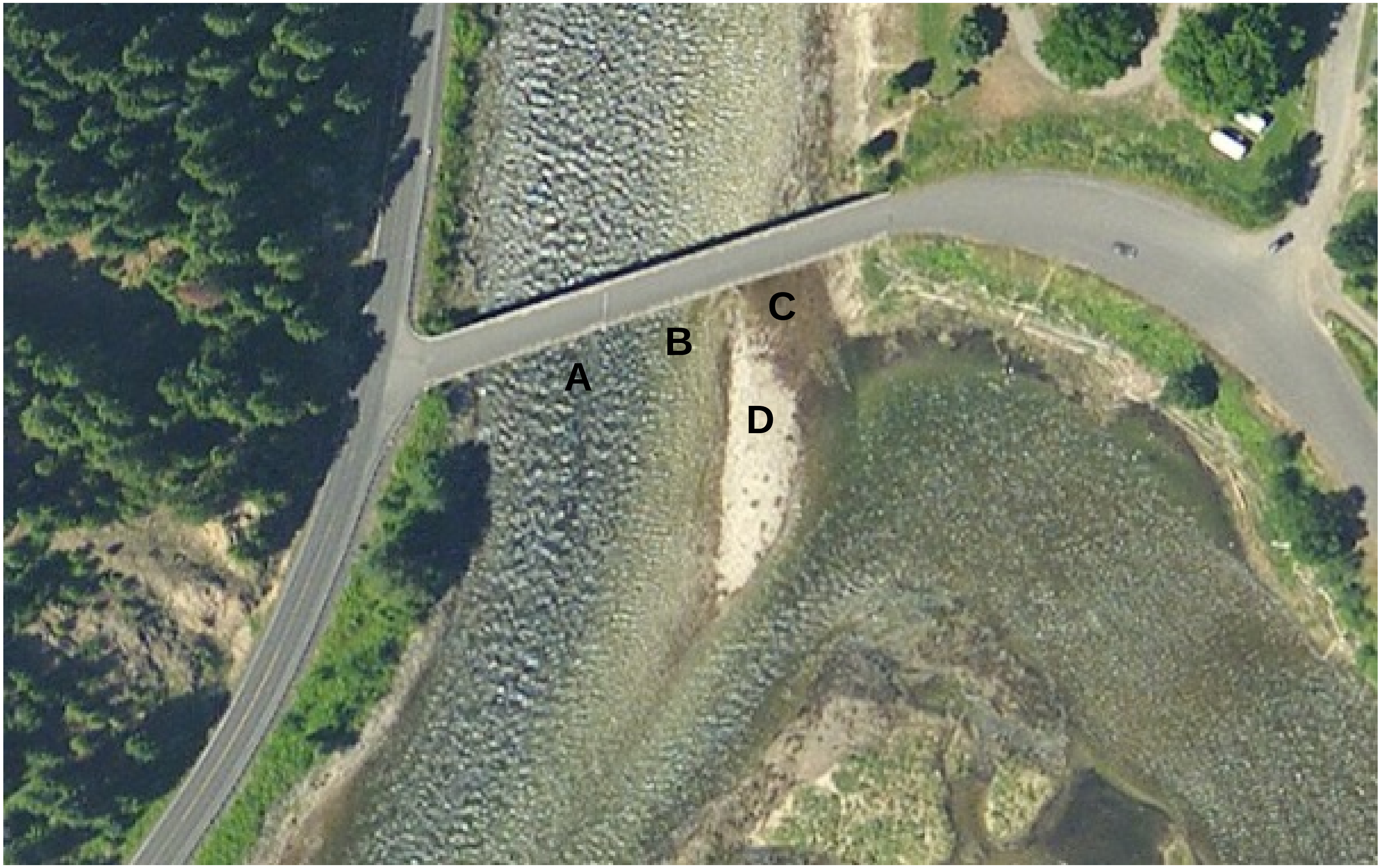
Appendix E. Figure 3. Length frequency histogram of juvenile steelhead (black) and Chinook Salmon (grey) captured in the Lochsa River screw trap at Lowell, Idaho. Length groups are binned every 10 mm. Fish that were released without being measured were excluded.



Appendix E. Figure 4. Daily discharge (cfs) from the USGS gage (13337000) and catch rates of PIT-tagged juvenile steelhead and Chinook Salmon from 5 June–22 November, 2015 in the Lochsa River, Idaho.

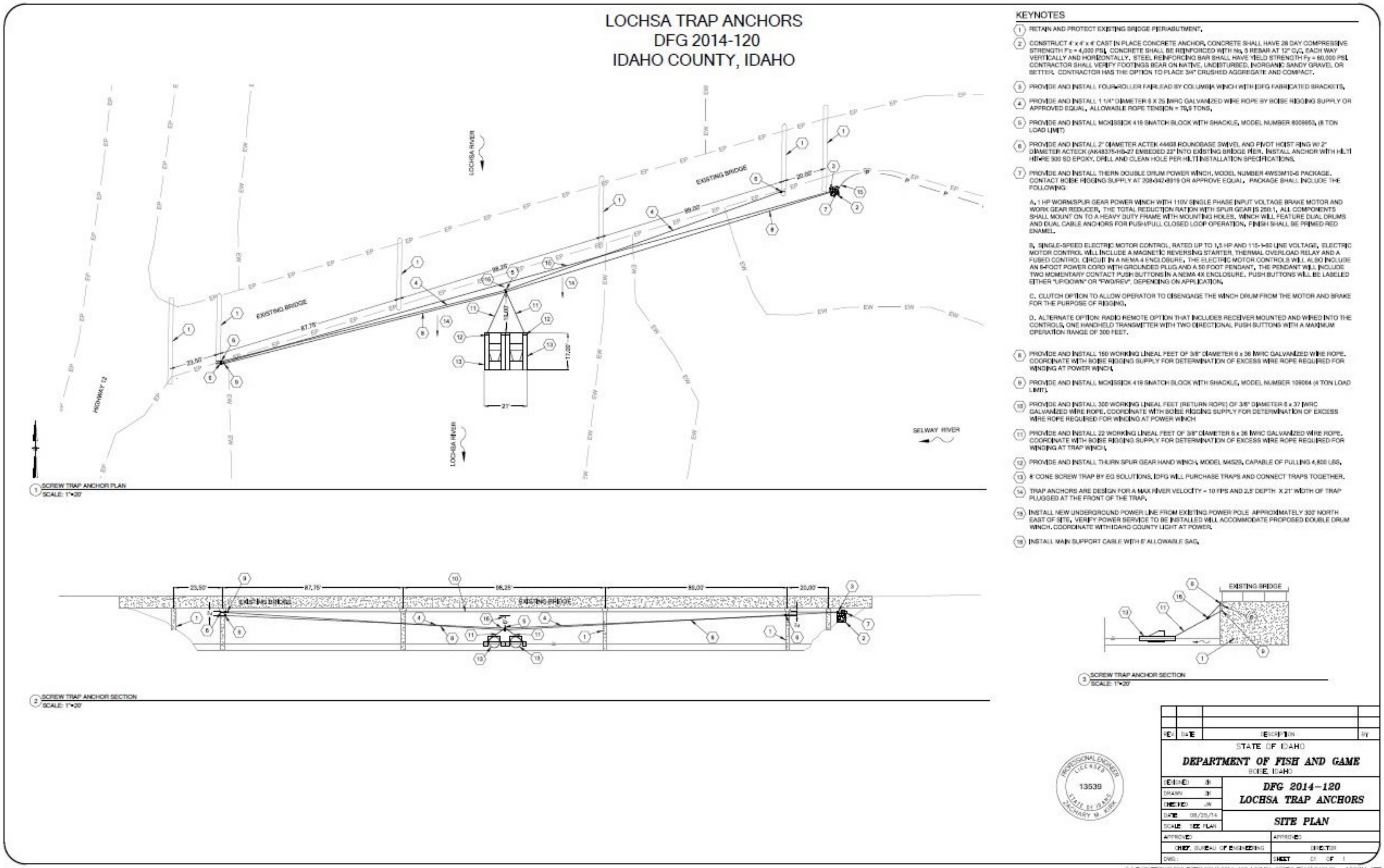


Appendix E. Figure 5. Cumulative proportions of juvenile steelhead captured at the Lochsa River screw trap (solid) and at the Fish Creek screw trap (Stark et al., this report; dashed) in 2015.



Appendix E. Figure 6. Site of the Lochsa River screw trap in Lowell, Idaho and recommended areas for sampling under certain flows. The areas include the thalweg region (A; 600–1,500 cfs), the littoral region (B; 800–4,000 cfs), and slack water region (C; >4,000 cfs). The gravel bar (D) is above the water level when flows are <4,000 cfs.

Appendix E. Figure 7. Current location of the release site for marked fish (circle) and two proposed release sites (triangles) in relation to the screw trap on the Lochsa River, Idaho.



Appendix E. Figure 8. Diagram of screw trap installation on the 223 Road Bridge at Lowell, Idaho.

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