FISHERY RESEARCH

IDAHO ANADROMOUS EMIGRANT MONITORING

2020 ANNUAL REPORT

Photo: Bruce Barnett, IDFG

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IDFG Report Number 21-11
April 2021

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IDFG Report Number 21-11
April 2021

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ABBREVIATIONS AND ACRONYMS

Abbreviation	Definition
BY	Brood Year
DPS	Distinct Population Segment
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
ICTRT	Interior Columbia (River Basin) Technical Recovery Team
IDFG	Idaho Department of Fish and Game
LGR	Lower Granite Dam
MPG	Major Population Group
PIT	Passive Integrated Transponder
RST	Rotary Screw Trap(s)

Suggested Citation: McClure C., B. Barnett, E.A. Felts, M. Davison, N. Smith, B.A. Knoth, J.R. Poole, S.F. Feeken. 2020. Idaho anadromous emigrant monitoring. Annual report 2020. Idaho Department of Fish and Game Report 21-11, Boise.

ANADROMOUS EMIGRANT MONITORING IN IDAHO USING ROTARY SCREW TRAPS

ABSTRACT

During 2020, Idaho Department of Fish and Game monitored emigration of wild juvenile Chinook Salmon and steelhead at ten rotary screw traps in the Salmon River basin and five in the Clearwater River basin. Estimated calendar year abundance of Chinook Salmon emigrants varied from 7,733 to 144,835 fish in the Salmon basin (n = 9 traps). In the Clearwater River basin, no estimates for Chinook Salmon were made due to low numbers of fish captured at only two of the five traps. Estimated abundance of Chinook Salmon for the BY2018 cohort (trapped during 2019 and spring 2020) varied from 8,094 to 128,901 fish in the Salmon River basin (n = 9 traps) and was 2,221 fish at the Crooked River trap. Estimated abundance of steelhead emigrants in 2020 varied from 932 to 31,446 fish in the Salmon River basin (n = 9 traps) and from 672 to 42,851 fish in the Clearwater River basin (n = 5 traps). We present adult-to-juvenile productivity for both species where data were available. Chinook productivity of smolts to Lower Granite Dam for BY2018 varied from 40 to 382 smolts per female spawner from the Salmon River basin (n = 9 traps) and no estimate from Crooked River as no redds were observed in 2020. Steelhead productivity at trapping locations from BY2015 varied from 38 to 624 emigrants per female in the Salmon River basin (n = 7 traps) and from 124 to 451 emigrants per female in the Clearwater River basin (n = 4 traps). Differences in productivity among populations within major population groups as well as differences among major population groups were observed along with density dependence, with fewer juveniles per female surviving as female abundance increased. The pairing of adult and juvenile abundance data provided insight into the variation in habitat and stock characteristics for Chinook Salmon and steelhead populations throughout Idaho.

INTRODUCTION

Chinook Salmon *Oncorhynchus tshawytscha* and steelhead *O. mykiss,* the anadromous form of Rainbow Trout, 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 spring-summer Chinook Salmon (hereafter Chinook Salmon) and steelhead from the Snake River following the construction of dams on the lower Snake River during the late 1960s and early 1970s. Adult Chinook Salmon and steelhead abundances over Lower Granite Dam (LGR) into the Snake River started increasing slightly in the early 1980s (Busby et al. 1996), declined in the 1990s, and noticeably increased again starting in 2000. Recent years have documented substantial declines in abundance to levels similar to the mid-1990s. As a result of critically low adult abundances in the 1990s, Snake River spring-summer Chinook Salmon were classified as threatened in 1992 and Snake River steelhead were classified as threatened under the Endangered Species Act (ESA) in 1997.

Within the Snake River spring-summer Chinook Salmon evolutionarily significant unit (ESU), there are seven major population groups (MPGs): Lower Snake River, Grande Ronde and 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 reestablished with stocks from other MPGs. A total of 28 extant demographically independent populations have been identified in the ESU.

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 (ICTRT 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 to fisheries in the basin) and recovery planning and implementation (aimed at recovering ESA-listed wild salmon and steelhead stocks). The Idaho Department of Fish and Game anadromous fish program’s long-range goal, consistent with basin-wide mitigation and recovery programs, is to preserve Idaho’s Chinook Salmon and steelhead runs and recover them to provide benefit to all users (IDFG 2019). Management to achieve these goals requires an understanding of how salmonid populations function as well as periodic status assessments (McElhany et al. 2000). Specific data necessary to achieve these goals on some Snake River steelhead and Chinook Salmon populations were lacking in the past, particularly key parameters such as abundance, age composition, genetic diversity, recruits per spawner, and survival rates (ICTRT 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. 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) estimation of the adult-to-juvenile productivity of both tributary emigrants and smolts through the Columbia River basin hydrosystem (Crawford and Rumsey 2011), which provides insight into survival throughout the life cycle. These are two of several critical metrics necessary to assess overall trends in abundance and productivity.

Freshwater rearing of anadromous salmonids in Idaho is spatially extensive and emigration is protracted, especially for steelhead. Chinook Salmon and steelhead may rear from headwater spawning areas to the lower Snake River throughout the year, with spatial distribution of multiple cohorts often overlapping temporally. Cohorts of Chinook Salmon are relatively easy to distinguish, with a few exceptions (e.g., Pahsimeroi River, where a significant proportion of age-0 emigrants smolt; Copeland and Venditti 2009). Extensive ageing of steelhead emigrants is necessary to estimate population productivity because several cohorts emigrate together and overlap in size. Ideal locations to estimate abundance of juvenile emigrants at the population scale are downstream from most spawning and early-rearing habitat, yet upstream enough in the drainage to allow efficient population-specific sampling. If traps are located appropriately downstream of important spawning and rearing habitats, standardized sampling through time and across locations can allow long-term evaluations and comparisons of population trends. Rotary screw traps (hereafter RSTs or traps) have been the primary tool used by IDFG since the early 1990s to address the following objectives: 1) estimation of juvenile emigrant abundance for select populations, and 2) implanting passive integrated transponder (PIT) tags in emigrants to evaluate hydrosystem passage (Venditti et al. 2015a; Copeland et al. 2015; Bowersox and Biggs 2012; Apperson et al. 2016 and 2017; Uthe et al. 2017; McCann et al. 2015).

A collaborative effort across the Columbia River basin offered guidance to standardize monitoring of juvenile emigrants and to coordinate and prioritize monitoring work (i.e., Anadromous Salmonid Monitoring Strategy, http://www.nwcouncil.org/fw/am/monitoring/monitoring-strategies). Since that collaborative process began, IDFG has continued some previous RST operations and strategically implemented new RST operations to contribute to the monitoring of the Major Population Groups (MPGs) and populations most important to overall recovery goals. Most monitoring restructuring was delayed until the completion of Idaho Supplementation Studies (Venditti et al. 2015b). However, monitoring in Marsh Creek downstream of the Beaver Creek confluence was implemented in 2010. Our goal with this report is to consolidate all information generated by means of RSTs operated by IDFG to assess trends in abundance and productivity of juvenile Chinook Salmon and steelhead populations. Additionally, juvenile Pacific Lamprey *Entosphenus tridentatus*, a species of greatest conservation need in Idaho (IDFG 2017), are captured at some locations, providing us the opportunity to monitor both supplemented and non-supplemented populations.

We continuously strive to sample populations efficiently and minimize potential harm to individual fish. Tagging and information derived from sampling is coordinated with and used among multiple projects (e.g., Copeland et al. 2015; Venditti et al. 2015b; McCann et al. 2015; Uthe et al. 2017). Take associated with trapping ESA-listed species is permitted under a State of Idaho 4d research permit issued by NMFS. A detailed take report is submitted to NMFS at the end of each year, which also outlines the measures we take to minimize stress or harm to fish.

We have three objectives for this report: 1) report estimates of emigrant abundance at RSTs by season and cohort for Chinook Salmon and steelhead, 2) estimate emigrant survival rate to Lower Granite Dam (LGR) by season and cohort for Chinook Salmon, and 3) present current estimates of adult-to-juvenile freshwater productivity for Chinook Salmon using the Beverton-Holt stock-recruit relationship and for steelhead using brood tables (Beverton and Holt 1957).

STUDY AREA

The Salmon River and Clearwater 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 in 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. In both the Clearwater River and the Salmon River basins, water quality is good 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 also 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. All waterbodies discussed in this report are inhabited by anadromous fishes.

Idaho Chinook Salmon and steelhead migrate long distances during their life cycle. They travel 1,451 km from the Pacific Ocean to the highest reaches of their spawning grounds in the Salmon River 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 their respective RST before encountering LGR. In the Clearwater River basin, juveniles migrate between 98 km and 324 km before encountering LGR. Juvenile Chinook Salmon and steelhead rear in a variety of locations ranging from natal tributaries to downstream mainstem rivers (Copeland et al. 2014).

Rotary screw traps operated by IDFG to sample wild juvenile Chinook Salmon and steelhead are distributed throughout the Salmon River and Clearwater River basins, Idaho (Figures 1 and 2). Traps were located to sample emigration from selected populations for either or both species. Details about trap coverage are given in Appendix A.

METHODS

Rotary Screw Trap Operations and Sampling Process

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 Rotary Screw Trap (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 since the early 1990s refining all protocols associated with operating RSTs in Idaho rivers to ensure 1) consistent information was collected and archived, 2) fish were handled appropriately to minimize stress, and 3) personnel safety. A RST manual is currently in development that will outline these methods in detail and will be used as a reference for future reports (Copeland et al. 2021). We anticipate the manual will be complete prior to the next annual report.

Traps are operated as much of the year as possible and operation is generally discontinued only when conditions jeopardize safety of personnel, fish, or the trap. While some low elevation traps are operated from late February into December, most traps are higher in elevation and are operated from the middle of March into the middle of November. Trap operations in some Clearwater River basin streams (Potlatch River and Big Bear Creek) are routinely unable to operate past June, limited by low stream flow and high stream temperatures (>17°C). Traps are not operated in the winter due to the lack of fish movement (Bjornn 1978) and adverse sampling conditions. We positioned RSTs in the thalweg (region of the stream that has most of the flow by volume) to maximize capture efficiency whenever flow conditions allow. Program personnel check traps and process fish at least once daily during daylight hours. High water flows, debris, and ice have inhibited trap operations and have caused the traps to be inoperable for short time periods (Appendix B). When we anticipated such problems or when unusually high numbers of hatchery 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 also may have moved traps out of the thalweg or stopped fishing them (i.e., raised the cone) during those times until it was safe for personnel and equipment to resume routine operation. With those exceptions, we deployed traps as early in the spring as possible and operated them continuously until ice-up in the fall.

Fish collected in RSTs were processed using standard protocols (Copeland et al. 2021). 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) bath, 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. Lengths and weights were recorded for all steelhead and all Chinook Salmon age-1 smolts. Lengths and weights were subsampled on age-0 fry, parr, and presmolts depending on the number captured in the trap and time/temperature constraints. Target species (Chinook Salmon and steelhead) were marked and sampled for biological data (e.g., PIT tags, scales).

Chinook Salmon ≥60 mm FL and steelhead ≥80 mm FL were implanted with 12 mm x 2.05 mm PIT tags. Effort was made to tag all steelhead and all Chinook Salmon age-1 smolts. Young-of-the-year Chinook were subsampled to place the tags needed to obtain abundance, survival, and SARs while not exceeding permitted take limits (Copeland et al. 2021). The number of tags placed to estimate trap efficiency was controlled by the number needed for statistical estimation of abundance with desired precision and the concurrent efficiency of the trap (Copeland et al. 2021). 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 (Venditti et al. 2013). Chinook Salmon <60 mm FL were generally not tagged; however, in the Lemhi River and Marsh Creek where Chinook Salmon <60 mm make up a substantial proportion of the total emigrants, we used Bismarck Brown Y stain to mark subsamples of fish that were 35-59 mm FL for mark-recapture abundance estimates (Venditti et al. 2015a). Steelhead <80 mm FL captured in the Potlatch River were marked with a ventral fin clip and included with PIT-tagged fish in mark-recapture abundance estimates. At the Hayden Creek, Upper Lemhi River, and Lower Lemhi River traps, steelhead 60-79 mm FL were implanted with 9 mm PIT tags. Tagging of Chinook Salmon and steelhead at the Potlatch River, Lemhi River, and Hayden Creek traps differed slightly from other traps because of the need for monitoring fish at various life stages as part of Intensively Monitored Watershed studies (Uthe et al. 2017). Fish recovered from handling in large, lidded perforated plastic containers placed in the stream with sufficient free flow of water or in buckets of water with aeration and temperature control prior to release into the stream.

Incidental catch of non-target species was enumerated, a subsample were measured for length and weight depending on catch, and all were then released downstream. All ESA-listed species were processed first to minimize duration of stress. Juvenile Pacific Lamprey were anesthetized with MS-222, counted, measured to the nearest 1 mm total length (TL), identified as ammocoetes or macrophthalmia based on physical characteristics, and subsampled for genetic tissue with a fin clip. Protocols for collecting data and samples from Pacific Lamprey were adapted from the Nez Perce Tribe (Mike Kosinski, Nez Perce Tribe, personal communication).

Trap efficiency was estimated using fish that were newly marked with either PIT tags, stain, or fin clips by releasing those fish upstream from the trap on a daily basis. Subsequent recaptures of marked fish were used to estimate daily trap efficiency. Efficiencies were computed from numbers of marked salmonids that were recaptured ≤5 days after release. We selected release sites approximately 0.5 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.

Scale samples were collected from steelhead ≥80 mm FL at most traps for ageing. We followed established protocols and methods to collect scales from up to 150 steelhead per season (spring and summer/fall), and subsequently assign ages to sampled fish (Wright et al. 2015). At RSTs where fewer than 150 steelhead are captured, scales are collected from all steelhead. In locations with high abundance, scales are collected systematically to evenly sample steelhead, up to a maximum of 150 per season. Age proportions derived from scales are applied to the emigrant abundance estimates to produce cohort abundance and productivity estimates.

Data Management

Data from RST operations are stored in the PTAGIS P4 database locally then uploaded to the PIT Tag Information System (PTAGIS) database (https://www.ptagis.org). All PIT-tagged and non-PIT-tagged fish data, along with metadata, are uploaded to the Idaho Fish and Wildlife Information System database (https://fishandgame.idaho.gov/ifwis/portal/page/juvenile-fish-trapping) via the J-Trap application. Data are queried from the Idaho Fish and Wildlife Information System database for analysis. Steelhead age data are archived in the IDFG BioSamples database (https://collaboration.idfg.idaho.gov/qci/default.aspx). Interested parties can access raw data with permission from IFWIS. Data were checked for accuracy and completeness at several stages (e.g., trap tender prior to initial uploading, trap supervisors, IDFG data coordinators, PTAGIS database managers). After analysis, juvenile abundance estimates are publicly available via the Coordinated Assessments data exchange website (https://www.streamnet.org/data/coordinated-assessments/).

Chinook Salmon Emigrant Abundance and Productivity

Abundance at Rotary Screw Traps

Age-specific abundances of Chinook Salmon emigrants passing the trap were estimated by season/life stage. Body size and date were used to distinguish cohorts (age-0 from age-1 fish) as two ages could be captured simultaneously, especially in the spring. Life stage designations for Chinook Salmon followed standard calendar periods and are described in the Protocols For Trapping Anadromous Emigrants in Idaho (Copeland et al. 2021). The spring period 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. Age-0 fry are also captured in the spring, depending on the trap site, but are often too small to mark for evaluation. The summer parr period is July 1 through August 31, a period of time when age-0 fish grow large enough to be marked with PIT tags. The fall presmolt period is 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 (Chapman 1966; Venditti et al. 2015b). Emigrants from a given cohort PIT tagged within each time period generally display distinct differences in overall survival rates to LGR (Venditti et al. 2015b). Seasonal life stage abundances are calculated by stratifying fish into smaller date ranges based on recapture efficiency of the trap and processing the strata in R statistical software (R Development Core Team 2020). Complete cohort abundance at the trap is calculated by processing all the strata for the seasons together. Abundance estimates of age-0 fish captured in 2019 and age-1 smolts captured in the spring of 2020 were used to complete the total estimate for brood year (BY) 2018.

We calculated emigrant abundance 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 season or year, i is season (defined below for each species), c_i is the number of all unique 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. (Bailey 1951). The estimator is computed using an iterative maximization of the log likelihood (Steinhorst et al. 2004), using R statistical software and is located at the following webpage location: http://ifwisshiny.idfg.state.id.us:3838/JLM/IDFGStatApps/. The method assumes that fish are captured independently with probability p (equivalent to trap efficiency) and tagged fish mix thoroughly with untagged fish. We computed 95% confidence intervals with the bootstrap option (10,000 iterations).

Trap efficiency was monitored to detect drastic changes caused by flow and temperature, and strata were established based on these efficiencies, within the species-specific seasonal periods described previously. This stratification resulted in an improvement in overall efficiency estimation and, therefore, a tighter bound on abundance 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 trap. Trap efficiencies were calculated as followed:

$$Trap\ efficiency = R_i/M_i$$

where R is the number of recaptured PIT-tagged fish, i is a specific time period (dependent upon trap), and M is the number of fish that were implanted with a PIT tag during the same time period.

Survival and Abundance at LGR

We estimated survival rates of PIT-tagged Chinook Salmon emigrants from each RST to LGR by cohort and season and used the survival rates to calculate the abundance of smolts at LGR. Estimates are made separately for the groups described in the Abundance methods because of their inherent differences in survival (Copeland et al. 2021). Main stem detection sites were Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, and Bonneville dams and the estuary towed array. A new detection site, the Lower Granite Spillway was brought online in 2020 and used in this analysis. We assumed that tagged fish represented untagged fish in each group. The data used to calculate survival were queried from the PTAGIS database in Advanced Reporting (https://www.ptagis.org/). Tagging detail data (i.e., the tagged fish from the screw traps) and Interrogation data (i.e., the PIT tag detections at the dams on the Snake River and Columbia River) were used. The software program PitPro (Westhagen and Skalski 2009) was used to translate raw PTAGIS PIT tag data into usable capture histories. This program implements a Cormack-Jolly-Seber model to output the basic point estimates of survival (RST to LGR) and detection probabilities at the dams. Cohort abundance of smolts at LGR was calculated by multiplying the seasonal abundance estimates by the survival proportion estimates before summation.

Productivity

Adult-to-juvenile productivity was modeled with stock-recruitment analysis for five locations (i.e., Big Creek, Marsh Creek, Pahsimeroi River, upper Salmon River, and Lemhi River) and updated through brood year 2018. Estimates of the number of redds (estimated from single or multiple pass surveys) or number of females (estimated from weir passage) above screw traps were taken as a measure of “stock” and estimated number of smolts at LGR were taken as a measure of “recruits”. Both weir counts and redds below the weir were used for the South Fork Salmon River because the screw trap is downstream of the weir. The stock-recruit relationship was modeled using a $\log_e$ transformed Beverton-Holt (Beverton and Holt 1957) model:

$$log_e[R] = \log(\frac{(\log(\alpha * S))}{(1 + \beta * S)}),$$

where recruits (*R*) is a function of stock (*S*), α is the maximum recruitment rate at low spawner abundance, β is the level of density dependence, and alpha/beta provides an estimate of the asymptote. A Bayesian hierarchical approach was used to estimate global and trap-level parameter estimates. This framework assumes parameters for groups (e.g., populations) are distributed around global or shared parameters (Gelman and Hill 2007). Analysis was conducted using the R2jags package (Su and Yajima 2015) in R statistical software (R Development Core Team 2020), which executes code in Program JAGS (Plummer 2003) from the R statistical software interface. In addition to the results of stock-recruit analysis, this report presents the relationship between Chinook Salmon juvenile productivity and adult spawner abundance at ten locations for brood year 2018 (Bowersox and Biggs 2012; Venditti et al. 2015b; Apperson et al. 2016; Uthe et al. 2017). This metric was estimated using either redd counts or the escapement estimate above a weir and the number of smolts that survived to Lower Granite Dam.

Steelhead Emigrant Abundance and Productivity

Abundance at Rotary Screw Traps

Age-specific abundances of steelhead emigrants passing RST were estimated by season. Estimated ages based on scale data were used to distinguish the multiple cohorts captured simultaneously. Season designations followed standard calendar periods and are based on the major periods of fish movement during spring and fall, which is consistent with past reports (e.g., Copeland et al. 2015; Apperson et al. 2017; Belnap et al. 2018). The spring period was the time from trap installation until May 31, a period of time when most steelhead emigrants are smolting. The summer period was from June 1 to August 14, a time period that emigrants generally continued to rear in freshwater for at least one more year. The fall period was from August 15 until trap removal, usually between late October and early December depending on the trap. Emigration past the screw traps generally increases in the fall period compared to the summer period. The summer and fall periods were ultimately combined for analyses because summer often lacked sufficient recaptures or catch to report a reliable estimate.

Productivity

The adult-to-juvenile productivity of steelhead at RST was estimated by dividing the seasonal sum of estimated cohort abundances by the number of adult female spawners that produced them. The number of adult female spawners was obtained by either PIT tag arrays or weir counts at locations with both a RST and an array or weir. These adult abundances and the methods used to estimate them are reported annually in our adult steelhead report (Stark et al. 2016; Knoth et al. 2018; Dobos et al. 2017 and 2019). Spring emigrant age composition is always older than summer and fall emigrant age composition and summer and fall are typically similar. Therefore, age composition for spring samples was calculated separately from combined summer and fall age compositions. Scale sample age proportions were directly applied to the seasonal emigrant abundance estimates. Brood tables were constructed by summing emigrant abundances by cohort, then dividing by the number of female spawners upstream of the RST to calculate brood year productivity. This report provides complete productivity estimates through BY 2015. A method to estimate survival of juvenile steelhead by cohort to Lower Granite Dam was described in the Idaho Anadromous Emigrant Monitoring 2019 Annual Report (Feeken et al. 2020) and may be used in future analysis.

RESULTS

Rotary Screw Trap Operations

The RSTs were operated in ten locations in the Salmon River basin and five locations in the Clearwater River basin (Appendix A). Of these traps, 11 have operated annually at the same location for a minimum of 14 years. Three traps have operated for 29 years (Lemhi, Upper Salmon, and Pahsimeroi rivers) since 1992, and the Crooked River RST has operated for 31 years since 1990. Calendar year 2020 represents the sixth complete year of operation for three RSTs included in this report (Lower South Fork Salmon, North Fork Salmon, and Lower Lochsa rivers). All RSTs included here were operated by IDFG, including the Lower Lemhi River RST (LLRTP), which IDFG took over from Biomark Applied Biological Services in 2020. Prior to 2020, the Lower Lemhi River has been operated by both IDFG and Biomark. IDFG operated the trap periodically from 2006 to 2011. In 2012 the trap was not operated due to trapping inefficiencies. Then, in 2013, Biomark took over trap operations and operated the trap through 2019.

Most traps were operated during three seasons (spring, summer, and fall). However, streamflow was insufficient to operate the two traps in the Potlatch River (Big Bear Creek and East Fork Potlatch River) during summer and fall. Summer flows typically limit RST operations in the Potlatch River; thus, we assume emigration is negligible during summer in the Potlatch River. The East Fork Potlatch River, Big Bear Creek, and Fish Creek RSTs did not capture Chinook Salmon in 2020. A couple of traps were installed a little later than normal due to COVID-19 restrictions but overall traps were operated for the majority of the trapping season, and therefore we can report reliable emigrant information for all seasons except winter or as noted previously (Appendix B).

Chinook Salmon Abundance at Rotary Screw Traps

Chinook Salmon emigrant abundance varied from 8,087 to 144,835 fish in the Salmon basin (n = 9 traps). No estimate was made in Rapid River due to low numbers of fish captured. In the Clearwater River basin; no estimates for Chinook Salmon were made due to low numbers of fish captured at the traps (Table 2).

Chinook Salmon Survival and Productivity

Total number of emigrants from RSTs to LGR was influenced by both seasonal abundance at a given RST and seasonal survival rate to LGR (Table 3). Survival to LGR increased for each successive seasonal group (from summer age-0 fish to spring age-1) within a brood year across all traps, with the exception of the Lower Marsh Creek RST (Table 3). With the exception of the Pahsimeroi and Lemhi rivers, survival of spring age-0 fry was not assessed because those fish are too small for PIT tag implantation.

Chinook Salmon productivity for BY2018 varied from 40 to 382 smolts at LGR per female spawner in the Salmon River basin (n = 10 traps). Crooked River caught a few juveniles in the trap even though no wild adults were trapped and passed above the weir. Thus, we were not able to estimate productivity (Table 4).

The Beverton-Holt model suggests a density dependent relationship between spawning Chinook Salmon female abundance and smolts at LGR in the Upper Salmon River MPG but not in the Middle Fork Salmon MPG. Insufficient data in the Clearwater River basin prohibited a Beverton-Holt analysis for any population in that MPG.

Steelhead Abundance at Rotary Screw Traps

Juvenile steelhead emigrant abundances were estimated at 14 of 15 RST locations operated across 11 steelhead populations (Table 5). Abundance of juveniles at Marsh Creek was not estimated because of low catch and limited recaptures.

Estimated abundance of steelhead emigrants varied from 932 to 31,446 fish in the Salmon River basin (n = 9 traps) and from 672 to 42,851 fish in the Clearwater River basin (n = 5 traps). Big Creek produced an estimated 31,446 emigrants, more than any other location in the Salmon River basin. The Crooked River trap produced the fewest emigrants in the Clearwater MPG with 672 fish and Lower Lochsa River produced the most with 42,851 fish. The catch of steelhead <80 mm FL, which were generally not marked to estimate trap efficiencies, varied from a low of zero in Big Bear Creek, Fish Creek, Lemhi River, and Lower Lochsa River to a high of 428 in Hayden Creek (Appendix C).

Scale samples were collected from juvenile steelhead at all 15 traps, with ages assigned to 3,245 fish (Table 6). Juvenile steelhead ages varied from zero to 4 years, and in general an older age distribution was observed in the spring than the summer/fall period at most RSTs. Fish were predominately age-1 or age-2 in the spring and in the fall.

Emigrant abundance, juvenile age proportions, and female spawner abundance data were used to produce adult-to-juvenile productivity estimates for multiple cohorts at six trap locations in the Salmon River MPG and four trap locations in the Clearwater River MPG (Appendix E). Steelhead emigrant/female decreased from BY2014 to BY2015 in all six traps in the Salmon River basin and all, except for Big Bear Creek in the Clearwater River basin. Steelhead emigrant/female productivity for BY2015 in the Salmon River basin ranged from 38 in Big Creek to 580 in the Upper Salmon River. In the Clearwater River basin emigrants/female ranged from 124 in Big Bear Creek to 451 in Crooked River. Compared to previous years, steelhead productivity in the Salmon River basin was low in Rapid River, South Fork Salmon River, and Big Creek, average in the Pahsimeroi and Lemhi rivers, and high in the Upper Salmon River. Steelhead productivity in the Clearwater River basin was low in the East Fork Potlatch River, average in Big Bear and Fish creeks, and high in Crooked River.

Steelhead Survival and Productivity

Plots of complete cohort estimates through BY2016 are presented in Figures 7 and 8. Even though age five emigrants are only complete through BY2015, BY2016 data are included in the plots because ~97% of the time there are no age five emigrants (Appendix E). This adds another data point to each stream's time series and will be adjusted next year if there are any age five emigrants for BY2016. Trend lines indicate that populations in both MPGs generally experience density-dependence, with juvenile productivity declining with increasing spawner escapement, with the exception of Crooked River which had an inverse relationship. Crooked River has not passed any adults over the weir in the past few years because they were used for brood stock. However, a few juvenile fish are still caught in the screw trap indicating that at least some fish are navigating past the weir or are entering the system prior to the weir being installed.

Pacific Lamprey Catch at Rotary Screw Traps

Pacific Lamprey were captured at the South Fork Salmon River and the Lochsa River RSTs (Table 8). A total of 1,245 Pacific Lamprey were captured at the South Fork Salmon River trap, consisting of 1,020 ammocoetes and 225 macrophthalmia. The length of lamprey in the South Fork Salmon River ranged from 32 mm to 177 mm. Genetic samples were collected from up to five lamprey per day. Samples were then given to CRITFC and analyzed. A total of 80 Pacific Lamprey were captured at the Lower Lochsa River trap, 79 of which were ammocoetes, which ranged from 133 mm to 162 mm.

DISCUSSION

Adult-to-juvenile productivity estimates provide insight to the quality and quantity of habitat available in Idaho. Adult-to-juvenile productivity estimates for Chinook Salmon, in terms of smolts per female, varied widely, both between locations and by brood year, making trends difficult to assess. Emigrant survival is influenced by the number of females spawning, available habitat, and the habitat quality from upstream of the traps to the end of freshwater rearing (i.e., upstream of LGR). Distinct differences in productivity among populations are evident, as expected with large spatial and temporal variability (Table 5). To better understand the differences in productivity among populations, the amount of habitat available and the quality of habitat necessary for juvenile fish rearing and overwintering should be further assessed for locations upstream of traps. The Intensively Monitored Watershed studies in the Potlatch River basin and the Lemhi River basin provide a unique opportunity to identify life stage specific limiting habitat factors through research, monitoring, and evaluation efforts. Information gathered will help guide habitat restoration actions to increase Chinook and steelhead abundance, survival, and productivity.

The stock-recruit analysis of smolt-to-adult productivity of Chinook Salmon indicated a density-dependent relationship between spawning female abundance and smolts at LGR in some populations. Density dependent smolt production has been shown for Snake River spring/summer

Chinook Salmon (Walters et al. 2013; Camacho et al. 2019), but the extent to which density dependence regulates smolt production across all populations may be more variable than previously thought. Adult-to-juvenile productivity estimates for Chinook Salmon show an increasing trend in density dependence in the Salmon River MPGs, lowest in the Middle Fork Salmon, and highest in Lemhi and Pahsimeroi rivers. Marsh Creek and Big Creek showed little evidence of reaching asymptotic smolt production over the observed range of female abundance. The specific mechanisms that cause density dependent mortality in juvenile Snake River spring/summer Chinook Salmon are unclear, although we suspect competition among juveniles due to habitat loss and/or hatchery influence to be likely contributors.

Variation present in natural populations can make comparison of productivity metrics difficult, and as a result, alternate juvenile life history forms may not be accounted for. For example, the Pahsimeroi and Lemhi populations tend to have age-0 Chinook Salmon reaching sufficient size to undergo smoltification and migrate downstream (Lutch et al. 2003; Copeland and Venditti 2009). In 2020, spring age-0 migrants made up approximately 47% of the Chinook that passed the Pahsimeroi River RST. Productivity values may not be comparable to other traps where this variant life history form does not exist.

Juvenile emigration estimates in this report are considered conservative (biased low), because no interpolation is attempted for time periods that traps are not operated. However, bias in emigration estimates is likely minimal since there is little indication of significant winter movements (Bjornn 1978). Also, the majority of fish at most locations (at least locations outside of the Potlatch River drainage) emigrate during the fall when RSTs are in operation and trapping efficiencies are high. To ensure the most precise estimates, a multiyear hierarchical Bayesian model has been developed to interpolate abundance during periods of sparse and missing trap data (Oldemeyer 2015). The model will need to be applied on a case-by-case basis and will need to be customized to each trap. Traps with longer data series (e.g., Pahsimeroi River, upper Lemhi River, Marsh Creek, and Upper Salmon River traps) can use historical data to populate the model. Newer traps (e.g., the North Fork Salmon River, Hayden Creek, and Lochsa River traps) will need more years of data to fully realize the benefits of the model. The model is currently not used to supplement emigrant estimates, due to the current methods possibly producing erroneous estimates when applied to certain life stages. In particular, subtaggable fry and parr are an issue because the model uses PIT tag records from PTAGIS (Bruce Barnett, IDFG, personal communication). This has the effect of over-estimating abundance of these groups to the point where emigrants/female are unrealistic (i.e., hundreds and thousands more than a female can produce). A possible solution to this issue would be to eliminate spring age-0s from analysis altogether since the majority of these fish likely have very poor survival compared to other life stages. The model is currently being validated by populating it with historical data and comparing the results with estimates obtained using traditional methods. As the model is refined, it may be incorporated into future reports.

Last year the WSS program performed a case study to investigate the efficacy of estimating steelhead survival to Lower Granite Dam. This effort was led by Marika Dobos. Estimating steelhead survival to the dam is difficult for a variety of reasons (e.g., complicated and various life history strategies of out migrating steelhead). Results from her work were included in the 2020 report (Feeken et al. 2020). While survival for steelhead to Lower Granite Dam was not included in this year’s report, the WSS program is continuing to pursue means to provide meaningful estimates that can be incorporated in the annual Anadromous Emigrant Monitoring report.

RECOMMENDATIONS

The following recommendations would improve our understanding of population status and trends in the juvenile freshwater life stage of Chinook Salmon and steelhead, and would improve reporting efficiency and effectiveness.

- Implement the Lowther-Skalski model through the Basin TribPIT program to estimate juvenile emigrant steelhead survival rates to LGR. Develop this model for all sites included in this report.

- Validate the Oldemeyer (2015) model by populating it with historical data and compare those estimates with estimates obtained with the current methods. Refine the model and implement where warranted.

- Continue to add annual information to the historical adult-to-juvenile productivity data series for both Chinook Salmon and steelhead populations presented in this report. Refine historical information as existing datasets are verified and estimation methods are improved.

ACKNOWLEDGEMENTS

We are grateful to the Bonneville Power Administration, especially our contracting officer's technical representative Russell Scranton, for partial project funding and support through project 1990-055-00: Idaho Salmon and Steelhead Monitoring and Evaluation Studies. Additional funding and support was provided by the Pacific States Marine Fisheries Commission through the Intensively Monitored Watersheds program (Monitoring State Restoration of Salmon Habitat in the Columbia basin, contract 12-10), and Pacific Coast Salmon Recovery Fund (project 006 15CW). Operation of the Rapid River weir and trap tender time for steelhead was funded by Idaho Power Company. Fieldwork was conducted by the following personnel, listed by administrative region: Clearwater Region (Jason Fortier, Kristina Morben, Elizabeth Kennedy, Ashley Hayes, Cecilia Spangler, Patrick Vrablik, John Jonet, Ryan Carrow, McLain Westra); McCall office of the Southwest Region (Katie Wauhkonen, Lauren Ralbovsky, Trent Foky, and Luke Brooks); Salmon Region (Eric Geisthardt, Courtnie Ghere, Taylor L. Morlan, Jonah Keith, Vasili Luzanau, Sam Zabronski, and Quinn Richard); and Nampa Research Office (Ron Roberts, Parks Crownover, Joseph Hirsch, Mack Woodruff, Travis Landon, Veronica Musso). Scale ageing was conducted by the Nampa Research Anadromous Ageing Laboratory personnel (Karen Gregory, Tyler Zumwalt, and Leslie Reinhardt). Idaho Department of Fish and Game Information Systems Bureau, especially Chris Harrington, provided technical oversight for the emigrant trapping dataset and developed the Jtrap Uploader program. This report benefited from reviews by Tim Copeland and Bill Schrader. Cheryl Leben helped format and edit the document.

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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; ICTRT 2003, 2005; NMFS 2011).

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]

Table 1. Continued.

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 River 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]	

[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 season and age from rotary screw traps (RST) operated in the Salmon River and Clearwater River basins, Idaho during calendar year 2020. Instances where no estimate was made are noted NE.

Major Population Group, RST location and PTAGIS code	Season and age	Trap Catch	Point Estimate	Lower 95% CI	Upper 95% CI
South Fork Salmon River					
Rapid River	Spring age-1	0	NE	NE	NE
RPDTRP	Spring age-0	2	NE	NE	NE
	Summer age-0	25	NE	NE	NE
	Fall age-0	35	NE	NE	NE
	Total	**62**	**NE**	**NE**	**NE**
Lower South Fork Salmon River	Spring age-1	885	24,589	16,709	55,309
SFSRKT	Spring age-0	167	NE	NE	NE
	Summer age-0	1136	18,376	13,876	26,151
	Fall age-0	8248	101,870	89,636	127,480
	Total	**10,436**	**144,835**	**120,221**	**208,940**
Middle Fork Salmon River					
Big Creek	Spring age-1	0	NE	NE	NE
BIG2CT	Spring age-0	0	NE	NE	NE
	Summer age-0	248	2,241	1,577	3,871
	Fall age-0	5,985	47,057	43,415	51,739
	Total	**6,223**	**49,289**	**44,992**	**55,610**
Lower Marsh Creek	Spring age-1	176	2,700	1,800	6,975
MARTR2	Spring age-0	160	1,556	778	4,669
	Summer age-0	975	17,199	12,636	28,973
	Fall age-0	1,582	25,308	21,324	32,301
	Total	**2,893**	**46,763**	**36,538**	**72,918**
Upper Salmon River					
North Fork Salmon River	Spring age-1	356	1,609	1,352	1,986
NFSTRP	Spring age-0	0	NE	NE	NE
	Summer age-0	34	NE	NE	NE
	Fall age-0	1,576	6,124	5,626	6,765
	Total	**1,966**	**7,733**	**6,978**	**8,751**
Upper Lemhi River	Spring age-1	511	4,942	3,722	8,467
LEMTRP	Spring age-0	35	558	279	1,116
	Summer age-0	20	47	32	84
	Fall age-0	1,499	15,228	13,247	18,637
	Total	**2,065**	**20,775**	**17,280**	**28,304**
Hayden Creek	Spring age-1	113	408	302	650
HAYTRP	Spring age-0	46	47	23	94
	Summer age-0	83	288	168	672
	Fall age-0	1,299	7,344	6,431	9,227
	Total	**1,541**	**8,087**	**6,924**	**10,643**

Table 2. Continued.

Major Population Group, RST location and PTAGIS code	Season and age	Trap Catch	Point Estimate	Lower 95% CI	Upper 95% CI
Lower Lemhi River	Spring age-1	2,836	8,978	8,317	9,796
LLRTP	Spring age-0	34	136	68	546
	Summer age-0	15	35	21	69
	Fall age-0	4,500	24,366	22,685	26,317
	Total	**7,385**	**33,515**	**31,091**	**36,728**
Upper Salmon River	Spring age-1	363	4,752	3,427	11,169
SAWTRP	Spring age-0	204	NE	NE	NE
	Summer age-0	186	4,648	2,712	10,846
	Fall age-0	131	2,860	1,560	8,580
	Total	**884**	**12,260**	**7,699**	**30,595**
Pahsimeroi River	Spring age-1	125	1,575	984	3,150
PAHTRP	Spring age-0	175	4,400	2,566	10,267
	Summer age-0	25	NE	NE	NE
	Fall age-0	100	3,367	1,683	10,100
	Total	**425**	**9,342**	**5,233**	**23,517**
Dry Clearwater River					
Crooked River	Spring age-1	16	NE	NE	NE
CROTRP	Spring age-0	0	NE	NE	NE
	Summer age-0	3	NE	NE	NE
	Fall age-0	6	NE	NE	NE
	Total	**25**	NE	NE	NE
Big Bear Creek	Spring age-1	NE	NE	NE	NE
BBCTRP	Spring age-0	NE	NE	NE	NE
	Summer age-0	NE	NE	NE	NE
	Fall age-0	NE	NE	NE	NE
	Total	**NE**	**NE**	**NE**	**NE**
East Fork Potlatch	Spring age-1	NE	NE	NE	NE
EFPTRP	Spring age-0	NE	NE	NE	NE
	Summer age-0	NE	NE	NE	NE
	Fall age-0	NE	NE	NE	NE
	Total	**NE**	**NE**	**NE**	**NE**
Wet Clearwater River					
Fish Creek	Spring age-1	NE	NE	NE	NE
FISTRP	Spring age-0	NE	NE	NE	NE
	Summer age-0	NE	NE	NE	NE
	Fall age-0	NE	NE	NE	NE
	Total	**NE**	**NE**	**NE**	**NE**
Lower Lochsa River	Spring age-1	362	NE	NE	NE
LOCTRP	Spring age-0	2	NE	NE	NE
	Summer age-0	14	NE	NE	NE
	Fall age-0	49	NE	NE	NE
	Total	**425**	**NE**	**NE**	**NE**

Table 3. Estimated abundance of emigrants at each rotary screw trap (RST), survival to Lower Granite Dam (LGR), and estimated smolt abundance at LGR for brood year 2018 wild juvenile Chinook Salmon from the Salmon River and Clearwater River basins, Idaho. Instances where no estimate was made are noted 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					
Lower South Fork	Spring age-0	NE	0	NE	NE
Salmon River	Summer age-0	45,441	1,306	0.235 (0.074)	10,660
SFSRKT	Fall age-0	58,871	3,870	0.312 (0.058)	18,362
	Spring age-1	24,589	798	0.917 (0.300)	22,555
	BY Total	**128,901**	**5,974**	**0.400**	**51,578**
Middle Fork Salmon River					
Big Creek	Spring age-0	NE	0	NE	NE
BIGC2T	Summer age-0	6,558	342	0.324 (0.236)	2,122
	Fall age-0	35,903	3,714	0.452 (0.109)	16,225
	Spring age-1	NE	0	NE	NE
	BY Total	**42,461**	**4,056**	**0.432**	**18,346**
Lower Marsh Creek	Spring age-0	7,774	26	NE	NE
MARTR2	Summer age-0	81,886	1,614	0.282 (0.137)	23,124
	Fall age-0	36,356	2,677	0.460 (0.146)	16,731
	Spring age-1	2,700	175	0.377 (0.217)	1,018
	BY Total	**128,716**	**4,492**	**0.338**	**40,874**
Upper Salmon River					
North Fork Salmon River	Spring age-0	NE	0	NE	NE
NFSTRP	Summer age-0	234	18	0.000 (0.000)	0
	Fall age-0	13,903	2,870	0.320 (0.023)	4,450
	Spring age-1	1,609	354	0.585 (0.131)	941
	BY Total	**15,746**	**3,242**	**0.348**	**5,391**
Lemhi River weir	Spring age-0	3,696	119	0.151 (0.117)	559
LEMTRP	Summer age-0	452	123	0.195 (0.071)	88
	Fall age-0	26,372	3,530	0.331 (0.023)	8,716
	Spring age-1	4,942	508	0.899 (0.122)	4,445
	BY Total	**35,462**	**4,280**	**0.389**	**13,808**
Hayden Creek	Spring age-0	4,414	0	NE	NE
HAYTRP	Summer age-0	NE	4	NE	NE
	Fall age-0	3,272	555	0.395 (0.097)	1,292
	Spring age-1	408	113	0.904 (0.203)	369
	BY Total	**8,094**	**672**	**0.451**	**1,661**
Lower Lemhi River	Spring age-0	1,084	77	NE	NE
LLRTP	Summer age-0	298	56	0.069 (0.479)	21
	Fall age-0	37,900	1,894	0.400 (0.033)	15,145
	Spring age-1	8,978	1,553	0.718 (0.047)	6,446
	BY Total	**48,260**	**3,580**	**0.448**	**21,612**
Upper Salmon River	Spring age-0	NE	0	NE	NE
SAWTRP	Summer age-0	15,400	226	0.111 (0.057)	1,703
	Fall age-0	2,677	406	0.222 (0.065)	593
	Spring age-1	4,752	367	0.575 (0.095)	2,731
	BY Total	**22,829**	**999**	**0.220**	**5,028**

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
Pahsimeroi River	Spring age-0	4,776	380	0.105 (0.035)	511
PAHTRP	Summer age-0	1,001	88	0.165 (0.068)	165
	Fall age-0	11,756	1,000	0.389 (0.070)	4,570
	Spring age-1	1,575	125	0.698 (0.267)	1,100
	BY Total	**19,109**	**1,593**	**0.332**	**6,346**
Dry Clearwater River					
Crooked River	Spring age-0	NE	0	NE	NE
CROTRP	Summer age-0	NE	4	NE	NE
	Fall age-0	2,221	513	0.266 (0.012)	590
	Spring age-1	NE	16	0.438 (0.124)	NE
	BY Total	**2,221**	**533**	**0.266**	**590**

Table 4. Estimated adult-to-juvenile productivity of wild juvenile Chinook Salmon for brood year (BY) 2018, expressed as both emigrants at rotary screw trap (RST) per female spawner and smolts at Lower Granite Dam (LGR) per female spawner. Instances where no estimates were made are noted NE.

Major Population Group and trap location, and PTAGIS site code	Female adults	Emigrants at trap	Emigrants /female	Smolts to LGR	Smolts at LGR / female
		Salmon River Basin			
South Fork Salmon River					
Rapid River RPDTRP	NE	NE	NE	NE	NE
Lower South Fork Salmon River SFSRKT	288[c]	128,901	448	51,578	179
Middle Fork Salmon River					
Big Creek BIG2CT	48[a]	42,461	885	18,346	382
Lower Marsh Creek MARTR2	125[b]	128,716	1,030	40,874	327
Upper Salmon River					
North Fork Salmon River NFSTRP	20[a]	15,746	787	5,391	270
Lemhi River (upper) LEMTRP	90[b]	35,462	394	13,808	153
Hayden Creek HYDTRP	37[a]	8,094	99	1,661	45
Lower Lemhi River LLRTP	128[a][b]	48,260	377	21,612	169
Upper Salmon River SAWTRP	59[c]	22,829	387	5,028	85
Pahsimeroi River PAHTRP	159[c]	19,109	120	6,346	40
		Clearwater River Basin			
Dry Clearwater River					
Crooked River CROTRP	0	2,221	NA	590	NA

a Data source: IDFG index (single pass) redd survey.
b Data source: Census (multi-pass) redd surveys.
c Data source: Females passed upstream from weir.

Table 5. Rotary screw trap (RST) catch and emigrant abundance estimates, with 95% confidence intervals (CI) for wild juvenile steelhead >80 mm FL, by season during 2020. Instances where no estimate was made are noted NE.

Population, trap location and PTAGIS site code	Season	Catch	Emigration estimate	Lower 95% CI	Upper 95% CI
	Salmon River Basin				
Little Salmon River					
Rapid River	Spring	103	494	353	760
RPDTRP	Sum/Fall	58	438	256	1,023
	Total	161	932	694	1,604
South Fork Salmon River					
Lower South Fork Salmon River	Spring	199	4,371	2,550	10,200
SFSRKT	Sum/Fall	547	14,451	9,951	26,639
	Total	746	18,822	12,501	36,839
Lower Middle Fork Salmon River					
Big Creek	Spring	0	NE	NE	NE
BIG2CT	Sum/Fall	984	31,446	23,735	49,172
	Total	984	31,446	23,735	49,172
Upper Middle Fork Salmon River					
Lower Marsh Creek	Spring	37	NE	NE	NE
MARTR2	Sum/Fall	65	NE	NE	NE
	Total	102	NE	NE	NE
North Fork Salmon River					
North Fork Salmon River	Spring	97	1,358	792	3,169
NFSTRP	Sum/Fall	406	2,762	2,270	3,772
	Total	503	4,120	3,377	6,333
Lemhi River					
Upper Lemhi River	Spring	57	541	295	1,624
LEMTRP	Sum/Fall	552	6,939	5,332	11,039
	Total	609	7,480	5,627	12,663
Hayden Creek	Spring	344	2,746	2,158	3,925
HYDTRP	Sum/Fall	151	1,152	820	2,052
	Total	495	3,898	2,978	5,977
Lower Lemhi River	Spring	320	2,930	2,255	4,349
LLRTP	Sum/Fall	394	4,091	2,998	6,874
	Total	714	7,021	5,253	11,223
Upper Salmon River mainstem					
Upper Salmon River	Spring	202	3,476	2,139	9,270
SAWTRP	Sum/Fall	369	5,643	2,821	22,570
	Total	571	9,119	5,911	26,046
Pahsimeroi River					
Pahsimeroi River	Spring	83	2,324	1,162	6,972
PAHTRP	Sum/Fall	145	4,205	2,336	10,512
	Total	228	6,529	4,079	17,484

Table 5. Continued

Population, trap location and PTAGIS site code	Season	Catch	Emigration estimate	Lower 95% CI	Upper 95% CI
	Clearwater River Basin				
South Fork Clearwater River					
Crooked River	Spring	6	NE	NE	NE
CROTRP	Sum/Fall	83	672	420	1,344
	Total	89	672	420	1,344
Lower Clearwater Mainstem					
Big Bear Creek	Spring	1,141	8,589	7,306	11,191
BBCTRP	Sum/Fall	NE	NE	NE	NE
	Total	1,141	8,589	7,306	11,191
East Fork Potlatch River	Spring	83	2,184	1,092	6,552
EFPTRP	Sum/Fall	NE	NE	NE	NE
	Total	83	2,184	1,092	6,552
Lochsa River					
Fish Creek	Spring	25	312	156	624
FISTRP	Sum/Fall	1,101	4,435	3,887	5,164
	Total	1,126	4,747	4,043	5,788
Lower Lochsa River	Spring	528	42,320	23,511	105,800
LOCTRP	Sum/Fall	76	531	310	1,240
	Total	589	42,851	23,924	106,730

Table 6. Seasonal age composition estimates of juvenile steelhead >80 mm FL in 2020 from rotary screw traps (RST) operated in the Salmon River and Clearwater River basins, Idaho.

Population, RST location and PTAGIS site code	Season	Total Aged	Estimated emigrant abundance by age						Total Est
			Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	
Little Salmon River									
Rapid River	Spring	82	0	6	90	337	54	0	494
RPDTRP	Sum/Fall	50	0	105	272	53	9	0	438
South Fork Salmon River									
Lower South Fork Salmon River	Spring	150	0	2,127	612	1,457	175	0	4,371
SFSRKT	Sum/Fall	144	502	9,634	3,512	803	0	0	14,451
Lower Middle Fork Salmon River									
Big Creek	Spring[a][b]	0	NA	NA	NA	NA	NA	NA	NA
BIG2CT	Sum/Fall	385	0	4,737	24,258	2,450	0	0	31,446
Upper Middle Fork Salmon River									
Lower Marsh Creek	Spring[b]	29	NA	NA	NA	NA	NA	NA	NA
MARTR2	Sum/Fall[b]	22	NA	NA	NA	NA	NA	NA	NA
North Fork Salmon River									
North Fork Salmon River	Spring	54	0	578	352	251	176	0	1,358
NFSTRP	Sum/Fall	186	0	1,336	1,129	282	15	0	2,762
Lemhi River									
Upper Lemhi River	Spring	46	0	329	165	35	12	0	541
LEMTRP	Sum/Fall	339	0	6,345	553	41	0	0	6,939
Lower Lemhi River	Spring	80	0	1,758	989	110	73	0	2,930
LLRTRP	Sum/Fall	221	0	3,202	796	93	0	0	4,091
Hayden Creek	Spring	132	0	83	1,997	666	0	0	2,746
HYDTRP	Sum/Fall	104	222	476	388	66	0	0	1,152
Upper Salmon River mainstem									
Upper Salmon River									
SAWTRP	Spring	135	0	1,442	1,828	180	26	0	3,476
	Sum/Fall	59	1,148	3,156	1,339	0	0	0	5,643

Table 6. Continued.

Population, RST location and PTAGIS site code	Season	Total Aged	Estimated emigrant abundance by age						Total Est
			Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	
Pahsimeroi River	Sum/Fall	59	1,148	3,156	1,339	0	0	0	5,643
Pahsimeroi River PAHTRP	Spring	64	0	1,561	690	73	0	0	2,324
	Sum/Fall	138	1,798	2,163	244	0	0	0	4,205
South Fork Clearwater River									
Crooked River	Spring[a][b]	5	NA	NA	NA	NA	NA	NA	NA
CROTRP	Sum/Fall	66	0	213	427	30	0	0	672
Lower Clearwater River Mainstem									
East Fork Potlatch River EFPTRP	Spring[a]	22	227	1,499	415	43	0	0	2,184
Big Bear Creek BBCTRP	Spring	206	0	4,544	3,377	625	42	0	8,589
Lochsa River									
Fish Creek	Spring[a]	10	1	116	171	22	3	0	312
FISTRP	Sum/Fall	192	0	2,356	1,756	300	23	0	4,435
Lochsa River	Spring[b]	261	NA	NA	NA	NA	NA	NA	NA
LOCTRP	Sum/Fall	63	0	405	118	8	0	0	531

a) Age was determined for fewer than 30 fish, thus age proportions are based off of average of prior years with greater than 30 fish aged.
b) No abundance estimate due to low catch or recaptures.

Table 7. Parameter estimates for wild Chinook Salmon Beverton-Holt stock recruit curves. “Recruits” are represented by smolts at Lower Granite Dam, and “stock” are wild redds above traps or female spawners above traps estimated using mark-recapture techniques. Alpha/beta is the estimated asymptote.

Major population group, trap location, and PTAGIS code	Brood years in analysis	α	β	α/β
Middle Fork Salmon River				
Big Creek BIG2CT	2006-2018	376.7	0.001	344,156
Lower Marsh Creek MARTR2	2009-2018	249.0	0.0005	496,524
Upper Salmon River				
Upper Lemhi River LEMTRP	1991-2018	113.0	0.002	52,107
Pahsimeroi River PAHTRP	1992-2018	182.7	0.008	22,341
Upper Salmon River SAWTRTP	1992-1994, 1996-2018	207.4	0.004	48,723

Table 8. Season and life stage of Pacific Lamprey captured in rotary screw traps (RST) operated in the Salmon River and Clearwater River basins, Idaho during calendar year 2020. Only RST that captured Pacific Lamprey are included.

Major Population Group, RST location and PTAGIS code	Season	Life stage	Trap Catch	Mean length (mm)	Length range (mm)
South Fork Salmon River					
Lower South Fork Salmon River SFSRKT	Spring*	Ammocoete	904	141.4	32-177
		Macrophthalmia	202	149.0	134-168
	Summer*	Ammocoete	107	132.5	72-160
		Macrophthalmia	23	139.0	NA[(a)]
	Fall*	Ammocoete	9	144.4	128-154
		Macrophthalmia	0	NA	NA
	Total		**1,245**		
Wet Clearwater River					
Lower Lochsa River LOCTRP	Spring*	Ammocoete	78	149.5	135-162
		Macrophthalmia	1	140.0	NA
	Summer*	Ammocoete	0	NA	NA
		Macrophthalmia	0	NA	NA
	Fall*	Ammocoete	1	133.0	NA
		Macrophthalmia	0	NA	NA
	Total		**80**		

*Spring = start of trapping-6/30; Summer = 7/1-8/31; Fall = 9/1-end of trapping.
a) Did not take lengths on 22 of 23.

FIGURES

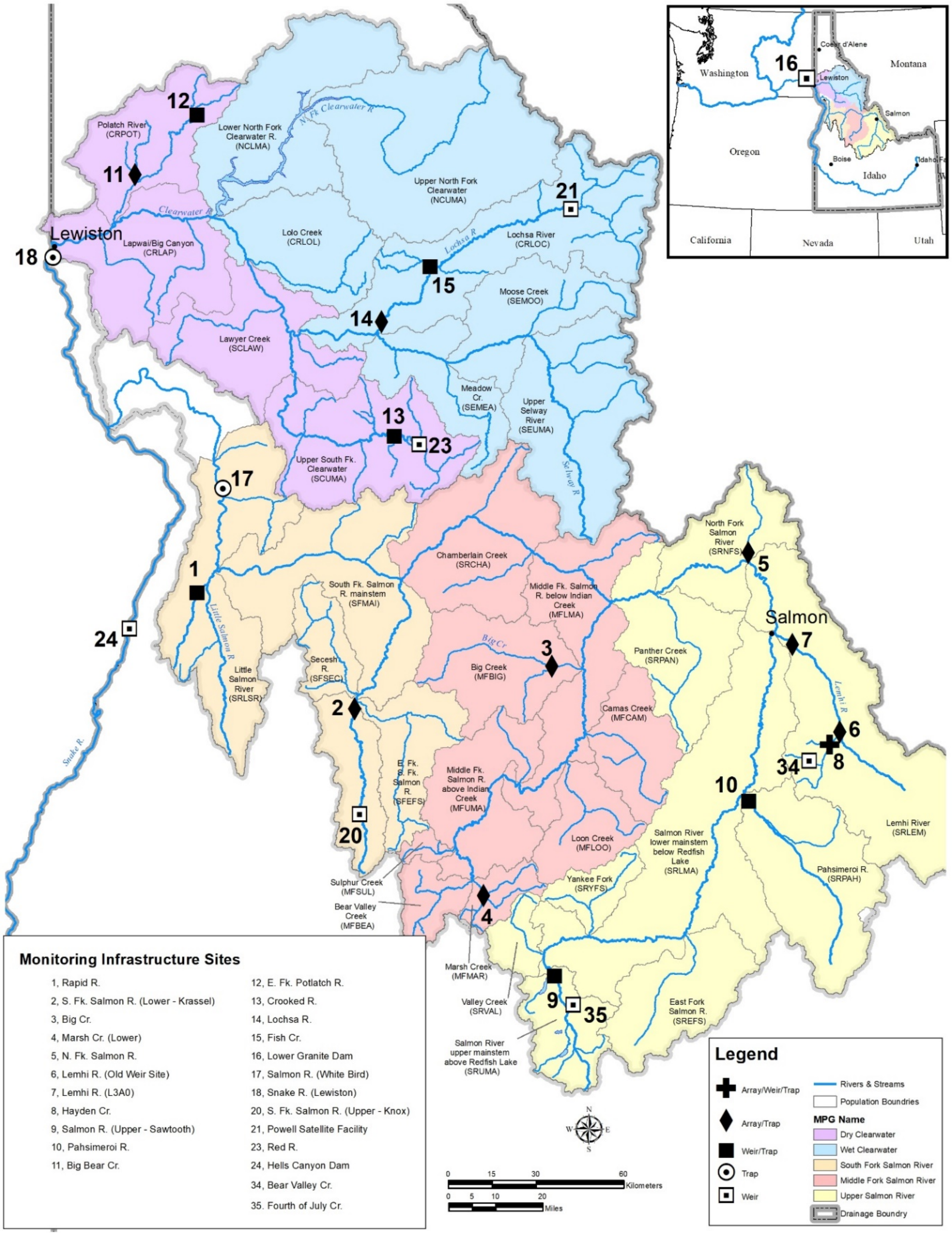

Figure 1. Location of rotary screw traps, weirs, and PIT arrays operated by IDFG in 2020 with reference to spring/summer Chinook Salmon population structure. Numbers correspond to infrastructure sites in the lower left inset. Chinook Salmon major population groups are highlighted and independent populations are delineated.

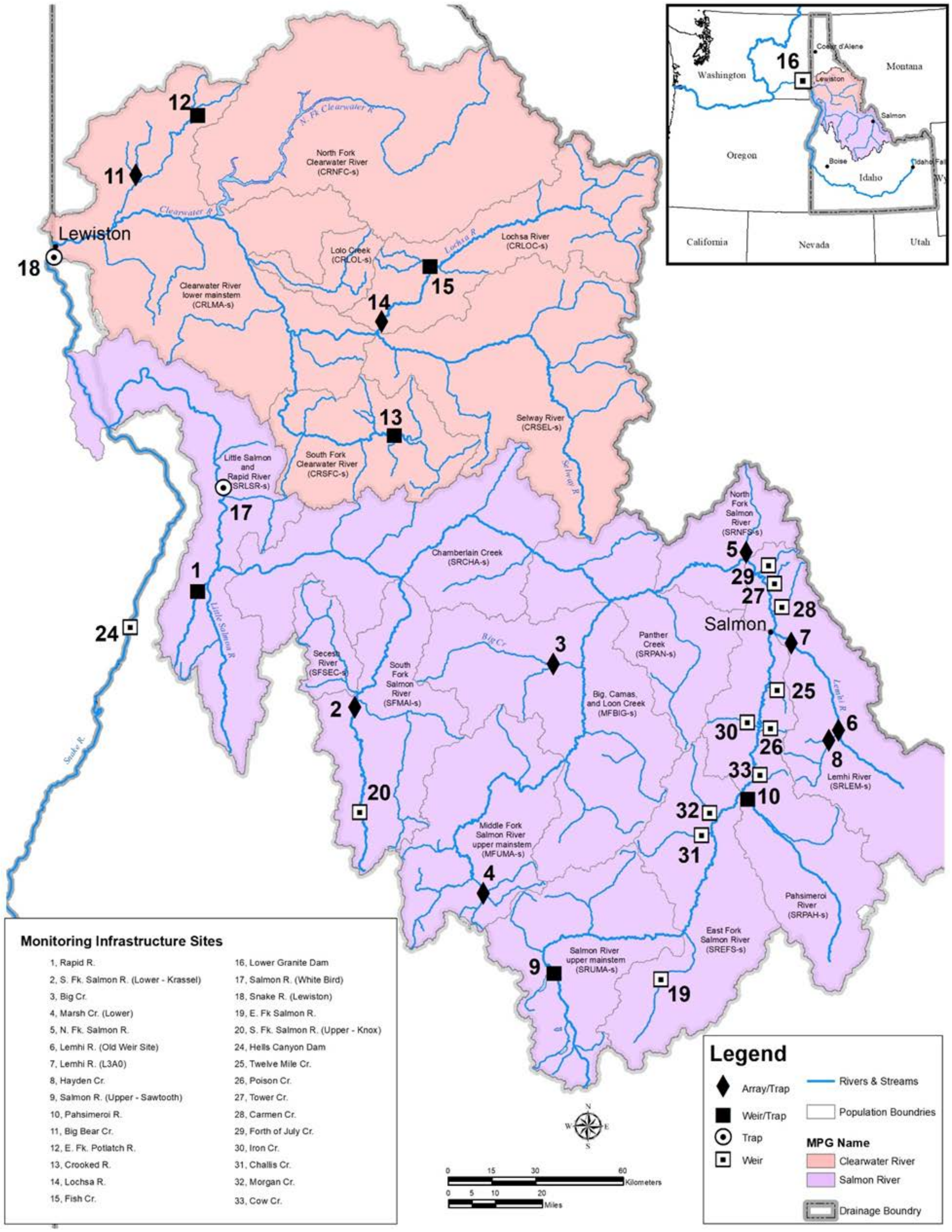

Figure 2. Location of rotary screw traps, weirs, and PIT arrays operated by IDFG in 2020 with reference to steelhead population structure. Numbers correspond to infrastructure sites in the lower left inset. Steelhead major population groups are highlighted and independent populations are delineated.

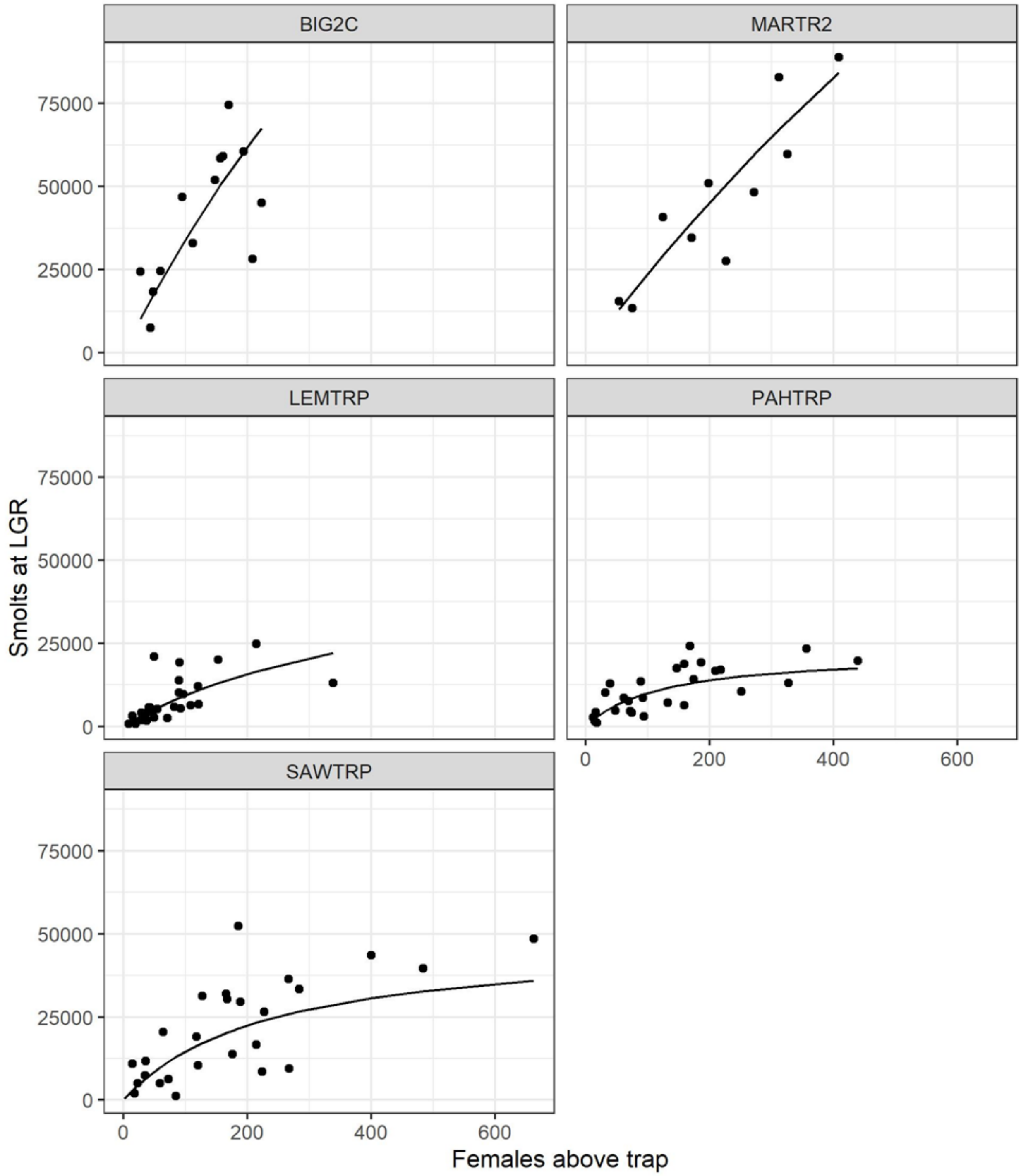

Figure 3. Relationship between wild Chinook Salmon smolts at Lower Granite Dam (LGR) and adult female spawner abundance (all redds above trap) for Chinook Salmon in Big Creek (brood years (BY 2006-2018) and Marsh Creek (BY 2009-2018) in the Middle Fork Salmon River MPG, Pahsimeroi River, Lemhi River, and the Upper Salmon River (BY 1992-2018).

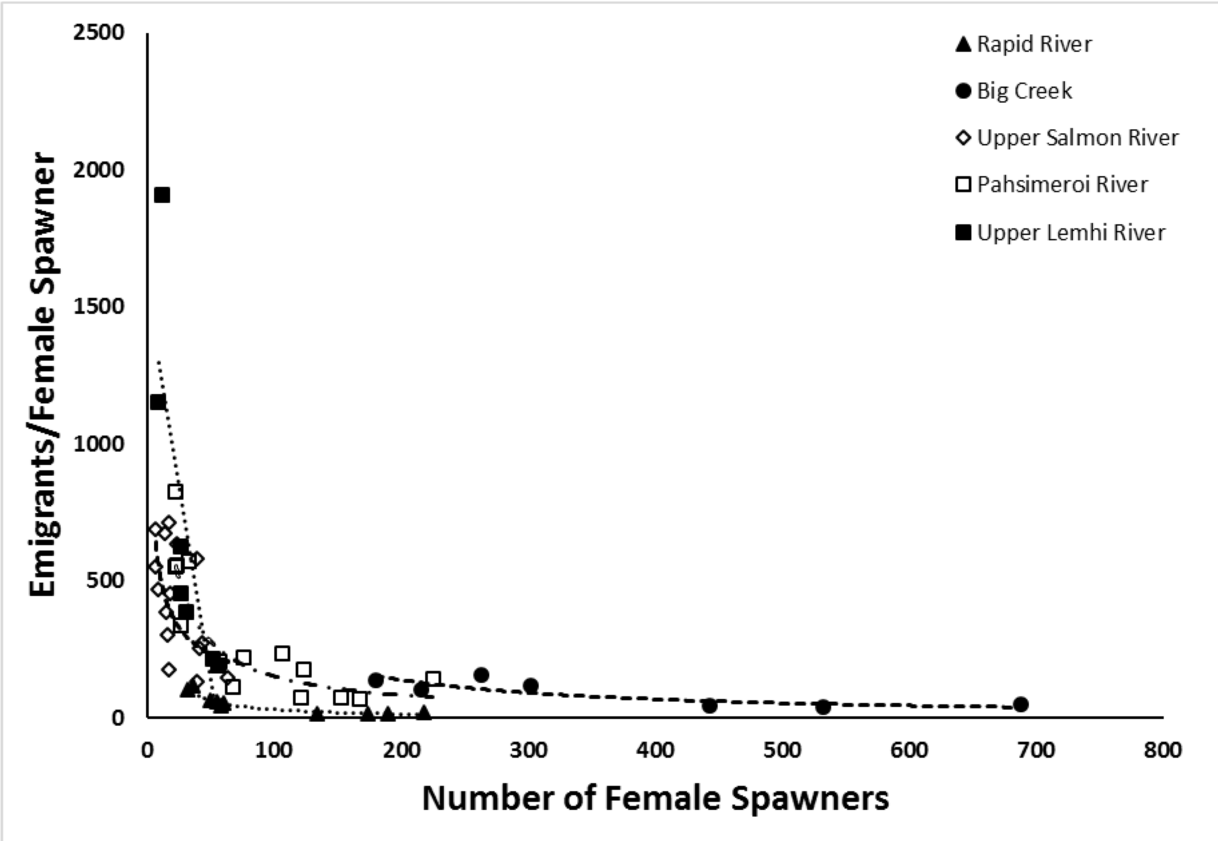

Figure 4. Relationship between wild steelhead emigrant productivity (recruits per spawner expressed as emigrants above the trap/ female spawner above the trap or array) and adult female spawner abundance above the trap or array from Rapid River (brood years 2006-2016), Big Creek (brood years 2010-2016), Upper Salmon River (brood years 2001-2016), Pahsimeroi River (brood years 2001-2016), and Lemhi River (brood years 2010-2016). Trend lines fit with a power function are shown for each data set.

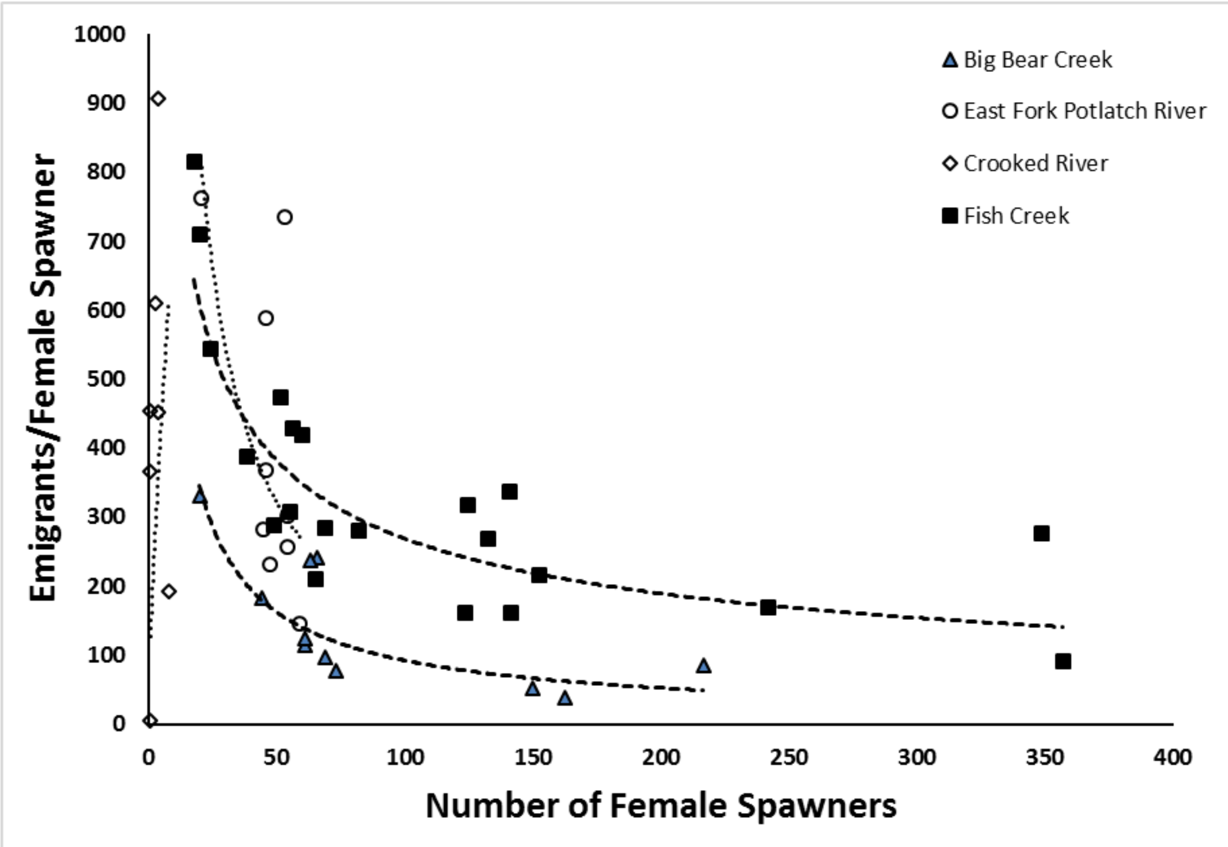

Figure 5. Relationship between wild juvenile steelhead productivity (recruits per spawner expressed as emigrants above the trap/ female spawner) and adult female spawner abundance above the trap or array for steelhead populations from Big Bear Creek (brood years 2005-2016), East Fork Potlatch River (brood years 2008-2016), Crooked River (brood years 2007-2016), Fish Creek (brood years 1996-2016). Trend lines fit with a power function are shown for each data set.

APPENDICES

Appendix A. Rotary screw traps (RSTs) operated by Idaho Department of Fish and Game in 2020 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), Intensively Monitored Watershed (IMW), and Integrated Status and Effectiveness Monitoring Project (ISEMP).

Map reference number	Trap location (PTAGIS code)	Chinook Salmon MPG / *population*	Steelhead Trout MPG / *population*	Funding project	Years of operation	Adult escapement infrastructure
			Salmon River Basin			
1	Rapid River (RPDTRP)	**South Fork Salmon River /** *Little Salmon River*	**Salmon River /** *Little Salmon River*	ISMES	2007-2020	Permanent weir
2	Lower South Fork Salmon River (SFSRKT)	**South Fork Salmon River /** *South Fork Salmon River*	**Salmon River** / *South Fork Salmon River*	INPMEP	2015-2020	PIT array
3	Big Creek (BIG2CT)	**Middle Fork Salmon River /** *Big Creek*	**Salmon River** / *Lower Middle Fork Salmon River*	ISMES	2007-2020	PIT array
4	Lower Marsh Creek (MARTR2)	**Middle Fork Salmon River** / *Marsh Creek*	**Salmon River /** *Upper Middle Fork Salmon River*	INPMEP	2009-2020	None
5	North Fork Salmon River (NFSTRP)	**Upper Salmon River /** *North Fork Salmon River*	**Salmon River /** *North Fork Salmon River*	ISMES	2015-2020	PIT array
6	Lemhi River (LEMTRP)	**Upper Salmon River /** *Lemhi River*	**Salmon River /** *Lemhi River*	IMW	1992-2020	PIT array
7	Lower Lemhi River (LLRTP)	**Upper Salmon River /** *Lemhi River*	**Salmon River /** *Lemhi River*	ISEMP	2013-2020	PIT array
8	Hayden Creek (HYDTRP)	**Upper Salmon River /** *Lemhi River*	**Salmon River /** *Lemhi River*	IMW	2006-2020	PIT array
9	Upper Salmon River (SAWTRP)	**Upper Salmon River /** *Upper Salmon River mainstem*	**Salmon River** / *Upper Salmon River mainstem*	INPMEP	1992-2020	Permanent weir
10	Pahsimeroi River (PAHTRP)	**Upper Salmon River** / *Pahsimeroi River*	**Salmon River** */ Pahsimeroi River*	INPMEP	1992-2020	Permanent weir

Appendix A. Continued.

Map reference number	Trap location (PTAGIS code)	Chinook Salmon MPG / *population*	Steelhead Trout MPG / *population*	Funding project	Years of operation	Adult escapement infrastructure
		Clearwater River Basin				
11	Big Bear Creek (BBCTRP)	**Dry Clearwater River /** *Upper South Fork Clearwater River*	**Clearwater River /** *Lower Clearwater Mainstem*	IMW	2004-2020	PIT array
12	East Fork Potlatch River (EFPTRP)	**Dry Clearwater River /** *Upper South Fork Clearwater River*	**Clearwater River /** *Lower Clearwater Mainstem*	IMW	2007-2020	Seasonal weir
13	Crooked River (CROTRP)	**Dry Clearwater River /** *Upper South Fork Clearwater River*	**Clearwater River /** *South Fork Clearwater River*	ISMES	1990-2020	Seasonal weir
14	Lower Lochsa River (LOCTRP)	**Wet Clearwater River /** *Lochsa River*	**Clearwater River** / *Lochsa River*	ISMES	2015-2020	PIT array
15	Fish Creek (FISTRP)	**Wet Clearwater River /** *Lochsa River*	**Clearwater River** / *Lochsa River*	ISMES	1995-2020	Seasonal weir

Appendix B. Rotary screw trap (RST) operations in the Salmon River and Clearwater River basins, Idaho for 2020, with a brief summary of operations and logistical issues that possibly affected estimation of juvenile Chinook Salmon and steelhead emigrants.

	Trap Operation		
Location (PTAGIS site code)	**Date range (mm/dd)**	**Total days operated / total days in date range**	**Operation summary and logistical issues**
Salmon River basin			
Rapid River (RPDTRP)	04/24 – 10/28	149/176	The trap did not operate until after the hatchery smolt release in late April. It was not in operation for 20 days due to high water. The trap fished intermittently for a several days the spring because of heavy debris and logs in the cone.
Lower South Fork Salmon River (SFSRKT)	03/16 – 11/09	161/239	The trap did not operate for 10 days following the hatchery smolt release and was pulled for high water on 4/29. The trap was shut down for 47 days due to high water. After the trap was redeployed there were no operations for 6 days due to mandatory training, debris, and icy conditions. The trap ceased fishing on 11/9 due to onset of winter conditions.
Big Creek (BIG2CT)	06/28 – 11/07	128.5/133	The Big Creek trap was not installed during the spring season due to COVID-19 restrictions. The trap was installed on 6/26. The trap had no operations for 1.5 days due to debris and for 3 days due to icy conditions. The trap ceased fishing on 11/7 due to onset of winter conditions.
Lower Marsh Creek (MARTR2)	03/23 – 11/01	165/222	The trap was pulled for 46 days during spring runoff and 3 days in mid-September due to fire activity and blocked access. Freezing conditions prevented the trap from fishing for 3 days in late October.
North Fork Salmon River (NFSTRP)	03/28 – 11/06	142.5/224	The trap was launched later than normal due to delays from potential COVID-19 exposures. From 5/03 – 07/10 the trap was not operated due to the potential for trap destruction as a result of high seasonal flows. The trap was not operated during several days in late October and early November as a result of the trap freezing during a drop in temperature. Additionally, on multiple occasions the trap was not operating due to logs jams, et cetera.
Lemhi River Weir (LEMTRP)	03/26 – 11/18	215.5/237	The upper Lemhi trap was installed on 3/26/2020 and ceased operations on 11/18/2020. The trap operated for 215.5 days (210 full and 11 partial days). The trap operated intermittently between 10/15 and 10/30 as a result of debris.

Appendix B. Continued

Location (PTAGIS site code)	Date range (mm/dd)	Trap Operation Total days operated / total days in date range	Operation summary and logistical issues
Hayden Creek (HYDTRP)	03/30 – 11/18	163.5/233	The Hayden Creek trap was installed 3/30/2020 and ceased operations on 11/18/2020. The trap operated for 163.5 days (155 full and 17 partial days). The trap was inoperable for a total of 62 days. The trap operated intermittently in April due to low flows and in June due to high flows. Similarly, the trap was operated intermittently in September and in late October through mid-January as a result of debris and ice.
Lower Lemhi River (LLRTP)	03/10 – 11/22	243/257	The lower Lemhi River trap was installed on 3/10/20 and ceased operations on 11/22/2020. The trap operated for 243 days (237 full and 12 partial days). The trap was inoperable for four days in late May due to algae and debris. Additionally, the trap was not operated for short periods of time throughout the month of June due to high flows.
Upper Salmon River (SAWTRP)	03/21 – 11/01	220/226	The trap was not in operation for 3.5 days in April due to the hatchery release of integrated brood Chinook smolts. During high water, the trap remained fishing but was pulled out of the main current.
Pahsimeroi River (PAHTRP)	04/01 – 11/19	203.5/233	The trap was not operated for 23 days in April due to hatchery release of juvenile Chinook Salmon from 04/07 – 04/30. For a period of 5 days (09/10 – 09/15) the trap was not operated due to a staffing shortage as a result for hiring restrictions (i.e., COVID-19) as employees were needed to conduct Chinook spawning ground surveys. Additionally, on one occasion the trap was found to be jammmed.
Big Bear Creek (BBCTRP)	03/03 – 06/06	93/95	Trap was not operated for 2 days due to personnel availability.
East Fork Potlatch River (EFPTRP)	03/03 – 06/06	93/95	Trap was not operated for 2 days due to personnel availability.
Crooked River (CROTRP)	040/8 – 11/08	190/215	Trap was installed later than normal due to COVID-19 restrictions. Trap was not operated for 25 days primarily during the spring and summer due to high flow and debris and personnel availability issues.
Fish Creek (FISTRP)	03/10 – 11/03	229/239	Trap did not operate for 18 days in May due to damages caused by high flows, repairs could not be made until water level went down.
Lower Lochsa (LOCTRP)	03/07-11/03	191/242	The trap did not operate for 10 days after a hatchery smolt release mid-March. It was not in operation for 38 days in late July/early August due to high temperatures. Freezing conditions prevented the trap from being fished for 13 days in late October.

Appendix C. Seasonal catch of juvenile steelhead <80 mm FL from rotary screw traps (RSTs) operated in streams in Idaho in 2020.

Population, location and PTAGIS site code	Season	Catch
Little Salmon River		
Rapid River	Spring	8
RPDTRP	Sum/Fall	6
South Fork Salmon River		
Lower South Fork Salmon River	Spring	52
SFSRKT	Sum/Fall	264
Lower Middle Fork Salmon River		
Big Creek	Spring	0
BIG2CT	Sum/Fall	13
Upper Middle Fork Salmon River		
Lower Marsh Creek	Spring	8
MARTR2	Sum/Fall	43
North Fork Salmon River		
North Fork Salmon River	Spring	23
NFSTRP	Sum/Fall	4
Lemhi River		
Lemhi River	Spring	0
LEMTRP	Sum/Fall	3
Hayden Creek	Spring	37
HYDTRP	Sum/Fall	428
Lower Lemhi River	Spring	37
LLRTP	Sum/Fall	4
Upper Salmon River mainstem		
Upper Salmon River	Spring	65
SAWTRP	Sum/Fall	308
Pahsimeroi River		
Pahsimeroi River	Spring	1
PAHTRP	Sum/Fall	55
South Fork Clearwater River		
Crooked River	Spring	6
CROTRP	Sum/Fall	83
Lower Clearwater Mainstem		
East Fork Potlatch River	Spring	NA
EFPTRP	Sum/Fall	NA
Big Bear Creek	Spring	NA
BBCTRP	Sum/Fall	NA
Lochsa River		
Fish Creek	Spring	0
FISTRP	Sum/Fall	4
Lower Lochsa River	Spring	1
LOCTRP	Sum/Fall	0

Appendix D. Chinook Salmon abundance and productivity estimates by cohort.

Location	Brood Year	Abundance at RST	Emigrants per Redd/Female	Abundance at LGR	Smolts at LGR per Redd/Female
			Salmon River Basin		
South Fork Salmon	2014	102,681	210	27,314	56
	2015	90,453	245	24,109	65
	2016	178,845	391	48,198	105
	2017	89,419	497	34,393	191
	2018	128,901	448	51,578	179
Big Creek	2006	63,442	1,475	7,573	176
	2007	55,885	931	24,469	408
	2008	131,740	1,387	46,867	493
	2009	183,268	1,167	58,509	373
	2010	247,912	1,271	60,485	310
	2011	211,204	943	45,161	202
	2012	129,134	615	28,287	135
	2013	127,661	1,130	33,051	292
	2014	323,649	1,904	74,589	435
	2015	205,194	1,274	59,057	367
	2016	215,345	1,455	51,981	351
	2017	56,476	2,017	24,462	874
	2018	42,461	885	18,346	382
Marsh Creek	2010	366,082	1,126	59,733	184
	2011	499,303	1,600	82,888	266
	2012	323,548	1,634	51,029	258
	2013	224,927	1,315	34,638	203
	2014	587,266	1,439	88,978	218
	2015	315,545	1,160	44,014	162
	2016	151,505	670	27,625	121
	2017	60,170	1,114	15,446	281
	2018	128,716	1,030	40,874	327
North Fork Salmon River	2014	16,199	228	6,002	85
	2015	17,812	262	5,565	82
	2016	27,377	1,141	7,941	331
	2017	2,086	1,043	1,202	601
	2018	15,746	787	5,391	270
Upper Lemhi River	1996	6,790	234	4,071	140
	1997	46,950	939	20,970	419
	1998	12,755	311	5,673	138
	1999	13,654	284	4,573	95
	2000	14,743	159	5,384	58
	2001	46,696	138	13,082	39
	2002	19,424	159	6,667	55
	2003	8,570	121	2,566	36
	2004	10,216	341	3,859	129
	2005	7,743	155	2,730	55
	2006	4,843	127	1,706	45

Appendix D. Continued.

Location	Brood Year	Abundance at RST	Emigrants per Redd/Female	Abundance at LGR	Smolts at LGR per Redd/Female
Lemhi River cont.	2007	4,376	151	1,842	64
	2008	7,035	213	2,224	67
	2009	47,560	523	19,238	211
	2010	23,018	256	10,231	114
	2011	33,951	281	12,047	100
	2012	11,721	143	5,873	72
	2013	20,877	215	9,644	99
	2014	80,386	374	24,842	116
	2015	55,177	361	19,994	131
	2016	34,065	313	6,387	59
	2017	16,381	381	5,758	134
	2018	35,462	394	13,808	153
Hayden Creek	2005	3,369	241	1,037	74
	2006	9,110	701	2,650	204
	2007	55,223	1,781	7,026	227
	2008	11,777	1,309	4,617	513
	2009	18,430	1,084	2,847	167
	2010	32,961	891	5,733	155
	2011	20,013	294	5,490	81
	2012	28,039	1,078	3,703	142
	2013	7,860	231	2,172	64
	2014	77,221	1,058	3,895	53
	2015	63,389	409	12,452	80
	2016	43,792	796	6,068	110
	2017	2,315	193	661	55
	2018	8,094	99	1,661	45
Pahsimeroi River	1996	3,180	227	1,552	111
	1997	17,793	574	10,131	327
	1998	26,240	673	12,867	330
	1999	19,954	289	7,595	110
	2000	17,288	360	4,715	98
	2001	62,567	372	24,148	144
	2002	42,508	244	14,182	82
	2003	72,724	166	19,754	45
	2004	36,989	147	10,495	42
	2005	79,159	222	23,439	66
	2006	13,255	141	3,063	33
	2007	14,133	196	4,600	64
	2008	22,341	243	8,607	94
	2009	50,896	320	18,696	118
	2010	44,247	301	17,491	119
	2011	51,713	247	16,706	80
	2012	62,148	679	15,368	173
	2013	16,525	223	3,879	52
	2014	70,596	200	22,856	70
	2015	44,166	237	19,323	104
	2016	79,501	365	27,511	126

Appendix D. Continued.

Location	Brood Year	Abundance at RST	Emigrants per Redd/Female	Abundance at LGR	Smolts at LGR per Redd/Female
Pahsimeroi River cont.	2017	16,656	126	7,166	54
	2018	19,109	120	6,346	40
Upper Salmon River	1996	3,804	211	1,976	110
	1997	22,703	631	11,781	327
	1998[a]	35,618	2,375	10,982	732
	1999	17,015	740	5,047	219
	2000	106,597	635	30,291	180
	2001	351,651	727	39,624	82
	2002	441,082	665	48,503	73
	2003	235,254	588	43,650	109
	2004	236,914	887	36,336	136
	2005	295,396	1,588	52,317	281
	2006	135,547	1,059	31,342	245
	2007	80,711	1,261	19,161	299
	2008	94,687	802	20,405	173
	2009	150,729	908	25,506	154
	2010	144,768	766	28,665	152
	2011	153,147	672	26,519	116
	2012	135,031	475	33,463	118
	2013	30,354	416	6,361	87
	2014	57,039	213	9,546	36
	2015	80,286	664	10,441	86
	2016	99,055	461	16,582	77
	2017	52,301	297	13,809	78
	2018	22,829	387	5,028	85
			Clearwater River Basin		
Crooked River	1996	6,422	1,284	3,730	746
	1997	12,132	221	4,203	76
	1998	10,887	1,089	2,141	214
	1999	611	611	271	271
	2000	6,470	70	2,503	27
	2001	5,819	67	1,228	14
	2002	6,640	226	1,481	82
	2003	19,955	499	4,886	122
	2004	10,149	597	3,419	201
	2005	2,008	502	703	176
	2006	698	698	218	218
	2007	455	114	255	64
	2008	4,388	169	1,631	63
	2009	3,608	241	2,021	135
	2010	1,944	194	810	81
	2011	2,318	166	816	58
	2012	7,868	NE	1,705	NE
	2013	622	207	NE	NE
	2014	1,857	98	421	22
	2015	11,911	851	2,793	200
	2016	1,704	170	263	26

Appendix D. Continued.

Location	Brood Year	Abundance at RST	Emigrants per Redd/Female	Abundance at LGR	Smolts at LGR per Redd/Female
	2017	305	305	184	184
	2018	2,221		590	

(a) This year is an outlier. Redds were missed.

Appendix E. 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 cohorts with dashes in any age column.

Population and RST Location	Cohort	Number of Emigrants by Age (years)						Sum	Female Parents	Productivity
		Age-0	Age-1	Age-2	Age-3	Age-4	Age-5			
				Salmon River MPG						
Little	2007	112	716	1,865	1,628	259	0	4,580	21	218
Salmon	2008	72	478	885	958	217	65	2,675	46	58
River	2009	17	286	1,327	768	725	19	3,142	63	50
	2010	0	448	1,782	1,698	261	0	4,189	116	36
[b]Rapid River	2011	0	773	1,377	956	94	0	3,200	101	32
RPDTRP	2012	24	405	1,561	1,084	60	0	3,134	57	55
	2013	0	579	1,530	478	28	0	2,615	15	174
	2014	9	1,175	1,155	565	132	0	3,036	16	190
	2015	71	1,039	677	1,338	127	0	3,252	54	60
	2016	8	416	800	453	63	--	1,740	13	134
	2017	0	162	265	396	--	--	823	8	100
	2018	0	100	362	--	--	--	462	5	92
	2019	0	111	--	--	--	--	111	8	14
	2020	0	--	--	--	--	--	0	8	0
South Fork	2012	--	--	--	0	0	0	0	369	--
Salmon River	2013	--	--	277	482	0	0	759	301	--
	2014	--	5,188	1,386	1,222	0	0	7,796	275	--
[a]Lower South	2015	5,049	28,262	10,954	429	170	0	44,864	550	82
Fork Salmon	2016	3,919	22,455	6,785	511	175	--	33,845	239	142
River	2017	711	15,202	6,133	2,260	--	--	24,306	163	149
SFSRKT	2018	859	3,918	4,124	--	--	--	8,901	55	162
	2019	454	11,761	--	--	--	--	12,215	45	271
	2020	502	--	--	--	--	--	502	39	13
Lower	2010	0	7,605	18,634	6,950	602	0	33,791	688	49
Middle Fork	2011	0	3,314	10,143	5,979	558	0	19,994	443	45
Salmon River	2012	84	14,551	19,330	6,754	243	0	40,962	263	156
	2013	85	13,263	20,762	1,097	211	0	35,418	302	117
[a]Big Creek	2014	0	13,432	9,812	1,603	0	0	24,847	180	138
BIGC2T	2015	0	12,826	6,777	666	98	0	20,367	532	38
	2016	442	4,772	14,701	2,557	0	--	22,472	216	104
	2017	0	4,098	8,179	2,450	--	--	14,727	42	351
	2018	154	7,841	24,258	--	--	--	32,253	85	379

Appendix E Continued

Population and RST Location	Cohort	Number of Emigrants by Age (years)						Sum	Female Parents	Productivity
		Age-0	Age-1	Age-2	Age-3	Age-4	Age-5			
Big Creek	2019	195	4,737	--	--	--	--	4,932	56	88
BIGC2T	2020	0	--	--	--	--	--	0	62	0
Upper Salmon River Mainstem	2001	264	9,916	4,318	656	57	0	15,211	24	634
	2002	32	1,779	2,830	563	0	0	5,204	39	133
	2003	16	3,045	1,548	204	13	0	4,826	16	302
	2004	70	988	954	1,842	0	0	3,854	7	551
	2005	62	1,000	4,734	0	0	0	5,796	15	386
[b]Upper Salmon River	2006	0	4,172	0	48	0	0	4,220	9	469
	2007	128	0	2,553	344	0	0	3,025	17	178
	2008	0	1,923	2,817	80	6	0	4,826	7	689
SAWTRP	2009	12	5,054	4,133	237	14	0	9,450	14	675
	2010	13	7,607	3,530	175	0	0	11,326	56	202
	2011	15	5,281	4,092	27	0	0	9,414	64	147
	2012	182	6,278	3,901	333	0	0	10,694	42	255
	2013	0	4,107	3,701	328	0	0	8,137	18	452
	2014	0	8,069	3,997	72	0	0	12,138	17	714
	2015	526	19,544	2,187	377	1	0	22,635	39	580
	2016	1,374	6,540	2,776	1,281	26	--	11,997	44	273
	2017	436	856	2,734	180	--	--	4,206	18	234
	2018	51	3,481	3,167	--	--	--	6,699	9	744
	2019	25	4,598	--	--	--	--	4,623	8	578
	2020	1,148	--	--	--	--	--	1,148	21	55
[b]Pahsimeroi	2001			6,772	172	0	0	6,944	77	
River	2002	12,194	17,211	2,478	336	0	0	32,220	225	143
PAHTRP	2003	7,264	10,010	4,505	155	0	0	21,935	124	177
	2004	6,695	10,049	2,065	0	0	0	18,810	33	570
	2005	2,822	5,897	189	151	0	0	9,059	27	336
	2006	3,146	8,044	1,445	77	0	0	12,711	23	553
	2007	5,766	11,467	903	550	0	0	18,686	7	2,669
	2008	5,040	8,139	5,371	453	0	0	19,004	23	826
	2009	2,227	9,879	1,305	0	0	0	13,412	24	559
	2010	1,580	3,410	2,050	666	0	0	7,707	68	113
	2011	202	4,897	6,418	64	0	0	11,581	153	76
	2012	1,224	8,369	2,104	22	0	0	11,719	168	70
	2013	12,085	11,431	1,399	159	0	60	25,135	107	235
	2014	2,533	4,941	1,566	0	0	0	9,040	121	75
	2015	5,524	10,340	680	132	0	0	16,676	76	219
	2016	3,330	6,140	2,114	127	0	--	11,711	57	205
	2017	1,436	6,339	679	73	--	--	8,527	18	474
	2018	1,142	2,614	934	--	--	--	4,690	20	234

Appendix E Continued.

Population and RST Location	Cohort	Number of Emigrants by Age (years)						Sum	Female Parents	Productivity
		Age-0	Age-1	Age-2	Age-3	Age-4	Age-5			
PAHTRP	2019	2,281	3,725	--	--	--	--	6,005	21	286
	2020	1,798	--	--	--	--	--	1,798	26	69
[a]Lower	2010	0	6,023	0	218	0	0	6,241	278	22
Lemhi River	2011	0	0	682	314	0	0	996	228	4
LLRTP	2012	0	682	2,666	1,176	7	1	4,531	249	18
	2013	0	610	4,819	93	14	22	5,557	226	25
	2014	0	11,181	4,904	185	33	0	16,303	181	90
	2015	1,884	7,600	1,539	929	141	0	12,092	249	49
	2016	260	4,457	3,705	2,407	73		10,903	190	57
	2017	292	3,799	4,925	202	--	--	9,219	123	75
	2018	99	5,898	1,785	--	--	--	7,782	74	105
	2019	309	4,960	--	--	--	--	5,270	48	110
	2020	0	--	--	--	--	--	0	86	0
[a]Upper	2010	388	8,600	1,732	109	47	0	10,876	9	1,154
Lemhi River	2011	89	9,202	1,195	186	22	0	10,694	56	191
LEMTRP	2012	1,056	8,541	2,142	183	41	0	11,963	26	454
	2013	922	7,086	2,259	807	0	0	11,074	52	214
	2014	704	17,398	5,407	51	0	0	23,560	12	1,908
	2015	1,733	13,390	1,138	204	0	0	16,464	26	624
	2016	0	11,119	882	142	12	--	12,155	31	388
	2017	725	6,852	1,204	76	--	--	8,857	16	554
	2018	611	5,091	717	--	--	--	6,419	12	557
	2019	388	6,675	--	--	--	--	7,063	6	1,226
	2020	0	--	--	--	--	--	0	6	0
Clearwater River MPG										
Lower	2006	1	2,450	3,286	903	0	0	6,640	20	332
Clearwater	2007	0	2,109	4,383	205	0	0	6,697	69	97
River	2008	23	1,266	6,621	175	0	0	8,085	44	182
Mainstem	2009	3	3,264	3,452	279	0	0	6,998	61	114
	2010	5	209	6,548	1,049	0	0	7,811	150	52
[b]Big Bear	2011	0	4,224	11,109	516	0	0	15,849	66	241
Creek	2012	4	10,526	6,911	930	0	0	18,371	217	85
BBCTRP	2013	1	608	4,880	213	0	0	5,702	73	78
	2014	0	2,742	3,388	73	0	0	6,203	163	38
	2015	0	4,224	3,242	139	0	0	7,605	61	124
	2016	61	7,613	6,788	533	42	--	15,037	64	237
	2017	0	3,256	4,890	625	--	--	8,771	16	537

Appendix E Continued.

Population and RST Location	Cohort	Number of Emigrants by Age (Years)							Female	
		Age-0	Age-1	Age-2	Age-3	Age-4	Age-5	Sum	Parents	Productivity
BBCTRP	2018	0	726	3,377	--	--	--	4,103	5	769
Cont.	2019	0	4,544	--	--	--	--	4,544	2	3,029
	2020[c]	0	--	--	--	--	--	0	3	0
[b]East Fork	2008	140	9,572	7,229	0	0	0	16,941	46	369
Potlatch	2009	10	22,017	4,366	666	0	0	27,059	46	588
River	2010	550	9,959	2,784	686	0	0	13,979	55	256
EFPTRP	[a]2011	0	9,139	6,192	393	0	0	15,724	21	762
	2012	258	33,473	4,515	1,020	0	0	39,266	53	736
	2013	21	5,628	5,006	379	0	0	11,034	48	232
	2014	0	9,456	3,296	0	0	0	12,752	45	282
	2015	0	5,538	2,937	107	0	0	8,583	59	145
	2016	206	12,273	3,547	326	0	--	16,353	54	301
	2017	0	6,127	1,468	43	--	--	7,638	8	955
	2018	0	1,305	413	--	--	--	1,718	10	174
	2019	0	1,501	--	--	--	--	1,501	2	750
	2020	227	--	--	--	--	--	227	10	24
South Fork	2007	0	131	827	376	144	0	1,479	8	193
Clearwater	2008	0	54	115	291	30	0	490	1	454
River	2009	0	0	93	125	9	0	226	0	
[b]Crooked	2010	0	1,024	1,751	1,026	9	0	3,810	4	906
River	2011	0	82	1,283	387	0	0	1,753	0	
CROTRP	2012	5	993	832	0	0	0	1,829	3	610
	2013	0	0	0	7	0	0	7	1	6
	2014	0	0	87	26	0	0	112	0	
	2015	0	1,455	343	0	8	0	1,805	4	451
	2016	0	290	0	42	0	--	332	1	366
	2017	0	0	136	30	--	--	166	0	
	2018	0	97	427	--	--	--	524	0	
	2019	0	213	--	--	--	--	213	0	
	2020[d]	0	--	--	--	--	--	0	0	
Lochsa	1996	0	5,286	6,869	1,057	20	0	13,232	24	543
River	1997	0	4,974	8,928	624	88	0	14,614	18	816
	1998	0	10,713	10,962	2,932	0	0	24,607	52	474
[b]Fish Creek	1999	99	8,582	15,847	600	0	0	25,128	60	418
FISTRP	2000	137	8,466	4,484	1,189	0	0	14,275	20	711
	2001	239	7,661	15,114	1,050	0	0	24,064	56	428
	2002	0	13,501	15,288	4,265	0	0	33,054	153	217

Appendix E Continued.

Population and RST Location	Cohort	Number of Emigrants by Age (years)						Sum	Female Parents	Productivity
		Age-0	Age-1	Age-2	Age-3	Age-4	Age-5			
FISTRP	2003	340	14,030	23,945	2,449	116	0	40,879	242	169
Cont.	2004	241	23,094	14,091	2,080	70	0	39,576	125	317
	2005	492	9,022	12,148	1,295	0	0	22,957	82	280
	2006	65	9,236	9,227	853	156	0	19,539	69	283
	2007	57	4,553	8,107	1,418	0	0	14,135	49	287
	2008	0	4,883	11,808	288	0	0	16,979	55	308
	2009	47	16,006	29,647	1,739	104	0	47,544	141	336
	2010	0	16,982	16,280	2,426	0	0	35,688	132	269
	2011	0	7,723	23,653	1,147	43	0	32,565	357	91
	2012	70	7,624	10,895	962	435	0	19,986	124	162
	2013	0	3,441	9,765	597	0	0	13,803	65	211
	2014	0	8,735	5,661	487	0	0	14,884	38	387
	2015	93	70,461	25,307	260	33	0	96,155	349	276
	2016	0	12,654	9,259	802	26	--	22,740	142	160
	2017	122	2,380	5,060	322	--	--	7,883	58	137
	2018	37	868	1,927	--	--	--	2,832	8	354
	2019	100	2,472	--	--	--	--	2,573	40	65
	2020	1	--	--	--	--	--	1	10	0

[a] Adult estimate from PIT array using DABOM model.
[b] Estimate from weir escapement.
[c] Low abundance so DABOM was not used. Female estimate is a minimum (detected).
[d] Weir was not in for most of the season

Appendix F. Plan for operation of rotary screw traps by Idaho Department of Fish and Game in 2019-2020.

FINAL 2-25-19

2019-2020 Plan for IDFG Screw Traps and Biosampling Adult Steelhead and Chinook Salmon Released at Weirs

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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 2019. 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. Starting in 2018, all hatchery weirs have been permitted under Hatchery and Genetic Management Plans (HGMPs). Sampling at IDFG research weirs and screw traps (outside the SMP/CSS traps and those covered in the HGMPs) in tributaries of the Clearwater and Salmon basins will be conducted under separate 4(d) permits. The Sawtooth screw trap (SAWTRP) and Lemhi River weir will operate under separate Section 10 permits. General contracting and permitting deadlines are as follows: BPA contracting due 9/30/18 and NOAA Section 4(d) permitting applications due 10/6/18.

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 in report). Additional screw traps are operated by the Potlatch and Lemhi IMW projects. IDFG trap operators include Brian Knoth (Potlatch IMW), Stacey Feeken (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 SMP/CSS traps, sampling at screw traps will include collecting scales for ageing wild steelhead; tissue samples for genetics will not be collected from any species. Outside the 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 IDFG weir biosampling plan refers to sampling wild or integrated hatchery steelhead and Chinook salmon adults trapped and released at hatchery or research weirs (Table 2; Figures 1 and 2). Sampling adults released at weirs will include collecting scales from wild steelhead for aging but not from Chinook Salmon. Tissue samples for genetics will be collected from all anadromous fish released at the weir. A comprehensive sampling checklist is provided for all Chinook Salmon trapped at IDFG hatchery weirs (Table 3).

Table 1. IDFG plan for rotary screw trap operations during 2019-2020.

Map #	Trap and PTAGIS Site Code	Subbasin	NOAA Juvenile Permit	Migratory Year 2020 Status	Calendar Year 2020 Contract and Operator	Screw Trap Comments
IDFG Wild Salmon & Steelhead Projects (INPMEP & ISMES)						
9	Sawtooth (SAWTRP)	Upper Salmon	10-2022-#1124-6R	OPERATE	INPMEP-Eli Felts	
10	Pahsimeroi River (PAHTRP)	Upper Salmon	4d-2019-#22513	OPERATE	INPMEP-Conor McClure	
5	North Fork Salmon River (NFSTRP)	Upper Salmon	4d-2019-#22513	OPERATE	ISMES- Conor McClure	
4	Marsh Creek Lower (MARTR2)	MF Salmon	4d-2019-#22513	OPERATE	INPMEP-Eli Felts	
3	Big Creek (BIG2CT)	MF Salmon	4d-2019-#22513	OPERATE	ISMES-Josh Poole	
2	Krassel (SFSRKT)	SF Salmon	4d-2019-#22513	OPERATE	INPMEP-Josh Poole	
1	Rapid River (RPDTRP)	Lower Salmon	4d-2019-#22513	OPERATE	ISMES-Eric Stark	
15	Fish Creek (FISTRP)	Lochsa	4d-2019-#22514	OPERATE	ISMES-Marika Dobos	
14	Lochsa River Lower (LOCTRP)	Lochsa	4d-2019-#22514	OPERATE	ISMES-Marika Dobos	
13	Crooked River (CROTRP)	SF Clearwater	4d-2019-#22514	OPERATE	ISMES-Brian Knoth	Steelhead monitoring, CSS PIT-tagging, habitat evaluation
IDFG Potlatch Project (IMW)						
11	Big Bear Creek (BBCTRP)	Lower Clearwater	4d-2019-#22514	OPERATE	Potlatch IMW-Brian Knoth	
12	East Fork Potlatch River (EFPTRP)	Lower Clearwater	4d-2019-#22514	OPERATE	Potlatch IMW-Brian Knoth	
IDFG Lemhi Projects (IMW)						
6	Lemhi River Upper (LEMTRP)	Upper Salmon	4d-2019-#22643	OPERATE	Lemhi IMW-Stacey Feeken	
8	Hayden Creek (HYDTRP)	Upper Salmon	4d-2019-#22643	OPERATE	Lemhi IMW-Stacey Feeken	
7, 22	Lemhi River Lower (LLRTP)	Upper Salmon	4d-2019-#22643	OPERATE	Lemhi IMW-Stacey Feeken	
IDFG Smolt Monitoring Project (SMP/CSS)						
17	White Bird (SALTRP) [a]	Lower Salmon	02-19-FPC47	OPERATE	Idaho SMP/CSS-Scott Putnam	Permitted (LOD) through FPC
18	Lewiston (SNKTRP) [a]	Lower Snake	02-19-FPC47	OPERATE	Idaho SMP/CSS-Scott Putnam	Permitted (LOD) through FPC

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

Table 2. Plan for contracts and operations of IDFG adult weirs relative to sampling wild and integrated fish released at each weir in 2019-2020. Scale and genetics sampling for steelhead and Chinook salmon are indicated.

	Wild and Integrated Adult Sampling at Hatchery and Research Weirs							
	Steelhead				Spring-Summer Chinook Salmon			
IDFG Adult Weir (Map #)	**Collect Scale Sample ?**	**Collect Genetic Sample ?**	**NOAA Adult Permit**	**2020 Contract & Operator**	**Collect Scale Sample ?**	**Collect Genetic Sample ?**	**NOAA Adult Permit**	**2020 Contract & Operator**
Sawtooth (9)	Yes	Yes	HGMP	ISMES-Sawtooth FH	No	Yes	HGMP	INPMEP-Sawtooth FH
EFSR (19)	Yes[a]	Yes	HGMP	ISMES-Sawtooth FH	N/A[b]	N/A[b]	N/A[b]	N/A[b]
Pahsimeroi (10)	Yes	Yes	HGMP	ISMES-Pahsimeroi FH	No	Yes	HGMP	INPMEP-Pahsimeroi FH
Lemhi River (22)	Yes[c]	Yes[c]	10-2020-#19690	Lemhi IMW-Stacey Feeken	No[c]	Yes[c]	10-2020-#19690	Lemhi IMW-Stacey Feeken
Hayden Creek (8)	N/A[c]	N/A[c]	N/A[c]	Lemhi IMW-Stacey Feeken	N/A[c]	N/A[c]	4d-2019-#22643	Lemhi IMW-Stacey Feeken
Bear Valley Creek (34)	N/A[c]	N/A[c]	N/A[c]	Lemhi IMW-Stacey Feeken	N/A[c]	N/A[c]	4d-2019-#22643	Lemhi IMW-Stacey Feeken
Twelve Mile Creek (25)	Yes	Yes	4d-2019-#22513	Region 7-Conor McClure	N/A	N/A	N/A	N/A
Poison Creek (26)	Yes	Yes	4d-2019-#22513	Region 7-Conor McClure	N/A	N/A	N/A	N/A
Carmen Creek (27)	Yes	Yes	4d-2019-#22513	Region 7-Conor McClure	N/A	N/A	N/A	N/A
Tower Creek (28)	Yes	Yes	4d-2019-#22513	Region 7-Conor McClure	N/A	N/A	N/A	N/A
Fourth of July Creek (29)	Yes	Yes	4d-2019-#22513	Region 7-Conor McClure	N/A	N/A	N/A	N/A
Iron Creek (30)	Yes	Yes	4d-2019-#22513	Region 7-Conor McClure	N/A	N/A	N/A	N/A
Cow Creek (33)	Yes	Yes	4d-2019-#22513	Region 7-Conor McClure	N/A	N/A	N/A	Not operated
Challis Creek (31)	Yes	Yes	4d-2019-#22513	Region 7-Conor McClure	N/A	N/A	N/A	Not operated
Morgan Creek (32)	Yes	Yes	4d-2019-#22513	Region 7-Conor McClure	N/A	N/A	N/A	Not operated
McCall SFSR (20)	Yes[d]	Yes[d]	HGMP	ISMES-Josh Poole	No	Yes	HGMP	INPMEP-McCall FH
Rapid River (1)	Yes[d]	Yes[d]	HGMP	ISMES-Eric Stark	No	Yes	HGMP	INPMEP-Rapid River FH
Hells Canyon Oxbow (24)	Yes	Yes	HGMP	ISMES-Oxbow FH	No	Yes	HGMP	INPMEP-Oxbow FH
Powell (21)	N/A[d]	N/A[d]	N/A	N/A	No	Yes	N/A[e]	INPMEP-Clearwater FH
Fish Creek (15)	Yes	Yes	4d-2019-#22514	ISMES-Marika Dobos	No	Yes	N/A[e]	ISMES-Marika Dobos
Red River (23)	N/A[d]	N/A[d]	N/A	N/A	No	Yes	N/A[e]	INPMEP-Clearwater FH
Crooked River (13)	Yes[d]	Yes[d]	4d-2019-#22514	ISMES-Brian Knoth	No	Yes	N/A[e]	INPMEP-Clearwater FH
EF Potlatch River (12)	Yes	Yes	4d-2019-#22514	Potlatch IMW-Brian Knoth	No	Yes	N/A[e]	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] Lemhi River weir is not a full escapement weir, anticipate capturing roughly half of the total return; Hayden and Bear Valley Creek weirs are operated for bull trout in September, anticipate Chinook incidental catch.
[d] Hatchery rack not generally operated for steelhead broodstock collection; opportunistic biosamples at McCall SFSR.
[e] Spring/summer Chinook are not listed in the Clearwater drainage and sampling them does not require a NOAA permit.

Table 3. Checklist for Chinook Salmon at IDFG hatchery weirs.

		CHINOOK SALMON AT IDFG HATCHERY WEIRS					
	To Do: (see footnotes below for why)	**TRAPPED - Record length, sex, marks and tags from all fish trapped**	**POND MORTS, GIVEAWAYS, OUTPLANTS - Record data according to weir protocols**	**SPAWNED MORTS**			
		RELEASED ABOVE WEIR Ad Intact (UNM), with or without CWT		BROOD Ad Intact (UNM), without CWT	BROOD Ad Intact (UNM), with CWT	BROOD Ad Clip, with CWT	BROOD Ad Clip, without CWT
(1)	Opercle punch (OP)	ALL	Recycled (different OP than released above weir)				
(2)	Collect tissue sample	ALL	UNM (and IBS at Sawtooth, Pahsimeroi, and SF Salmon/McCall)	ALL	ALL	ALL	ALL
(3)	Collect dorsal fin ray sample			ALL			
(4)	Collect snout		20 JACKS (CWT lab request)				
(5)	Collect snout AND dorsal fin ray sample				30 KNOWN AGE - 10 FROM EACH AGE GROUP TO BE PAIRED WITH CWT SAMPLE (based on standard length cut-offs, hatchery defined). Can also be collected from pond morts or giveaways to achieve desired sample size.		
(6)	Collect scale sample						

(1) Opercle punches are needed for any fish released above the weir to enable mark/recapture estimates of weir efficiency and total spawner abundance. Recycled fish are punched on the opposite opercle to distinguish them from newly arrived fish returning to the weir.

(2) Fin clip tissue samples are used to establish parentage based tagging (PBT) genetic baselines for hatchery fish. They are also used to age and assign returning fish to their appropriate parents and to their hatchery stock of origin or release group. Tissue samples from wild fish are used to derive genetic diversity information.

(3) Dorsal fin ray samples are used to assign age to returning fish. They should not be collected from live fish, only morts or carcasses. Both wild and hatchery Chinook can be aged using these samples. Fin rays are not commonly used to age steelhead or sockeye.

(4) Snouts are collected from a sample of fish that have a coded wire tag (CWT). These tags are used to assign hatchery stock of origin, release group, and age. These can be collected from spawned broodstock, pond morts, or giveaways.

(5) Snouts are collected from a sample of fish that have a coded wire tag (CWT). These tags are used to assign hatchery stock of origin, release group, and age. When paired with a fin ray sample, these tagged fish are used for fin ray age validation since their absolute age is known from the CWT. These can be collected from spawned broodstock, pond morts, or giveaways.

(6) Scale samples are used to assign age to returning fish. They should not be collected from Chinook at hatchery weirs or on the spawning grounds due to their degraded condition. Scale samples should be collected from wild steelhead returning to and passed above the weir. In general throughout Idaho, only wild and not hatchery steelhead can be accurately aged using scales.

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