FISHERY RESEARCH

IDAHO ADULT STEELHEAD MONITORING

2020 ANNUAL REPORT

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Idaho Adult Steelhead Monitoring

2020 Annual Report

By

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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
MY	Migration Year cohort
PIT	Passive Integrated Transponder
PTAGIS	PIT Tag Information System
SY	Spawn Year
VSP	Viable Salmonid Population

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ABSTRACT

During 2020, Idaho Department of Fish and Game personnel used weirs (temporary picket, floating board resistance, and hatchery traps) and select PIT tag arrays to monitor wild adult steelhead in Idaho. Three weirs and two PIT tag array sites were in the Clearwater River basin, whereas four weirs and three PIT tag array sites were in the Salmon River basin. Steelhead escapement ranged from six (95% CI 11-44) fish in the upper Lemhi River to 189 (95% CI 152–243) fish in the Lochsa River. Across all sites, 52.7% of return adults were 1-ocean, 46.2% were 2-ocean, 1.1% were 3-ocean, and 0.0% were repeat spawners. Sex ratios varied from 28.6% females in the Big Bear Creek to 79.3% females in the lower Lemhi River. Information on run timing through the hydrosystem was limited due to a low number of detections of PIT-tagged adults. Adult-to-adult productivity estimates for brood year (BY) 2013 are now complete with the last of that cohort returning in 2020. Productivity estimates for BY 2013 (n = 9 locations) varied from 0.03 recruits per spawner in the East Fork Salmon River to 0.30 recruits per spawner in Rapid River. Steelhead were below replacement at all monitored locations (Big Bear Creek, East Fork Potlatch River, Fish Creek, Rapid River, Big Creek, Lemhi River, Pahsimeroi River, East Fork Salmon River, and the upper Salmon River) for BY 2013. Mean productivity estimates for populations across all completed BYs varied from 0.39 recruits per spawner in Big Creek to 2.82 recruits per spawner in the Pahsimeroi River. Productivity decreased from BY 2012 to BY 2013 at all locations except Rapid River and Big Creek. Productivity at Rapid River and Big Creek increased 29.1% and 36.5%, respectively, from BY 2012 to BY 2013. Including BY 2014, productivity has been below replacement for the last 3 to 7 BYs, depending on location. At all locations except for Big Creek and the Lemhi River, the trend in recruits per spawner decreased as spawner abundance increased, suggesting density dependent mechanisms are occurring. The productivity data series at both Big Creek and the Lemhi River are the two shortest data series considered in this report, and additional years may elucidate density dependent mechanisms. The smolt-to-adult return (SAR) rates for fish from Big Bear Creek, Fish Creek, Big Creek, and the Lemhi River were 1.7%, 0.7%, 0.6%, and 0.7%, respectively, for migration year 2016. These SARs all fell below the range of the Northwest Power and Conservation Council Fish and Wildlife goal (2.0–6.0%).

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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 populations with later run timing and older age structure (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 that include the Clearwater River, Salmon River, and Hells Canyon tributaries (ICTRT 2007; 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 2007). Nonetheless, there are 17 demographically independent and extant steelhead populations identified within the Clearwater River and Salmon River MPGs (ICTRT 2007; NWFSC 2015; Table 1).

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 2019) 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. The IDFG Management Goals for wild- and natural-origin steelhead for the Snake River basin including populations in Oregon and Washington is 104,500 with a goal of 72,000 for the Idaho component (IDFG 2019). The mean return of wild- and natural-origin steelhead from 2008–2017 was 30,452 (IDFG 2019). 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.

Wild steelhead population status in Idaho are evaluated by IDFG based upon the viable salmonid population (VSP) criteria (McElhany et al. 2000). Hence, this report was organized in the VSP framework with the following subsections: abundance and productivity, diversity, and spatial structure. To assess steelhead spatial structure, IDFG uses parr distribution as a surrogate, and a full accounting was reported in Poole et al. 2020. 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, will be reported by Baum et al. (*in prep*) and Hargrove et al. (2021). The four objectives of this report are:

Objective 1: Summarize IDFG's intensive, high-precision monitoring of wild adult steelhead in the following sixteen locations and twelve populations of the Clearwater River and Salmon River MPGs:

MPG	Site Location	Population
Clearwater River	Big Bear Creek (Weir/Array)	Lower Clearwater River
	East Fork Potlatch River (Weir)	Lower Clearwater River
	Crooked River (Weir)	South Fork Clearwater River
	Lochsa River (Array)	Lochsa River
	Fish Creek (Weir)	Lochsa River
Salmon River	Rapid River (Weir)	Little Salmon River
	South Fork Salmon River (Array)	South Fork Salmon River
	Big Creek (Array)	Lower Middle Fork Salmon River
	Marsh Creek (Array)	Upper Middle Fork Salmon River
	North Fork Salmon River (Array)	North Fork Salmon River
	Lower Lemhi River (Array)	Lemhi River
	Hayden Creek (Array)	Lemhi River
	Upper Lemhi River (Array)	Lemhi River
	Pahsimeroi River (Weir)	Pahsimeroi River
	East Fork Salmon River (Weir)	East Fork Salmon River
	Upper Salmon River (Weir)	Upper Salmon River

Objective 2: Estimate steelhead adult abundance and productivity at all twelve locations.

Objective 3: Estimate steelhead smolt-to-adult return (SAR) rates at select locations.

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

METHODS

Adult Abundance and Productivity

Sampling

and Abundance

Weirs and passive integrated transponder (PIT) tag arrays were used to monitor wild adult steelhead populations. Temporary weirs were constructed and removed annually in the East Fork Potlatch River and Fish Creek. Permanent hatchery weirs were operated at hatchery facilities on Rapid, Pahsimeroi, East Fork Salmon, Crooked and the upper Salmon rivers. Temporary and permanent weirs were used to monitor adult steelhead that spawned upstream of the structures. Lastly, PIT tag arrays installed perpendicularly to the stream channel were used to passively detect fish implanted with PIT tags that migrated into spawning tributaries.

Natural repeat spawners, reconditioned kelts, and hatchery steelhead were also encountered at weirs and PIT tag arrays. A reconditioned kelt was defined as a natural kelt that was opportunistically trapped at LGR, reconditioned at a hatchery, and released in the Snake River for natural repeat spawning (Hatch et al. 2017). All repeat spawners were released above weirs to naturally spawn and were incorporated as spawners in productivity analyses. Adults identified as hatchery-origin at weirs were not released upstream for natural spawning purposes except on the East Fork Salmon River, which has an integrated broodstock program for steelhead. Any hatchery-origin fish that made it upstream of a weir unintentionally or were detected at a PIT tag array were assumed to have a negligible impact on productivity and abundance, and therefore excluded from analyses in this report.

Temporary Weirs—During 2020, 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. Additionally, during 2005–2012, a temporary picket weir was used on Big Bear Creek during the adult migration period prior to the installation of the PIT tag arrays in 2012.

At temporary weirs, adult steelhead 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 for release.

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 temporary weirs was estimated using a Lincoln-Peterson estimator with a Bailey's modification:

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

where $\hat{N}$ 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 with R statistical software (ifwisshiny.idfg.state.id.us:3838/JLM/IDFGStatApps/) using an iterative maximization of the log likelihood, assuming fish were captured independently with probability *p* (equivalent to weir efficiency) and marked fish mix thoroughly with unmarked fish (Steinhorst et al. 2004). The 95% confidence intervals were computed with a bootstrap option (10,000 iterations).

Permanent Weirs—During 2020, hatchery weir structures were operated at Crooked River, Rapid River, Pahsimeroi River, East Fork Salmon River, and the upper Salmon River to enumerate wild adult steelhead escapement. Panel weirs were operated on Crooked River,

Pahsimeroi River, and the upper Salmon River, whereas velocity barriers were used at East Fork Salmon River and Rapid River. Methods for processing adult steelhead at the hatchery weirs were the same as at the temporary weirs.

Permanent hatchery weirs are designed to be complete barriers such that all upstream migrating fish are captured. Although kelts can be caught on the weir panels at some hatchery locations, they are currently not sampled to estimate weir efficiency. 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 may 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 count 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 stream flows and logistics do not allow weir operations: Big Bear Creek, Lochsa River, Big Creek, North Fork Salmon River, lower Lemhi River, upper Lemhi River, Hayden Creek, Marsh Creek, and the South Fork Salmon River.

In order to estimate escapement at each array site, wild adult steelhead were systematically PIT tagged at LGR throughout the run (Lawry et al. 2020). A State-Space Adult Dam Escapement Model (STADEM; See et al. 2021) was then used to estimate total abundance of wild adult steelhead at LGR. Total escapement of wild adult steelhead at LGR was then partitioned to branches of the lower Snake River basin stream network using the Lower Granite Dam Adult Branch Occupancy Model (DABOM; Kinzer et al. 2021). The DABOM model estimated movement probabilities and site-specific detection probabilities of fish traveling throughout the lower Snake River basin stream network upstream of LGR using PIT tag detections extracted from the Columbia Basin PIT Tag Information System (PTAGIS) database (https://www.ptagis.org/) at locations where they could be detected (i.e., PIT tag arrays and weirs). Hatchery-origin adult steelhead strays were excluded.

Estimated abundances were reported using this method for Big Creek and the lower Lemhi River PIT tag array sites (2010–2020). Spawn year 2020 marks the first year that a DABOM estimate for the Lochsa River array site was incorporated into this report. Prior to SY 2020, only the lower array was incorporated into the DABOM model, and information from upper array detections were not included. However, both the upper and lower arrays on the Lochsa were integrated into the SY 2020 estimate. Additionally, abundance estimates using the DABOM model were reported for PIT tag arrays in the South Fork Salmon River at Krassel Creek, the North Fork Salmon River, the upper Lemhi River (old weir site), and Hayden Creek where IDFG rotary screw traps operate.

Adult steelhead abundance at some sites could not be estimated using the DABOM model with confidence due to the small sample size of fish detected (i.e., Big Bear Creek and Marsh Creek). For these sites, alternative site-specific methods were applied. Detection probabilities for the PIT tag array at the Big Bear Creek site (2013–2017), the Lochsa River site (2018 and 2019), and Marsh Creek 2020 were estimated using methods from Connolly et al. (2005) through the program USER (Lady et al. 2009). Information on PIT-tagged adult steelhead detected on PIT tag arrays were queried from the PTAGIS database. Abundance of returning adult steelhead was estimated by expanding the number of unique PIT-tagged prespawn adults that were PIT tagged or recaptured at LGR and detected at the array site by an estimated detection probability, and incorporating an adjustment based on the mean trapping rate of unclipped adult steelhead at LGR for a given spawn year. A parametric bootstrap and percentile method was used to estimate 95% confidence intervals. Since SY 2018, estimating detection

probability at the Big Bear Creek array site has not been possible due to small sample sizes and the lack of a second array span. The two previous iterations of this report (SY 2018 and SY 2019) reported Big Bear Creek abundance as the number of fish detected. However, for this report we will estimate a minimum abundance by expanding the number of unique prespawn adults detected at the array site that were PIT-tagged and sampled at LGR by the mean trap rate at LGR for SY 2020. Under this method, we are assuming 100% detection efficiency at the Big Bear Creek array site, and therefore the abundance estimate will be considered a minimum. This same method will be applied to the Big Bear Creek array site for SYs 2018 and 2019, and the resulting estimates will be used in subsequent analyses.

Adult-to-Adult Productivity

Adult-to-adult productivity time series were constructed for Big Bear Creek, East Fork Potlatch River, Fish Creek, Rapid River, Big Creek, Lemhi River, Pahsimeroi River, East Fork Salmon River, and the upper Salmon River. Productivity results were reported for the most recently completed brood year (BY 2013), with preliminary information for BY 2014. The entire range of adult productivity estimates for each location are presented in Appendices (C and D). Comparisons across populations were limited to BYs 2003–2014, in which most populations had estimates available. Productivity was not determined for Crooked River because the dataset does not have adequate adult age structure information available to construct brood tables and accurate adult abundance estimates are lacking. Productivity analyses are not conducted at the upper Lemhi and Hayden Creek PIT tag array sites due to concerns with discerning which tributary a fish actually spawns in because of the close proximity of the arrays to the spawning grounds.

Productivity was calculated by combining adult abundances with age composition determined from scale samples. Only scale samples in which total age could be determined were used in assigning age proportions. Age composition for returning adult recruits was applied to the escapement estimate to determine the total number of fish of specific ages for a given SY. Age categories (total age was the sum of freshwater age, ocean age, and adult river overwintering) were combined into 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 per spawner). Brood years were considered complete when progeny from all possible total age categories returned as spawning adults. Since few age-7 adult spawners have been observed, BY 2014 comprising age-3 through age-6 returning adults were considered mostly complete. Repeat spawners (including reconditioned kelts) 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. Hatchery strays were excluded from productivity analysis at all temporary and permanent weirs because they were not passed upstream for natural spawning with the exception of the East Fork Salmon River. On occasion, hatchery strays with PIT tags migrate upstream of PIT tag arrays but are generally either too low in numbers to be statistically expanded or nonexistent. Therefore, hatchery strays are not included in productivity analysis for sites with PIT tag arrays. Replacement rate of a population was determined to be 1.0 adult recruits per adult spawner assuming an even sex ratio.

Temporary and Permanent Weirs—We obtained numbers of natural fish returning to hatchery weirs from Chuck Warren (IDFG steelhead hatchery evaluation biologist, personal communication) for years prior to 2015. Since 2015, adult trapping data was extracted from the Fish Inventory System (FINS) hatchery database (https://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 some 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 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 sites. The PIT tag array estimates at the Lochsa River and the North Fork Salmon River were only recently incorporated; therefore, productivity analyses are currently incomplete, but will be developed as brood years are completed. Brood years will be complete for the Lochsa River and North Fork Salmon River populations in 2023, and South Fork Salmon River and Marsh Creek populations will be completed in 2025. Methods for annual abundance estimates for these locations are outlined in the Sampling and Abundance section. Age and sex composition of returning adults to PIT tag array sites was estimated from genetic and scale samples of adult steelhead handled at LGR (see Age, Sex, and Size Composition section below).

Smolt-to-Adult Return (SAR) Rates

Smolt-to-adult return (SAR) rate is a commonly used index that measures survival of anadromous salmonids from the time they emigrate as smolts out of freshwater rearing habitat to their return migration as mature adults. Performances of anadromous salmonid populations are commonly characterized by SAR rates and are used to assess management strategies and progress towards recovery. We report SAR rates for Big Bear Creek, Fish Creek, Big Creek, and Lemhi River steelhead as smolts that were detected emigrating past LGR and their rate of return as an adult to Bonneville Dam. Other weir and PIT tag array sites lacked large enough returns of PIT-tagged adults across years to estimate SAR from LGR to Bonneville Dam.

Although steelhead smolts from the same brood year emigrate at different ages, SARs were measured on the basis of a smolt cohort or migration year (MY). Queries of hydrosystem detections in the PTAGIS database were used to compile the number of emigrating smolts that were tagged in the four watersheds of interest. Smolts detected in the hydrosystem were assigned to a MY based on the year they emigrated. The sum of all unique PIT-tagged emigrating smolts detected at any interrogation site at dams from LGR to the Columbia River estuary comprised the cohort for a given MY. We then used detections of returning adults PIT tagged as juveniles in a given watershed (i.e., Big Bear Creek, Fish Creek, Big Creek, Lemhi River) as they ascended the adult ladder at Bonneville Dam. Adult status was confirmed either through upstream movement between dams or in the adult ladder at Bonneville Dam and were assigned to a MY based on the date of their first detection as an emigrating smolt. Adults that were not detected emigrating as a smolt were omitted from SAR calculations since they could not be assigned to a MY with certainty. The SAR was calculated by dividing the number of adults detected returning from a given migratory cohort by the number of total migrating smolts detected for that given cohort. We used formulas from Fleiss (1981) to determine 95% confidence intervals on SAR estimates.

Diversity

Age, Sex, and Size Composition

Weirs—We determined age composition of adult fish returning to temporary and permanent weirs from scale samples. Scale samples were collected from all unique adults

sampled at weirs, including both prespawn fish and kelts. The target area to remove scales from 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 using methods established by Wright et al. (2015). Scale ageing data are stored and accessed through the BioSamples database (available at: https://collaboration.idfg.idaho.gov/qci/default.aspx). The reader should contact the author for information on how to access these data.

We determined the sex and size composition of all unique adult steelhead (prespawn fish and kelts) handled at weirs. For each fish, sex was determined based on phenotypic characteristics (e.g., protruding vent and short snout 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 sites (Big Bear Creek, Lochsa River, South Fork Salmon River, Big Creek, Marsh Creek, North Fork Salmon River, lower Lemhi River, upper Lemhi River, Hayden Creek, and South Fork Salmon River); therefore, diversity information was collected from samples of wild adult steelhead sampled at LGR with known tributary destinations. Lower Granite Dam adult trapping data are stored and accessed through the LGR trapping database (available at: https://collaboration.idfg.idaho.gov/qci/default.aspx). The LGR trapping database was queried for adult steelhead sampled at the dam between June 30, 2019 and July 1, 2020, which were subsequently detected at these PIT tag array sites during 2020. We also queried adult steelhead sampled at LGR, which had been previously PIT tagged as juveniles upstream of PIT tag arrays through rotary traps or roving efforts (e.g., electrofishing, hook and line). Adult steelhead were processed at LGR using similar methods as was done at weirs (Lawry et al. 2020). Sex was determined from genetic samples (Hargrove et al. 2021) and freshwater and saltwater ages were determined from scale samples (Wright et al. 2015). For a given PIT tag array, we assumed all fish included in the analysis had an equal probability of conversion from LGR to their upstream interrogation site.

Adult Migration Timing and Conversion Rates

We depicted migration timing of PIT-tagged adult steelhead returning to all of the streams where adult abundances were estimated. Queries of the PTAGIS database were used to obtain detection dates of adult fish that were PIT tagged as juveniles at rotary screw traps or through roving tagging efforts in select streams. We examined migration timing of those adults through the hydrosystem using detections between July 1, 2019 and June 30, 2020 at Bonneville, McNary, and Lower Granite dams. Detections of kelts moving downstream were excluded. The median and range of timing of adult steelhead over each dam were reported. We also examined the proportion of total unique PIT-tagged fish detected at Bonneville Dam that were sequentially detected at McNary and LGR dams moving upstream (i.e., conversion rates). Fish that were not detected at Bonneville, but were detected at upstream hydrosystem facilities were included as having passed over Bonneville Dam for calculating conversion rates. Conversion rates from Bonneville Dam to weirs and arrays were not examined for SY 2020 due to low number of PIT-tagged fish returns.

The timing of wild adult steelhead captured at weirs and detected on arrays was also examined. Distribution curves of total unique prespawn adults captured or detected at structures were constructed to compare timing of adult arrival to tributary streams. At weirs where kelts

were captured (East Fork Potlatch River and Fish Creek) kelt distribution curves were also constructed to estimate spawn timing.

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 and Salmon river basins (Nielsen et al. 2009). Baseline data from past collections were 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; Hargrove et al. 2021). The genetic diversity and structure of populations surveyed were evaluated and reported with other Snake River steelhead populations by Hargrove et al. (2021). During this report period, tissue samples were taken and archived for future analyses.

RESULTS

Adult Abundance and Productivity

Sampling and Abundance

During SY 2020 unclipped adult steelhead (both wild and unclipped hatchery fish) were trapped and PIT tagged at LGR from July 1, 2019 through November 12, 2019, and continued from March 2, 2020 through March 24, 2020 (Baum et al. *in prep*). Traditionally, trapping for a given SY continues through the end of June. However, due to the COVID-19 pandemic, SY 2020 trapping at LGR concluded earlier than normal. Based on window counts at LGR, 5.7% of the SY 2020 run passed during this trap shutdown. While the trap was operational, the mean weekly trap and PIT tagging rate for unclipped adult steelhead during the SY 2020 run at LGR was 0.278 (SE = 0.04). The cumulative mean trap and PIT tagging rate for unclipped adult steelhead during the entire SY 2020 migration was 0.241. The trap rate was elevated from August 19 – September 15 in order to reach fall Chinook broodstock collection goals, resulting in an overall trap rate above the target rate of 0.2.

Big Bear Creek Array—The lower floating PIT tag array (KHS) of Big Bear Creek began operating on February 24, 2020 and operated during the entire migration period except during a brief power outage from May 28 until June 3. The upper in-stream PIT tag array (BBA) became operational on March 5, 2020 and was operated through the entire migration year experiencing a brief power outage from May 11 until May 13. Thirteen PIT-tagged adult wild steelhead were detected on the Big Bear Creek PIT tag arrays, of which five were tagged as adults at LGR and eight were tagged as juveniles in Big Bear Creek. All detections occurred on the single span Big Bear Creek array, with no detections on the Kendrick High School array due to issues maintaining operation during the migration period. Because all detections occurred on a single span array, a detection efficiency could not be estimated for SY 2020. A minimum abundance estimate of 29 adults was derived by expanding the number of detected adult steelhead PIT-tagged and sampled at LGR by the mean weekly LGR SY 2020 trap rate (Figure 2; Appendix A).

East Fork Potlatch River Weir—The East Fork Potlatch River weir was installed and began operating on March 3. The weir was either partially operable or inoperable for six days during high flow period and was fully operating through the remaining adult steelhead migration period. Twenty-one upstream migrating adult steelhead were captured at the site (Table 2). In addition, eleven downstream migrating kelts were captured at the weir, two of which were

unmarked and not previously handled as a prespawn adult. The total steelhead abundance estimated via mark-recapture was 25 adults (95% CI 21—36; Figure 2; Appendix A).

Crooked River Weir—The Crooked River weir was operational from April 8, 2020 until April 23, 2020 when high flows and debris resulted in the need to pull panels and operate a partial weir. On April 28, excessive amounts of debris resulted in the need to pull all remaining panels. On May 5, the weir was completely disassembled to avoid possible damage from debris. The weir was reassembled June 15 once flows and debris receded. Zero adults were captured during SY 2020 (Table 2; Figure 2; Appendix A).

Lochsa River Array—The Lochsa River PIT tag arrays operated continuously through the adult steelhead migration period. Forty-one PIT-tagged adult wild steelhead were detected on the Lochsa River PIT tag arrays, of which 31 were tagged as an adult at LGR, three were tagged as adults at Bonneville Dam, five were tagged as juveniles in the Lochsa River basin, and two were tagged as juveniles at LGR. The DABOM model estimated an escapement of 189 adult steelhead returning to the Lochsa River (95% CI 152–243; Figure 2; Appendix A; Kinzer et al. 2021).

Fish Creek Weir—The Fish Creek weir was installed and began operating on March 11. The weir partially operated for 25 days during the high flow period and was fully operating through the remaining adult steelhead migration period. Twelve wild, adult steelhead were trapped, marked, and released upstream of the weir (Table 2). No hatchery fish were captured at the weir. Eleven unique kelts were captured, five of which were previously marked (Table 2). The total steelhead abundance estimated via mark-recapture was 24 adults (95% CI 16–48; Figure 2; Appendix A).

Rapid River Weir—The Rapid River weir began operating on March 16 and ran continuously through the remaining adult steelhead migration period. Thirteen wild adult steelhead were trapped and released upstream of the weir for natural spawning (Table 2; Figure 3; Appendix B).

South Fork Salmon River Array—The South Fork Salmon River PIT tag array at Krassel Creek operated continuously during the adult steelhead migration period. Fifteen PIT-tagged adult wild steelhead were detected on the South Fork Salmon River PIT tag array, of which 11 were tagged as adults at LGR, one was tagged as an adult at Priest Rapids Dam, two were tagged as juveniles at LGR, and one was tagged as a juvenile in the South Fork Salmon River. The DABOM model estimated an escapement of 52 adult steelhead for the South Fork Salmon River (95% CI 28–74; Figure 3, Appendix B; Kinzer et al. 2021).

Big Creek Array—The Big Creek PIT tag array operated continuously during the adult steelhead migration period. Twenty-two PIT-tagged adult wild steelhead were detected on the Big Creek PIT tag array, 20 of which were tagged as adults at LGR, resulting in an escapement estimate of 96 adult steelhead for Big Creek (95% CI 76–120; Figure 3, Appendix B; Kinzer et al. 2021).

Marsh Creek Array—The Marsh Creek PIT tag array operated continuously during the adult steelhead migration period. Five PIT-tagged adult wild steelhead were detected on the Marsh Creek PIT tag array, of which three were tagged as adults at LGR, and two were tagged as juveniles at LGR. Detection probability was estimated at 64.0% (SE = 0.235) for both PIT tag arrays combined, resulting in an estimated abundance of 17 adult steelhead for Marsh Creek (95% CI 11–44; Appendix B).

North Fork Salmon River Array—The North Fork Salmon River PIT tag array operated continuously during the adult steelhead migration period. Twenty-four PIT-tagged adult wild steelhead were detected on the North Fork Salmon River PIT tag array, of which 20 were tagged as adults at LGR, one was tagged as an adult at Bonneville Dam, one was tagged as a juvenile in the North Fork Salmon River, and two were tagged as juveniles at LGR. The DABOM model estimated an escapement of 93 adult steelhead for the North Fork Salmon River (95% CI 76–116; Figure 3, Appendix B; Kinzer et al. 2021).

Lower Lemhi River Array—The lower Lemhi River PIT tag array operated continuously during the adult steelhead migration period. Thirty-two PIT-tagged adult wild steelhead were detected on the Lemhi River PIT tag array, of which 22 were tagged as adults at LGR, one was tagged as an adult at Bonneville Dam, and nine were tagged as juveniles in the Lemhi River. The DABOM model estimated an escapement of 109 adult steelhead for the Lemhi River (95% CI 87–131; Figure 3, Appendix B; Kinzer et al. 2021).

Hayden Creek Array—The Hayden Creek PIT tag array operated continuously during the adult steelhead migration period. Nine PIT-tagged adult wild steelhead were detected on the Hayden Creek PIT tag array, of which six were tagged as adults at LGR, one was tagged as an adult at Bonneville Dam, and two were tagged as juveniles at the Hayden Creek screw trap. The DABOM model estimated an escapement of 27 adult steelhead for Hayden Creek (95% CI 12–45; Figure 3, Appendix B; Kinzer et al. 2021).

Upper Lemhi River Array—The Upper Lemhi River PIT tag array operated continuously during the adult steelhead migration period. Two PIT-tagged adult wild steelhead were detected on the Upper Lemhi River PIT tag array, of which one was tagged as an adult at LGR, and one was tagged as a juvenile within the Lemhi River basin. The DABOM model estimated an escapement of six adult steelhead for Hayden Creek (95% CI 0–16; Figure 3, Appendix B; Kinzer et al. 2021).

Pahsimeroi River Weir—The Pahsimeroi River hatchery weir began operating on February 26 and ran continuously through April 30. Forty-one wild, adult steelhead were trapped and released upstream of the Pahsimeroi Fish Hatchery for natural spawning (Table 2; Figure 3, Appendix B).

East Fork Salmon River Weir—The East Fork Salmon River hatchery weir began operating on April 1 and ran continuously through May 20. Twenty-nine wild, adult steelhead were trapped at the East Fork Salmon River hatchery weir (Table 2; Figure 3, Appendix B). Twenty-seven wild returning adult steelhead (12 females; 15 males) were removed and used for hatchery broodstock. Two wild adult female steelhead, five hatchery adult female steelhead, and seven hatchery adult male steelhead were passed upstream of the weir for natural spawning purposes.

Upper Salmon River Weir—The upper Salmon River weir at Sawtooth Fish Hatchery began operating on March 16 and ran continuously through May 7. Forty-four wild, adult steelhead were trapped, marked, and released upstream of the weir (Table 2; Figure 3, Appendix B). All wild adult steelhead were passed upstream of the weir for natural spawning. No hatchery fish were passed upstream of the weir.

Adult-to-Adult Productivity

Big Bear Creek Array—Brood year 2013 spawning steelhead returned 12 adult progeny, which resulted in an adult-to-adult productivity estimate of 0.10 recruits per spawner (Figure 4; Appendix C). During BYs 2005–2013, Big Bear Creek steelhead recruited an average of 166 adult progeny (range = 12–265 adult progeny) per year. Adult-to-adult productivity estimates averaged 1.45 recruits per spawner (range = 0.10–2.65 recruits per spawner) per year across all completed BYs. On average, Big Bear Creek steelhead spawned mostly as age-4 (43.8%) and age-5 (47.4%), and to a lesser extent, age-3 (4.7%) and age-6 (3.5%) adults. The preliminary adult-to-adult productivity estimate for BY 2014 was 0.10 recruits per spawner (Figure 4; Appendix C). Big Bear Creek adult-to-adult productivity estimates have been below the replacement threshold of 1.0 adult recruits per adult spawner for the last three brood years, including BY 2014 (2012-2014; Figure 4; Appendix C). Across BYs 2005–2014, Big Bear Creek productivity (adult recruits per spawner) decreased as spawner escapement increased (Figure 5).

East Fork Potlatch River Weir—Brood year 2013 spawning steelhead returned 11 adult progeny, which resulted in an adult-to-adult productivity estimate of 0.14 recruits per spawner (Figure 4; Appendix C). During BYs 2008–2013, East Fork Potlatch River steelhead recruited an average of 69 adult progeny (range = 11–124 adult progeny) per year. Adult-to-adult productivity estimates averaged 1.04 recruits per spawner (range = 0.14–2.64 recruits per spawner) per year for all completed BYs. On average, East Fork Potlatch River steelhead spawned mostly as age-5 (50.1%), and age-4 (39.2%), and to a lesser extent age-3 (1.8%), age-6 (8.5%) and age-7 (0.3%) adults. The preliminary adult-to-adult productivity estimate for BY 2014 was 0.16 recruits per spawner (Figure 4; Appendix C). East Fork Potlatch River adult-to-adult productivity estimates have been below the replacement threshold of 1.0 adult recruits per adult spawner for the last three brood years, including BY 2014 (2012-2014; Figure 4; Appendix C). East Fork Potlatch River productivity estimates decreased as spawner abundance increased during BYs 2008–2014 (Figure 5).

Fish Creek Weir—Brood year 2013 spawning steelhead returned 26 adult progeny, which resulted in an adult-to-adult productivity estimate of 0.27 recruits per spawner (Figure 4; Appendix C). During BYs 1992–2013, Fish Creek recruited an average of 163 adult progeny (range = 26–465 adult progeny) per year. Adult-to-adult productivity estimates averaged 1.79 recruits per spawner (range = 0.27–10.25 recruits per spawner) per year for all completed BYs. On average, Fish Creek steelhead spawned mostly as age-5 (46.3%) and age-6 (44.6%), and to a lesser extent, age-3 (0.3%), age-4 (6.9%), and age-7 (0.7%) adults. The preliminary adult-to-adult productivity estimate for BY 2013 was 0.40 recruits per spawner, which may increase slightly with the addition of age-7 adult returns in 2021 (Figure 4; Appendix C). Fish Creek adult-to-adult productivity estimates have been below the replacement threshold of 1.0 adult recruits per adult spawner for the last four brood years, including BY 2014 (2011-2014; Figure 4; Appendix C). Fish Creek productivity estimates decreased as spawner escapement increased across completed BYs (1992–2014; Figure 5).

Rapid River Weir—Brood year 2013 spawning steelhead returned eight adult progeny, which resulted in an adult-to-adult productivity estimate of 0.30 recruits per spawner (Figure 4; Appendix D). During BYs 2004–2013, Rapid River steelhead recruited an average 66 adult progeny (range = 8–145 adult progeny) per year. Adult-to-adult productivity estimates averaged 0.82 recruits per spawner (range = 0.21–2.13 recruits per spawner) per year for all completed BYs. On average, Rapid River steelhead spawned mostly as age-5 (50.1%), and age-4 (26.8%), and to a lesser extent, age-3 (1.2%), age-6 (20.1%), and age-7 (1.5%) adults. The preliminary

BY 2014 productivity estimate was 0.62 recruits per spawner (Figure 4; Appendix D). Rapid River adult-to-adult productivity estimates have been below the replacement threshold of 1.0 adult recruits per adult spawner for the last seven brood years, including BY 2014 (2008-2014; Figure 4; Appendix D). Across BYs 2004–2014, Rapid River productivity estimates decreased as spawner escapement increased (Figure 6).

Big Creek Array—Brood year 2013 spawning steelhead returned 127 adult progeny, which resulted in an adult-to-adult productivity estimate of 0.29 recruits per spawner (Figure 4; Appendix D). During BY 2010–2013, Big Creek steelhead recruited an average 282 adult progeny (range = 73–720 adult progeny) per year. Adult-to-adult productivity estimates averaged 0.39 recruits per spawner (range = 0.18–0.78 recruits per spawner) per year for all completed BYs. On average, Big Creek steelhead spawned mostly as age-5 (42.5%), and age-6 (42.9%), and to a lesser extent age-4 (6.3%), and age-7 (7.7%) adults. The preliminary adult-to-adult productivity estimate for BY 2014 was 0.31 recruits per spawner (Figure 4; Appendix D). Big Creek adult-to-adult productivity estimates have been below the replacement threshold of 1.0 adult recruits per adult spawner for all brood years available in this data series, including BY 2014 (2010-2014; Figure 4; Appendix D). Across BYs 2010–2014, Big Creek productivity estimates were flat or increased slightly as spawner escapement increased (Figure 6).

Lower Lemhi River Array—Brood year 2013 spawning steelhead returned 96 adult progeny, which resulted in an adult-to-adult productivity estimate of 0.26 recruits per spawner (Figure 4; Appendix D). During BY 2010–2013, lower Lemhi River steelhead recruited an average 241 adult progeny (range = 96–342 adult progeny) per year. Adult-to-adult productivity estimates averaged 0.61 recruits per spawner (range = 0.26–0.83 recruits per spawner) per year for all completed BYs. On average, lower Lemhi River steelhead spawned mostly as age-4 (44.8%), and age-5 (41.3%), and to a lesser extent age-3 (6.8%), age-6 (6.2%), and age-7 (0.2%) adults. The preliminary adult-to-adult productivity estimate for BY 2014 was 0.404 recruits per spawner (Figure 4; Appendix D). Lemhi River adult-to-adult productivity estimates have been below the replacement threshold of 1.0 adult recruits per adult spawner for all brood years available in this data series, including BY 2014 (2010-2014; Figure 4; Appendix D). Across BYs 2010–2014, Lemhi River productivity estimates were flat or increased slightly as spawner escapement increased (Figure 6).

Pahsimeroi River Weir—Brood year 2013 spawning steelhead returned 12 adult progeny, which resulted in an adult-to-adult productivity estimate of 0.067 recruits per spawner (Figure 4; Appendix D). During BY 2004–2013, Pahsimeroi River steelhead recruited an average 137 adult progeny (range = 12–262 adult progeny) per year. Adult-to-adult productivity estimates averaged 2.82 recruits per spawner (range = 0.067–9.86 recruits per spawner) per year for all completed BYs. On average, Pahsimeroi River steelhead spawned mostly as age-4 (63.1%), and age-5 (22.5%), and to a lesser extent age-3 (12.2%), age-6 (1.7%), and age-7 (0.1%) adults. The preliminary adult-to-adult productivity estimate for BY 2014 was 0.146 recruits per spawner (Figure 4; Appendix D). Pahsimeroi River adult-to-adult productivity estimates have been below the replacement threshold of 1.0 adult recruits per adult spawner for the last four brood years, including BY 2014 (2011-2014; Figure 4; Appendix D). Pahsimeroi River productivity estimates decreased as spawner escapement increased across completed BYs (2004–2014; Figure 6)

East Fork Salmon River Weir—Brood year 2013 spawning steelhead returned 16 adult progeny, which resulted in an adult-to-adult productivity estimate of 0.02 recruits per spawner (Figure 4; Appendix D). During BY 2007–2013, East Fork Salmon River steelhead recruited an average 44 adult progeny (range = 10–100 adult progeny) per year. Adult-to-adult productivity estimates averaged 0.51 recruits per spawner (range = 0.02–1.82 recruits per spawner) per year

for all completed BYs. On average, East Fork Salmon River steelhead spawned mostly at age-5 (57.0%), and age-4 (27.9%), and to a lesser extent age-3 (0.5%) and age-6 (13.7%) adults. The preliminary adult-to-adult productivity estimate for BY 2014 was 0.04 recruits per spawner (Figure 4; Appendix D). East Fork Salmon River adult-to-adult productivity estimates have been below the replacement threshold of 1.0 adult recruits per adult spawner for the last seven brood years, including BY 2014 (2008-2014; Figure 4; Appendix D). East Fork Salmon River productivity estimates decreased as spawner escapement increased across completed BYs (2007–2014; Figure 6)

Upper Salmon River Weir—Brood year 2013 spawning steelhead returned six adult progeny, which resulted in an adult-to-adult productivity estimate of 0.15 recruits per spawner (Figure 4; Appendix D). During BY 2005–2013, upper Salmon River steelhead recruited an average 61 adult progeny (range = 6–129 adult progeny) per year. Adult-to-adult productivity estimates averaged 1.86 recruits per spawner (range = 0.15–5.86 recruits per spawner) per year for all completed BYs. On average, upper Salmon River steelhead spawned mostly at age-5 (48.2%), and age-4 (43.7%), and to a lesser extent age-3 (1.9%) and age-6 (5.8) adults. The preliminary adult-to-adult productivity estimate for BY 2014 was 0.30 recruits per spawner (Figure 4; Appendix D). Upper Salmon River adult-to-adult productivity estimates have been below the replacement threshold of 1.0 adult recruits per adult spawner for the last six brood years, including BY 2014 (2009-2014; Figure 4; Appendix D). Upper Salmon River productivity estimates decreased as spawner escapement increased across completed BYs (2005–2014; Figure 6)

Smolt-to-Adult Return Rates

Big Bear Creek

Beginning in 2005, the number of PIT-tagged smolts from Big Bear Creek that were subsequently detected in the hydrosystem ranged from 194 (MY 2006) to 1,727 (MY 2018). Sixty adults were detected that were not previously detected as emigrating smolts and were excluded from further analysis. No 3-ocean adults tagged as juveniles in Big Bear Creek have yet been detected in the hydrosystem; therefore, we consider a MY cohort complete after 2-ocean adults return. From MYs 2005–2017, 251 adults were used to calculate SARs to Bonneville Dam. The number of adults detected ranged from three fish (MY 2015) to 43 fish (MY 2013). Migration year 2016 was the most recently completed estimate and had an SAR of 1.3% (95% CI 0.7–2.4%). For MY 2005–2017, the median SAR was 3.9% and ranged from 0.7% (MY 2015) to 6.0% (MY 2013; Figure 7). Nine of the 13 completed SAR estimates (69.2%) were ≥2.0%.

Fish Creek

Beginning in 1994, the number of PIT-tagged smolts from Fish Creek that were subsequently detected in the hydrosystem ranged from 128 (MY 1994) to 4,979 (MY 2012). Eighty-five adults were detected that were not previously detected as emigrating smolts and were excluded from further analysis. From MYs 1996–2017, 795 adults were used to calculate SARs. The number of adults detected ranged from two fish (MY 1996) to 180 fish (MY 2012). Migration year 2016 was the most recently completed estimate and had an SAR of 0.7% (95% CI 0.4–1.2%). Migration year 2017 is mostly complete, missing only 3-ocean adults returning in 2021 (SAR = 0.2%). For MYs 1996–2017, the median SAR was 0.7% and ranged from 0.1% (MY 2015) to 4.2% (MY 2008; Figure 7). Six of the 21 completed SAR estimates (28.5%) were ≥2.0%.

Big Creek

Beginning in 2003, the number of PIT-tagged smolts from Big Creek that were subsequently detected in the hydrosystem ranged from eight (MY 2006) to 951 (MY 2012). Forty-nine adults were detected that were not previously detected as emigrating smolts and were excluded from further analysis. From MYs 2003–2017, 148 adults were used to calculate SARs to Bonneville Dam. The number of adults detected ranged from zero fish (MY 2005–2007, 2015) to 40 fish (MY 2008). Migration year 2016 was the most recently completed estimate and had an SAR of 0.6% (95% CI 0.1–2.3%). Migration year 2017 is mostly complete, missing only 3-ocean adults returning in 2020 (SAR = 0.7%). For MYs 2003–2017, the median SAR was 2.0% and ranged from 0.0% (MY 2005-2007, 2015) to 9.1% (MY 2004; Figure 7). Eight of the 14 completed SAR estimates (57.1%) were ≥2.0%.

Lemhi River

Beginning in 2003, the number of PIT-tagged smolts from Lemhi River that were subsequently detected in the hydrosystem ranged from 21 (MY 2003) to 1,077 (MY 2014). Seventy adults were detected that were not previously detected as emigrating smolts and were excluded from further analysis. No 3-ocean adults tagged as juveniles in the Lemhi River basin have yet been detected in the hydrosystem; therefore, we consider a MY cohort complete after 2-ocean adults return. From MYs 2003–2017, 187 adults were used to calculate SARs to Bonneville Dam. The number of adults detected ranged from zero fish (MY 2004, 2005) to 38 fish (MY 2008). Migration year 2017 was the most recently completed estimate and had an SAR of 0.6% (95% CI 0.2–2.0%). For MYs 2003–2017, the median SAR was 1.7% and ranged from 0.0% (MY 2004, 2005) to 5.0% (MY 2008; Figure 7). Seven of the 15 completed SAR estimates (46.7%) were ≥2.0%.

Diversity

Age, Sex, and Size Composition

Big Bear Creek Array—Age composition of SY 2020 Big Bear Creek steelhead was determined from adult fish sampled at LGR because no fish were physically handled at the PIT tag array site. Age data was collected from eight unique adult steelhead detected at the Big Bear Creek array that were sampled at LGR (Table 2). All eight unique wild adult steelhead sampled were assigned complete ages (Table 3). Four fish (50.0%) were 1-ocean adults, and four fish (50%) were 2-ocean adults (Figure 8). Two adults smolted after one year in freshwater (25.0%), and the other six adults smolted after two years (75.0%). Total ages ranged from three to five years at spawning, with four different freshwater-saltwater age class combinations (Table 3).

Sex and size composition data were collected from the eight prespawn adult steelhead sampled at LGR for age composition (Table 2). Females comprised 25.0% (n = 2) and males comprised 75.0% (n = 6) of the adults sampled at LGR (Table 2). Mean fork length for females was 66.5 cm (range = 62.0–71.0 cm) and mean fork length for males was 67.7 cm (range = 57.0–81.0 cm).

East Fork Potlatch River Weir—Age composition of SY 2020 East Fork Potlatch River steelhead was determined from data collected at the weir. Age data was collected from 23 unique wild, adult steelhead (prespawn and kelts) captured at the weir. Of the 23 unique wild steelhead sampled, 18 were assigned complete ages and five were not assigned a freshwater age (Table 2). Of those assigned ocean ages, 16 fish (69.6%) were 1-ocean and the other seven (30.4%)

were 2-ocean fish (Figure 8). One adult (5.6%) smolted after one year in freshwater, 12 (66.7%) smolted after two years, and five (27.8%) smolted after three years. Total ages ranged from four to six years at spawning, with five different freshwater-saltwater age class combinations (Table 3).

Sex and size composition data were collected from the 23 unique adult steelhead sampled for age composition (Table 2). Females comprised 39.1% (n = 9), males comprised 56.5% (n = 13), and 4.3% were unable to be sexed (n = 1). Mean fork length for females was 66.0 cm (range = 56.5–75.3 cm) and mean fork length for males was 63.4 cm (range = 53.9–78.3 cm).

Crooked River Weir—Age data for SY 2020 Crooked River steelhead was not collected because no adult steelhead were captured at the weir (Table 3). Sex and size composition data were also not analyzed on adult steelhead (Table 2).

Lochsa River Array—Age composition of SY 2020 Lochsa River steelhead was determined from adult fish sampled at LGR because no fish were physically handled at the PIT tag array site. Age data was collected from 32 unique adult steelhead detected at the PIT tag arrays in the Lochsa River that were sampled at LGR; 22 were assigned complete ages, and ten had unknown freshwater ages (Table 3). Of those assigned ocean ages, nine fish (28.1%) were 1-ocean adults, 22 (68.8%) were 2-ocean adults, and one (3.1%) was a 3-ocean adult (Figure 8). No adults (0.0%) smolted after one year in freshwater, 14 (63.6%) smolted after two years, 7 (31.8%) smolted after three years, and one (4.5%) smolted after four years. Total ages ranged from four to seven years at spawning, with six different freshwater-saltwater age class combinations (Table 3).

Sex and size composition data were collected from the 32 prespawn adult steelhead sampled at LGR for age composition (Table 2). Females comprised 53.1% (n = 17) and males comprised 46.9% (n = 15) of the adults sampled at LGR (Table 2). Mean fork length for females was 75.6 cm (range = 60.0–87.0 cm) and mean fork length for males was 74.9 cm (range = 65.0–87.0 cm).

Fish Creek Weir—Age composition of SY 2020 Fish Creek steelhead was determined solely from data collected at the weir. Age data was collected from 18 unique wild, adult steelhead (prespawn and kelts) captured at the weir. Of the 18 unique adults sampled, 12 were assigned complete ages, four had unknown freshwater ages, and two were not assigned an age (Table 2). Of those assigned ocean ages, eight (50.0%) were 1-ocean adults, seven (43.8%) were 2-ocean adults, and one (6.3%) was a 3-ocean adult (Figure 8). Five fish (41.7%) smolted after two years in freshwater and seven (58.3%) smolted after three years. Total ages ranged from four to seven years, with five different freshwater-saltwater age class combinations (Table 3).

Sex and size composition data were collected from the 12 unique adult steelhead sampled for age composition (Table 2). Females comprised 50.0% (n = 9) and males comprised 50.0% (n = 9) of the adults sampled at the weir (Table 2). Mean fork length for females was 73.6 cm (range = 63.8–79.8 cm) and males was 71.9 cm (range = 58.8–87.1 cm; Table 2).

Rapid River Weir—Age composition of SY 2020 Rapid River steelhead was determined from data collected at the weir. Age data was collected from 13 unique wild, adult steelhead captured at the weir. Of the 13 unique adults sampled, ten were assigned complete ages, and three fish had an unknown freshwater age (Table 3). Of those assigned ocean ages, seven

(53.8%) were 1-ocean adults and six (46.2%) were 2-ocean adults (Figure 8). Six fish (60.0%) smolted after two years in freshwater, and four (40.0%) smolted after three years. Total ages ranged from four to six years at spawning, with four different freshwater-saltwater age class combinations (Table 3).

Sex and size composition data were collected from the 13 prespawn adult steelhead sampled for age composition (Table 2). Females comprised 53.9% (n = 7) and males comprised 46.2% (n = 6) of the adults sampled at the weir (Table 2). Mean fork length for females was 69.7 cm (range = 59.0–78.0 cm) and males was 66.3 cm (range = 59.0–81.0 cm; Table 2).

South Fork Salmon River—Age composition of SY 2020 South Fork Salmon River steelhead was determined from adult fish sampled at LGR because no fish were physically handled at the PIT tag array site. Age data was collected from 12 unique adult steelhead detected at the PIT tag array in the South Fork Salmon River that were sampled at LGR; eight were assigned complete ages, and four had unknown freshwater age (Table 3). Of those assigned ocean ages, four fish (33.3%) were 1-ocean adults, seven (58.3%) were 2-ocean adults, and one (8.3%) was a 3-ocean adult (Figure 8). Three adults (37.5%) smolted after two years in freshwater, four (50.0%) smolted after three years, and one (12.5%) smolted after four years. Total ages ranged from four to seven years at spawning, with six different freshwater-saltwater age class combinations (Table 3).

Sex and size composition data were collected from the 12 prespawn adult steelhead sampled at LGR for age composition (Table 2). Females comprised 75.0% (n = 9) and males comprised 25.0% (n = 3) of the adults sampled at LGR (Table 2). Mean fork length for females was 74.2 cm (range = 63.0–80.0 cm) and mean fork length for males was 69.3 cm (range = 58.0–86.0 cm).

Big Creek Array—Age composition of SY 2020 Big Creek steelhead was determined from adult fish sampled at LGR because no fish were physically handled at the PIT tag array site. Age data was collected from 20 unique adult steelhead detected at the PIT tag array in Big Creek that were sampled at LGR; 10 were assigned complete ages, seven had unknown freshwater age, and three were not assigned an age (Table 3). Of those assigned ocean ages, nine fish (52.9%) were 1-ocean adults, and eight (47.1%) were 2-ocean adults (Figure 8). One adult (10.0%) smolted after two years in freshwater, eight (80.0%) smolted after three years, and one (10.0%) smolted after four years. Total ages ranged from five to seven years at spawning, with four different freshwater-saltwater age class combinations (Table 3).

Sex and size composition data were collected from the 20 prespawn adult steelhead sampled at LGR for age composition (Table 2). Females comprised 65.0% (n = 13) and males comprised 35.0% (n = 7) of the adults sampled at LGR (Table 2). Mean fork length for females was 67.0 cm (range = 57.0–77.0 cm) and mean fork length for males was 66.0 cm (range = 59.0–73.0 cm).

North Fork Salmon River Array—Age composition of SY 2020 North Fork Salmon River steelhead was determined from adult fish sampled at LGR because no fish were physically handled at the PIT tag array site. Age data was collected from 23 unique adult steelhead detected at the PIT tag array in the North Fork Salmon River that were sampled at LGR, 18 were assigned complete ages and five had unknown freshwater ages (Table 3). Of those assigned ocean ages, seven fish (30.4%) were 1-ocean adults, and 16 (69.6%) were 2-ocean adults (Figure 8). Eight adults (44.4%) smolted after two years in freshwater, and 10 (55.6%) smolted after three years.

Total ages ranged from four to six years at spawning, with four different freshwater-saltwater age class combinations (Table 3).

Sex and size composition data were collected from the 23 prespawn adult steelhead sampled at LGR for age composition (Table 2). Females comprised 60.9% (n = 14) and males comprised 39.1% (n = 9) of the adults sampled at LGR (Table 2). Mean fork length for females was 66.9 cm (range = 56.0–74.0 cm) and mean fork length for males was 64.1 cm (range = 52.0–78.0 cm).

Lower Lemhi River Array—Age composition of SY 2020 Lemhi River steelhead was determined from adult fish sampled at LGR because no fish were physically handled at the PIT tag array site. Age data was collected from 29 unique adult steelhead detected at the PIT tag arrays in the lower Lemhi River that were sampled at LGR, 25 were assigned complete ages and four had unknown freshwater ages (Table 3). Of those assigned ocean ages, 16 fish (55.2%) were 1-ocean adults, and 13 (44.8%) were 2-ocean adults (Figure 8). Fourteen adults (56.0%) smolted after two years in freshwater, and 11 (44.0%) smolted after three years. Total ages ranged from four to six years at spawning, with four different freshwater-saltwater age class combinations (Table 3).

Sex and size composition data were collected from the 29 prespawn adult steelhead sampled at LGR for age composition (Table 2). Females comprised 79.3% (n = 23) and males comprised 20.7% (n = 6) of the adults sampled at LGR (Table 2). Mean fork length for females was 63.8 cm (range = 55.0–73.0 cm) and mean fork length for males was 56.0 cm (range = 51.0–69.0 cm).

Pahsimeroi River Weir—Age composition of SY 2020 Pahsimeroi River steelhead was determined from data collected at the weir. Forty-one unique wild adult steelhead were captured at the weir, but age data was only collected from 39 adults. Of the 39 unique adults sampled, 18 were assigned complete ages, 11 had unknown freshwater ages, and 10 were not assigned an age (Table 3). Of those assigned ocean ages, 23 (79.3%) were 1-ocean adults and six (20.7%) were 2-ocean adults (Figure 8). One fish (5.6%) smolted after one year in freshwater, 13 (72.2%) smolted after two years in freshwater and four (22.2%) smolted after three years in freshwater. Total ages ranged from four to five years, with four different freshwater-saltwater age class combinations (Table 3).

Sex and size composition data were collected from the 41 prespawn adult steelhead trapped during SY 2020 (Table 2). Females comprised 63.4% (n = 26) and males comprised 36.6% (n = 15) of the adults sampled at the weir (Table 2). Mean fork length for females was 60.8 cm (range = 53.0–71.0 cm) and males was 63.5 cm (range = 55.0–70.0 cm; Table 2).

East Fork Salmon River Weir—Age composition of SY 2020 East Fork Salmon River steelhead was determined from data collected at the weir. Age data was collected from unique wild, adult steelhead captured at the weir. Of the 29 unique adults sampled, 22 were assigned complete ages and seven had unknown freshwater ages (Table 3). Of those assigned ocean ages, 12 (41.4%) were 1-ocean adults and 17 (58.6%) were 2-ocean adults (Figure 8). Fifteen fish (68.2%) smolted after two years in freshwater, six (27.3%) smolted after three years, and one (4.5%) smolted after four years in freshwater. Total ages ranged from four to six years, with five different freshwater-saltwater age class combinations (Table 3).

Sex and size composition data were collected from the 29 prespawn adult steelhead sampled for age composition (Table 2). Females comprised 48.3% (n = 14) and males comprised

51.7% (n = 15) of the adults sampled at the weir (Table 2). Mean fork length for females was 66.5 cm (range = 59.0–72.0 cm) and males was 63.1 cm (range = 56.0–73.0 cm; Table 2).

Upper Salmon River Weir—Age composition of SY 2020 upper Salmon River steelhead was determined from data collected at the weir. Age data was collected from 44 unique wild, adult steelhead captured at the weir. Of the 44 unique adults sampled, 38 were assigned complete ages, five had unknown freshwater age, and one was not assigned an age (Table 3). Of those assigned ocean ages, 29 (67.4%) were 1-ocean adults and 14 (32.6%) were 2-ocean adults (Figure 8). Thirty-three (86.8%) fish smolted after two years in freshwater, and five (13.2%) smolted after three years. Total ages ranged from four to five years, with three different freshwater-saltwater age class combinations (Table 3).

Sex and size composition data were collected from the 44 prespawn adult steelhead sampled for age composition (Table 2). Females comprised 47.7% (n = 21) and males comprised 52.3% (n = 23) of the adults sampled at the weir (Table 2). Mean fork length for females was 63.2 cm (range = 54.0–74.0 cm) and males was 60.6 cm (range = 48.0–77.0 cm; Table 2).

Adult Migration Timing and Conversion Rates

Big Bear Creek Array—Twenty-six adult steelhead were detected in the hydrosystem during the SY 2020 adult migration that were PIT tagged as juveniles in Big Bear Creek. Twenty-five individuals were detected at Bonneville Dam upon their return migration (Figure 9). The median date of passage over Bonneville Dam was August 12, 2019 (range = July 3–September 23). Conversion rates from Bonneville Dam to McNary Dam and from Bonneville Dam to LGR were both 80.1% (Appendix E). Twenty of the 21 PIT-tagged adult steelhead detected at LGR were detected during fall 2019, and the other adult was detected during spring 2020. The median date of passage at LGR was October 17 (range = July 19–March 12). Eight of the twenty-six PIT-tagged adults that entered the hydrosystem were detected at the Big Bear Creek PIT tag array.

The median date for prespawn wild adult steelhead detected at the Big Bear Creek PIT tag array was March 27 (March 11–April 24; Figure 10).

East Fork Potlatch River Weir—Three adult steelhead were detected in the hydrosystem during the SY 2020 adult migration that were PIT tagged as juveniles in the East Fork Potlatch River. All individuals were first detected at Bonneville Dam (Figure 9). The median date of passage over Bonneville Dam was August 20, 2019 (range = August 12—September 25). Conversion rates from Bonneville Dam to McNary Dam was 100.0% and from Bonneville to LGR was 100.0% (Appendix E). One of the two PIT-tagged adult steelhead (33.3%) detected at LGR was detected during the fall and the remaining two fish were detected during spring 2020. The median date of passage at LGR was March 26 (range = September 27—April 6). Two of the three PIT-tagged adults that entered the hydrosystem were captured at the East Fork Potlatch weir.

Prespawn adult steelhead were captured at the weir between April 6–May 11 and kelts were captured between May 15–June 5 (Figure 10). The median date of capture for prespawn adults and kelts was April 23 and May 24, respectively.

Lochsa River Array— Six adult steelhead were detected in the hydrosystem during the SY 2020 adult migration that were PIT tagged as juveniles in Lochsa River main stem and tributaries (Figure 9). Five of those were tagged in Fish Creek, and one was tagged in the Lochsa River. The median date of passage over Bonneville Dam was September 27, 2019 (range =

August 17–October 16). Conversion rates from Bonneville Dam to McNary Dam was 83.3% and from Bonneville Dam to LGR was 83.3% (Appendix E). Four of the five PIT-tagged adult steelhead (80.0%) detected at LGR were detected during the fall and the remaining fish was detected the following spring. The median date of passage over LGR was October 31 (range = October 9–March 26). Of the initial six PIT-tagged adults that entered the hydrosystem, five (83.3%) were subsequently detected on the Lochsa River PIT tag arrays.

The median date for prespawn wild adult steelhead detected at the Lochsa River PIT tag arrays was April 19 (March 26–October 31; Figure 10).

Fish Creek Weir—Five adult steelhead were detected in the hydrosystem during the SY 2020 adult 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 16, 2019 (range = August 17–November 9). Conversion rates from Bonneville Dam to McNary Dam was 80.0% and from Bonneville to LGR was 80.0% (Appendix E). Three of the four PIT-tagged adult steelhead (80.0%) detected at LGR were detected during the fall and the remaining one fish was detected the following spring. The median date of passage at LGR was October 28 (range = October 9–March 26). None of the PIT-tagged adults that entered the hydrosystem were captured at the Fish Creek weir. Because the weir was inoperable or partially operable for 25 days during the migration period, it is likely some individuals passed upstream undetected.

Prespawn adult steelhead were captured at the weir between March 30–June 24 and kelts were captured between June 16–July 11 (Figure 10). The median date of capture for prespawn adults and kelts was April 16 and June 27, respectively. The weir was operating partially for 25 days during high flows at the end of May and beginning of June, potentially compromising our ability to accurately determine the true median dates for both prespawn adults and kelts.

Rapid River Weir—Three adult steelhead were detected in the hydrosystem during the SY 2020 adult migration that were PIT tagged as juveniles in Rapid River. The median date of passage over Bonneville Dam was August 31, 2019 (range = August 4—September 12). The conversion rate from Bonneville Dam to McNary Dam was 100.0% and from Bonneville to LGR was 100.0% (Appendix E). All three of the PIT-tagged adult steelhead detected at LGR were detected during the fall. The median date of passage at LGR was October 3 (range = September 17—October 8). Two of the three PIT-tagged adults that entered the hydrosystem were captured at the Rapid River weir on April 22 and April 27.

Prespawn adult steelhead were captured at the weir between April 22–June 29 (Figure 10). The median date of capture for prespawn adults was April 24. (Figure 10).

South Fork Salmon River Array—One adult steelhead was detected in the hydrosystem during the SY 2020 adult migration that was PIT-tagged as a juvenile in the South Fork Salmon River. The fish was first detected as an adult at McNary Dam on September 18, 2019, and subsequently detected again at LGR on September 24 (conversion rate = 100%).

The median date for prespawn wild adult steelhead detected at the South Fork Salmon River PIT tag array was April 20 (April 6–May 11; Figure 10).

Big Creek Array—Two adult steelhead were detected in the hydrosystem during the SY 2020 adult migration that were PIT tagged as juveniles in Big Creek. The median date of passage

over Bonneville Dam was September 28, 2019 (range = August 26—October 30). Conversion rates from Bonneville Dam to McNary Dam was 100.0% and from Bonneville to LGR was 100.0%. One of the two PIT-tagged adult steelhead (50.0%) detected at LGR was detected during the fall and the other was detected the following spring. The median date of passage over LGR was December 26 (range = October 9—March 13). Of the initial two PIT-tagged adults that entered the hydrosystem, both were subsequently detected on the Big Creek PIT tag arrays.

The median date for prespawn wild adult steelhead detected at the Big Creek array was April 22 (April 10–May 9; Figure 10).

North Fork Salmon River Array—One adult steelhead was detected in the hydrosystem during the SY 2020 adult migration that was PIT tagged as a juvenile in the North Fork Salmon River. The fish was detected at Bonneville Dam on August 3, 2019, and subsequently detected at McNary Dam and LGR on August 8 and August 17, respectively (conversion rate = 100%).

The median date for prespawn adult steelhead detected at the North Fork Salmon River PIT tag array was April 9 (March 19–April 27; Figure 10). There was one returning adult steelhead of hatchery origin that was also detected on the PIT tag array and tagged as an un-clipped adult at LGR.

Lower Lemhi River Array—Twelve adult steelhead were detected in the hydrosystem during the SY 2020 adult migration that were PIT tagged as juveniles in the Lemhi River. Eleven individuals were detected at Bonneville Dam upon their return migration (Figure 9). The median date of passage over Bonneville Dam was August 6, 2019 (range = July 6–September 18). Ten of the twelve adults that passed Bonneville were subsequently detected at McNary Dam and at LGR (conversion rate = 83.3%; Appendix F). All adults were detected at LGR during the fall. The median date of passage for migrants over LGR was August 30 (range = July 29–November 3). Eight of the PIT-tagged adults were detected at the lower Lemhi River PIT tag arrays.

The median date for prespawn adult steelhead detected at the lower Lemhi River PIT tag array was April 19 (March 14–May 19; Figure 10).

Pahsimeroi River Weir—One adult steelhead was detected in the hydrosystem during the SY 2020 adult migration that was PIT tagged as a juvenile in the Pahsimeroi River. The adult was first detected at Bonneville Dam on September 18, 2019. The individual was subsequently detected at McNary Dam and at LGR (conversion rate = 100%). The fish was detected at LGR on October 11 and was captured at the Pahsimeroi River weir on April 20, 2020. Thirteen additional adult steelhead were either PIT tagged as adults or juveniles at LGR and subsequently captured at the Pahsimeroi River weir. The median date of passage for these fish sampled at LGR was September 22, 2019 (range = July 17–October 30).

The median date for prespawn adult steelhead captured at the weir was April 10 (March 20—April 27; Figure 10).

East Fork Salmon River Weir—No adult steelhead were detected in the hydrosystem during the SY 2020 adult migration that were PIT tagged as juveniles in the East Fork Salmon River. There were eleven adult steelhead PIT tagged as adults at LGR that were subsequently captured at the East Fork Salmon River weir. The median date of passage for these fish sampled at LGR was September 9, 2019 (range = July 10–October 8).

The median date for prespawn adult steelhead captured at the weir was April 26 (April 12–May 19; Figure 10).

Upper Salmon River Weir—Three adult steelhead were detected in the hydrosystem during the SY 2020 adult migration that were PIT tagged as juveniles in the upper Salmon River. The median date of passage over Bonneville Dam was July 25, 2019 (range = July 23—August 20). The conversion rate from Bonneville Dam to McNary Dam was 100.0% and from Bonneville to LGR was 100.0% (Appendix E). All three of the PIT-tagged adult steelhead detected at LGR were detected on the same day during the fall (September 27). One of the PIT-tagged adults that entered the hydrosystem was captured at the Upper Salmon River weir on April 30.

The median date for prespawn adult steelhead captured at the weir was April 22 (March 30–May 7; Figure 10).

Genetic Sampling

During 2020, we collected genetic samples from wild adult steelhead captured in the course of other project activities. Two hundred and ten genetic samples were collected across seven IDFG research and hatchery weir locations. All samples were archived for later analysis (Appendix G).

DISCUSSION

The purpose of this report is to collate and summarize population-level information to evaluate the status of selected wild steelhead populations in Idaho. Population abundance, productivity, and life history information are key data needed to inform DPS viability and management. This is the sixth year in which we assembled all wild adult steelhead information collected statewide under one cover. The reporting process continually evolves as data collection infrastructure (arrays and weirs) expands and shifts. This requires an adaptive approach of how to best combine, analyze, and visualize information from various projects. The collation of these data can be used for future tools such as population or life cycle models to increase our knowledge of life-stage specific survival, population dynamics, and predictive powers in assessing long-term viability. Such work has already been completed using data from Fish Creek (McCormick et al. 2020).

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 (NWFSC 2015). 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 steelhead 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 for the past four years have been low across all populations compared to years preceding them. However, from SY 2019 to SY 2020 abundance

increased in a majority of monitored populations, including Big Bear Creek, Big Creek, East Fork Potlatch River, East Fork Salmon River, Hayden Creek, lower Lemhi River, North Fork Salmon River, Pahsimeroi River, Rapid River, and the upper Salmon River. The mean rate of change from SY 2019 to SY 2020 for Clearwater River basin populations was -21.5% and for Salmon River basin populations, the mean rate of change was 51.9%. Adult abundances in the Clearwater River basin were variable in SY 2020, with increases in Potlatch River and decreases in the Lochsa River. Relative to SY 2019, adult abundance at the Lochsa River array decreased by 64.1%, and in the Potlatch River (Big Bear Creek array) abundance increased by 52.6%.

Understanding performance differences between steelhead populations will be advanced through the development of future tools, such as life cycle modeling. Developing robust life cycle models is contingent upon well-understood ecosystem factors that influence the survival and productivity of steelhead at various life phases, and the ocean phase is of particular need for increased knowledge. Ecosystem indicators are available through the Northwest Fisheries Science Center (Peterson et al. 2020); however, these indicators were established to understand factors affecting coho and Chinook. Few studies have looked at how these “stoplight” rankings relate to steelhead and steelhead populations with diverse life history strategies and overlapping cohorts.

Infrastructure deficiencies at certain sites, compounded by low numbers of returning adult steelhead over the past four years, continue to hamper our ability to accurately estimate spawners and generate adult-to-adult and adult-to-juvenile productivity analyses. For example, the permanent weir structure at Crooked River is ineffective during high spring flows when adult steelhead are migrating, and has not had enough individuals trapped to estimate an expanded abundance of spawners in recent years. Therefore, a PIT tag array site is scheduled to be installed on Crooked River in the fall of 2021. Additionally, we continue to struggle generating expanded estimates of adult spawners at Big Bear Creek due to a low number of detections resulting from difficulties maintaining a dual span array. A new PIT tag array system was installed in Big Bear Creek with the first array completed during the fall of 2019 and the second during the fall of 2020. The two new channel-spanning arrays are designed to better withstand the bedload movement and flashy spring conditions and will be more effective with adult detections. If detection efficiencies can reliably be determined utilizing the upgraded array infrastructure over the next handful of years, we may be able to use environmental data, such as flow, to model what detection efficiency was like from 2018-2020 to develop post hoc abundance estimates for Big Bear Creek.

The 2020 SY marks the first time that both Lochsa River PIT tag arrays were integrated into the DABOM model for estimating adult abundance. For SY 2018 and SY 2019, Lochsa River abundance estimates were derived via the Connolly et al. (2005) method. The significant abundance decrease observed at the Lochsa River array in SY 2020 raised concern that there may be incongruence between the DABOM model and the Connolly et al. (2005) method. To quantify differences between the two methods, detection probabilities at the Lochsa River array site during the SY 2020 migration period were determined using the program USER (Lady et al. 2009), and subsequently used to develop an abundance estimate via the Connolly et al. (2005) method. The Connolly et al. (2005) method resulted in an estimated SY 2020 abundance of 175 (95% C.I. = 151–210), while the DABOM model resulted in an estimate of 189 (95% C.I. = 152–243). Given the strong overlap observed between the two methods, we feel confident reporting the DABOM estimate in this report. Additionally, the overlap among the two methods lends confidence that the estimates from SYs 2018 and 2019 can be used for trend analyses. A future robust analysis of variance between the two models at multiple sites would help to characterize differences and add confidence to trend data.

Typically, we use the LGR mean weekly trap rate for Connolly et al. (2005) method PIT array abundance estimates. However, because the LGR adult trap was shut down during the final 5.7% of the SY 2020 migration period due to the COVID-19 pandemic, and considering the later adult migration life history strategy that is typical of the Lochsa River steelhead population, we used the mean cumulative trap rate in the above Lochsa River abundance estimate. In the preceding two SYs (SY 2018 and SY 2019) where the LGR trap operated through the duration of the spring migration period, 4.7% of the wild adult steelhead handled at LGR that were subsequently detected at the Lochsa River array site migrated over LGR in the spring. The other abundance estimate derived via the Connolly et al. (2005) method in this report was on Marsh Creek, where we used the mean weekly trap rate, due to the historically earlier migration pattern observed among Marsh Creek steelhead. We believe that this trap rate more accurately represents the rate specific to Marsh Creek steelhead as they migrated over LGR dam. Mean weekly trap rate is preferable in a normal year, because it allows for the ability to capture and characterize the variance in trap rates among statistical weeks. Weekly trap rates vary throughout the migration period in order to achieve certain management objectives, such as broodstock collection for various anadromous hatchery programs.

Reconditioned kelts and hatchery strays make up a small percentage (<5%) of annual adult returns to wild steelhead spawning areas but can contribute to productivity where they are allowed to spawn with the wild population (e.g., above PIT tag array sites). Reconditioned kelts are wild adults that have spawned and are captured as kelts at LGR which are then artificially reconditioned in a hatchery and released in the Snake River to naturally spawn a second time (Jenkins et al. 2018). Natural repeat spawners and reconditioned kelts are counted as parents for every year that they return to spawn and are assumed to have the same probability of producing the same number of progeny with each spawning event as all other adult returners. Contributions from repeat spawners diversify steelhead life history and can buffer anthropogenic effects (Moore et al. 2014; Copeland et al. 2019). In the Yakima River basin, reconditioned kelts were found to have a much higher return rate than an in-river migration control group (Trammell et al. 2016). However, no reconditioned kelts were observed in tributary systems in 2020. Occurrence of hatchery strays above PIT tag array sites are also relatively low based on PIT tag detections but total contributions to the population are unknown and current productivity analyses have not incorporated them. Monitoring trends in abundance of hatchery-origin strays and wild-origin reconditioned kelts in areas managed for wild steelhead populations are important for understanding the long-term effects of hatchery-reared fish and wild fish interactions as they have been associated with decreasing natural production over time in some systems (Chilcote 2003).

Idaho wild steelhead are not consistently meeting replacement based on adult-to-adult productivity. All populations reported on here were below replacement for the last 3-7 BYs (Figure 4). Fish Creek (Clearwater River MPG) contains the longest productivity time series (22 complete BYs) and highlights the variability in steelhead productivity. Adult-to-adult productivity in Fish Creek varied from 0.3 to 10.3 recruits per spawner with nine years (40.9%) meeting replacement. Mean productivity for BY 2013 decreased by 65.9% from BY 2012 across all populations monitored, except for Rapid River and Big Bear Creek, which increased by 49.4%. Mean productivity for BY 2013 across all populations monitored was 0.18 (range = 0.07–0.30), well below replacement. Fluctuations in productivity are expected in wild populations and was illustrated in existing data. However, the complex life history diversity of Idaho steelhead likely lends to their ability to rebound from previous low productivity years (Dobos et al. 2020a). Small populations are more easily influenced by random processes such as environmental variation and stochasticity, making them more vulnerable to extinction compared to large populations

(McElhany et al. 2000). Identifying the extent of these processes will help determine extinction risks and the resiliency of the population.

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 (Dobos et al. 2020a; Dobos et al. 2020b) 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 6). Improving freshwater rearing habitat is one of the suite of actions being taken to reduce density-dependent effects on salmonid populations. Efforts by IDFG focus on evaluating fish population response to habitat restoration in two intensively monitored watersheds, the Potlatch River (Clearwater River MPG) and Lemhi River (Salmon River MPG; IDFG 2019). Restoration and monitoring programs have been underway in these watersheds for more than ten 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.

Smolt-to-Adult Return Rates

Smolt-to-adult return rates remain an important parameter for monitoring population performance and influences of ocean conditions for anadromous fish in Idaho. Smolt-to-adult return rates have been below objective in all four monitored populations for the last three MYs reported (2015-2017; Figure 7).This trend closely mirrors the poor BY replacement observed in recent years among monitored populations (Figure 4), highlighting the influence of ocean conditions on Idaho steelhead. In 2019, new standard methods were established and SARs (to Bonneville Dam) for Big Bear Creek, Big Creek, Fish Creek, and the Lemhi River were reported (Dobos et al. 2020b). Currently, low or no returns of PIT-tagged adults in other systems limits the expansion of calculating SARs in other areas. Another consideration would be to combine systems (e.g., upper Salmon River sites) so that SARs could be estimated for larger sub-watersheds where data is more sparse. Smolt-to-adult return rates for steelhead in the Snake River basin are currently being reported at the MPG level for the Comparative Survival Study (McCann et al. 2018). Population level SARs will complement the large-scale analysis and can guide management by examining population-specific performance within MPGs.

Diversity

Steelhead have the most diverse portfolio of life history strategies of Pacific salmonids (Quinn 2018) 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). Dramatic shift in age composition occurred in recent years. Spawn year 2017 run was dominated by 2-ocean fish (89.7%), which shifted dramatically to predominantly 1-ocean adults in SY 2018 (73.5%). The last two spawn cycles have demonstrated a more balanced ocean-age portfolio, with SY 2019 and SY 2020 comprised of 59.0% and 46.2% 2-ocean fish, respectively. The observed shifts in age composition likely reflect fluctuations in ocean productivity, which can heavily influence year class strength. The large age composition shifts observed between SY 2017 and SY 2018 were also compounded by drought conditions in 2015 and poor performance by the MY 2015 cohort.

These data highlight the benefits of having a diverse range of ages at maturity for steelhead to buffer against the possibility of a single brood year or ocean year failure.

Further evidence of diversity among steelhead populations, even within MPGs, was reflected in their freshwater and saltwater ages. The Lochsa River, including the Fish Creek population, and Big Creek are generally older aged fish in both time spent in freshwater and in saltwater. Returning adults from these populations were mostly comprised of freshwater age-3 fish (57.3%), whereas, the freshwater age-3 comprised a mean of 31.2% in all other populations in this study. These three populations normally display an older ocean age as well; however, in SY 2020 Fish Creek and Big Creek had a 2-ocean mean of 44.6%, while the Lochsa maintained a larger 2-ocean proportion (68.8%). Means of all other populations were 52.6% for 1-ocean, 46.5% for 2-ocean, and 0.8% for 3-ocean fish.

Diversity of steelhead populations was further reflected in their run timing through the hydrosystem. Across years, Big Bear Creek and Lemhi River steelhead populations, comprised of relatively younger and smaller fish, had an earlier arrival date to Bonneville Dam compared to older, larger fish generally found in the Lochsa River basin. 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). Adult steelhead returning to the Lochsa River basin usually have a small proportion of fish that do not migrate above LGR until the spring season. Earlier timing at LGR for upper Salmon River basin populations is likely also related to the longer distance to travel to spawning grounds.

Challenges and PIT Tag Array Infrastructure

Abundance estimates derived from PIT tag array data provide a valuable tool for fishery managers. New PIT tag array infrastructure resulting in abundance estimates that are included in this report include two channel-spanning arrays on Marsh Creek (installed 2019), and an upgrade to the South Fork Salmon River site near Krassel Creek to include two channel-spanning arrays (fall 2020). However, potential limitations of the current models need to be addressed prior to including additional array sites in this report. IPTDSW (2020) describes potential issues with the DABOM model that include model maintenance. As additions of new PIT tag array sites and better modeling capabilities are developed, the model estimating abundances will evolve. Versions of the DABOM model have been modified multiple times since results were first published (See et al. 2016). The addition of new PIT tag array sites helps improve the accuracy of other sites in the branch model. In 2019, a newer version of the model was able to re-run escapement estimates for all previous years. The Bayesian framework allows older data (prior to installation of some new PIT tag arrays) to be informed by data collected from all new infrastructure in recent years. Increased precision in abundance estimates lends to higher precision in estimating productivity; however, this analysis influences other analyses reported under other IDFG reports (e.g., Feeken et al. 2020). Another potential issue with using DABOM model estimates is the limitation of the number of PIT-tagged adult steelhead available for diversity and productivity analysis. The number of adults handled and tagged at LGR is annually decided through a cooperative agreement of multiple agencies. In low return years such as 2020, sample sizes might not provide accurate sex and age information for population demographic inference at all sites. Small sample sizes will also limit the capabilities of the DABOM model to estimate escapement to PIT tag array sites. A power analysis for PIT tag array sites would aid in deciding rules on whether to include certain escapement estimates for productivity analysis.

RECOMMENDATIONS

1. Estimate SARs for additional populations in the Clearwater River and Salmon River MPGs using methods developed for Big Bear Creek, Fish Creek, Big Creek, and the Lemhi River. For systems that have too few PIT-tagged returning adults to calculate SARs, consider combining watersheds such as all marked sites in the upper Salmon River basin.

2. Expand population productivity baseline data sets 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, the South Fork Salmon, and the North Fork Salmon rivers and Marsh Creek.

3. Identify the influence of hatchery spawners on the productivity of wild steelhead populations where they cannot be regulated (i.e., PIT tag array sites). Examine the inclusion of hatchery spawners into productivity analyses.

4. Compare age structure and sex composition between GSI populations sampled at LGR to index tributaries to determine if metrics estimated at LGR dam are sufficient for viability monitoring at the tributary level.

5. Investigate available indices of ocean conditions for predicting adult steelhead returns.

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LITERATURE CITED

Ackerman, M.W., N. Vu, and M.R. Campbell. 2016. Chinook Salmon and steelhead genotyping for genetic stock identification at Lower Granite Dam. July 1, 2015–June 30, 2015 annual progress report to the US Department of Energy, Bonneville Power Administration. Contract 69548, Project 2010-026-00. Idaho Department of Fish and Game Report 16-03, Boise.

Baum, C., T. Delomas, M. Davison, M.E. Dobos, W.C. Schrader, T. Copeland, and M.R. Campbell. *In prep*. Wild steelhead and Chinook Salmon abundance and composition at Lower Granite Dam, spawn year 2020. Annual Report. Idaho Department of Fish and Game Report 20-12.

Bowersox, B.J., R. Banks, and N. Davids. 2012. Potlatch River steelhead monitoring and evaluation, annual performance report 2011. Idaho Department of Fish and Game Report 12-108, Boise.

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

Chilcote, M.W. 2003. Relationship between natural productivity and the frequency of wild fish in the mixed spawning populations of wild and hatchery steelhead (*Oncorhynchus mykiss*). Canadian Journal of Fisheries and Aquatic Science 60:1057–1067.

Connolly, P.J., I.G. Jezorek, and E.F. Prentice. 2005. Development and use of in-stream PIT tag detection systems to assess movement behavior of fish in tributaries of the Columbia River Basin, USA. Pages 217-220 in L. Noldus, F. Grieco, L. Loijens, P. Zimmerman, eds., Proceedings of Measuring Behavior 2005, 5th International Conference on Methods and Techniques in Behavioral Research: Noldus Information Technology, Wageningen, The Netherlands.

Copeland, T., M.W. Ackerman, K.K. Wright, and A. Byrne. 2017. Life history diversity of Snake River steelhead populations between and within management categories. North American Journal of Fisheries Management 37:395–404.

Copeland, T., B.J. Bowersox, M.W. Ackerman, and C. Camacho. 2019. Patterns of iteroparity in wild Snake River steelhead trout. Transactions of the American Fisheries Society 148:926–937.

Dobos, M.E., B.J. Bowersox, T. Copeland, and E.J. Stark. 2020a. Understanding life history diversity of a wild steelhead population and managing for resiliency. North American Journal of Fisheries Management 40(5):1087-1099.

Dobos, M.E., M. Davison, J.T. Fortier, B.A. Knoth, and E.J. Stark. 2020b. Idaho adult steelhead monitoring. Idaho Department of Fish and Game, Annual Report 20-06, Boise.

Feeken S.F., B. Barnett, E. Felts, E.J. Stark, M. Davison, J.R. Poole, C. McClure, B.A. Knoth, and M.E. Dobos. 2020. Idaho anadromous emigrant monitoring. 2019 annual report. Idaho Department of Fish and Game Report 20-09, Boise.

Fleiss, J.L. 1981. Statistical methods for rates and proportions. 2nd edition. John Wiley and Sons. New York.

Gregory, S.V., and P.A. Bisson. 1997. Degradation and loss of anadromous salmonid habitat in the Pacific Northwest. Pages 277–314 in D.J. Stouder, P.A. Bisson, and R.J. Naiman, editors. Pacific salmon and their ecosystems: status and future options. Chapman and Hall, New York.

Hargrove, J.S., T.A. Delomas, J. McCane, M. Davison, M.R. Campbell, R.L. Horn, and S.R. Narum. 2021. Chinook and steelhead genotyping for genetic stock identification at Lower Granite Dam. Idaho Department of Fish and Game Report 21-03. Annual Report, BPA Project 2010-026-00.

Hatch, D., R. Branstetter, J. Stephenson, A. Pierce, J. Newell, W. Bosch, S. Everett, N. Graham, L. Medeiros, L. Jenkins, T. Tall Bull, J. Goodwin, N. Hoffman, T. Cavileer, J. Nagler, M. Fiander, C. Frederickson, J. Blodgett, D. Fast, R. Lessard, J. Whiteaker, and R. Johnson. 2017. Kelt Reconditioning and Reproductive Success Evaluation Research. 1/1/2016 – 12/31/2016. Annual Report, BPA Project 2007-401-00.

ICTRT (Interior Columbia Basin Technical Recovery Team). 2007. Viability criteria for application to interior Columbia Basin salmonid ESUs. Review Draft. Available at https://nwcouncil.app.box.com/s/y4q1yuam6wvscphbgtfvc6618vursfec. (Accessed August 2020).

IDFG (Idaho Department of Fish and Game). 2019. Fisheries management plan 2019–2024. Idaho Department of Fish and Game, Boise.

IPTDSW (in-stream PIT-tag detection systems workgroup). 2020. Report to NOAA fisheries for 5-year status review: Snake River basin steelhead and Chinook Salmon population abundance, life history, and diversity metrics calculated from in-stream PIT-tag observations (SY2010–SY2019). Available online at: https://collaboration.idfg.idaho.gov/FisheriesTechnicalReports/NMFS%20Status%20Assessment%20Report%20Snake%20River%20Basin.pdf. (Accessed June 2020).

ISAB (Independent Scientific Advisory Board). 2015. Density dependence and its implications for fish management and restoration programs in the Columbia River basin. Available online at: https://www.nwcouncil.org/media/7148891/isab2015-1.pdf. (Accessed April 2018).

Jenkins, L.E., A.L. Pierce, N. Graham, R. Branstetter, D.R. Hatch, and J.J. Nagler. 2018. Reproductive performance and energy balance in consecutive and skip repeat spawning female steelhead reconditioned in captivity. Transactions of the American Fisheries Society 147:959–971.

Kinzer, R.N., C. Albee, B. Arnsberg, P. Cleary, N. Espinosa, J. Harbeck, D. Nelson, J. Robbins, and S. Vatland. 2021. Snake River Basin Adult Chinook Salmon and Steelhead Monitoring. 2020 Annual Report. Nez Perce Tribe, Department of Fisheries Resources Management, Research Division. Lapwai, ID.

Lady, J.M., and J.R. Skalski. 2009. USER 4: User-specified estimation routine. Report to the Bonneville Power Administration, Project 1989-107-00, Portland, Oregon.

Lawry, K.M., C. Camacho, T. Delomas, M. Davison, M.E. Dobos, W.C. Schrader, T. Copeland, and M.R. Campbell. 2020. Wild steelhead and Chinook Salmon abundance and composition at Lower Granite Dam, spawn year 2020. Annual Report. Idaho Department of Fish and Game Report 20-12.

McCann, J., B. Chockley, S. Haeseker, R. Lessard, C. Petrosky, T. Copeland, E. Tinus, A. Storch, and D. Rawding. 2018. Comparative survival study of PIT-tagged spring/summer/fall Chinook, summer steelhead, and sockeye. 2018 Annual Report to the Bonneville Power Administration, BPA Contract 19960200.

McCormick, J.L., M.E. Dobos, B.J. Bowersox, and T. Copeland. 2020. Evaluation of management strategies for an incidental catch-and-release steelhead fishery. North American Journal of Fisheries Management 41:498–512.

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

Moore, J.W., J.D. Yeakel, D. Peard, J. Lough, and M. Beere. 2014. Life-history diversity and its importance to population stability and persistence of a migratory fish: steelhead in two large North American watersheds. Journal of Animal Ecology 83:1035–1046.

Nehlsen, W., J.E. Williams, and J.A. Lichatowich. 1991. Pacific salmon at the crossroads: stocks at risk from California, Oregon, Idaho, and Washington. Fisheries 16:4–20.

Nielsen, J.L., A. Byrne, S.L. Graziano, and C.C. Kozfkay. 2009. Steelhead genetic diversity at multiple spatial scales in a managed basin: Snake River, Idaho. North American Journal of Fisheries Management 29:680–701.

NPCC (Northwest Power and Conservation Council). 2014. Columbia River Basin Fish and Wildlife Program: 2014. Northwest Power and Conservation Council document 2014-12.

NWFSC (Northwest Fisheries Science Center). 2015. Status review update for Pacific salmon and steelhead under the Endangered Species Act: Pacific Northwest. Available at https://archive.fisheries.noaa.gov/wcr/publications/status_reviews/salmon_steelhead/2016/2016_nwfsc.pdf. (Accessed August 2020).

Peterson, W.T., J.L. Fisher, C.A. Morgan, S.M Zeman, B.J. Burke, and K.C. Jacobson. 2020. Ocean ecosystem indicators of salmon marine survival in the Northern California Current. Northwest Fisheries Science Center, Newport, Oregon. Available online at: https://www.fisheries.noaa.gov/west-coast/science-data/ocean-ecosystem-indicators-pacific-salmon-marine-survival-northern. (Accessed April 2021).

Poole, J.R., B. Barnett, C. McClure, S. Putnam, R.V. Roberts, E.J. Stark, R. Waskovich, and K. Wauhkonen. 2020. Idaho anadromous parr monitoring. 2019 Annual Report. Idaho Department of Fish and Game Report 20-04. Boise.

Quinn, T.P. 2018. The behavior and ecology of Pacific salmon and trout, 2nd edition. University of Washington Press, Seattle.

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

Robards, M.D., and T.P. Quinn. 2002. The behavior and ecology of Pacific salmon and trout. University of Washington Press, Seattle.

Schrader, W.C., M.W. Ackerman, T. Copeland, M.R. Campbell, M.P. Corsi, K.K. Wright, and P. Kennedy. 2014. Wild adult steelhead and Chinook salmon abundance and composition at Lower Granite Dam, spawn year 2012. Idaho Department of Fish and Game Report 14-16. BPA Projects 1990-055-00, 1991-073-00, 2010-026-00. Boise.

See, K., R. Orme, R. Kinzer, and M. Ackerman. 2016. PIT tag based escapement estimates to Snake basin populations. Prepared by ISEMP for the Bonneville Power Administration. Published by QCI.

See, K.E., R.N. Kinzer, and M.W. Ackerman. 2021. State-Space Model to Estimate Salmon Escapement Using Multiple Data Sources. North American Journal of Fisheries Management. Accepted Author Manuscript. doi.org/10.1002/nafm.10649

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

Trammell, J.L.J, D.E. Fast, D.R. Hatch, W.J. Bosch, R. Branstetter, A.L. Pierce, J.W. Blodgett, and C.R. Frederiksen. 2016. Evaluating Steelhead Kelt Treatments to Increase Iteroparous Spawners in the Yakima River Basin. North American Journal of Fisheries Management 36(4):876-887.

Uthe, P., B. Knoth, T. Copeland, A.E. Butts, B.J. Bowersox, and J. Diluccia. 2017. Intensively monitored watersheds and restoration of salmon habitat in Idaho: ten-year summary report. Idaho Department of Fish and Game Report 17-14, Boise.

Walters, A.W., T. Copeland, and D.A. Venditti. 2013. The density dilemma: limitations on juvenile production in threatened salmon populations. Ecology of Freshwater Fish 22:508–519.

WDFW (Washington Department of Fish and Wildlife) and ODFW (Oregon Department of Fish and Wildlife). 2002. Status report: Columbia River fish runs and fisheries 1938-2000. Available online at: https://wdfw.wa.gov/sites/default/files/publications/00935/wdfw00935.pdf. (Accessed August 2020).

Williams, R.N., W.E. McConnaha, P.R. Mundy, J.A. Stanford, R.R. Whitney, P.A. Bisson, D.L. Bottom, L.D. Calvin, C.C. Coutant, M.W. Erho Jr., C.A. Frissell, J.A. Lichatowich, and W.J. Liss. 1999. Return to the river: scientific issues in the restoration of salmonid fishes in the Columbia River. Fisheries 24:10–19.

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

TABLES

Table 1. Major population groups and independent populations within the Snake River steelhead distinct population segment (DPS; ICTRT 2007; NWFSC 2015; NMFS 2016).

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

Table 2. Number of wild adult steelhead (prespawn and kelts) captured at weirs or sampled at Lower Granite Dam (LGR) that were subsequently detected at PIT tag arrays, spawn year 2020. Numbers by sex and size were also given. NA = not applicable.

Site Location	Sex	Unique prespawn adults trapped at weirs	Unique adults sampled at LGR	Fork length (cm)			Kelts recovered	
				Minimum	Mean	Maximum	Unmarked	Marked
			Clearwater River MPG					
Big Bear Creek (Array)	Female	NA	2	62.0	66.5	71.0	NA	NA
	Male	NA	6	57.0	67.7	81.0	NA	NA
	All	NA	8	57.0	67.4	81.0	NA	NA
East Fork Potlatch River (Weir)	Female	8	NA	57.9	67.2	75.3	1	6
	Male	13	NA	53.9	63.4	78.3	0	3
	Unknown	0	NA	NA	NA	NA	1	0
	All	21	NA	53.9	64.9	78.3	2	9
Crooked River (Weir)	Female	0	NA	NA	NA	NA	0	0
	Male	0	NA	NA	NA	NA	0	0
	All	0	NA	NA	NA	NA	0	0
Lochsa River (Array)	Female	NA	17	60.0	75.6	87.0	NA	NA
	Male	NA	15	65.0	74.9	87.0	NA	NA
	All	NA	32	60.0	75.3	87.0	NA	NA
Fish Creek (Weir)	Female	5	NA	68.6	75.6	79.8	4	1
	Male	7	NA	65.9	74.5	87.1	2	4
	All	12	NA	65.9	74.9	87.1	6	5
			Salmon River MPG					
Rapid River (Weir)	Female	7	NA	59.0	69.7	78.0	NA	NA
	Male	6	NA	59.0	66.3	81.0	NA	NA
	All	13	NA	59.0	68.2	81.0	NA	NA
South Fork Salmon River (Array)	Female	9	NA	63.0	74.2	80.0	NA	NA
	Male	3	NA	58.0	69.3	86.0	NA	NA
	All	12	NA	58.0	73.0	86.0	NA	NA
Big Creek (Array)	Female	NA	13	57.0	67.0	77.0	NA	NA
	Male	NA	7	59.0	66.0	73.0	NA	NA
	All	NA	20	57.0	66.7	77.0	NA	NA
Marsh Creek (Array)	Female	NA	2	62.0	66.5	71.0	NA	NA
	Male	NA	1	68.0	68.0	68.0	NA	NA
	All	NA	3	62.0	67.0	68.0	NA	NA
North Fork Salmon River (Array)	Female	NA	14	56.0	66.9	74.0	NA	NA
	Male	NA	9	52.0	64.1	78.0	NA	NA
	All	NA	23	52.0	65.8	78.0	NA	NA
Lower Lemhi River (Array)	Female	NA	23	55.0	62.8	73.0	NA	NA
	Male	NA	6	51.0	59.0	71.0	NA	NA
	All	NA	29	51.0	62.0	73.0	NA	NA
Hayden Creek (Array)	Female	NA	6	55.0	63.7	72.0	NA	NA
	Male	NA	1	53.0	53.0	53.0	NA	NA
	All	NA	7	53.0	62.1	72.0	NA	NA
Upper Lemhi River (Array)	Female	NA	2	61.0	64.0	67.0	NA	NA
	Male	NA	0	NA	NA	NA	NA	NA
	All	NA	2	61.0	64.0	67.0	NA	NA

Table 2. Continued.

Site Location	Sex	Unique prespawn adults trapped at weirs	Unique adults sampled at LGR	Fork length (cm)			Kelts recovered	
				Minimum	Mean	Maximum	Unmarked	Marked
			Salmon River MPG					
Pahsimeroi River (Weir)	Female	26	NA	53.0	60.8	71.0	NA	NA
	Male	15	NA	55.0	63.5	70.0	NA	NA
	All	41	NA	53.0	61.8	71.0	NA	NA
East Fork Salmon River (Weir)	Female	14	NA	59.0	66.5	72.0	NA	NA
	Male	15	NA	56.0	63.1	73.0	NA	NA
	All	29	NA	56.0	64.8	72.0	NA	NA
Upper Salmon River (Weir)	Female	21	NA	54.0	63.2	74.0	NA	NA
	Male	23	NA	48.0	60.6	77.0	NA	NA
	All	44	NA	48.0	61.9	77.0	NA	NA

Table 3. Age frequencies of wild adult steelhead captured at weirs or sampled at Lower Granite Dam (LGR) that were subsequently detected at PIT tag arrays, spawn year 2020. Freshwater age that could not be determined was signified by x, any age that could not be determined was signified by NA, and natural repeat spawners were signified by R.

	Adult Steelhead Age (FW.SW)															
Site location	**1.1**	**1.2**	**2.1**	**2.2**	**2.3**	**3.1**	**3.2**	**3.3**	**4.1**	**4.2**	**R**	**x.1**	**x.2**	**x.3**	**NA**	**Total**
							Clearwater River MPG									
Big Bear Creek (Array)	1	1	3	3	0	0	0	0	0	0	0	0	0	0	0	8
East Fork Potlatch River (Weir)	0	1	8	4	0	4	1	0	0	0	0	4	1	0	0	23
Crooked River (Weir)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lochsa River (Array)	0	0	3	10	1	3	4	0	0	1	0	3	7	0	0	32
Fish Creek (Weir)	0	0	2	3	0	4	2	1	0	0	0	2	2	0	2	18
							Salmon River MPG									
Rapid River (Weir)	0	0	2	4	0	3	1	0	0	0	0	2	1	0	0	13
South Fork Salmon River (Array)	0	0	4	1	1	3	1	0	0	1	0	0	4	0	0	12
Big Creek (Array)	0	0	0	1	0	5	3	0	0	1	0	4	3	0	3	20
North Fork Salmon River (Array)	0	0	3	5	0	1	9	0	0	0	0	3	2	0	0	23
Lemhi River (Array)	0	0	7	7	0	7	4	0	0	0	0	2	2	0	0	29
Pahsimeroi River (Weir)	0	1	10	3	0	4	0	0	0	0	0	9	2	0	10	39
East Fork Salmon River (Weir)	0	0	8	7	0	2	4	0	1	0	0	1	6	0	0	29
Upper Salmon River (Weir)	0	0	21	12	0	5	0	0	0	0	0	3	2	0	1	44
Total	1	3	67	59	1	38	28	1	1	2	0	33	28	0	16	278

FIGURES

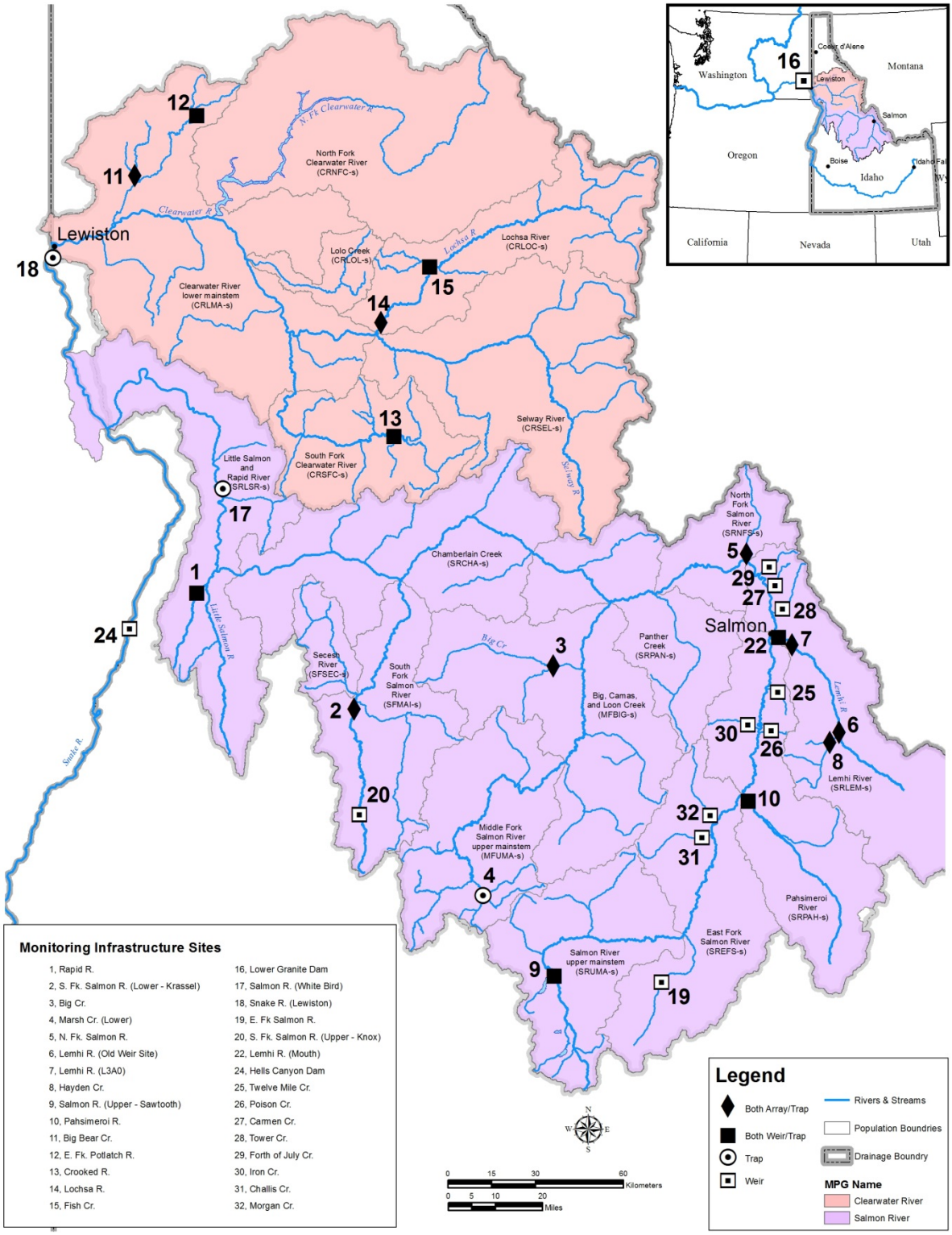

Figure 1. Location of wild steelhead monitoring infrastructure operated by IDFG in Idaho. The Clearwater River Major Population Group is in pink; the Salmon River Major Population Group is in purple. Population boundaries are shown as light gray lines.

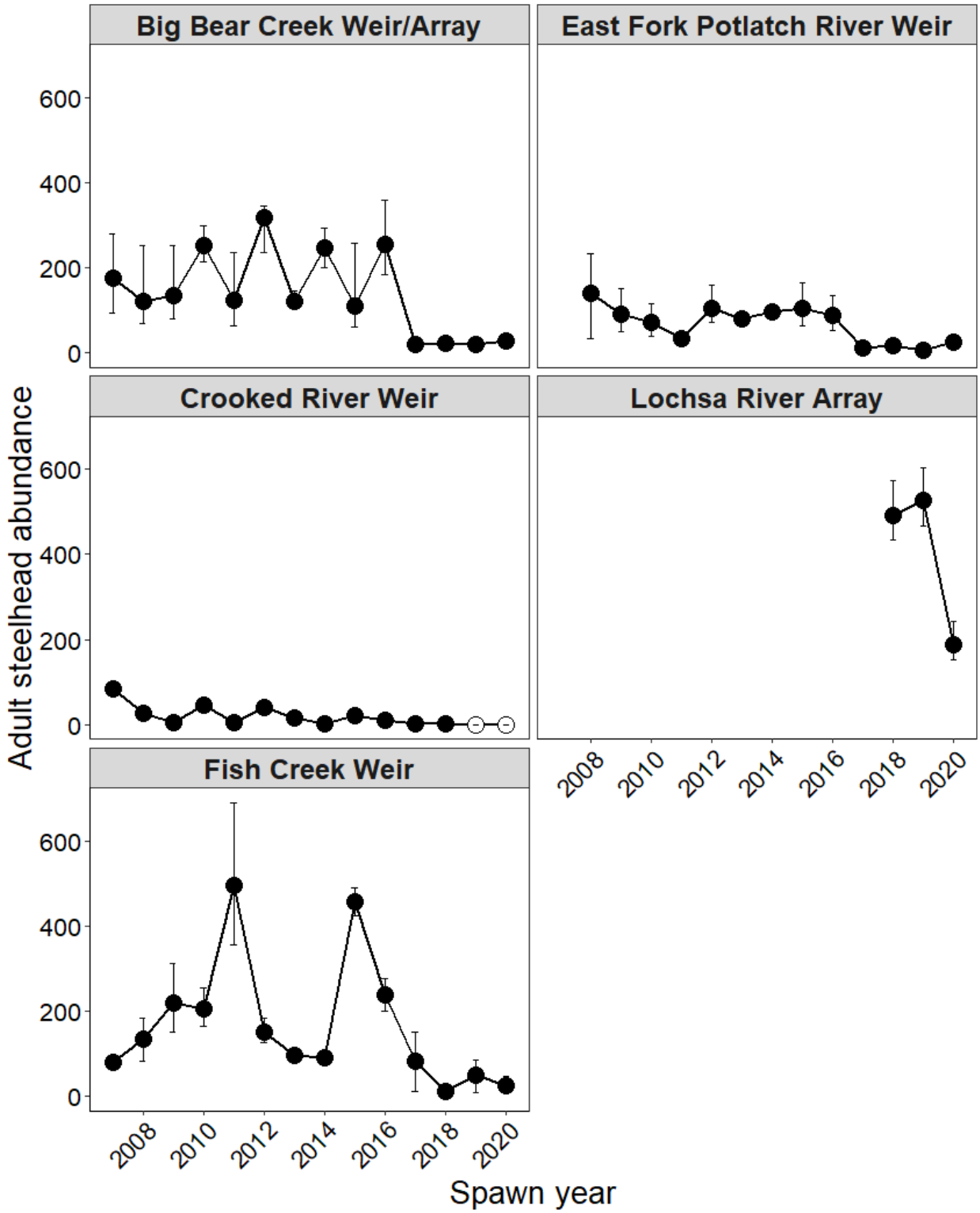

Figure 2. Abundance trends of wild adult steelhead at weirs or PIT tag arrays in the Clearwater River basin, spawn years 2007–2020. Confidence intervals are at 95%. Points without confidence intervals are unique adults trapped or detected. Hollow points indicate an abundance of zero.

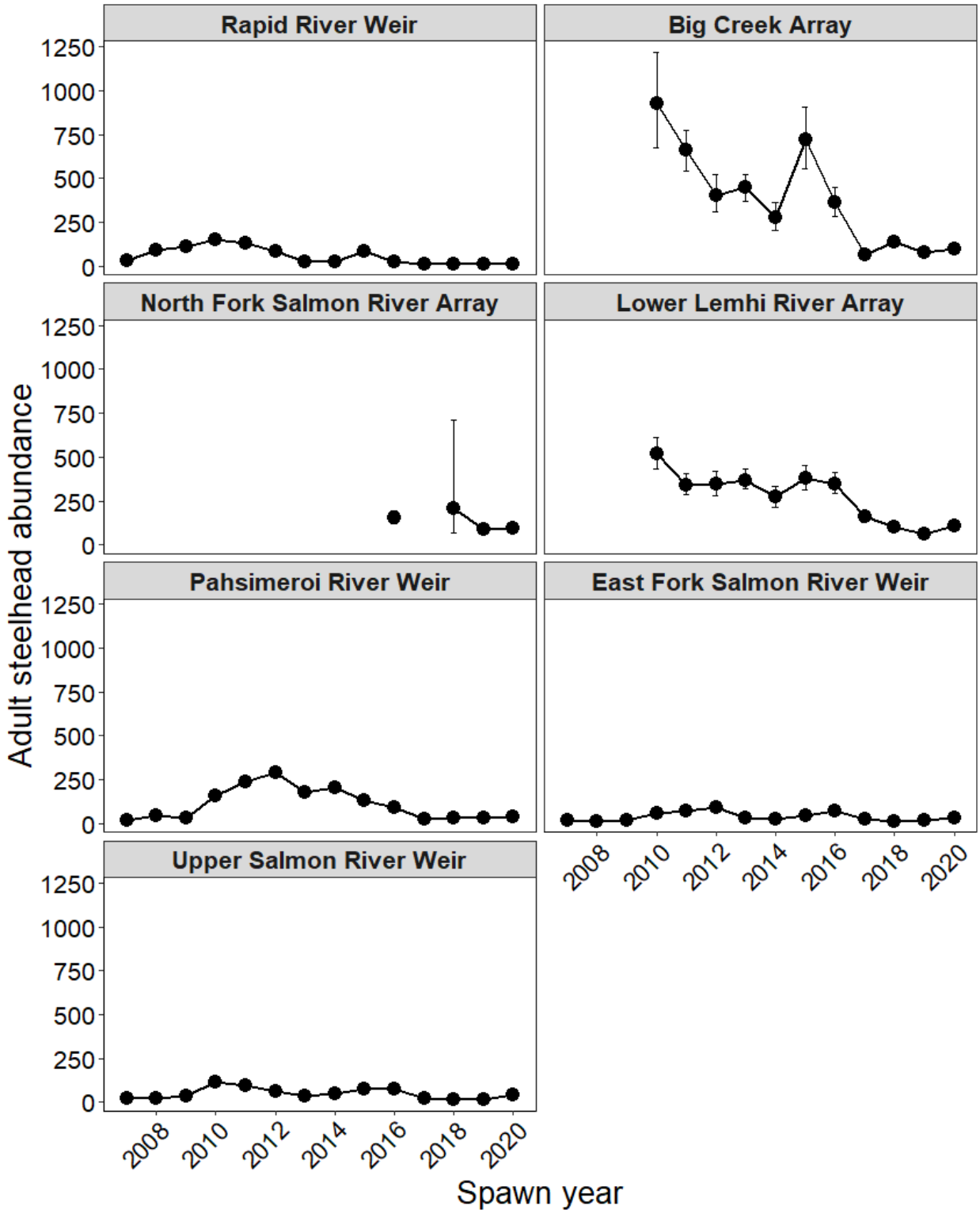

Figure 3. Abundance trends of wild adult steelhead at weirs or PIT tag arrays in the Salmon River basin, spawn years 2007–2020. Confidence intervals are at 95%. Points without confidence intervals are unique adults trapped or detected.

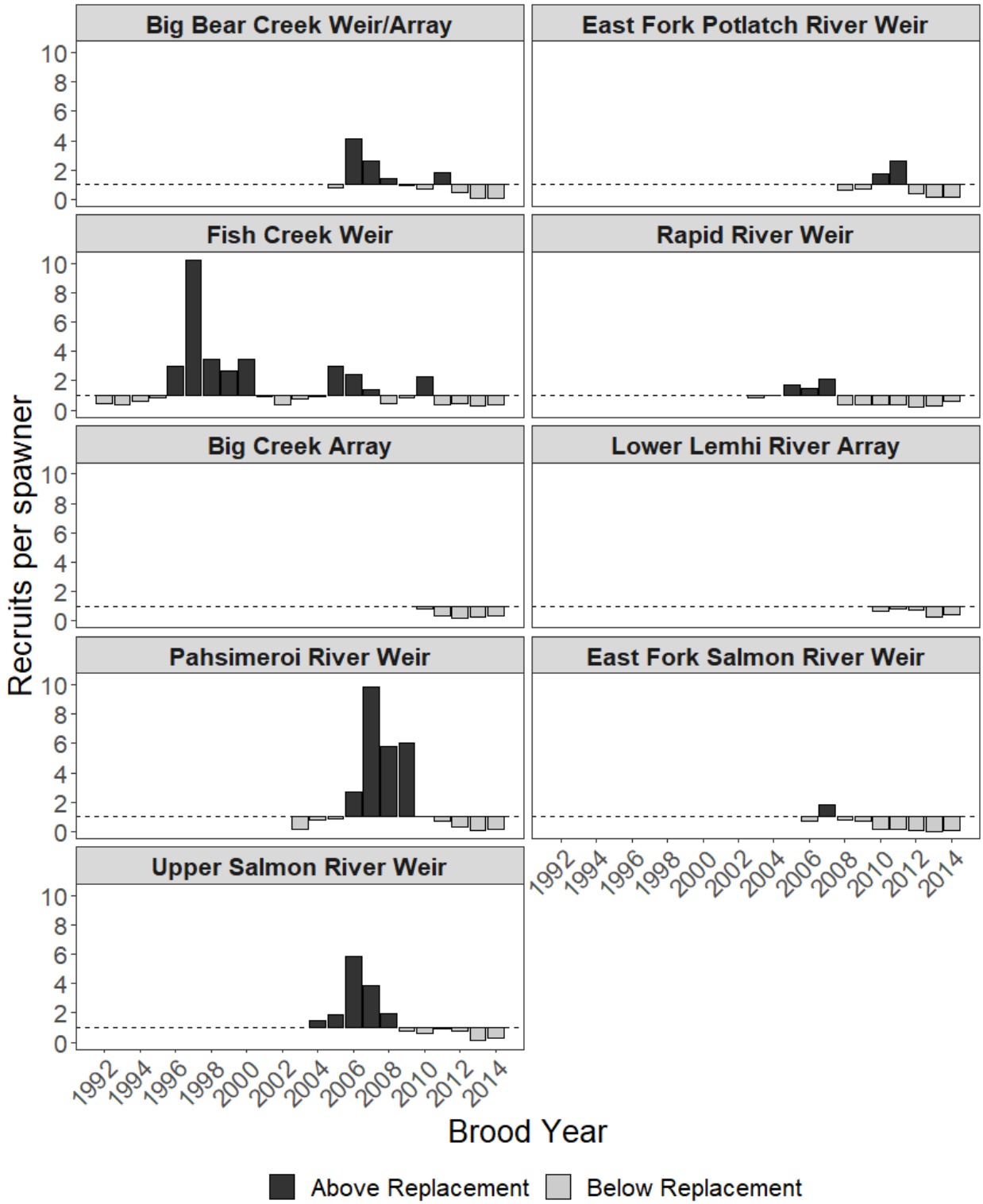

Figure 4. Productivity (wild adult recruits per spawner) of steelhead at select Idaho weirs or PIT tag arrays, brood years 1992–2014. Select brood years were omitted due to incomplete data. Dashed line represents 1:1 replacement.

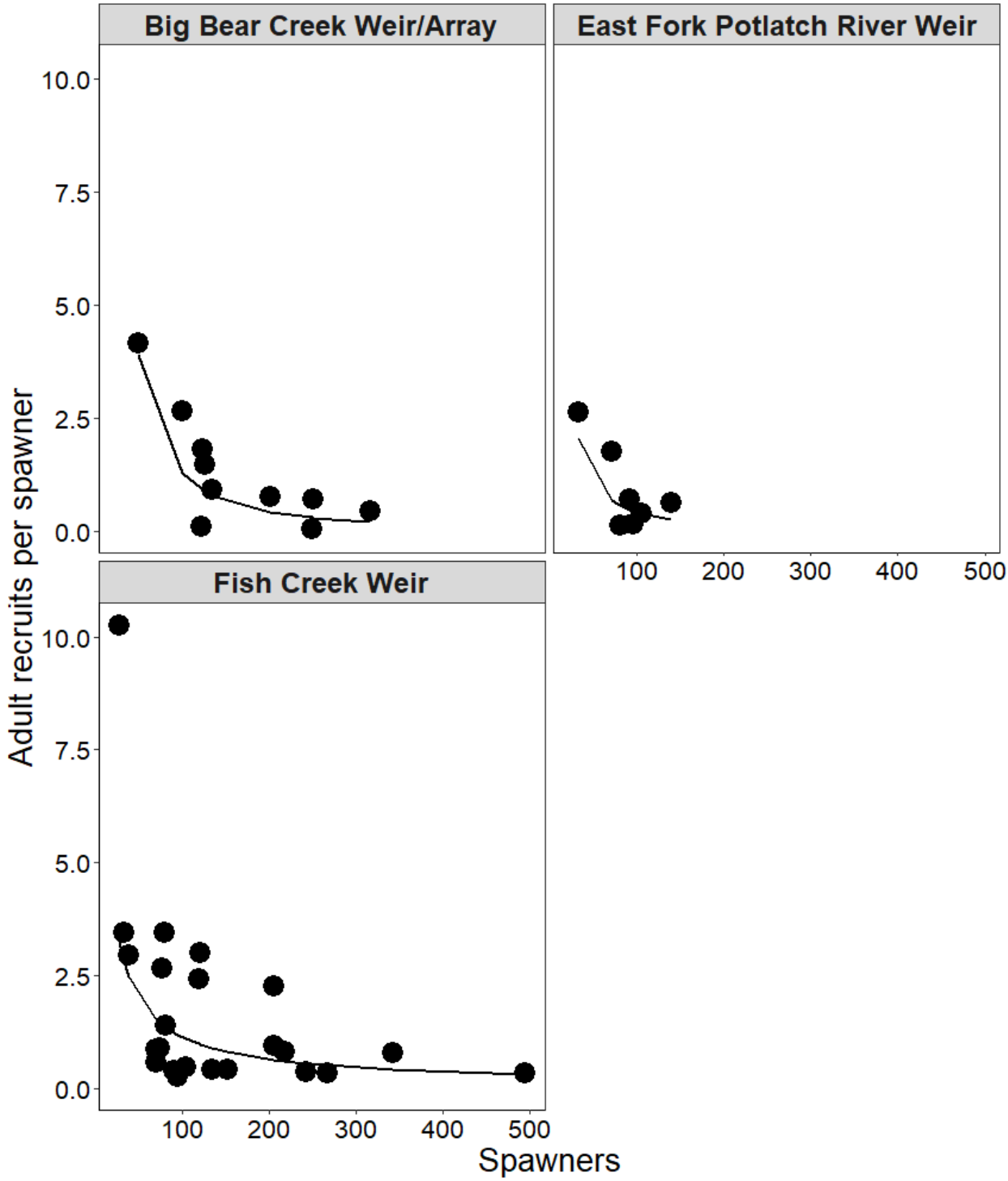

Figure 5. Relationship of steelhead productivity (wild adult recruits per spawner) to spawner abundance at select weirs or PIT tag arrays in the Clearwater River basin, brood years 1992–2014. Select brood years were omitted due to incomplete data. Trend lines for each data set were fit with a power function.

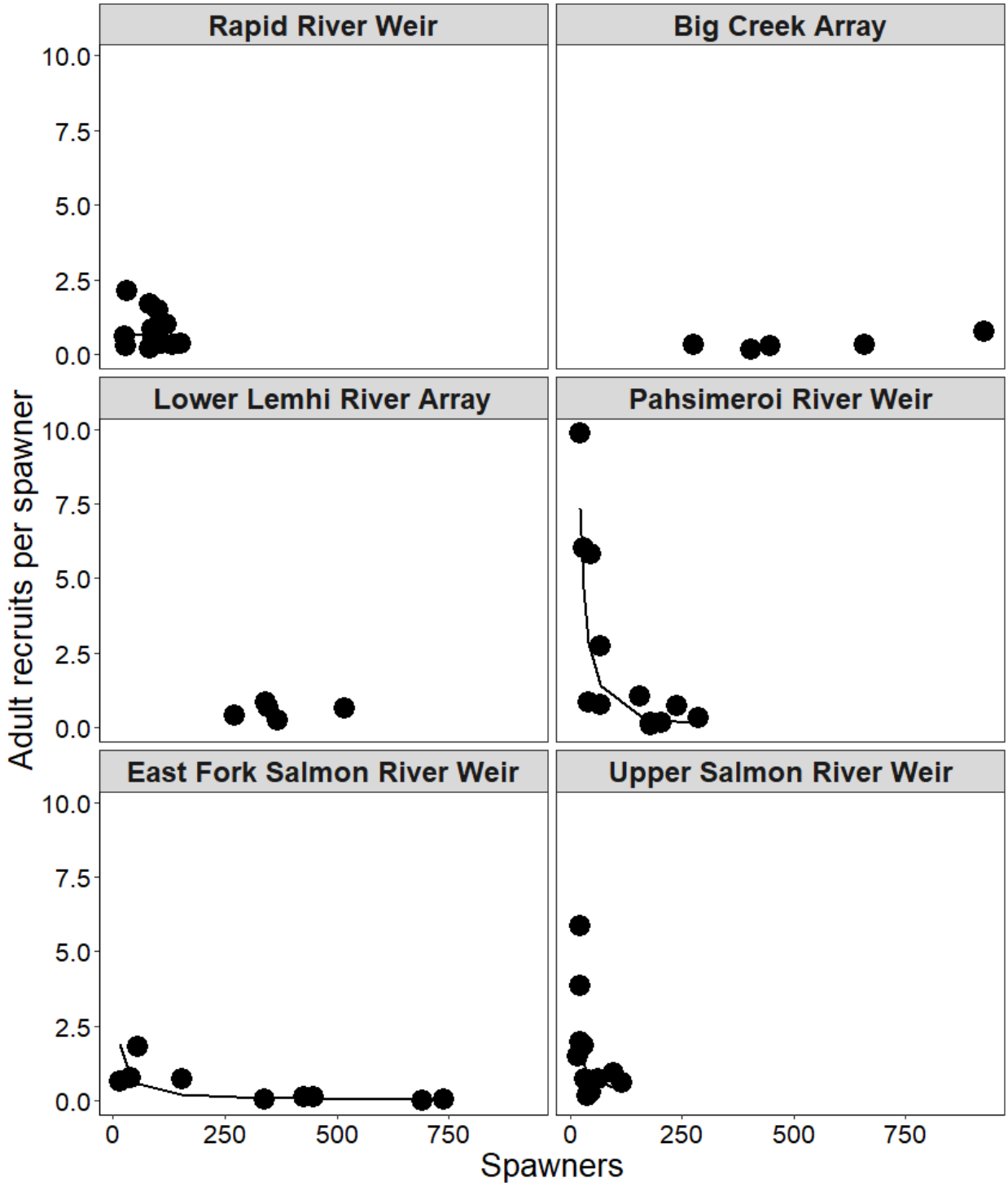

Figure 6. Relationship of steelhead productivity (wild adult recruits per spawner) to spawner abundance at select weirs or PIT tag arrays in the Salmon River basin, brood years 1992–2014. Select brood years were omitted due to incomplete data. Trend lines for each data set were fit with a power function where applicable.

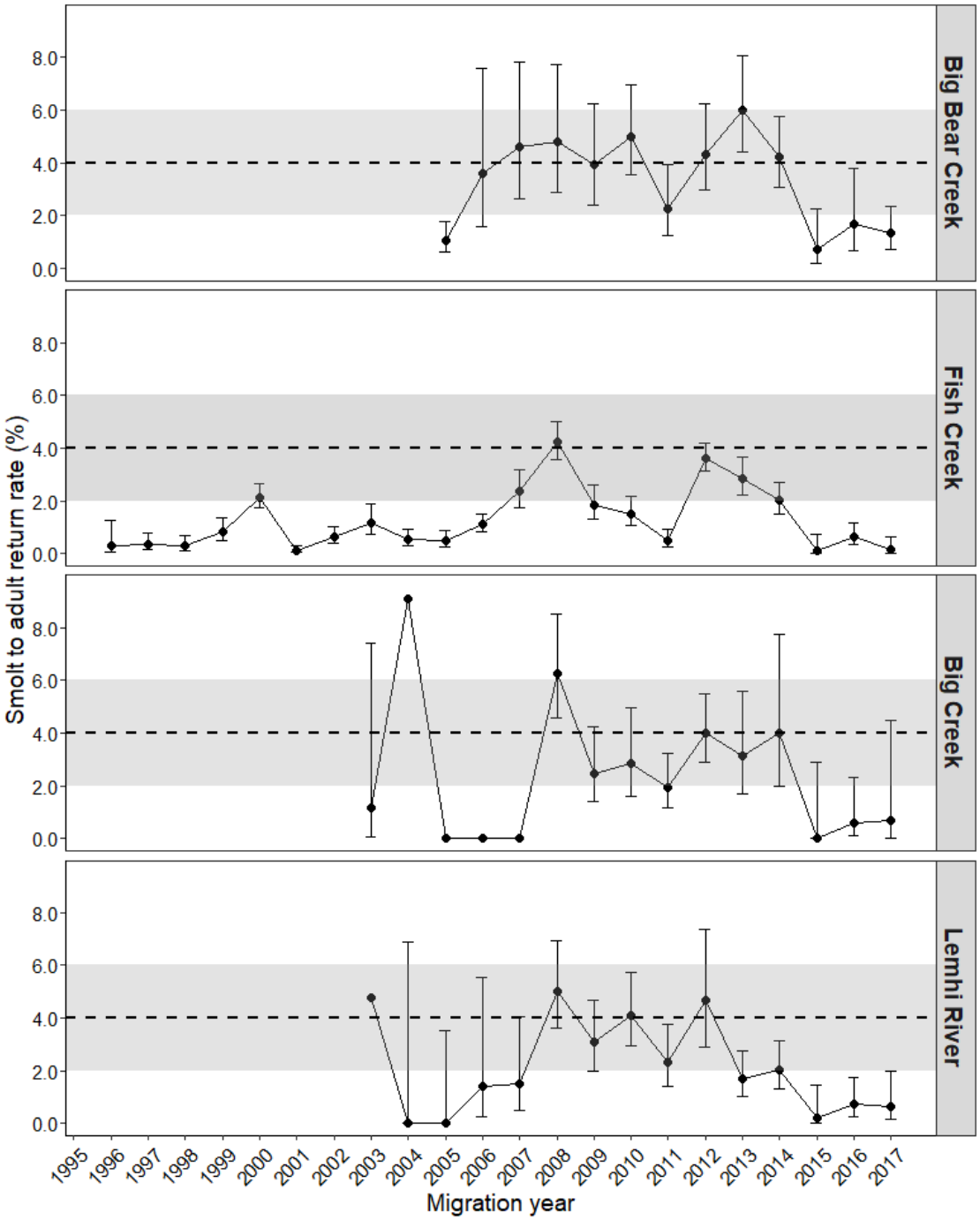

Figure 7. Wild steelhead smolt-to-adult return rate (SAR, %) from select Idaho weirs or PIT tag arrays to Bonneville Dam, migratory years 1996–2017. Confidence intervals are at 95%. Select confidence intervals were omitted due to small number of smolts used for analyses and extreme interval values. Median SAR objective (dashed lines) with upper and lower range (shaded areas) were established by the Northwest Power and Conservation Council (NPCC 2014).

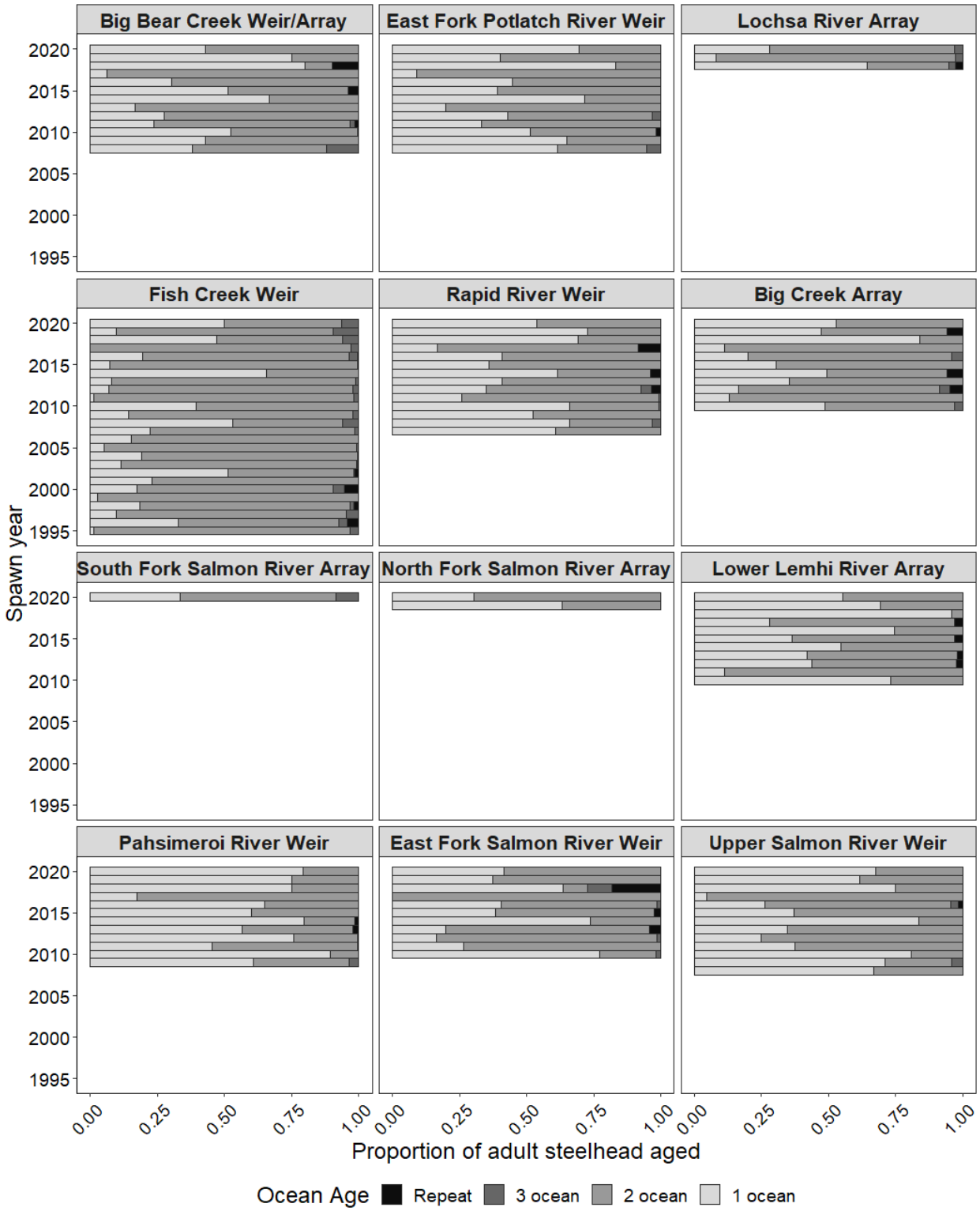

Figure 8. Ocean age composition of wild adult steelhead at select Idaho weirs or PIT tag arrays, spawn years 1995–2020. Select spawn years were omitted due to incomplete data.

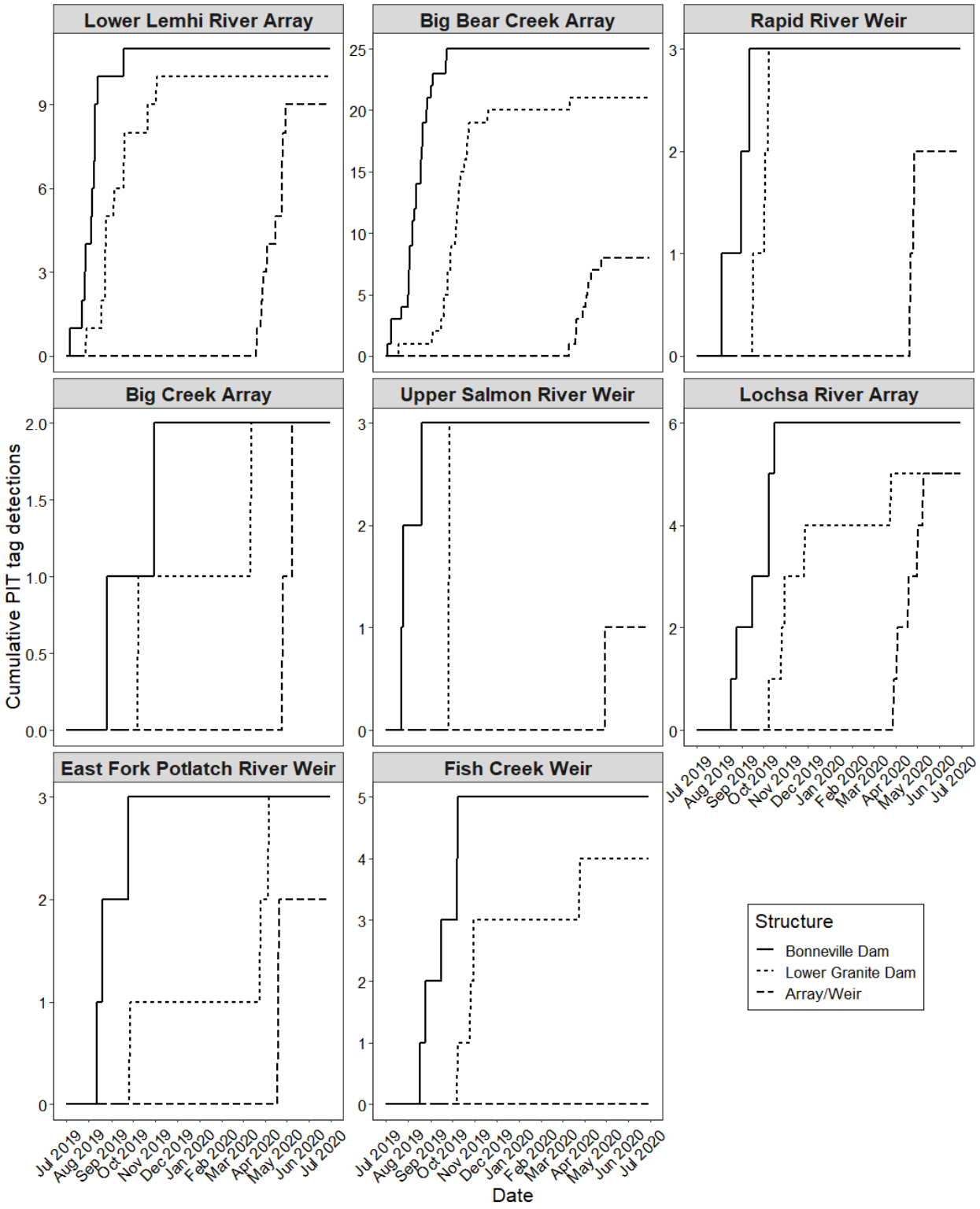

Figure 9. Cumulative wild steelhead run-timing curves based on tags applied in juveniles at Bonneville Dam, Lower Granite Dam, and select Idaho PIT tag arrays and weirs, spawn year 2020.

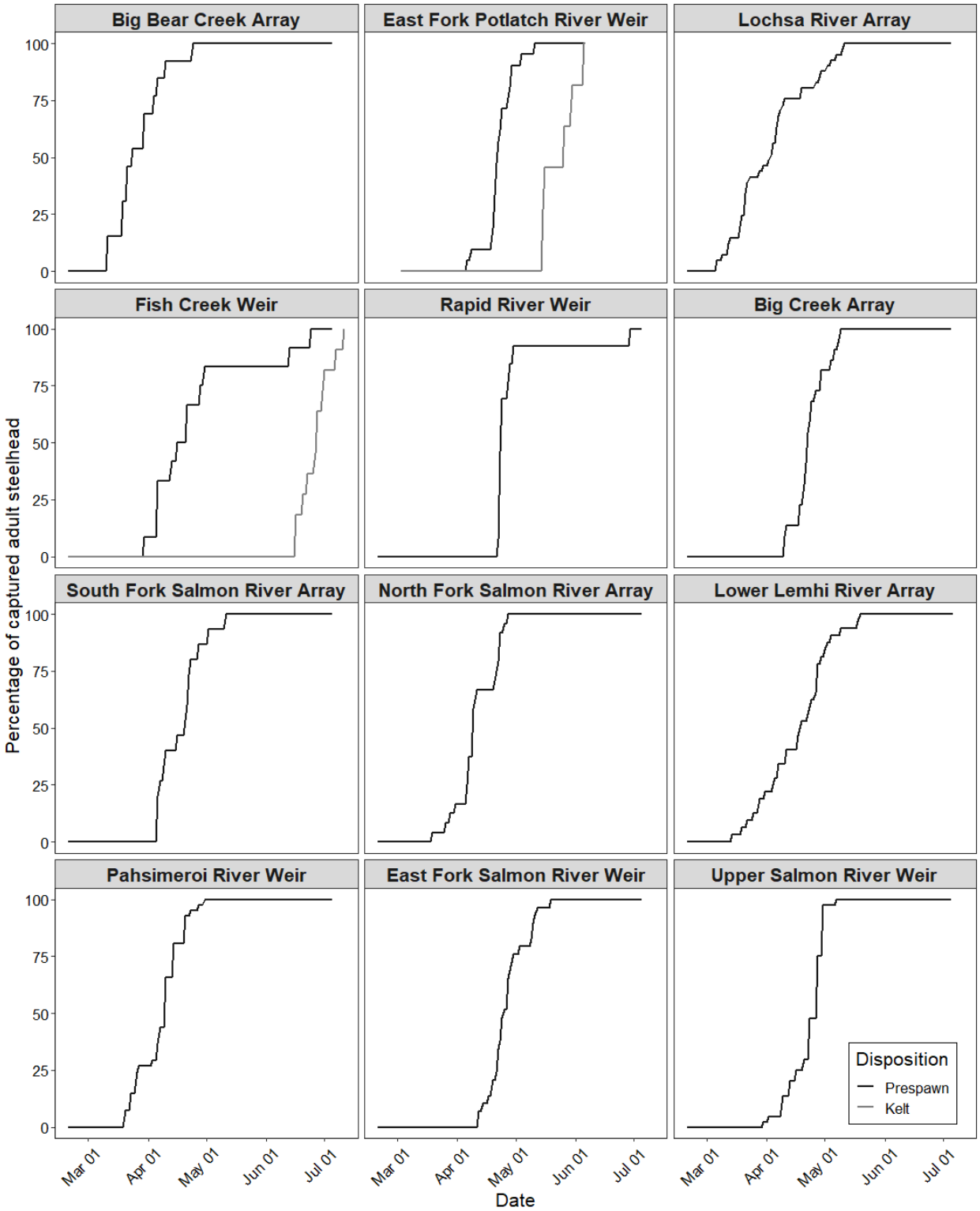

Figure 10. Cumulative wild prespawn and kelt steelhead run-timing curves at select Idaho weirs and PIT tag arrays, spawn year 2020. Kelt data were mostly unavailable.

APPENDICES

Appendix A. Wild adult steelhead abundance estimate time series for Clearwater River weirs or PIT tag arrays. LCI and UCI are lower and upper 95% confidence intervals, respectively. NA = not available.

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	112	157
		2014	249	206	825
		2015	109	75	NA
		2016	254	127	507
		2017[a]	21	9	31
		2018[b]	23	NA	NA
		2019[b]	19	NA	NA
		2020[b]	29	NA	NA
East Fork Potlatch River	Weir	2008	140	33	232
		2009	92	50	152
		2010	72	41	113
		2011[a]	33	33	33
		2012	101	67	151
		2013[c]	81	81	81
		2014	96	78	115
		2015	105	64	167
		2016	89	53	136
		2017[a]	11	2	24
		2018	18	NA	NA
		2019	6	NA	NA
		2020	25	21	36
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
		2018	1	NA	NA
		2019	0	NA	NA
		2020	0	NA	NA

Appendix A. Continued.

Population	Structure	Spawn year	Abundance	LCI	UCI
Lochsa River	Array	2018	490	433	572
		2019	526	469	615
		2020	189	152	243
Fish Creek	Weir	1992[d]	105	NA	NA
		1993[d]	267	NA	NA
		1994[d]	70	NA	NA
		1995[d]	70	NA	NA
		1996[d]	39	NA	NA
		1997[d]	28	NA	NA
		1998	80	NA	NA
		1999[c]	77	NA	NA
		2000	33	7	35
		2001[c]	75	NA	NA
		2002	242	181	333
		2003	343	315	371
		2004	206	185	230
		2005[c]	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[c]	91	91	91
		2015	452	420	485
		2016	239	201	277
		2017	83	13	150
		2018	16	10	43
		2019	51	10	85
		2020	24	16	48

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

[b] Detection efficiency unable to be estimated; abundance is a minimum. This differs from SY 2018 and SY 2019 reports.

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

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

Appendix B. Wild adult steelhead abundance estimate time series for Salmon River weirs or PIT tag arrays. LCI and UCI are lower and upper 95% confidence intervals, respectively. NA = not available.

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
		2018	14	NA	NA
		2019	11	NA	NA
		2020	13	NA	NA
Big Creek[a]	Array	2010	926	676	1221
		2011	658	544	773
		2012	404	306	520
		2013	446	371	520
		2014	275	206	362
		2015	721	552	907
		2016	360	283	446
		2017	67	47	92
		2018	138	109	167
		2019	80	58	110
		2020	96	76	120
South Fork Salmon River	Array	2010[b]	754	605	934
		2011[b]	1340	1131	1578
		2012[b]	558	432	706
		2013[b]	435	348	526
		2014[b]	394	276	522
		2015[b]	836	662	1021
		2016[b]	356	270	448
		2017[b]	243	188	309
		2018[b]	82	54	115
		2019[b]	67	36	102
		2020[a]	52	28	74
Marsh Creek	Array	2020	17	11	44
North Fork Salmon River[a]	Array	2016	157	123	191
		2017	NA	NA	NA
		2018	209	69	713
		2019	91	67	122
		2020	93	76	116
Lower Lemhi River[a]	Array	2010	518	435	613
		2011	342	287	406

Appendix B. Continued

Population	Structure	Spawn year	Abundance	LCI	UCI
Lower Lemhi River[a]	Array	2012	347	280	419
		2013	368	317	434
		2014	272	214	335
		2015	379	315	453
		2016	348	292	414
		2017	158	129	188
		2018	102	81	126
		2019	62	44	91
		2020	109	87	131
Upper Lemhi River[a]	Array	2010	18	1	54
		2011	80	33	128
		2012	39	9	75
		2013	84	41	128
		2014	19	2	44
		2015	39	11	79
		2016	49	19	88
		2017	25	9	46
		2018	18	6	34
		2019	9	2	23
		2020	6	0	16
Hayden Creek[a]	Array	2010	105	49	170
		2011	34	10	72
		2012	67	26	116
		2013	79	45	127
		2014	49	21	87
		2015	30	3	75
		2016	87	49	132
		2017	31	12	56
		2018	15	4	32
		2019	11	1	24
		2020	27	12	45
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
		2018	30	NA	NA
		2019	35	NA	NA

Appendix B. Continued

Population	Structure	Spawn year	Abundance	LCI	UCI
Pahsimeroi River	Weir	2020	41	NA	NA
East Fork Salmon River[c]	Weir	2007	16	NA	NA
		2008	11	NA	NA
		2009	17	NA	NA
		2010	61	NA	NA
		2011	72	NA	NA
		2012	92	NA	NA
		2013	33	NA	NA
		2014	25	NA	NA
		2015	43	NA	NA
		2016	71	NA	NA
		2017	26	NA	NA
		2018	12	NA	NA
		2019	16	NA	NA
		2020	29	NA	NA
Upper Salmon River	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	77	NA	NA
		2017	22	NA	NA
		2018	17	NA	NA
		2019	14	NA	NA
		2020	44	NA	NA

[a] Abundance estimates analyzed with the latest version of the DABOM model (Kinzer et al. 2021). Results will vary from SY 2018 report and prior (Dobos et al. 2019).

[b] Minimum estimate due to having a single spanning PIT tag array. The model assumed detection probability was 1.00. Estimates generated from the latest version of the DABOM model (See et al. 2019).

[c] 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 per spawner) for select Clearwater River wild steelhead populations, Idaho. Accounting is incomplete for brood years with dashes in any age column. Grey, hatched cells indicate years where adult abundance represented only unique adults trapped (i.e., not expanded).

		Number of adult recruits							
Stream	**Brood year**	**Age-3**	**Age-4**	**Age-5**	**Age-6**	**Age-7**	**Total**	**Parents**	**Productivity**
Big Bear Creek	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	3	0	226	124	1.82
	2012	9	115	14	3	0	141	317	0.44
	2013	8	4	0	0	0	12	120	0.10
	2014	0	20	5	0	--	25	249	0.10
	2015	0	14	11	--	--	25	109	0.23
	2016	0	14	--	--	--	14	254	0.06
	2017	4	--	--	--	--	4	21	0.19
EF Potlatch River	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*	10	30	46	1	0	87	33	2.64
	2012	0	32	9	0	0	41	106	0.39
	2013	1	1	8	1	0	11	81	0.14
	2014	0	10	4	1	--	15	96	0.16
	2015	0	1	11	--	--	12	105	0.11
	2016	0	13	--	--	--	13	89	0.15
	2017	0	--	--	--	--	0	11	0.00
Fish Creek	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

Appendix C. Continued

Stream	Brood year	Number of adult recruits Age-3	Age-4	Age-5	Age-6	Age-7	Total	Parents	Productivity
Fish Creek	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
	2011	5	23	100	37	3	168	494	0.34
	2012	0	18	43	5	0	66	152	0.43
	2013	0	0	5	19	2	26	95	0.27
	2014	0	3	29	4	--	35	91	0.40
	2015	0	3	14	--	--	17	452	0.04
	2016	0	4	--	--	--	4	239	0.02
	2017	0	--	--	--	--	0	83	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 per spawner) for select Salmon River wild steelhead populations, Idaho. Accounting is incomplete for brood years with dashes in any age column.

		Number of adult recruits							
Stream	**Brood year**	**Age-3**	**Age-4**	**Age-5**	**Age-6**	**Age-7**	**Total**	**Parents**	**Productivity**
Rapid River	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	0	45	133	0.34
	2012	0	7	9	1	0	17	81	0.21
	2013	0	0	5	3	0	8	27	0.30
	2014	0	8	7	1	--	16	26	0.62
	2015	0	0	9	--	--	9	82	0.11
	2016	0	3	--	--	--	3	27	0.11
	2017	0	--	--	--	--	0	11	0.00
Big Creek	2010	0	65	417	223	15	720	926	0.78
	2011	0	76	103	30	0	209	658	0.32
	2012	0	17	22	29	0	68	404	0.17
	2013	0	0	86	32	9	127	446	0.28
	2014	0	24	32	30	--	86	275	0.31
	2015	0	5	57	--	--	62	721	0.09
	2016	0	0	--	--	--	0	360	0.00
	2017	0	--	--	--	--	0	67	0.00
Lower Lemhi River	2010	24	111	189	13	5	342	518	0.66
	2011	55	118	74	36	0	283	342	0.83
	2012	24	141	76	0	0	241	347	0.69
	2013	40	31	20	5	0	96	368	0.26
	2014	0	72	21	17	--	110	272	0.40
	2015	0	36	61	--	--	97	379	0.26
	2016	0	31	--	--	--	31	348	0.09
	2017	0	--	--	--	--	0	158	0.00

Appendix D. Continued.

Stream	Brood year	Number of adult recruits Age-3	Age-4	Age-5	Age-6	Age-7	Total	Parents	Productivity
Pahsimeroi River	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	0	170	239	0.71
	2012	15	63	17	1	0	96	288	0.33
	2013	4	4	4	0	0	12	179	0.07
	2014	0	25	5	0	--	30	205	0.15
	2015	0	30	16	--	--	46	130	0.35
	2016	0	25	--	--	--	25	92	0.27
	2017	0	--	--	--	--	0	24	0.00
East Fork Salmon River	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	0	58	448	0.13
	2012	1	24	17	1	0	43	738	0.06
	2013	0	2	7	7	0	16	690	0.02
	2014	0	1	5	7	--	13	339	0.04
	2015	0	4	12	--	--	16	884	0.02
	2016	0	10	--	--	--	10	405	0.02
	2017	0	--	--	--	--	0	135	0.00
Upper Salmon River	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

Appendix D. Continued.

Stream	Brood year	Number of adult recruits Age-3	Age-4	Age-5	Age-6	Age-7	Total	Parents	Productivity
Upper Salmon River	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	0	88	96	0.92
	2012	6	23	16	2	0	47	63	0.75
	2013	0	0	6	0	0	6	39	0.15
	2014	0	9	5	0	--	14	46	0.30
	2015	0	7	20	--	--	27	73	0.37
	2016	0	24	--	--	--	24	77	0.31
	2017	0	--	--	--	--	0	22	0

Appendix E. Number of PIT-tagged adults from selected populations in the Clearwater River MPG detected at three hydrosystem dams and their conversion rates to McNary and Lower Granite dams from Bonneville Dam across spawn years where data is available.

Population	Spawn year	Bonneville Dam count	McNary Dam count	Lower Granite Dam count	Conversion to McNary Dam	Conversion to Lower Granite Dam
Big Bear Creek	2007	5	4	2	80.0%	40.0%
	2008	17	17	16	100.0%	94.1%
	2009	7	6	6	85.7%	85.7%
	2010	19	15	15	78.9%	78.9%
	2011	18	14	14	77.8%	77.8%
	2012	33	29	27	87.9%	81.8%
	2013	35	29	27	82.9%	77.1%
	2014	21	18	18	85.7%	85.7%
	2015	43	37	33	86.0%	76.7%
	2016	61	57	56	93.4%	91.8%
	2017	25	20	19	80.0%	76.0%
	2018	8	5	5	62.5%	62.5%
	2019	8	5	5	62.5%	62.5%
	2020	25	21	21	80.1%	80.1%
Fish Creek	1998	1	1	1	100.0%	100.0%
	1999	4	4	4	100.0%	100.0%
	2000	6	5	5	83.3%	83.3%
	2001	8	8	8	100.0%	100.0%
	2002	47	45	45	95.7%	95.7%
	2003	64	55	52	85.9%	81.3%
	2004	16	14	14	87.5%	87.5%
	2005	11	10	10	90.9%	90.9%
	2006	23	18	18	78.3%	78.3%
	2007	11	10	9	90.9%	81.8%
	2008	19	18	18	94.7%	94.7%
	2009	50	39	34	78.0%	68.0%
	2010	78	66	60	84.6%	76.9%
	2011	112	94	83	83.9%	74.1%
	2012	49	37	31	75.5%	63.3%
	2013	32	27	22	84.4%	68.8%
	2014	36	30	30	83.3%	83.3%
	2015	189	151	144	79.9%	76.2%
	2016	70	63	61	90.0%	87.1%
	2017	36	29	25	80.6%	69.4%
	2018	11	9	8	81.8%	72.7%
	2019	7	6	5	85.7%	71.4%
	2020	5	4	4	80.0%	80.0%

Appendix F. Number of PIT-tagged adults from selected populations in the Salmon River MPG detected at three hydrosystem dams and their conversion rates to McNary and Lower Granite dams from Bonneville Dam across spawn years where data is available.

Population	Spawn year	Bonneville Dam count	McNary Dam count	Lower Granite Dam count	Conversion to McNary Dam	Conversion to Lower Granite Dam
Big Creek	2006	1	1	1	100.0%	100.0%
	2007	2	2	2	100.0%	100.0%
	2008	0	0	0	NA	NA
	2009	0	0	0	NA	NA
	2010	42	37	36	88.1%	85.7%
	2011	19	14	14	73.7%	73.7%
	2012	23	17	16	73.9%	69.6%
	2013	20	13	13	65.0%	65.0%
	2014	40	29	29	72.5%	72.5%
	2015	29	21	20	72.4%	69.0%
	2016	17	14	14	82.4%	82.4%
	2017	0	0	0	NA	NA
	2018	3	3	3	100.0%	100.0%
	2019	1	1	1	100.0%	100.0%
	2020	2	2	2	100.0%	100.0%
Lemhi River	2006	1	1	1	100.0%	100.0%
	2007	0	0	0	NA	NA
	2008	2	2	2	100.0%	100.0%
	2009	4	4	4	100.0%	100.0%
	2010	41	35	32	85.4%	78.0%
	2011	25	21	20	84.0%	80.0%
	2012	49	39	34	79.6%	69.4%
	2013	25	22	20	88.0%	80.0%
	2014	29	17	16	58.6%	55.2%
	2015	26	19	18	73.1%	69.2%
	2016	29	28	26	96.6%	89.7%
	2017	13	9	9	69.2%	69.2%
	2018	5	4	4	80.0%	80.0%
	2019	2	2	2	100.0%	100.0%
	2020	12	10	10	90.9%	90.9%

Appendix G. Number of genetic samples collected from wild adult steelhead captured at select IDFG weirs, 2010–2019.

Population Location	Structure	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
					Clearwater River MPG							
Potlatch River												
Big Bear Creek	Weir	51	18	38	0	0	0	0	0	0	0	0
Little Bear Creek	Weir	212	46	180	0	0	0	0	0	0	0	0
WF Potlatch River	Weir	50	0	0	0	0	0	0	0	0	0	0
EF Potlatch River	Weir	71	33	73	82	87	90	97	9	18	0	23
SF Clearwater River												
Crooked River	Weir	0	5	41	17	2	22	10	1	1	0	0
Lochsa River												
Fish Creek	Weir	200	224	135	91	90	450	204	53	11	22	20
					Salmon River MPG							
Snake River												
Snake River	Hells Canyon Dam Adult Ladder	0	164	114	161	150	186	38	21	14	52	39
Little Salmon River												
Rapid River	Weir	149	133	82	27	26	82	27	12	14	10	13
SF Salmon River												
SF Salmon River	Weir	12	0	0	5	0	2	0	0	0	0	0
Pahsimeroi River												
Pahsimeroi River	Weir	157	239	285	177	205	130	94	24	31	35	41
EF Salmon River												
EF Salmon River	Weir	425	442	721	690	339	885	410	132	7	5	29
Upper Salmon River												
Fourth of July Creek	Weir	0	0	0	0	27	0	10	5	2	4	0
Tower Creek	Weir	0	0	0	0	29	0	18	19	5	0	0
Carmen Creek	Weir	0	0	0	0	79	0	16	3	2	1	0
Salmon River	Weir	114	96	82	39	46	74	77	22	17	14	44
Total		1,441	1,400	1,751	1,289	1,080	1,969	1,055	301	122	143	209

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