FISHERY RESEARCH

IDAHO ADULT STEELHEAD MONITORING

2017 ANNUAL REPORT

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ABBREVIATIONS AND ACRONYMS

BY	Brood Year
CI	Confidence Interval
DPS	Distinct Population Segment
ESA	Endangered Species Act
GSI	Genetic Stock Identification
ICTRT	Interior Columbia Technical Recovery Team
IDFG	Idaho Department of Fish and Game
ISEMP	Integrated Status and Effectiveness Monitoring Program
LGR	Lower Granite Dam
MPG	Major Population Group
PIT	Passive Integrated Transponder
PTAGIS	PIT Tag Information System
VSP	Viable Salmonid Population

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ABSTRACT

During 2017, Idaho Department of Fish and Game personnel used weirs (temporary picket, floating board resistance, and hatchery trap) and PIT tag arrays to monitor wild adult steelhead in Idaho. Three weirs and one array were located in the Clearwater River basin, whereas four weirs and two arrays were located in the Salmon River basin. Steelhead escapement ranged from one fish in Crooked River to 149 fish in the Lemhi River. Escapement estimates across all locations were lower in 2017 compared to 2016. Abundance estimates were hampered by monitoring conditions during the 2017 spring migration and should be viewed with caution. Averaged across all locations, two-ocean fish dominated the return at 89.0%, whereas the one-ocean component was 10.6%; three-ocean and repeat spawning fish comprised the remaining 0.4%. Sex ratios ranged from 67.0% females in Big Creek to 84.2% females in Big Bear Creek. Run timing was described for all locations. Adult-to-adult productivity estimates for brood year 2010 are now complete with the last of its cohort returning in 2017. Productivity estimates for that brood year (n = 9 locations) ranged from 0.12 recruits/spawner in the East Fork Salmon River to 2.27 recruits/spawner in Fish Creek. An estimate of 1.00 recruits/spawner is necessary for replacement; steelhead at all locations were below replacement except the East Fork Potlatch River, Fish Creek, and the Pahsimeroi River. Productivity estimates over all brood years where sufficient data were available ranged from 0.34 recruits/spawner in Fish Creek and Rapid River to 10.25 recruits/spawner in Fish Creek (n = 9 locations). In locations where sufficient data were available (n = 7 locations), productivity decreased as spawner abundance increased suggesting density dependence. The Fish Creek smolt-to-adult return (SAR) rate to Bonneville Dam was 2.68% for migratory year 2013 and fell within the 0.16% - 4.24% range observed over migratory years 1996-2012.

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INTRODUCTION

Snake River basin steelhead trout *Oncorhynchus mykiss* (hereafter steelhead) populations have declined substantially following the construction of hydroelectric dams in the Snake and Columbia rivers. Survival of juvenile steelhead and Chinook Salmon *O. tshawytscha* emigrating from the Snake River basin decreased following the construction of dams on the lower Snake River during the late 1960s and early 1970s (Raymond 1988). Degradation of freshwater spawning and rearing habitats have also reduced wild steelhead abundance (Nehlsen et al. 1991; Gregory and Bisson 1997; Williams et al. 1999). The abundance of wild steelhead in Idaho streams has fluctuated at low levels since the completion of Lower Granite Dam (LGR) in 1975 (Busby et al. 1996). Consequently, Snake River steelhead were classified as threatened under the Endangered Species Act (ESA) in 1997. The total adult steelhead abundance in the Snake River basin increased slightly during 2002–2010 (Schrader et al. 2014), though the increase was dominated by hatchery-origin returning adults. Since 2010, total steelhead abundance again declined. Presently, returns of naturally produced steelhead remain critically low, especially for stocks with later run timing (B-run populations; Busby et al. 1996).

There are six major population groups (MPGs) within the Snake River steelhead Distinct Population Segment (DPS). Three MPGs are located in Idaho, including the Clearwater River, Salmon River, and Hells Canyon tributaries (ICTRT 2003; Figure 1). Only a small number of tributaries in the Hells Canyon MPG support spawning, and these streams are geographically separated from historical major spawning areas now considered to be extirpated. Thus, it was determined none of these tributaries were large enough to support an independent population (ICTRT 2003). Nonetheless, there are 17 demographically independent and extant steelhead populations identified within the Clearwater River and Salmon River MPGs (ICTRT 2003).

The Idaho Department of Fish and Game (IDFG) anadromous fish program's long-term goals to preserve Idaho's wild salmon and steelhead runs and recover them to provide benefit to all users (IDFG 2013) are consistent with basinwide mitigation and recovery programs. Snake River basin anadromous fish management programs include: 1) large-scale hatchery programs intended to mitigate for the impacts of hydroelectric dam construction and operation in the basin, 2) recovery planning and implementation efforts aimed at recovering ESA-listed wild salmon and steelhead stocks, and 3) management of sport and tribal fisheries. An understanding of how salmonid populations function (McElhany et al. 2000), as well as long-term trend monitoring for status assessments, is required to achieve these management goals.

There are two overarching goals of this report. The first goal is to provide annual information on the abundance of spawning steelhead at key locations (weirs and PIT tag arrays) throughout the Clearwater River and Salmon River basins in Idaho. We focus monitoring efforts in select spawning tributaries primarily due to the difficulty in collecting adult steelhead or estimating redd production during high stream runoff in the spring. The second goal is to report important spawner composition metrics (sex ratio, age composition, hatchery fraction, SARs) these key locations. These data, along with abundance information, are used to estimate population productivity and replacement rates which are needed to properly evaluate population status. This is the third year in which wild adult steelhead information was assembled into a single statewide report. Consequently, this report continues to evolve as we identify the best means to incorporate disparate data from multiple sources.

OBJECTIVES

This report has four objectives:

1. Describe IDFG's intensive, high-precision monitoring of wild adult steelhead in the following ten locations and nine populations of the Clearwater River and Salmon River MPGs:

Location	**Population**
Clearwater River MPG	
Big Bear Creek Array	Lower Clearwater River
East Fork Potlatch River Weir	Lower Clearwater River
Crooked River Weir	South Fork Clearwater River
Fish Creek Weir	Lochsa River
Salmon River MPG	
Rapid River Weir	Little Salmon River
Big Creek Array	Lower Mainstem Middle Fork Salmon River
Lemhi River Array	Lemhi River
East Fork Salmon River	East Fork Salmon River
Upper Salmon River (Sawtooth) Weir	Upper Mainstem Salmon River
Pahsimeroi River Weir	Pahsimeroi River

2. Estimate steelhead adult abundance and productivity at all locations.

3. Estimate steelhead smolt-to-adult return (SAR) rates at selected locations.

4. Estimate steelhead population demographic or diversity metrics including sex ratio, length and age composition, and run timing at all locations. Enumerate genetic samples collected.

IDFG evaluates wild steelhead population status in Idaho based upon the viable salmonid population (VSP) criteria (McElhany et al. 2000). Hence, this report is organized in the VSP framework with the following subsections: abundance and productivity, diversity, and spatial structure. For the spatial structure criterion, IDFG uses parr distribution as a surrogate, and a full accounting is reported under a separate cover (Putnam et al. 2018). The diversity subsection includes information on population demographic metrics including sex ratio, length and age composition, migration timing, and genetic sampling at weirs. A full accounting of steelhead genetic stock composition at LGR, covering the entire Snake River basin, is reported under separate covers (Camacho et al. 2018; Powell et al. 2018).

METHODS

Adult Abundance and Productivity

Sampling and Abundance

Wild adult steelhead populations were monitored using three primary techniques: research weirs, hatchery weirs, and passive integrated transponder (PIT) tag arrays. Research weirs (picket and floating resistance board) were installed to monitor adult steelhead for research purposes. Hatchery permanent and temporary weirs were used for broodstock collection and to monitor fish passed upstream for natural spawning purposes. Channel-spanning PIT tag arrays were used to passively detect fish implanted with PIT tags that migrate into spawning tributaries.

Research Weirs—During 2017, a temporary picket weir was operated on Fish Creek and a floating resistance board weir was operated on the East Fork Potlatch River to estimate wild adult steelhead escapement. Fish moving upstream entered a holding box that was checked several times daily. Trapped fish were removed with a net and placed in a plastic livestock trough for processing. Fork length (cm) and sex were recorded for all prespawn fish. Each fish was examined for marks (e.g., fin clips), injuries, and external tags (e.g., floy tags, visual-implanted elastomer [VIE] tags) and scanned for the presence of internal tags (e.g., PIT tag, coded wire tag [CWT], radio tag). Scales and a small portion of fin tissue (for genetic analysis) were sampled from each unique fish. All prespawn wild steelhead were marked with a right operculum punch and released upstream of the weir. All hatchery steelhead were marked with a left operculum punch and transported downstream of the weir.

Steelhead kelts were captured on the upstream side of weirs and processed similarly to prespawn adult fish. Fork length (cm) and sex were recorded for all kelts. Kelts were examined for any previous marks (e.g., operculum punches, fin clips) and tags (e.g., PIT tags, CWT, radio tags). Scales and fin tissue were collected from all unmarked kelts. Live kelts were marked with a left operculum punch and released downstream of the weir.

Total adult escapement above research weirs was estimated using software developed by Steinhorst et al. (2004). A Lincoln-Peterson estimator with a Bailey’s modification was used:

$$\widehat{N} = \frac{c(m+1)}{(r+1)}$$

where $\widehat{N}$ was estimated adult abundance; *c* was the total number of marked and unmarked kelts captured; *m* was the number of unique adults marked and passed upstream; and *r* was the number of marked adults recaptured as kelts. The estimate was computed using an iterative maximization of the log likelihood, assuming fish are captured independently with probability *p* (equivalent to weir efficiency) and tagged fish mix thoroughly with untagged fish. The 95% confidence intervals were computed with the bootstrap option (2,000 iterations).

Hatchery Weirs—During 2017, hatchery weir structures were operated at Crooked River, Rapid River, Pahsimeroi River, East Fork Salmon River, and the upper Salmon River (Sawtooth) to enumerate wild adult steelhead escapement. Panel weirs were operated on Crooked River, Pahsimeroi River, and the upper Salmon River (Sawtooth) whereas velocity barriers were used at East Fork Salmon River and Rapid River. Methods for processing steelhead at the hatchery weirs were the same as at the research weirs.

Hatchery fish were not released upstream of hatchery weirs, with the exception of the East Fork Salmon River weir which operates under an integrated hatchery program. Hatchery weirs are designed to be complete barriers such that all upstream migrating fish are captured, but none are designed to capture kelts. Weir panels are occasionally removed during high water to protect the trap structure at these locations, with the exception of Rapid River. As a result, some individuals are able to pass the weir without being sampled. Therefore, adult steelhead escapement to areas upstream of hatchery structures (i.e., fish released for natural spawning) are considered a minimum census of the spawning population without variance.

PIT tag Arrays—Instream PIT tag arrays were used to estimate wild adult steelhead escapement into spawning tributaries in areas where logistics do not allow weir operations, specifically Big Bear Creek, Big Creek, and the Lemhi River. Starting this year, we report adult steelhead tributary escapement estimates at each of these locations using the Lower Granite Dam Adult Branch Occupancy Model (DABOM) (Orme and Kinzer 2018). The DABOM model estimates movement probabilities of fish traveling throughout the stream network above LGR, then combines those probabilities with total wild adult steelhead escapement estimates at the dam using the State Space Adult Dam Escapement Model (STADEM). Escapement is then estimated at each PIT tag detection location. Prior to 2017, adult steelhead escapement estimates into Big Bear Creek (2013-2016) were estimated using methods from Connolly et al. 2005 and estimates into Big Creek and the Lemhi River (2010-2016) were generated using a hierarchical patch occupancy model (See et al. 2016).

Adult-to-Adult Productivity

We extended adult-to-adult productivity time series for the East Fork Potlatch River, Fish Creek, Rapid River, Pahsimeroi River, East Fork Salmon River, and the upper Salmon River and started new series for Big Bear Creek, Big Creek, and the Lemhi River. Productivity was not determined for Crooked River because the dataset does not have adequate adult age structure information available to construct brood tables. Productivity results were reported for the most recently completed BY (2010), with preliminary information for BY 2011. The entire range of adult productivity estimates for each location are presented in the appendices (Appendix C and D). Comparisons across populations were limited to BYs 2003–2011, in which most populations had comparable estimates available.

Productivity was calculated by combining adult abundances with age composition determined from scale samples. Samples where total age could not be determined were excluded. Age composition for each return year was then determined from the remaining samples and applied to the escapement estimate to determine the total number of fish for specific ages. Age categories were combined into brood years (BYs) to determine the number of adult returns by total age. Brood years were summed across return years and divided by parental escapement to get adult-to-adult productivity rates (adult recruits/spawner). Brood years were considered complete when progeny from all possible total age categories returned as spawning adults. Since few age-7 adult spawners were observed, BYs comprising of age-3 through age-6 returning adults were considered mostly complete. Repeat spawners were included as recruits (numerator) in the productivity analysis only during their first spawn year; however, they were included as spawners (denominator) in the analysis for every year they returned which could result in underestimating adult productivity when repeat spawners were observed. Replacement of a population was determined as 1.00 adult recruits/ adult spawner assuming an even sex ratio.

Research and Hatchery Weirs—We obtained numbers of natural fish returning to hatchery weirs from Charles Warren (IDFG steelhead hatchery evaluation biologist, personal communication) for years prior to 2015. After 2014, adult trapping data was extracted from the Fish Inventory System (FINS) hatchery database (www.finsnet.org). In the East Fork Salmon River, hatchery fish were commonly passed above the weir as part of a supplementation program. Therefore, all steelhead passed upstream for natural spawning were counted as parents whereas only natural-origin fish returning to the weir were counted as progeny. Although wild adult steelhead were removed from the East Fork Salmon River weir for broodstock as part of an integrated broodstock management program, they were considered wild returning recruits for the productivity analysis.

PIT Tag Arrays—We developed adult-to-adult productivity series for Big Bear Creek, Big Creek, and the Lemhi River PIT tag array locations. Methods for annual abundance estimates for these locations are outlined in the Sampling and Abundance section. Age composition of returning adults to PIT tag array locations was estimated from known destination adult steelhead sampled at LGR (see Age, Sex, and Size Composition section below).

Smolt-to-Adult Return (SAR) Rates

Smolt-to-adult return (SAR) rate measures survival of juveniles from the time they leave their freshwater rearing habitat to their return migration as mature adults. We report SAR rates for Fish Creek and in the future we will develop SAR estimates for additional locations where sufficient juvenile PIT tagging at rotary screw traps coincides with sufficient adult detections in the hydrosystem (e.g. Big Bear Creek, Big Creek, and the Lemhi River). Although steelhead smolts can emigrate at different ages, SARs were measured on the basis of an emigrant cohort. We used detections of fish PIT tagged as juveniles in Fish Creek on their return as adults as they move upstream past Bonneville Dam. Detections were queried from the PTAGIS database and adult status confirmed by upstream movement, either between dams or in the adult ladder at Bonneville Dam. Each adult was assigned to a cohort based on date of first detection as a smolt. Records of adults not detected emigrating as a smolt were omitted because they could not be assigned to a cohort with certainty. From the same PTAGIS query, we summarized the number of unique juvenile detections anywhere in the hydrosystem (including the towed array in the estuary). Number of smolts detected were summarized by year of detection. The SAR was computed as number of adults detected returning from a migratory year divided by the number of out-migrating smolts detected. We used formulas from Fleiss (1981) to estimate the 95% confidence intervals on SAR values.

Diversity

Age, Sex, and Size Composition

Research and Hatchery Weirs—We determined age composition of adult fish returning to research and hatchery weirs from scale samples. Scale samples were collected from all unique adults sampled at the weirs, including both prespawn fish and kelts. The target area to remove scales was the second and third rows of scales above the lateral line and between the posterior fin ray of the dorsal fin and the anterior fin ray of the anal fin (Wright et al. 2015). At least ten scales per fish were collected from this target area. Scales were sent to the IDFG Nampa Research Anadromous Ageing Laboratory for processing.

The IDFG Nampa Research Anadromous Ageing Laboratory processed all adult steelhead scales collected at the weirs. Scales were examined for regeneration and 6–10 nonregenerated scales were cleaned and mounted between two glass microscope slides. Scales were examined on a computer video monitor using a Leica DM4000B microscope and a Leica DC500 digital camera (Wright et al. 2015). A technician chose the best 2–4 scales for ageing each fish and saved them as digitized images. The entire scale was imaged using 12.5x magnification. The freshwater portion was imaged using 40x magnification. Two technicians independently viewed each image to assign age without reference to fish length. If there was no age consensus among readers, a third reader viewed the image and all readers collectively examined the image to resolve their differences before a final age was assigned. If a consensus was not attained, the sample was excluded from analysis (Wright et al. 2015).

Freshwater annuli were defined by pinching or cutting-over of circuli within the freshwater zone in the center of the scale. The criterion for a saltwater annulus was the crowding of circuli after rapid saltwater growth had begun (Wright et al. 2015). We used only visible annuli formed on the scales, excluding time spent overwintering in fresh water prior to spawning. A spawn check, indicative of a repeat spawner, was identified as a ragged scar-like annulus within the saltwater zone. We use the European system to designate ages: freshwater age is separated from saltwater age by a decimal (Wright et al. 2015). Total age at spawning is the sum of freshwater and saltwater ages, plus one.

We determined the sex and size composition of all unique adult steelhead (prespawn fish and kelts) handled at research and hatchery weirs. For each fish, sex was determined based on phenotypic characteristics (e.g., protruding vent for females, developed kype for males) and fork length was measured to the nearest centimeter.

PIT Tag Arrays—Adult steelhead were not physically handled at PIT tag array locations (Big Bear Creek, Big Creek, and the Lemhi River); therefore, diversity information was collected from samples of known destination wild adult steelhead sampled at LGR. The LGR database was queried for adult steelhead sampled at the dam which were detected at PIT tag arrays at each location during 2017. We also queried adult steelhead sampled at the dam which had been previously PIT tagged as juveniles at upstream research traps. In addition for Big Bear Creek, returning adults that were specifically targeted from the population at LGR (i.e., sort-by-code) were also included. Only adult steelhead sampled at LGR between June 30, 2016-July 1, 2017 were included in the queries. All sample PIT tags were cross-referenced to ensure no individuals were double sampled. Adult steelhead were processed at the dam using similar methods as was done at research and hatchery weirs (Camacho et al. 2017). Sex was determined from genetic samples (Powell et al. 2017) and freshwater and saltwater ages were determined from scale samples (Wright et al. 2015). For a given location, we assumed all fish included in the analysis had an equal probability of conversion from LGR to their upstream interrogation site.

Supplemental Collections—Weir efficiency was low in 2017 resulting in a reduced number of samples being collected off adult steelhead at weir locations. In order to increase sample size and reduce bias of adult steelhead diversity information, we supplemented collections at weirs with known destination adult steelhead sampled at LGR. The LGR database was queried for adult steelhead sampled at the dam which had been previously PIT tagged as juveniles at upstream research traps. Lower Granite sampled fish were then cross-referenced to weir locations to ensure no individuals were double sampled. Only adult steelhead sampled at LGR between June 30, 2016-July 1, 2017 were included in the queries. Individuals that were sampled at LGR were included in the diversity information reporting section for the research location where they were PIT tagged as a juvenile. The major assumption of this approach is that all life history types had an equal probability of conversion from LGR to their upstream interrogation site (weir or array).

Adult Migration Timing and Conversion Rates

We estimated the timing of PIT-tagged adult steelhead returning to all of the streams where escapement was estimated. The PTAGIS database was queried to obtain detection dates of fish PIT tagged as juveniles at rotary screw traps in each stream and returning to spawn as adults. We examined migration timing through the hydrosystem using detections between July 1, 2016 and June 30, 2017 at Bonneville, McNary, and Lower Granite dams. Detections of kelts moving downstream were excluded. The median and range of timing over each dam were reported; however, since the timing of adult steelhead at LGR is typically bimodal for some populations, fall and spring timing were reported separately. We also examined the proportion of total unique PIT-tagged fish that were sequentially detected at dams moving upstream (i.e., conversion rates). Conversion rates were also examined between dams and to research weirs and arrays. Conversion rates to research weirs and arrays were likely biased low due to lower capture and detection efficiencies compared to the dams. Detection efficiencies and corrected conversion rates were reported for arrays on Big Bear Creek, Big Creek, and Lemhi River and research weirs on East Fork Potlatch River and Fish Creek.

Timing of wild adult steelhead captured at weirs was also examined. Distribution curves of total unique prespawn adults and kelts captured were constructed to compare timing of adult arrival to tributary streams and estimate spawn timing at weirs where kelts were captured (East Fork Potlatch River, Crooked River, Fish Creek).

Genetic Sampling

Since 2000, we have collected tissue samples for genetic analysis from populations that span the range of geographic, temporal, and phenotypic variability observed in the Clearwater River and Salmon River basins (Nielsen et al. 2009). Baseline data from past collections are used to conduct genetic stock identification (GSI) at LGR and to monitor genetic diversity of natural origin steelhead in the Snake River basin (Ackerman et al. 2016). The genetic diversity and structure of populations surveyed were evaluated and reported with other Snake River steelhead populations by Powell et al. (2017). During this report period, activity in this category was confined to collection of tissue samples from adult steelhead captured at the weirs; these samples were archived pending future analysis.

RESULTS

<u>Adult Abundance and Productivity</u>

Sampling and Abundance

Big Bear Creek Array—The Big Bear Creek array began operating on February 8, 2017; however, a high flow event damaged the array the following day (February 9). The array was inoperable from February 9 to April 5 (55 d). A single array span (three antennas) was re-deployed on April 6 and ran continuously until the end of the migration period on June 30 (85 d). Seven unique adults were detected on the single span. However, detection probability could not be estimated because only a single span was operated; therefore, detection probability was assumed to be 100% (Orme and Kinzer 2018). The estimated adult escapement for Big Bear Creek in 2017 was 19 adult steelhead (SE = 5.4; Figure 2, Appendix A; Orme and Kinzer 2018). This should be considered a minimum estimate because the array was inoperable for 55 d of the migration period and it is likely adult steelhead passed upstream undetected.

East Fork Potlatch River Weir—The East Fork Potlatch River weir was installed and began operating on March 9, 2017; however, it was breached due to high flows the following day (March 10). The weir was inoperable from March 10 to April 10 (31 d). The weir was re-deployed on April 10 and operated continuously to the end of the trapping season on May 30 (49 d). Eight wild, adult steelhead were trapped, marked, and released upstream of the weir (Table 1). Five unique kelts were captured, two of which were not previously marked (Table 1). All adults and kelts were natural origin. The total steelhead abundance estimated via mark-recapture was 11 adults (95% CI 2–24; Figure 2, Appendix A). The estimate is likely biased due to the small sample size of kelts to establish the mark rate within the population.

Crooked River Weir—The Crooked River weir was installed and began operating on March 18, 2017 and ended operating after the adult Chinook Salmon trapping season on October 25. The weir was partially operated (weir panels removed during high flows) for 13 days during the steelhead migration period. One wild, adult steelhead was trapped, marked, and released upstream of the weir (Table 1) and no kelts were captured. This should be considered a minimum census since the weir panels were pulled during high flows and fish could pass upstream undetected (Figure 2, Appendix A).

Fish Creek Weir—The Fish Creek weir was installed and began operating on March 3, 2017. The weir was breached due to high flows and debris on March 15 and was partially operated until June 13 (90 d). The weir was repaired on June 13 and operated continuously through July 31 (48 d). Forty-nine wild, adult steelhead were trapped, marked, and released upstream of the weir (Table 1). No hatchery fish were captured at the weir. Five unique kelts were captured, three of which were not previously marked (Table 1). The total steelhead abundance estimated via mark-recapture was 83 adults (95%CI 13-150; Figure 2, Appendix A). The estimate is likely biased due to the small sample size of kelts to establish the mark rate within the population.

Rapid River Weir—The Rapid River weir began operating on March 14, 2017 and ran continuously through the steelhead migration period. Eleven wild adult steelhead were trapped, marked, and released upstream of the weir (Table 1). It is not possible to capture kelts at the Rapid River weir. The number of trapped wild fish should be considered a population census without error (Figure 3, Appendix B). Four hatchery fish were captured and released downstream of the weir.

Big Creek Array—The Big Creek array was operated continuously during the steelhead migration period. Eleven adult fish were detected on the two arrays. Detection probability was estimated at 26% for the lower span and 63% for the upper span, and the resulting escapement estimate for Big Creek was 64 adult steelhead (SE = 12.5; Figure 3, Appendix B; Orme and Kinzer 2018).

Lemhi River Array—The Lemhi River array was operated continuously during the steelhead migration period. Fifty-nine adult steelhead were detected between the two arrays and detection probability was estimated at 98% on the lower span and 83% on the upper span (Orme and Kinzer 2018). The resulting escapement estimate for the Lemhi River was 149 adult steelhead (SE = 14.8; Figure 3, Appendix B; Orme and Kinzer 2018).

Pahsimeroi River Weir—The Pahsimeroi River hatchery weir began operating on February 9, 2017 and ran continuously through the steelhead migration period. Twenty-four wild, adult steelhead were trapped, marked, and released upstream of the Pahsimeroi Fish Hatchery

(Table 1). Kelts could not be captured at the weir; therefore, the number of trapped wild fish should be considered a population census without error (Figure 3, Appendix B).

East Fork Salmon River Weir—The East Fork Salmon River hatchery weir began operating on March 21, 2017 and ran continuously through the steelhead migration period. Twenty-six wild, adult steelhead were trapped at the East Fork Salmon River hatchery weir. Kelts could not be captured at the weir; therefore, the number of trapped wild fish should be considered a population census without error (Figure 3, Appendix B). Twenty wild returning adult steelhead (14 females; 6 males) were removed and used for hatchery broodstock, whereas six adults (4 females; 2 males) were marked and released upstream of the weir for natural spawning. Additionally, 129 hatchery adult steelhead (80 females, 49 males) were passed upstream of the weir for natural spawning purposes.

Upper Salmon River (Sawtooth) Weir—The Sawtooth hatchery weir began operating on March 3, 2017 and ran continuously through the steelhead migration period. Twenty-two wild, adult steelhead were trapped, marked, and released upstream of the weir. Kelts could not be captured at the weir; therefore, the number of trapped wild fish should be considered a population census without error (Figure 3, Appendix B). All hatchery fish were retained for broodstock purposes.

Adult-to-Adult Productivity

Big Bear Creek Array—Brood year 2010 spawning steelhead returned 180 adult progeny, which resulted in an adult-to-adult productivity estimate of 0.72 recruits/spawner (Figure 4; Appendix C). During BYs 2005-2010, spawning Big Bear Creek steelhead recruited an average of 186 adult progeny (range = 125–265 adult progeny) per year and adult-to-adult productivity estimates averaged 1.78 recruits/spawner (range = 0.72–2.65 recruits/spawner) annually. On average, the majority of Big Bear Creek steelhead spawned at age-5 (48.9%) and age-4 (45.9%) across all complete brood years. Very few Big Bear Creek steelhead returned as age-3 (3.5%) and age-6 (1.7%) adults. The preliminary adult-to-adult productivity estimate for BY 2011 was 1.81 recruits/spawner (Figure 4; Appendix C). This estimate is unlikely to change because no Big Bear Creek steelhead have returned as age-7 adults in previous years. Across BYs 2005–2011, Big Bear Creek productivity (adult recruits per spawner) decreased as spawner escapement increased (Figure 5).

East Fork Potlatch River Weir—Brood year 2010 spawning steelhead returned 124 adult progeny, which resulted in an adult-to-adult productivity estimate of 1.75 recruits/spawner (Figure 4; Appendix C). Spawning East Fork Potlatch River steelhead recruited an average of 92 adult progeny (range = 66–124 adult progeny) per year and adult-to-adult productivity estimates averaged 1.03 recruits/spawner (range = 0.61–1.75 recruits/spawner) annually for all complete brood years (2008–2010). On average, East Fork Potlatch River steelhead spawned primarily as age-5 (54.0%), age-4 (35.1%), and to a lesser extent age-6 (9.1%) adults across all complete brood years. The preliminary adult-to-adult productivity estimate for BY 2011 was 2.64 recruits/spawner (Figure 4; Appendix C). This estimate is likely biased because spawner abundance in 2011 was the weir catch and not an expanded escapement estimate. Therefore, the denominator in the productivity equation (spawner abundance) was biased low causing the productivity estimate to be biased high. East Fork Potlatch River productivity estimates decreased as spawner abundance increased during BYs 2008–2011 (Figure 5).

Crooked River Weir—Productivity was not estimated for the Crooked River weir location because the dataset does not have adequate adult age structure information available to construct brood tables.

Fish Creek Weir—Brood year 2010 spawning steelhead returned 465 adult progeny, which resulted in an adult-to-adult productivity estimate of 2.27 recruits/spawner (Figure 4; Appendix C). During BYs 1992–2010, adult-to-adult productivity estimates averaged 2.02 recruits/spawner (range = 0.34 to 10.25 recruits/spawner) and Fish Creek steelhead recruited an average of 175 adult progeny (range = 41–465 adult progeny) per year. Across all complete BYs, the majority of adult steelhead spawned primarily at age-6 (46.4%) and age-5 (45.6%). The remaining adults spawned at age-4 (6.4%), age-7 (1.4%), and age-3 (0.2%). The preliminary adult-to-adult productivity estimate for BY 2011 is 0.33 recruits/spawner, which may change slightly with the addition of age-7 adult returns in 2018 (Figure 4; Appendix C). Similar to other populations in the Clearwater River MPG, Fish Creek productivity estimates decreased as spawner escapement increased across completed BYs (1992–2011) (Figure 5).

Rapid River Weir—Brood year 2010 spawning steelhead returned a total of 53 adult progeny, which resulted in an adult-to-adult productivity estimate of 0.35 recruits/spawner (Figure 4; Appendix D). During BYs 2004–2010, wild spawning Rapid River steelhead recruited an average 84.3 adult progeny (range = 30-145 adult progeny) per year, and adult-to-adult productivity estimates averaged 1.04 recruits/spawner (range = 0.34 to 2.13 recruits/spawner) annually. Within a BY, most steelhead in Rapid River spawned at age-5 (52.2%), followed in abundance by age-4 (26.4%) and age-6 (19.3%) adults. Similar to Fish Creek, very few Rapid River steelhead returned as age-3 (1.2%) or age-7 (0.8%) adults. Therefore, the preliminary BY 2011 productivity estimate of 0.34 recruits/spawner is unlikely to change appreciably with the addition of age-7 adults in 2018 (Figure 4; Appendix D). Across BYs 2004-2011, Rapid River productivity estimates decreased as spawner escapement increased (Figure 6).

Big Creek Array—Brood year 2010 spawning steelhead returned a total of 684 adult progeny, which resulted in an adult-to-adult productivity estimate of 0.58 recruits/spawner (Figure 4; Appendix D). This is the first complete brood year in the series. During BY 2010, most Big Creek steelhead spawned at age-5 (62.0%) and age-6 (26.5%). The remaining adults spawned at age-4 (9.5%) and age-7 (2.0%). The preliminary adult-to-adult productivity estimate for BY 2011 is 0.31 recruits/spawner, which may increase slightly with the addition of age-7 adult returns in 2018 (Figure 4; Appendix D).

Lemhi River Array—Brood year 2010 spawning steelhead returned a total of 342 adult progeny, which resulted in an adult-to-adult productivity estimate of 0.82 recruits/spawner (Figure 4; Appendix D). This is the first complete brood year in the series. During BY 2010, most Lemhi River steelhead spawned at age-5 (55.3%), age-4 (32.5%), and age-3 (7.0%). The remaining adults spawned at age-6 (3.8%) and age-7 (1.5%). The preliminary adult-to-adult productivity estimate for BY 2011 is 0.90 recruits/spawner, which may increase slightly with the addition of age-7 adult returns in 2018 (Figure 4; Appendix D).

Pahsimeroi River Weir—Brood year 2010 spawning steelhead returned a total of 162 adult progeny, which resulted in an adult-to-adult productivity estimate of 1.03 recruits/spawner (Figure 4; Appendix D). During BYs 2004–2010, natural spawning Pahsimeroi River steelhead recruited an average 156 adult progeny (range = 36-262 adult progeny) per year, and adult-to-adult productivity averaged 3.87 recruits/spawner (range = 0.76-9.86 recruits/spawner) annually. Within completed BYs, the majority of Pahsimeroi River steelhead spawned at age-4 (65.1%), followed in abundance by age-5 (23.3%) and age-3 adults (9.6%). Relatively few steelhead returned as age-6 (1.8%) or age-7 (0.1%) adults. Although a few age-7 adults could return in 2018, the preliminary estimate of adult-to-adult productivity for BY 2011 is 0.71 recruits/spawner (Figure 4; Appendix D). The productivity of Pahsimeroi River steelhead population decreased sharply as spawner escapement increased across BYs 2003-2011 (Figure 6).

East Fork Salmon River Weir—Brood year 2010 spawning steelhead returned a total of 52 adult progeny, which resulted in an adult-to-adult productivity estimate of 0.12 recruits/spawner (Figure 4; Appendix D). During BYs 2007–2010, East Fork Salmon River steelhead recruited an average 47.8 adult progeny (range = ten-100 adult progeny) per year, and adult-to-adult productivity averaged 0.84 recruits/spawner (range = 0.67-1.82 recruits/spawner) annually. Adult parents included both natural-origin and hatchery origin adult steelhead passed upstream of the weir for natural spawning. Across the four complete BYs (2007–2010), most steelhead in the East Fork Salmon River spawned at age-5 (63.9%), followed in abundance by age-4 (22.0%) and age-6 adults (14.1%). No steelhead returned to the East Fork Salmon River as age-3 or age-7 adults during these BYs. Thus, BY 2010 adult-to-adult productivity estimate for the East Fork Salmon River (0.13 recruits/spawner) is likely complete (Figure 4; Appendix D). Productivity estimates for the East Fork Salmon River have remained relatively stable as spawner escapement ranged from 52 to 111 adults (Figure 6).

Upper Salmon (Sawtooth) River Weir—Brood year 2010 spawning steelhead returned a total of 72 adult progeny, which resulted in an adult-to-adult productivity estimate of 0.63 recruits/spawner (Figure 4; Appendix D). During BYs 2005–2010, spawning upper Salmon River steelhead recruited an average 68 adult progeny (range = 25-129 adult progeny) per year, and adult-to-adult productivity estimates averaged 2.48 recruits/spawner (range = 0.63-5.86 recruits/spawner) annually. Most upper Salmon River steelhead spawned at age-5 (49.3%) and age-4 (45.3%) on average across all completed brood years. Relatively few adults spawned at age-6 (4.9%) and age-3 (0.5%), and none returned as age-7 adults. Therefore, it remains unlikely any age-7 adults will return in 2018 and the BY 2011 adult-to-adult productivity estimate for the upper Salmon River population (0.92 recruits/spawner) is likely complete (Figure 4; Appendix D). Similar to other Salmon River MPGs, upper Salmon River productivity estimates decreased as spawner escapement increased across BYs 2004–2011 (Figure 6).

Smolt-to-Adult Return Rates

Sufficient data are currently available to calculate the smolt-to-adult return (SAR) rate at only one location: Fish Creek weir. Beginning in 1994, the number of PIT-tagged smolts in Fish Creek that were subsequently detected in the hydrosystem ranged from 128 smolts (1994) to 4,644 smolts (2012). One hundred and thirty adults were detected that were not previously detected as emigrating smolts and were excluded from further analysis. From migratory years (MYs) 1996–2014, 767 adults were used to calculate SARs. The number of adults detected ranged from three fish (MY 1996) to 168 fish (MY 2012). Migratory year 2015 had only one year of adult returns (n = 0) and was excluded from further analysis. Migratory year 2013 was the most recent complete estimate and had an SAR of 2.68% (95%CI 2.06–3.47%). Migratory year 2014 is mostly complete, missing only 3-ocean adults returning in 2018 (SAR = 2.03%). For migratory years (MYs) 1996–2014, the geometric mean SAR was 0.94% and ranged from 0.15% (MY 2001) to 4.36% (MY 2008; Figure 7). Seven of the 19 completed SAR estimates (31.6%) were ≥2.0%.

Diversity

Age, Sex, and Size Composition

Big Bear Creek Array—Age composition of Big Bear Creek steelhead was determined solely from adult fish sampled at LGR because no fish were physically handled at the array location. Specifically, age data were collected from six individuals PIT tagged at the dam and subsequently detected at the PIT tag array, 11 fish sampled in the sort-by-code system at the dam, and two fish that were tagged as juveniles in Big Bear Creek but not included in the sort-by-code or detected on the array. Of the 19 unique wild adult steelhead sampled, 15 were assigned complete ages, one had unknown freshwater age, and 3 were not aged (Table 2). Of those assigned ocean ages, one fish (6.3%) was a 1-ocean adult and the remaining 15 fish (93.7 %) were 2-ocean adults (Figure 8). Eleven adults smolted after two years in freshwater (73.3%), two fish smolted after one year (13.3%), and two fish smolted after three years (13.3%). Total ages ranged from four to six years, with four different freshwater-saltwater age class combinations (Table 2).

Sex and size composition data were collected from the same 19 fish sampled for age composition (Table 1). The sex ratio of Big Bear Creek prespawn adult steelhead was female biased (n = 16; 84.2%). Mean fork length for females was 71.5 cm (range = 62.0–78.0 cm) and males was 79.0 cm (range = 77.0–79.0 cm).

East Fork Potlatch River Weir—We supplemented age composition data collected at the weir with data collected on East Fork Potlatch River adults sampled at LGR. Specifically, we collected age data on nine unique wild, adult steelhead (prespawn and kelts) captured at the weir and three wild returning adults sampled at LGR that were tagged as juveniles in the East Fork Potlatch River. Eleven of the twelve unique adults sampled were assigned complete ages (Table 2). One fish (9.1%) was 1-ocean and the other 10 adults (90.9%) were 2-ocean fish (Figure 8). Ten adults (90.9%) smolted after two years in freshwater and one adult (9.1%) smolted after three years. Total ages ranged from four to six years, with three different freshwater-saltwater age class combinations (Table 2).

Sex and size composition data were collected from the same adult steelhead sampled for age composition (Table 1). The sex ratio of East Fork Potlatch River adult steelhead was female biased. Females comprised 72.3% (n = 8) of the adults sampled at the weir and LGR. Mean fork length for females was 70.4 cm (range = 53.4–81.0 cm) and males was 76.7 cm (range = 71.0–81.5 cm; Table 1). Two of the five kelts were female (40%). Mean fork length for female kelts was 68.5 cm (range = 67.5–69.5 cm) and male kelts was 76.5 cm (range = 72.5–80.5 cm).

Crooked River Weir—We supplemented age data collected at the weir with data collected on Crooked River adults sampled at LGR. Specifically, age data was collected on one unique wild, adult steelhead captured at the weir and four wild returning adults sampled at the dam that were tagged as juveniles at the Crooked River screw trap. All sampled fish were assigned complete ages (Table 2). All five of the adults were 2-ocean fish (Figure 8). Three adults (60.0%) smolted after three years in freshwater and two fish (40.0%) smolted after two years in freshwater. There were two different freshwater-saltwater age class combinations identified and total ages ranged from five to six years (Table 2).

Sex and size composition data were collected on all five adult steelhead sampled for age composition (Table 1). Females comprised 80.0% (n = 4) of adults sampled at the weir and LGR.

Mean fork length of females was 76.0 cm (range = 74.0–79.0 cm) and the fork length of the one male sampled was 87.0 cm (Table 1).

Fish Creek Weir—Due to the relatively low number of adults handled at the Fish Creek weir, we supplemented age composition data with data collected on Fish Creek adults sampled at LGR. Specifically, we collected age data on 53 unique wild, adult steelhead (prespawn and kelts) captured at the weir and 17 wild adults sampled at the dam that were tagged as juveniles at the Fish Creek screw trap. Of the 70 unique adults sampled, 63 fish were assigned complete ages, five fish had unknown freshwater ages, and two fish could not be aged (Table 2). Of those assigned ocean ages, 66 fish (97.1%) were 2-ocean adults, and two fish (2.9%) were 3-ocean adults (Figure 8). Thirty-four fish (53.9%) smolted after two years in freshwater, 28 fish (44.5%) smolted after three years, and one fish (1.6%) smolted after four years. Total ages ranged from five to seven years, with five different freshwater-saltwater age class combinations (Table 2).

Sex and size composition data were collected from the same group of Fish Creek adults sampled for age composition (Table 1). The sex ratio of Fish Creek adult steelhead was strongly female biased, with females comprising 76.9% (n = 50) of the adults sampled at the weir and LGR. Mean fork length for females was 75.5 cm (range = 68.0–81.0 cm) and males was 80.1 cm (range = 73.8–88.0 cm; Table 1). Three of the five kelts captured were female (60.0%). Mean fork length for female kelts was 77.4 cm (range = 75.7–79.2 cm) and males was 81.1 cm (range = 79.2–83.0 cm).

Rapid River Weir—We could not supplement age data collected at the Rapid River weir because no PIT-tagged Rapid River wild adult steelhead were handled at LGR during 2017. Therefore, age composition was determined solely from the eleven unique wild, adult steelhead captured at the weir. Ten fish were assigned complete ages and one fish had an unknown freshwater age but was a repeat spawner (Table 2). Of those assigned ocean ages, two fish (10.0%) were 1-ocean adults, eight fish (80.0%) were 2-ocean adults, and one fish (8.3%) spent two years in the ocean before spawning for two consecutive years (Figure 8). Seven fish (58.3%) smolted after two years in freshwater and four fish (33.3%) smolted after three years. Total ages ranged from five to six years at spawning, with four different freshwater-saltwater age class combinations (Table 2).

Sex and size composition data was collected from the eleven adults sampled for age composition, but sex was not determined on three fish (Table 1). Females comprised 75.0% (n = 6) and males comprised 25.0% (n = 2) of the fish sexed. Mean fork length of females was 70.2 cm (range = 63.0–73.0 cm) and males was 70.0 cm (range = 52.0–88.0 cm; Table 1).

Big Creek Array—Age composition of Big Creek steelhead was determined solely from adult fish sampled at LGR because no fish were physically handled at the array location. Complete ages were assigned to nine unique wild, adult steelhead sampled at the dam that were subsequently detected at the Big Creek PIT tag array (Table 2). One fish (11.1%) was a 1-ocean adult and the remaining eight fish (89.9%) were 2-ocean adults (Figure 8). Five adults (55.6%) smolted after three years in freshwater, two adults (22.2%) smolted after two years, and two fish (22.2%) smolted after four years in freshwater. Total ages ranged from five to seven years at spawning, with four different freshwater-saltwater age class combinations (Table 2).

We collected genotypic sex and size composition data on the nine adult steelhead sampled for age composition (Table 1). Females comprised 67.0% (n = 6) and males 33.0% (n = 3) of the adults sampled at LGR (Table 1). Mean fork length for females was 73.7 cm (range = 67.0–79.0 cm) and males was 71.0 cm (range = 59.0–80.0 cm).

Lemhi River Array—Age composition of Lemhi River steelhead was determined solely from adult fish sampled at LGR because no fish were physically handled at the array. Specifically, we collected age data on 32 adult steelhead sampled at the dam that were subsequently detected at the Lemhi River PIT tag array. These include fish PIT tagged as adults at LGR, as well as fish tagged as juveniles at the Lemhi River screw trap. Thirty of the 32 unique wild, adult steelhead were assigned complete ages and two fish had unknown freshwater ages (Table 2). Twenty-two fish (68.7%) were two-ocean adults, nine fish (28.1%) were one-ocean adults, and one fish (3.2%) was a repeat spawner that spent one year in the ocean before spawning two consecutive years (Figure 8). Nineteen fish (59.4%) smolted after two years in freshwater, 10 fish (31.3%) smolted after three years, and one fish (3.1%) smolted after four years. There were seven different freshwater-saltwater age class combinations and total ages ranged from four to seven years (Table 2).

We collected genotypic sex and size composition data from the same group of Lemhi River adults sampled for age composition (Table 1). Similar to other locations, the sex ratio of Lemhi River adult steelhead was female biased. Females comprised 78.1% (n = 25) and males comprised 21.9% (n = 7) of adults sampled at LGR (Table 1). Mean fork length of females was 65.3 cm (range = 53.0–73.0 cm) and males was 63.6 cm (range = 54.0–73.0 cm; Table 1).

Pahsimeroi River Weir—We could not supplement age data collected at the weir because no PIT-tagged Pahsimeroi River wild adult steelhead were handled at LGR during 2017. Therefore, age composition was determined solely from 24 unique wild, adult steelhead captured at the weir. Eighteen fish were assigned complete ages, five fish had unknown freshwater ages, and one fish could not be aged (Table 2). Of those assigned ocean ages, four fish (17.4%) were 1-ocean adults and 19 fish were 2-ocean adults (Figure 8). Fifteen fish (65.2%) smolted after two years in freshwater, one fish (4.3%) smolted after a single year, and two fish (8.7%) smolted after three years. There were six different freshwater-saltwater age class combinations and total ages ranged from four to six years (Table 2).

Sex and size composition data were collected from the 24 adult steelhead sampled for age composition (Table 1). The sex ratio of Pahsimeroi River wild adult steelhead was female biased, with females comprising 75.0% (n = 18) and males comprising 25.0% (n = 6) of the wild fish return. Mean fork length of females was 65.4 cm (range = 52.0–73.0 cm) and males was 70.2 cm (range = 61.0–76.0 cm; Table 1).

East Fork Salmon River Weir—We supplemented age data collected at the weir with data collected on East Fork Potlatch River adults sampled at LGR. Specifically, we collected age composition data on 26 unique wild, adult steelhead captured at the weir and one additional wild adult sampled at LGR that was tagged as a juvenile at the East Fork Salmon screw trap. Twenty-five adults were assigned complete ages and two adults had unknown freshwater ages (Table 2). All fish (n = 27) were 2-ocean adults (Figure 8). Sixteen fish (59.3%) smolted after two years in freshwater, two fish (7.4%) smolted after one year, and seven fish (25.9%) smolted after three years. There were four different freshwater-saltwater age class combinations and total ages ranged from four to six years (Table 2).

We collected sex and size composition data from the 27 adult steelhead sampled for age composition (Table 1). The sex ratio of East Fork Salmon River wild, adult steelhead was female biased, with females comprising 70.4% (n = 19) and males 29.6% (n = 8) of the total return. Mean fork length of females was 72.3 cm (range = 68.0–79.0 cm) and males was 70.1 cm (range = 59.0–78.0 cm; Table 1).

Upper Salmon River (Sawtooth) Weir—We could not supplement age data collected at the weir because no PIT-tagged upper Salmon River wild adult steelhead were handled at LGR during 2017. Therefore, age composition was determined solely from 22 unique wild, adult steelhead captured at the weir. Twenty-one fish were assigned complete ages and one fish had an unknown freshwater age (Table 2). Of those assigned ocean ages, 21 fish (95.4%) were 2-ocean adults and one fish (4.6%) was a 1-ocean adult (Figure 8). Fourteen fish (63.6%) smolted after two years in freshwater and seven fish (31.8%) smolted after three years. There were four different freshwater-saltwater age class combinations and total ages ranged from five to six years (Table 2).

We collected phenotypic sex and size composition data from the 22 adult steelhead sampled for age composition (Table 1). The sex ratio of upper Salmon River adult steelhead was female biased, with females comprising 81.8% (n = 18) and males 18.2% (n = 4) of the returning wild fish. Mean fork length of females was 67.2 cm (range = 54.0-75.0 cm) and males was 70.8 cm (range = 67.0-73.0 cm; Table 1).

Adult Migration Timing and Conversion Rates

Big Bear Creek Array—Twenty-six individual adult steelhead were detected in the hydrosystem during the 2016–2017 spawning migration that were PIT tagged as juveniles in Big Bear Creek (Figure 9). Twenty-four of the 26 individuals (92%) were first detected at Bonneville Dam. The median date of passage over Bonneville Dam was July 28, 2016 (range = June 25–September 6). Conversion rates from Bonneville Dam to McNary Dam and LGR were 79% and 75%, respectively. Nineteen of the 20 PIT-tagged adult steelhead detected at LGR were detected during the fall 2016. The median date of passage for fall migrants over LGR was September 25, 2016 (range = July 6–October 25). One upstream migrating adult steelhead was detected at LGR during the spring (March 28, 2017). Of the initial 26 adults that entered the hydrosystem, three individuals (12%) were detected at the Big Bear Creek array. The Big Bear Creek array was inoperable during the bulk of the migration period and it is almost certain some individuals detected in the hydrosystem passed upstream undetected. Therefore, the conversion rate between Bonneville Dam and the array should be considered a minimum estimate. There were seven unique adult steelhead detected on the Big Bear Creek array during the 2017 migration. Of these fish, the first prespawn fish was detected on April 8, 50% of the fish passed upstream by April 11, and the final fish was detected on April 23 (Figure 10). These results are not representative of the entire spawning migration because the array was inoperable from February 9–April 5.

East Fork Potlatch River Weir—Five individual adult steelhead were detected in the hydrosystem during the 2016–2017 spawning migration that were PIT tagged as juveniles in the East Fork Potlatch River. All individuals were first detected at Bonneville Dam. The median date of passage over Bonneville Dam was August 13, 2016 (range = June 27–August 22). All individuals detected at Bonneville Dam were subsequently detected at McNary Dam and LGR (conversion rate = 100%). Four of the five PIT-tagged adult steelhead were detected at LGR in the fall and the median date of passage for fall migrants over LGR was September 21, 2016 (range = July 11–October 8). One upstream migrating adult steelhead was detected at LGR during the spring (April 23, 2017). Of the initial five adults that entered the hydrosystem, only one fish (20%) was captured at the East Fork Potlatch River weir. Because the weir was inoperable for 30 d during the migration period, it is likely some individuals passed upstream undetected. Therefore, the conversion rate from Bonneville Dam to the weir should be considered a minimum estimate. Prespawn adult steelhead were captured at the weir between April 18-May 2 and kelts were captured between May 4-14, 2017 (Figure 10). The median date of capture for prespawn adults was April 22 and kelts was May 7.

Crooked River Weir—Five individual adult steelhead were detected in the hydrosystem during the 2016-2017 spawning migration that were PIT tagged as juveniles in Crooked River. All individuals were first detected at Bonneville Dam. The median date of passage over Bonneville Dam was September 11, 2016 (range = July 19-October 7). All individuals detected at Bonneville Dam were subsequently detected at McNary Dam and LGR (conversion rate = 100%). Four of the five PIT-tagged adult steelhead were detected at LGR in the fall and the median date of passage for fall migrants over LGR was September 21, 2016 (range = August 11–October 8). One upstream migrating adult steelhead was detected at LGR during the spring (March 24, 2017). None of the five individuals that entered the hydrosystem were captured at the Crooked River weir. Because the weir panels were removed when flows were high during 13 days of the migration period, it is likely some individuals passed upstream undetected. Therefore, the conversion rate from Bonneville Dam to the weir should be considered a minimum estimate. One prespawn adult steelhead was captured at the Crooked River weir on May 5, 2017.

Fish Creek Weir—Thirty-six individual adult steelhead were detected in the hydrosystem during the 2016–2017 spawning migration that were PIT tagged as juveniles in Fish Creek (Figure 9). All individuals were first detected at Bonneville Dam. The median date of passage over Bonneville Dam was September 15, 2016 (range = August 8-October 10). Conversion rates from Bonneville Dam to McNary Dam and to LGR were 78% and 69%, respectively. Thirteen of the 25 PIT-tagged adult steelhead (52%) detected at LGR were detected during the fall and the remaining 12 fish were detected during the following spring. The median date of passage for fall migrants at LGR was October 19 (range = October 7–December 10) and for spring migrants was April 18 (range = March 23–June 8). Of the initial 36 adults that entered the hydrosystem, four individuals (11%) were subsequently captured as prespawn adults at the Fish Creek weir. In addition, two individuals were captured as unmarked kelts at the weir, for a total of six unique PIT-tagged adults. The Fish Creek weir was partially operable for 90 d during the migration period and it is possible some individuals detected in the hydrosystem passed upstream undetected. Therefore, the conversion rate from Bonneville Dam to the Fish Creek weir (17%) should be considered a minimum estimate. Prespawn adult steelhead were captured at the weir between April 1–June 21 and kelts were captured between June 17–21 (Figure 10). The median date of capture for prespawn adults and kelts was June 7 and June 17, respectively.

Rapid River Weir—Four individual adult steelhead were detected in the hydrosystem during the 2016–2017 spawning migration that were PIT tagged as juveniles in Rapid River. All individuals were first detected at Bonneville Dam. The median date of passage over Bonneville was August 8, 2016 (range = August 3–September 2). Three of the four fish were detected at McNary Dam, with a median date of passage of September 7. Only two individuals were detected at LGR on August 31 and September 16. None of the PIT-tagged fish detected in the hydrosystem were captured at the Rapid River weir. Two of the 11 adult steelhead captured at the Rapid River weir were PIT-tagged, but they were not detected in the hydrosystem during the spawning migration. Prespawn adults were captured at the weir from April 24 to May 8, with 50% of prespawn adults captured by May 5 (Figure 10).

Big Creek Array—Two returning Big Creek adult steelhead were detected in the hydrosystem during the 2016–2017 spawning migration, one fish was PIT tagged as a juvenile, and one fish was PIT tagged as an adult at Bonneville Dam. For these fish, the median date of passage over Bonneville Dam was September 12, 2016 (range = September 6-19) and McNary Dam was September 23, 2016 (range = September 16-October 1). Both fish were detected at

LGR, one fish in the fall (September 23, 2016) and one fish the following spring (March 27, 2017). In addition, eight more adults were sampled at LGR during the 2016-2017 migration that were subsequently detected at the Big Creek Array. The median date of passage for these fish at LGR was September 18, 2016 (range = September 11-October 8). Prespawn adult steelhead were detected on the PIT tag array from April 1 to May 27 (median detection date = April 21) (Figure 10).

Lemhi River Array—Thirteen individual adult steelhead were detected in the hydrosystem during the 2016–2017 spawning migration that were PIT tagged as juveniles in the Lemhi River (Figure 9). Twelve of the 13 individuals (92%) were first detected at Bonneville Dam. The median date of passage over Bonneville Dam was August 2, 2016 (range = July 6–September 5). Conversion rates from Bonneville Dam to McNary Dam and LGR were 67% for each dam. All PIT-tagged adult steelhead detected at LGR were detected during the fall 2016. The median date of passage for migrants over LGR was September 15 (range = September 9–27). Of the initial 12 adults detected at Bonneville Dam, seven individuals (58%) were detected at the Lemhi River array. After incorporating an adjustment for detection efficiency at the array site, the estimated percentage of PIT-tagged adults that converted from Bonneville Dam to the Lemhi River was 67% (n = 8). There were 52 unique adult steelhead detected on the Lemhi River array during the 2016–2017 spawning migration. Prespawn adult steelhead were detected at the array between February 18–June 8, 2017 (median detection date = April 13; Figure 10).

Pahsimeroi River Weir—During the 2016–2017 spawning migration, no returning adult steelhead were detected in the hydrosystem that were PIT tagged as juveniles in the Pahsimeroi River. Two of the 24 adult steelhead captured at the Pahsimeroi weir were sampled at LGR, but the remaining 22 fish were untagged. The median date of passage for the two fish sampled at LGR was September 22, 2016 (range = September 18-22). Prespawn adult steelhead were captured at the weir from February 27 to May 1, 2017 (median detection date = April 3; Figure 10).

East Fork Salmon River Weir—No returning East Fork Salmon River adult steelhead were detected in the hydrosystem during the 2016–2017 spawning migration. There was one adult steelhead sampled at LGR on September 19, 2016 that was captured at the Pahsimeroi weir the following spring. The remaining adults captured at the weir (n = 26) were not PIT tagged and could not be detected in the hydrosystem. Prespawn adult steelhead were captured at the weir from April 4 to May 7, 2017 (median detection date = April 24; Figure 10).

Upper Salmon River (Sawtooth) Weir—No returning upper Salmon River adult steelhead were detected in the hydrosystem during the 2016–2017 spawning migration. There were 22 adult steelhead captured at the upper Salmon River weir, three of which were sampled at LGR and 19 fish that were untagged. The median date of passage for the three fish sampled at the dam was August 22, 2016 (range = August 21-September 29). Prespawn adult steelhead were captured at the Sawtooth weir from March 23–April 27, 2017 (median detection date = April 13; Figure 10).

Genetic Sampling

During 2017, we collected genetic samples from wild adult steelhead captured in the course of other project activities. Three hundred and one genetic samples were collected across 11 IDFG research and hatchery weir locations. All samples were archived for later analysis (Appendix E).

DISCUSSION

The purpose of this report is to develop and summarize population-level information to evaluate the status of wild adult steelhead populations in Idaho. Population abundance, productivity, and life history information are key data needed to inform DPS viability and management. This is the third year in which we assembled all wild adult steelhead information collected statewide under one cover. The reporting process continues to develop as we determine the best ways to combine and analyze information from various projects. In future years, the utility and inference of this work will expand as we develop and standardize methods across sampling locations and assimilate information on additional steelhead populations in Idaho.

Adult Abundance and Productivity

Population-specific abundance and productivity data are key criteria in ESA status assessments of Pacific salmonids (McElhany et al. 2000). Idaho's wild steelhead populations are considered to have a high risk of extinction within 100 years (probability >25%) based on current abundance and productivity estimates (ICTRT 2010). Idaho Department of Fish and Game conducts population-specific monitoring of adult steelhead abundance and productivity across a diverse assemblage of populations in Idaho. This annual monitoring also provides valuable demographic data (length and age structure) critical to the management of wild salmonid populations. Population-specific monitoring is a key component of the management framework needed in order to evaluate these populations at the proper scale to assess recovery objectives (Copeland et al. 2017).

Adult steelhead abundance estimates decreased across all monitored populations in 2017 relative to 2016. From 2016 to 2017, the Clearwater River MPG populations decreased on average by 83.9% and the Salmon River MPG populations decreased by 64.7%. The magnitude of the Clearwater River MPG decrease should be viewed with caution because abundance estimates for three of the four populations (Big Bear Creek, East Fork Potlatch River, and Fish Creek) were likely biased low in 2017. Unlike previous years when returning adult steelhead were a mix of mostly 1-ocean and 2-ocean individuals (1-ocean = 43.8% and 2-ocean = 54.8% on average across all populations in all years), adult returns in 2017 were comprised of almost entirely 2-ocean fish (89% on average across all populations). The 1-ocean component (adults that out-migrated to the ocean as juveniles in 2015) was significantly reduced in 2017 (10.6% on average across all populations). In 2015, the relative abundance of wild and unmarked steelhead smolts that passed LGR was the lowest among the previous nine years (approximately 50% of the next highest estimate; Fish Passage Center 2015). In addition, flow conditions during the 2015 juvenile outmigration were poor and steelhead smolt survival from the Idaho/Washington border to Bonneville Dam was <40%, the lowest estimate since 2006 (Faulkner et al. 2016). These factors, coupled with poor ocean conditions for juvenile salmonid survival in 2015 (Peterson et al. 2015), resulted in the low return of adult steelhead to Idaho in 2017. Furthermore, these factors will continue to impact the return of 2-ocean adult steelhead to Idaho in 2018.

We expanded our population productivity baseline dataset to three populations in the Clearwater River MPG and six populations in the Salmon River MPG. Fish Creek (Clearwater River MPG) contains the longest productivity time series (18 complete BYs) and highlights the variability in steelhead productivity (range = 0.3 to 10.3 recruits/spawner). Similarly, Big Bear Creek, Pahsimeroi River, and upper Salmon River populations show wide fluctuations in annual productivity, though in more limited data sets. For many of the monitored populations, there was a peak in productivity in BYs 2005-2007 followed by a general decline through BY 2010. To date, productivity estimates for only 15 BYs in the Clearwater River MPG (48%) and 14 BYs in the Salmon River MPG (39%) have been above replacement (replacement occurs when recruits/spawner = 1.00, assuming an even sex ratio). However, in years when populations did replace themselves, the average recruit/spawner estimate was three times above replacement (mean = 3.2 recruits/spawner; range = 1.0–10.3 recruits/spawner).

Density dependence has been observed in most ESA-listed salmonid populations in the Columbia River basin (ISAB 2015). In Idaho, density dependence in smolt production has been observed in steelhead populations in Fish Creek (Stark et al. 2016) and the Potlatch River (Bowersox et al. 2012; Uthe et al. 2017), and in spring/summer Chinook salmon (Walters et al. 2013). Although our dataset is limited, density dependent patterns are starting to emerge in other study populations, specifically Pahsimeroi River, East Fork Salmon River, and upper Salmon River populations (Figure 8). Improving freshwater rearing habitat is one of the suite of actions being taken to reduce density dependent effects on salmonid populations. Idaho Department of Fish and Game concentrates efforts to evaluate fish population response to habitat restoration in two intensively monitored watersheds, the Potlatch River (Clearwater River MPG) and Lemhi River (Salmon River MPG) (IDFG 2013). Restoration and monitoring programs have been underway in these watersheds for approximately 10 years and although significant amounts of restoration remain to be implemented, positive strides are being made (Uthe et al. 2017). Further monitoring of adult productivity should highlight the population-level benefits from these efforts and allow for more adequate evaluation of potential density dependence in additional populations in Idaho.

Diversity

Steelhead have the most diverse portfolio of life history strategies of Pacific salmonids (Quinn 2005) and as a result they display a tremendous amount of variation in age and size at maturity. Understanding this diversity within and among populations is important to the management and recovery of wild populations (McElhany et al. 2000). In 2017, there was a noticeable shift in the age class structure of returning adult steelhead to the study populations. Two-ocean fish dominated adult returns in 2017, and ranged from 71% (Lemhi River) to 100% (East Fork Salmon River) of returns across all populations. In contrast, the average proportion of 2-ocean adults ranged from 32% (Pahsimeroi River) to 78% (Fish Creek) during previous years. In 2017, the proportion of 1-ocean adults ranged from 5% (upper Salmon River) to 29% (Lemhi River), and two populations (East Fork Salmon River and Fish Creek) had no 1-ocean adults sampled. In previous years, the average proportion of 1-ocean adults ranged from 20% (Fish Creek) to 66% (Pahsimeroi River). The observed shift in proportions was due to the absence of 1-ocean adults in 2017 rather than an increase in 2-ocean abundance. Interestingly, the opposite pattern was observed in 2014, when the majority of populations were dominated by 1-ocean fish. These data highlight the benefits of having a diverse range of ages at maturity to buffer against the possibility of a single brood year or ocean year failure.

Differences in run timing also reflect the diversity seen in freshwater/saltwater residency, length, and age of adult steelhead in Idaho. Although our dataset was limited, the run timing of adult steelhead populations in 2017 was similar to previous years. We found that Big Bear Creek and Lemhi River steelhead populations, which are comprised of relatively younger and smaller fish, had an earlier arrival date to Bonneville Dam compared to Fish Creek which is comprised of relatively older, larger individuals. Run timing differences associated with the age and size structure of summer-run steelhead populations has been previously documented (Robards and Quinn 2002; Copeland et al. 2017) and were historically used to differentiate and manage A-run and B-run stocks in the Columbia River basin (WDFW and ODFW 2002). Similar to previous years, Big Bear Creek and Fish Creek steelhead populations (Clearwater River MPG) showed a bi-modal run timing (both fall and spring) past LGR. Conversely, the Lemhi River steelhead population (Salmon River MPG) displayed more of a singular pulse past LGR during the fall. This is similar to previous findings that showed few Salmon River steelhead wintered downstream of LGR; whereas a larger portion of Clearwater River steelhead wintered downstream of LGR (Tim Copeland, personal communication).

Sampling Challenges and Infrastructure

Spring flow conditions hampered adult steelhead monitoring efforts in 2017, particularly in Clearwater River MPG. Above average spring precipitation resulted in near historic spring flows in the Potlatch and Lochsa River drainages (https://waterdata.usgs.gov/id/nwis/current/?type=flow), which resulted in damage to infrastructure and loss of abundance and life history data. As a result, abundance estimates for Big Bear Creek, East Fork Potlatch River, and Fish Creek locations were biased in 2017 and should be viewed with caution. In addition, the Crooked River estimate was biased low because weir panels were pulled during the migration. It is important to note these biases will also affect future productivity estimates for these locations.

This is the first year we leveraged the systematic sampling program at LGR to increase sample sizes for demographic data, including length, age, and sex composition of returning adults that were tagged as juveniles in their respective natal streams. We recommend this approach be utilized in the future when weir and array sample sizes are low. We suggest incorporating LGR samples into demographic data reporting when a sample size <20 is collected at a single weir or array location. Future analysis to test the life history composition of LGR sampled individuals versus fish sampled at weirs will be used to evaluate if any differential mortality is occurring between LGR and weirs. Assuming no mortality bias is observed, including LGR sampled fish in the diversity information reporting will increase the accuracy of demographic data contained within this report.

The use of PIT tag arrays to monitor adult steelhead escapement continues to expand throughout Idaho and we incorporated another location (Lemhi River) into the current report. In 2017, additional arrays were installed on the Lochsa, Salmon (North Fork, East Fork, and Panther Creek), and Selway rivers and should provide the ability to estimate wild steelhead escapement into those systems starting in 2018. Advantages to PIT tag arrays include the ability to operate them in larger main stem rivers where weirs cannot operate, and they typically require less effort to maintain the structures and alleviate the handling of adult fish. However, as was experienced in 2017, they are susceptible to damage during high flow events and are costly to replace. Further, the use of PIT tag arrays to monitor escapement requires leveraging the adult steelhead sampling program at LGR to provide demographic data (age, sex, and length data) and the low detectability at PIT tag arrays at some locations can limit their use. Information we gain through PIT tag arrays will only enhance our knowledge of wild steelhead populations in Idaho and will benefit long-term trend analysis between and among populations.

RECOMMENDATIONS

1. Integrate SARs for additional populations in the Clearwater River and Salmon River MPGs. Many systems have too few PIT-tagged returning adults to calculate SARs. However, some locations such as Big Bear Creek, the Lemhi River, and possibly Big Creek could be estimated and reported.

2. Expand population productivity baseline dataset to include other monitoring locations. Potential locations where sufficient juvenile tagging at rotary screw traps coincides with sufficient adult collections at weirs or detections at tributary arrays include the Lochsa River and NF Salmon River.

3. Compare the life history composition of LGR sampled individuals versus fish sampled at weirs to evaluate if any differential mortality is occurring between LGR and weirs.

4. Compare productivity metrics of Idaho steelhead populations to other steelhead populations in the Columbia River.

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Table 1. Number of wild adult steelhead (prespawn and kelts) captured at select Idaho weirs and number of known destination wild adult steelhead sampled at Lower Granite Dam (LGR), by sex and size, 2017. NA = not applicable.

Location	Sex	Prespawn adults trapped at weir	Prespawn adults sampled at LGR	Fork length (cm)			Kelts recovered	
				Minimum	Mean	Maximum	Unmarked	Marked
Clearwater River MPG								
Big Bear Creek	Female	NA	16	620	715	780	NA	NA
Array	Male	NA	3	770	790	820	NA	NA
	All	NA	19	620	727	820	NA	NA
East Fork Potlatch River	Female	5	3	534	704	810	1	1
Weir	Male	3	0	710	767	815	1	2
	All	8	3	534	721	815	2	3
Crooked River	Female	1	3	740	760	790	NA	NA
Weir	Male	0	1	---	---	870	NA	NA
	All	1	4	740	782	870	NA	NA
Fish Creek	Female	34	16	680	755	810	2	1
Weir	Male	15	0	738	801	880	1	1
	Unknown	0	1	---	---	810		
	All	49	17	680	766	880	3	2
Salmon River MPG								
Rapid River	Female	6	0	630	702	730	NA	NA
Weir	Male	2	0	520	700	880	NA	NA
	Unknown	3	0	620	683	730	NA	NA
	All	11	0	520	696	880	NA	NA
Big Creek	Female	NA	6	670	737	790	NA	NA
Array	Male	NA	3	590	710	800	NA	NA
	All	NA	9	590	728	800	NA	NA
Lemhi River	Female	NA	25	530	653	730	NA	NA
Array	Male	NA	7	540	636	730	NA	NA
	All	NA	32	530	649	730	NA	NA
Pahsimeroi River	Female	18	0	520	654	730	NA	NA
Weir	Male	6	0	610	702	760	NA	NA
	All	24	0	520	666	760	NA	NA
East Fork Salmon River	Female	18	1	680	723	790	NA	NA
Weir	Male	8	0	590	701	780	NA	NA
	All	26	1	590	716	790	NA	NA
Upper Salmon River (Sawtooth)	Female	18	0	540	672	750	NA	NA
Weir	Male	4	0	670	708	730	NA	NA
	All	22	0	540	679	750	NA	NA

Table 2. Age frequencies of wild adult steelhead captured at select Idaho weirs and known destination wild adult steelhead sampled at Lower Granite Dam, 2017. Repeat spawners were signified by R.

	Adult Steelhead Age (FW.SW)									
Location	**1.2**	**2.1**	**2.2**	**2.3**	**3.1**	**3.2**	**3.3**	**4.2**	**R**	**Total aged**
Clearwater River MPG										
Big Bear Creek Array	2	1	10	0	0	2	0	0	0	15
East Fork Potlatch River Weir	0	1	9	0	0	1	0	0	0	11
Crooked River Weir	0	0	2	0	0	3	0	0	0	5
Fish Creek Weir	0	0	33	1	0	27	1	1	0	68
Salmon River MPG										
Rapid River Weir	0	0	7	0	2	2	0	0	1	12
Big Creek Array	0	0	2	0	1	4	0	2	0	9
Lemhi River Array	0	6	12	0	3	7	0	1	1	32
Pahsimeroi River Weir	1	2	13	0	0	2	0	0	0	23
East Fork Salmon River Weir	2	0	16	0	0	7	0	0	0	27
Upper Salmon River (Sawtooth) Weir	0	0	14	0	1	6	0	0	0	22
Total	5	10	118	1	7	61	1	4	2	233

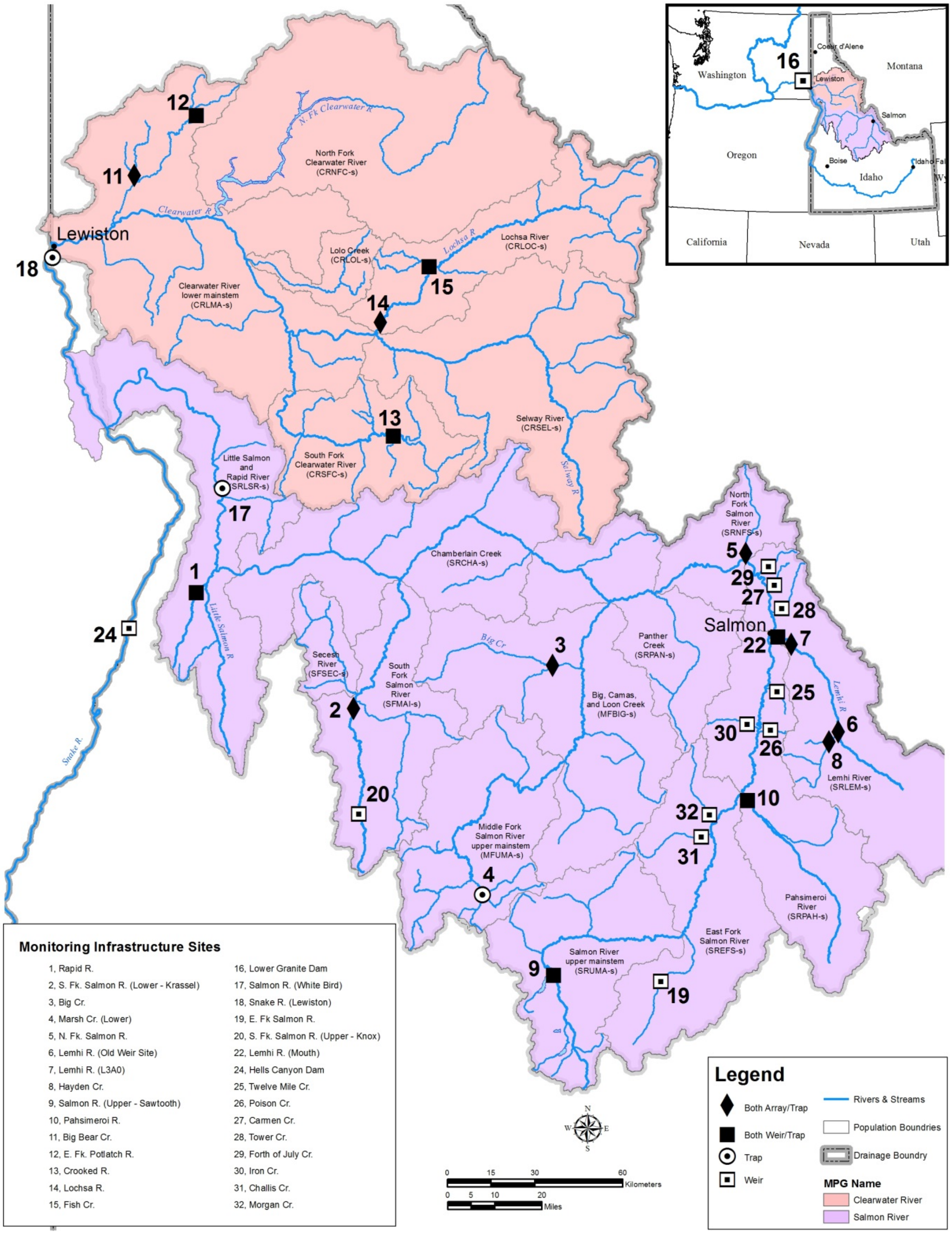

Figure 1. Location of wild steelhead monitoring infrastructure in Idaho. The Clearwater River Major Population Group is in pink; the Salmon River Major Population Group is in purple. Population boundaries are shown as light gray lines.

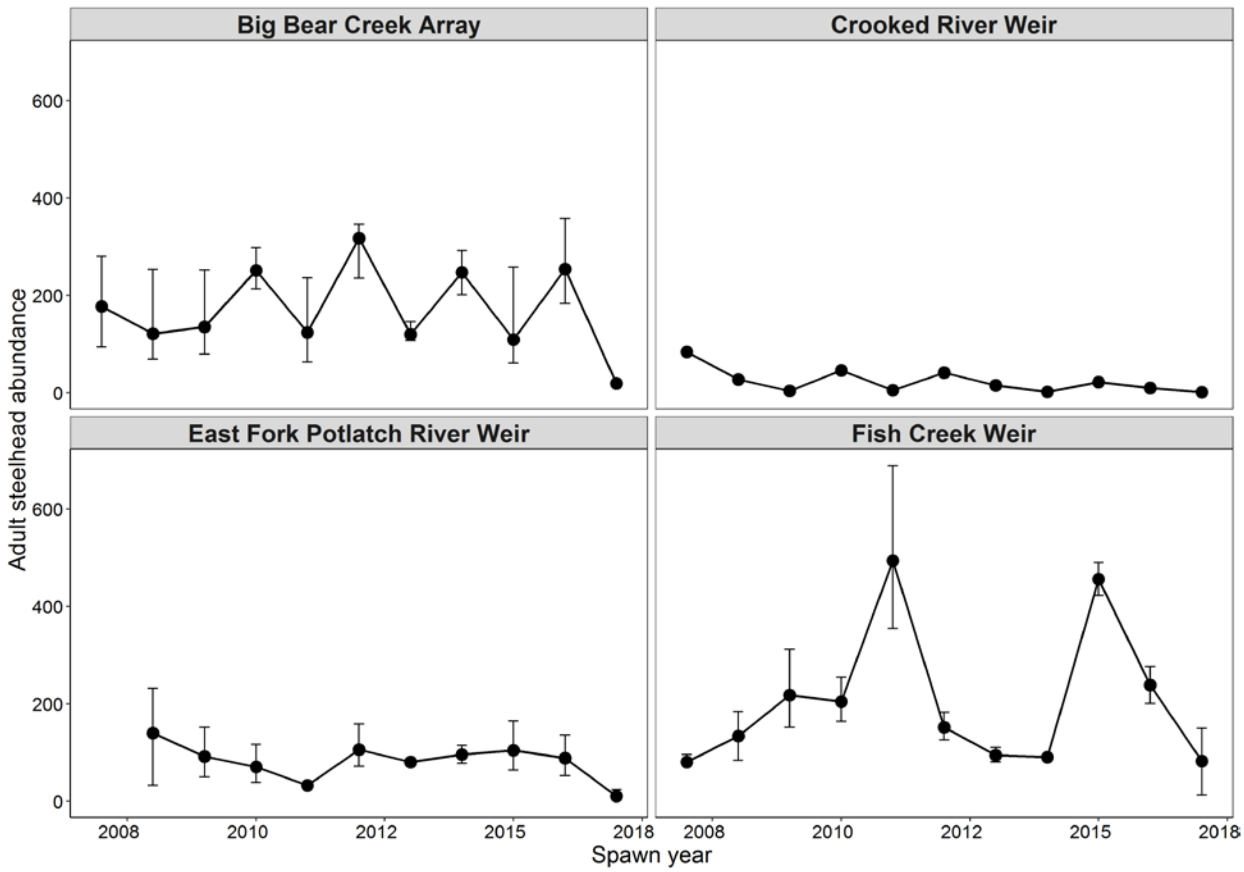

Figure 2. Abundance trends of wild adult steelhead at select weirs and PIT tag arrays in the Clearwater River basin, 2007-2017. Confidence intervals are at 95%, but could not be calculated at Crooked River because kelts were not collected efficiently across years.

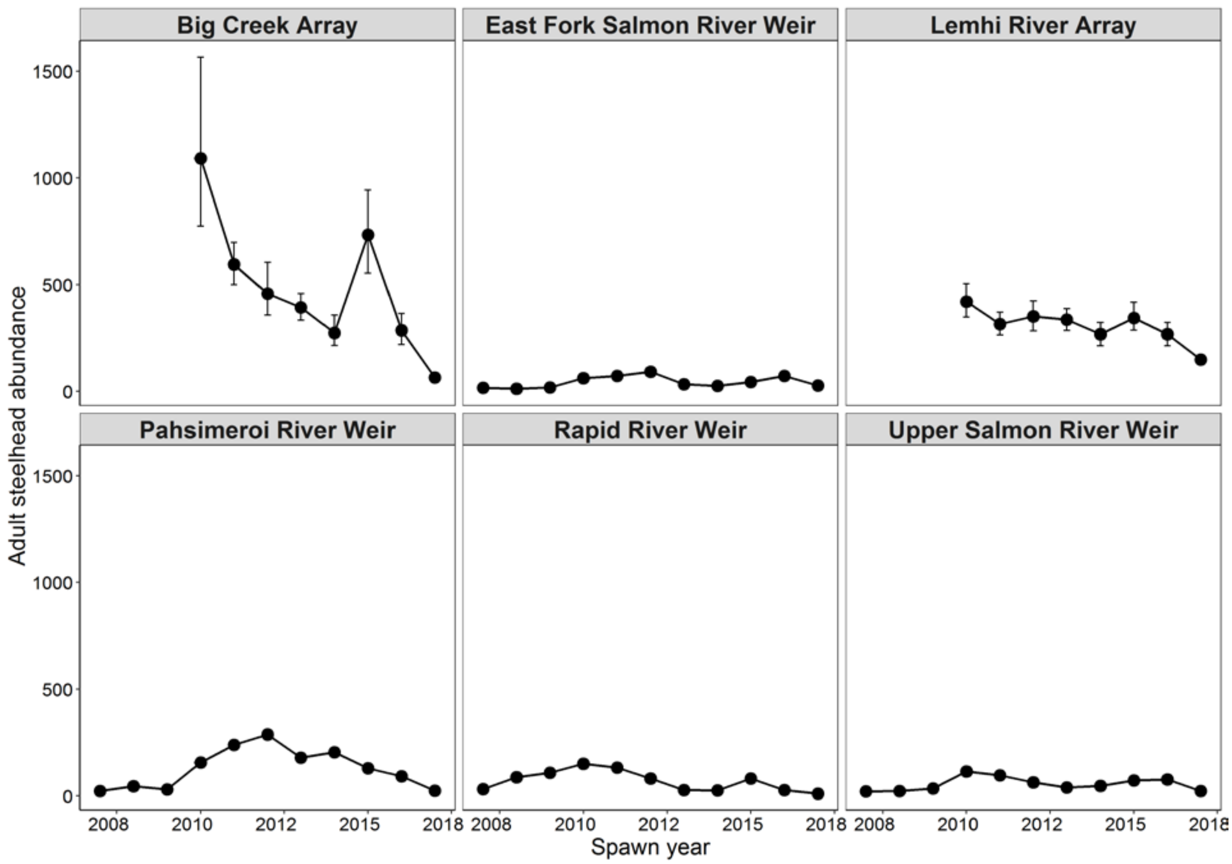

Figure 3. Abundance trends of wild adult steelhead at select weirs and PIT tag arrays in the Salmon River basin, 2007-2017. Confidence intervals are at 95%, but were not calculated at several weirs because their counts are considered a census.

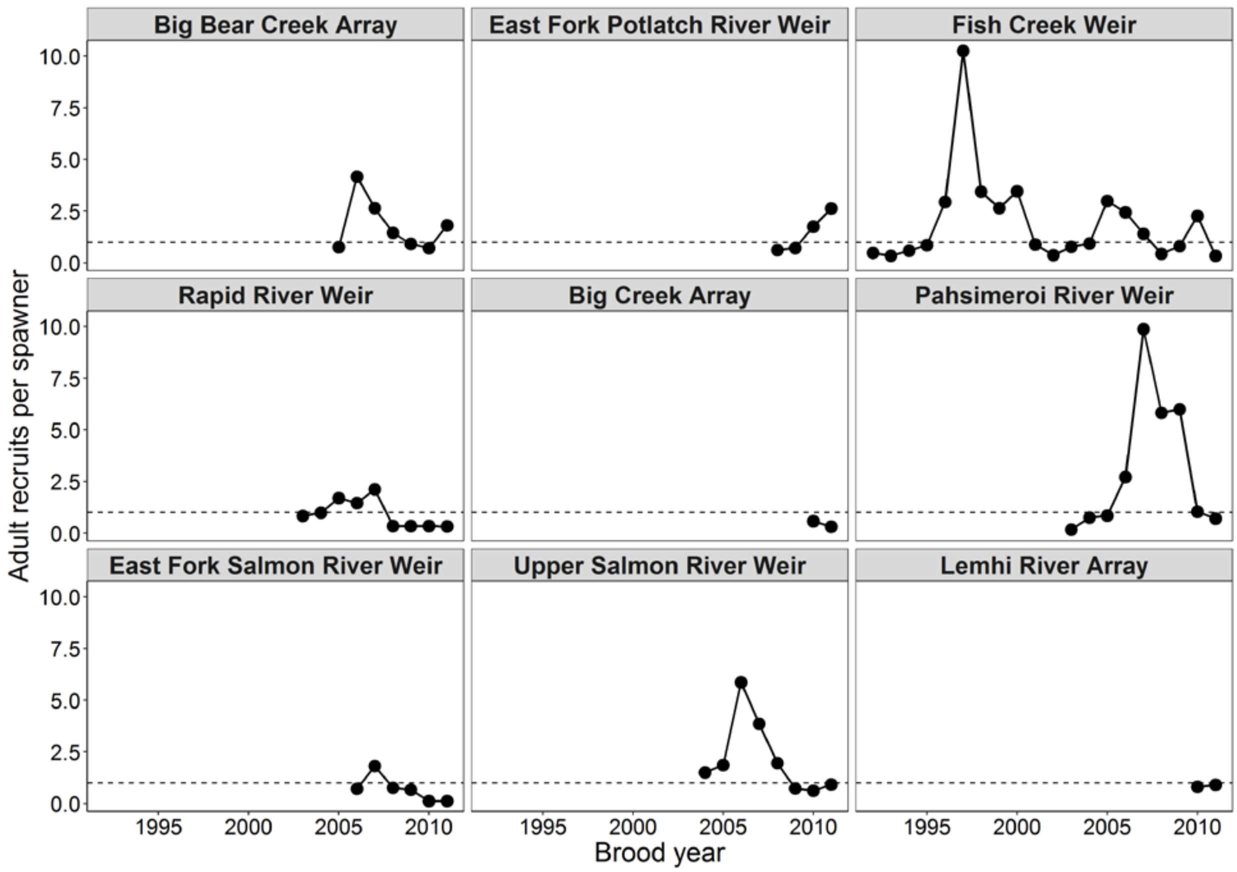

Figure 4. Adult-to-adult productivity (recruits/spawner) through brood year 2011 of wild adult steelhead at select weirs and PIT tag arrays in Idaho across years in which complete brood years were available for estimating total recruits. The dotted line at 1.0 adult recruit/spawner represents replacement.

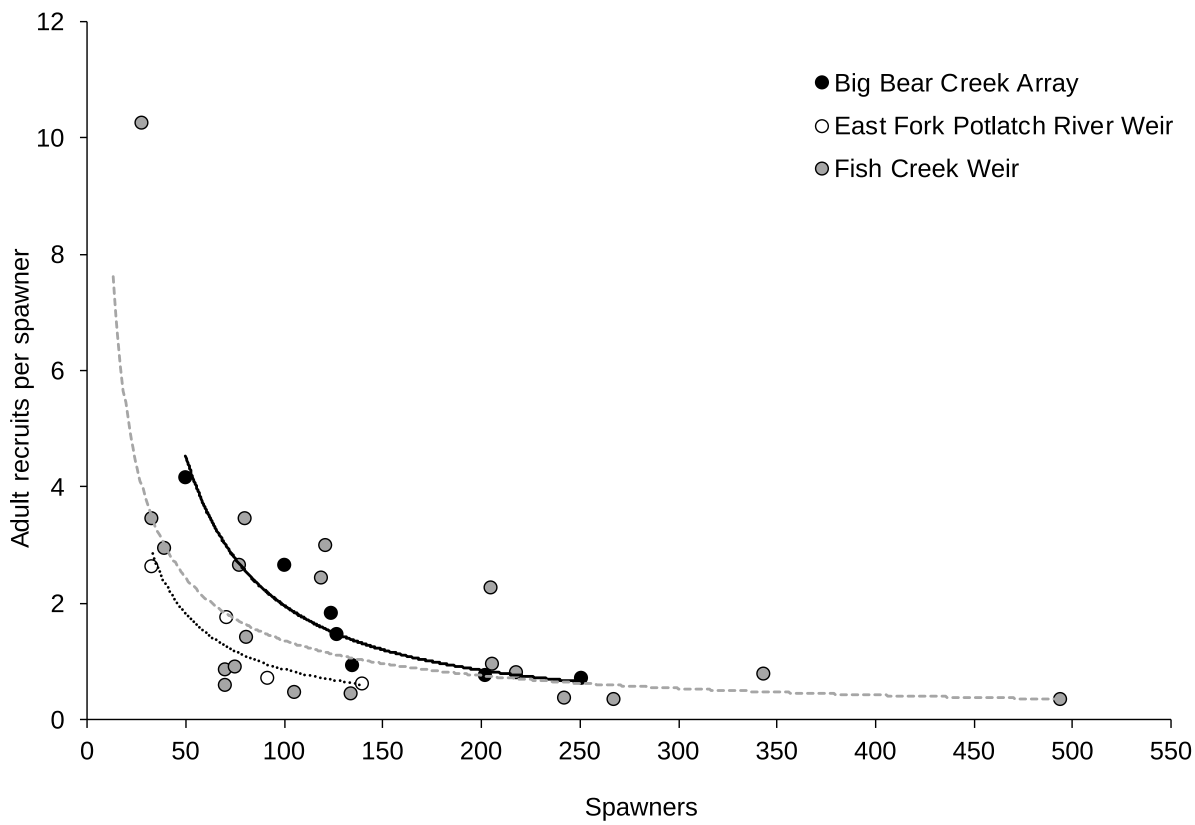

Figure 5. Relationship of adult-to-adult productivity (recruits/spawner) to spawner abundance of wild steelhead in select populations in the Clearwater River basin, Idaho across years in which completed brood years were available for estimating total recruits. Trend lines fit with a power function are shown for each data set.

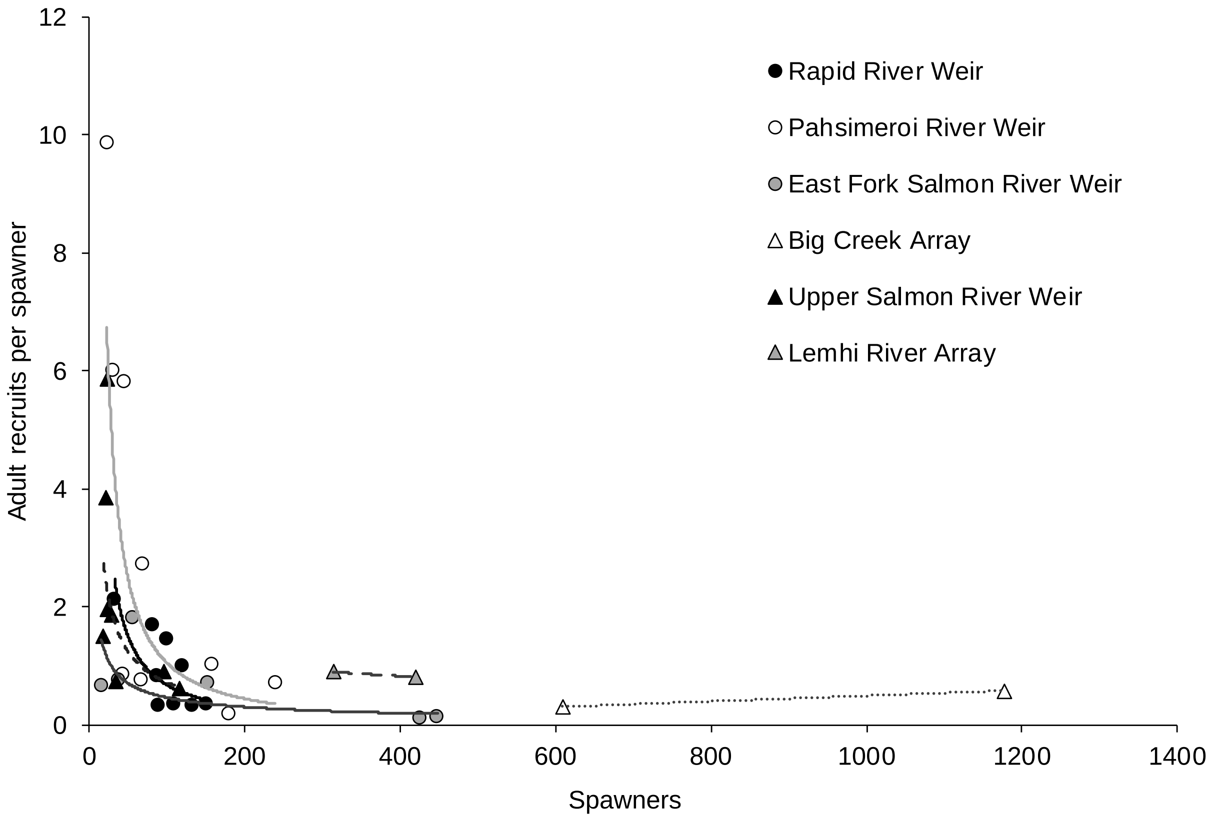

Figure 6. Relationship of adult-to-adult productivity (recruits/spawner) to spawner abundance of wild steelhead in select populations in the Salmon River basin, Idaho across years in which completed brood years were available for estimating total recruits. Trend lines fit with a power function are shown for each data set.

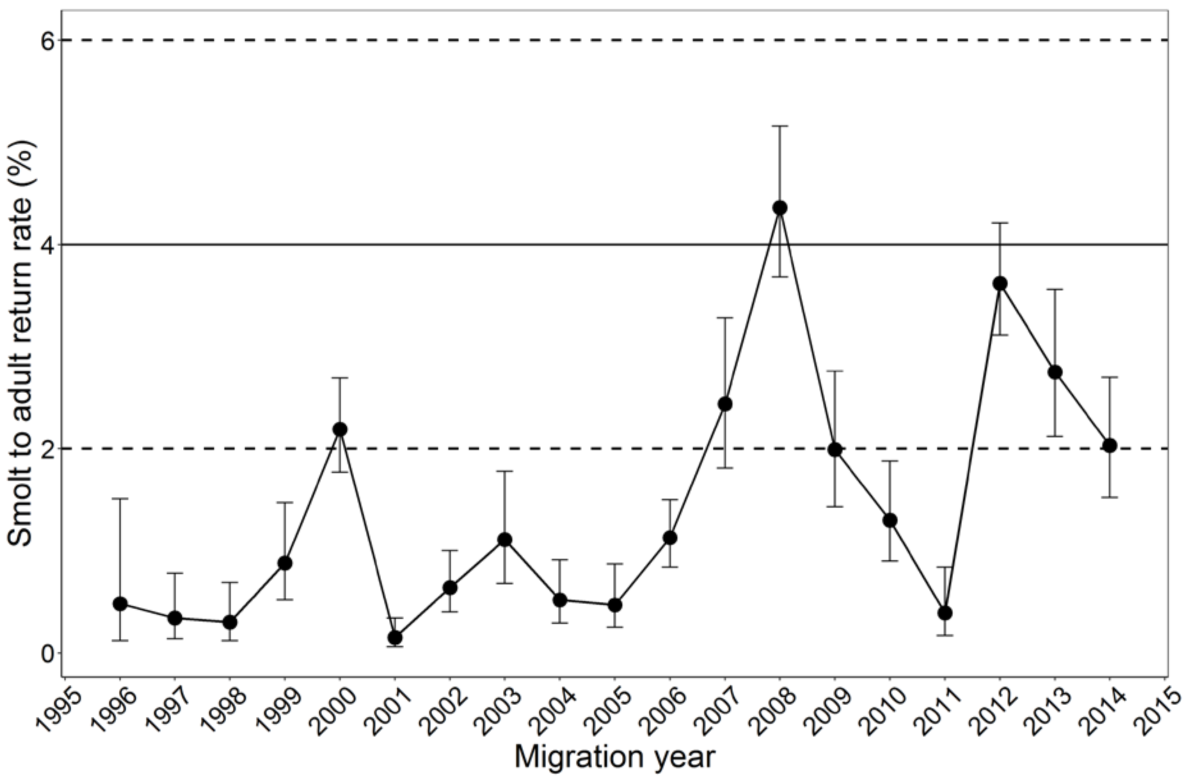

Figure 7. Smolt-to-adult return (SAR) rate estimates for wild adult steelhead tagged at Fish Creek across years where returns from smolt migration years were complete (1996–2014). Confidence intervals are at 95%. Horizontal lines represent the lower and upper range (dashed) and median (solid) SAR objectives for Snake River wild steelhead established by the Northwest Power and Conservation Council.

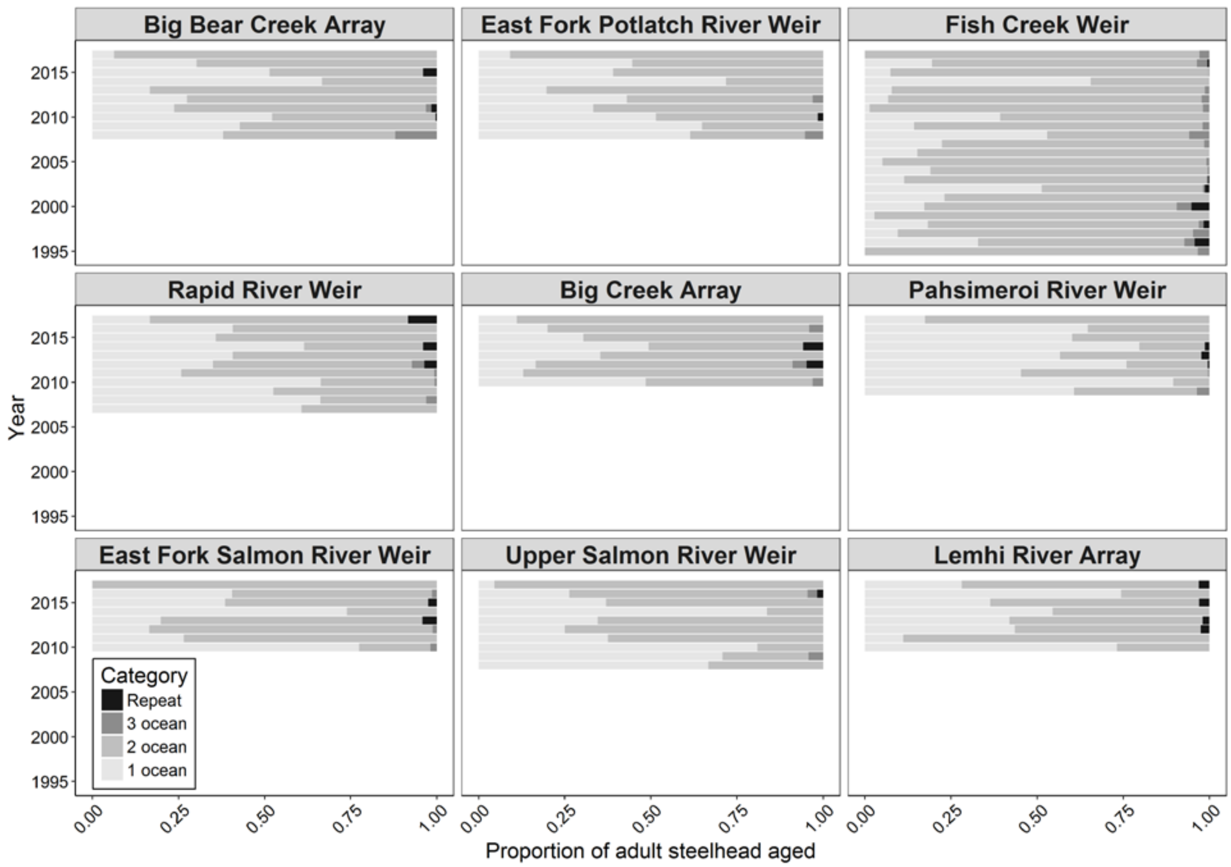

Figure 8. Ocean age composition of wild adult steelhead over various years captured or detected at select weirs and PIT tag arrays in Idaho.

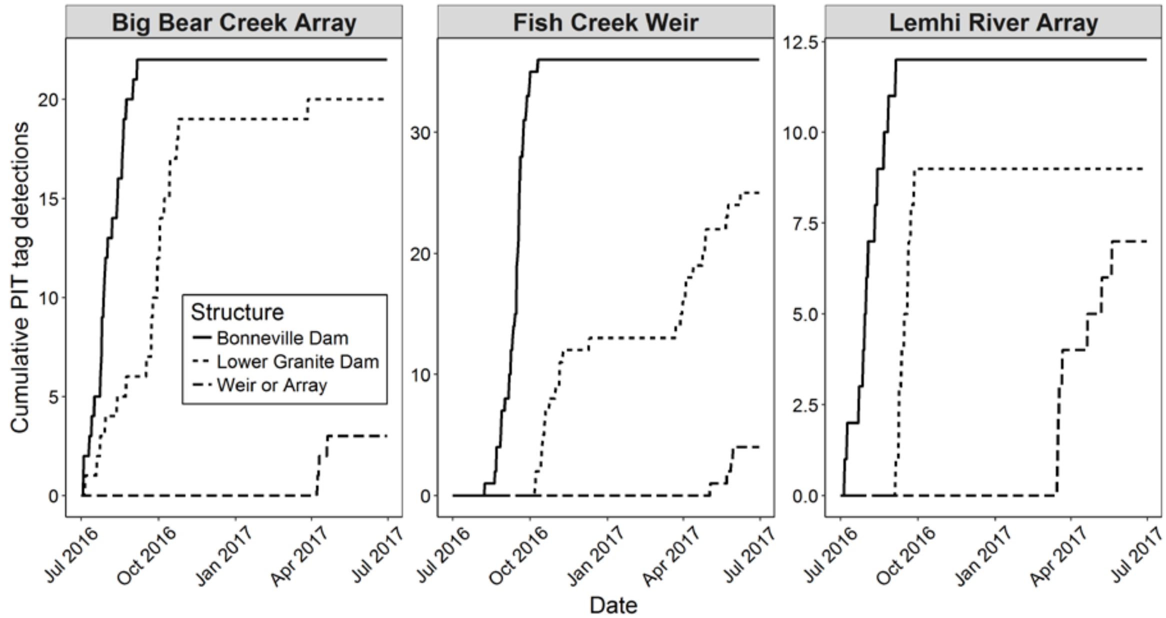

Figure 9. Cumulative run-timing curves for wild steelhead PIT tagged as juveniles in Big Bear Creek, Fish Creek, and the Lemhi River and returning as adults across Bonneville Dam, Lower Granite Dam, and their natal stream.

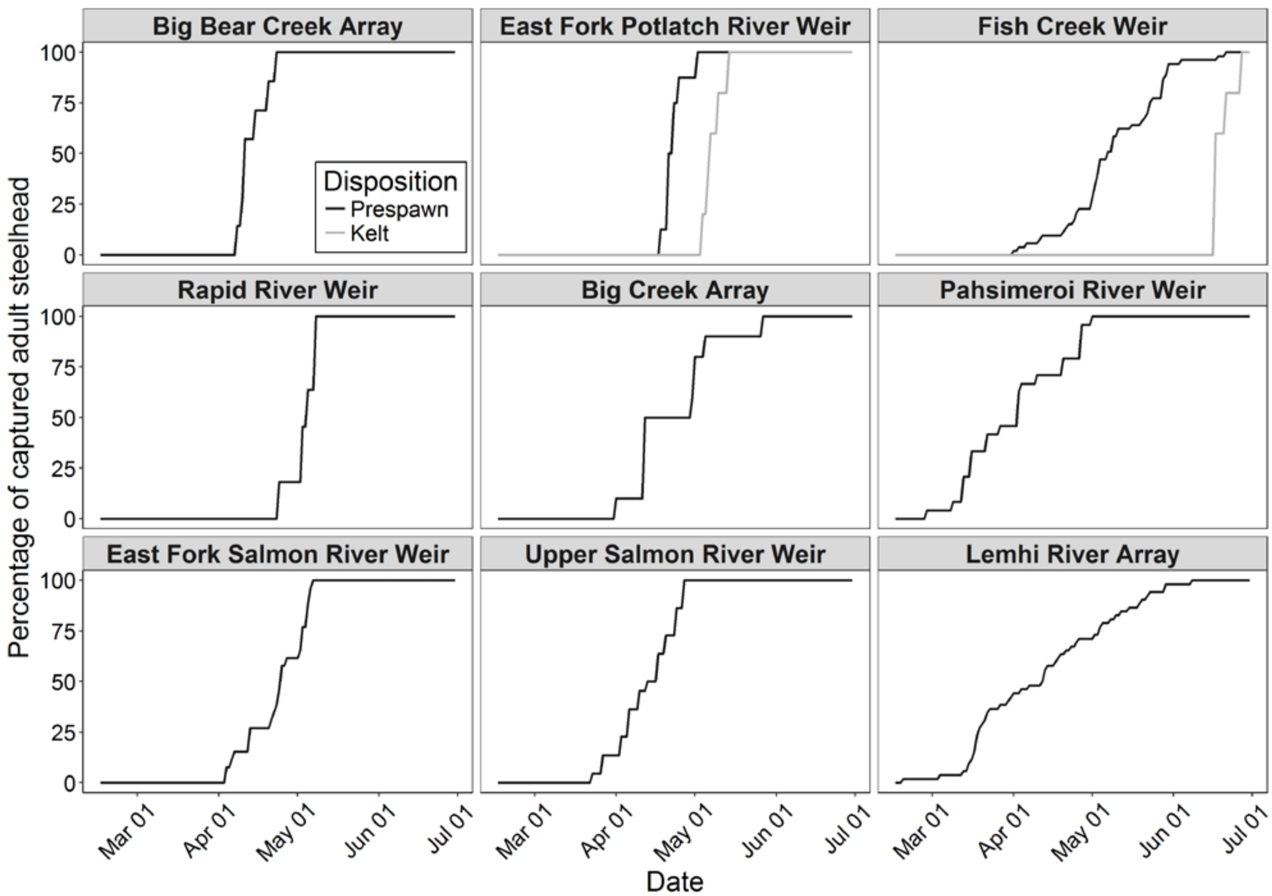

Figure 10. Cumulative run-timing curves for wild adult prespawn and kelt steelhead captured or detected at select weirs or PIT tag arrays in Idaho. Kelts were only captured on the East Fork Potlatch River and Fish Creek weirs. Curve was not constructed for Crooked River because only a single adult was captured.

APPENDICES

Appendix A. Abundance estimate time series for select Clearwater River wild adult steelhead populations, Idaho. LCI and UCI are lower and upper 95% confidence intervals.

Population	**Structure**	**Spawn year**	**Abundance**	**LCI**	**UCI**
Big Bear Creek	Weir	2005	202	107	372
		2006	50	19	94
		2007	100	66	158
		2008	127	69	253
		2009	135	79	252
		2010	251	200	310
		2011	124	55	242
		2012	317	220	363
	Array	2013	120	109	149
		2014	249	202	294
		2015	109	61	257
		2016	254	183	358
		2017[c]	19	NA	NA
East Fork Potlatch River	Weir	2008	140	33	232
		2009	92	50	152
		2010	72	41	113
		2011[c]	33	33	33
		2012	101	67	151
		2013[a]	81	81	81
		2014	96	78	115
		2015	105	64	167
		2016	89	53	136
		2017[c]	11	2	24
Crooked River	Weir	2007	84	NA	NA
		2008	27	NA	NA
		2009	4	NA	NA
		2010	46	NA	NA
		2011	5	NA	NA
		2012	41	NA	NA
		2013	15	NA	NA
		2014	2	NA	NA
		2015	22	NA	NA
		2016	10	NA	NA
		2017	1	NA	NA
Fish Creek	Weir	1992[b]	105	NA	NA
		1993[b]	267	NA	NA
		1994[b]	70	NA	NA
		1995[b]	70	NA	NA
		1996[b]	39	NA	NA
		1997[b]	28	NA	NA
		1998	80	NA	NA
		1999[a]	77	NA	NA
		2000	33	7	35
		2001[a]	75	NA	NA
		2002	242	181	333
		2003	343	315	371
		2004	206	185	230

Appendix A. Continued.

Population	Structure	Spawn year	Abundance	LCI	UCI
Fish Creek	Weir	2005[a]	121	NA	NA
		2006	119	82	156
		2007	81	79	96
		2008	134	84	184
		2009	218	152	312
		2010	205	164	255
		2011	494	355	689
		2012	152	126	183
		2013	95	81	111
		2014[a]	91	91	91
		2015	452	420	485
		2016	239	201	277
		2017	83	13	150

[a] Signifies years in which all recovered kelts were marked, therefore, the estimate was considered a census of the adult population.

[b] Methods for estimating escapement at Fish Creek used a cumulative curve due to the weir being breached or information on kelt recaptures was unreliable.

[c] Indicates the weir/array was comprised and only operated for a period of the entire migration, therefore, abundance was considered a minimum estimate.

Appendix B. Abundance estimate time series for select Salmon River wild adult steelhead populations, Idaho. LCI and UCI are lower and upper 95% confidence intervals.

Population	**Structure**	**Spawn year**	**Abundance**	**LCI**	**UCI**
Rapid River	Weir	2007	32	NA	NA
		2008	88	NA	NA
		2009	108	NA	NA
		2010	150	NA	NA
		2011	133	NA	NA
		2012	81	NA	NA
		2013	27	NA	NA
		2014	26	NA	NA
		2015	82	NA	NA
		2016	27	NA	NA
		2017	11	NA	NA
Big Creek	Array	2010	1177	393	2660
		2011	609	426	808
		2012	459	230	851
		2013	401	294	522
		2014	215	134	328
		2015	818	402	1644
		2016	286	219	364
		2017	64	NA	NA
Lemhi River	Array	2010	419	347	504
		2011	314	264	370
		2012	350	283	423
		2013	335	284	387
		2014	268	214	321
		2015	343	285	417
		2016	268	214	322
		2017	149	NA	NA
Pahsimeroi River	Weir	2007	22	NA	NA
		2008	45	NA	NA
		2009	30	NA	NA
		2010	157	NA	NA
		2011	239	NA	NA
		2012	288	NA	NA
		2013	179	NA	NA
		2014	205	NA	NA
		2015	130	NA	NA
		2016	92	NA	NA
		2017	24	NA	NA
East Fork Salmon River[a]	Weir	2007	16	55	55
		2008	11	38	38
		2009	17	15	15
		2010	61	425	425
		2011	72	448	448
		2012	92	725	725
		2013	33	690	690

Appendix B. Continued.

Population	Structure	Spawn year	Abundance	LCI	UCI
East Fork Salmon River[a]	Weir	2014	25	164	164
		2015	43	910	910
		2016	71	71	71
		2017	26	26	26
Upper Salmon River (Sawtooth)	Weir	2007	21	NA	NA
		2008	23	NA	NA
		2009	34	NA	NA
		2010	115	NA	NA
		2011	96	NA	NA
		2012	63	NA	NA
		2013	39	NA	NA
		2014	46	NA	NA
		2015	73	NA	NA
		2016	73	NA	NA
		2017	22	NA	NA

[a] Abundance represents all wild adult steelhead trapped at the weir, including those collected for broodstock. Hatchery adult steelhead passed upstream for natural spawning were not included.

Appendix C. Age composition of adult recruits by brood year, number of parent spawners, and adult-to-adult productivity estimates (recruits/spawner) for select Clearwater River wild steelhead populations, Idaho. Accounting is incomplete for brood years with dashes in any age column.

			Number of Adult Recruits							
Population	Structure	Brood Year	Age-3	Age-4	Age-5	Age-6	Age-7	Total	Parents	Productivity
Big Bear Creek	Weir	2005	3	52	96	2	0	153	202	0.76
		2006	2	137	66	3	0	208	50	4.16
		2007	8	46	211	0	0	265	100	2.65
		2008	9	93	69	14	0	185	127	1.46
		2009	10	46	69	0	0	125	135	0.93
		2010	7	138	35	0	0	180	251	0.72
		2011	28	64	131	2	--	225	124	1.81
		2012	9	115	13	--	--	137	317	0.43
	Array	2013	8	4	--	--	--	12	122	0.10
		2014	0	--	--	--	--	0	249	0.00
East Fork Potlatch River	Weir	2008	1	28	57	0	0	86	140	0.61
		2009	4	15	32	15	0	66	92	0.72
		2010	0	54	60	10	0	124	71	1.75
		2011[a]	10	30	46	1	--	87	33	2.64
		2012	0	32	9	--	--	41	106	0.39
		2013	1	1	--	--	--	2	81	0.02
		2014	0	--	--	--	--	0	96	0.00
Fish Creek	Weir	1992	0	0	9	38	3	50	105	0.48
		1993	0	2	39	51	0	92	267	0.34
		1994	0	1	22	17	1	41	70	0.59
		1995	0	1	14	42	3	60	70	0.86
		1996	0	2	31	82	0	115	39	2.95
		1997	0	1	119	167	0	287	28	10.25
		1998	0	38	166	72	0	276	80	3.45
		1999	0	9	124	71	0	204	77	2.65
		2000	0	10	46	58	0	114	33	3.45
		2001	0	4	59	4	0	67	75	0.89
		2002	0	2	45	34	8	89	242	0.37
		2003	0	29	67	170	2	268	343	0.78
		2004	3	33	40	98	20	194	206	0.94
		2005	0	0	89	271	2	362	121	2.99
		2006	0	16	194	79	0	289	119	2.43
		2007	0	6	64	44	0	114	81	1.41
		2008	3	7	40	7	1	58	134	0.43
		2009	0	11	40	121	5	177	218	0.81
		2010	0	39	307	116	3	465	205	2.27

Appendix C. Continued.

Population	Structure	Brood Year	Number of Adult Recruits Age-3	Age-4	Age-5	Age-6	Age-7	Total	Parents	Productivity
Fish Creek	Weir	2011	5	23	100	37	--	165	494	0.33
		2012	0	18	43	--	--	61	152	0.40
		2013	0	0	--	--	--	0	95	0.00
		2014	0	--	--	--	--	0	91	0.00

[a] The number of East Fork Potlatch River parents in 2011 is a minimum estimate, thus brood year productivity may be biased high.

Appendix D. Age composition of adult recruits by brood year, number of parent spawners, and adult-to-adult productivity estimates (recruits/spawner) for select Salmon River wild steelhead populations, Idaho. Accounting is incomplete for brood years with dashes in any age column.

Population	Structure	Brood Year	Number of Adult Recruits Age-3	Age-4	Age-5	Age-6	Age-7	Total	Parents	Productivity
Rapid River	Weir	2001	--	--	--	2	4	6	31	0.19
		2002	--	--	10	20	2	32	106	0.30
		2003	--	17	38	18	0	73	87	0.84
		2004	3	26	67	22	1	119	120	0.99
		2005	0	21	72	40	4	137	81	1.69
		2006	0	53	70	22	0	145	99	1.46
		2007	3	21	35	9	0	68	32	2.13
		2008	1	18	9	2	0	30	88	0.34
		2009	0	9	14	15	0	38	108	0.35
		2010	0	8	41	4	0	53	150	0.35
		2011	1	26	16	2	--	45	133	0.34
		2012	0	7	10	--	--	17	81	0.21
		2013	0	0	--	--	--	0	27	0.00
		2014	0	--	--	--	--	0	26	0.00
Big Creek	Array	2010	0	65	424	181	14	684	1177	0.58
		2011	0	77	83	29	--	189	609	0.31
		2012	0	14	21	--	--	35	459	0.08
		2013	0	0	--	--	--	0	401	0.00
		2014	0	--	--	--	--	0	215	0.00
Lemhi River	Array	2010	24	111	189	13	5	342	419	0.82
		2011	55	118	74	36	--	283	314	0.90
		2012	24	141	76	--	--	241	350	0.69
		2013	40	31	--	--	--	71	335	0.21
		2014	0	--	--	--	--	0	268	0.00
Pahsimeroi River	Weir	2002	--	--	5	0	0	5	378	0.01
		2003	--	15	17	1	0	33	180	0.18
		2004	2	28	17	3	1	51	67	0.76
		2005	0	11	18	7	0	36	42	0.86
		2006	1	116	68	0	0	185	68	2.72
		2007	20	147	44	6	0	217	22	9.86
		2008	16	192	51	3	0	262	45	5.82
		2009	51	104	25	0	0	180	30	6.00
		2010	15	114	32	1	0	162	157	1.03
		2011	60	83	24	3	--	170	239	0.71
		2012	15	63	18	--	--	96	288	0.33
		2013	4	4	--	--	--	8	179	0.04

Appendix D. Continued.

Population	Structure	Brood Year	Number of Adult Recruits Age-3	Age-4	Age-5	Age-6	Age-7	Total	Parents	Productivity
Pahsimeroi River	Weir	2014	0	--	--	--	--	0	205	0.00
East Fork Salmon River	Weir	2004	--	--	--	10	0	10	7	1.43
		2005	--	--	9	0	0	9	63	0.14
		2006	--	42	61	8	0	111	153	0.73
		2007	0	11	74	15	0	100	55	1.82
		2008	0	11	15	3	0	29	38	0.76
		2009	0	3	4	3	0	10	15	0.67
		2010	0	17	29	6	0	52	426	0.12
		2011	1	9	41	7	--	58	448	0.13
		2012	1	24	17	--	--	42	738	0.06
		2013	0	2	--	--	--	2	690	0.00
		2014	0	--	--	--	--	0	339	0.00
Upper Salmon River (Sawtooth)	Weir	2003	--	--	12	9	0	21	30	0.70
		2004	--	11	13	3	0	27	18	1.50
		2005	0	11	37	6	0	54	29	1.86
		2006	0	75	52	2	0	129	22	5.86
		2007	0	36	42	3	0	81	21	3.86
		2008	2	19	24	0	0	45	23	1.96
		2009	0	12	11	2	0	25	34	0.74
		2010	0	31	34	7	0	72	115	0.63
		2011	4	31	47	6	--	88	96	0.92
		2012	6	23	16	--	--	45	63	0.71
		2013	0	0	--	--	--	0	39	0.00
		2014	0	--	--	--	--	0	46	0

Appendix E. Number of genetic samples collected from wild adult steelhead captured at select IDFG weirs, 2010-2017.

			Adult spawn year							
Population	**Location**	**Structure**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Clearwater River MPG										
Potlatch River	Big Bear Creek	Weir	51	18	38	0	0	0	0	0
	Little Bear Creek	Weir	212	46	180	0	0	0	0	0
	WF Potlatch River	Weir	50	0	0	0	0	0	0	0
	EF Potlatch River	Weir	71	33	73	82	87	90	97	9
SF Clearwater River	Crooked River	Weir	0	5	41	17	2	22	10	1
Lochsa River	Fish Creek	Weir	200	224	135	91	90	450	204	53
Salmon River MPG										
Snake River	Snake River	Hells Canyon Dam	0	164	114	161	150	186	38	21
Little Salmon River	Rapid River	FH barrier	149	133	82	27	26	82	27	12
SF Salmon River			12	0	0	5	0	2	0	0
MF Salmon River	Big Creek	Weir								
Pahsimeroi River	Pahsimeroi River	FH barrier	157	239	285	177	205	130	94	24
EF Salmon River	EF Salmon River	Weir	425	442	721	690	339	885	410	132
Upper Salmon River	Fourth of July Creek	Weir	0	0	0	0	27	0	10	5
	Tower Creek	Weir	0	0	0	0	29	0	18	19
	Carmen Creek	Weir	0	0	0	0	79	0	16	3
	Salmon River	FH barrier	114	96	82	39	46	74	77	22
	Total		**1,441**	**1,400**	**1,751**	**1,289**	**1,080**	**1,969**	**1,055**	**301**

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